RF TEST REPORT

Applicant	High-Flying Electronics Technology Co., Ltd.
FCC ID	2ACSVHF-LPT6200
Product	Low Power 2.4GWi-Fi6 + BLE Module
Model	HF-LPT6200
Report No.	R2210A0966-R1V1
Issue Date	March 10, 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.

Prepared by: Xu Ying

Approved by: Xu Kai

TA Technology (Shanghai) Co., Ltd.

Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China

TEL: +86-021-50791141/2/3

FAX: +86-021-50791141/2/3-8000

TABLE OF CONTENT

Version	Revision description	Issue Date
Rev.0	Initial issue of report.	February 24, 2023
Rev.1	Update information.	March 10, 2023
Note: This revised report (Report No. R2210A0966-R1V1) supersedes and replaces the previously issued report (Report No. R2210A0966-R1). 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 6.7	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: November 22, 2022 ~ February 9, 2023 Date of Sample Received: November 14, 2022			
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.			

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
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

2. General Description of Equipment Under Test

2.1. Applicant and Manufacturer Information

Applicant	High-Flying Electronics Technology Co., Ltd.
Applicant address	Building 17, No.1500 Zu Chongzhi Road, Pudong District, Shanghai, China
Manufacturer	Shandong Qipengfa Electronics Technology Co. LTD
Manufacturer address	East Road 800 meters south of government, Nanzheng Village, Nanluji Town, Chengwu County, Heze City, Shandong Province

2.2. General Information

EUT Description	
Model	HF-LPT6200
MAC	E8FDF8B9E0B3
Hardware Version	V1.0
Software Version	V1.0
Power Supply	External power supply
Antenna Type	Internal Antenna
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)
Antenna Gain	0.75 dBi
additional beamforming gain	NA
Operating Frequency Range(s)	802.11b/g/n(HT20)/ ax(HE20): 2412 ~ 2462 MHz 802.11n(HT40): 2422 ~ 2452 MHz Bluetooth LE: 2402 ~2480 MHz
Modulation Type	802.11b: DSSS 802.11g/n(HT20/HT40): OFDM 802.11ax (HE20): OFDM / OFDMA Bluetooth LE: GFSK
Max. Output Power	Wi-Fi 2.4G: 18.47 dBm Bluetooth LE: 6.95 dBm
EUT Accessory	
Adapter	Manufacturer: Maoshuo Power Technology Co., Ltd. Model: MSA-C1000IC5.0-7.5A-CN
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 (2022) 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 (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X 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
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0
802.11ax(HE20)	MCS0

5. Test Case Results

5.1. Maximum output power

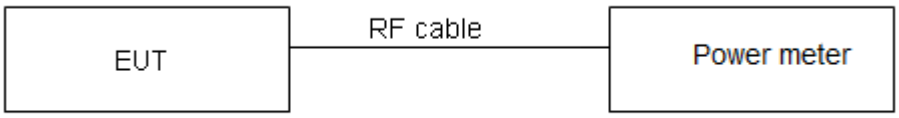
Ambient Condition

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.

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.

Test Results

Power Index						
Channel	**802.11b**	**802.11g**	**802.11n HT20**	**802.11ax HE20**	**Channel**	**802.11n HT40**
CH1	20	N/A	N/A	-40	**CH3**	N/A
CH2	/	/	/	-5	**/**	N/A
CH6	35	N/A	N/A	N/A	**CH6**	N/A
CH11	35	N/A	N/A	-2	**CH9**	N/A

Test Mode	Duty cycle	Duty cycle correction Factor(dB)
802.11b	0.93	0.320
802.11g	0.98	0.000
802.11n HT20	1.00	0.000
802.11n HT40	0.99	0.000
802.11ax HE20	0.99	0.000
Bluetooth LE (1M)	0.85	0.706
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	18.15	18.47	30	PASS
	2437/CH 6	17.82	18.14	30	PASS
	2462/CH11	17.96	18.28	30	PASS
802.11g	2412/CH 1	15.76	15.76	30	PASS
	2437/CH 6	14.78	14.78	30	PASS
	2462/CH11	14.35	14.35	30	PASS
802.11n HT20	2412/CH 1	15.48	15.48	30	PASS
	2437/CH 6	15.09	15.09	30	PASS
	2462/CH11	14.48	14.48	30	PASS
802.11n HT40	2422/CH3	14.61	14.61	30	PASS
	2437/CH6	14.19	14.19	30	PASS
	2452/CH9	14.16	14.16	30	PASS
802.11ax HE20	2412/CH 1	11.04	11.04	30	PASS
	2417/CH 2	14.10	14.10	30	PASS
	2437/CH 6	14.17	14.17	30	PASS
	2462/CH11	13.98	13.98	30	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	6.24	6.95	30	PASS
	2440/CH19	5.38	6.09	30	PASS
	2480/CH39	4.77	5.48	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

TB Mode

	Power Index		
Channel	**802.11ax HE20 26-Tones**	**802.11ax HE20 52-Tones**	**802.11ax HE20 106-Tones**
CH1	5	N/A	-5
CH6	-5	-5	N/A
CH11	15	10	5

Test Mode	Duty cycle	Duty cycle correction Factor(dB)
802.11ax HE20 26-Tones:RU Index 0	0.97	0.12
802.11ax HE20 26-Tones:RU Index 8	0.97	0.12
802.11ax HE20 26-Tones:RU Index 16	0.97	0.12
02.11ax HE20 52-Tones:RU Index 74	0.97	0.11
802.11ax HE20 52-Tones:RU Index 76	0.97	0.12
802.11ax HE20 52-Tones:RU Index 80	0.97	0.12
802.11ax HE20 106-Tones:RU Index 106	0.97	0.12
802.11ax HE20 106-Tones:RU Index 108	0.97	0.12
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
802.11ax HE20 26-Tones	2412/CH 1	14.28	14.40	30	PASS
	2437/CH 6	14.29	14.41	30	PASS
	2462/CH11	14.26	14.38	30	PASS
802.11ax HE20 52-Tones	2412/CH 1	14.32	14.43	30	PASS
	2437/CH 6	14.33	14.45	30	PASS
	2462/CH11	14.21	14.33	30	PASS
802.11ax HE20 106-Tones	2412/CH 1	14.30	14.42	30	PASS
	2437/CH 6	14.28	14.40	30	PASS
	2462/CH11	14.26	14.38	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

5.2. 99% Bandwidth and 6dB Bandwidth

Ambient Condition

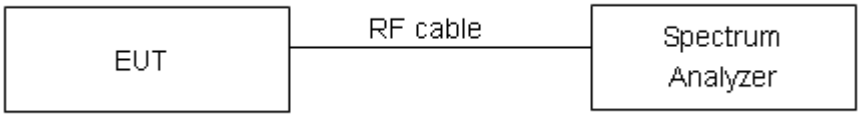
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

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

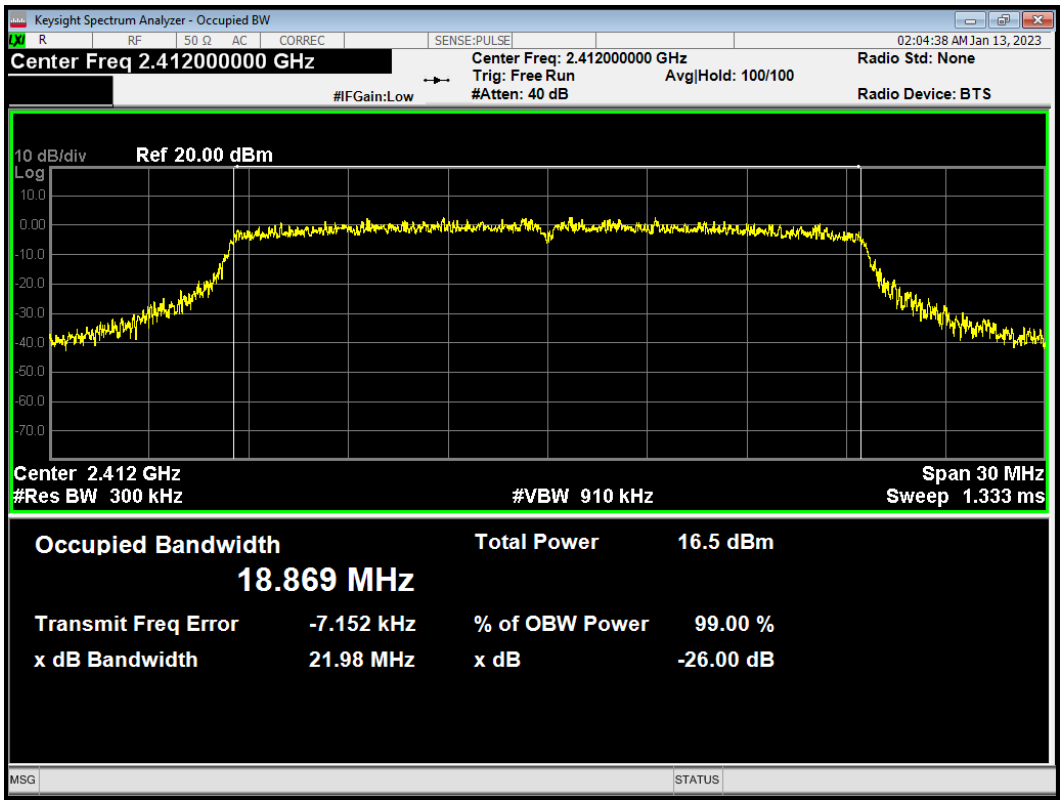
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936 Hz.

Test Results:

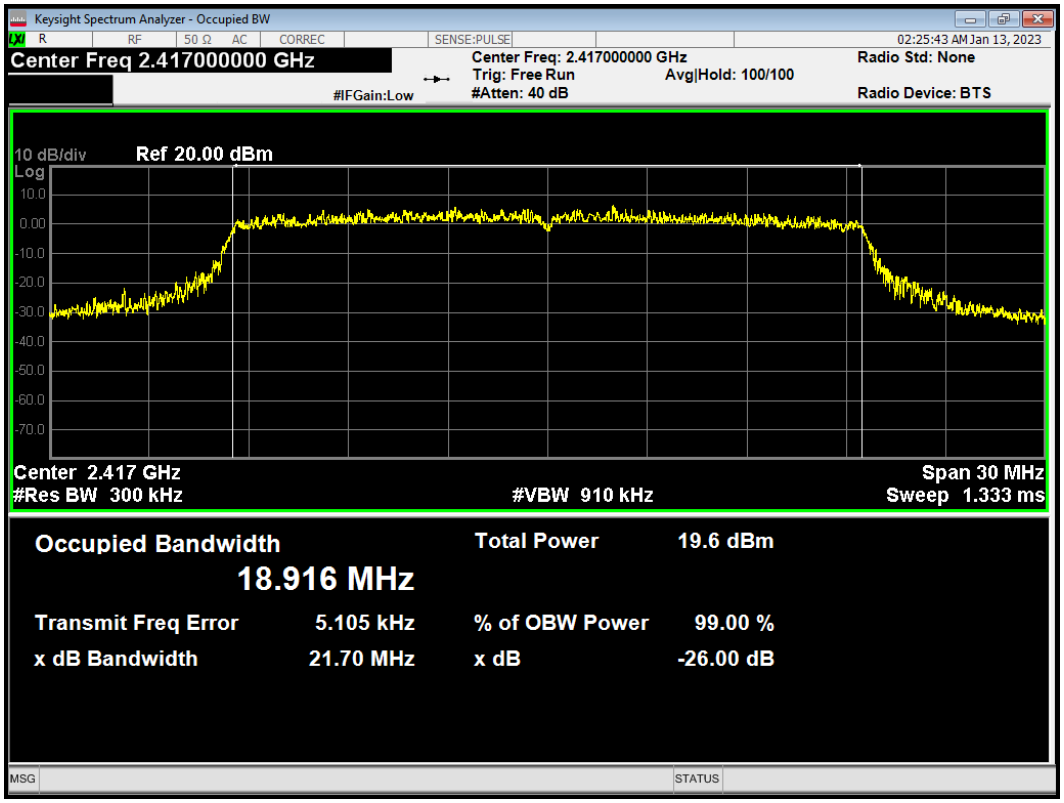
Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412	15.366	10.022	500	PASS
	2437	15.475	9.604	500	PASS
	2462	15.449	10.034	500	PASS
802.11g	2412	16.329	15.033	500	PASS
	2437	16.331	14.414	500	PASS
	2462	16.314	15.051	500	PASS
802.11n HT20	2412	17.502	13.445	500	PASS
	2437	17.530	15.023	500	PASS
	2462	17.508	15.001	500	PASS
802.11n HT40	2422	35.786	28.125	500	PASS
	2437	35.773	27.373	500	PASS
	2452	35.741	35.006	500	PASS
802.11ax HE20	2412	18.869	17.683	500	PASS
	2417	18.916	17.634	500	PASS
	2437	18.908	18.800	500	PASS
	2462	18.914	18.286	500	PASS
Bluetooth (Low Energy) (1M)	2402	1.018	0.658	500	PASS
	2440	1.021	0.695	500	PASS
	2480	1.022	0.668	500	PASS

99%bandwidth

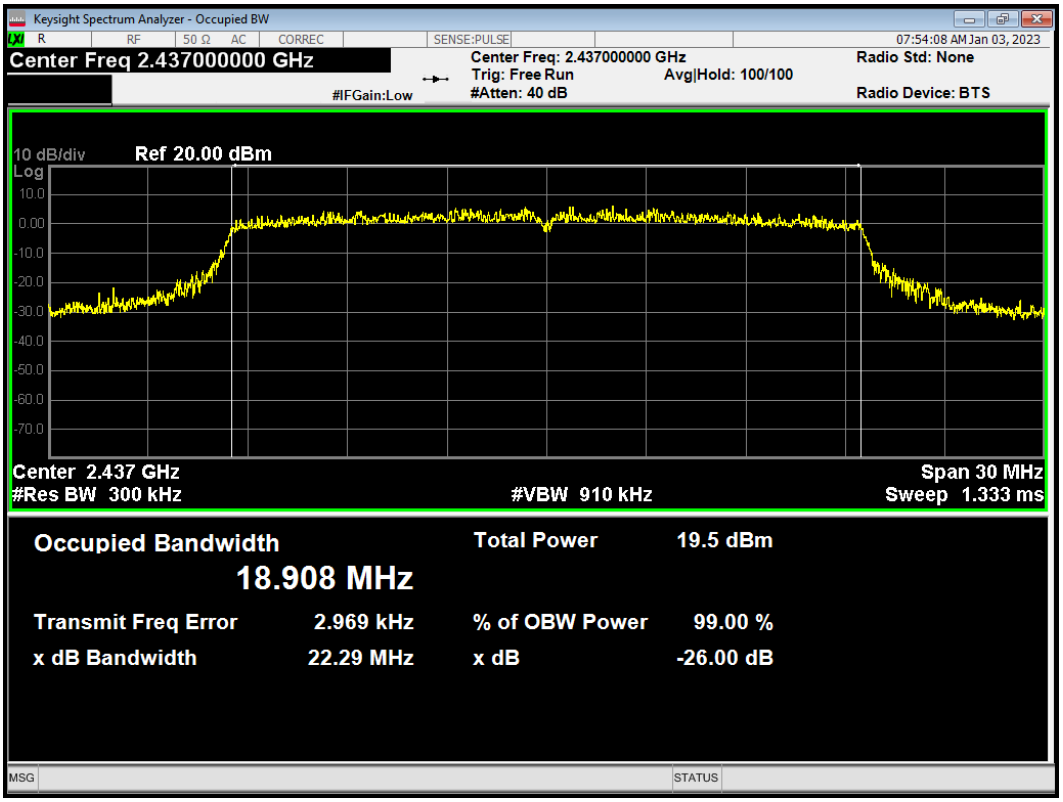
OBW 802.11ax (HE20) 2412MHz



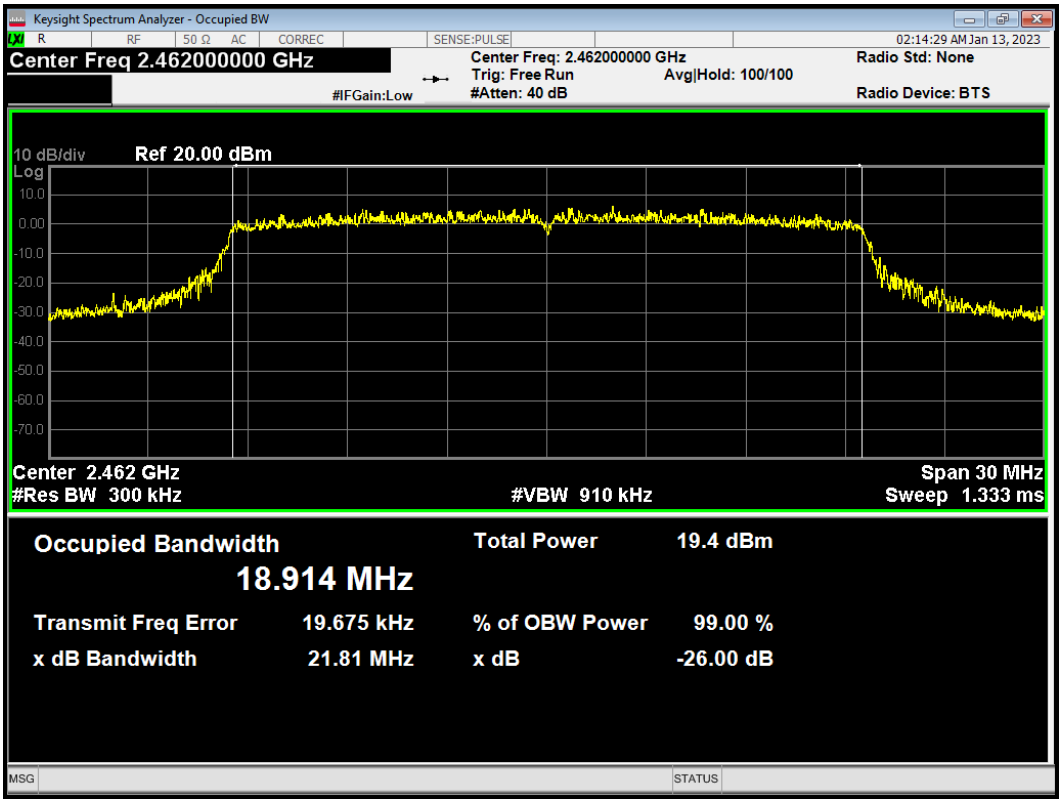
OBW 802.11ax(HE20) 2417MHz



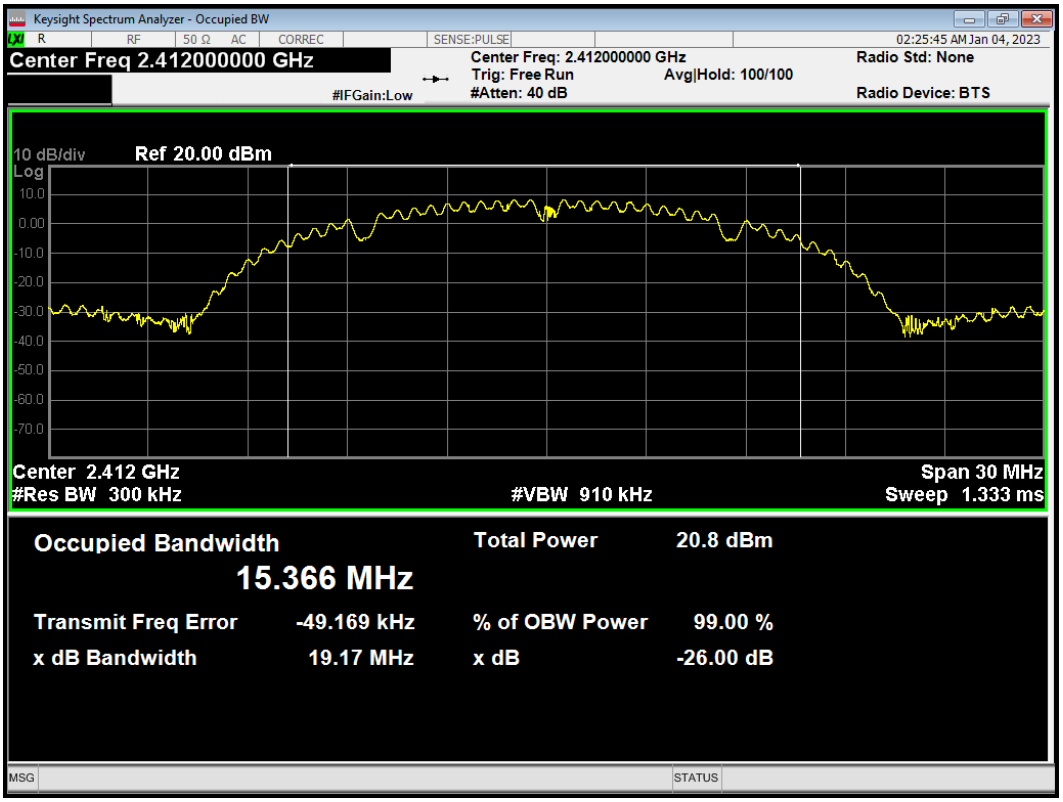
OBW 802.11ax(HE20) 2437MHz



OBW 802.11ax(HE20) 2462MHz



OBW 802.11b 2412MHz



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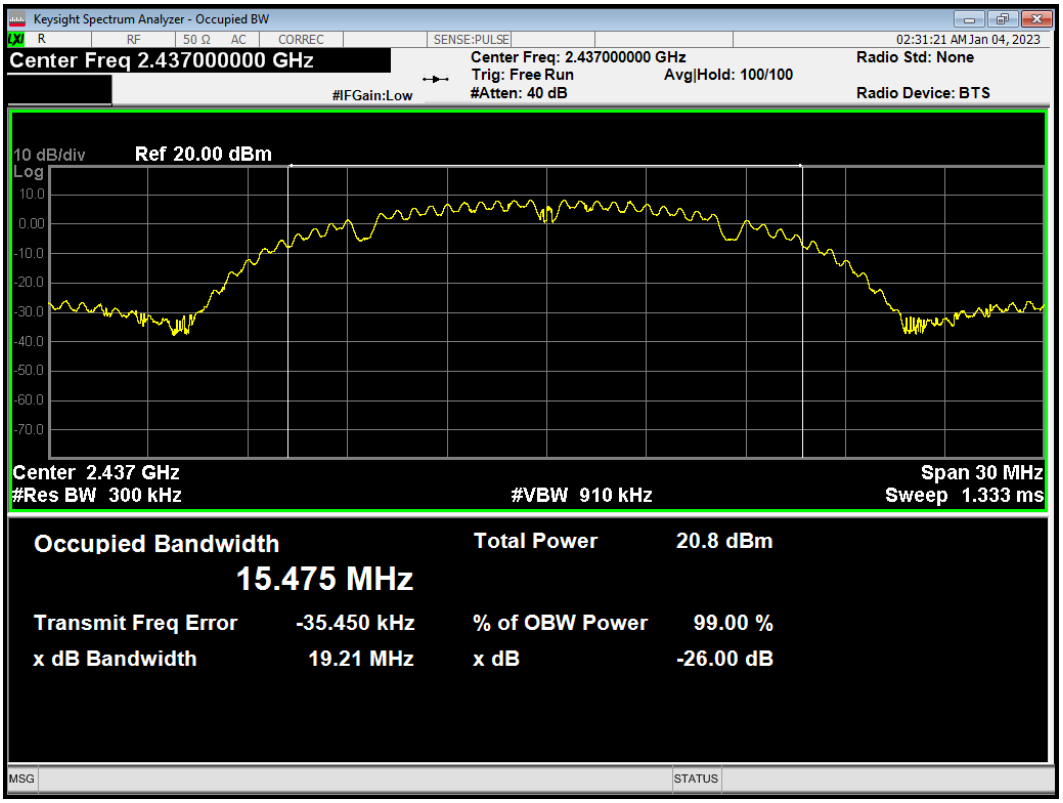
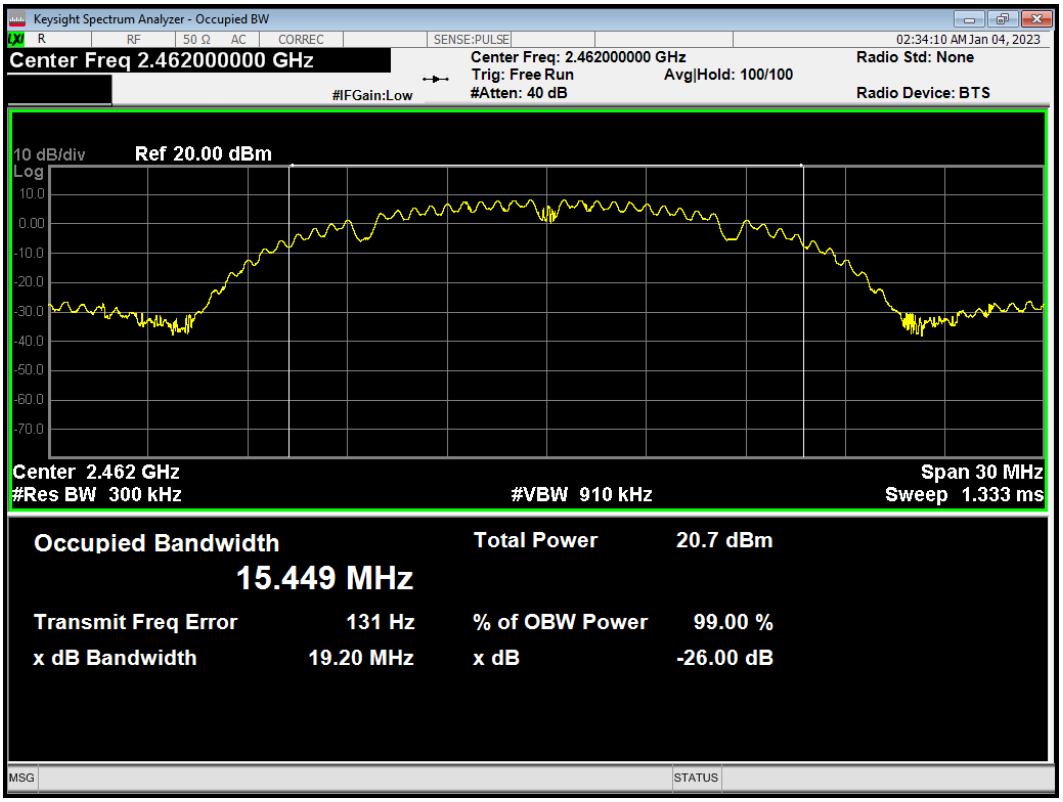
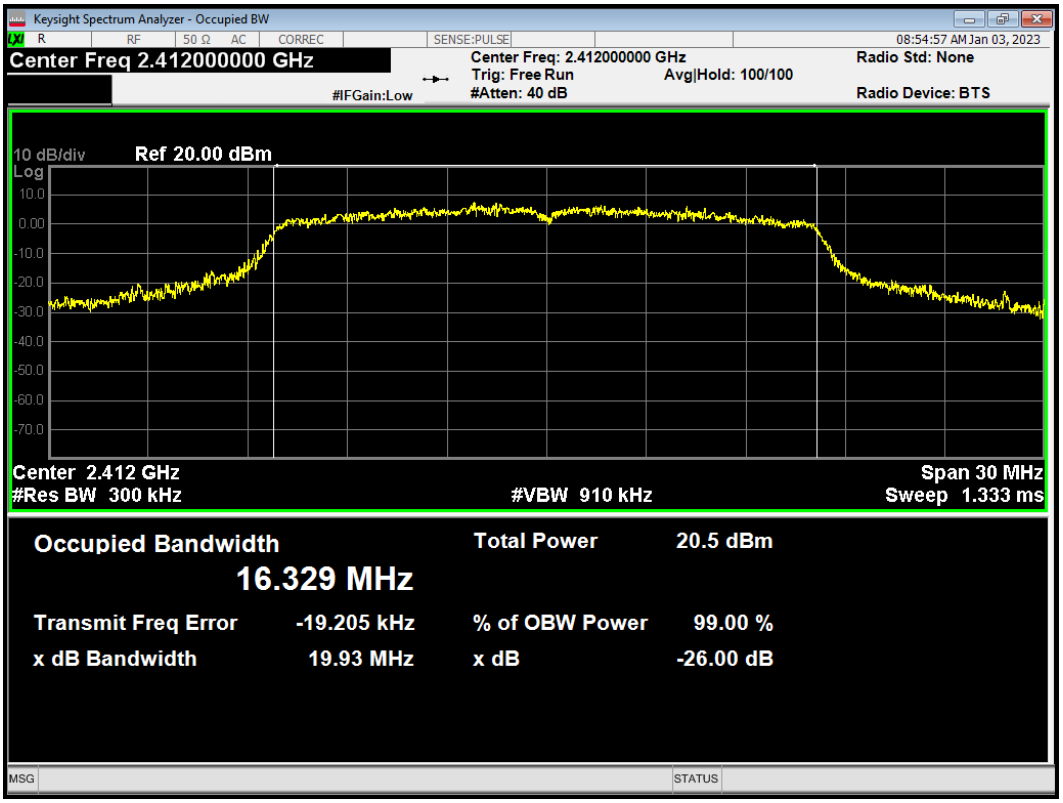


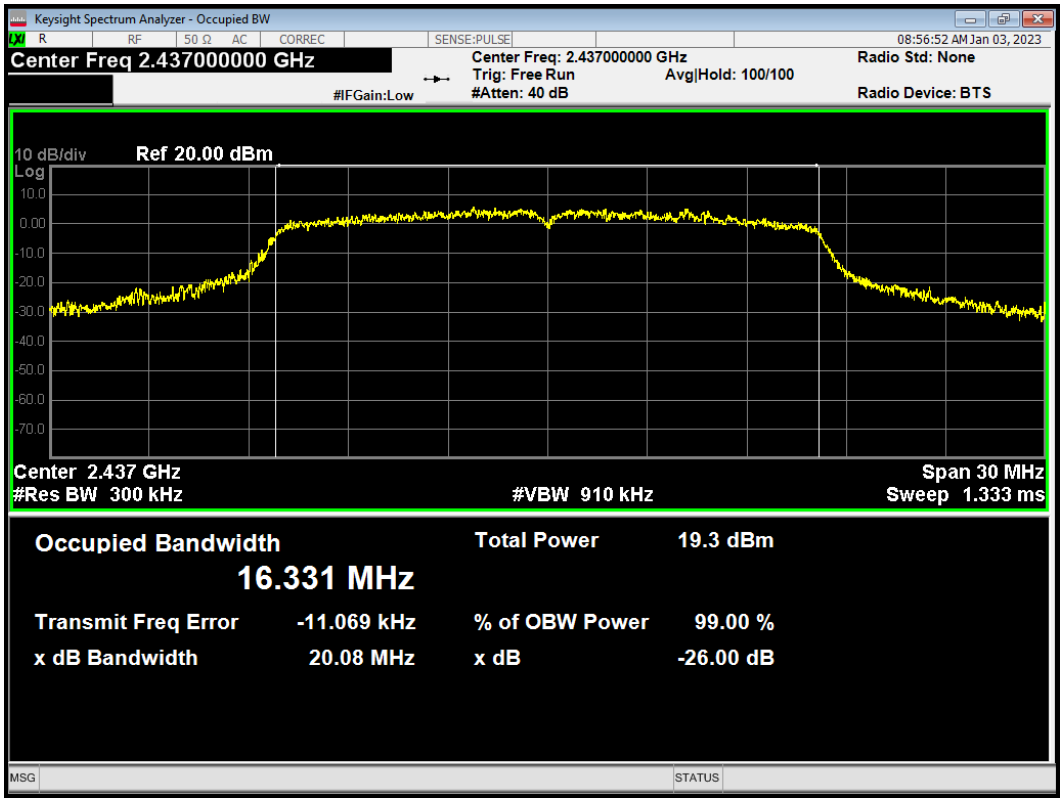
OBW 802.11b 2462MHz



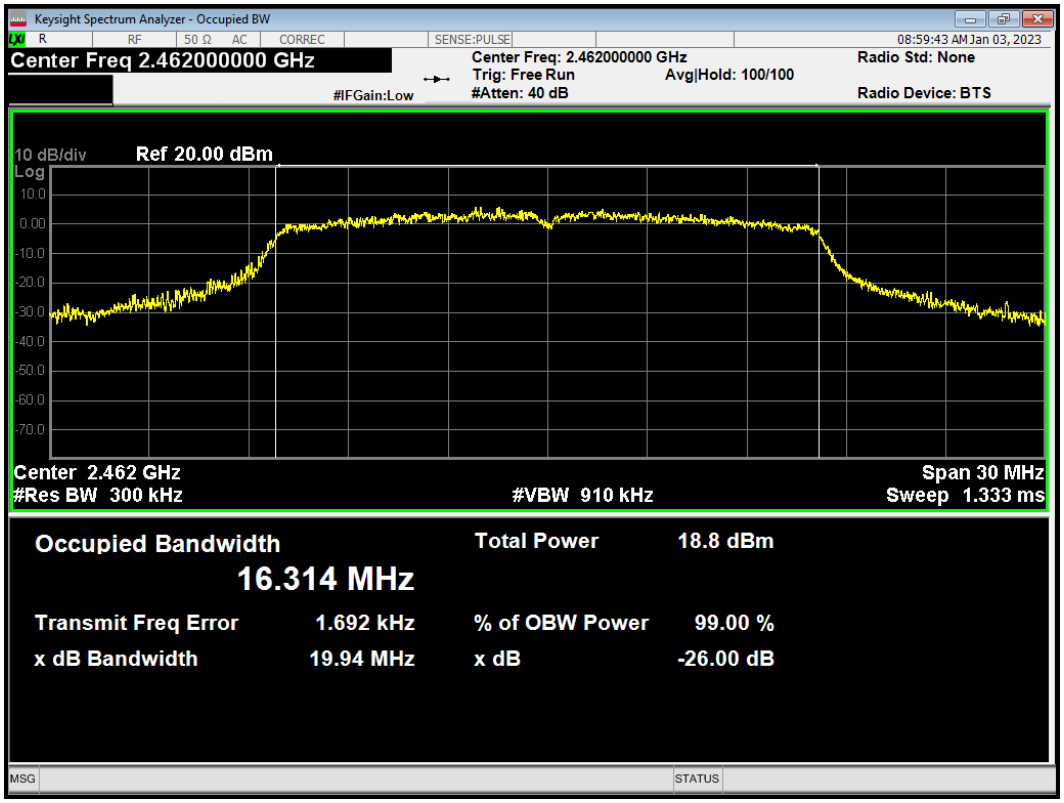
OBW 802.11g 2412MHz



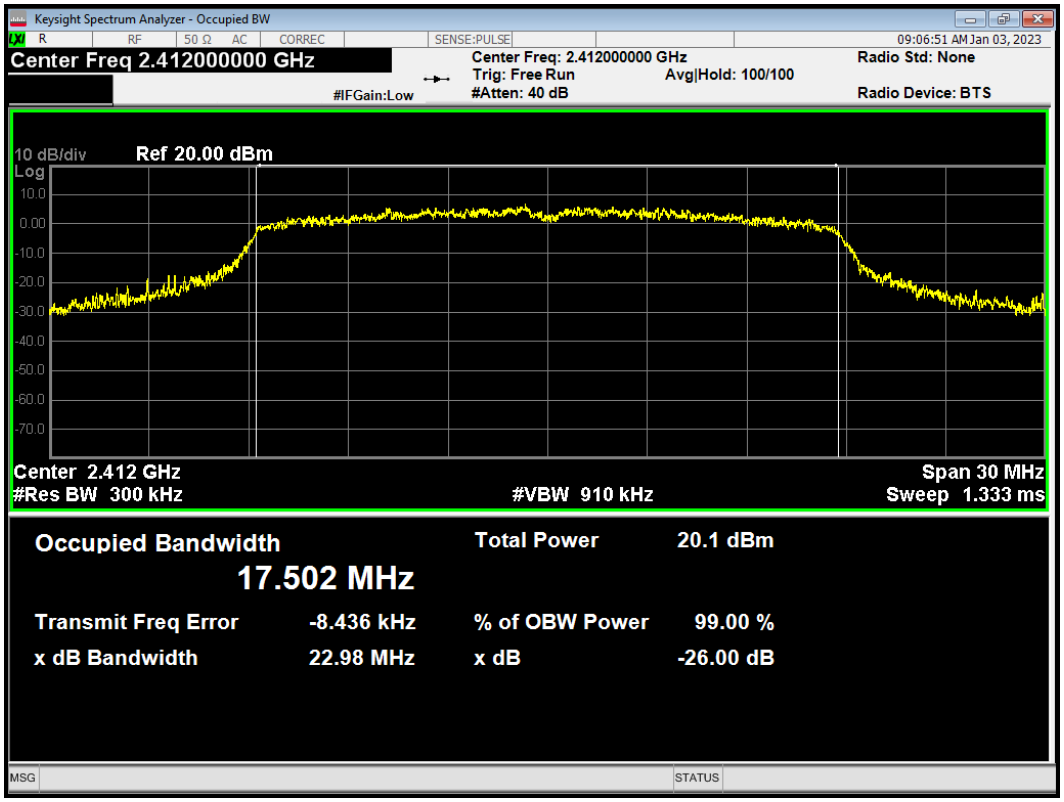
OBW 802.11g 2437MHz



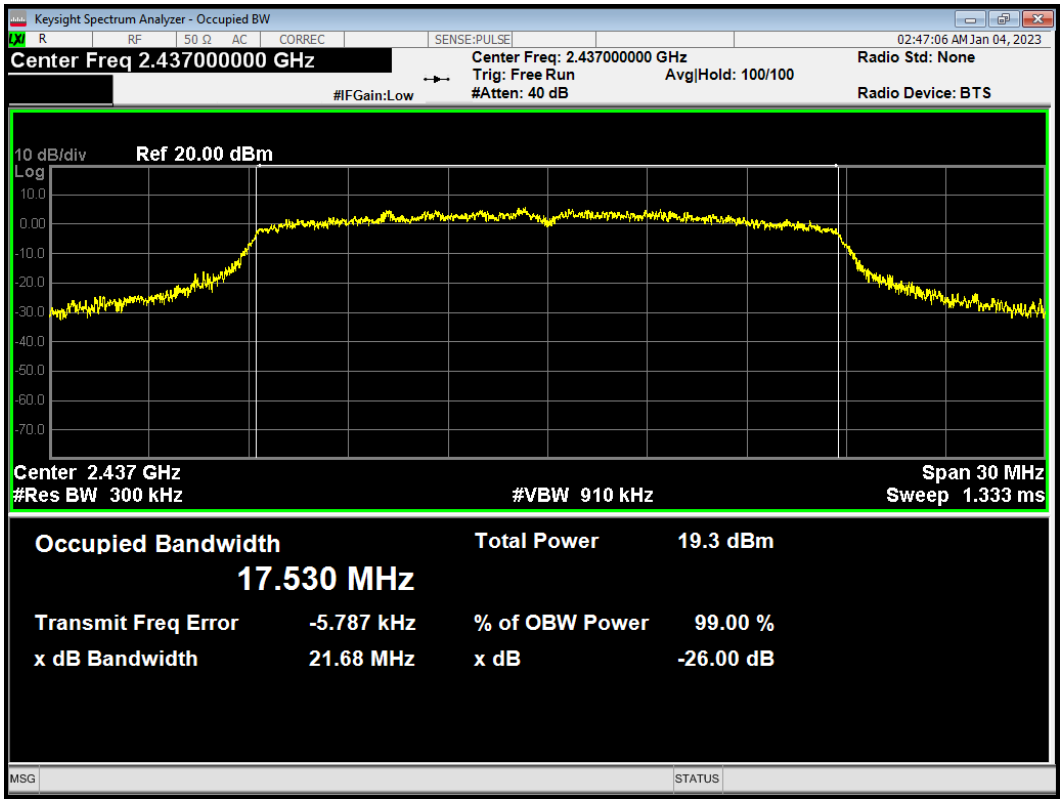
OBW 802.11g 2462MHz



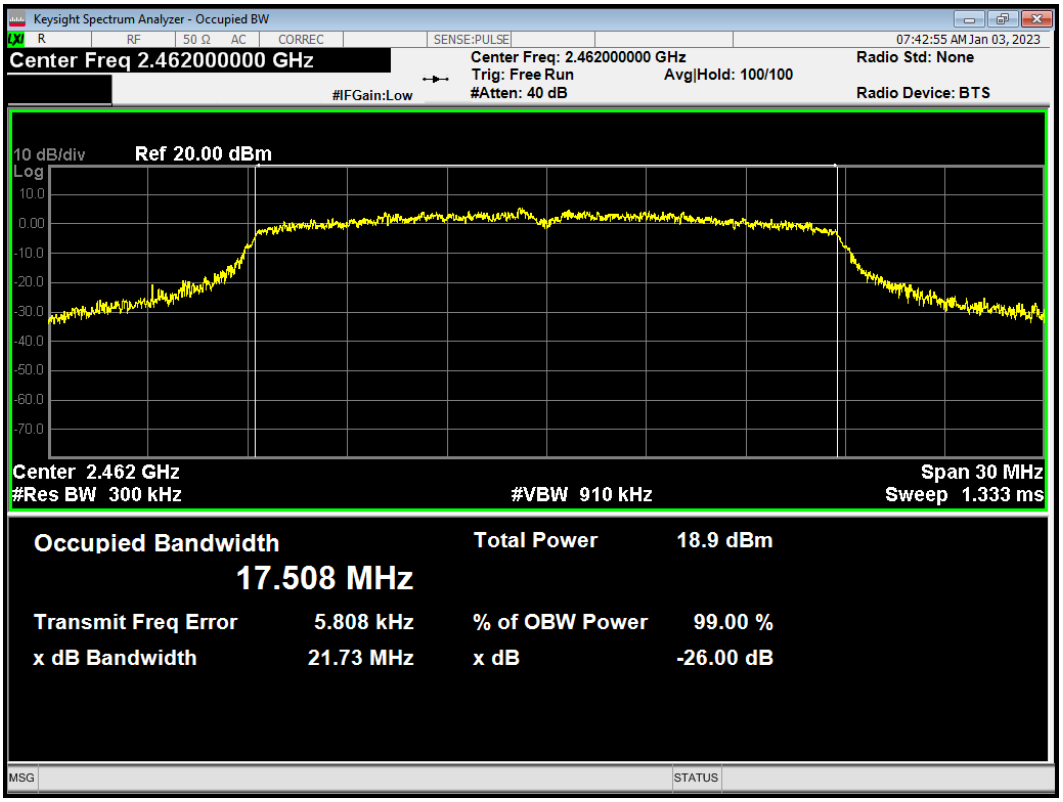
OBW 802.11n(HT20) 2412MHz



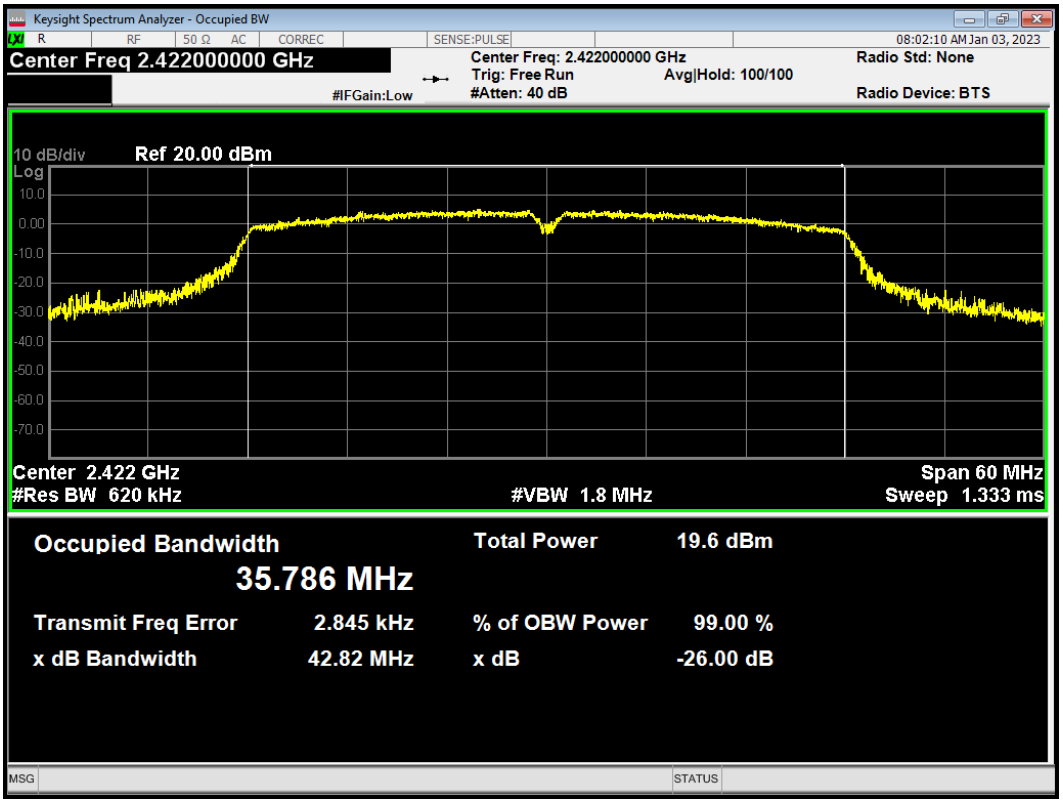
OBW 802.11n(HT20) 2437MHz



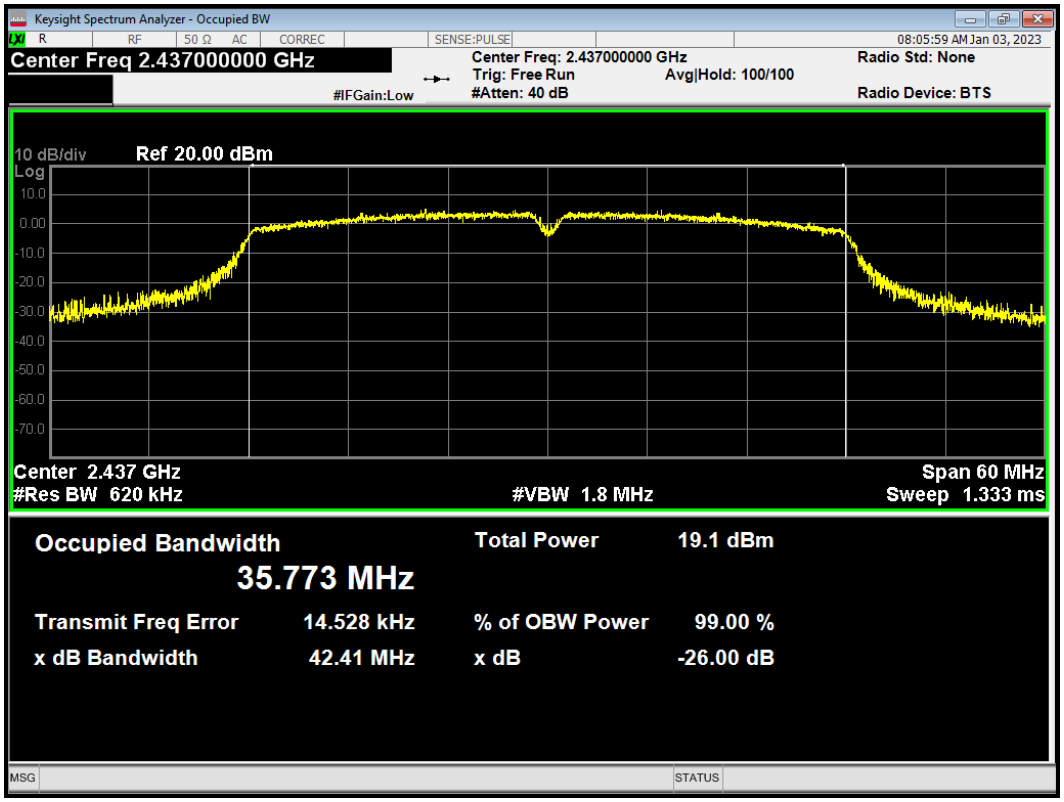
OBW 802.11n(HT20) 2462MHz



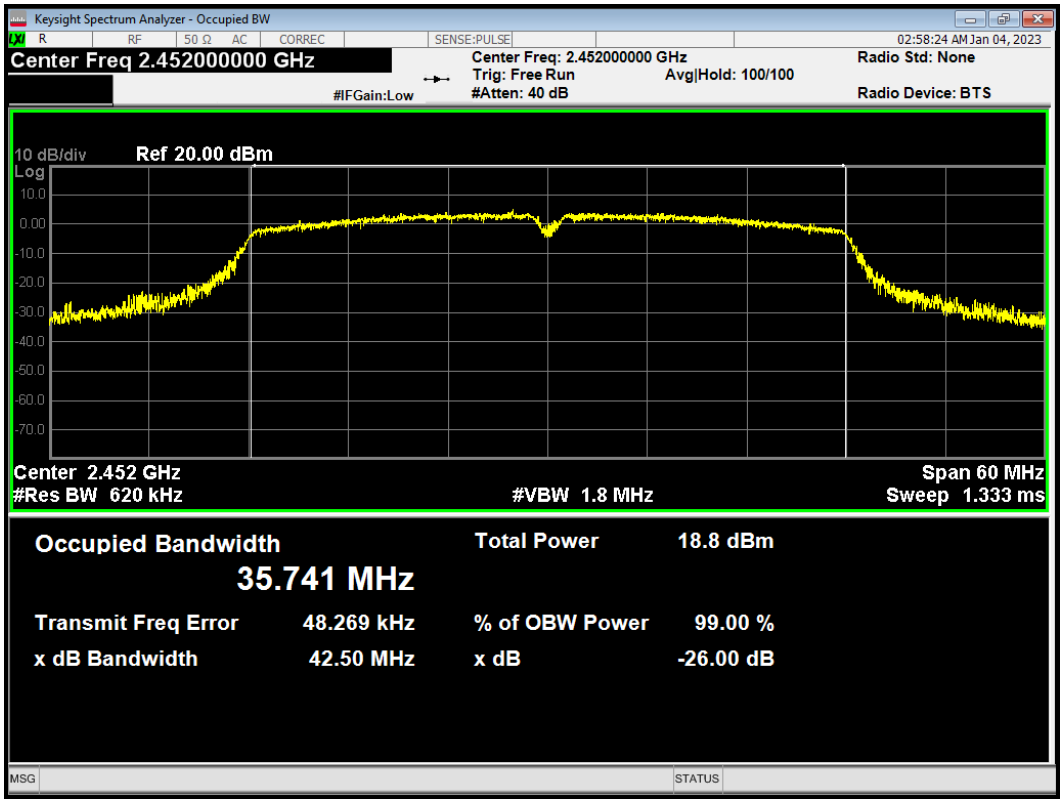
OBW 802.11n(HT40) 2422MHz



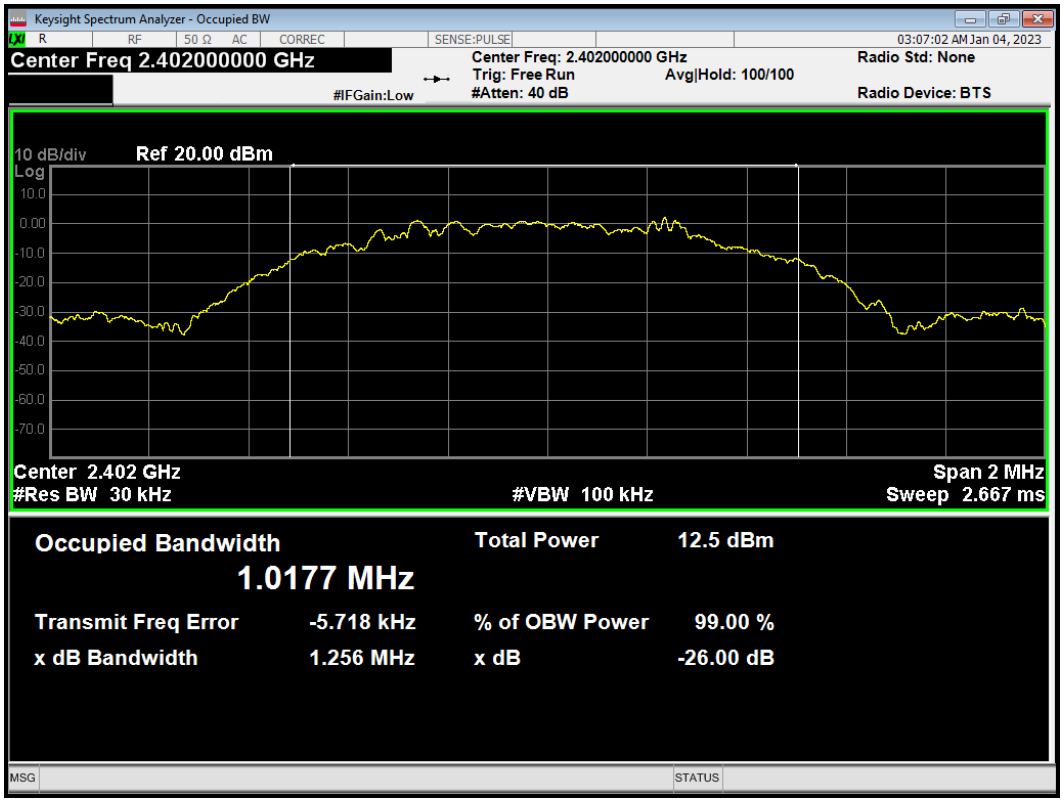
OBW 802.11n(HT40) 2437MHz



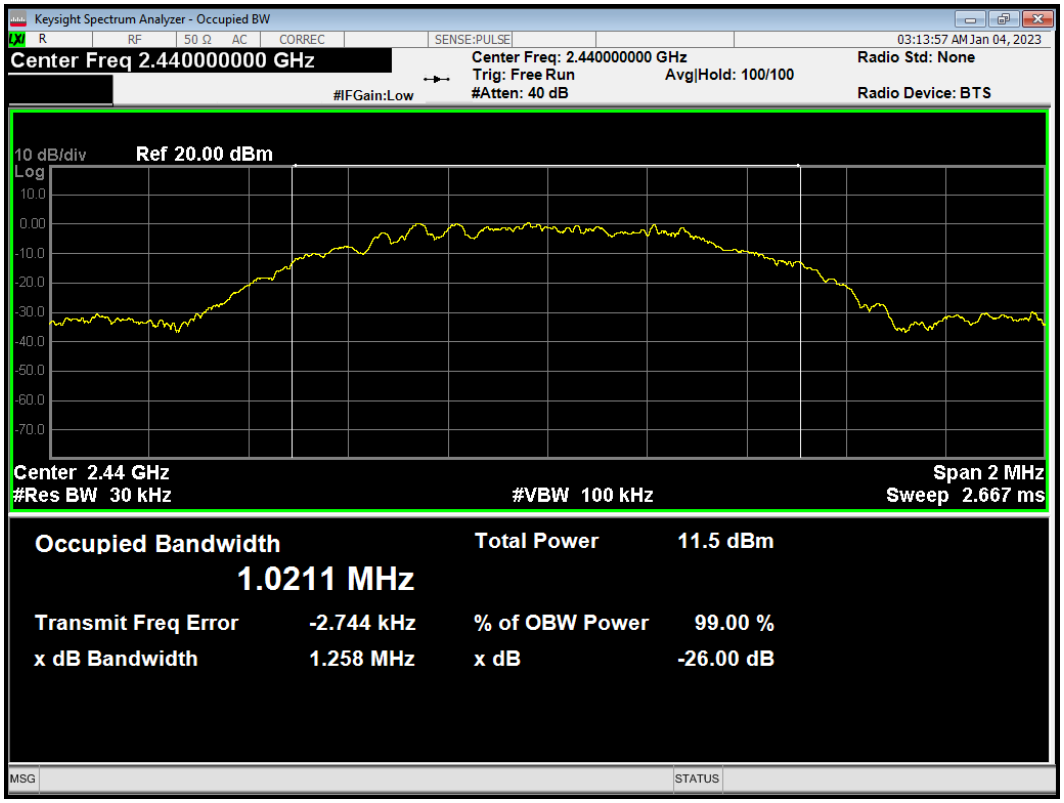
OBW 802.11n(HT40) 2452MHz



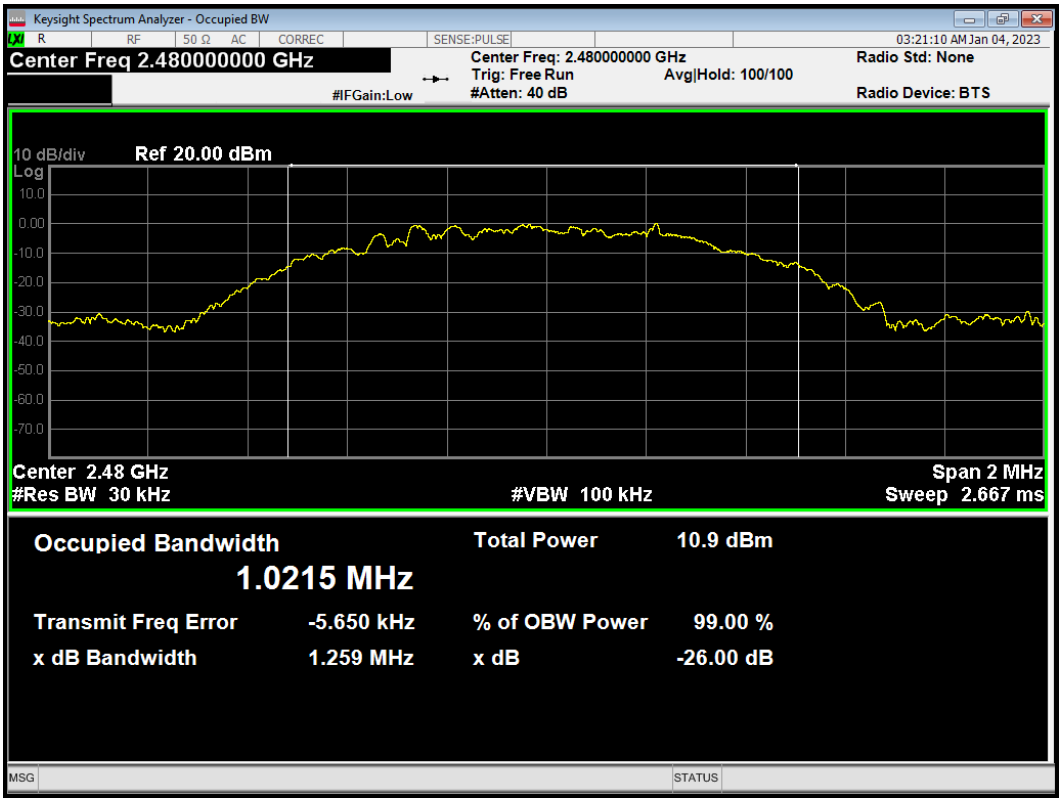
OBW BLE 2402MHz



OBW BLE 2440MHz

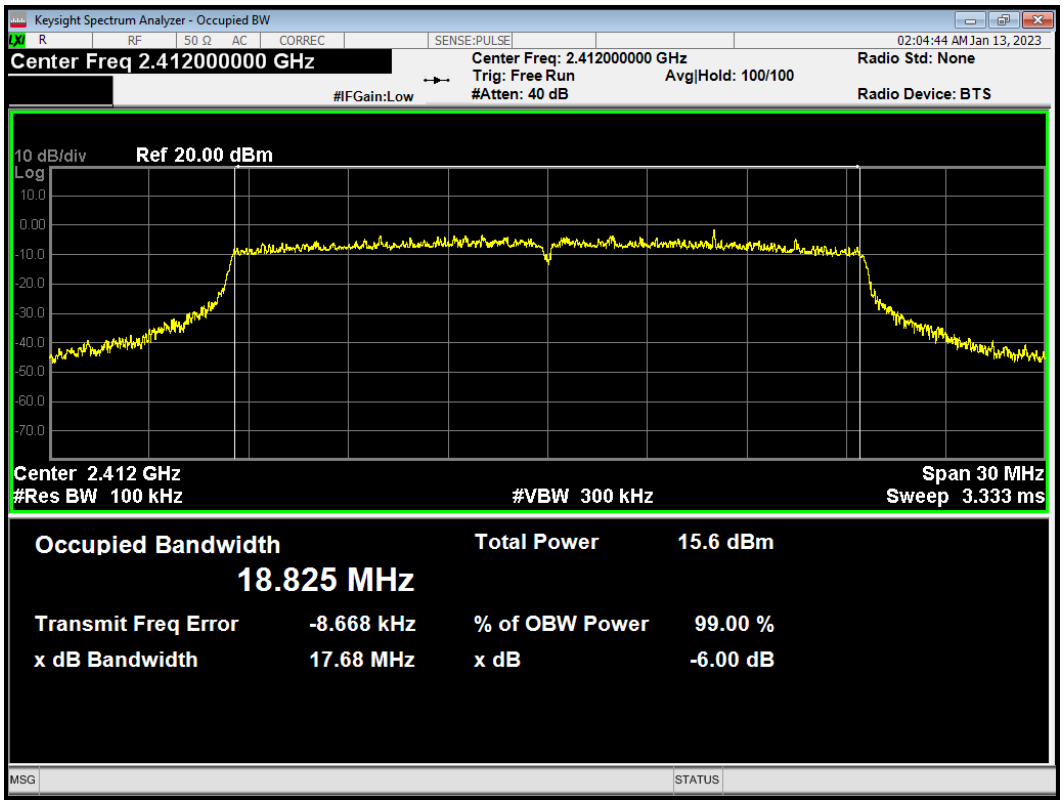


OBW BLE 2480MHz

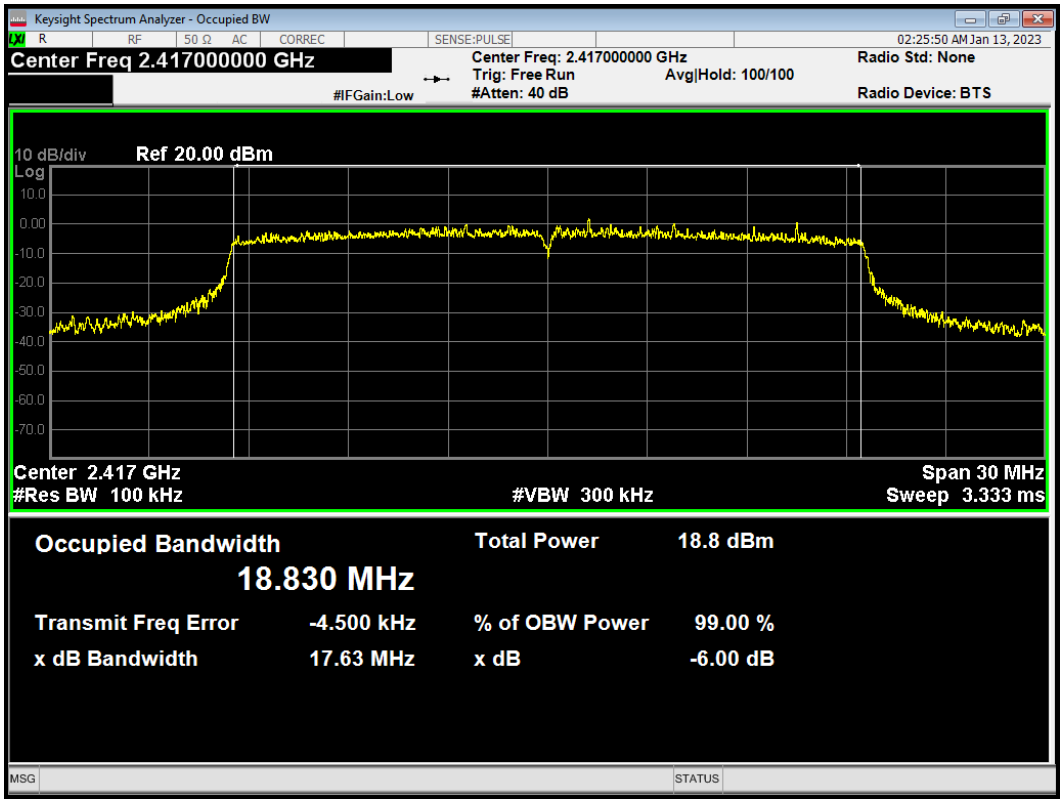


6 dB bandwidth

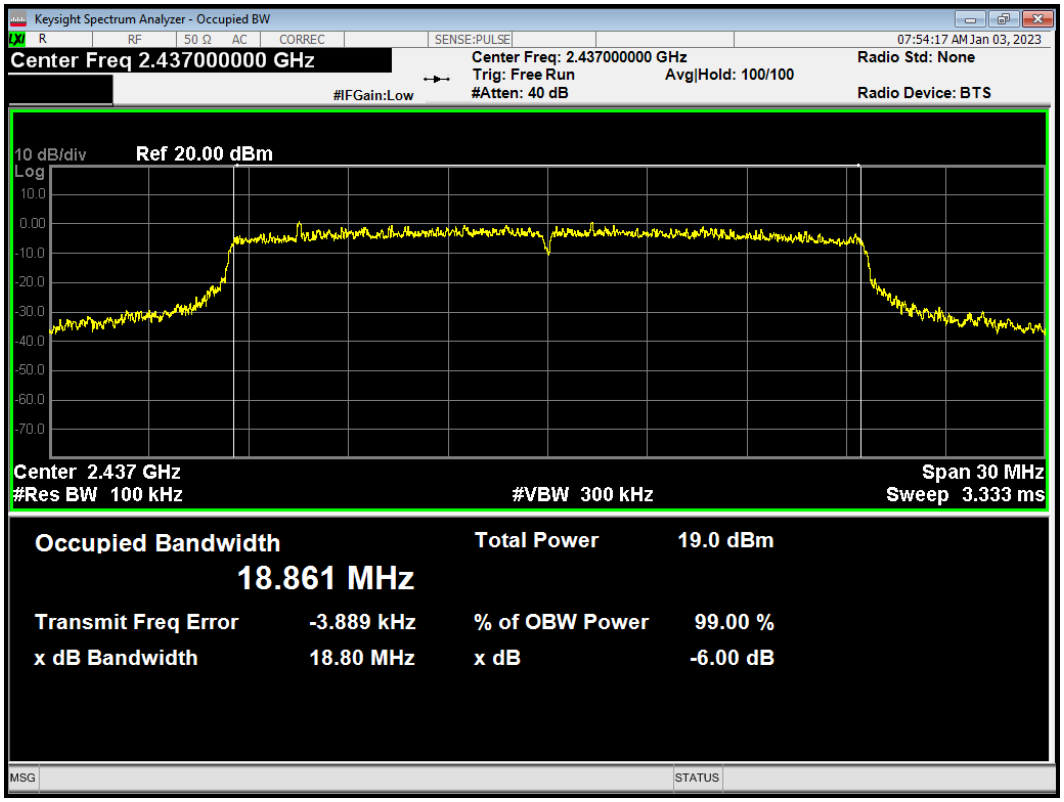
-6dB Bandwidth 802.11ax(HE20) 2412MHz



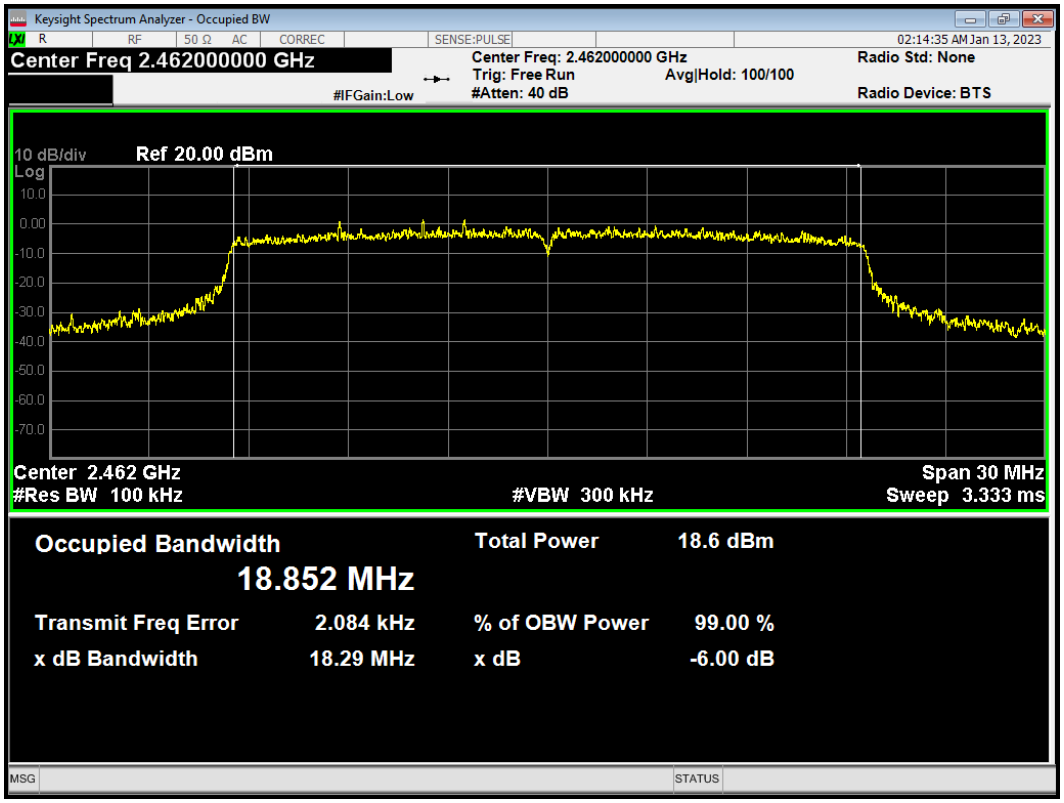
-6dB Bandwidth 802.11ax(HE20) 2417MHz



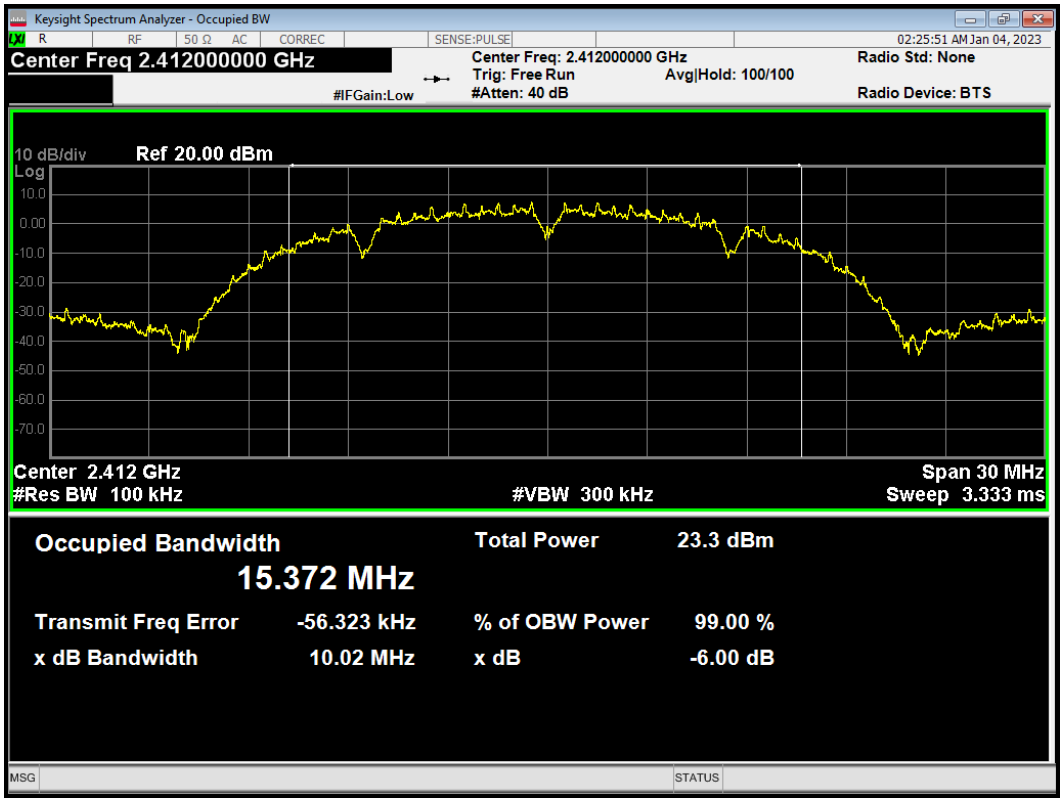
-6dB Bandwidth 802.11ax(HE20) 2437MHz



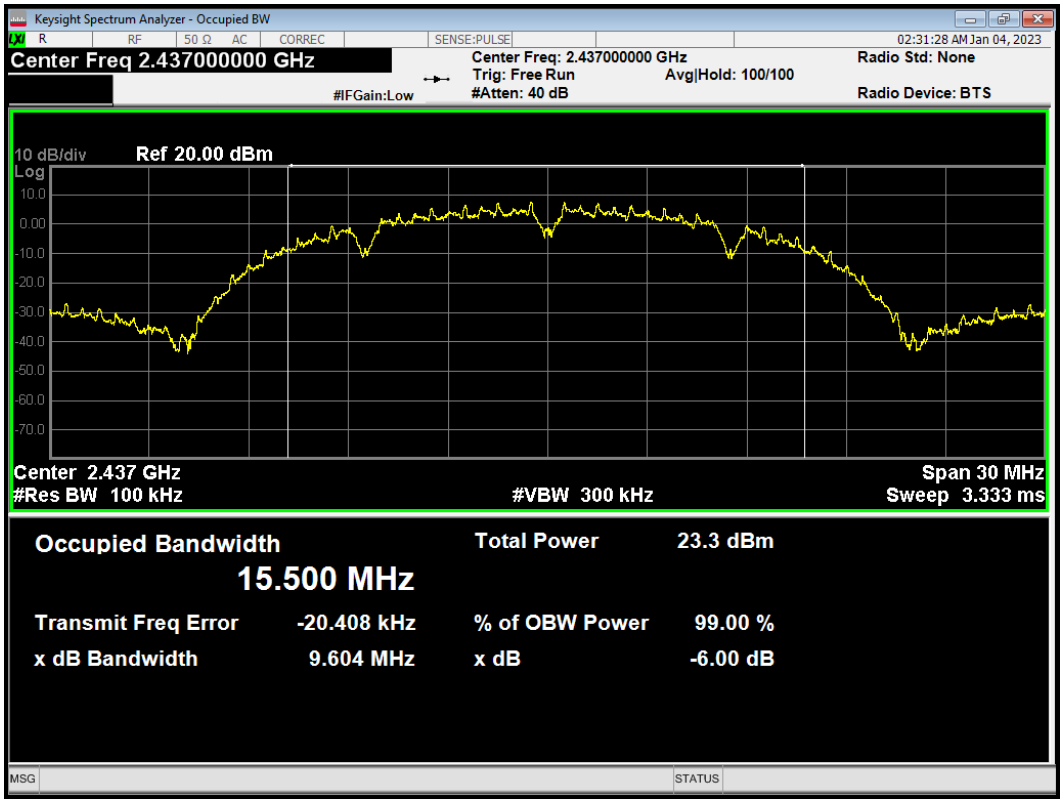
-6dB Bandwidth 802.11ax(HE20) 2462MHz



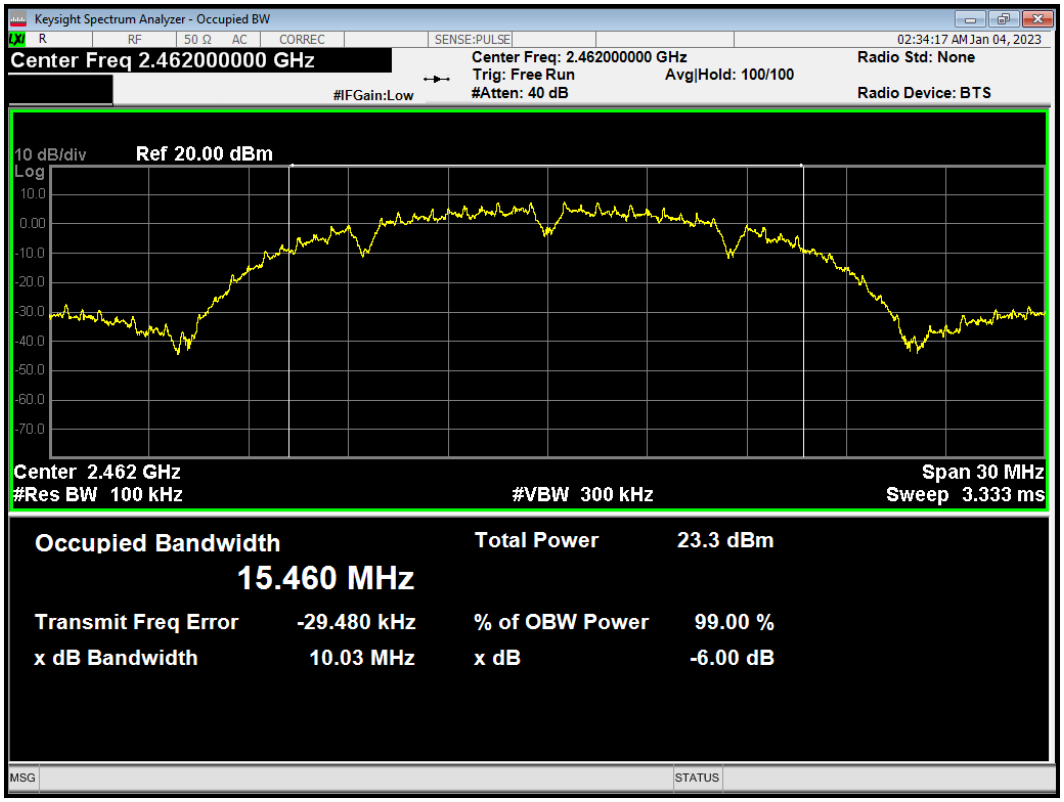
-6dB Bandwidth 802.11b 2412MHz



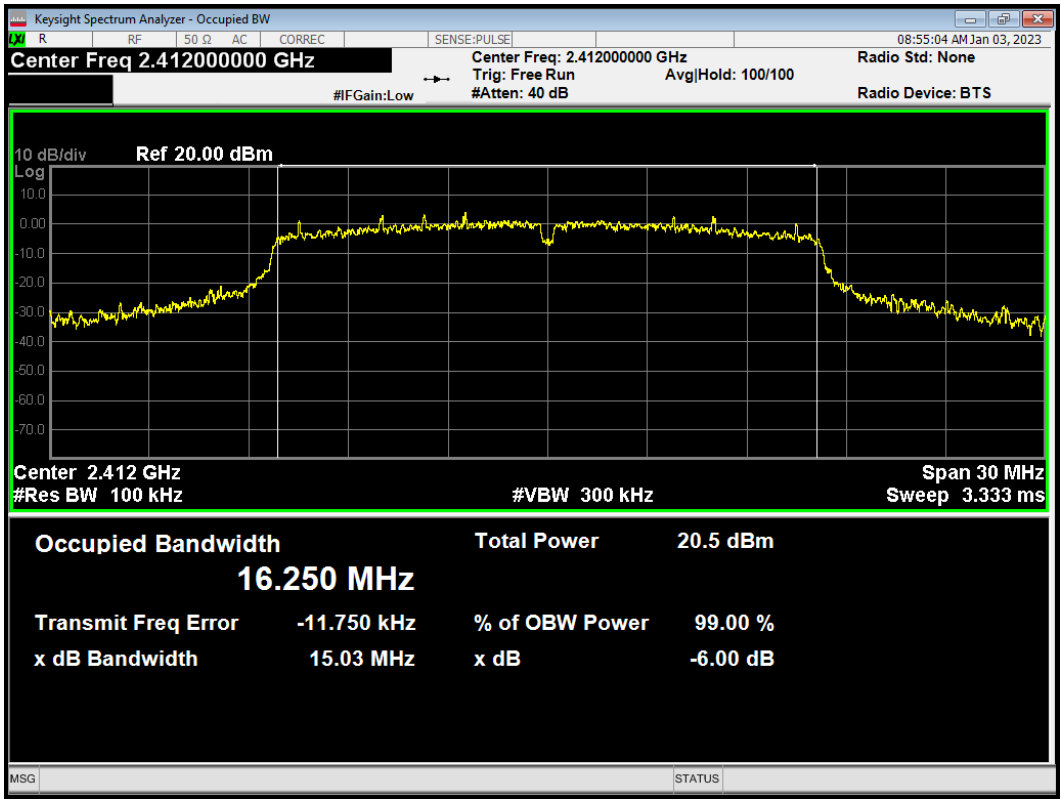
-6dB Bandwidth 802.11b 2437MHz



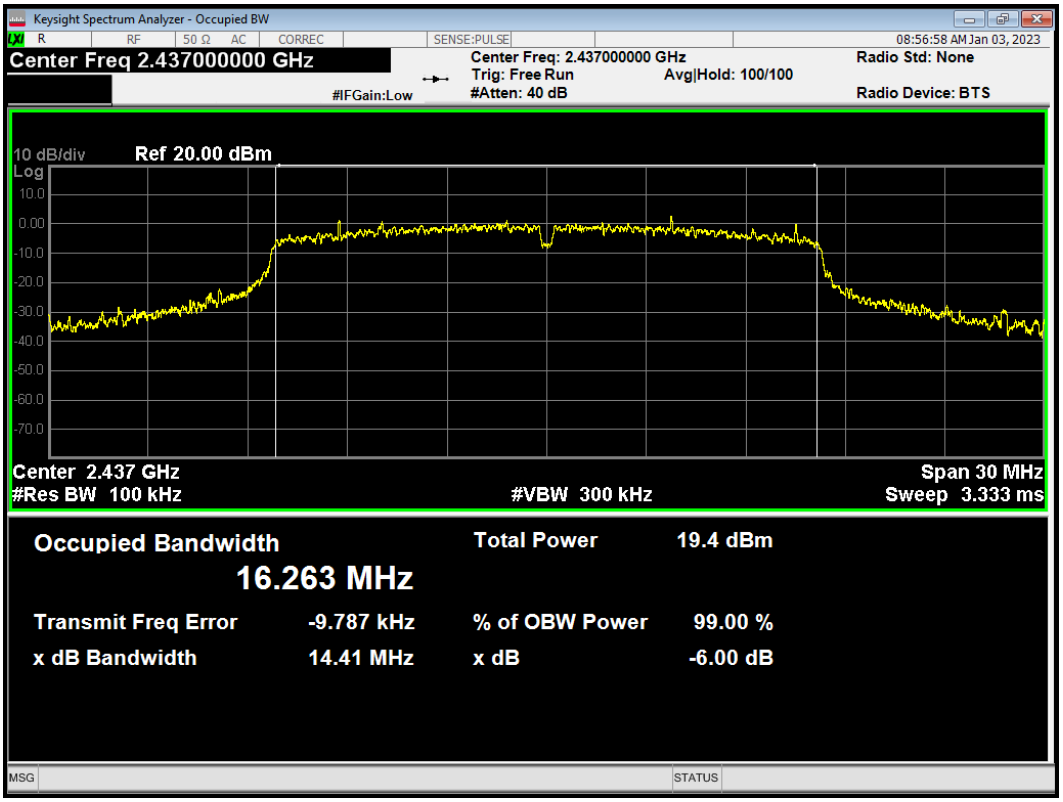
-6dB Bandwidth 802.11b 2462MHz



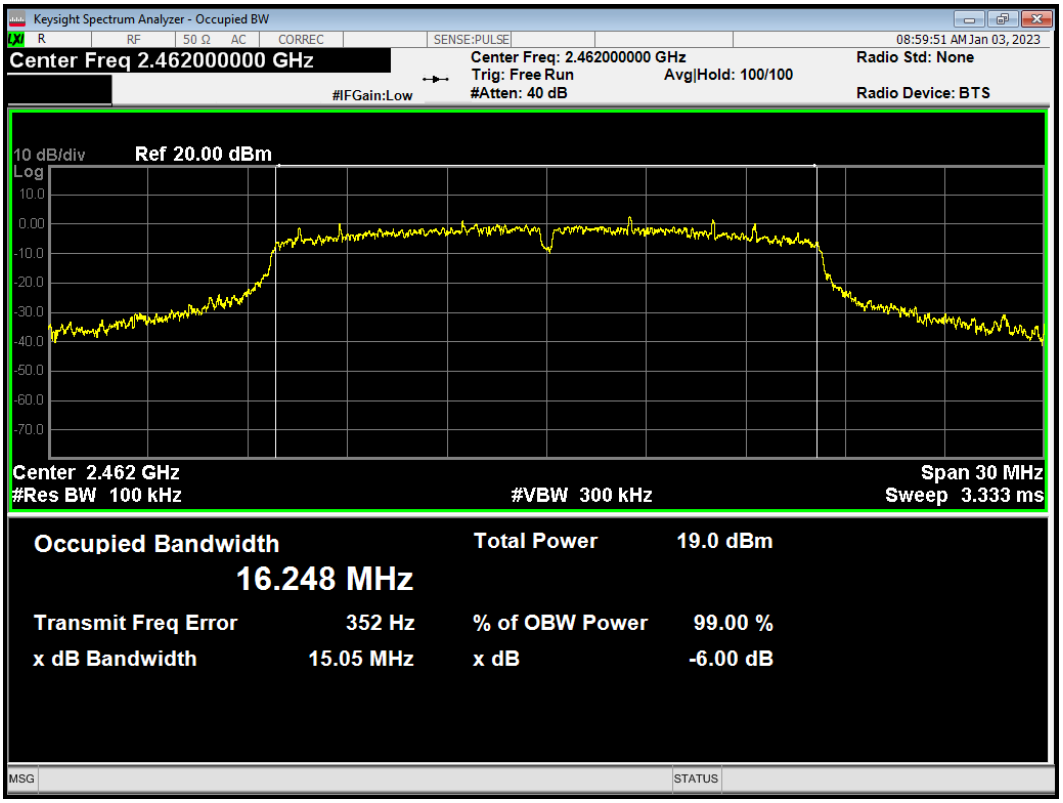
-6dB Bandwidth 802.11g 2412MHz



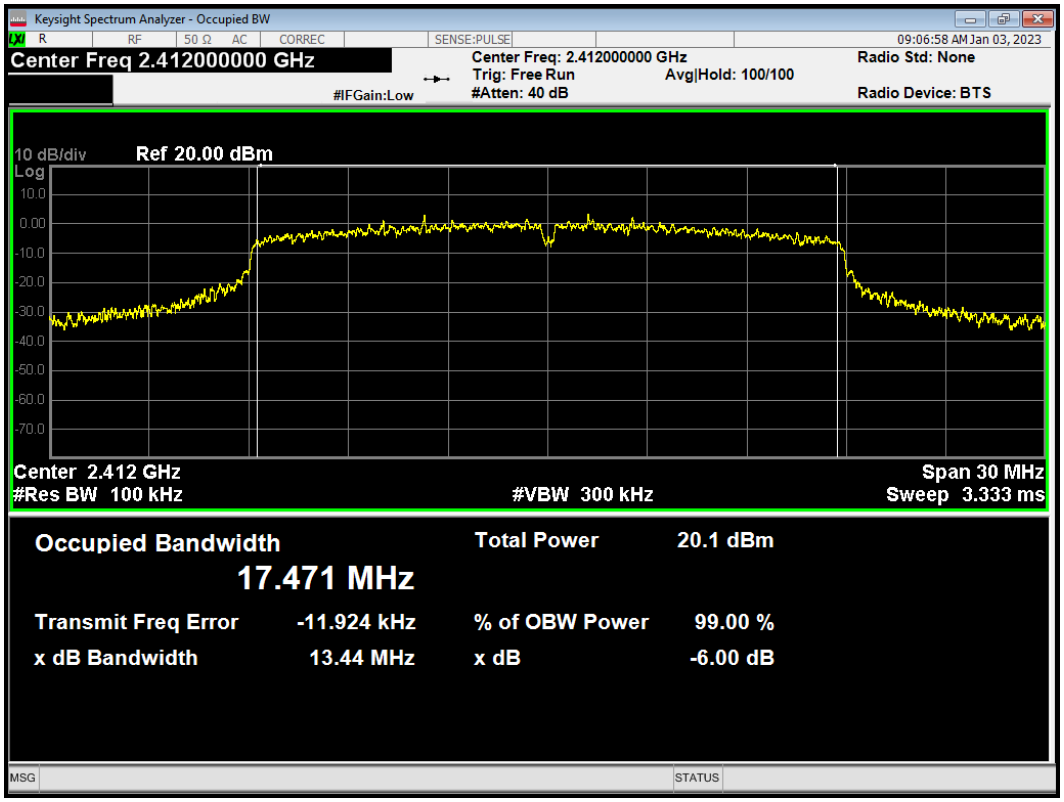
-6dB Bandwidth 802.11g 2437MHz



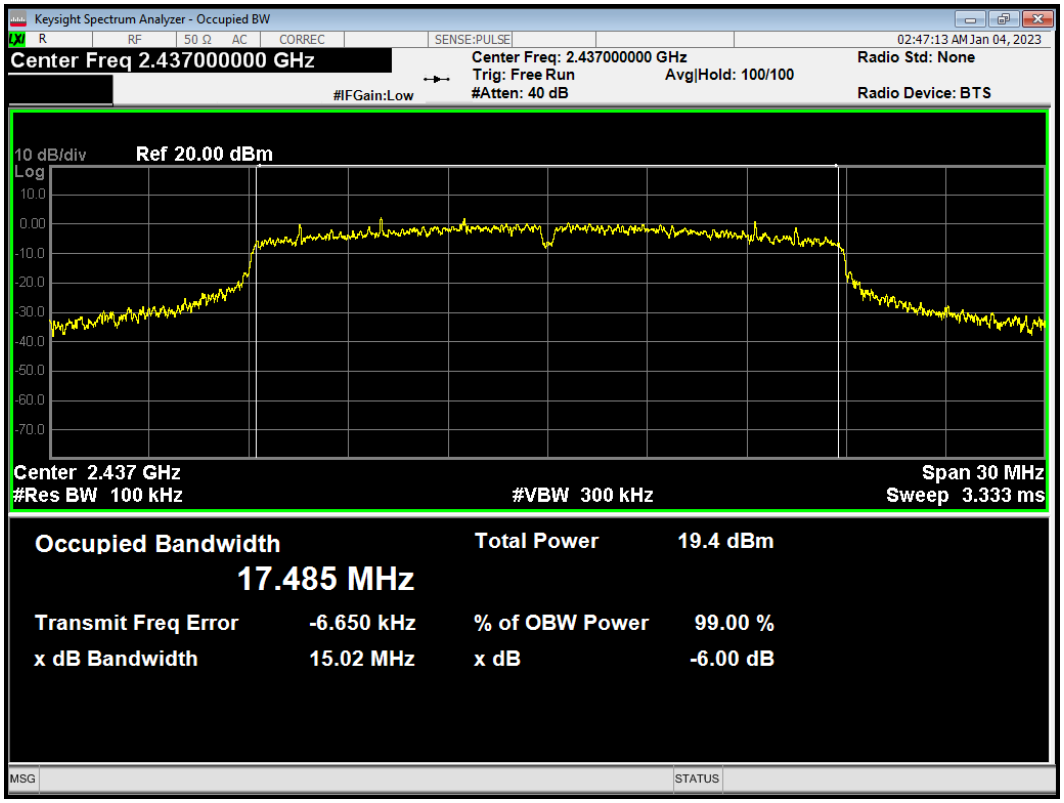
-6dB Bandwidth 802.11g 2462MHz



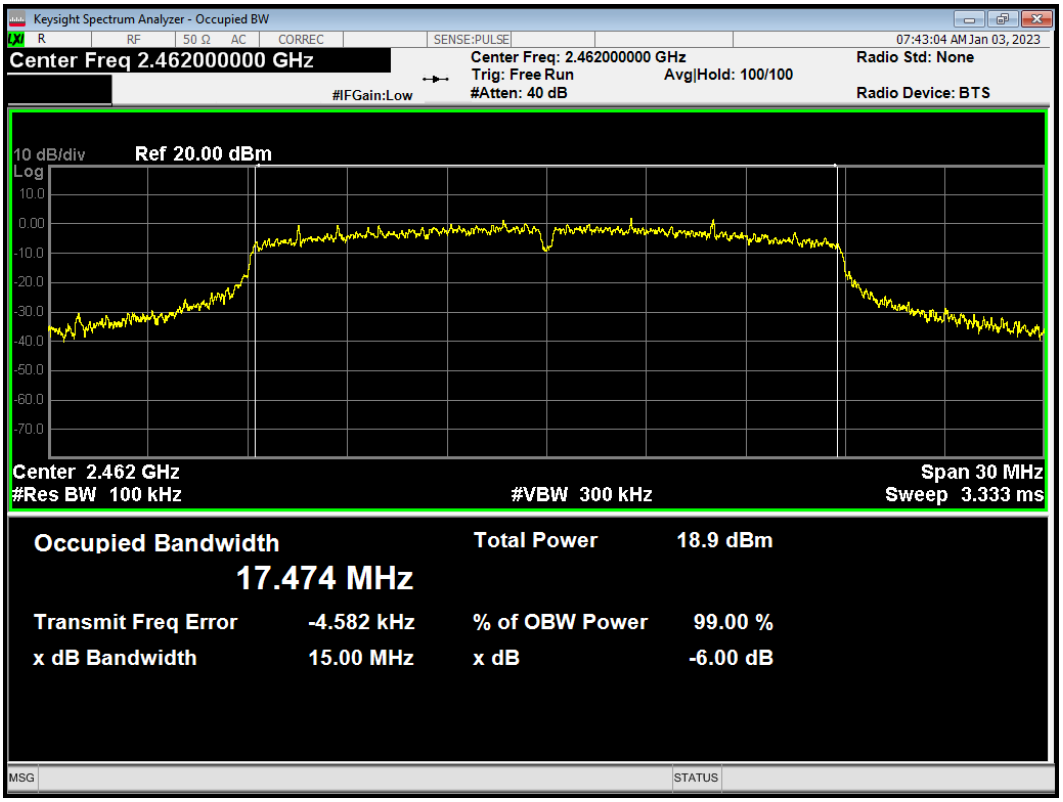
-6dB Bandwidth 802.11n(HT20) 2412MHz



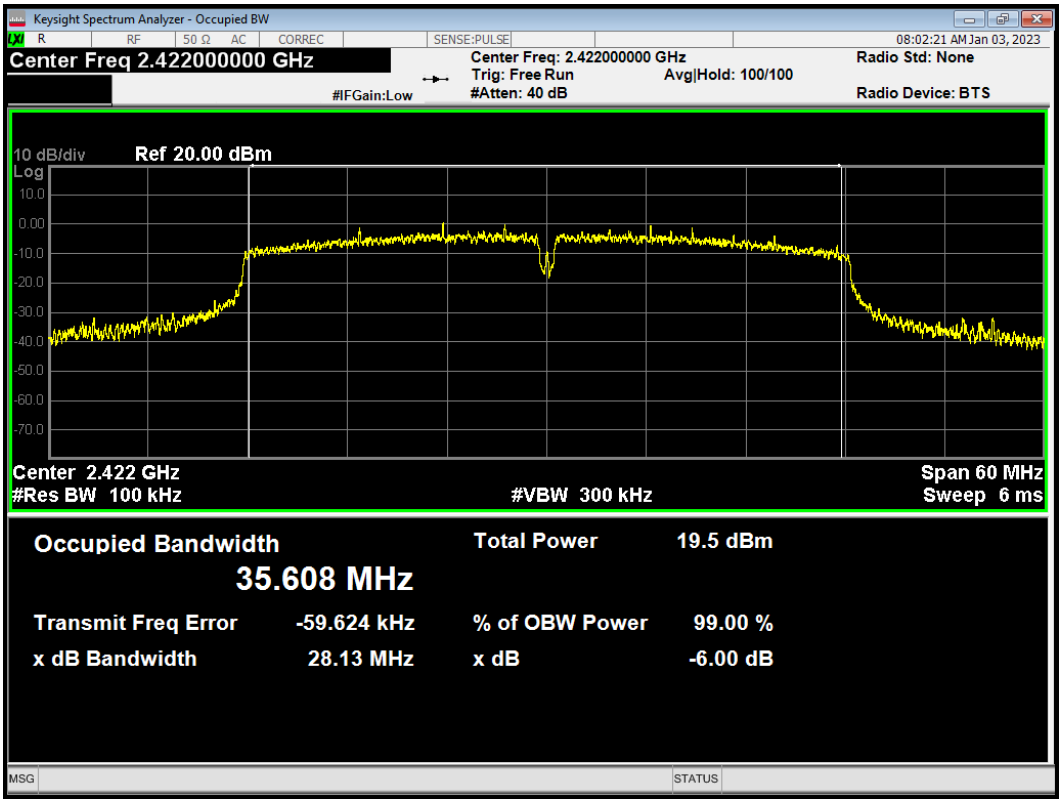
-6dB Bandwidth 802.11n(HT20) 2437MHz



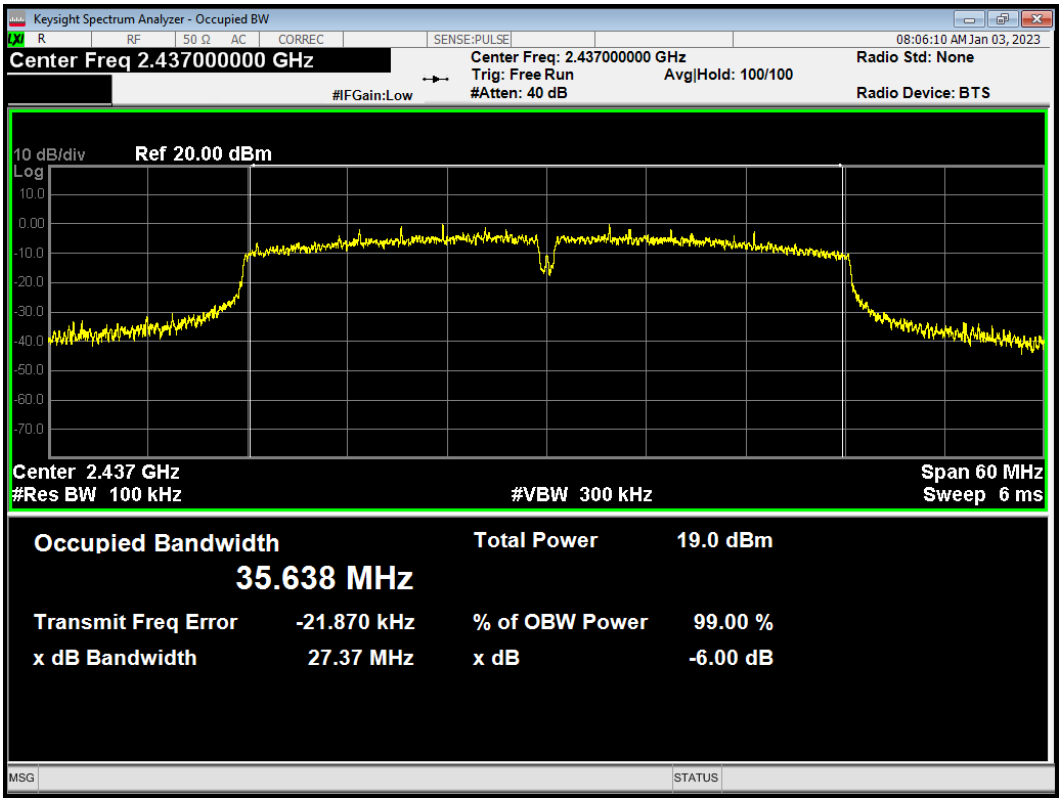
-6dB Bandwidth 802.11n(HT20) 2462MHz



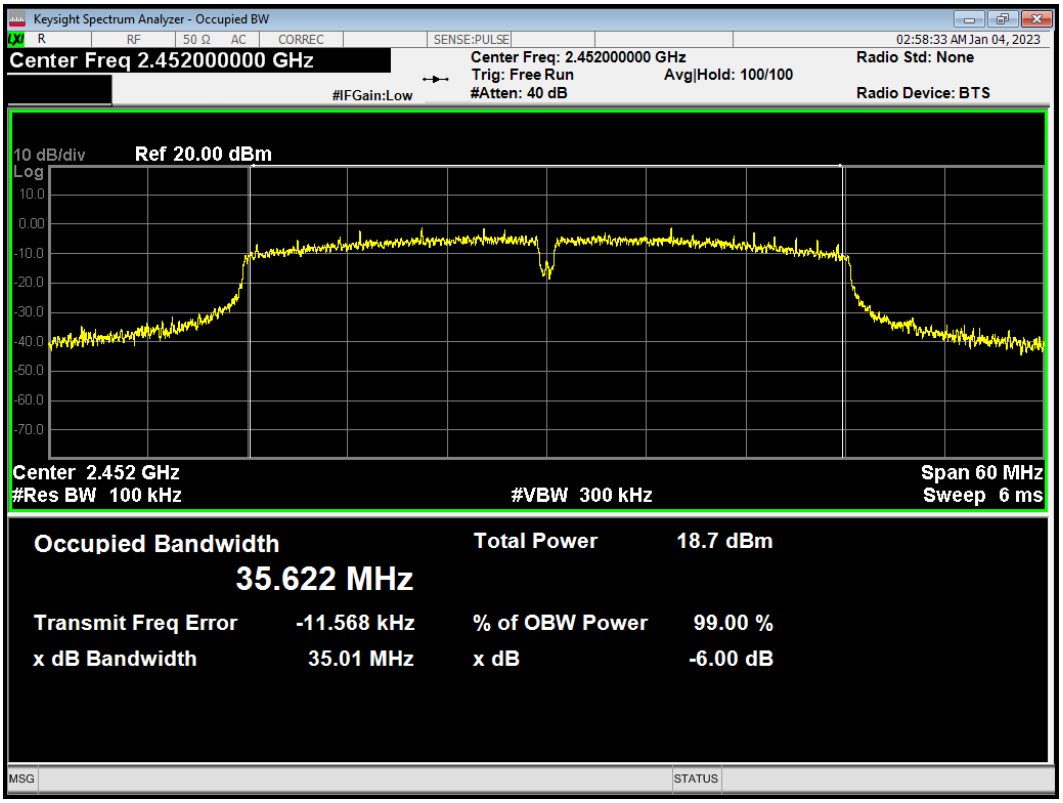
-6dB Bandwidth 802.11n(HT40) 2422MHz



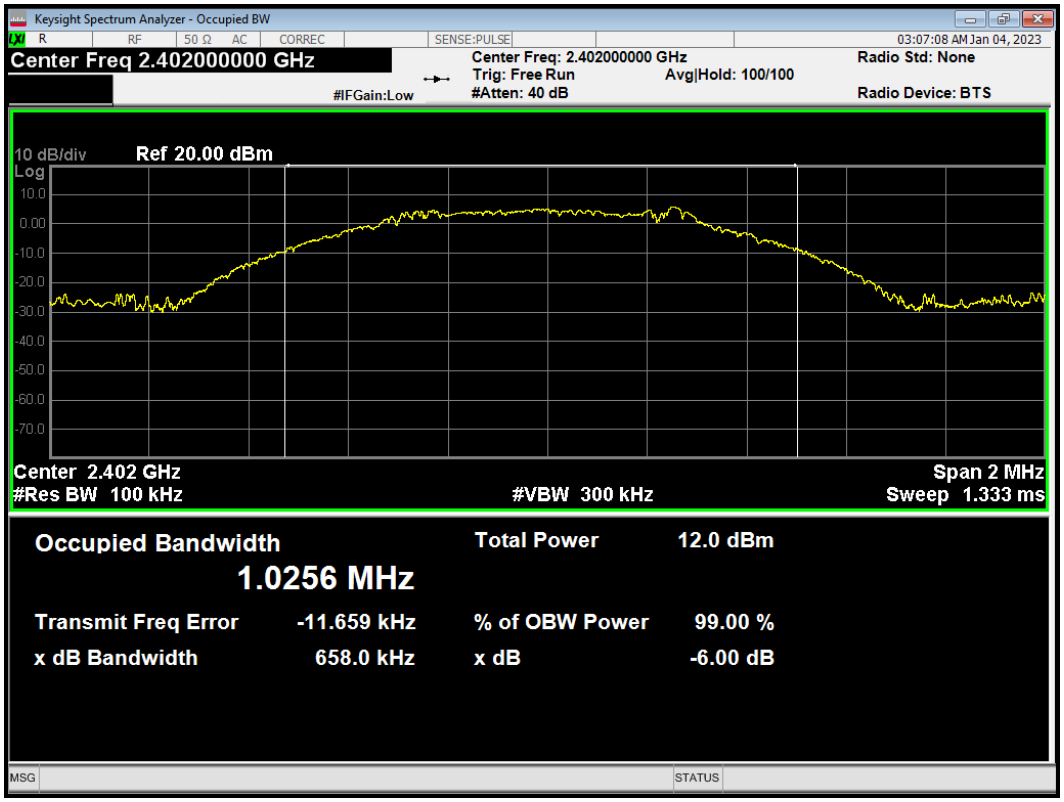
-6dB Bandwidth 802.11n(HT40) 2437MHz



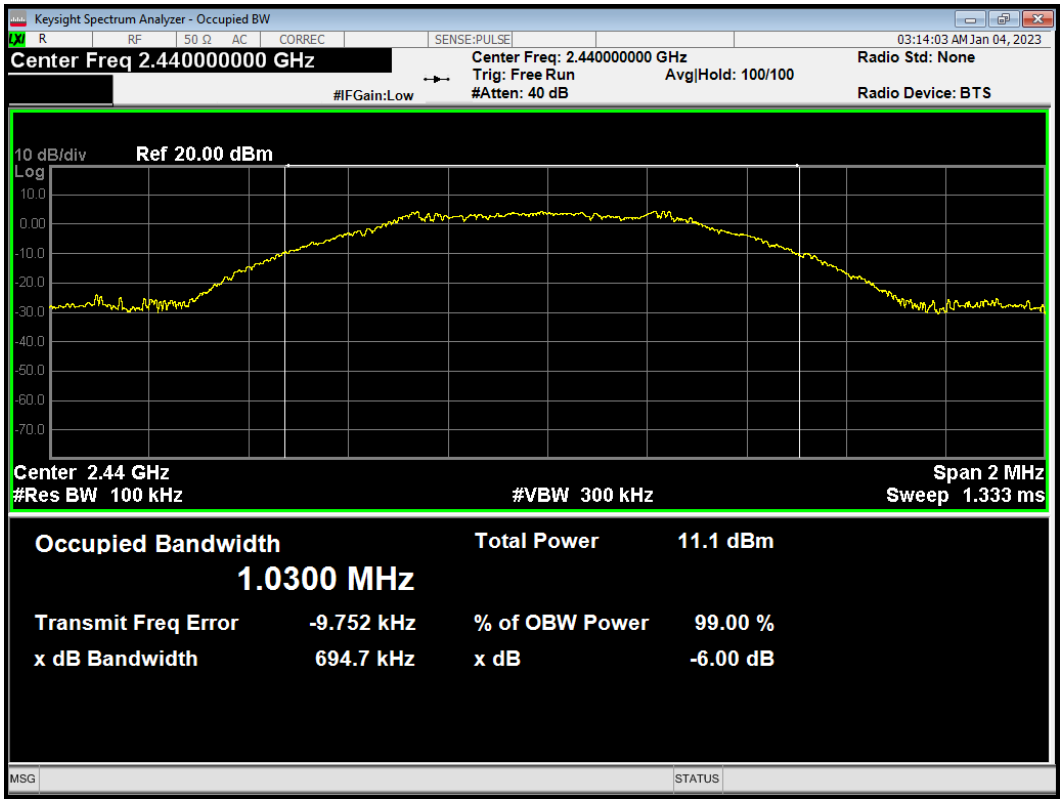
-6dB Bandwidth 802.11n(HT40) 2452MHz



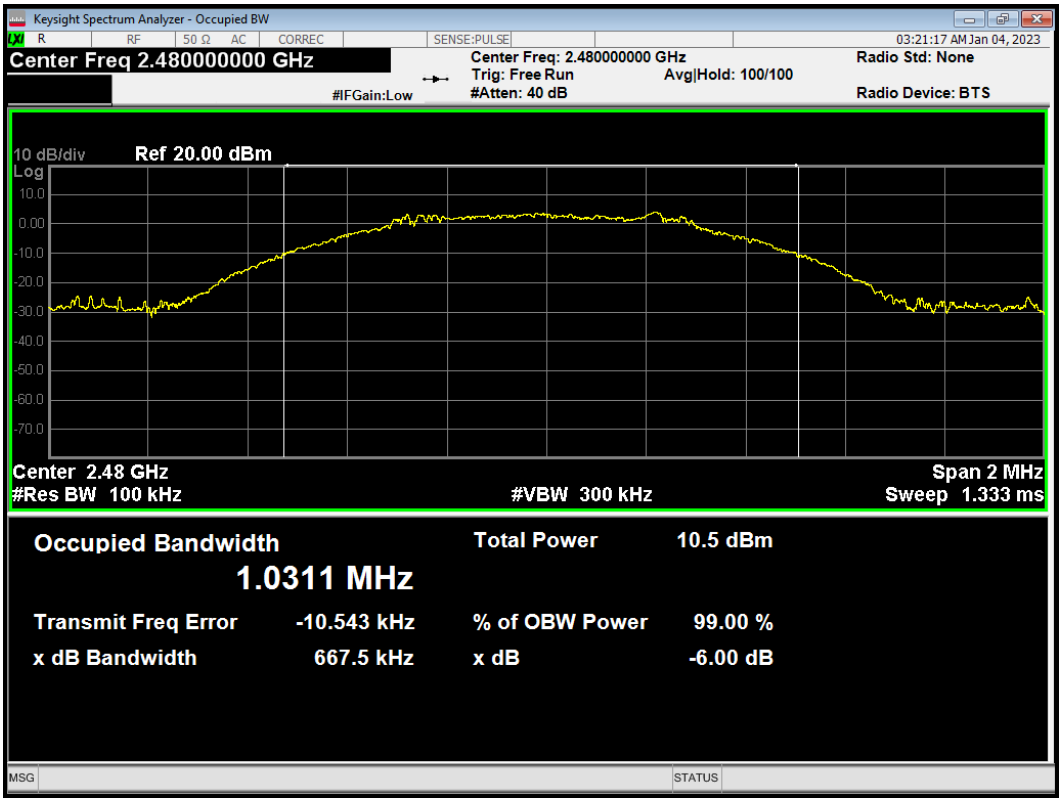
-6dB Bandwidth BLE 2402MHz



-6dB Bandwidth BLE 2440MHz



-6dB Bandwidth BLE 2480MHz



5.3. Band Edge

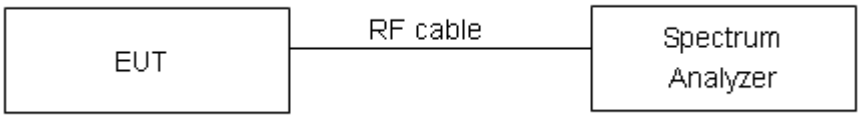
Ambient Condition

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.”

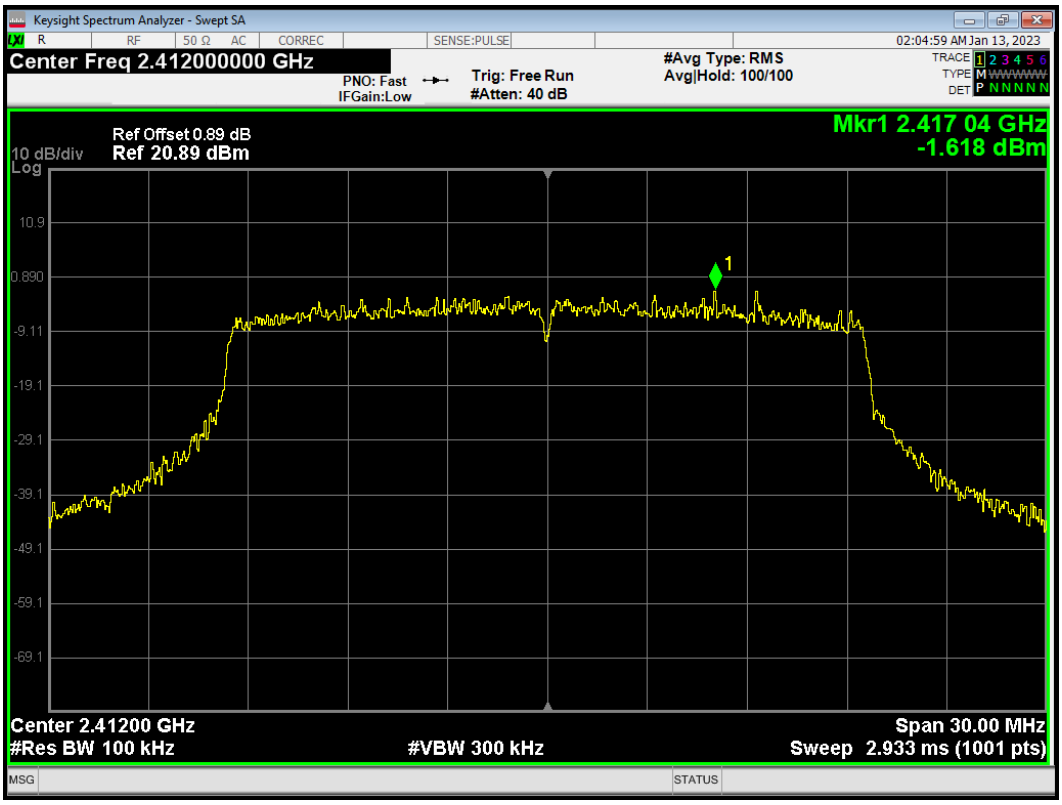
Measurement Uncertainty

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

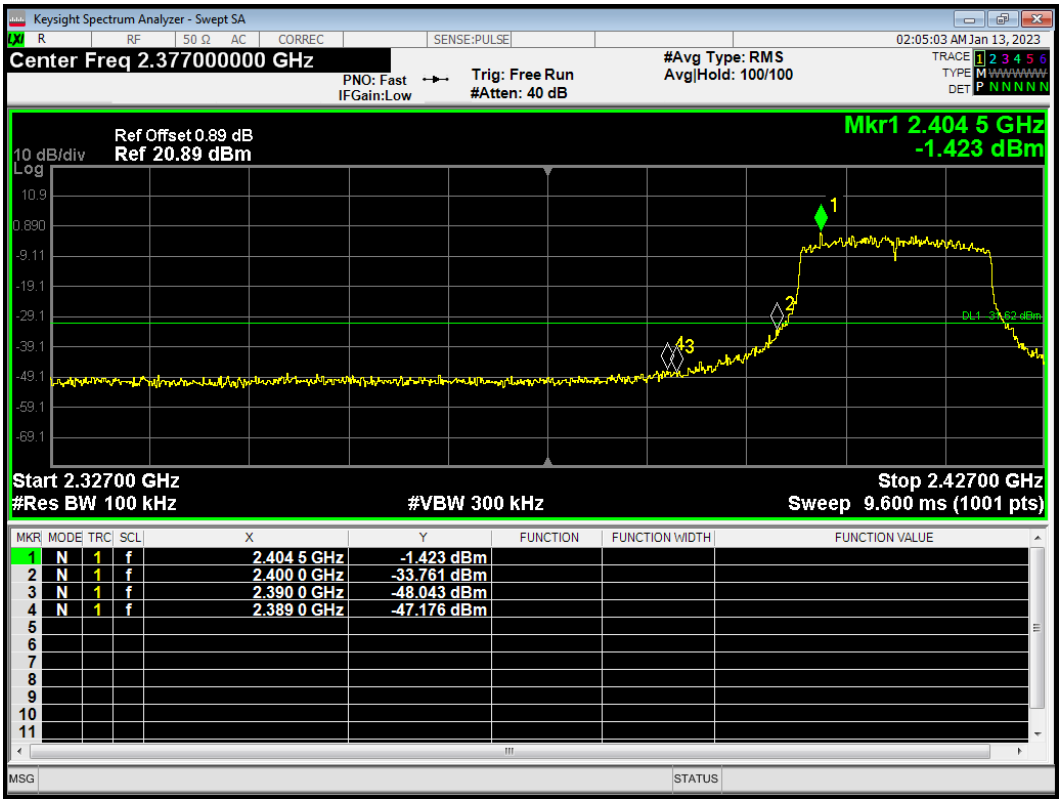
Frequency	Uncertainty
2GHz-3GHz	1.407 dB

Test Results: PASS

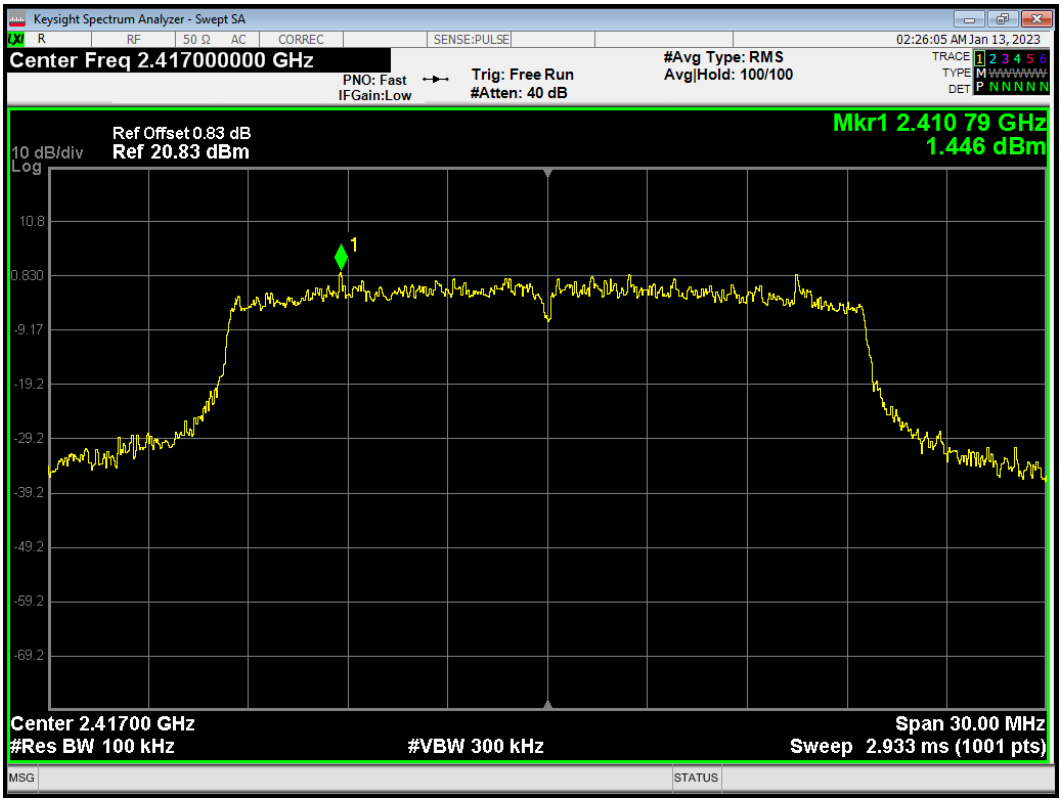
Band Edge 802.11ax(HE20) 2412MHz Ref



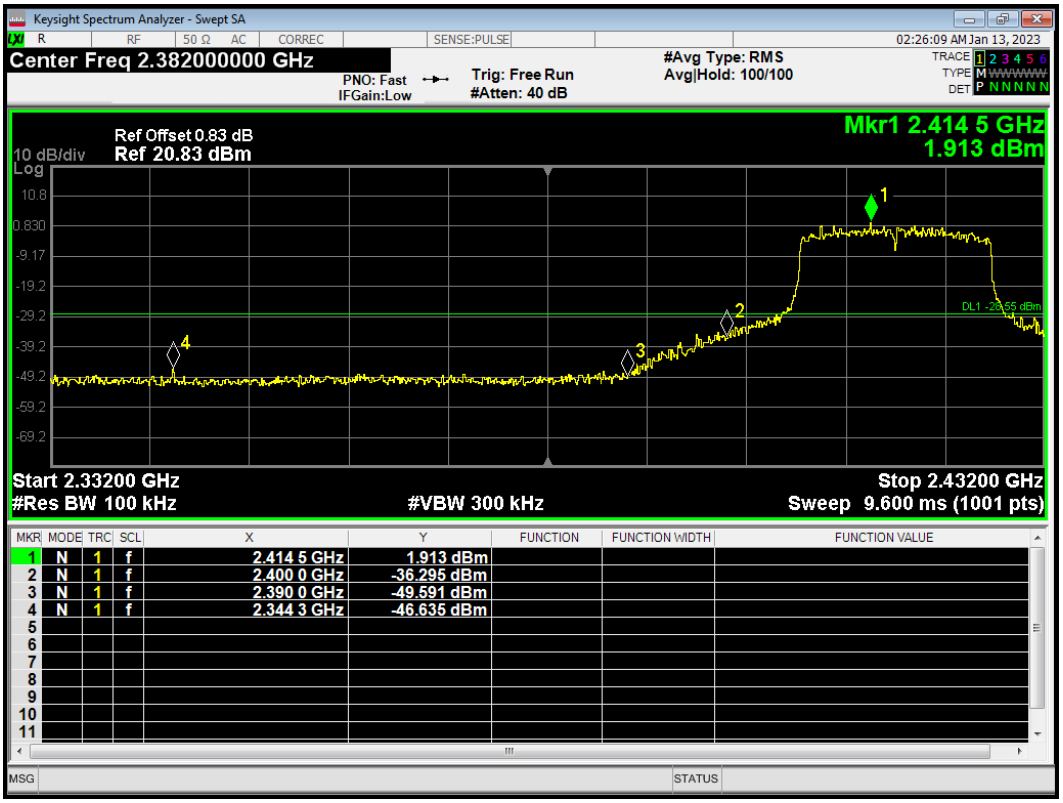
Band Edge 802.11ax(HE20) 2412MHz Emission



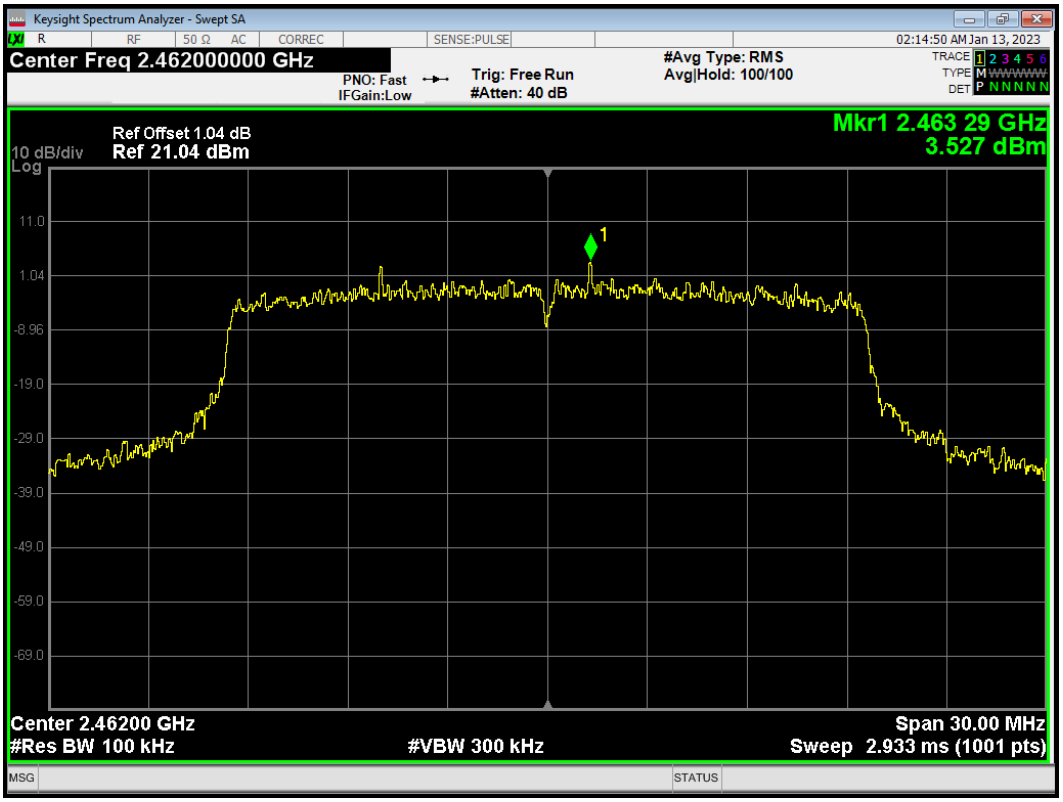
Band Edge 802.11ax(HE20) 2417MHz Ref



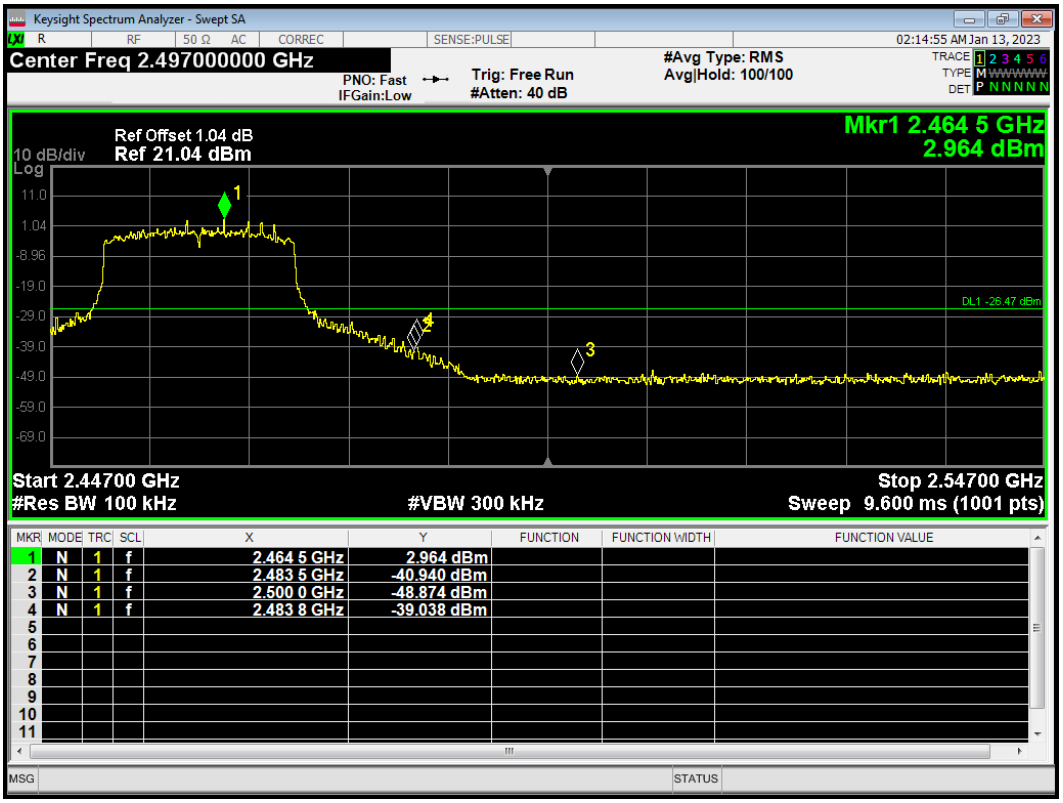
Band Edge 802.11ax(HE20) 2417MHz Emission



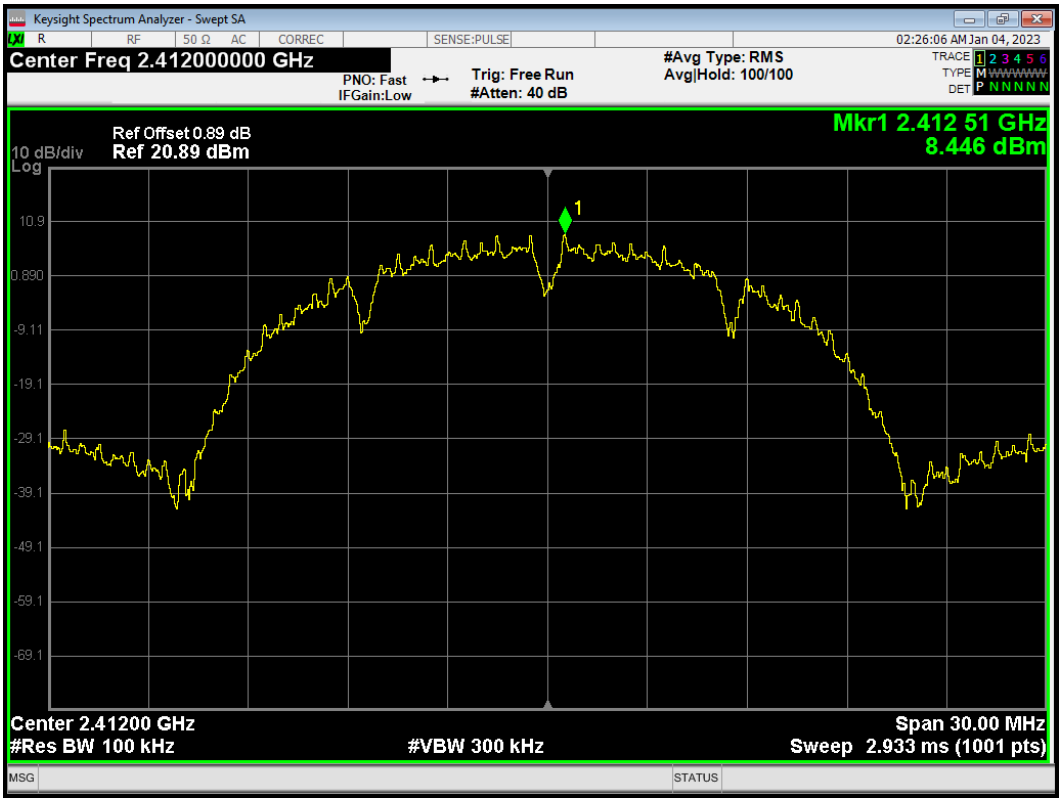
Band Edge 802.11ax(HE20) 2462MHz Ref



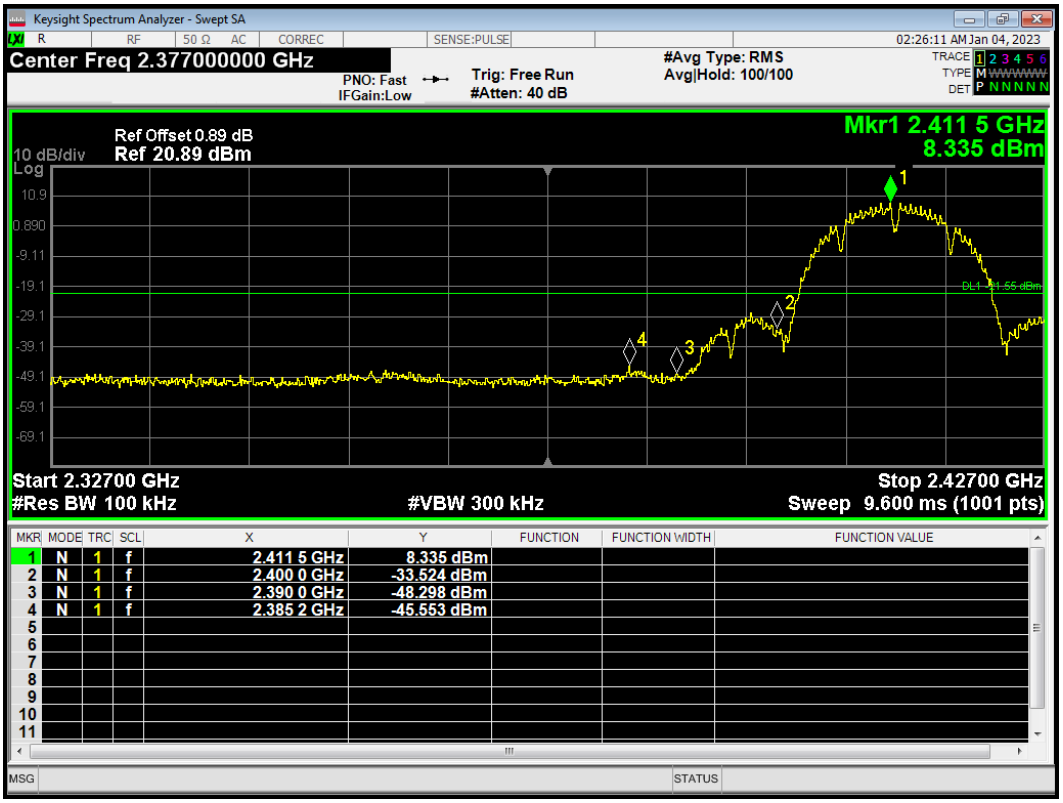
Band Edge 802.11ax(HE20) 2462MHz Emission



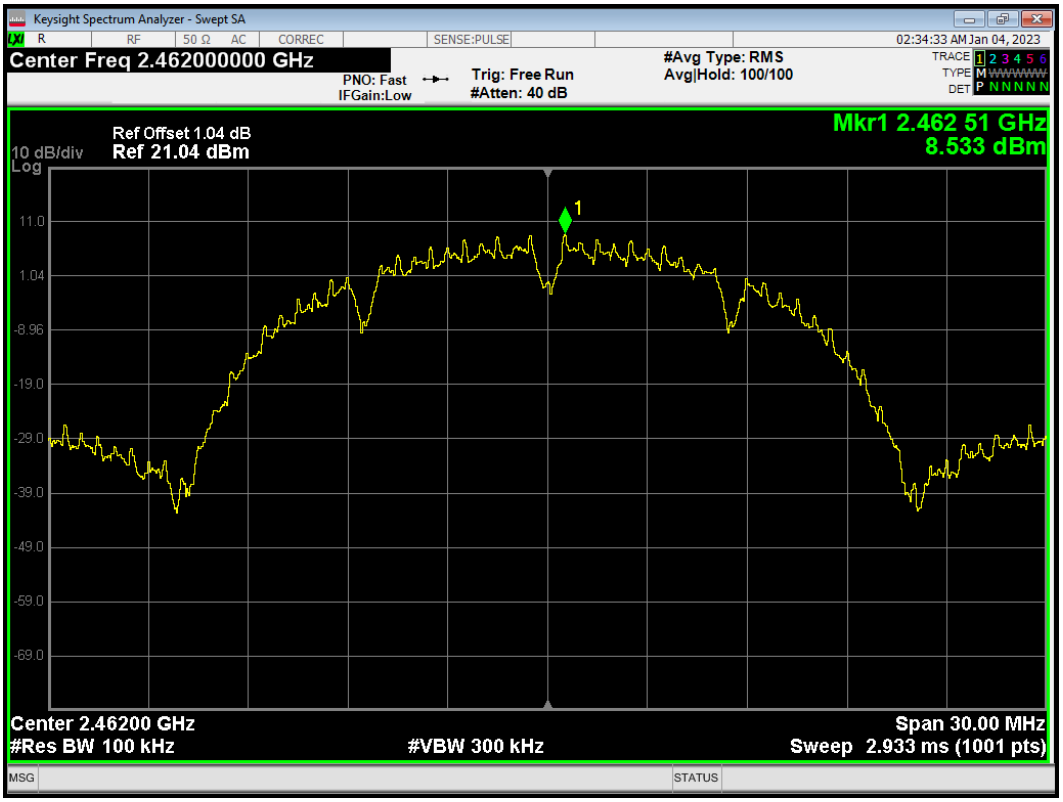
Band Edge 802.11b 2412MHz Ref



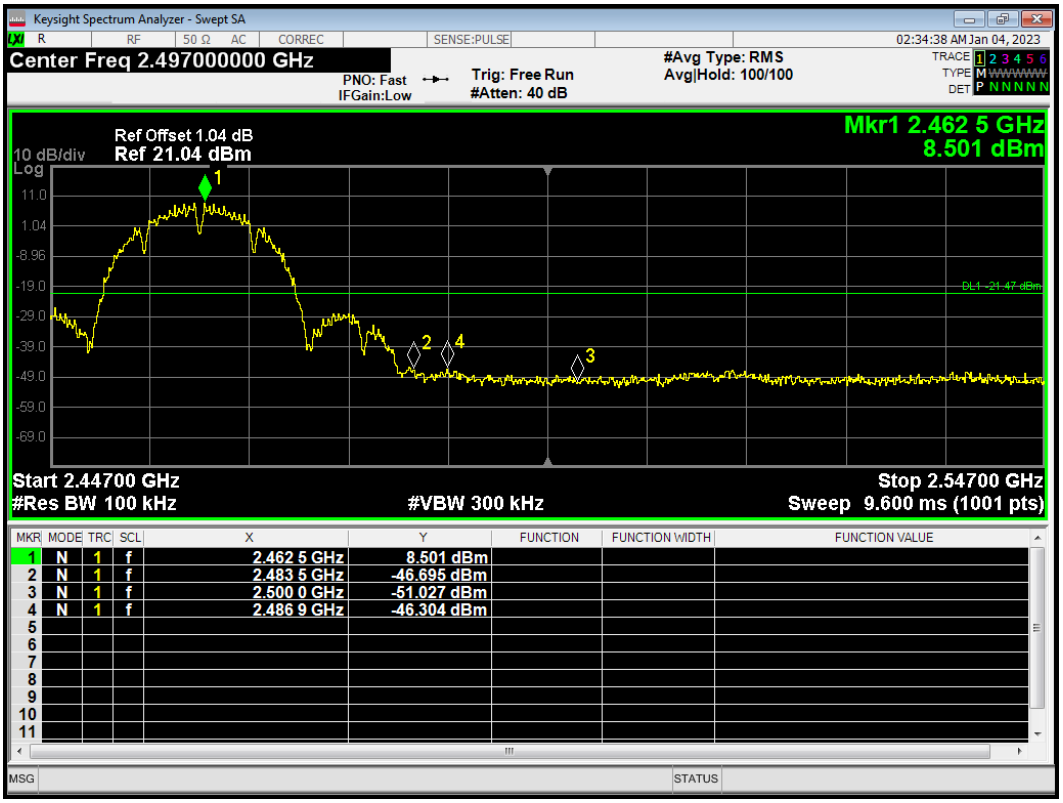
Band Edge 802.11b 2412MHz Emission



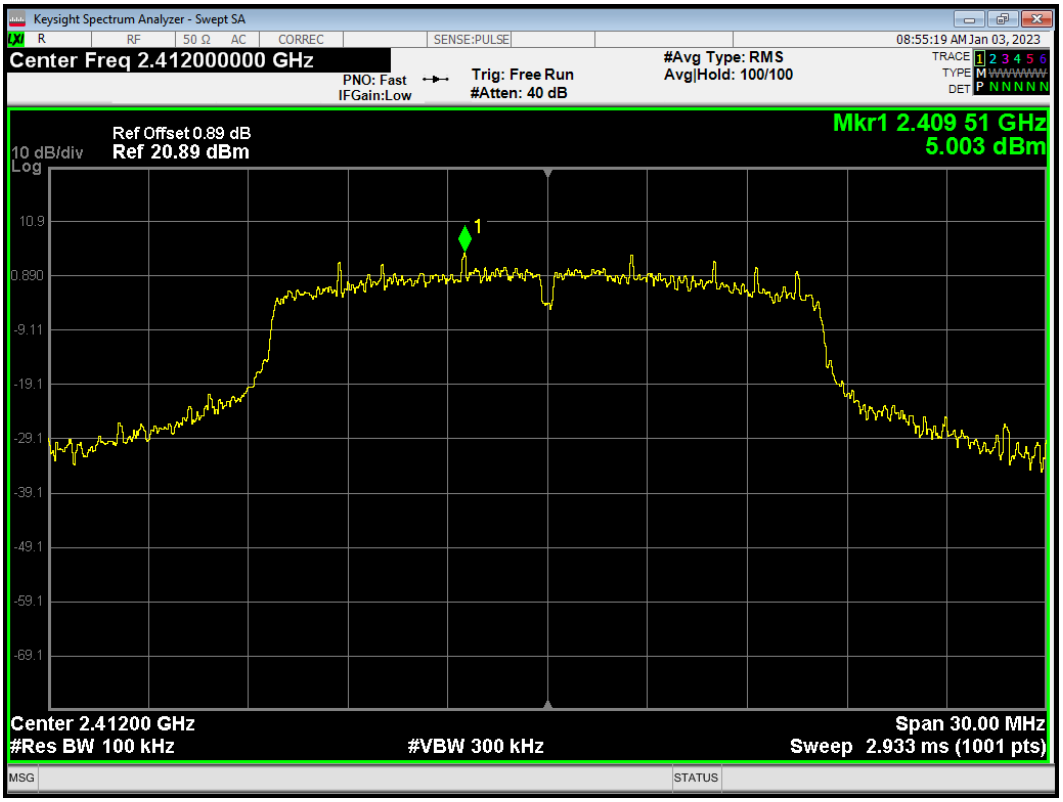
Band Edge 802.11b 2462MHz Ref



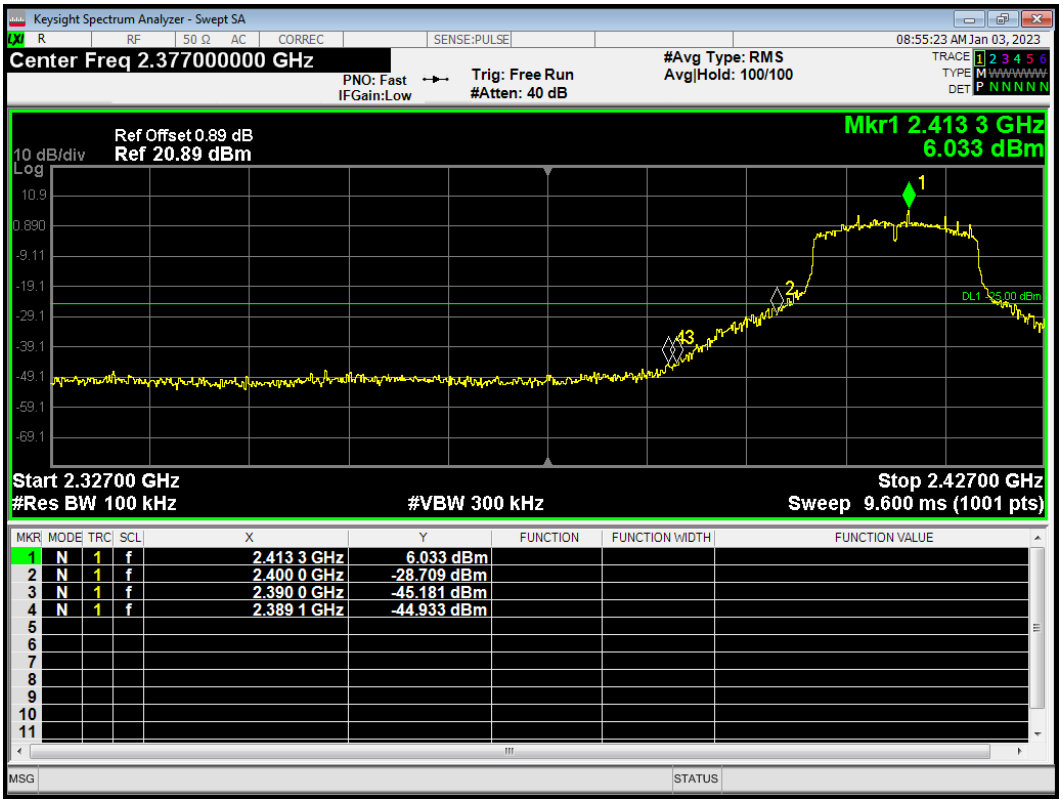
Band Edge 802.11b 2462MHz Emission



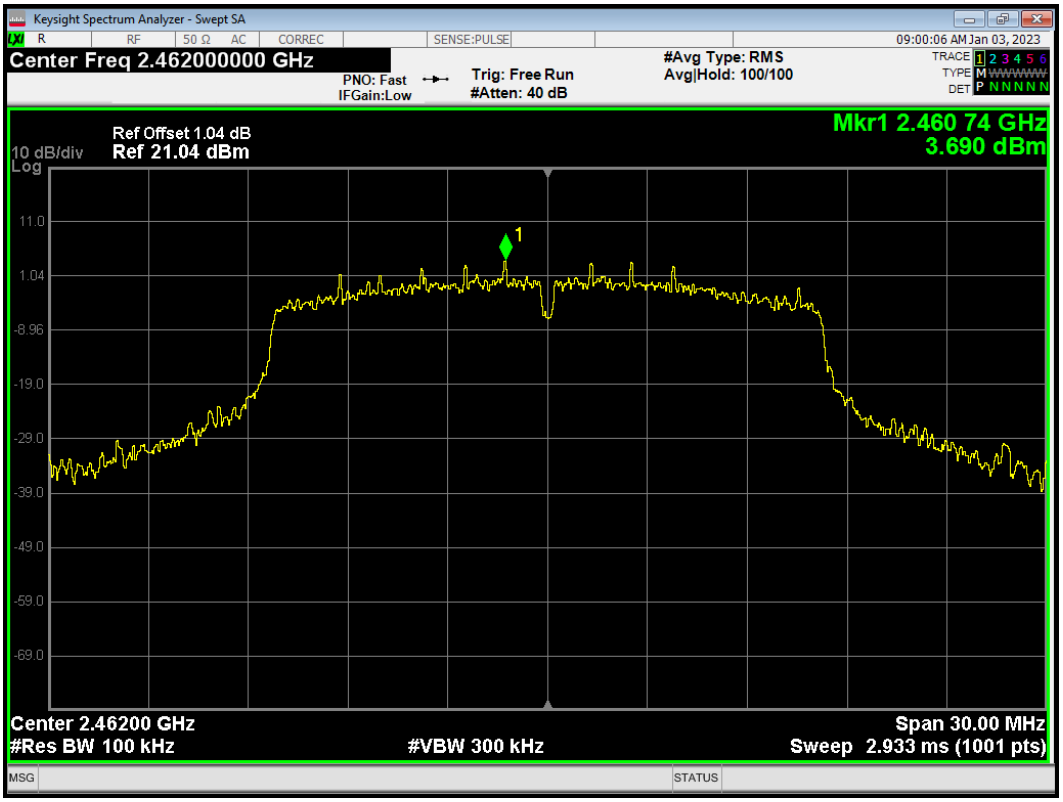
Band Edge 802.11g 2412MHz Ref



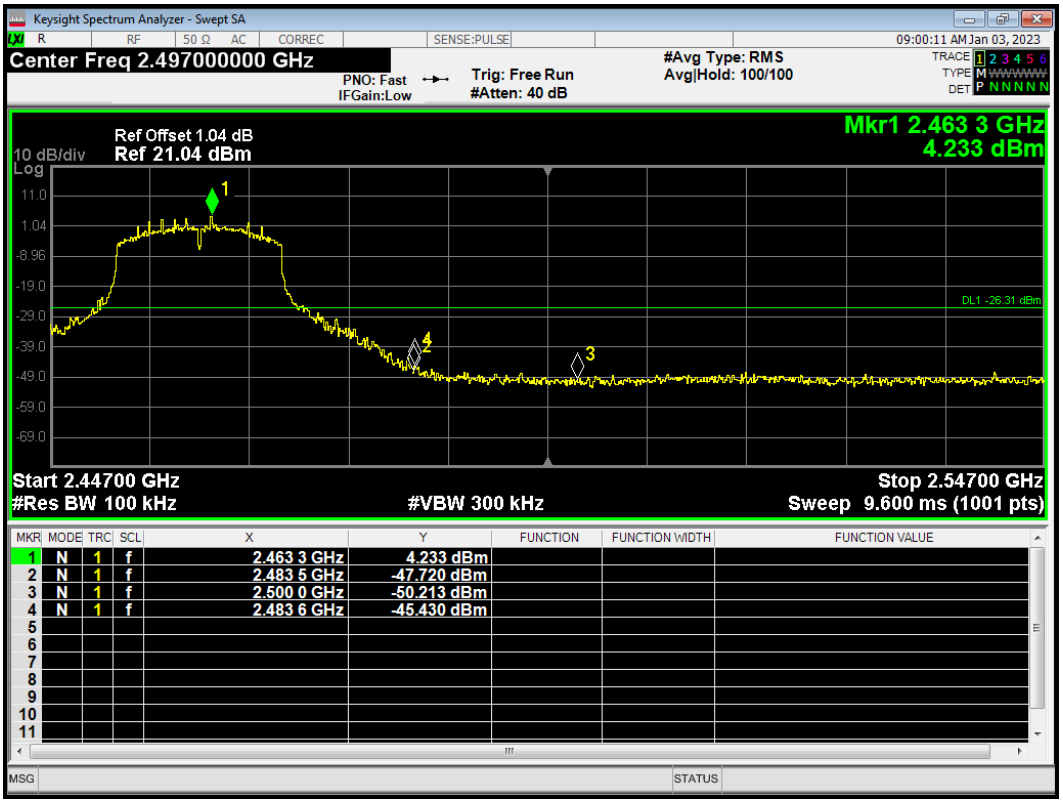
Band Edge 802.11g 2412MHz Emission



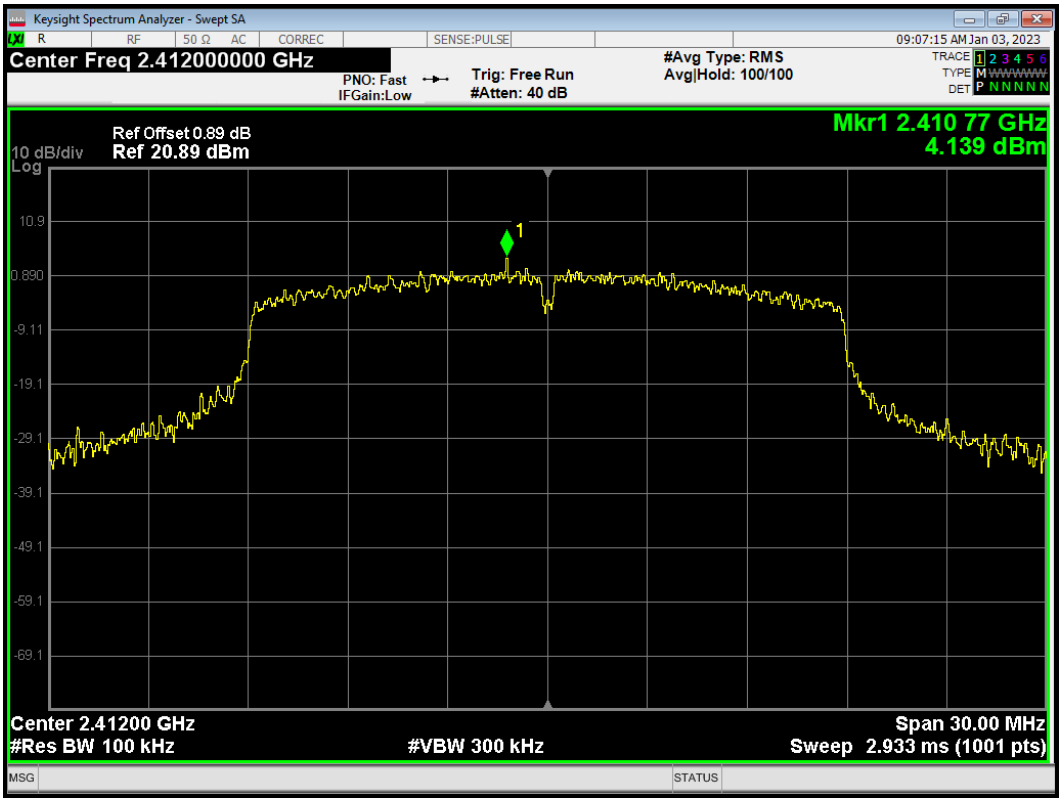
Band Edge 802.11g 2462MHz Ref



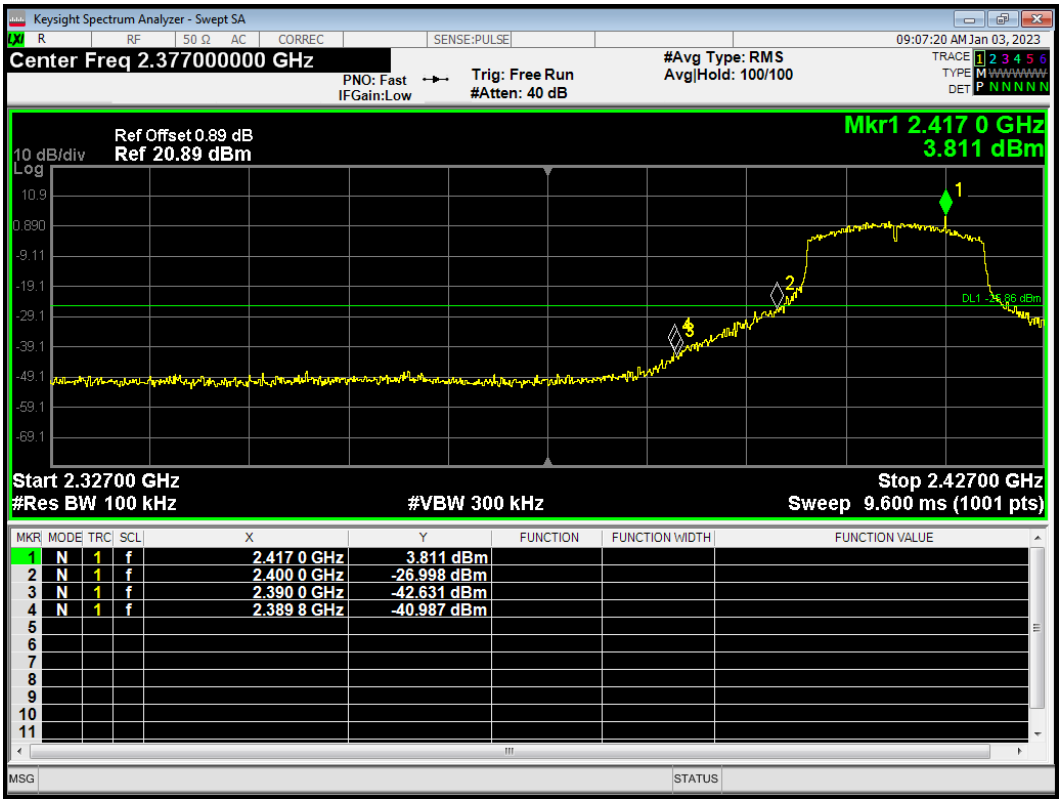
Band Edge 802.11g 2462MHz Emission



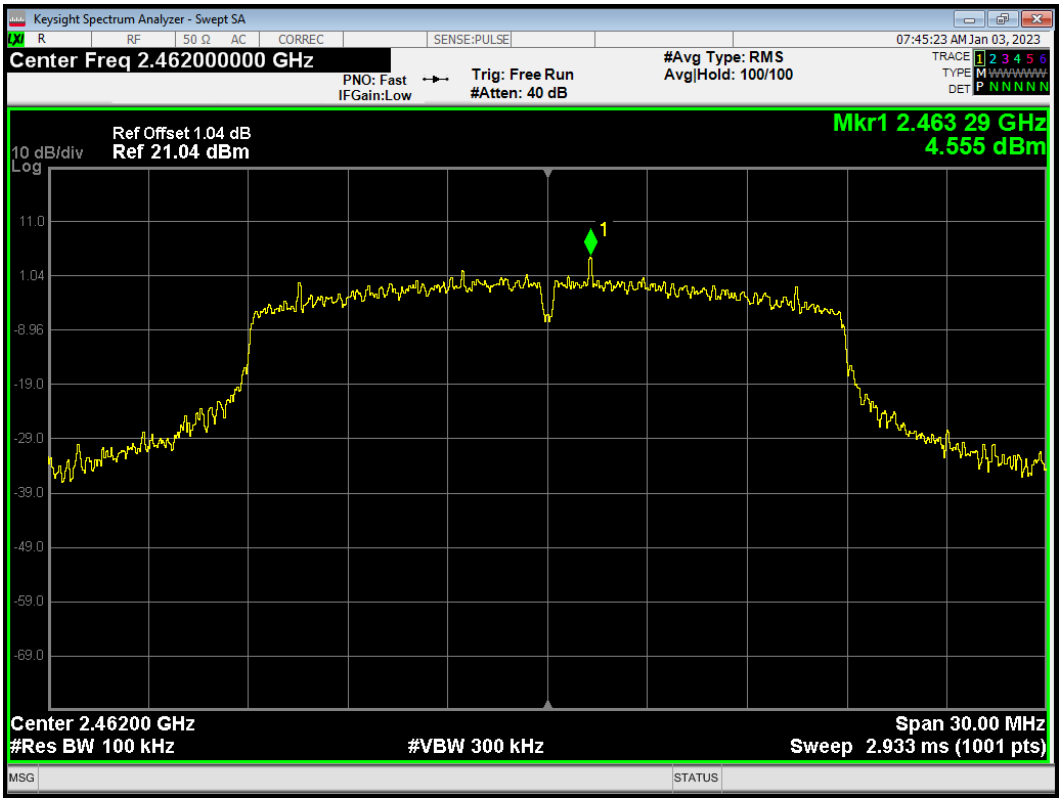
Band Edge 802.11n(HT20) 2412MHz Ref



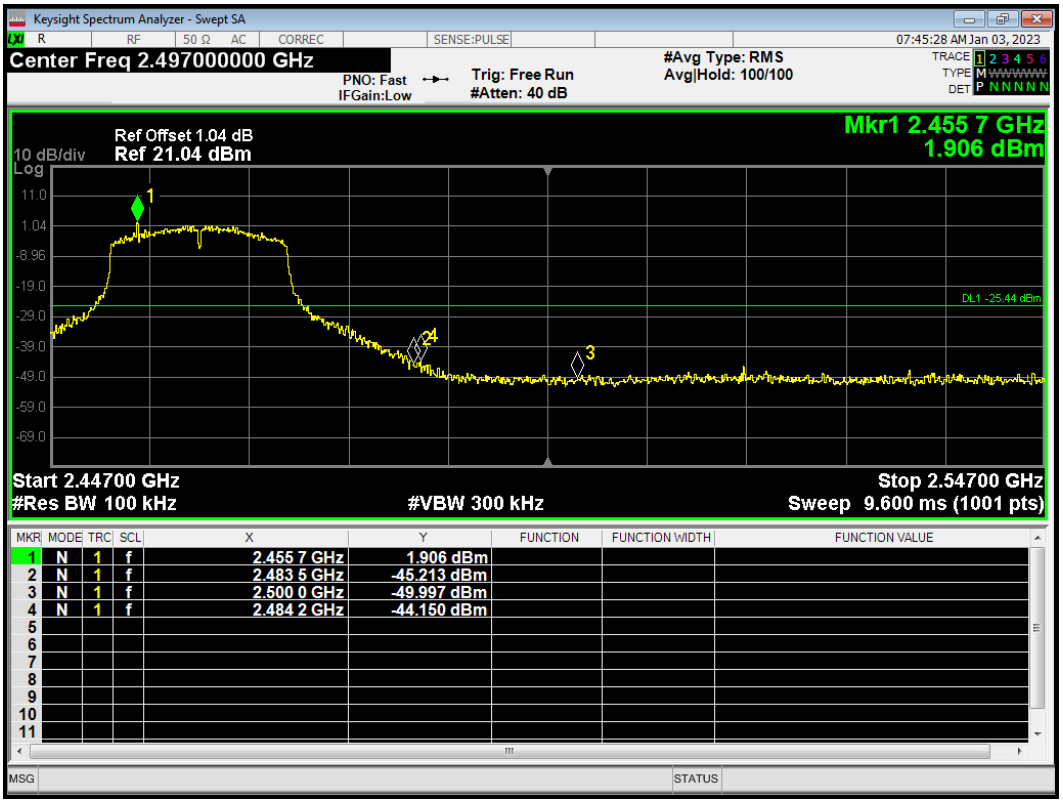
Band Edge 802.11n(HT20) 2412MHz Emission



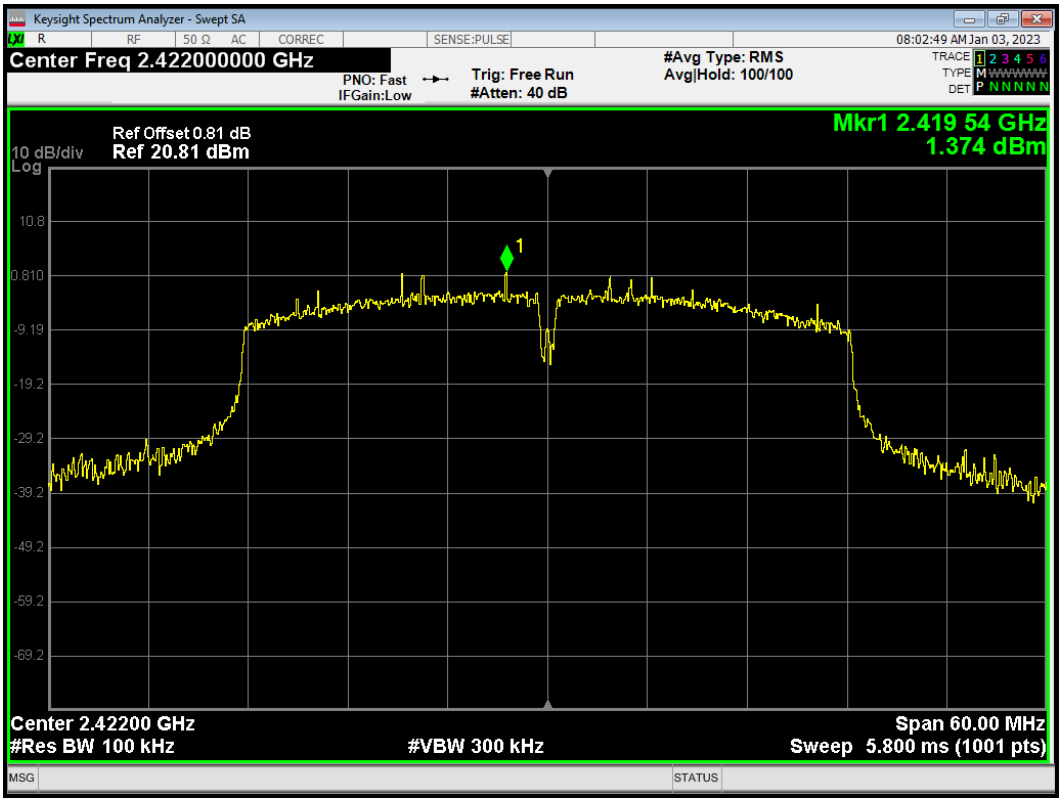
Band Edge 802.11n(HT20) 2462MHz Ref



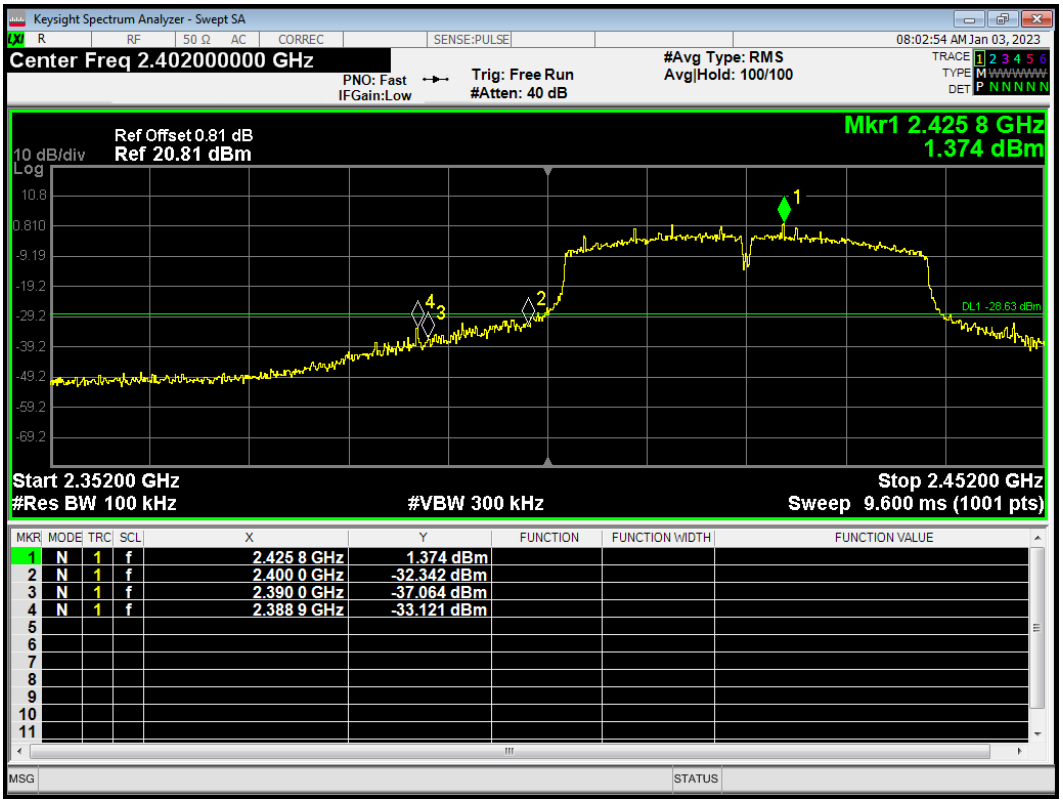
Band Edge 802.11n(HT20) 2462MHz Emission



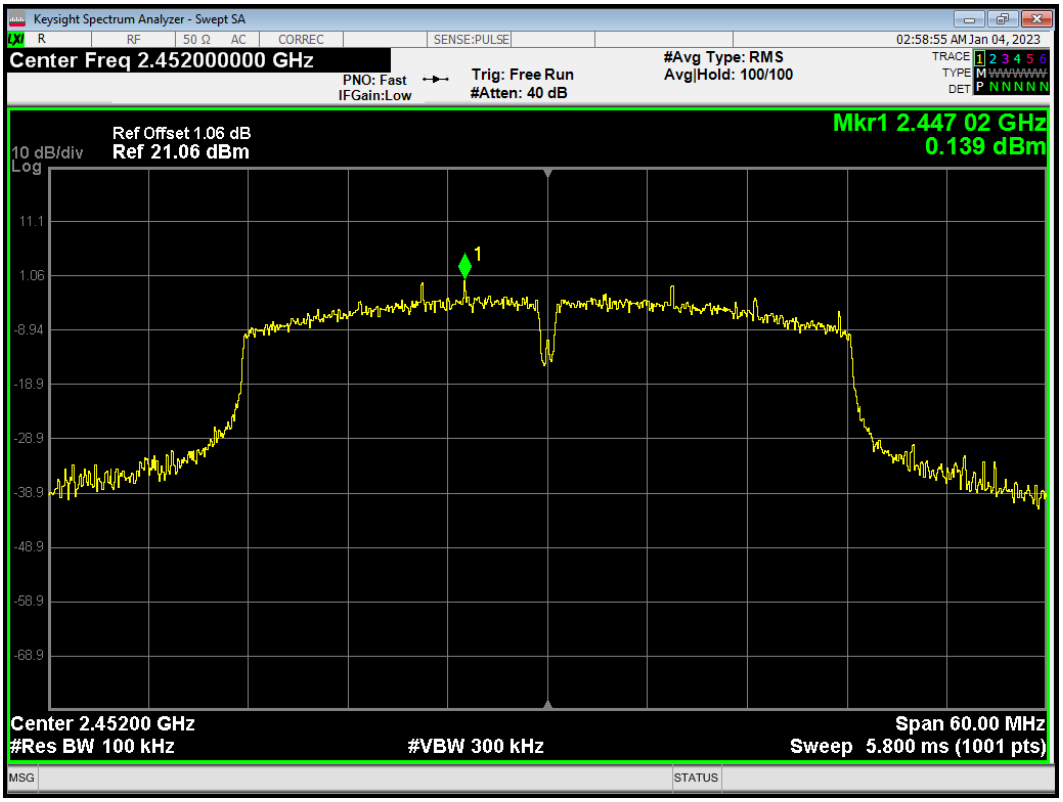
Band Edge 802.11n(HT40) 2422MHz Ref



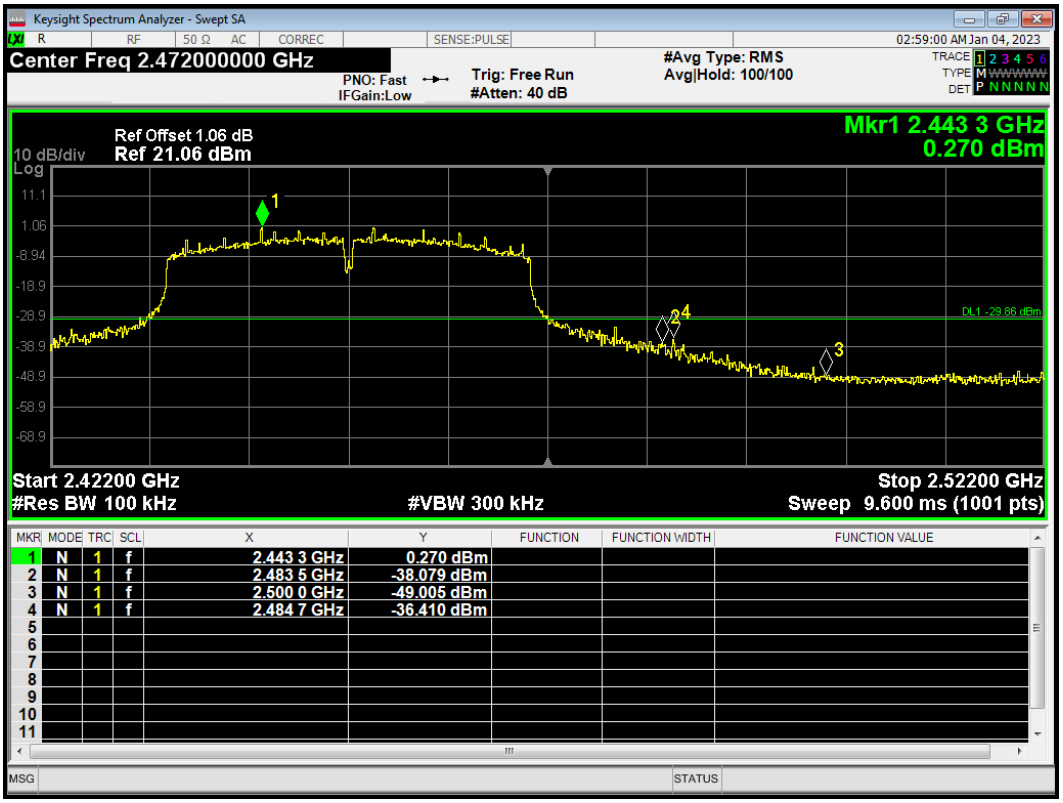
Band Edge 802.11n(HT40) 2422MHz Emission



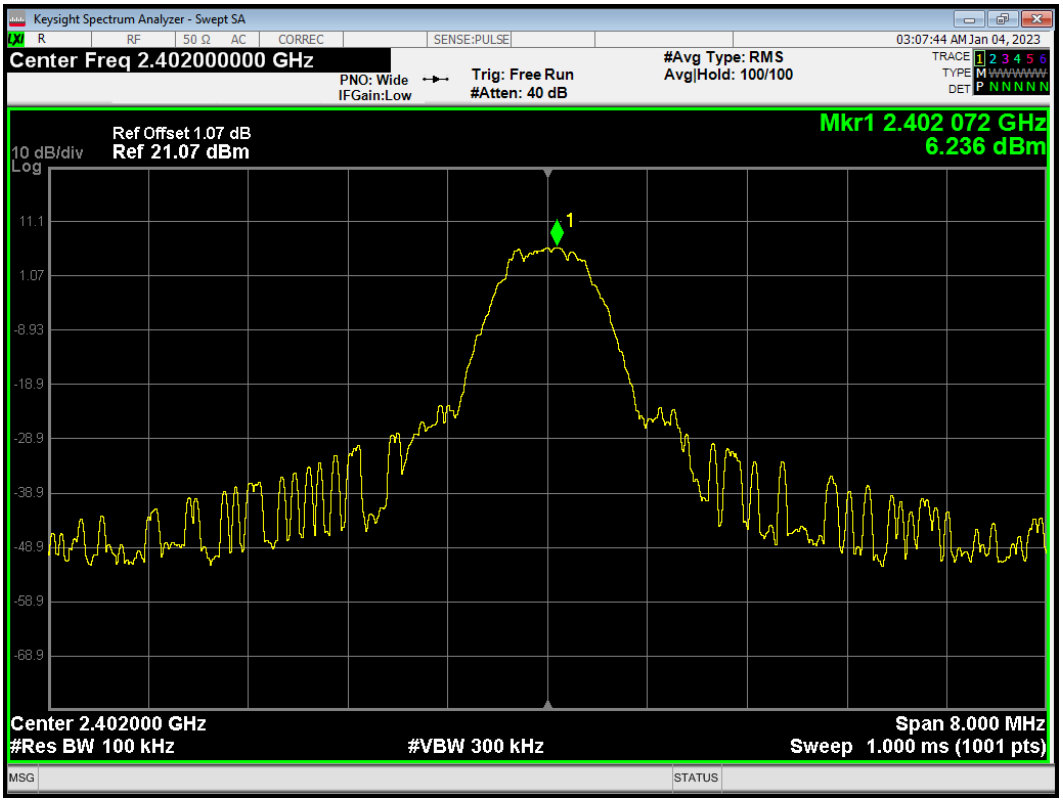
Band Edge 802.11n(HT40) 2452MHz Ref



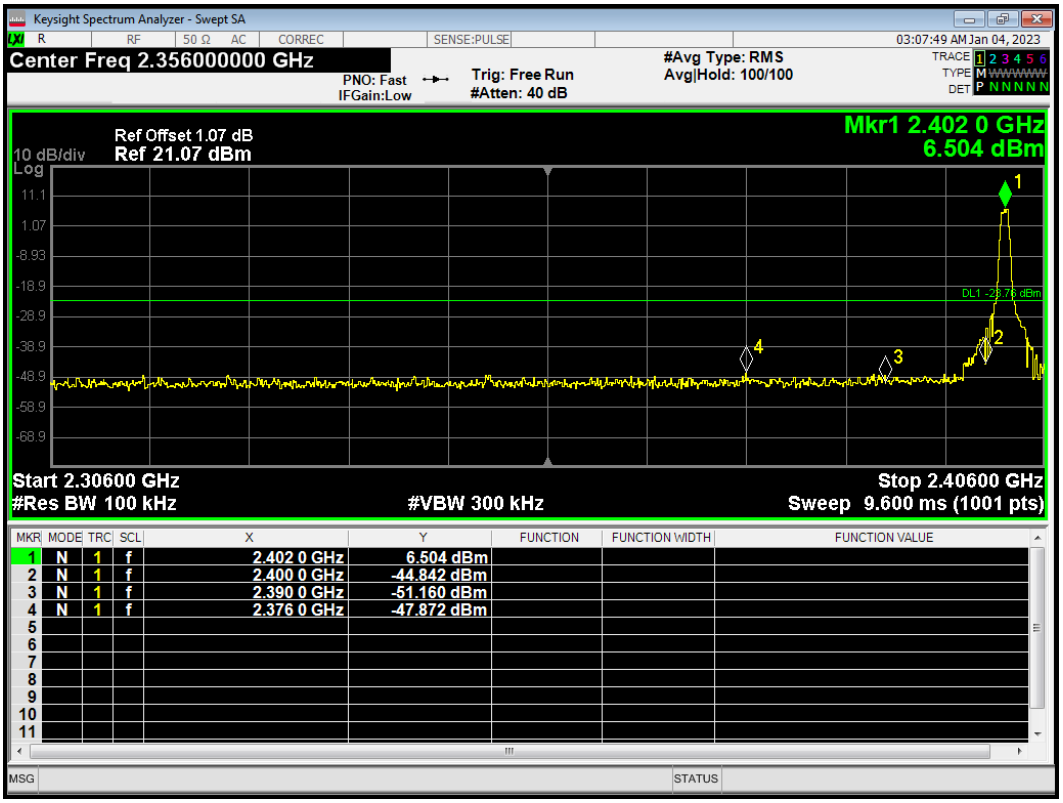
Band Edge 802.11n(HT40) 2452MHz Emission



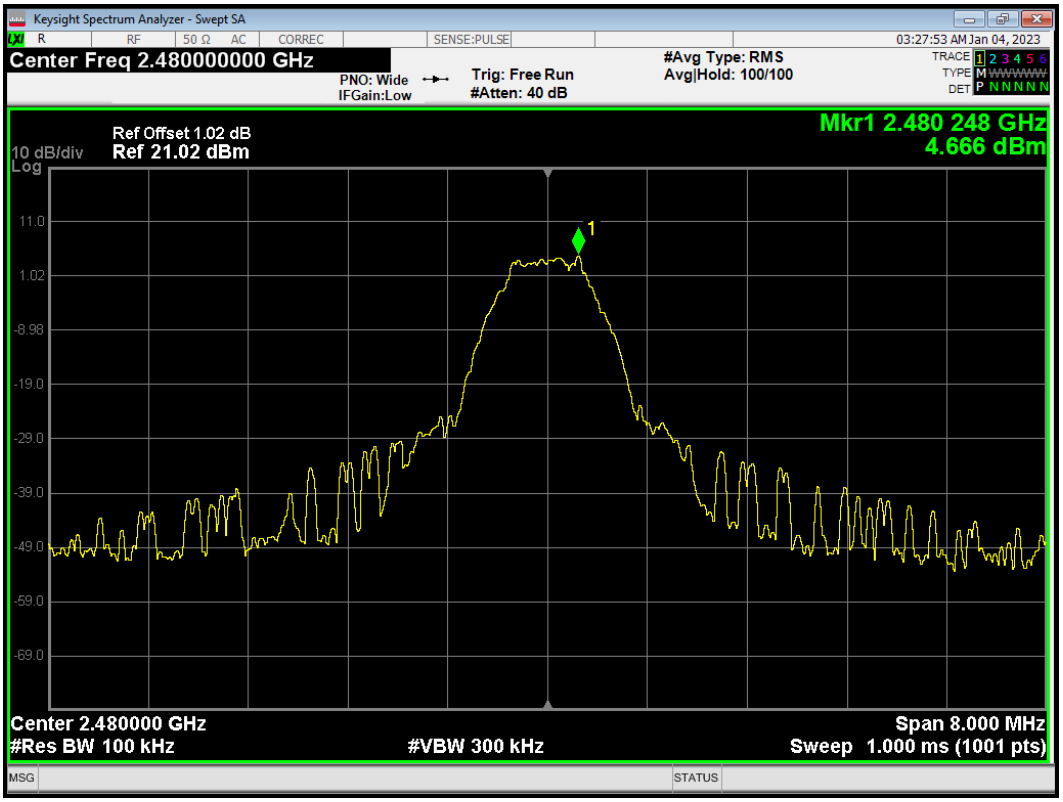
Band Edge BLE 2402MHz Ref



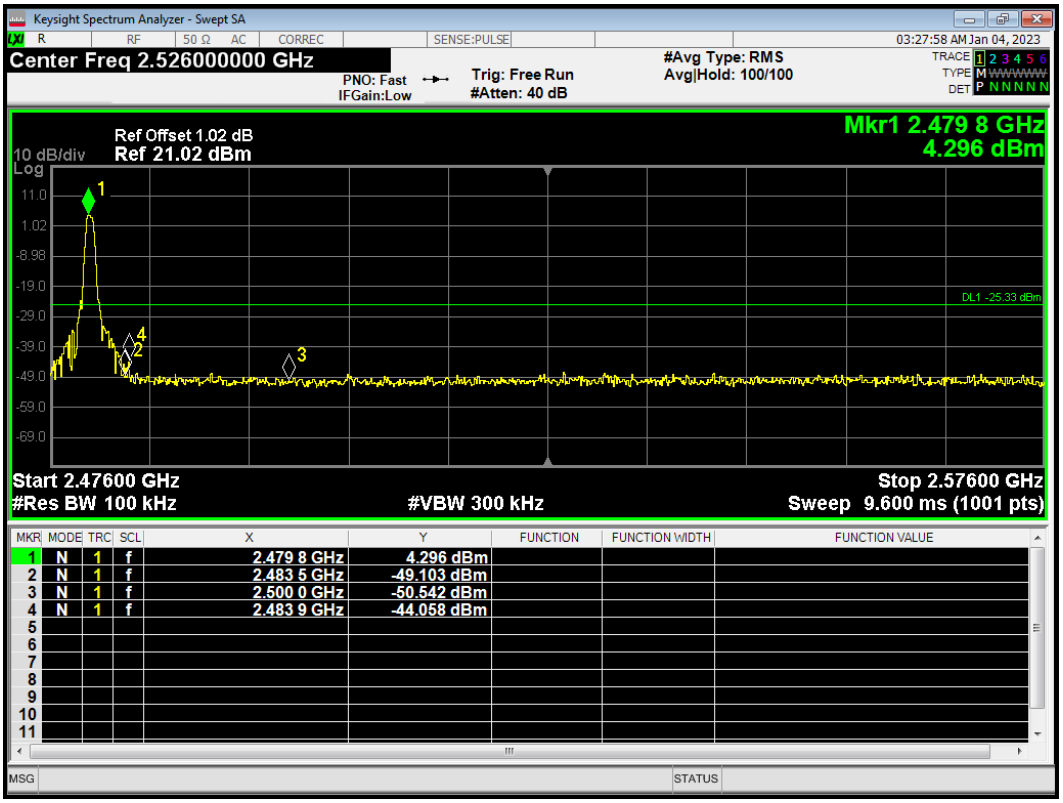
Band Edge BLE 2402MHz Emission



Band Edge BLE 2480MHz Ref



Band Edge BLE 2480MHz Emission



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-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≤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”

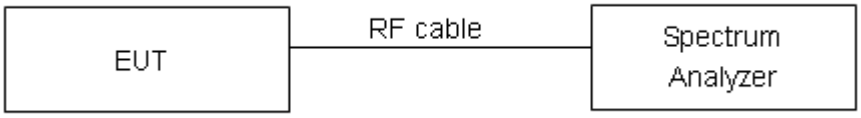
j) Employ trace averaging (rms) mode over a minimum of 100 traces

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)

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.

Test Results:

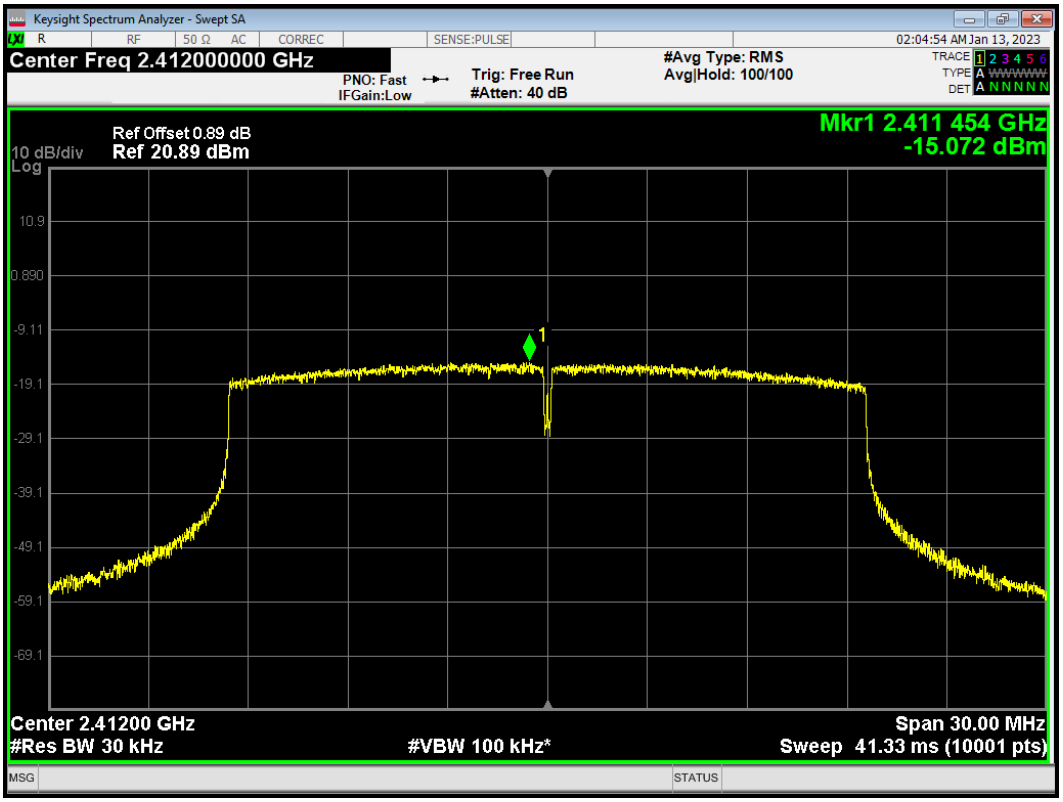
Test Mode	Channel Number	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	1	-3.70	-13.38	8	PASS
	6	-3.96	-13.64	8	PASS
	11	-3.41	-13.09	8	PASS
802.11g	1	-7.42	-17.42	8	PASS
	6	-8.11	-18.11	8	PASS
	11	-9.01	-19.01	8	PASS
802.11n HT20	1	-7.90	-17.90	8	PASS
	6	-8.42	-18.42	8	PASS
	11	-8.61	-18.61	8	PASS
802.11n HT40	3	-12.10	-22.10	8	PASS
	6	-12.41	-22.41	8	PASS
	9	-12.73	-22.73	8	PASS
802.11ax HE20	1	-15.07	-25.07	8	PASS
	2	-11.29	-21.29	8	PASS
	6	-11.79	-21.79	8	PASS
	11	-12.07	-22.07	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3 / 30)					

Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth (Low Energy)	0	-14.45	-13.74	8	PASS
	19	-15.81	-15.10	8	PASS
	39	-16.37	-15.66	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

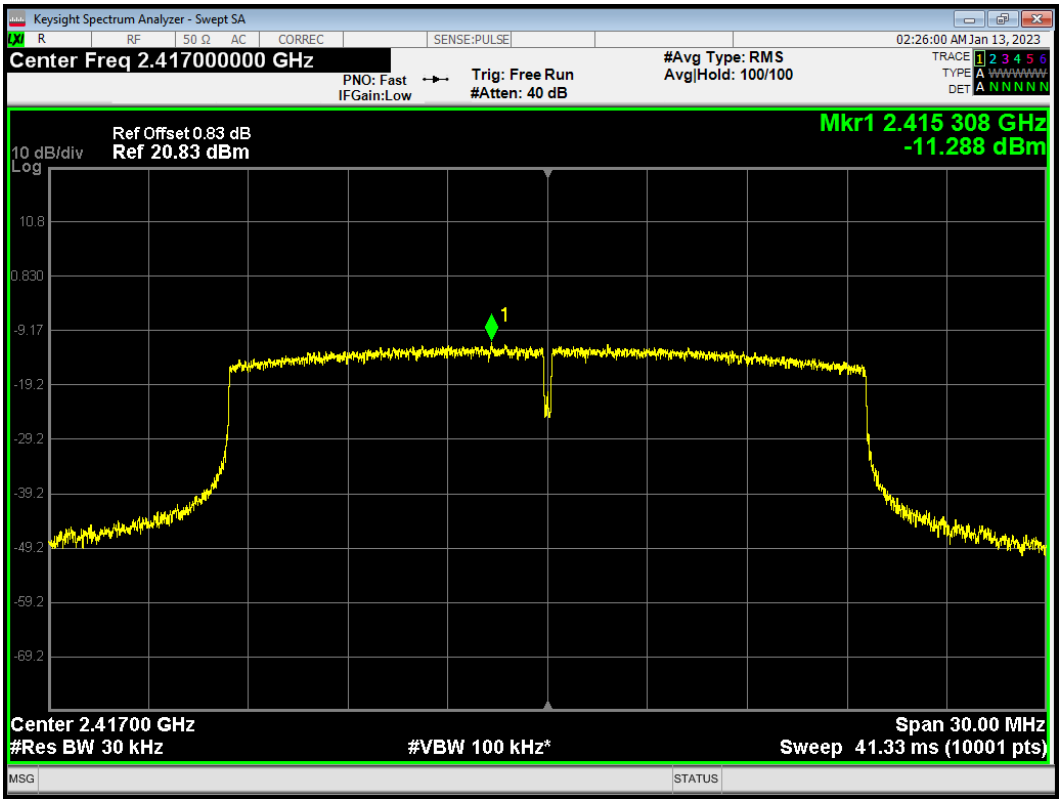
TB Mode

Test Mode	Channel Number	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11ax HE20 26-Tones	1	-1.77	-11.65	8	PASS
	6	-2.05	-11.93	8	PASS
	11	-2.21	-12.09	8	PASS
802.11ax HE20 52-Tones	1	-4.02	-13.91	8	PASS
	6	-4.80	-14.68	8	PASS
	11	-4.19	-14.07	8	PASS
802.11ax HE20 106-Tones	1	-7.36	-17.24	8	PASS
	6	-7.38	-17.26	8	PASS
	11	-7.46	-17.34	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3 / 30)					

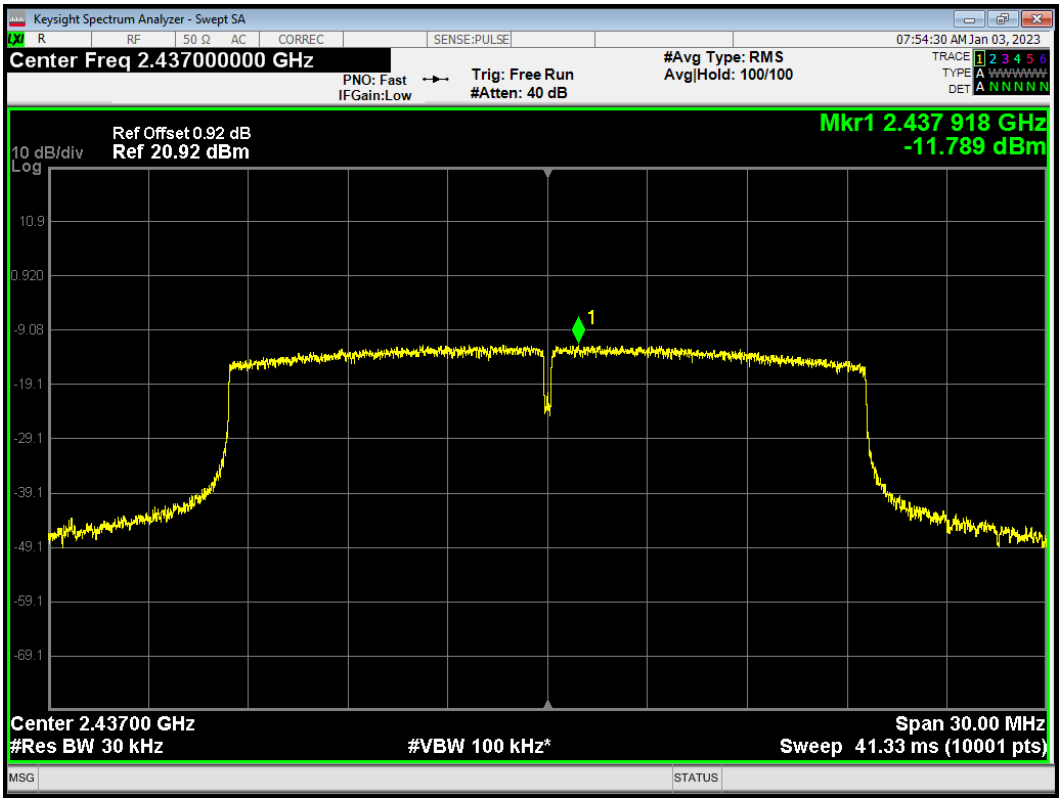
PSD 802.11ax(HE20) 2412MHz



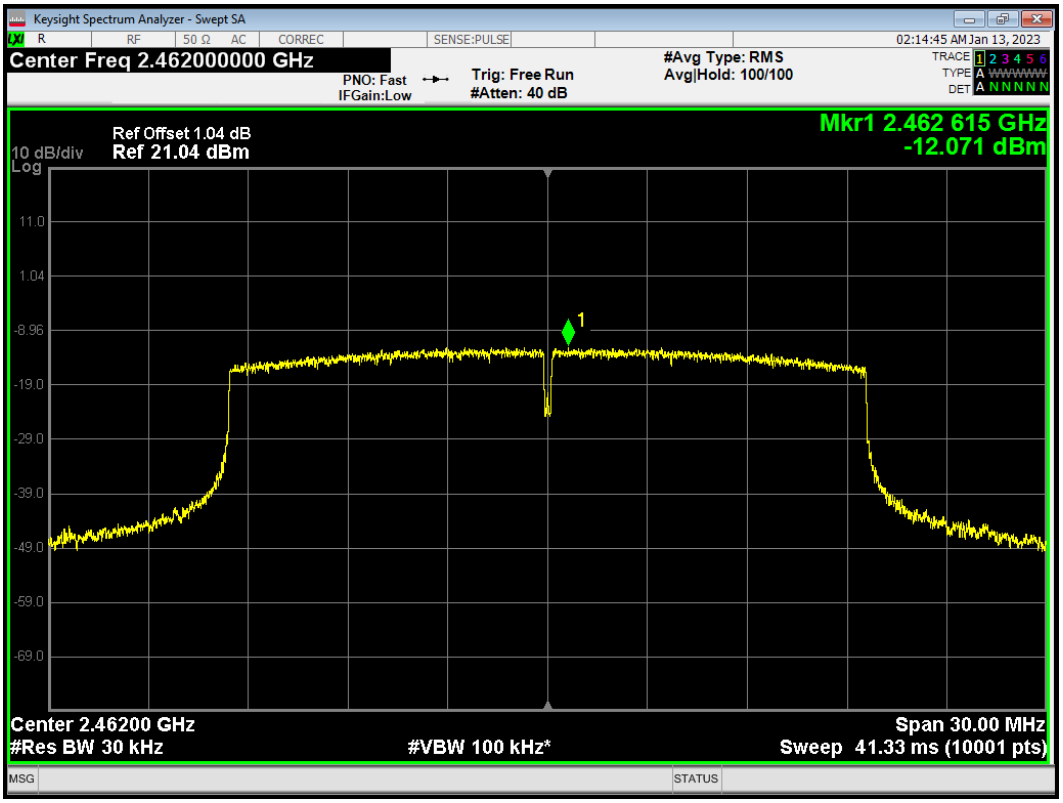
PSD 802.11ax(HE20) 2417MHz



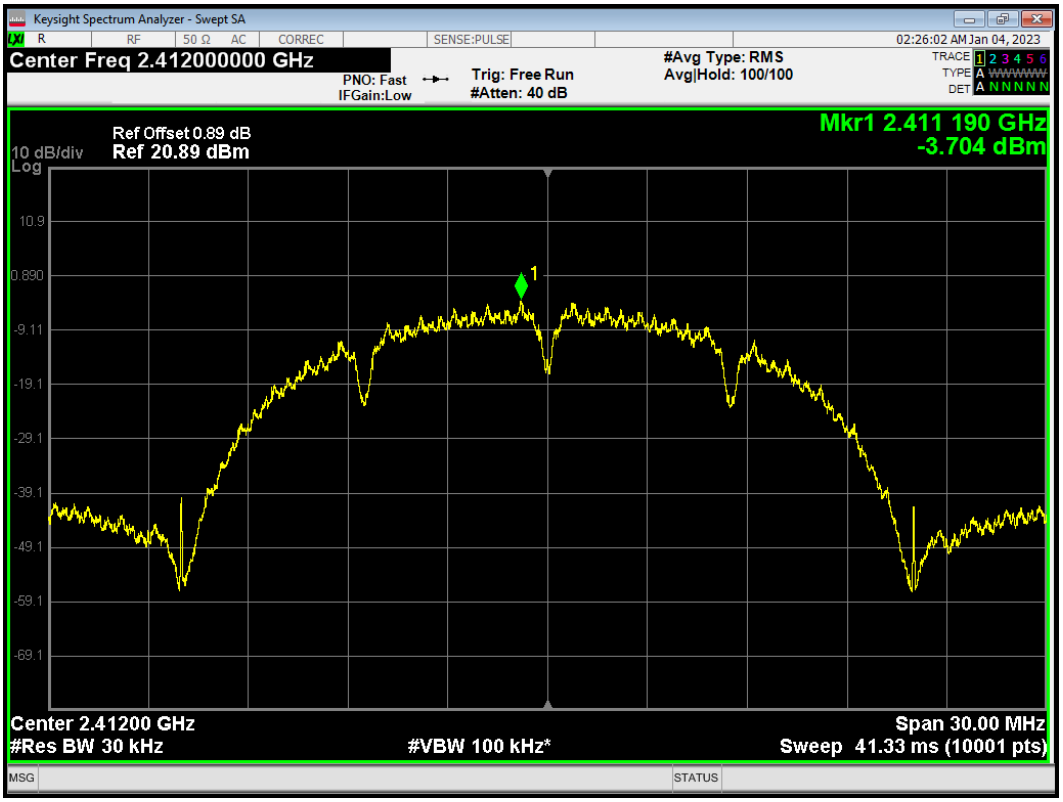
PSD 802.11ax(HE20) 2437MHz



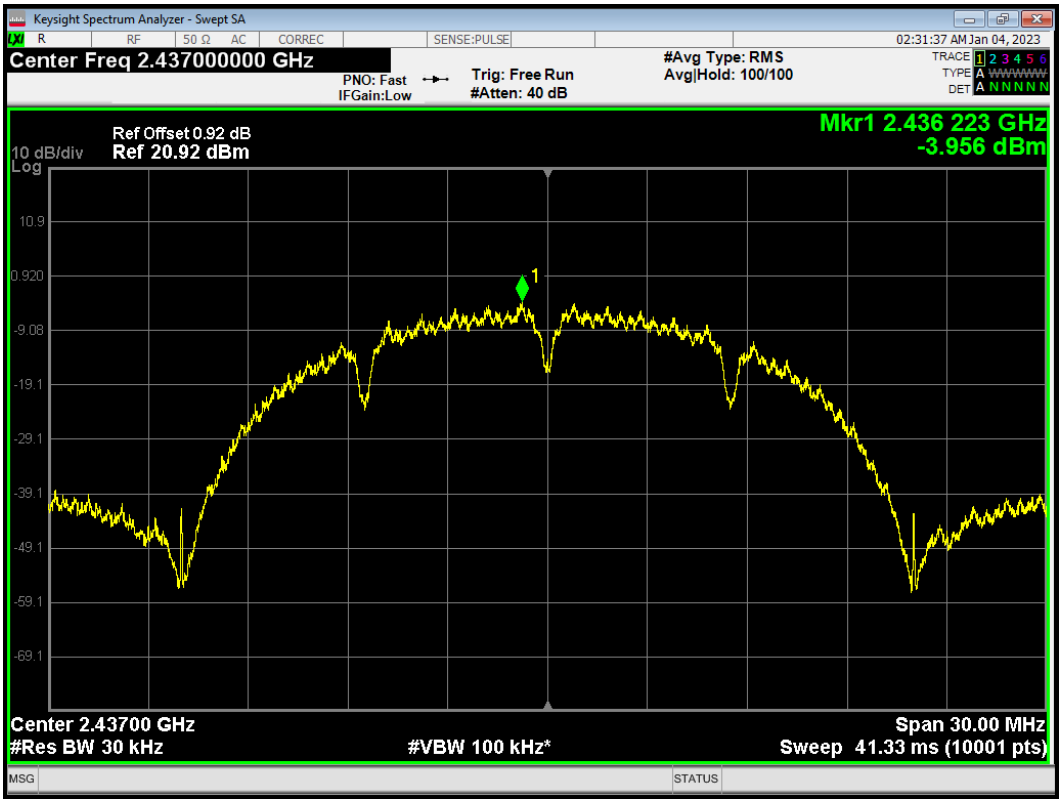
PSD 802.11ax(HE20) 2462MHz



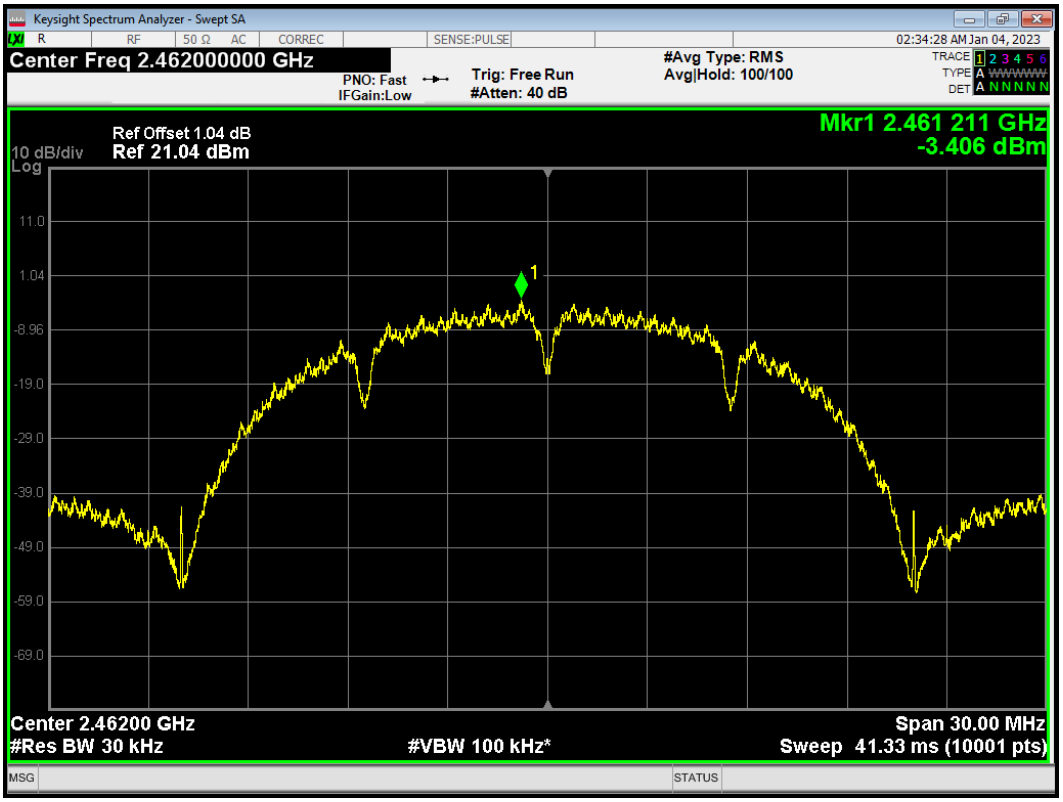
PSD 802.11b 2412MHz



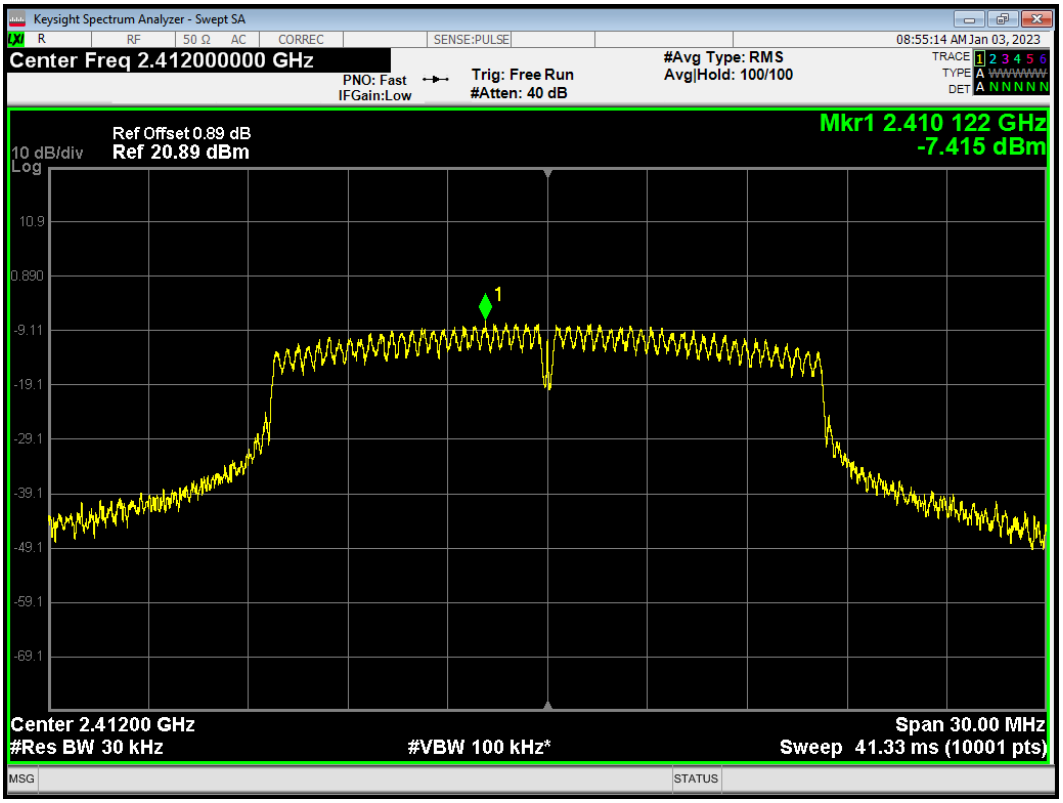
PSD 802.11b 2437MHz



PSD 802.11b 2462MHz



PSD 802.11g 2412MHz



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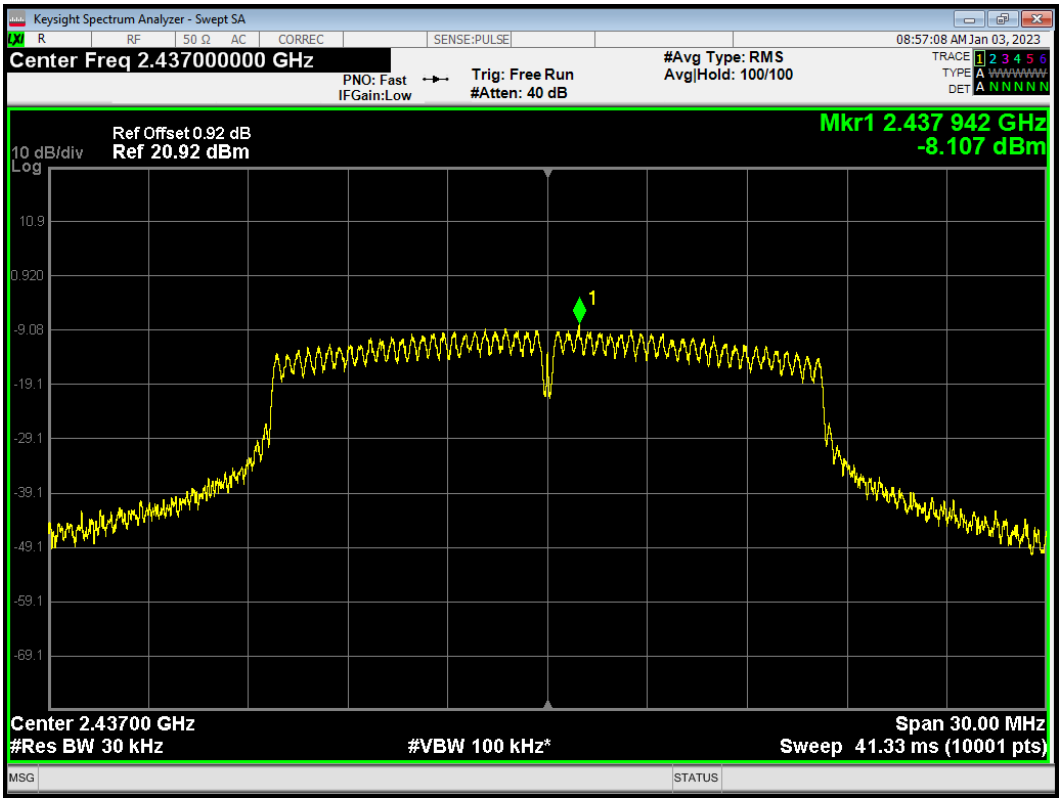

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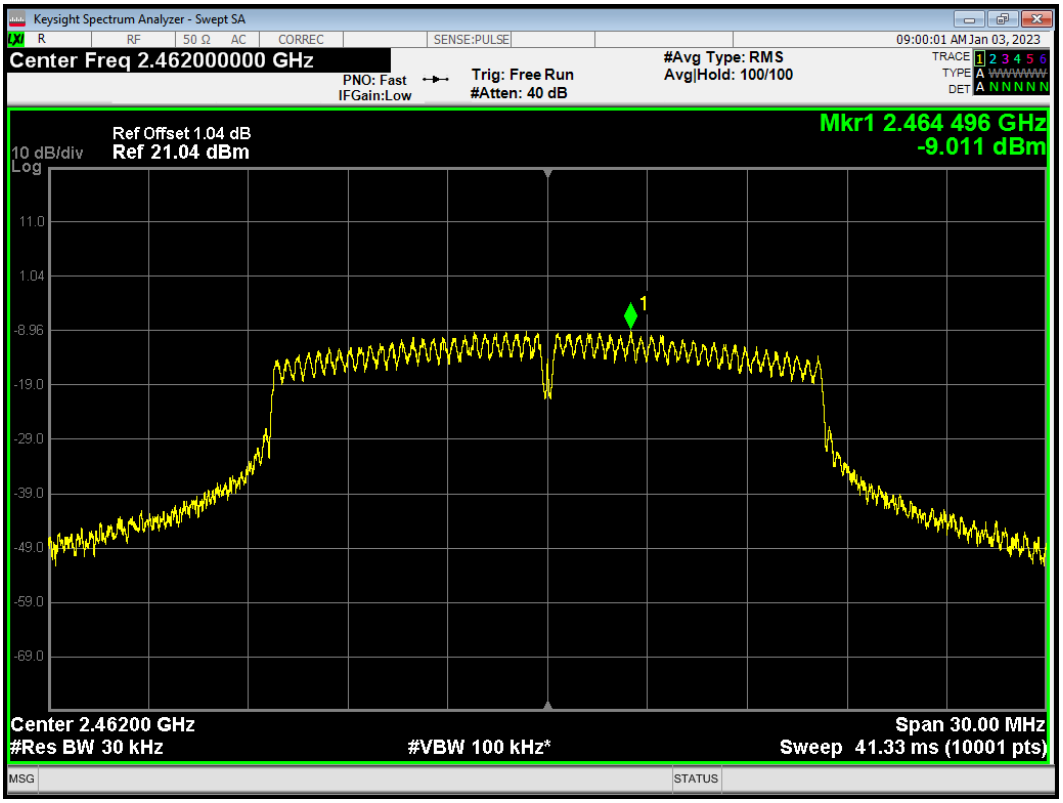
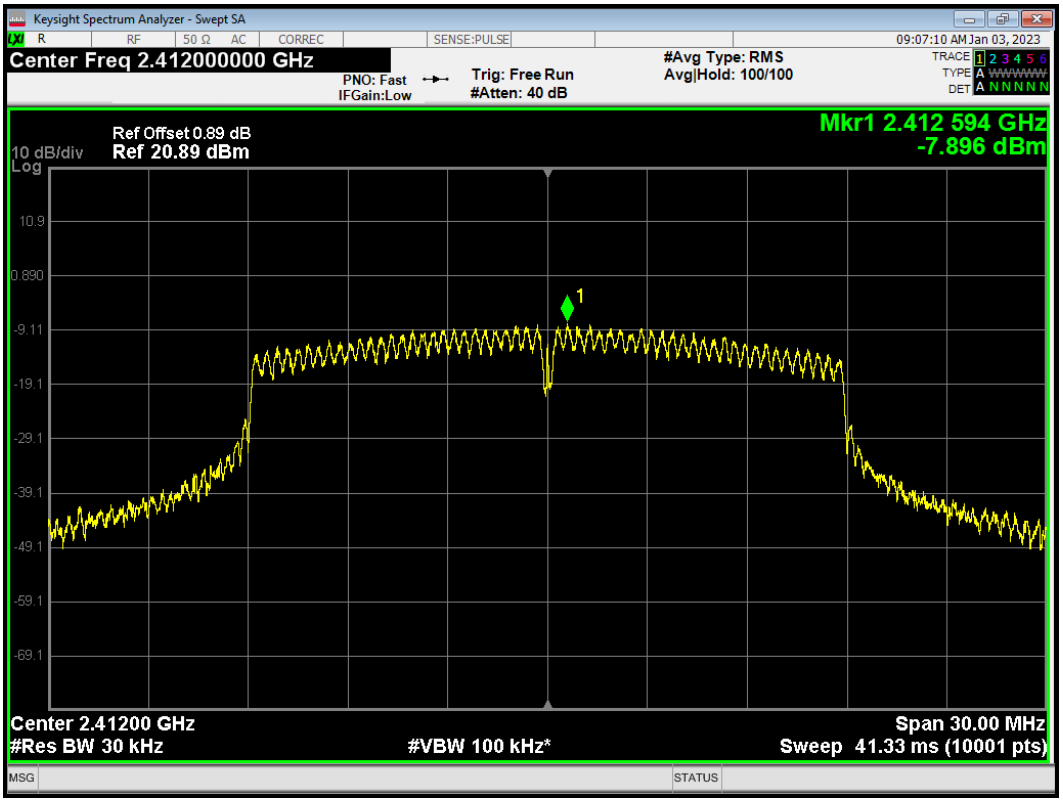


PSD 802.11n(HT20) 2412MHz



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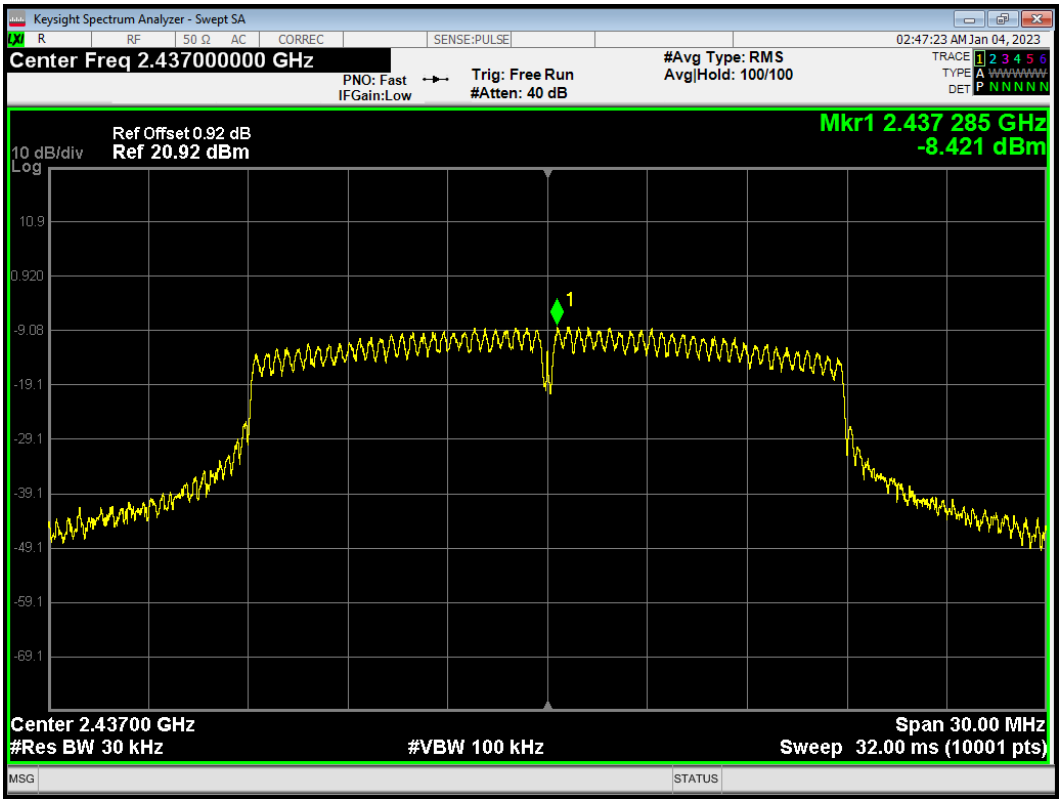
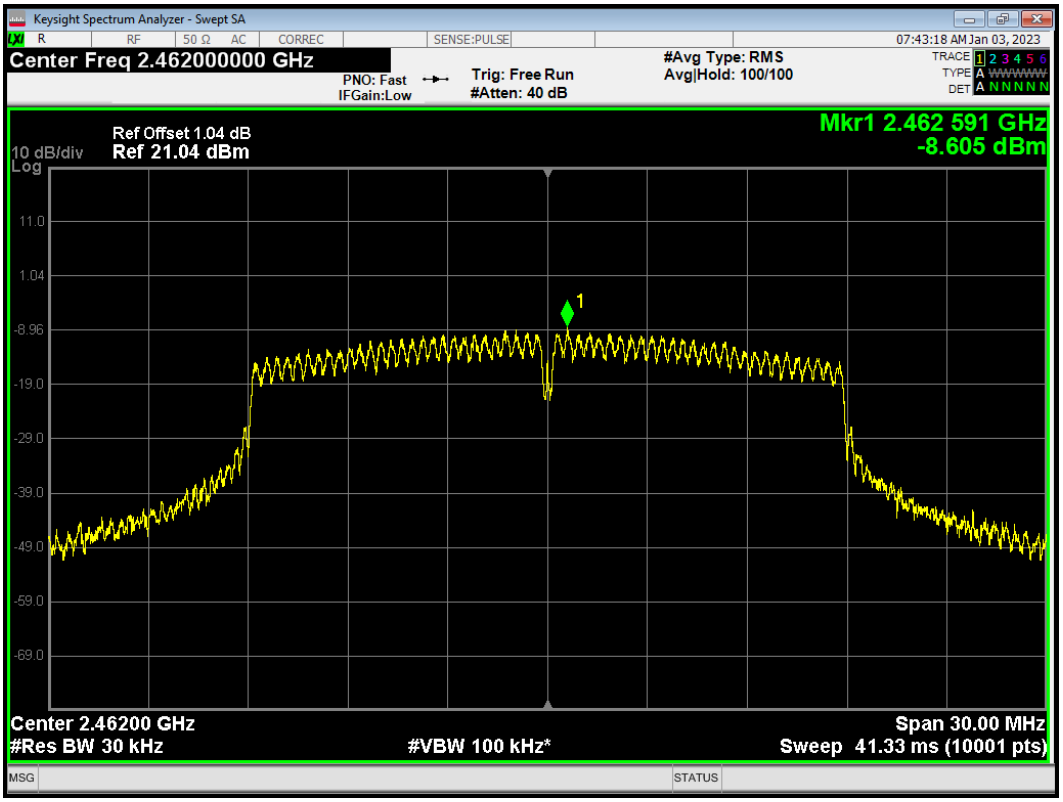
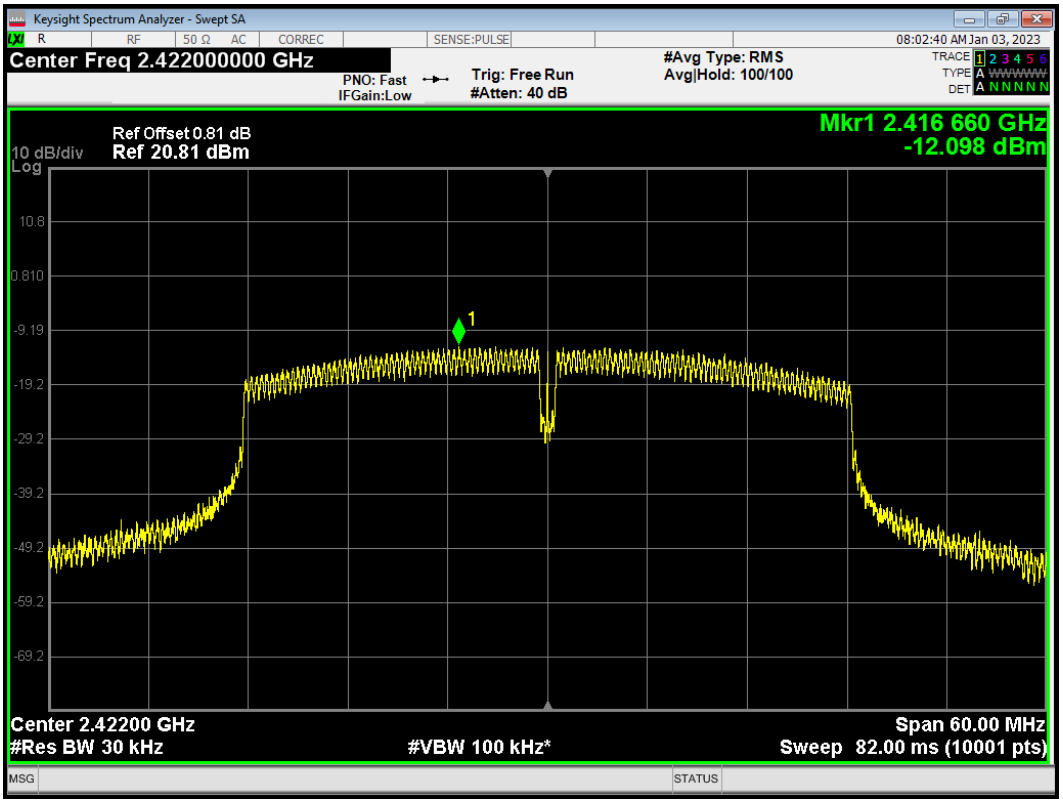


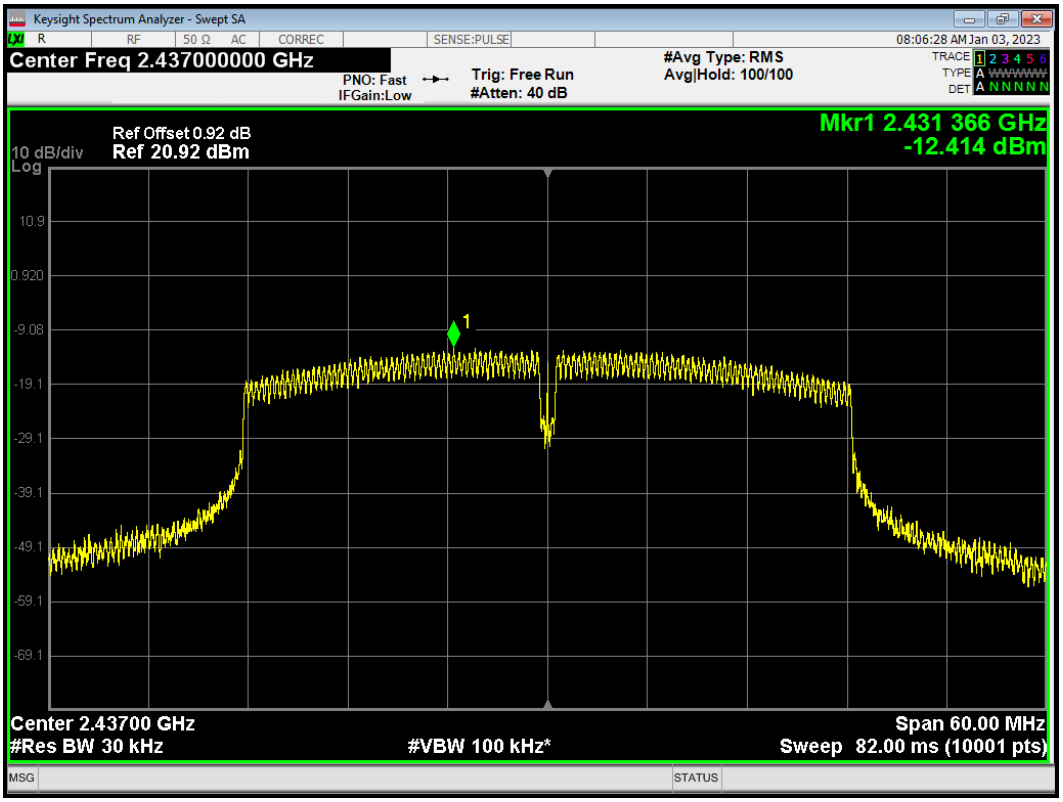
PSD 802.11n(HT20) 2462MHz



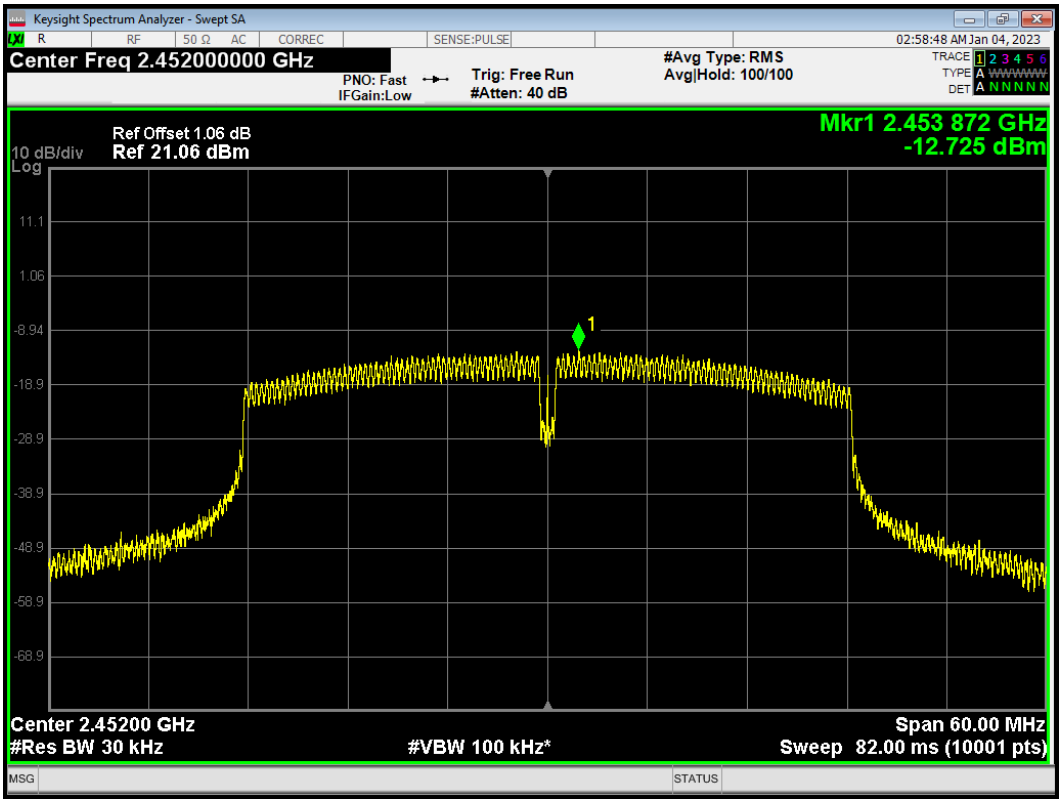
PSD 802.11n(HT40) 2422MHz



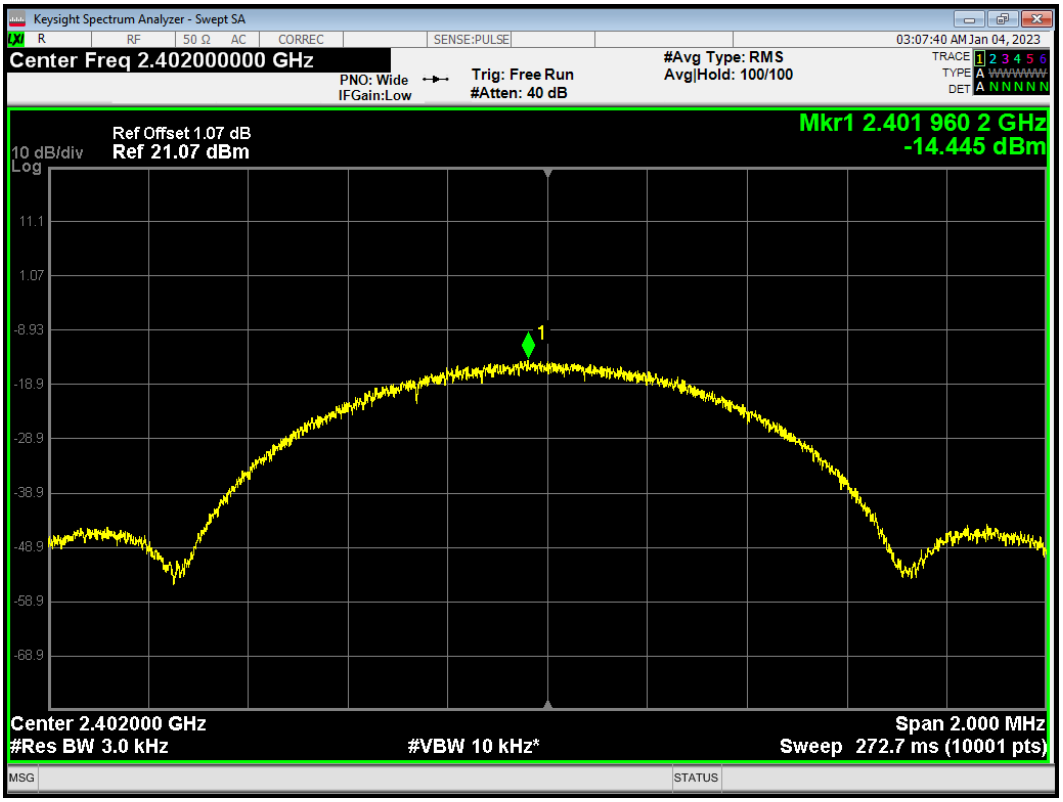
PSD 802.11n(HT40) 2437MHz



PSD 802.11n(HT40) 2452MHz



PSD BLE 2402MHz



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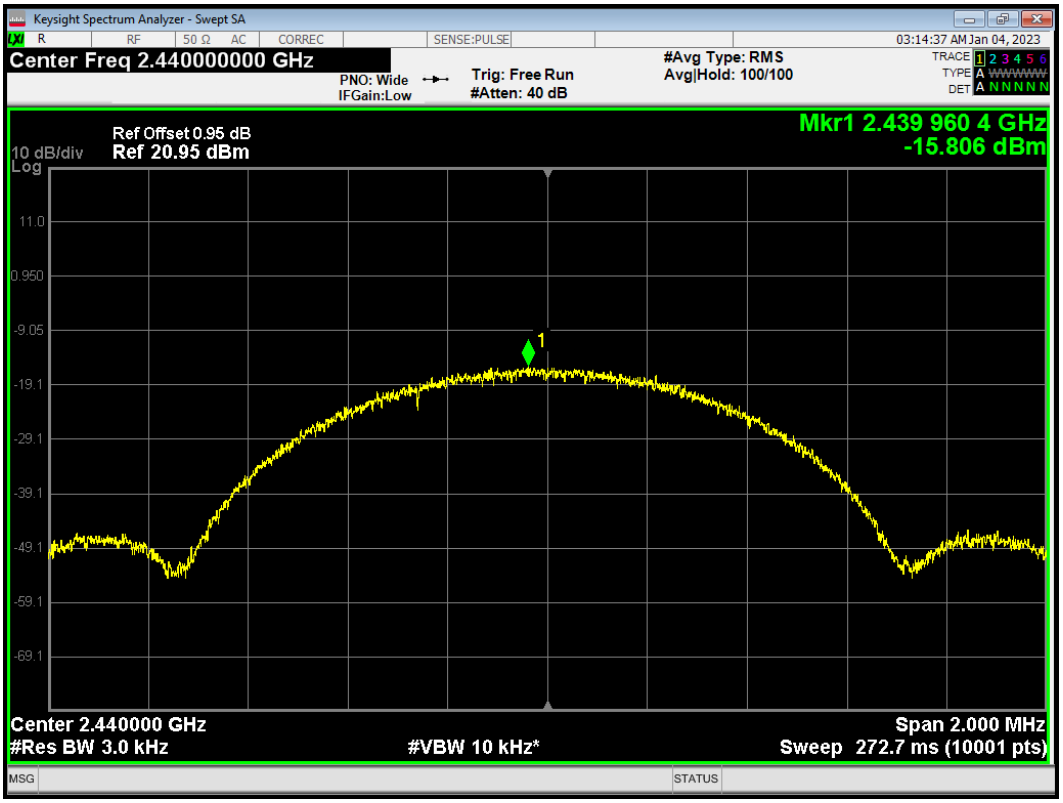
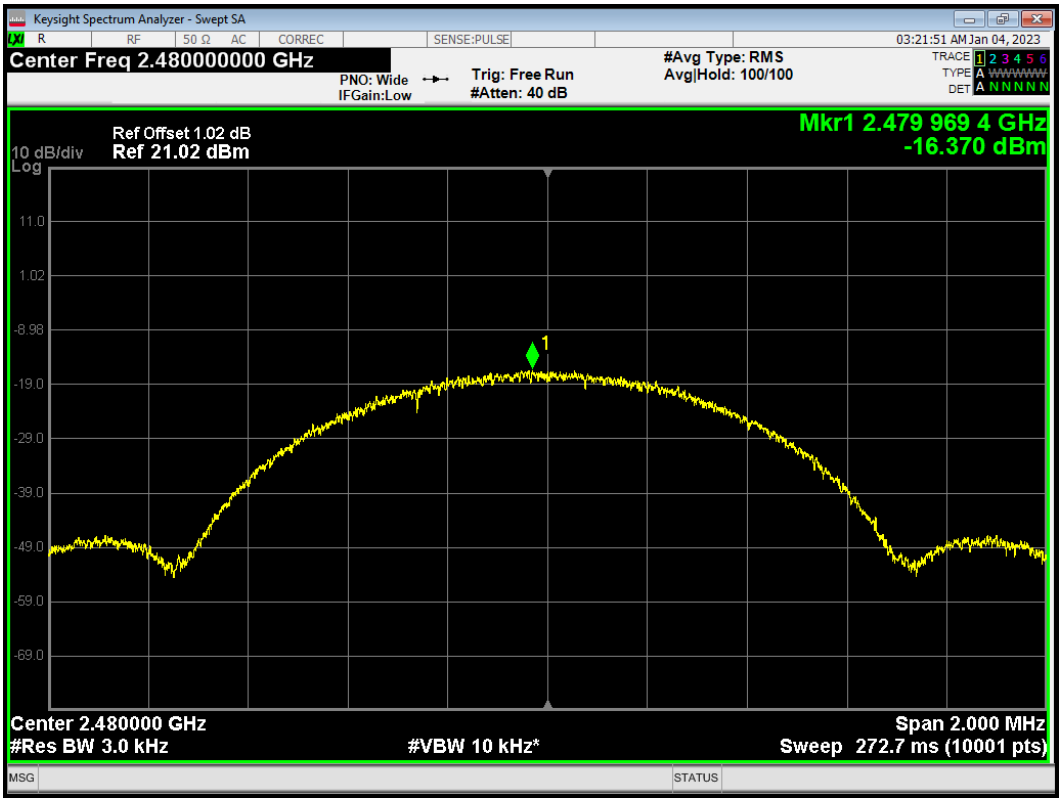
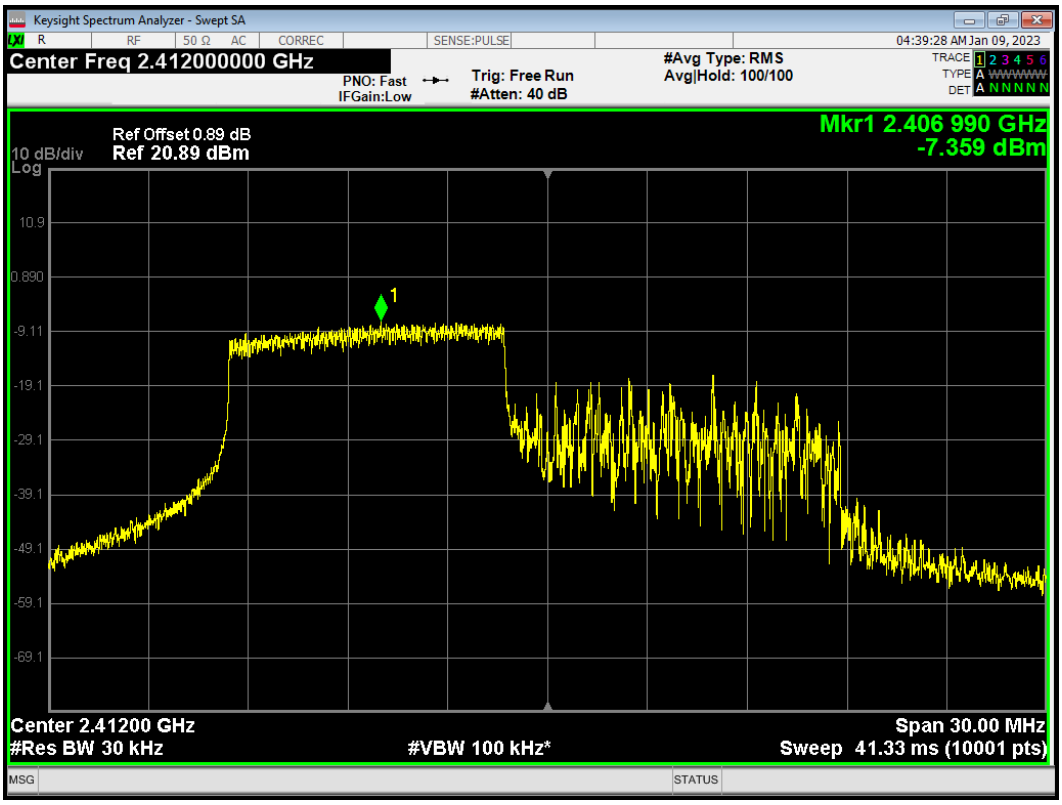


PSD BLE 2480MHz

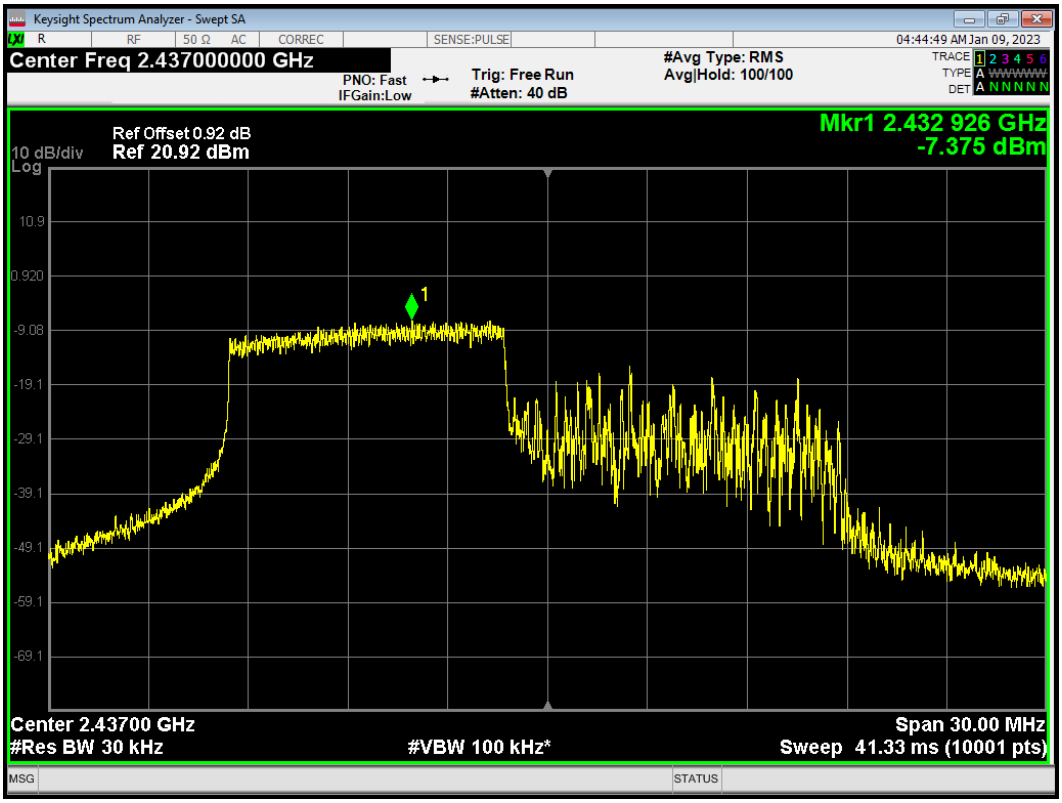


TB Mode

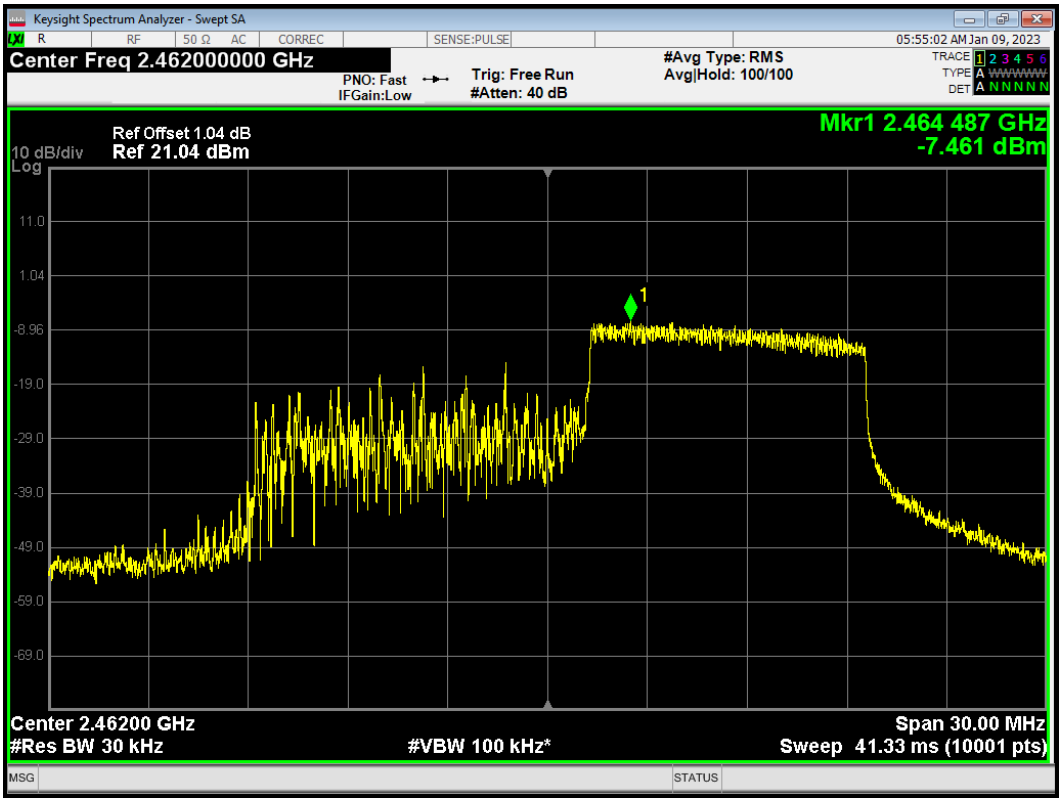
PSD 802.11ax HE20 106-Tones 2412MHz



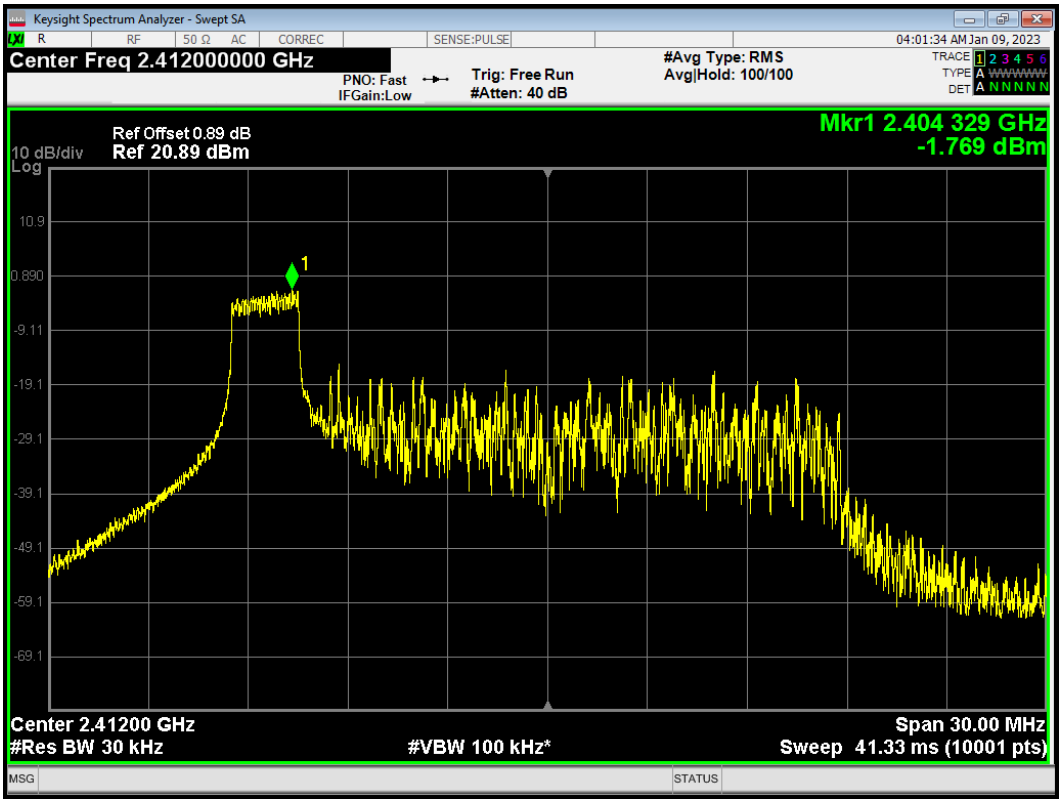
PSD 802.11ax HE20 106-Tones 2437MHz



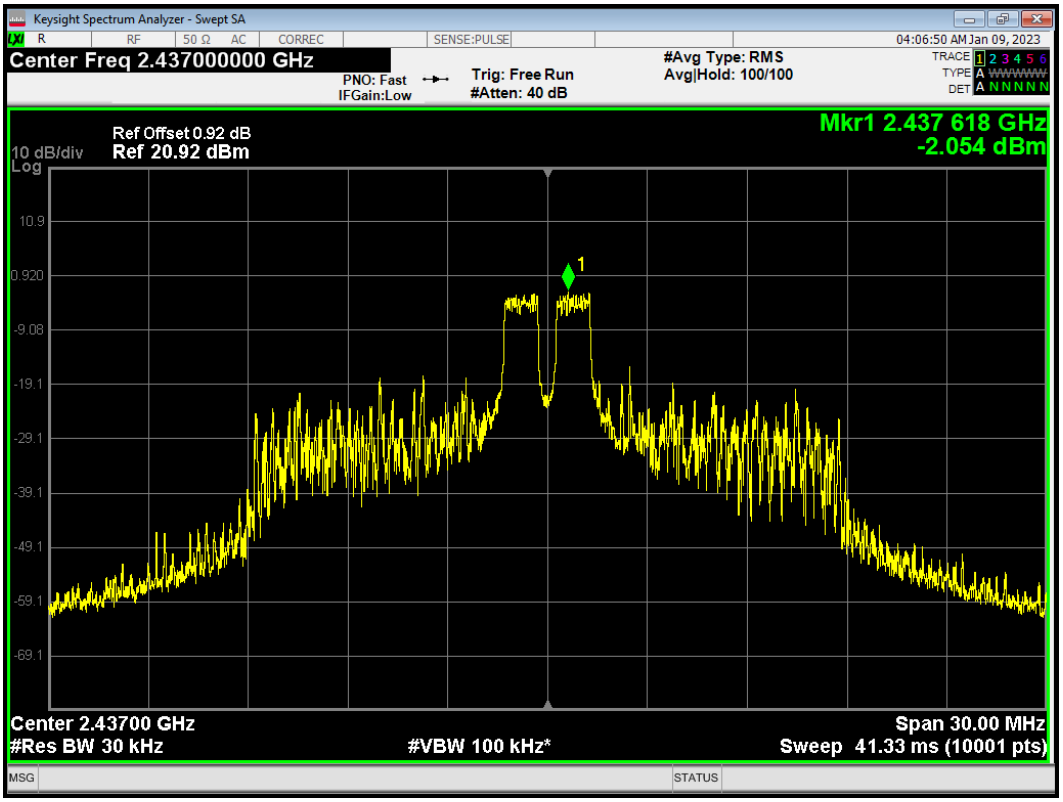
PSD 802.11ax HE20 106-Tones 2462MHz



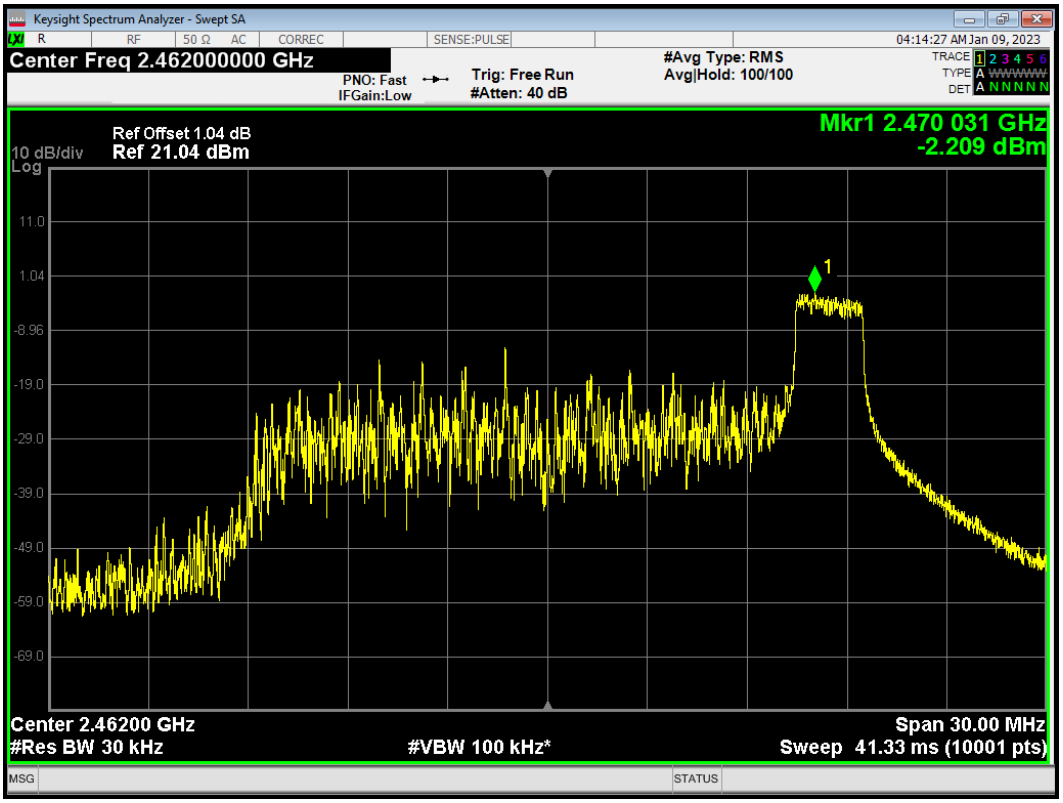
PSD 802.11ax HE20 26-Tones 2412MHz



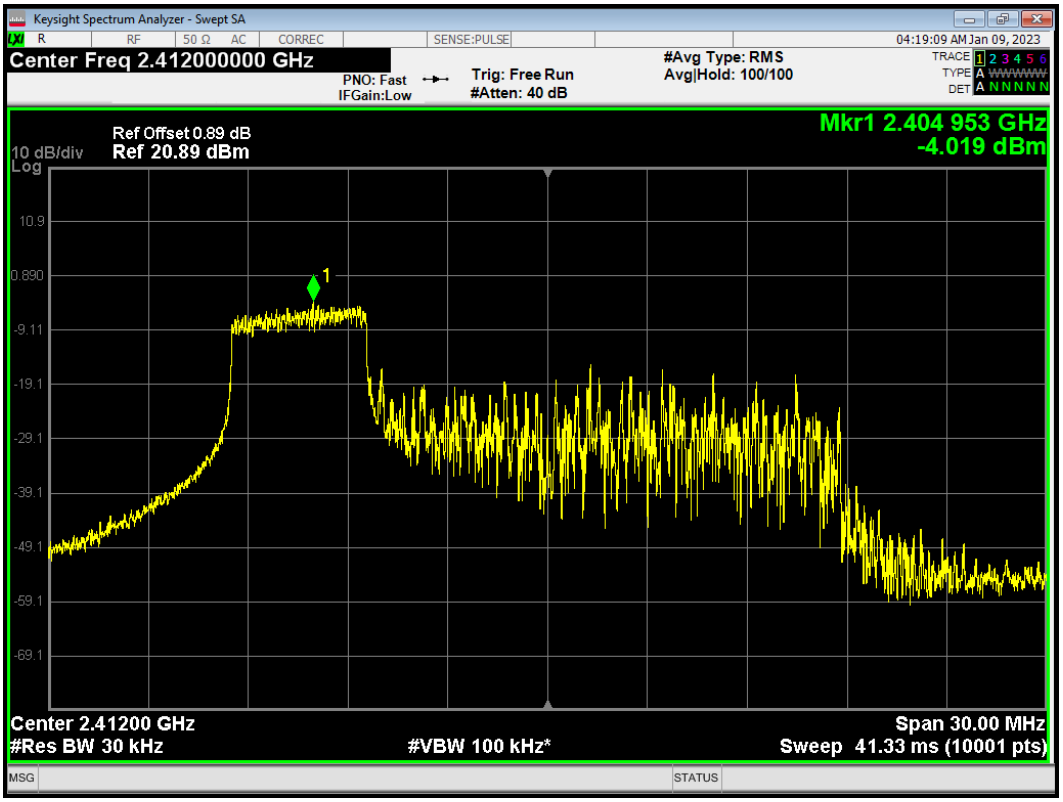
PSD 802.11ax HE20 26-Tones 2437MHz



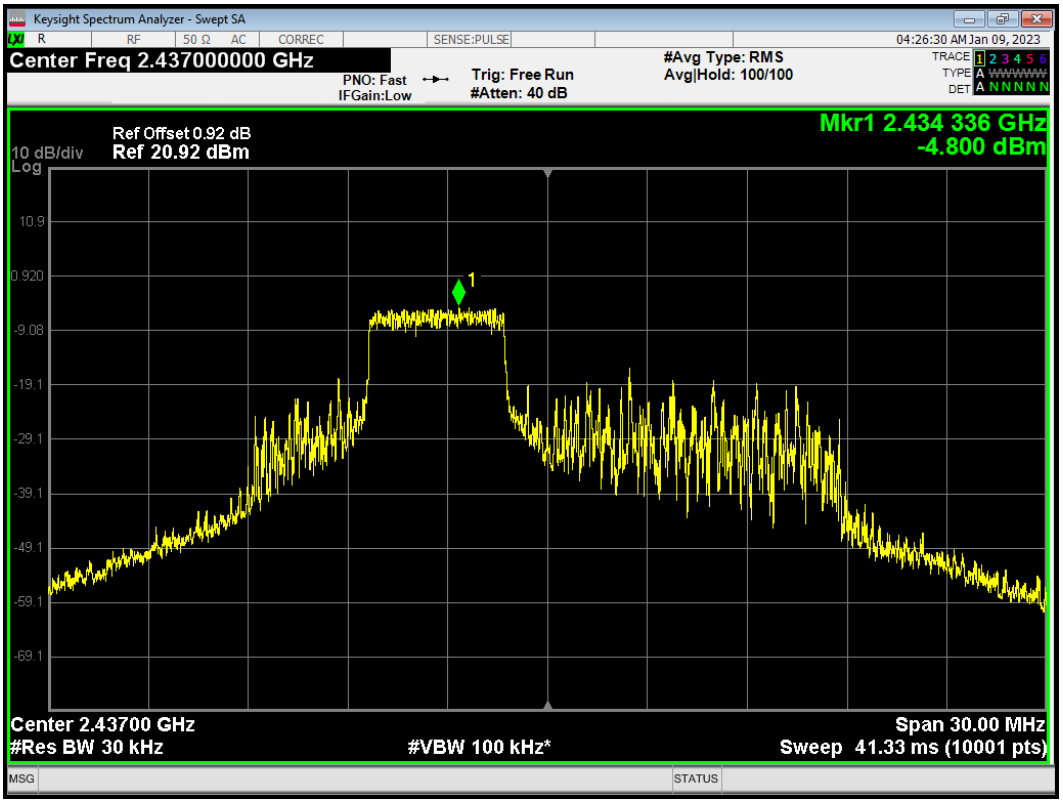
PSD 802.11ax HE20 26-Tones 2462MHz



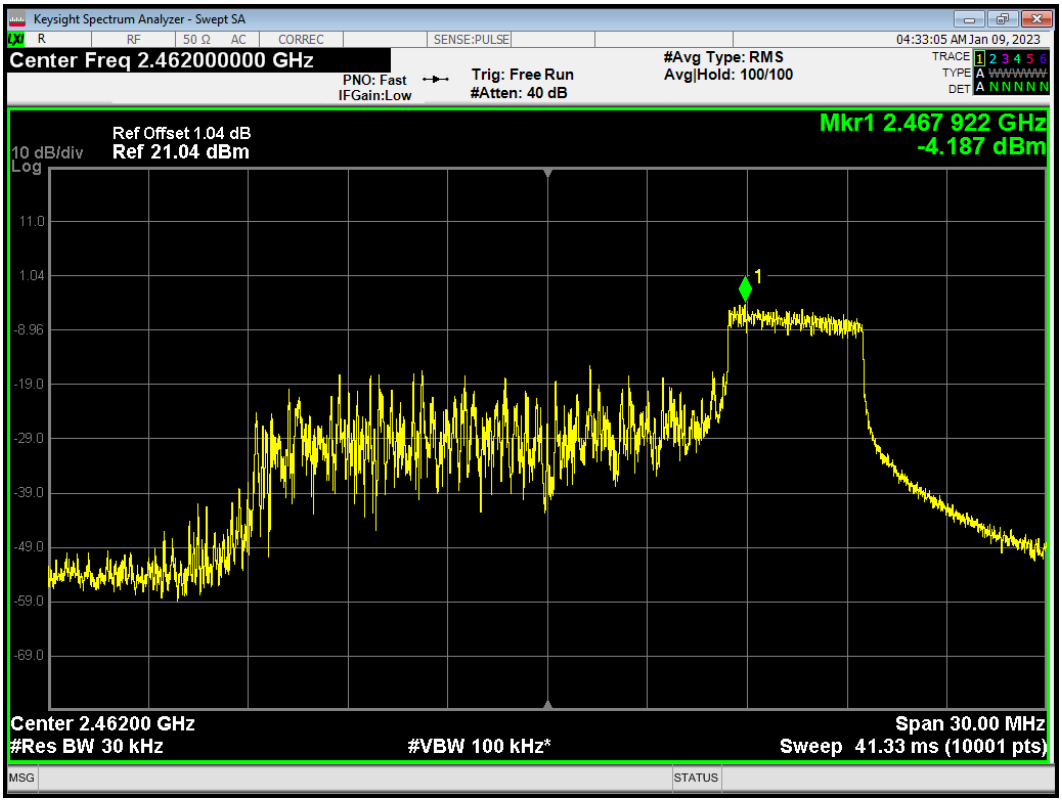
PSD 802.11ax HE20 52-Tones 2412MHz



PSD 802.11ax HE20 52-Tones 2437MHz



PSD 802.11ax HE20 52-Tones 2462MHz



5.5. Spurious RF Conducted Emissions

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 with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. Set RBW to 100 kHz and VBW to 300 kHz, Sweep is set to ATUO.
The test is in transmitting mode.

Test Setup

Limits

Rule Part 15.247(d) pacifies 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. ”

Test Mode	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11b	2412	8.430	-21.57
	2437	8.190	-21.81
	2462	8.510	-21.49
802.11g	2412	4.790	-25.21
	2437	4.460	-25.54
	2462	3.500	-26.50
802.11n HT20	2412	5.510	-24.49
	2437	4.680	-25.32
	2462	3.110	-26.89
802.11n HT40	2422	1.420	-28.58
	2437	0.190	-29.81

	2452	0.570	-29.43
802.11ax HE20	2412	-1.360	-31.36
	2417	2.660	-27.34
	2437	3.140	-26.86
	2462	2.950	-27.05
Bluetooth (Low Energy) (1M)	2402	6.560	-23.44
	2440	6.080	-23.92
	2480	5.460	-24.54

TB Mode

Test Mode	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11ax HE20 26-Tones	2412	8.960	-21.04
	2437	8.970	-21.03
	2462	9.150	-20.85
802.11ax HE20 52-Tones	2412	6.750	-23.25
	2437	6.600	-23.40
	2462	6.370	-23.63
802.11ax HE20 106-Tones	2412	3.970	-26.03
	2437	3.900	-26.10
	2462	3.780	-26.22

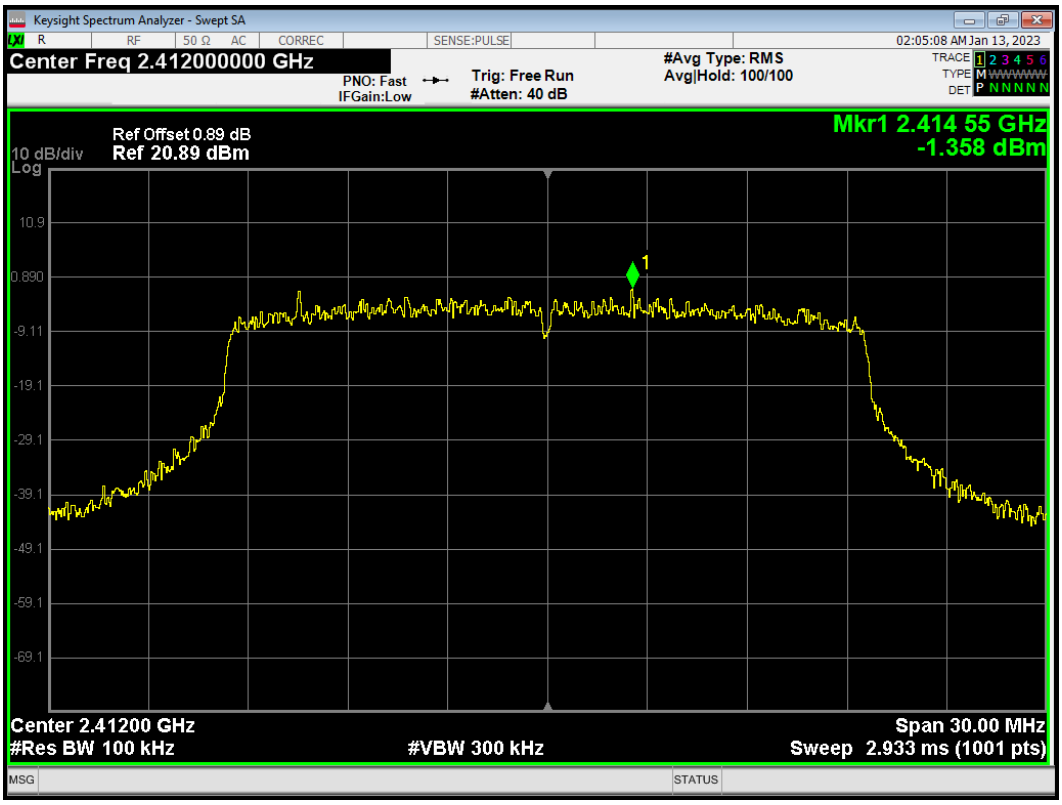
Measurement Uncertainty

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

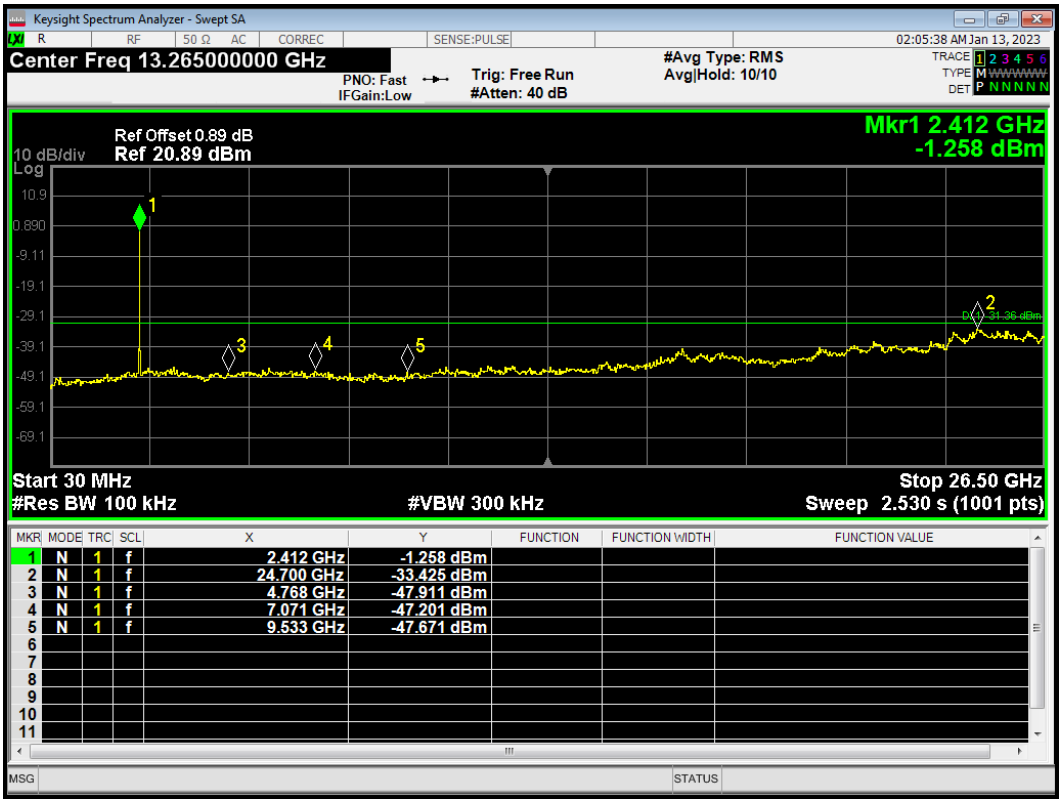
Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

Test Results:

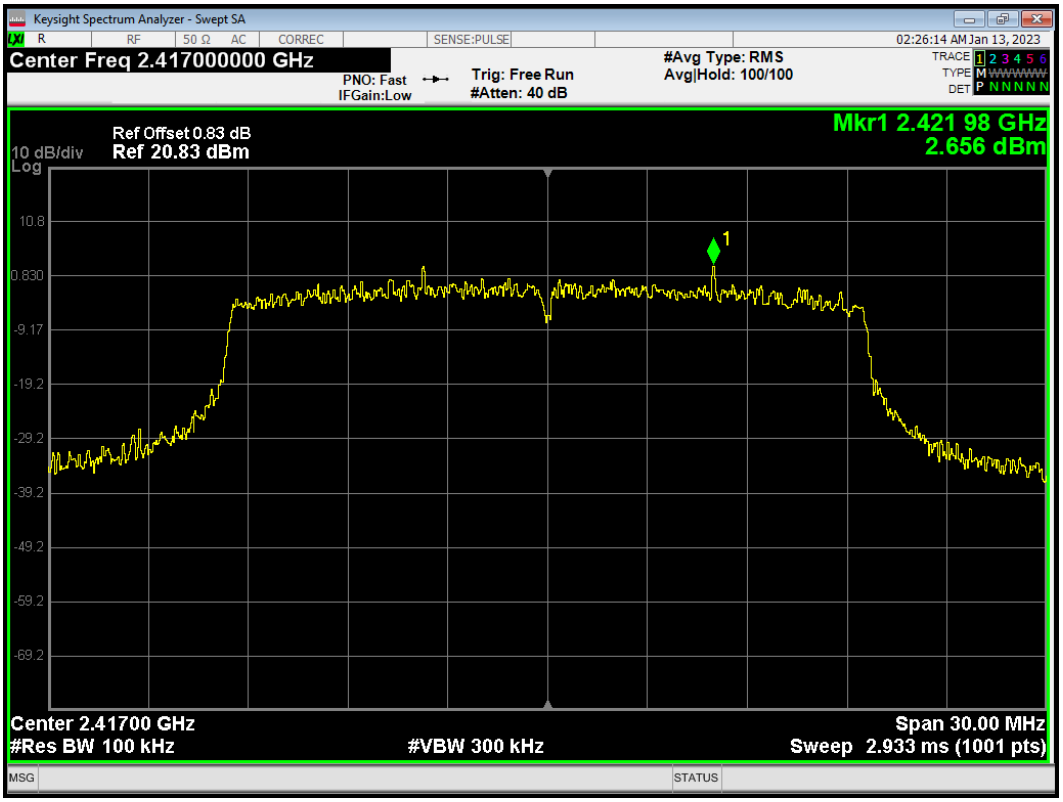
Tx. Spurious 802.11ax(HE20) 2412MHz Ref



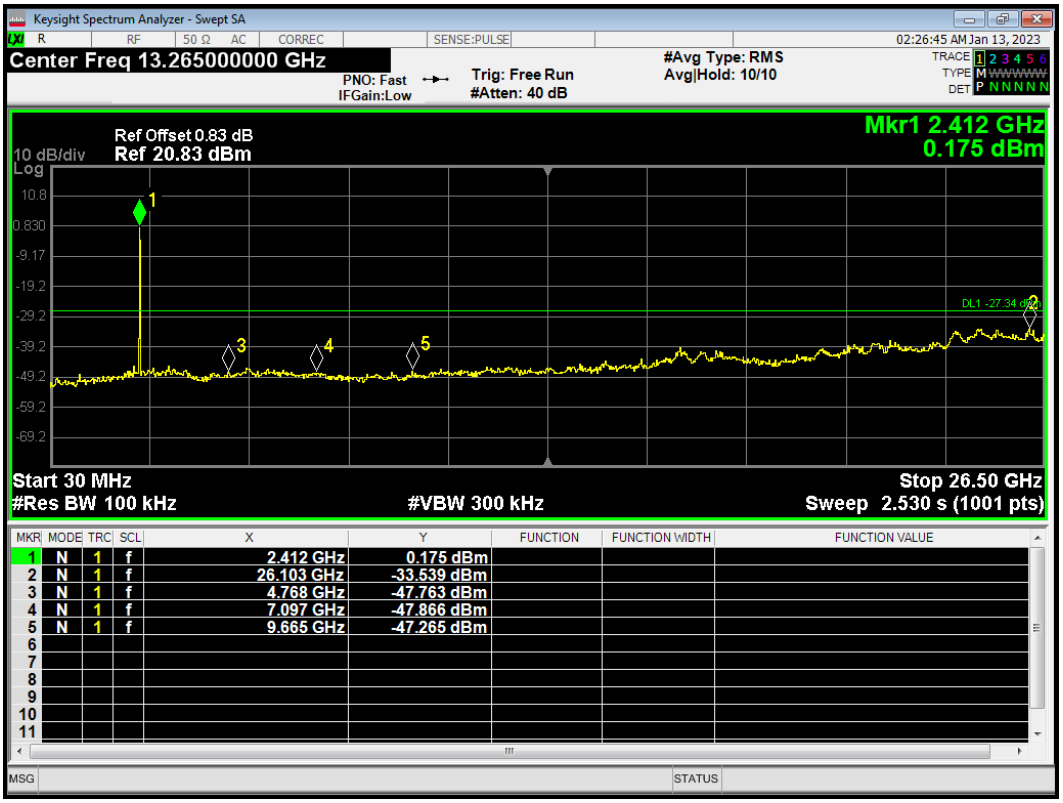
Tx. Spurious 802.11ax(HE20) 2412MHz Emission



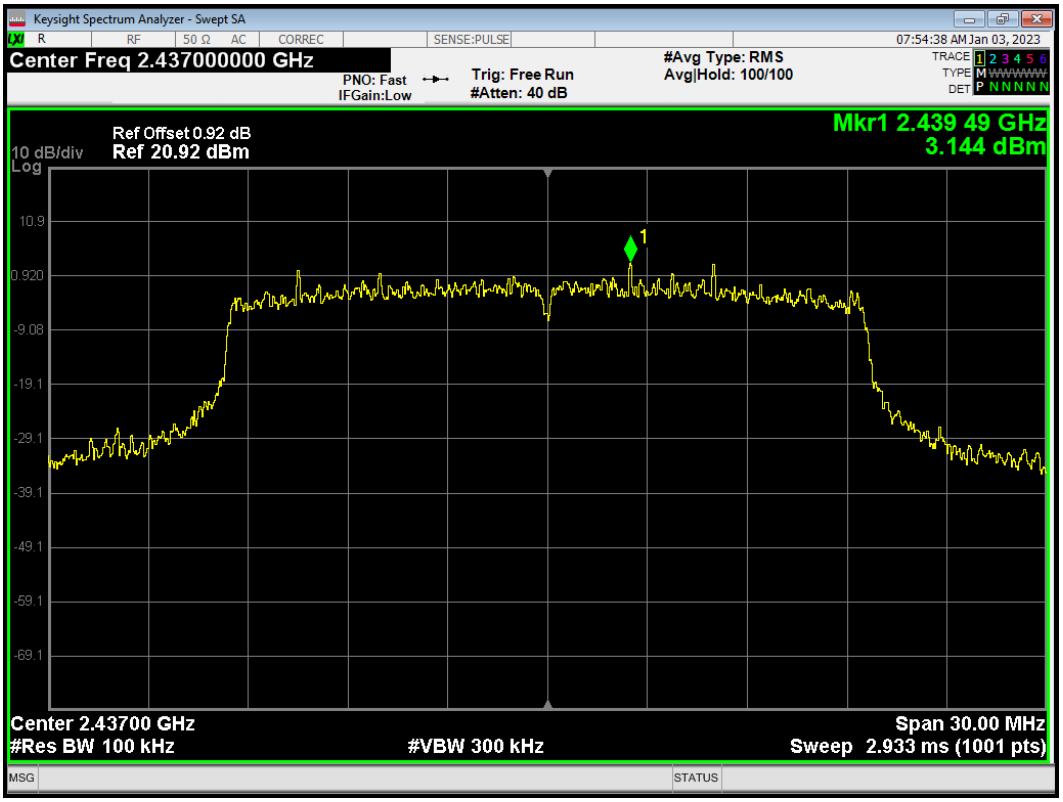
Tx. Spurious 802.11ax(HE20) 2417MHz Ref



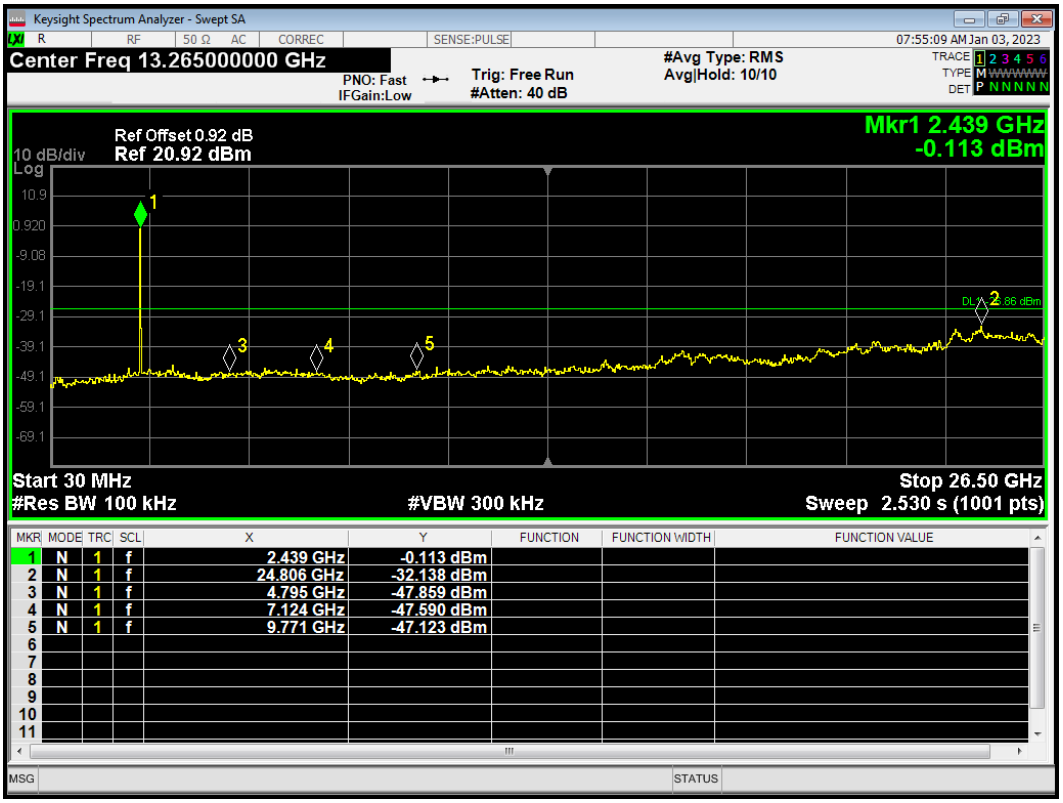
Tx. Spurious 802.11ax(HE20) 2417MHz Emission



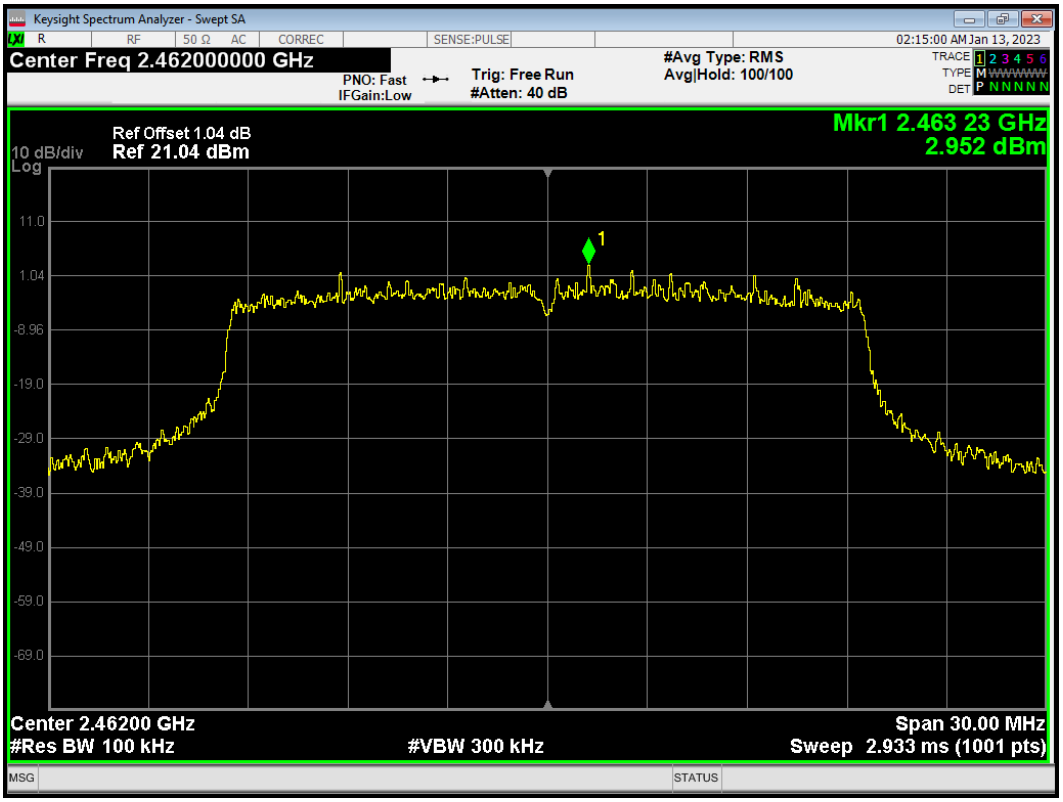
Tx. Spurious 802.11ax(HE20) 2437MHz Ref



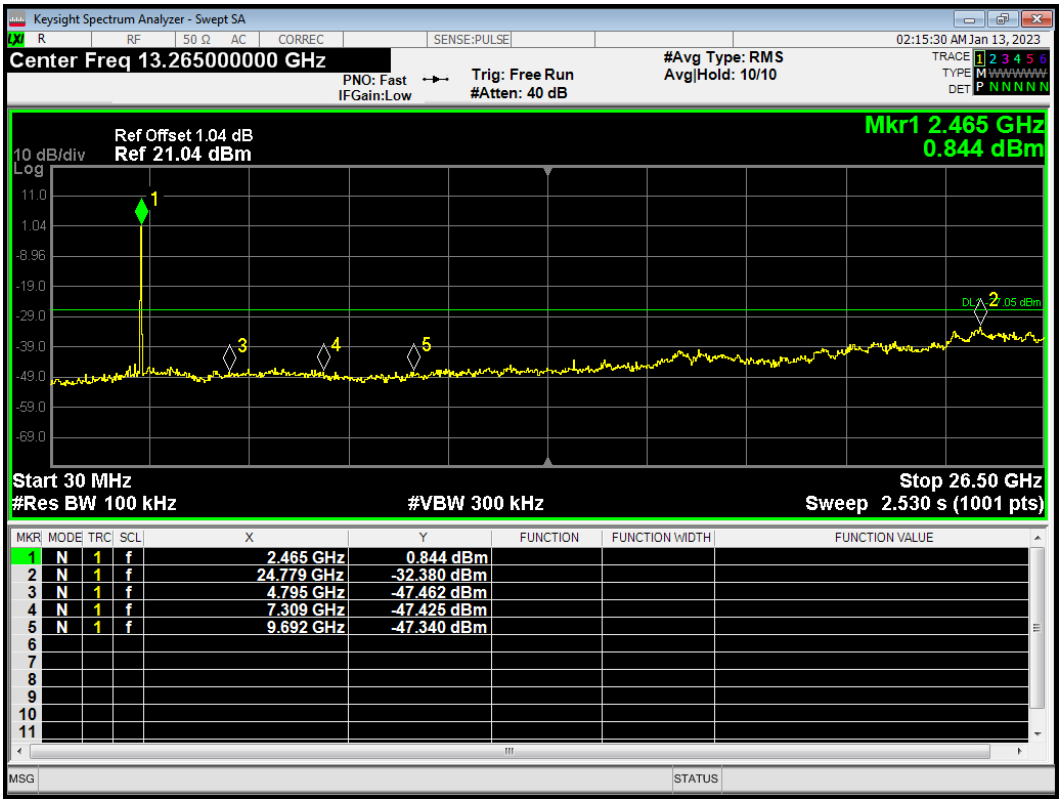
Tx. Spurious 802.11ax(HE20) 2437MHz Emission



Tx. Spurious 802.11ax(HE20) 2462MHz Ref



Tx. Spurious 802.11ax(HE20) 2462MHz Emission



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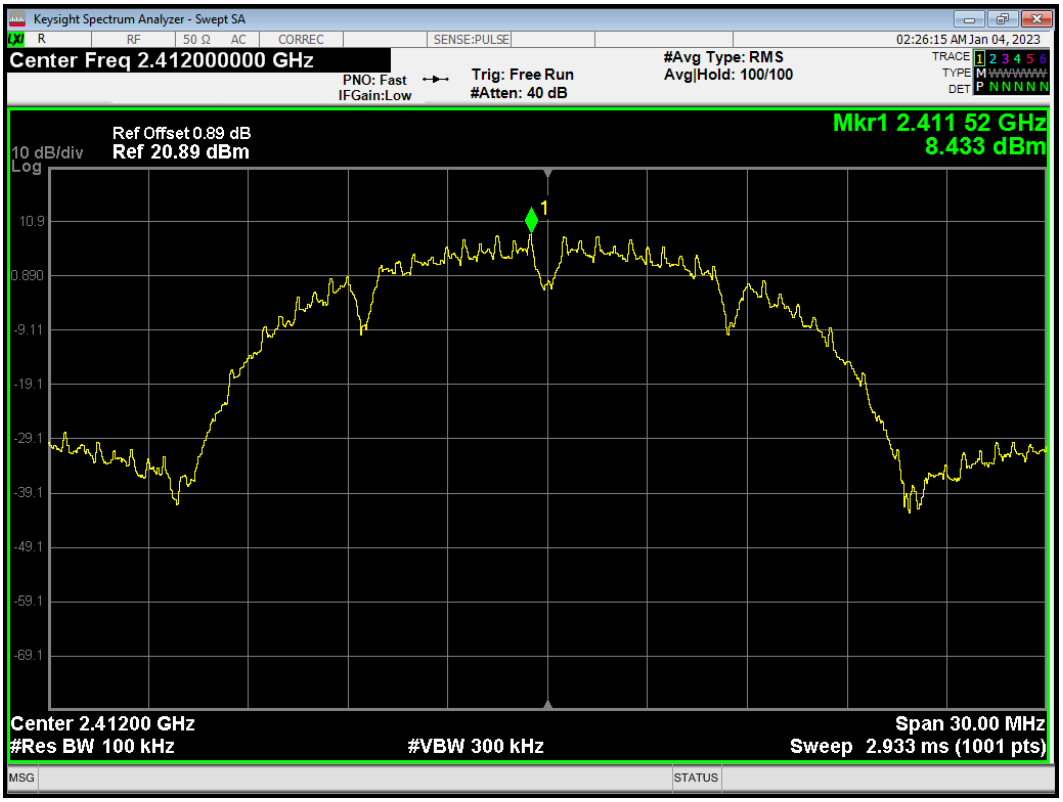

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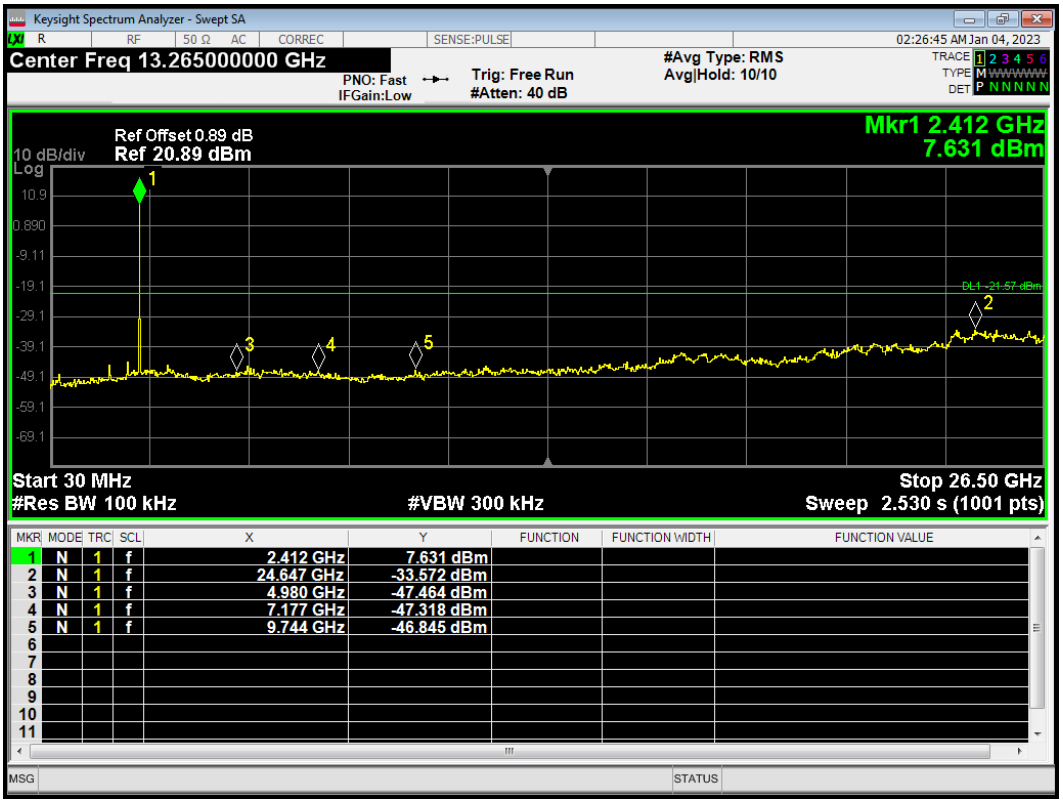

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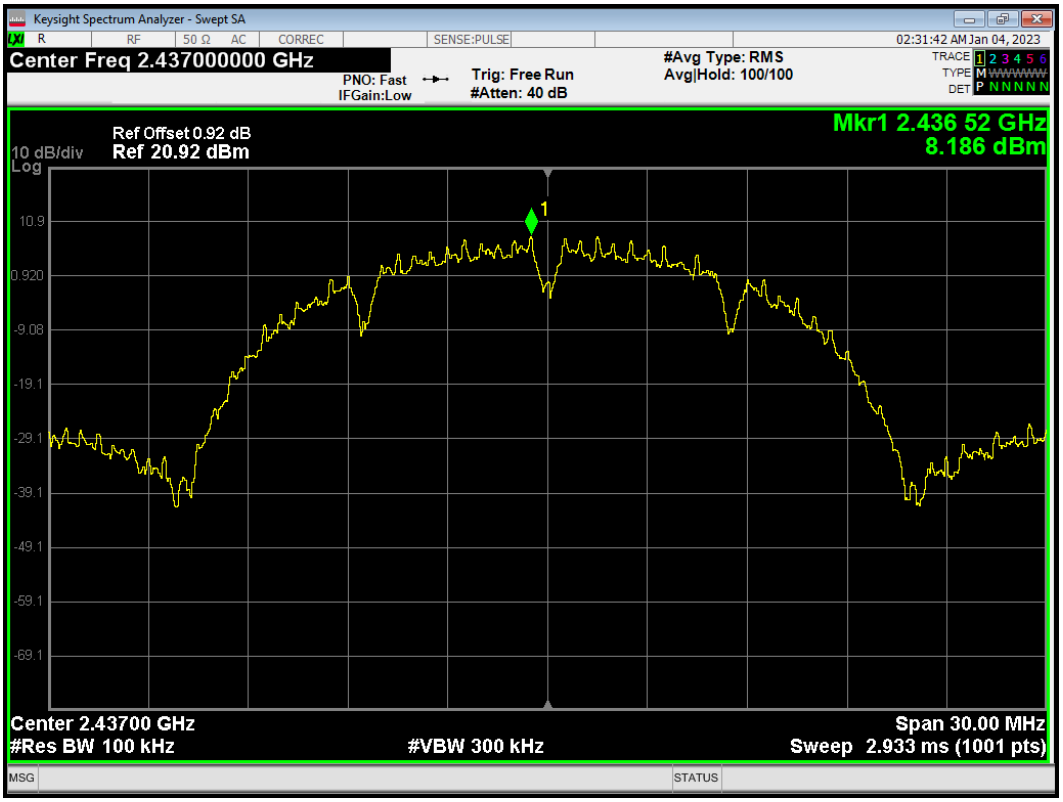
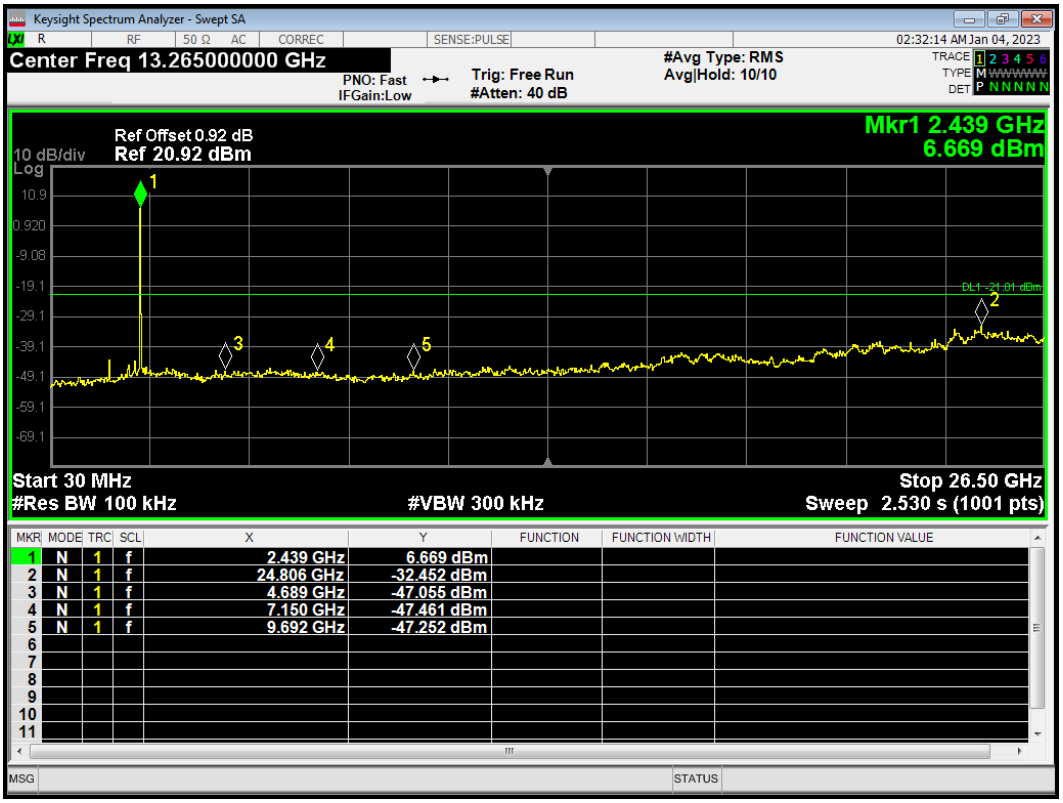
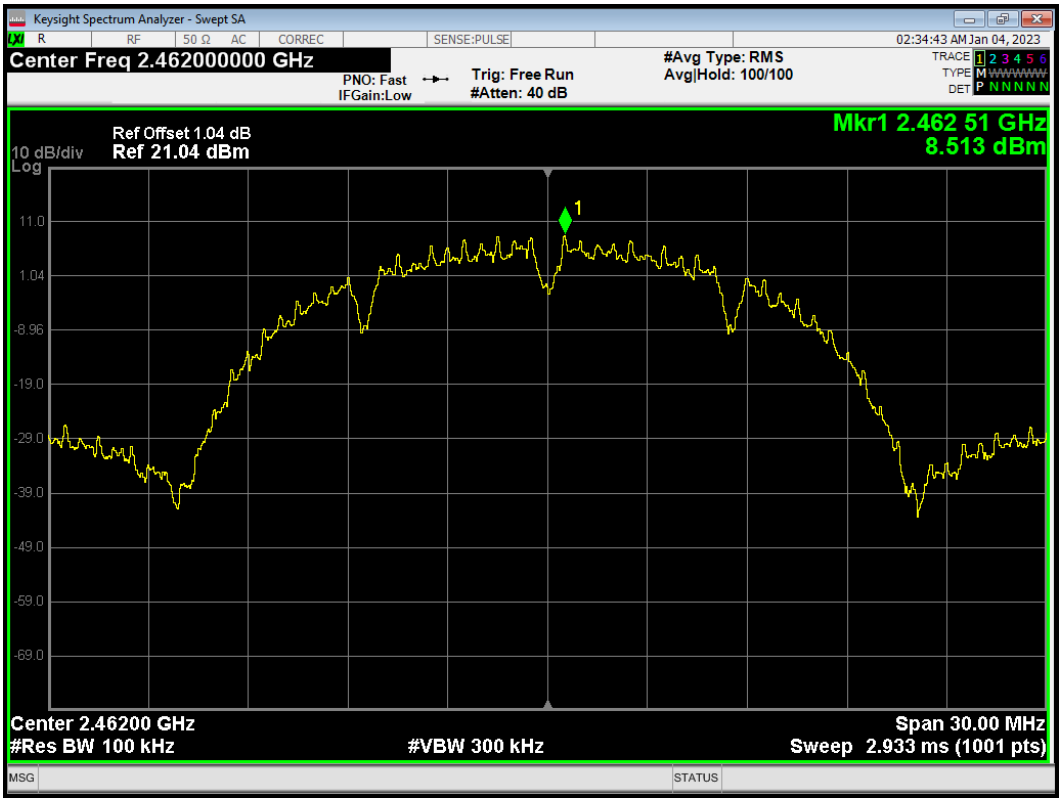


Tx. Spurious 802.11b 2437MHz Emission

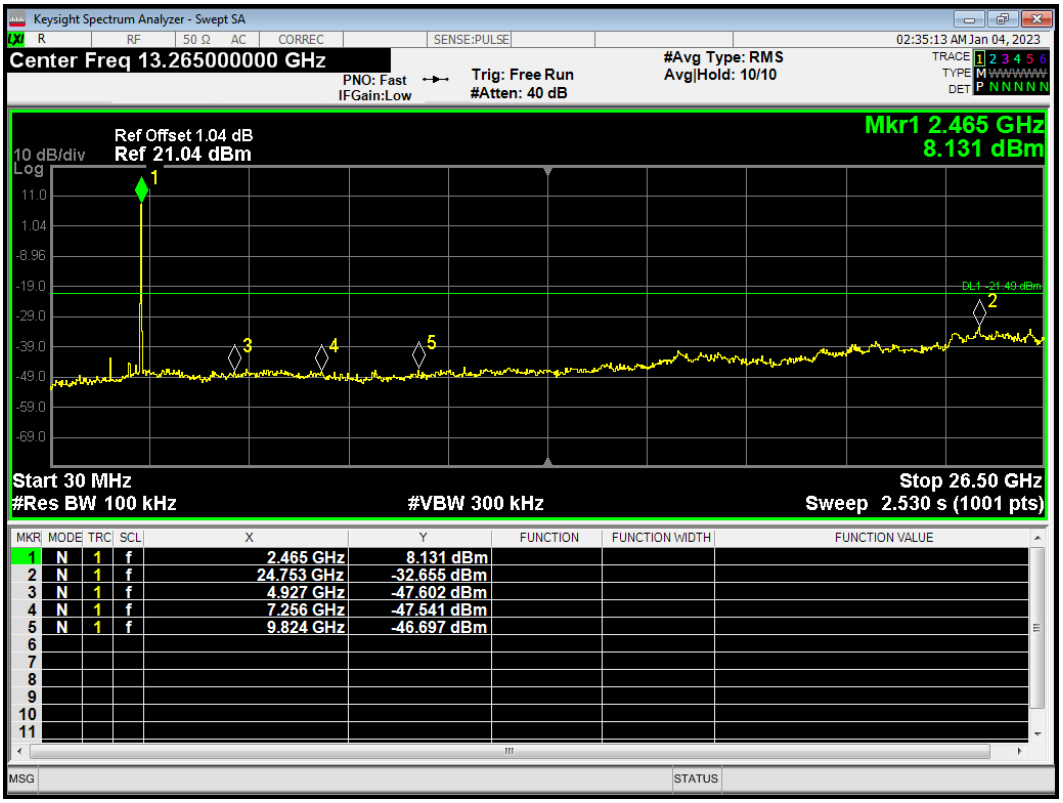


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.439 GHz	6.669 dBm			
2	N	1	f	24.806 GHz	-32.452 dBm			
3	N	1	f	4.689 GHz	-47.055 dBm			
4	N	1	f	7.150 GHz	-47.461 dBm			
5	N	1	f	9.692 GHz	-47.252 dBm			

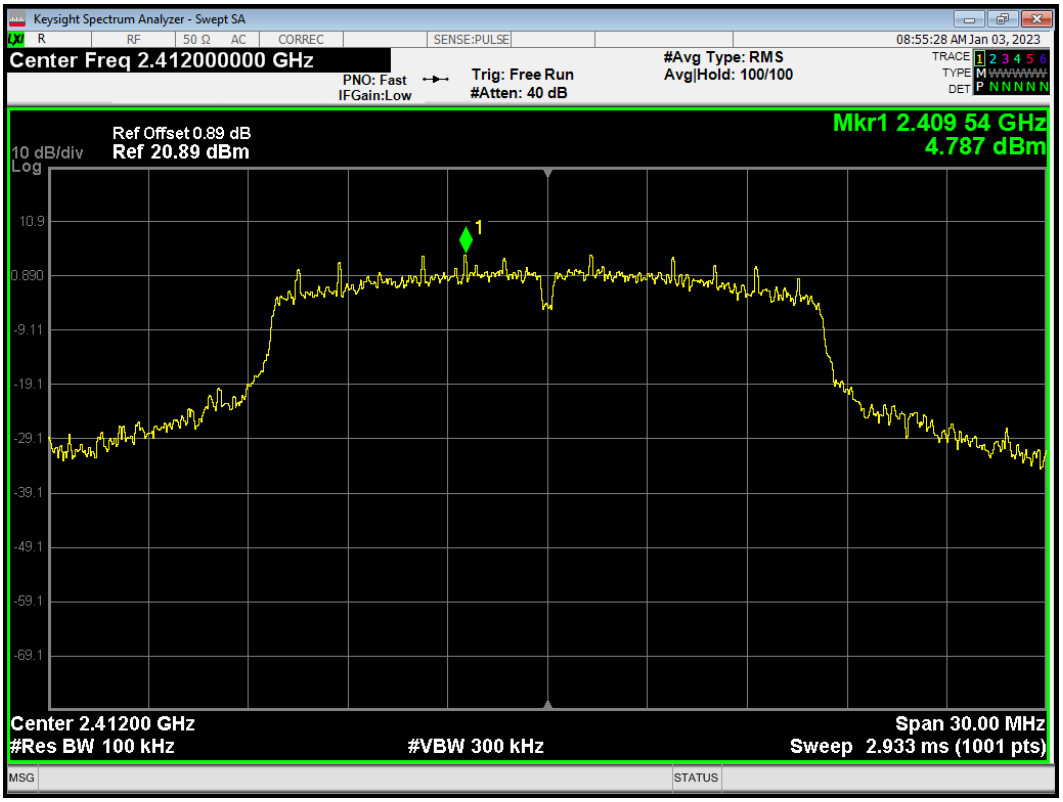
Tx. Spurious 802.11b 2462MHz Ref



Tx. Spurious 802.11b 2462MHz Emission



Tx. Spurious 802.11g 2412MHz Ref



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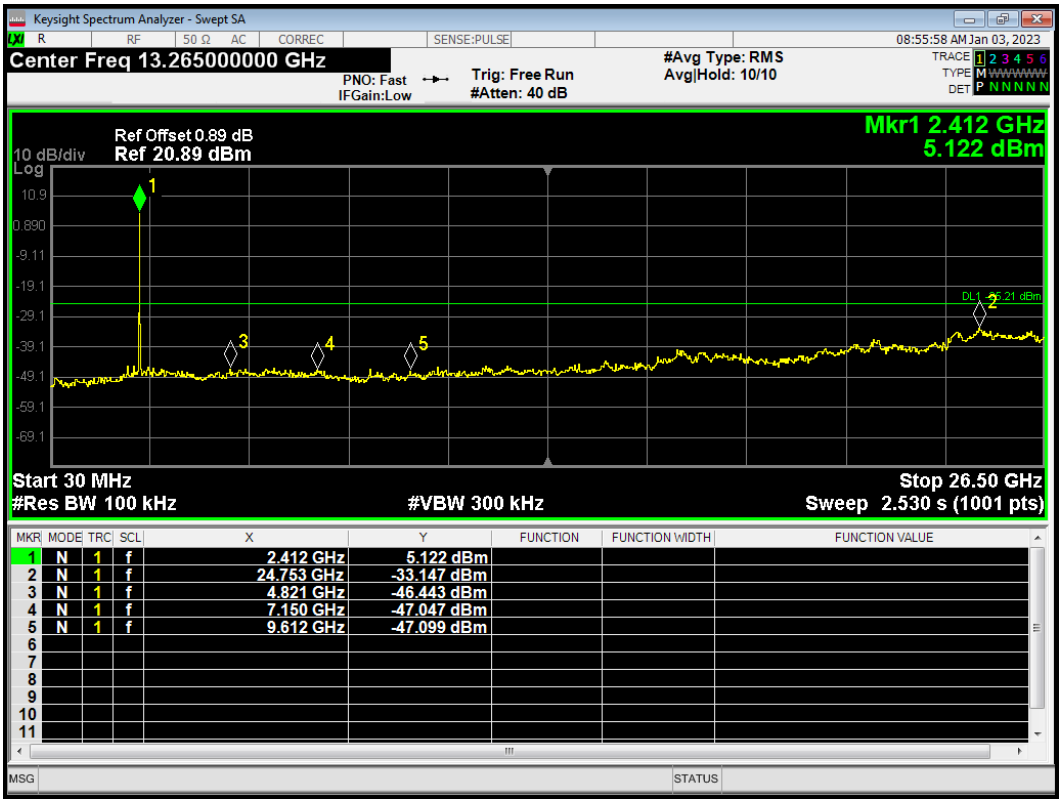
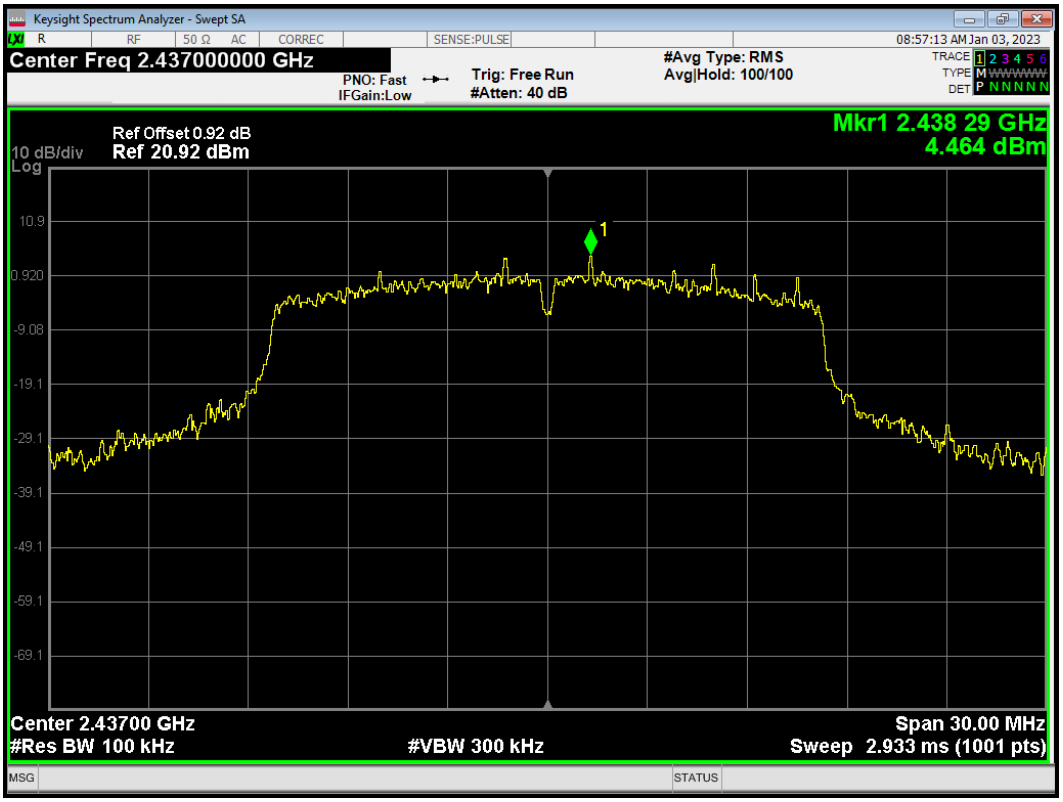


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.412 GHz	5.122 dBm			
2	N	1	f	24.753 GHz	-33.147 dBm			
3	N	1	f	4.821 GHz	-46.443 dBm			
4	N	1	f	7.150 GHz	-47.047 dBm			
5	N	1	f	9.612 GHz	-47.099 dBm			
6								
7								
8								
9								
10								
11								

Tx. Spurious 802.11g 2437MHz Ref



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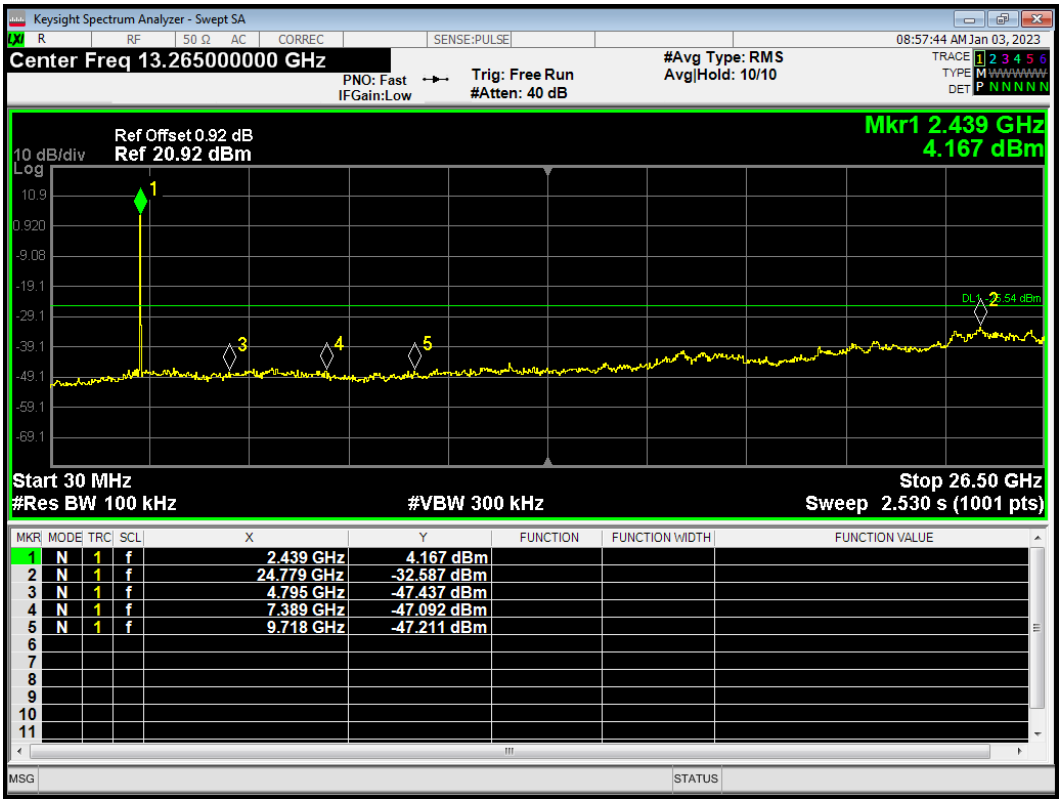

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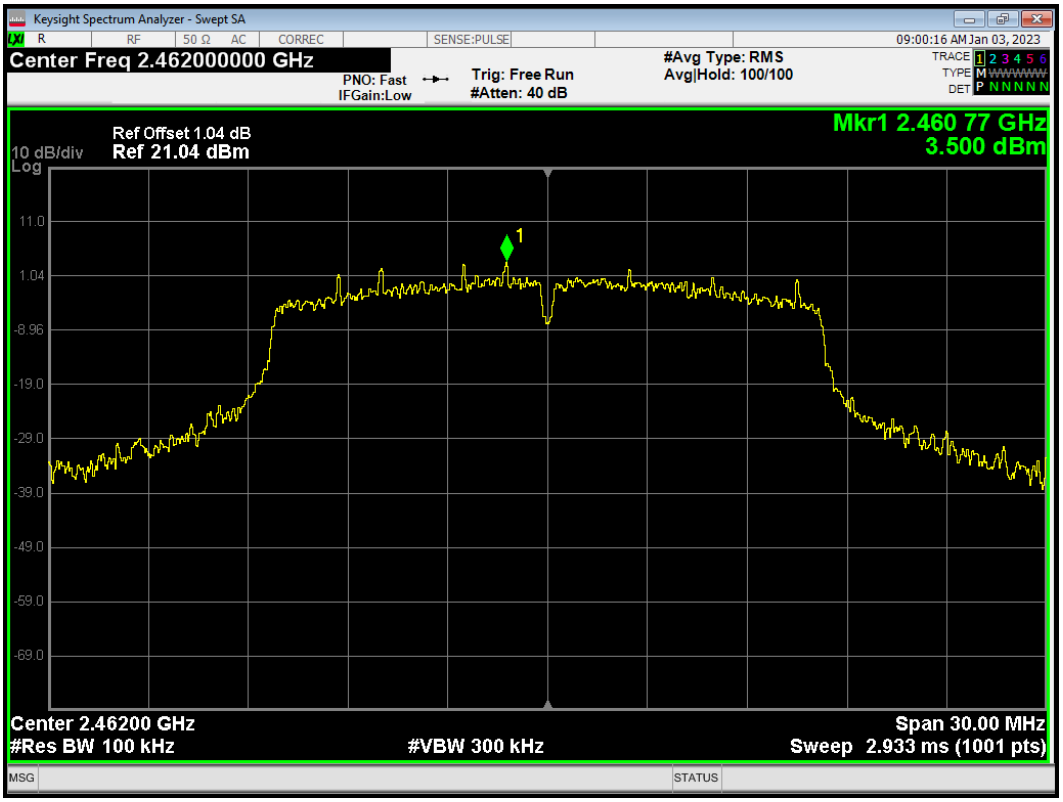
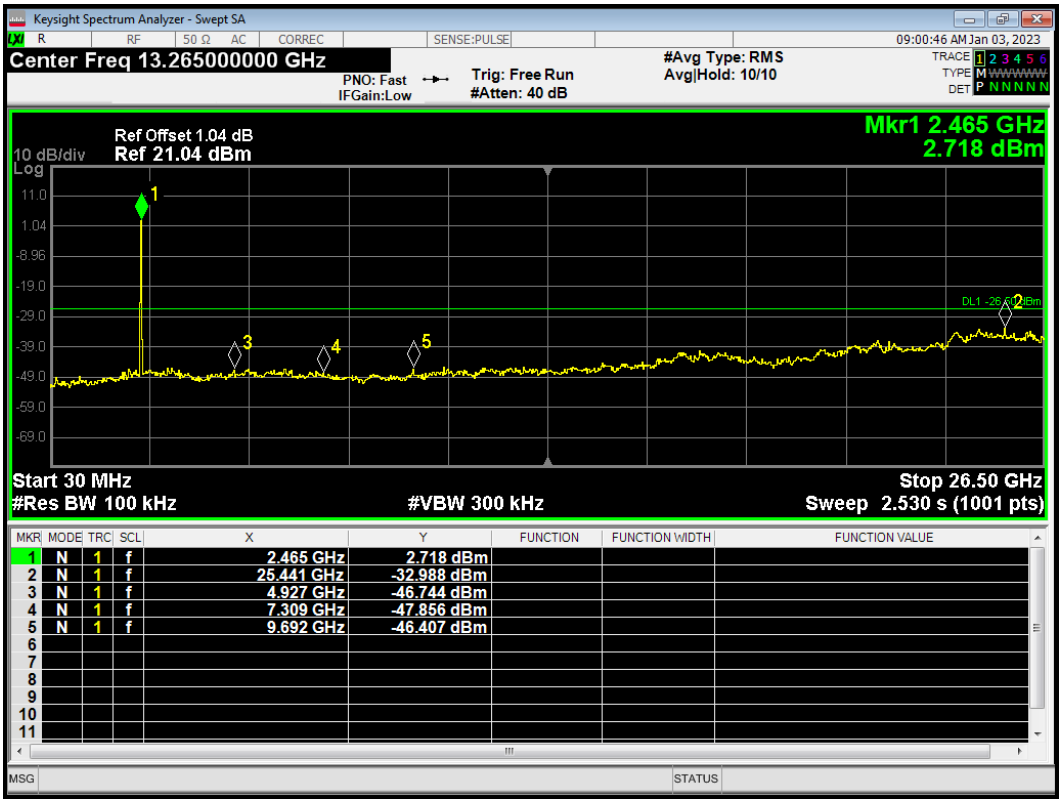
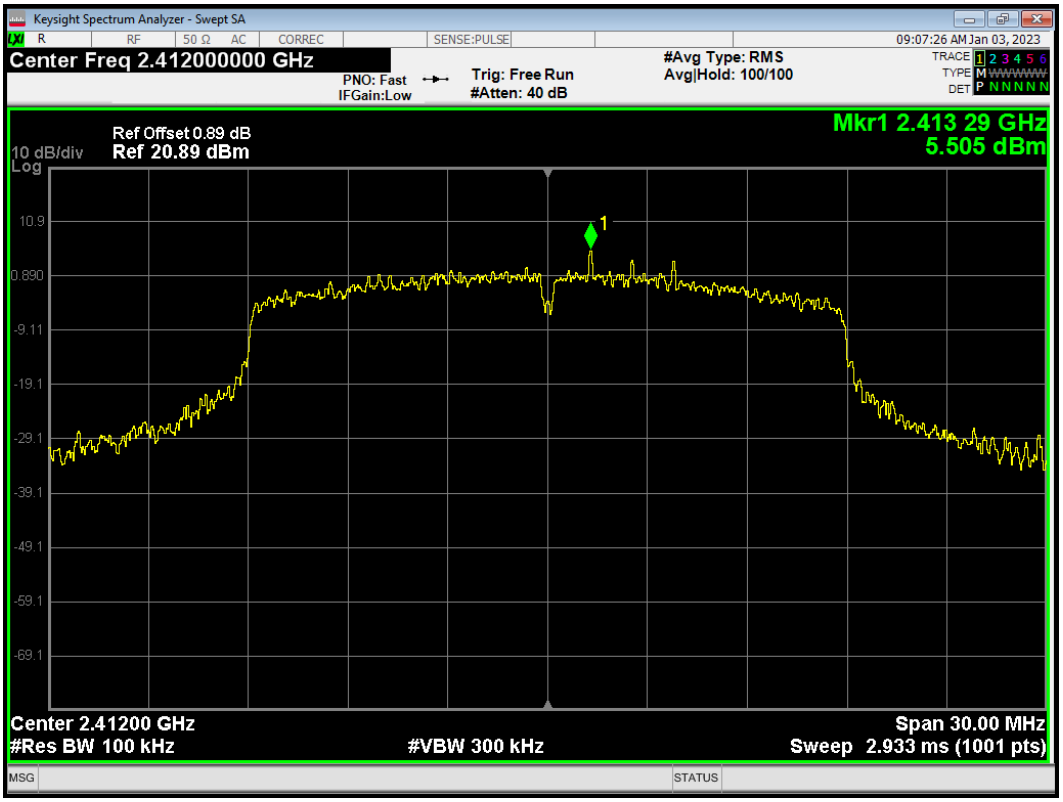


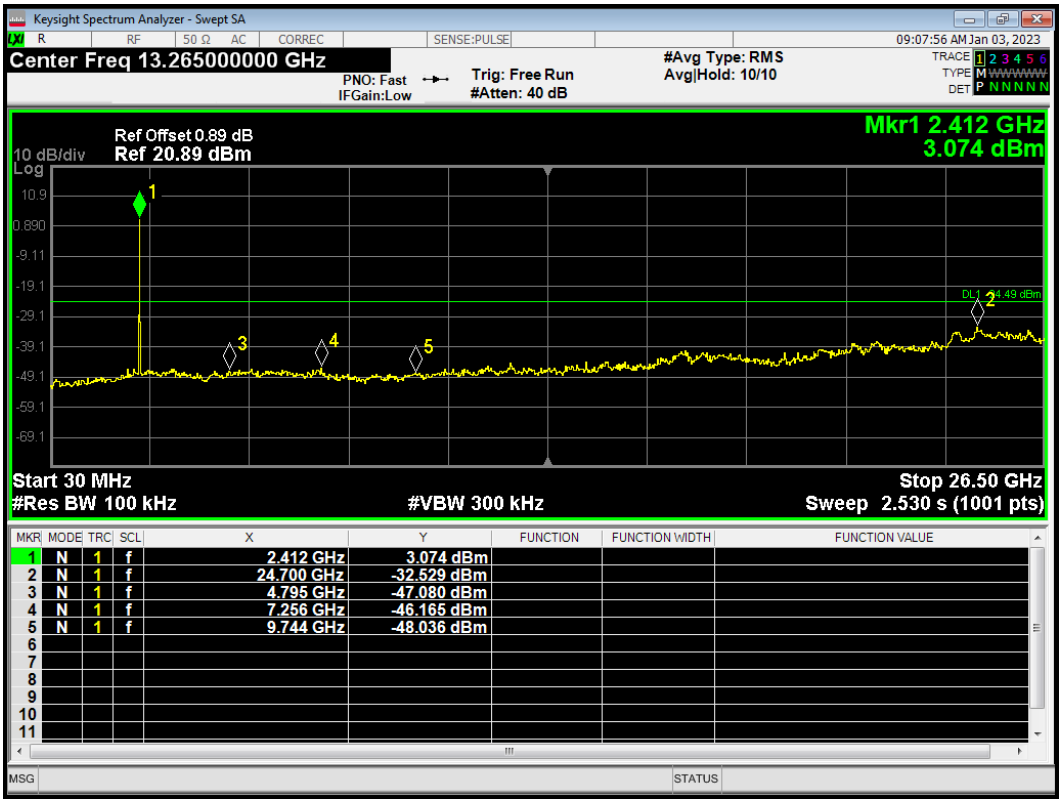
Tx. Spurious 802.11g 2462MHz Emission



Tx. Spurious 802.11n(HT20) 2412MHz Ref

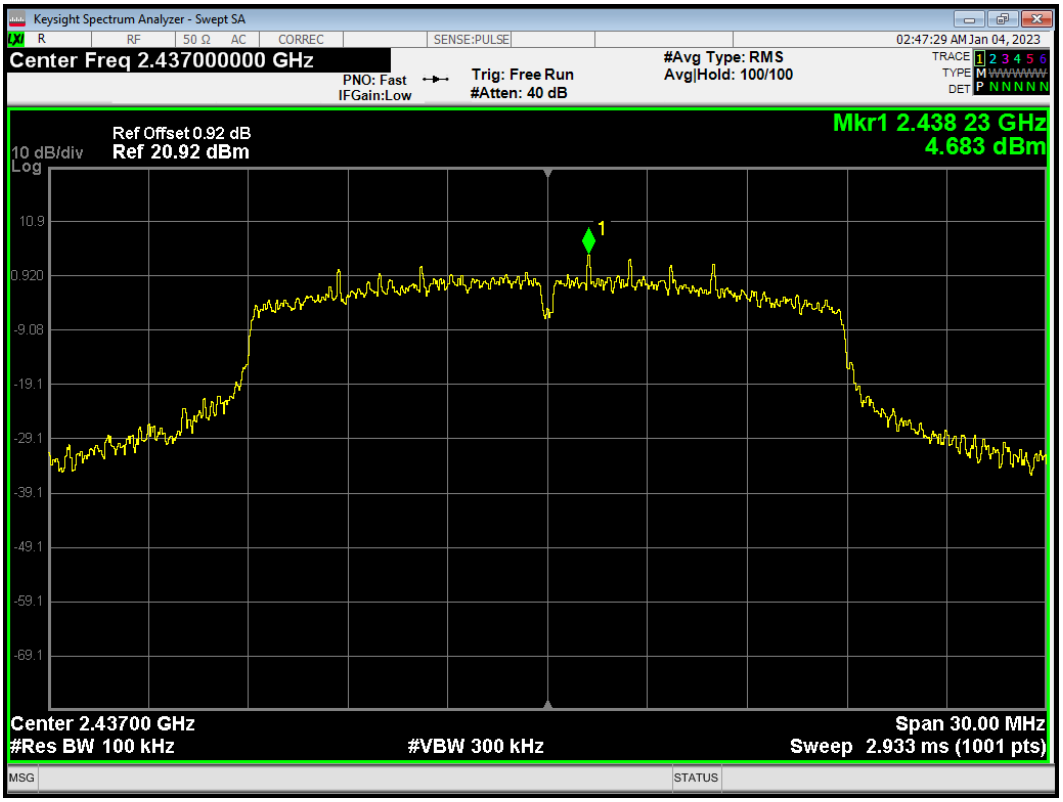


Tx. Spurious 802.11n(HT20) 2412MHz Emission

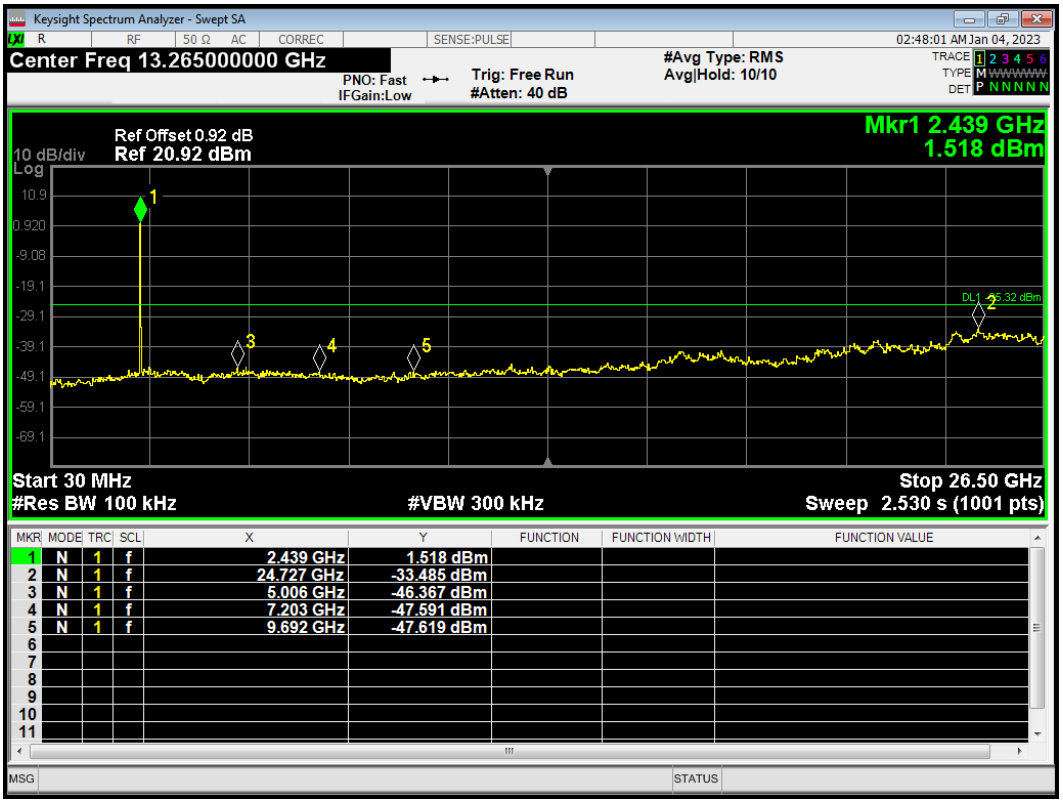


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.412 GHz	3.074 dBm			
2	N	1	f	24.700 GHz	-32.529 dBm			
3	N	1	f	4.795 GHz	-47.080 dBm			
4	N	1	f	7.256 GHz	-46.165 dBm			
5	N	1	f	9.744 GHz	-48.036 dBm			
6								
7								
8								
9								
10								
11								

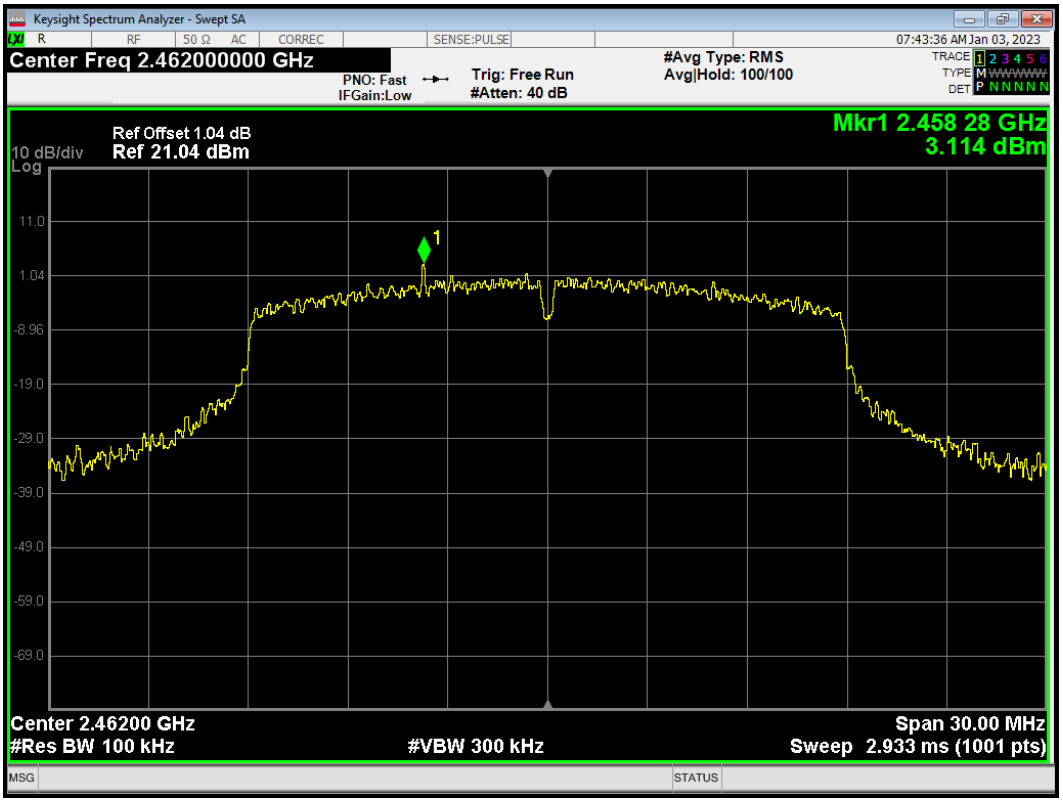
Tx. Spurious 802.11n(HT20) 2437MHz Ref



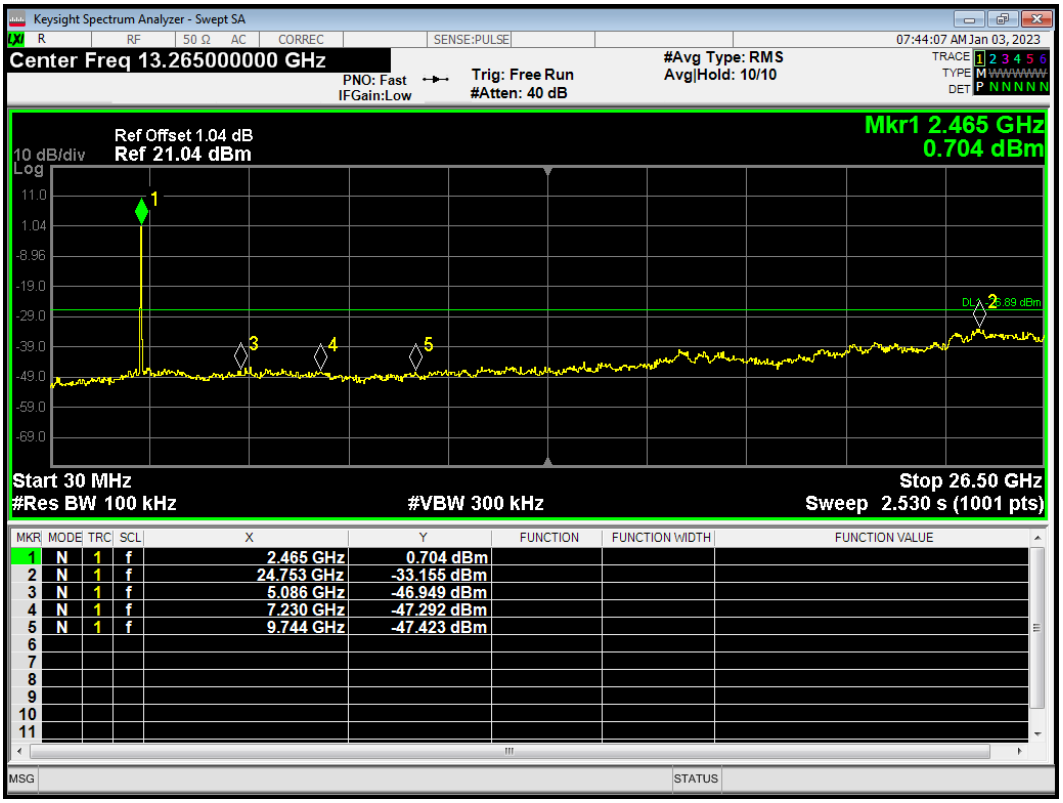
Tx. Spurious 802.11n(HT20) 2437MHz Emission



Tx. Spurious 802.11n(HT20) 2462MHz Ref

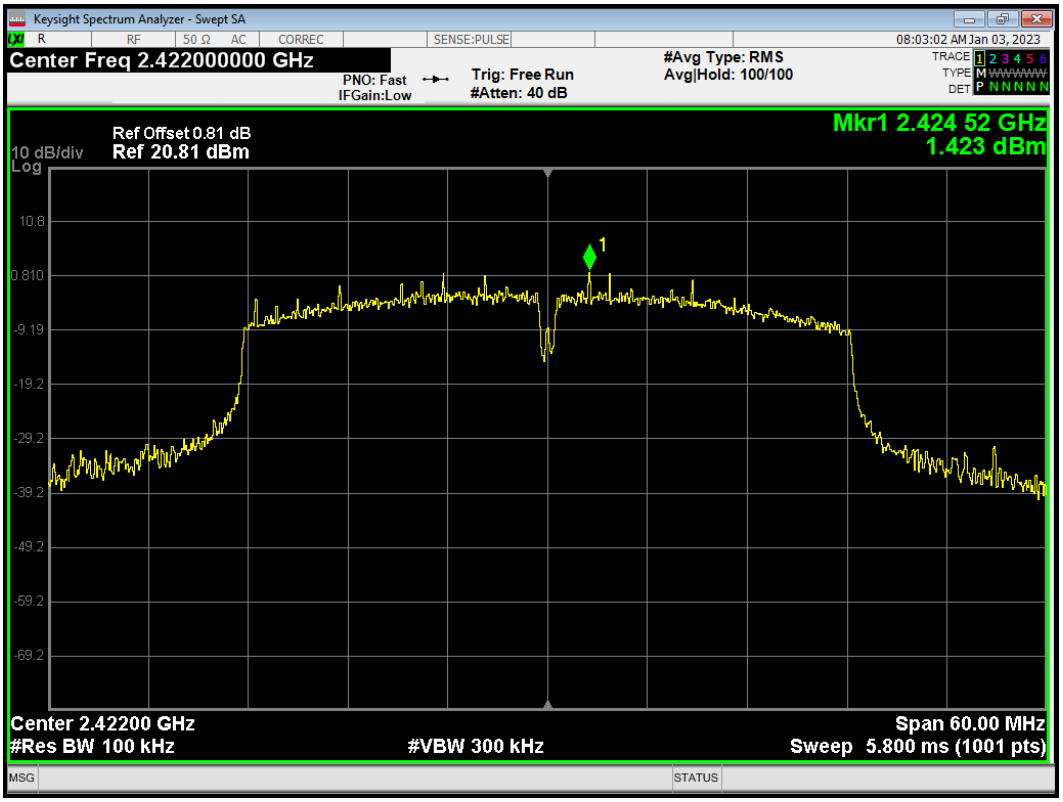


Tx. Spurious 802.11n(HT20) 2462MHz Emission

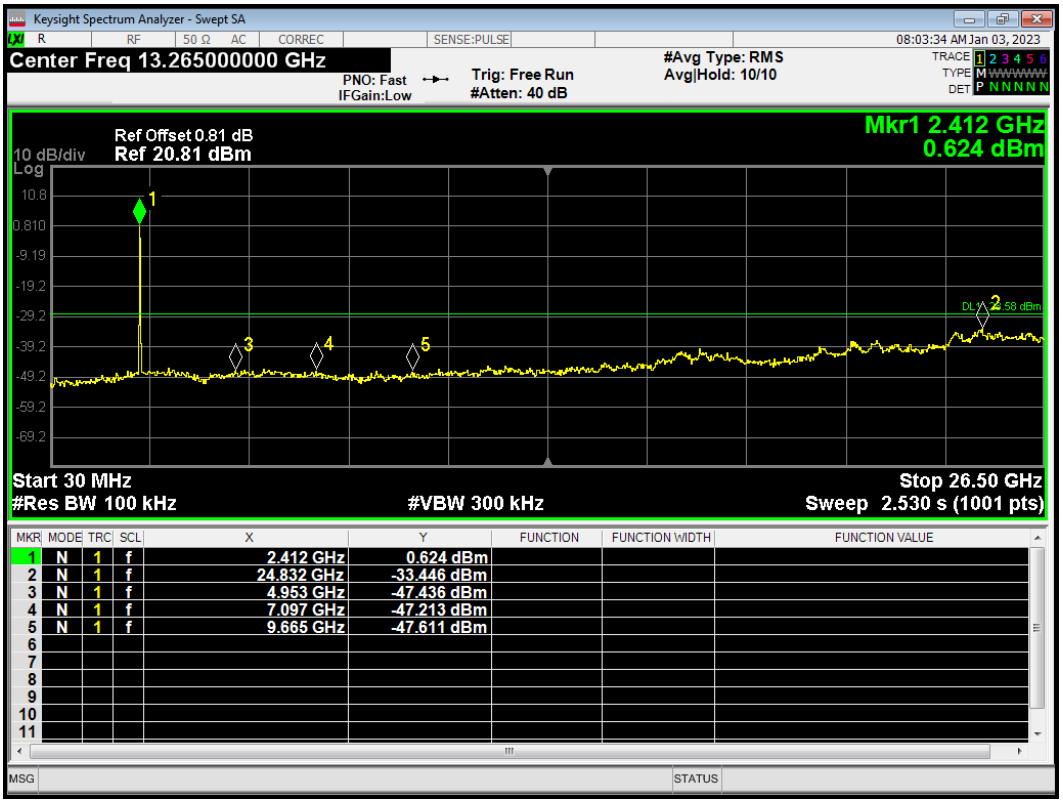


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.465 GHz	0.704 dBm			
2	N	1	f	24.753 GHz	-33.155 dBm			
3	N	1	f	5.086 GHz	-46.949 dBm			
4	N	1	f	7.230 GHz	-47.292 dBm			
5	N	1	f	9.744 GHz	-47.423 dBm			
6								
7								
8								
9								
10								
11								

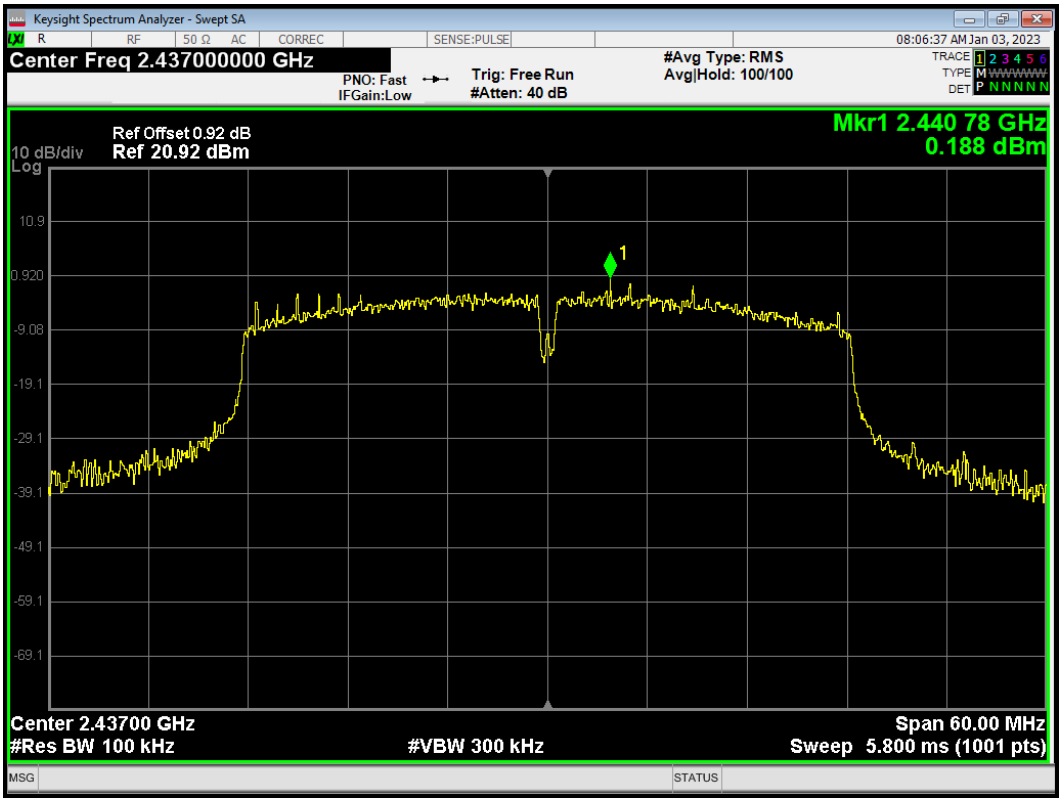
Tx. Spurious 802.11n(HT40) 2422MHz Ref



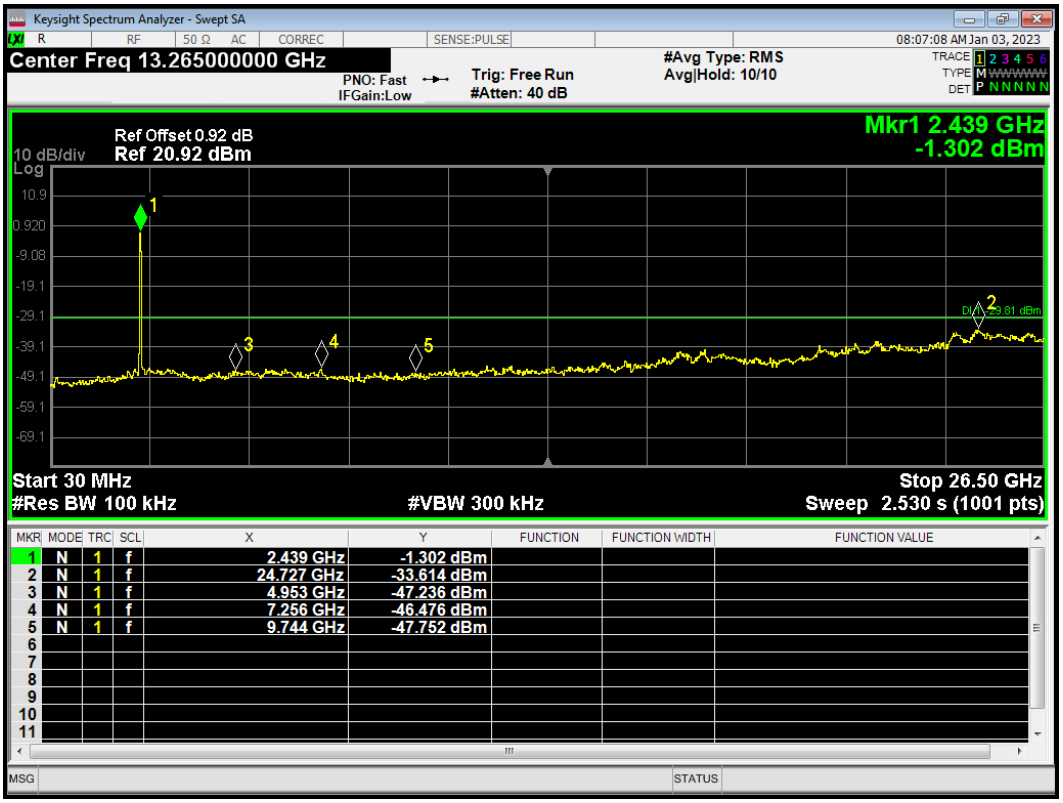
Tx. Spurious 802.11n(HT40) 2422MHz Emission



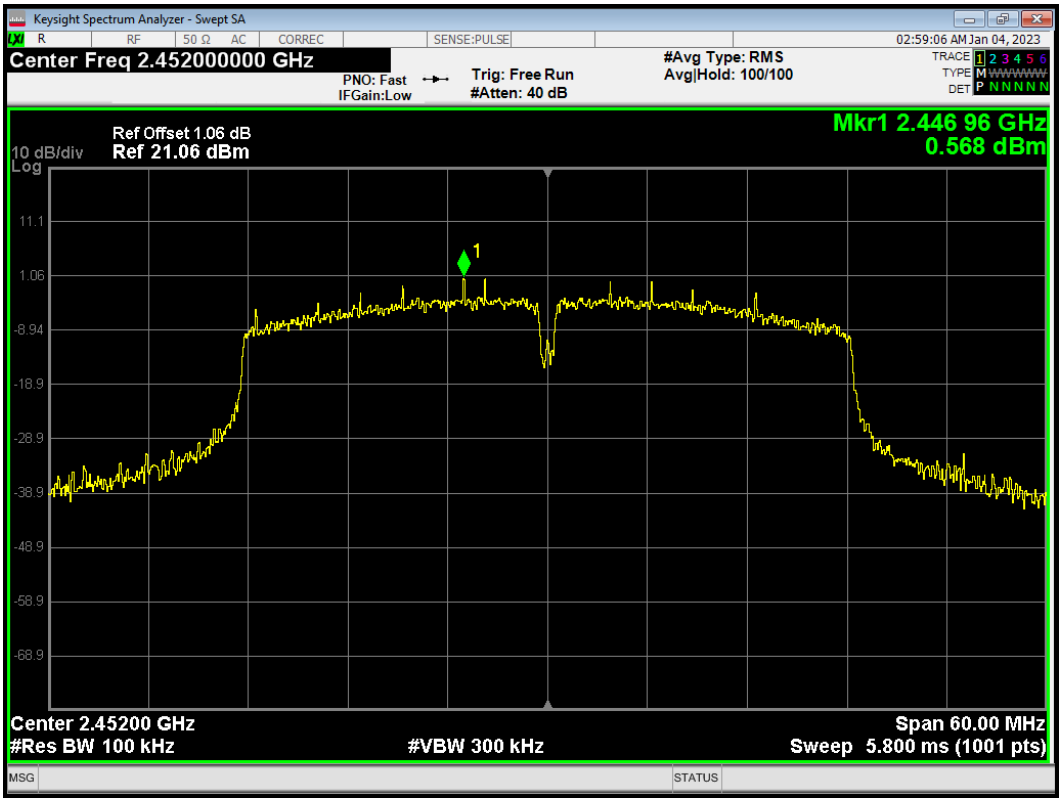
Tx. Spurious 802.11n(HT40) 2437MHz Ref



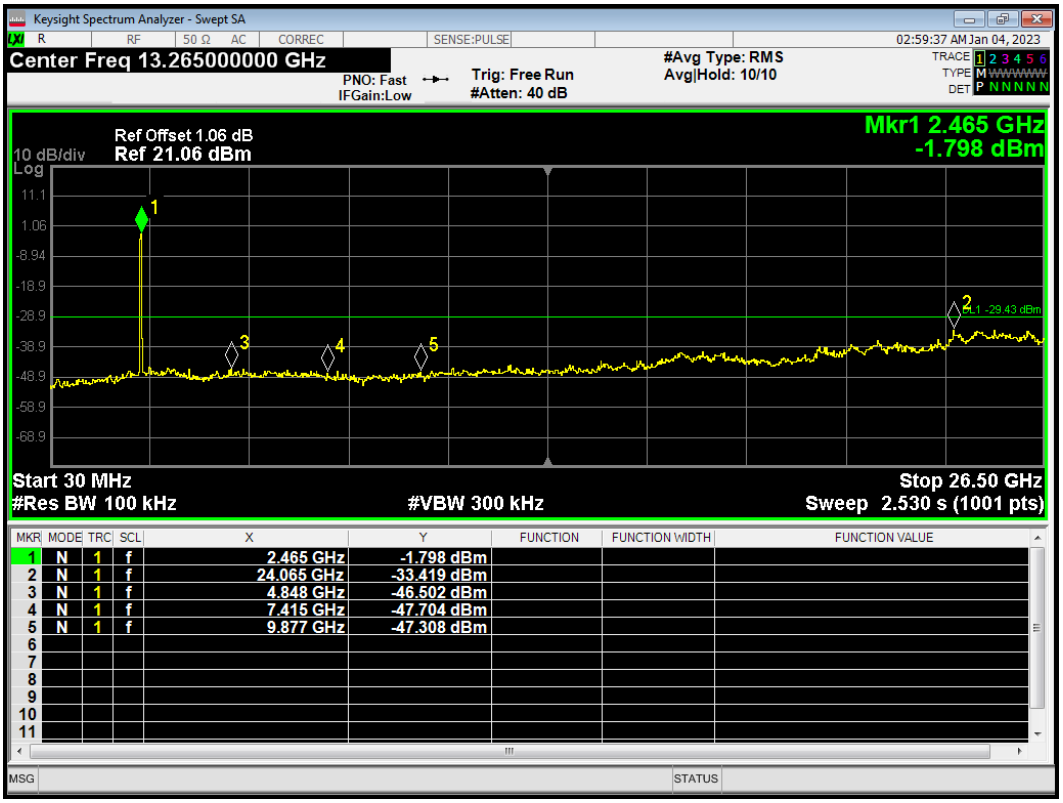
Tx. Spurious 802.11n(HT40) 2437MHz Emission



Tx. Spurious 802.11n(HT40) 2452MHz Ref

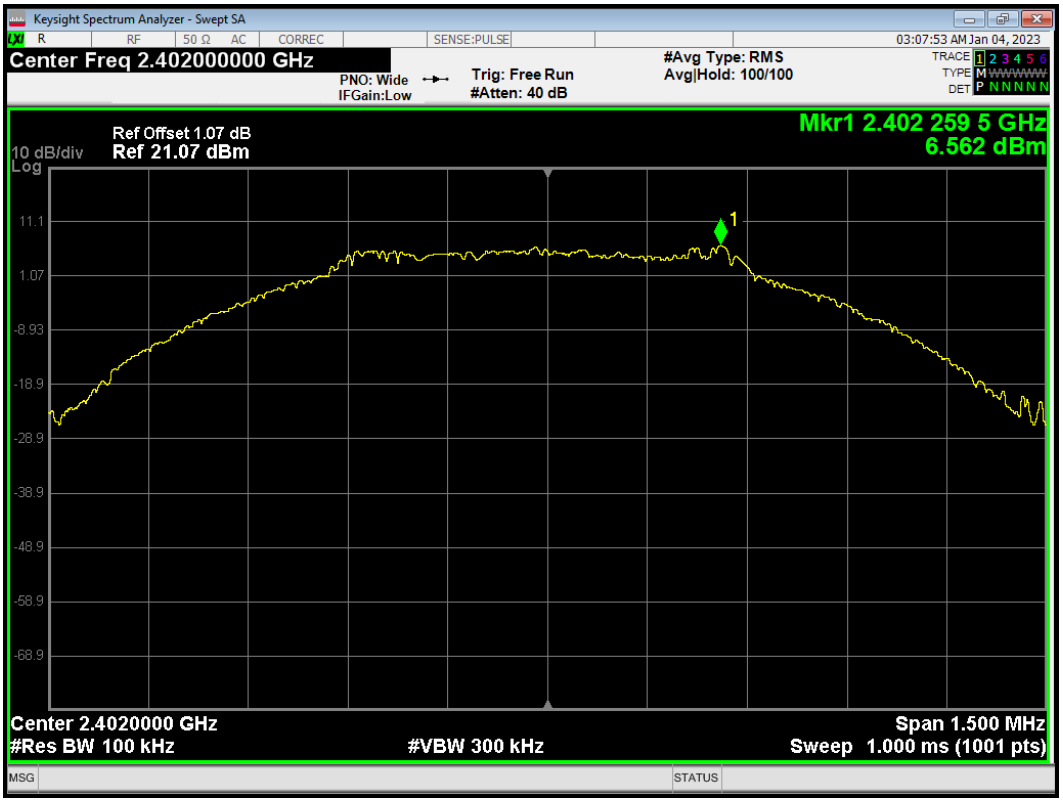


Tx. Spurious 802.11n(HT40) 2452MHz Emission

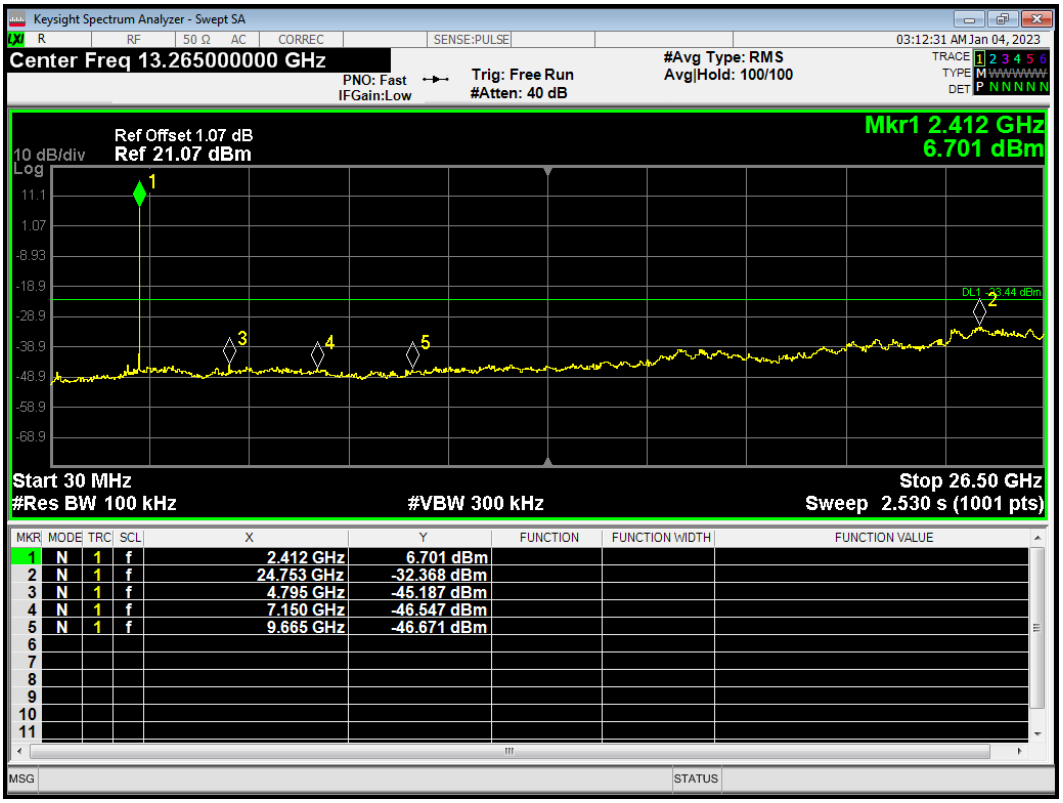


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.465 GHz	-1.798 dBm			
2	N	1	f	24.065 GHz	-33.419 dBm			
3	N	1	f	4.848 GHz	-46.502 dBm			
4	N	1	f	7.415 GHz	-47.704 dBm			
5	N	1	f	9.877 GHz	-47.308 dBm			
6								
7								
8								
9								
10								
11								

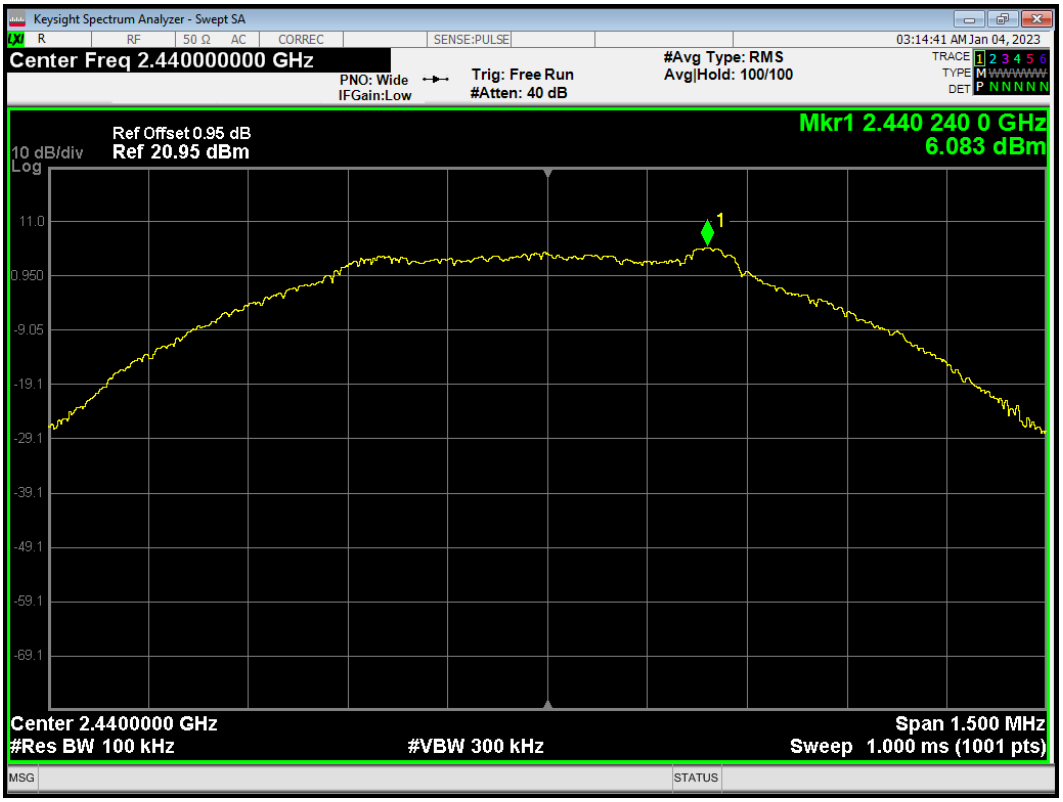
Tx. Spurious BLE 2402MHz Ref



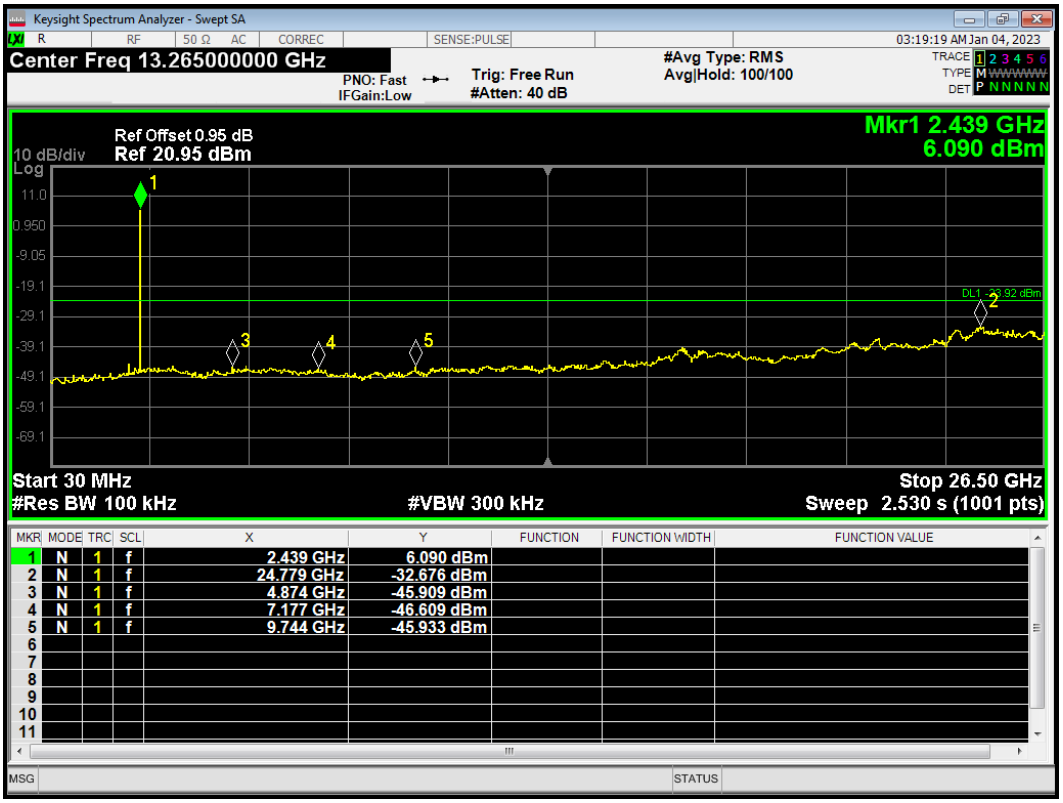
Tx. Spurious BLE 2402MHz Emission



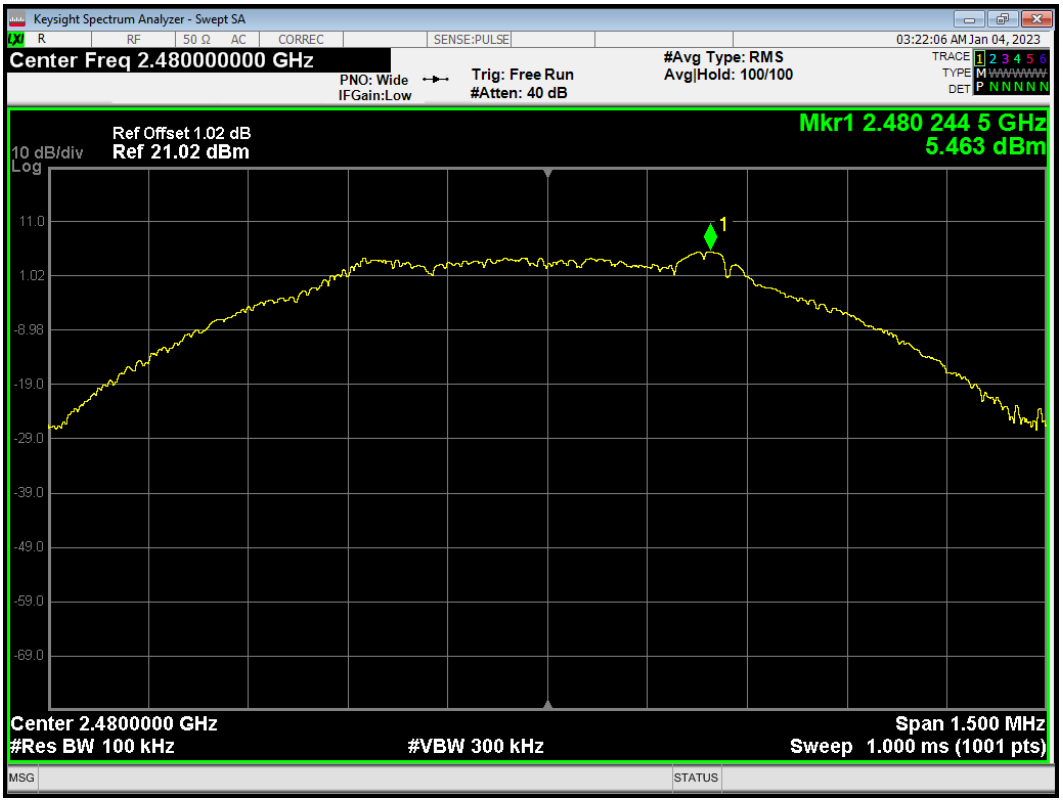
Tx. Spurious BLE 2440MHz Ref



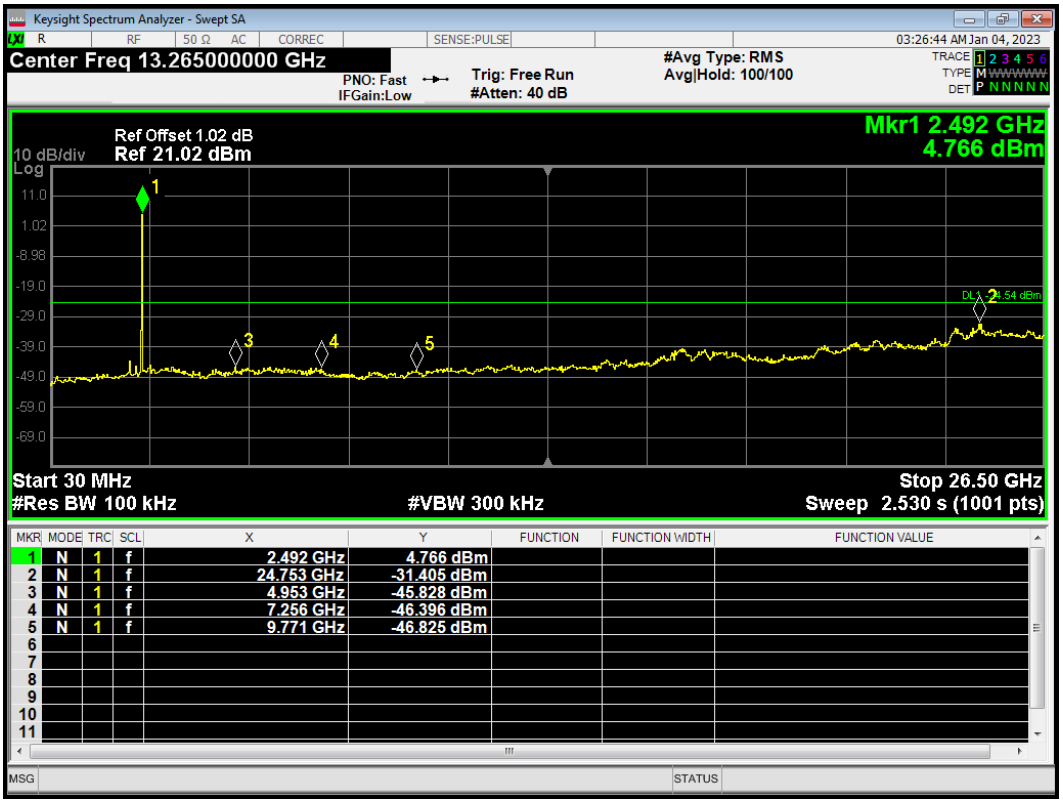
Tx. Spurious BLE 2440MHz Emission



Tx. Spurious BLE 2480MHz Ref



Tx. Spurious BLE 2480MHz Emission



5.6. Unwanted Emission

Ambient Condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	102.5kPa

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10.
The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.

The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna.The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing. Sweep the Restricted Band and the emissions less than 20 dB below the permissible value are reported.
The radiated emissions measurements were made in a typical installation configuration.
Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

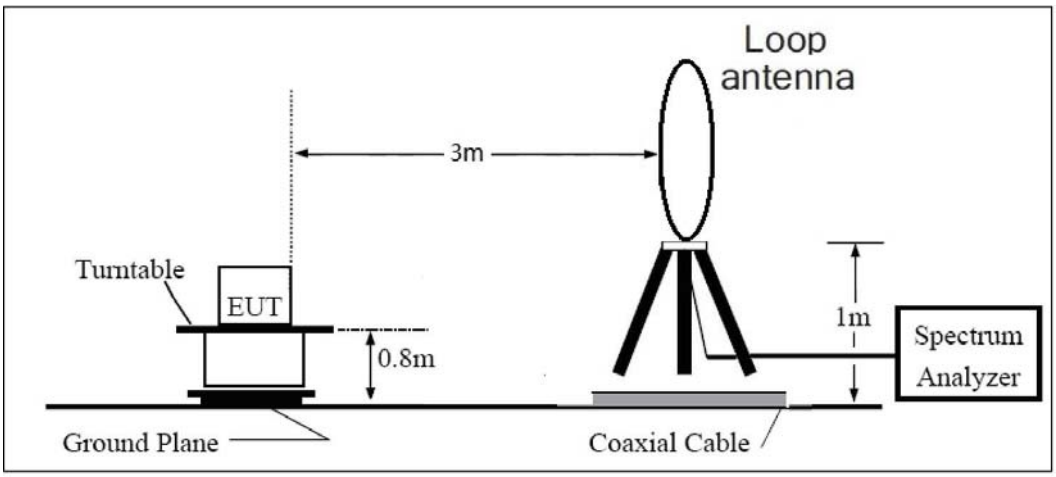
This method refer to ANSI C63.10.
The procedure for peak unwanted emissions measurements above 1000 MHz is as follows:
Set the spectrum analyzer in the following:
9kHz~150 kHz
RBW=200Hz, VBW=1kHz/ Sweep=AUTO
150 kHz~30MHz
RBW=9KHz, VBW=30KHz,/ Sweep=AUTO
Below 1GHz
RBW=100kHz / VBW=300kHz / Sweep=AUTO
a) Peak emission levels are measured by setting the instrument as follows:
Above 1GHz
PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO
b) Average emission levels are measured by setting the instrument as follows:
Above 1GHz
AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO
c) Detector: The measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage

averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

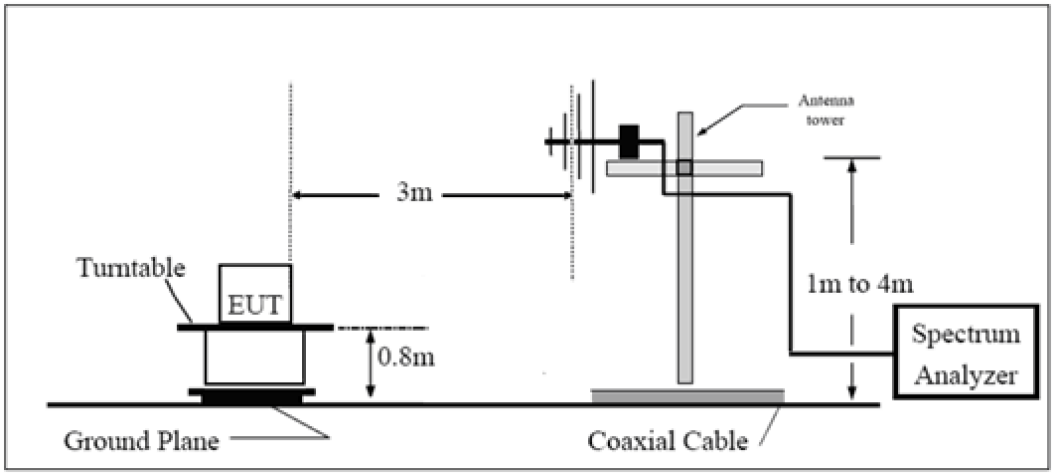
The test is in transmitting mode.

Test Setup

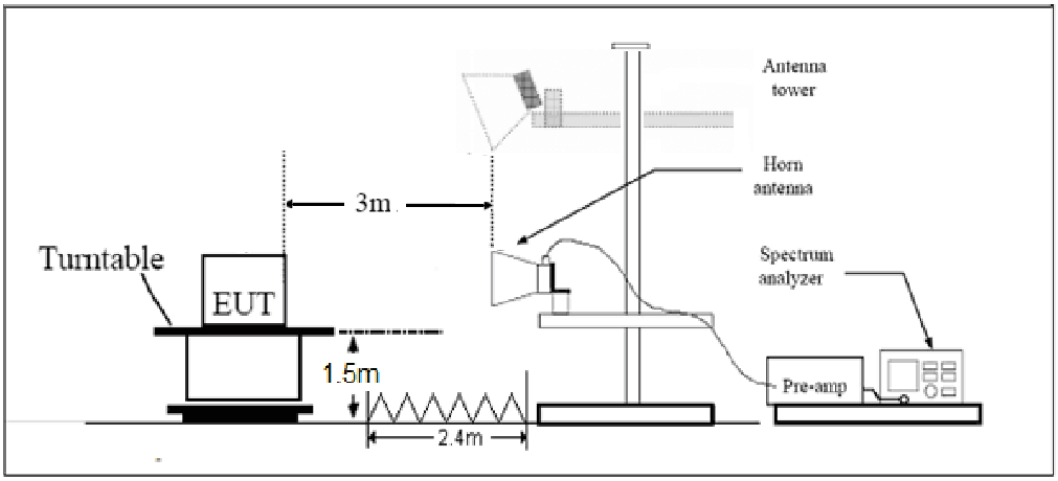
9KHz~ 30MHz



30MHz~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

Rule Part 15.247(d) specifies that “In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).”

Limit in restricted band

Frequency of emission (MHz)	Field strength(μV/m)	Field strength(dBμV/m)
0.009–0.490	2400/F(kHz)	/
0.490–1.705	24000/F(kHz)	/
1.705–30.0	30	/
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

§15.35(b)

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

Peak Limit=74 dBμV/m

Average Limit=54 dBμV/m

Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1] 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

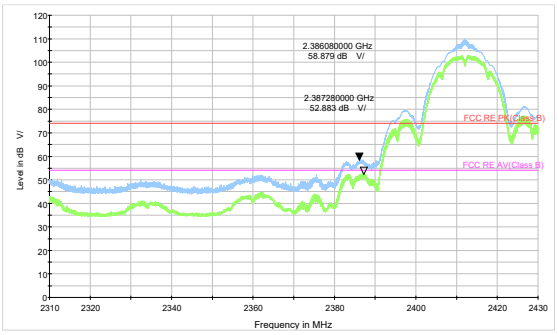
Measurement Uncertainty

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

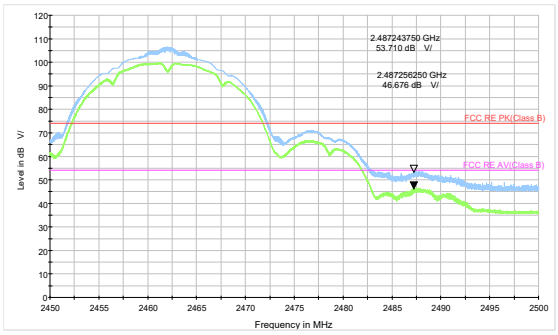
Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.17 dB
200MHz-1GHz	4.84 dB
1-18GHz	4.35 dB
18-26.5GHz	5.90 dB
26.5GHz~40GHz	5.92 dB

Test Results:

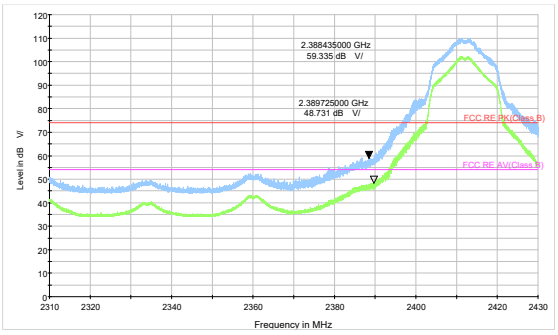
A symbol (dB V/) in the test plot below means (dBμV/m)



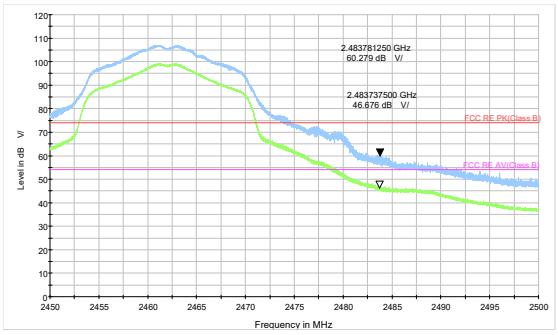
802.11b-Channel 1 Peak+ Average



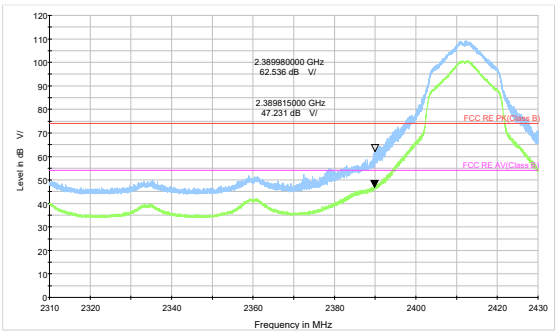
802.11b-Channel 11 Peak+ Average



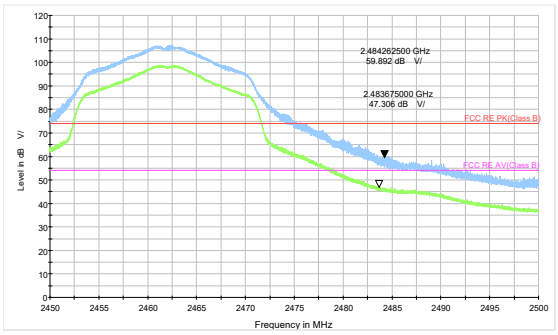
802.11g-Channel 1 Peak+ Average



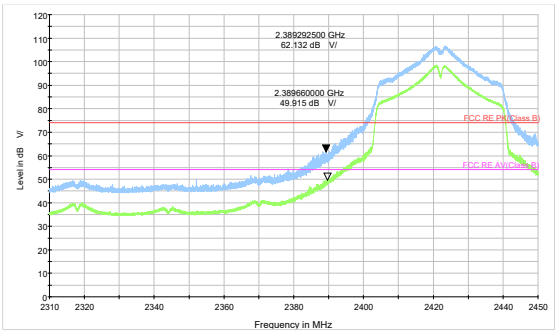
802.11g-Channel 11 Peak+ Average



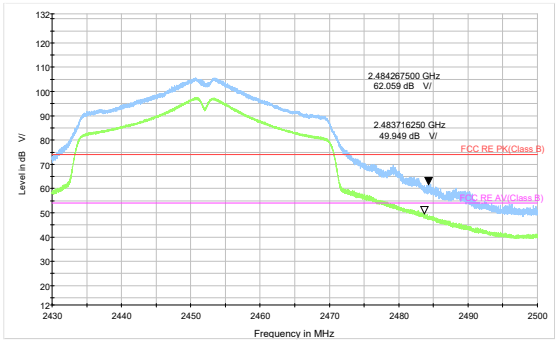
802.11n HT20 -Channel 1 Peak+ Average



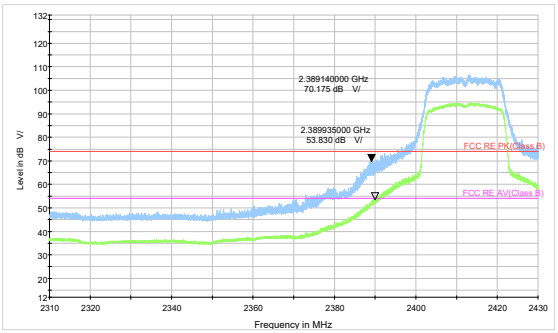
802.11n HT20 -Channel 11 Peak+ Average



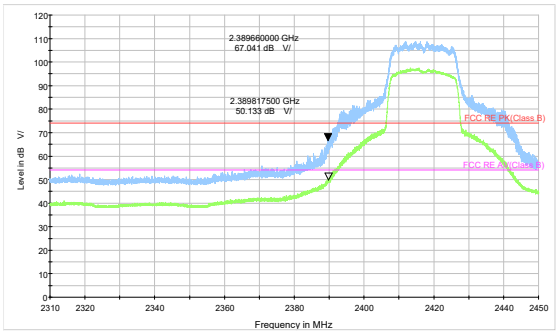
802.11n HT40 –Channel 3 Peak+ Average



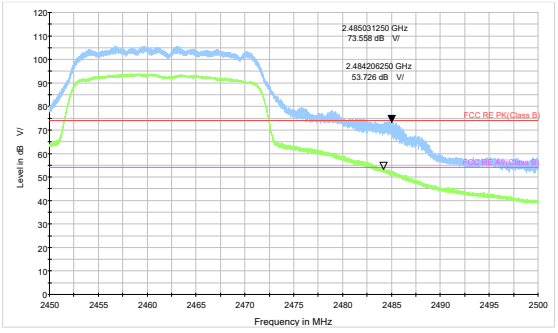
802.11n HT40 –Channel 9 Peak+ Average



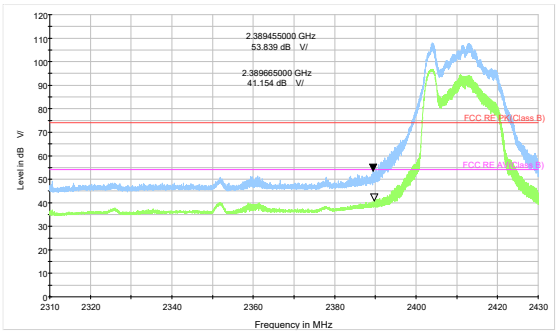
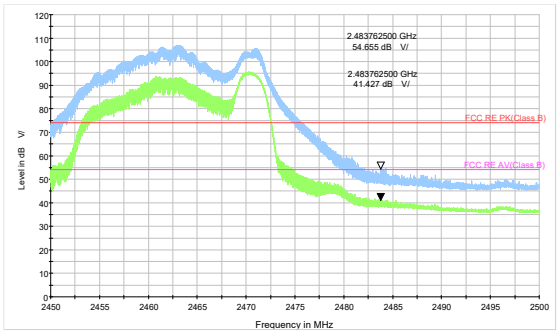
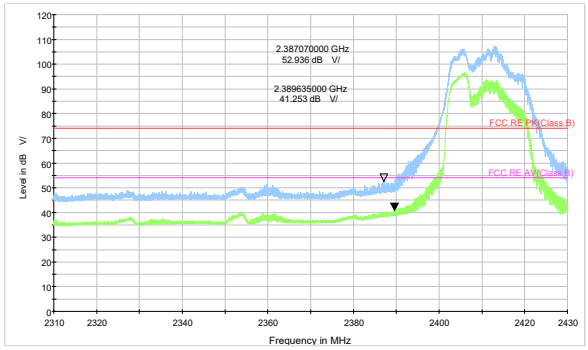
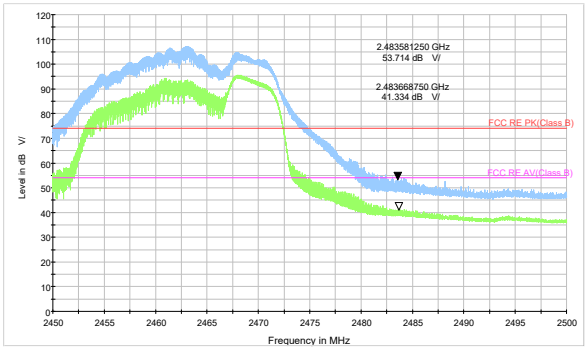
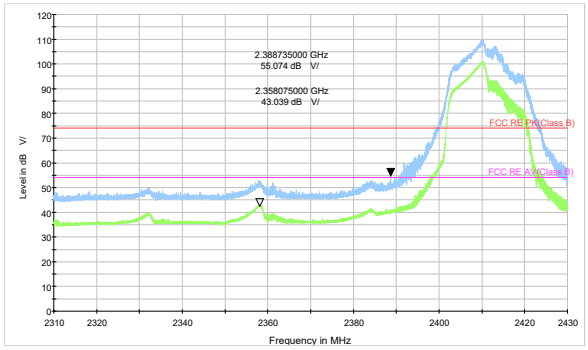
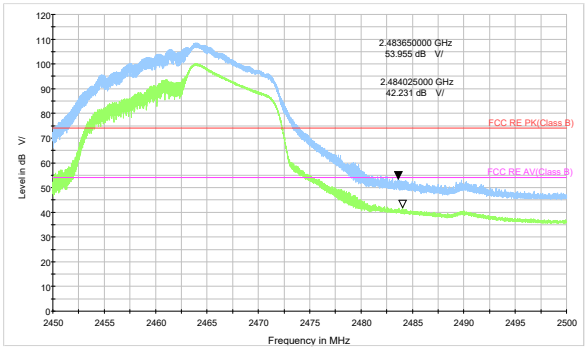
802.11ax HE20-Channel 1 Peak+ Average

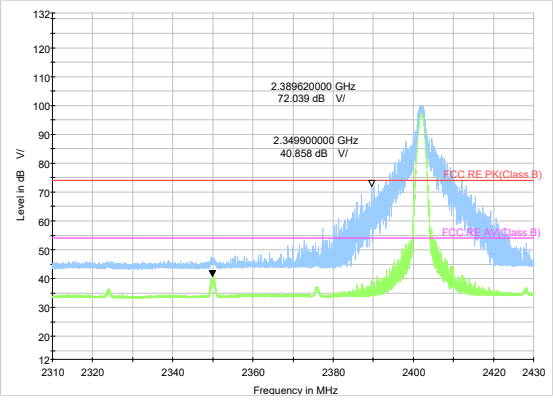


802.11ax HE20-Channel 2 Peak+ Average

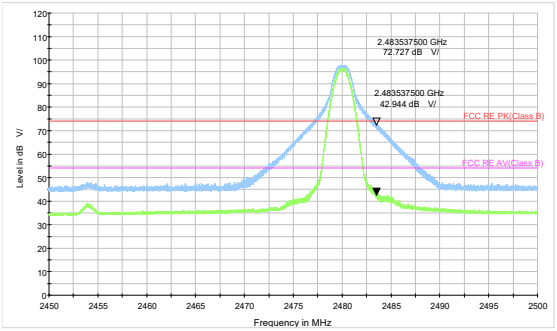


802.11ax HE20-Channel 11 Peak+ Average

	
26-Tones 802.11ax HE20-Channel 1 Peak+ Average	26-Tones 802.11ax HE20-Channel 11 Peak+ Average
	
52-Tones 802.11ax HE20-Channel 1 Peak+ Average	52-Tones 802.11ax HE20-Channel 11 Peak+ Average
	
106-Tones 802.11ax HE20-Channel 1 Peak+ Average	106-Tones 802.11ax HE20-Channel 11 Peak+ Average



Bluetooth LE (1M) Channel 0 Peak+ Average



Bluetooth LE (1M) Channel 39 Peak+Average

Result of RE

Test result

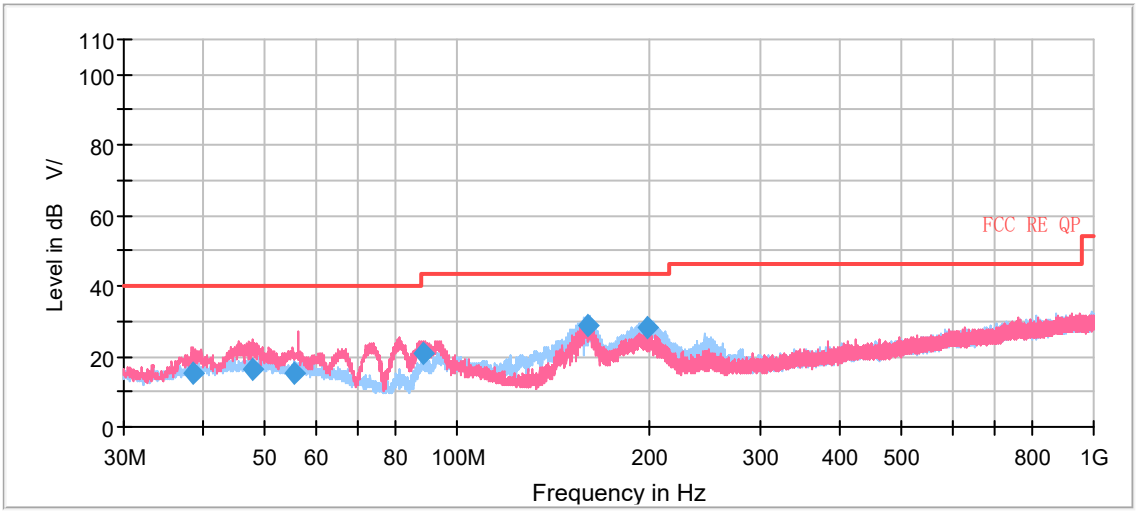
Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, the Emissions in the frequency band 9kHz-30MHz and 18GHz-26.5GHz are more than 20dB below the limit are not reported.

The following graphs display the maximum values of horizontal and vertical by software.
For above 1GHz, Blue trace uses the peak detection, Green trace uses the average detection.

Continuous TX mode:

Wi-Fi 2.4G

During the test, the Radiates Emission from 30MHz to 1GHz was performed in all modes with all channels, 26-Tones 802.11ax (HE20) CH6 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.
A symbol (dB V/) in the test plot below means (dBμV/m)



Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
38.530000	15.39	40.00	24.61	100.0	V	134.0	19.0
47.935667	16.31	40.00	23.69	110.0	V	192.0	20.5
55.751667	15.42	40.00	24.58	100.0	V	260.0	20.0
88.374333	21.06	43.50	22.44	110.0	V	221.0	15.7
160.801000	28.69	43.50	14.81	185.0	H	107.0	15.1
199.598667	27.97	43.50	15.53	109.0	H	103.0	17.9

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)
2. Margin = Limit – Quasi-Peak