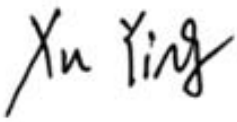
RF TEST REPORT

Applicant	Quectel Wireless Solutions Co., Ltd.
FCC ID	XMR2023FCS945R
Product	Wi-Fi & Bluetooth Module
Brand	Quectel
Model	FCS945R
Report No.	R2306A0636-R1
Issue Date	August 7, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.



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Approved by: Xu Kai

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TABLE OF CONTENT

Summary of Measurement Results

Number	Test Case	Clause in FCC rules	Verdict
1	Maximum output power	15.247(b)(3)	PASS
2	99% Bandwidth and 6dB Bandwidth	15.247(a)(2) C63.10 6.9	PASS
3	Power spectral density	15.247(e)	PASS
4	Band Edge	15.247(d)	PASS
5	Spurious RF Conducted Emissions	15.247(d)	PASS
6	Unwanted Emissions	15.247(d),15.205,15.209	PASS
7	Conducted Emissions	15.207	PASS
Date of Testing: June 26, 2023 ~ July 25, 2023 Date of Sample Received: June 15, 2023			
Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

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

2.2. General Information

EUT Description	
Model	FCS945R
SN	E1M23DR04000183
Hardware Version	R1.0
Software Version	NA
Power Supply	External power supply
Antenna Type	External Antenna
Antenna Connector	SMA Male (Center Pin)
Additional Beamforming Gain	NA
Operating Frequency Range(s)	802.11b/g/n(HT20): 2412 ~ 2462 MHz 802.11n(HT40): 2422 ~ 2452 MHz Bluetooth LE V5.2: 2402 ~2480 MHz
Modulation Type	802.11b: DSSS 802.11g/n: OFDM Bluetooth LE: GFSK
Max. Output Power	Wi-Fi 2.4G: 19.66 dBm Bluetooth LE: 5.48 dBm
Auxiliary test equipment	
Antenna	Manufacturer: Quectel Wireless Solutions Co., Ltd. Model: YE0038AA Antenna Gain: 0.52 dBi
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.

The test software is used Command Prompt.

Worst-case data rates are shown as following table.

Test Mode	Data Rate
Bluetooth (Low Energy)	1Mbps; 2Mbps; S=2; S=8
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

5. Test Case Results

5.1. Maximum output power

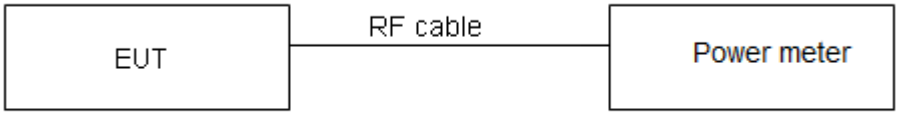
Ambient Condition

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

Methods of Measurement

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

Test Setup



Limits

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

Average Output Power	≤ 1W (30dBm)

Measurement Uncertainty

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

Test Results

Power Index					
Channel	**802.11b**	**802.11g**	**802.11n HT20**	**Channel**	**802.11n HT40**
CH1	18	15	13	**CH3**	10
CH2	/	18	17	**CH4**	11
CH6	18	18	17	**CH5**	14
CH9	/	18	/	**CH6**	14
CH10	/	17	17	**CH7**	12
CH11	18	13	13	**CH8**	11
/	/	/	/	**CH9**	10

Power Index				
Channel	**Bluetooth LE (1M)**	**Bluetooth LE (2M)**	**Bluetooth LE (S=2)**	**Bluetooth LE (S=8)**
CH0	0x52	0x52	0X4F	0X4E
CH19	0x53	0x53	0X4F	0X4F
CH39	0x55	0x54	0X51	0x50

Test Mode	Duty cycle	Duty cycle correction Factor (dB)
802.11b	1.000	0.000
802.11g	0.801	0.960
802.11n HT20	0.791	1.020
802.11n HT40	0.649	1.880
Bluetooth LE (1M)	0.855	0.680
Bluetooth LE (2M)	0.577	2.390
Bluetooth LE (S=2)	0.913	0.400
Bluetooth LE (S=8)	0.975	0.110
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/CH1	19.17	19.17	30	PASS
	2437/CH6	19.16	19.16	30	PASS
	2462/CH11	19.29	19.29	30	PASS
802.11g	2412/CH1	16.08	17.04	30	PASS
	2417/CH2	18.70	19.66	30	PASS
	2437/CH6	18.61	19.57	30	PASS
	2452/CH9	18.70	19.66	30	PASS
	2457/CH10	17.94	18.90	30	PASS
	2462/CH11	14.29	15.25	30	PASS
802.11n HT20	2412/CH1	13.70	14.72	30	PASS
	2417/CH2	17.27	18.29	30	PASS
	2437/CH6	17.03	18.05	30	PASS
	2457/CH10	17.71	18.73	30	PASS
	2462/CH11	13.99	15.01	30	PASS
802.11n HT40	2422/CH3	10.29	12.17	30	PASS
	2427/CH4	11.01	12.89	30	PASS
	2432/CH5	13.54	15.42	30	PASS
	2437/CH6	13.36	15.24	30	PASS
	2442/CH7	11.55	13.43	30	PASS
	2447/CH8	11.06	12.94	30	PASS
	2452/CH9	10.31	12.19	30	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	4.35	5.03	30	PASS
	2440/CH19	4.26	4.94	30	PASS
	2480/CH39	4.39	5.07	30	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	2.81	5.20	30	PASS
	2440/CH19	2.70	5.09	30	PASS
	2480/CH39	2.67	5.06	30	PASS
Bluetooth (Low Energy) (S=2)	2402/CH0	5.08	5.48	30	PASS
	2440/CH19	4.66	5.06	30	PASS
	2480/CH39	4.67	5.07	30	PASS
Bluetooth (Low Energy) (S=8)	2402/CH0	4.93	5.04	30	PASS
	2440/CH19	4.95	5.06	30	PASS
	2480/CH39	4.92	5.03	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

5.2. 99% Bandwidth and 6dB Bandwidth

Ambient Condition

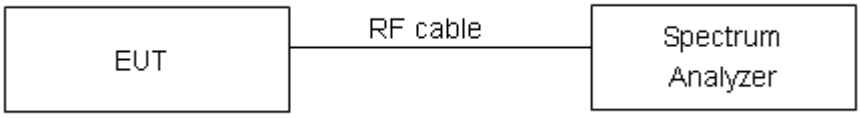
Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Method of Measurement

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

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

Test Setup



Limits

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

minimum 6 dB bandwidth	≥ 500 kHz

Measurement Uncertainty

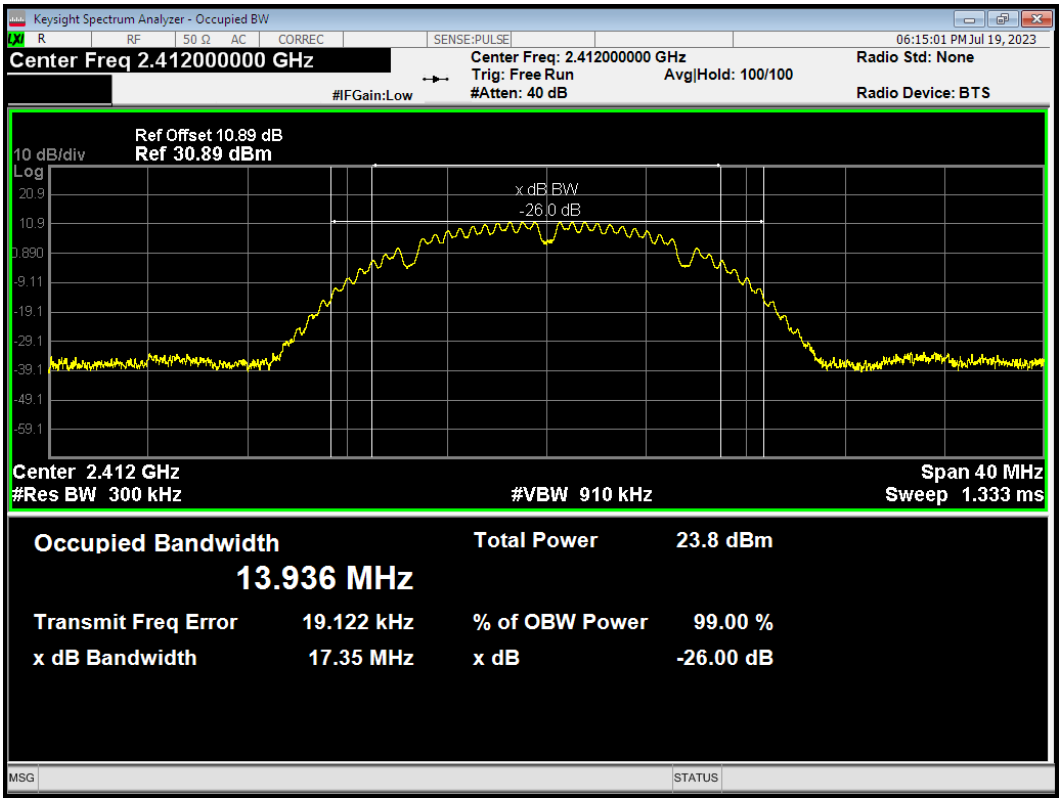
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936 Hz.

Test Results:

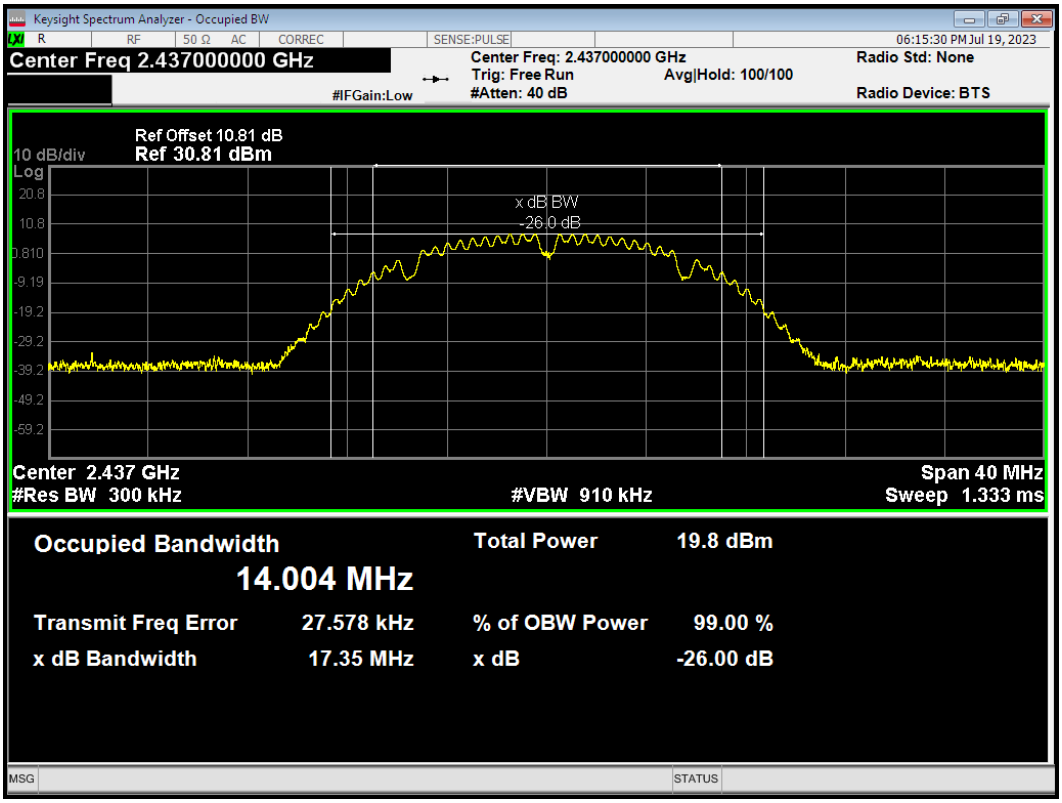
Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412/CH1	13.936	9.092	500	PASS
	2437/CH6	14.004	9.061	500	PASS
	2462/CH11	14.011	9.126	500	PASS
802.11g	2412/CH1	16.270	12.760	500	PASS
	2417/CH2	16.296	13.414	500	PASS
	2437/CH6	16.302	15.106	500	PASS
	2452/CH9	16.303	14.743	500	PASS
	2457/CH10	16.306	15.056	500	PASS
	2462/CH11	16.283	15.048	500	PASS
802.11n HT20	2412/CH1	17.424	15.772	500	PASS
	2417/CH2	17.427	15.323	500	PASS
	2437/CH6	17.440	14.980	500	PASS
	2457/CH10	17.401	15.317	500	PASS
	2462/CH11	17.417	13.823	500	PASS
802.11n HT40	2422/CH3	35.335	30.061	500	PASS
	2427/CH4	35.320	28.834	500	PASS
	2432/CH5	35.294	30.123	500	PASS
	2437/CH6	35.307	27.516	500	PASS
	2442/CH7	35.304	32.583	500	PASS
	2447/CH8	35.372	26.250	500	PASS
	2452/CH9	35.363	30.079	500	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	1.028	0.662	500	PASS
	2440/CH19	1.032	0.689	500	PASS
	2480/CH39	1.032	0.653	500	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	2.048	1.105	500	PASS
	2440/CH19	2.067	1.109	500	PASS
	2480/CH39	2.045	1.116	500	PASS
Bluetooth (Low Energy) (S=2)	2402/CH0	1.023	0.699	500	PASS
	2440/CH19	1.014	0.656	500	PASS
	2480/CH39	1.022	0.659	500	PASS
Bluetooth (Low Energy) (S=8)	2402/CH0	1.051	0.603	500	PASS
	2440/CH19	1.048	0.591	500	PASS
	2480/CH39	1.046	0.595	500	PASS

99%bandwidth

OBW 802.11b 2412MHz



OBW 802.11b 2437MHz



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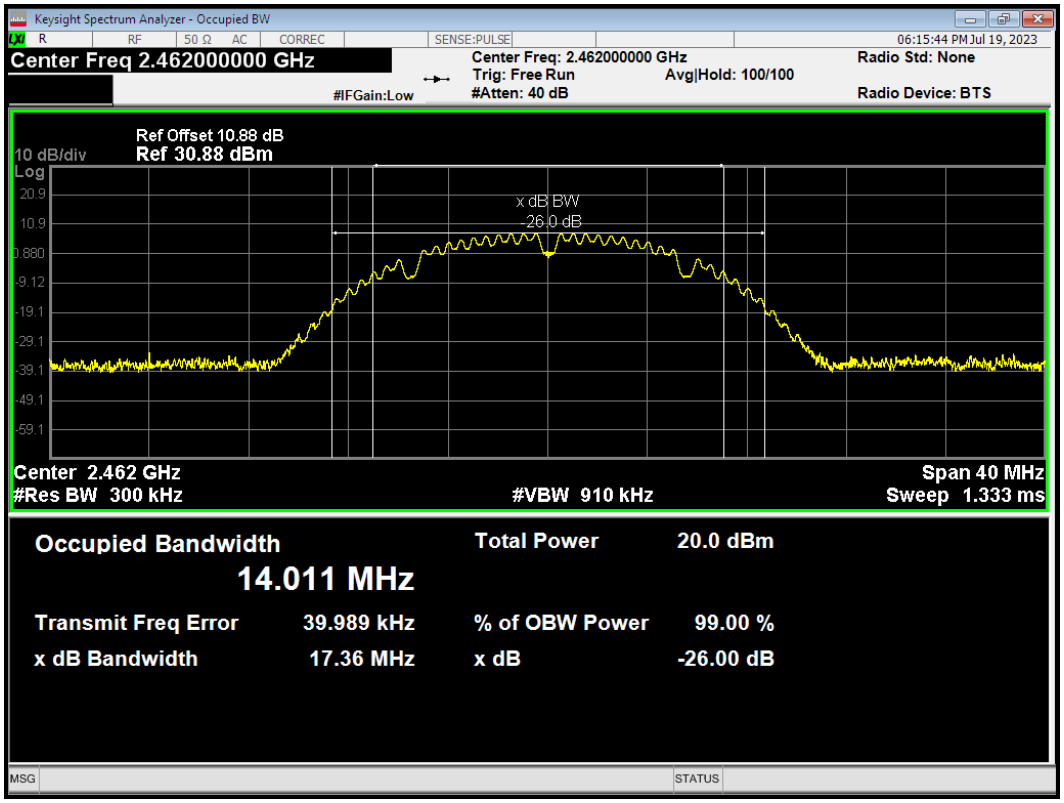
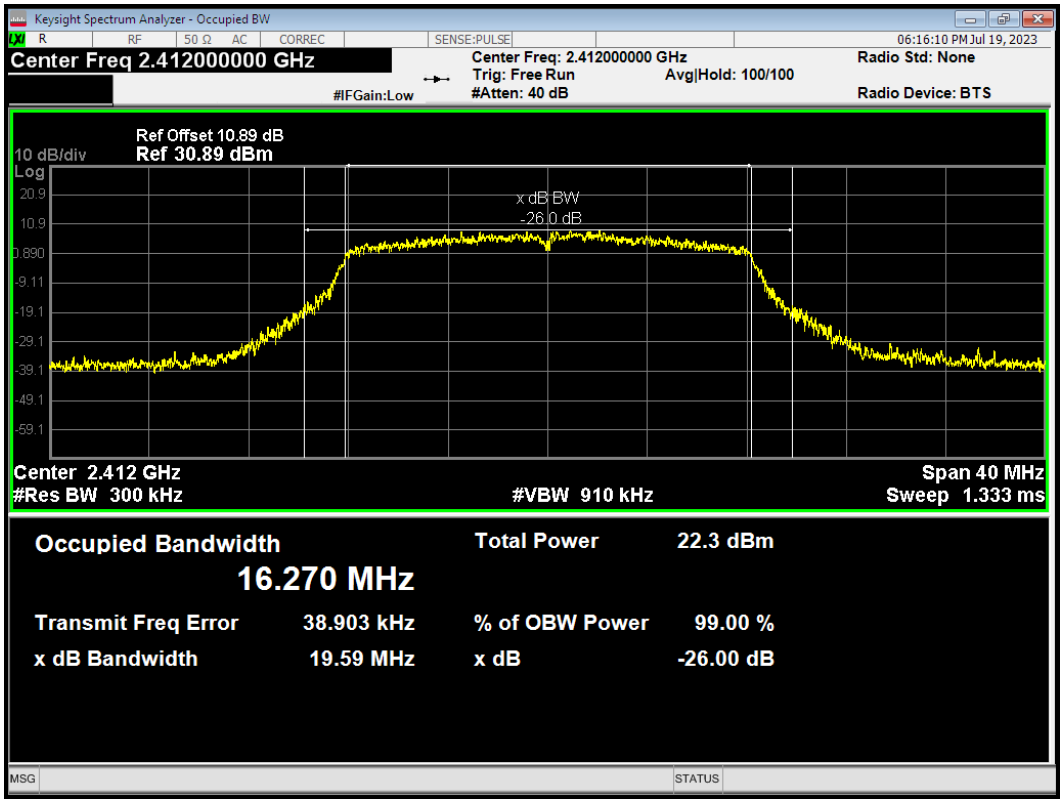


OBW 802.11g 2412MHz



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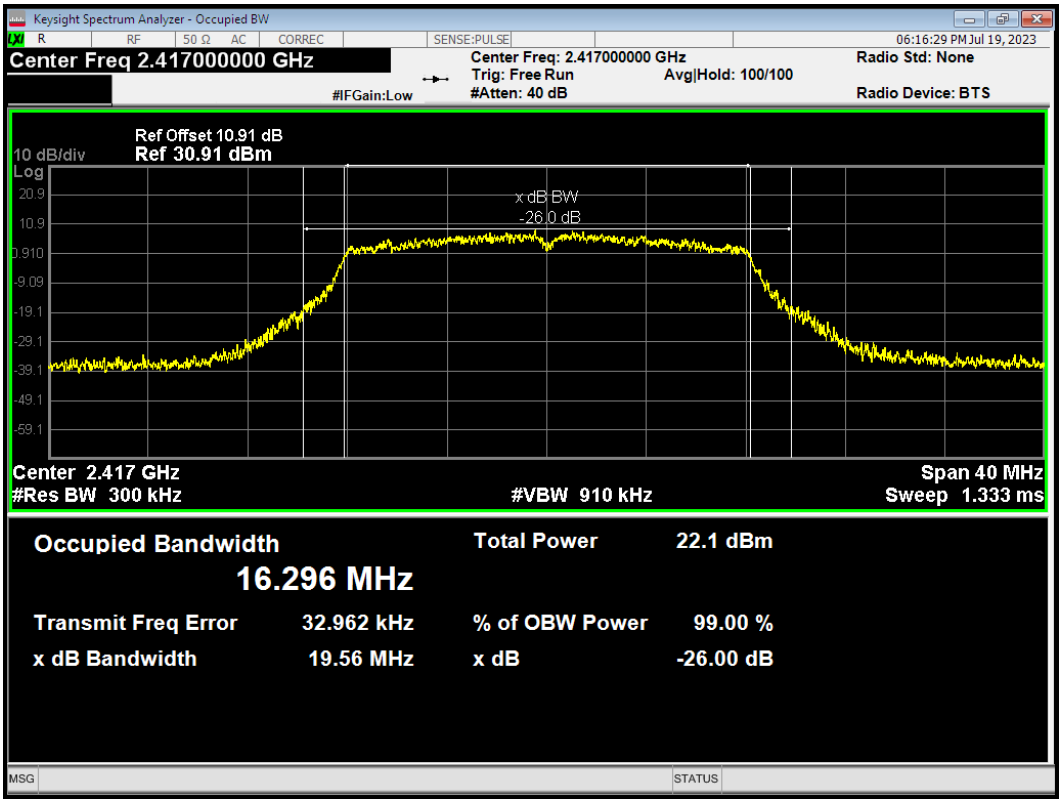

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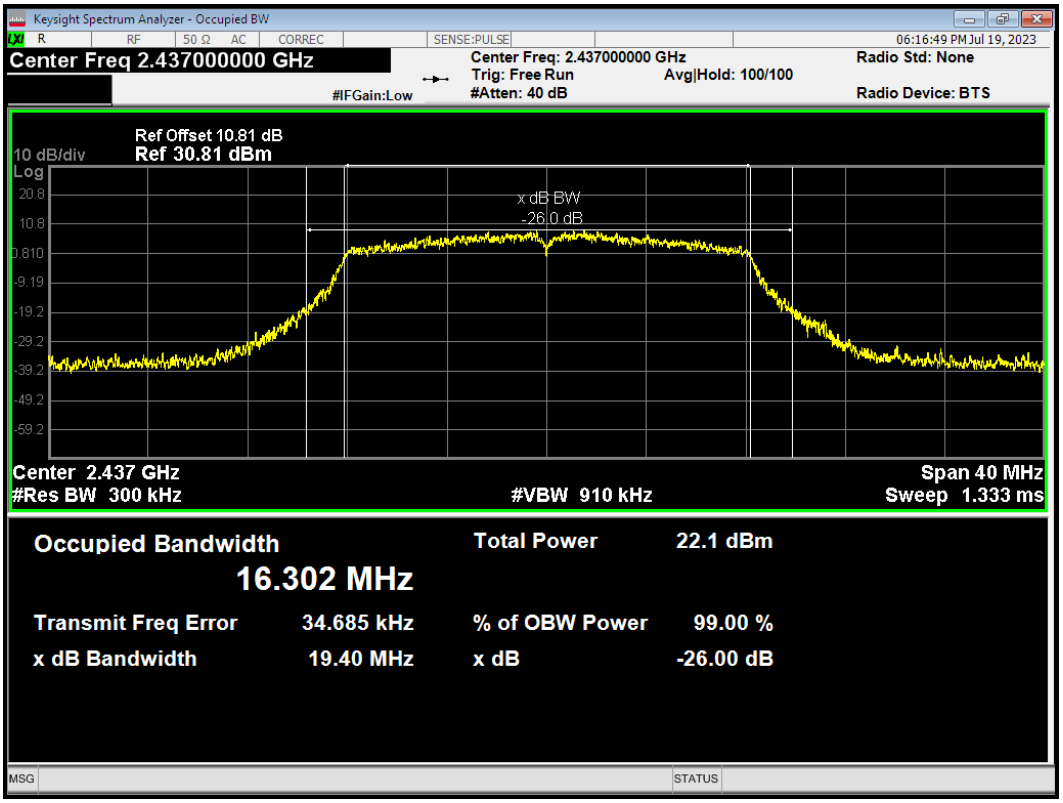

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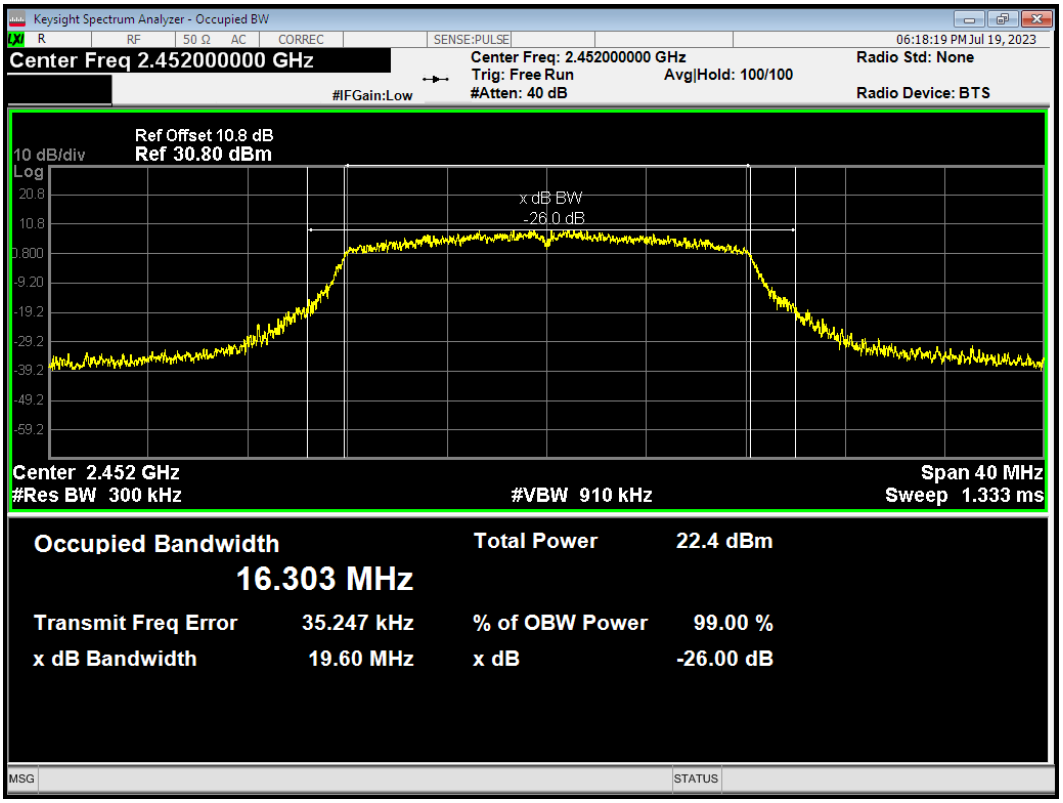

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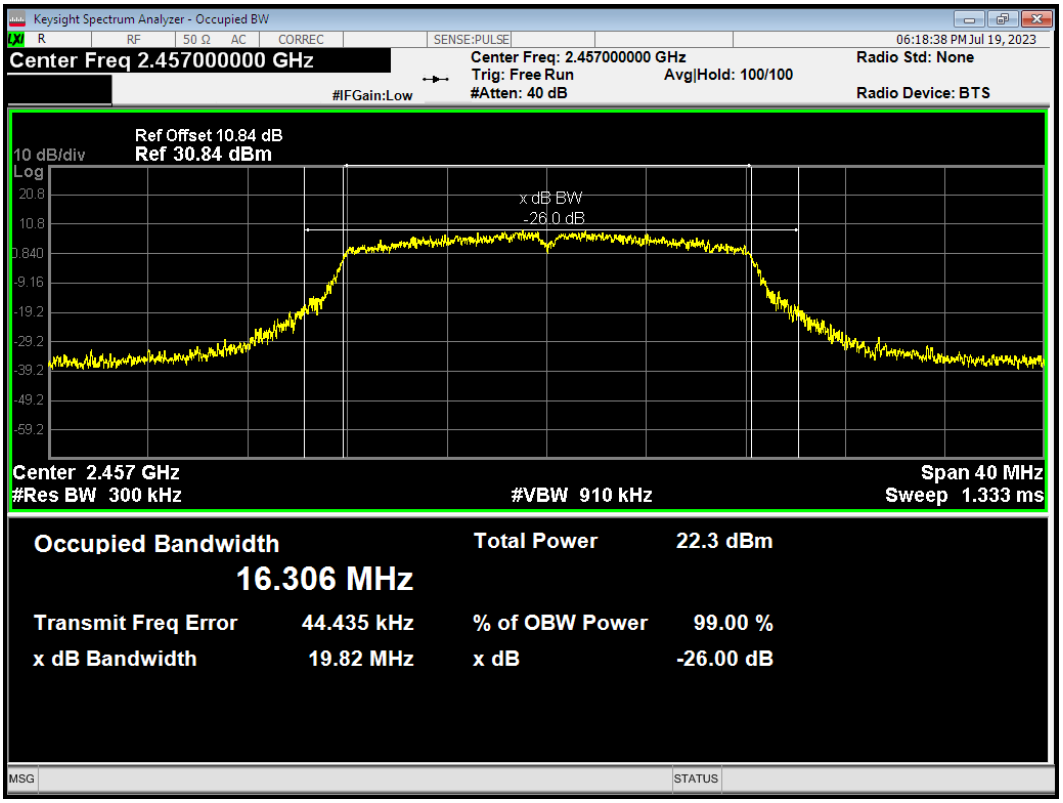

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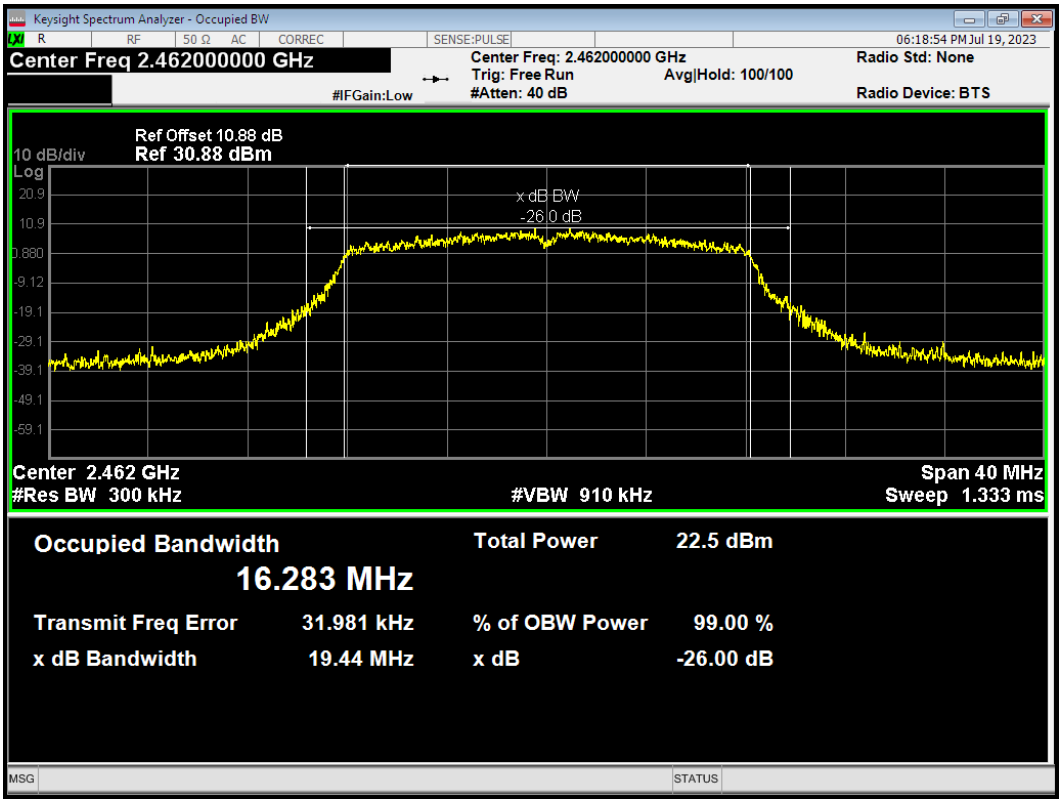
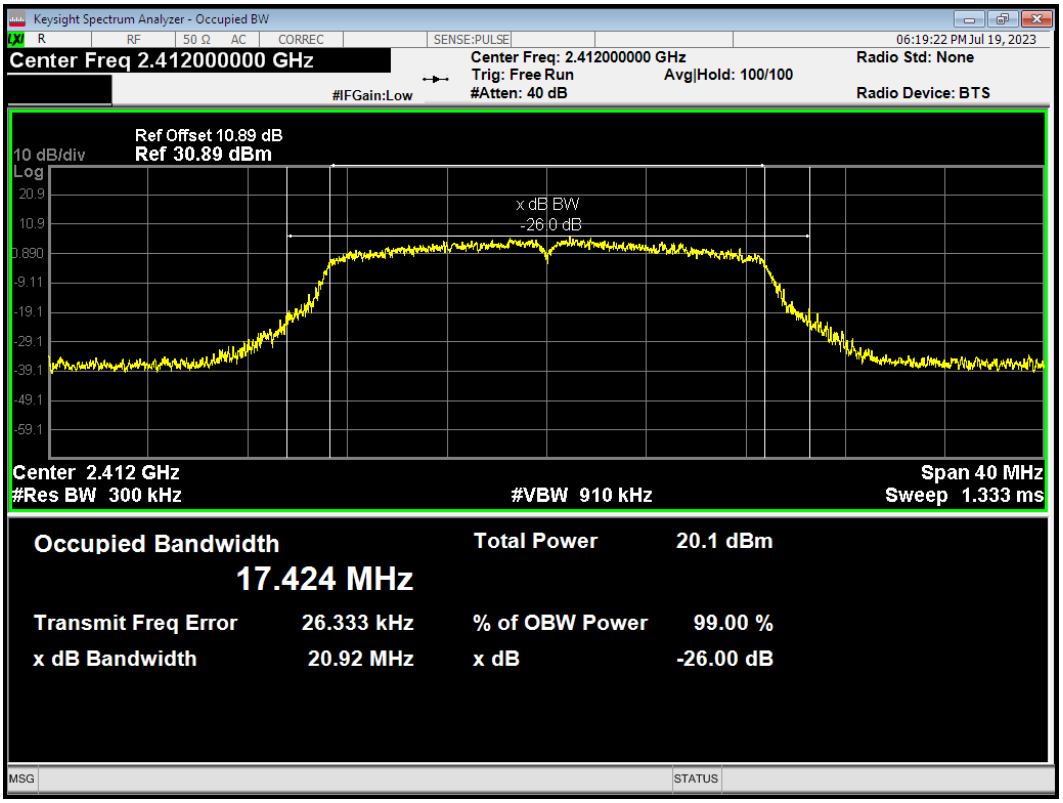
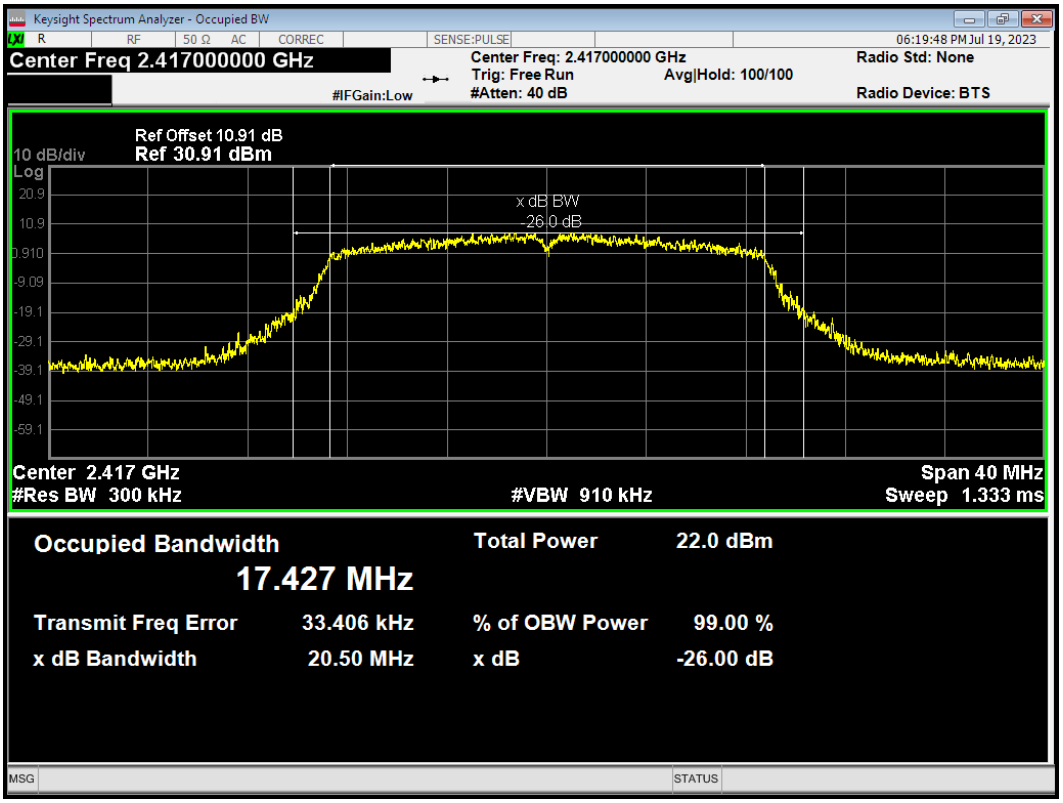


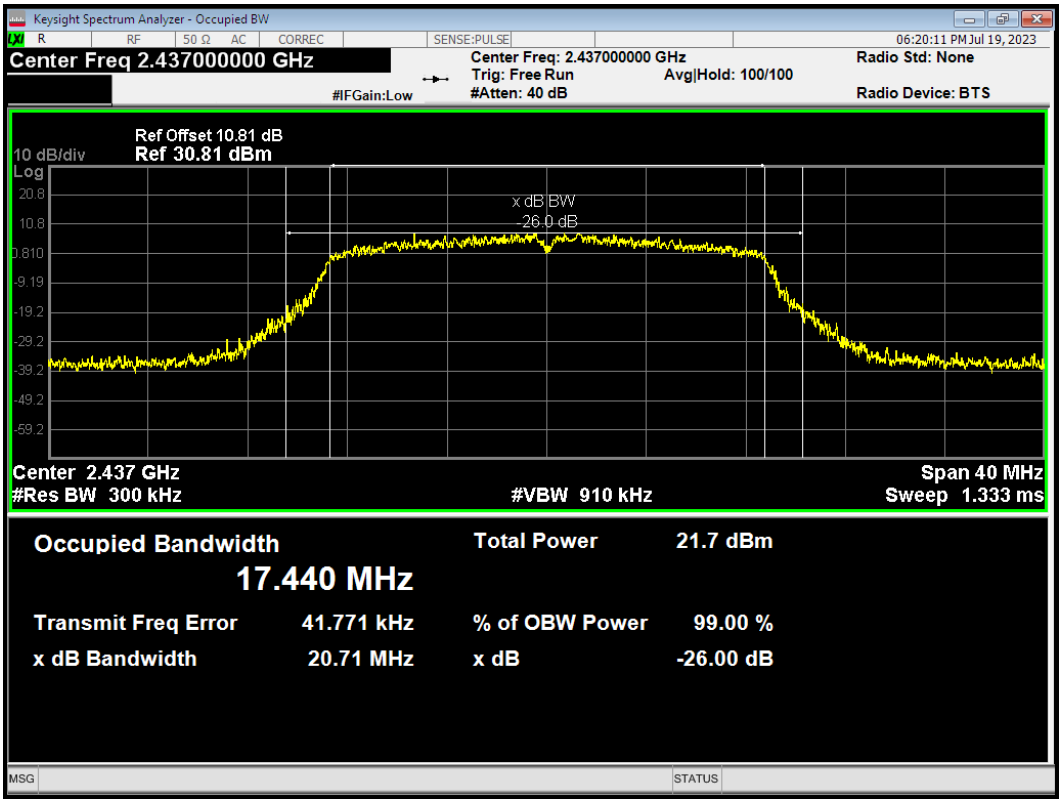
OBW 802.11n(HT20) 2412MHz



OBW 802.11n(HT20) 2417MHz



OBW 802.11n(HT20) 2437MHz



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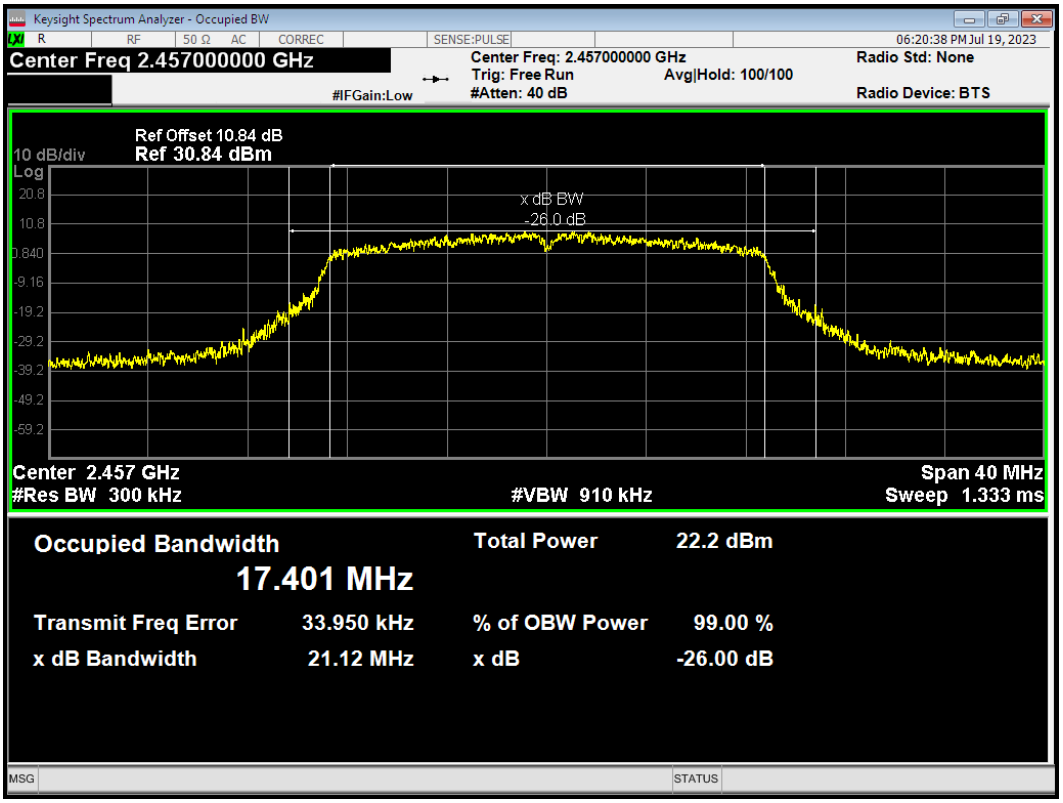

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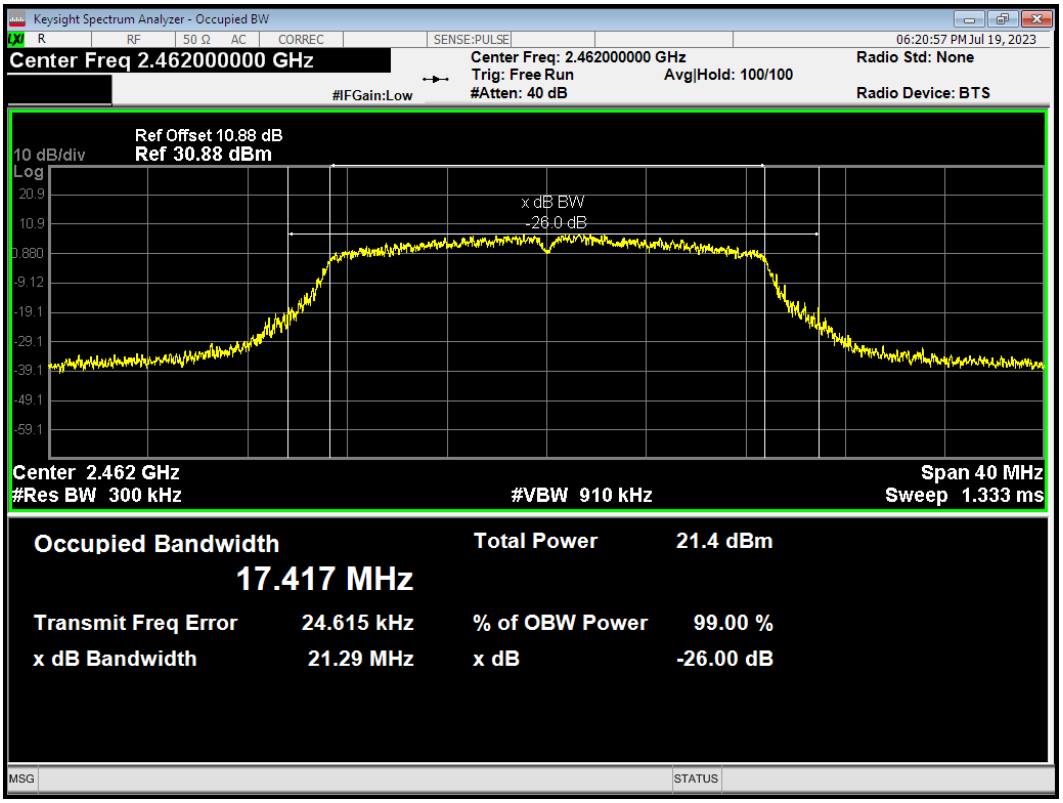

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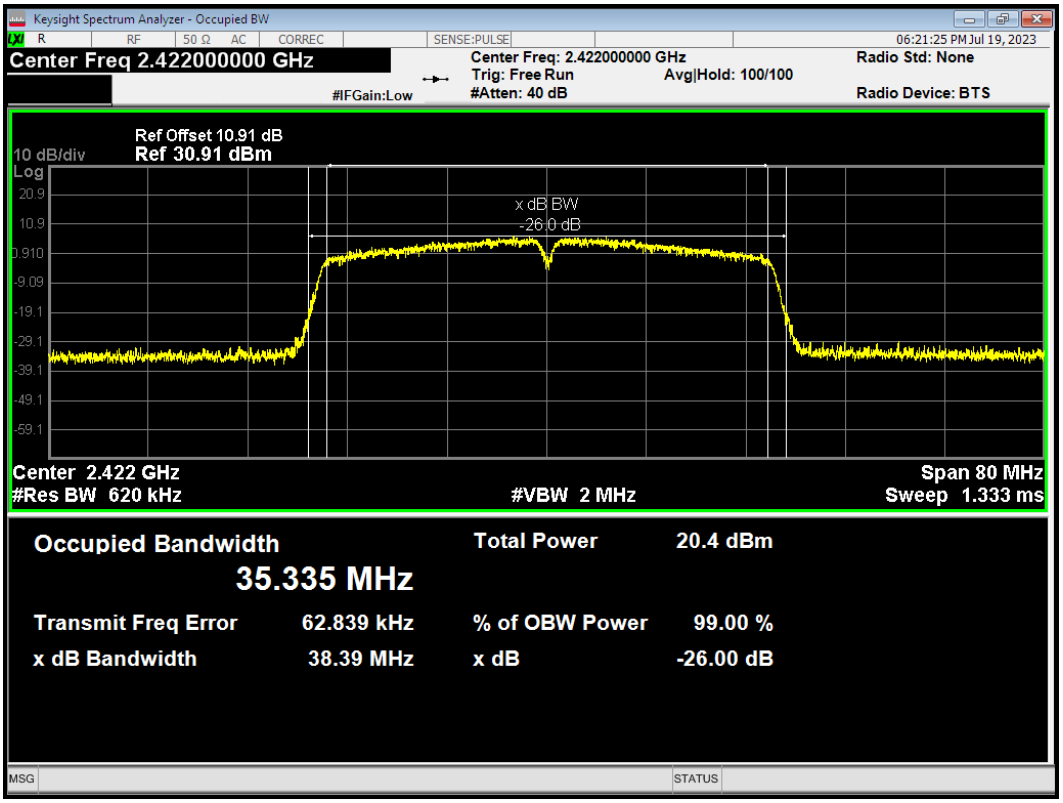

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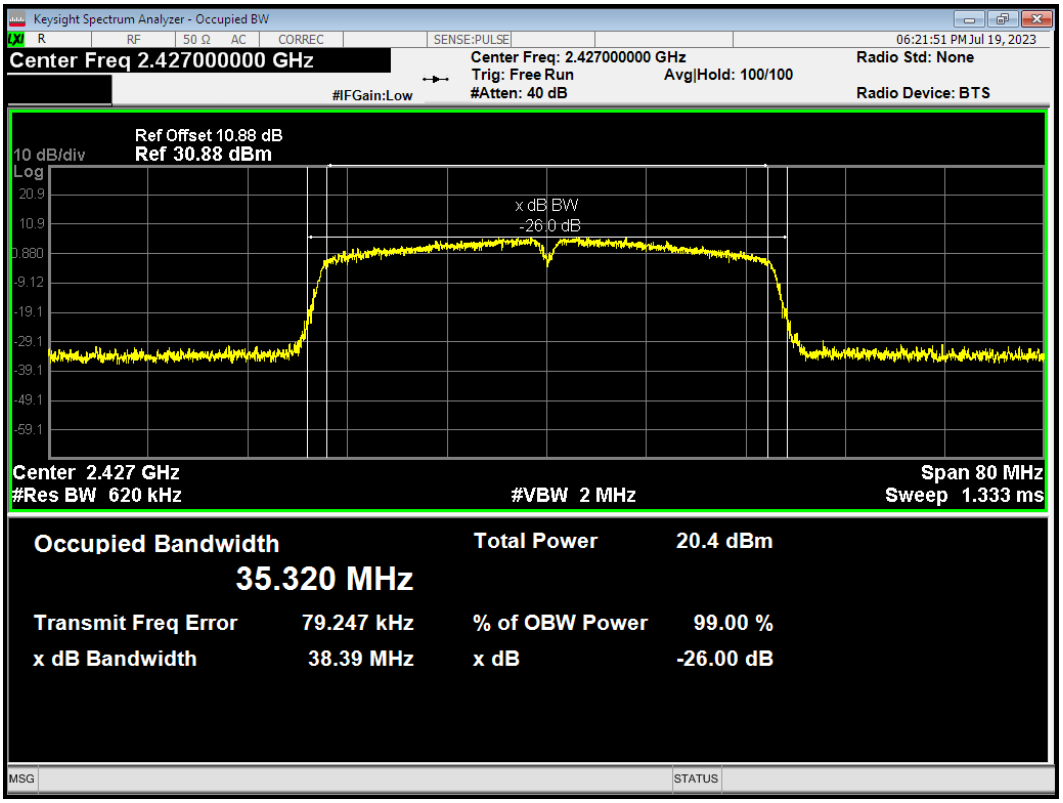

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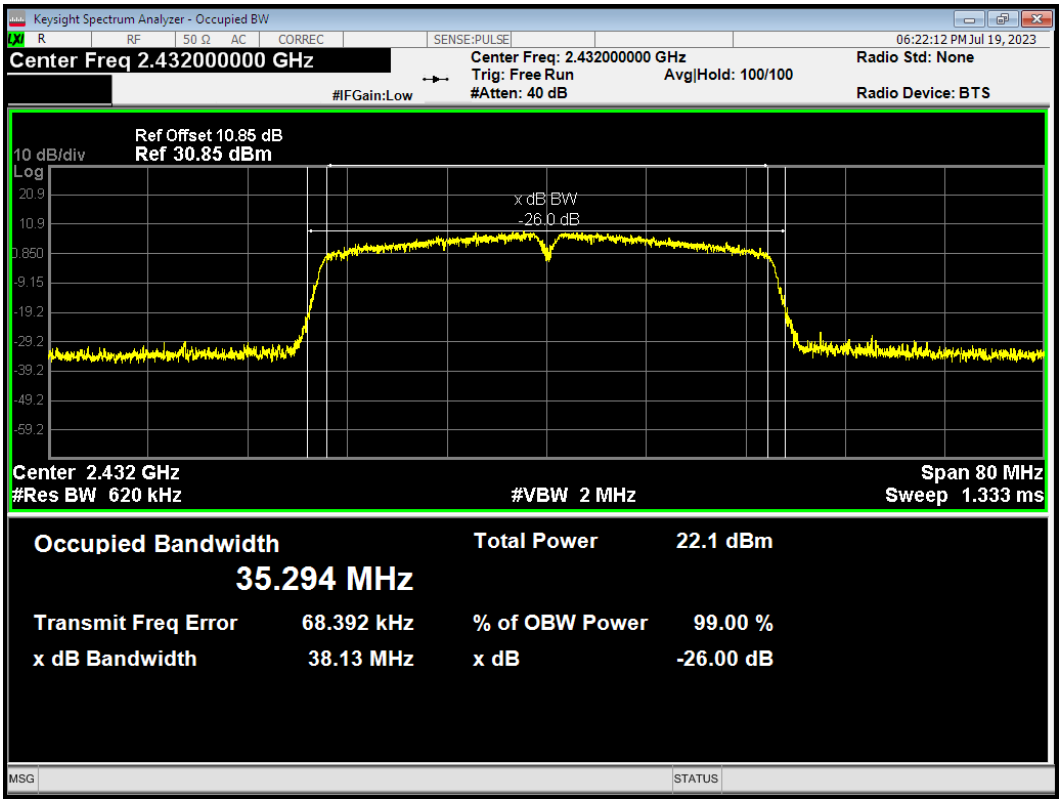

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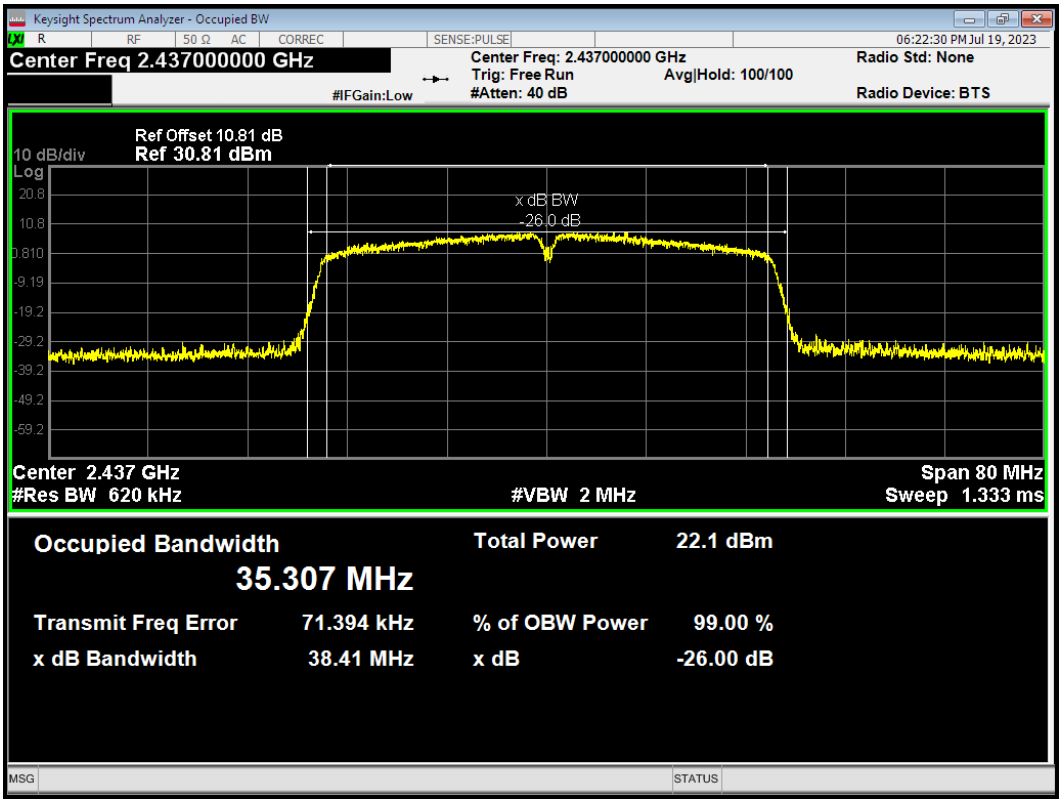

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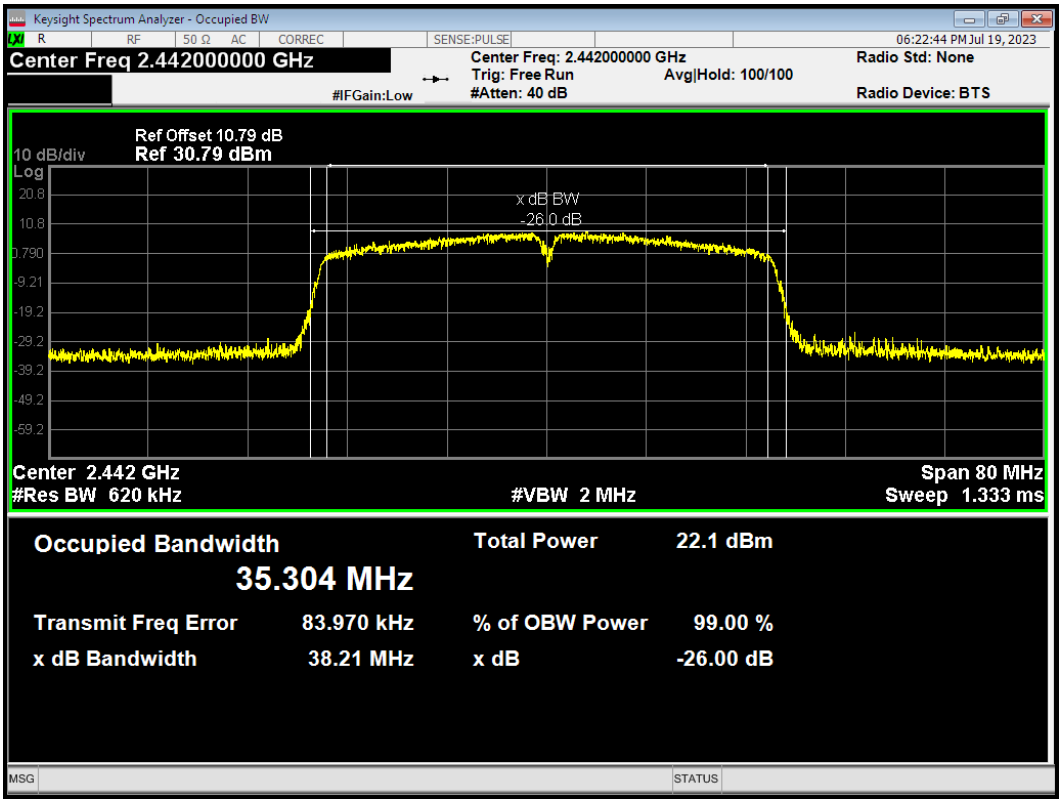
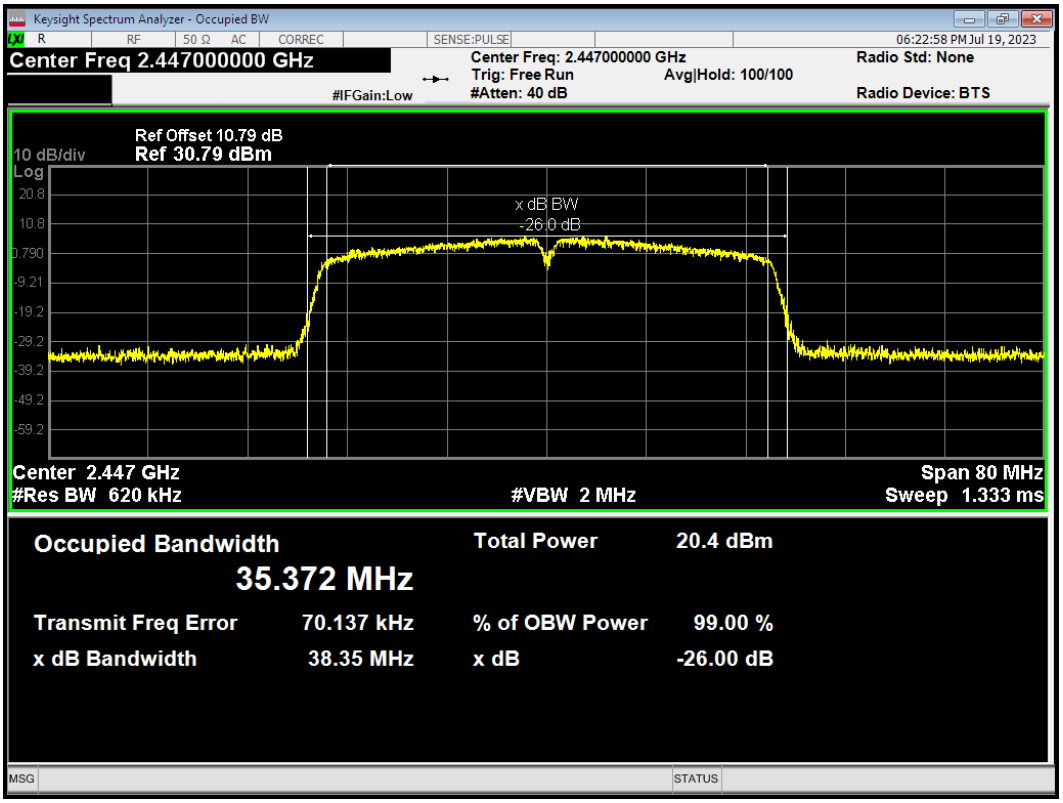


OBW 802.11n(HT40) 2447MHz



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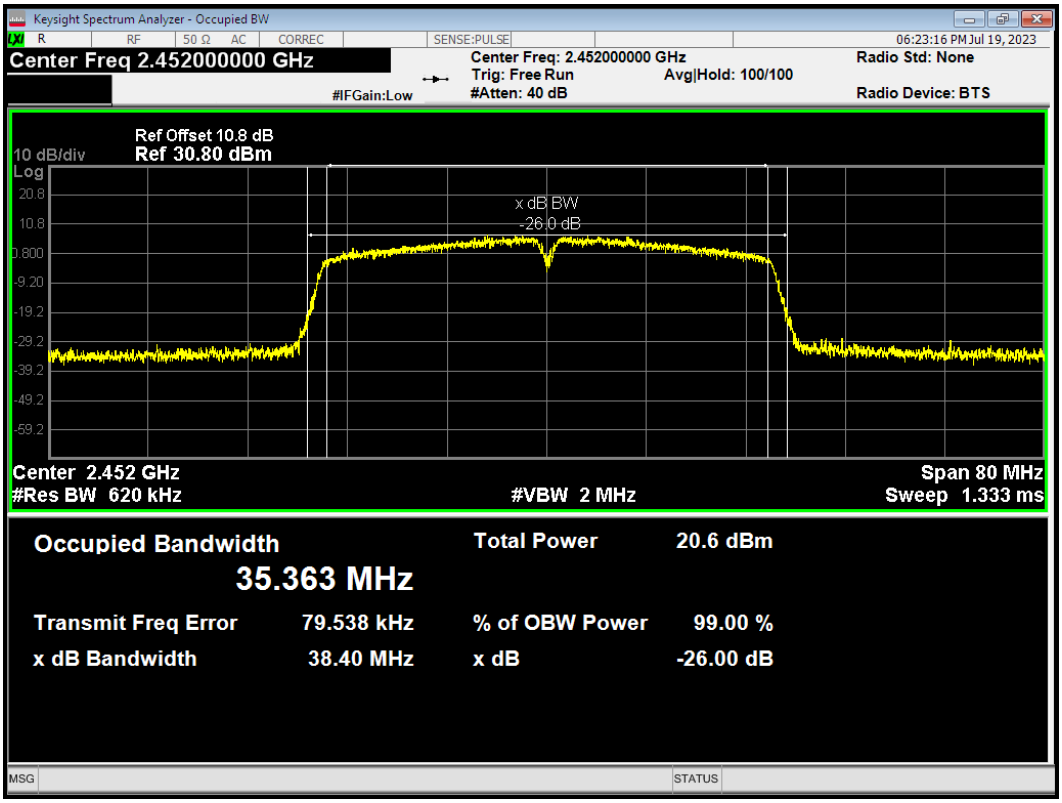
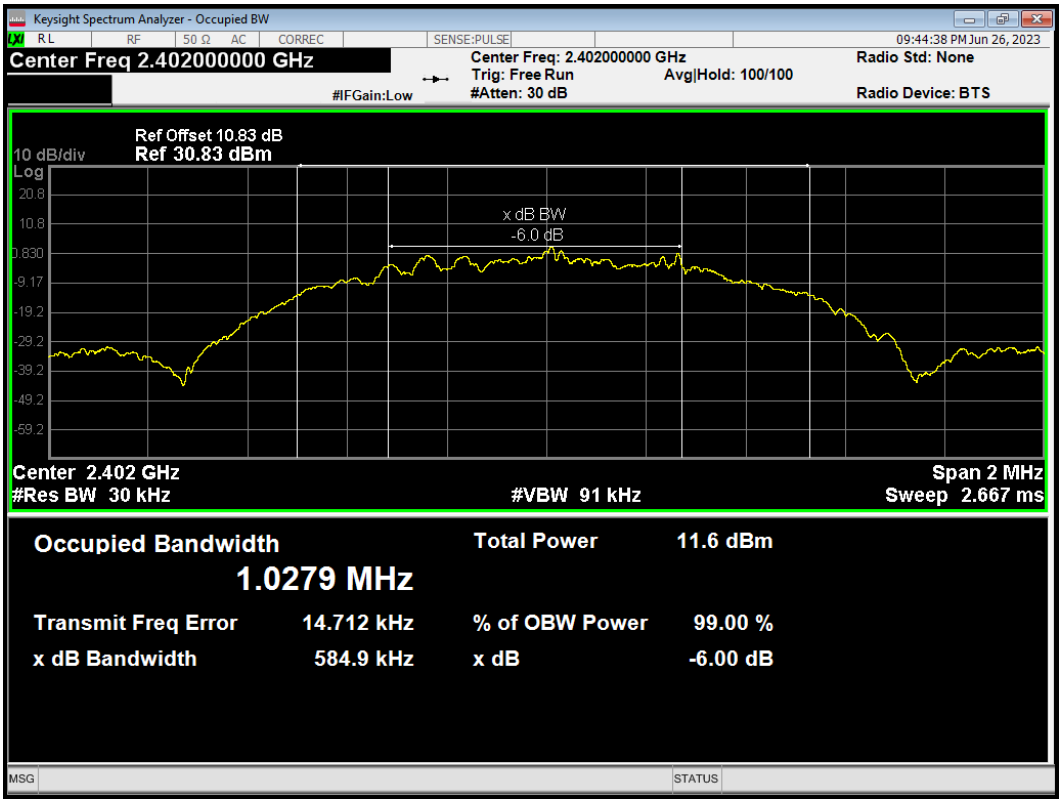


OBW Bluetooth LE (1M) 2402MHz



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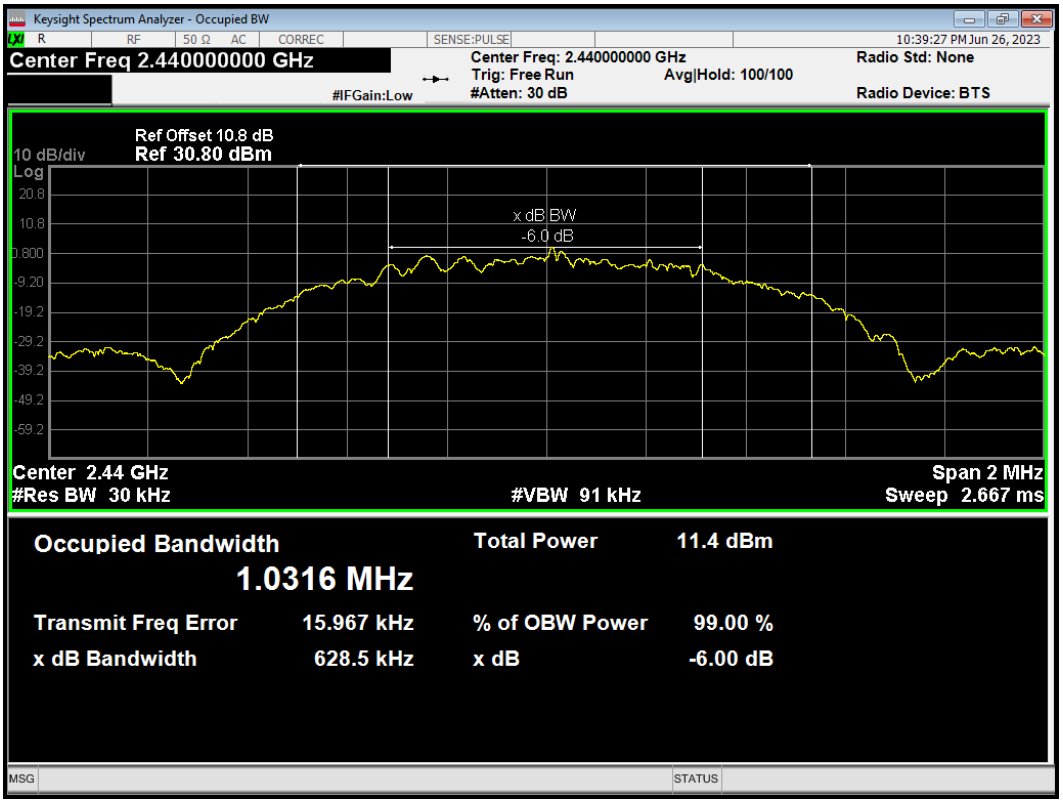

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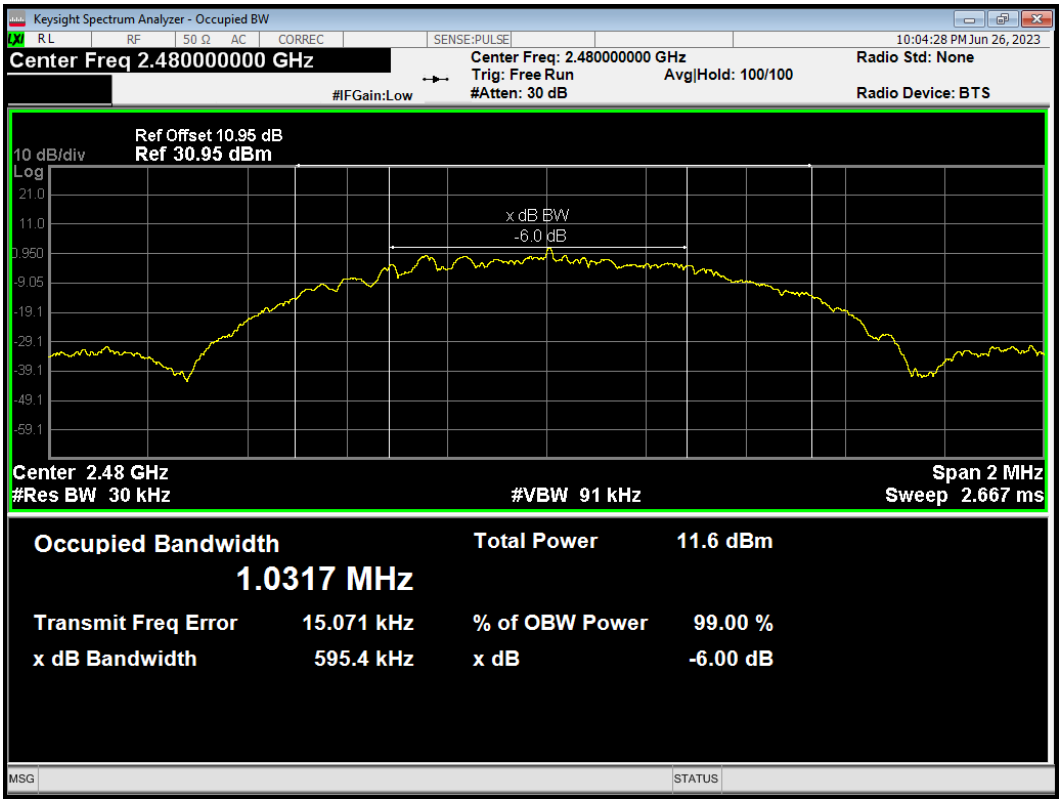

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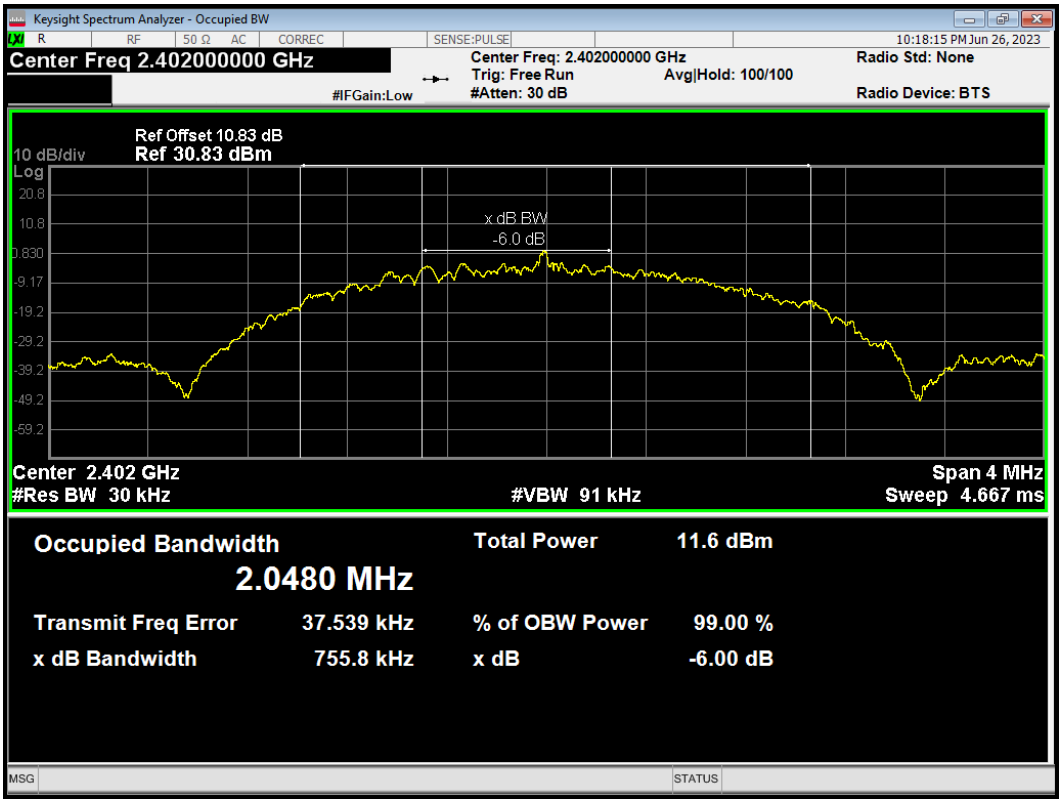

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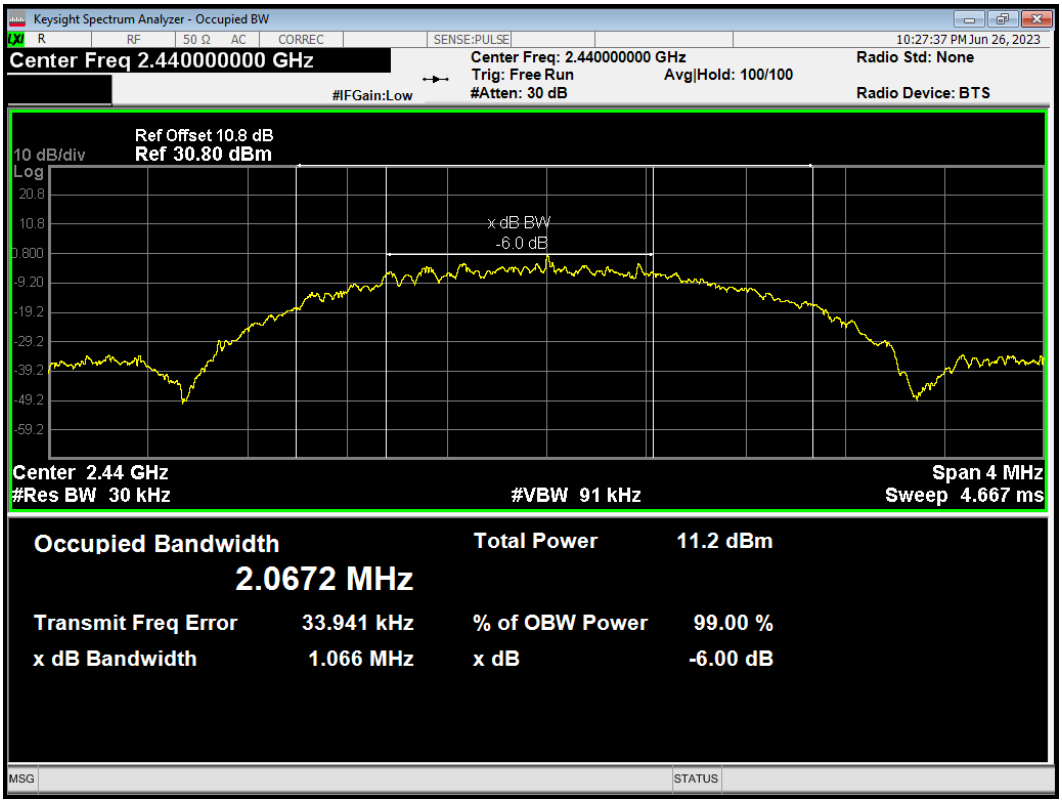
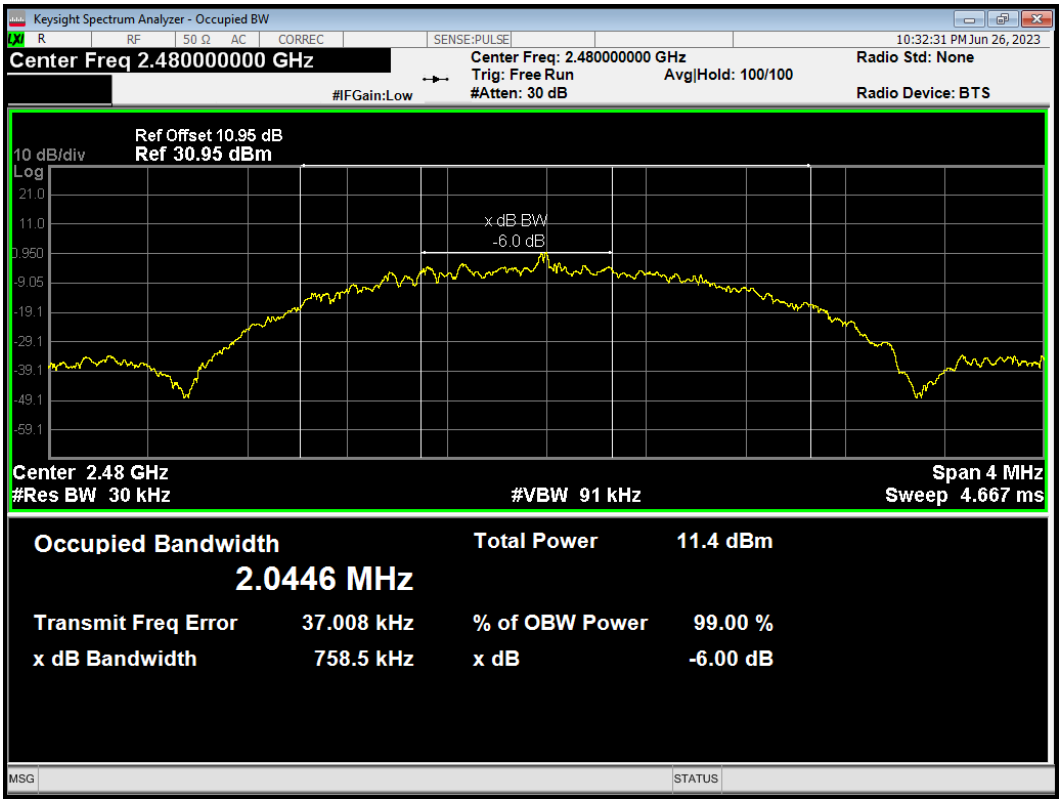
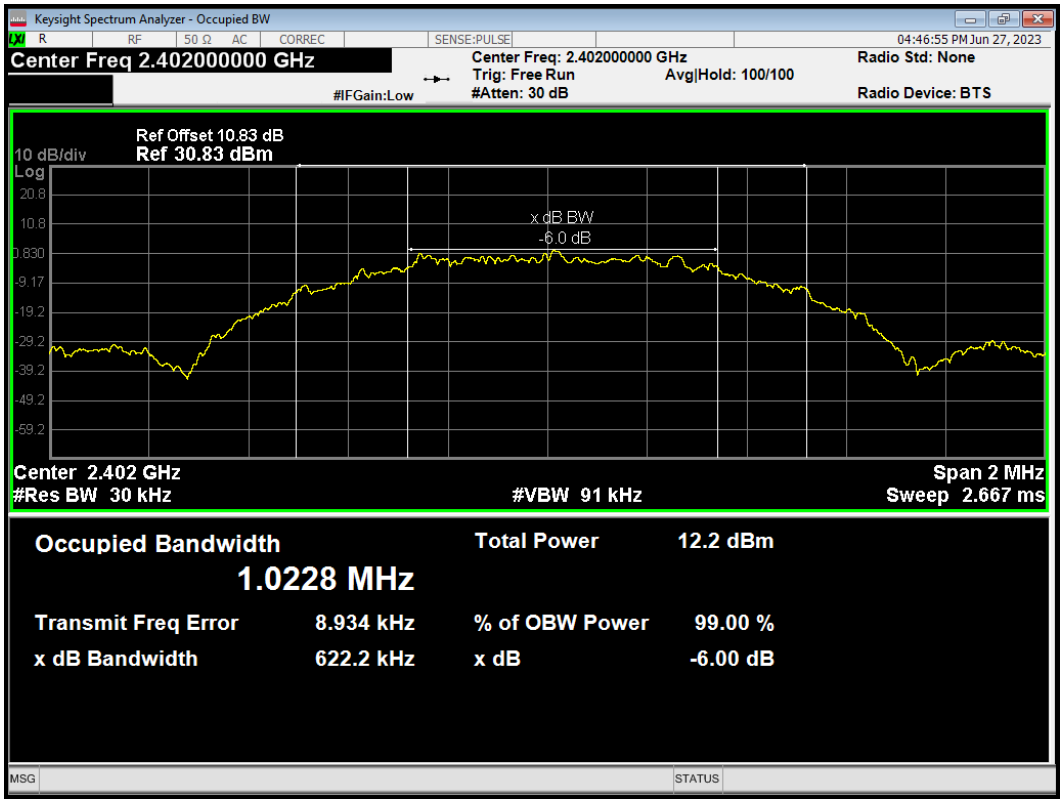


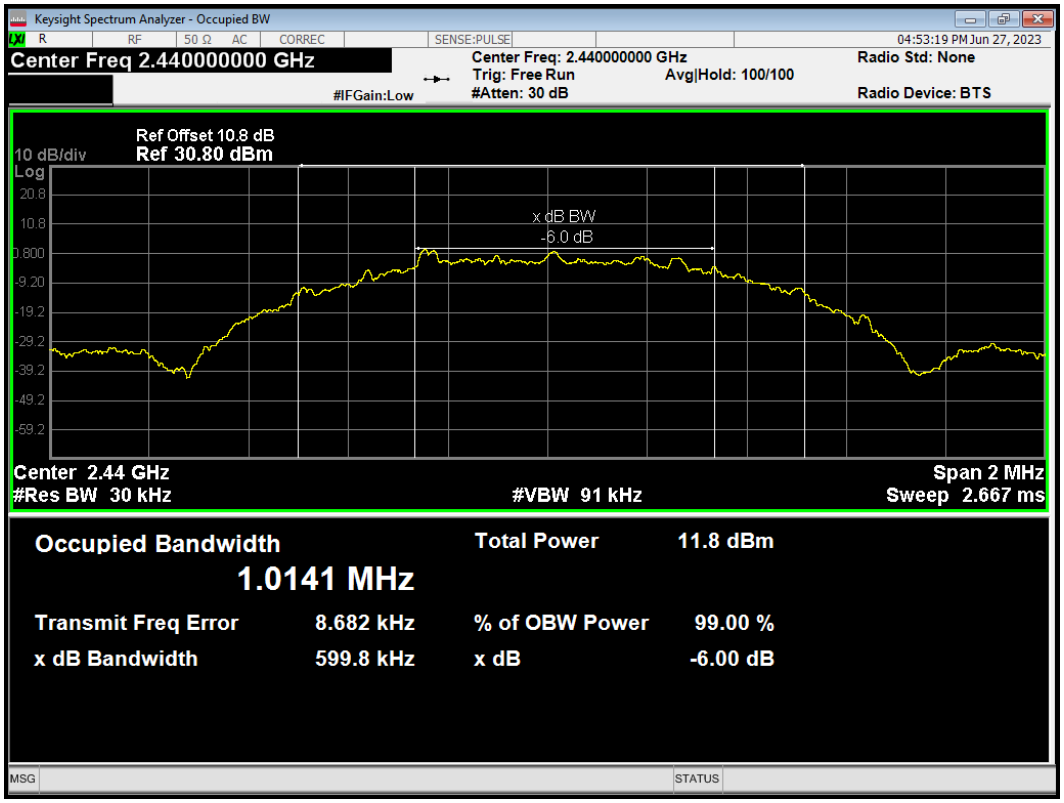
OBW Bluetooth LE (2M) 2480MHz



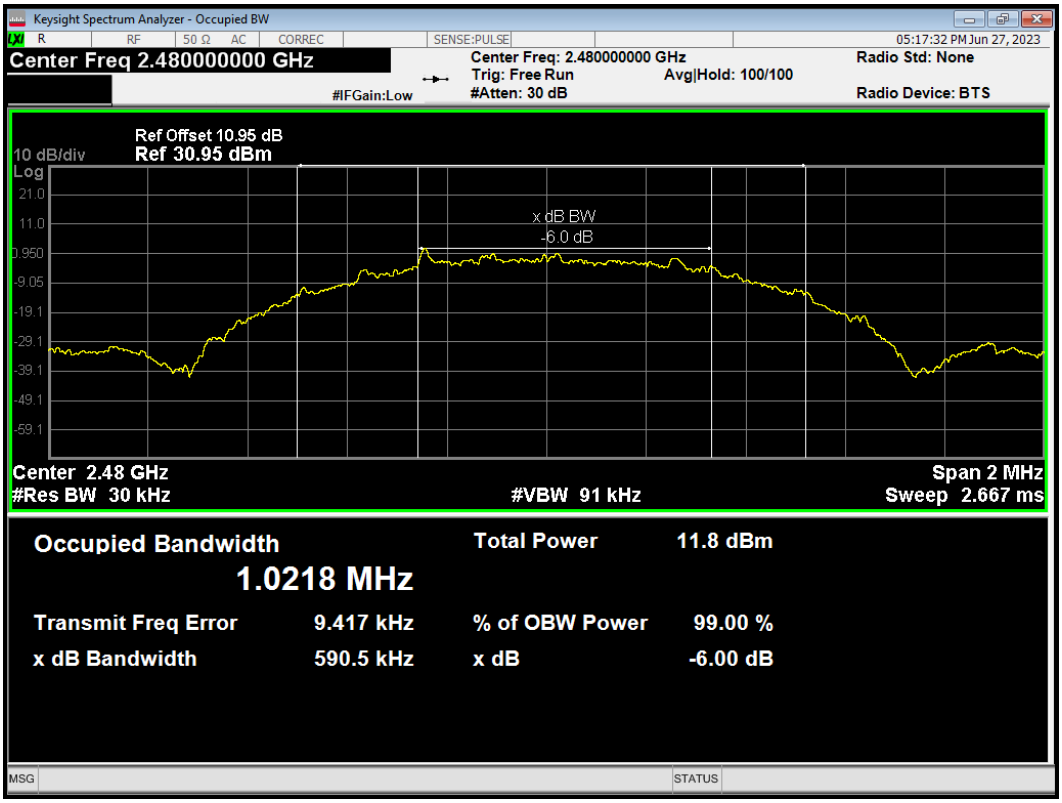
OBW Bluetooth LE (S=2) 2402MHz



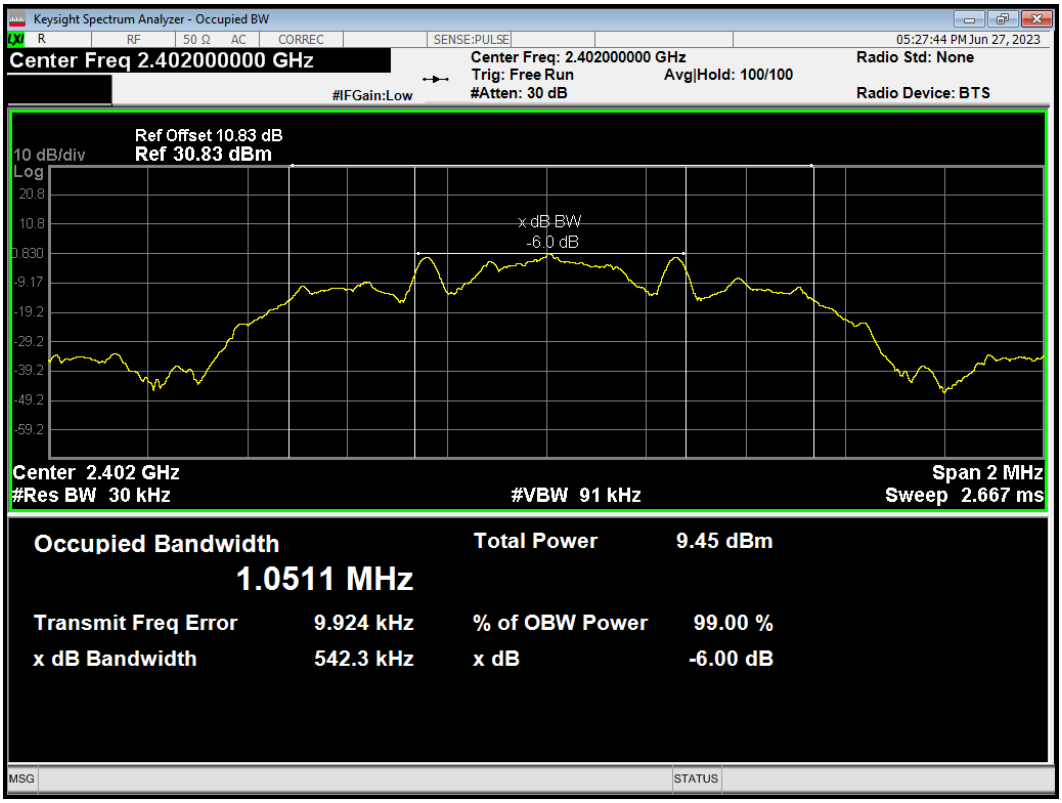
OBW Bluetooth LE (S=2) 2440MHz



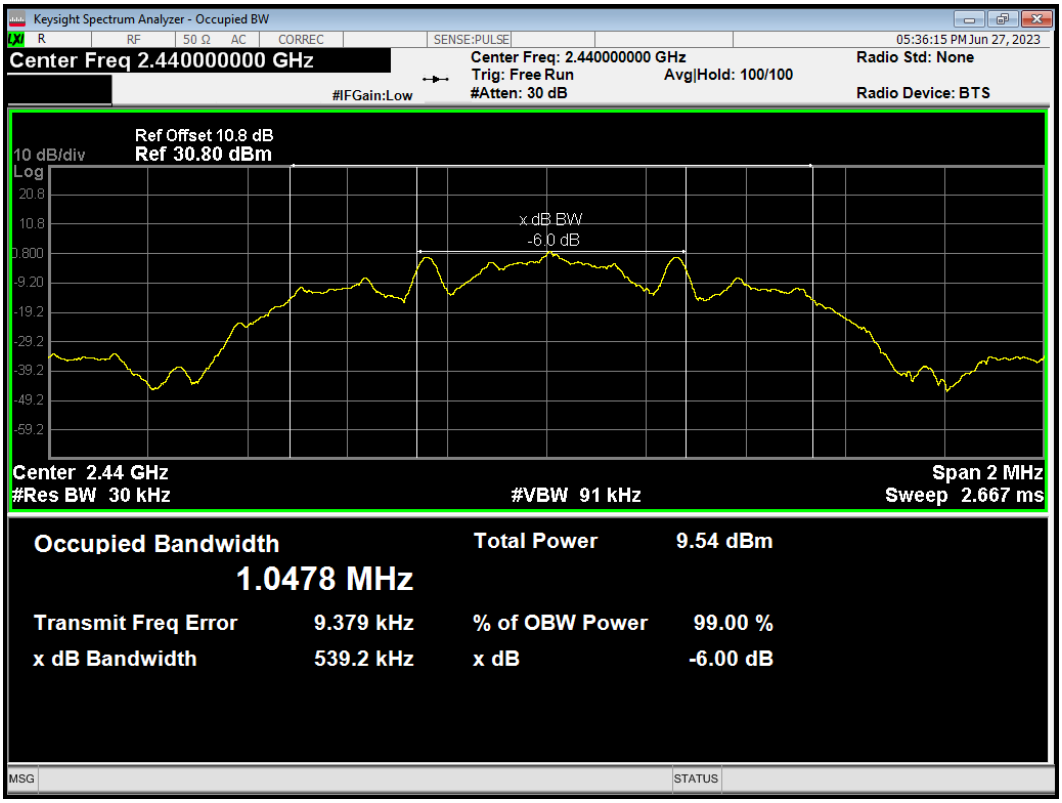
OBW Bluetooth LE (S=2) 2480MHz



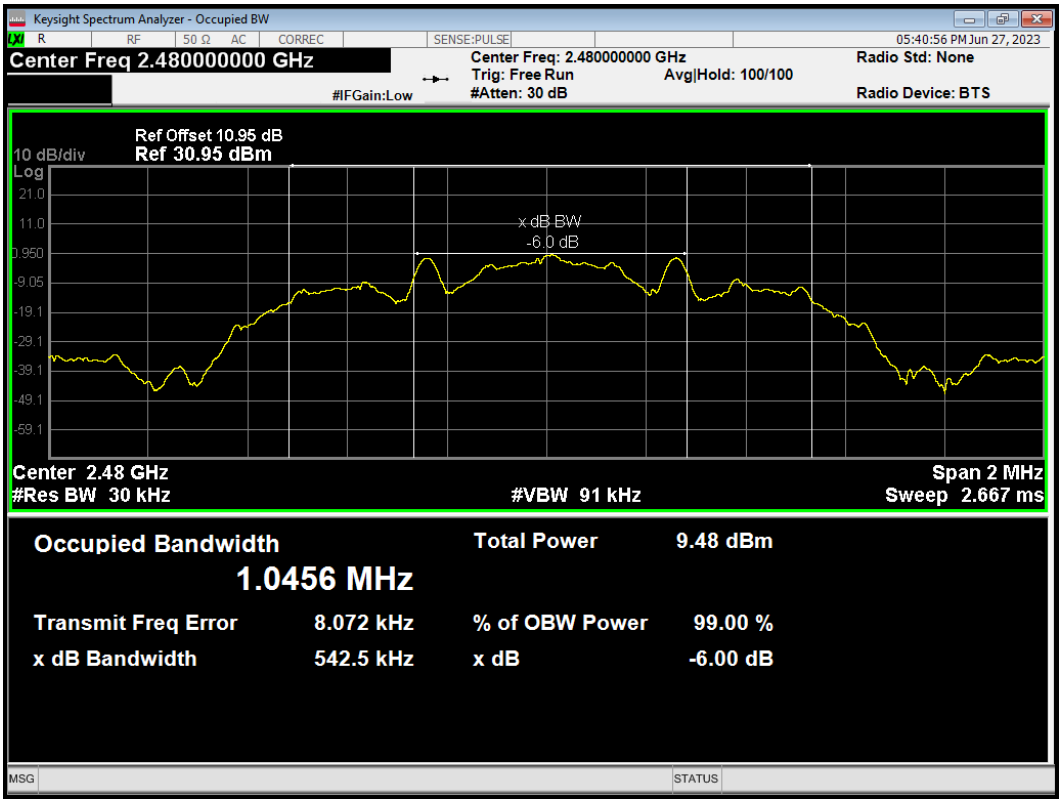
OBW Bluetooth LE (S=8) 2402MHz



OBW Bluetooth LE (S=8) 2440MHz

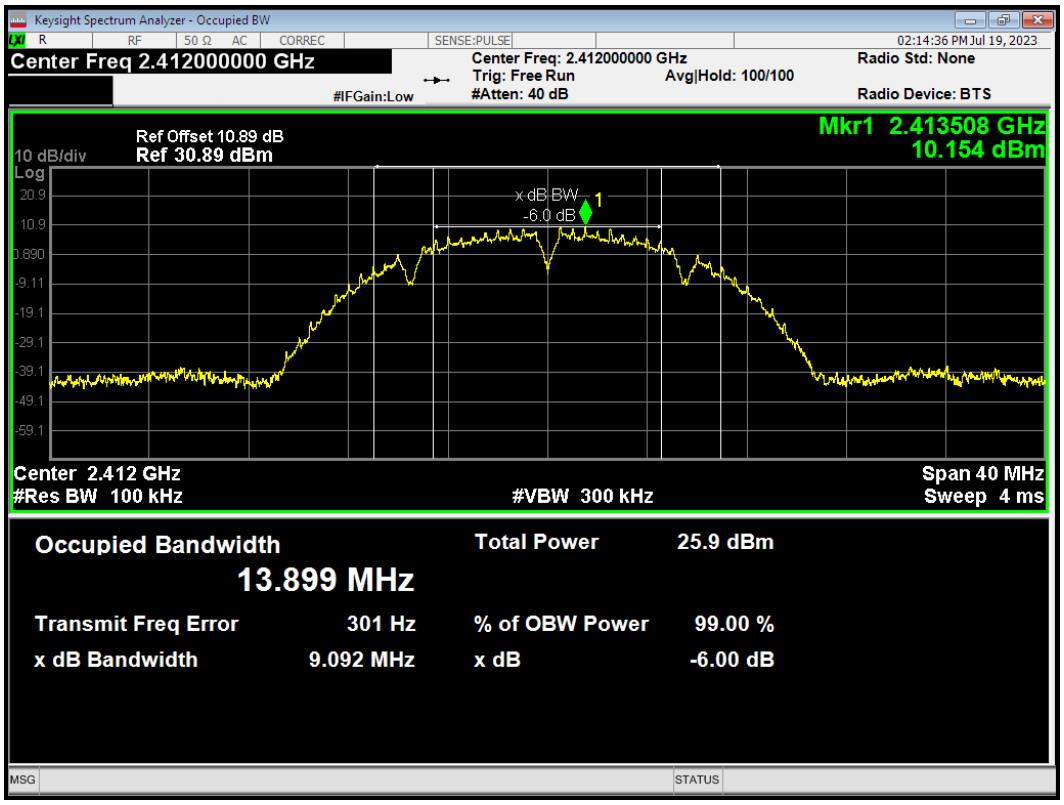


OBW Bluetooth LE (S=8) 2480MHz

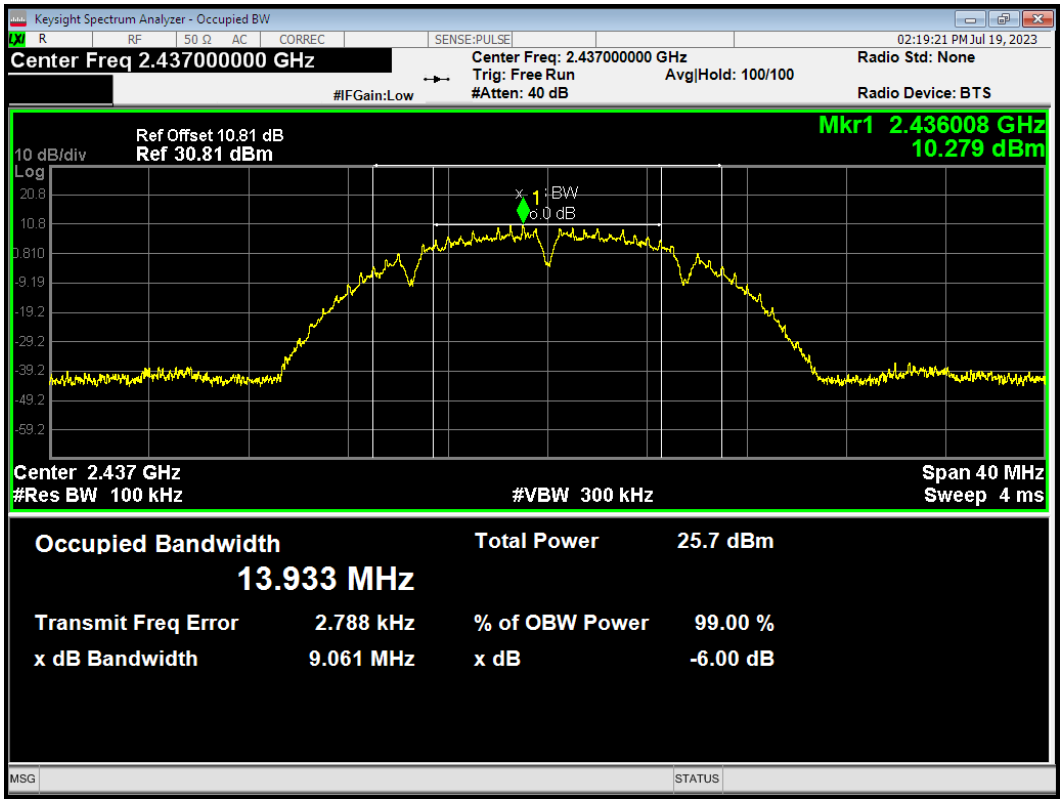


6 dB bandwidth

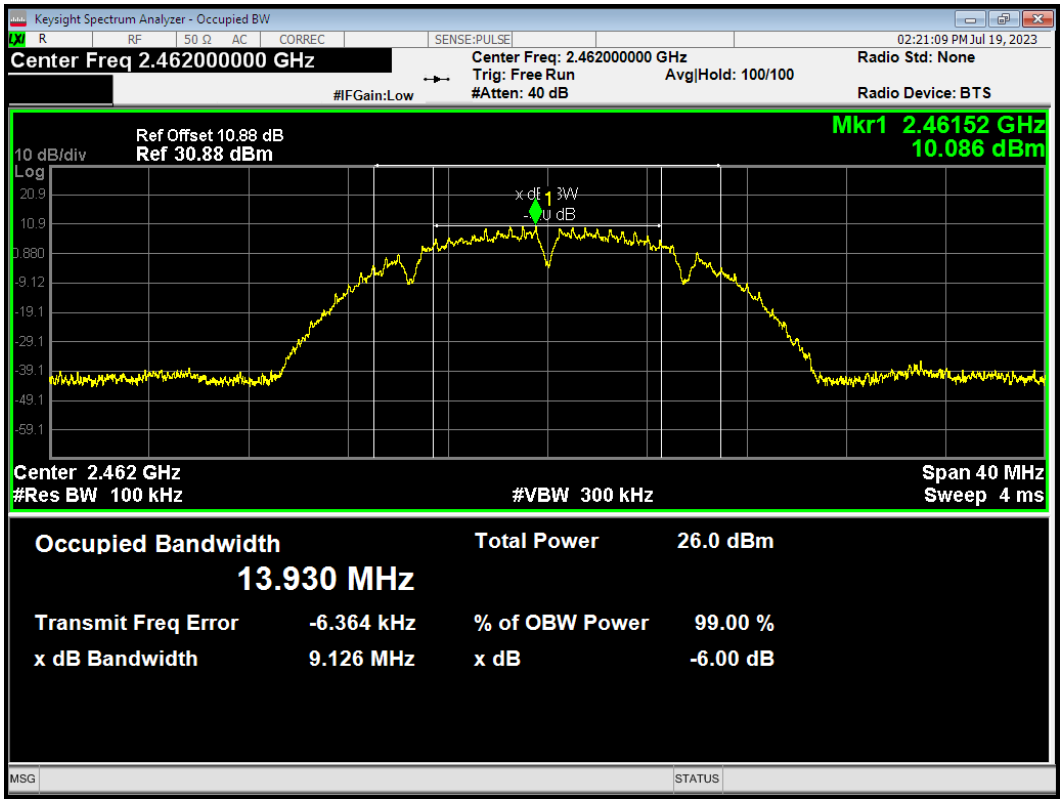
-6dB Bandwidth 802.11b 2412MHz



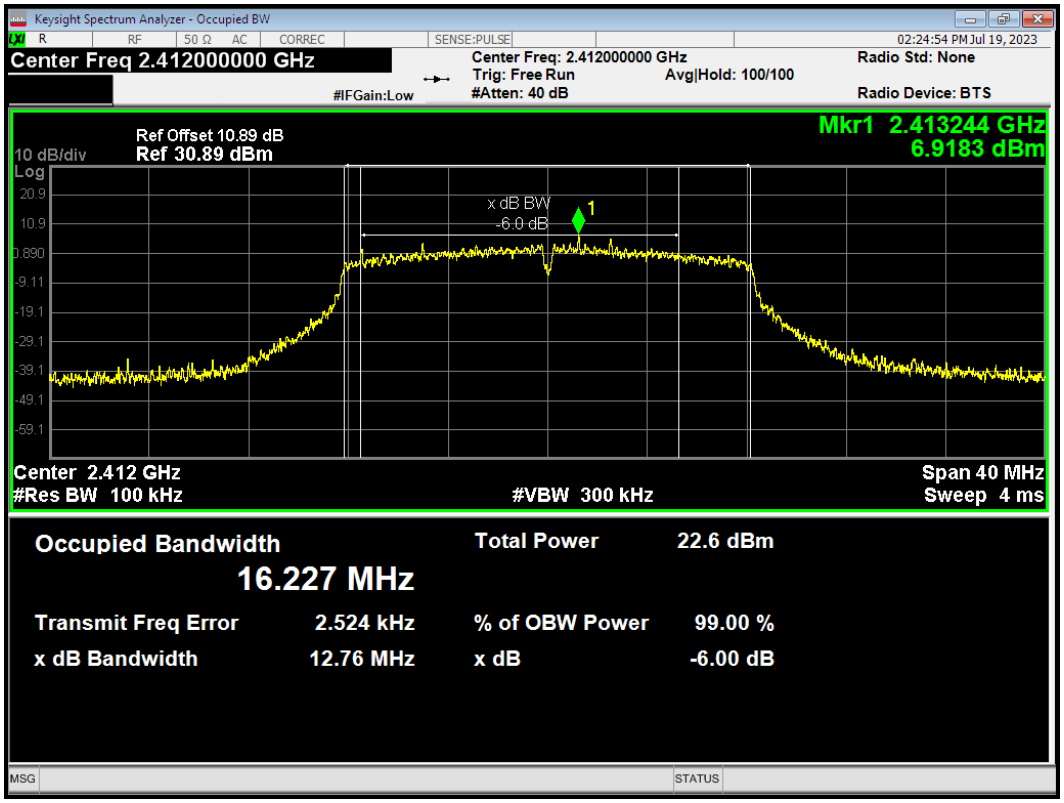
-6dB Bandwidth 802.11b 2437MHz



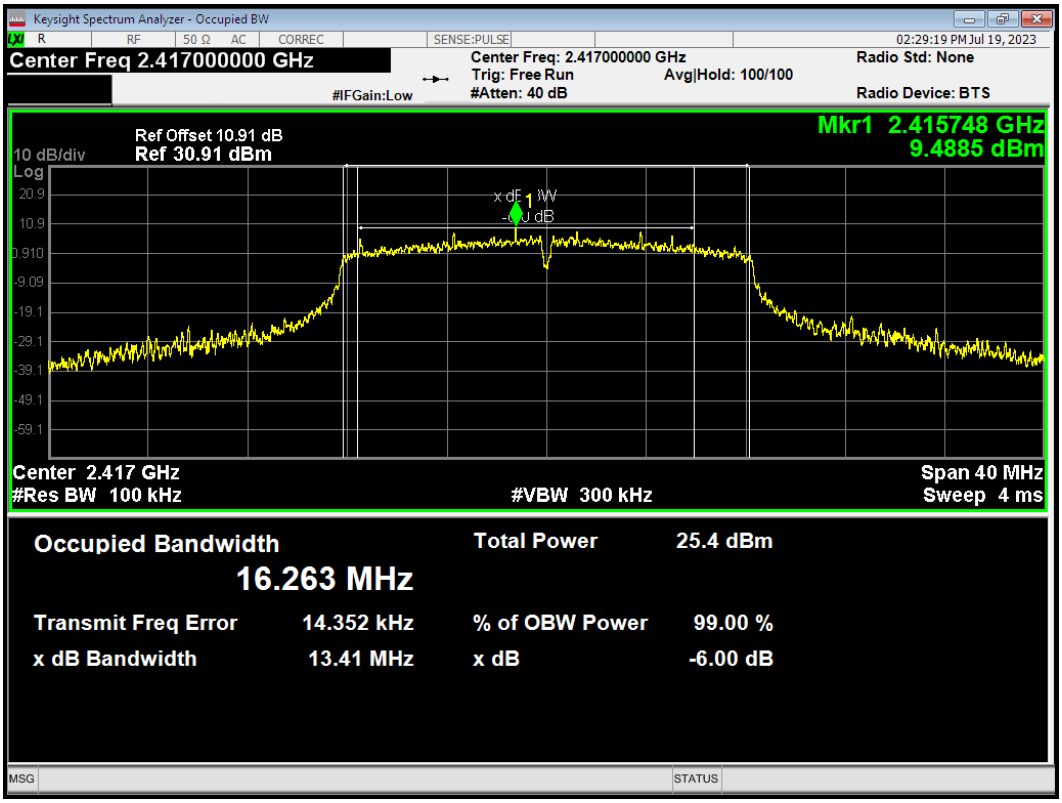
-6dB Bandwidth 802.11b 2462MHz



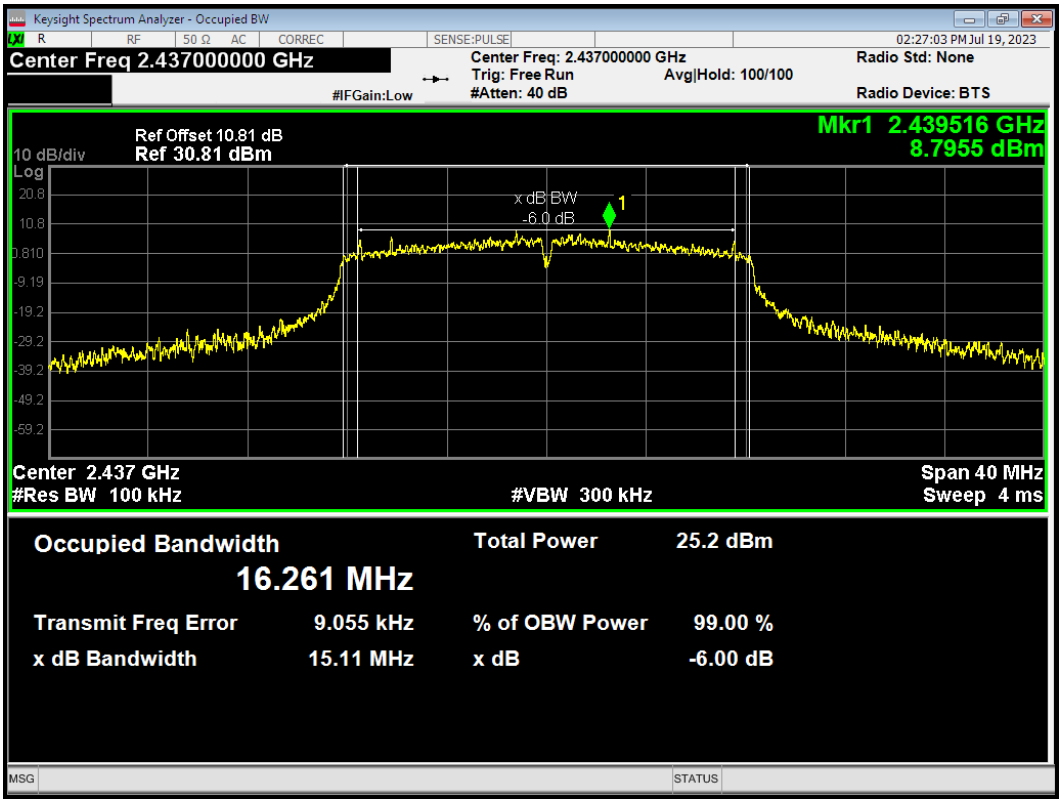
-6dB Bandwidth 802.11g 2412MHz



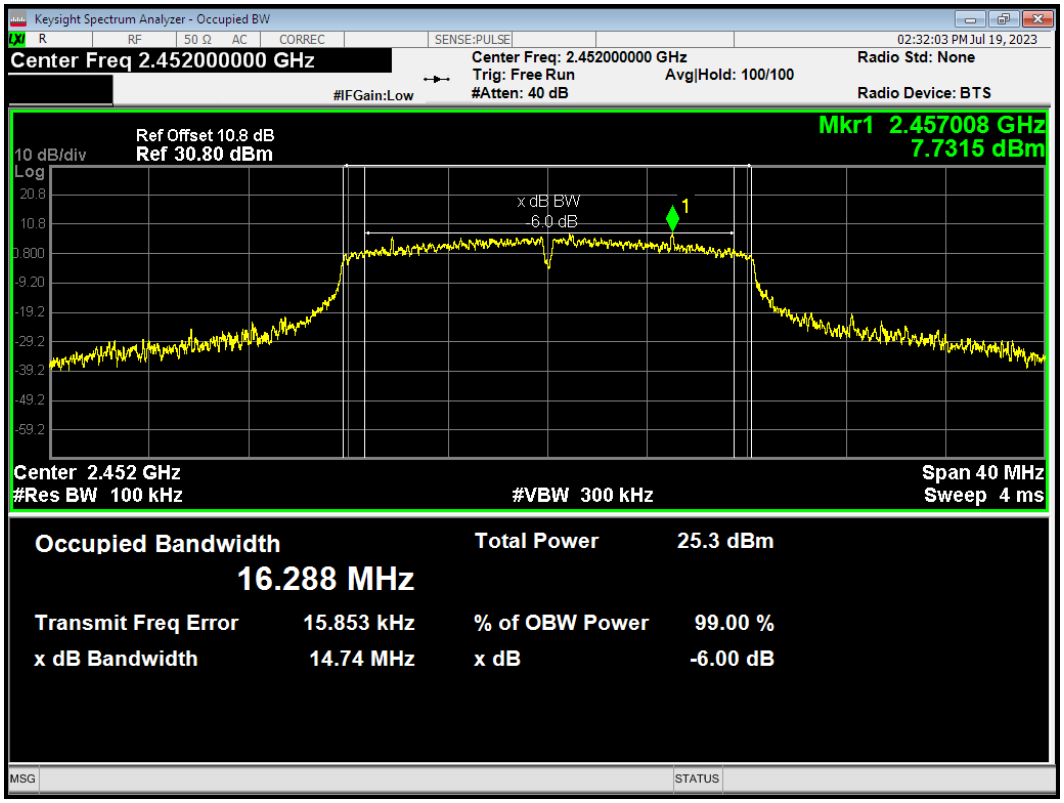
-6dB Bandwidth 802.11g 2417MHz



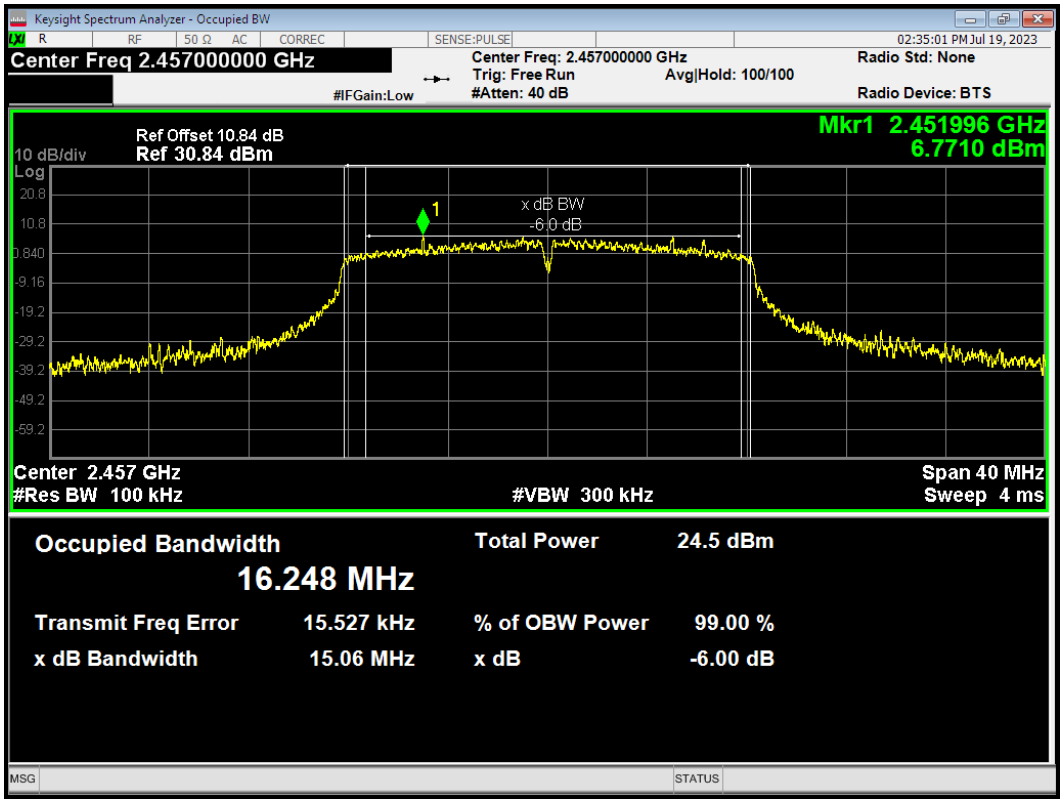
-6dB Bandwidth 802.11g 2437MHz



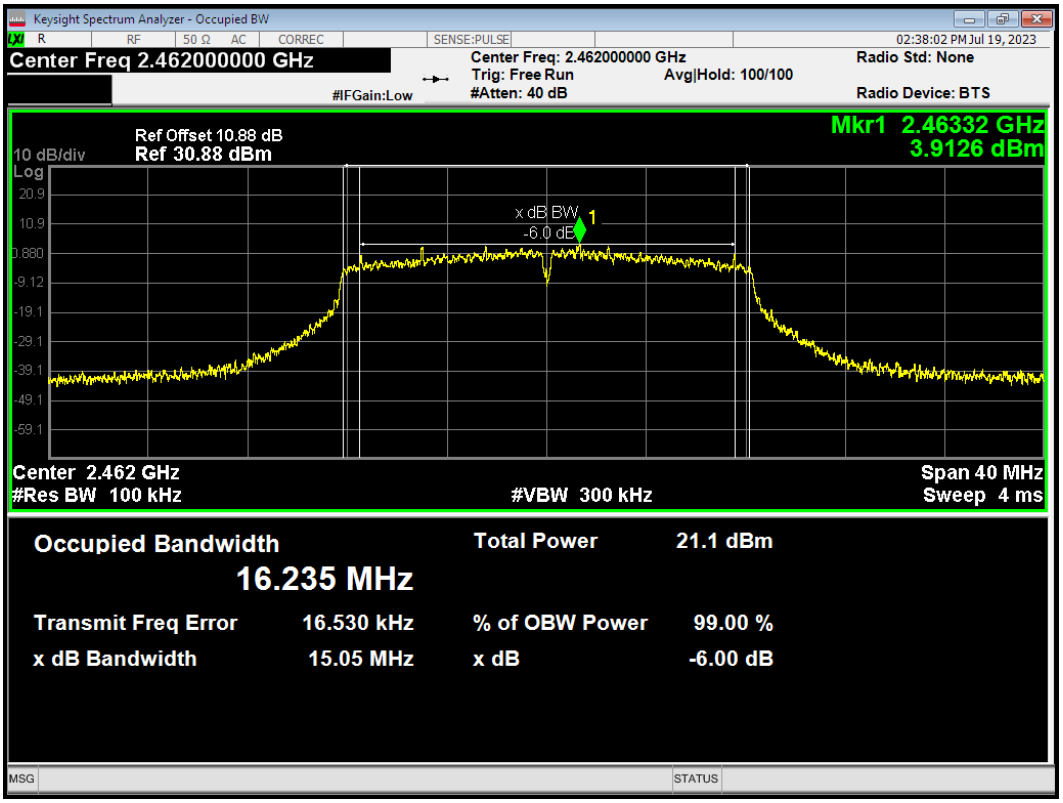
-6dB Bandwidth 802.11g 2452MHz



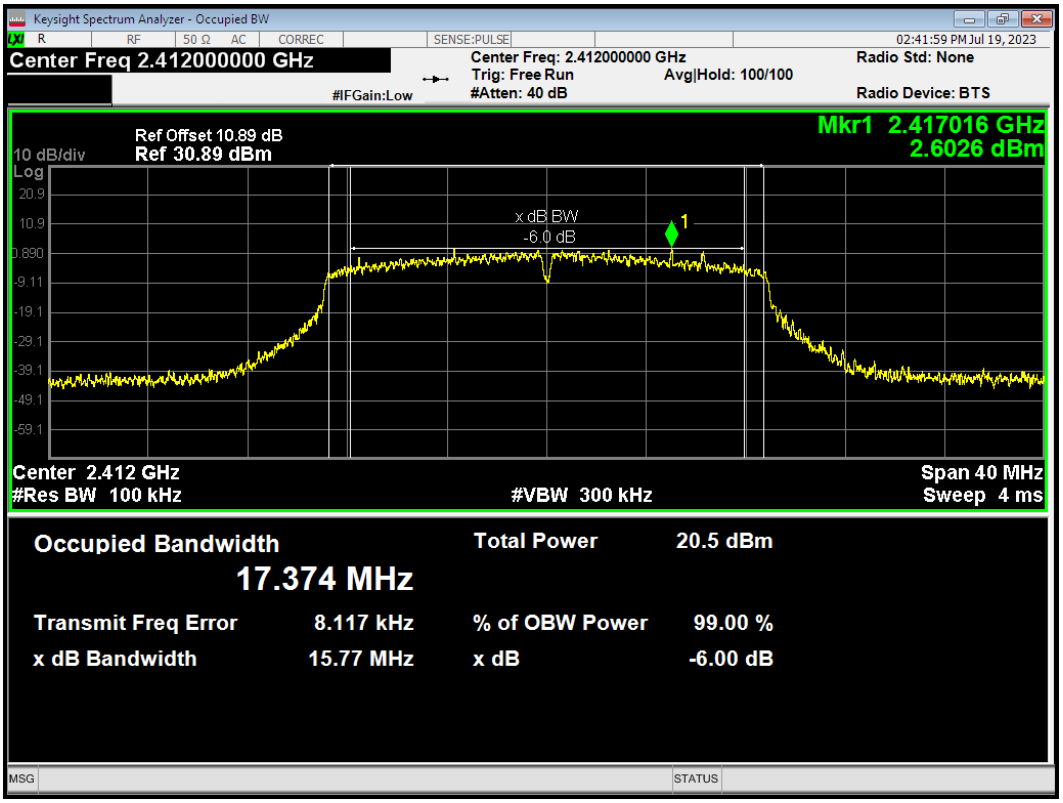
-6dB Bandwidth 802.11g 2457MHz



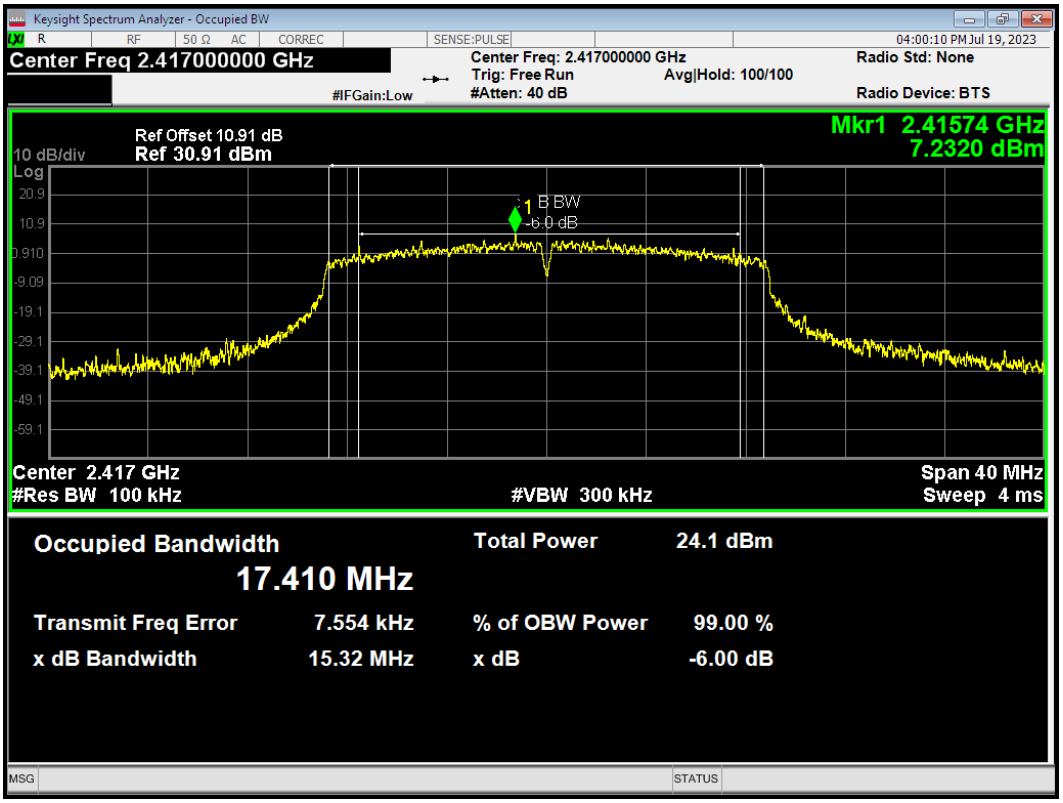
-6dB Bandwidth 802.11g 2462MHz



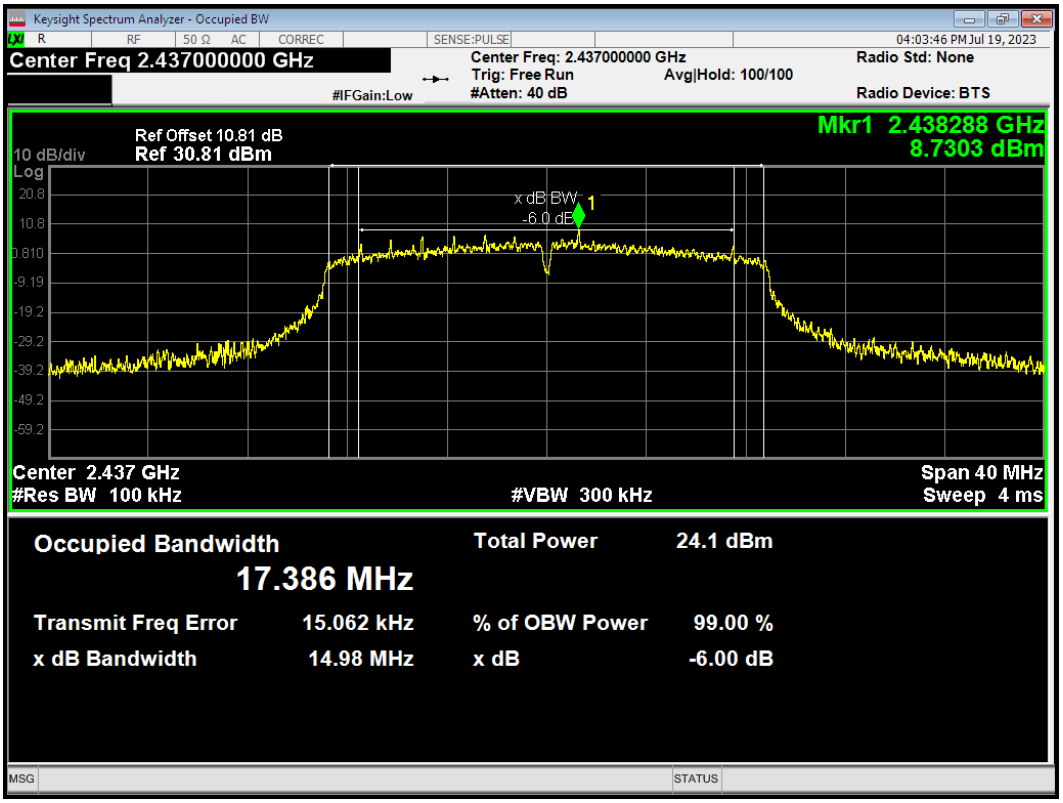
-6dB Bandwidth 802.11n(HT20) 2412MHz



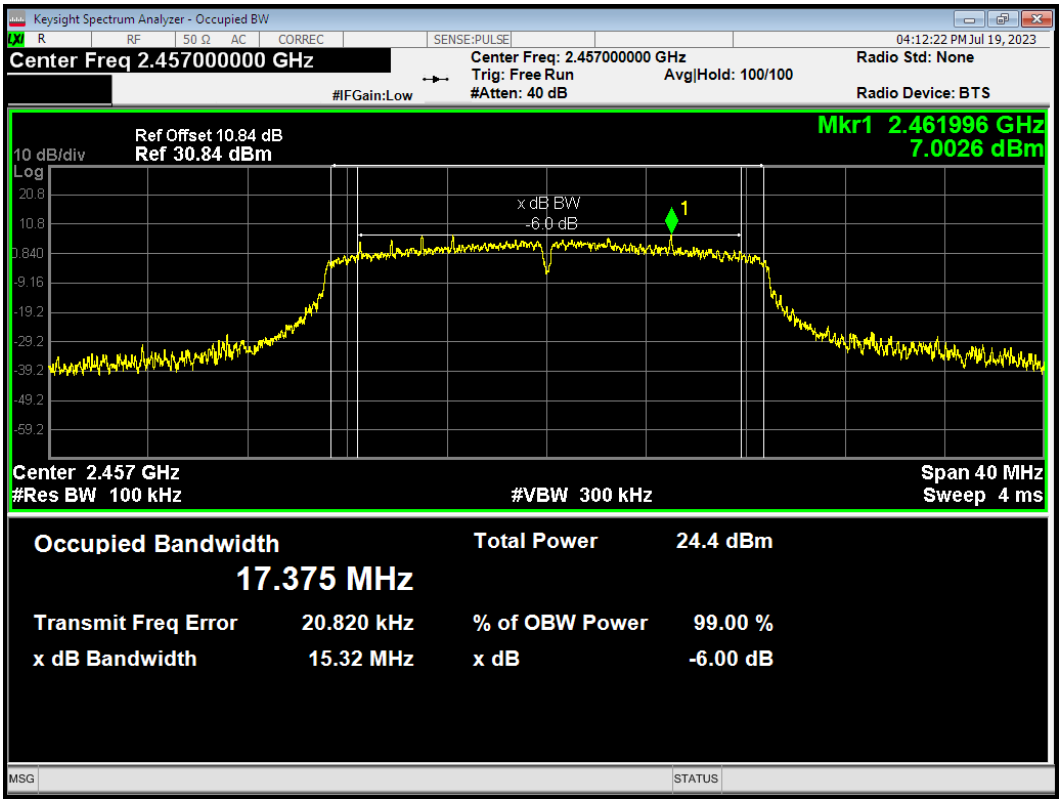
-6dB Bandwidth 802.11n(HT20) 2417MHz



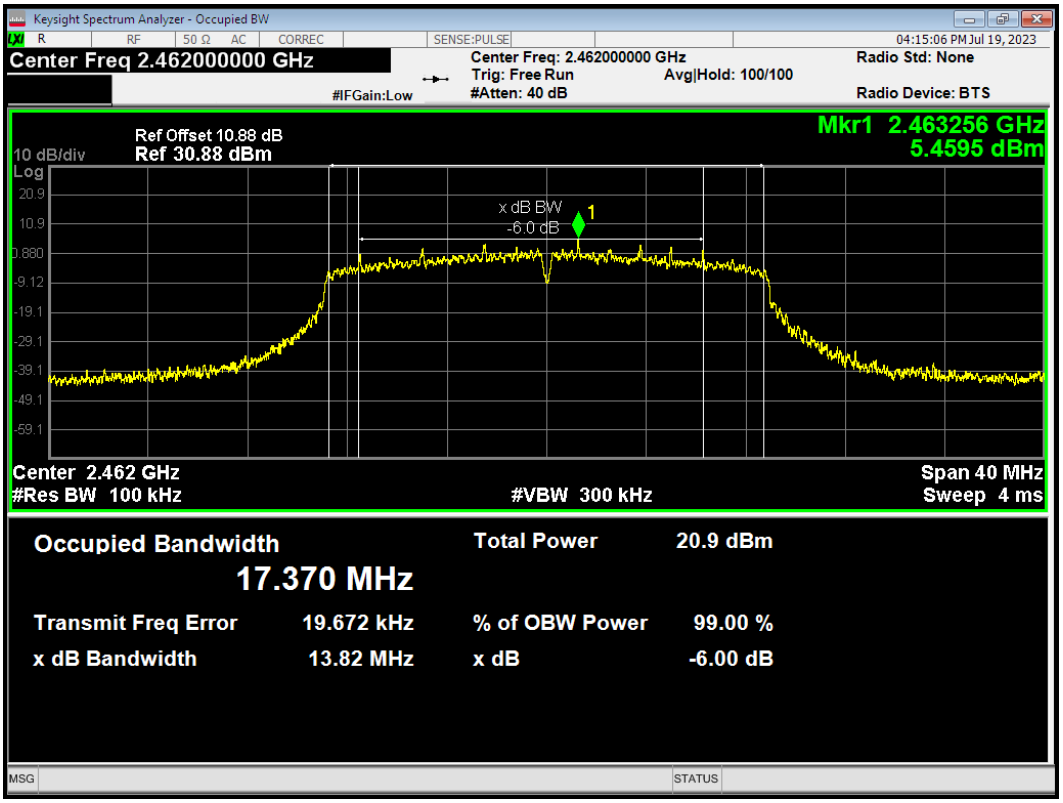
-6dB Bandwidth 802.11n(HT20) 2437MHz



-6dB Bandwidth 802.11n(HT20) 2457MHz



-6dB Bandwidth 802.11n(HT20) 2462MHz



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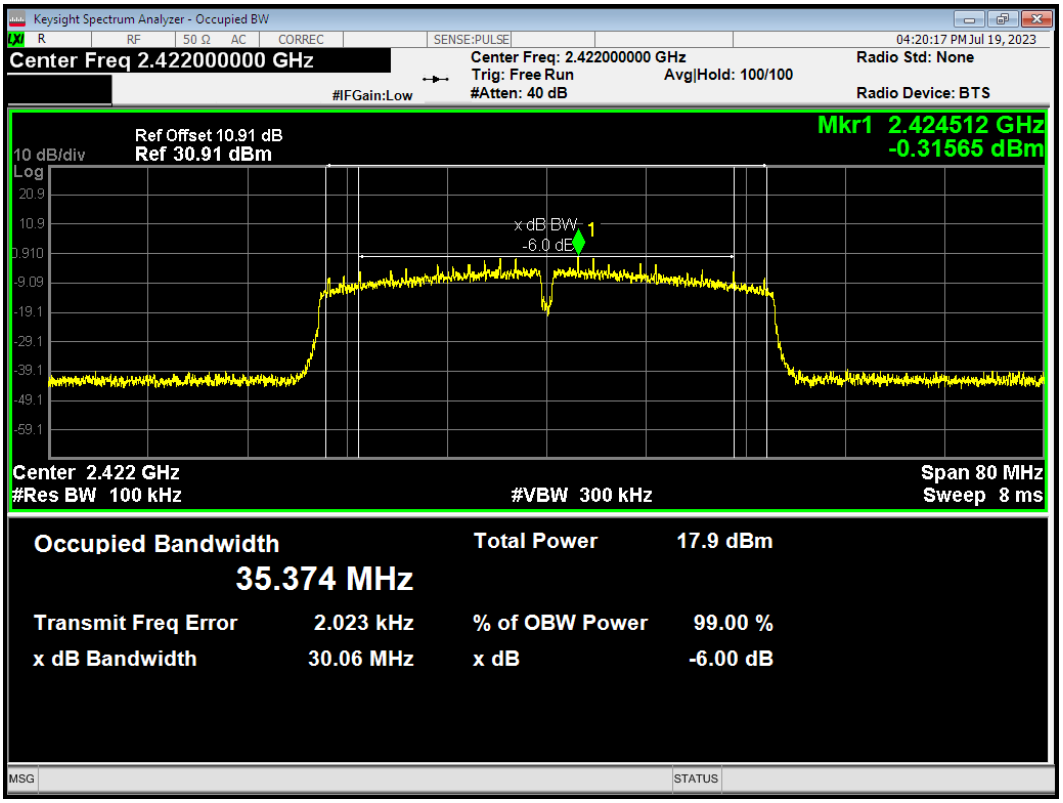

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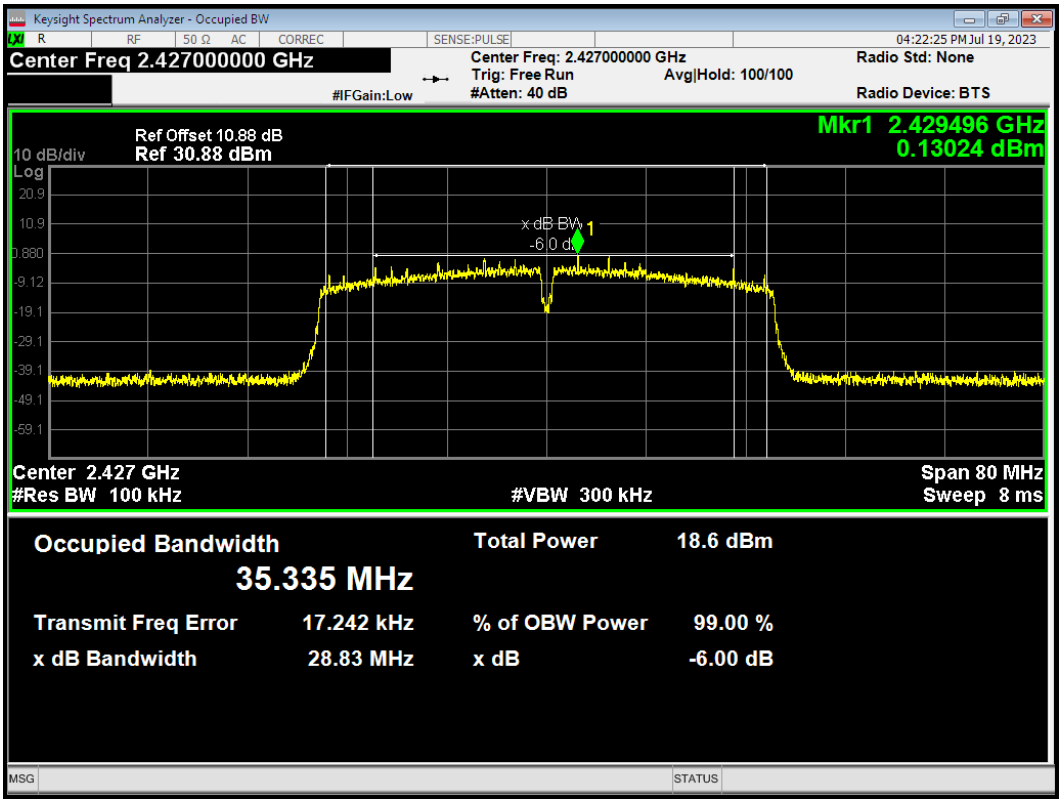
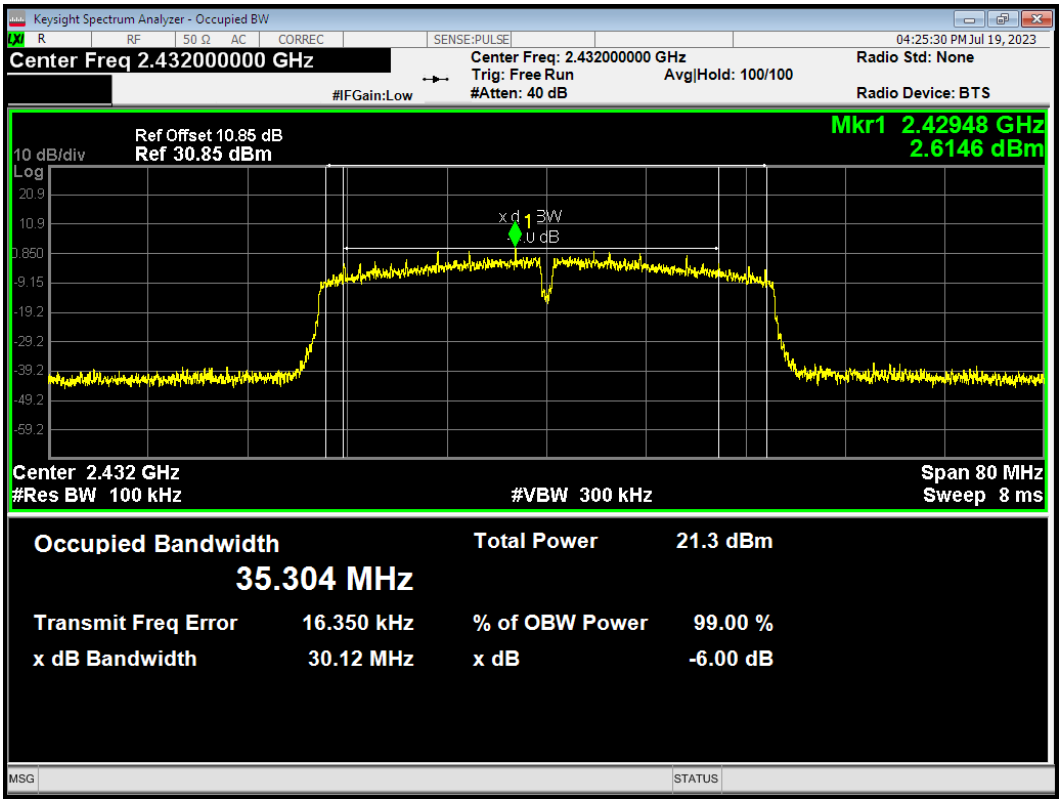
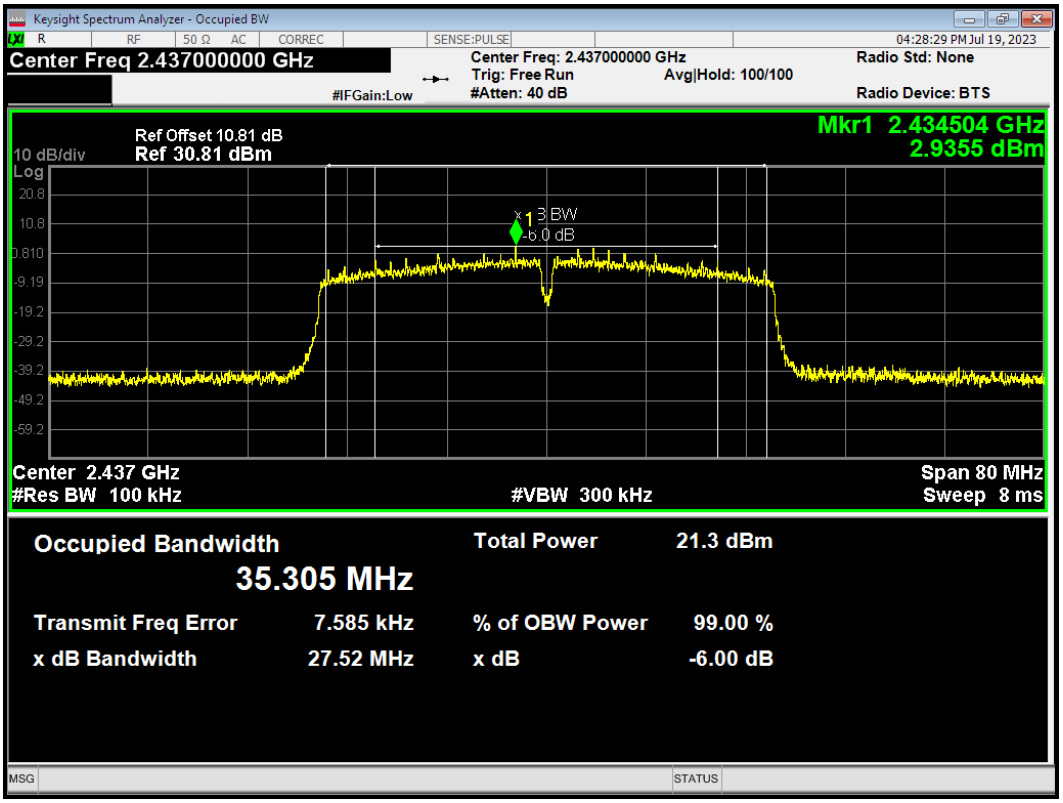


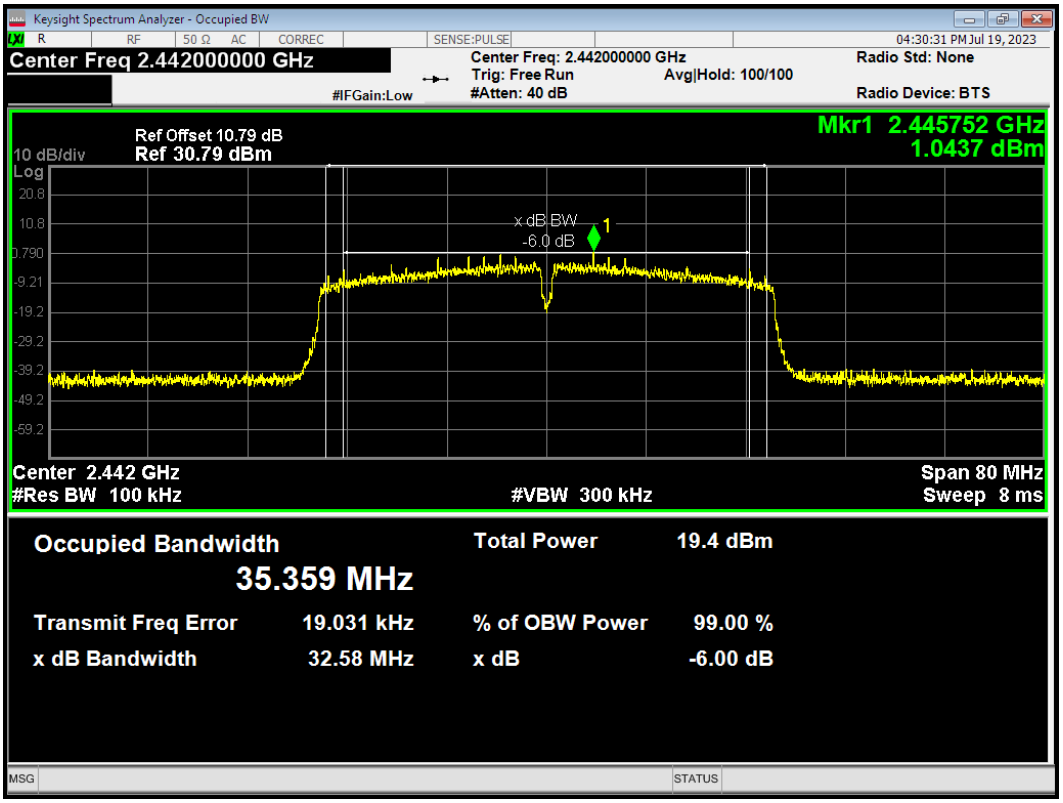
-6dB Bandwidth 802.11n(HT40) 2432MHz



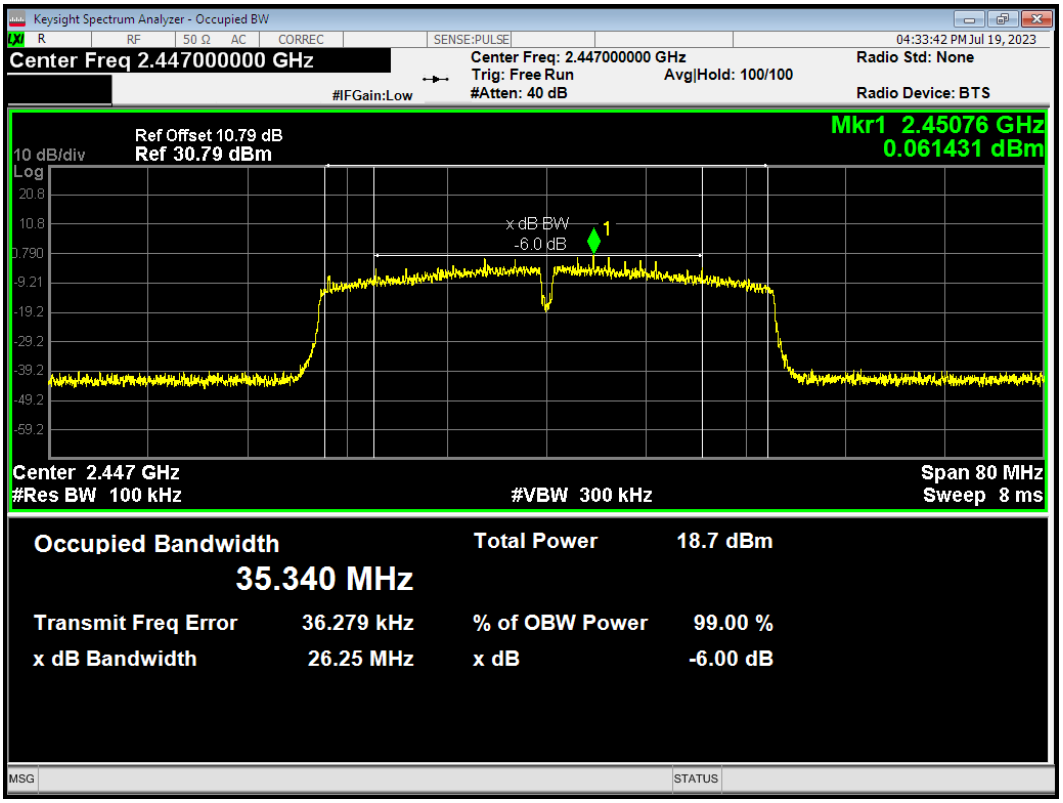
-6dB Bandwidth 802.11n(HT40) 2437MHz



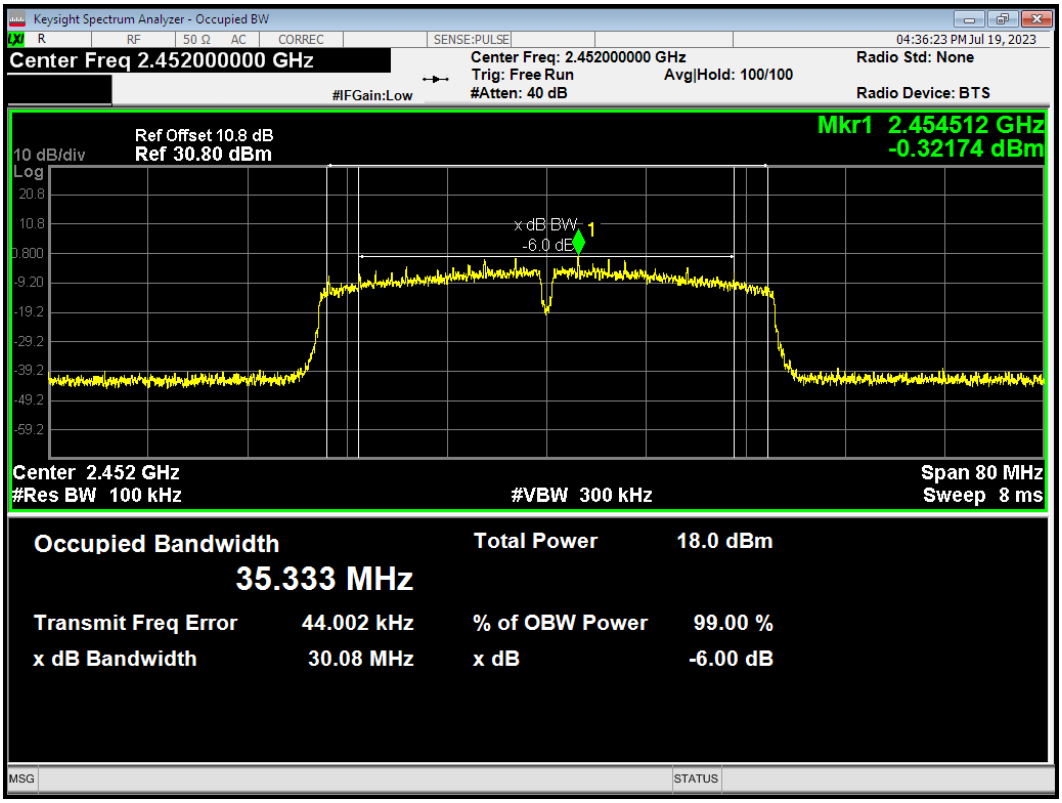
-6dB Bandwidth 802.11n(HT40) 2442MHz



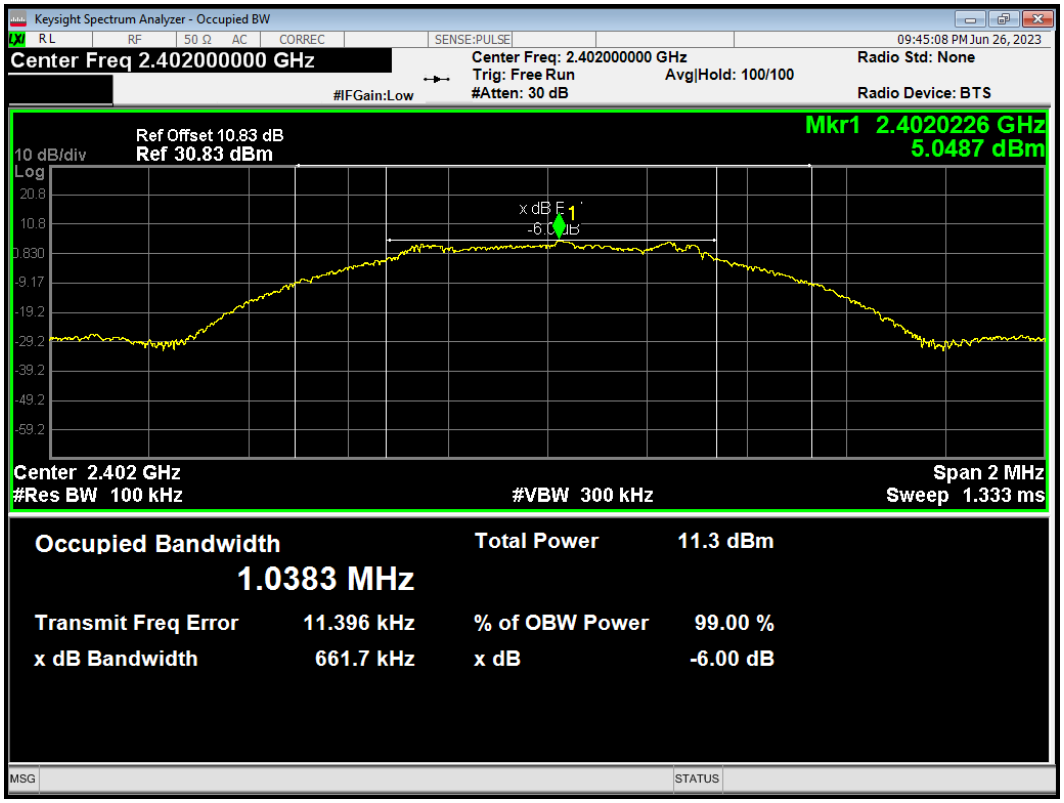
-6dB Bandwidth 802.11n(HT40) 2447MHz



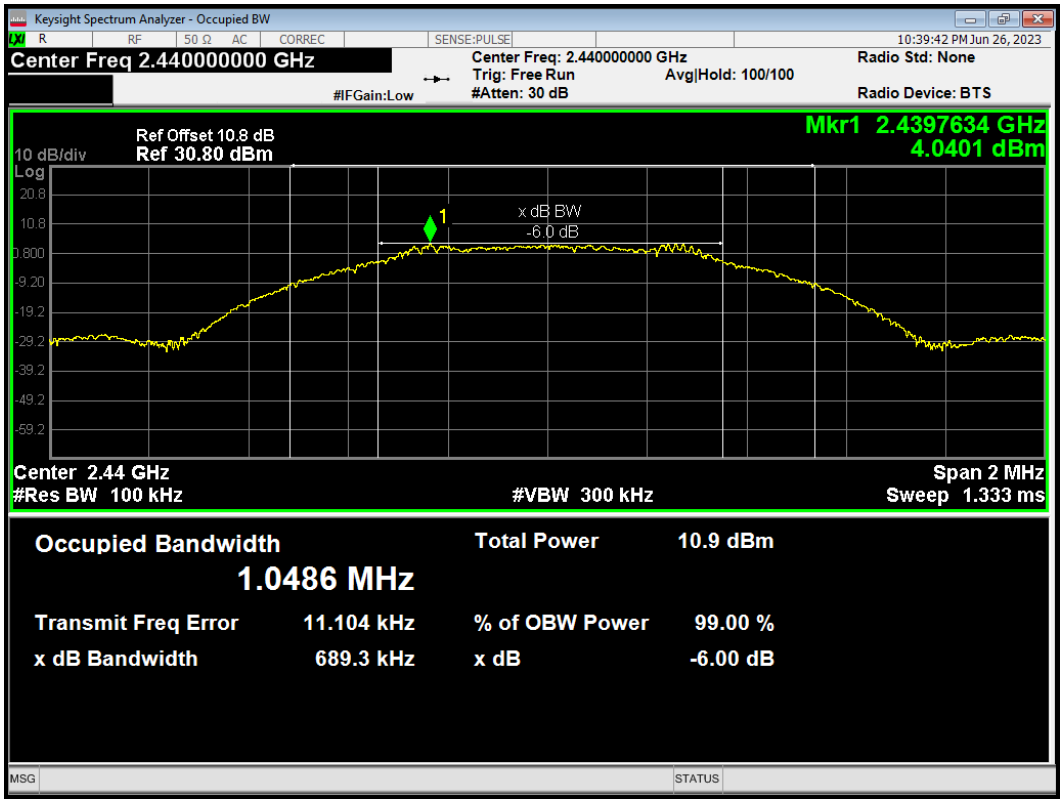
-6dB Bandwidth 802.11n(HT40) 2452MHz



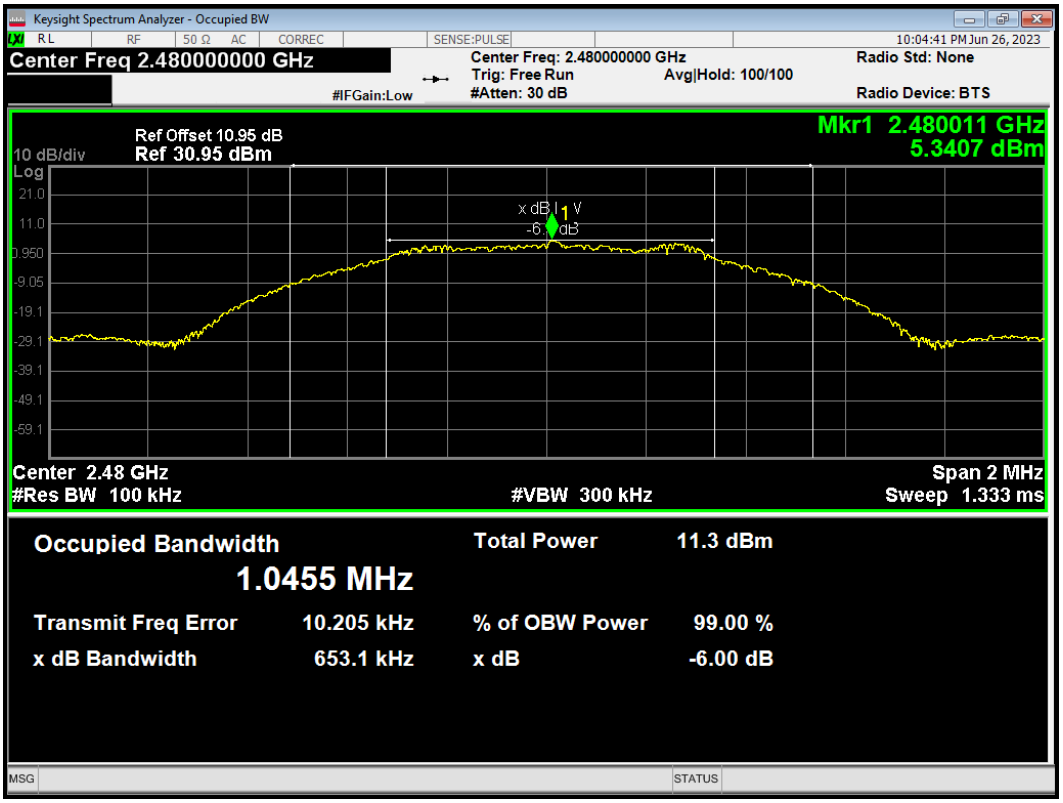
-6dB Bandwidth Bluetooth LE (1M) 2402MHz



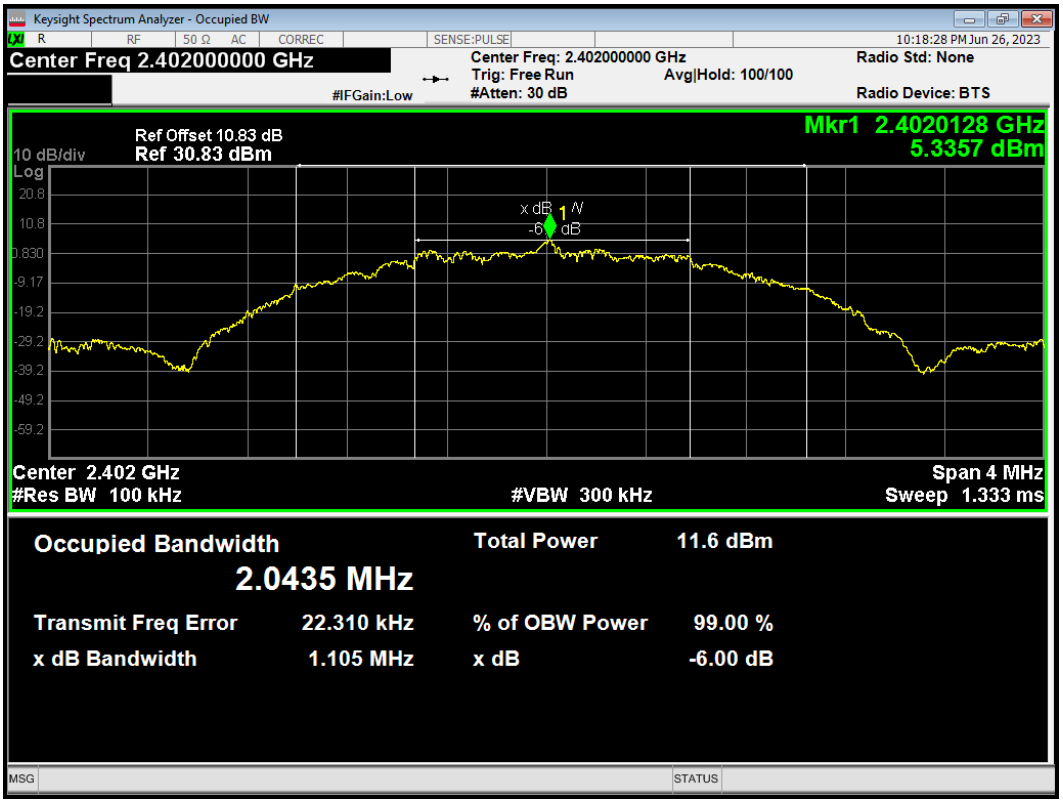
-6dB Bandwidth Bluetooth LE (1M) 2440MHz



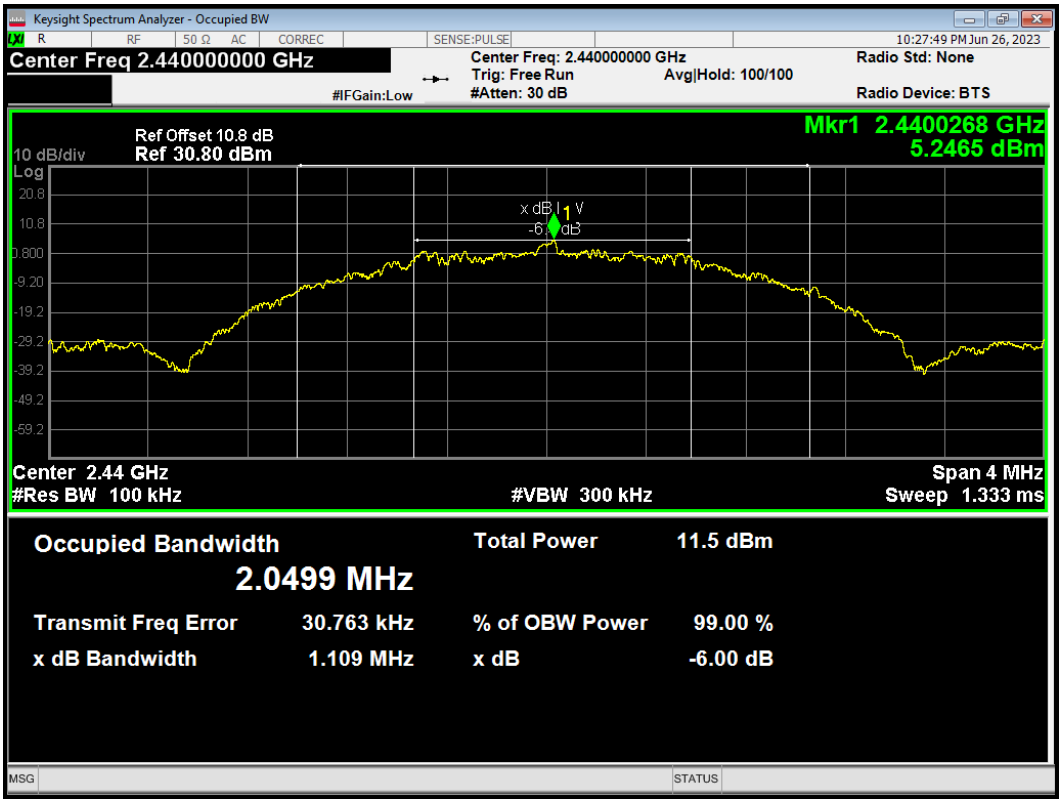
-6dB Bandwidth Bluetooth LE (1M) 2480MHz



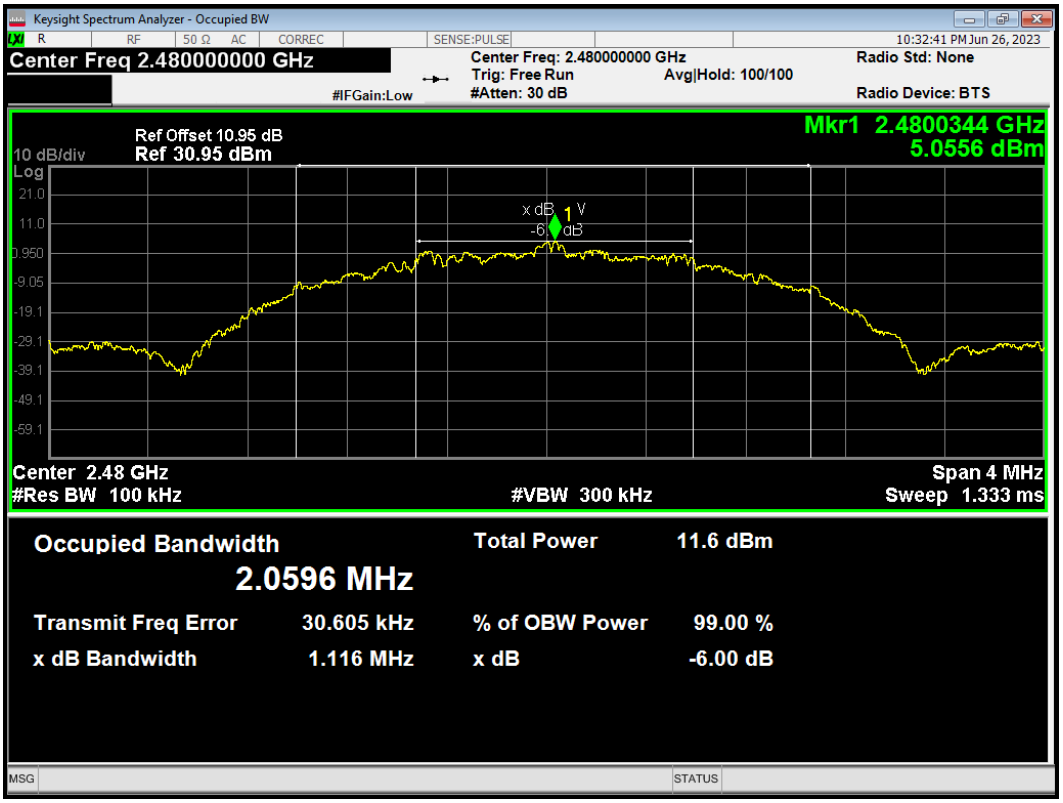
-6dB Bandwidth Bluetooth LE (2M) 2402MHz



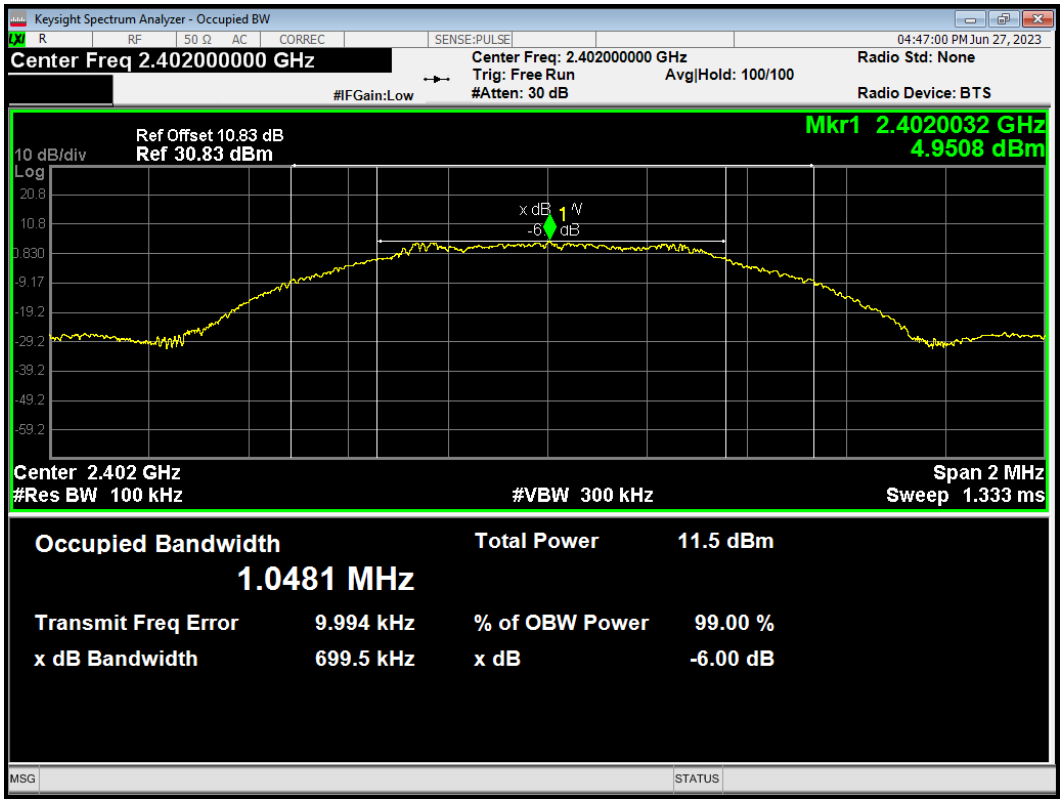
-6dB Bandwidth Bluetooth LE (2M) 2440MHz



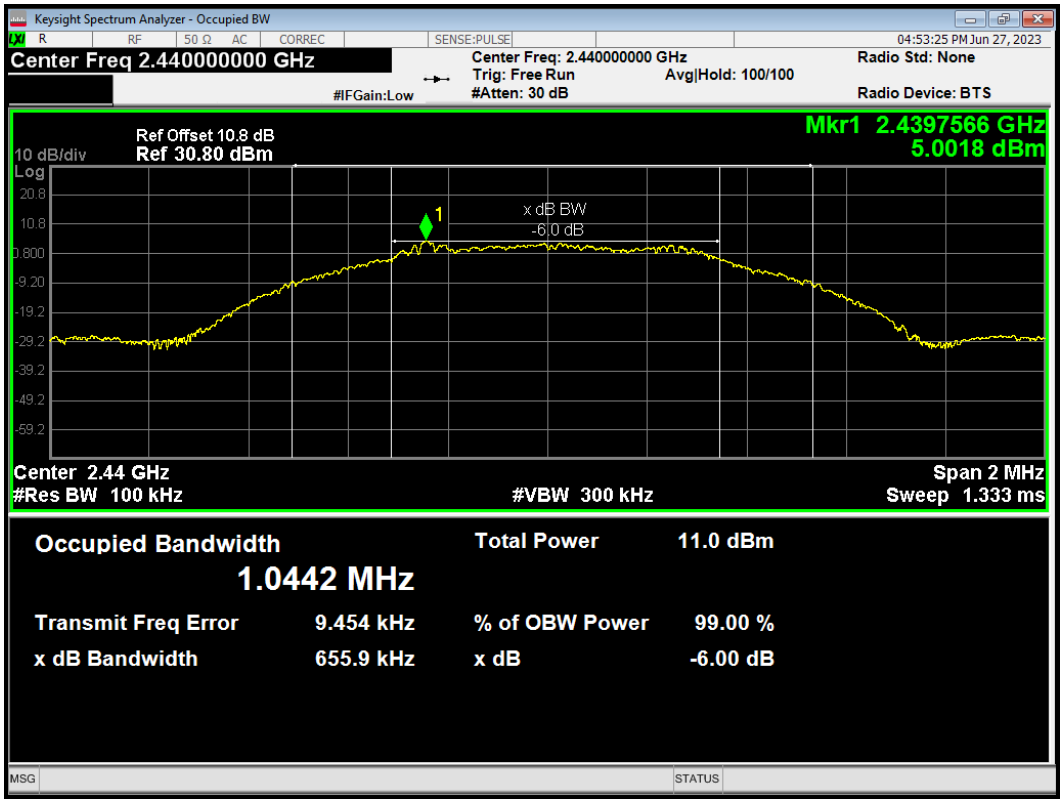
-6dB Bandwidth Bluetooth LE (2M) 2480MHz



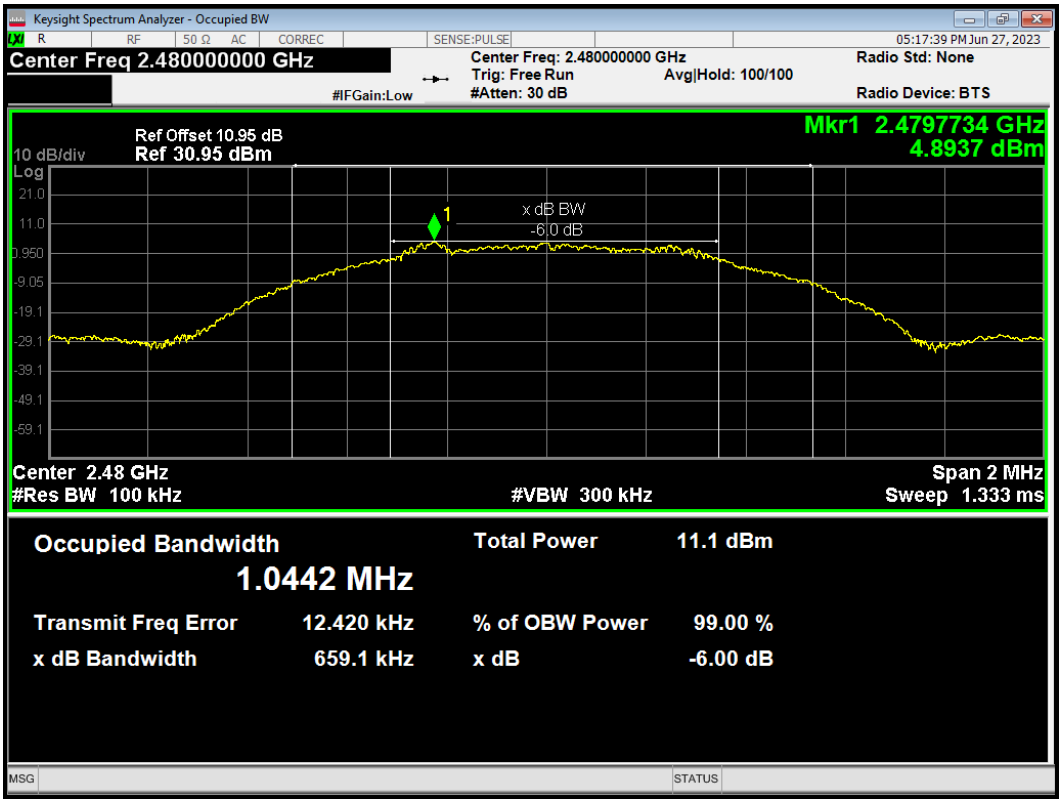
-6dB Bandwidth Bluetooth LE (S=2) 2402MHz



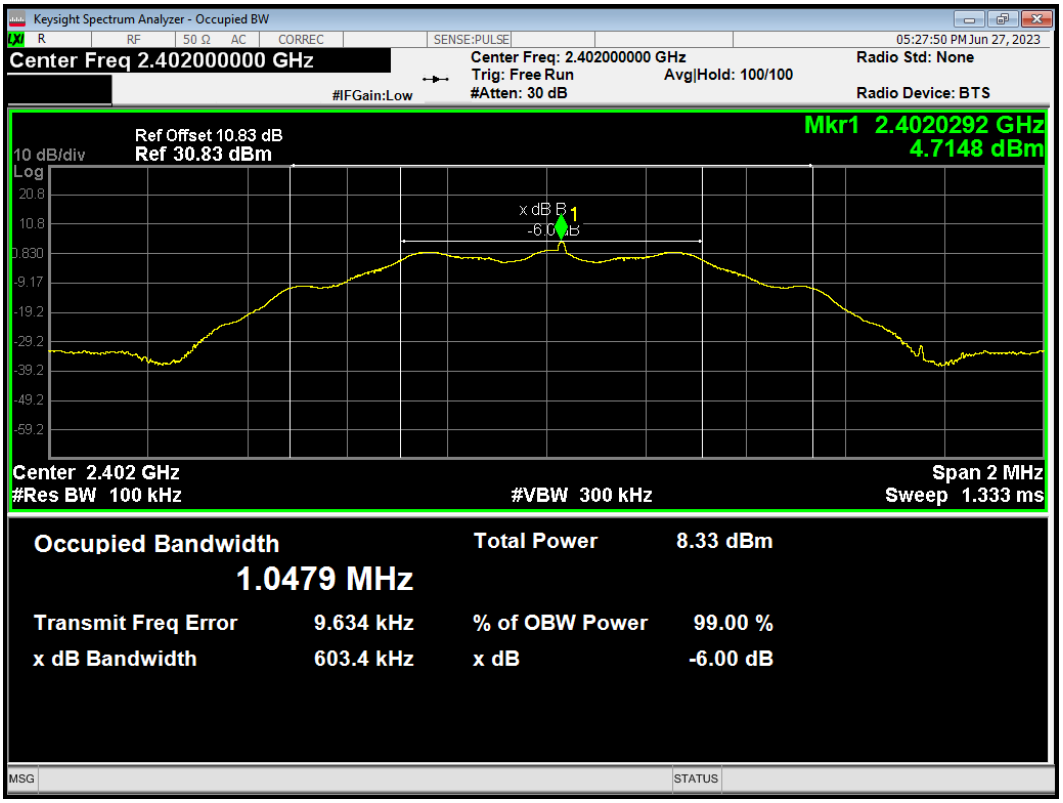
-6dB Bandwidth Bluetooth LE (S=2) 2440MHz



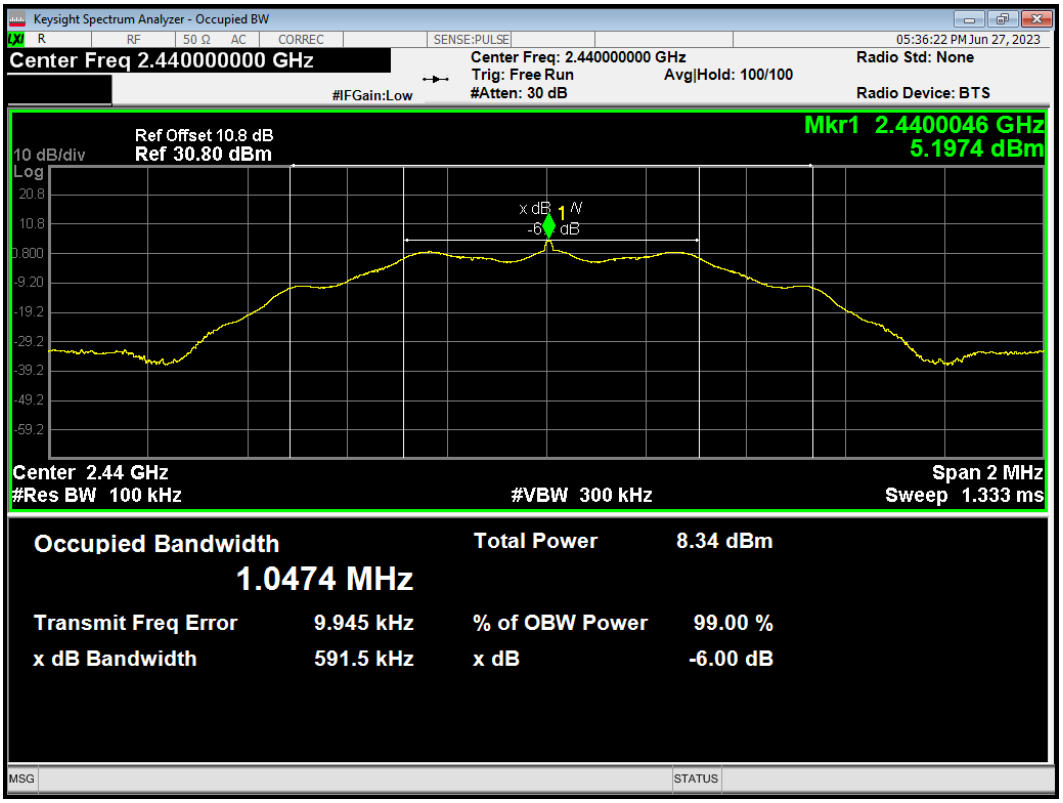
-6dB Bandwidth Bluetooth LE (S=2) 2480MHz



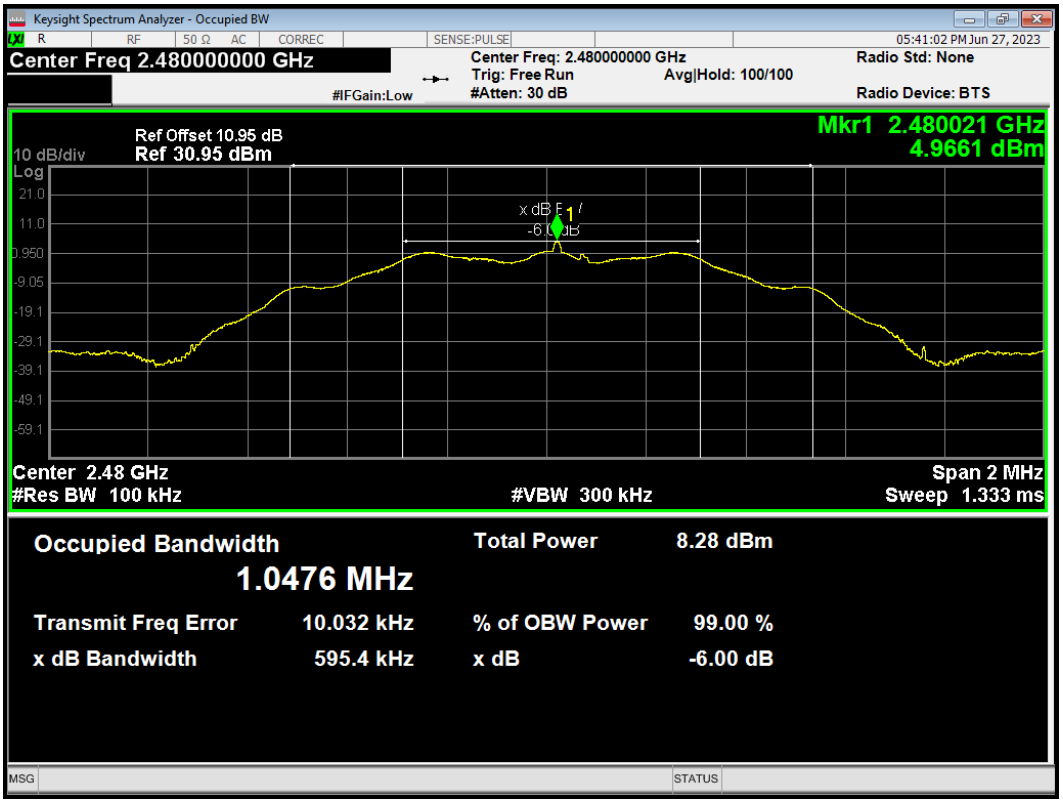
-6dB Bandwidth Bluetooth LE (S=8) 2402MHz



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



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



5.3. Band Edge

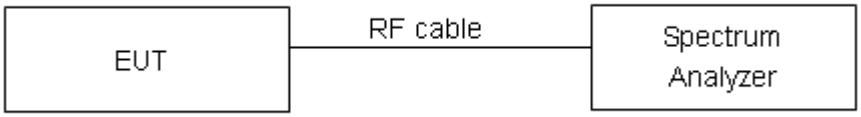
Ambient Condition

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

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

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

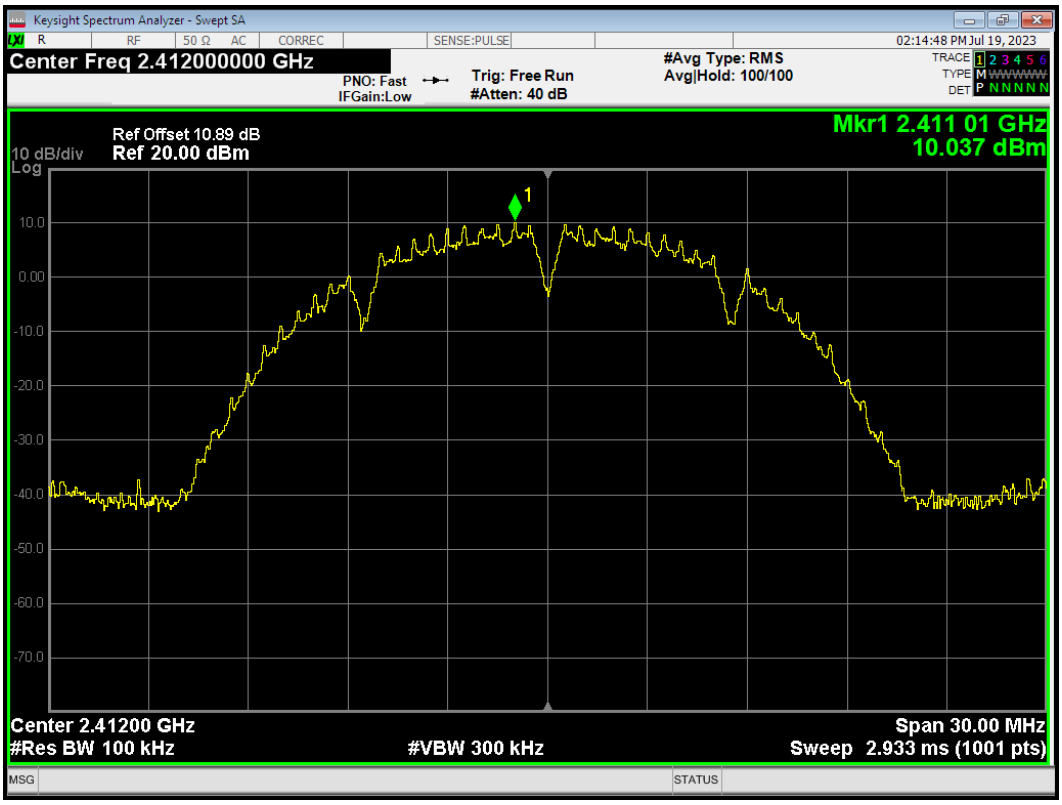
Measurement Uncertainty

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

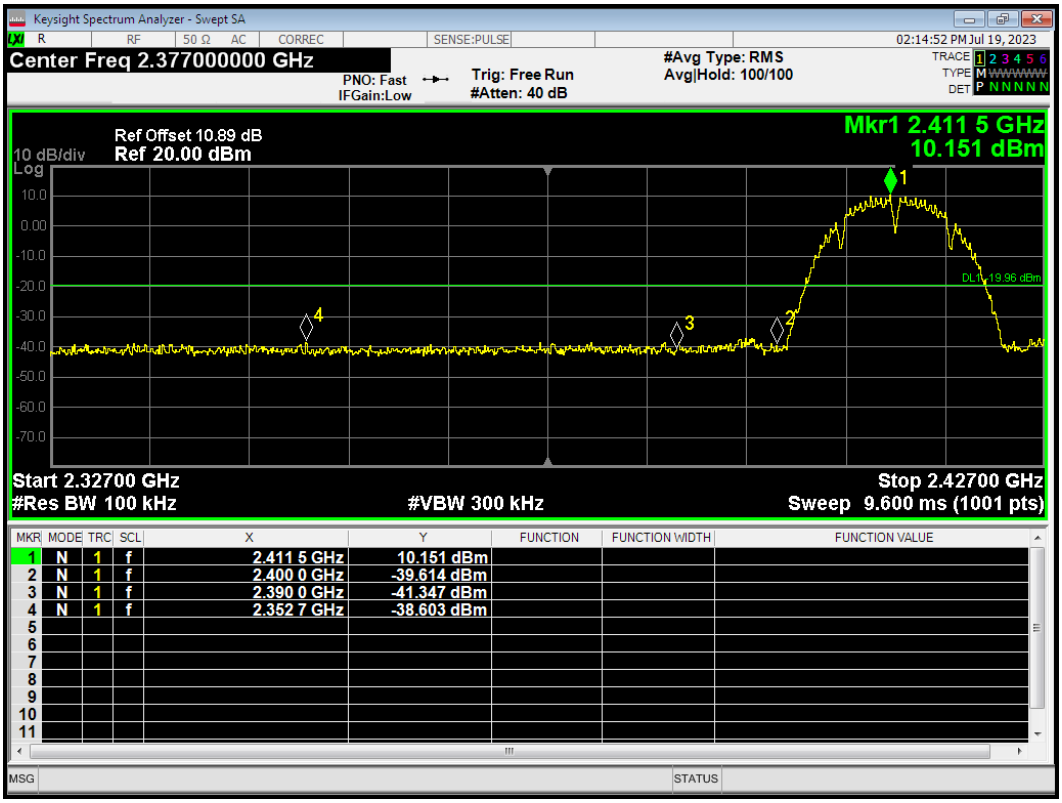
Frequency	Uncertainty
2GHz-3GHz	1.407 dB

Test Results: PASS

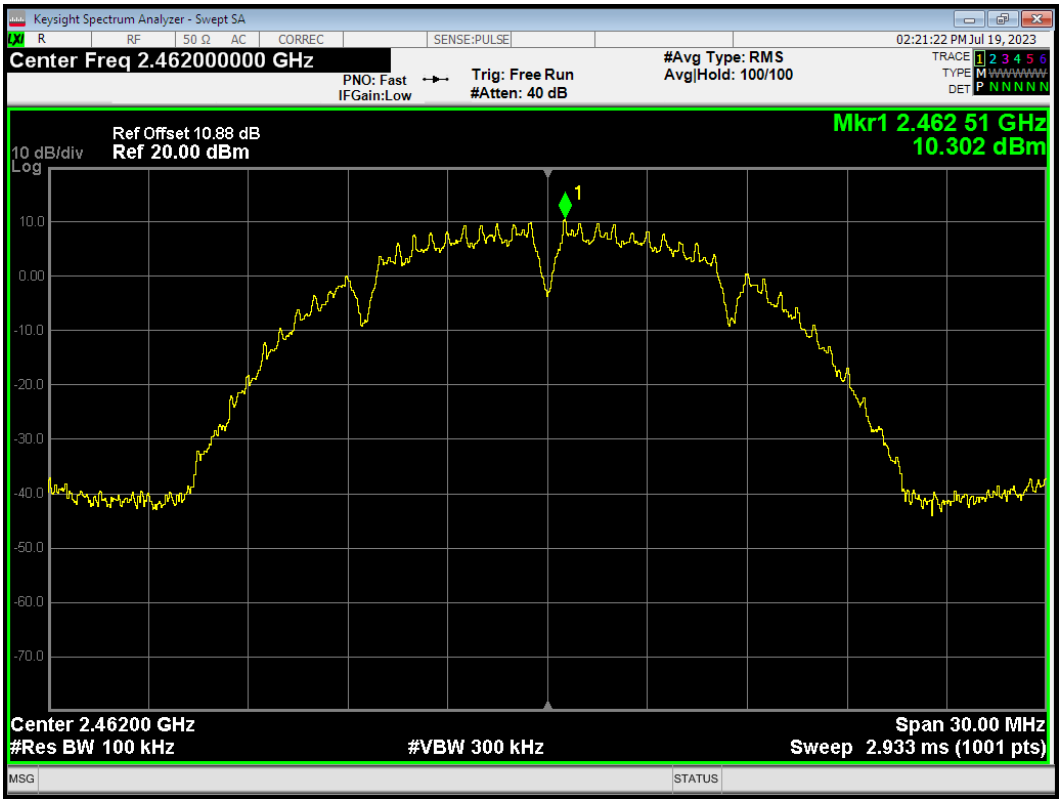
Band Edge 802.11b 2412MHz Ref



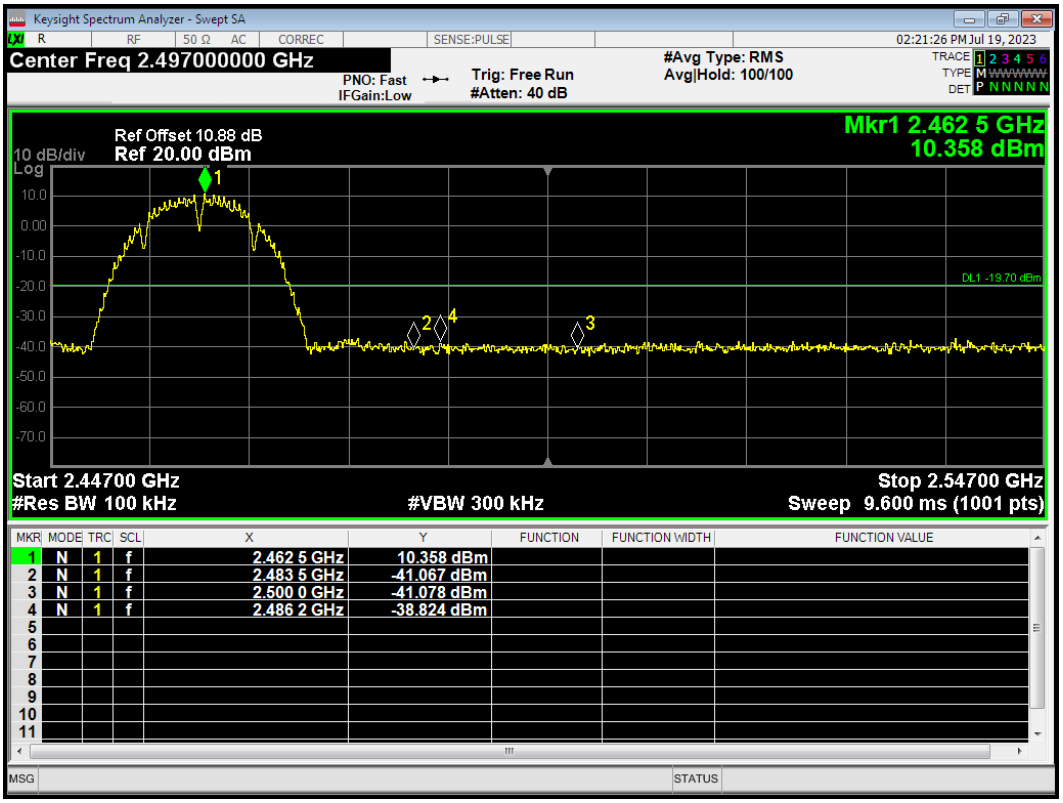
Band Edge 802.11b 2412MHz Emission



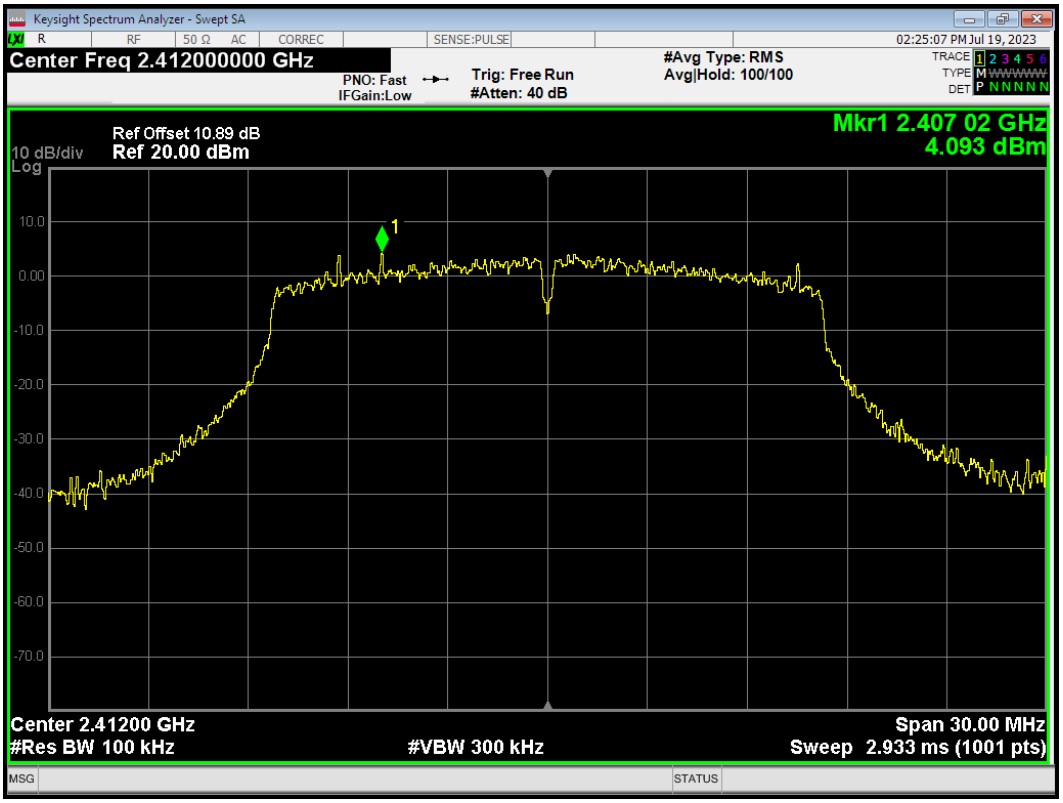
Band Edge 802.11b 2462MHz Ref



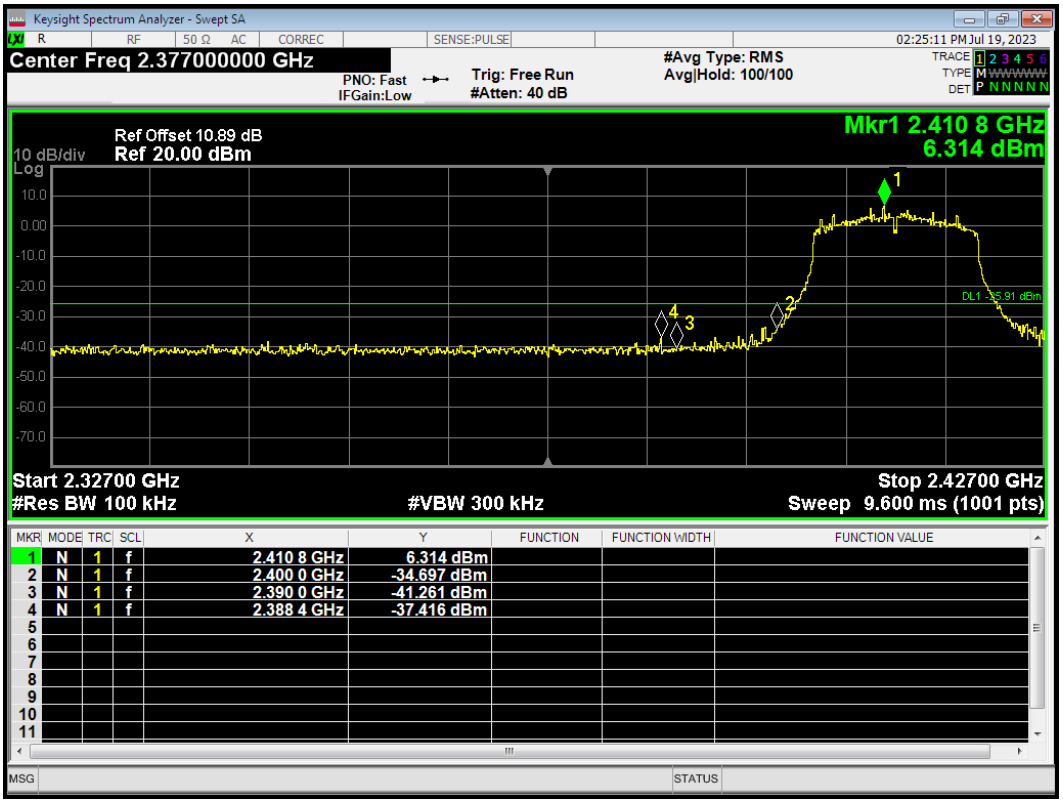
Band Edge 802.11b 2462MHz Emission



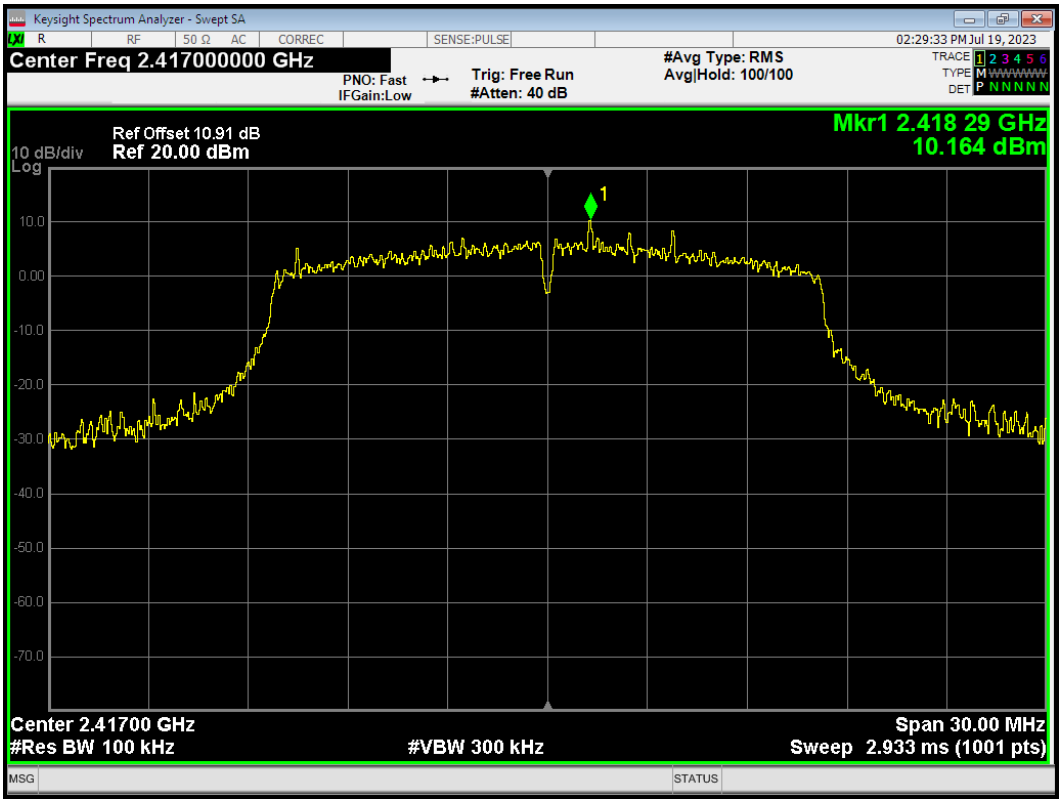
Band Edge 802.11g 2412MHz Ref



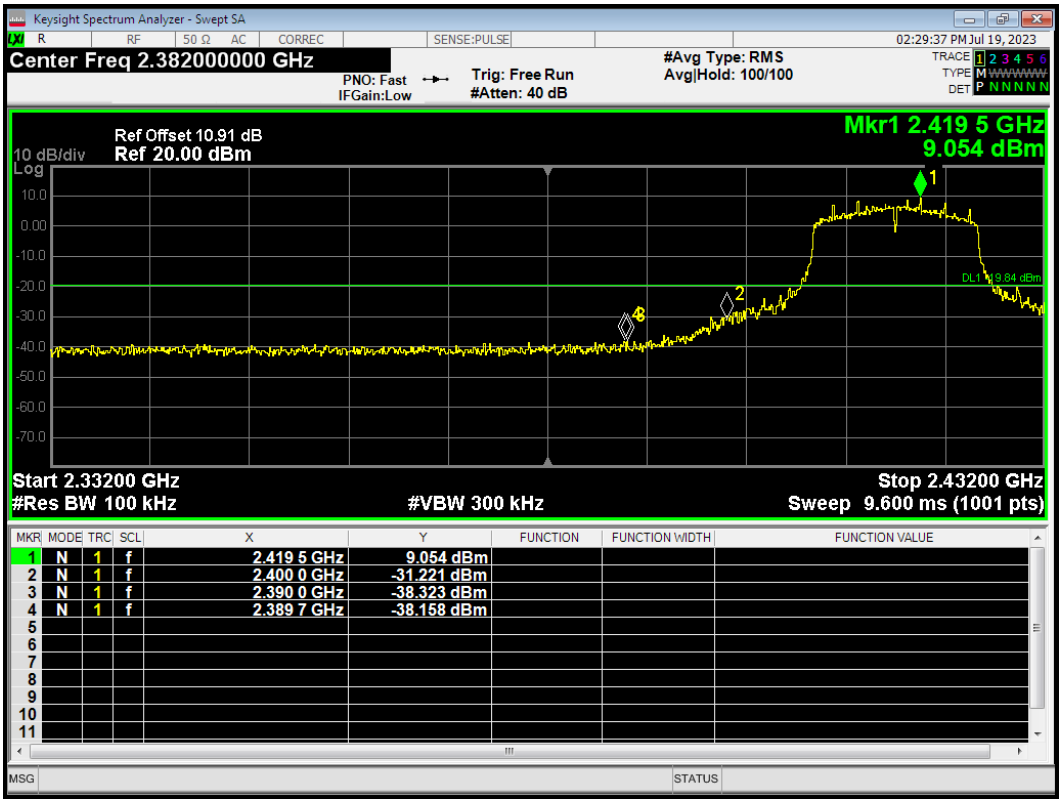
Band Edge 802.11g 2412MHz Emission



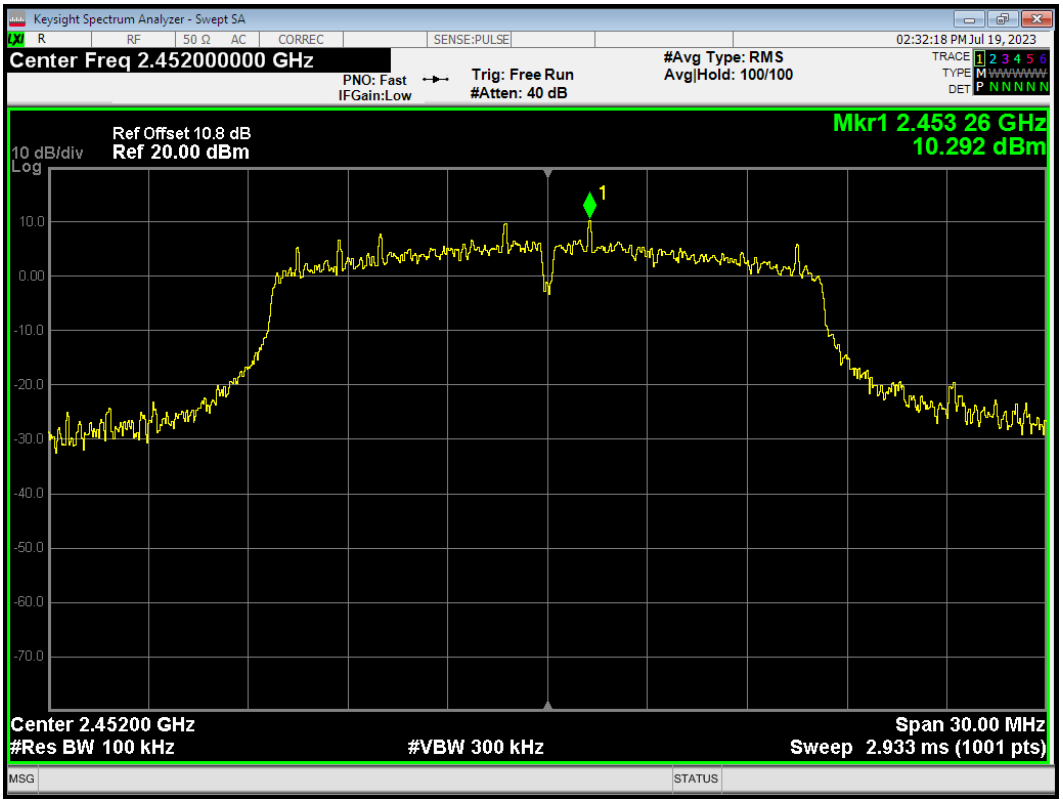
Band Edge 802.11g 2417MHz Ref



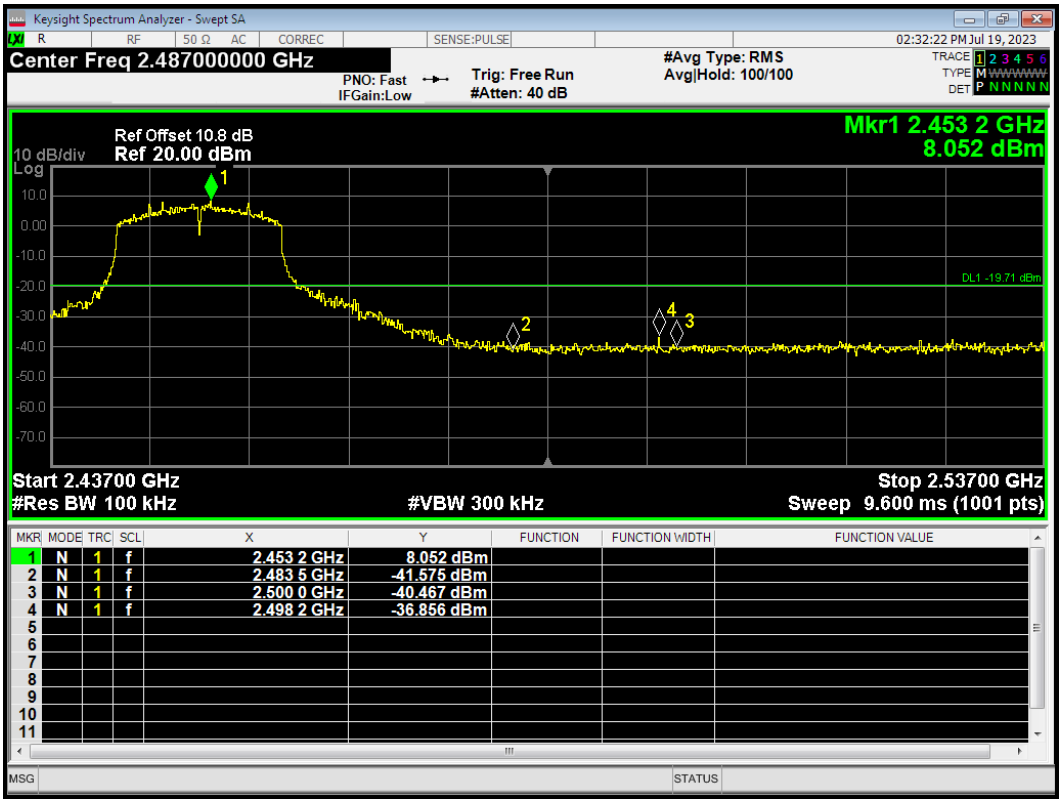
Band Edge 802.11g 2417MHz Emission



Band Edge 802.11g 2452MHz Ref

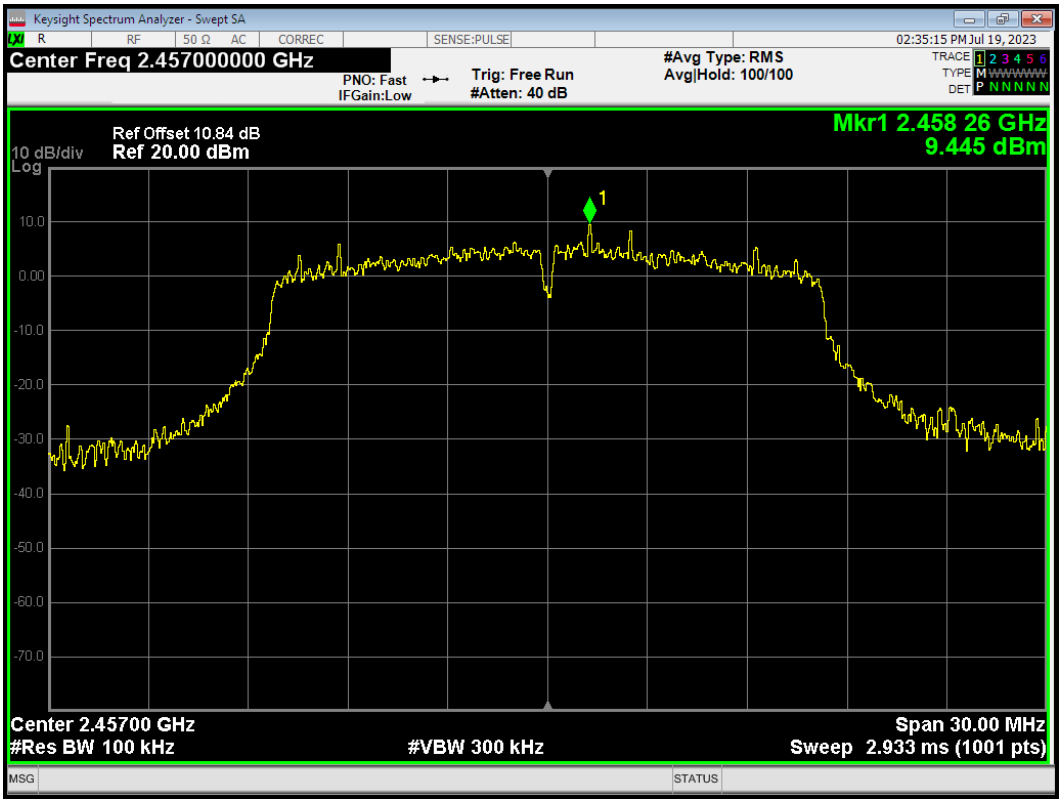


Band Edge 802.11g 2452MHz Emission

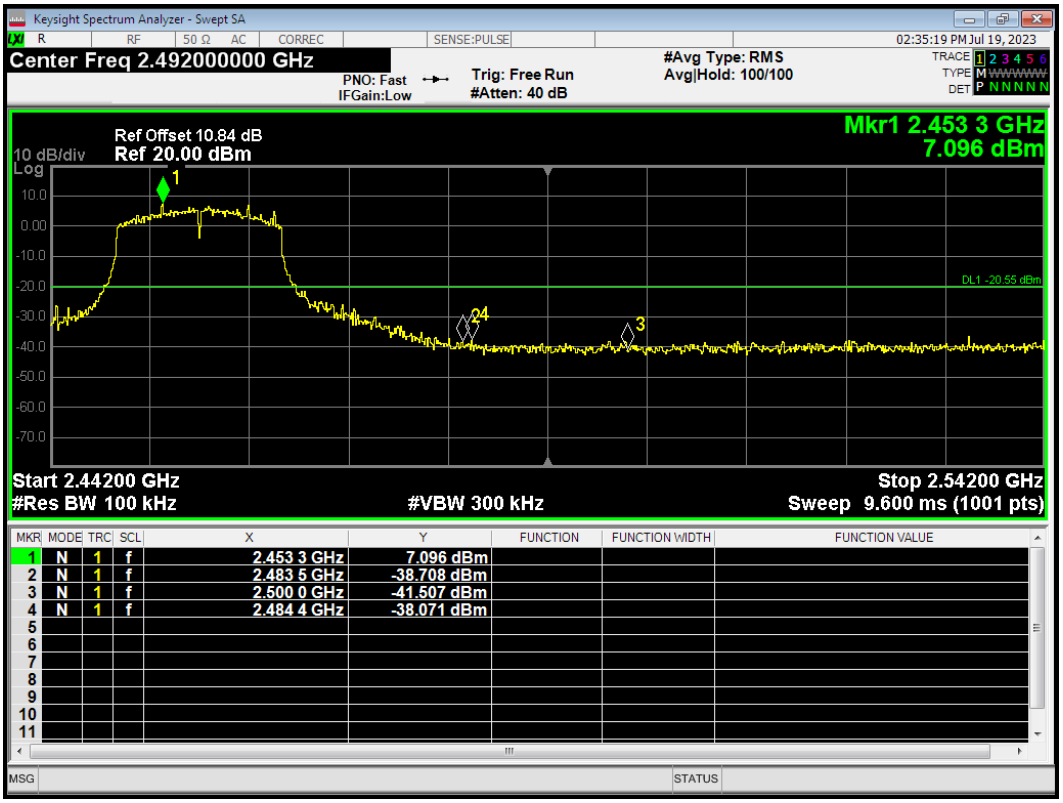


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.453 2 GHz	8.052 dBm			
2	N	1	f	2.483 5 GHz	-41.575 dBm			
3	N	1	f	2.500 0 GHz	-40.467 dBm			
4	N	1	f	2.498 2 GHz	-36.856 dBm			

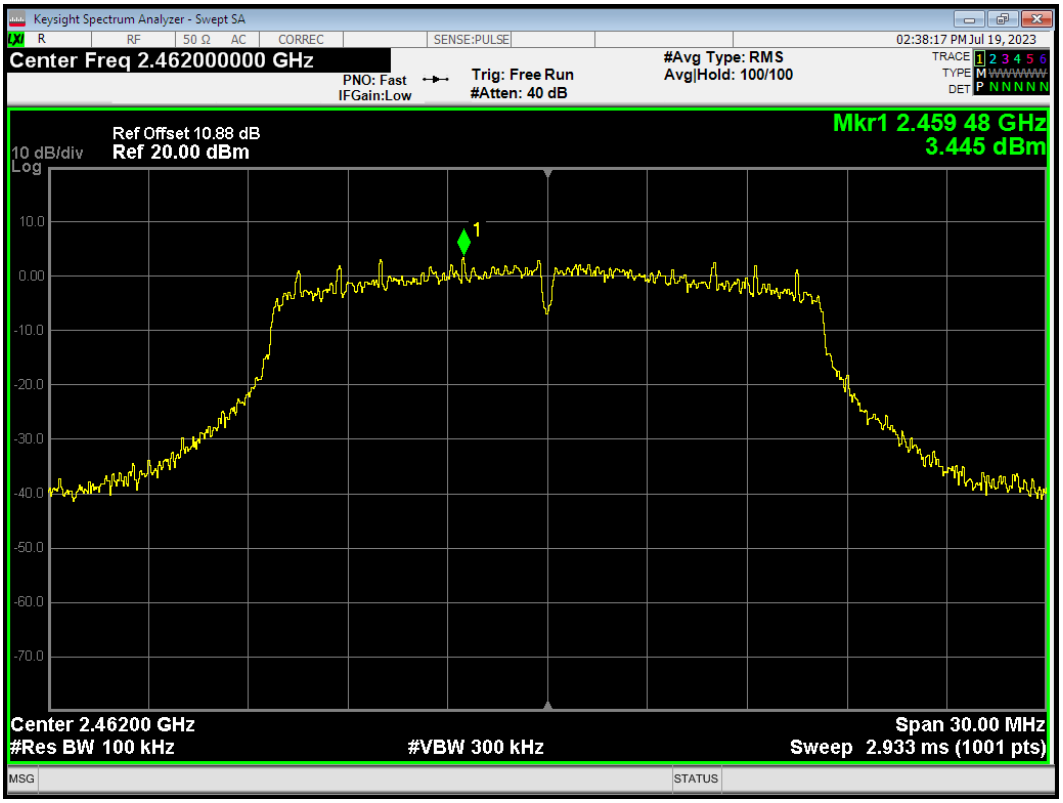
Band Edge 802.11g 2457MHz Ref



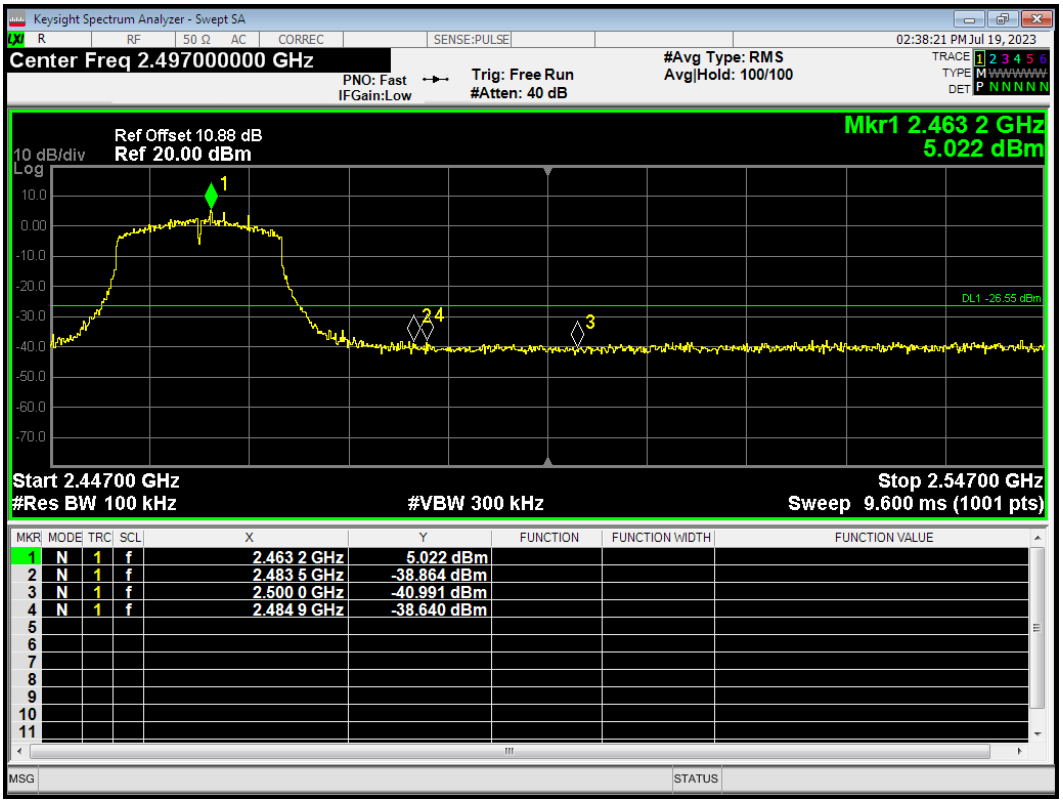
Band Edge 802.11g 2457MHz Emission



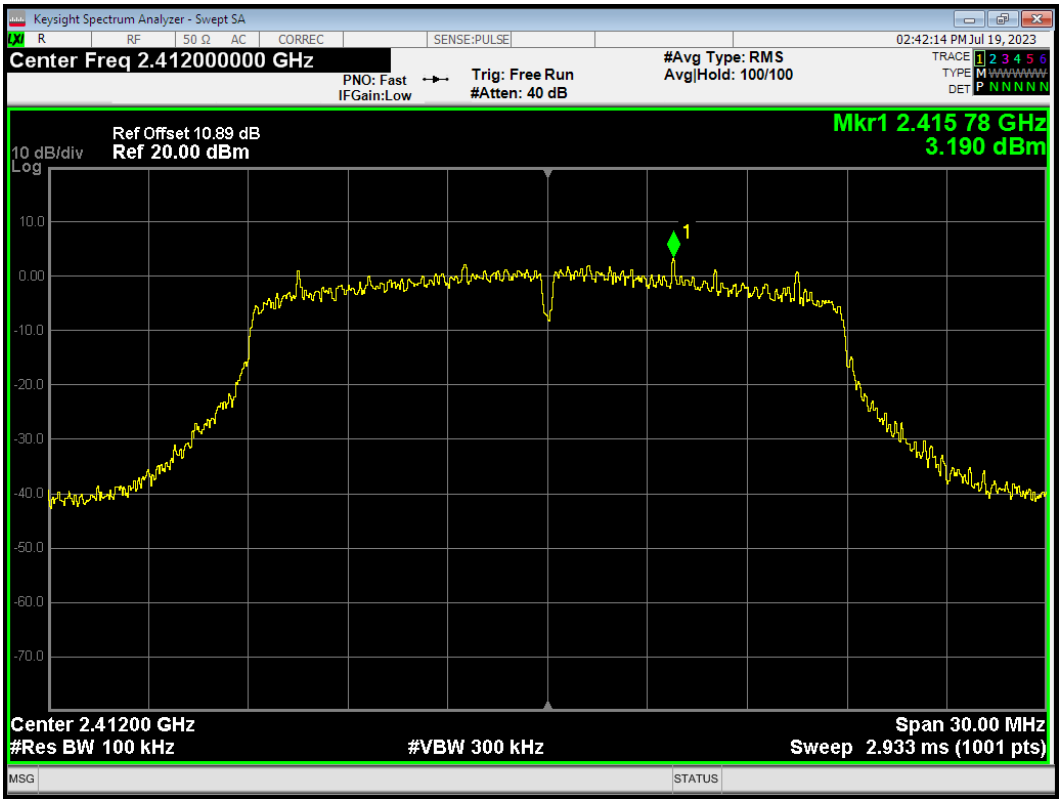
Band Edge 802.11g 2462MHz Ref



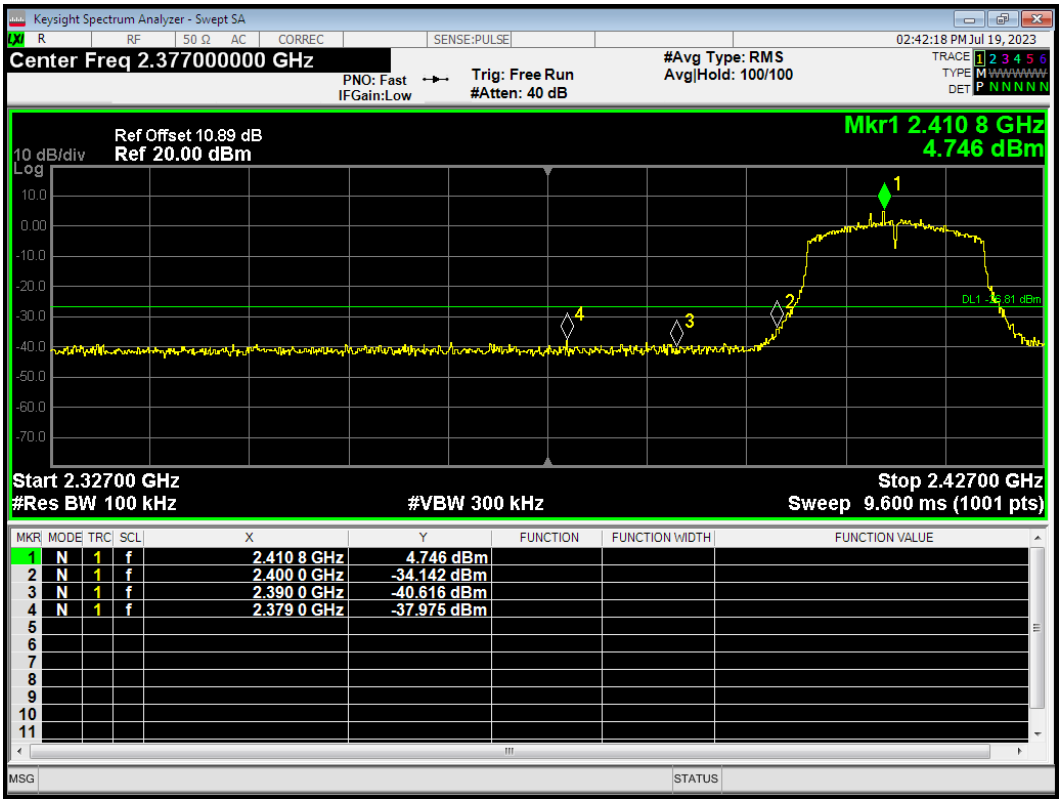
Band Edge 802.11g 2462MHz Emission



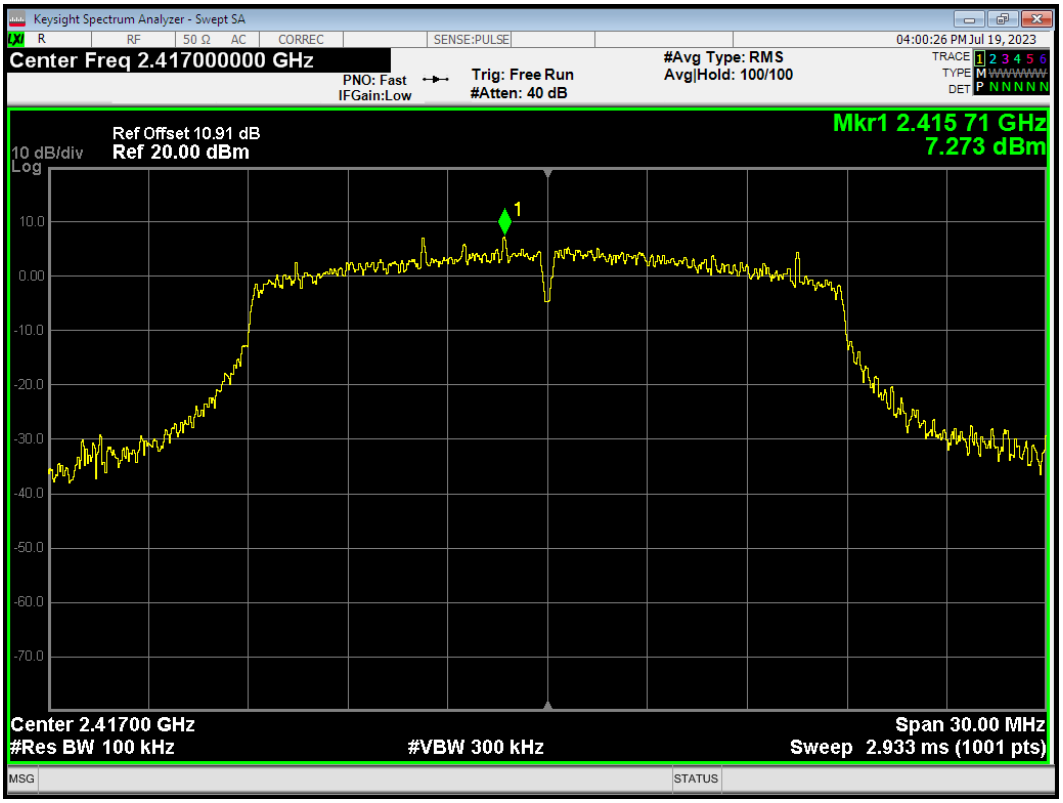
Band Edge 802.11n(HT20) 2412MHz Ref



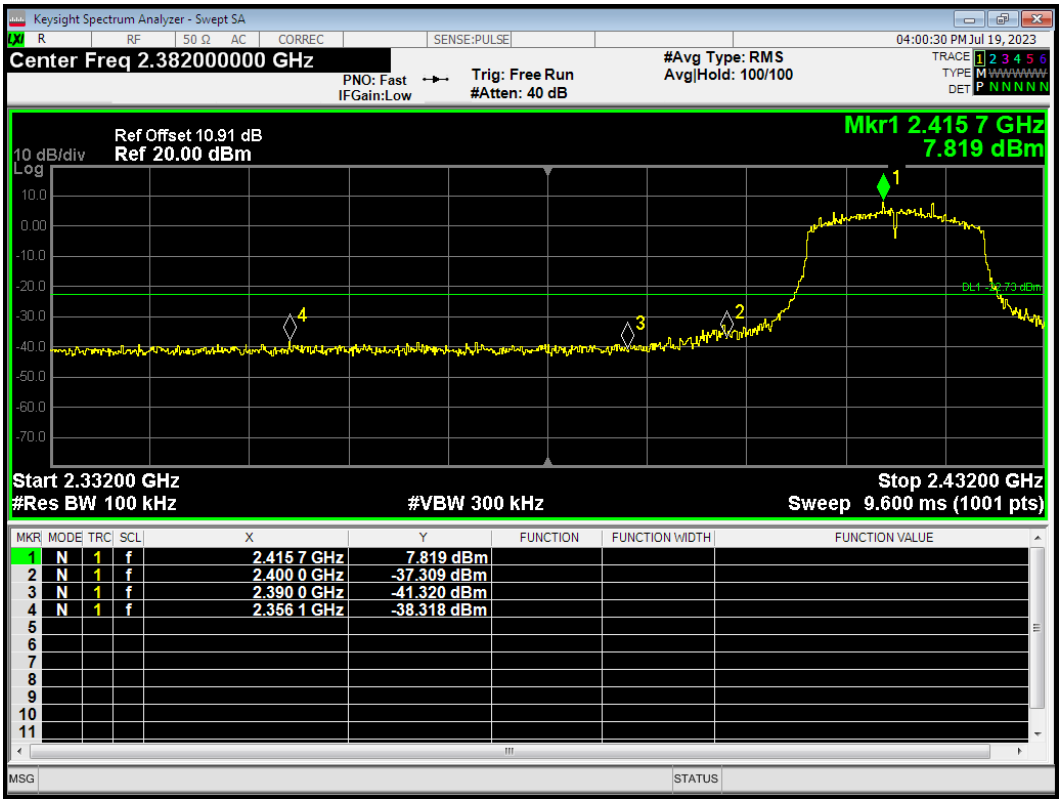
Band Edge 802.11n(HT20) 2412MHz Emission



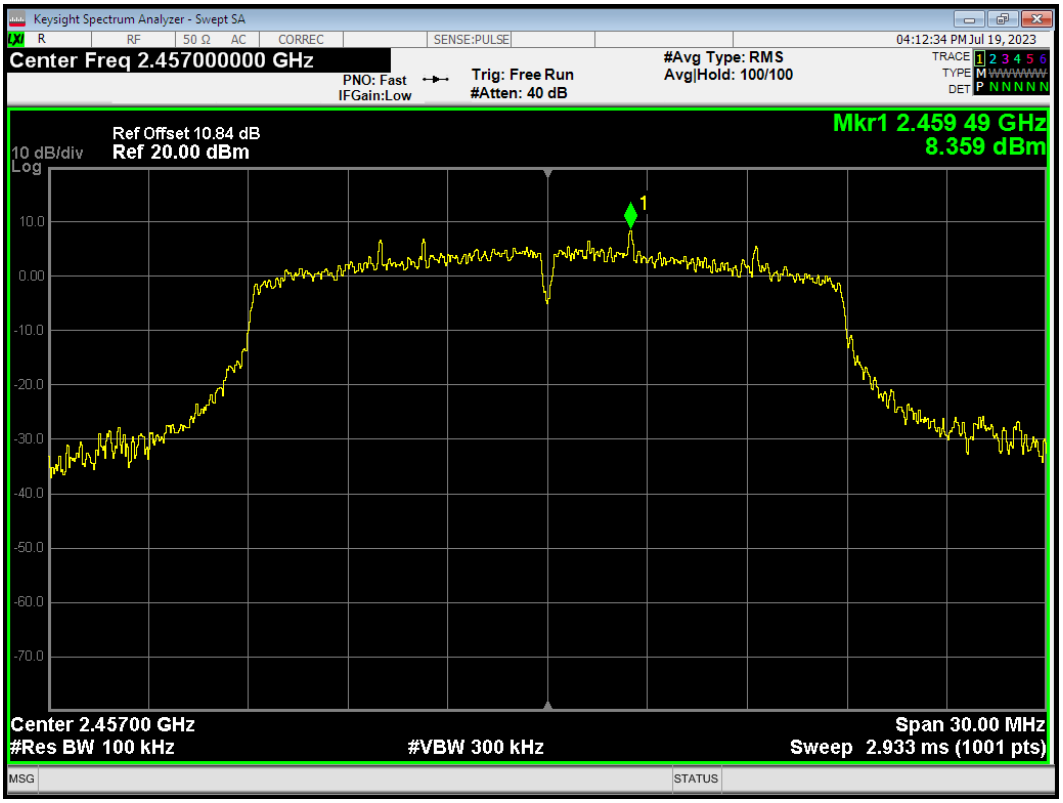
Band Edge 802.11n(HT20) 2417MHz Ref



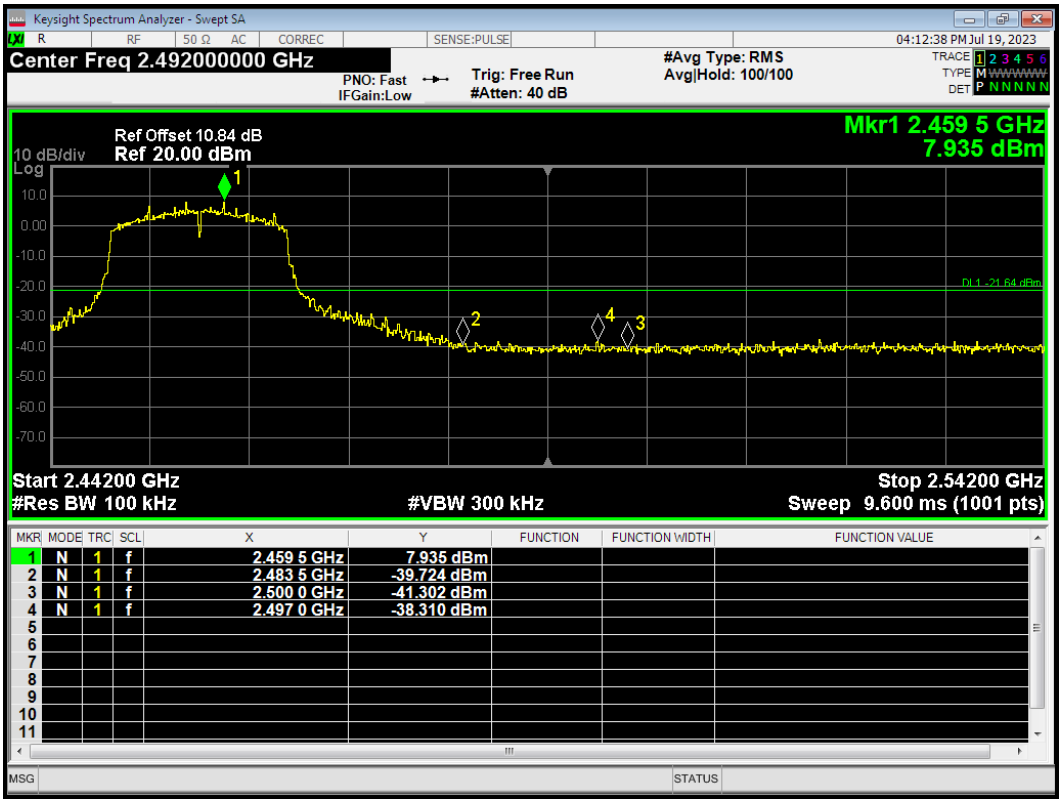
Band Edge 802.11n(HT20) 2417MHz Emission



Band Edge 802.11n(HT20) 2457MHz Ref



Band Edge 802.11n(HT20) 2457MHz Emission



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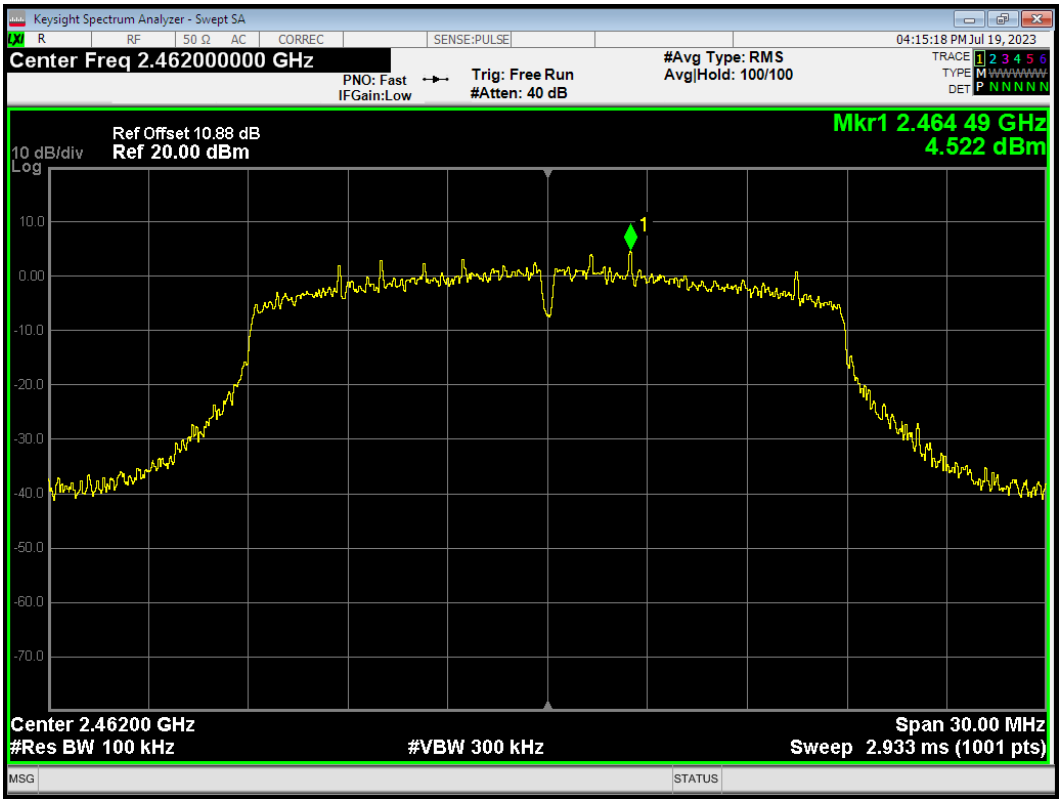
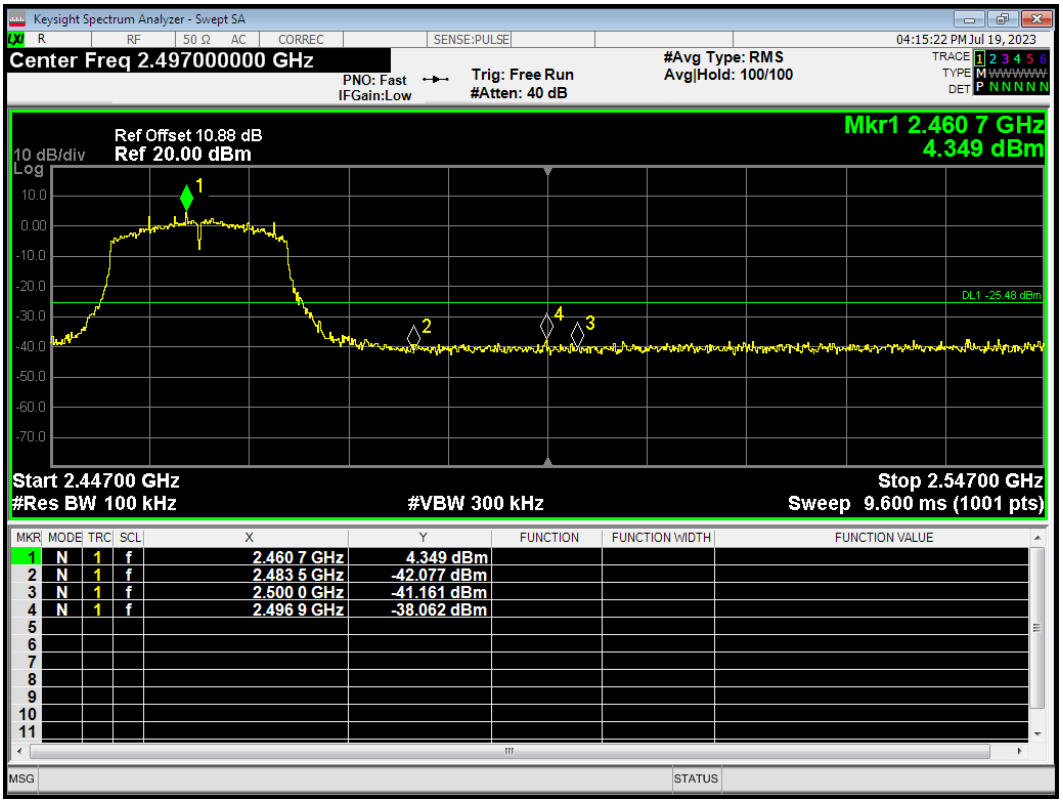
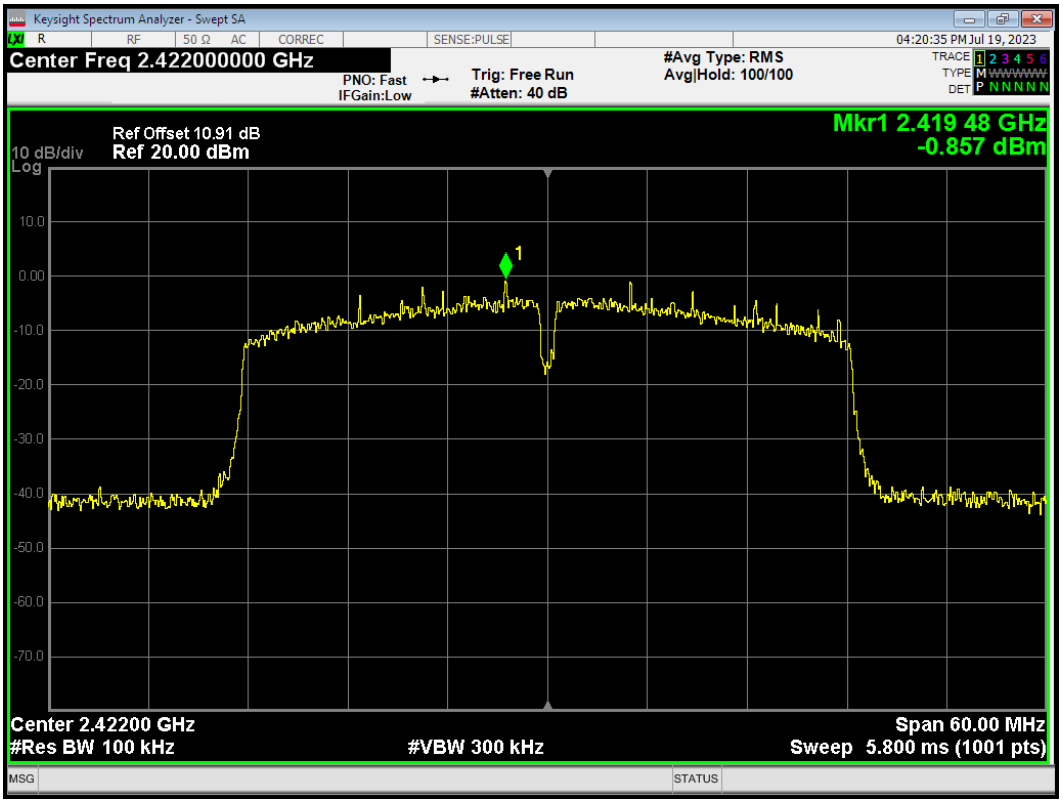


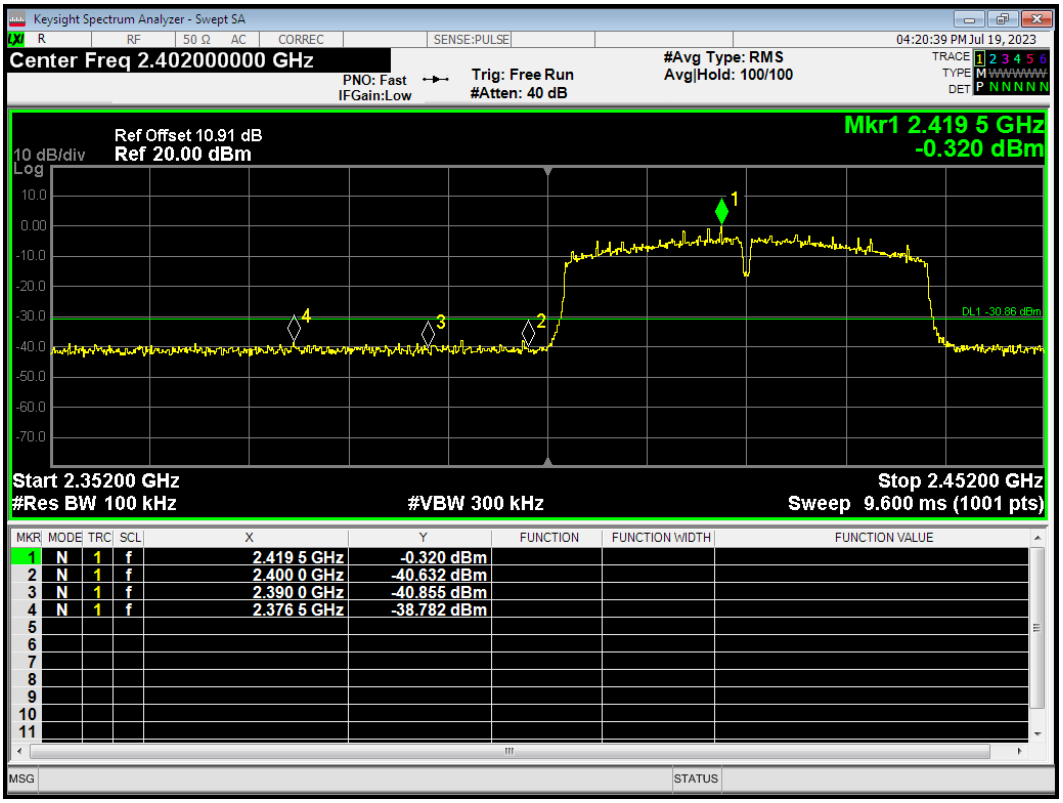
Band Edge 802.11n(HT20) 2462MHz Emission



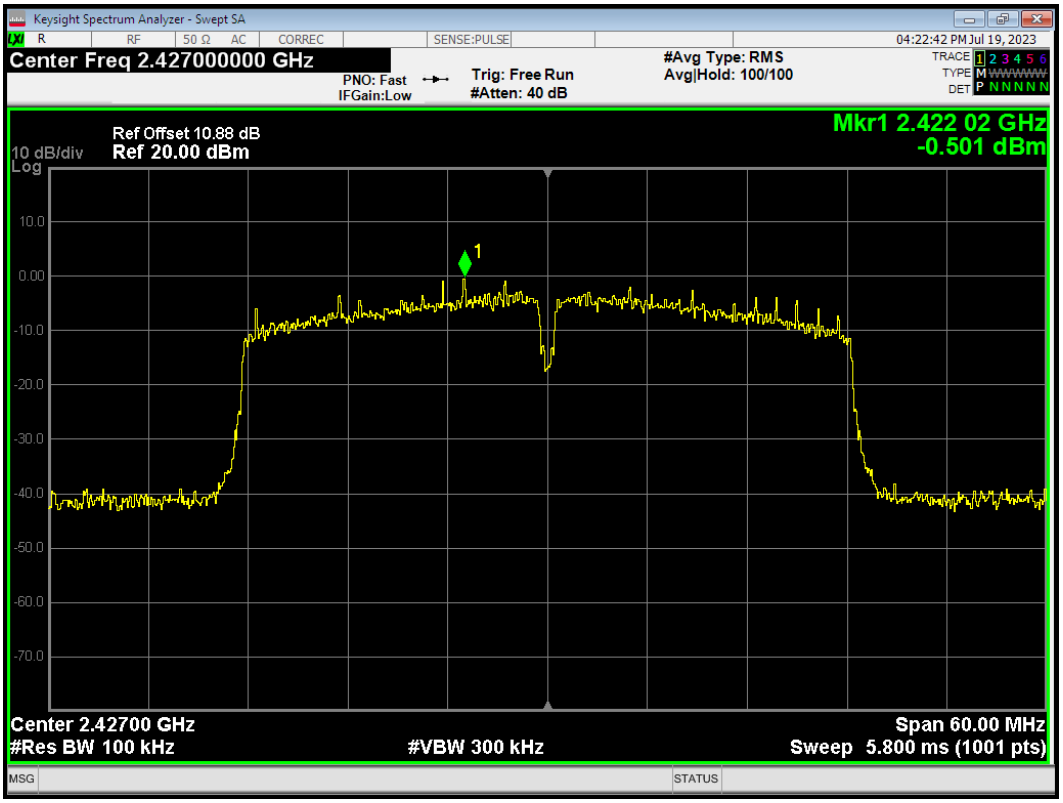
Band Edge 802.11n(HT40) 2422MHz Ref



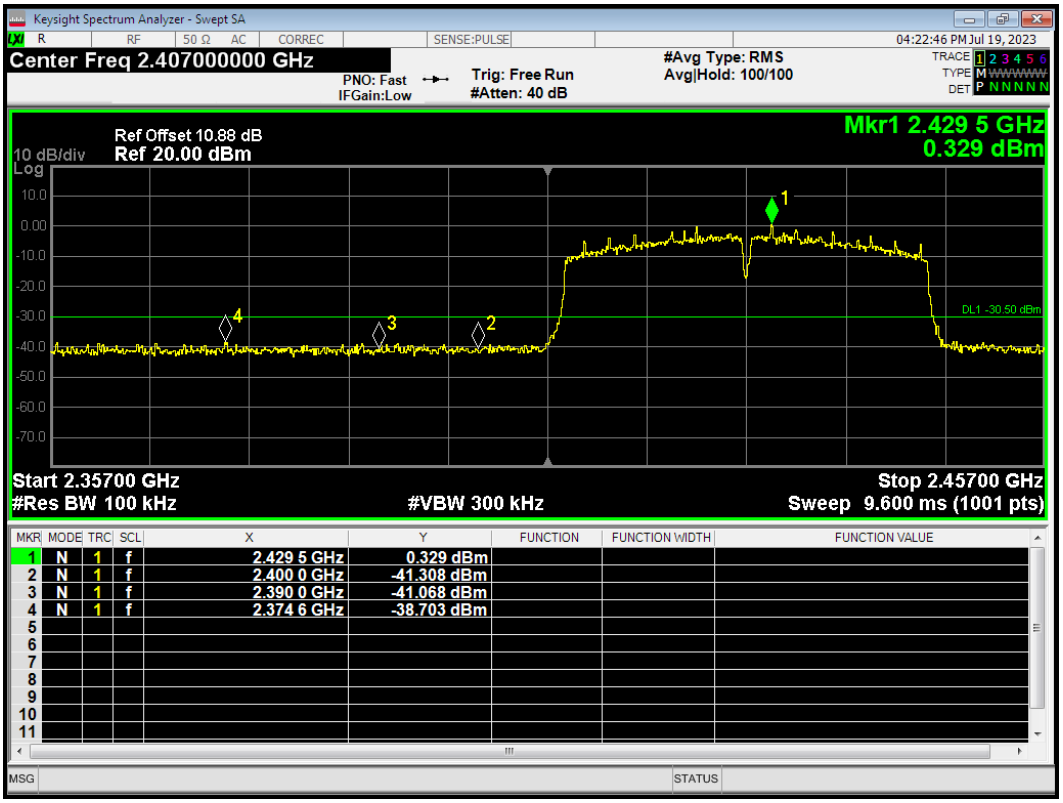
Band Edge 802.11n(HT40) 2422MHz Emission



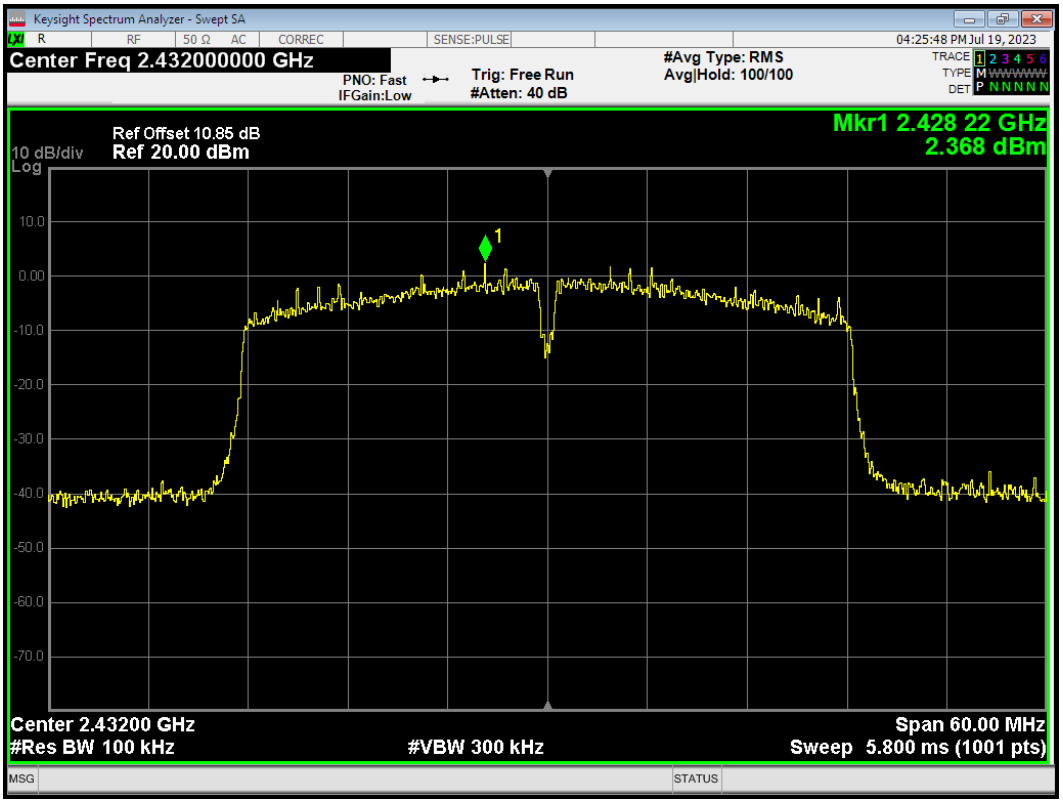
Band Edge 802.11n(HT40) 2427MHz Ref



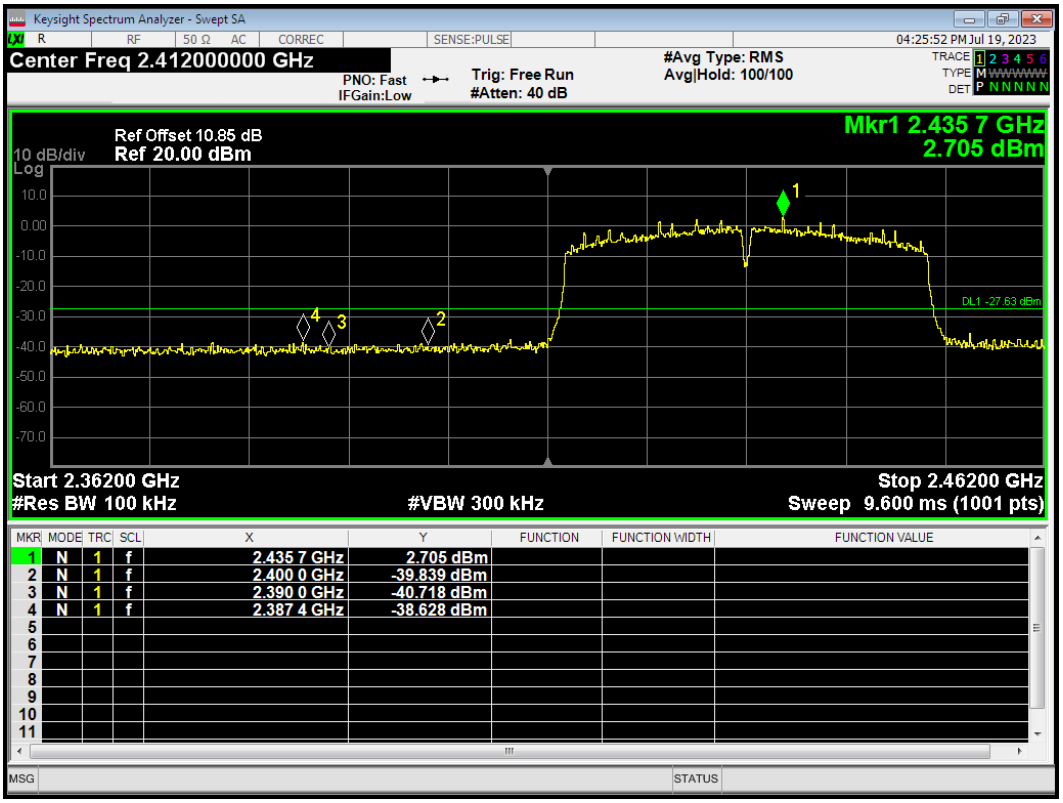
Band Edge 802.11n(HT40) 2427MHz Emission



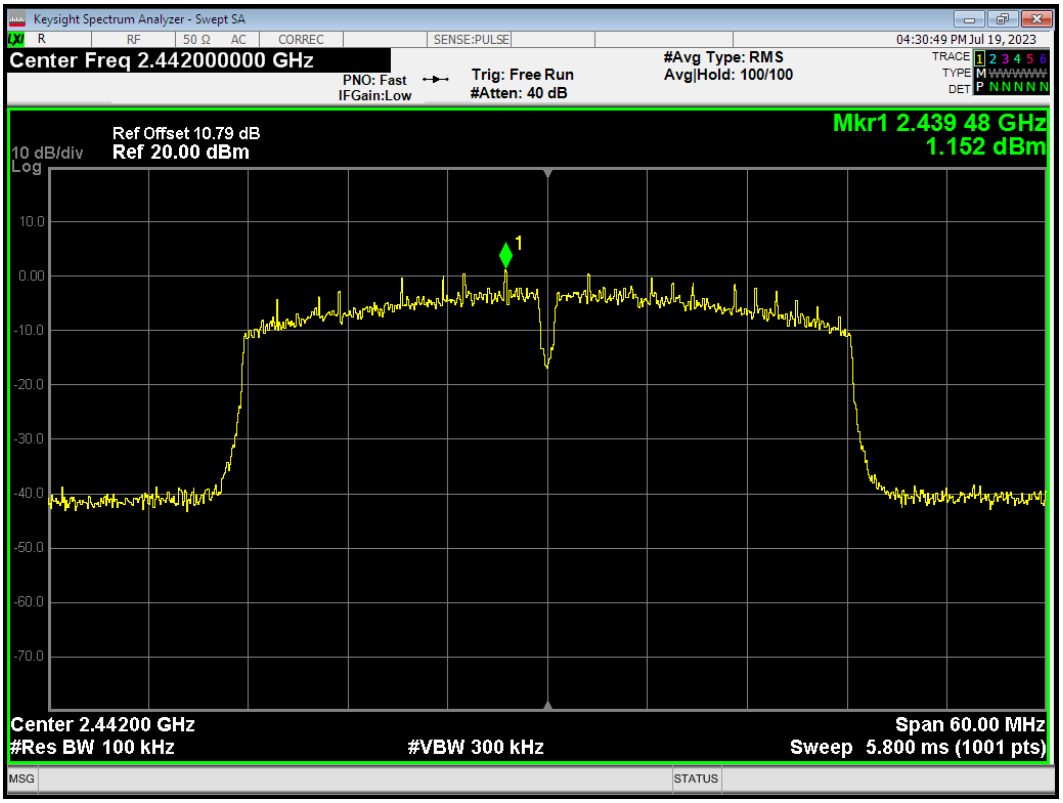
Band Edge 802.11n(HT40) 2432MHz Ref



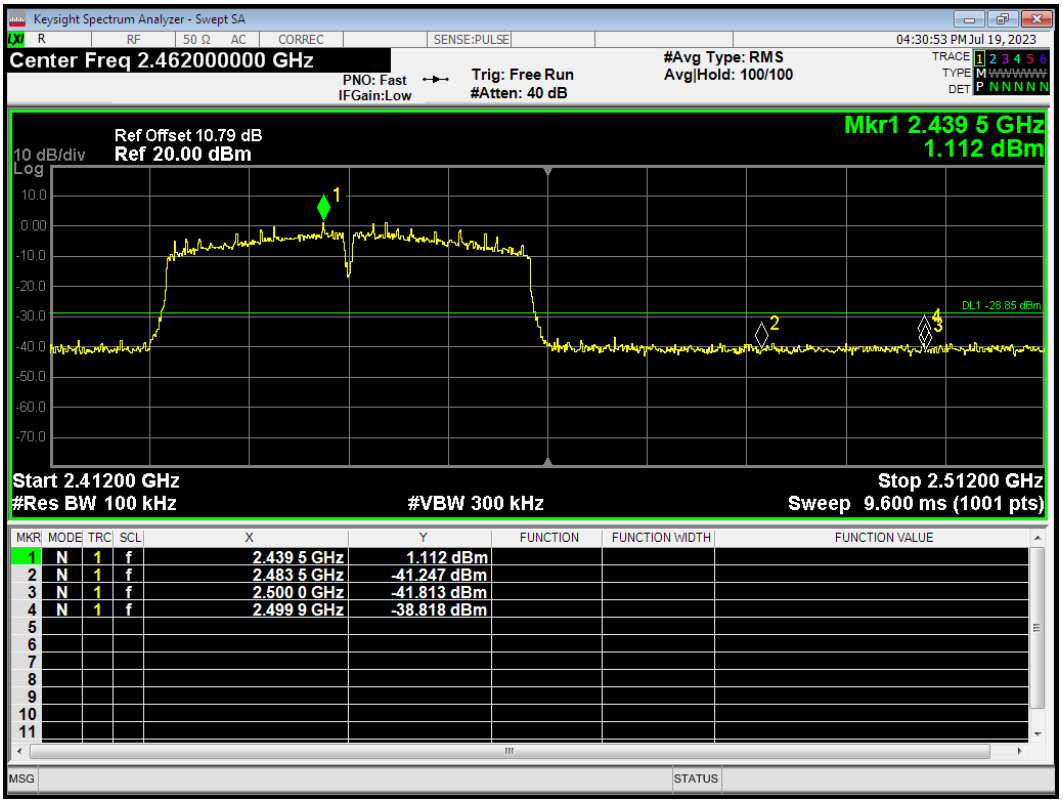
Band Edge 802.11n(HT40) 2432MHz Emission



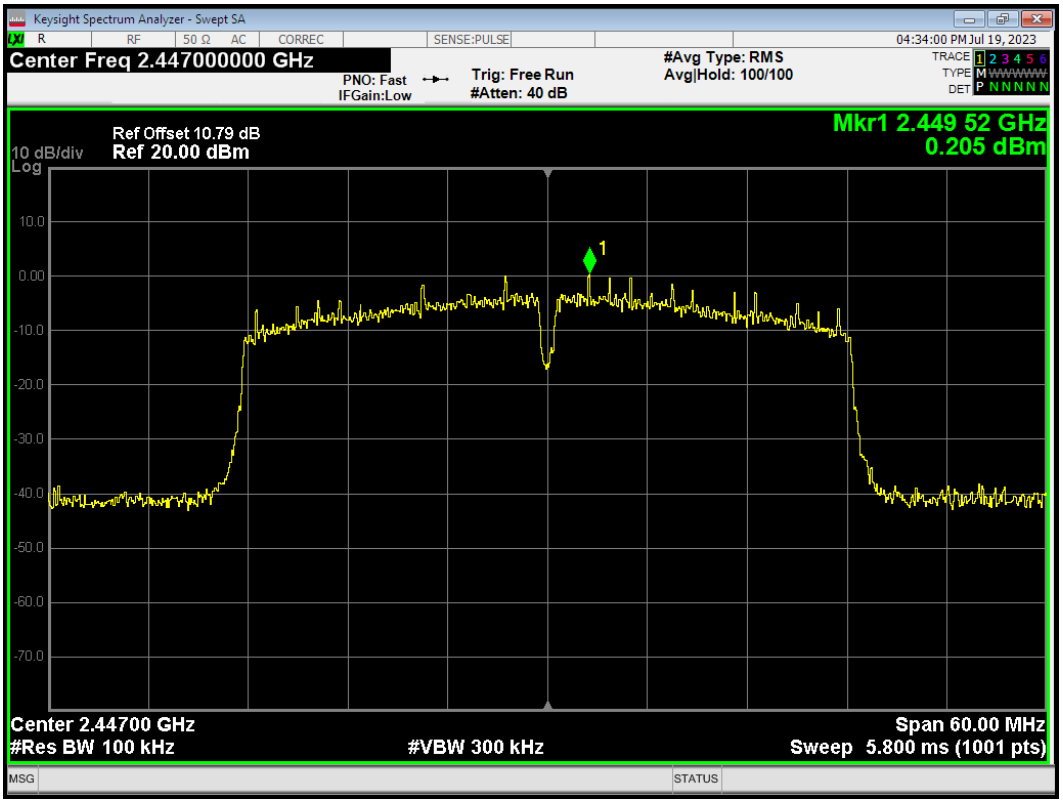
Band Edge 802.11n(HT40) 2442MHz Ref



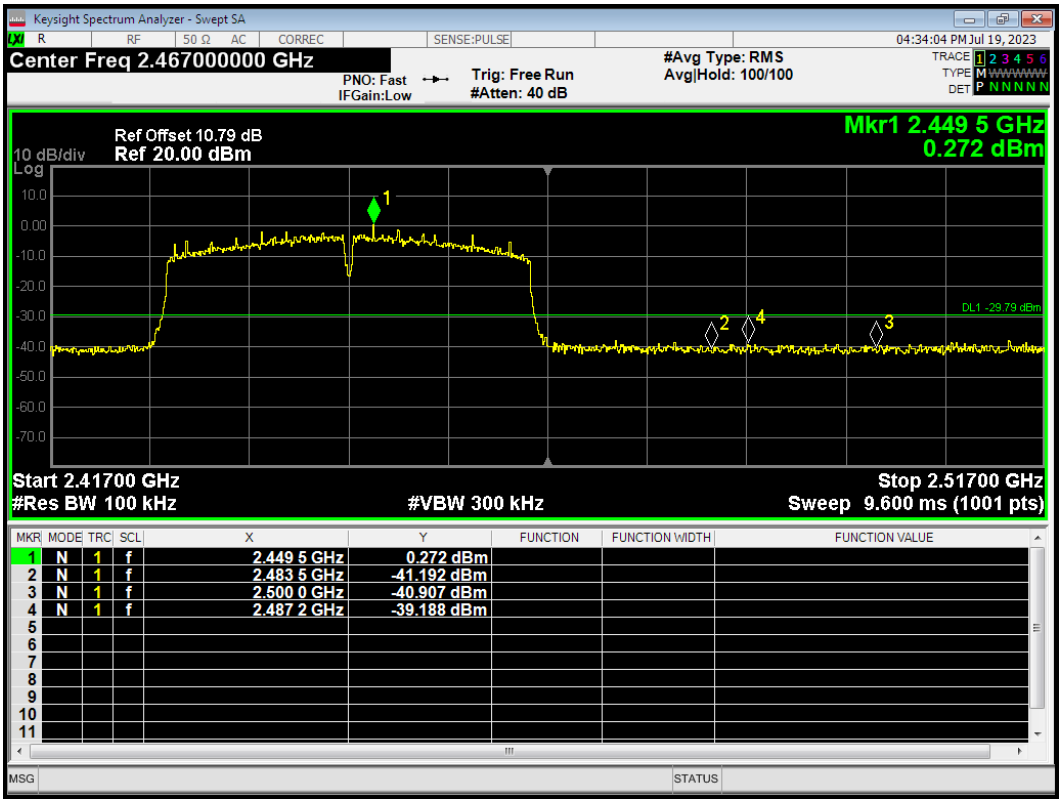
Band Edge 802.11n(HT40) 2442MHz Emission



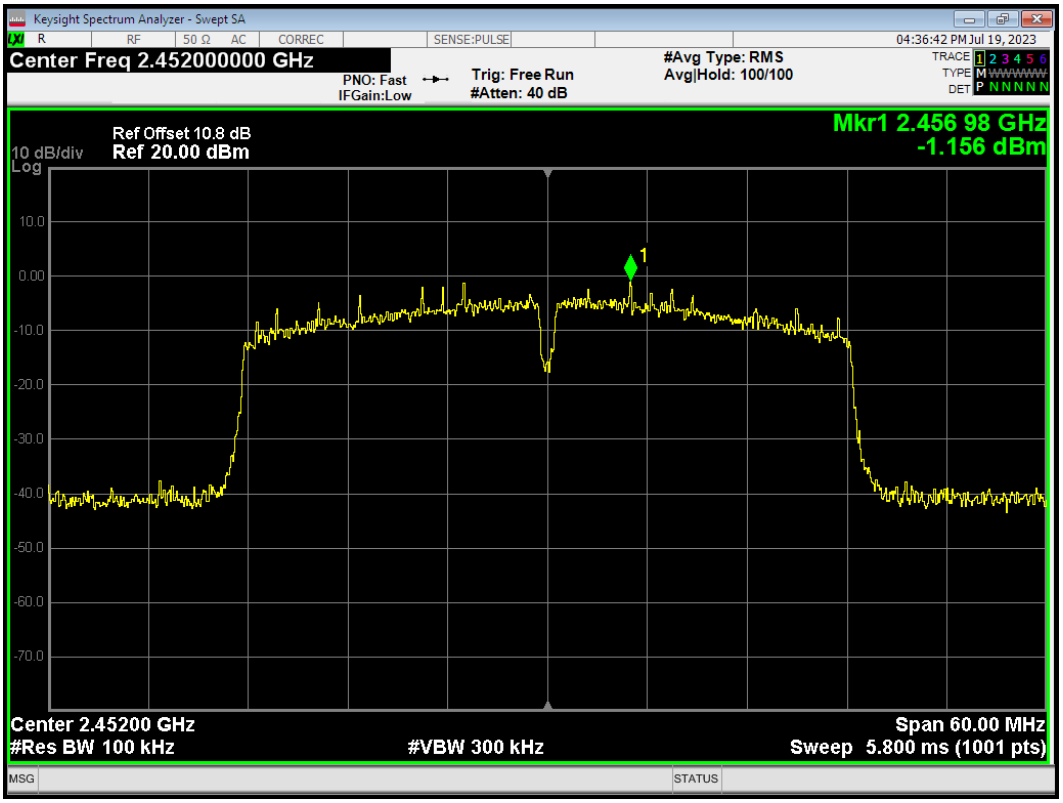
Band Edge 802.11n(HT40) 2447MHz Ref



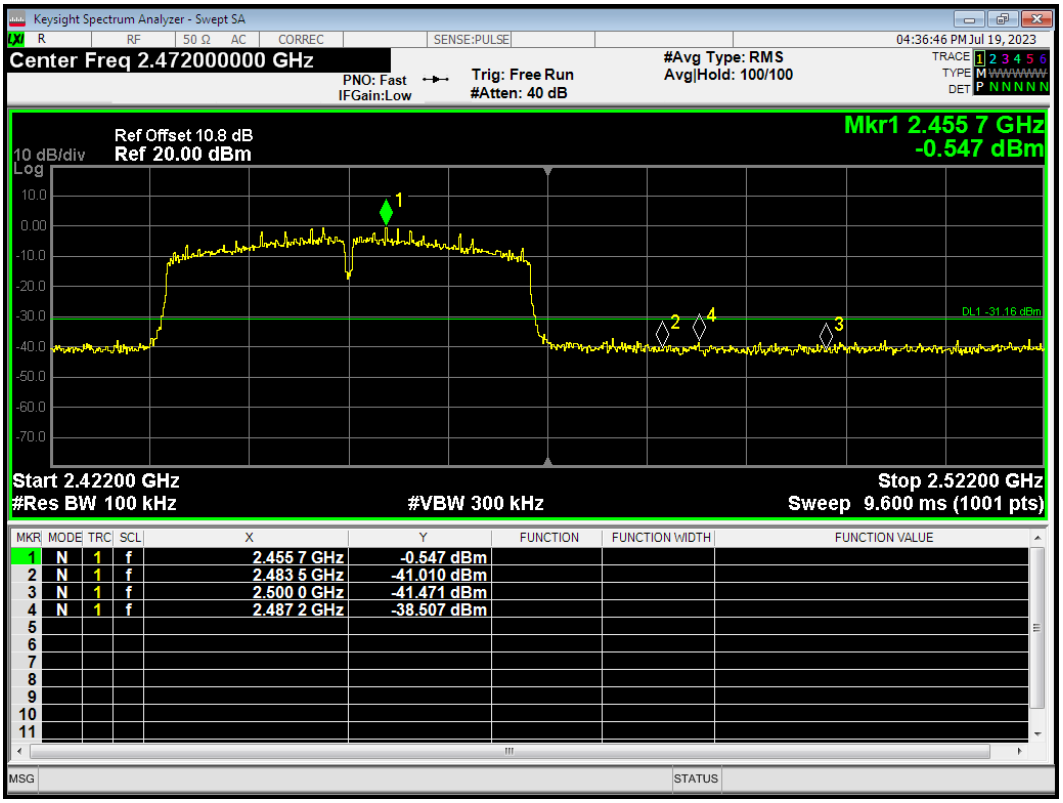
Band Edge 802.11n(HT40) 2447MHz Emission



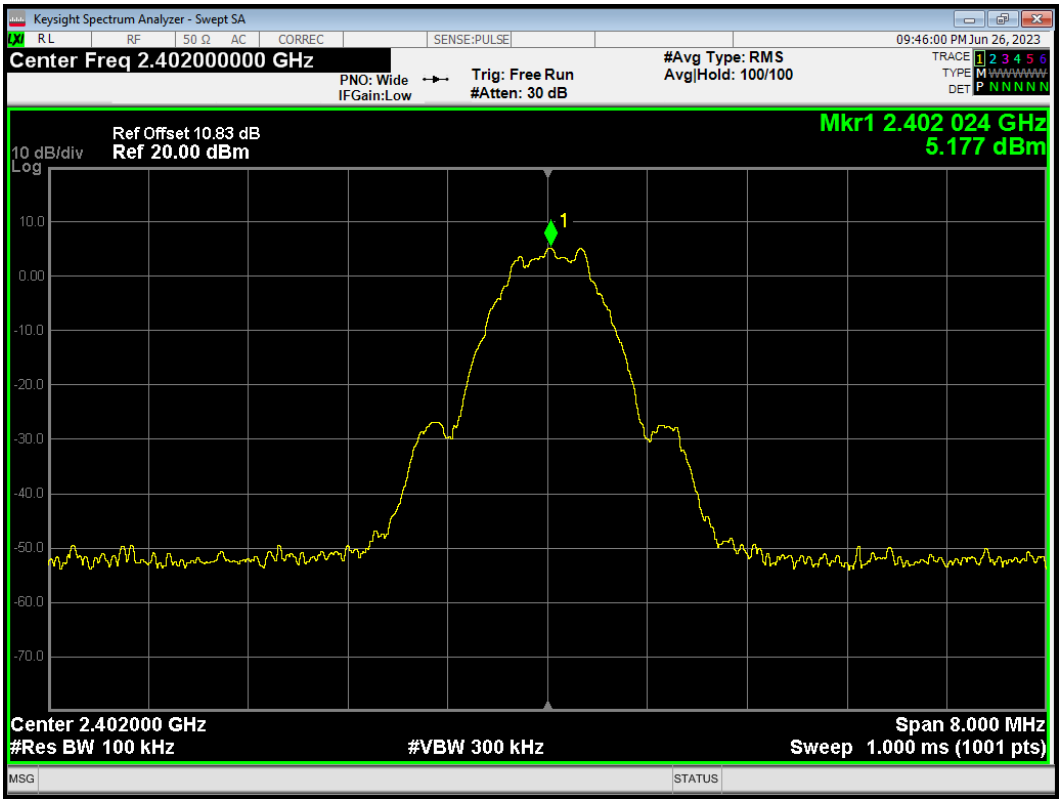
Band Edge 802.11n(HT40) 2452MHz Ref



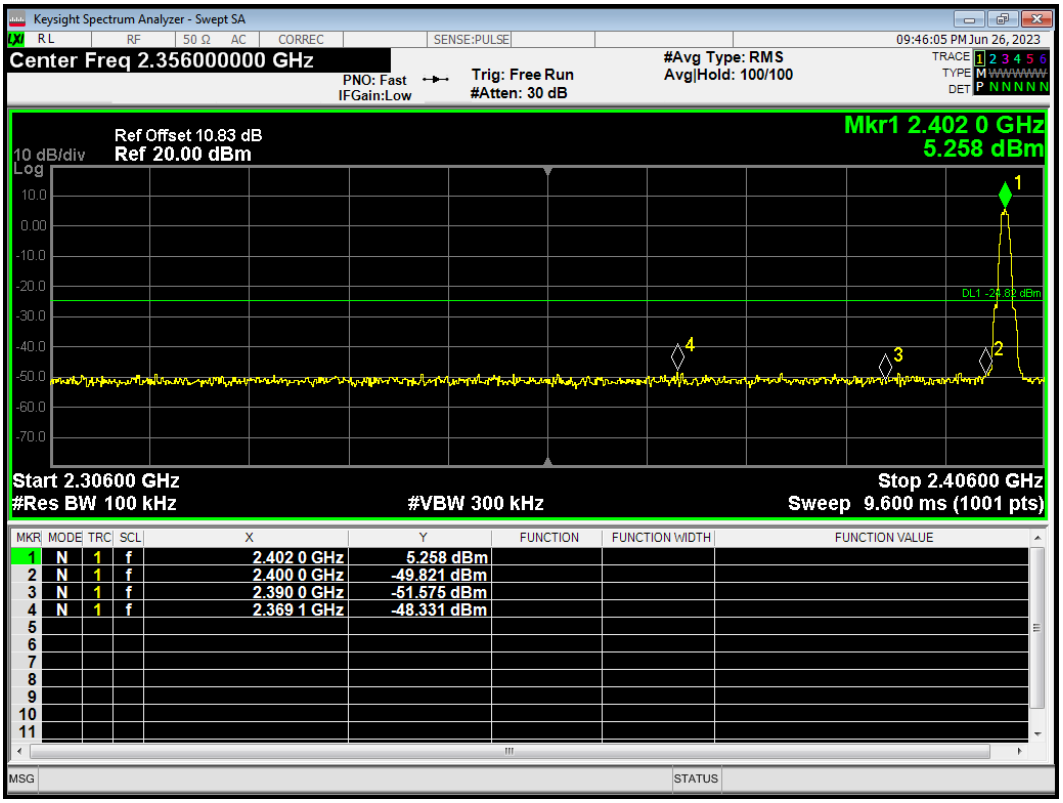
Band Edge 802.11n(HT40) 2452MHz Emission



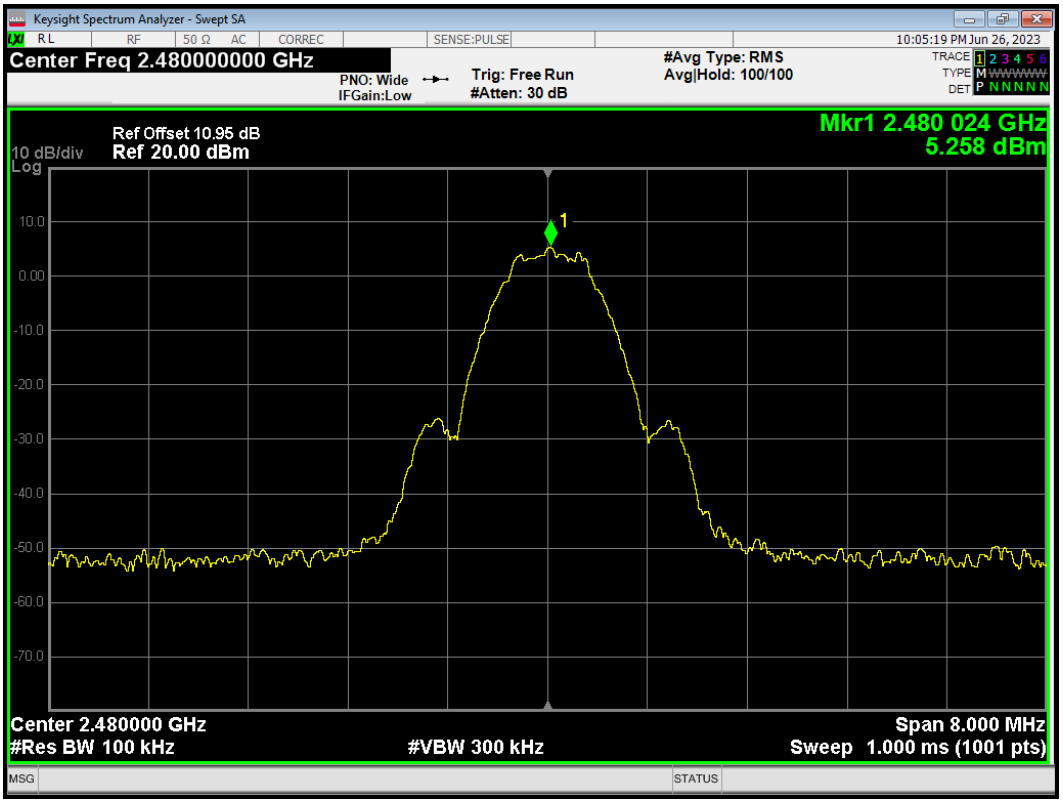
Band Edge Bluetooth LE (1M) 2402MHz Ref



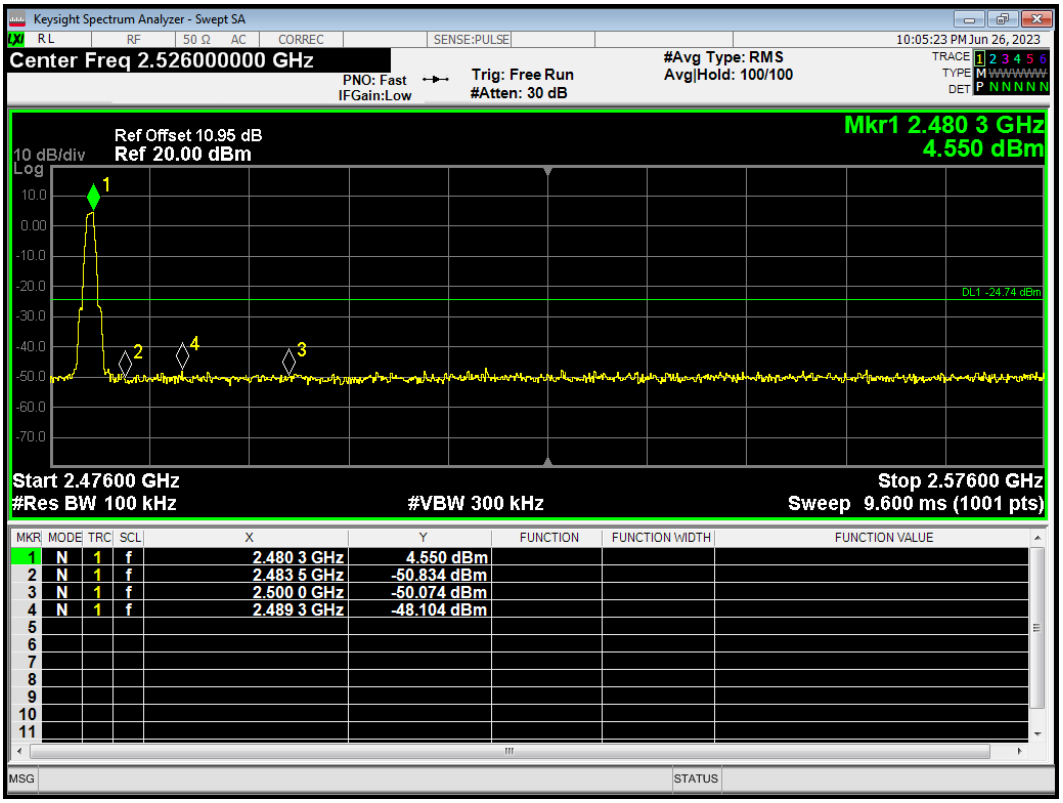
Band Edge Bluetooth LE (1M) 2402MHz Emission



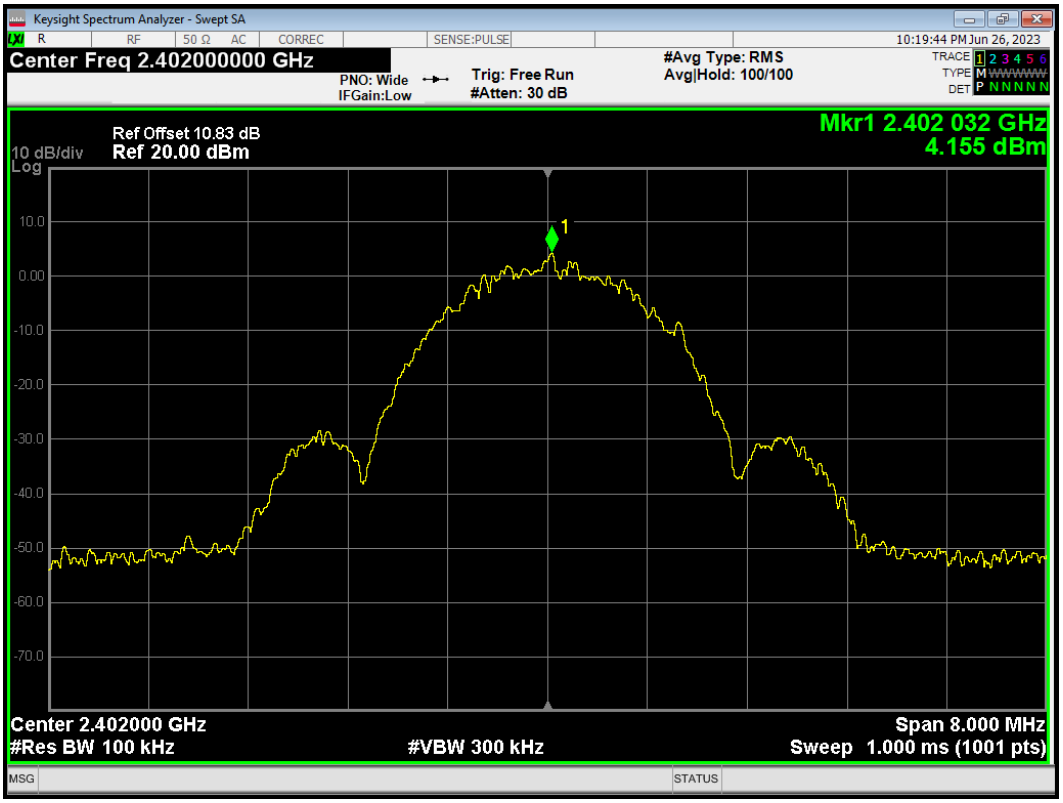
Band Edge Bluetooth LE (1M) 2480MHz Ref



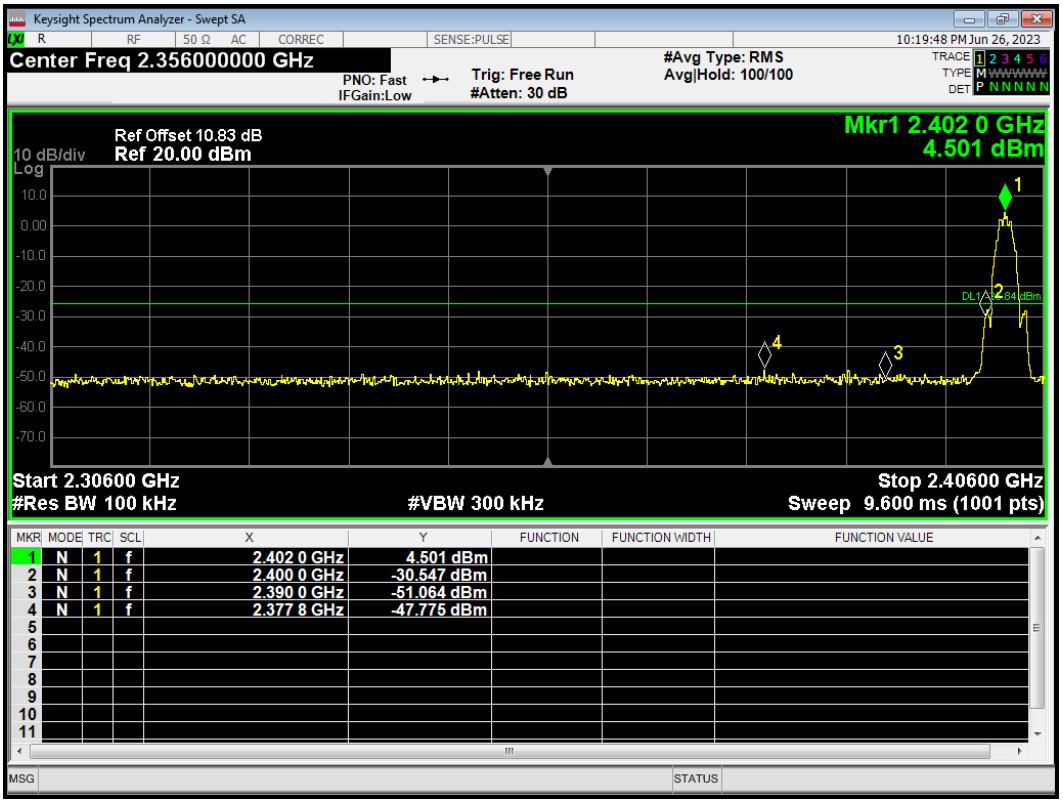
Band Edge Bluetooth LE (1M) 2480MHz Emission



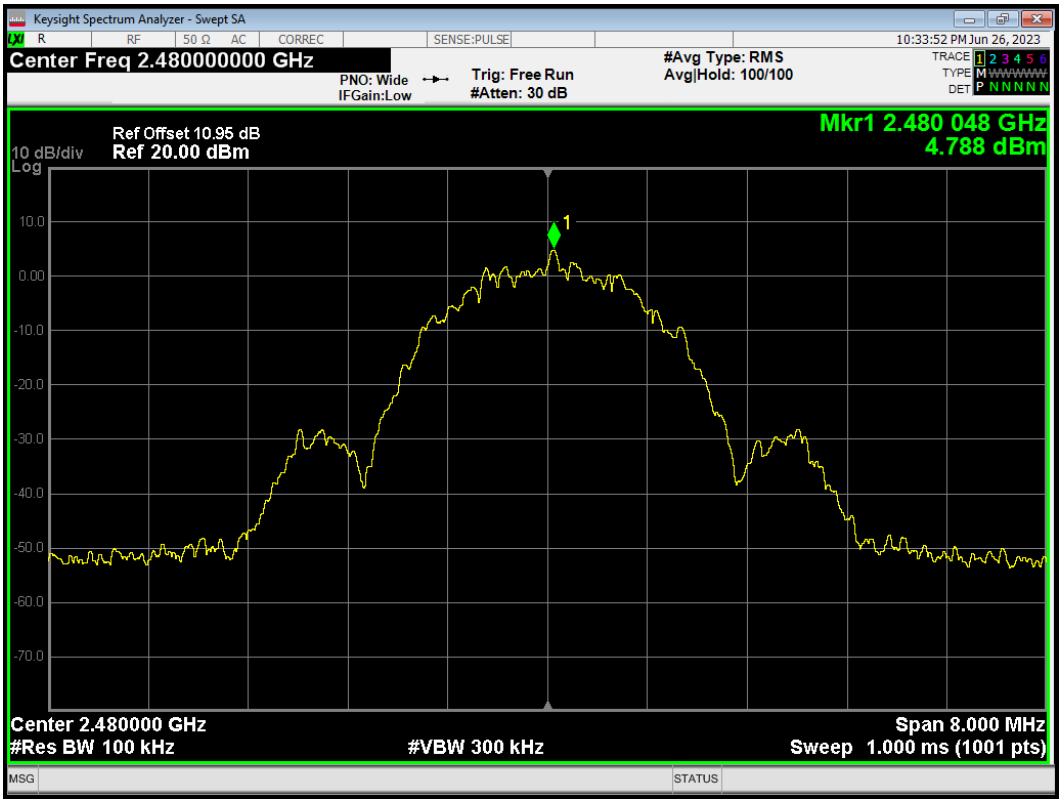
Band Edge Bluetooth LE (2M) 2402MHz Ref



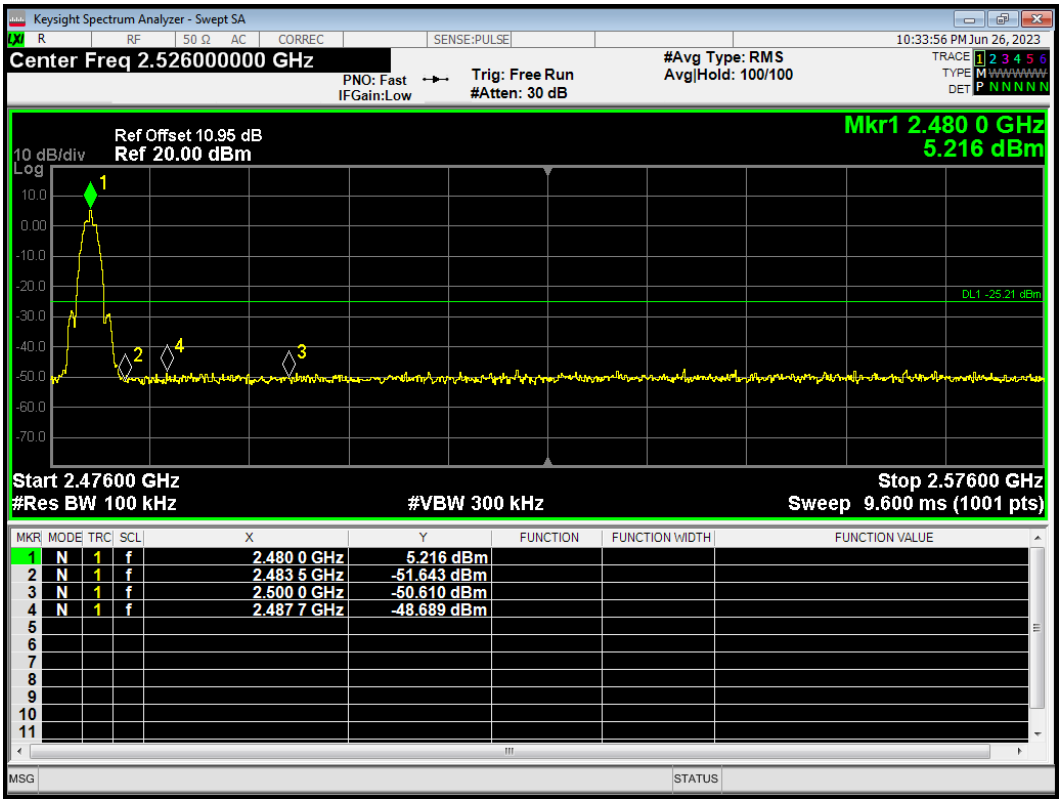
Band Edge Bluetooth LE (2M) 2402MHz Emission



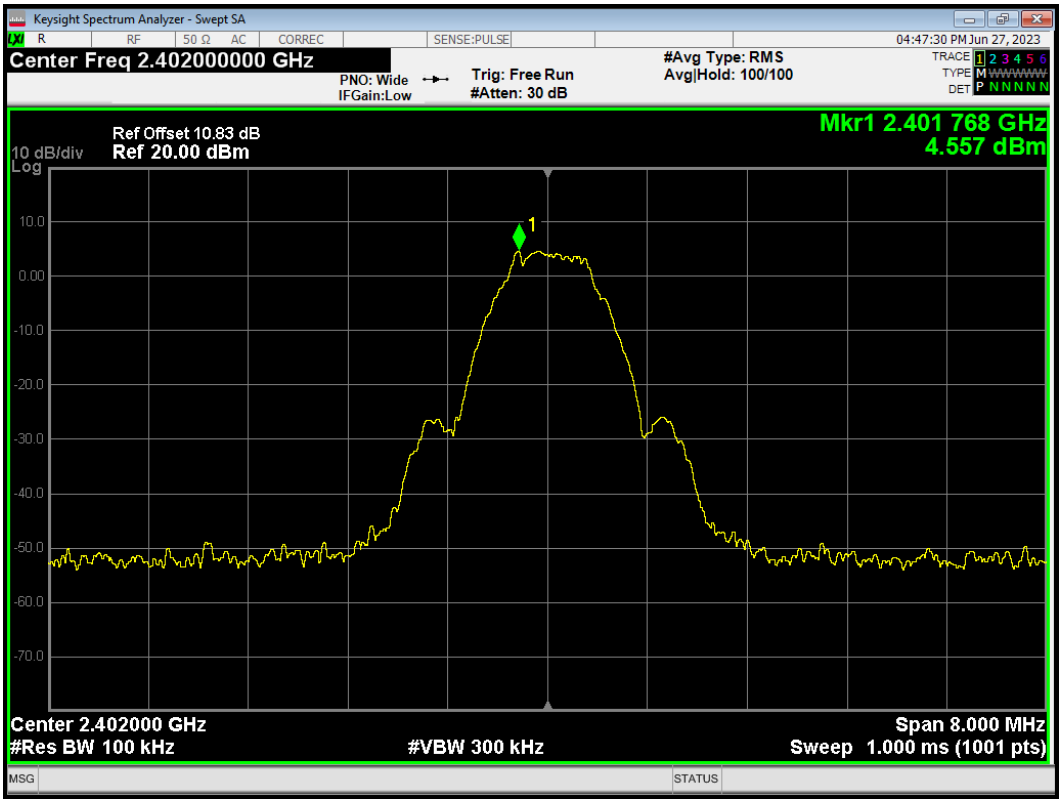
Band Edge Bluetooth LE (2M) 2480MHz Ref



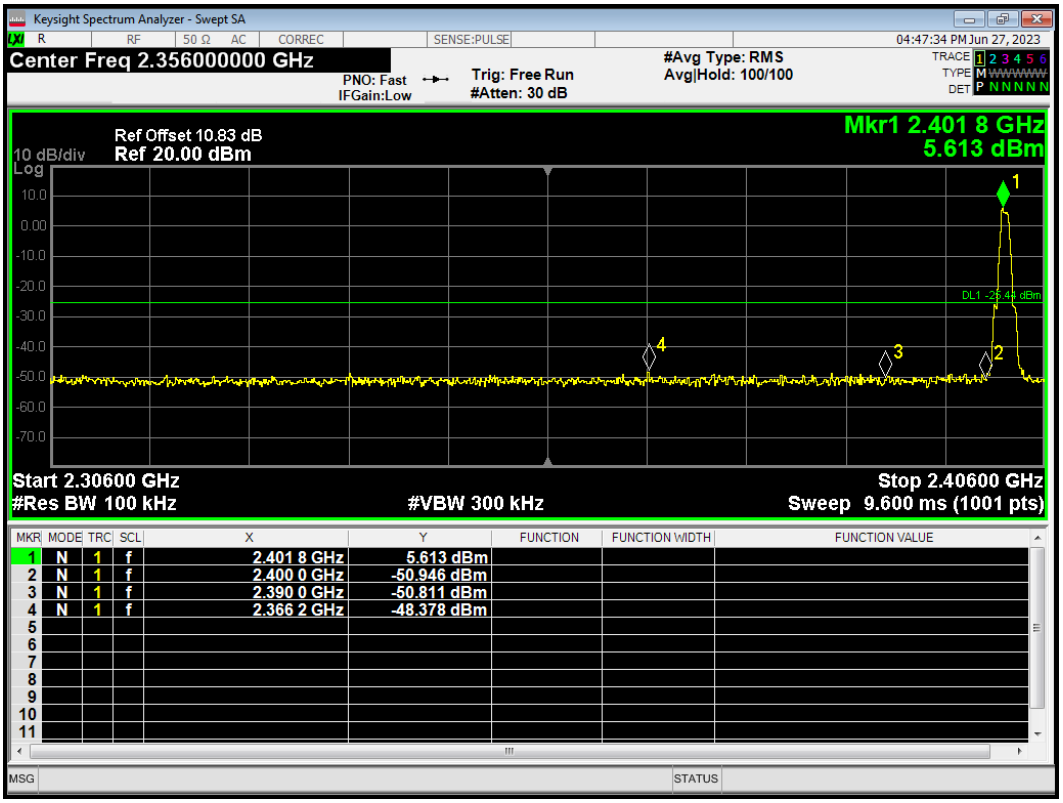
Band Edge Bluetooth LE (2M) 2480MHz Emission



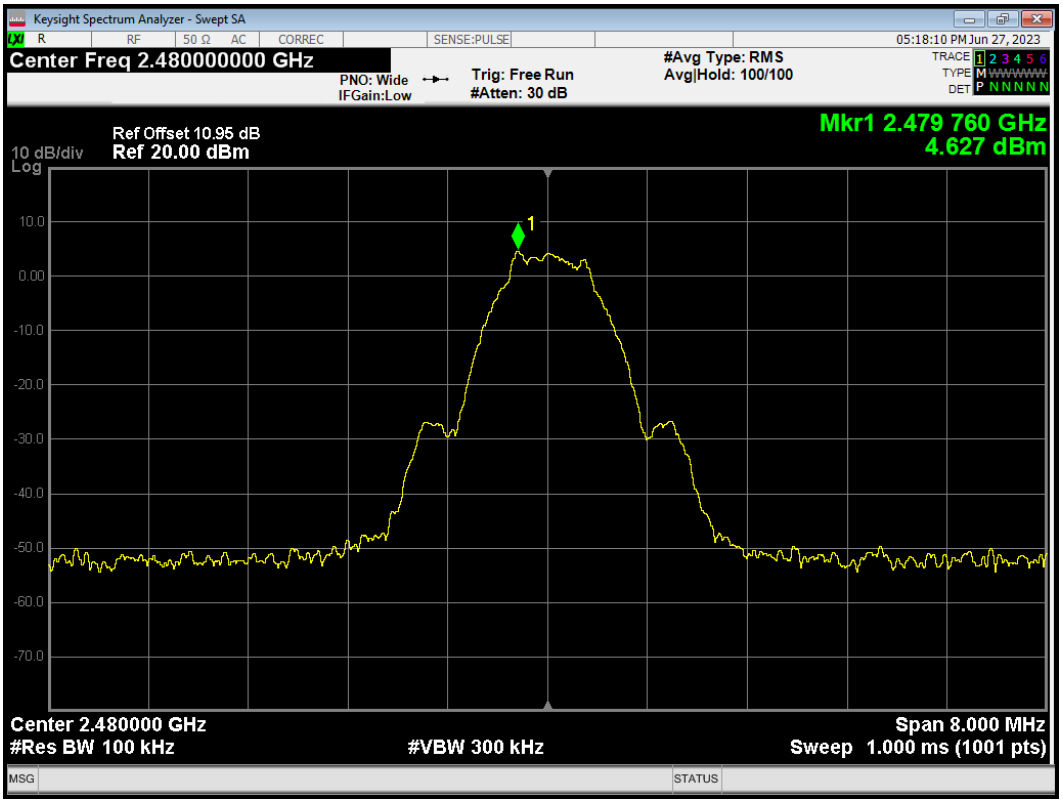
Band Edge Bluetooth LE (S=2) 2402MHz Ref



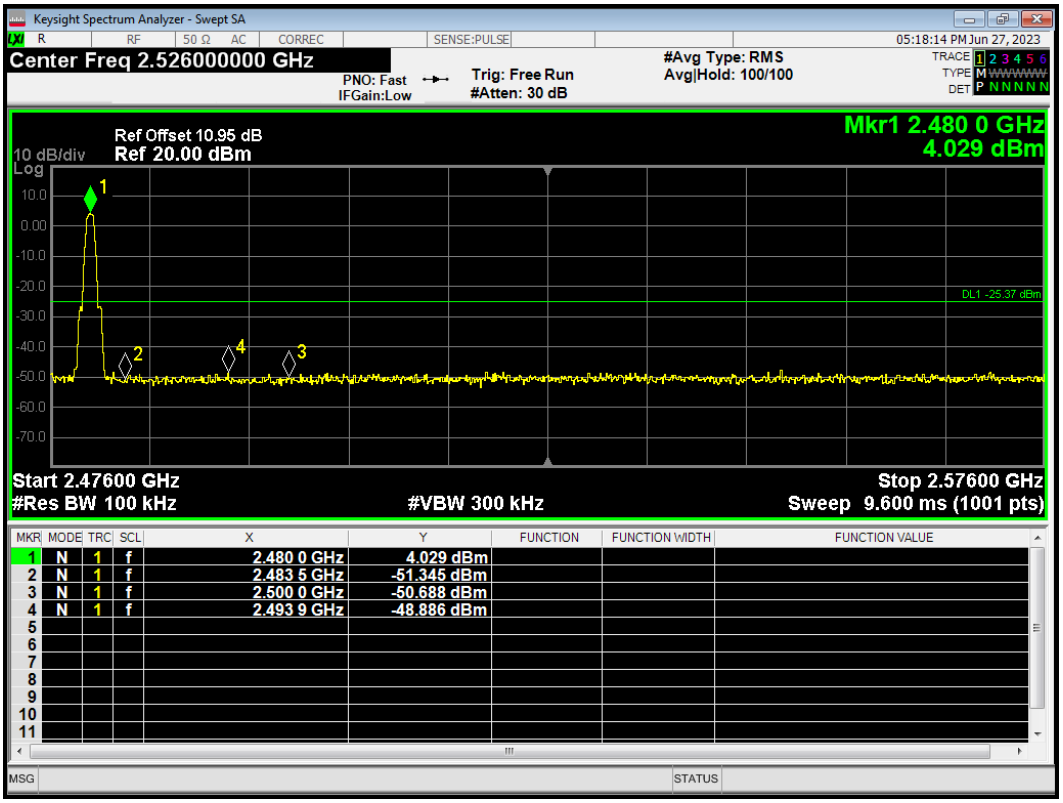
Band Edge Bluetooth LE (S=2) 2402MHz Emission



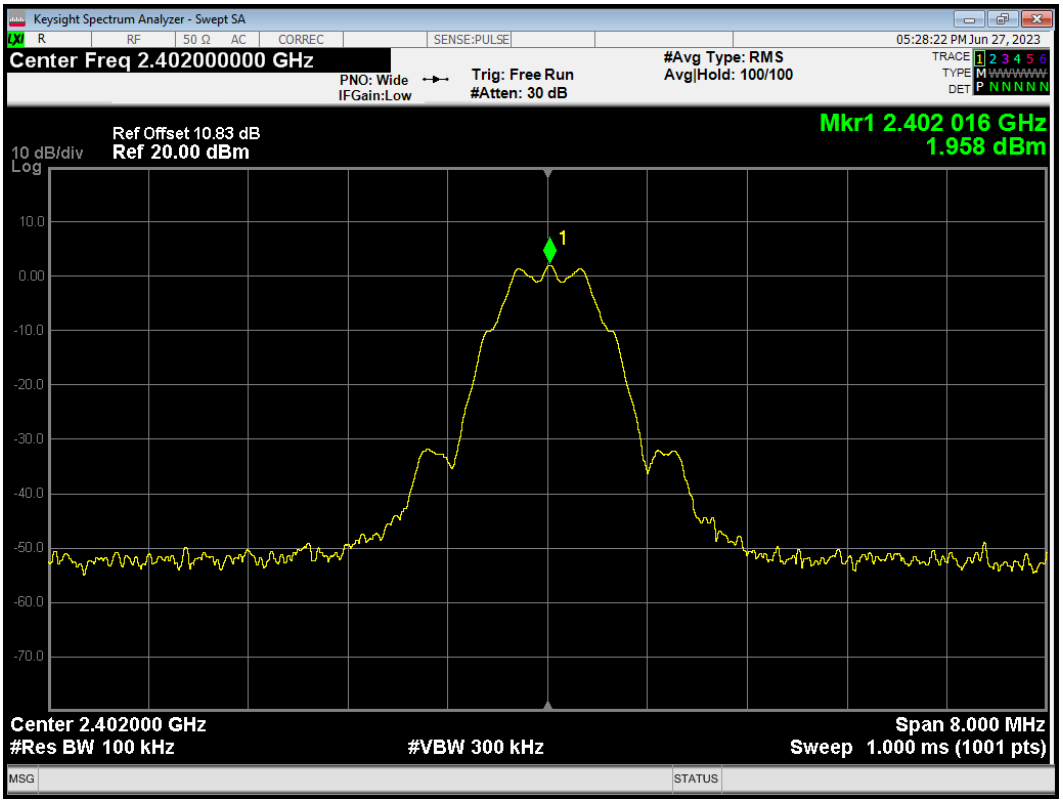
Band Edge Bluetooth LE (S=2) 2480MHz Ref



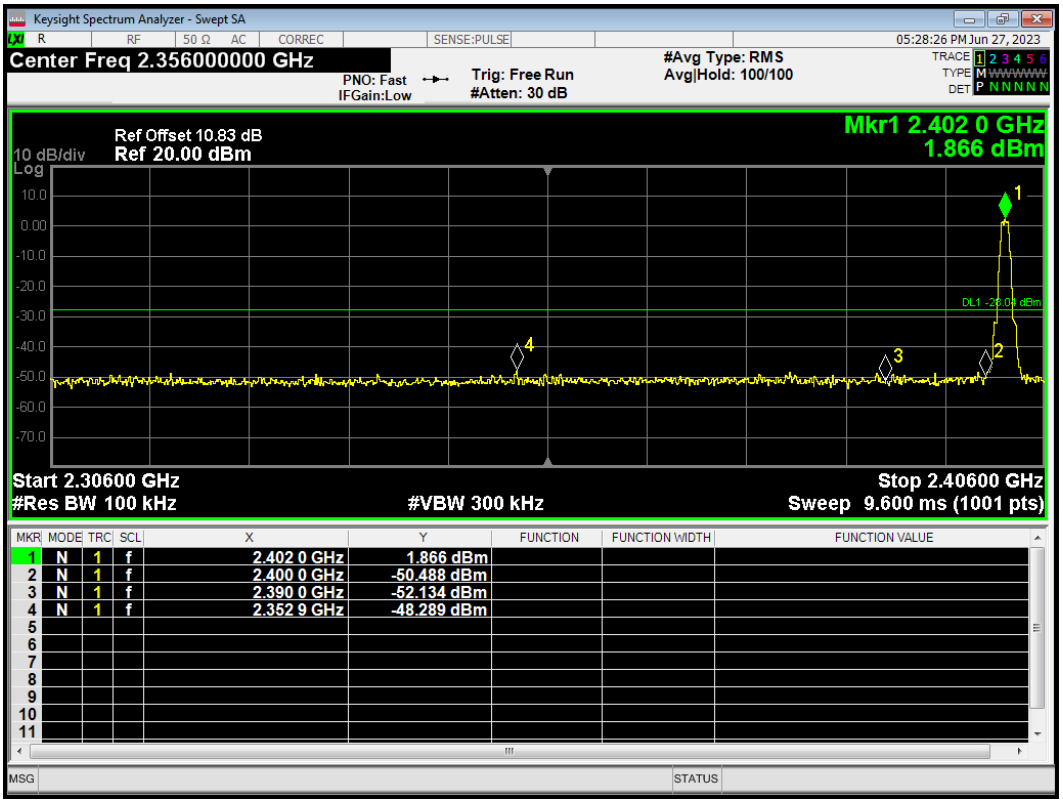
Band Edge Bluetooth LE (S=2) 2480MHz Emission



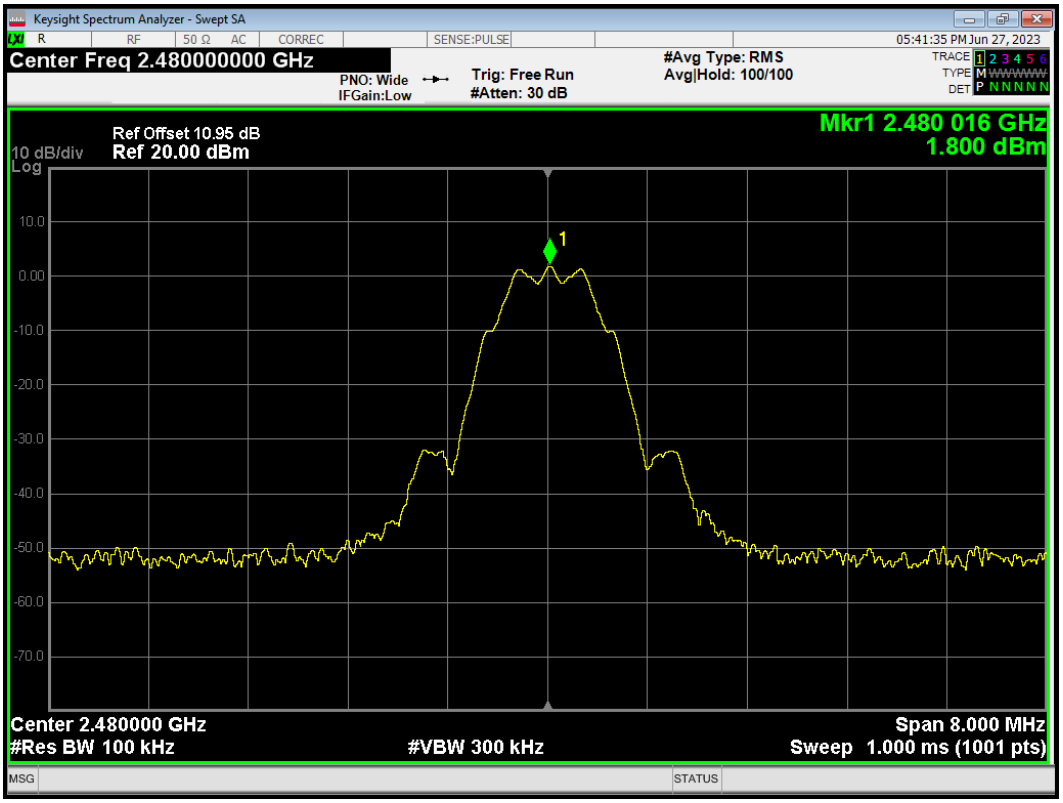
Band Edge Bluetooth LE (S=8) 2402MHz Ref



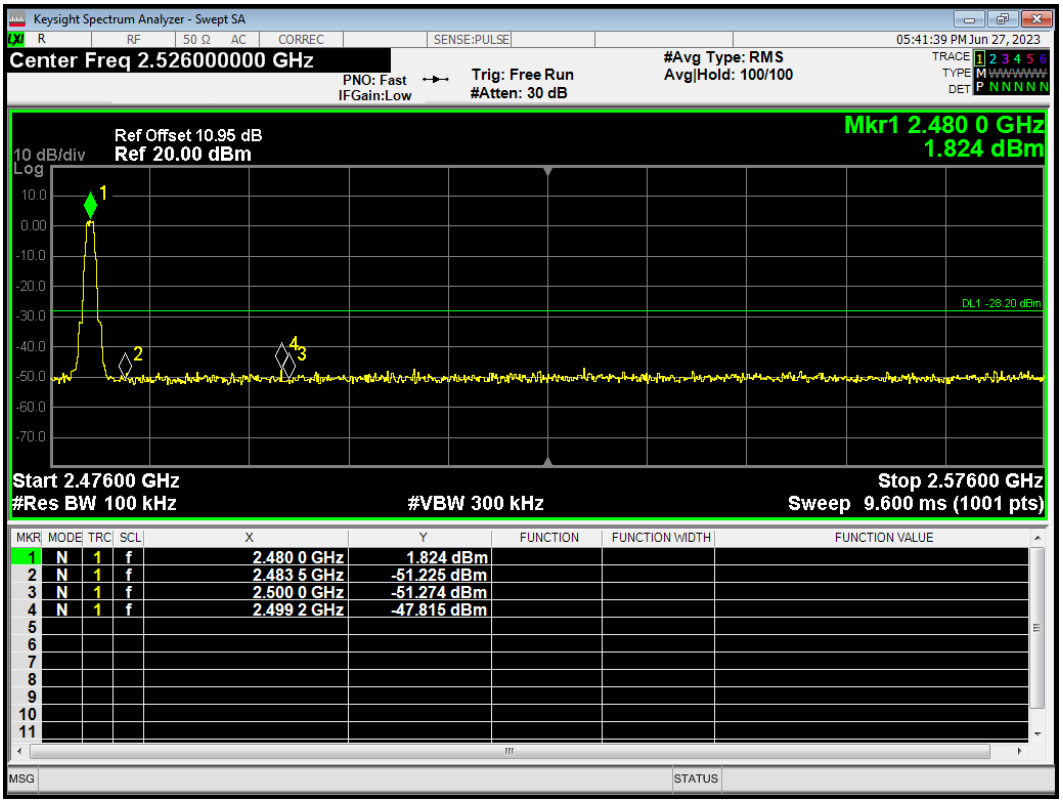
Band Edge Bluetooth LE (S=8) 2402MHz Emission



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



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



5.4. Power Spectral Density

Ambient Condition

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

Method of Measurement

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

Method AVGPSD-1 was used for this test.

a) Set instrument center frequency to DTS channel center frequency

b) Set span to at least 1.5 times the OBW

c) Set RBW to:3kHz≤RBW≤100kHz

d) Set VBW≥[3x RBW]

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

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

g) Sweep time auto couple

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

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

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

Method AVGPSD-2 was used for this test.

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

b) Set instrument center frequency to DTS channel center frequency

c) Set span to at least 1.5 times the OBW

d) Set RBW to:3kHz≤RBW≤100kHz

e) Set VBW≥[3x RBW]

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

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

h) Sweep time =auto couple

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

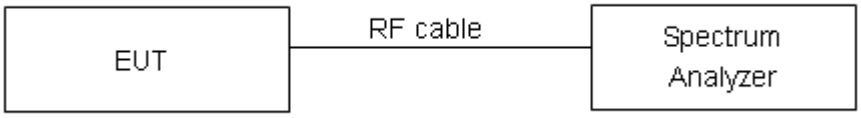
j) Employ trace averaging (rms) mode over a minimum of 100 traces

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

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

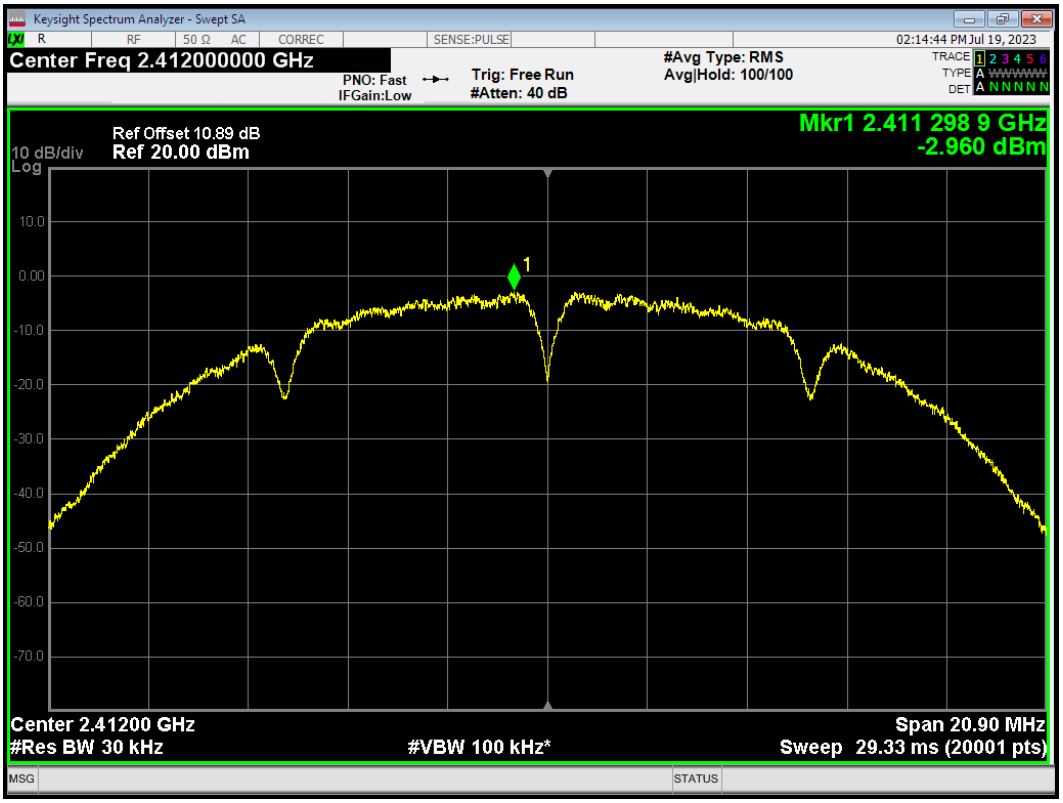
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.75dB.

Test Results:

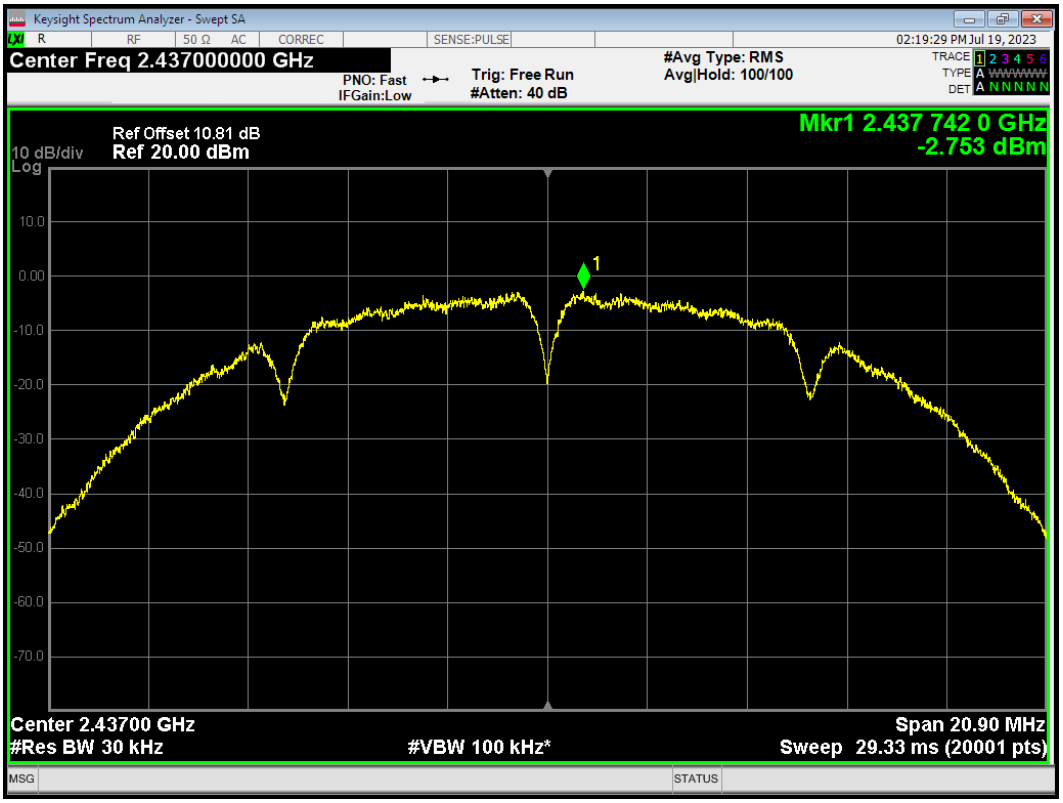
Test Mode	Carrier frequency (MHz))/ Channel	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	2412/CH1	-2.96	-12.96	8	PASS
	2437/CH6	-2.75	-12.75	8	PASS
	2462/CH11	-2.26	-12.26	8	PASS
802.11g	2412/CH1	-6.66	-15.70	8	PASS
	2417/CH2	-4.06	-13.10	8	PASS
	2437/CH6	-4.45	-13.49	8	PASS
	2452/CH9	-3.94	-12.98	8	PASS
	2457/CH10	-4.63	-13.67	8	PASS
	2462/CH11	-8.31	-17.35	8	PASS
802.11n HT20	2412/CH1	-8.47	-17.45	8	PASS
	2417/CH2	-4.75	-13.73	8	PASS
	2437/CH6	-5.53	-14.51	8	PASS
	2457/CH10	-5.10	-14.08	8	PASS
	2462/CH11	-8.30	-17.28	8	PASS
802.11n HT40	2422/CH3	-13.94	-22.06	8	PASS
	2427/CH4	-13.27	-21.39	8	PASS
	2432/CH5	-11.01	-19.13	8	PASS
	2437/CH6	-11.21	-19.33	8	PASS
	2442/CH7	-12.98	-21.10	8	PASS
	2447/CH8	-13.19	-21.31	8	PASS
	2452/CH9	-14.17	-22.29	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3/30)					

Test Mode	Carrier frequency (MHz))/ Channel	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth (Low Energy) (1M)	2402/CH0	-16.89	-16.21	8	PASS
	2440/CH19	-17.00	-16.32	8	PASS
	2480/CH39	-16.58	-15.90	8	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	-19.78	-17.39	8	PASS
	2440/CH19	-20.44	-18.05	8	PASS
	2480/CH39	-20.50	-18.11	8	PASS
Bluetooth LE (S=2)	2402/CH0	-14.22	-13.82	8	PASS
	2440/CH19	-11.77	-11.37	8	PASS
	2480/CH39	-13.64	-13.24	8	PASS
Bluetooth LE (S=8)	2402/CH0	-2.38	-2.27	8	PASS
	2440/CH19	-2.12	-2.01	8	PASS
	2480/CH39	-2.14	-2.03	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

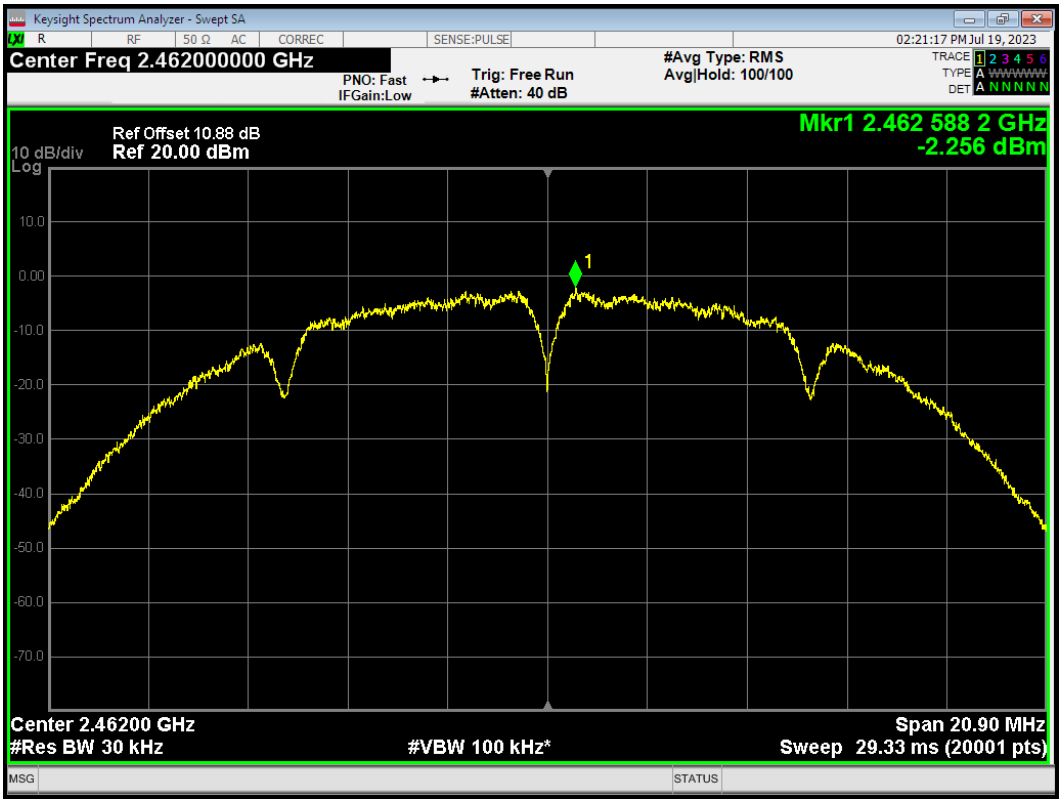
PSD 802.11b 2412MHz



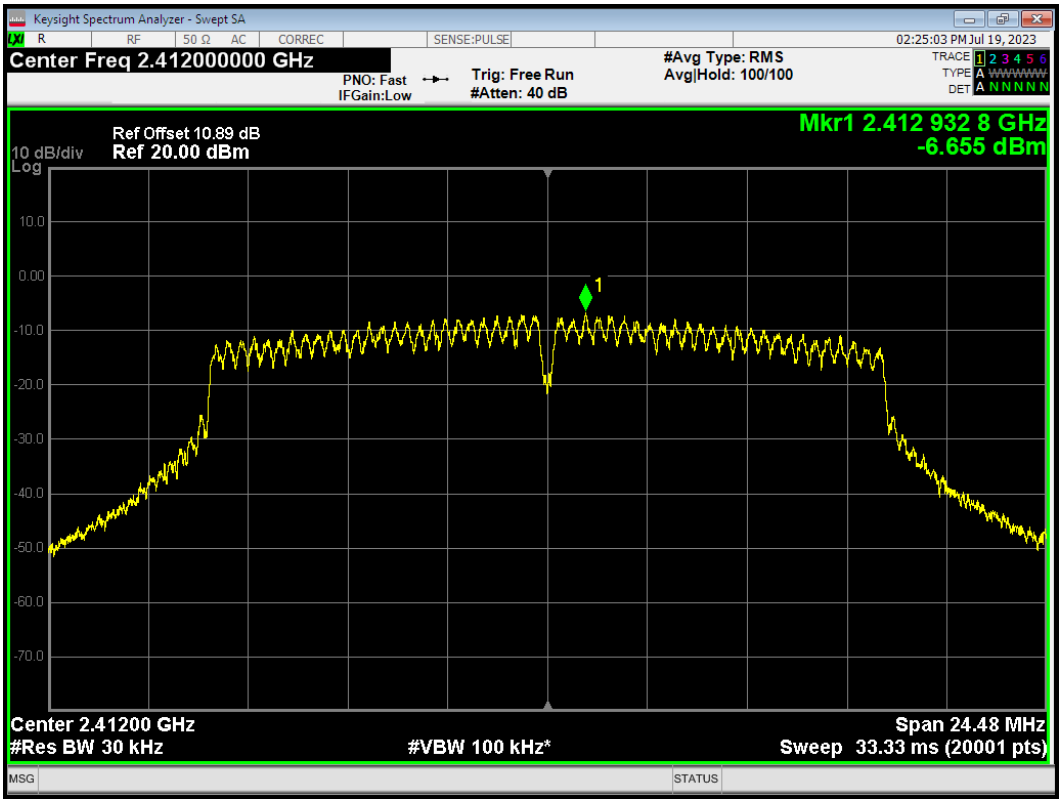
PSD 802.11b 2437MHz



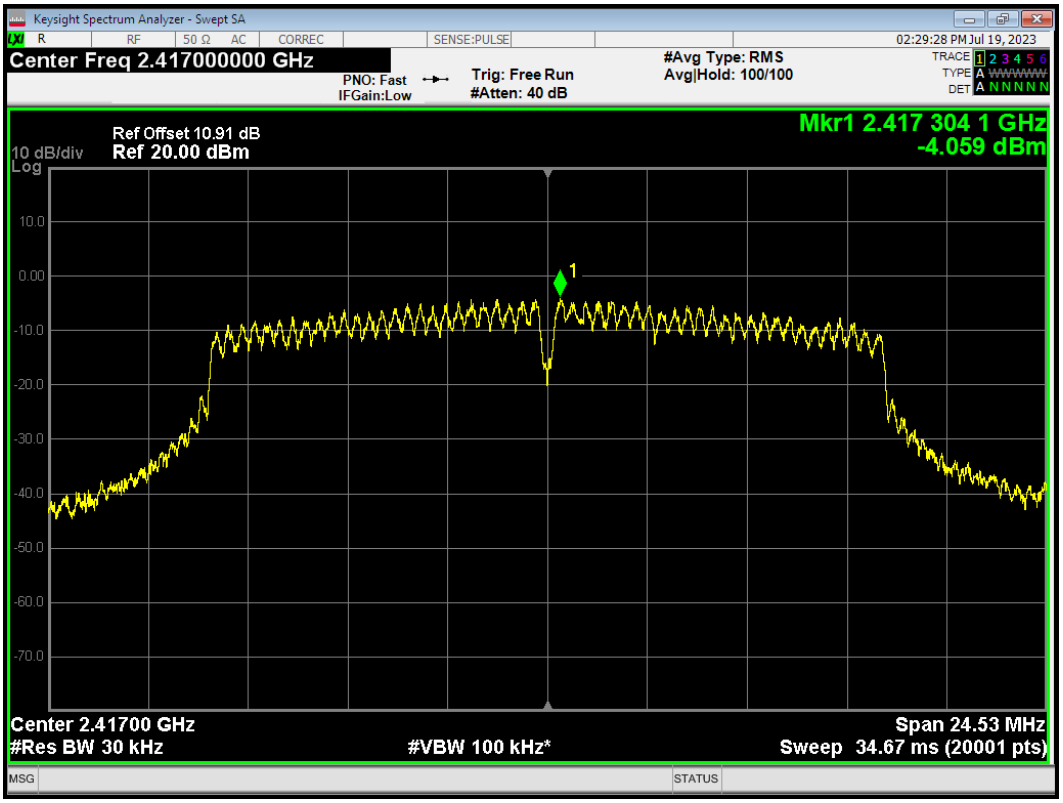
PSD 802.11b 2462MHz



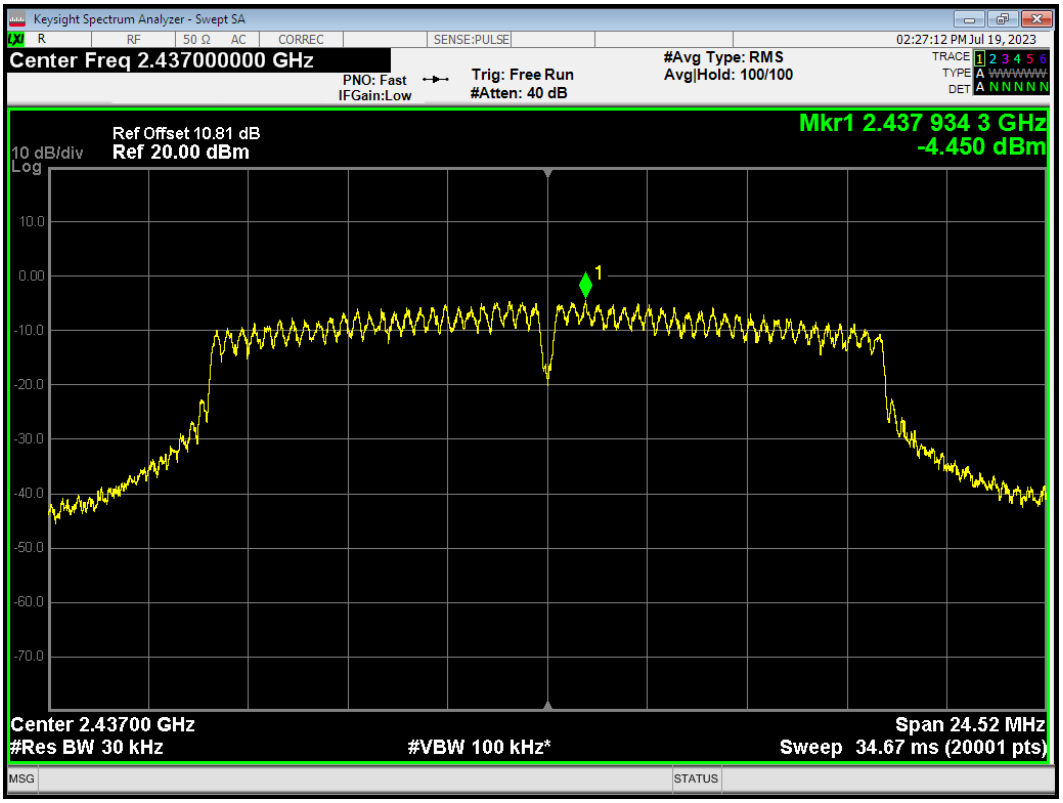
PSD 802.11g 2412MHz



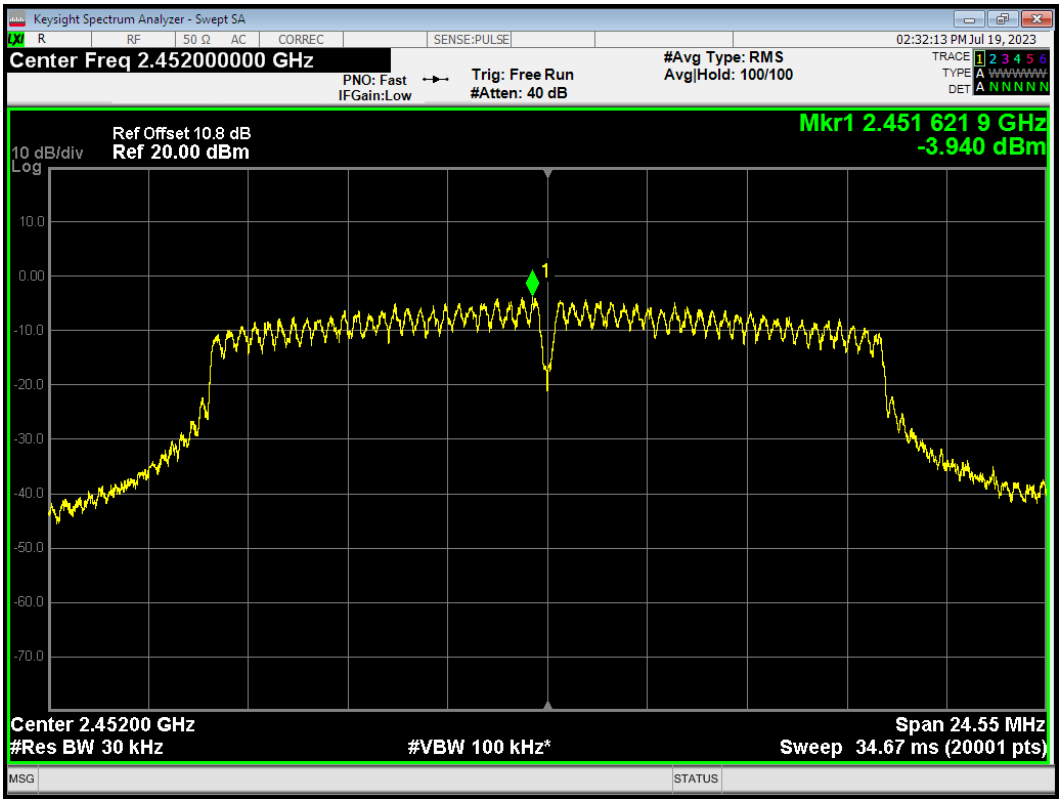
PSD 802.11g 2417MHz



PSD 802.11g 2437MHz



PSD 802.11g 2452MHz



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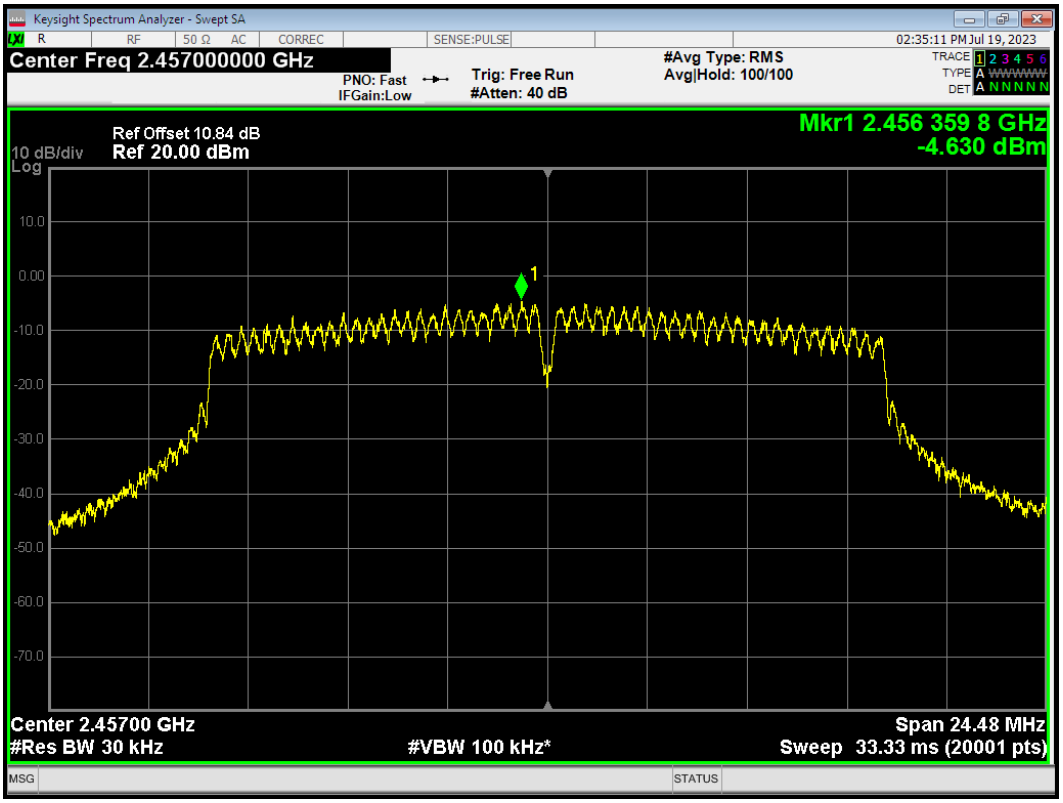
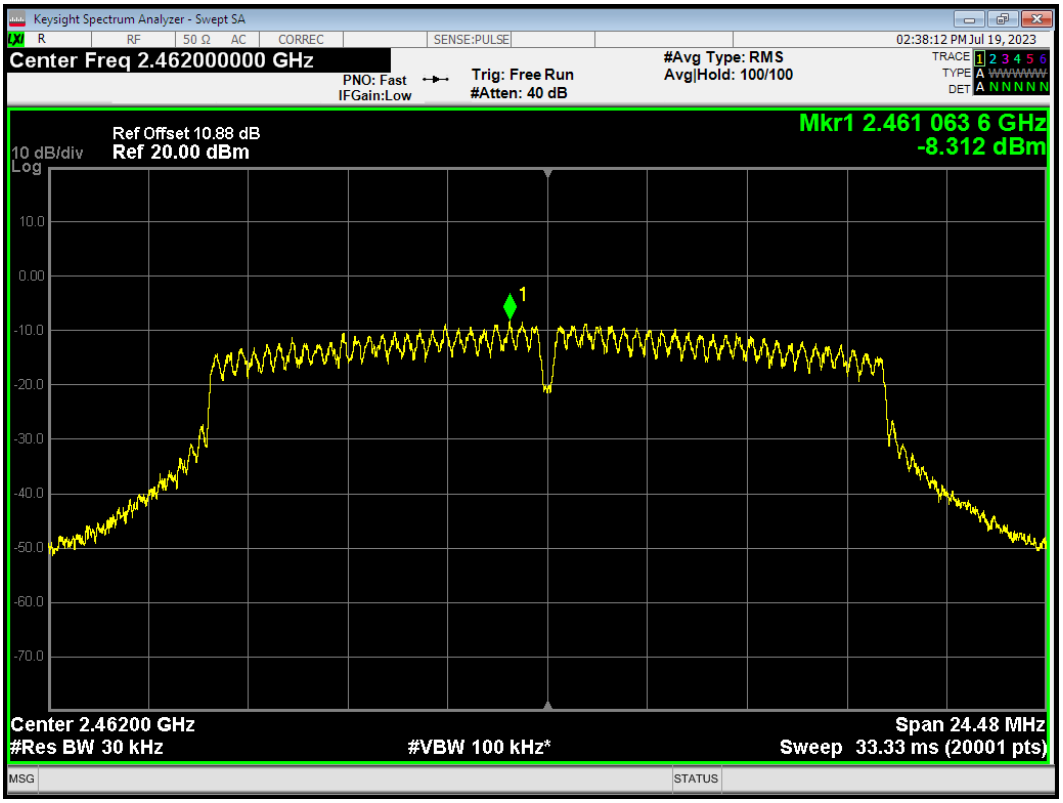
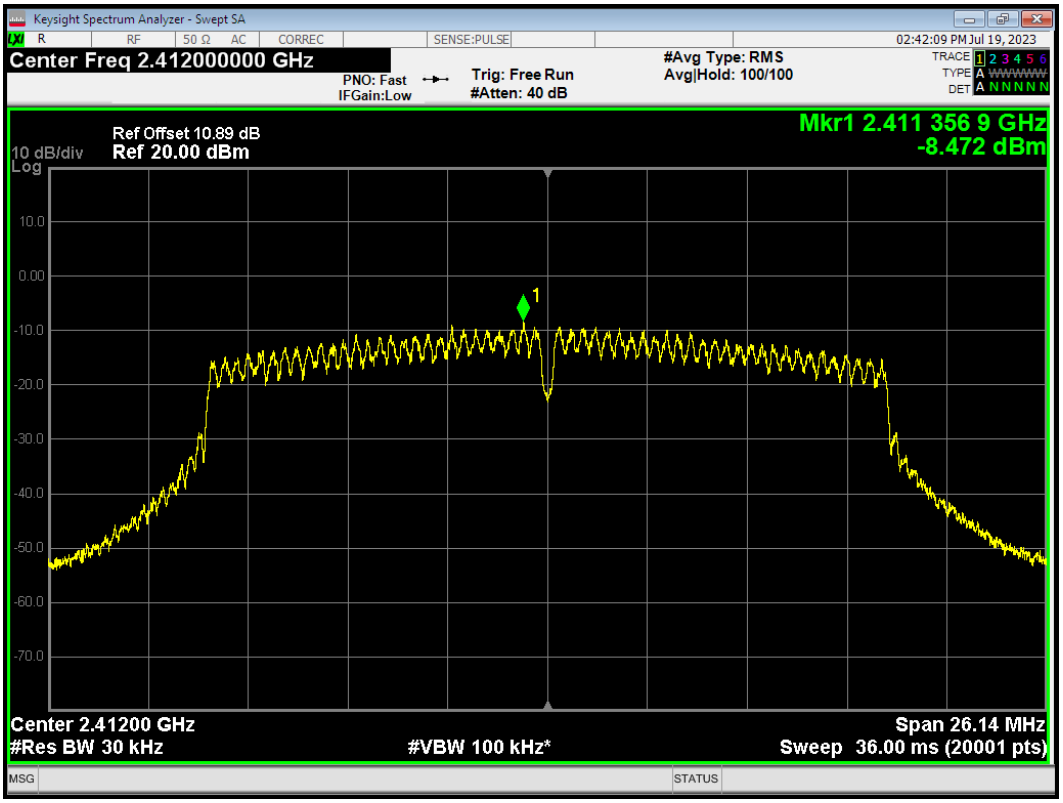


PSD 802.11g 2462MHz



PSD 802.11n(HT20) 2412MHz



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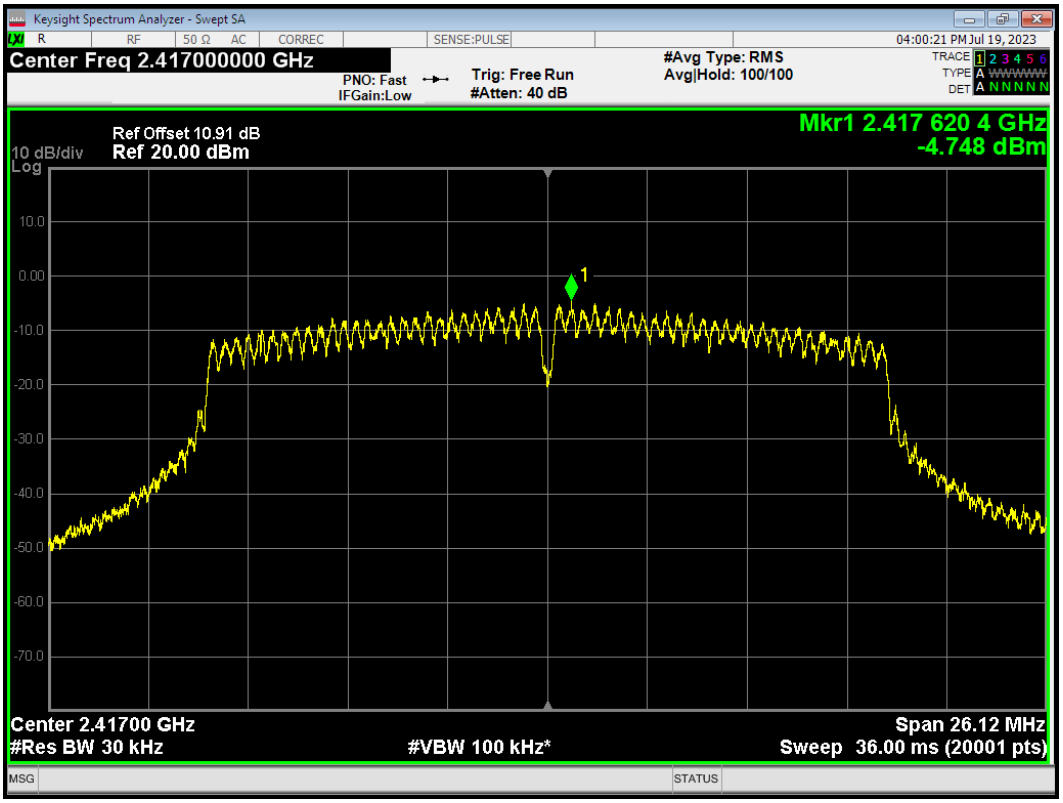

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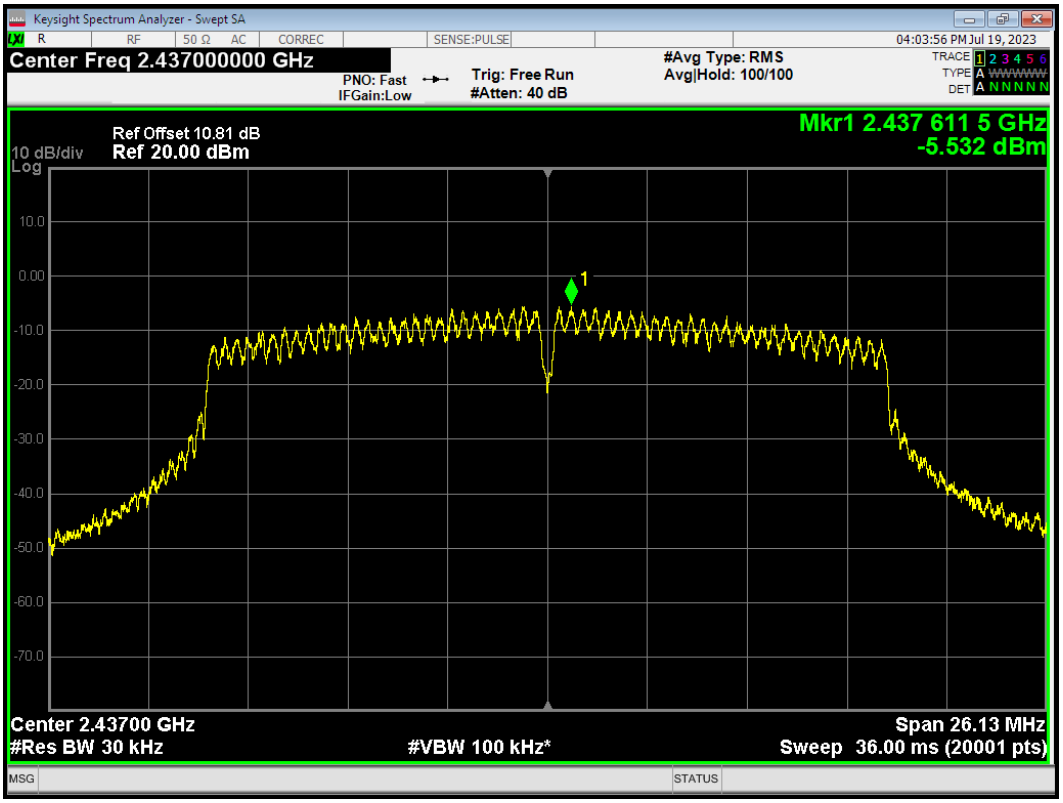

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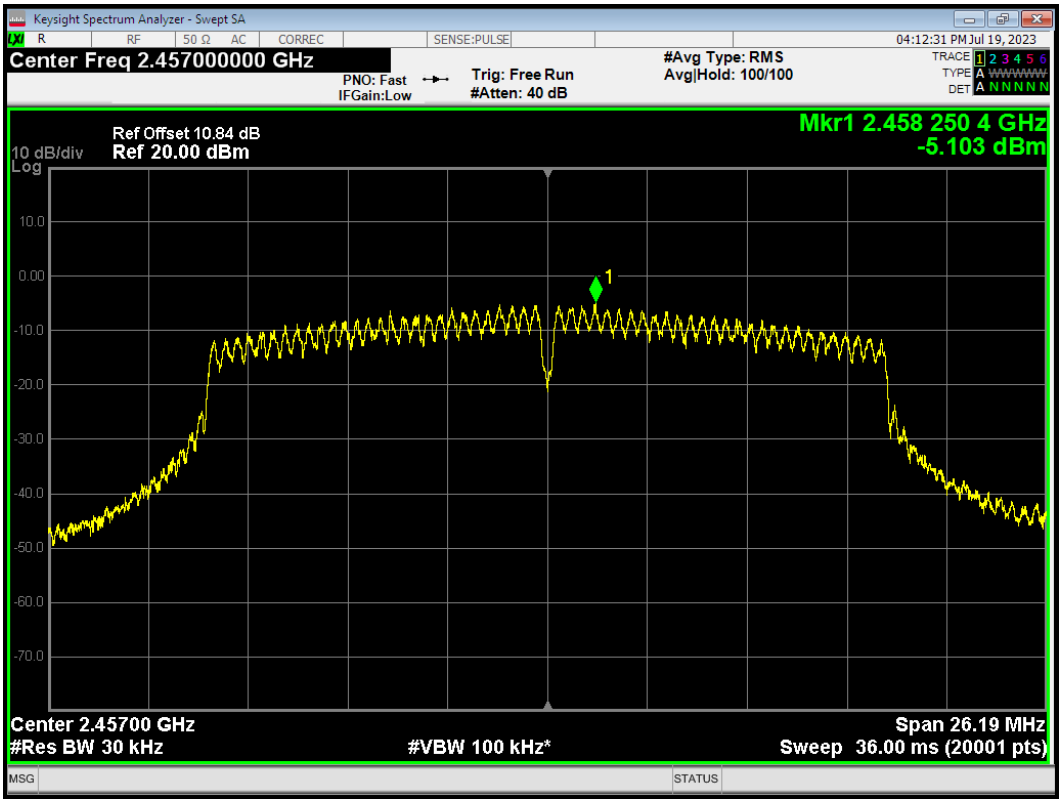

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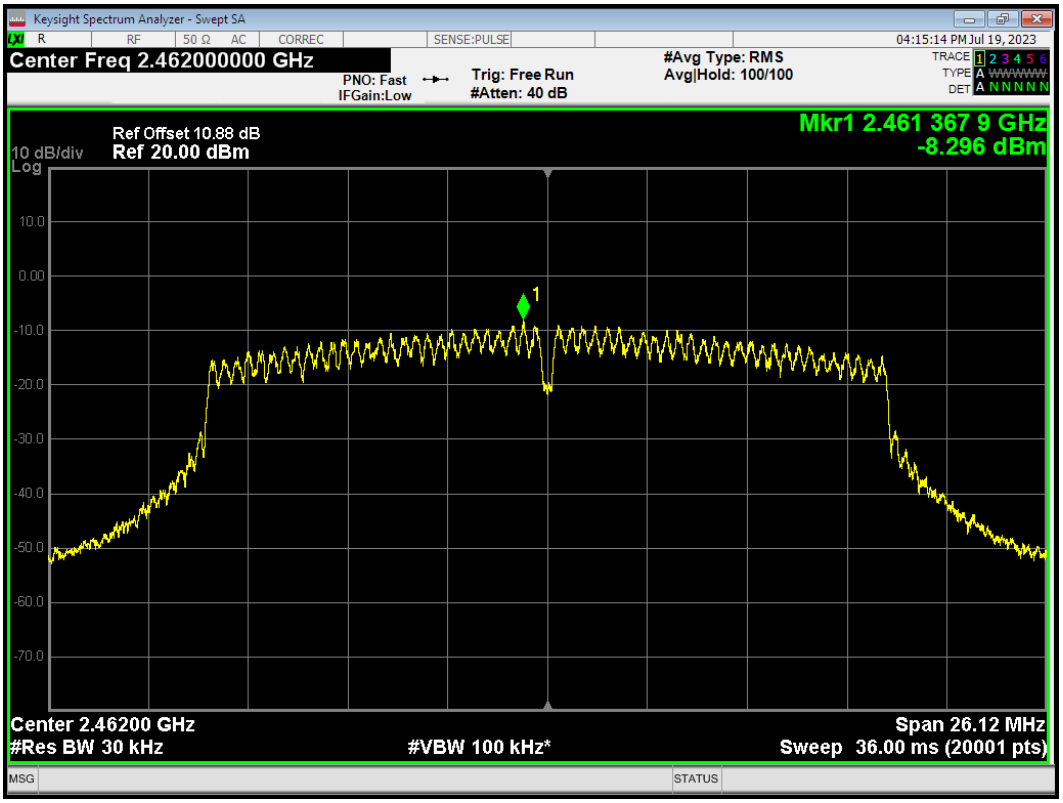

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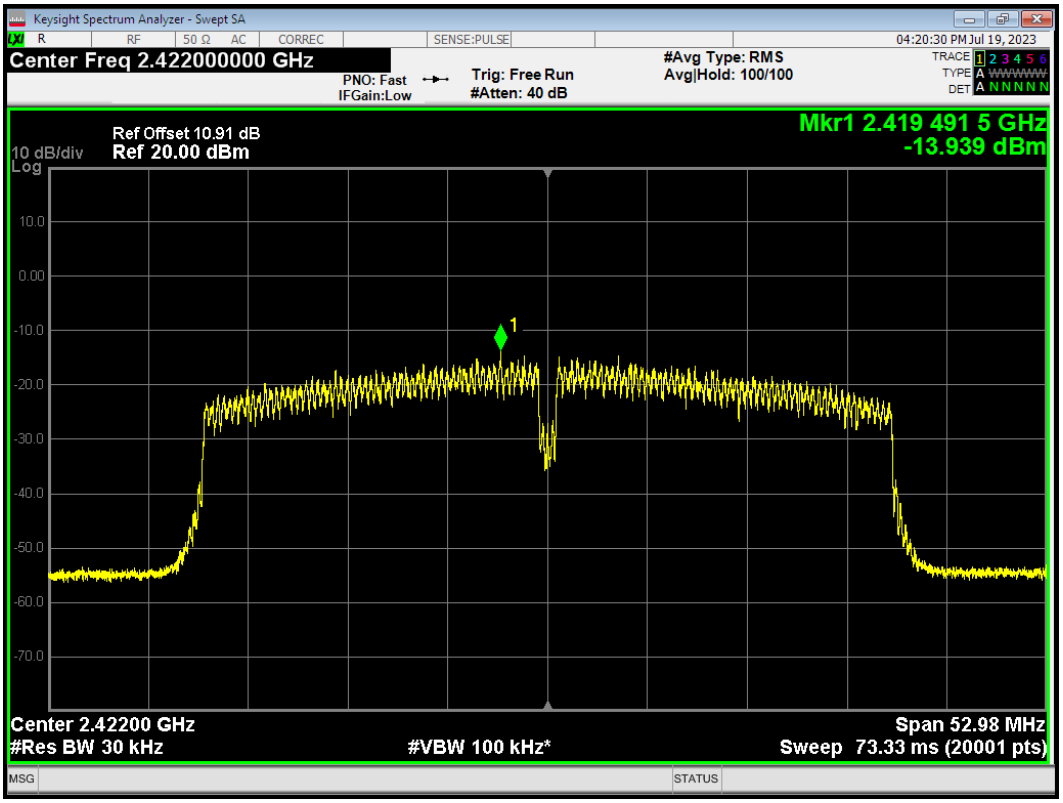

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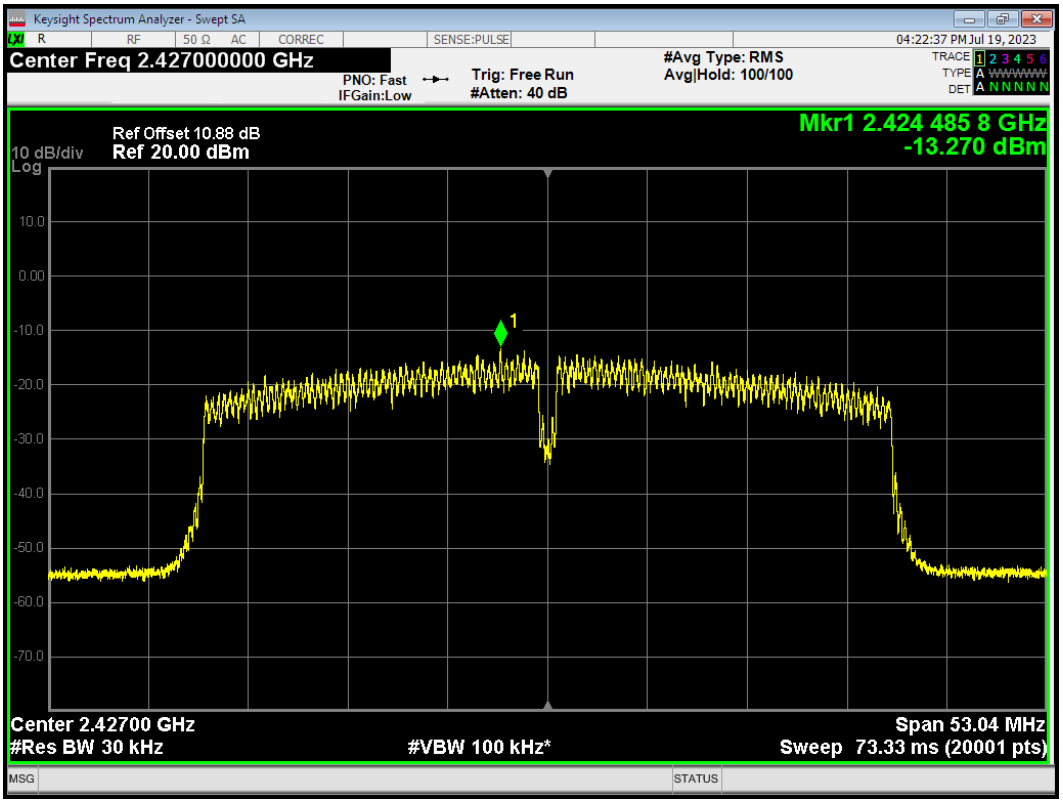

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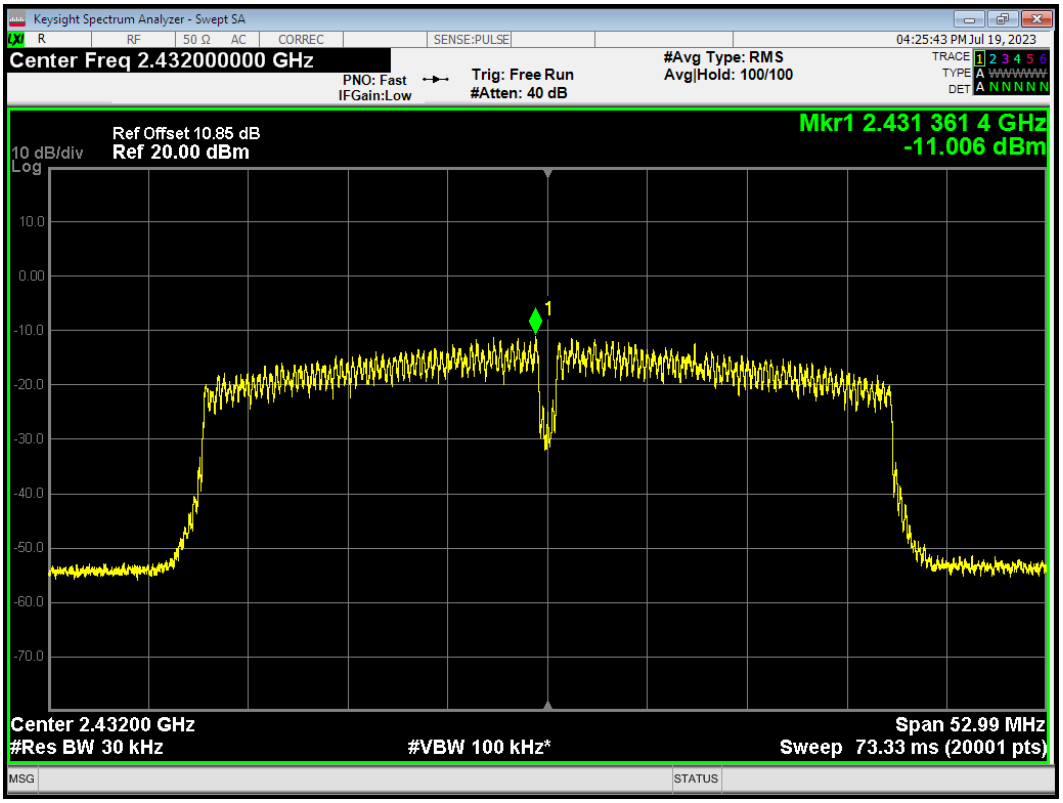

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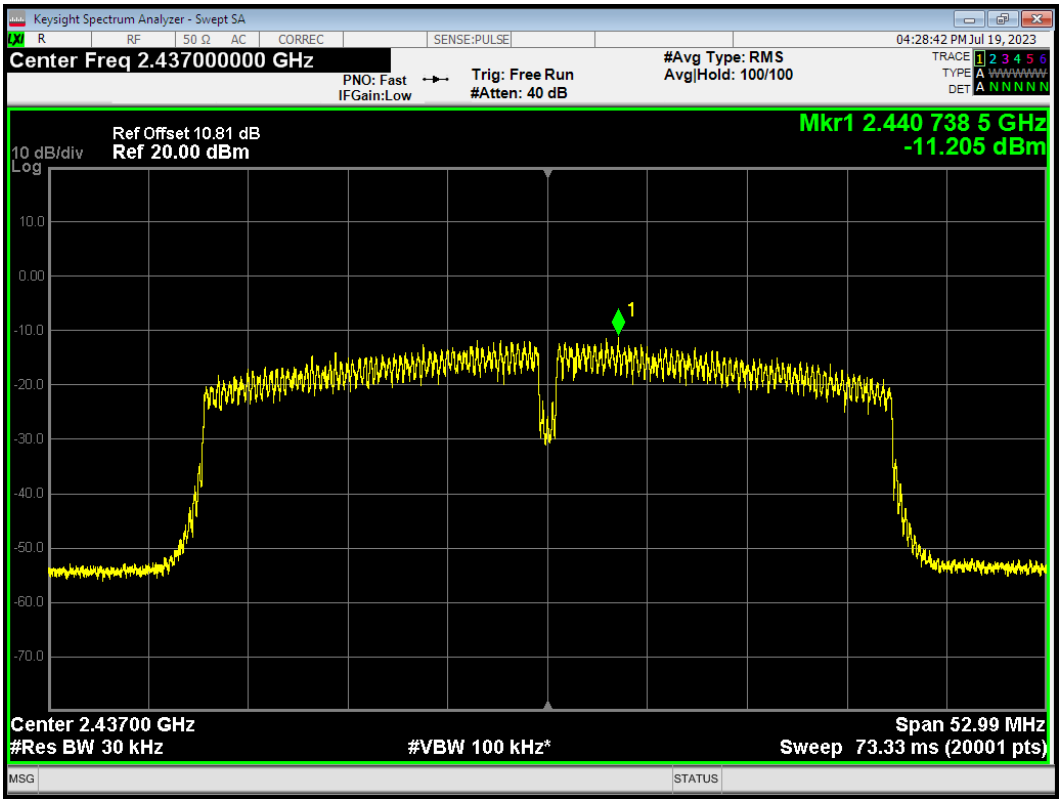

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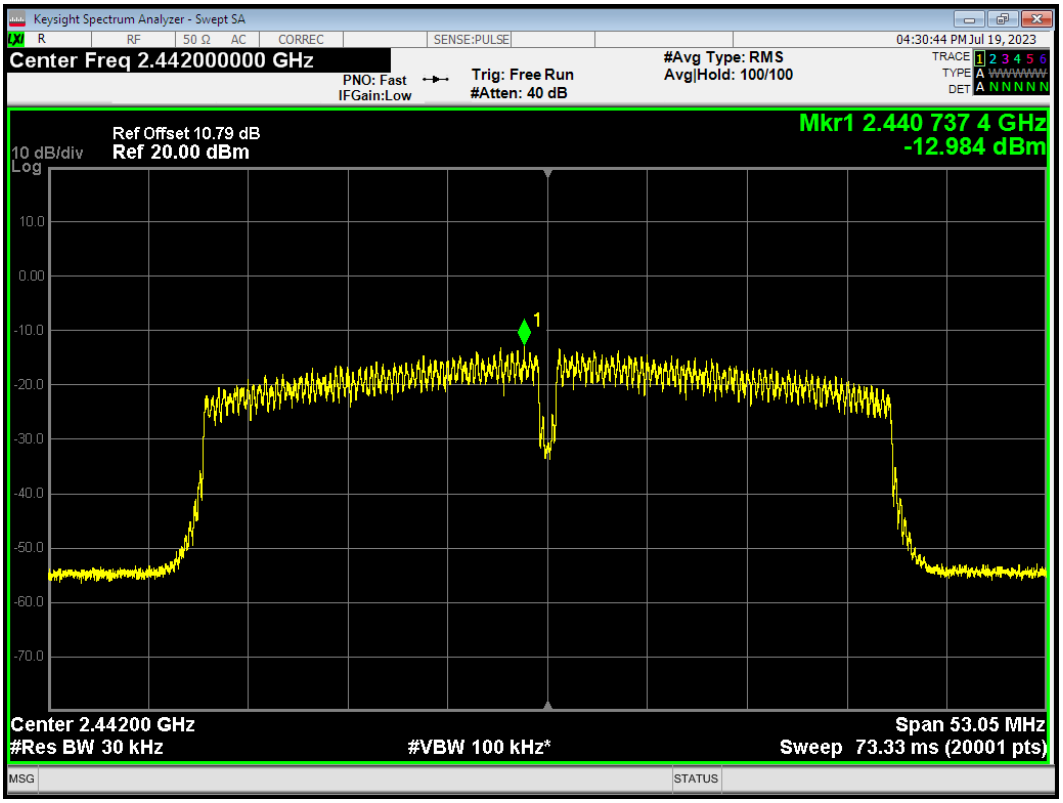
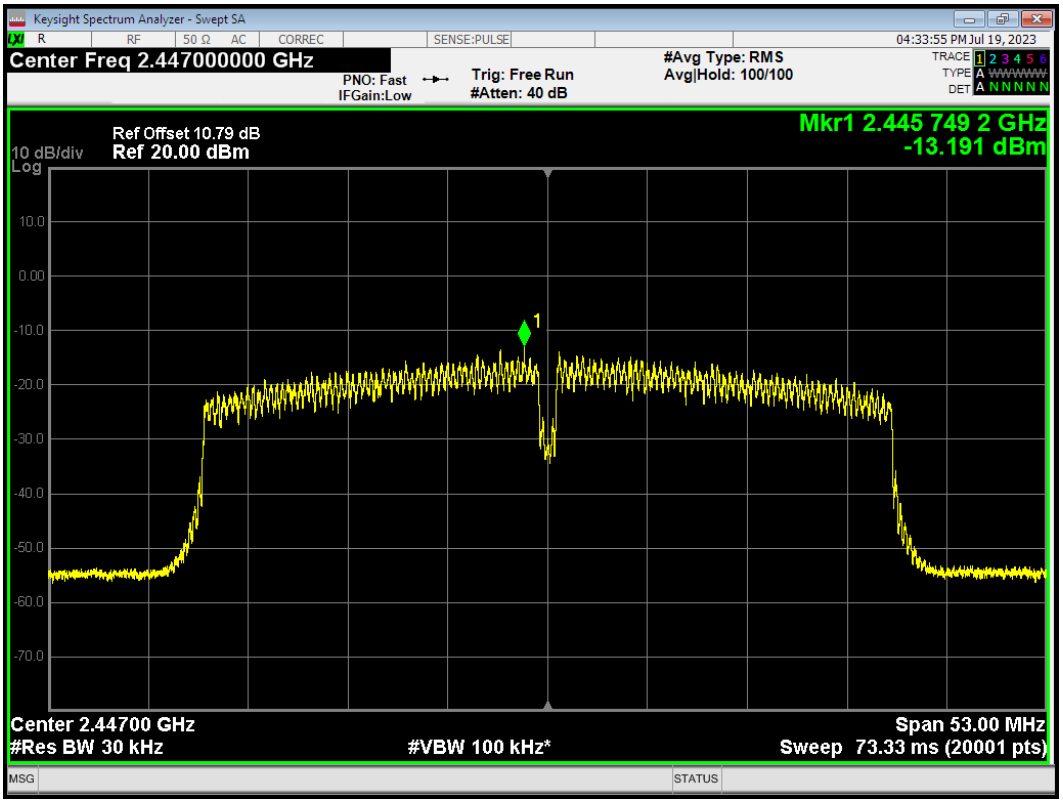
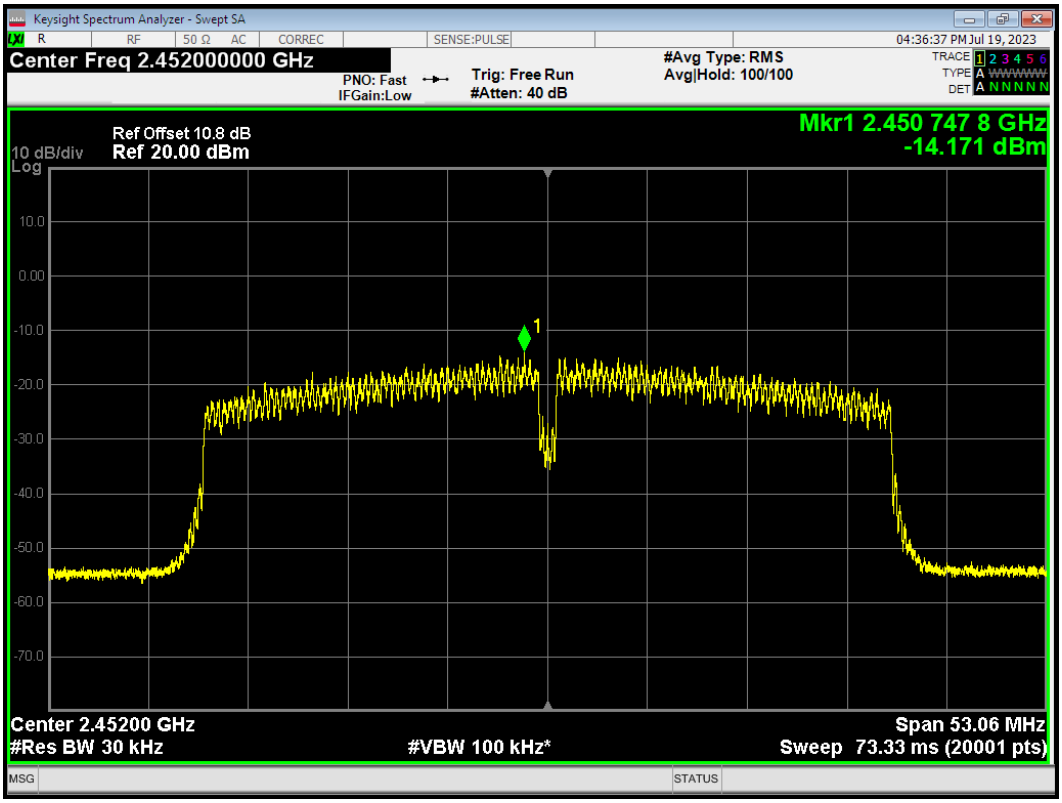


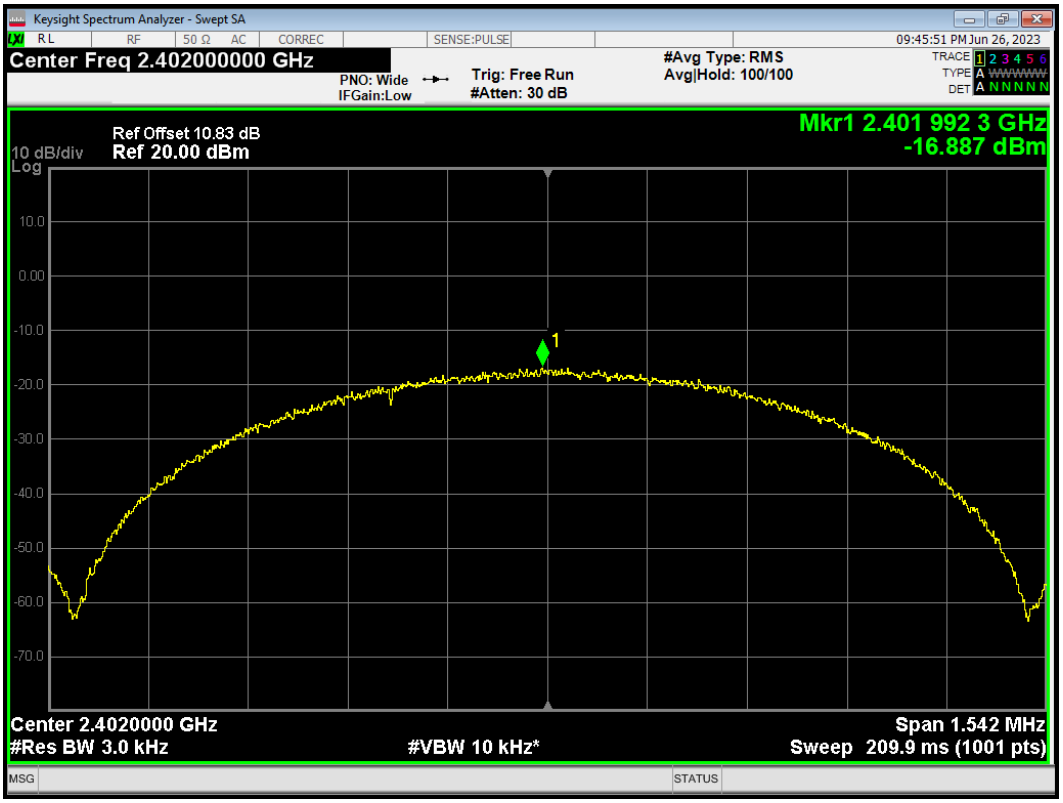
PSD 802.11n(HT40) 2447MHz



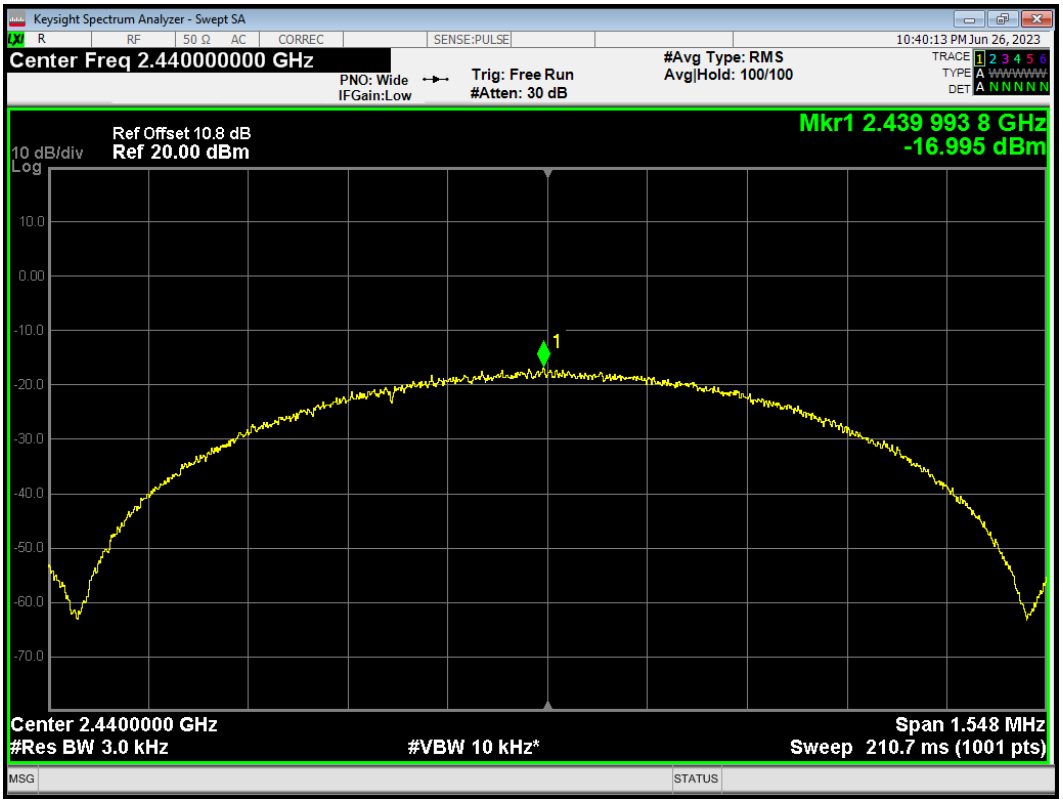
PSD 802.11n(HT40) 2452MHz



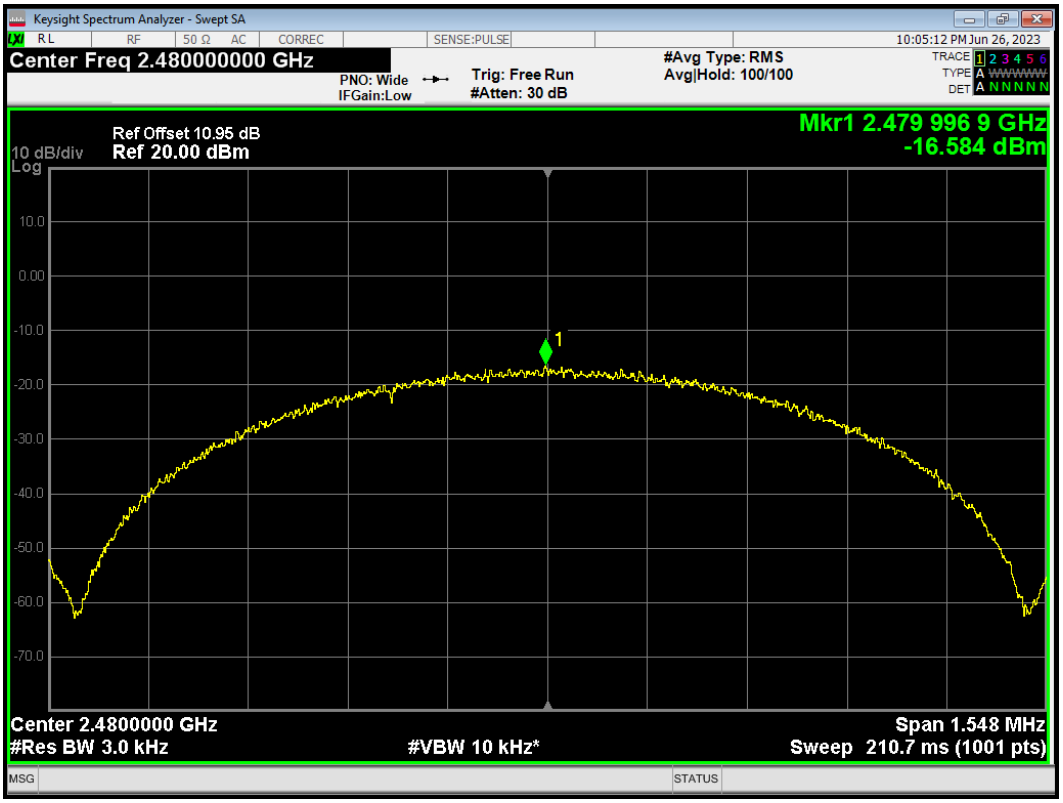
PSD Bluetooth LE (1M) 2402MHz



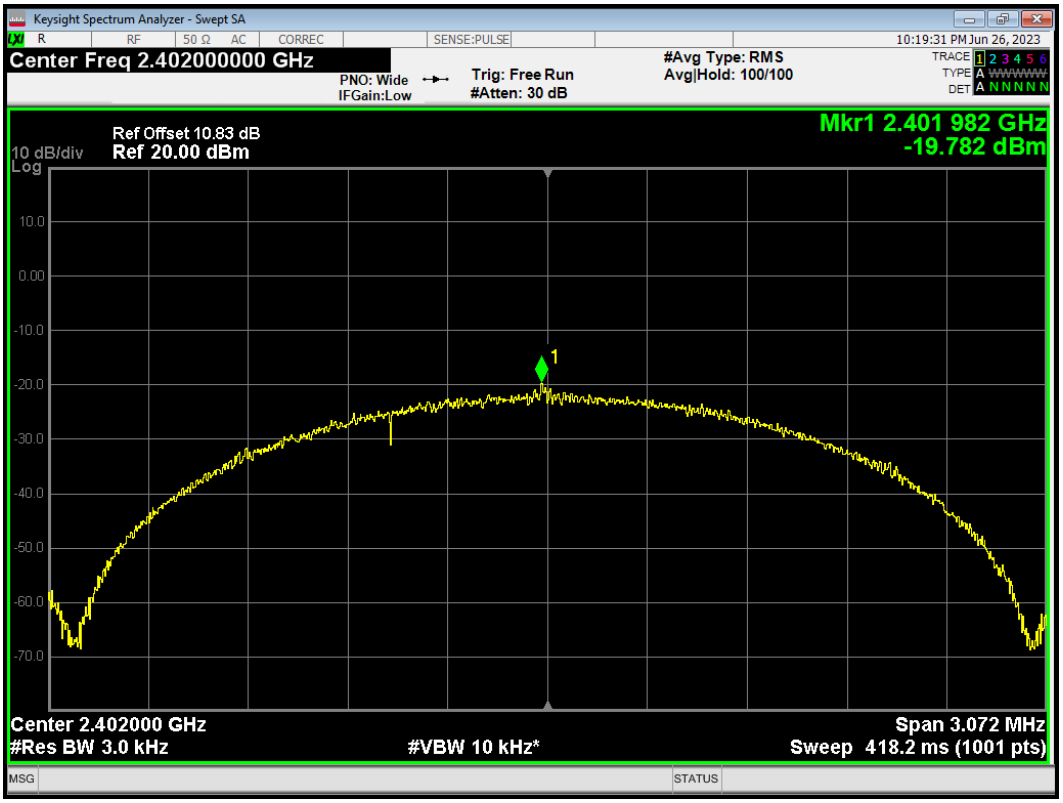
PSD Bluetooth LE (1M) 2440MHz



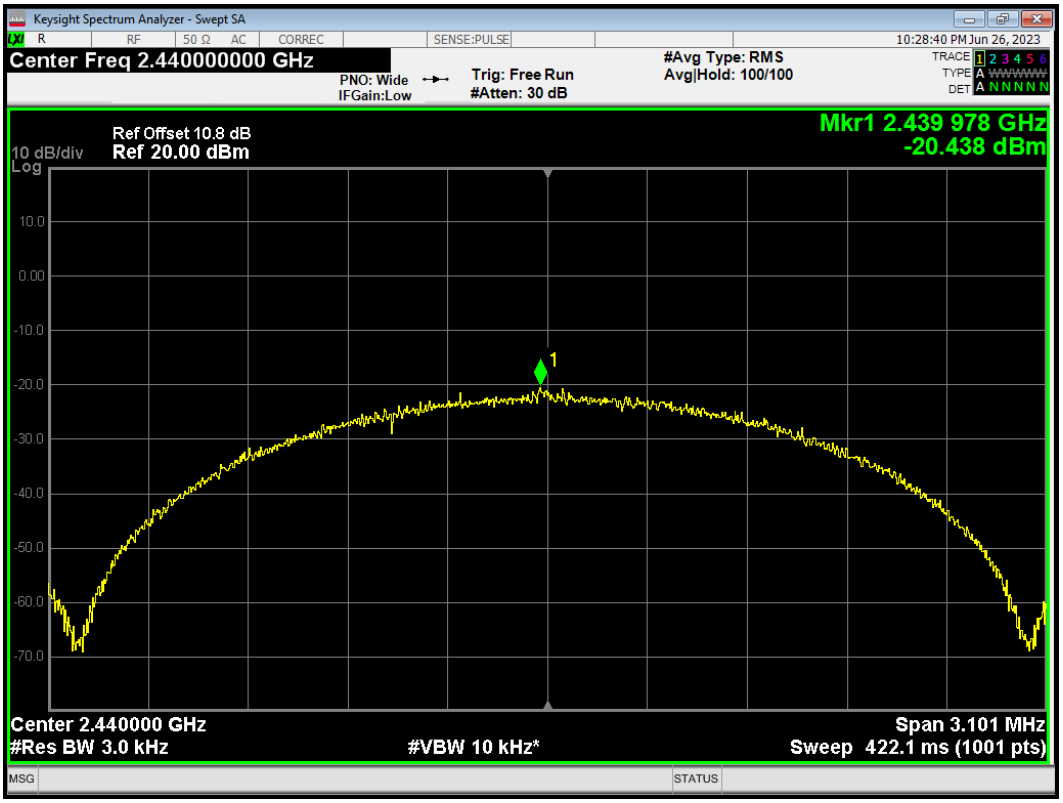
PSD Bluetooth LE (1M) 2480MHz



PSD Bluetooth LE (2M) 2402MHz



PSD Bluetooth LE (2M) 2440MHz



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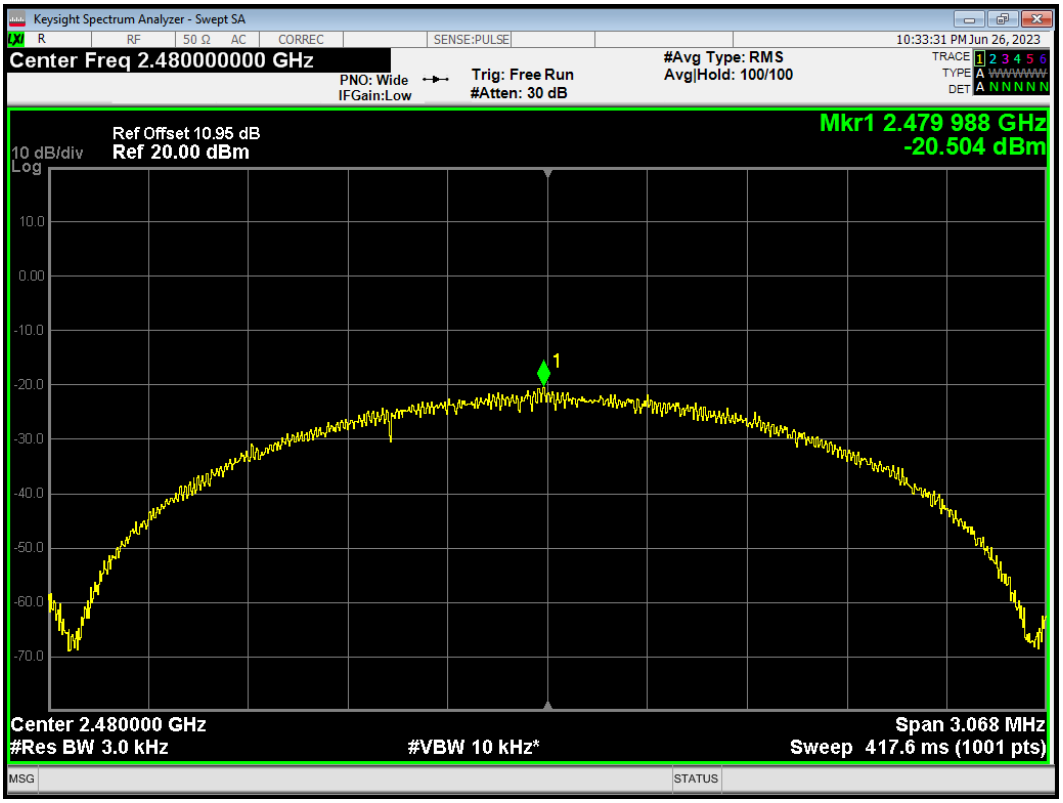
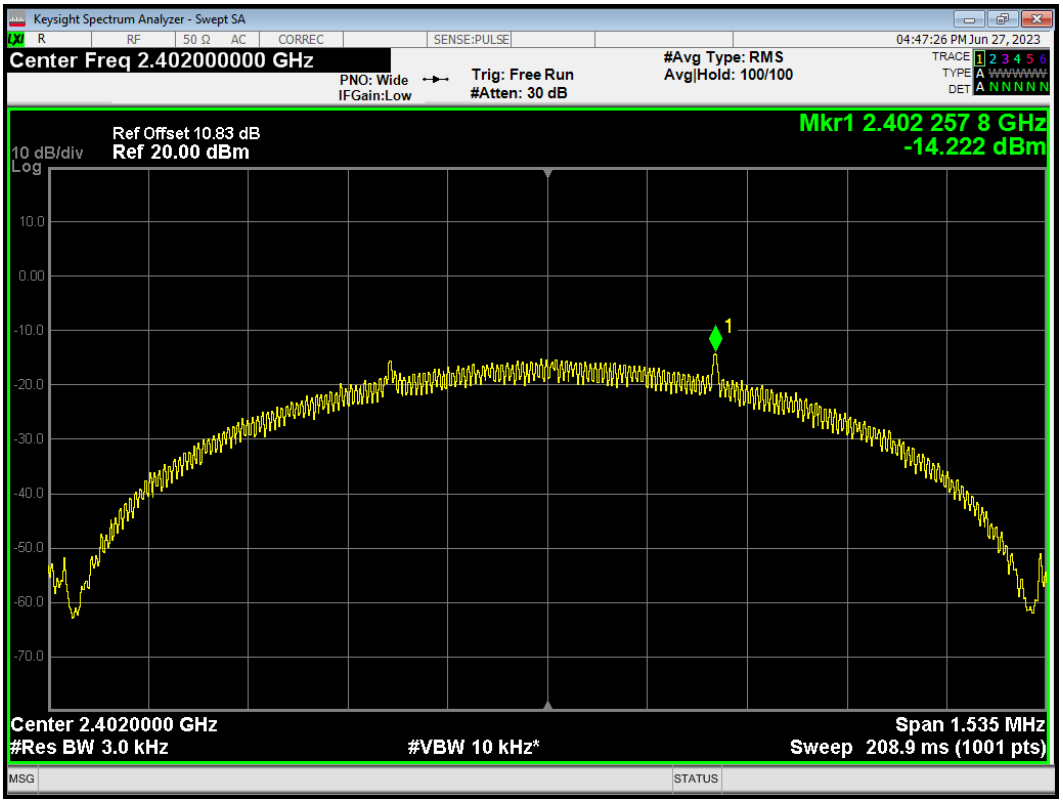


PSD Bluetooth LE (S=2) 2402MHz



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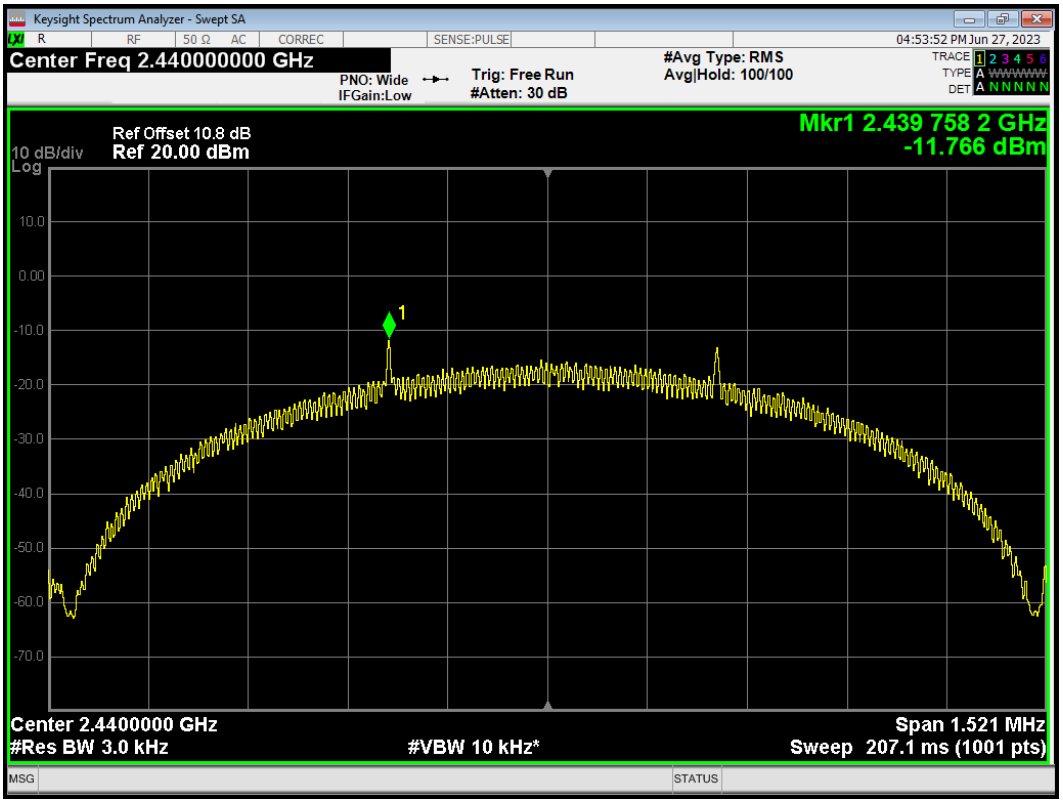
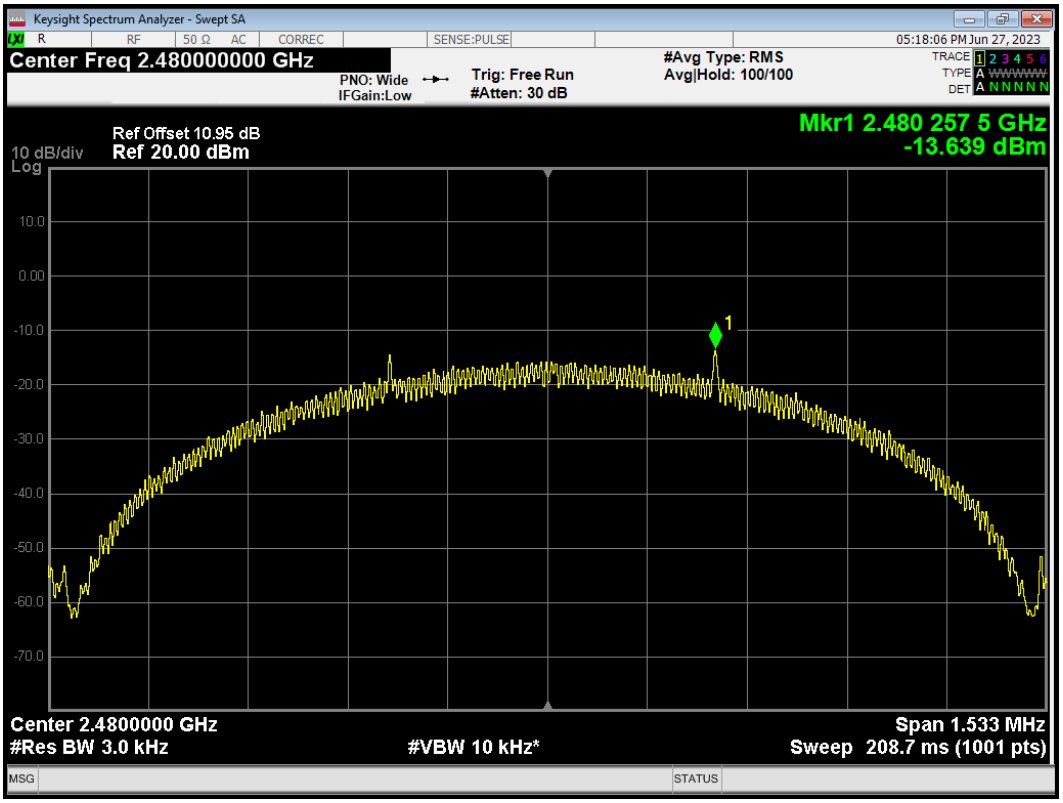
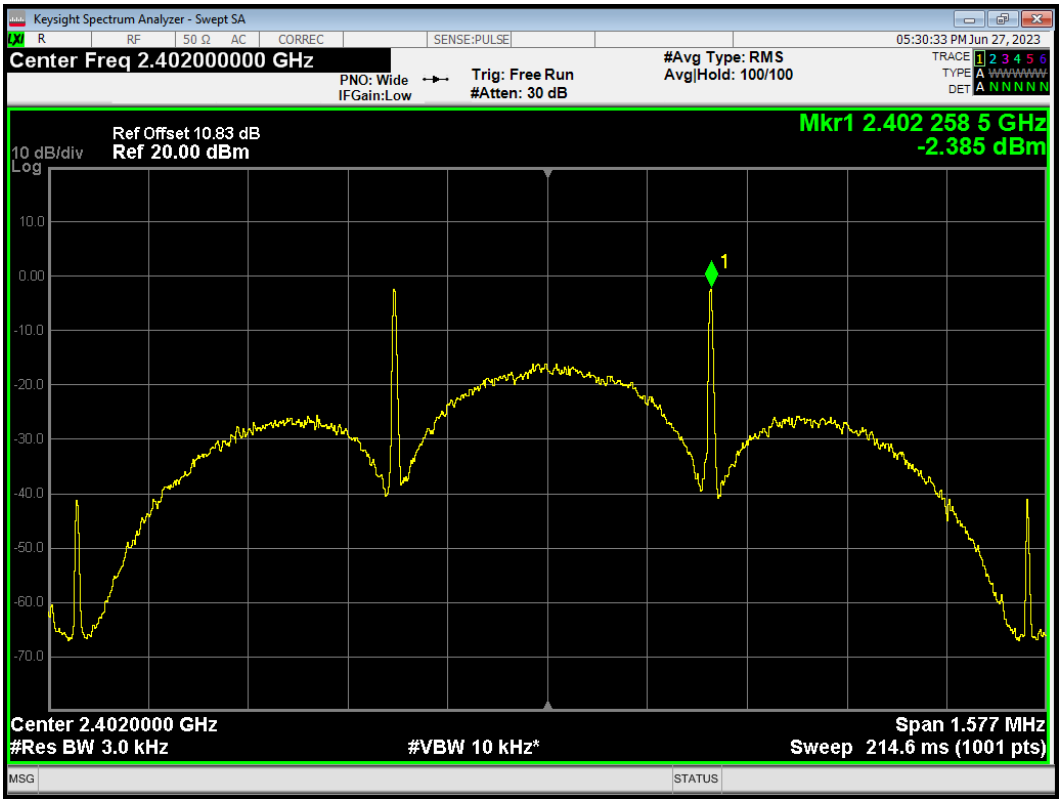


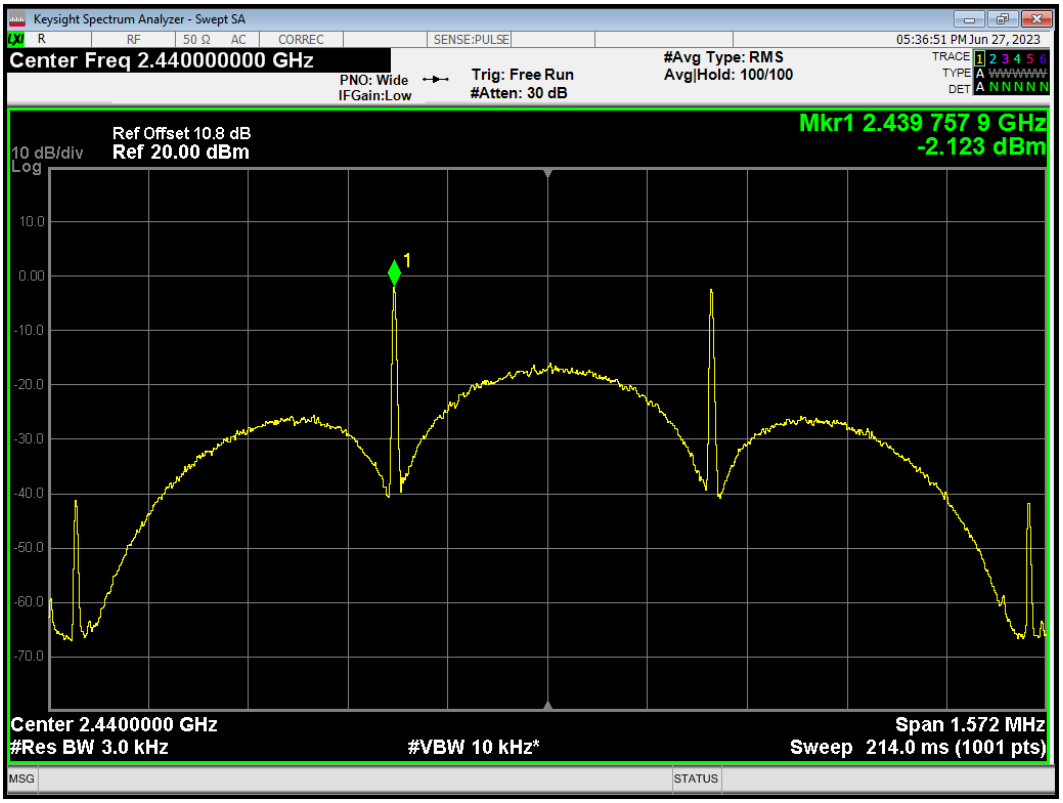
PSD Bluetooth LE (S=2) 2480MHz



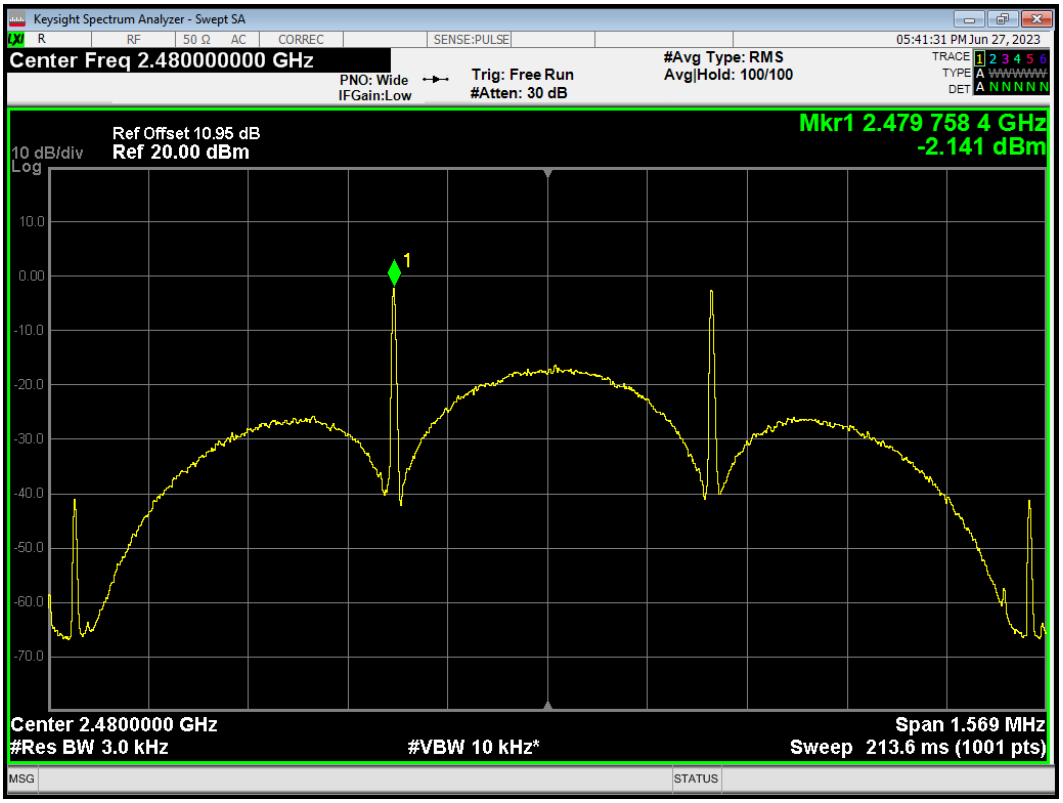
PSD Bluetooth LE (S=8) 2402MHz



PSD Bluetooth LE (S=8) 2440MHz



PSD Bluetooth LE (S=8) 2480MHz



5.5. Spurious RF Conducted Emissions

Ambient Condition

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

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/CH1	10.320	-19.680
	2437/CH6	9.860	-20.140
	2462/CH11	10.220	-19.780
802.11g	2412/CH1	7.100	-22.900
	2417/CH2	9.200	-20.800
	2437/CH6	9.300	-20.700
	2452/CH9	10.050	-19.950
	2457/CH10	8.780	-21.220
	2462/CH11	5.060	-24.940
802.11n HT20	2412/CH1	4.460	-25.540
	2417/CH2	6.960	-23.040
	2437/CH6	8.160	-21.840

	2457/CH10	7.140	-22.860
	2462/CH11	5.610	-24.390
802.11n HT40	2422/CH3	-0.320	-30.320
	2427/CH4	0.230	-29.770
	2432/CH5	3.030	-26.970
	2437/CH6	2.820	-27.180
	2442/CH7	0.640	-29.360
	2447/CH8	0.210	-29.790
	2452/CH9	-0.510	-30.510
Bluetooth (Low Energy) (1M)	2402/CH0	4.270	-25.730
	2440/CH19	5.010	-24.990
	2480/CH39	5.210	-24.790
Bluetooth (Low Energy) (2M)	2402/CH0	5.410	-24.590
	2440/CH19	5.280	-24.720
	2480/CH39	4.970	-25.030
Bluetooth LE (S=2)	2402/CH0	5.060	-24.940
	2440/CH19	5.080	-24.920
	2480/CH39	5.260	-24.740
Bluetooth LE (S=8)	2402/CH0	1.960	-28.040
	2440/CH19	1.960	-28.040
	2480/CH39	4.450	-25.550

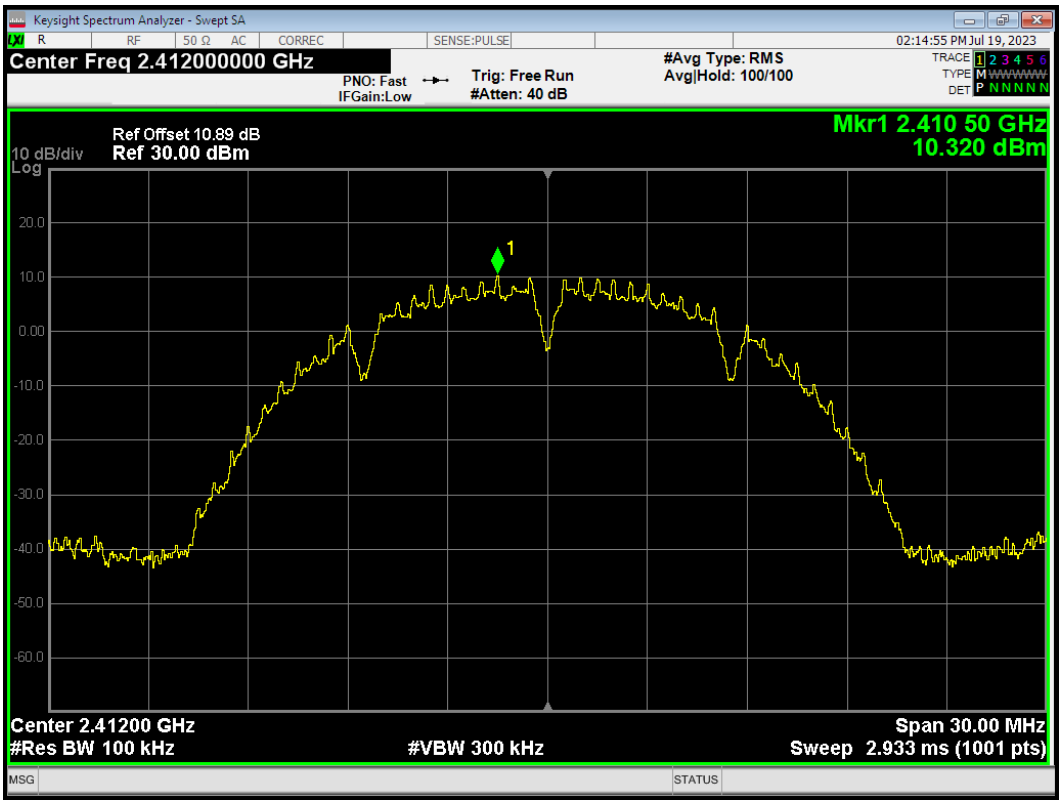
Measurement Uncertainty

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

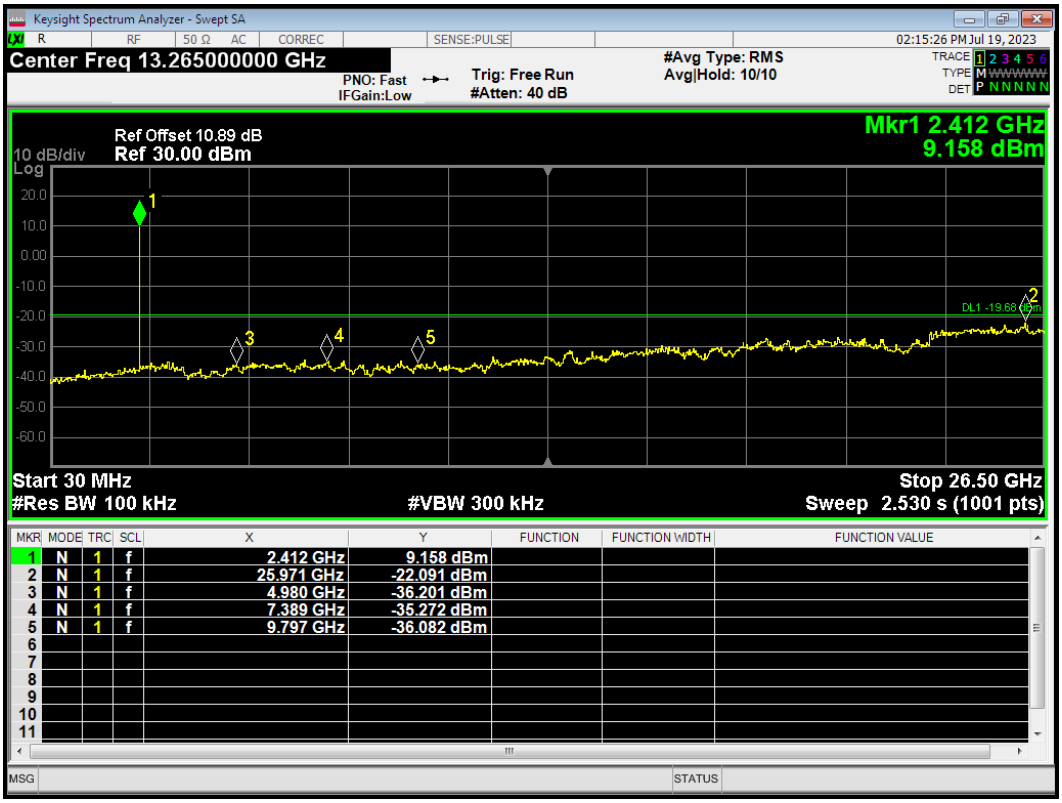
Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

Test Results:

Tx. Spurious 802.11b 2412MHz Ref



Tx. Spurious 802.11b 2412MHz Emission



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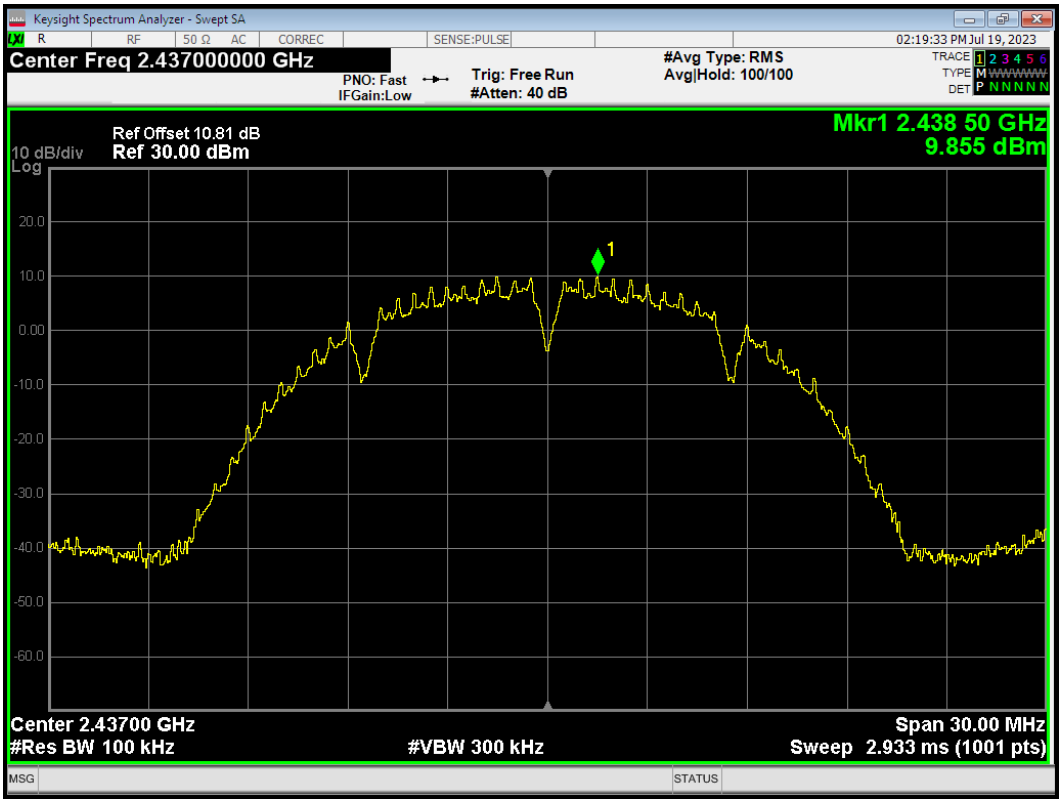
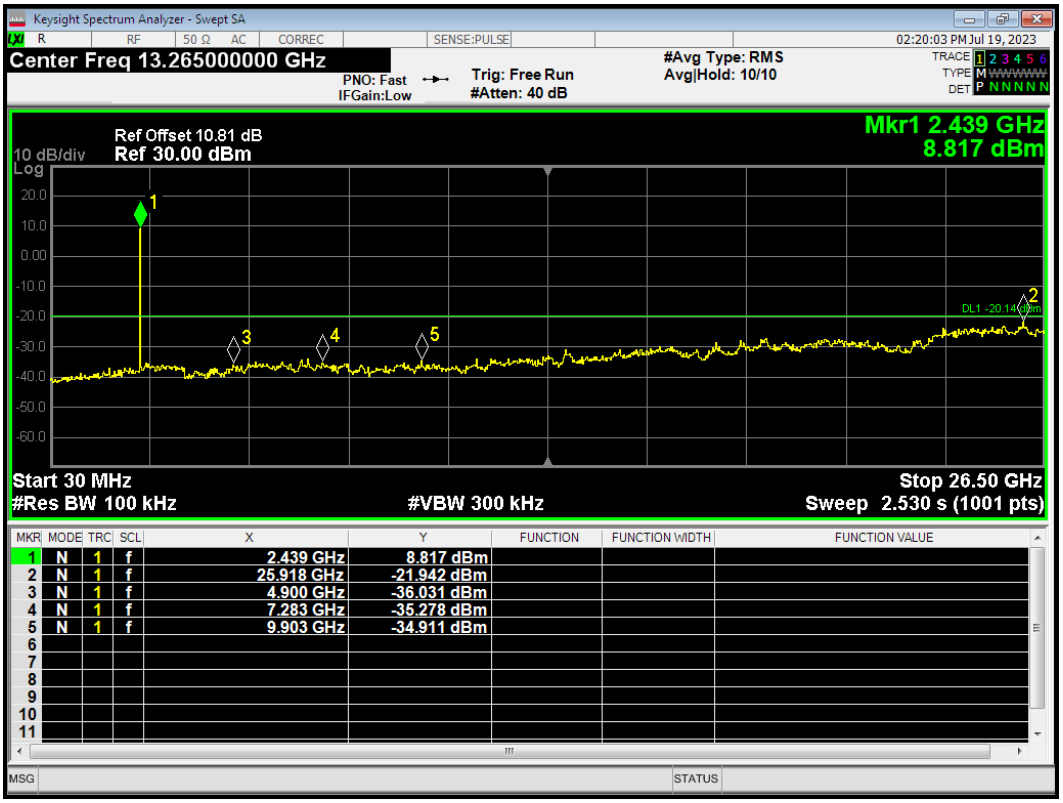
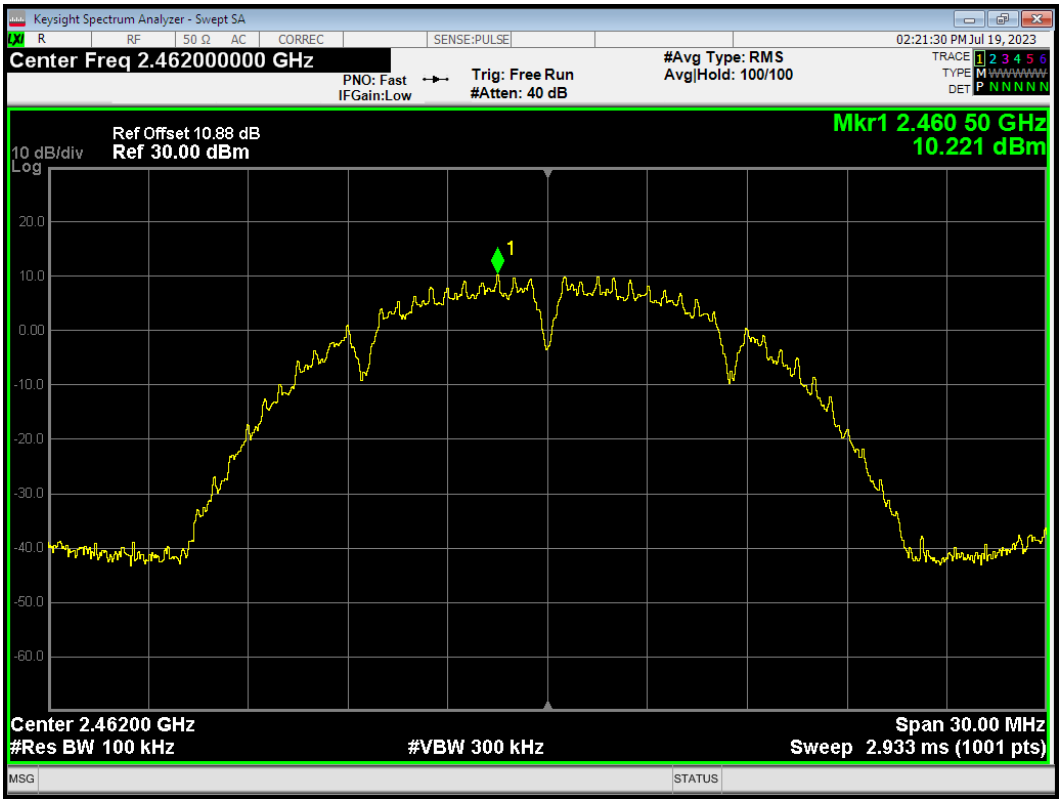


Tx. Spurious 802.11b 2437MHz Emission

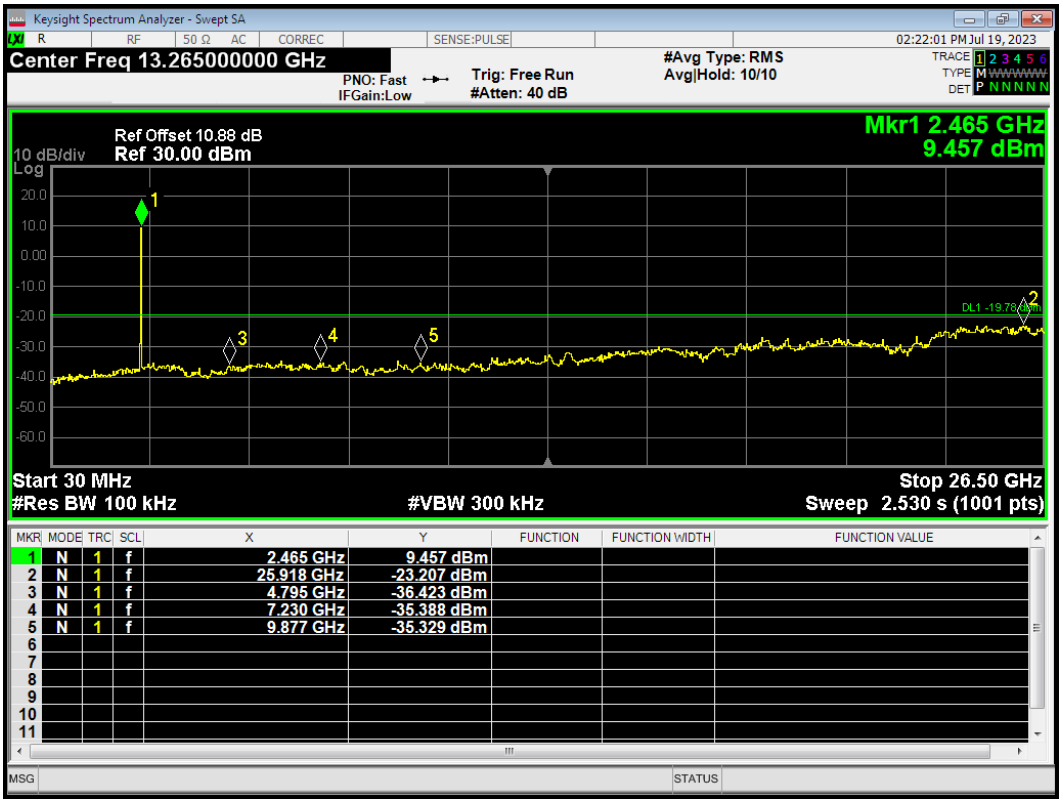


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.439 GHz	8.817 dBm			
2	N	1	f	25.918 GHz	-21.942 dBm			
3	N	1	f	4.900 GHz	-36.031 dBm			
4	N	1	f	7.283 GHz	-35.278 dBm			
5	N	1	f	9.903 GHz	-34.911 dBm			

Tx. Spurious 802.11b 2462MHz Ref



Tx. Spurious 802.11b 2462MHz Emission



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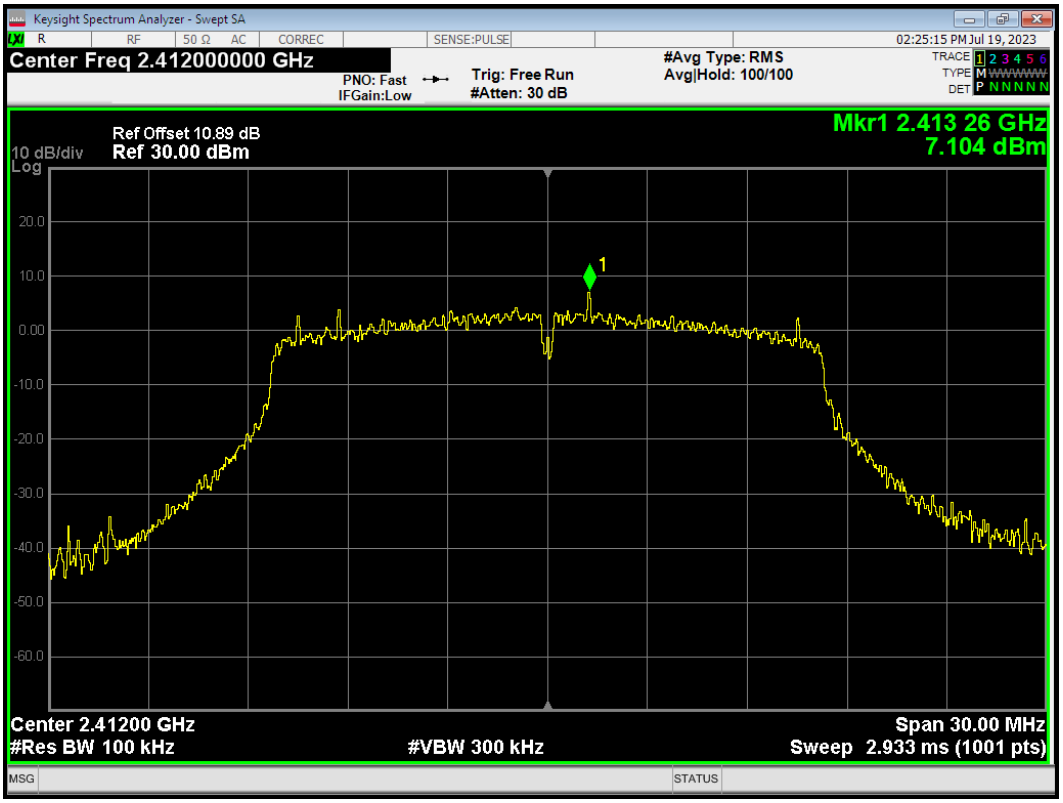

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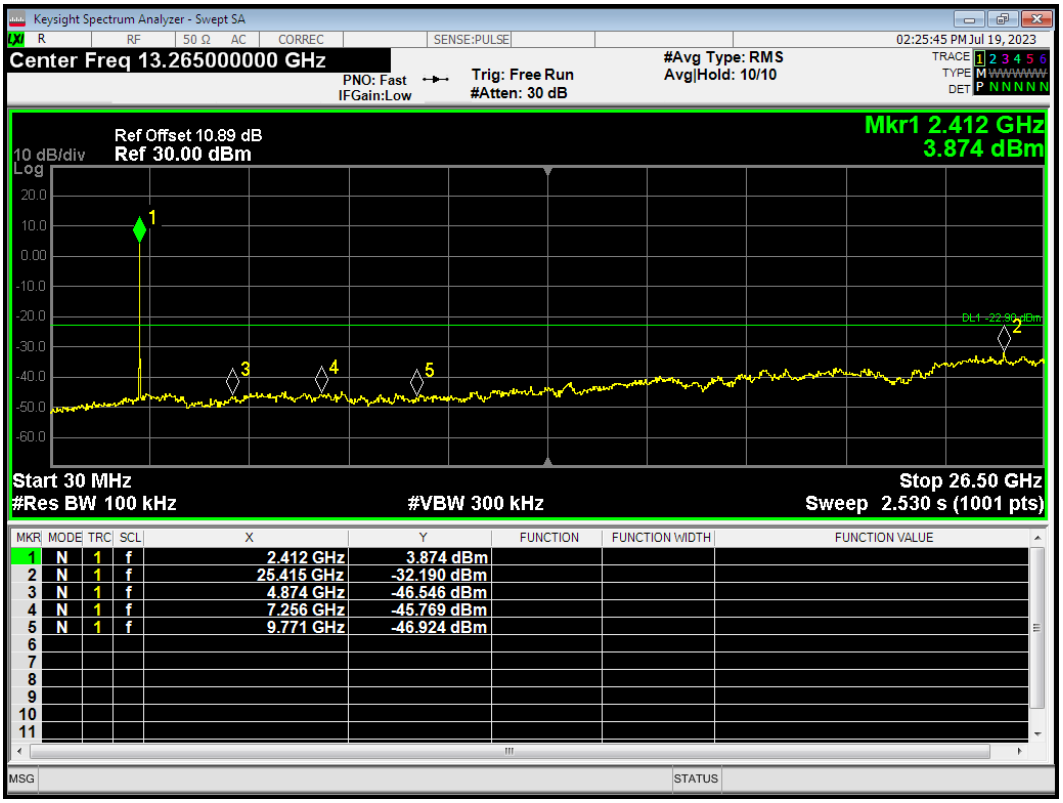

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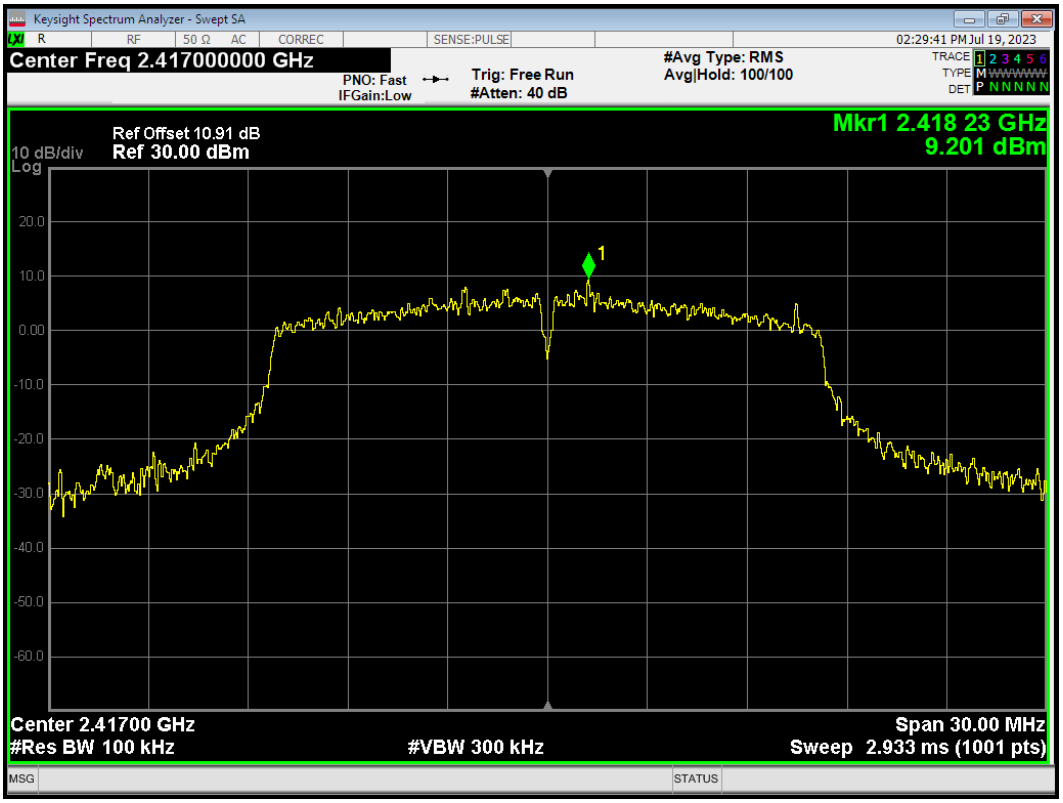

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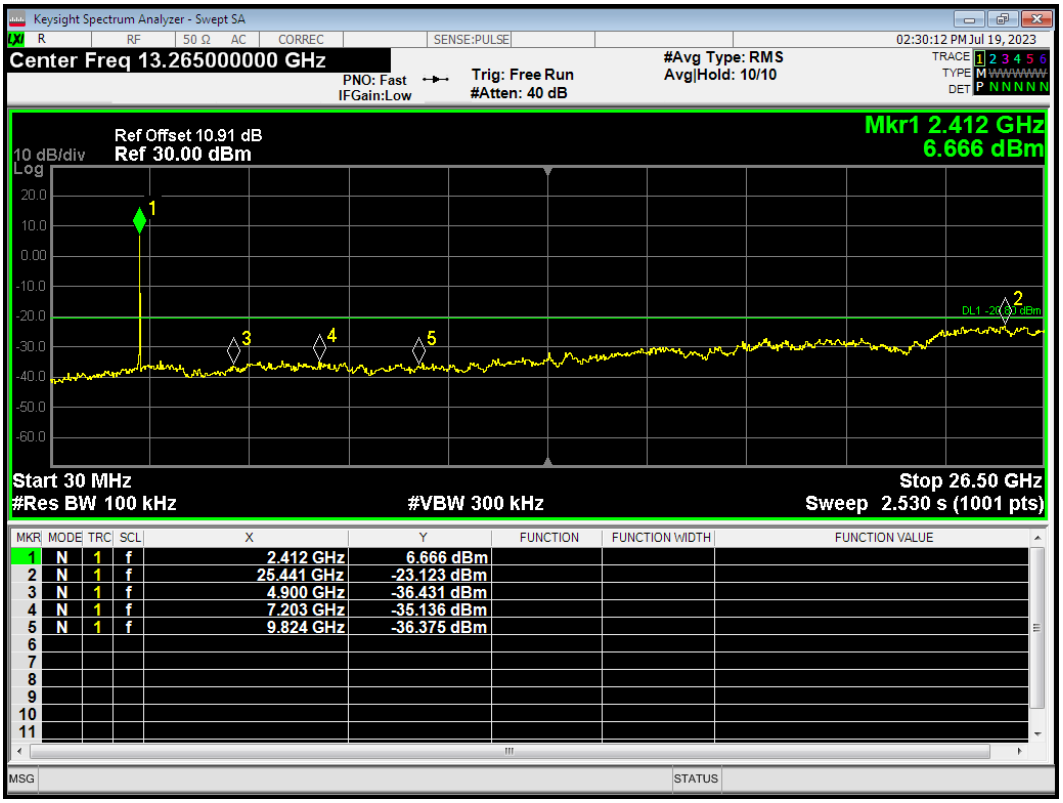
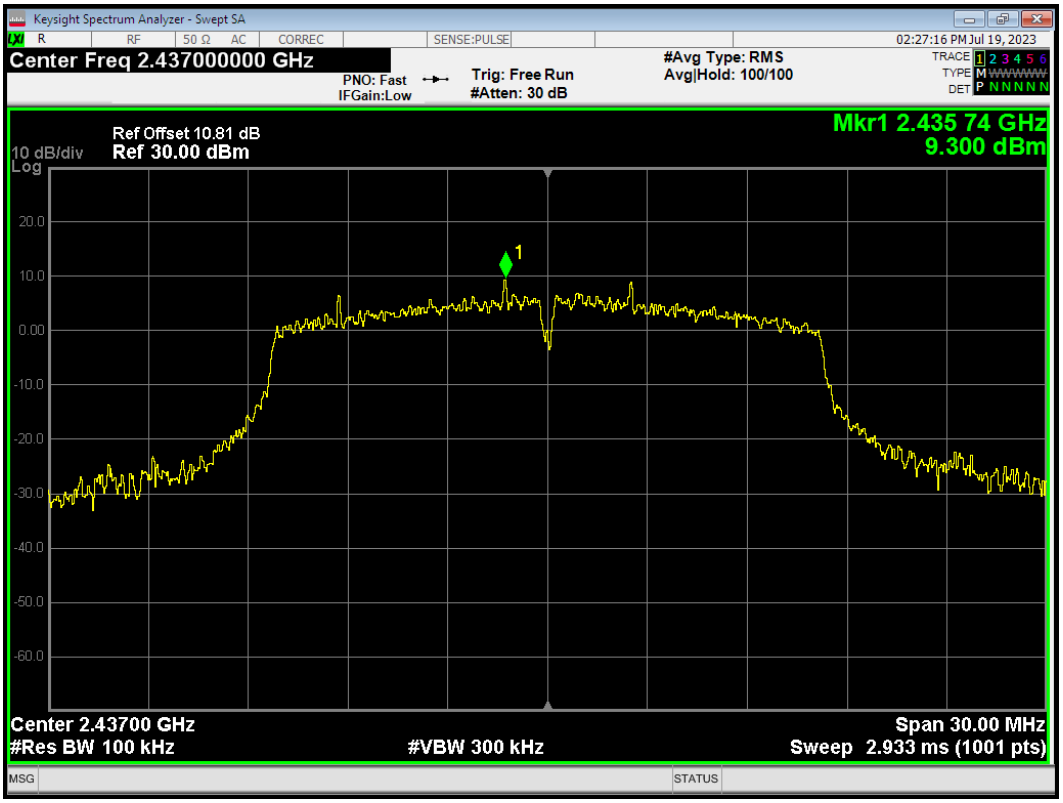


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.412 GHz	6.666 dBm			
2	N	1	f	25.441 GHz	-23.123 dBm			
3	N	1	f	4.900 GHz	-36.431 dBm			
4	N	1	f	7.203 GHz	-35.136 dBm			
5	N	1	f	9.824 GHz	-36.375 dBm			

Tx. Spurious 802.11g 2437MHz Ref



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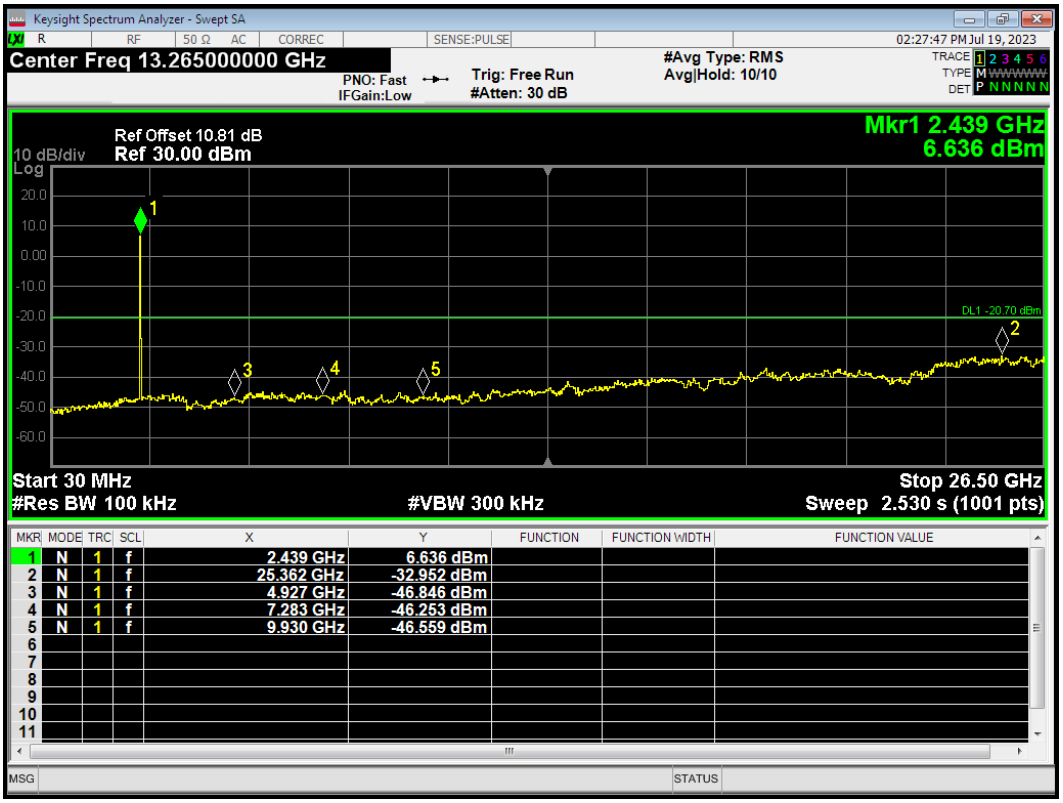

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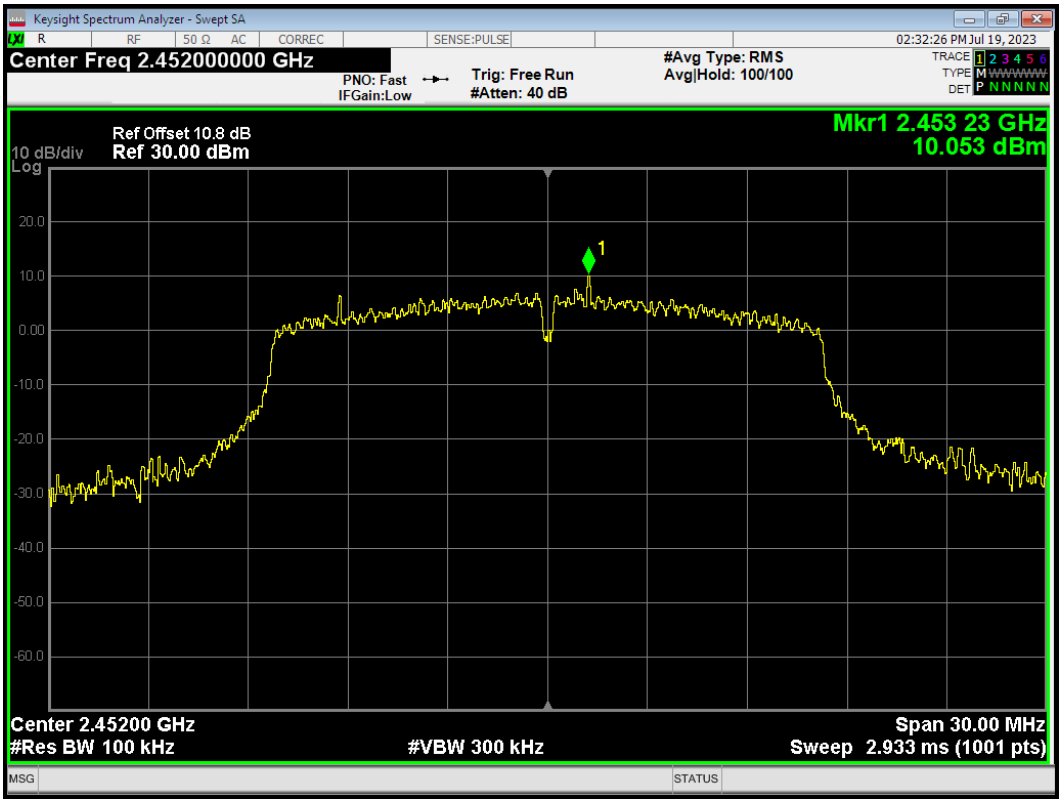

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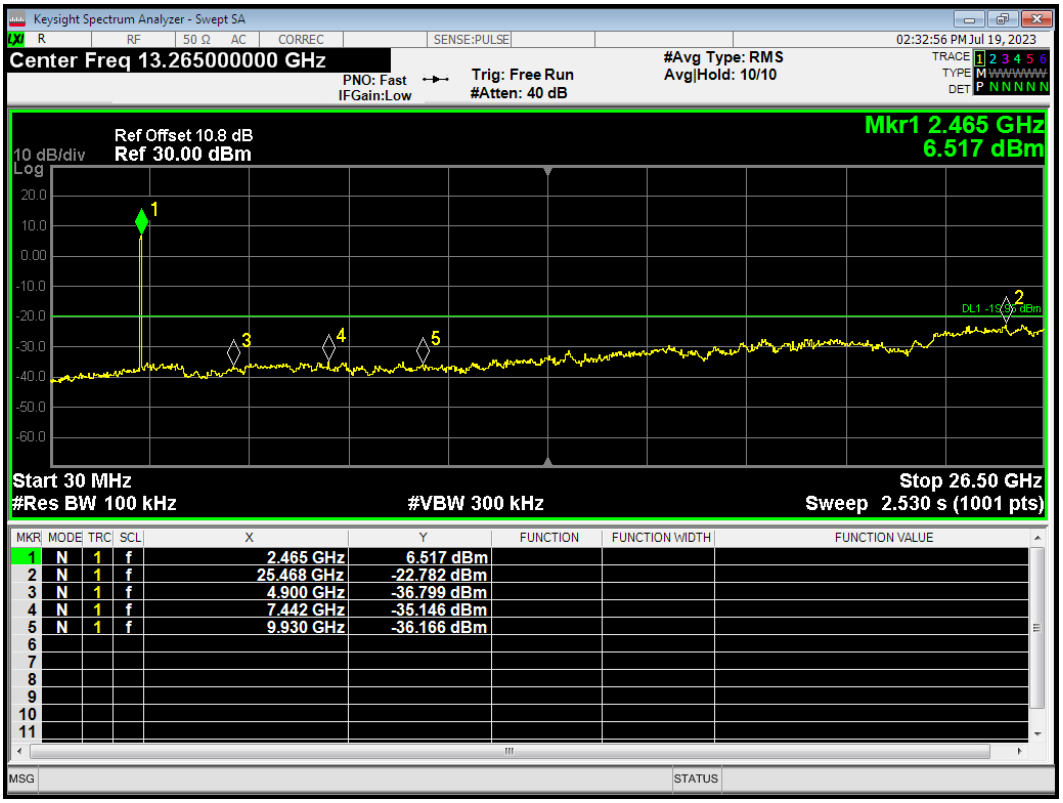

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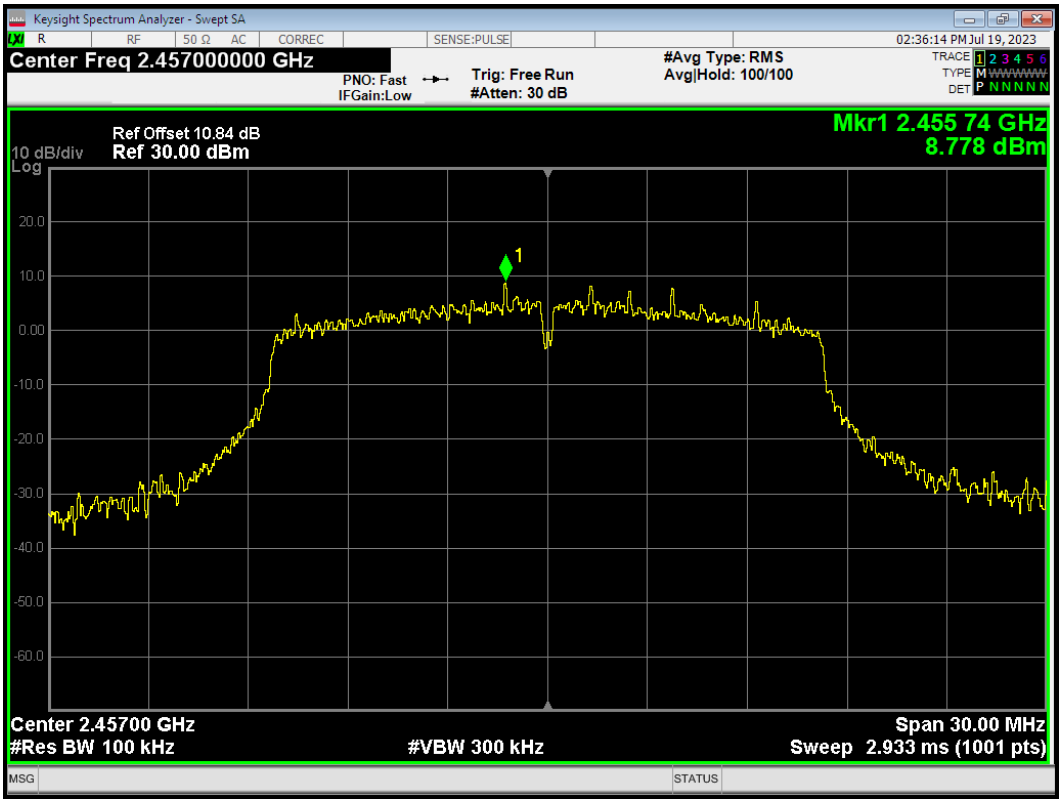

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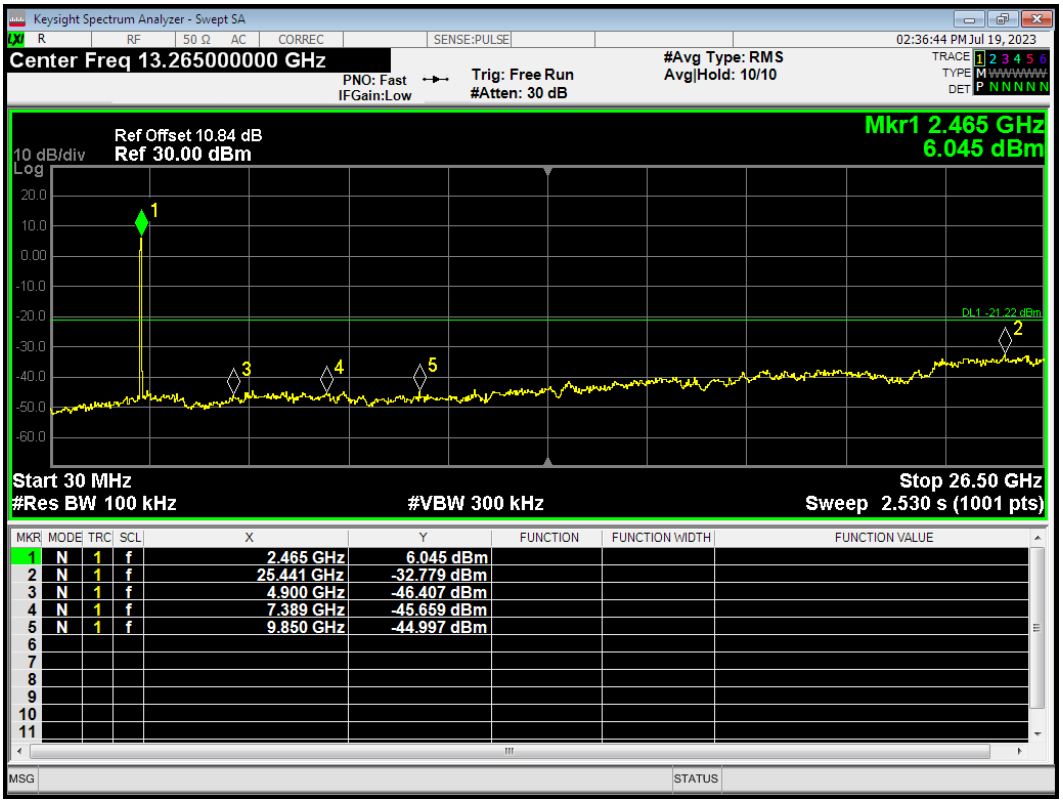

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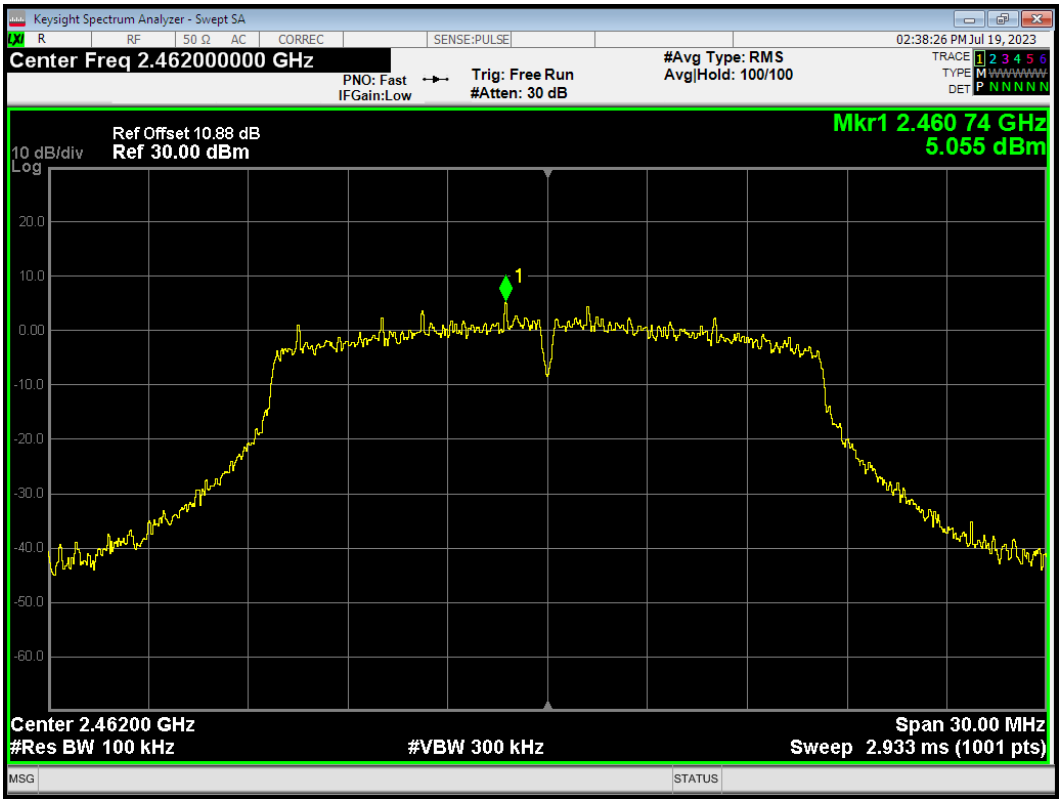

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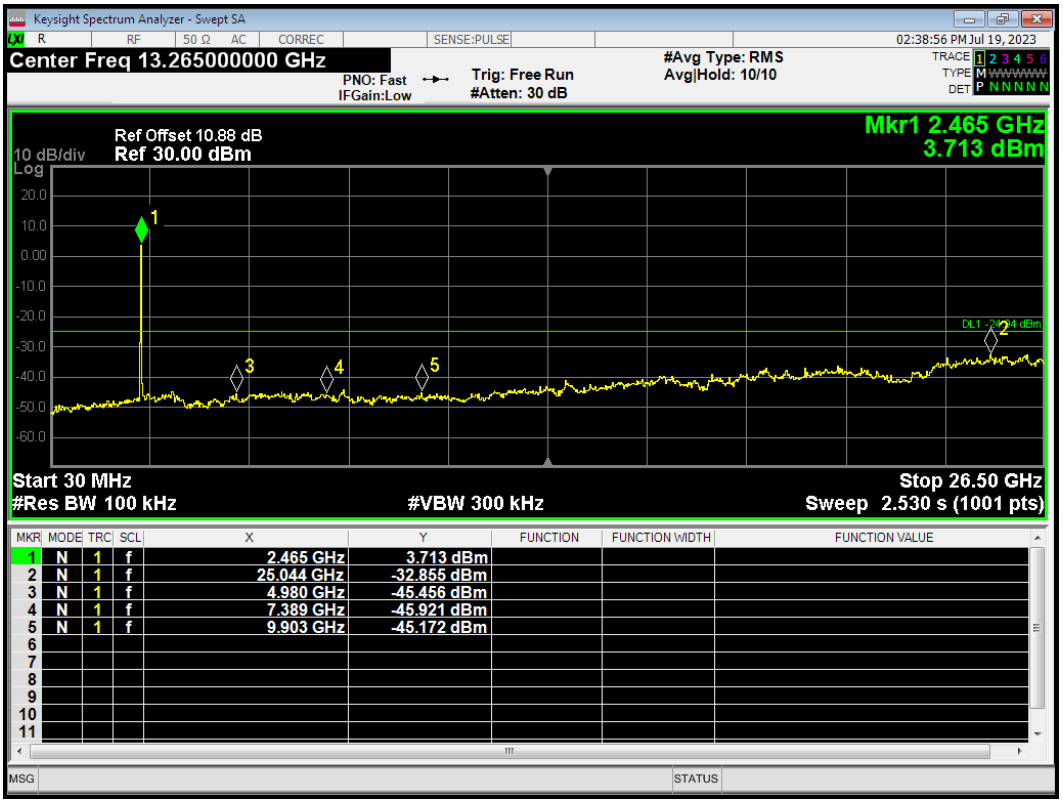
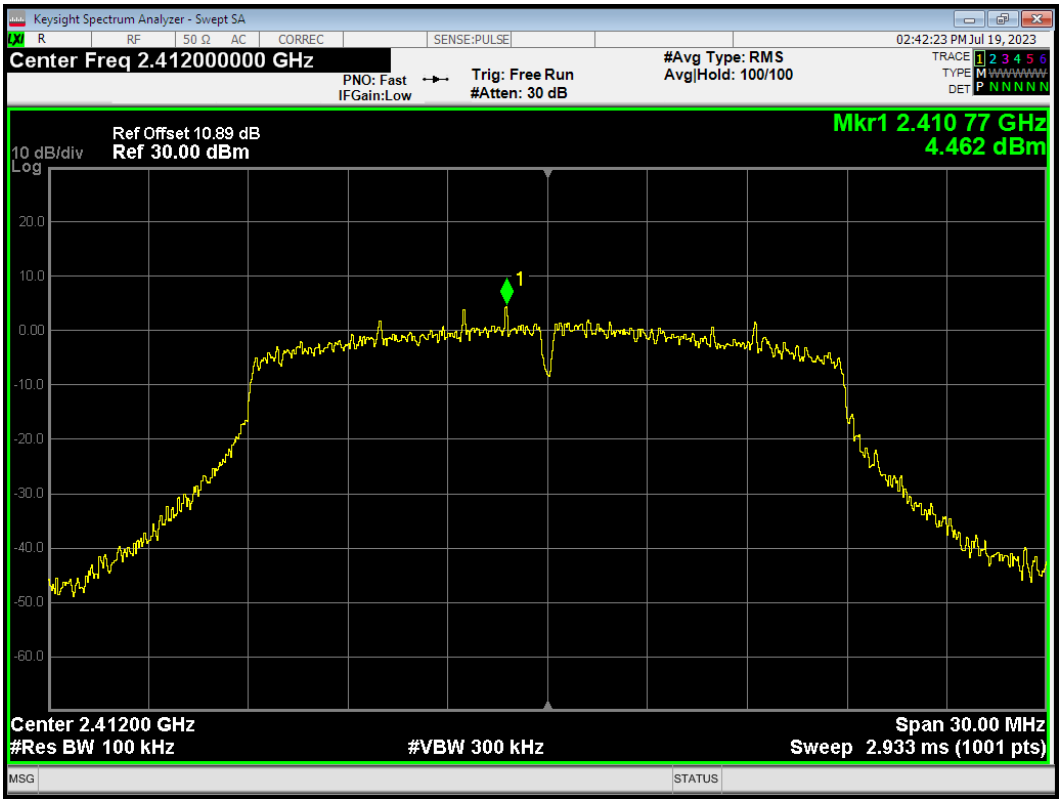


Tx. Spurious 802.11n(HT20) 2412MHz Ref



Tx. Spurious 802.11n(HT20) 2412MHz Emission