8 EMISSION LIMITATIONS MEASUREMENT

8.1 Test Equipment

The following test equipment was used during the emission limitations test:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2023.08.09	1 Year
2.	RF Cable	Mini-Circuits	FLC-3FT-SM SM+	22022838	2023.08.09	1 Year
3.	20 dB Attenuator	Mini-Circuits	BW-S20W2+	001	2023.09.21	1 Year

8.2 Block Diagram of Test Setup

The Same as Section. 5.2.

8.3 Specification Limits (§15.247(d))

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. Attenuation below the general limits specified in §15.209(a) is not required.
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)). (※This test result attaching to Section. 4.7)

8.4 Operating Condition of EUT

The software as section 2.3 was used to enable the EUT to change the test mode one by one.

8.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ [3 × RBW].
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.
Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Establish an emission level by using the following procedure:
a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

Scan up through 10th harmonic.

The test procedure is defined in ANSI C63.10-2013 (11.11.2 Reference level measurement and 11.11.3 Emission level measurement was used).

For Emissions Testing of Transmitters with Multiple Outputs in the Same Band: Per KDB 662911 D01 Multiple Transmitter Output v02r01, section E).3).b), The out-of-band and spurious emissions against relative emission limits, tests may be performed on each output individually without summing or adding 10 log(N_{ANT}) if the measurements are made relative to the in-band emissions on the individual outputs.

8.6 Test Results

PASSED.

The test data was attached in the next pages.

(Test Date: 2024.04.03-14 Temperature: 23℃ Humidity: 51 %)

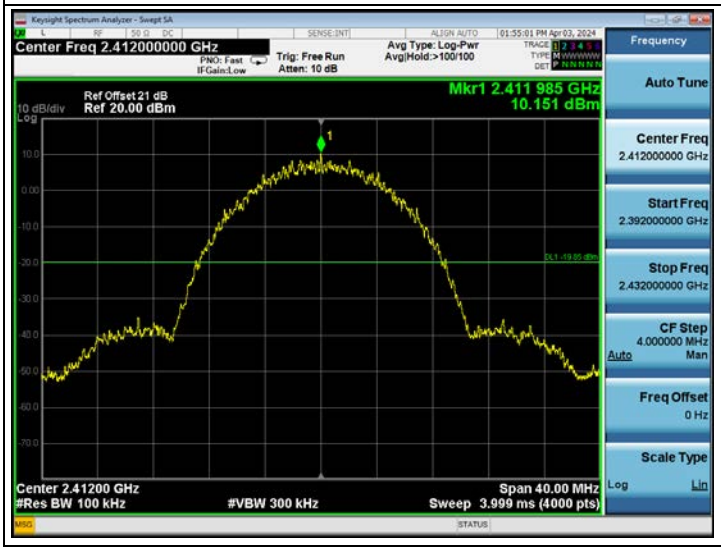
Mode	Transmit Port	Channel	Frequency (MHz)	Data Page
802.11b	CNF2	1	2412	P81
		6	2437	P82
		11	2462	P83
802.11g	CNF2	1	2412	P84
		6	2437	P85
		11	2462	P86
802.11n20	CNF2	1	2412	P87
		6	2437	P88
		11	2462	P89
802.11n40	CNF2	3	2422	P90
		6	2437	P91
		9	2452	P92
802.11b	CNF3	1	2412	P93
		6	2437	P94
		11	2462	P95
802.11g	CNF3	1	2412	P96
		6	2437	P97
		11	2462	P98
802.11n20	CNF3	1	2412	P99
		6	2437	P100
		11	2462	P101
802.11n40	CNF3	3	2422	P102
		6	2437	P103
		9	2452	P104

802.11b

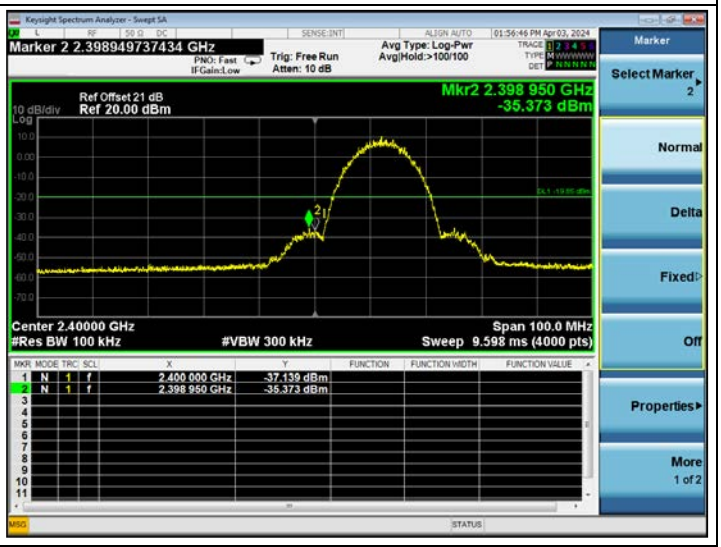
CNF2

CH2412

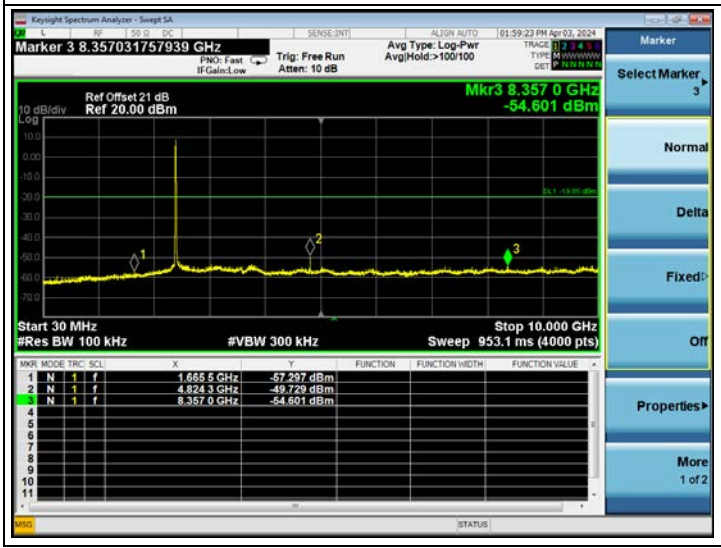
Reference Level



Lower Edge



Emission Level

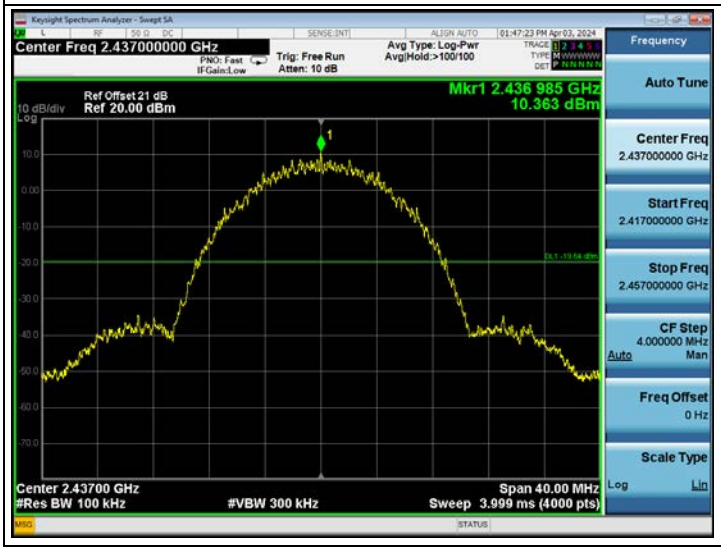


802.11b

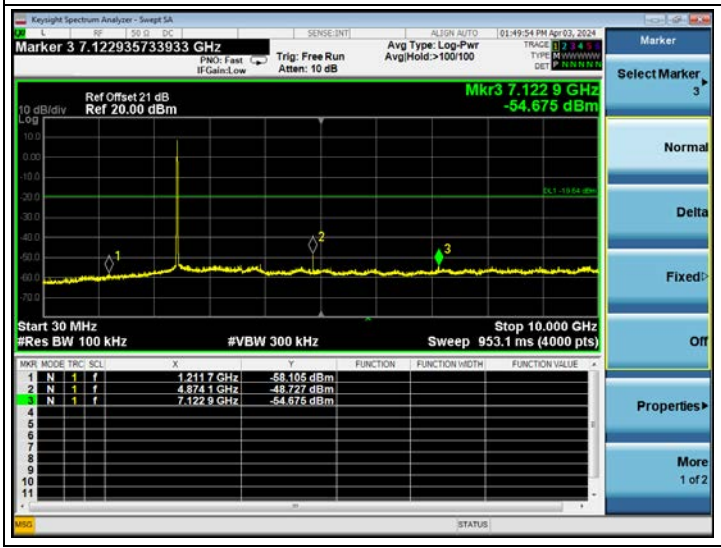
CNF2

CH2437

Reference Level



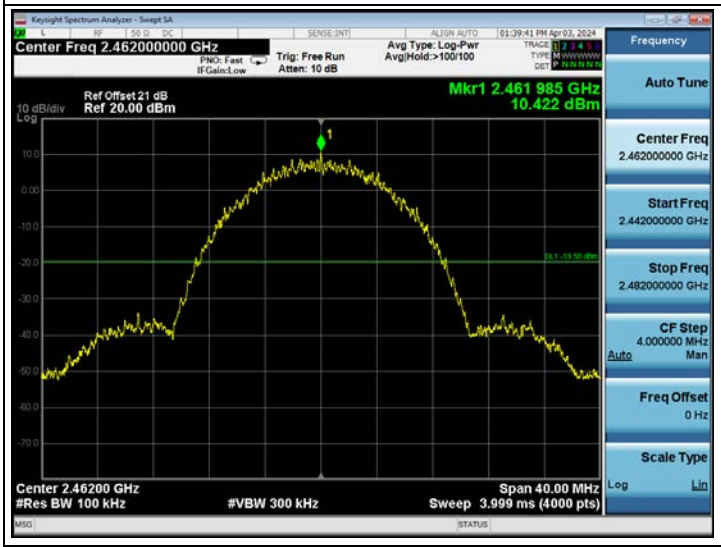
Emission Level



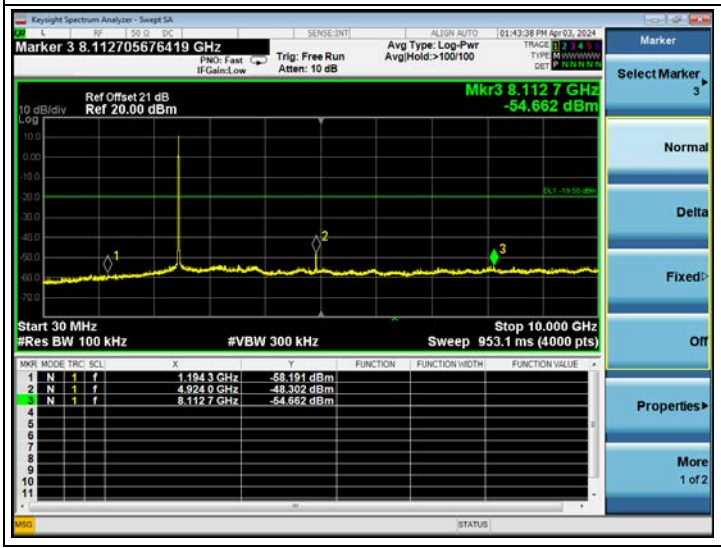
802.11b

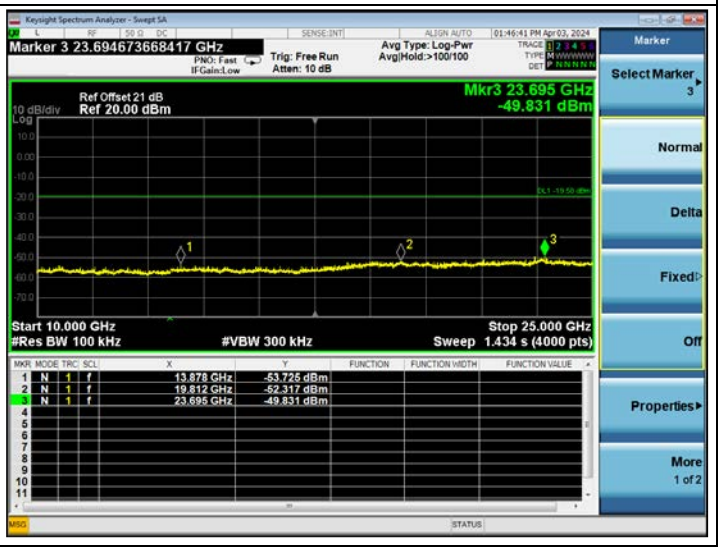
CNF2

CH2462

Reference Level	Higher Edge
	

Emission Level





802.11g

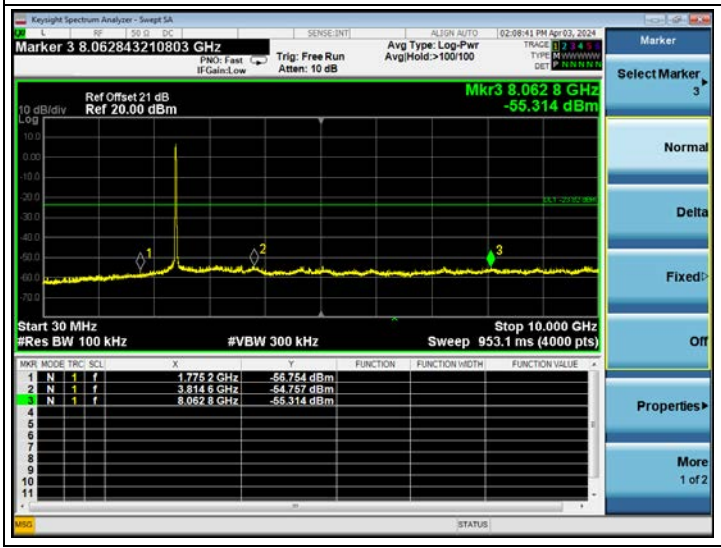
CNF2

CH2412

Reference Level

Lower Edge

Emission Level



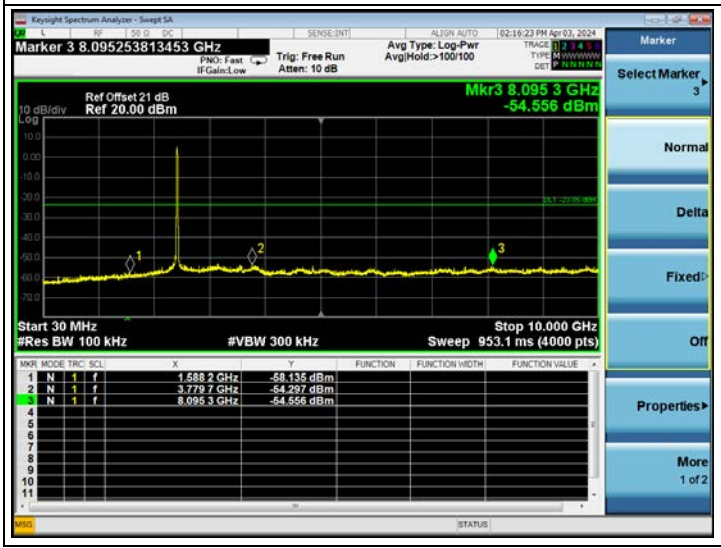
802.11g

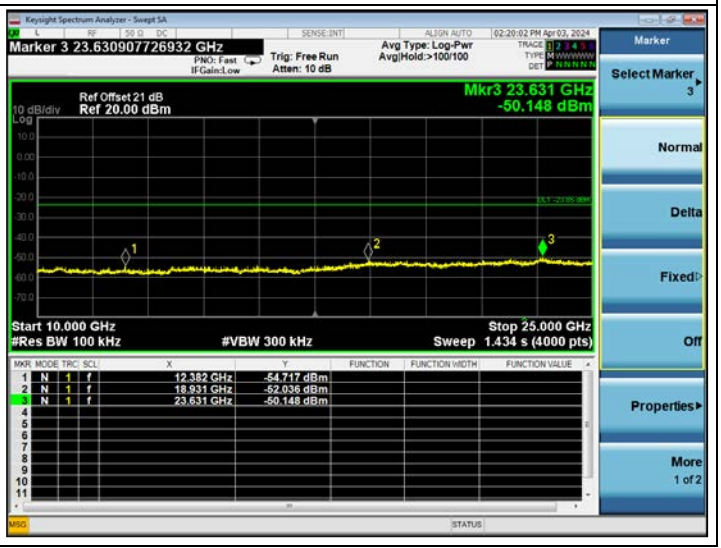
CNF2

CH2437

Reference Level

Emission Level





802.11g

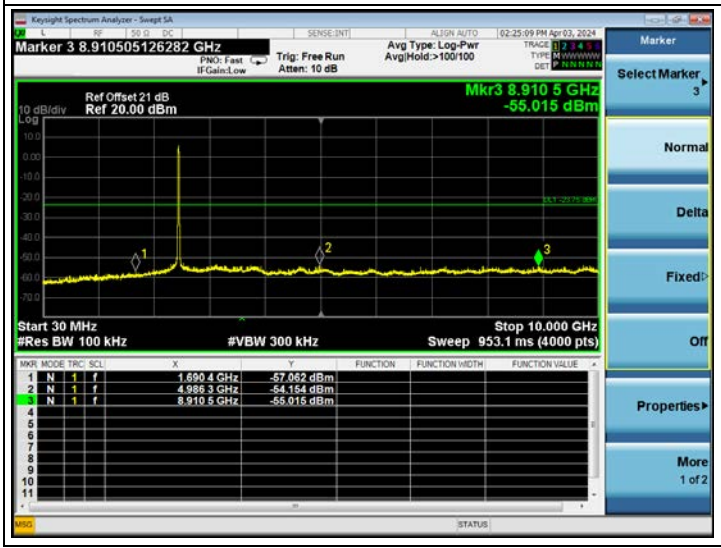
CNF2

CH2462

Reference Level

Higher Edge

Emission Level



802.11n20

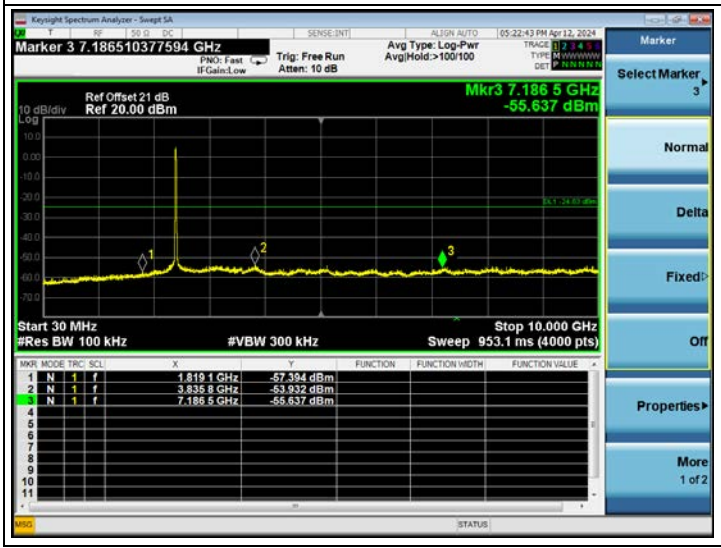
CNF2

CH2412

Reference Level

Lower Edge

Emission Level

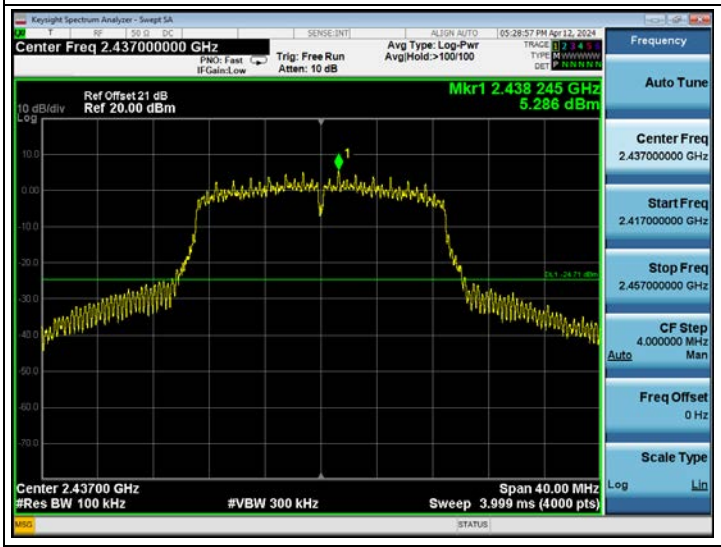


802.11n20

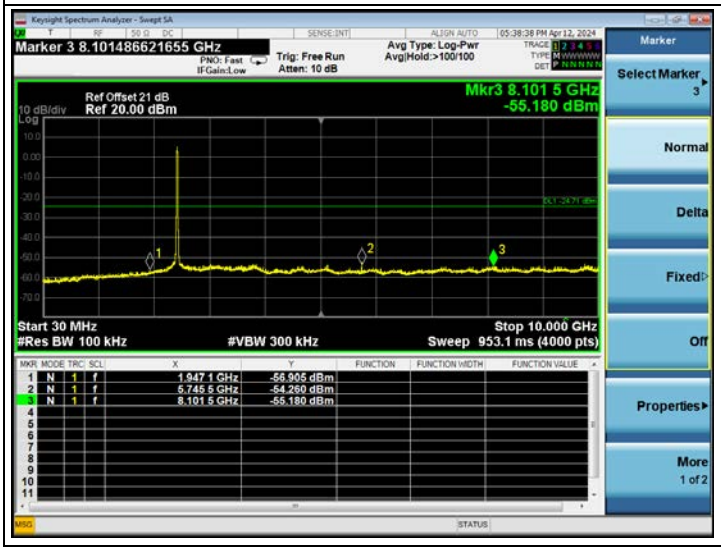
CNF2

CH2437

Reference Level



Emission Level

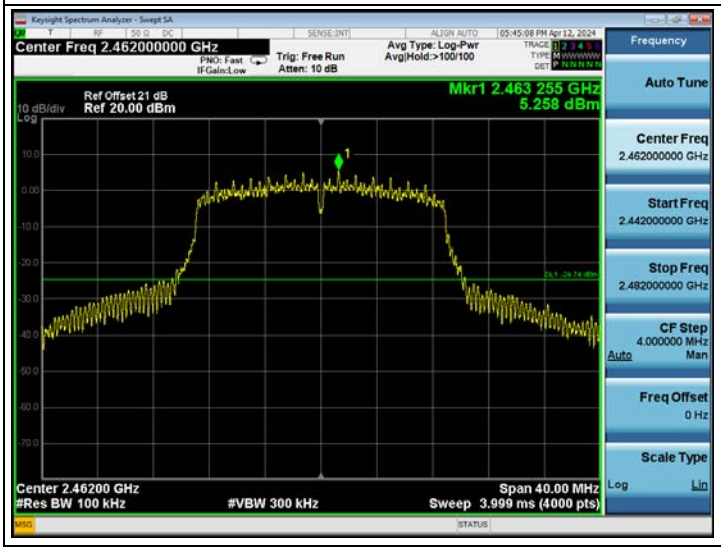


802.11n20

CNF2

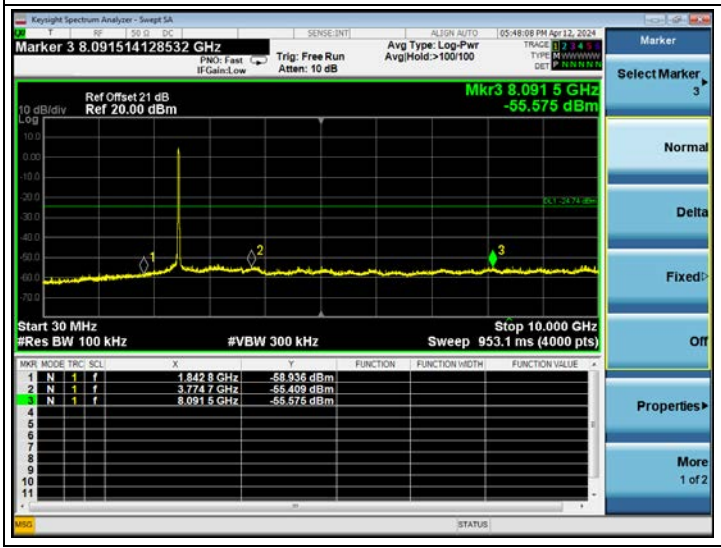
CH2462

Reference Level



Higher Edge

Emission Level

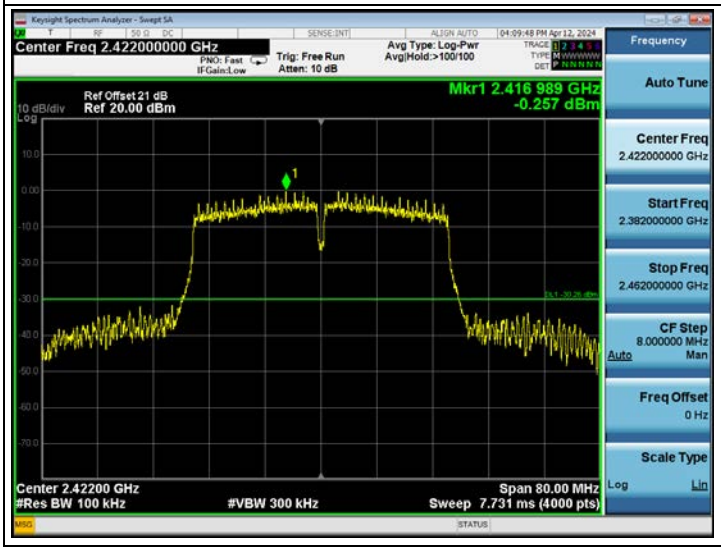


802.11n40

CNF2

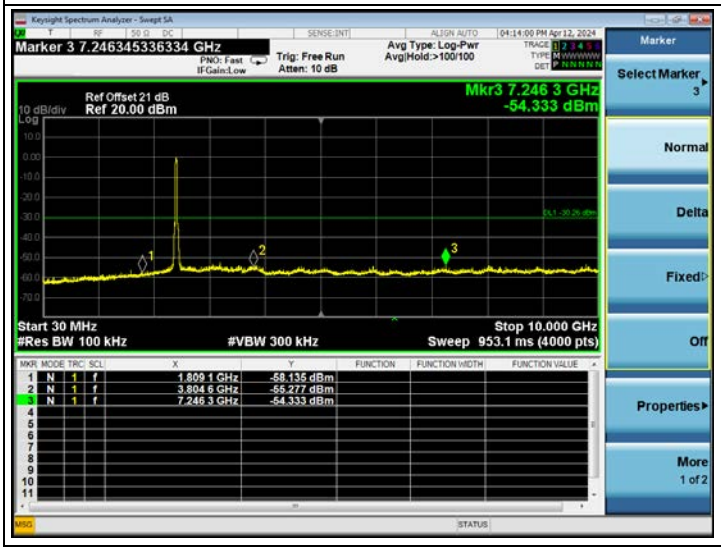
CH2422

Reference Level



Lower Edge

Emission Level

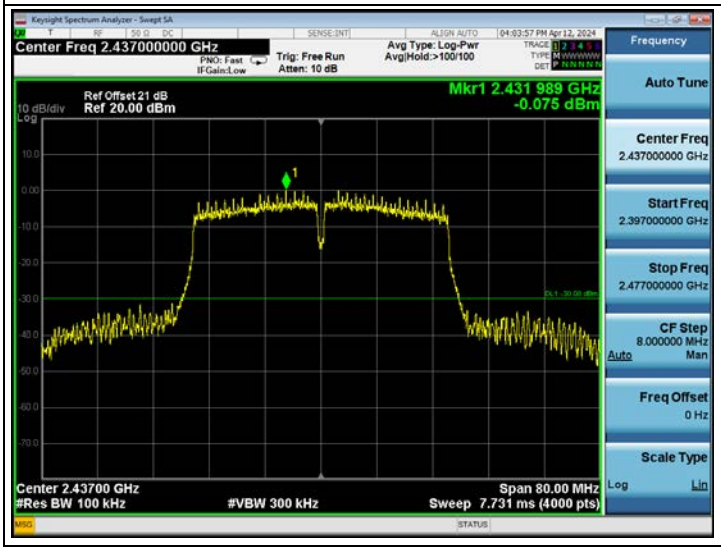


802.11n40

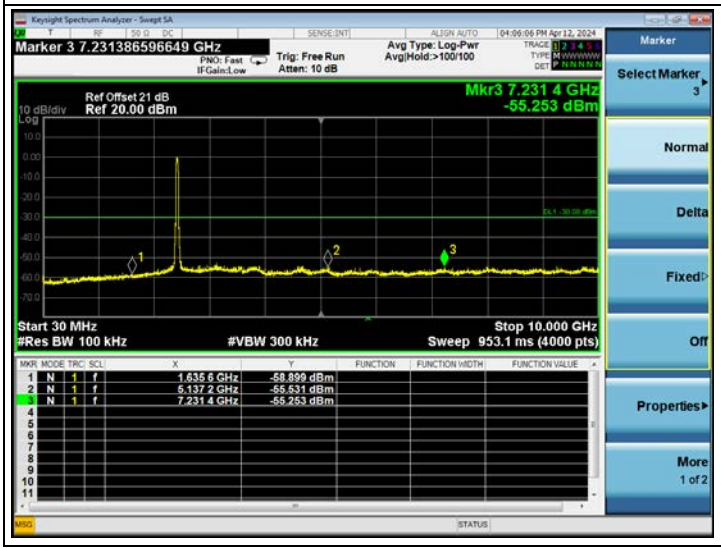
CNF2

CH2437

Reference Level



Emission Level

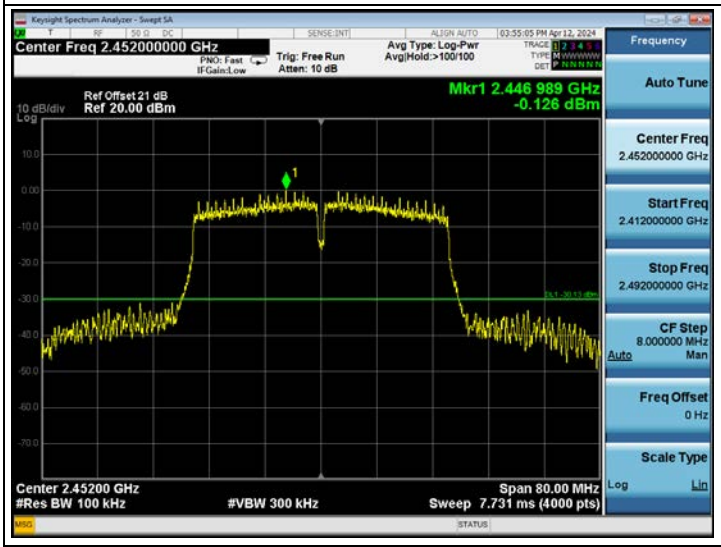


802.11n40

CNF2

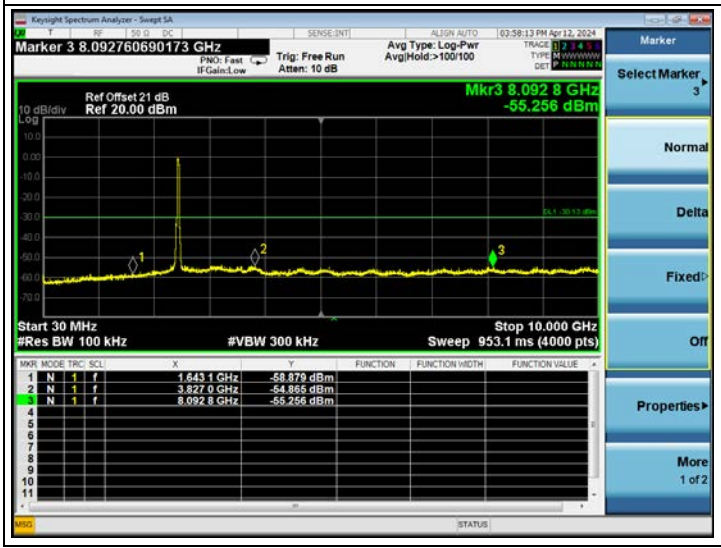
CH2452

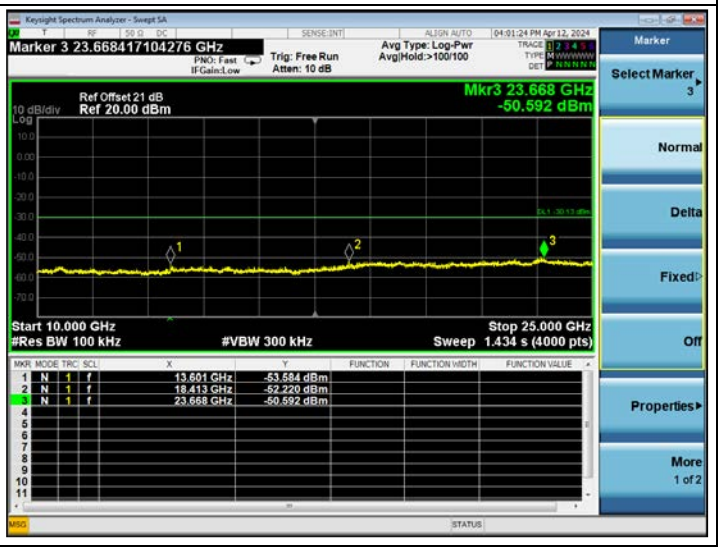
Reference Level



Higher Edge

Emission Level



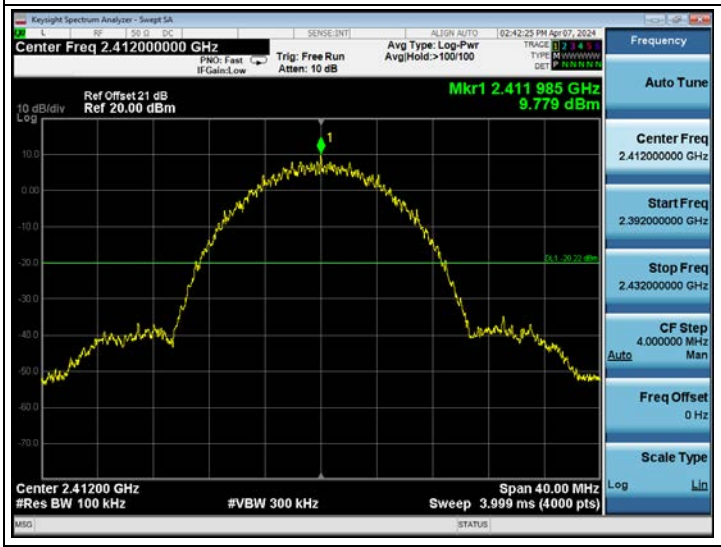


802.11b

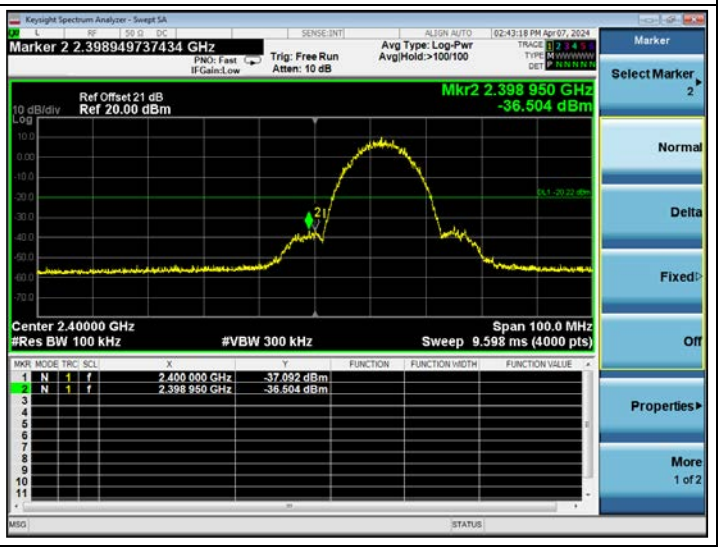
CNF3

CH2412

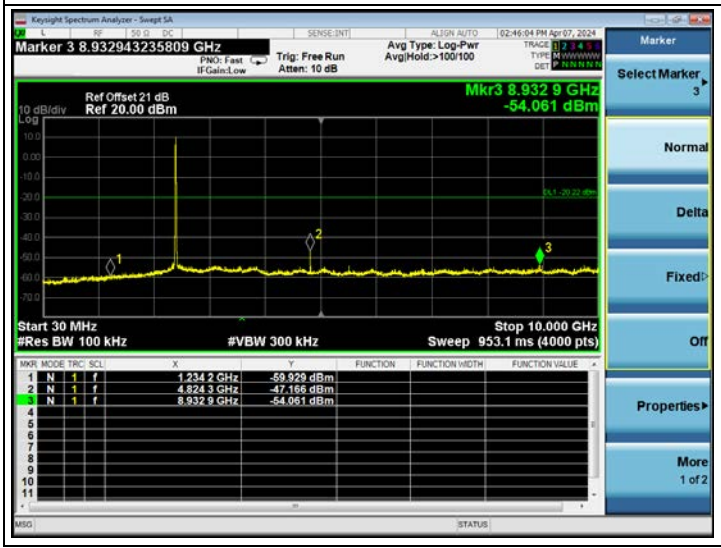
Reference Level

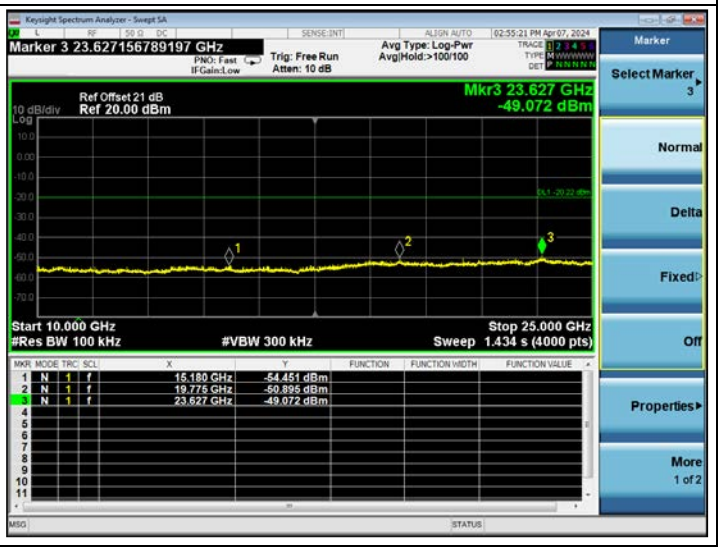


Lower Edge



Emission Level



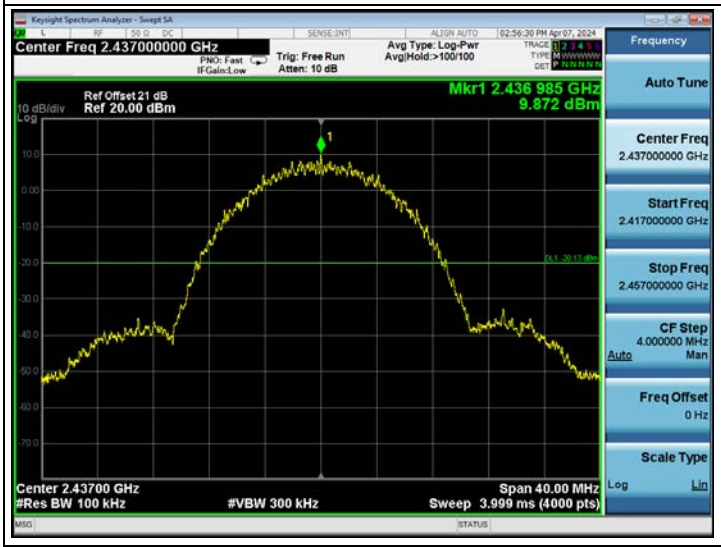


802.11b

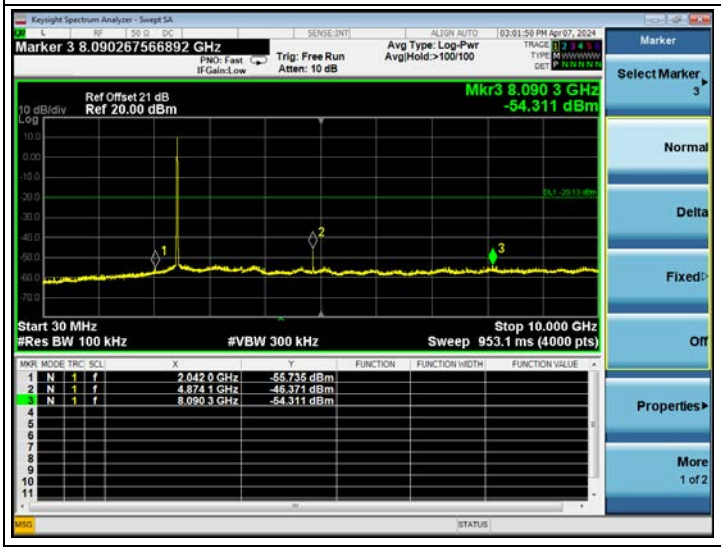
CNF3

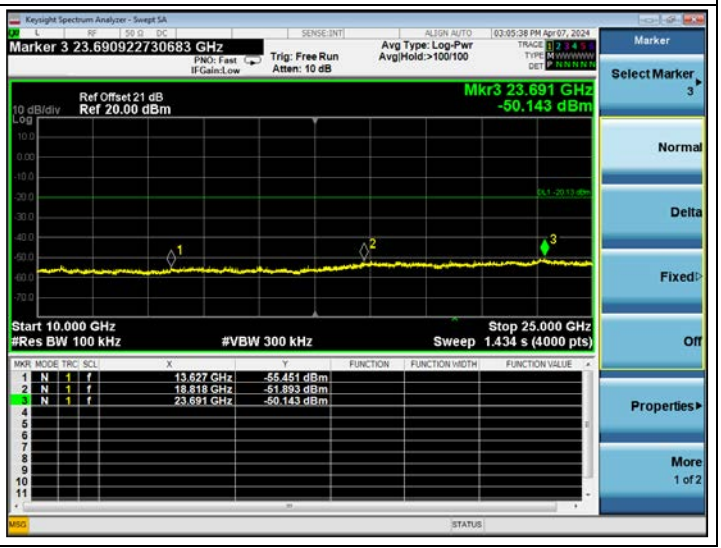
CH2437

Reference Level



Emission Level





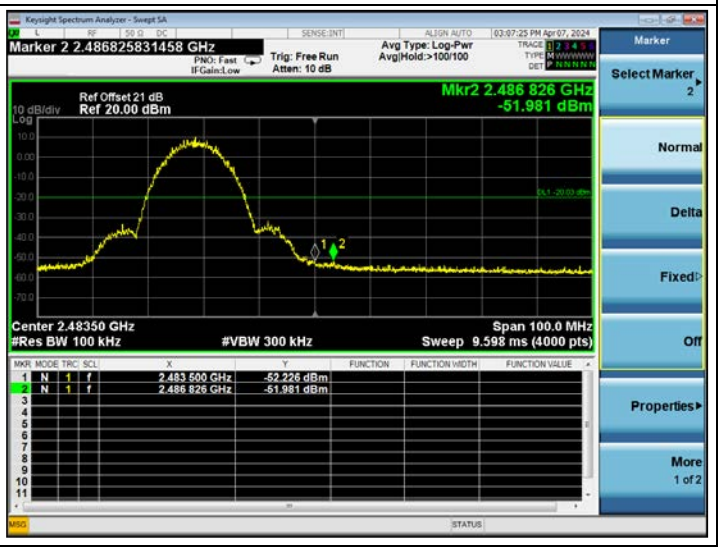
802.11b

CNF3

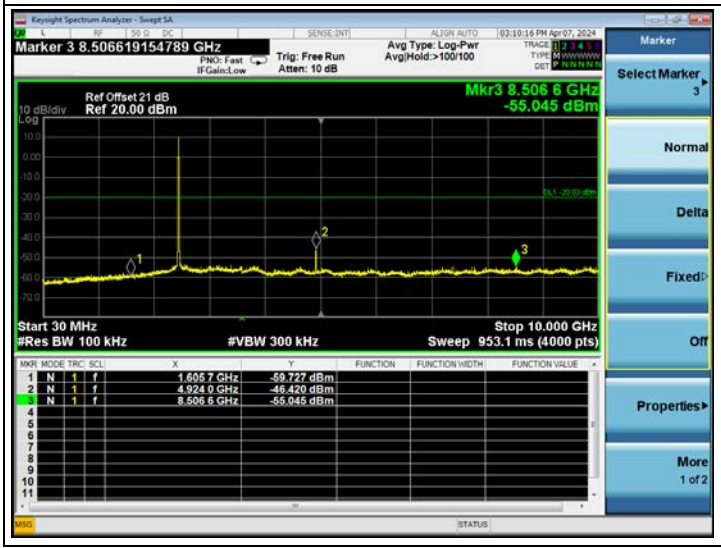
CH2462

Reference Level

Higher Edge



Emission Level



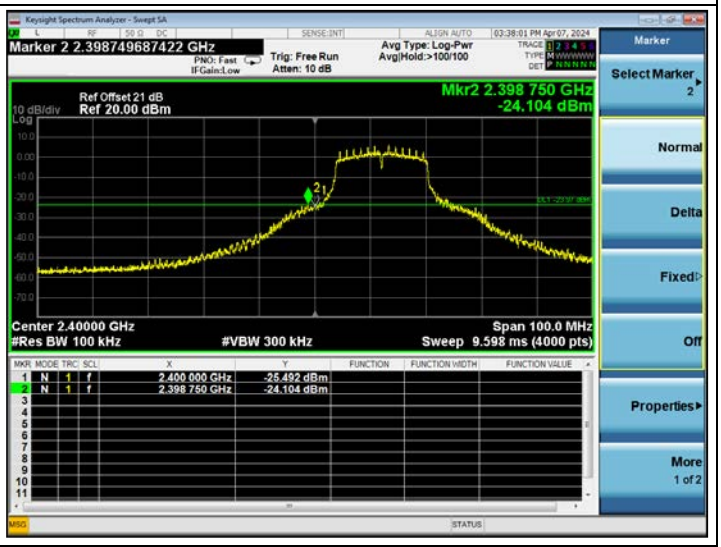
802.11g

CNF3

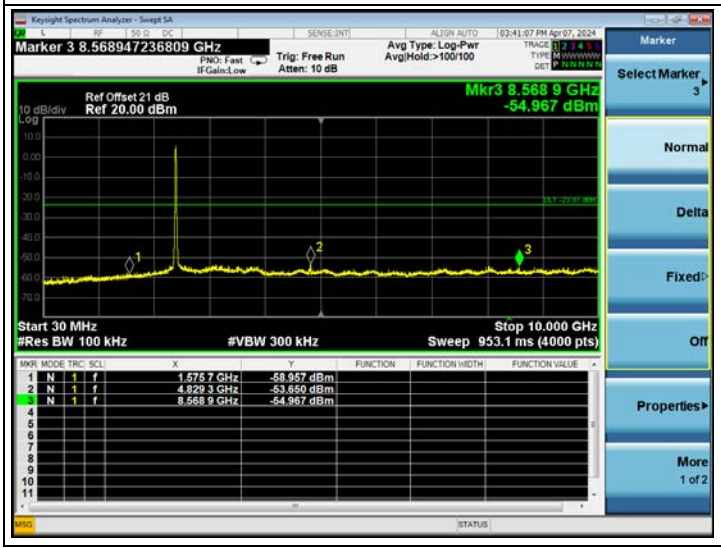
CH2412

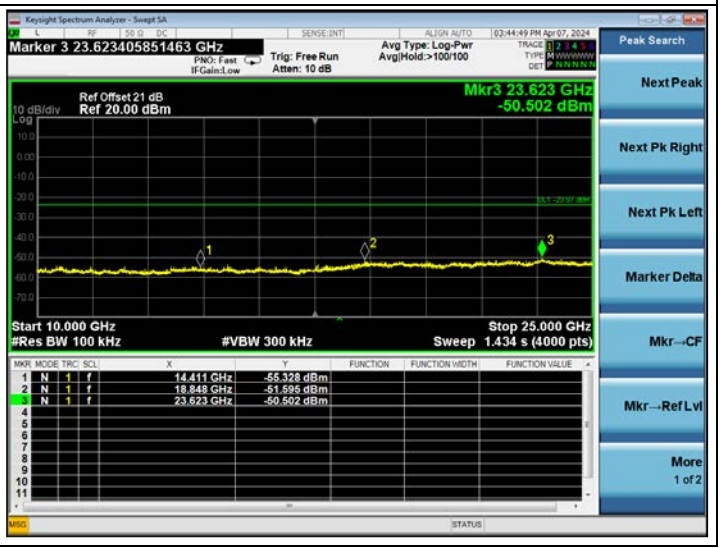
Reference Level

Lower Edge



Emission Level





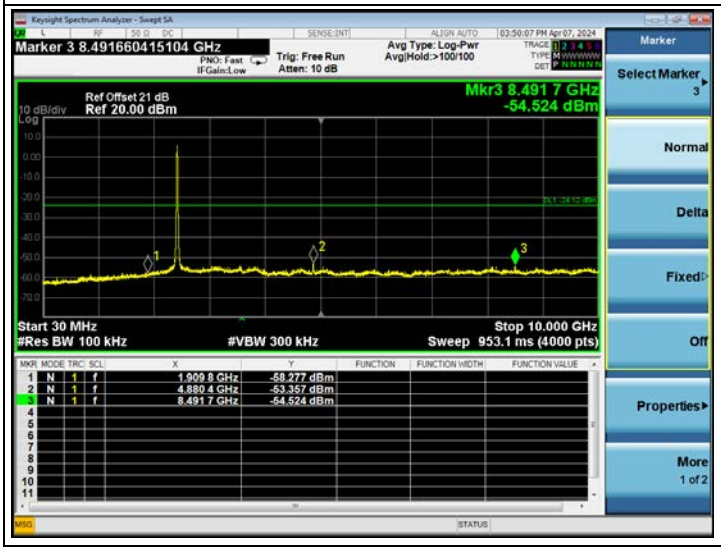
802.11g

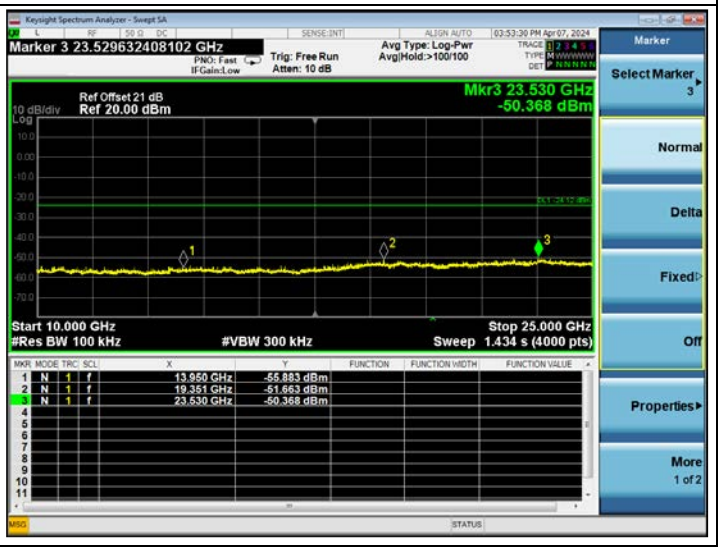
CNF3

CH2437

Reference Level

Emission Level





802.11g

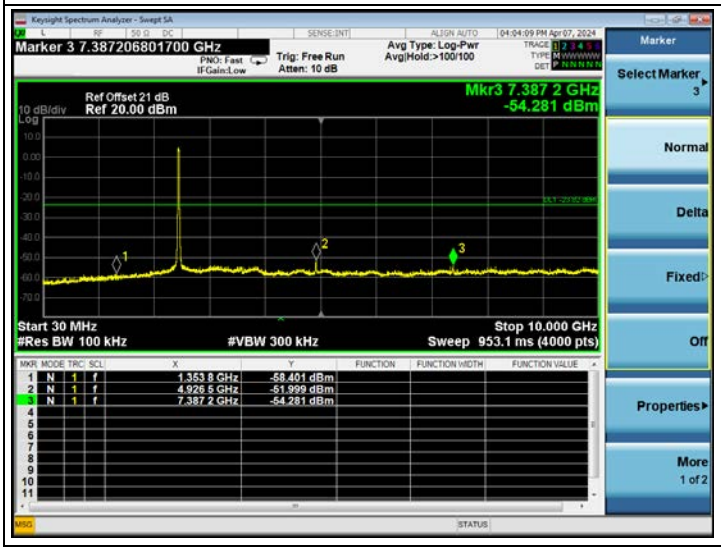
CNF3

CH2462

Reference Level

Higher Edge

Emission Level



802.11n20

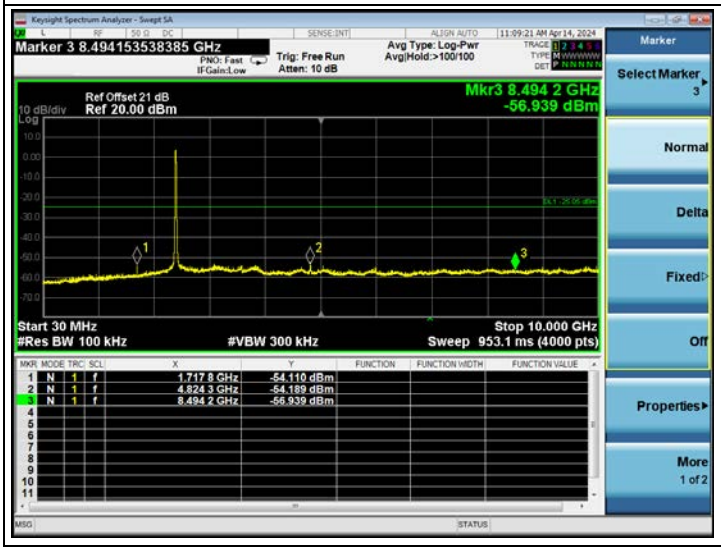
CNF3

CH2412

Reference Level

Lower Edge

Emission Level

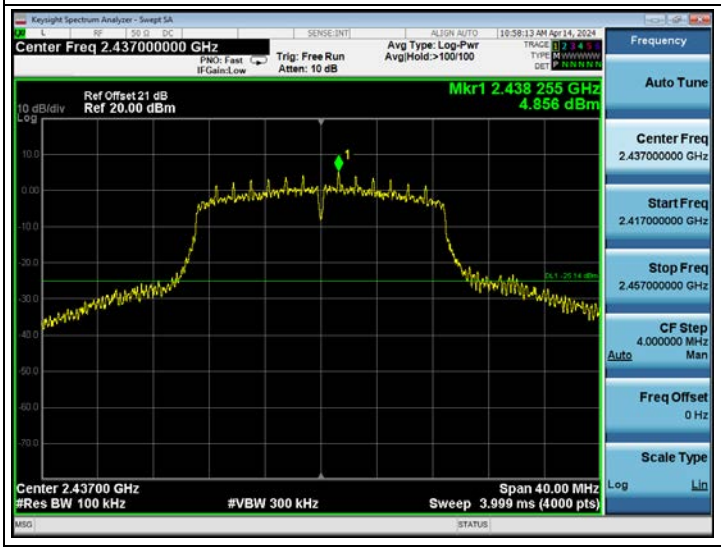


802.11n20

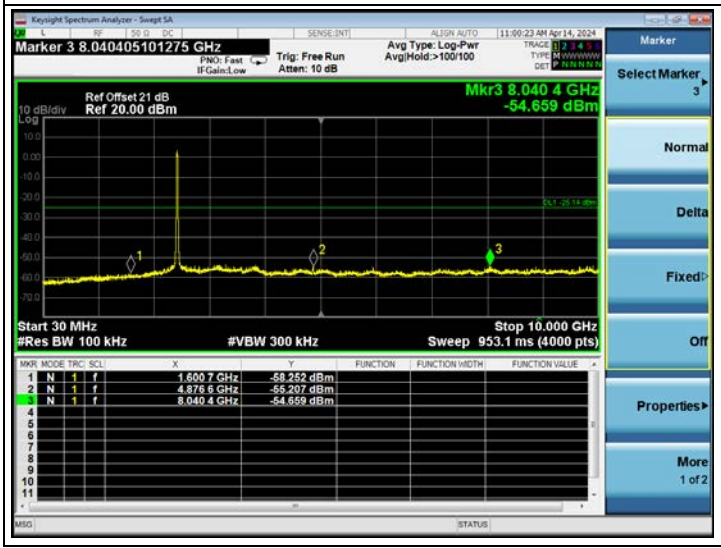
CNF3

CH2437

Reference Level



Emission Level

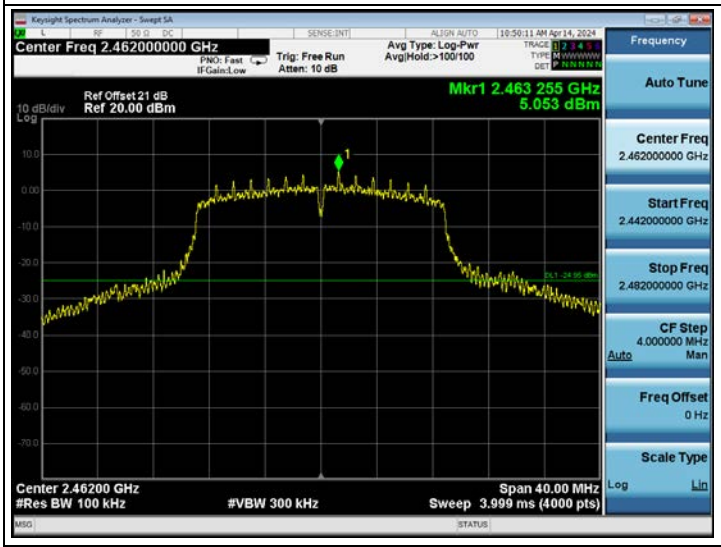


802.11n20

CNF3

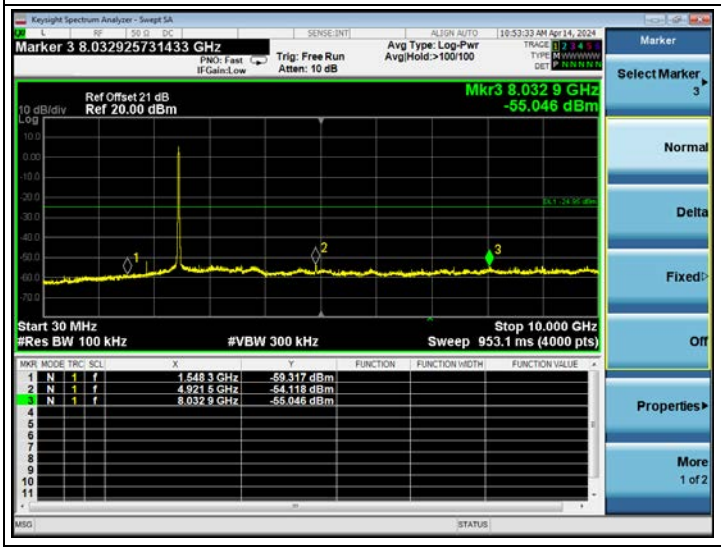
CH2462

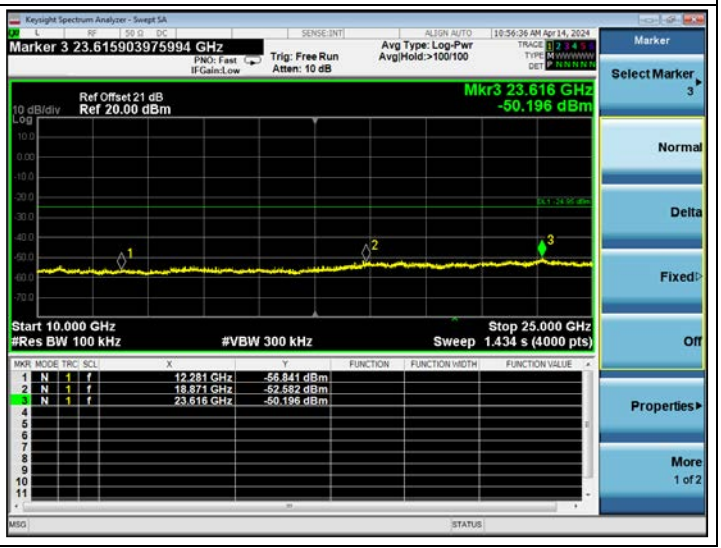
Reference Level



Higher Edge

Emission Level





802.11n40

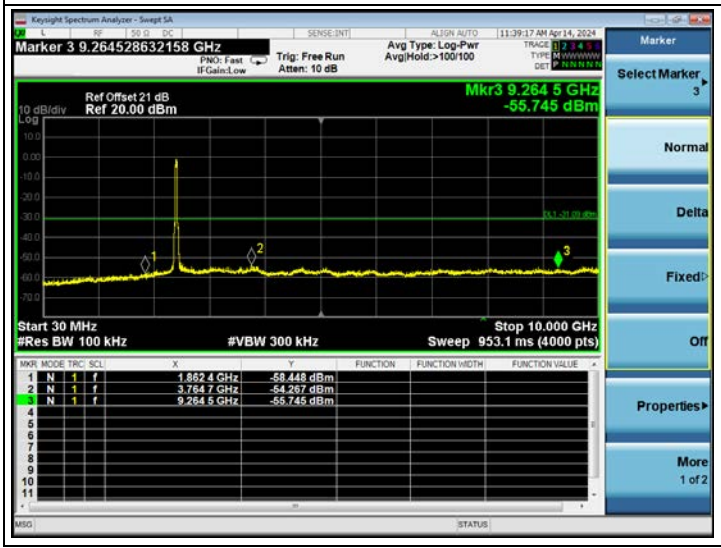
CNF3

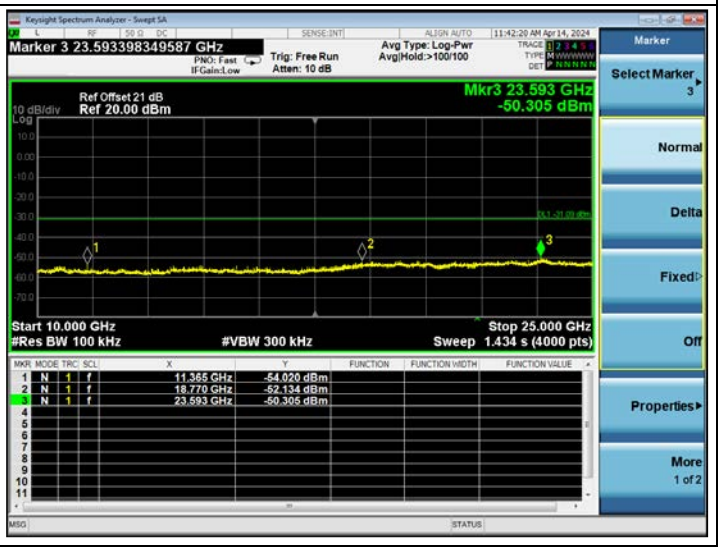
CH2422

Reference Level

Lower Edge

Emission Level



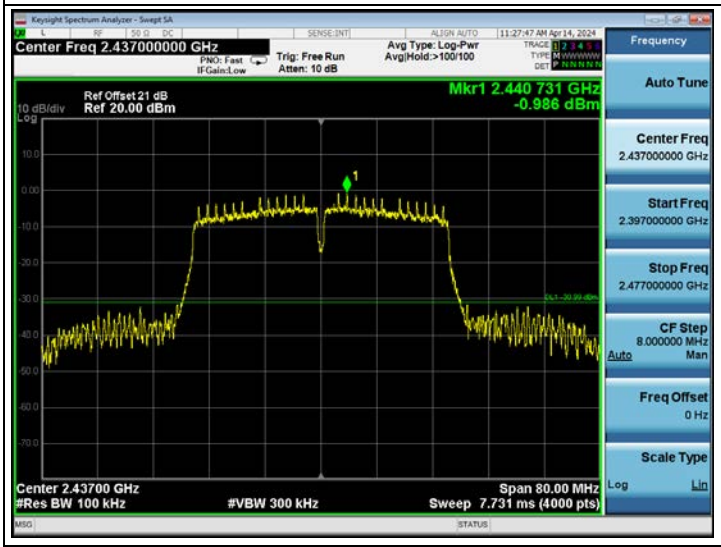


802.11n40

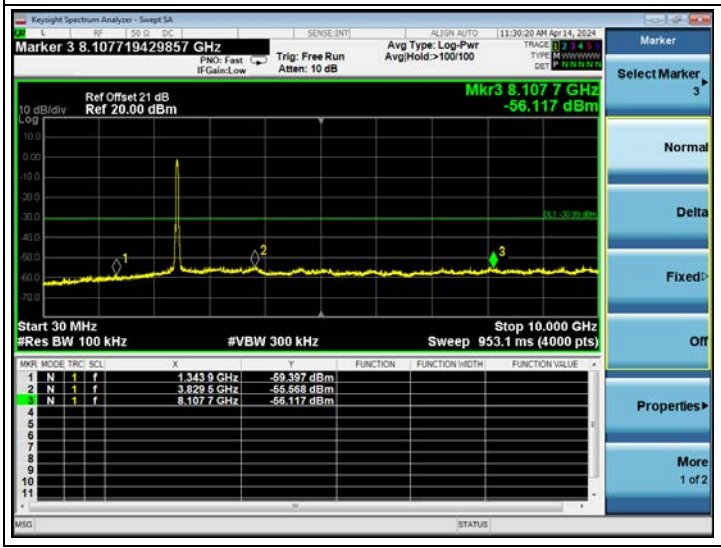
CNF3

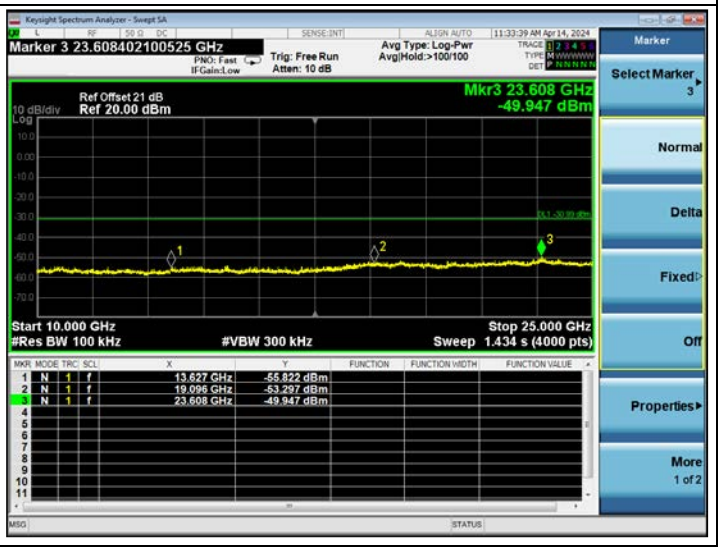
CH2437

Reference Level



Emission Level





802.11n40

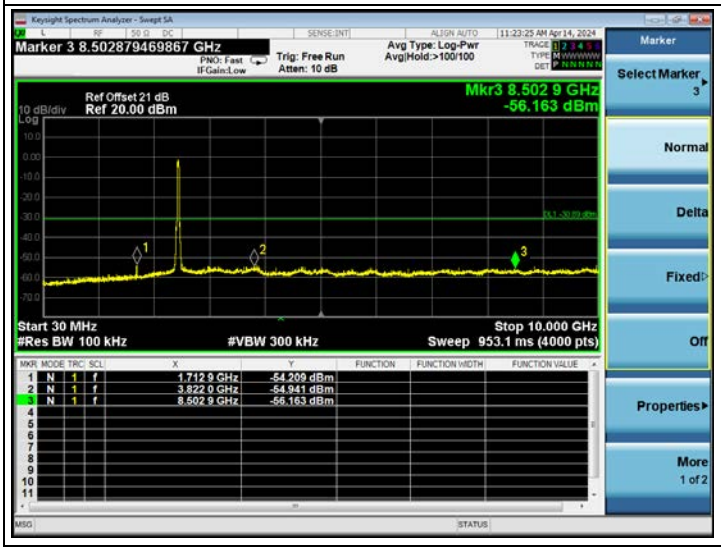
CNF3

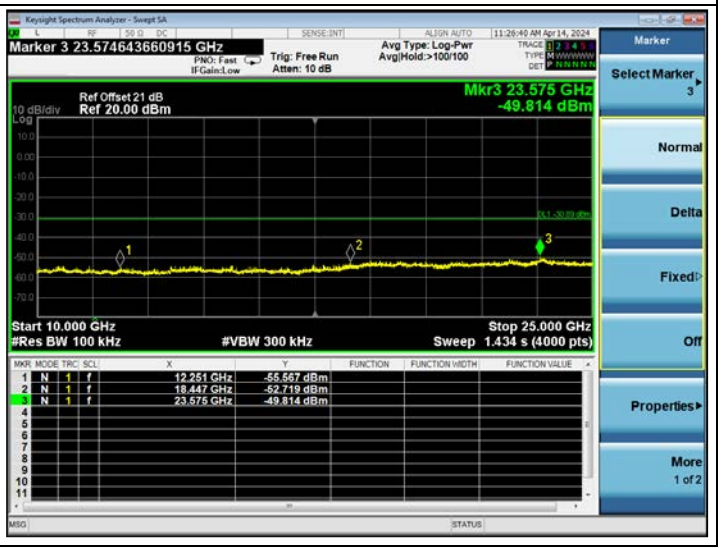
CH2452

Reference Level

Higher Edge

Emission Level





9 POWER SPECTRAL DENSITY MEASUREMENT

9.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2023.08.09	1 Year
2.	RF Cable	Mini-Circuits	FLC-3FT-SM SM+	22022838	2023.08.09	1 Year
3.	20 dB Attenuator	Mini-Circuits	BW-S20W2+	001	2023.09.21	1 Year

9.2 Block Diagram of Test Setup

The Same as section 5.2.

9.3 Specification Limits (§15.247(e))

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band. The same method of determining the conducted output power shall be used to determine the power spectral density.

9.4 Operating Condition of EUT

The software as section 2.3 was used to enable the EUT to change the test mode one by one.

9.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

Method AVGPSD-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.
a) Measure the duty cycle (D) of the transmitter output signal.
b) Set analyzer center frequency to DTS channel center frequency.
c) Set the span to at least 1.5 times the OBW.
d) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
e) Set the VBW ≥ [3 × 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 × 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 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).

The test procedure is defined in ANSI C63.10-2013 (11.10.5 Measurement Procedure “Method AVGPSD-2” was used).

For Emissions Testing of Transmitters with Multiple Outputs in the Same Band: Per KDB 662911 D01 Multiple Transmitter Output v02r01, section E).2), When performing measurements for compliance with PSD limits within the band of operation of a transmitter, any of the three techniques below may be used to combine the emission measurements from multiple outputs prior to comparing to the emission limit:

a) *Measure and sum the spectra across the outputs*.

b) *Measure and sum spectral maxima across the outputs*.

c) *Measure and add 10 log(N_{ANT}) dB*, where N_{ANT} is the number of outputs.

We selected the method b). *Measure and sum spectral maxima across the outputs*. for measure Power Spectral Density.

9.6 Test Results

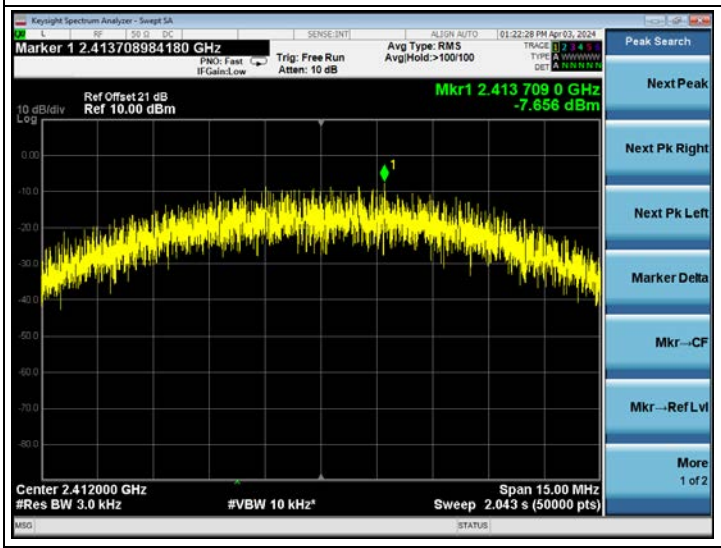
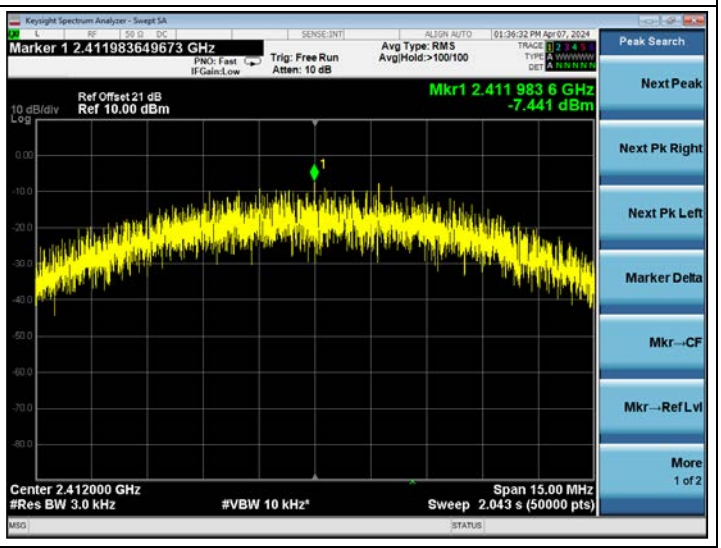
PASSED.

Note1: [Power Spectral Density] = Maximum of [Average Power Spectral Density] + [DCCF]
Note2: The [DCCF(Duty Cycle Correct Factor)] shows on section 2.4.

All the test results are listed below..

(Test Date: 2024.04.03-14 Temperature: 23℃ Humidity: 51 %)

Mode	Channel	Frequency (MHz)	**Average Power Spectral Density (dBm)**			**Power Spectral Density (dBm)**	Limit (dBm)
			SISO CNF2	**SISO CNF3**	**MIMO (CNF2 + CNF3)**		
802.11b	1	2412	**-7.656**	**-7.441**	**-**	**-7.181**	8
	6	2437	**-7.639**	**-8.545**	**-**	**-7.379**	8
	11	2462	**-7.703**	**-7.761**	**-**	**-7.443**	8
802.11g	1	2412	**-15.42**	**-15.547**	**-**	**-15.230**	8
	6	2437	**-15.462**	**-16.129**	**-**	**-15.272**	8
	11	2462	**-15.252**	**-15.518**	**-**	**-15.062**	8
802.11n20	1	2412	**-16.311**	**-17.475**	**-13.844**	**-10.944**	8
	6	2437	**-16.712**	**-17.378**	**-14.022**	**-11.122**	8
	11	2462	**-16.498**	**-17.023**	**-13.742**	**-10.842**	8
802.11n40	3	2422	**-22.039**	**-22.141**	**-19.079**	**-15.069**	8
	6	2437	**-21.106**	**-22.075**	**-18.553**	**-14.543**	8
	9	2452	**-21.382**	**-22.226**	**-18.773**	**-14.763**	8

802.11b	
CNF2	**CNF3**
CH2412	CH2412
	
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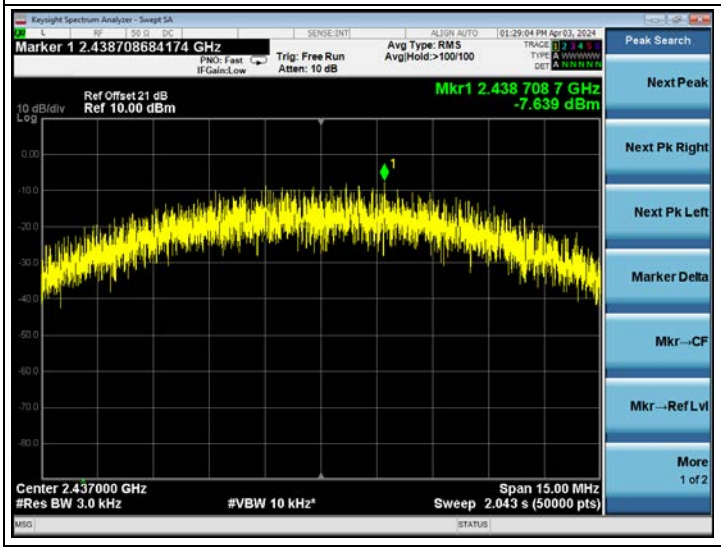	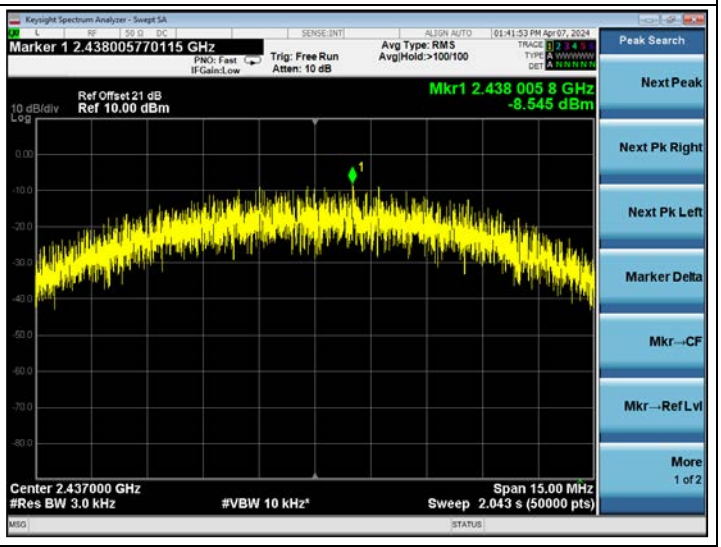
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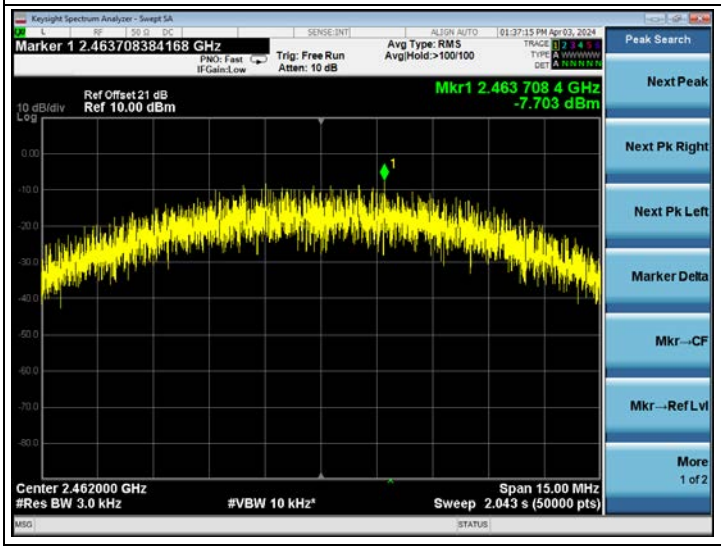	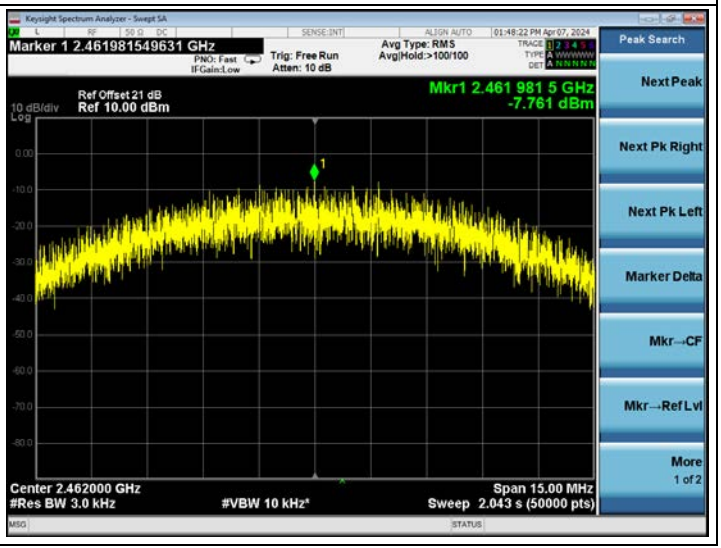

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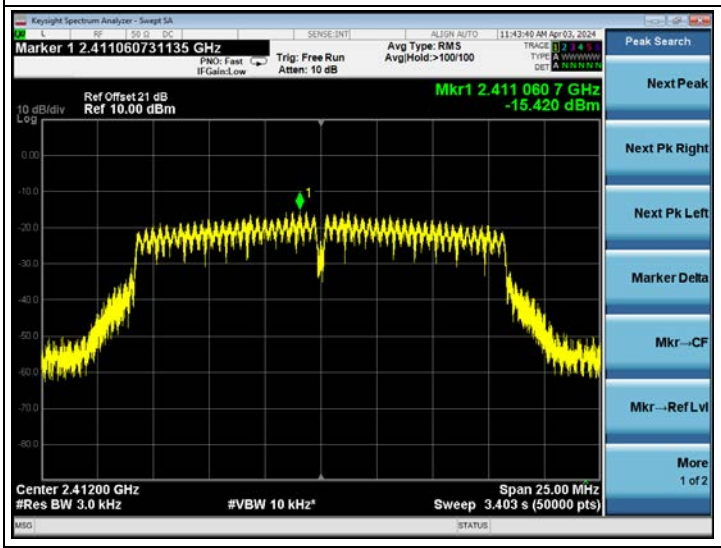	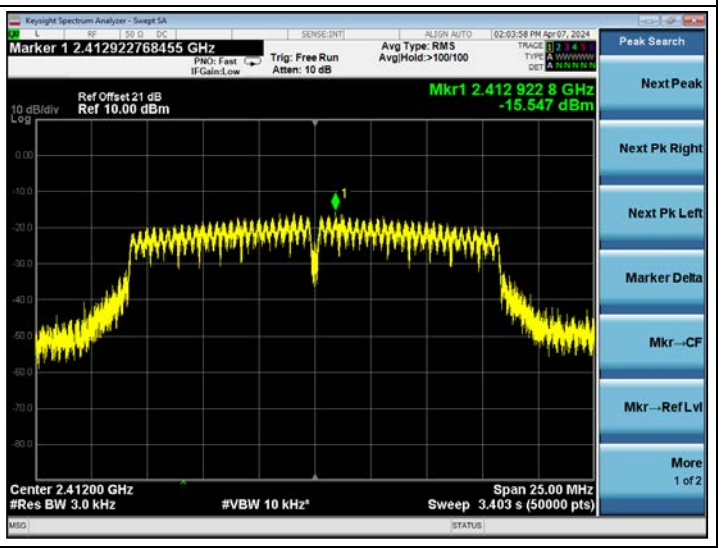
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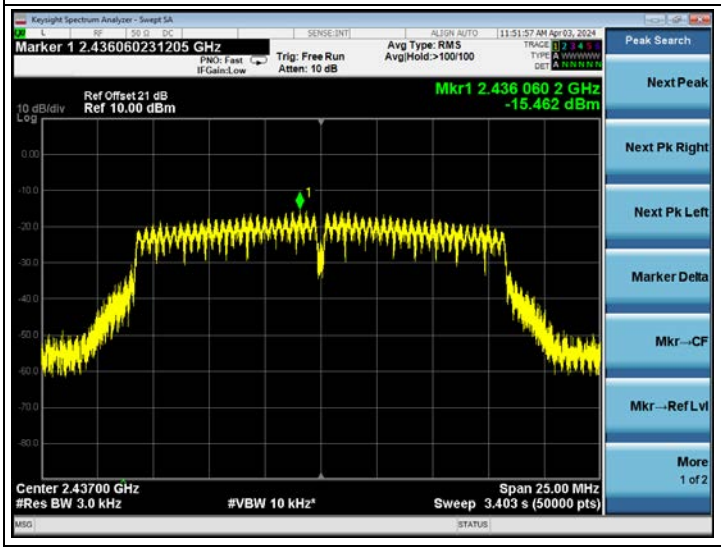	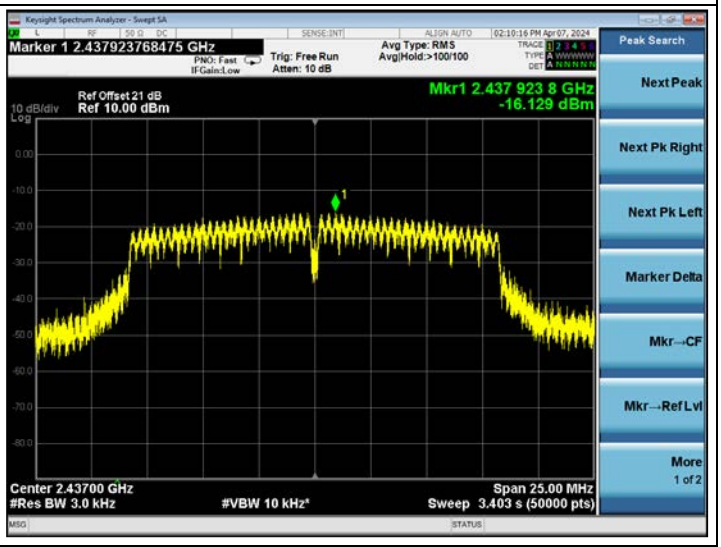
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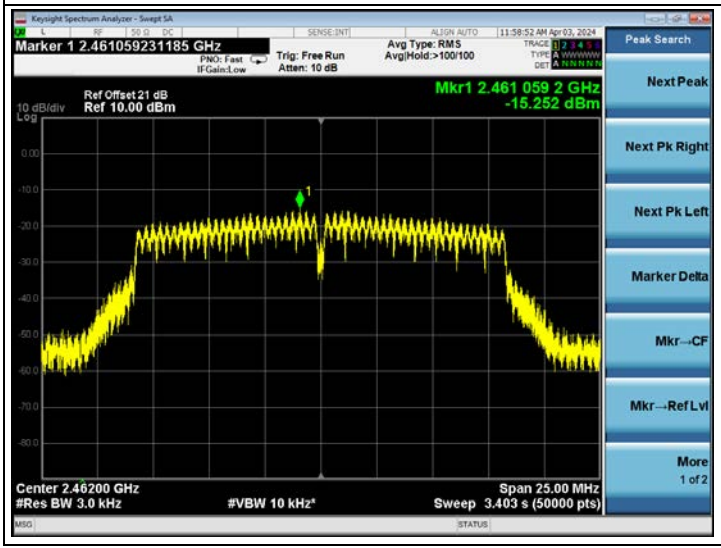	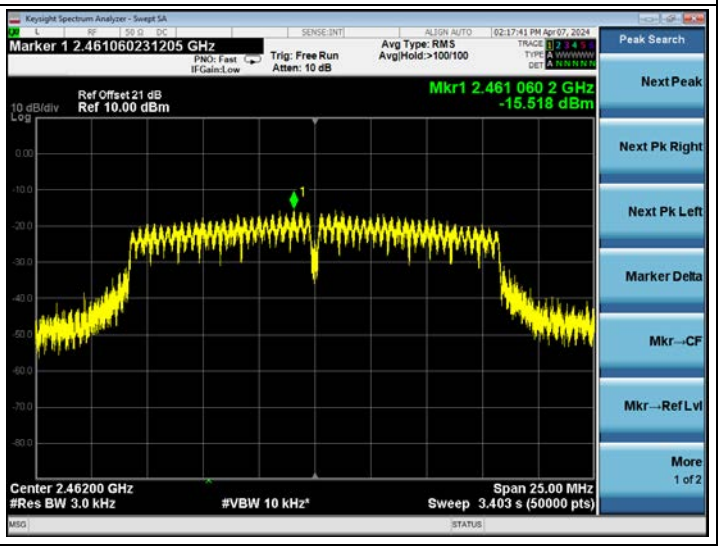

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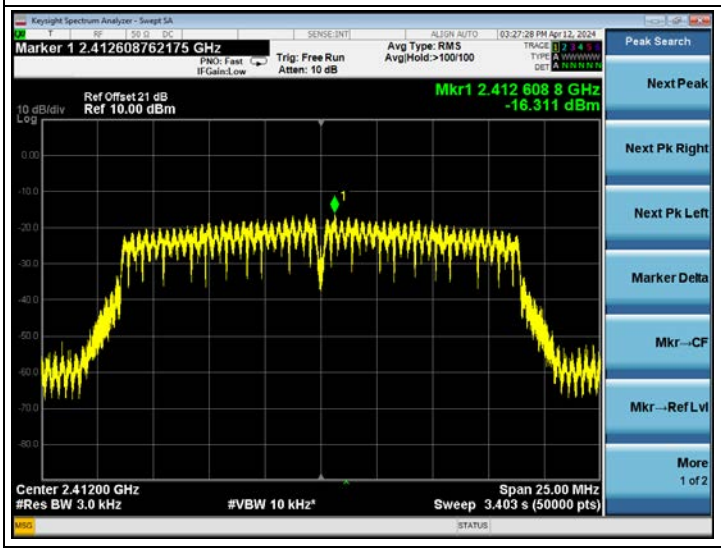	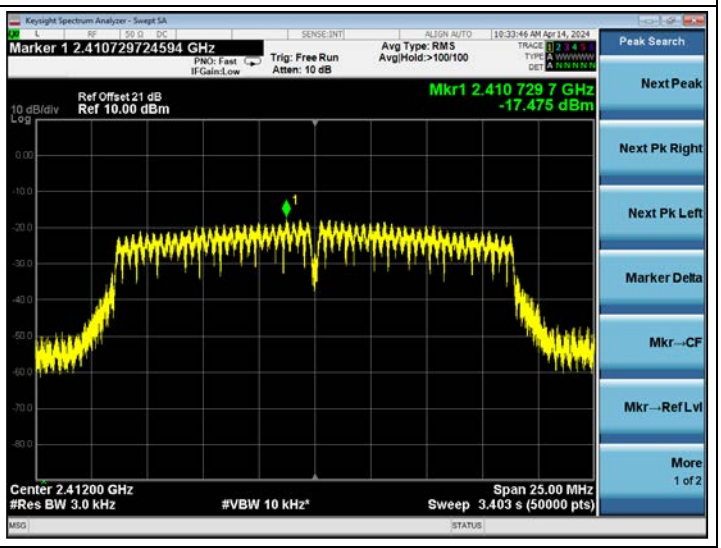
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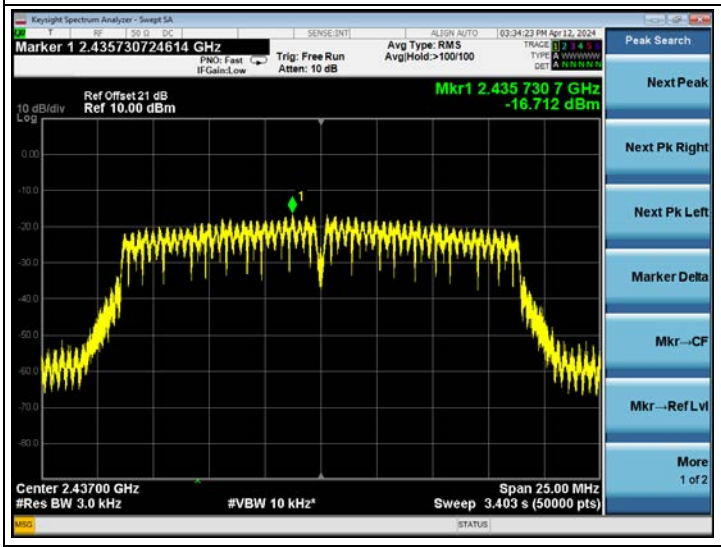	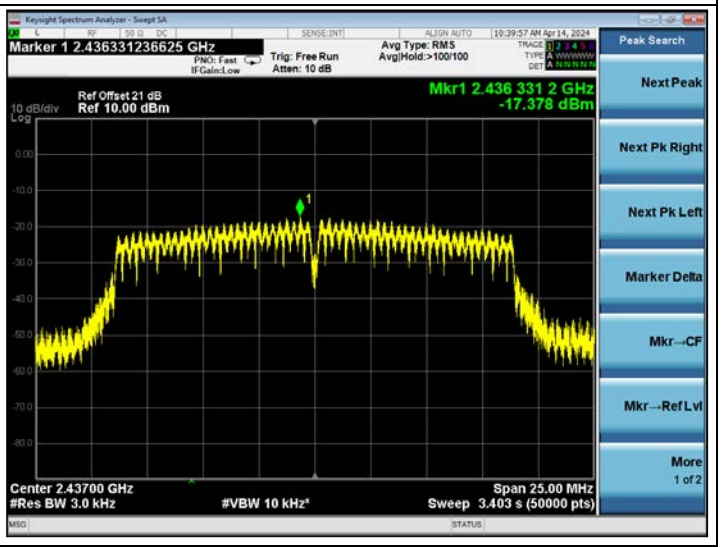
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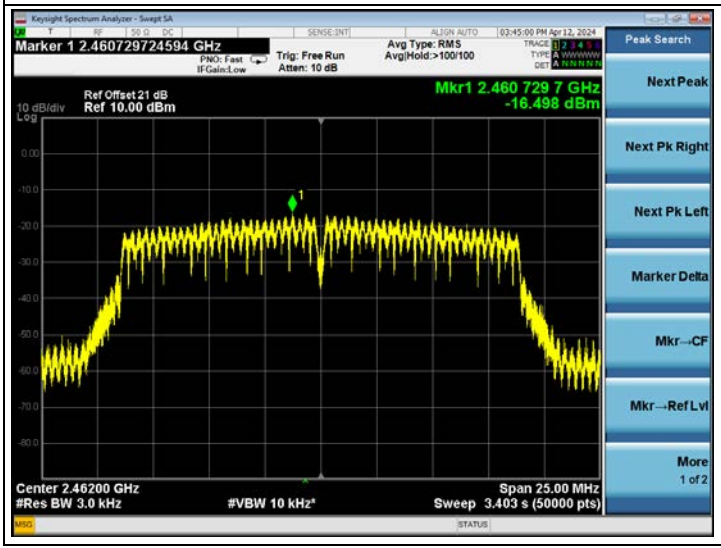	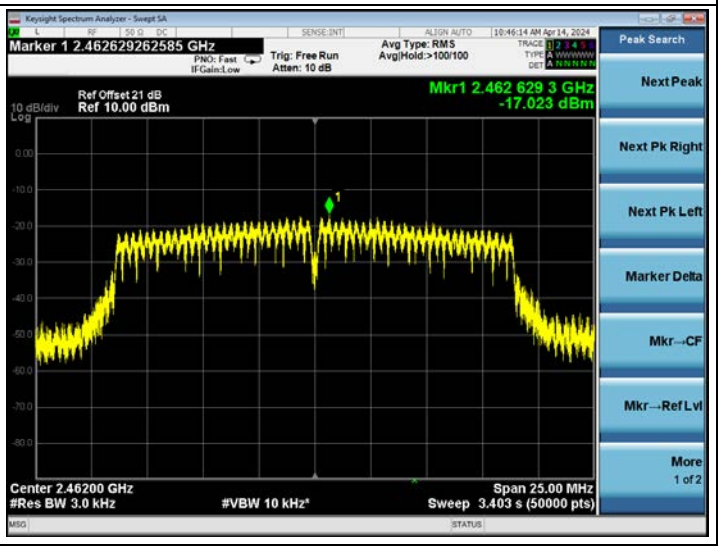

802.11n40	
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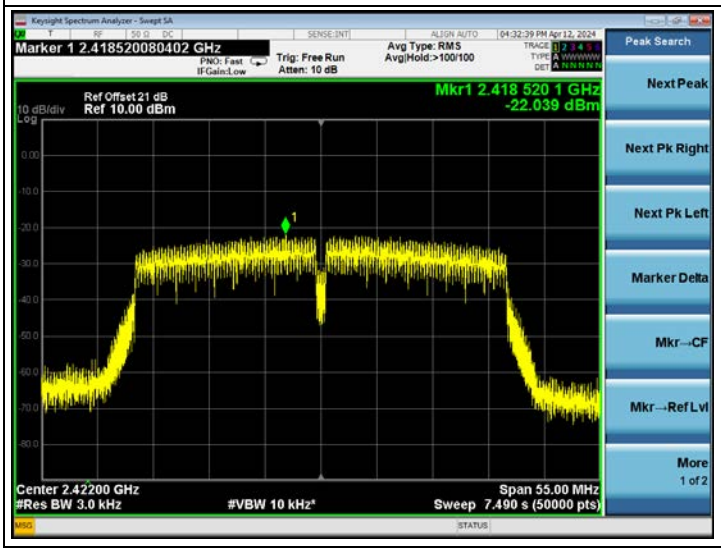	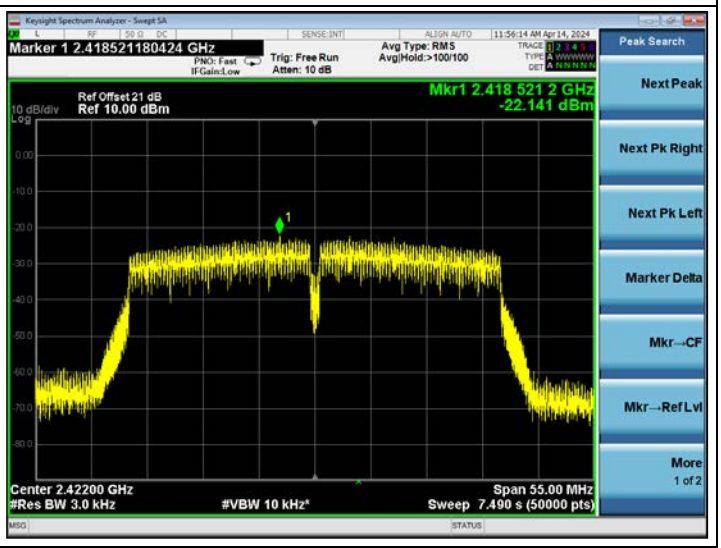
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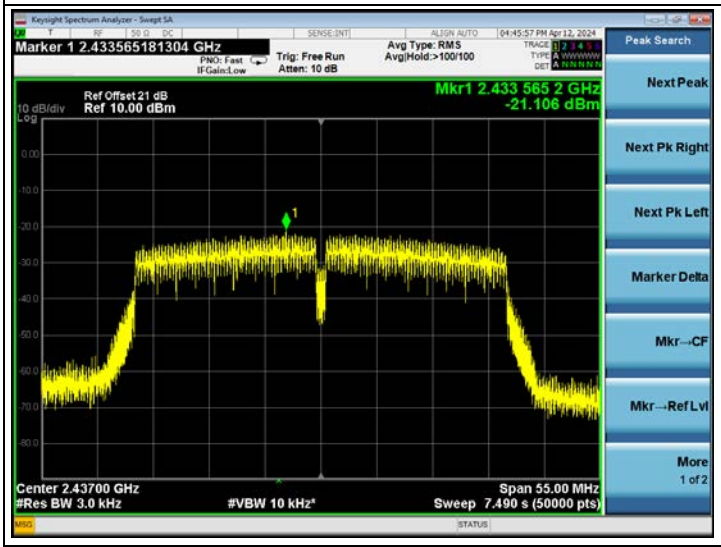	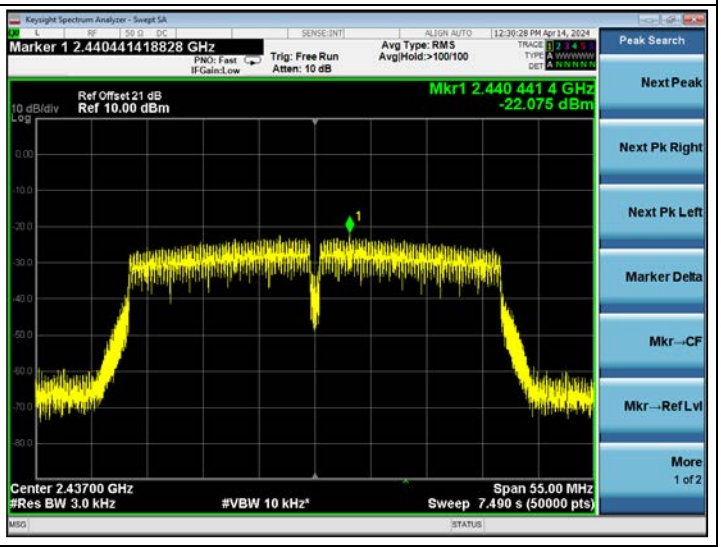
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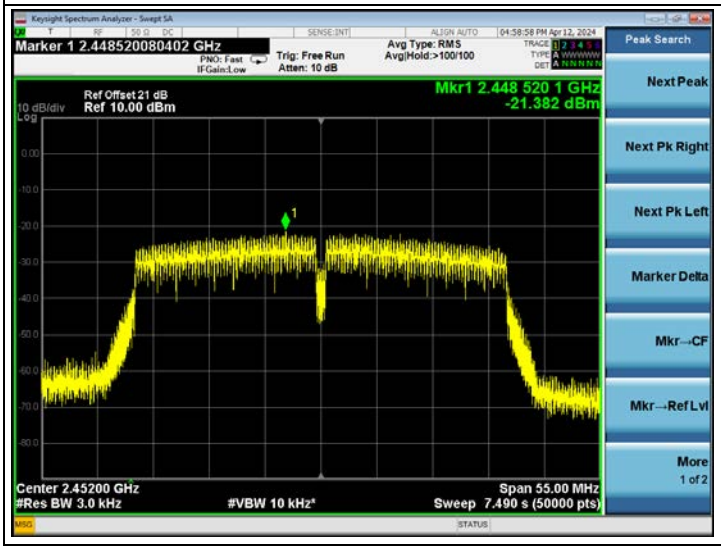	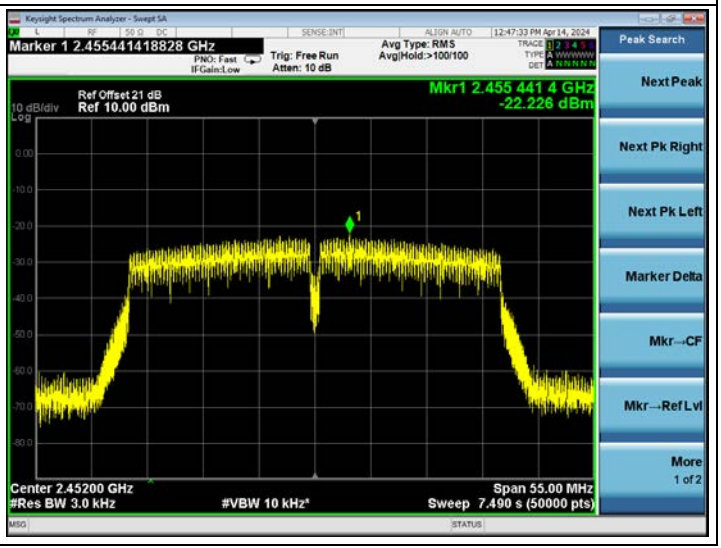

10 ANTENNA REQUIREMENT

10.1 Specification Limits (§15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

10.2 Result

According to KDB 353028 D1, the following describes the three ways that can be used to demonstrate compliance to Section 15.203: a) Antenna permanently attached. b) Unique (non-standard) antenna connector. c) Professional installation.
For this product, the antenna is: ☐ Antenna permanently attached ☑ Unique (non-standard) antenna connector ☐ Professional installation ☐ not meet any of ways list above that ☑ compliant ☐ not compliant with the requirement of Section 15.203.

11 DEVIATION TO TEST SPECIFICATIONS

None.

12 MEASUREMENT UNCERTAINTY LIST

The measurement uncertainty was estimated for test on the EUT according to CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage of K=2.
The uncertainties value is not used in determining the PASS/FAIL results.

Test Items/Facilities	Frequency/Equipment/Unit	Uncertainty
Conducted Emission No.1 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Conducted Emission No.3 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Radiated Emission	30MHz~200MHz, Horizontal	±3.8 dB
	30MHz~200MHz, Vertical	±4.1 dB
	200MHz~1000MHz, Horizontal	±3.6 dB
	200MHz~1000MHz, Vertical	±5.1 dB
	1GHz~6GHz	±5.3 dB
	6GHz~18GHz	±5.3 dB
	18GHz~40GHz	±3.5 dB
Output Power Test	50MHz~18GHz	0.77 dB
Power Density Test	9kHz~6GHz	1.08 dB
RF Frequency Test	9kHz~40GHz	$6*10^{-4}$
Bandwidth Test	9kHz~6GHz	$1.5*10^{-3}$
RF Radiated Power Test	30MHz~1000MHz	3.06 dB
Conducted Output Power Test	50MHz~18GHz	0.83 dB
AC Voltage(<10kHz) Test	120V~230V	0.04 %
DC Power Test	0V~30V	0.4 %
Temperature	-40℃~+100℃	0.52 ℃
Humidity	30%~95%	2.6 %