

# TEST REPORT

**Report Number:** 15167222-E1V2

**Applicant :** SONOS INC.  
301 COROMAR DRIVE  
GOLETA, CA, 93117, U.S.A

**Model :** S14

**Brand :** SONOS

**FCC ID :** SBVRM014

**IC :** 5373A-RM014

**EUT Description :** HOME THEATER SPEAKER

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
ISED RSS-247 ISSUE 3  
ISED RSS-GEN ISSUE 5 + A1 + A2

**Date Of Issue:**

2024-04-16

**Prepared by:**

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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024-03-21	Initial Issue	
V2	2024-04-16	Updated Section 6.3, 6.6, 9.1, 9.2.3 9.4, 9.5 and 10	Kiya Kedida

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SONOS INC.  
301 Coromar Drive  
Goleta, CA, 93117, U.S.A.

**EUT DESCRIPTION:** HOME THEATER SPEAKER

**MODEL:** S14

**BRAND:** SONOS

**SERIAL NUMBER:** Conducted: 000E58606E049  
Radiated: 000E587B242D3

**SAMPLE RECEIPT DATE:** Feb 12, 2024

**DATE TESTED:** Feb 12, 2024 – Feb 14, 2024

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 3	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST or any agency of the U.S. government.

Approved & Released For  
UL Verification Services Inc. By:

Prepared By:



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Dan Corona  
Operations Leader  
Consumer Technology Division  
UL Verification Services Inc.

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Kiya Kedida  
Senior Project Engineer  
Consumer Technology Division  
UL Verification Services Inc.

## 2. TEST RESULTS SUMMARY

This report contains data provided by the customer, which can impact the validity of results. UL Verification Services Inc. is only responsible for correctly integrating customer-provided data with measurements performed by UL Verification Services Inc.

Below is a list of the data provided by the customer:

- 1) Antenna gain and type (see section 6.4)

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	N/A	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	N/A	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	N/A	None.
See Comment		Average power	N/A	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 5.2 (b)	PSD	N/A	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	N/A	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Compliant	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Compliant	None.

### 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 3.

### 4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number 0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building 1: 47173 Benicia Street Fremont, CA 94538, U.S.A	US0104	2324A	550739
<input type="checkbox"/>	Building 2: 47266 Benicia Street Fremont, CA 94538, U.S.A	US0104	2324A	550739
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd Fremont, CA 94538, U.S.A	US0104	2324A	550739



## 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U <sub>Lab</sub>
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Occupied Bandwidth	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) / 0.45 dB (AV)
Unwanted Emissions, Conducted	1.94 dB
Worst Case Conducted Disturbance, 9kHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9kHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Time Domain Measurements	3.39%
Temperature	0.57°C
Humidity	3.39%
DC Supply Voltages	0.57%

Uncertainty figures are valid to a confidence level of 95%.

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## 5.4. SAMPLE CALCULATION

### **RADIATED EMISSIONS**

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

### **MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The EUT is 802.11 a/b/g/n (HT20) master device. The model S14 is a high-performance all-in-one home theater smart speaker and part of Sonos' home sound system.

### 6.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This is to request a Class II permissive change for FCC ID: SBVRM014 and IC Certification No: 5373A-RM0164

Class II Permissive Change to address the following proposed changes to the hardware for this device:

- The radio design for Model S14 has two components in the RF path that are no longer in production: Qorvo QPF7221 (2.4 GHz FEM) and Murata LFD182G45DP (WiFi Diplexer).
- We propose replacing them with electrically equivalent components: Qorvo QPF4211 (2.4 GHz FEM) + Qualcomm B7520 (SAW Filter) and TDK DPX167125DT (WiFi Diplexer)

Additional details are provided in the Schematics, modified Theory of Operation, and photograph exhibits for this application.

The purpose of this change is to replace the 2.4 GHz FEM (Front end module) & Diplexer that are no longer in production. Sonos would like to continue producing Sonos S14 (or Beam) per our FCC Grant.

This is a Class 2 Permissive change type C2PCPX. It is relatively minor in scope and only impacts 2.4GHz operation and does not impact 5 GHz, DFS, etc. No impact on BLE authorization.

### 6.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum average conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
<b>4Tx</b>			
2412 - 2462	802.11b	26.97	497.74
2412 - 2462	802.11g	26.96	496.59
2412 - 2462	802.11n HT20	26.26	422.67

### 6.4. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

Frequency Range MHz	2.4GHz Antenna Identification / Max Antenna Gain dBi			
	PWS-Stamped (Vertical Polarization)	PWR-Dipole (Horizontal Polarization)	HYSK-IFA (Vertical Polarization)	HTSK-Slot (Horizontal Polarization)
2412-2462	Chain 0 / <b>3.47</b>	Chain 1 / <b>3.66</b>	Chain 2 / <b>4.76</b>	Chain 3 / <b>3.45</b>

NOTE: All final tests were performed using the EUT highest antenna gain with the same polarity as the test measurement setup.

## **6.5. SOFTWARE AND FIRMWARE**

The EUT firmware installed, and the test utility software used during testing was 77.3-43210-diag-ci-401.

## **6.6. WORST-CASE CONFIGURATION AND MODE**

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

For radiated harmonics spurious below 1GHz, 1-18GHz low, middle, high channels, 18-26GHz, and power line conducted emissions were performed with the EUT set at the 4TX CDD mode.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle, and high channels.

The EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

For simultaneous transmission in the 2.4GHz and 5GHz bands, tests were conducted for configurations having the highest power. No noticeable new emission was found.

Worst-case data rates as provided by the client were:

802.11b mode: 11 Mbps.  
802.11g mode: 24 Mbps.  
802.11n HT20mode: MCS1

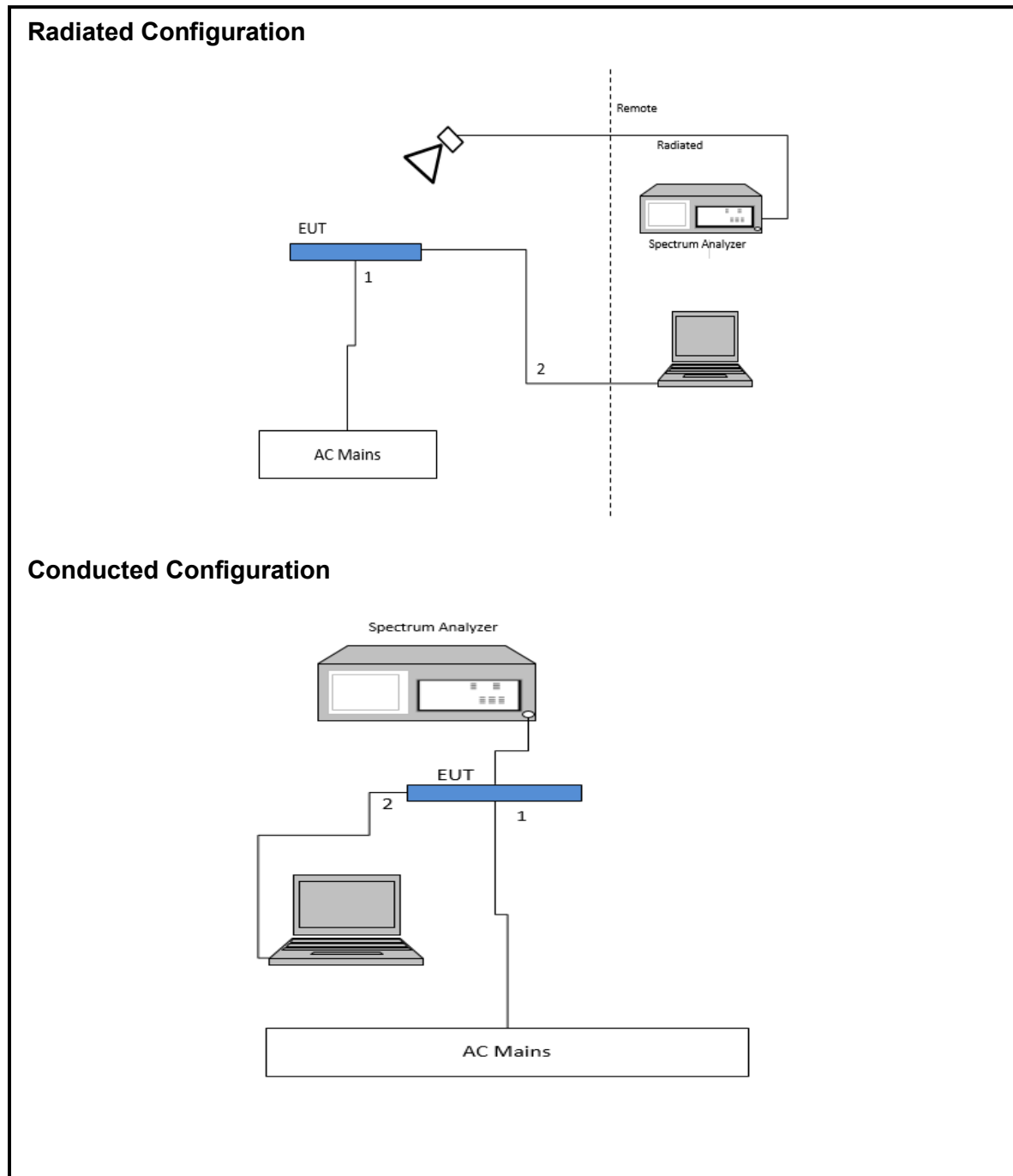
## 6.7. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	Lenovo	TP00072B	PC0RSJLJ	-		
Laptop AC/DC Adapter	Lenovo	ADLX65NCC2A	11S36200284ZZ20042J6L0	-		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	EUT to AC MAINS
2	Ethernet	1	RJ45	Un-shielded	20	EUT to Switch Box
I/O CABLES (RADIATED TEST EMISSIONS)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	EUT to AC MAINS
2	Ethernet	1	RJ45	Un-shielded	20	EUT to Switch Box

### TEST SETUP

The EUT is a stand-alone unit, and the radio is exercised by Sonos Compliance GUI software, via Ethernet cable.

**SETUP DIAGRAM**



## 7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Section 11.6.

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW  $\geq$  DTS BW

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.3 Method AVGPSD-1

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.2 Integration method -Peak detection

Band-edge: ANSI C63.10 Subclause -11.13.3.3 Integration method -Trace averaging with continuous transmission at full power

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Integration method -Trace averaging across ON and OFF times DC correction

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4



## 8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Broadband Hybrid, 30MHz to 2GHz	Sunol Sciences Corp.	JB3	232075	2024-03-31	2023-03-13
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	175953	2024-03-31	2023-03-03
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	80404	2024-08-31	2022-08-08
RF Filter Box, 1-18GHz	UL-FR1 (CTECH)	SAC 8 port rf box 1	197920	2024-05-31	2023-05-17
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	225688	2025-02-11	2023-02-11
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	172362	2024-03-31	2023-03-15
Amplifier 18-26.5GHz, +5Vdc, -54dBm P1dB	AMPLICAL	AMP18G26.5-60	171583	2024-06-30	2023-06-20
Antenna, Horn 26 to 40GHz	ARA	MWH-2640/B	172368	2024-03-31	2023-03-08
Amplifier 26-40GHz +5Vdc, -62dBm P1dB	AMPLICAL	AMP26G40-65	172346	2024-06-30	2023-06-20
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	219908	2024-09-30	2023-09-13
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	219910	2024-05-31	2023-05-31
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90731	2024-06-30	2024-06-28
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90754	2025-01-31	2024-01-31
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent Technologies	N9030A	125188	2025-01-31	2024-01-22
10dB Fixed Attenuator	Pasternack Enterprises	PE7087-10	N/A	Verified	Verified
AC Line Conducted					
EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESR	93091	2025-02-29	2024-02-29
LISN for Conducted Emissions CISPR-16	FISCHER CUSTOM COMMUNICATIONS	FCC-LISN-50/250-25-2-01-480V	175764	2025-01-31	2024-01-31
Transient Limiter	TE	TBFL1	207996	2024-08-31	2023-08-31
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Version 9.5, 01 May 2023-01-05		
Conducted Software	UL	UL EMC	2022-08-16		
AC Line Conducted Software	UL	UL EMC	Version 9.5, 2023-03-03		

### NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

## 9. ANTENNA PORT TEST RESULTS

### 9.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

#### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

#### ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
<b>2.4GHz Band</b>						
802.11b 1TX	3.169	3.496	0.906	90.65	0.43	0.316
802.11g 1TX	1.388	1.730	0.802	80.23	0.96	0.720
802.11n HT20 1TX	2.268	2.593	0.875	87.47	0.58	0.441

Note: Duty cycle 4TX is the same as 1TX.

DUTY CYCLE PLOTS



DUTY CYCLE 802.11b 1TX MODE



DUTY CYCLE 802.11g 1TX MODE



DUTY CYCLE 802.11n HT20 1TX MODE

## **9.2. 99% BANDWIDTH**

### **LIMITS**

None; for reporting purposes only.

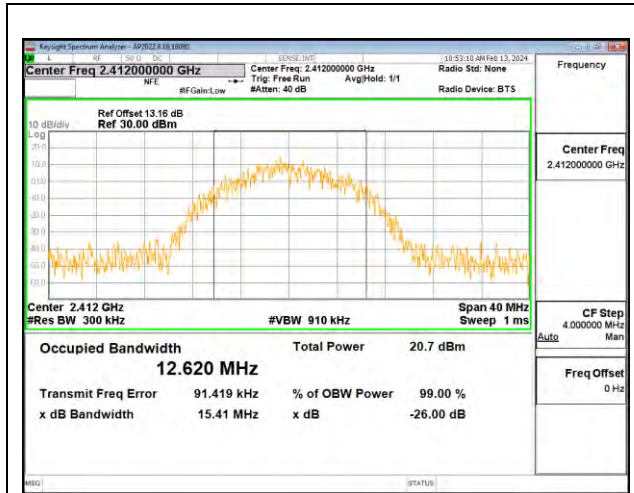
### **RESULTS**

### 9.2.1. 802.11b MODE

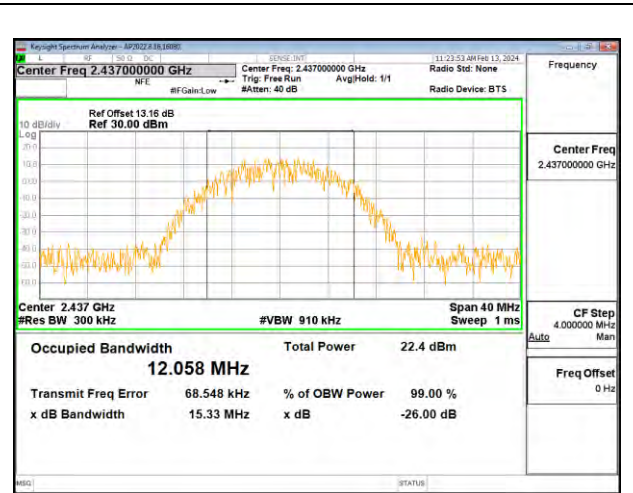
#### 4TX Antenna

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)	99% Bandwidth Chain 2 (MHz)	99% Bandwidth Chain 3 (MHz)
Low 1	2412	12.620	12.490	12.312	12.114
Mid 6	2437	12.058	12.201	12.303	12.005
High 11	2462	12.363	12.442	12.187	12.253

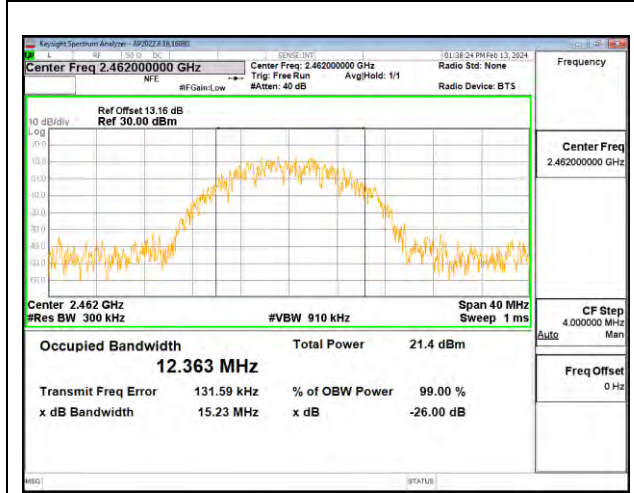
**Chain 0**



**LOW CHANNEL 1**

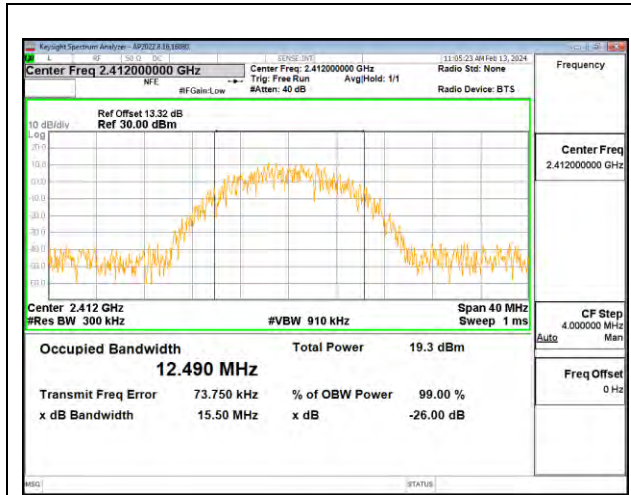


**MID CHANNEL 6**

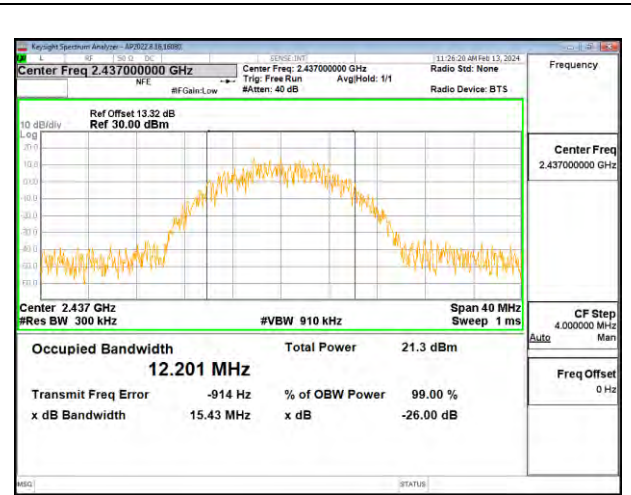


**HIGH CHANNEL 11**

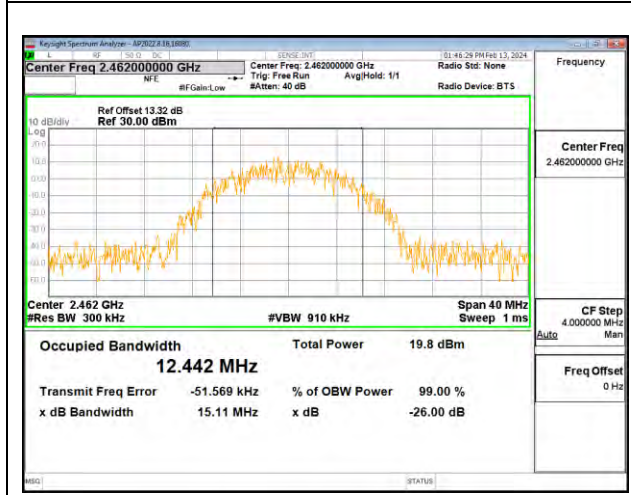
**Chain 1**



**LOW CHANNEL 1**



**MID CHANNEL 6**

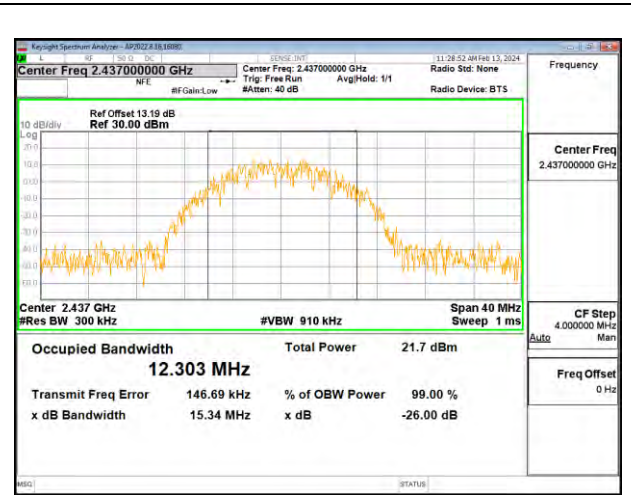


**HIGH CHANNEL 11**

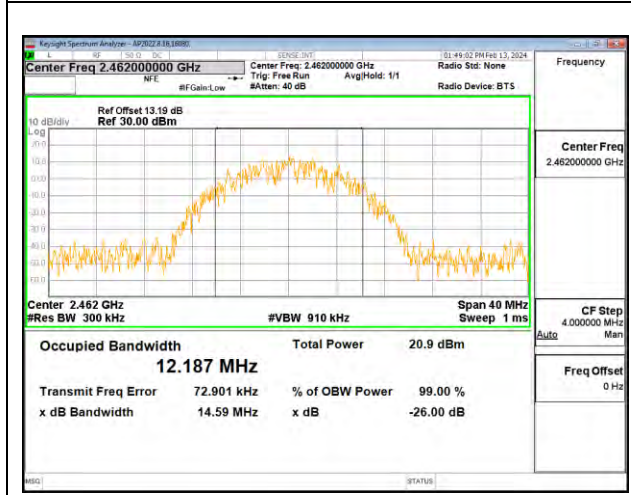
**Chain 2**



**LOW CHANNEL 1**



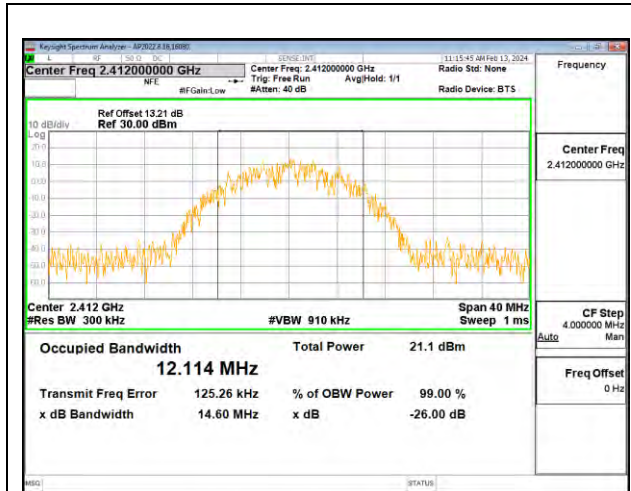
**MID CHANNEL 6**



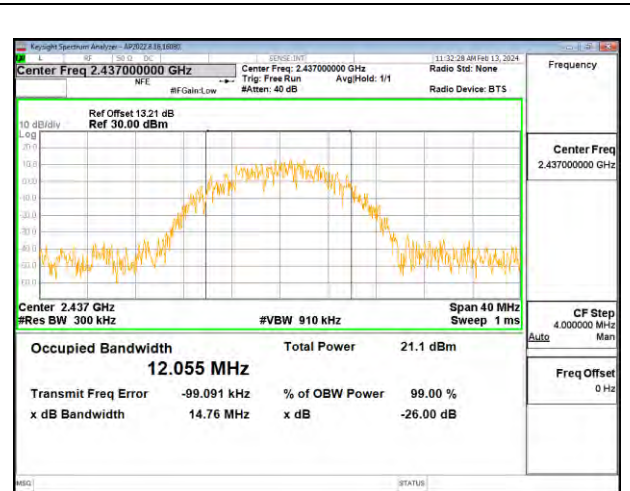
**HIGH CHANNEL 11**



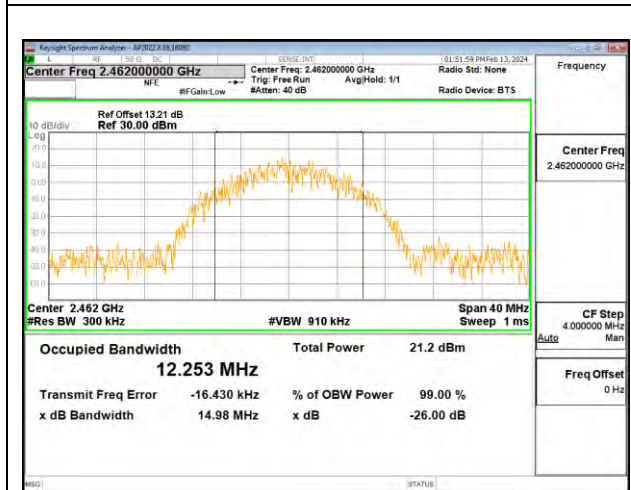
**Chain 3**



**LOW CHANNEL 1**



**MID CHANNEL 6**



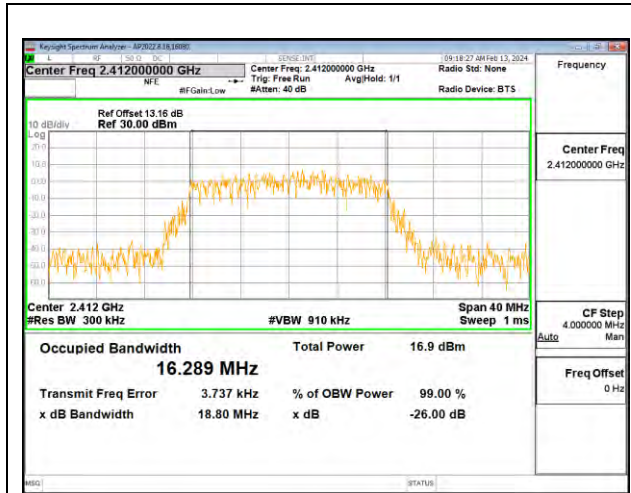
**HIGH CHANNEL 11**

### 9.2.2. 802.11g MODE

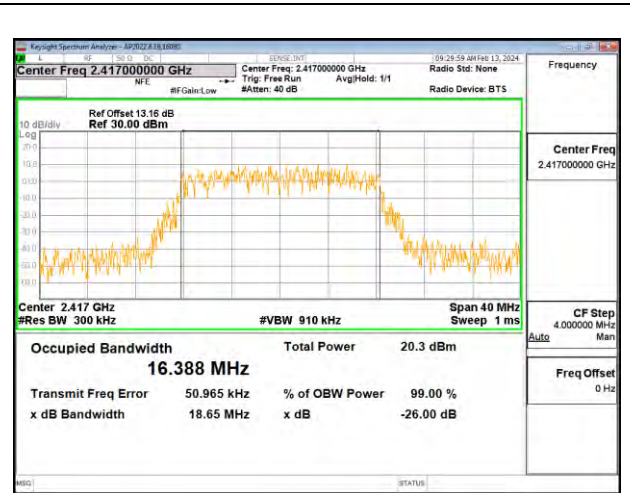
#### 4TX Antenna

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)	99% Bandwidth Chain 2 (MHz)	99% Bandwidth Chain 3 (MHz)
Low 1	2412	16.289	16.444	16.220	16.239
Low 2	2417	16.388	16.071	16.283	16.468
Mid 6	2437	16.240	16.218	16.459	16.145
High 10	2457	16.212	16.353	16.202	16.175
High 11	2462	16.228	16.365	16.385	16.349

**Chain 0**



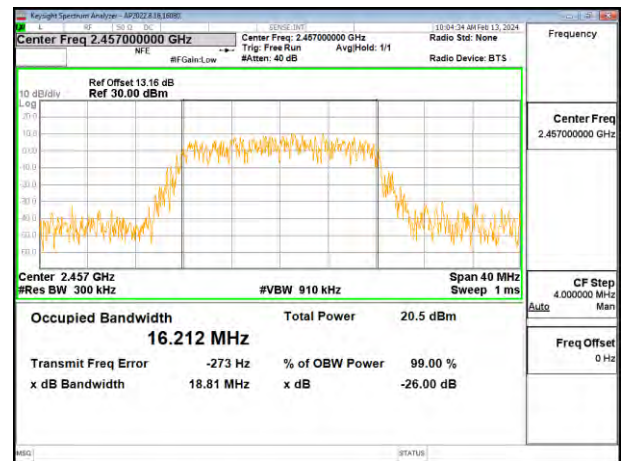
**LOW CHANNEL 1**



**LOW CHANNEL 2**



**MID CHANNEL 6**

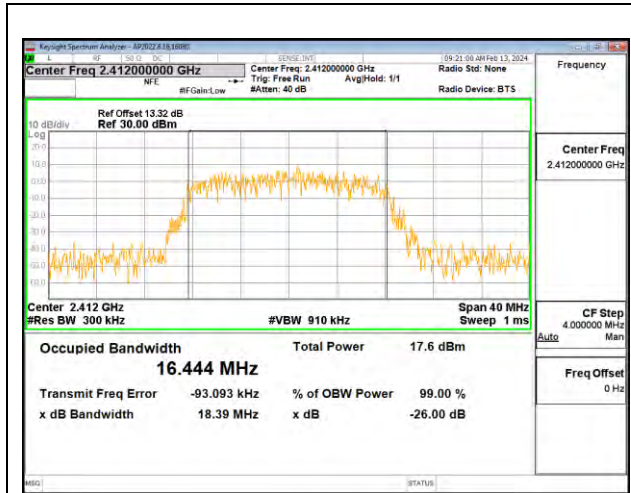


**HIGH CHANNEL 10**

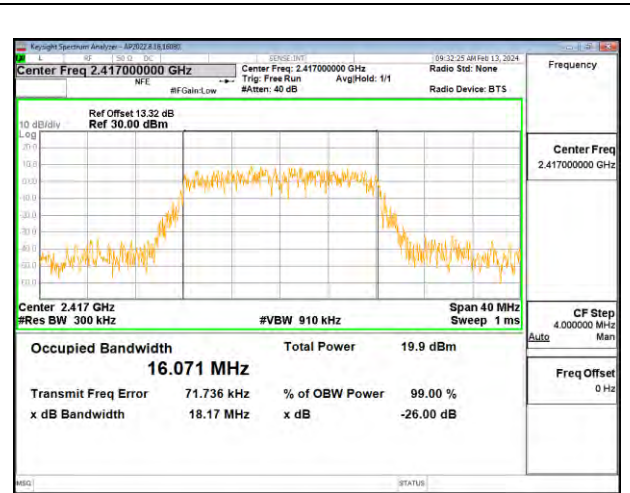


**HIGH CHANNEL 11**

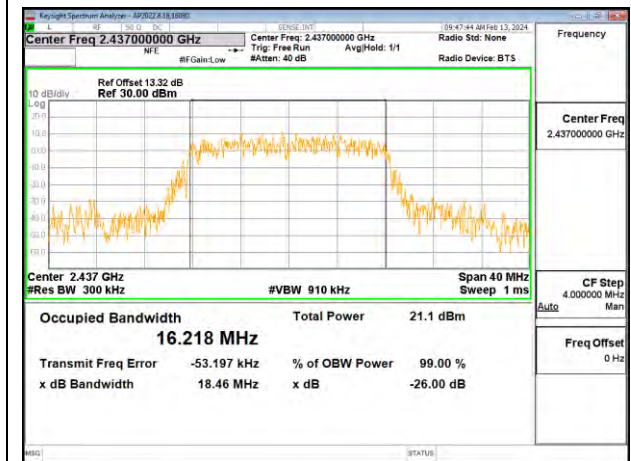
**Chain 1**



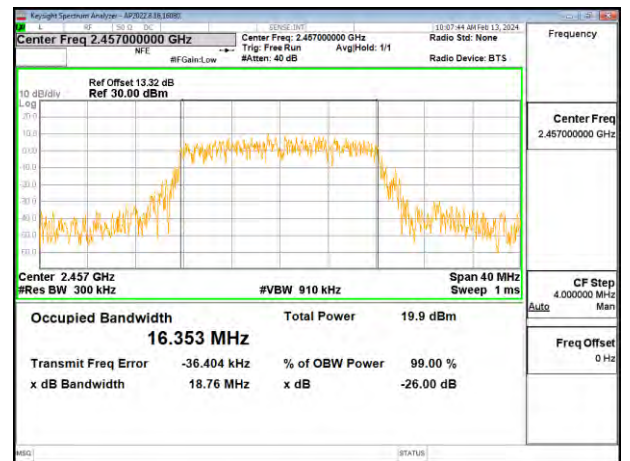
**LOW CHANNEL 1**



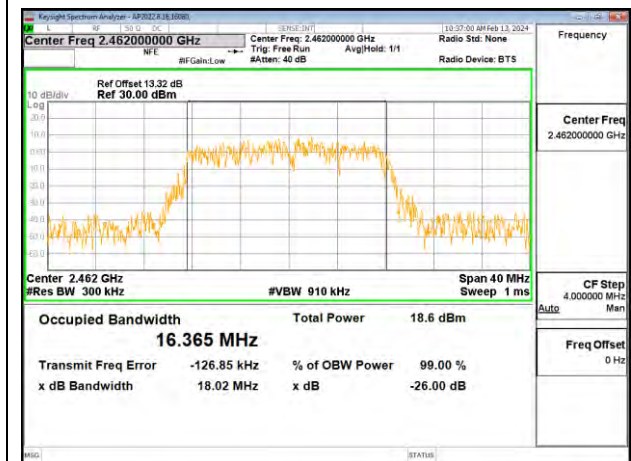
**LOW CHANNEL 2**



**MID CHANNEL 6**

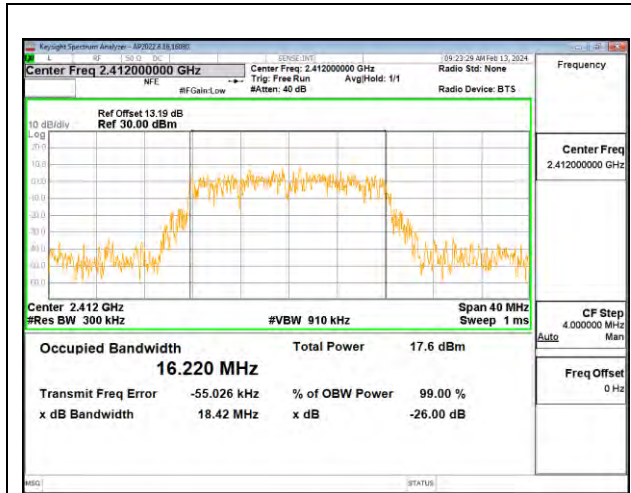


**HIGH CHANNEL 10**

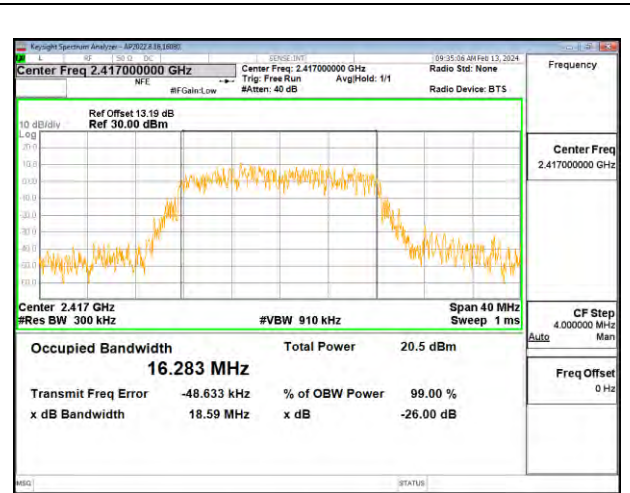


**HIGH CHANNEL 11**

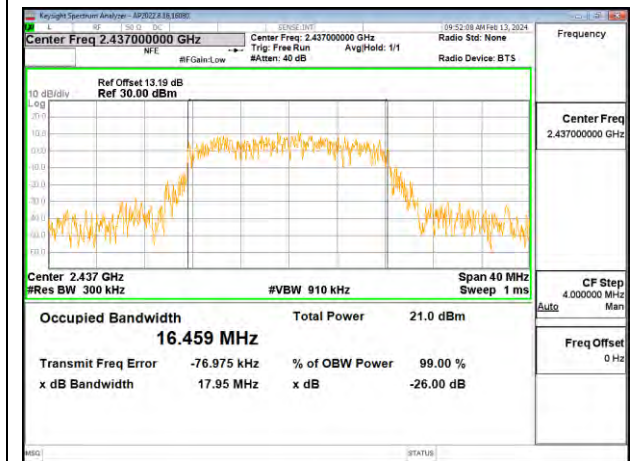
**Chain 2**



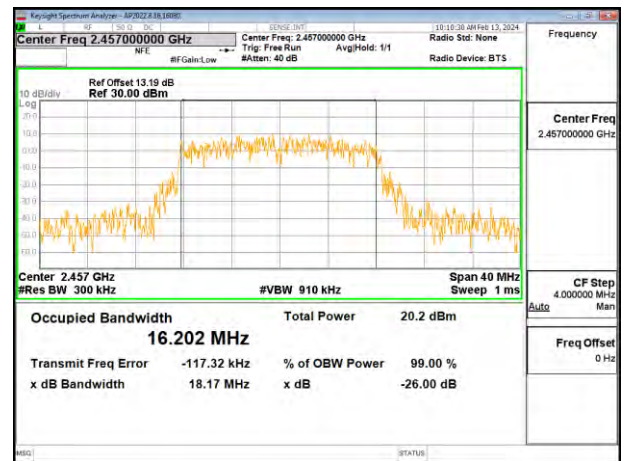
**LOW CHANNEL 1**



**LOW CHANNEL 2**



**MID CHANNEL 6**

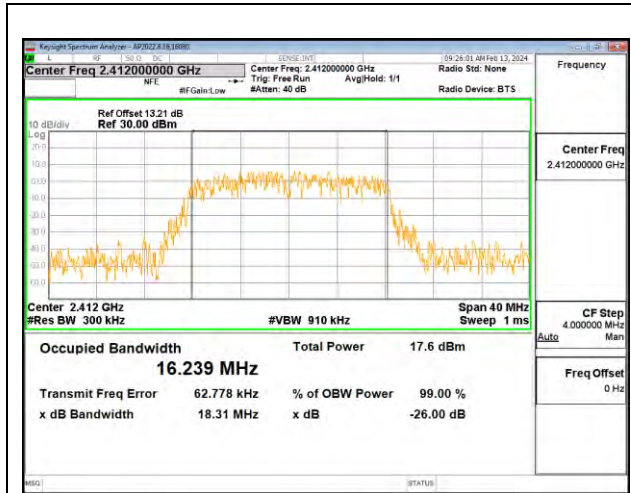


**HIGH CHANNEL 10**

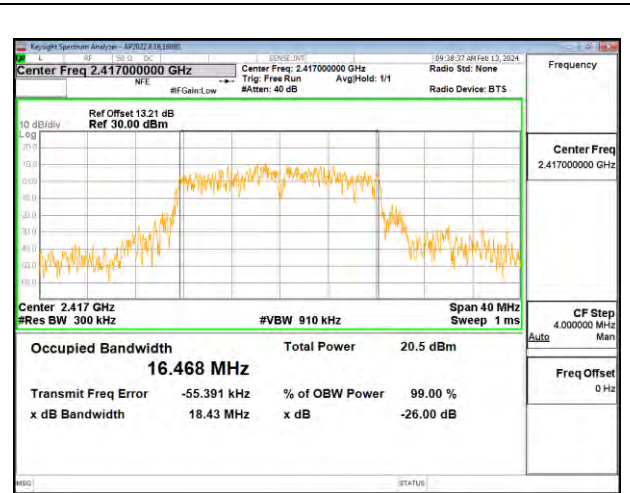


**HIGH CHANNEL 11**

**Chain 3**



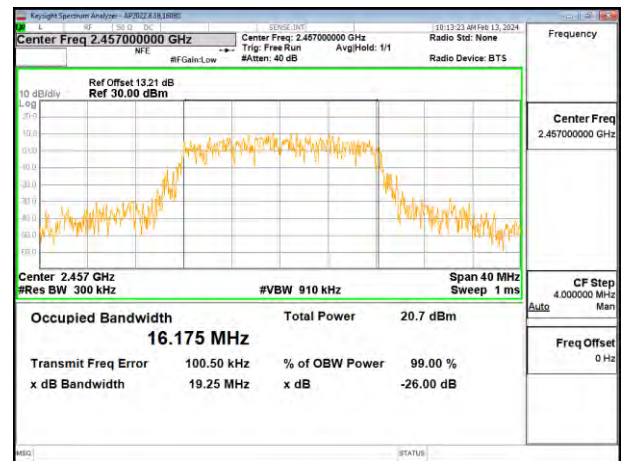
**LOW CHANNEL 1**



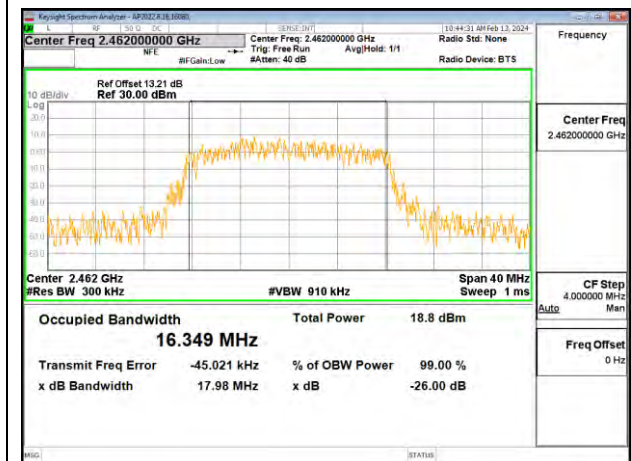
**LOW CHANNEL 2**



**MID CHANNEL 6**



**HIGH CHANNEL 10**



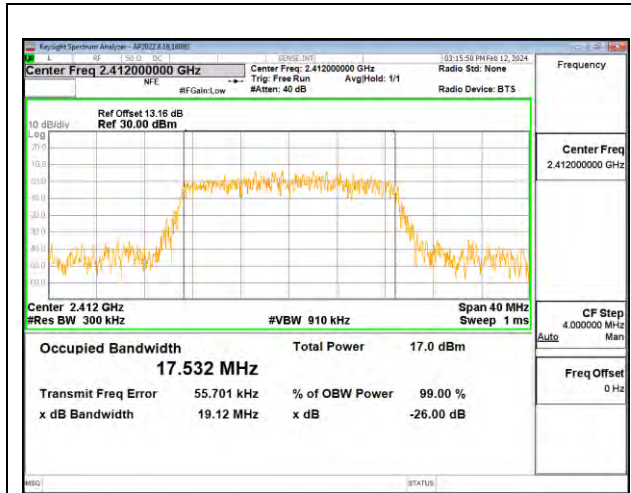
**HIGH CHANNEL 11**

**9.2.3. 802.11n HT20 MODE**

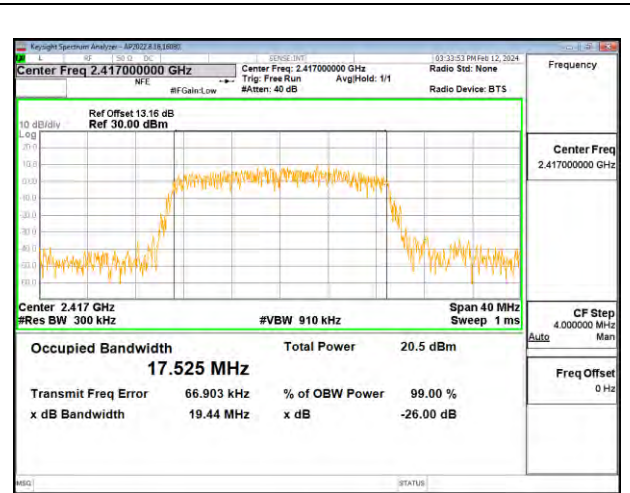
**4TX Antenna**

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)	99% Bandwidth Chain 2 (MHz)	99% Bandwidth Chain 3 (MHz)
Low 1	2412	17.532	17.544	17.605	17.604
Low 2	2417	17.525	17.463	17.552	17.631
Mid 6	2437	17.361	17.581	17.604	17.521
High 9	2452	17.471	17.611	17.423	17.635
High 10	2457	17.417	17.483	17.300	17.157
High 11	2462	17.524	17.528	17.472	17.507

Chain 0



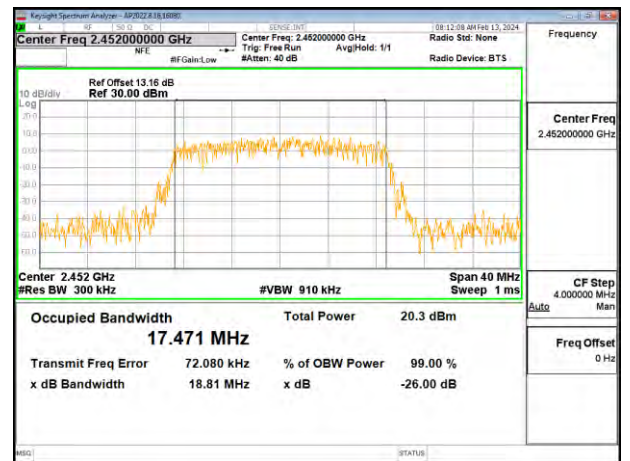
LOW CHANNEL 1



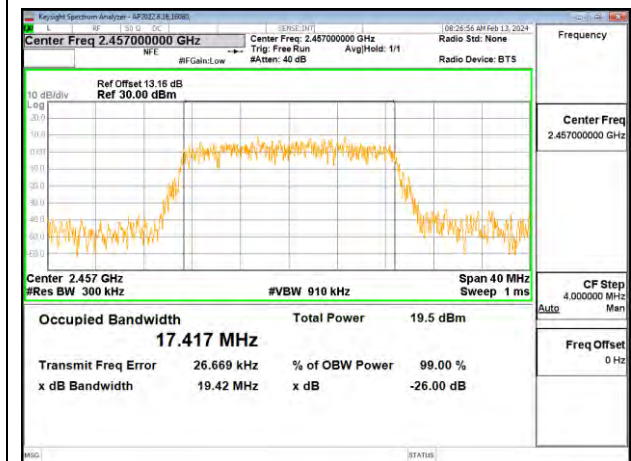
LOW CHANNEL 2



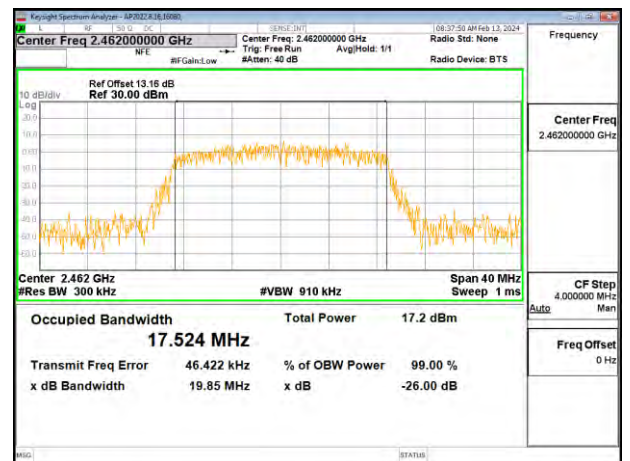
MID CHANNEL 6



HIGH CHANNEL 9



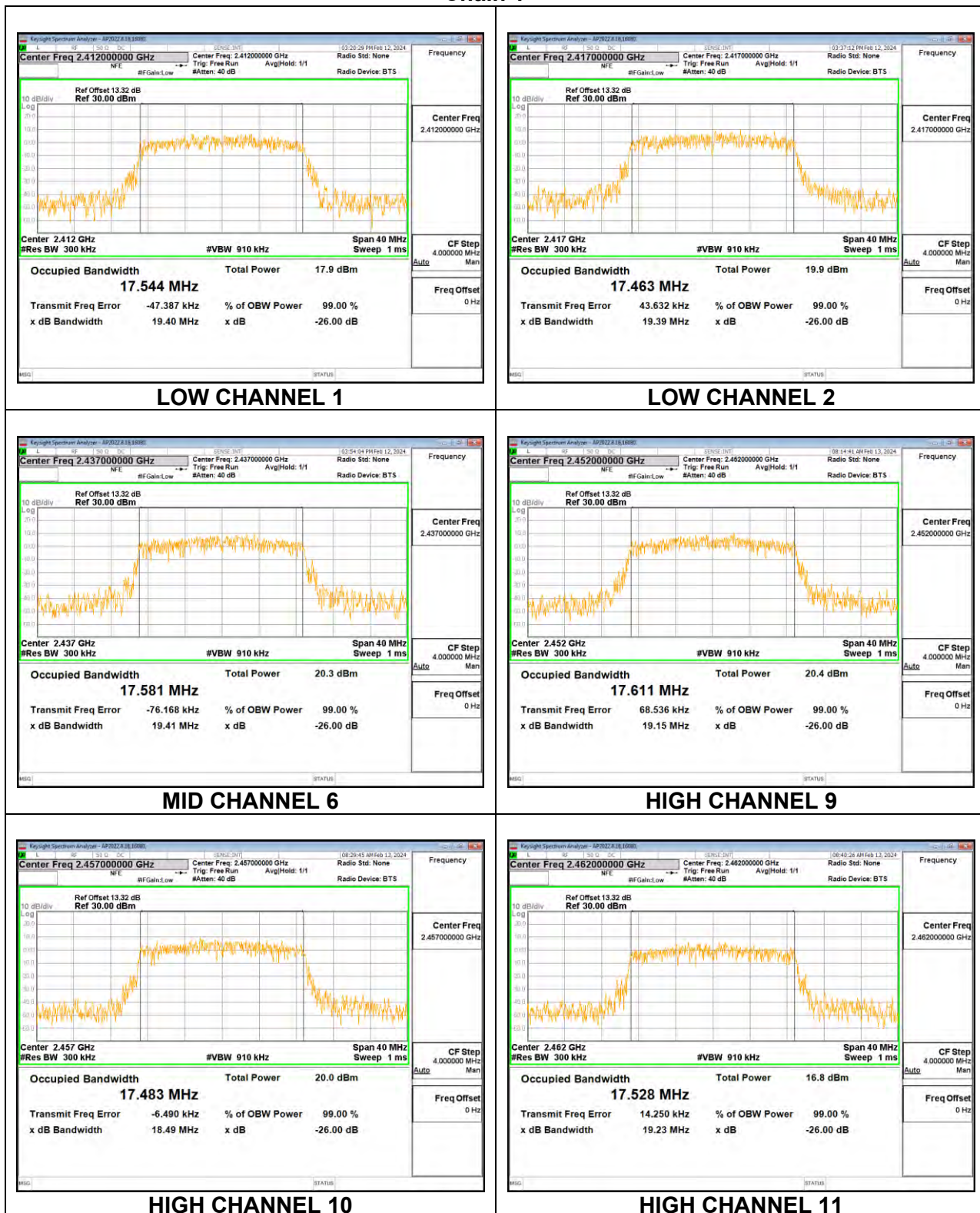
HIGH CHANNEL 10



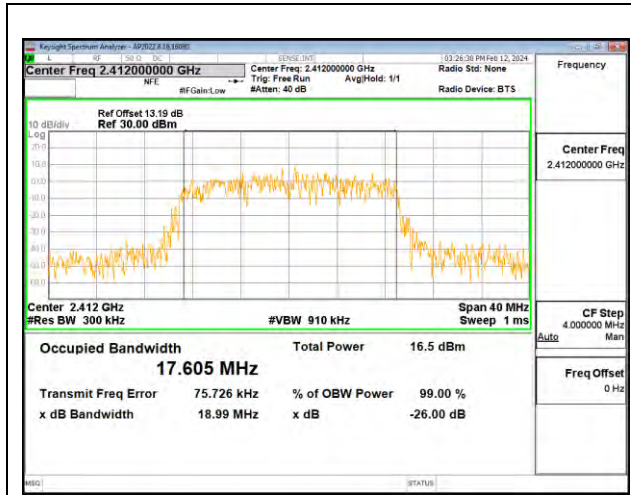
HIGH CHANNEL 11



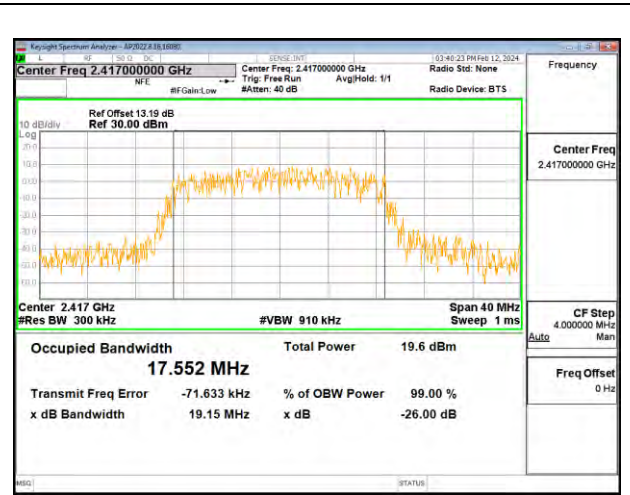
Chain 1



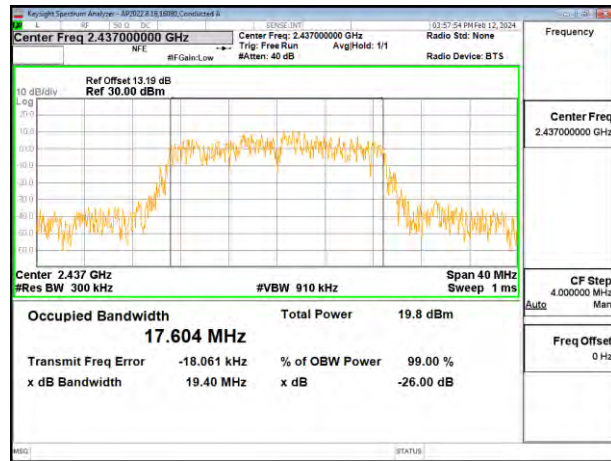
Chain 2



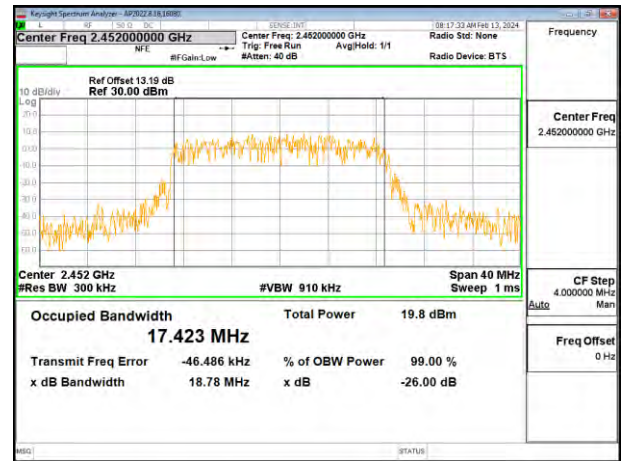
LOW CHANNEL 1



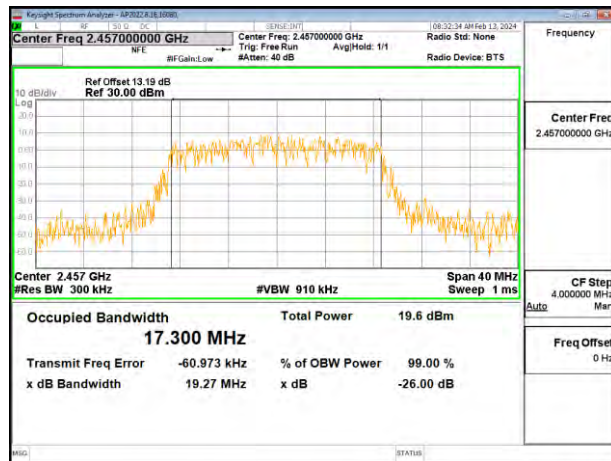
LOW CHANNEL 2



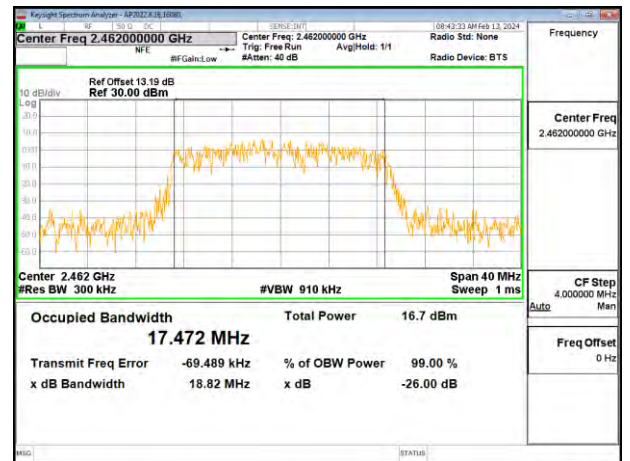
MID CHANNEL 6



HIGH CHANNEL 9

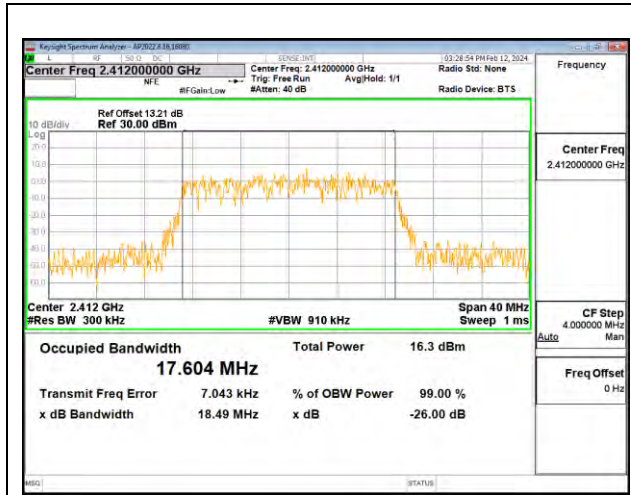


HIGH CHANNEL 10

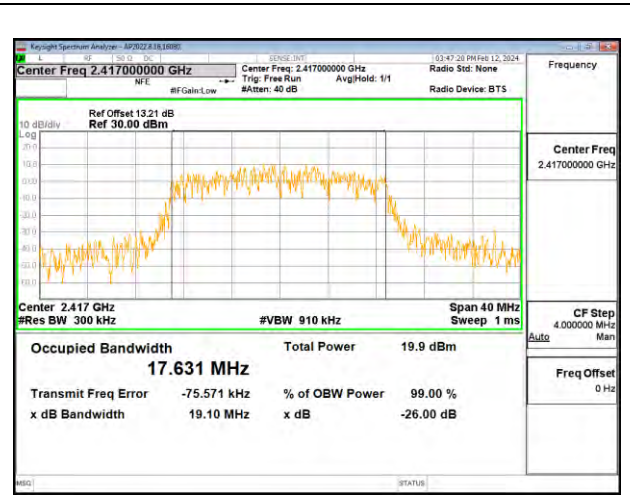


HIGH CHANNEL 11

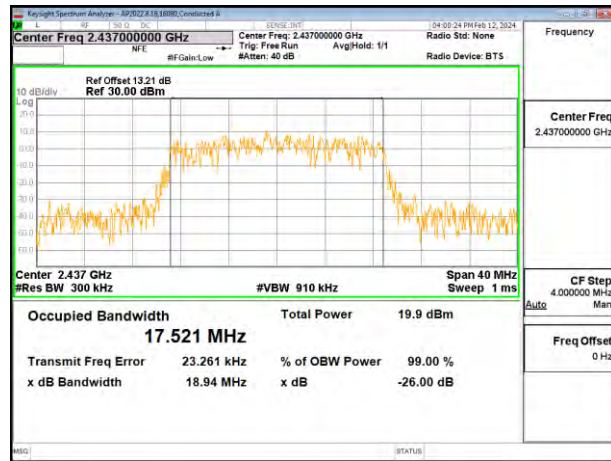
Chain 3



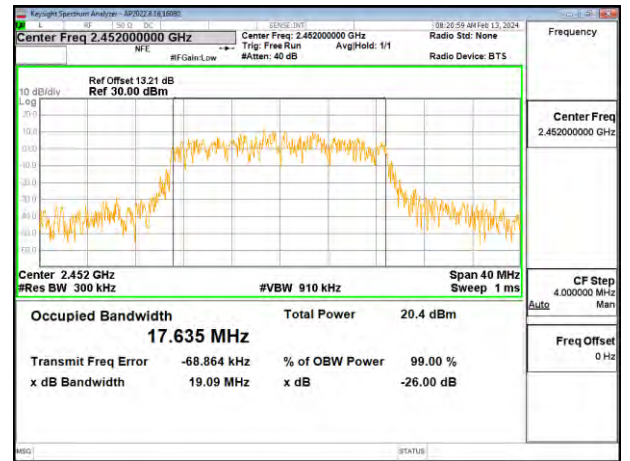
LOW CHANNEL 1



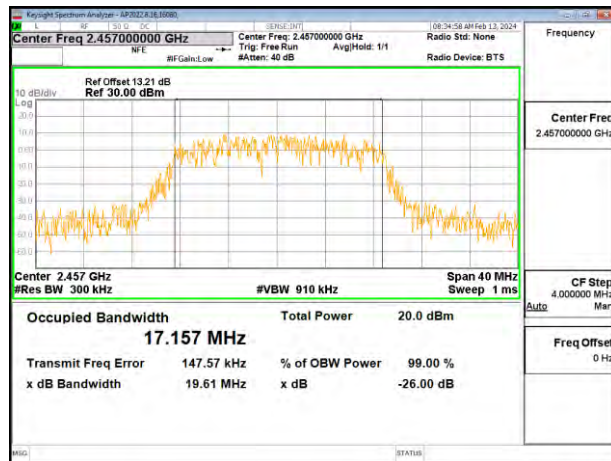
LOW CHANNEL 2



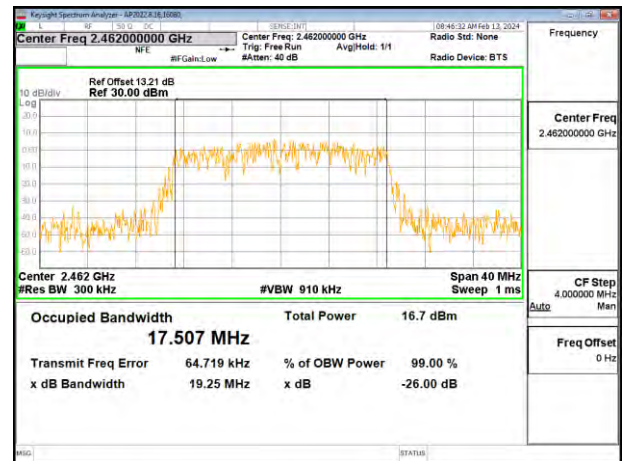
MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11

### **9.3. 6 dB BANDWIDTH**

#### **LIMITS**

FCC §15.247 (a) (2)

RSS-247 5.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

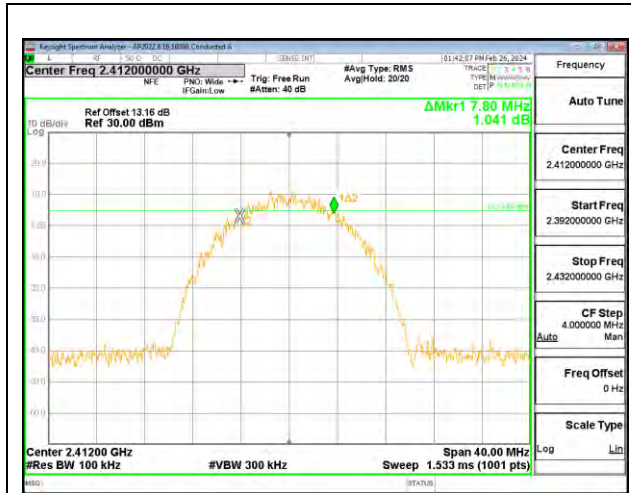
#### **RESULTS**

### 9.3.1. 802.11b MODE

#### 4TX Antenna

Channel	Frequency (MHz)	6 dB Bandwidth Chain 0 (MHz)	6 dB Bandwidth Chain 1 (MHz)	6 dB Bandwidth Chain 2 (MHz)	6 dB Bandwidth Chain 3 (MHz)	Minimum Limit (MHz)
Low 1	2412	7.80	7.40	6.96	7.20	0.5
Mid 6	2437	6.84	7.32	7.16	7.44	0.5
High 11	2462	7.88	6.80	7.32	6.88	0.5

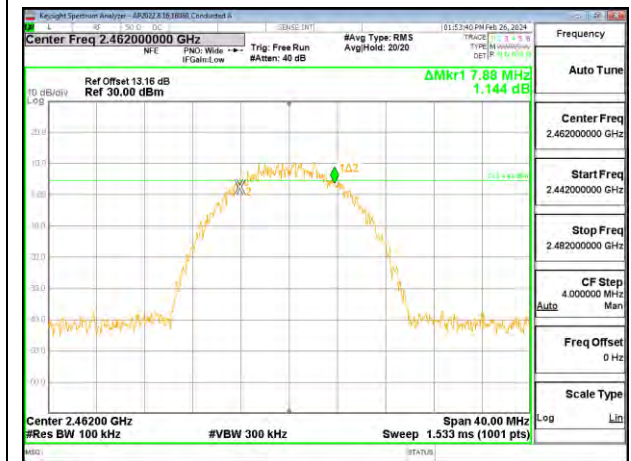
Chain 0



LOW CHANNEL 1

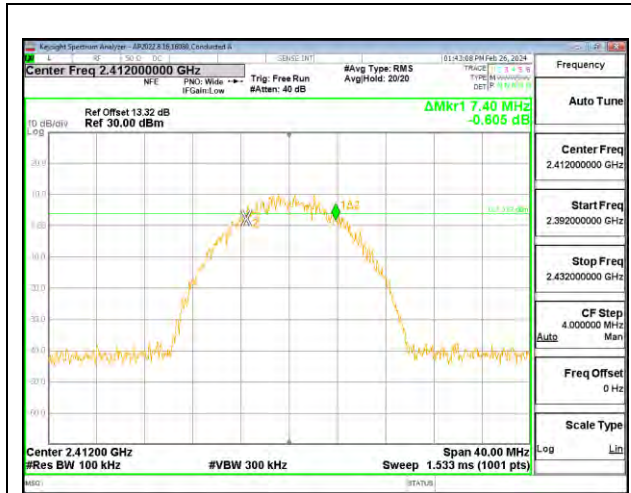


MID CHANNEL 6

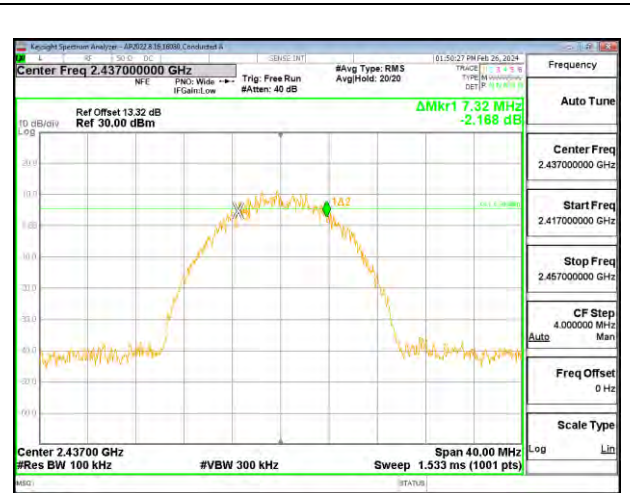


HIGH CHANNEL 11

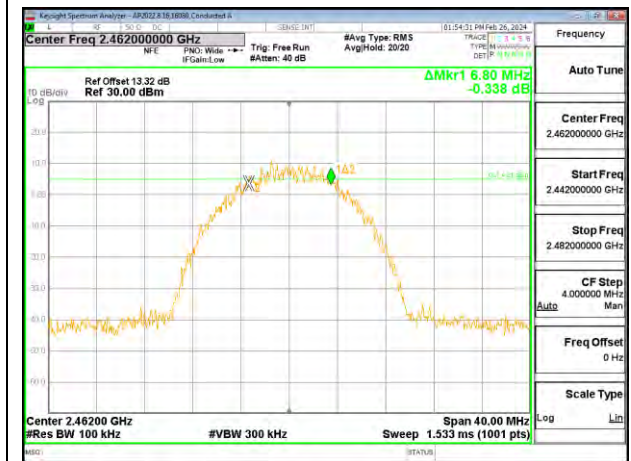
**Chain 1**



**LOW CHANNEL 1**



**MID CHANNEL 6**

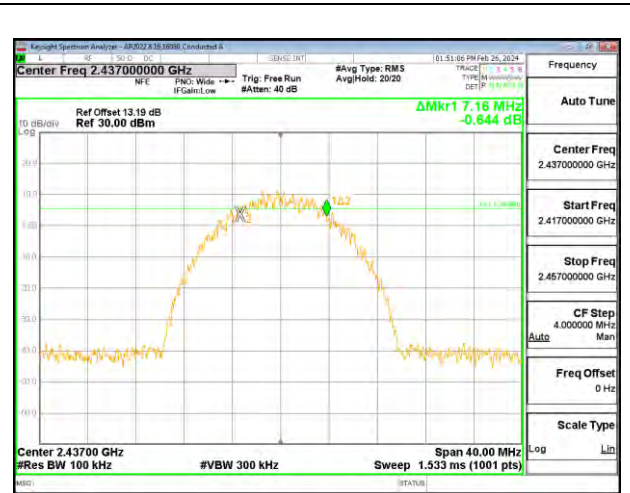


**HIGH CHANNEL 11**

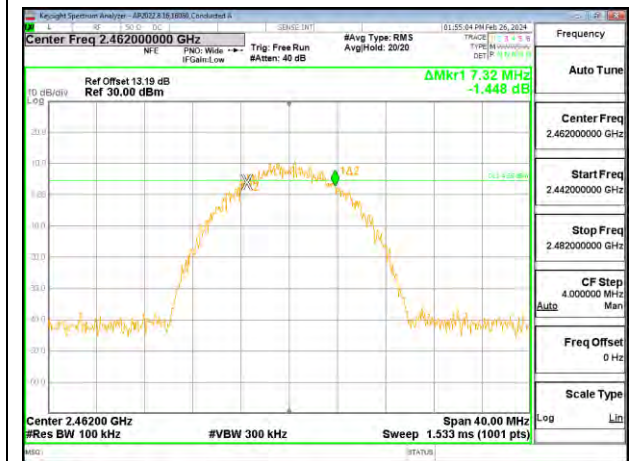
**Chain 2**



**LOW CHANNEL 1**



**MID CHANNEL 6**



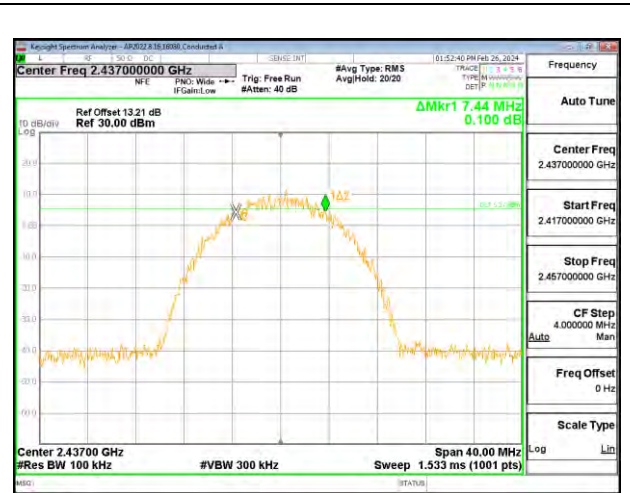
**HIGH CHANNEL 11**



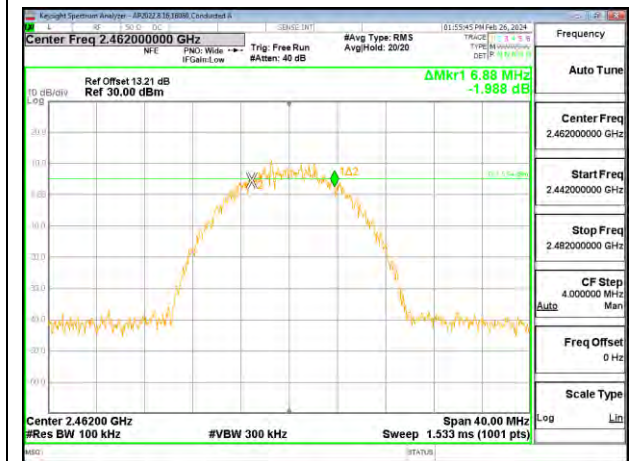
**Chain 3**



**LOW CHANNEL 1**



**MID CHANNEL 6**



**HIGH CHANNEL 11**

**9.3.2. 802.11g MODE**

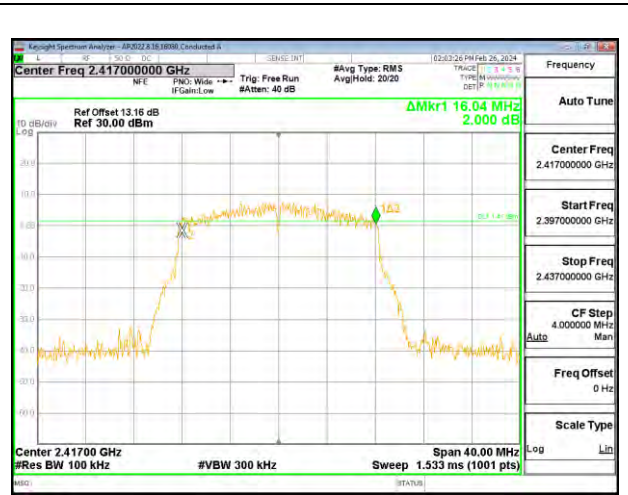
**4TX Antenna**

Channel	Frequency (MHz)	6 dB Bandwidth Chain 0 (MHz)	6 dB Bandwidth Chain 1 (MHz)	6 dB Bandwidth Chain 2 (MHz)	6 dB Bandwidth Chain 3 (MHz)	Minimum Limit (MHz)
Low 1	2412	16.16	16.52	16.24	16.08	0.5
Low 2	2417	16.04	16.36	16.12	15.84	0.5
Mid 6	2437	16.24	16.16	16.44	16.44	0.5
High 10	2457	16.20	16.40	16.20	16.44	0.5
High 11	2462	15.88	16.12	15.96	16.08	0.5

Chain 0



LOW CHANNEL 1



LOW CHANNEL 2



MID CHANNEL 6

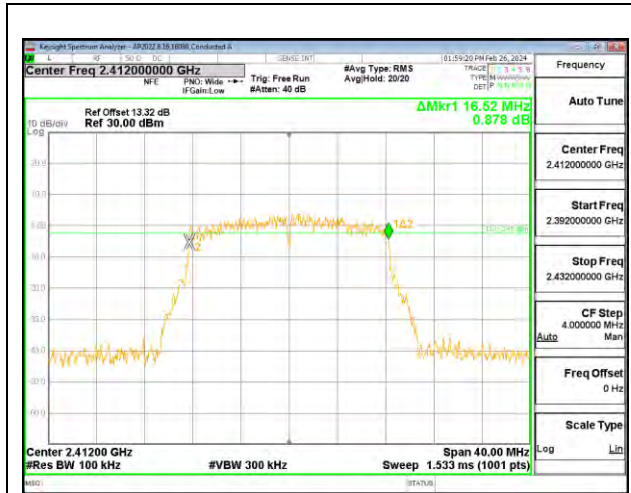


HIGH CHANNEL 10

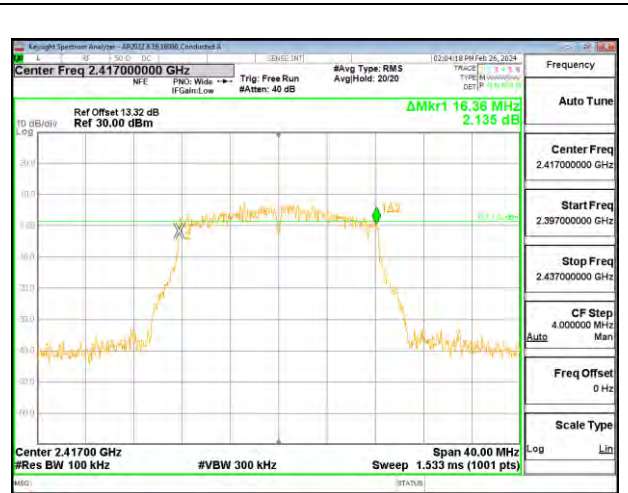


HIGH CHANNEL 11

Chain 1



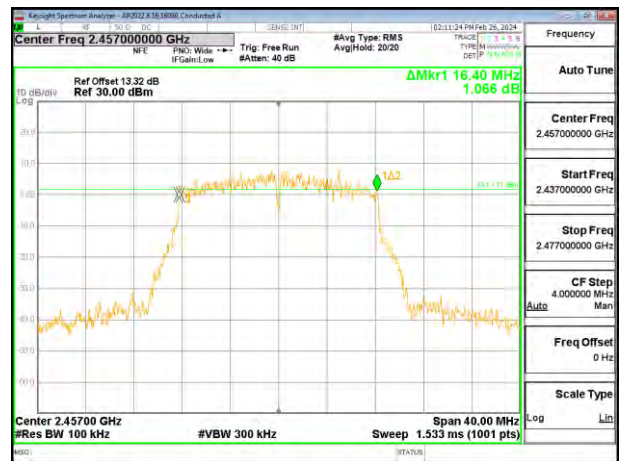
LOW CHANNEL 1



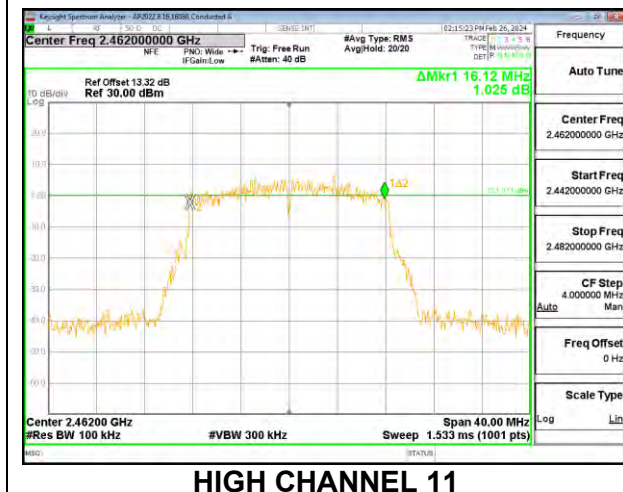
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 10

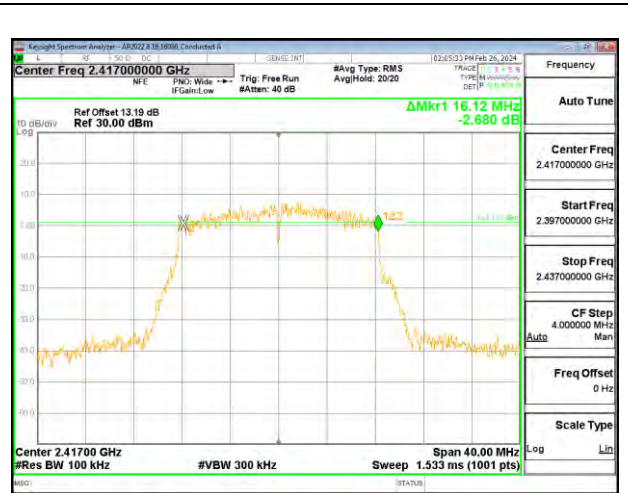


HIGH CHANNEL 11

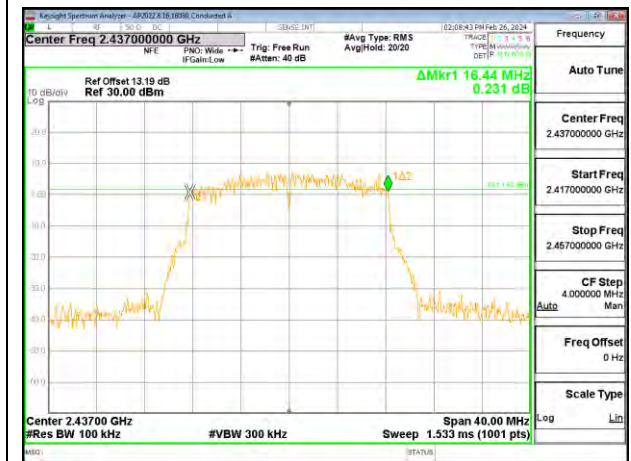
Chain 2



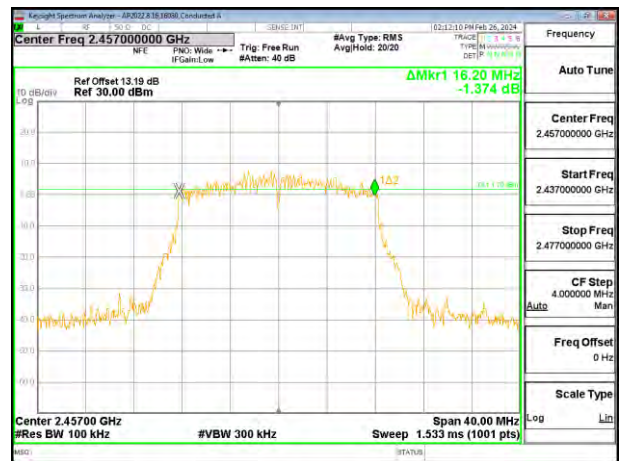
LOW CHANNEL 1



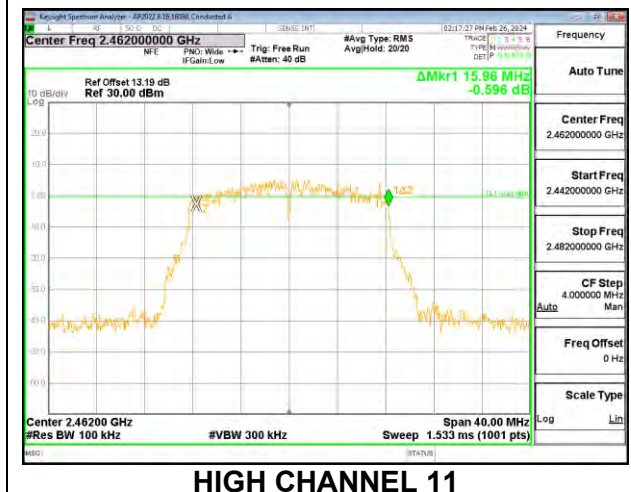
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 10

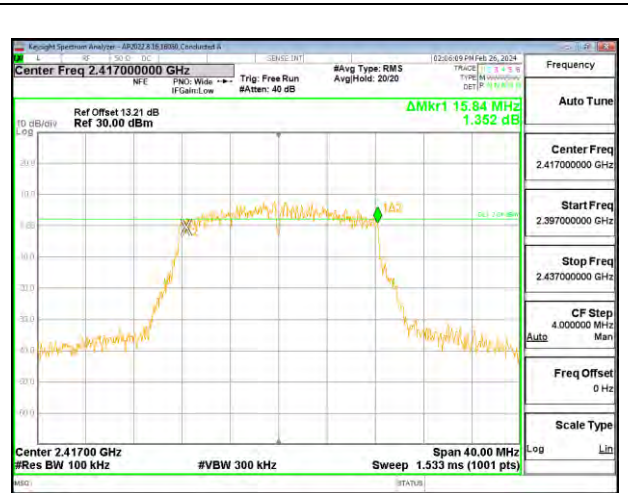


HIGH CHANNEL 11

Chain 3



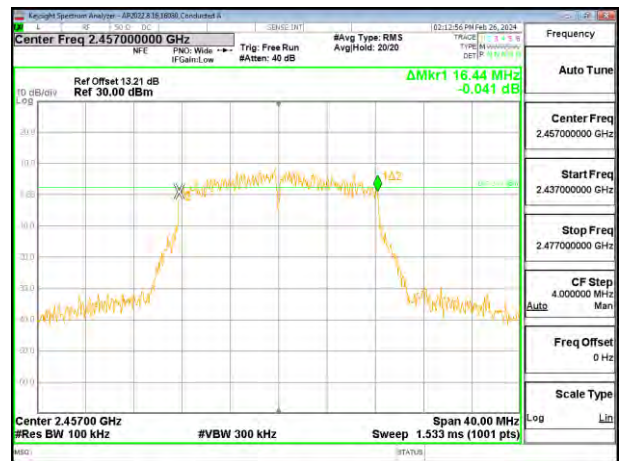
LOW CHANNEL 1



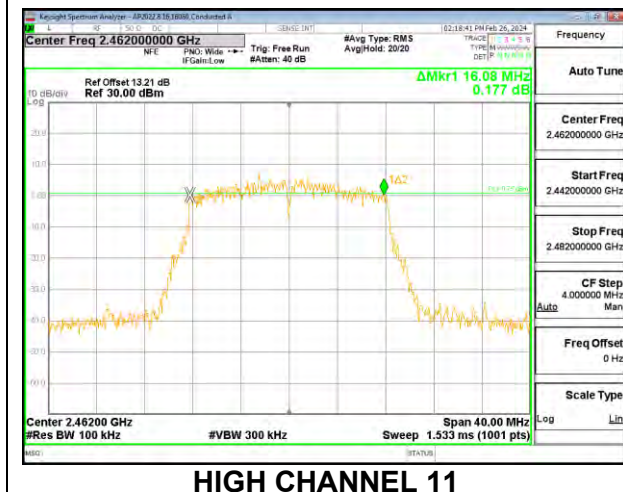
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 10



HIGH CHANNEL 11

**9.3.3. 802.11n HT20 MODE**

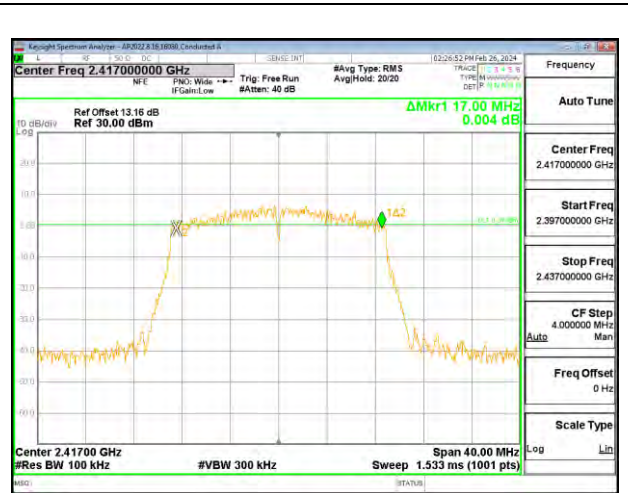
**4TX Antenna**

Channel	Frequency (MHz)	6 dB Bandwidth Chain 0 (MHz)	6 dB Bandwidth Chain 1 (MHz)	6 dB Bandwidth Chain 2 (MHz)	6 dB Bandwidth Chain 3 (MHz)	Minimum Limit (MHz)
Low 1	2412	17.20	17.32	17.28	17.44	0.5
Low 2	2417	17.00	17.68	17.72	17.60	0.5
Mid 6	2437	17.28	17.72	17.40	17.40	0.5
High 9	2452	17.08	17.40	17.28	17.68	0.5
High 10	2457	17.36	17.12	17.28	17.60	0.5
High 11	2462	17.04	17.04	17.28	17.32	0.5

Chain 0



LOW CHANNEL 1



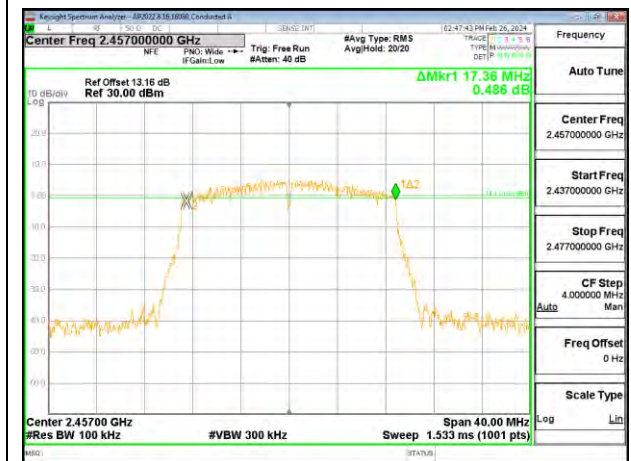
LOW CHANNEL 2



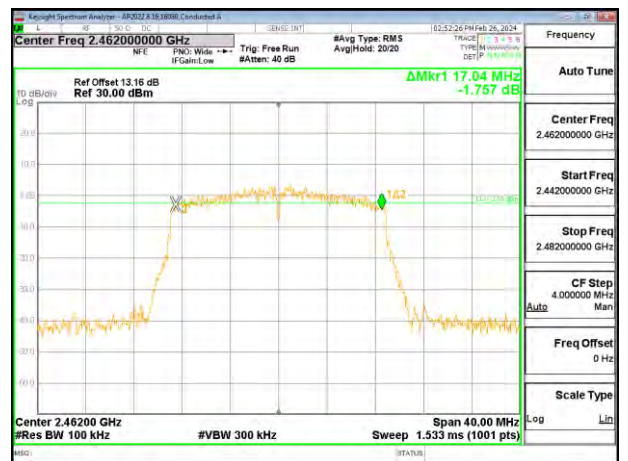
MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10



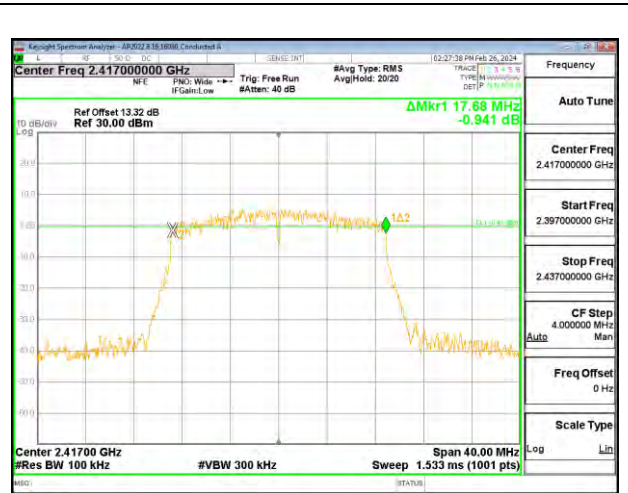
HIGH CHANNEL 11



Chain 1



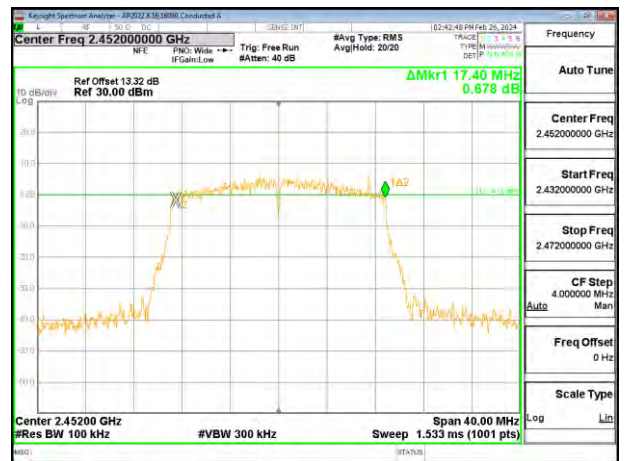
LOW CHANNEL 1



LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10

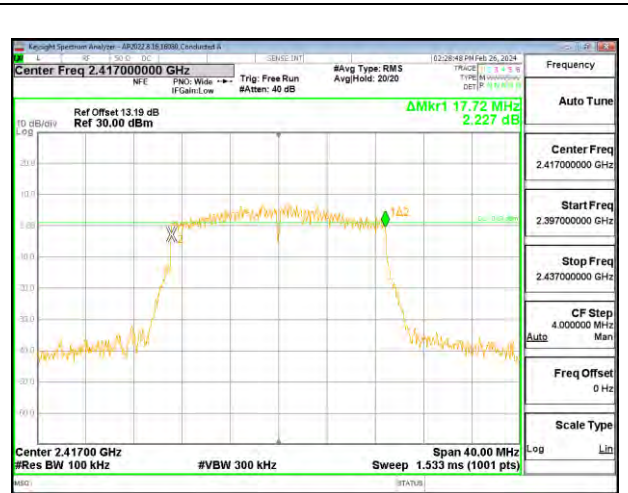


HIGH CHANNEL 11

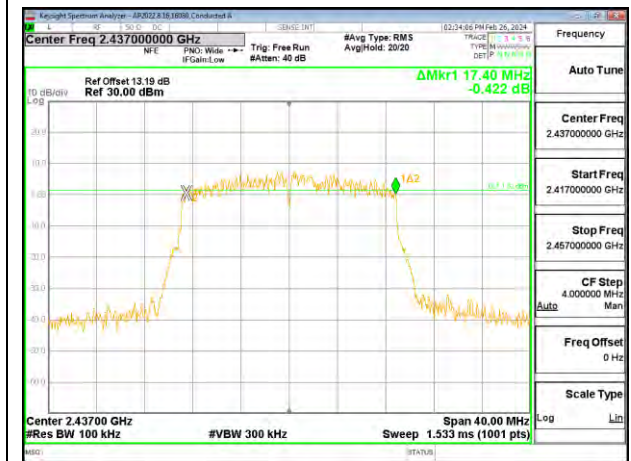
Chain 2



LOW CHANNEL 1



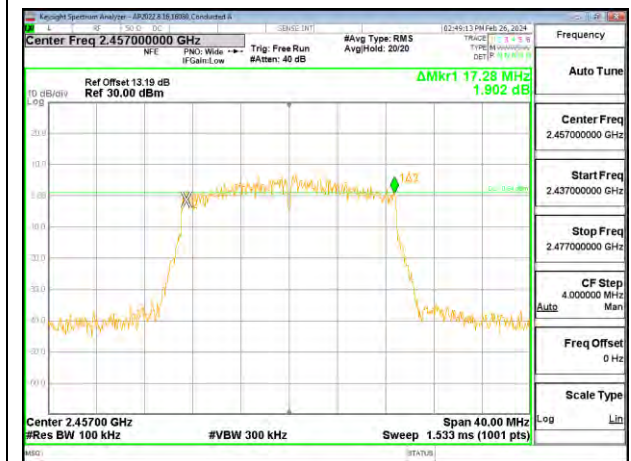
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 9

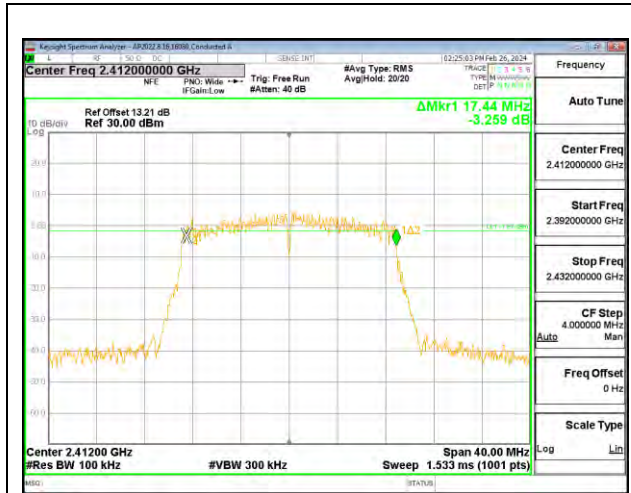


HIGH CHANNEL 10

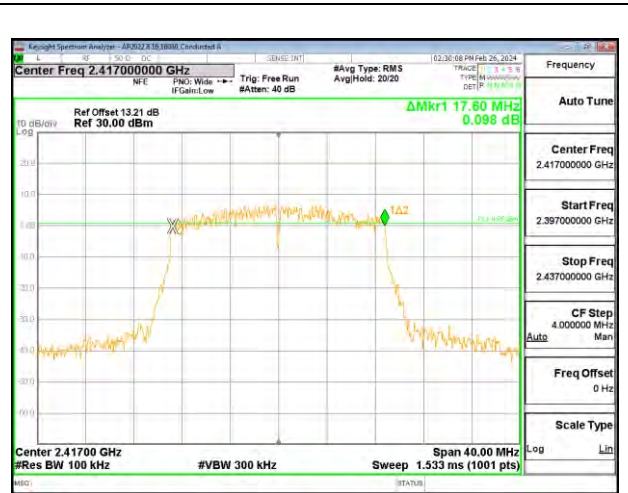


HIGH CHANNEL 11

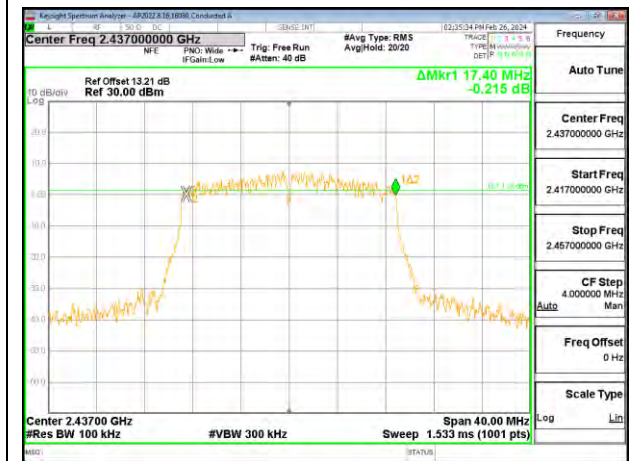
Chain 3



LOW CHANNEL 1



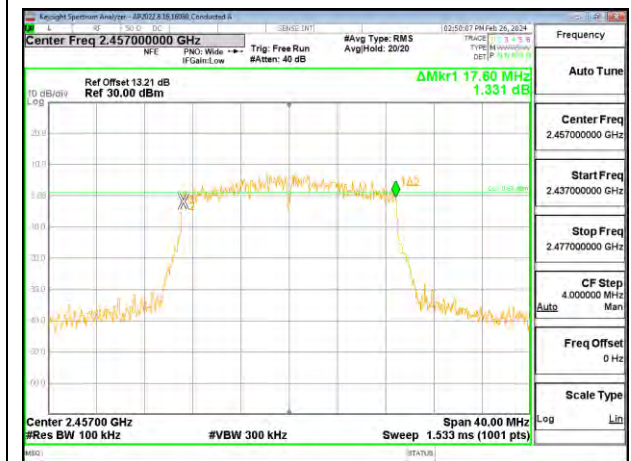
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11

## 9.4. OUTPUT POWER

### LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband power sensor. Gated average output power was read directly from the power meter.

### DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Horizontal Polarity

Chain 1 Antenna Gain (dBi)	Chain 3 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.47	3.45	3.46	6.47

Vertical Polarity (Worst Case)

Chain 0 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.47	4.76	4.16	7.15

**RESULTS**

**9.4.1. 802.11b MODE**

**4TX Antenna**

<b>Test Engineer:</b>	ZS 16080
<b>Test Date:</b>	2024-02-12

**Limits**

Channel	Frequency (MHz)	Direction Gain (dBi)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	ISED EIRP Limit (dBm)
Ch 1	2412	4.16	30.00	30	36	30.00
Ch 6	2437	4.16	30.00	30	36	30.00
Ch 11	2462	4.16	30.00	30	36	30.00

**Results**

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Ch 1	2412	20.46	19.68	19.62	20.64	26.14	30.00	-3.86
Ch 6	2437	20.98	20.64	20.37	20.79	26.72	30.00	-3.28
Ch 11	2462	21.55	20.87	20.77	20.53	<b>26.97</b>	30.00	-3.03

**9.4.2. 802.11g MODE**

**4TX Antenna**

<b>Test Engineer:</b>	ZS 16080
<b>Test Date:</b>	2024-02-12

**Limits**

Channel	Frequency (MHz)	Directio Gain (dBi)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	ISED EIRP Limit (dBm)
Ch 1	2412	4.16	30.00	30	36	30.00
Ch 2	2417	4.16	30.00	30	36	30.00
Ch 6	2437	4.16	30.00	30	36	30.00
Ch 10	2457	4.16	30.00	30	36	30.00
Ch 11	2462	4.16	30.00	30	36	30.00

**Results**

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Ch 1	2412	18.69	17.97	18.24	17.99	24.25	30.00	-5.75
Ch 2	2417	21.07	21.27	20.88	20.49	<b>26.96</b>	30.00	-3.04
Ch 6	2437	21.09	20.79	20.76	20.88	26.90	30.00	-3.10
Ch 10	2457	21.08	20.77	20.48	20.95	26.85	30.00	-3.15
Ch 11	2462	19.68	18.94	19.05	19.06	25.21	30.00	-4.79

**9.4.3. 802.11n HT20 MODE**

**4TX Antenna**

<b>Test Engineer:</b>	ZS 16080
<b>Test Date:</b>	2024-02-12

**Limits**

Channel	Frequency (MHz)	Directio Gain (dBi)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	ISED EIRP Limit (dBm)
Ch 1	2412	4.16	30.00	30	36	30.00
Ch 2	2417	4.16	30.00	30	36	30.00
Ch 6	2437	4.16	30.00	30	36	30.00
Ch 9	2452	4.16	30.00	30	36	30.00
Ch 10	2457	4.16	30.00	30	36	30.00
Ch 11	2462	4.16	30.00	30	36	30.00

**Results**

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Ch 1	2412	17.49	16.42	17.05	16.57	22.92	30.00	-7.08
Ch 2	2417	19.98	19.32	19.31	19.95	25.67	30.00	-4.33
Ch 6	2437	20.65	20.02	19.89	20.35	<b>26.26</b>	30.00	-3.74
Ch 9	2452	19.73	19.24	19.02	19.77	25.47	30.00	-4.53
Ch 10	2457	19.50	19.03	18.64	19.39	25.17	30.00	-4.83
Ch 11	2462	16.73	16.07	16.04	16.23	22.30	30.00	-7.70

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## 9.5. POWER SPECTRAL DENSITY

### **LIMITS**

FCC §15.247 (e)

RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **RESULTS**

RBW setting used 30kHz according to ANSI 63.10, Section 11.10.3 Method AVGPS-1



**9.5.1. 802.11b MODE**

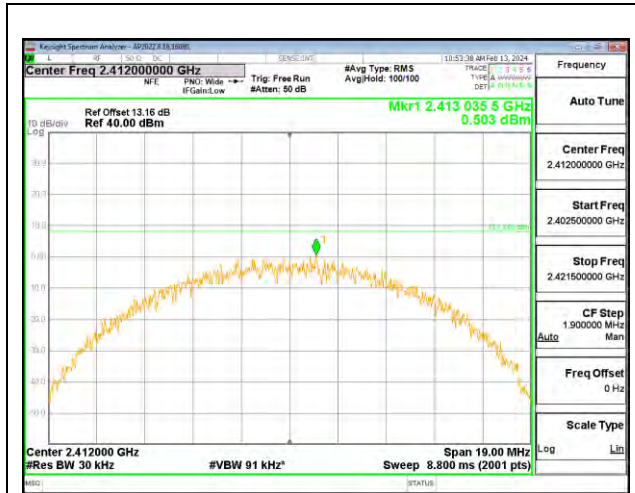
**4TX Antenna**

<b>Duty Cycle CF (dB)</b>	0.43	<b>Included in Calculations of Corr'd PSD</b>
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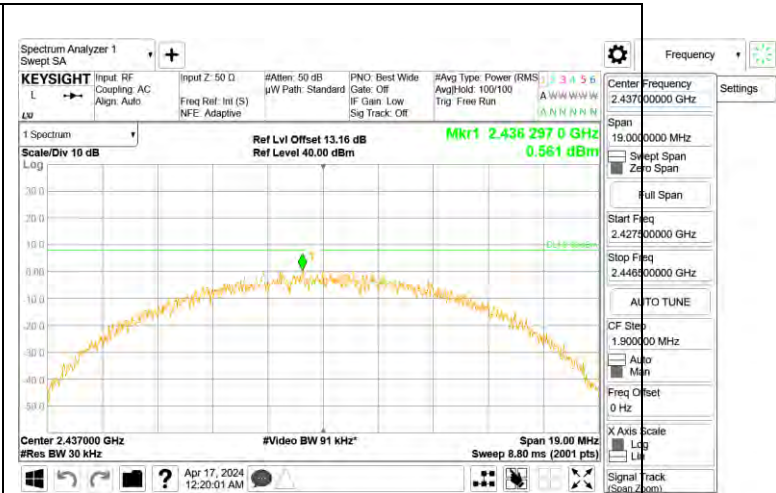
**PSD Results**

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Chain 0 Meas (dBm)</b>	<b>Chain 1 Meas (dBm)</b>	<b>Chain 2 Meas (dBm)</b>	<b>Chain 3 Meas (dBm)</b>	<b>Total Corr'd PSD (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
CH_1	2412	0.50	-0.37	-0.69	0.73	6.53	6.85	-0.3
CH_6	2437	0.56	0.18	-0.40	0.19	6.59	6.85	-0.3
CH_11	2462	0.26	-0.16	0.22	0.55	6.67	6.85	-0.2

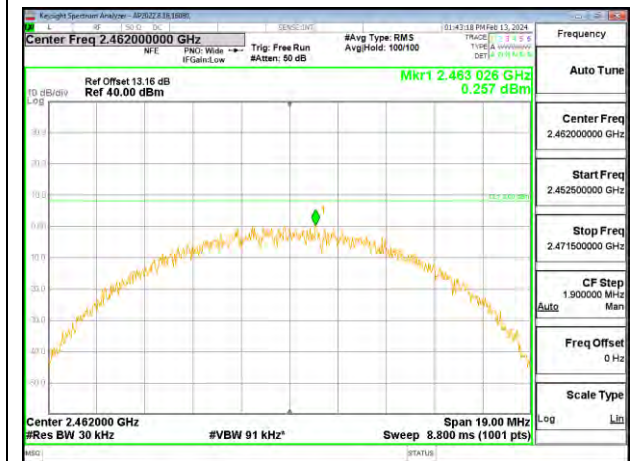
Chain 0



LOW CHANNEL 1

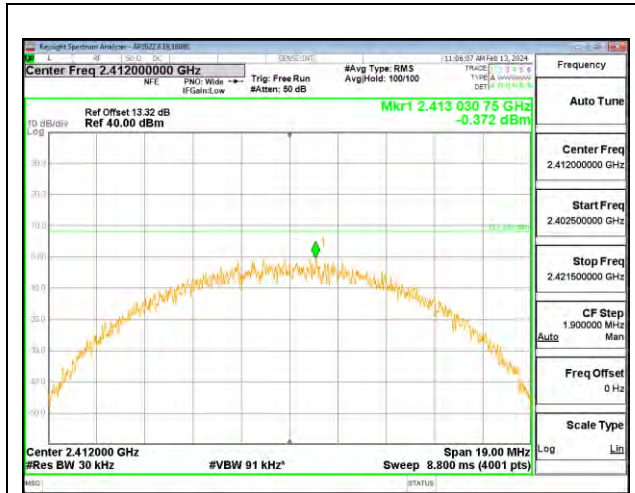


MID CHANNEL 6

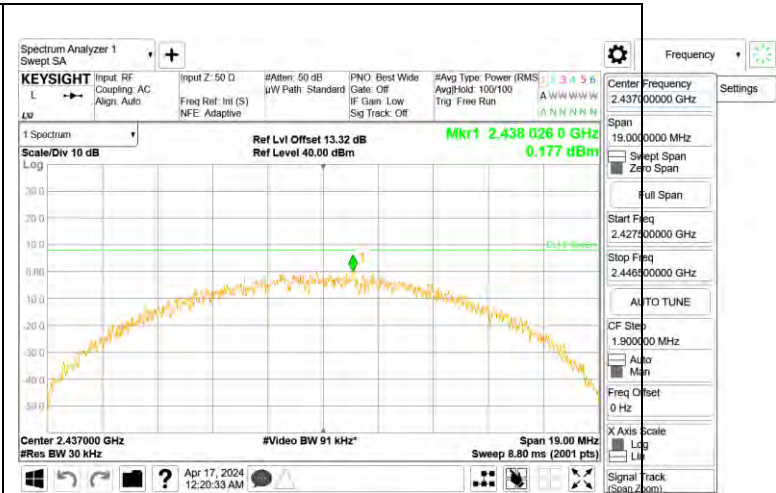


HIGH CHANNEL 11

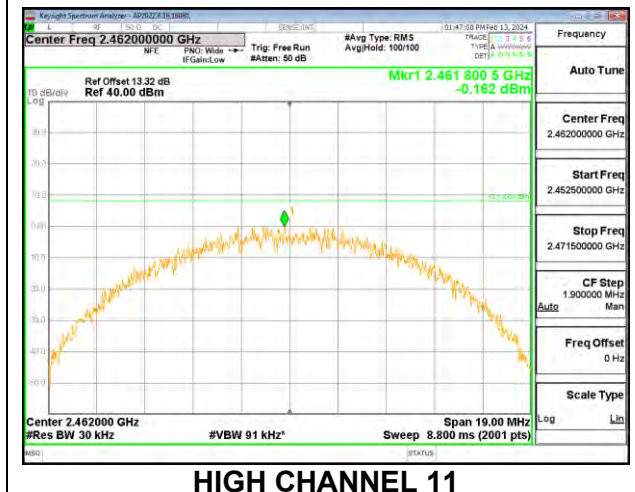
Chain 1



LOW CHANNEL 1

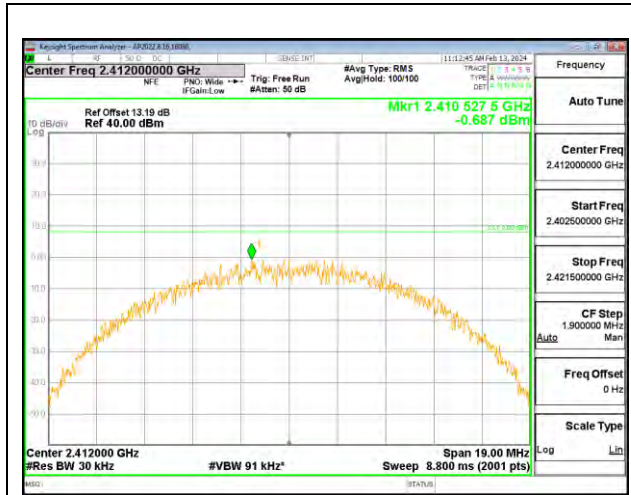


MID CHANNEL 6

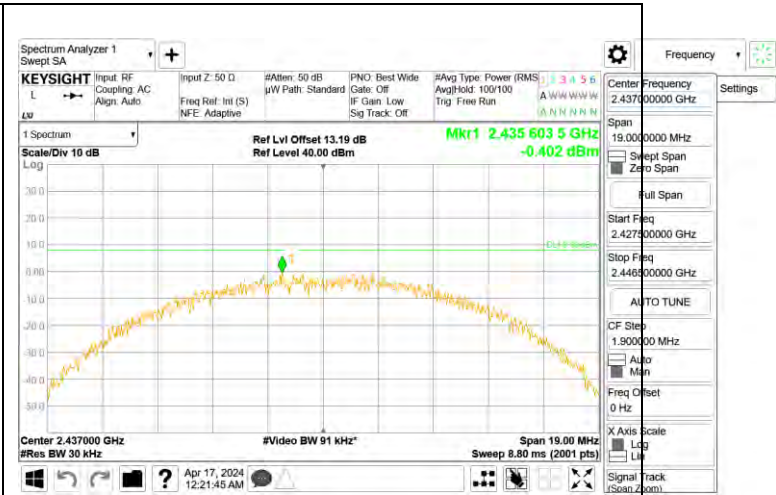


HIGH CHANNEL 11

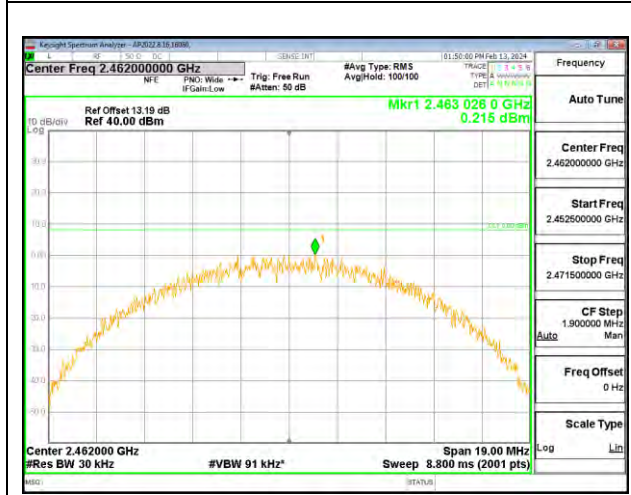
Chain 2



LOW CHANNEL 1

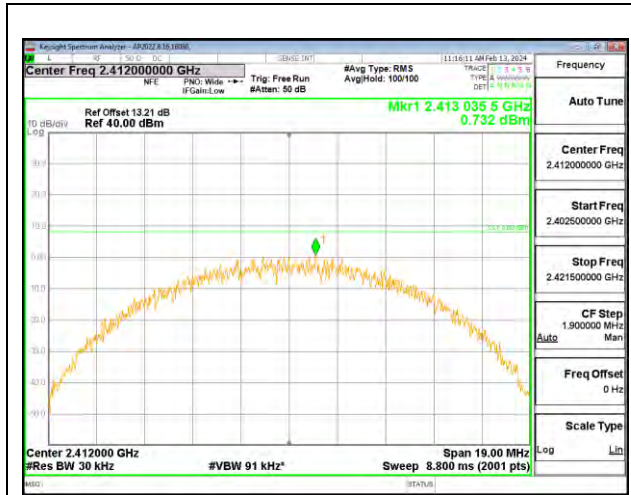


MID CHANNEL 6

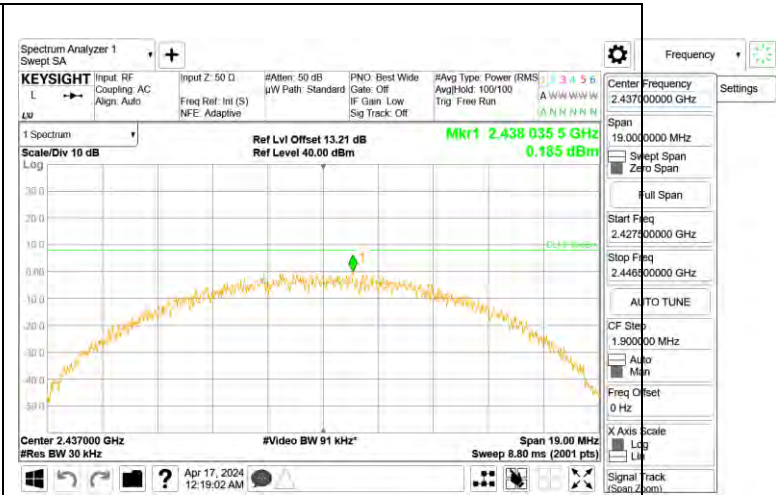


HIGH CHANNEL 11

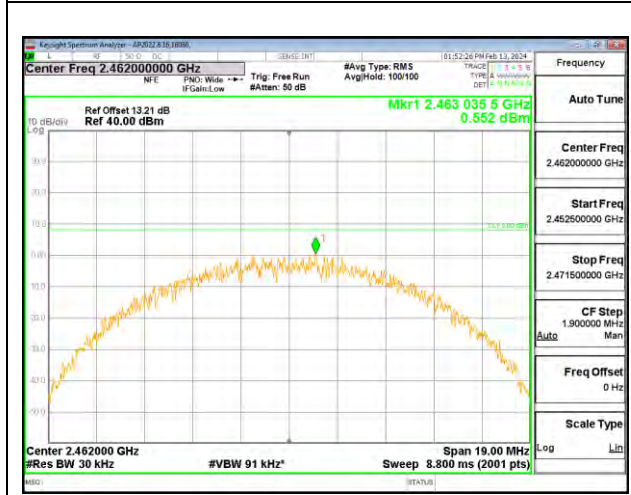
Chain 3



LOW CHANNEL 1



MID CHANNEL 6



HIGH CHANNEL 11

### 9.5.2. 802.11g MODE

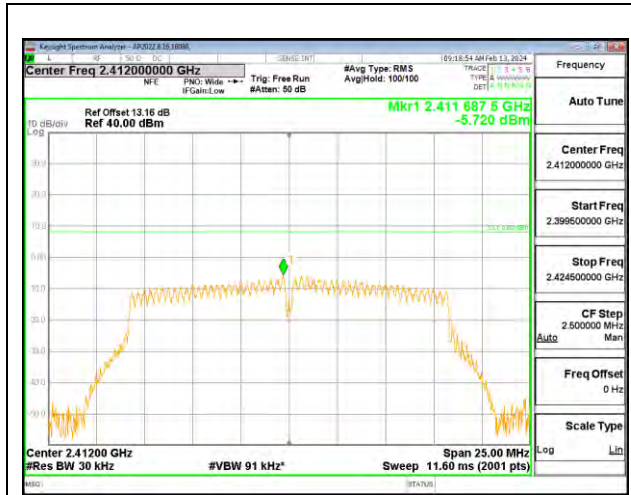
#### 4TX Antenna

Duty Cycle CF (dB)	0.96	Included in Calculations of Corr'd PSD
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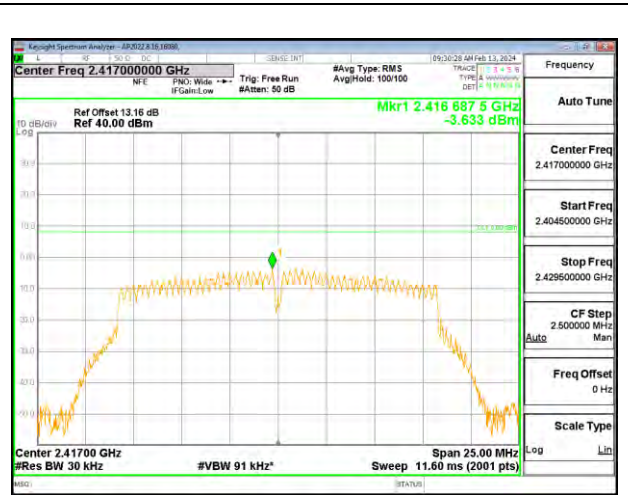
#### PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Chain 3 Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
CH_1	2412	-5.72	-6.67	-6.27	-6.61	0.68	6.85	-6.2
CH_2	2417	-3.63	-4.02	-3.56	-3.41	3.33	6.85	-3.5
CH_6	2437	-2.51	-3.06	-2.71	-3.27	<b>4.10</b>	6.85	-2.7
CH_10	2457	-3.33	-3.94	-3.58	-2.49	3.68	6.85	-3.2
CH_11	2462	-4.84	-5.60	-5.37	-4.98	1.80	6.85	-5.1

Chain 0



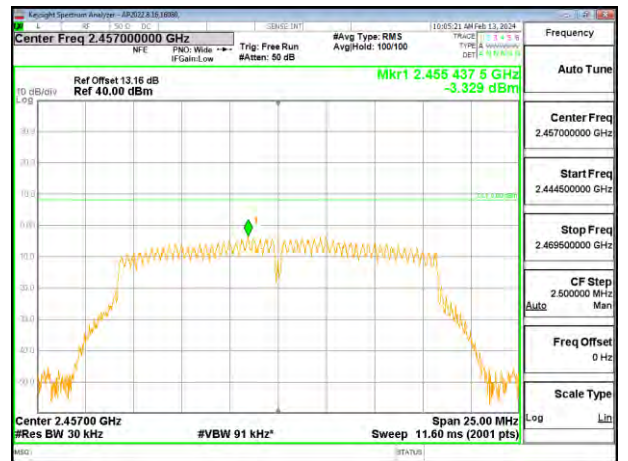
LOW CHANNEL 1



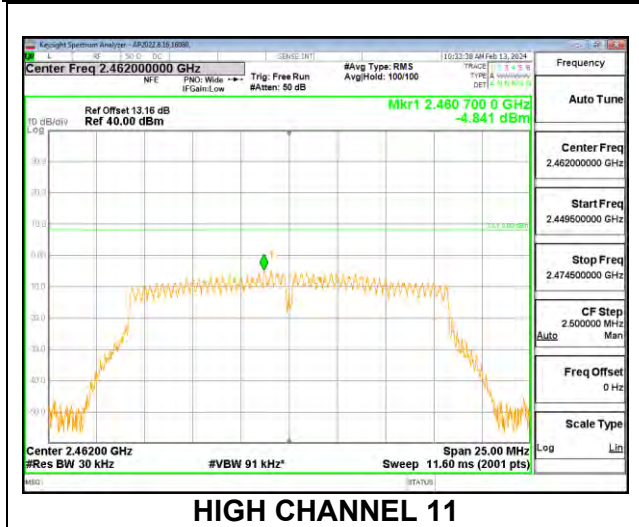
LOW CHANNEL 2



MID CHANNEL 6

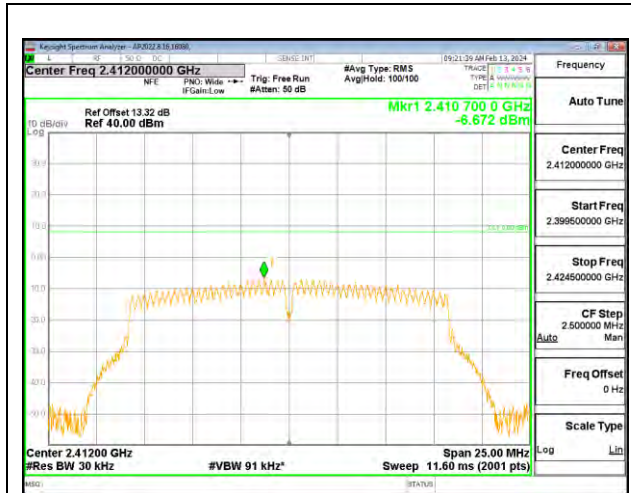


HIGH CHANNEL 10

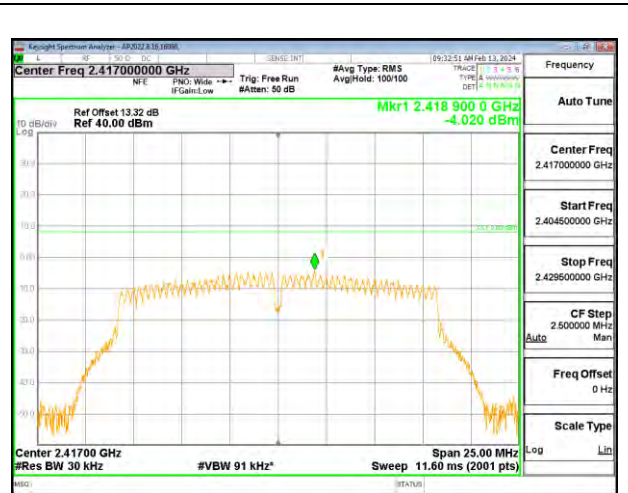




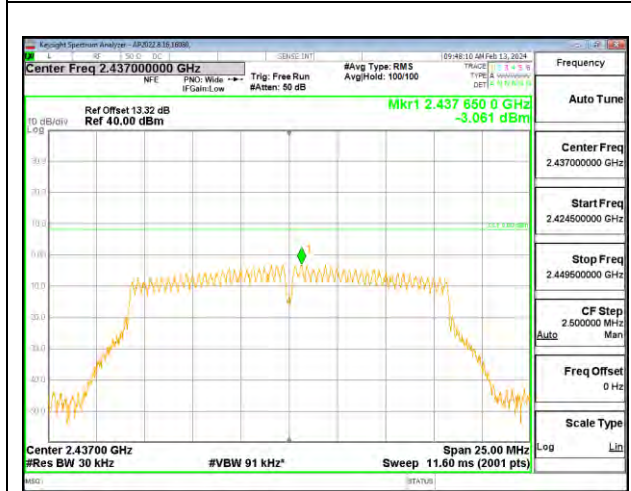
Chain 1



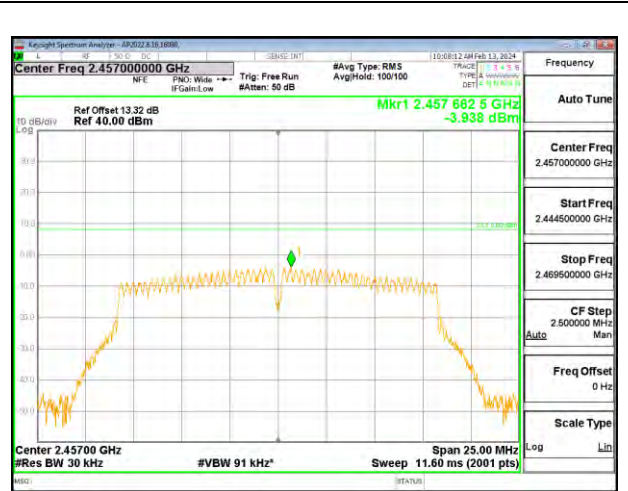
LOW CHANNEL 1



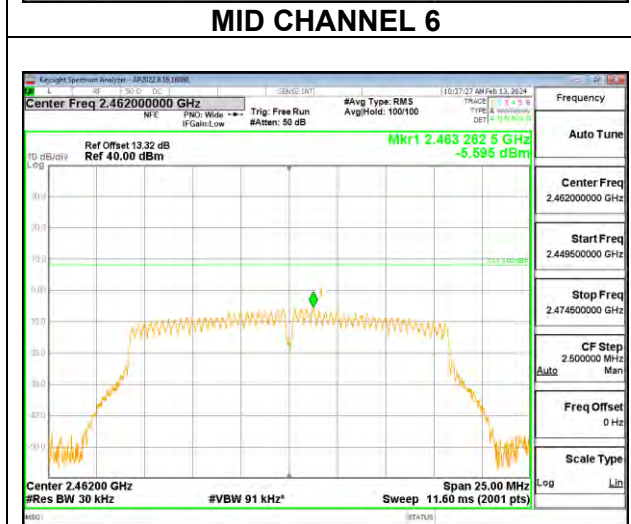
LOW CHANNEL 2



MID CHANNEL 6

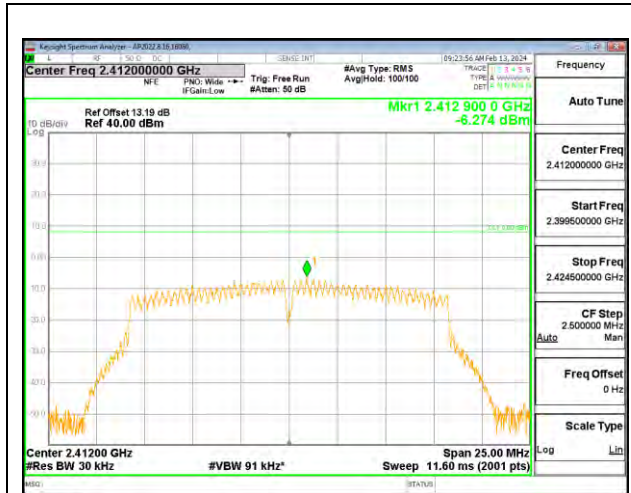


HIGH CHANNEL 10

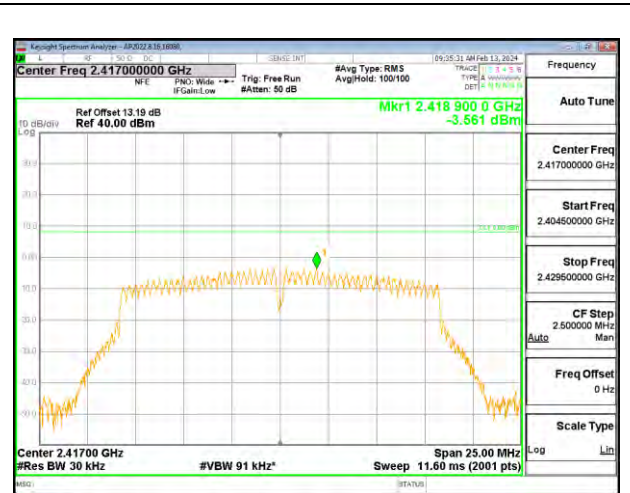


HIGH CHANNEL 11

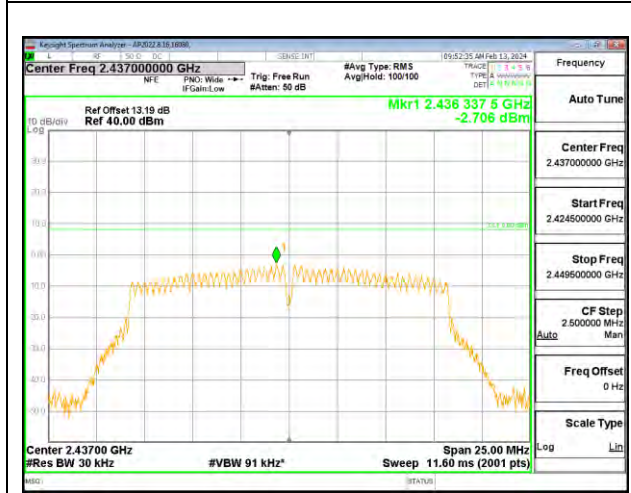
Chain 2



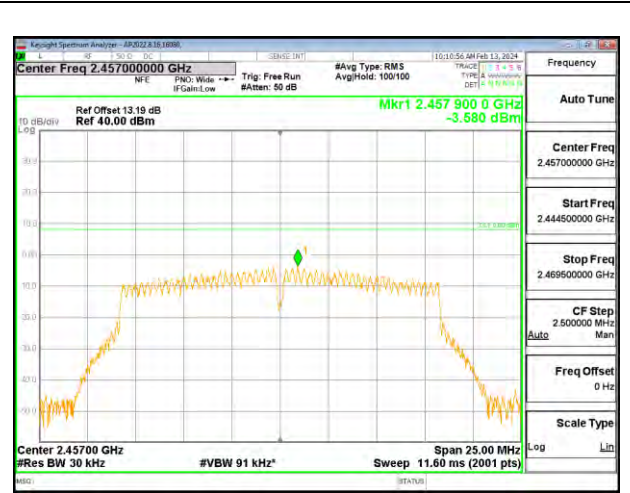
LOW CHANNEL 1



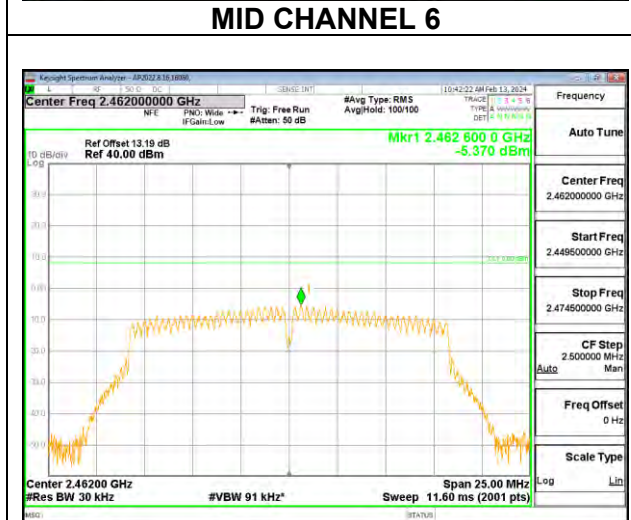
LOW CHANNEL 2



MID CHANNEL 6

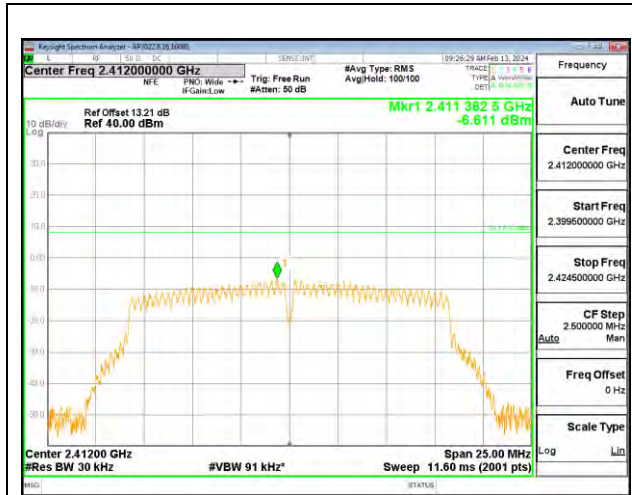


HIGH CHANNEL 10

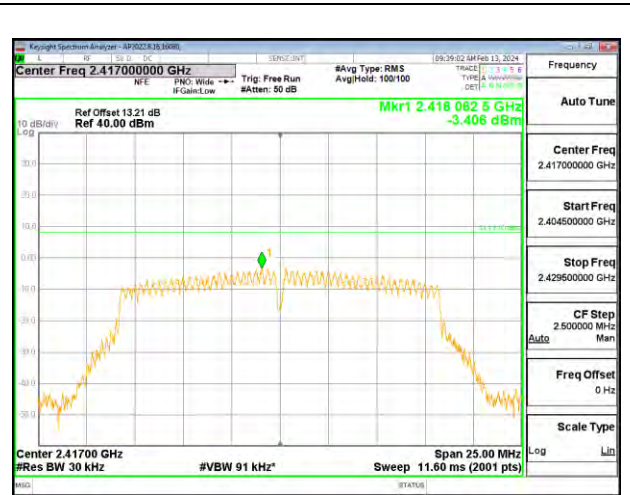


HIGH CHANNEL 11

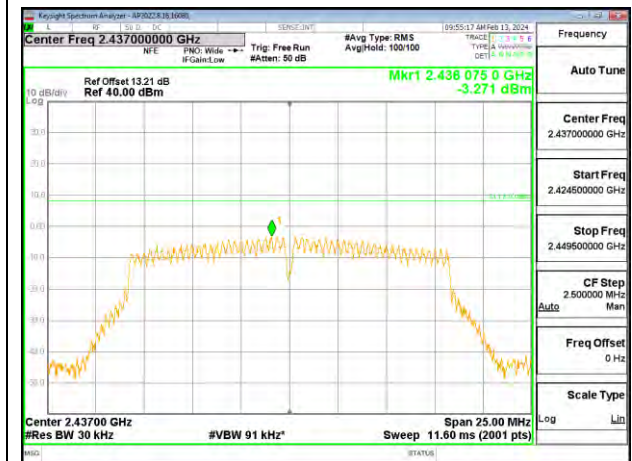
Chain 3



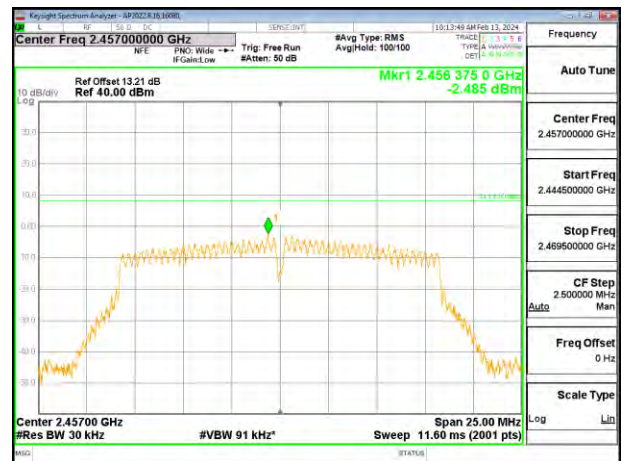
LOW CHANNEL 1



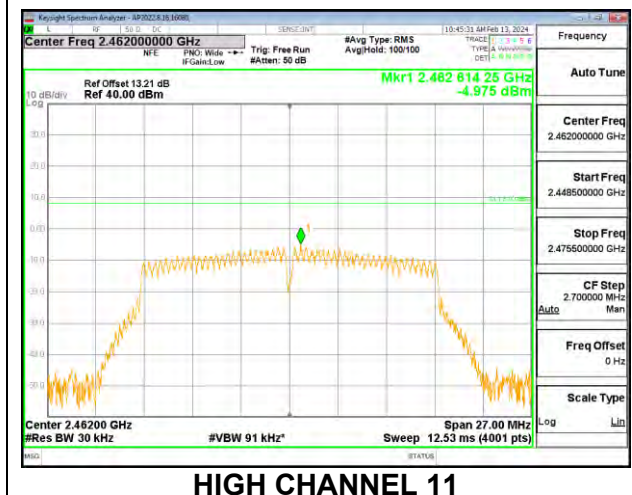
LOW CHANNEL 2



MID CHANNEL 6



HIGH CHANNEL 10



HIGH CHANNEL 11

### 9.5.3. 802.11n HT20 MODE

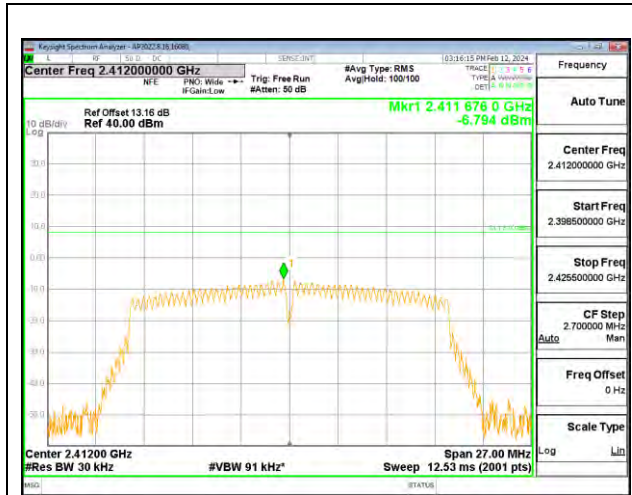
#### 4TX Antenna

Duty Cycle CF (dB)	0.58	Included in Calculations of Corr'd PSD
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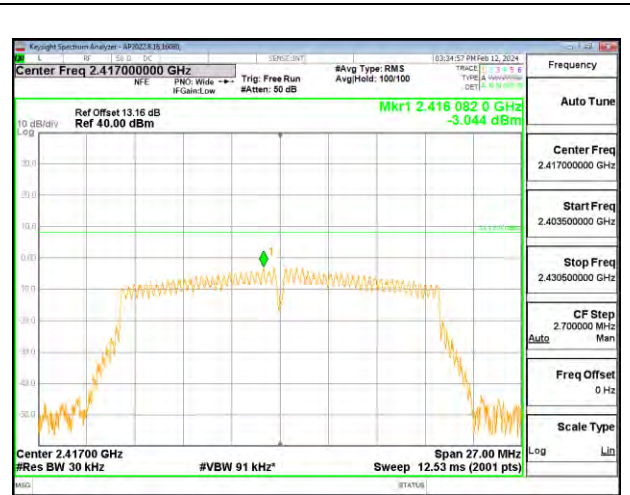
#### PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Chain 3 Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
CH_1	2412	-6.79	-7.36	-6.16	-6.00	0.06	6.85	-6.8
CH_2	2417	-3.04	-4.60	-3.16	-3.82	2.99	6.85	-3.9
CH_6	2437	-3.71	-4.01	-2.67	-2.09	3.55	6.85	-3.3
CH_9	2452	-3.59	-3.98	-2.31	-2.11	<b>3.68</b>	6.85	-3.2
CH_10	2457	-4.33	-4.39	-3.23	-3.13	2.87	6.85	-4.0
CH_11	2462	-6.77	-7.09	-5.97	-6.18	0.12	6.85	-6.7

Chain 0



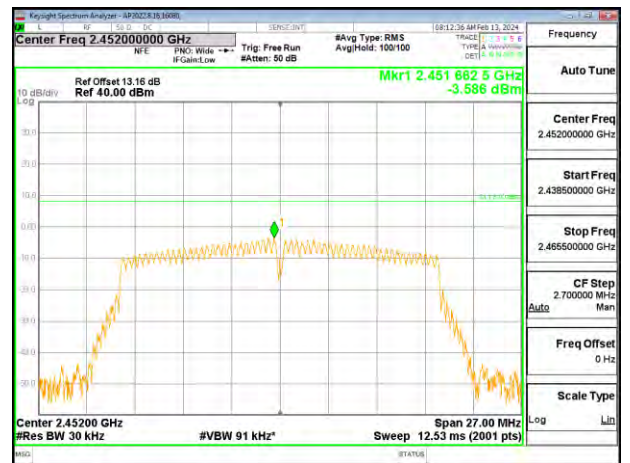
LOW CHANNEL 1



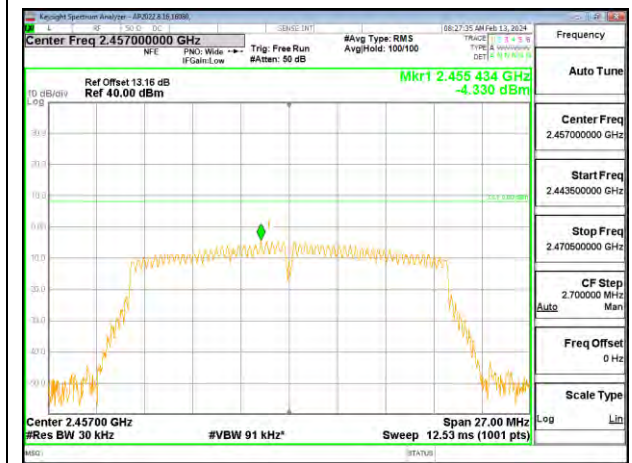
LOW CHANNEL 2



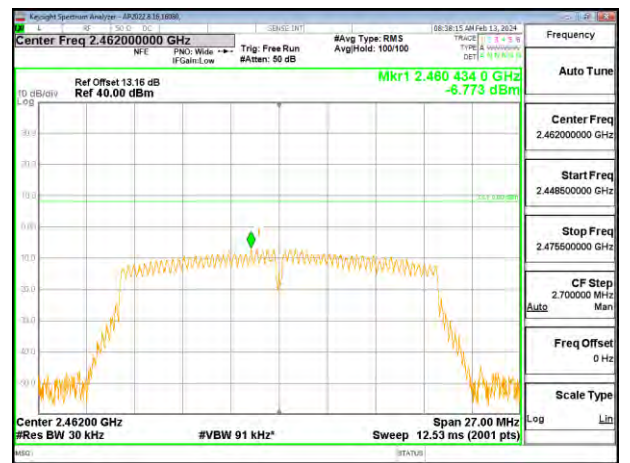
MID CHANNEL 6



HIGH CHANNEL 9

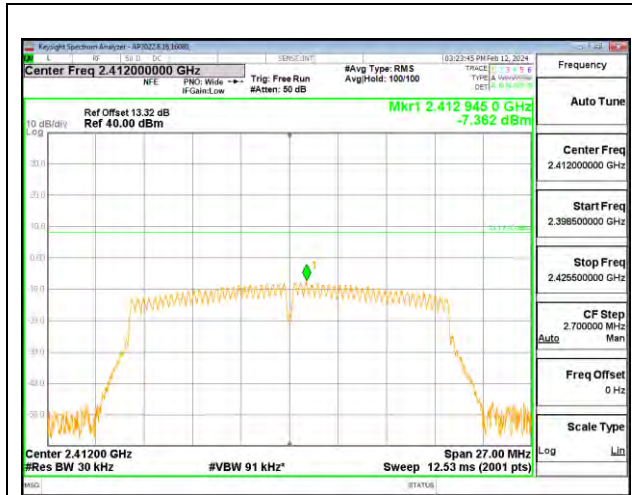


HIGH CHANNEL 10

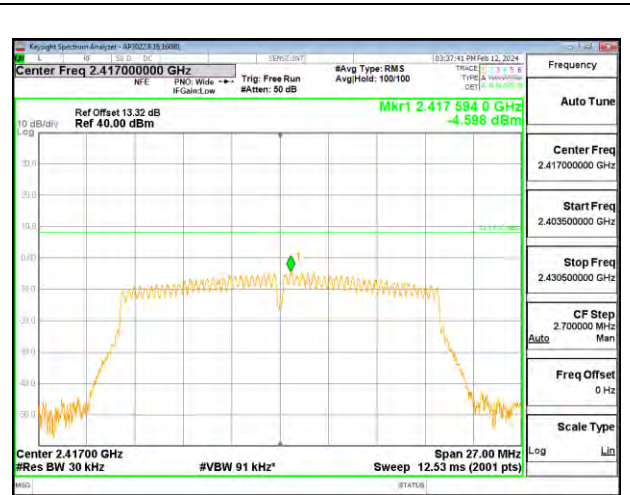


HIGH CHANNEL 11

Chain 1



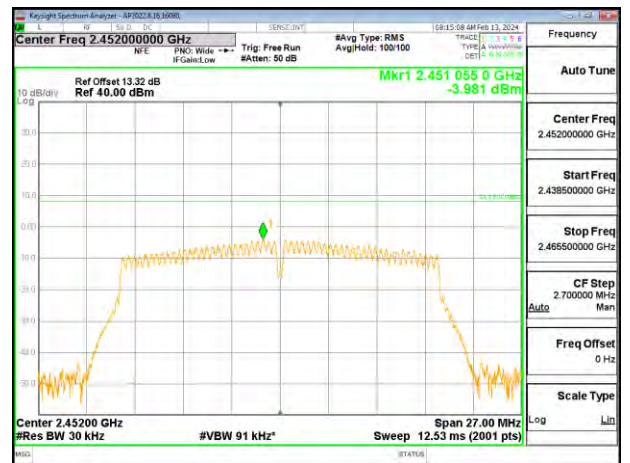
LOW CHANNEL 1



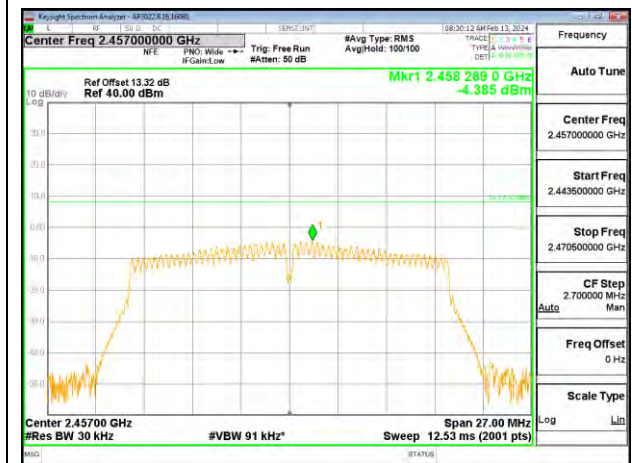
LOW CHANNEL 2



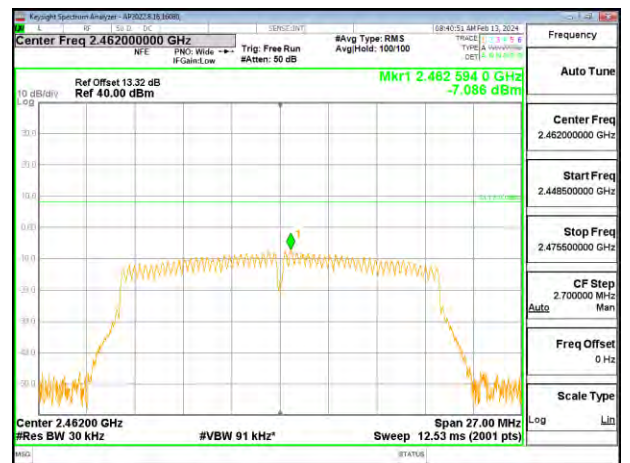
MID CHANNEL 6



HIGH CHANNEL 9

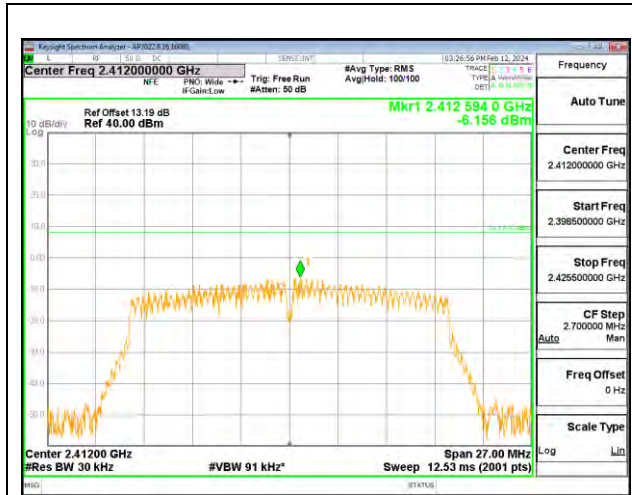


HIGH CHANNEL 10

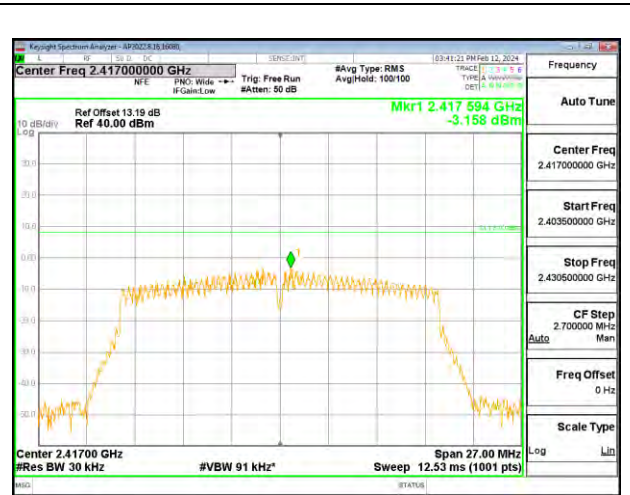


HIGH CHANNEL 11

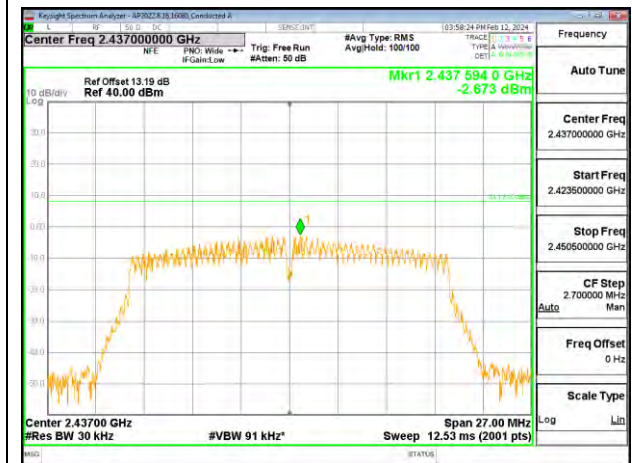
Chain 2



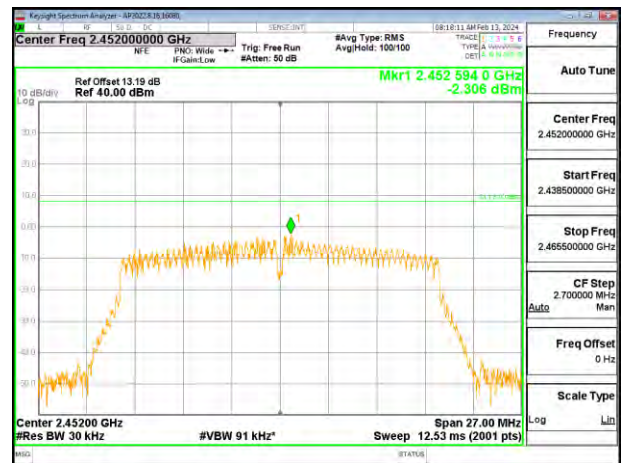
LOW CHANNEL 1



LOW CHANNEL 2



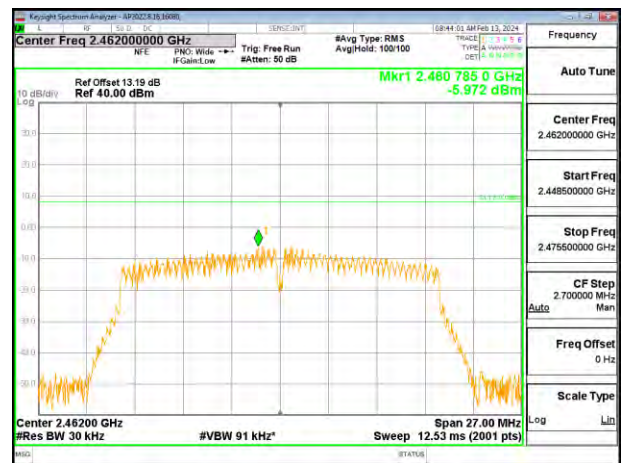
MID CHANNEL 6



HIGH CHANNEL 9

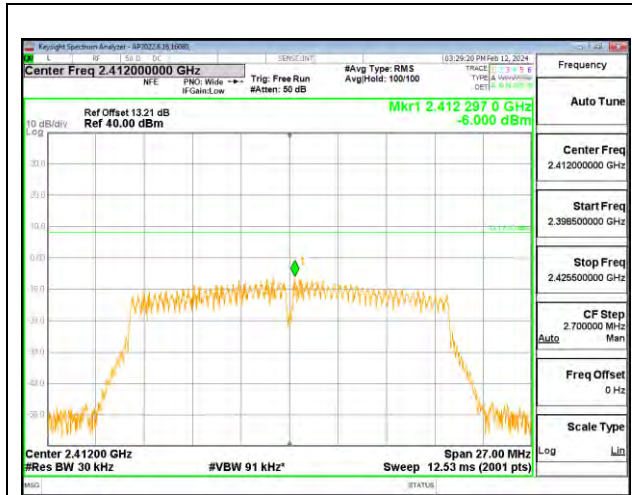


HIGH CHANNEL 10

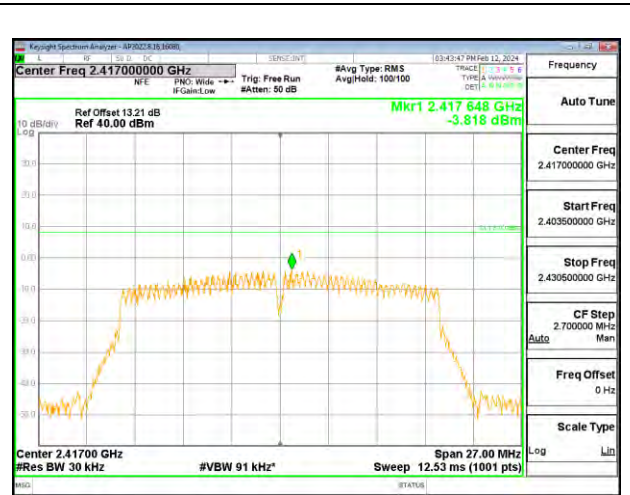


HIGH CHANNEL 11

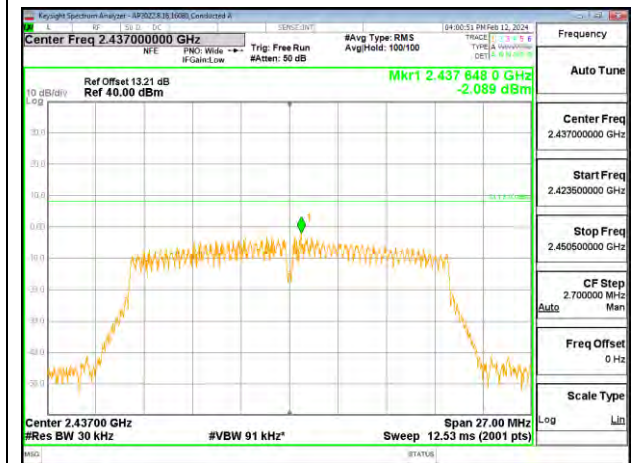
Chain 3



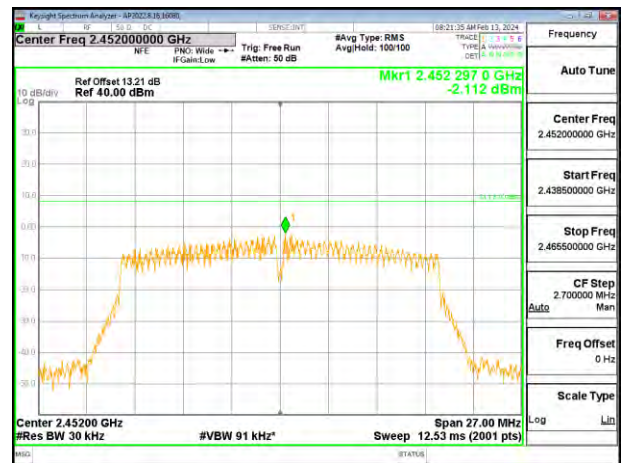
LOW CHANNEL 1



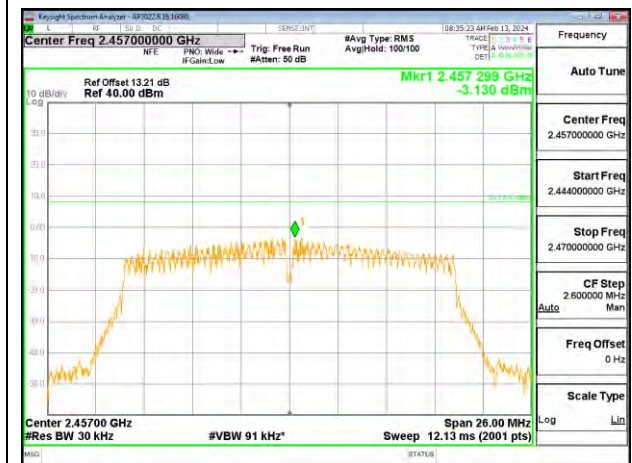
LOW CHANNEL 2



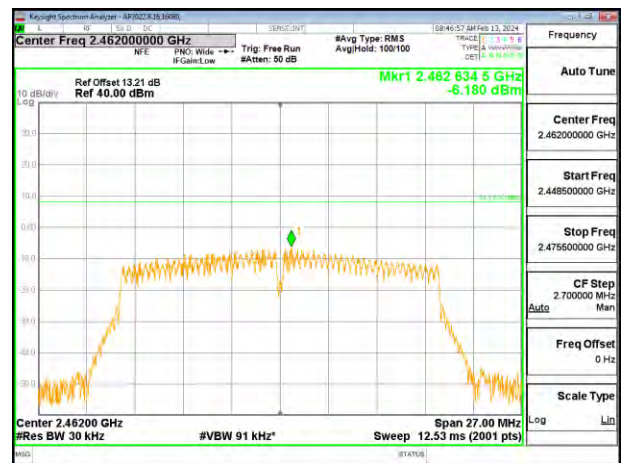
MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11



## **9.6. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

RSS-247 5.5

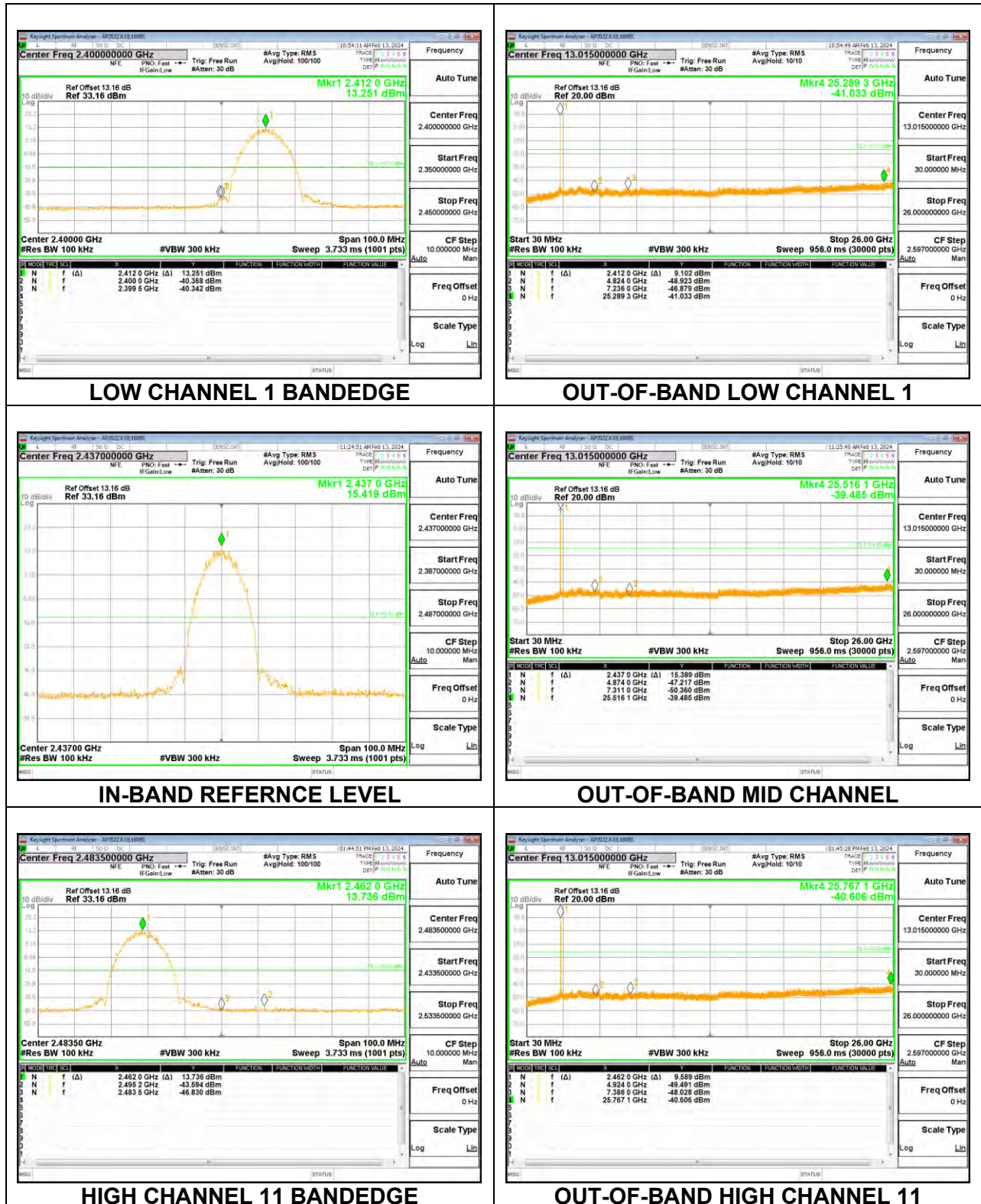
Output power was measured based on the use of a RMS averaging measurement; spurious emissions are required to be 30dBc.

### **RESULTS**

### 9.6.1. 802.11b MODE

#### 4TX Antenna

#### Chain 0



Chain 1

