

TEST REPORT

Product Name : Micro Inverter
Model Number : SUN-M65G5-US-Q1,
 SUN-M80G5-US-Q1,
 SUN-M100G5-US-Q1
FCC ID : 2AV6UMG5Q1

Prepared for : NingBo Deye Inverter Technology Co., Ltd.
Address : No. 26 South YongJiang Road, Daqi, Beilun, NingBo,
 Zhejiang, China

Prepared by : EMTEK (NINGBO) CO., LTD.
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Report Number : ENB2401220128W00101R
Date(s) of Tests : January 22, 2024 to March 08, 2024
Date of Issue : March 18, 2024

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1 TEST RESULT CERTIFICATION

Applicant : NingBo Deye Inverter Technology Co., Ltd.
Address : No. 26 South YongJiang Road, Daqi, Beilun, NingBo, Zhejiang, China
Manufacturer : NingBo Deye Inverter Technology Co., Ltd.
Address : No. 26 South YongJiang Road, Daqi, Beilun, NingBo, Zhejiang, China
EUT : Micro Inverter
Model Name : SUN-M65G5-US-Q1, SUN-M80G5-US-Q1, SUN-M100G5-US-Q1
Trademark : Deye

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 2, Subpart J	
FCC 47 CFR Part 15, Subpart C	PASS

The above equipment was tested by EMTEK (NINGBO) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.247

The test results of this report relate only to the tested sample identified in this report.

Date of Test : January 22, 2024 to March 08, 2024

Prepared by : June Gao
June Gao/Engineer

Reviewer : Vinay
Vinay/Supervisor

Approved & Authorized Signer : Tony Wei
Tony Wei/Manager

2 EUT TECHNICAL DESCRIPTION

Characteristics	Description
Product	Micro Inverter
Model Number	SUN-M65G5-US-Q1, SUN-M80G5-US-Q1, SUN-M100G5-US-Q1 Note: The PCB Layout and schematic design of the three models are the same. Through the difference of software limit power, we choose SUN-M100G5-US-Q1 with the highest power for RF test.
Sample Number	ENB2401220128W001-1-1
IEEE 802.11 WLAN Mode Supported	<input checked="" type="checkbox"/> 802.11b <input checked="" type="checkbox"/> 802.11g <input checked="" type="checkbox"/> 802.11n(20MHz channel bandwidth) <input checked="" type="checkbox"/> 802.11n(40MHz channel bandwidth)
Data Rate	802.11 b:1,2,5.5,11Mbps; 802.11 g:6,9,12,18,24,36,48,54Mbps; 802.11 n: MCS0~7, up to 150Mbps;
Modulation	DSSS with DBPSK/DQPSK/CCK for 802.11b; OFDM with BPSK/ CCK /16QAM/64QAM for 802.11g/n(HT20)/n(HT40);
Operating Frequency Range	<input checked="" type="checkbox"/> 2412-2462MHz for 802.11b/g/n(HT20); <input checked="" type="checkbox"/> 2422-2452MHz for 802.11n(HT40);
Number of Channels	<input checked="" type="checkbox"/> 11 channels for 802.11b/g n(HT20); <input checked="" type="checkbox"/> 7 Channels for 802.11n(HT40);
Transmit Power Max	16.64 dBm
Smart system	<input checked="" type="checkbox"/> SISO for 802.11 b/g/n(HT20)/n(HT40); <input type="checkbox"/> MIMO for 802.11n(HT20);
Antenna Type	External Antenna
Antenna Gain	1.52 dBi
Power supply	Input: DC 40-55/DC 42.5V, 30A Output: AC 240V, 60Hz, 4.6A, 1000W
Temperature Range	-40°C~+65°C
Date of Received	January 22, 2024

Note: for more details, please refer to the User's manual of the EUT.

3 SUMMARY OF TEST RESULT

FCC Part Clause	Test Parameter	Verdict	Remark
15.247(a)(2)	DTS (6dB) Bandwidth	PASS	
15.247(b)(3)	Maximum Peak Conducted Output Power	PASS	
15.247(e)	Maximum Power Spectral Density Level	PASS	
15.247(d)	Unwanted Emission Into Non-Restricted Frequency Bands	PASS	
15.247(d) 15.209	Unwanted Emission Into Restricted Frequency Bands (conducted)	PASS	
15.247(d) 15.209	Radiated Spurious Emission	PASS	
15.207	Conducted Emission Test	PASS	
15.247(b)	Antenna Application	PASS	
	NOTE1:N/A (Not Applicable) NOTE2: According to FCC OET KDB 558074, the report use radiated measurements in the restricted frequency bands. In addition, the radiated test is also performed to ensure the emissions emanating from the device cabinet also comply with the applicable limits.		

RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: 2AV6UMG5Q1 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules

4 TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:
 FCC 47 CFR Part 2, Subpart J
 FCC 47 CFR Part 15, Subpart C
 FCC KDB 558074 D01 15.247 Meas Guidance v05r02

4.2 MEASUREMENT EQUIPMENT USED

4.2.1 Conducted Emission Test Equipment

Equ.No.	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
ENE-002	EMI Test Receiver	R & S	ESCI	101107	July 06, 2023	1 Year
ENE-158	L.I.S.N	Schwarzbeck	NNLK 8129	0373	Nov 17, 2023	1 Year
ENE-004	L.I.S.N	Schwarzbeck	NSLK 8126	8126-462	July 06, 2023	1 Year
ENE-162-1	RF Cable	TIMES	2M(N-N)	605236-0001	May 31, 2023	1 Year
ENE-070	Pulse Limiter	Schwarzbeck	VTSD 9561F-N	00525	Mar 15, 2023	1 Year
ENE-150	Conduction Test Room 2#	SKET	6.5*5*4m	/	Apr 17, 2023	3 Year

4.2.2 Radiated Emission Test Equipment

Equ.No.	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
ENE-185	EMI Test Receiver	R&S	ESR7	102480	Apr 28, 2023	1 Year
ENE-190	Antenna Multiple	Schwarzbeck	VULB 9163	01499	May 21, 2022	2 Year
ENE-195	Pre-Amplifier	JS Denki	PA09K03-40	JSPA21019	Apr 28, 2023	1 Year
ENE-204	Low Frequency Notch Filter RF Switching	JS Denki	JSDSW-F	JSDSW2211D 02	Apr 28, 2023	1 Year
ENE-251	6dB Attenuator	Mini-Circuits	UNAT-6+	11542	July 06, 2023	1 Year
ENE-279-1	RF Cable	Rosenberger	L17-C001-7000	/	May 31, 2023	1 Year
ENE-279-2	RF Cable	Rosenberger	L17-C001-3500	/	May 31, 2023	1 Year
ENE-279-3	RF Cable	Rosenberger	L17-C001-1500	/	May 31, 2023	1 Year
ENE-279-4	RF Cable	Rosenberger	/	/	May 31, 2023	1 Year
ENE-279-5	RF Cable	Rosenberger	/	/	May 31, 2023	1 Year
ENE-279-6	RF Cable	Rosenberger	L08-C446-1500	/	May 31, 2023	1 Year
ENE-144	3-Meter Anechoic Chamber2#	SKET	9*6*6m	/	June 19, 2022	3 Year
ENE-171	EXA Signal Analyzer	KEYSIGHT	N9010B	MY60242467	Dec 14, 2023	1 Year
ENE-191	Horn Antenna	Schwarzbeck	BBHA 9120 D	02588	May 21, 2022	2 Year

ENE-198	Pre-Amplifier	JS Denki	PA0118-50	JSPA21022	Apr 28, 2023	1 Year
ENE-281-1	RF Cable	Rosenberger	LA2-C125-3500	/	May 31, 2023	1 Year
ENE-281-2	RF Cable	Rosenberger	LA2-C125-1500	/	May 31, 2023	1 Year
ENE-281-3	RF Cable	Rosenberger	LU7-C1511-1200	/	May 31, 2023	1 Year
ENE-285-1	RF Cable	Rosenberger	LA2-C199-6500	/	May 31, 2023	1 Year
ENE-206	High Frequency Notch FilterRf Switching	JS Denki	JSDSW-F	202083582	Apr 28, 2023	1 Year

4.2.3 Radio Frequency Test Equipment

Equ. No.	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
ENE-256	EXA Signal Analyzer	Keysight	N9010B	MY62060219	July 05, 2023	1 Year
ENE-172	RF Control Unit	Tonscend	JS0806-2(V.6E)	21L8060521	March 01, 2023	1 Year
ENE-172	RF Control Unit	Tonscend	JS0806-2(V.6E)	21L8060521	Feb 27, 2024	1 Year
ENE-092	DC Power Supply	KEFUNA	KDP3603	2004D3062946	July 07, 2023	1 Year

Note: The ENE-172 was calibrated on February 27, 2024, and was not tested on that date.

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (802.11b: 1 Mbps; 802.11g: 6 Mbps; 802.11n(HT20): MCS0; 802.11n(HT40): MCS0) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for 802.11b/g/n (HT20):

Channel	Frequency	Channel	Frequency	Channel	Frequency
	(MHz)		(MHz)		(MHz)
1	2412	6	2437	11	2462
2	2417	7	2442		
3	2422	8	2447		
4	2427	9	2452		
5	2432	10	2457		

Frequency and Channel list for 802.11n (HT40):

Channel	Frequency	Channel	Frequency	Channel	Frequency
	(MHz)		(MHz)		(MHz)
3	2422	6	2437	9	2452
4	2427	7	2442		
5	2432	8	2447		

Test Frequency and Channel for 802.11b/g/n (HT20):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	6	2437	11	2462

Test Frequency and Channel for 802.11n (HT40):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	6	2437	9	2452

4.4 TEST SOFTWARE

Item	Software
Radiated Emission:	EspRFTestTool_v2.8_Manuall (V 2.8)
Conducted Emission	EspRFTestTool_v2.8_Manuall (V 2.8)



5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

No. 8, Building 8, Lane 216, Qingyi Road, Ningbo Hi-Tech Zone, Ningbo, Zhejiang, China
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 32.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab.

: Accredited by CNAS

The Certificate Registration Number is L6666.

The Laboratory has been assessed and proved to be in compliance with
CNAS-CL01:2018 (identical to ISO/IEC 17025:2017)

Designation by FCC

Designation Number: CN1354

Test Firm Registration Number: 427606

Accredited by A2LA

The Certificate Number is 4321.03.

The certificate is valid until May 31, 2025

Designation by Industry Canada

The Conformity Assessment Body Identifier is CN0114

Name of Firm

Site Location

: EMTEK (NINGBO) CO., LTD.

: No. 8, Building 8, Lane 216, Qingyi Road, Hi-Tech Zone, Ningbo,
Zhejiang, China

6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

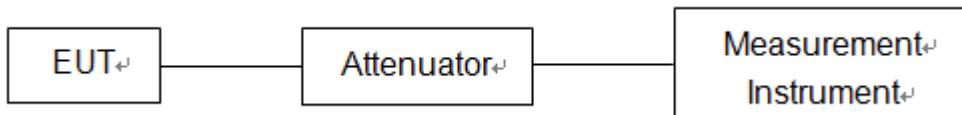
Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Maximum Peak Output Power Test	± 1.0 dB
Conducted Emissions Test	± 2.0 dB
Radiated Emission Test	± 2.0 dB
Power Density	± 2.0 dB
Occupied Bandwidth Test	± 1.0 dB
Band Edge Test	± 3 dB
All emission, radiated	± 3 dB
Antenna Port Emission	± 3 dB
Temperature	± 0.5 °C
Humidity	± 3 %

Measurement Uncertainty for a level of Confidence of 95%

7 SETUP OF EQUIPMENT UNDER TEST

7.1 RADIO FREQUENCY TEST SETUP 1

The WLAN component's antenna port(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



7.2 RADIO FREQUENCY TEST SETUP 2

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

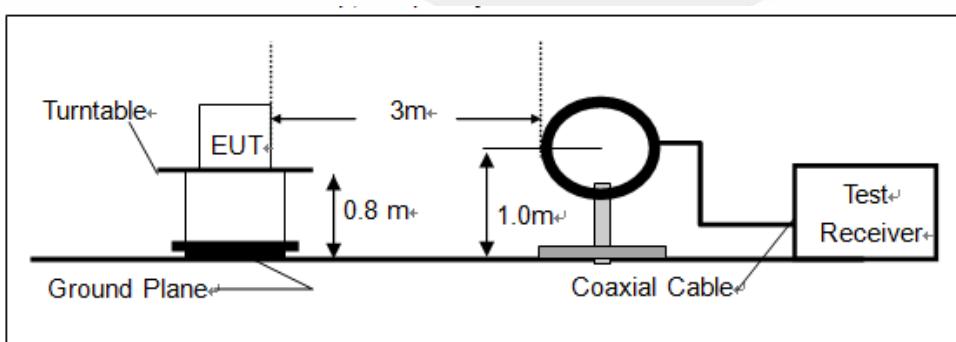
30MHz-1GHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

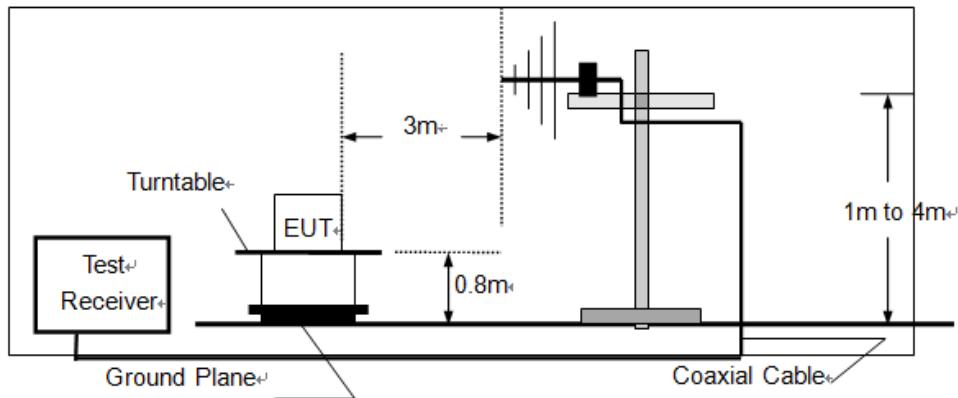
Above 1GHz:

The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

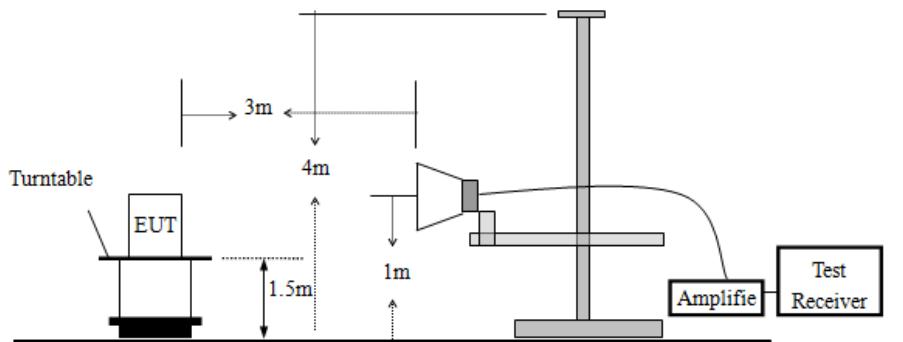
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

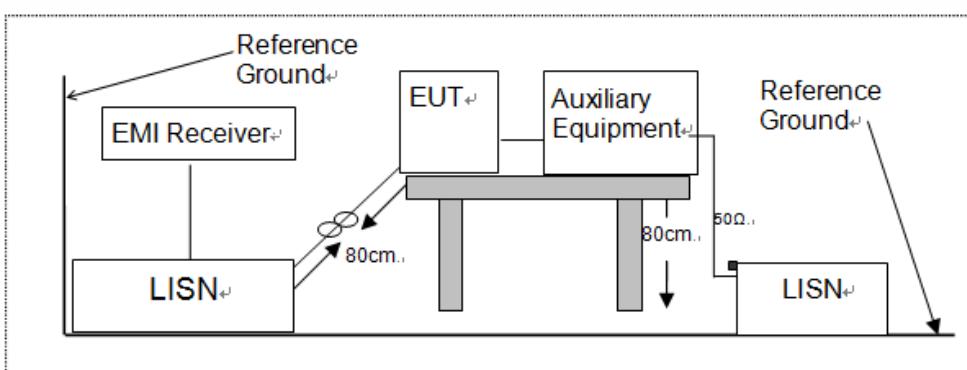


7.3 CONDUCTED EMISSION TEST SETUP

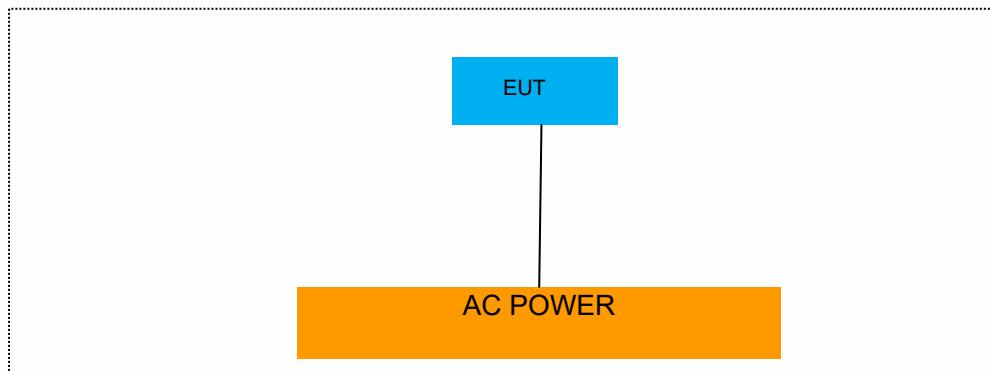
The mains cable of the EUT (maybe per AC/DC Adapter) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



7.4 BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM



7.5 SUPPORT EQUIPMENT

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. Unless otherwise denoted as EUT in **【Remark】** column , device(s) used in tested system is a support equipment

8 TEST REQUIREMENTS

8.1 DTS (6DB) BANDWIDTH

8.1.1 Applicable Standard

According to FCC Part15.247 (a)(2) and KDB 558074 D01 15.247 Meas Guidance v05r02

8.1.2 Conformance Limit

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

8.1.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.1.4 Test Procedure

The EUT was operating in IEEE 802.11b/g/n mode and controlled its channel. Printed out the test result from the spectrum by hard copy function.

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously

Set RBW = 100 kHz.

Set the video bandwidth (VBW) =300kHz.

Set Span=2 times OBW

Set Detector = Peak.

Set Trace mode = max hold.

Set Sweep = auto couple.

Allow the trace to stabilize.

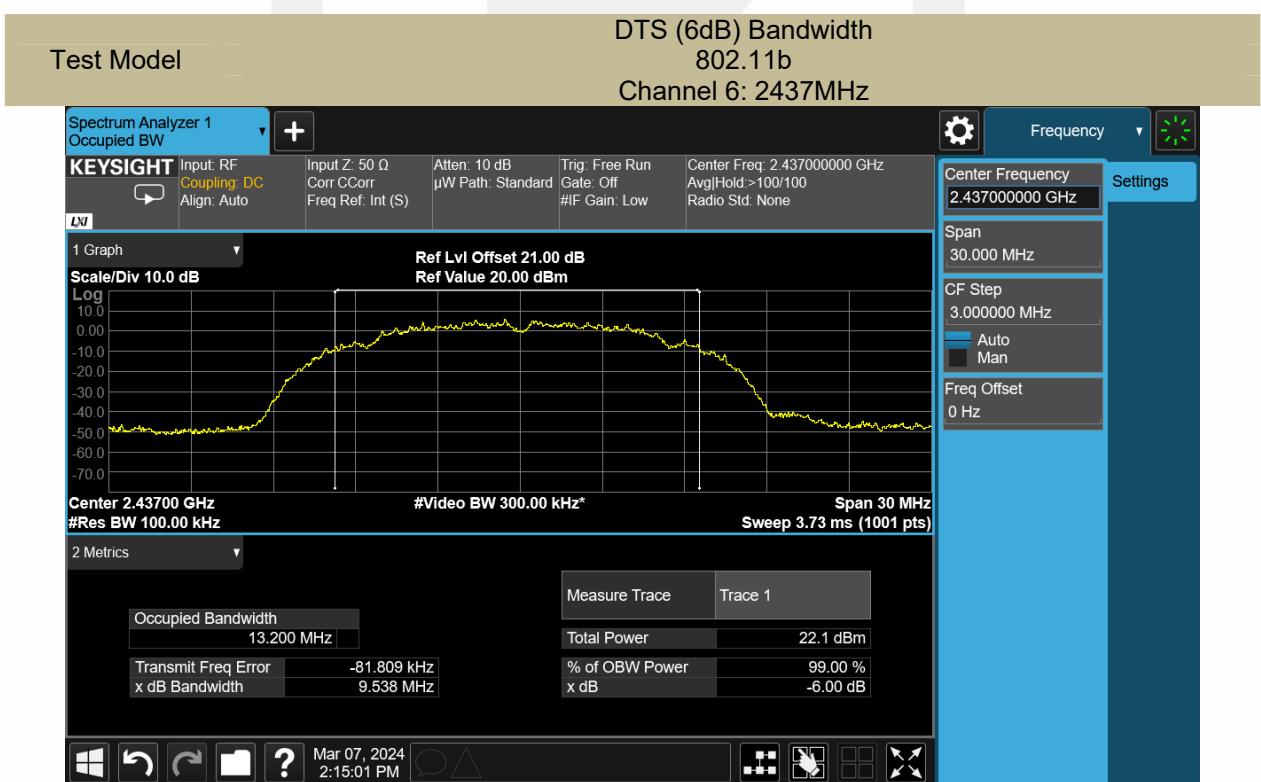
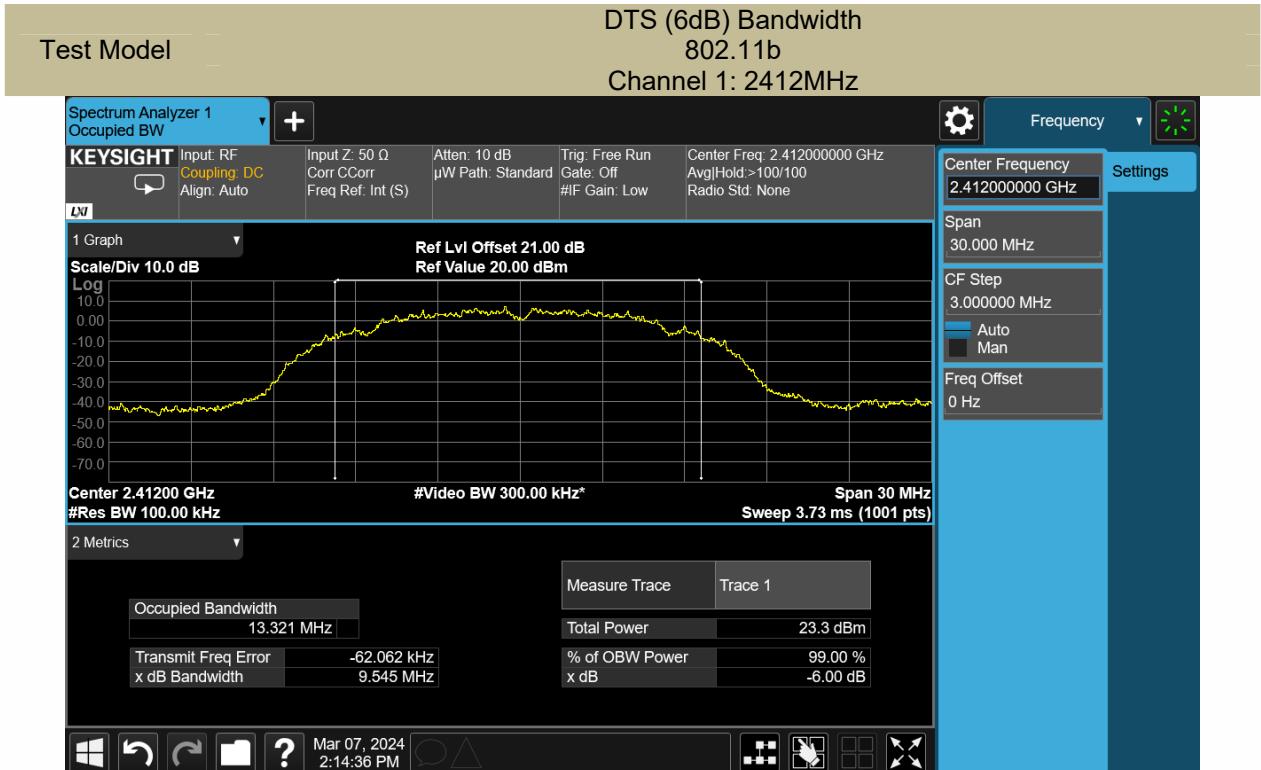
Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

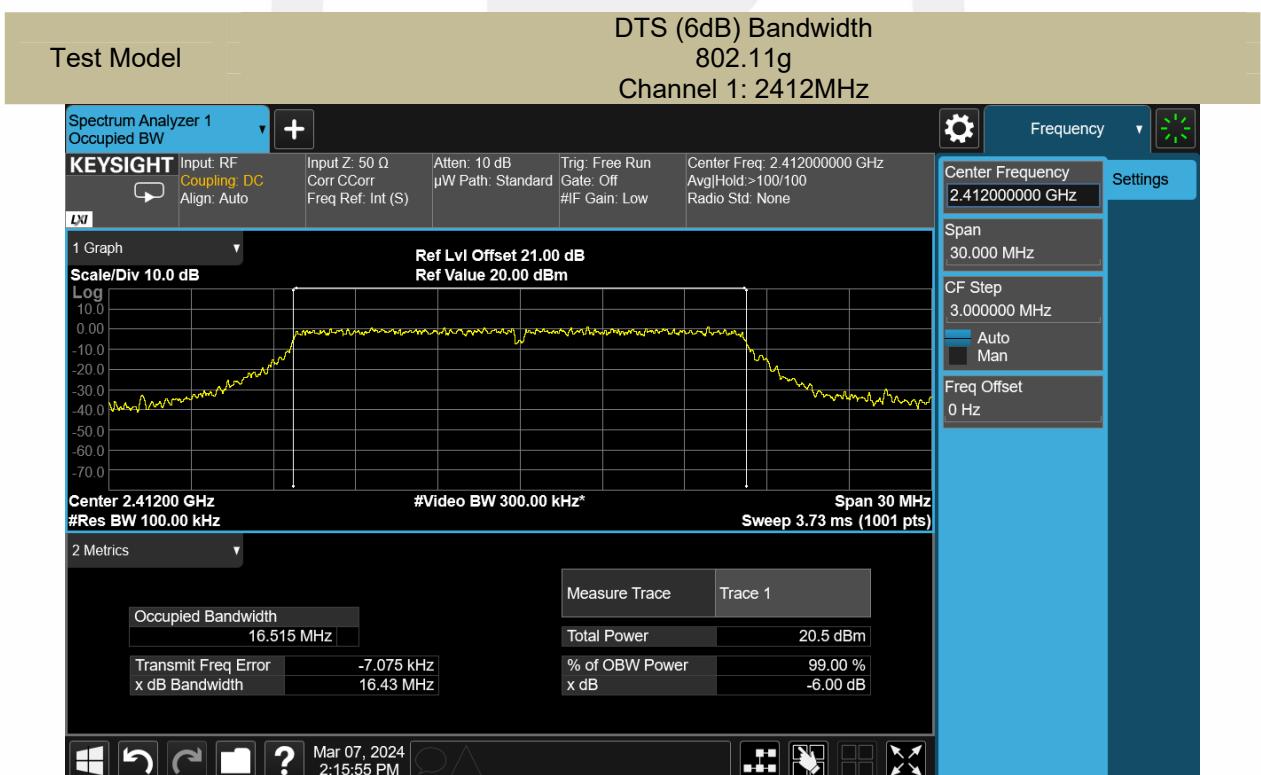
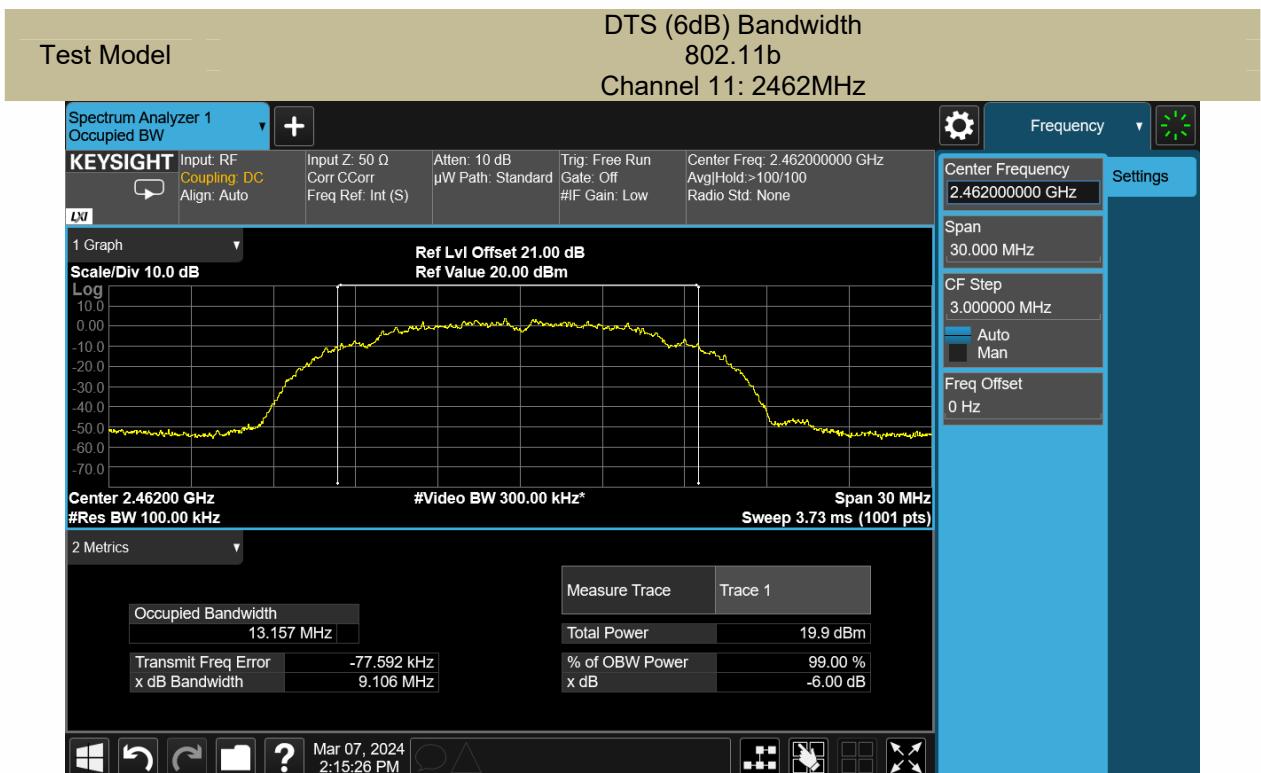
Measure and record the results in the test report.

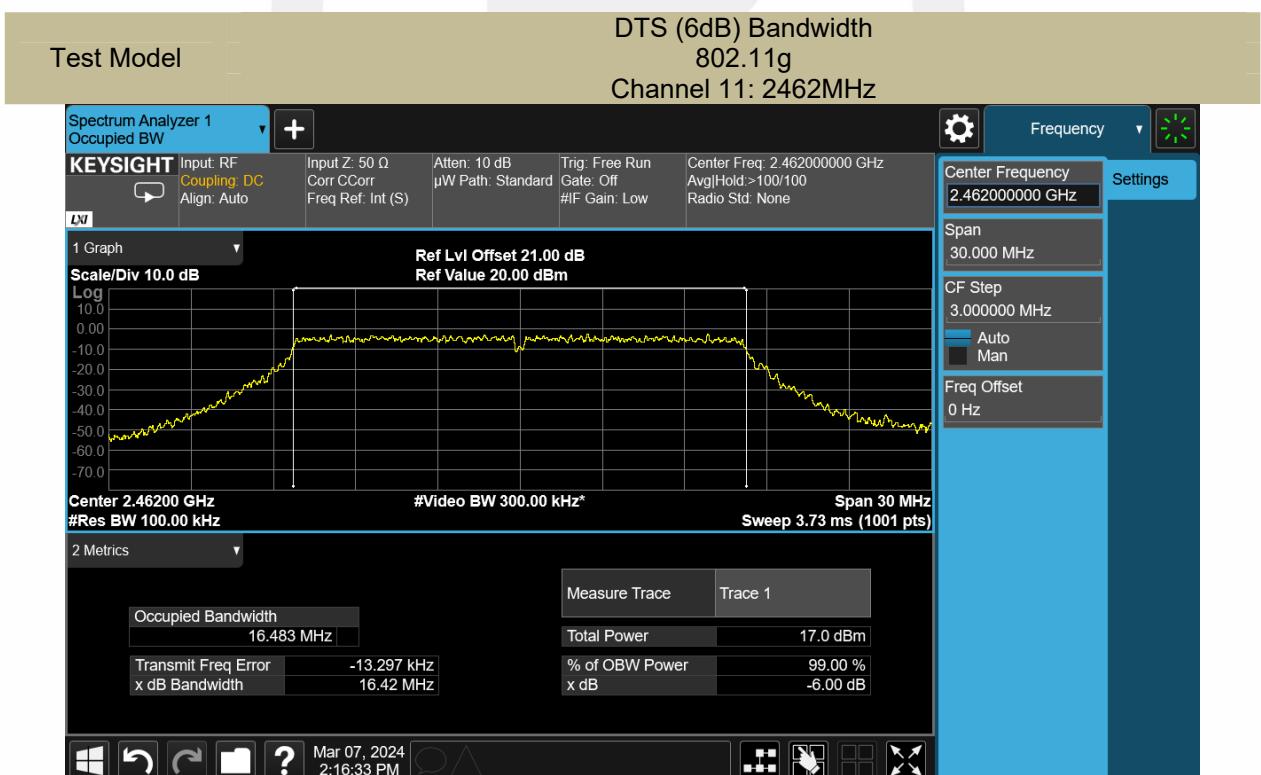
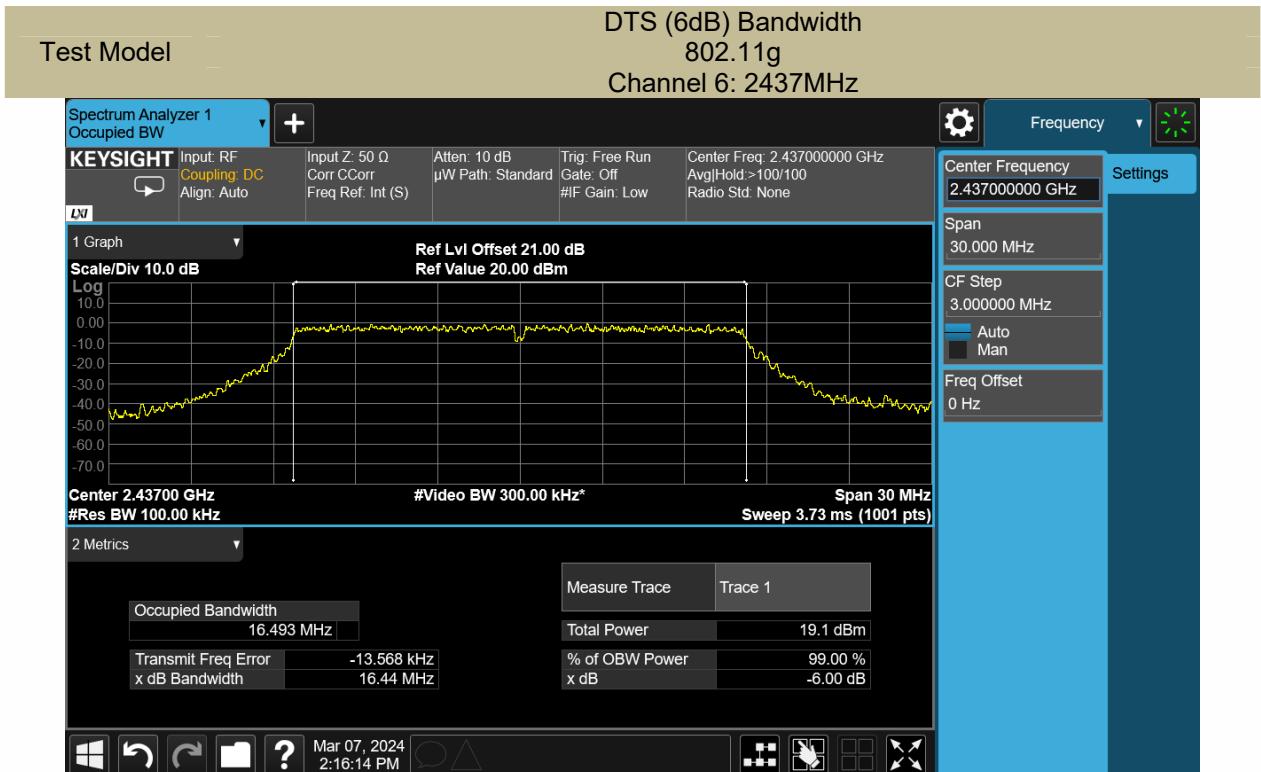
8.1.5 Test Results

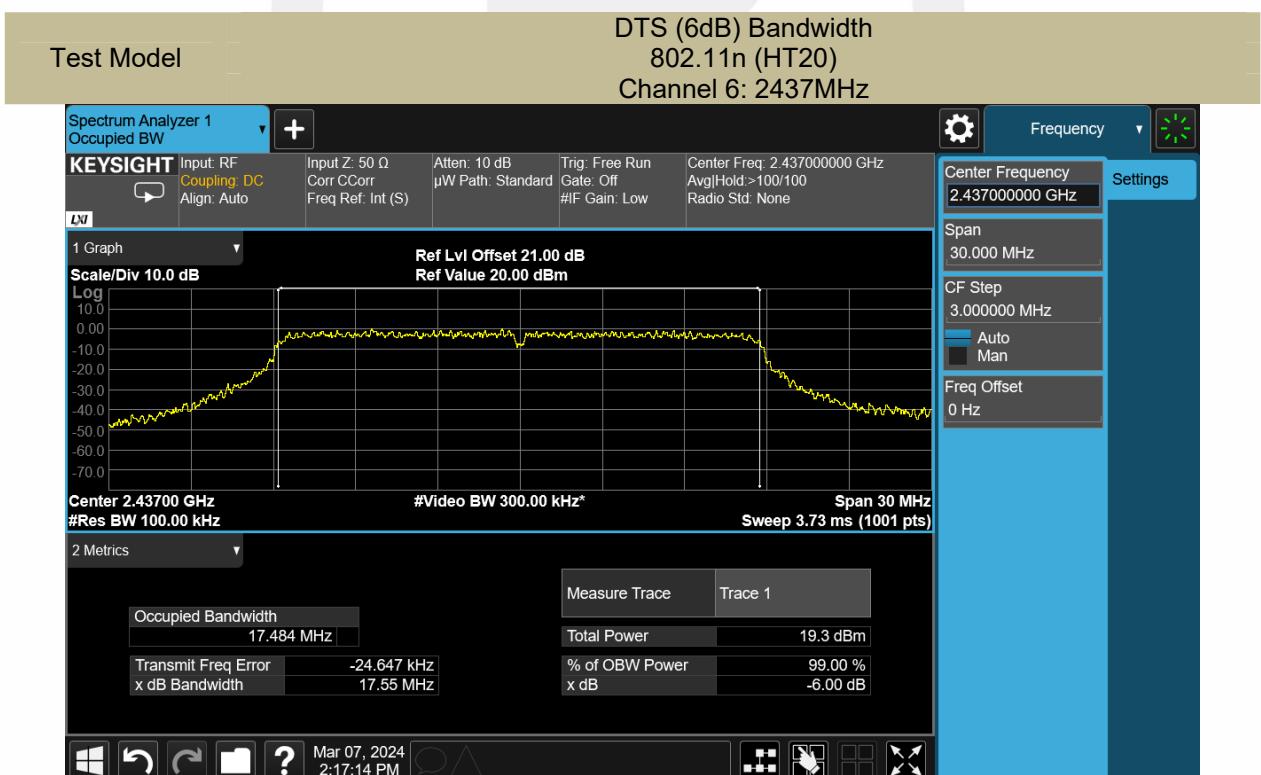
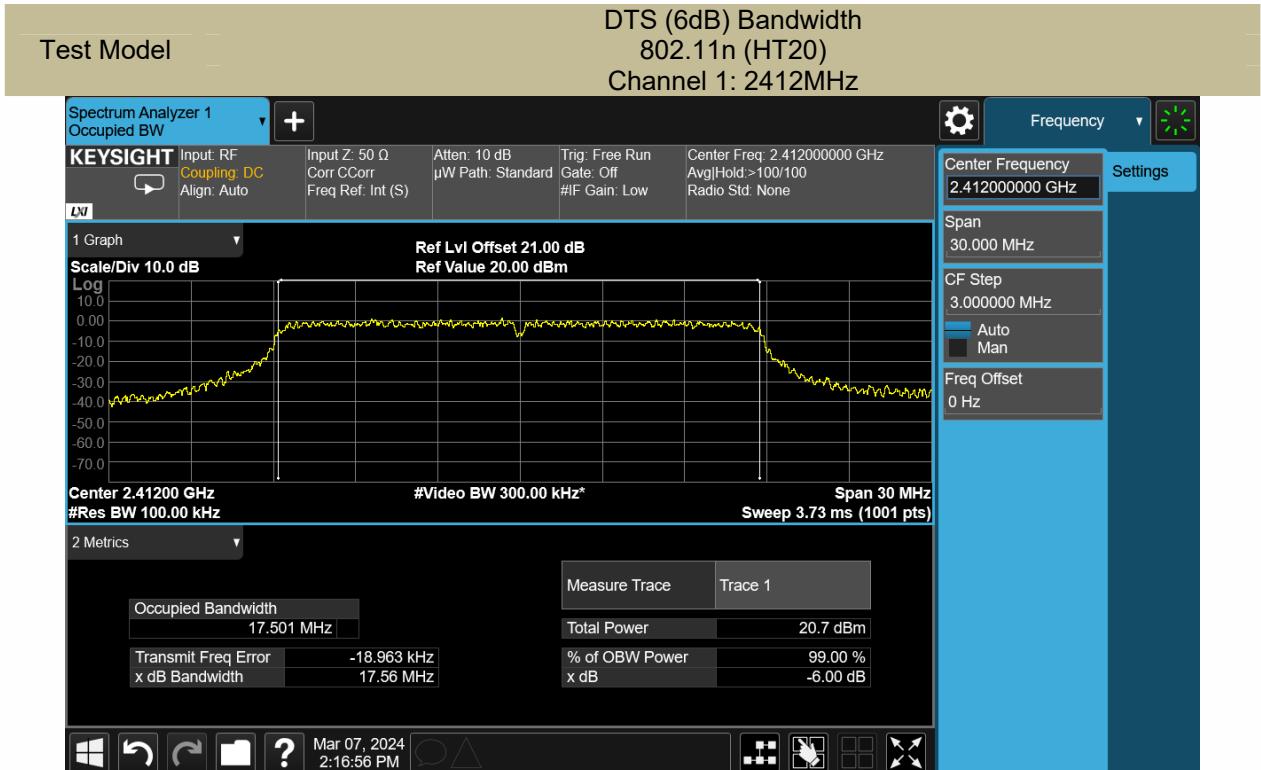
Temperature:	16°C
Relative Humidity:	48%
ATM Pressure:	1011 mbar

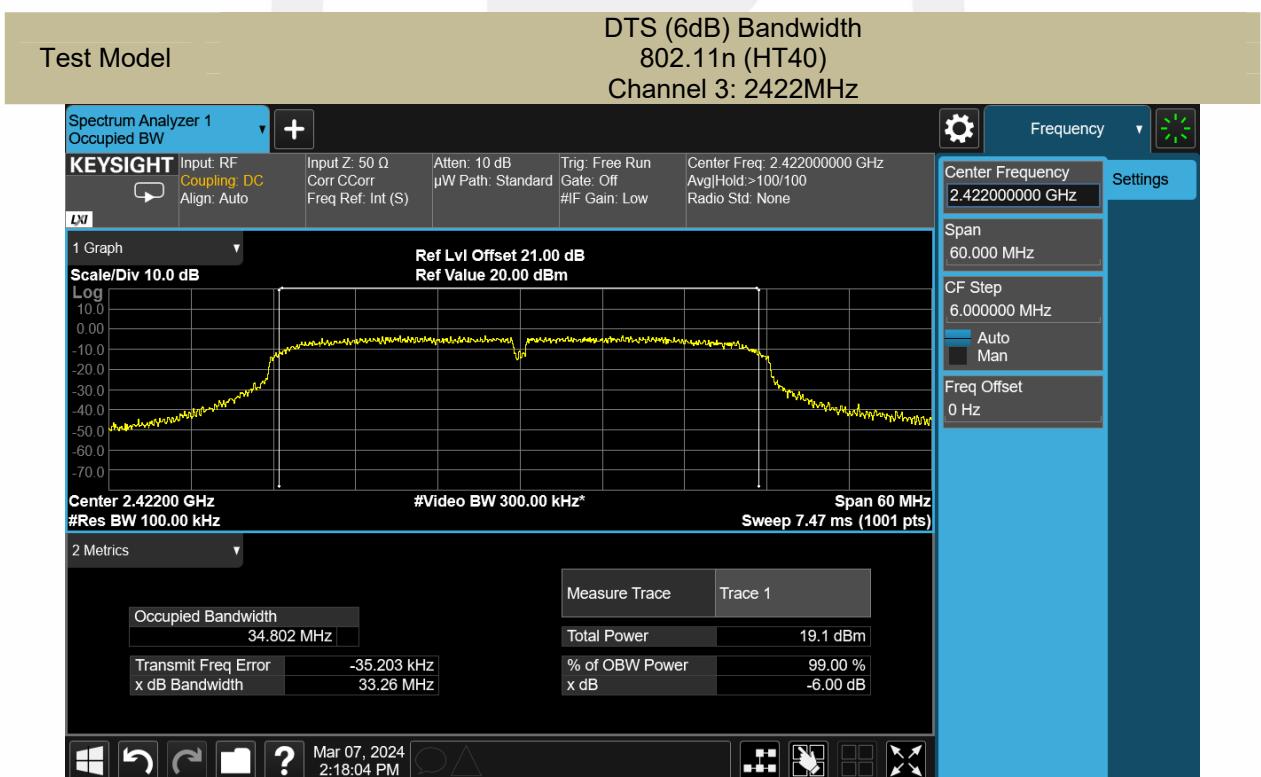
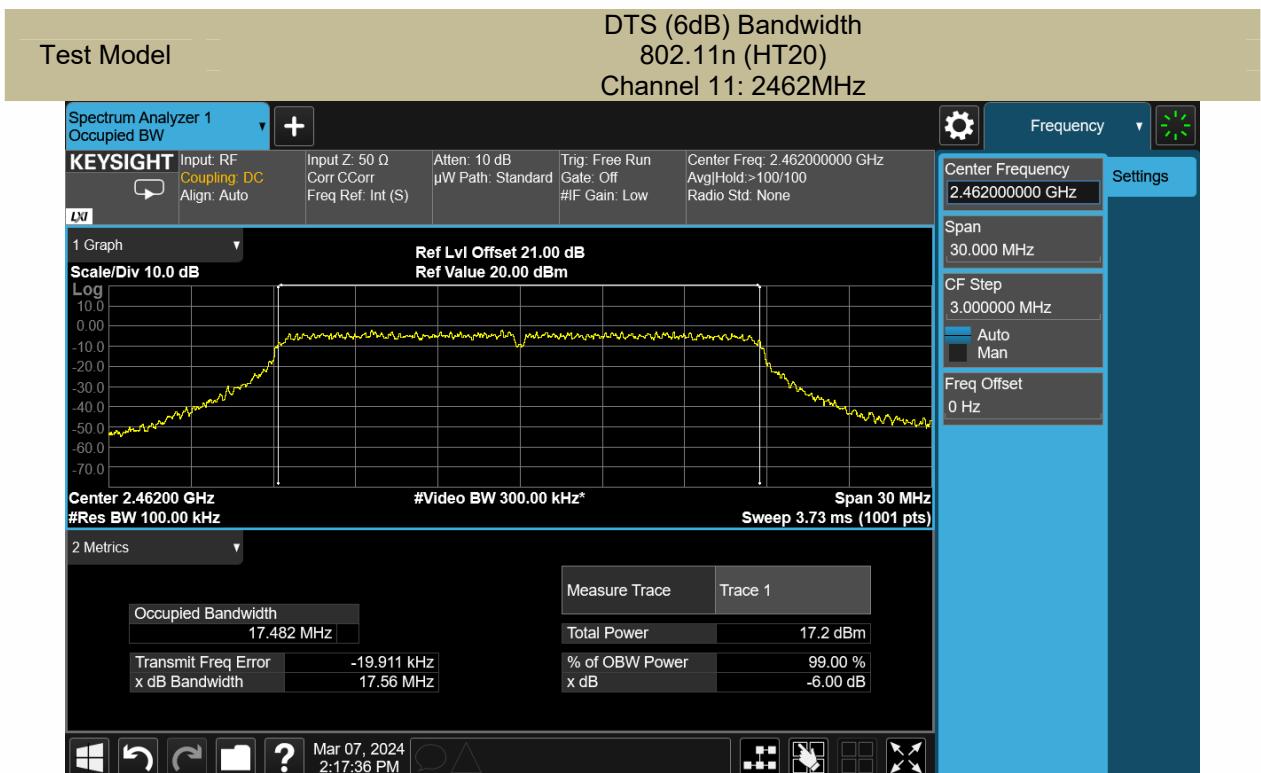
Operation Mode	Channel Number	Channel Frequency (MHz)	Measurement Bandwidth (MHz)	Limit (kHz)	Verdict
802.11b	1	2412	9.545	>500	PASS
	6	2437	9.538	>500	PASS
	11	2462	9.106	>500	PASS
802.11g	1	2412	16.430	>500	PASS
	6	2437	16.440	>500	PASS
	11	2462	16.420	>500	PASS
802.11n (HT20)	1	2412	17.560	>500	PASS
	6	2437	17.550	>500	PASS
	11	2462	17.560	>500	PASS
802.11n (HT40)	3	2422	33.260	>500	PASS
	6	2437	33.450	>500	PASS
	9	2452	33.590	>500	PASS

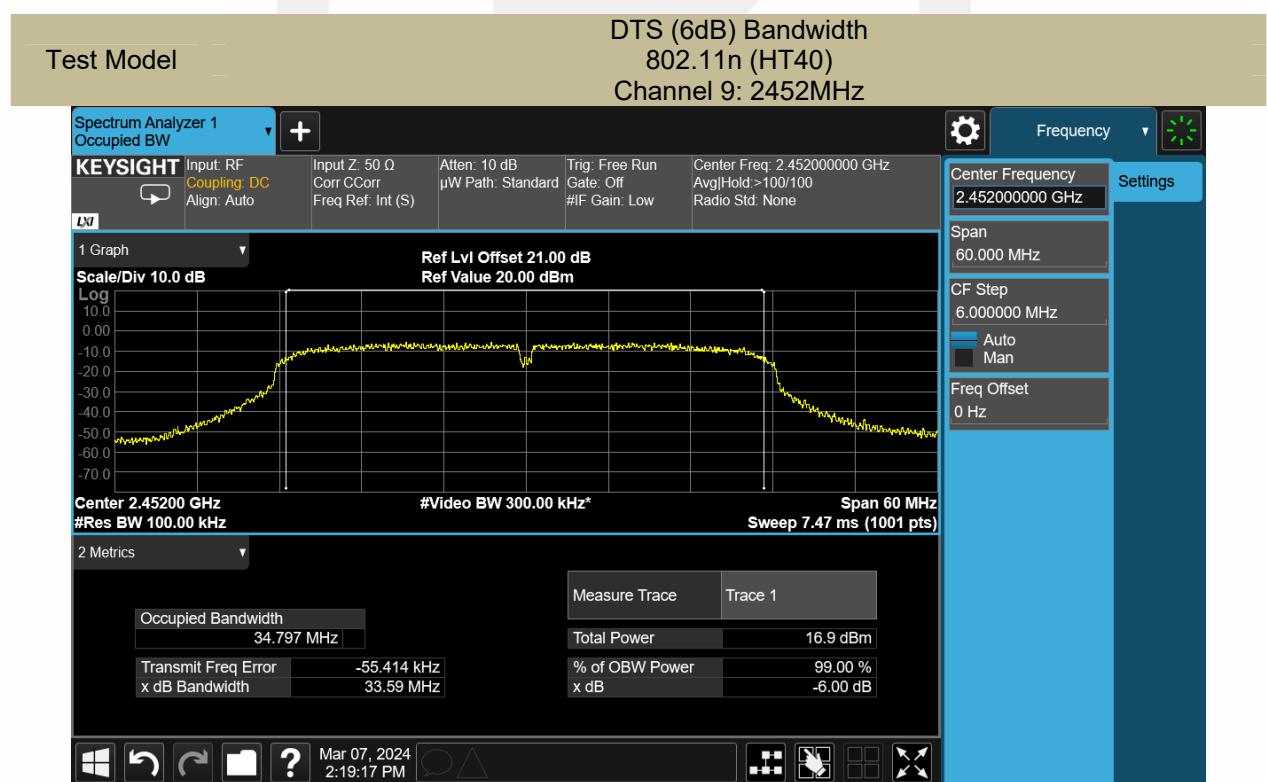
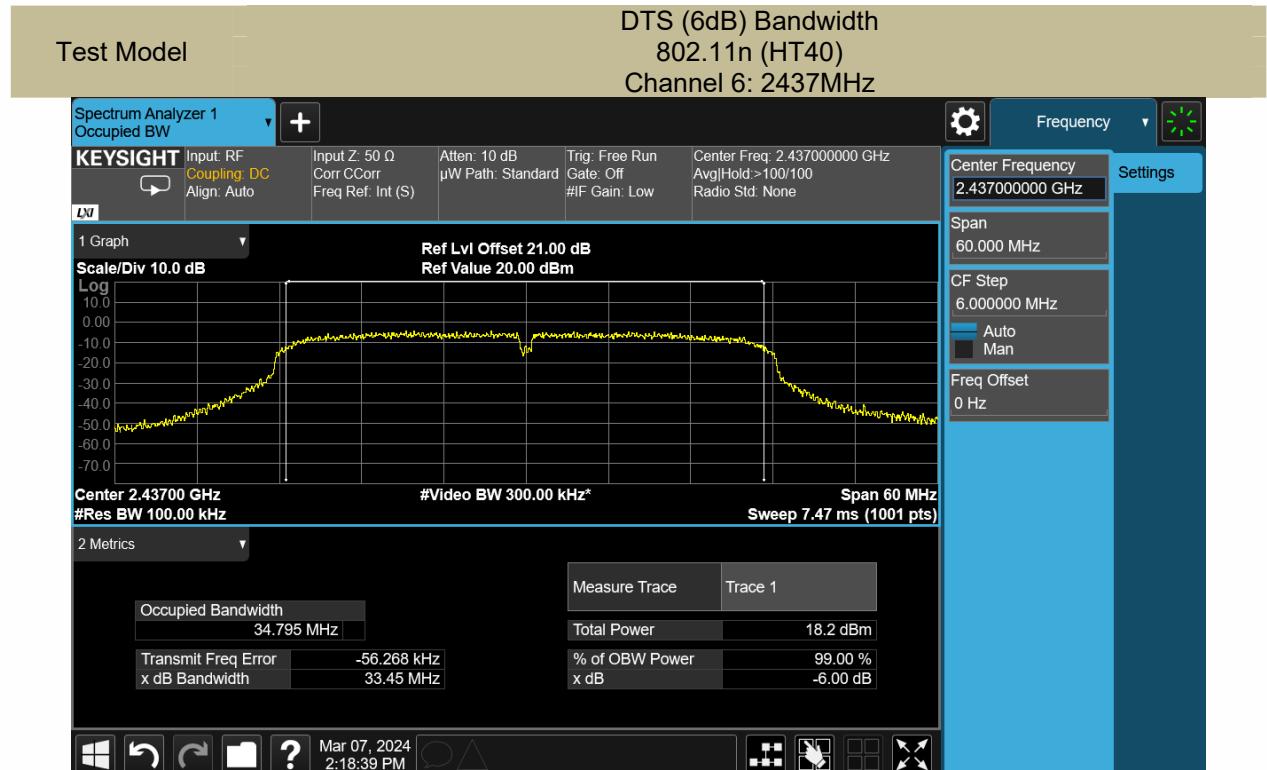












8.2 MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER

8.2.1 Applicable Standard

According to FCC Part15.247 (b)(3) and KDB 558074 D01 15.247 Meas Guidance v05r02

8.2.2 Conformance Limit

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 2400 - 2483.5 MHz bands shall not exceed: 1 Watt (30dBm).

8.2.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

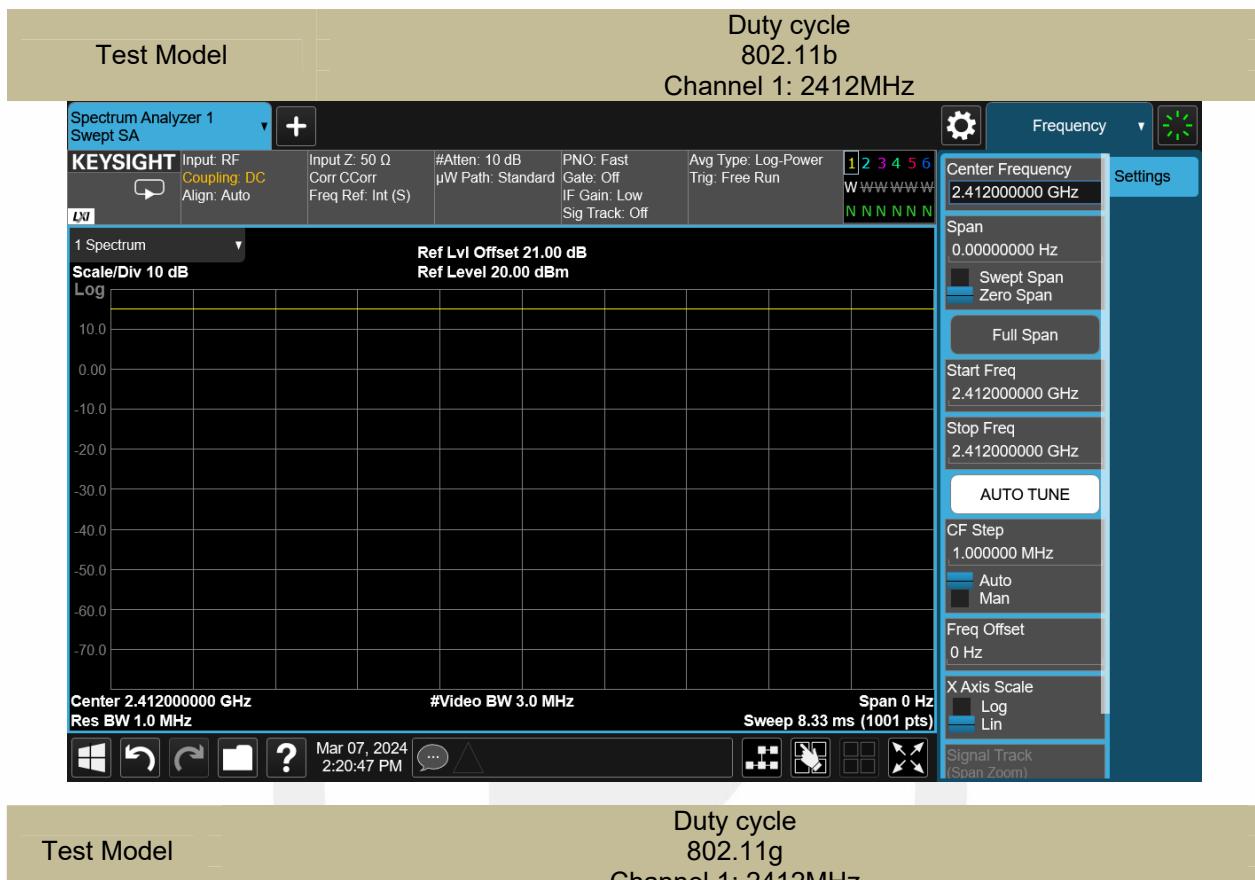
8.2.4 Test Procedure

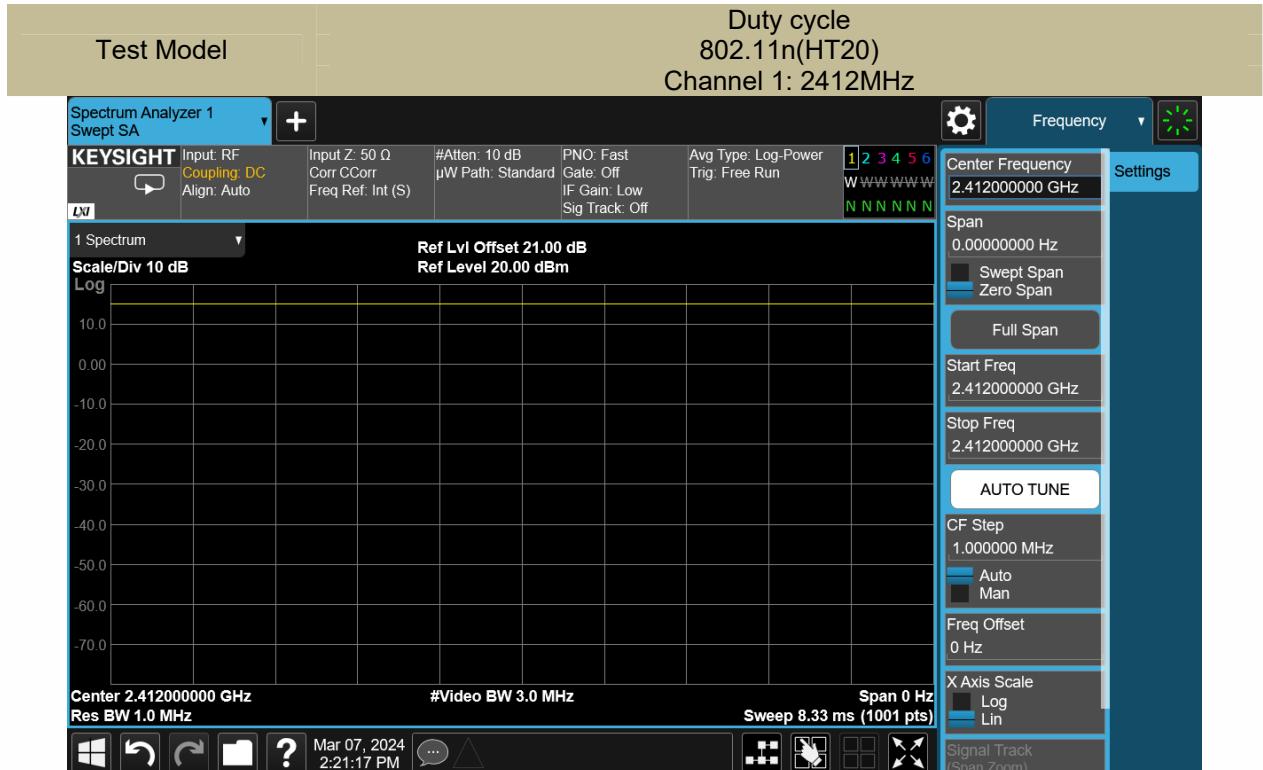
- a) Set span to at least 1.5 times the OBW.
- b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing \leq RBW/2, so that narrowband signals are not lost between frequency bins.)
- e) Sweep time = auto.
- f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- g) If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run” .
- h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

8.2.5 Test Results

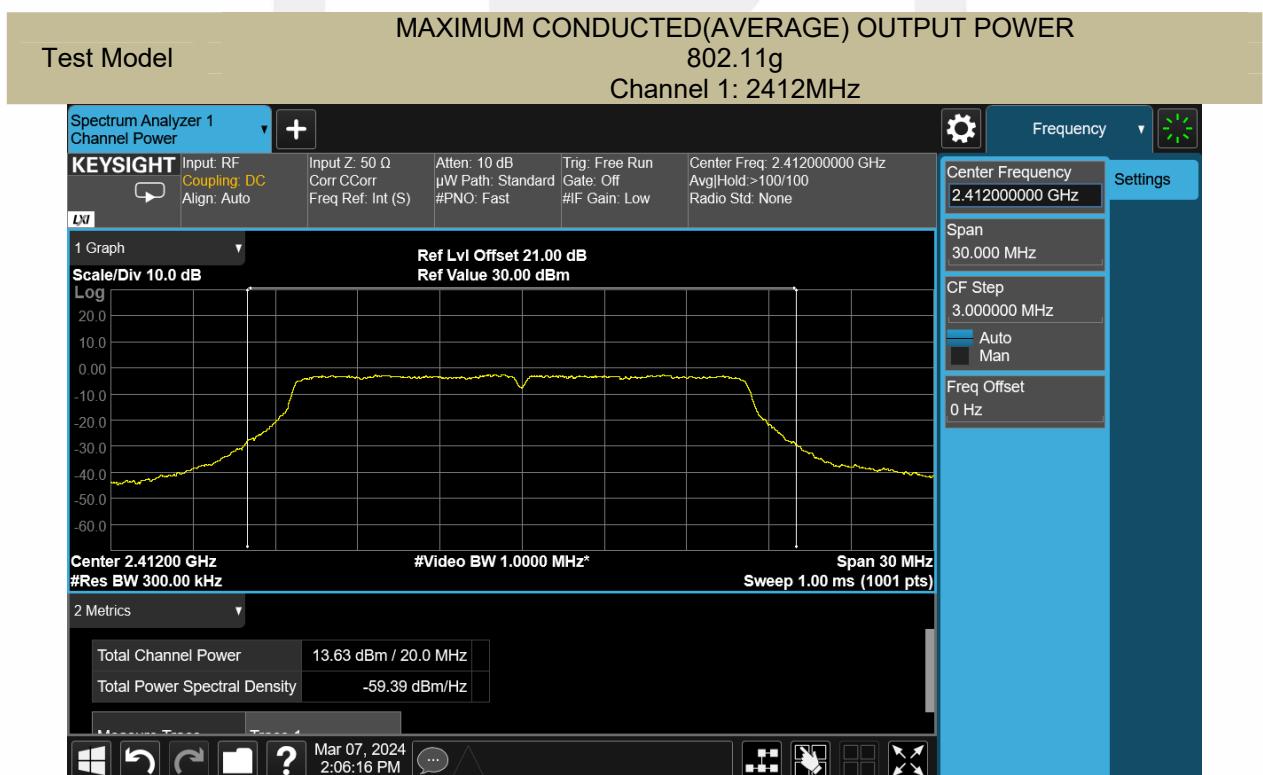
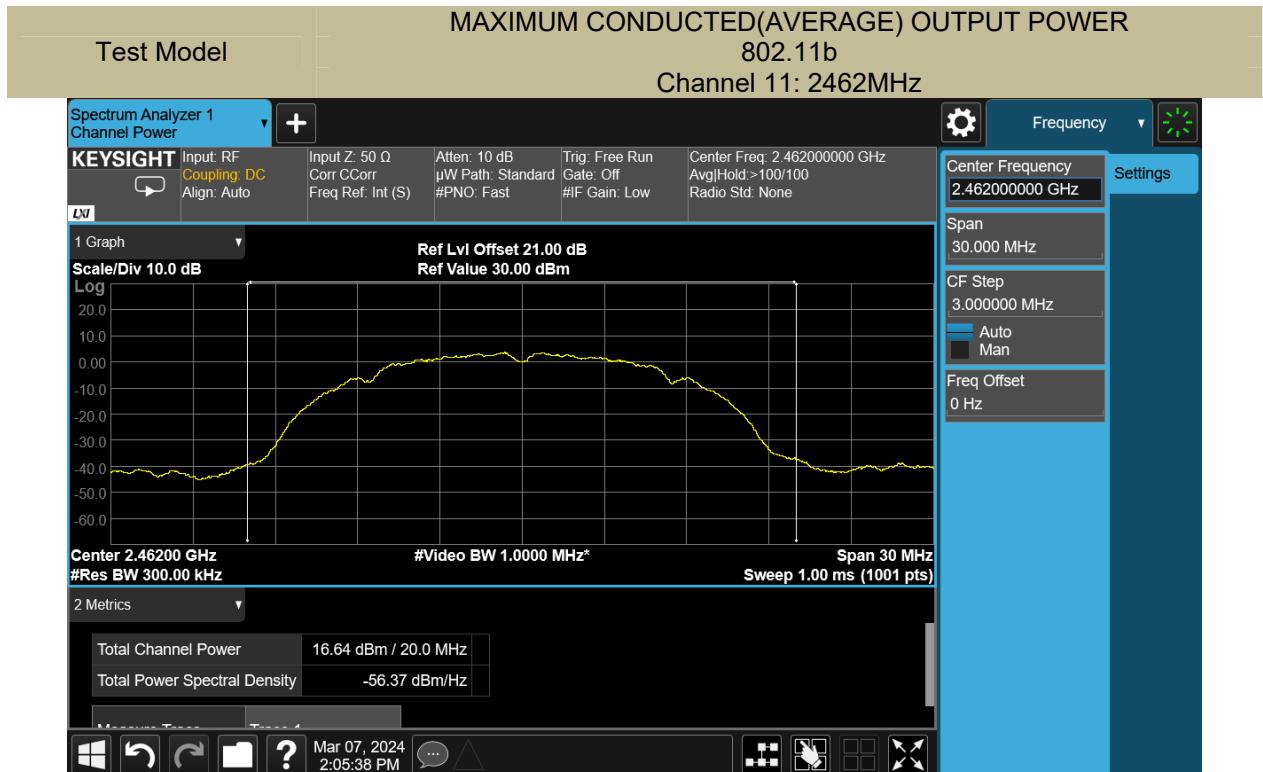
Temperature:	16°C
Relative Humidity:	48%
ATM Pressure:	1011 mbar

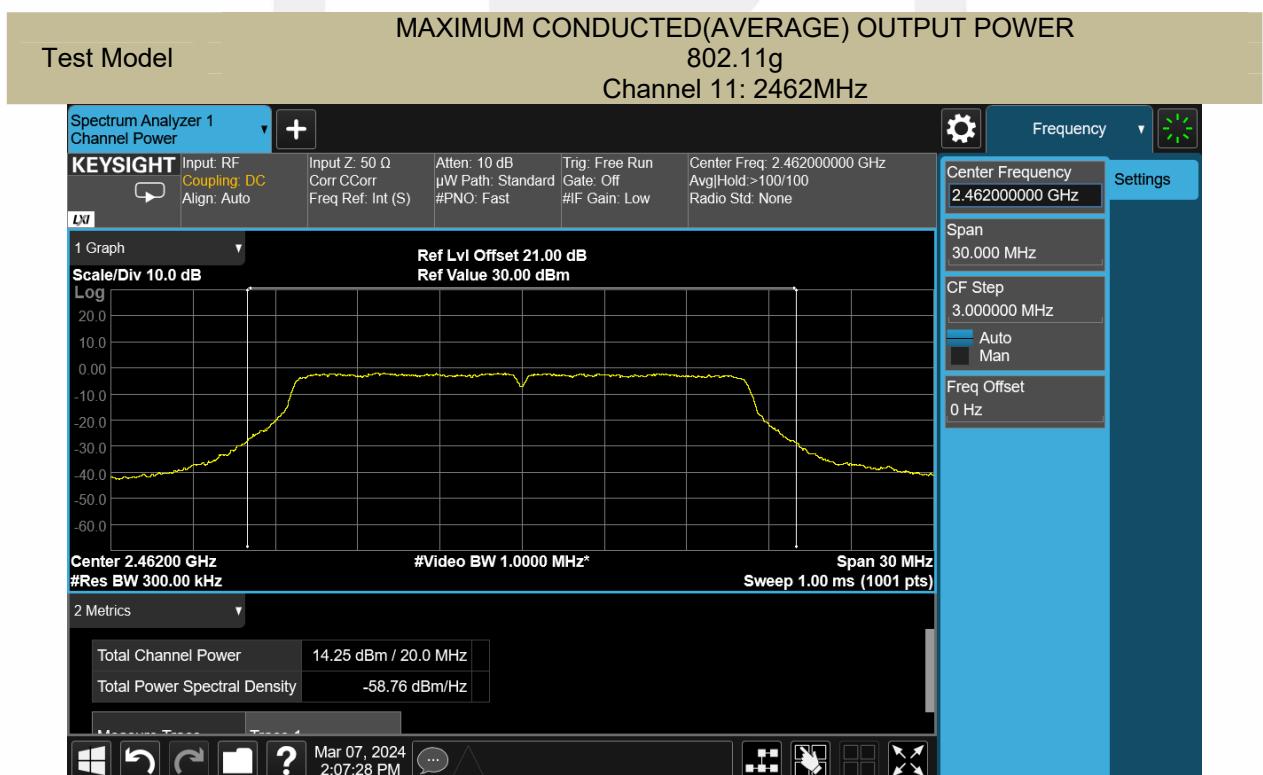
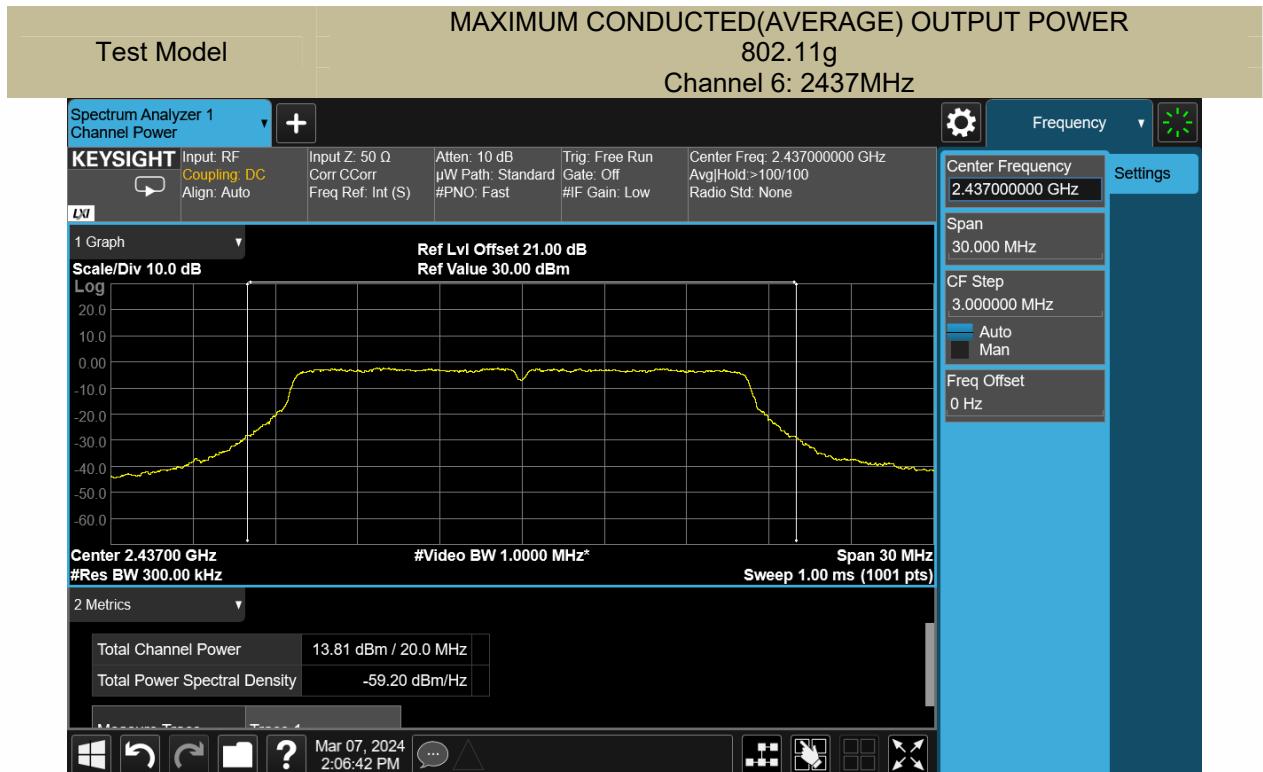
Operation Mode	Channel Number	Channel Frequency (MHz)	Measurement Level (dBm)	Limit (dBm)	Verdict
802.11b	1	2412	16.39	30	PASS
	6	2437	16.39	30	PASS
	11	2462	16.64	30	PASS
802.11g	1	2412	13.63	30	PASS
	6	2437	13.81	30	PASS
	11	2462	14.25	30	PASS
802.11n (HT20)	1	2412	13.51	30	PASS
	6	2437	13.69	30	PASS
	11	2462	14.13	30	PASS
802.11n (HT40)	3	2422	12.98	30	PASS
	6	2437	13.15	30	PASS
	9	2452	13.32	30	PASS

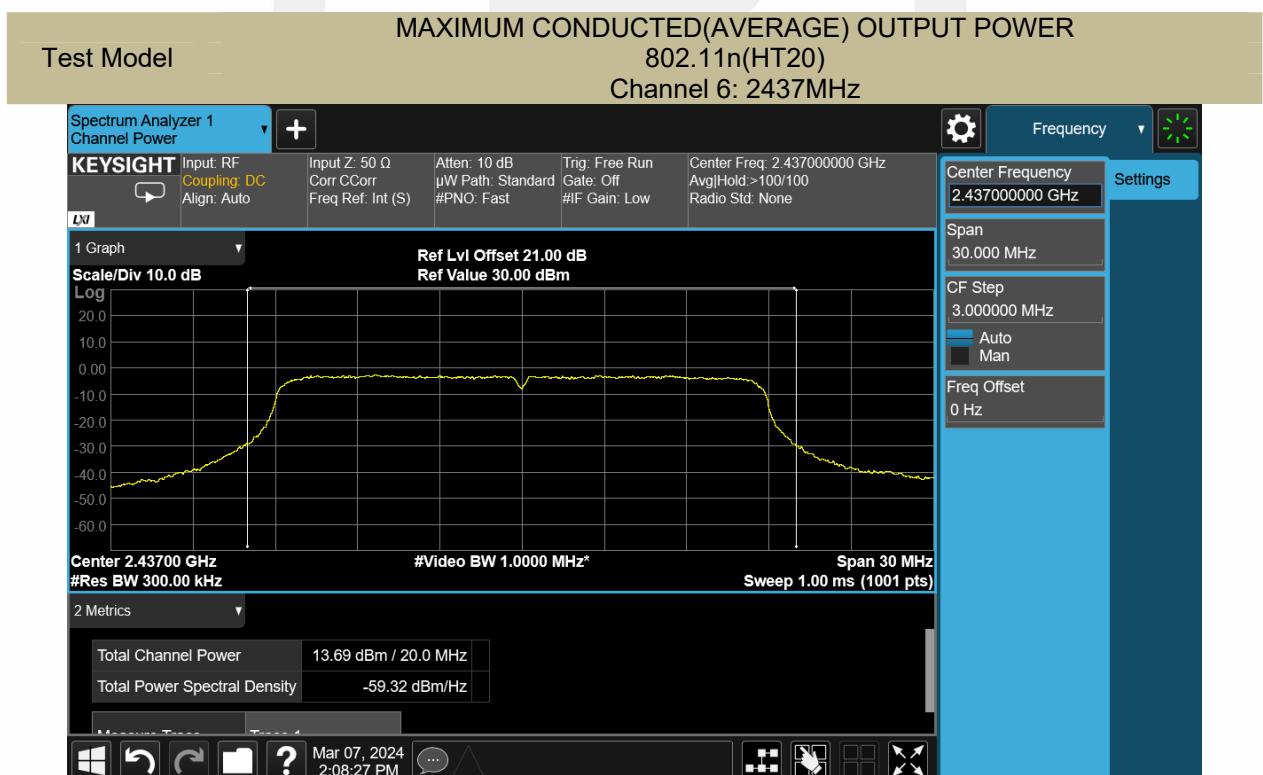
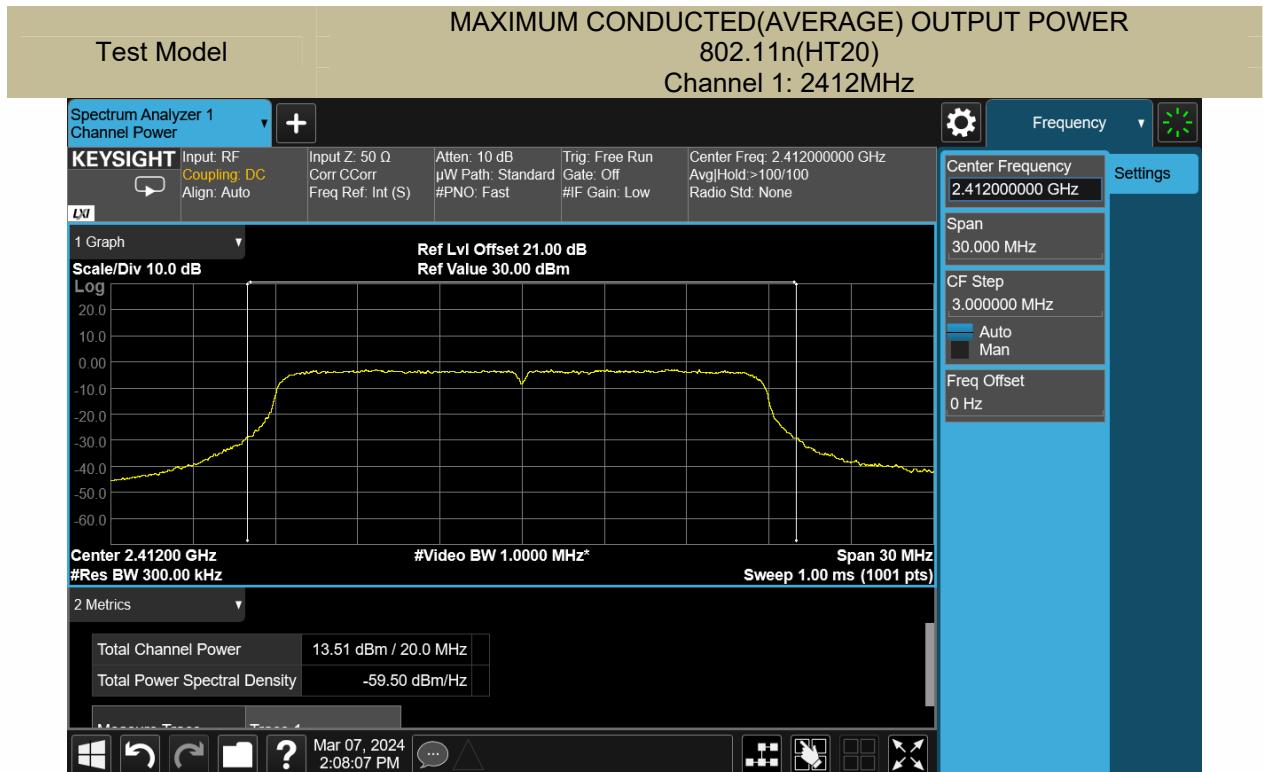


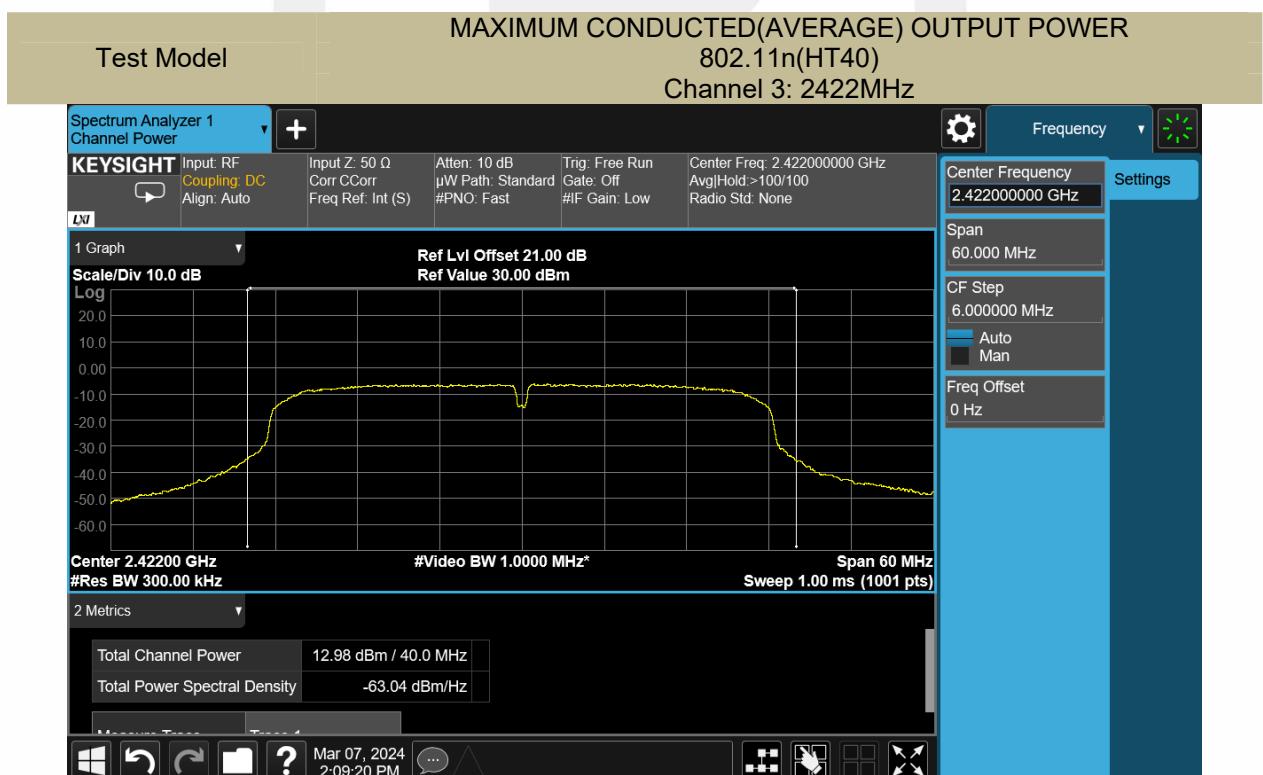
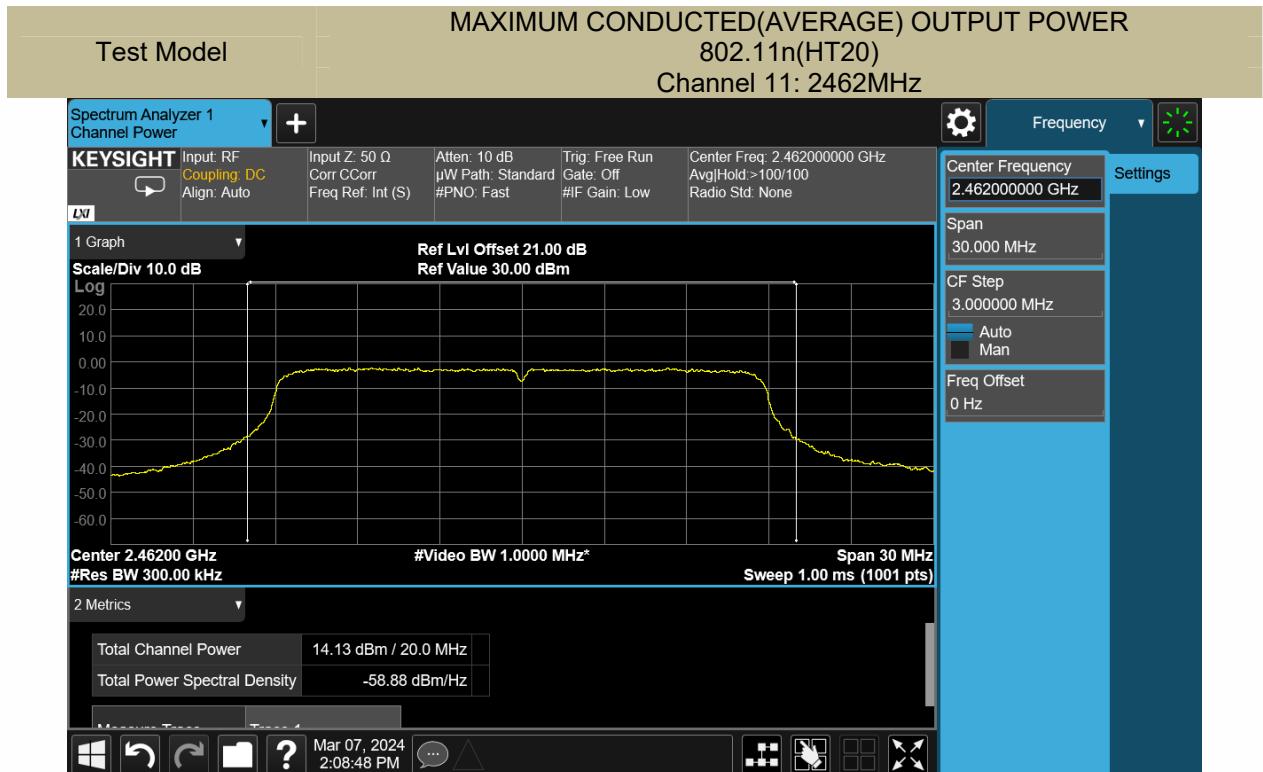


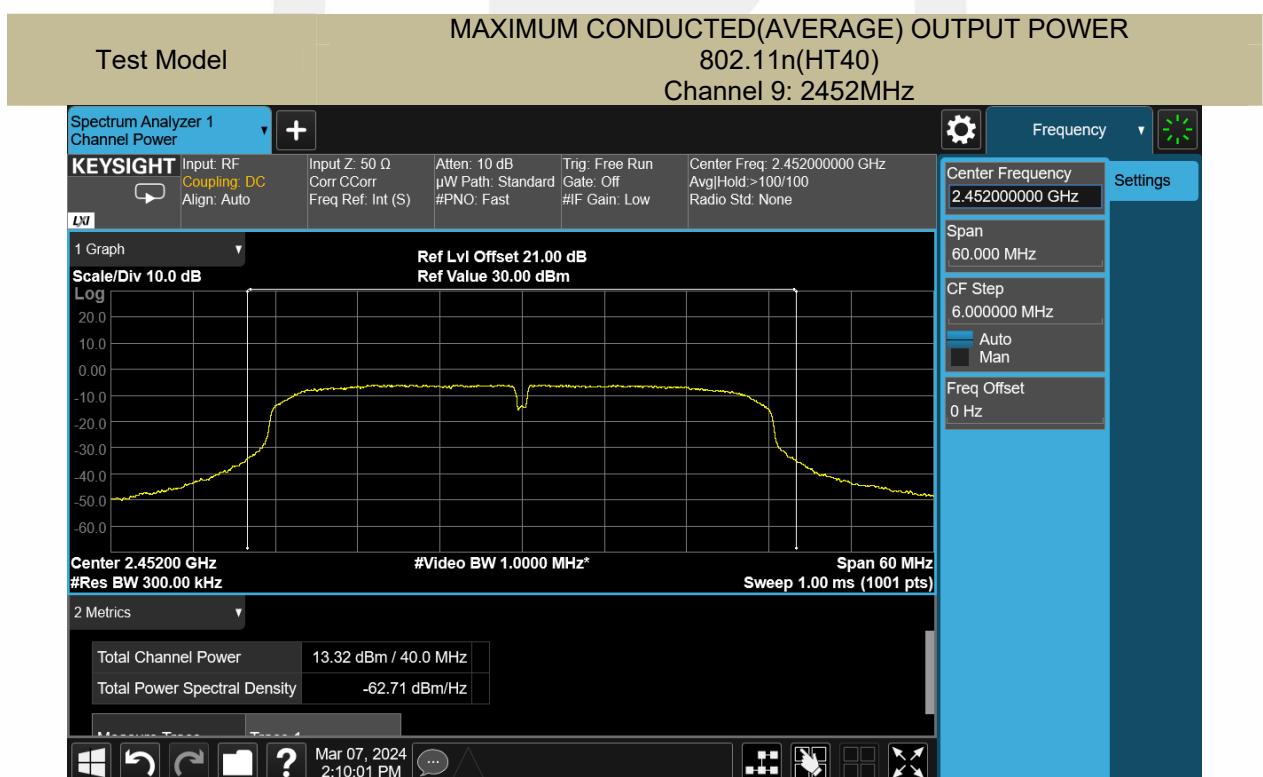
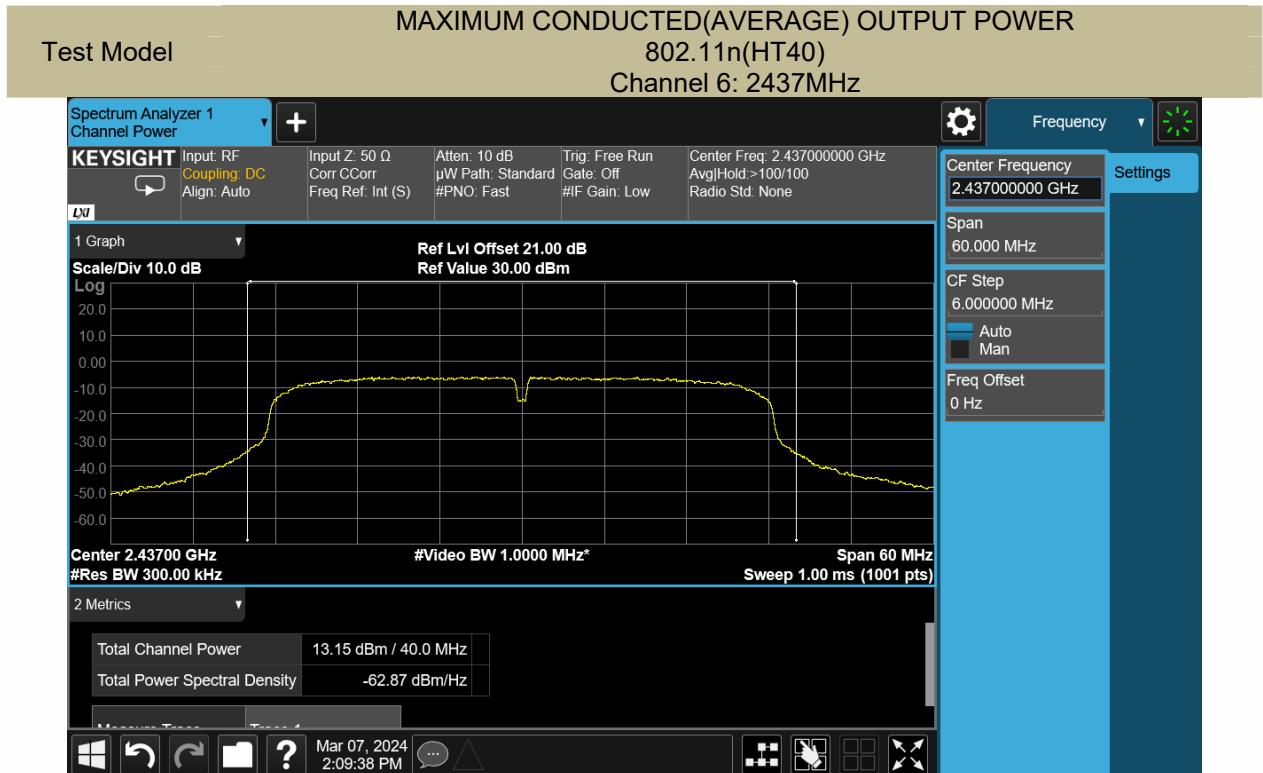












8.3 MAXIMUM POWER SPECTRAL DENSITY

8.3.1 Applicable Standard

According to FCC Part15.247(e) and KDB 558074 D01 15.247 Meas Guidance v05r02

8.3.2 Conformance Limit

The transmitter 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.

8.3.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.3.4 Test Procedure

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance

The transmitter output (antenna port) was connected to the spectrum analyzer

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz

Set the VBW to:10 kHz.

Set Detector = peak.

Set Sweep time = auto couple.

Set Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

Note: If antenna Gain exceeds 6 dBi, then PSD Limit=8-(Gain- 6)

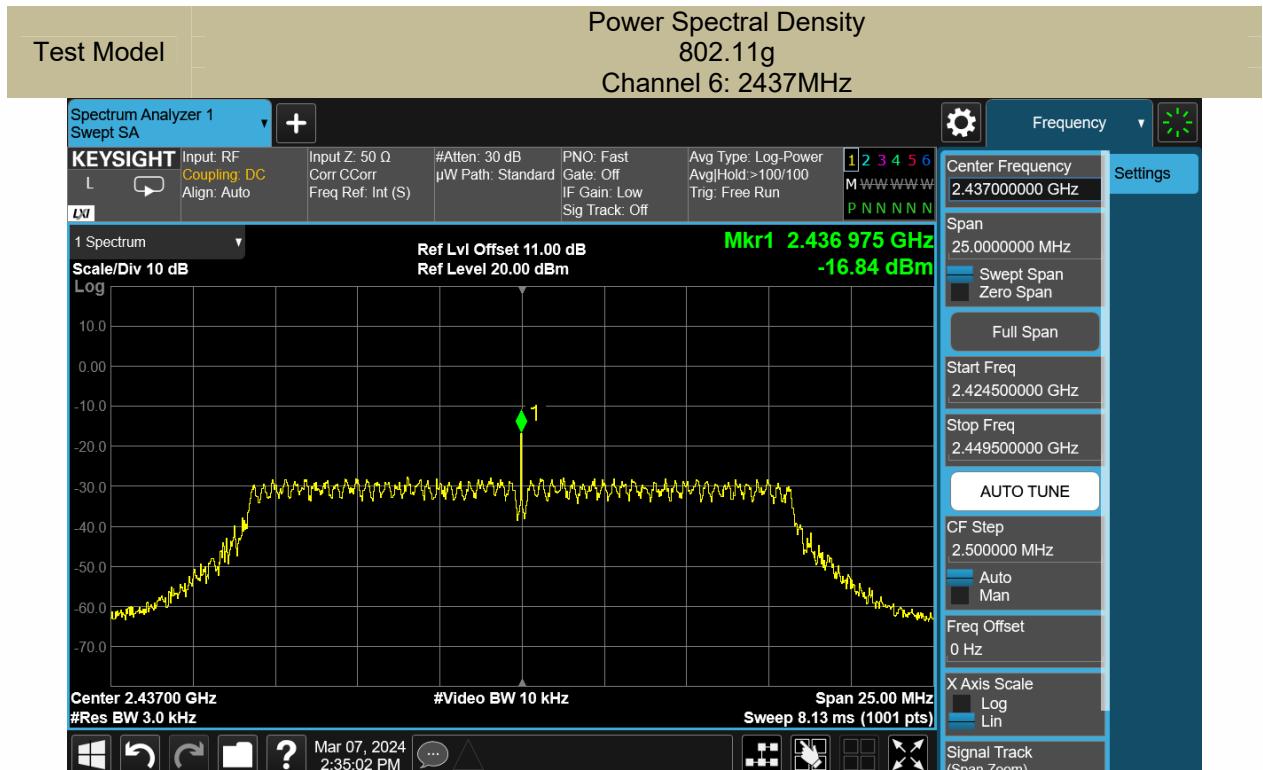
8.3.5 Test Results

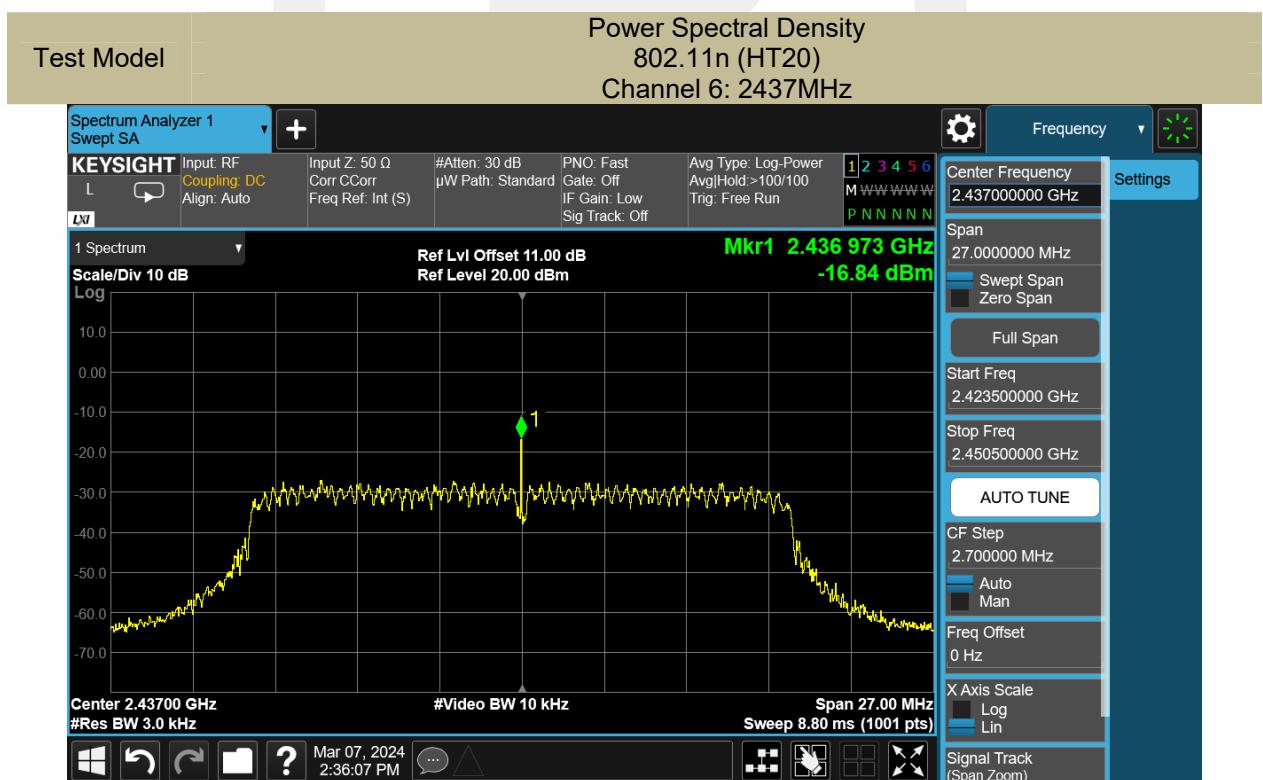
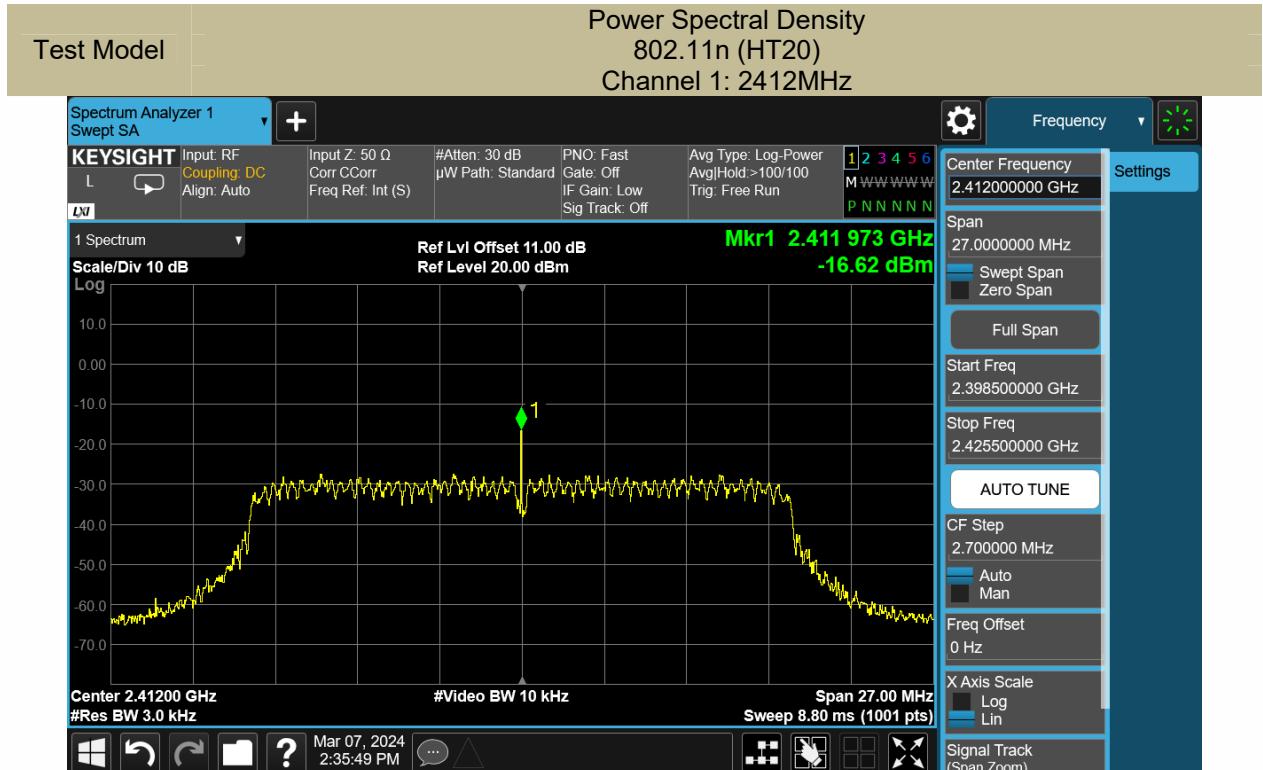
Temperature:	16°C
Relative Humidity:	48%
ATM Pressure:	1011 mbar

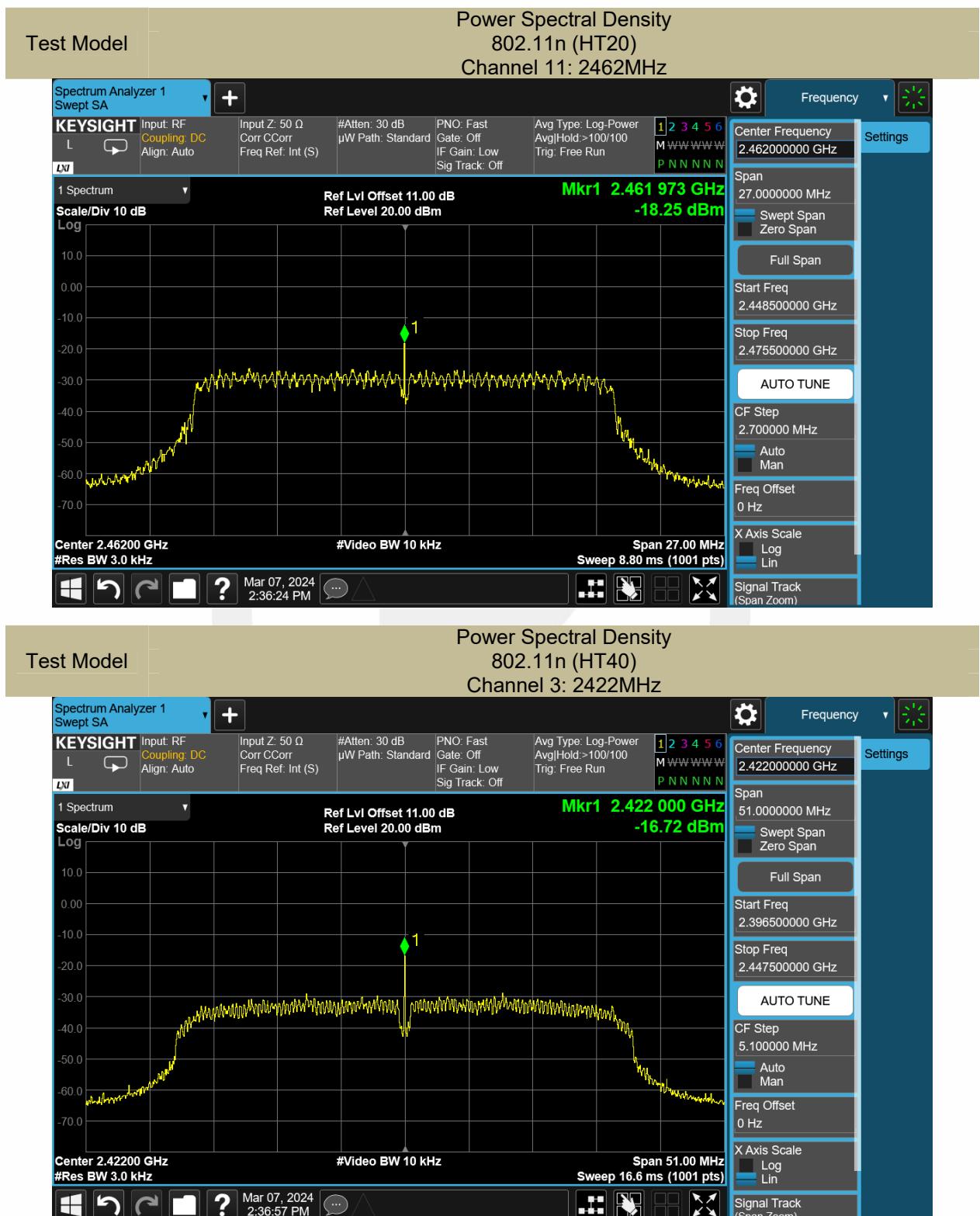
Operation Mode	Channel Number	Channel Frequency (MHz)	Measurement Level (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
802.11b	1	2412	-12.97	8	PASS
	6	2437	-13.25	8	PASS
	11	2462	-12.91	8	PASS
802.11g	1	2412	-17.37	8	PASS
	6	2437	-16.84	8	PASS
	11	2462	-17.68	8	PASS
802.11n (HT20)	1	2412	-16.62	8	PASS
	6	2437	-16.84	8	PASS
	11	2462	-18.25	8	PASS
802.11n (HT40)	3	2422	-16.72	8	PASS
	6	2437	-17.06	8	PASS
	9	2452	-17.79	8	PASS

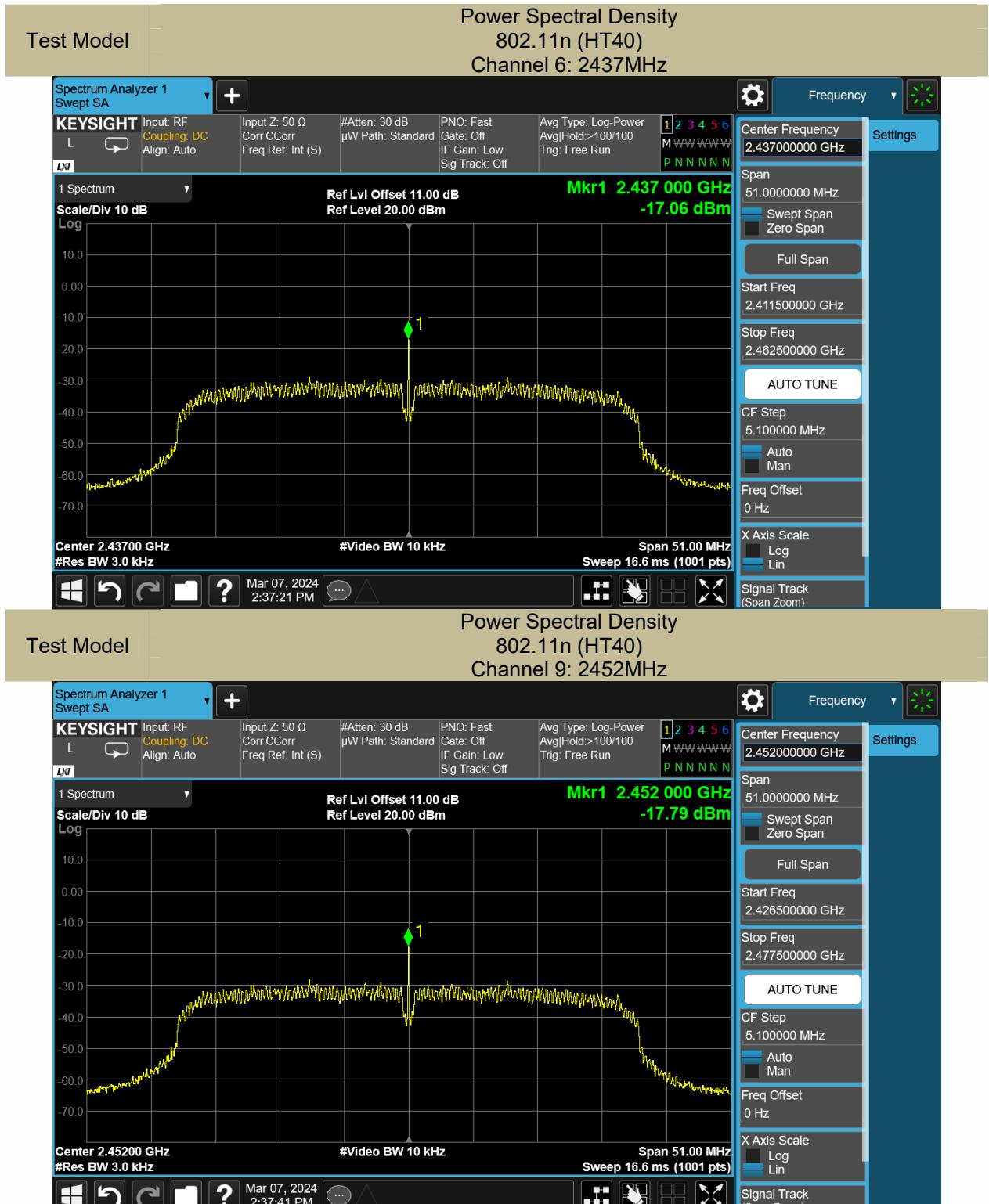












8.4 UNWANTED EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS

8.4.1 Applicable Standard

According to FCC Part15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02

8.4.2 Conformance Limit

According to FCC Part 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.

8.4.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.4.4 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

■ Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW $\geq 3 \times$ RBW.

Set Detector = peak.

Set Sweep time = auto couple.

Set Trace mode = max hold.

Allow trace to fully stabilize.

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.

■ Emission level measurement

Set the center frequency and span to encompass frequency range to be measured.

Set the RBW = 100 kHz.

Set the VBW = 300 kHz.

Set Detector = peak

Sweep time = auto couple.

Trace mode = max hold.

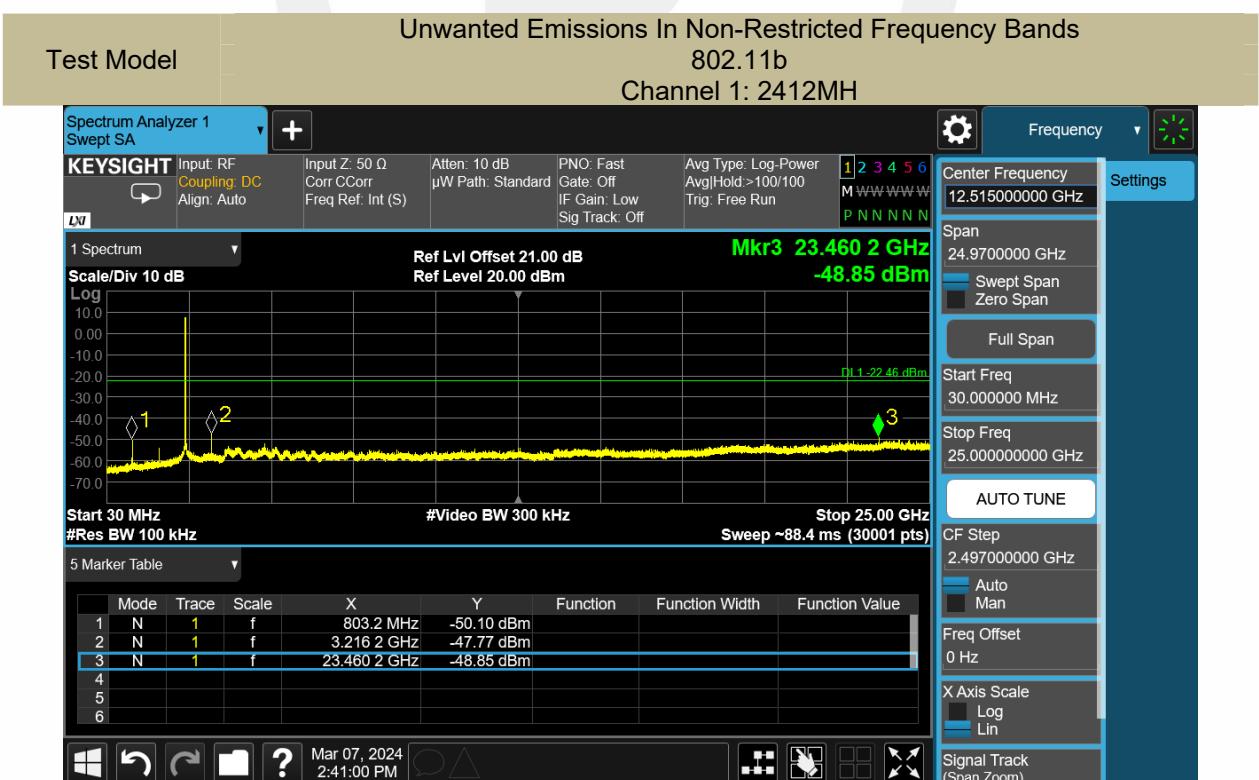
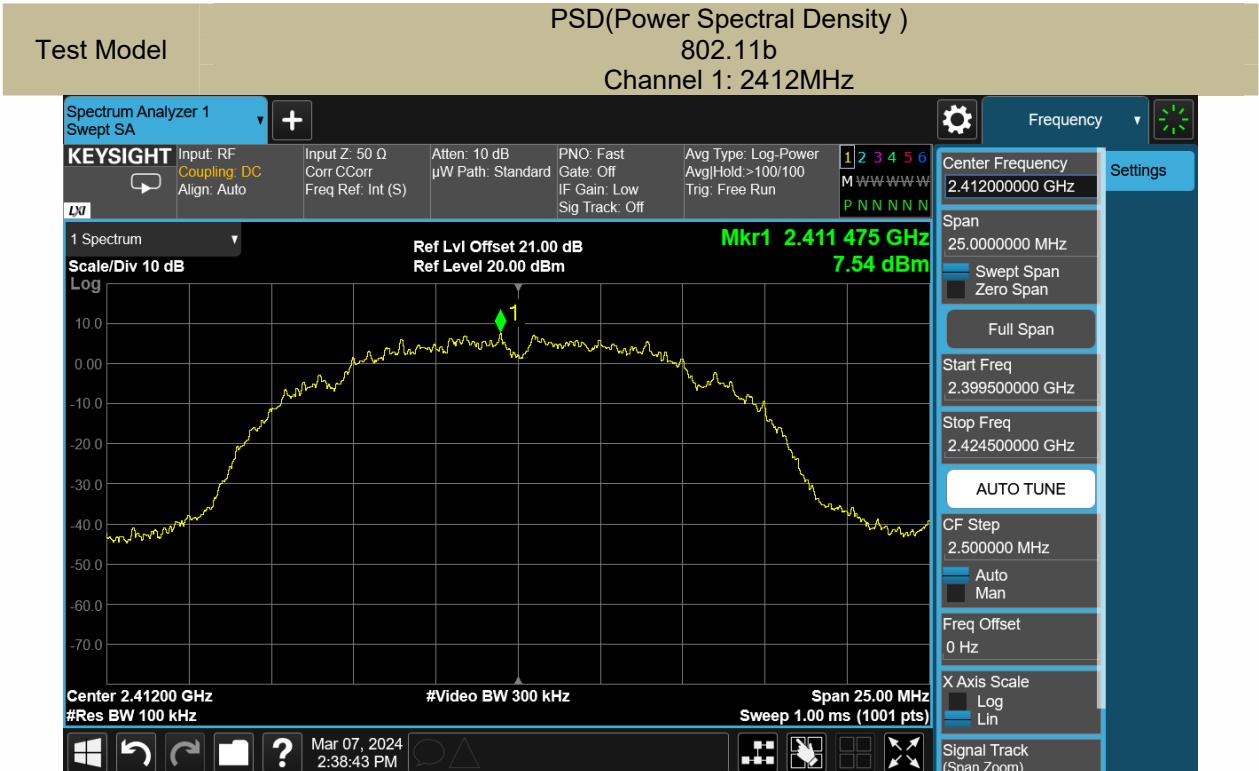
Allow trace to fully stabilize.

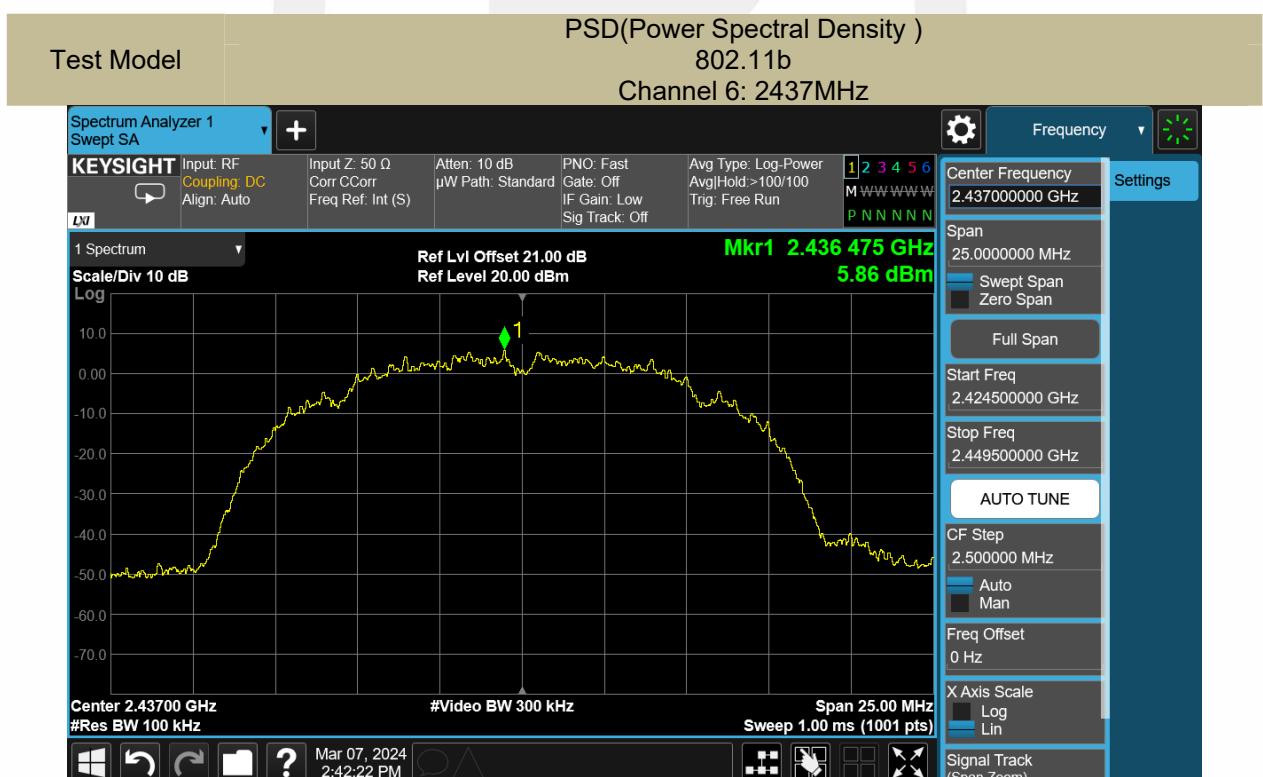
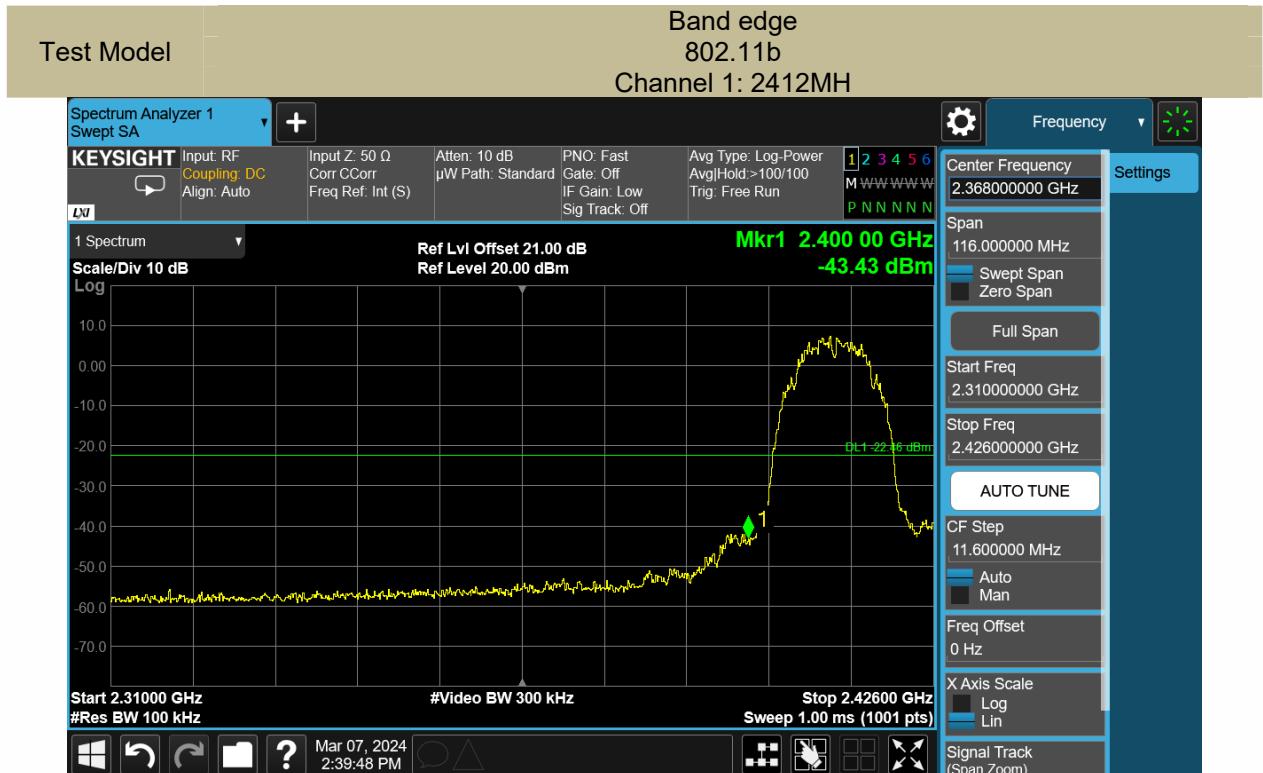
Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements . Report the three highest emissions relative to the limit.

8.4.5 Test Results

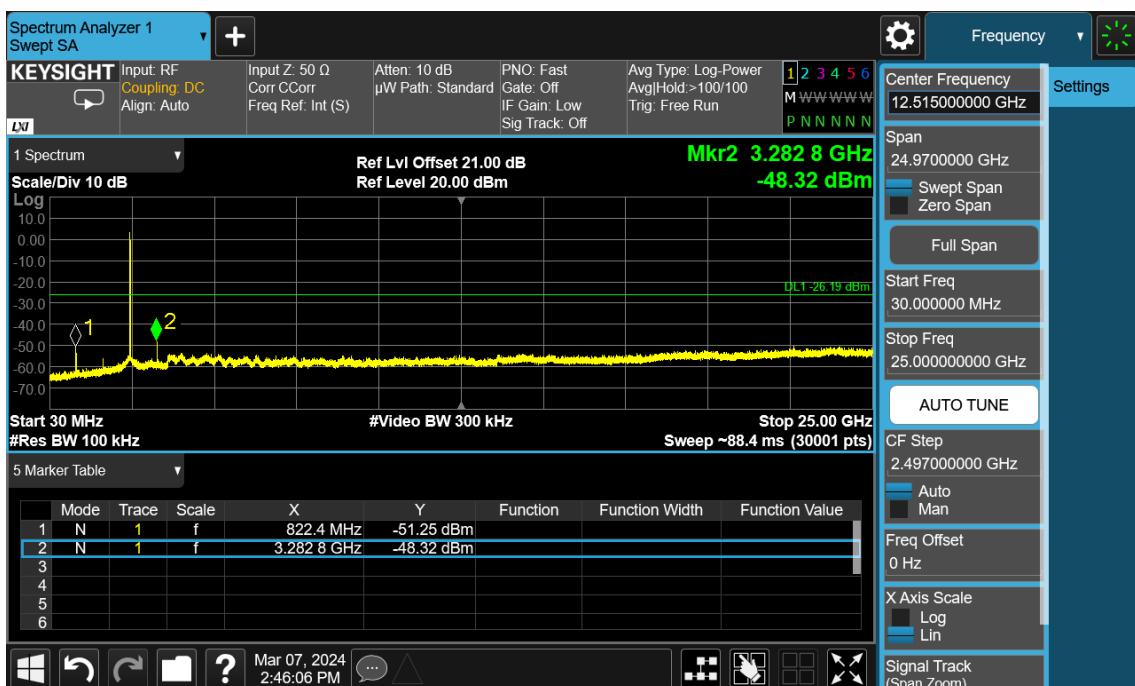
All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11b recorded was report as below:







Test Model

 Unwanted Emissions In Non-Restricted Frequency Bands
 802.11b
 Channel 1: 2462MH


Test Model



8.5 RADIATED SPURIOUS EMISSION

8.5.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and KDB 558074 D01 15.247 Meas Guidance v05r02

8.5.2 Conformance Limit

According to FCC Part 15.247(d): 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)).
According to FCC Part15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part15.205, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μ V/m)	Field Strength ($\text{dB}\mu$ V/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (μ V/m)	300
0.490-1.705	24000/F(KHz)	20 log (μ V/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

8.5.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

8.5.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz(1GHz to 25GHz), 100 kHz for $f < 1$ GHz(30MHz to 1GHz), 200Hz for $f < 150$ KHz(9KHz to 150KHz), 9KHz for $f < 30$ MHz(150KHz to 30KHz)

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Repeat above procedures until all frequency measured was complete.

8.5.5 Test Results

Temperature:	21°C
Relative Humidity:	43%
ATM Pressure:	1011 mbar

■ Spurious Emission below 30MHz(9KHz to 30MHz)

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance}/ \text{test distance})(\text{dB})$;

Limit line=Specific limits(dBuV) + distance extrapolation factor

- Spurious Emission Above 1GHz(1GHz to 25GHz)
- All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11b recorded was report as below:

Test mode: 802.11 b Frequency: Channel 1: 2412MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4824.000	V	51.77	37.19	74.00	54.00	-22.23	-16.81
14937.000	V	53.84	36.24	74.00	54.00	-20.16	-17.76
17944.500	V	54.65	38.06	74.00	54.00	-19.35	-15.94
4824.000	H	52.85	38.42	74.00	54.00	-21.15	-15.58
11030.000	H	51.56	36.51	74.00	54.00	-22.44	-17.49
17984.500	H	53.95	37.22	74.00	54.00	-20.05	-16.78

Test mode: 802.11 b Frequency: Channel 6: 2437MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4874.000	V	55.77	36.57	74.00	54.00	-18.23	-17.43
14006.500	V	52.25	37.29	74.00	54.00	-21.75	-16.71
17986.500	V	54.22	38.05	74.00	54.00	-19.78	-15.95
4874.500	H	53.56	38.74	74.00	54.00	-20.44	-15.26
14252.000	H	52.74	36.51	74.00	54.00	-21.26	-17.49
17987.500	H	54.25	39.63	74.00	54.00	-19.75	-14.37

Test mode: 802.11 b Frequency: Channel 11: 2462MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4924.000	V	57.50	25.31	74.00	54.00	-16.50	-28.69
14882.500	V	53.38	37.59	74.00	54.00	-20.62	-16.41
17929.000	V	53.68	36.25	74.00	54.00	-20.32	-17.75
4924.000	H	54.72	31.29	74.00	54.00	-19.28	-22.71
14265.500	H	52.11	38.51	74.00	54.00	-21.89	-15.49
17968.500	H	53.59	37.92	74.00	54.00	-20.41	-16.08

Note: (1) All Readings are Peak Value (VBW=3MHz) and Average Value (VBW=10Hz).

(2) Emission Level= Reading Level+Correct Factor.

(3) Correct Factor= Ant_F + Cab_L - Preamp

(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11g recorded was report as below:

Test mode: 802.11 b Frequency: Channel 1: 2412MHz

Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2385.480	H	59.91	74.00	43.84	54.00
2362.400	V	58.08	74.00	42.16	54.00

Test mode: 802.11 b Frequency: Channel 11: 2462MHz

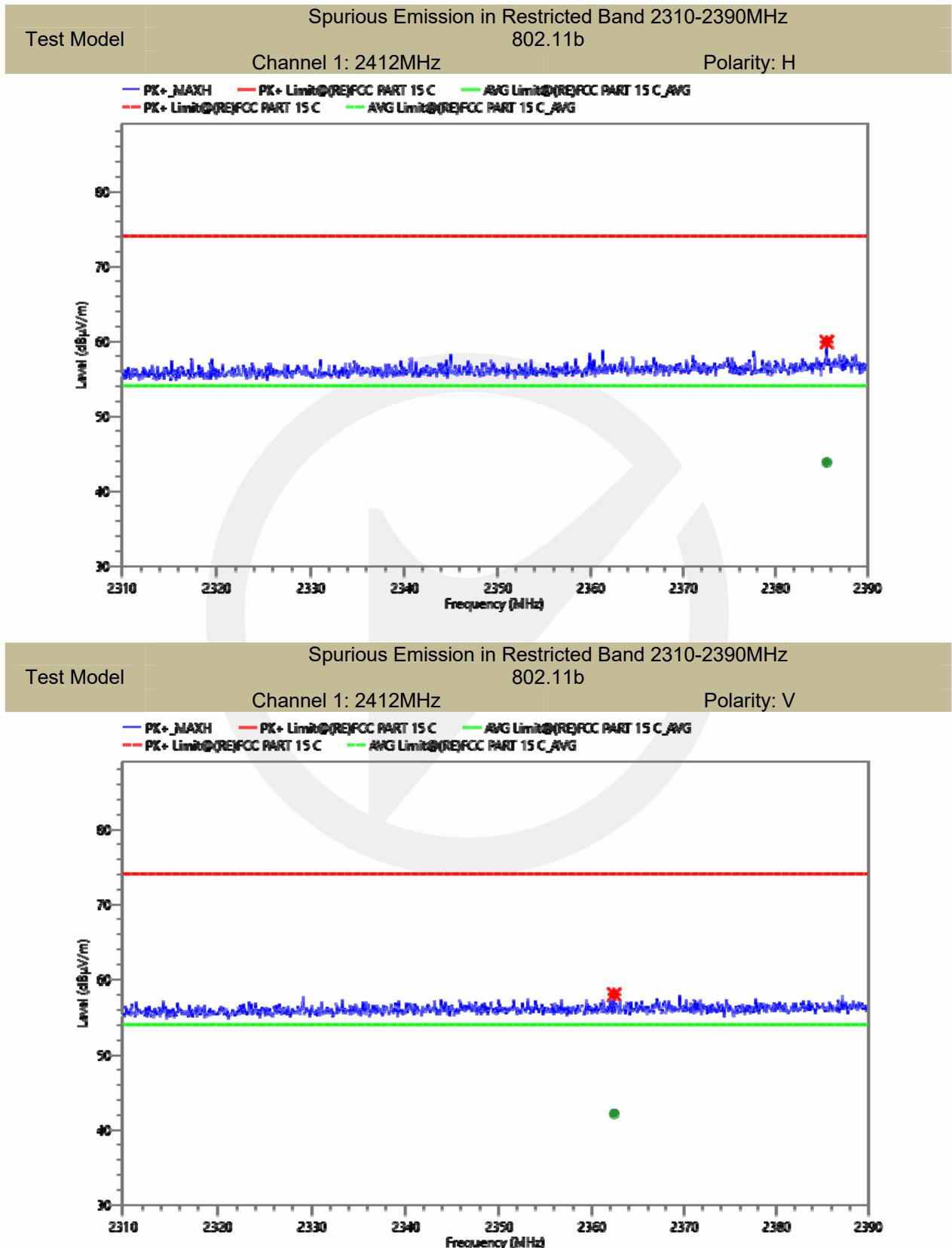
Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2490.876	H	60.83	74.00	45.26	54.00
2495.702	V	58.49	74.00	42.56	54.00

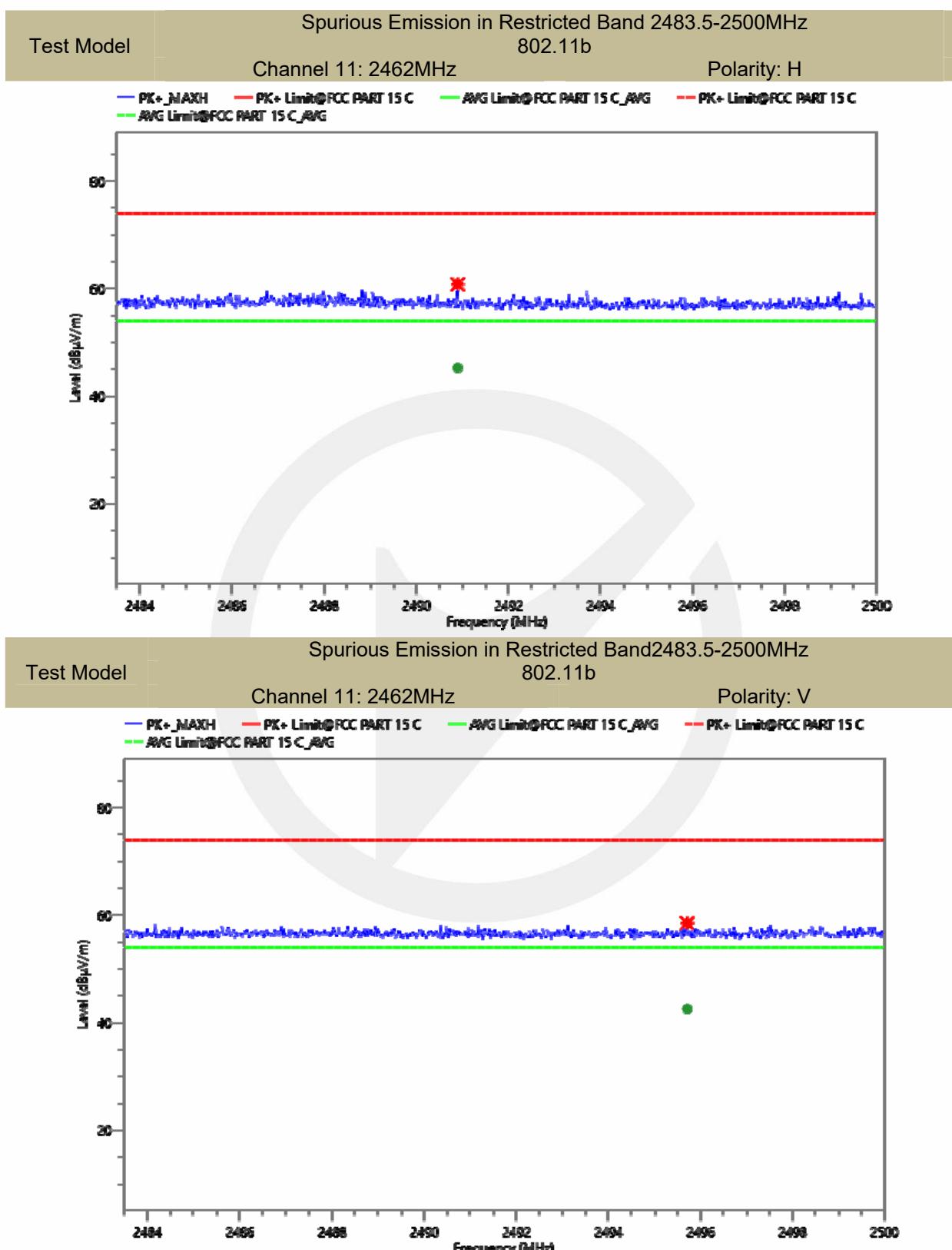
Note: (1) All Readings are Peak Value (VBW=3MHz) and Average Value (VBW=10Hz).

(2) Emission Level= Reading Level+Correct Factor +Cable Loss.

(3) Correct Factor= Ant_F + Cab_L - Preamp

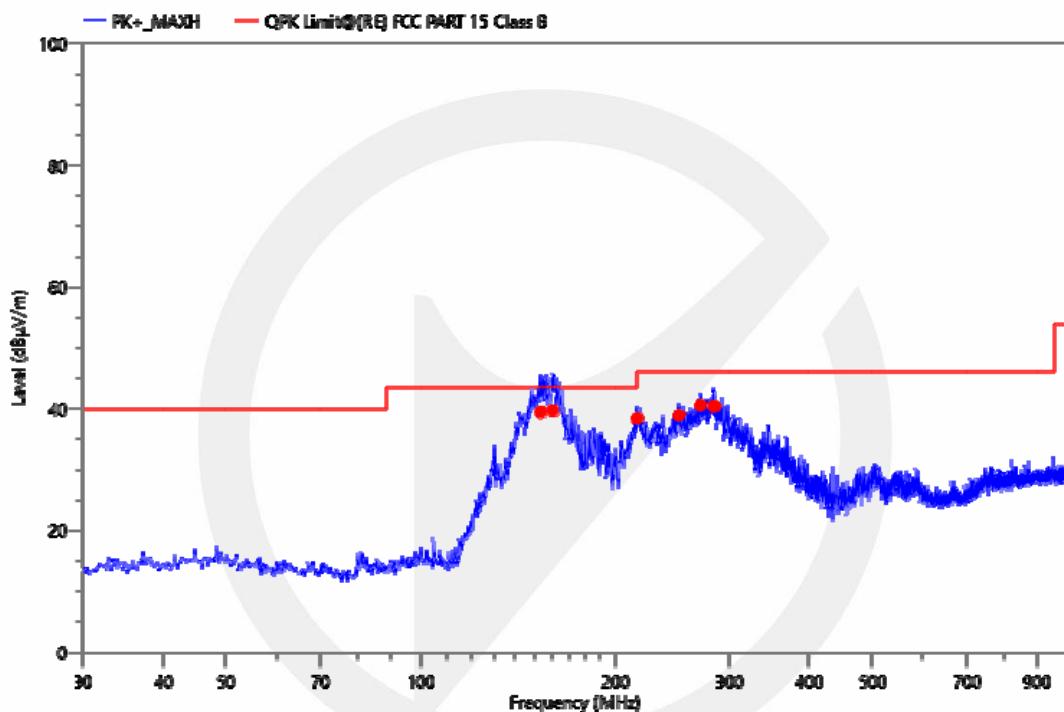
(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.





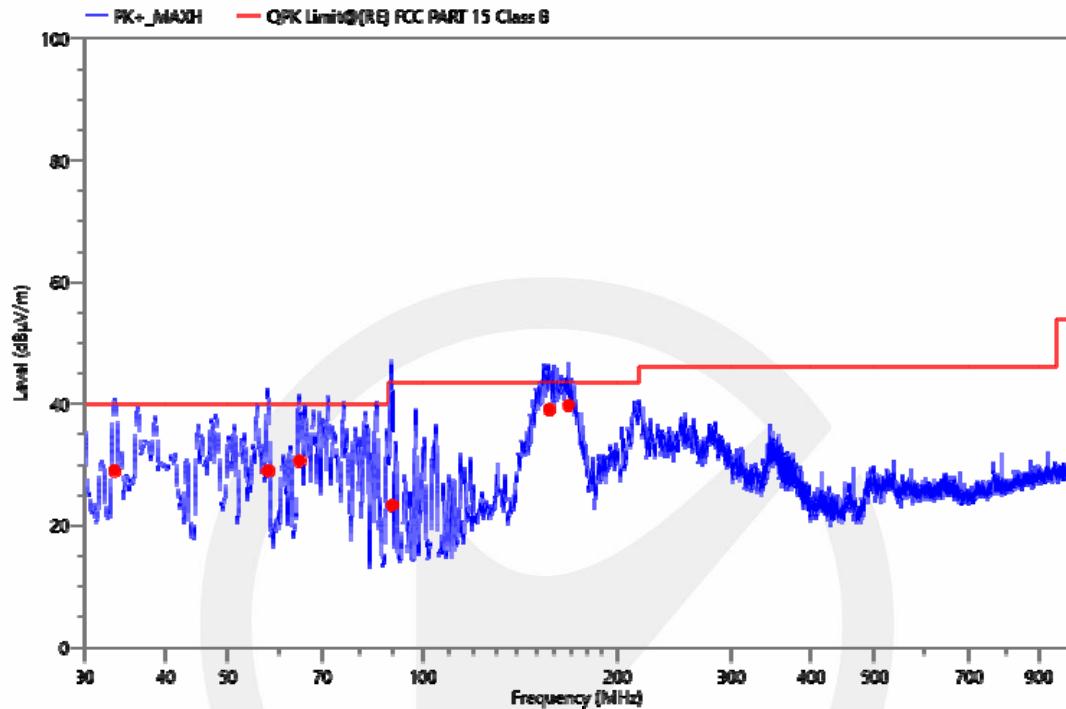
- Spurious Emission below 1GHz (30MHz to 1GHz)
- All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11g recorded was report as below:

Project Information			
Mode:	TX2412 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



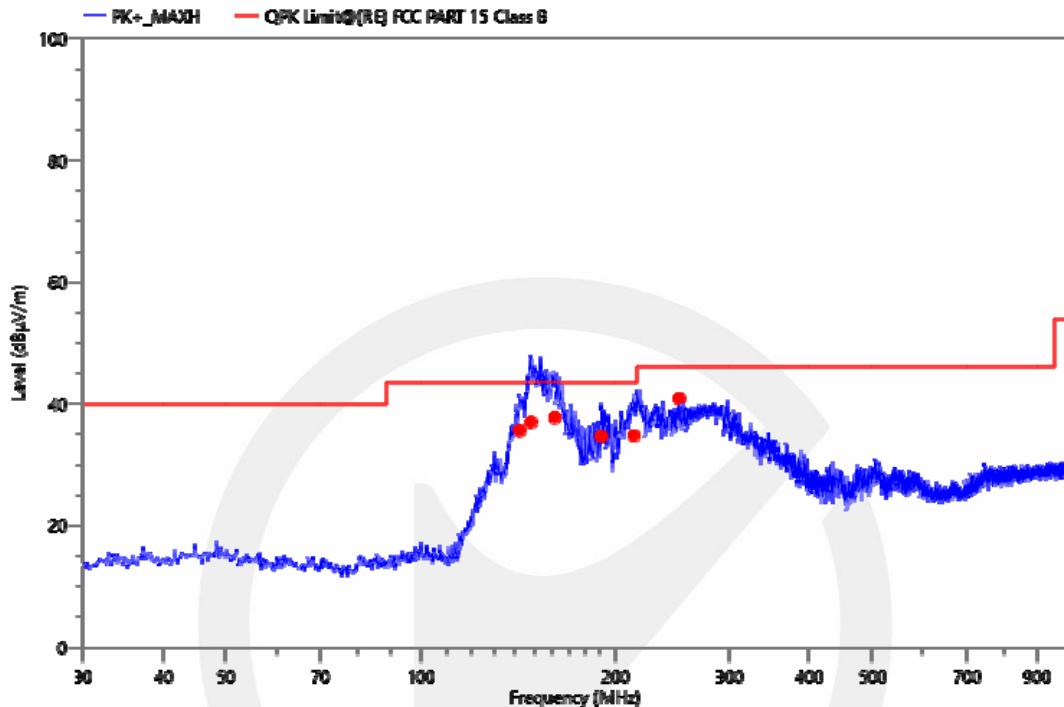
Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
153.430	66.22	-26.76	39.46	43.50	4.04	QPK	200.0	H	125.5	PASS
160.258	66.10	-26.38	39.72	43.50	3.78	QPK	200.0	H	132.1	PASS
216.124	62.17	-23.77	38.40	46.00	7.60	QPK	100.0	H	160.6	PASS
251.235	61.15	-22.27	38.88	46.00	7.12	QPK	100.0	H	235.0	PASS
271.700	62.60	-22.06	40.54	46.00	5.46	QPK	100.0	H	237.4	PASS
285.084	62.32	-21.96	40.36	46.00	5.64	QPK	100.0	H	230.8	PASS

Project Information			
Mode:	TX2412 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



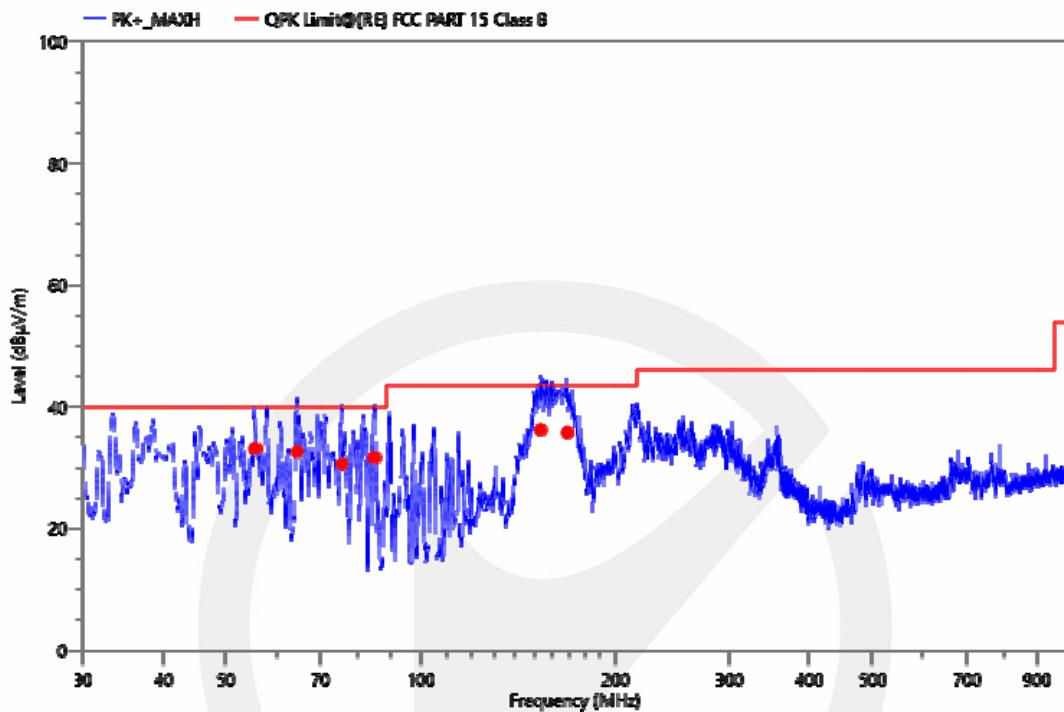
Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
33.395	53.75	-24.71	29.04	40.00	10.96	QPK	100.0	V	73.6	PASS
57.545	54.18	-25.2	28.98	40.00	11.02	QPK	100.0	V	32.0	PASS
64.432	56.57	-25.96	30.61	40.00	9.39	QPK	100.0	V	32.0	PASS
89.552	48.61	-25.31	23.30	43.50	20.20	QPK	100.0	V	73.6	PASS
156.979	65.64	-26.56	39.08	43.50	4.42	QPK	100.0	V	230.8	PASS
168.568	65.99	-26.26	39.73	43.50	3.77	QPK	100.0	V	229.0	PASS

Project Information			
Mode:	TX2437 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



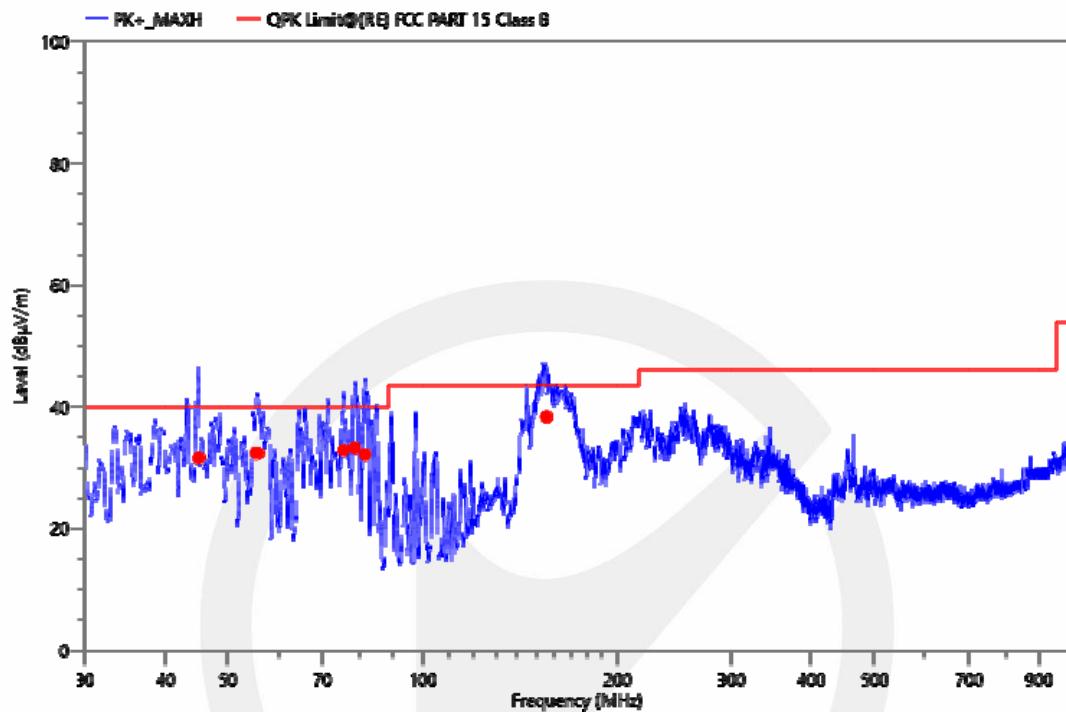
Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
142.024	62.97	-27.34	35.63	43.50	7.87	QPK	200.0	H	333.9	PASS
147.940	64.06	-27.05	37.01	43.50	6.49	QPK	200.0	H	342.8	PASS
161.131	64.14	-26.37	37.77	43.50	5.73	QPK	100.0	H	130.8	PASS
190.616	59.88	-25.26	34.62	43.50	8.88	QPK	100.0	H	188.6	PASS
213.409	58.65	-23.86	34.79	43.50	8.71	QPK	100.0	H	178.5	PASS
251.235	63.15	-22.27	40.88	46.00	5.12	QPK	100.0	H	235.0	PASS

Project Information			
Mode:	TX2437 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



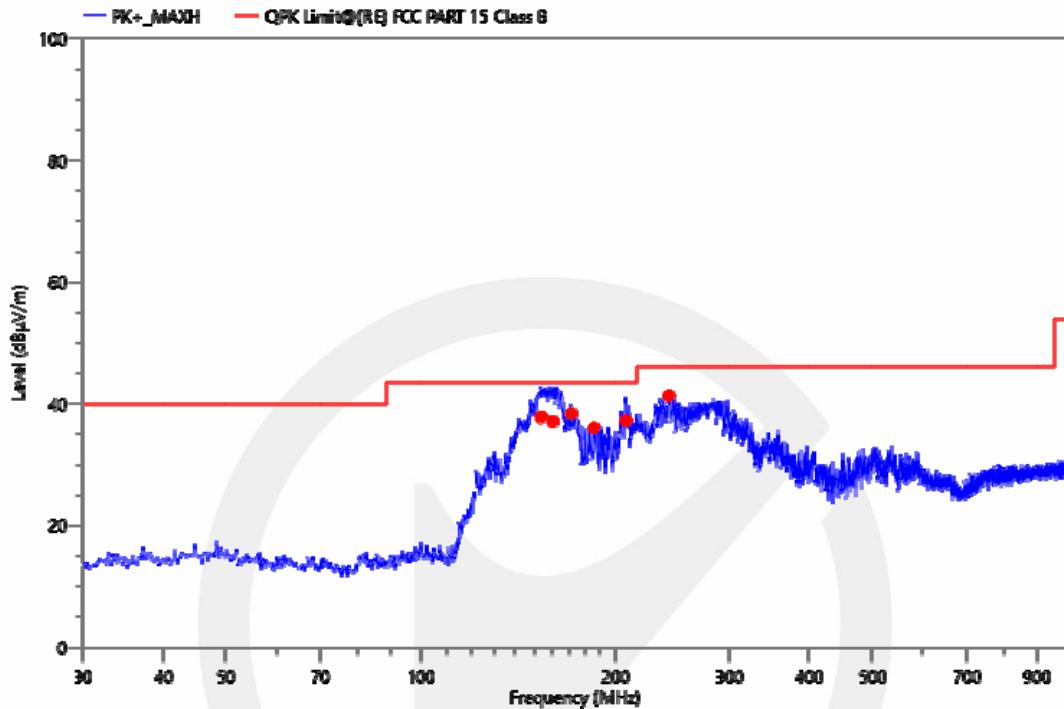
Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
55.508	57.92	-24.81	33.11	40.00	6.89	QPK	100.0	V	145.7	PASS
64.432	58.57	-25.96	32.61	40.00	7.39	QPK	100.0	V	32.0	PASS
75.682	57.10	-26.52	30.58	40.00	9.42	QPK	100.0	V	79.6	PASS
84.800	57.61	-25.98	31.63	40.00	8.37	QPK	100.0	V	37.9	PASS
153.275	62.99	-26.76	36.23	43.50	7.27	QPK	100.0	V	233.8	PASS
168.696	62.06	-26.26	35.80	43.50	7.70	QPK	100.0	V	229.0	PASS

Project Information			
Mode:	TX2462 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
45.033	55.24	-23.65	31.59	40.00	8.41	QPK	100.0	V	159.3	PASS
55.411	57.19	-24.8	32.39	40.00	7.61	QPK	100.0	V	145.7	PASS
75.585	59.36	-26.52	32.84	40.00	7.16	QPK	100.0	V	79.6	PASS
78.689	59.85	-26.62	33.23	40.00	6.77	QPK	100.0	V	159.3	PASS
81.696	58.53	-26.42	32.11	40.00	7.89	QPK	100.0	V	37.9	PASS
155.311	65.03	-26.65	38.38	43.50	5.12	QPK	100.0	V	230.8	PASS

Project Information			
Mode:	TX2462 MHz	Voltage:	AC 208V/60Hz
Environment:	Temp: 22°C; Humi:38%	Engineer:	Elvis Xia



Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
153.566	64.56	-26.75	37.81	43.50	5.69	QPK	200.0	H	125.5	PASS
160.161	63.52	-26.38	37.14	43.50	6.36	QPK	200.0	H	132.1	PASS
171.315	64.54	-26.19	38.35	43.50	5.15	QPK	200.0	H	353.5	PASS
185.960	61.54	-25.54	36.00	43.50	7.50	QPK	200.0	H	166.0	PASS
207.492	61.22	-24.03	37.19	43.50	6.31	QPK	100.0	H	167.7	PASS
242.215	63.98	-22.71	41.27	46.00	4.73	QPK	100.0	H	0.0	PASS

8.6 CONDUCTED EMISSIONS TEST

8.6.1 Applicable Standard

According to FCC Part 15.207(a)

8.6.2 Conformance Limit

Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

8.6.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

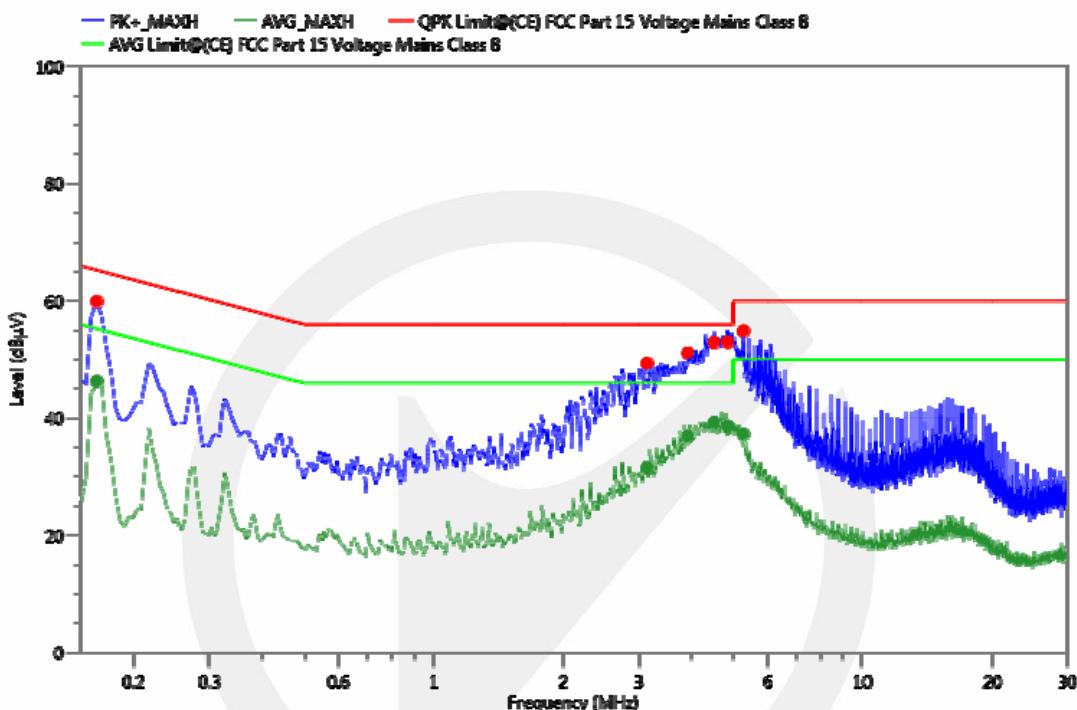
8.6.4 Test Procedure

The EUT was placed on a table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Repeat above procedures until all frequency measured were complete.

8.6.5 Test Results

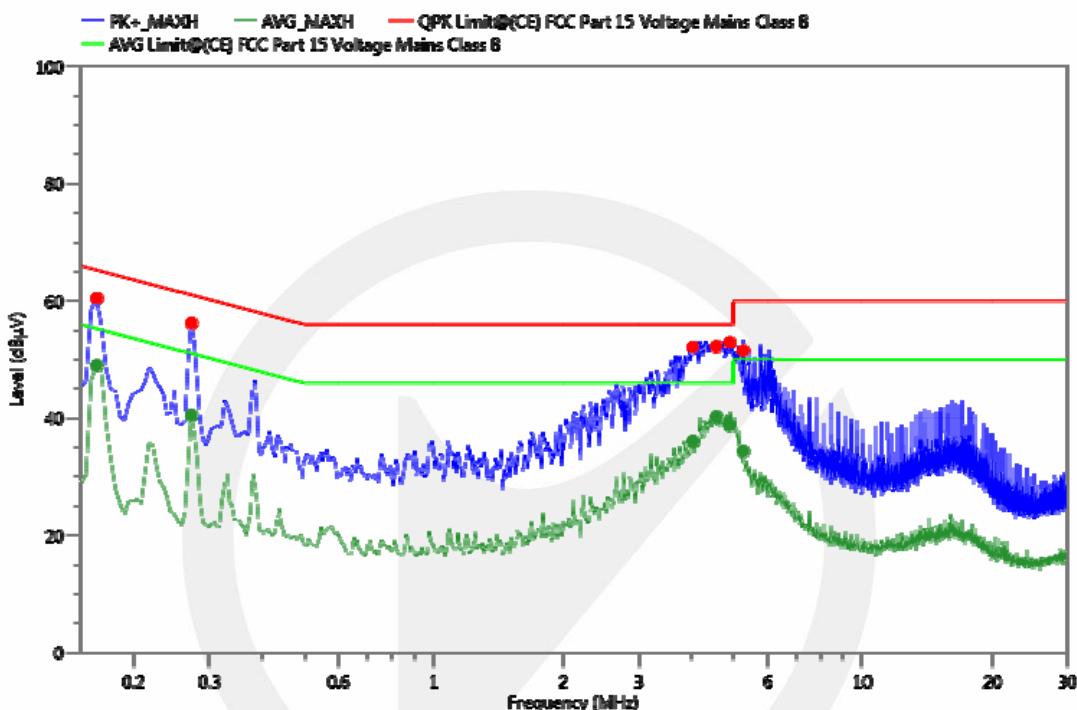
Pass

Project Information			
Mode:	TX	Voltage:	AC 208V/60Hz
Environment:	Temp: 23°C; Humi:38%	Engineer:	Alan Li



Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V)	Limit (dB μ V)	Margin (dB)	Det.	Line	Verdict
0.164	38.49	21.39	59.88	65.28	5.40	QPK	N	PASS
0.164	24.90	21.39	46.29	55.28	8.99	AVG	N	PASS
3.129	30.67	18.63	49.30	56.00	6.70	QPK	N	PASS
3.129	12.91	18.63	31.54	46.00	14.46	AVG	N	PASS
3.903	32.40	18.71	51.11	56.00	4.89	QPK	N	PASS
3.903	18.23	18.71	36.94	46.00	9.06	AVG	N	PASS
4.506	34.09	18.78	52.87	56.00	3.13	QPK	N	PASS
4.506	20.45	18.78	39.23	46.00	6.77	AVG	N	PASS
4.853	34.14	18.83	52.97	56.00	3.03	QPK	N	PASS
4.853	19.78	18.83	38.61	46.00	7.39	AVG	N	PASS
5.280	36.02	18.85	54.87	60.00	5.13	QPK	N	PASS
5.280	18.41	18.85	37.26	50.00	12.74	AVG	N	PASS

Project Information			
Mode:	TX	Voltage:	AC 208V/60Hz
Environment:	Temp: 23°C; Humi:38%	Engineer:	Alan Li



Freq. (MHz)	Reading (dB μ V)	Corr. (dB)	Meas. (dB μ V)	Limit (dB μ V)	Margin (dB)	Det.	Line	Verdict
0.164	39.08	21.37	60.45	65.28	4.83	QPK	L1	PASS
0.164	27.61	21.37	48.98	55.28	6.30	AVG	L1	PASS
0.272	36.70	19.48	56.18	61.07	4.89	QPK	L1	PASS
0.272	20.97	19.48	40.45	51.07	10.62	AVG	L1	PASS
4.016	33.40	18.69	52.09	56.00	3.91	QPK	L1	PASS
4.016	17.33	18.69	36.02	46.00	9.98	AVG	L1	PASS
4.560	33.47	18.73	52.20	56.00	3.80	QPK	L1	PASS
4.560	21.49	18.73	40.22	46.00	5.78	AVG	L1	PASS
4.902	34.12	18.76	52.88	56.00	3.12	QPK	L1	PASS
4.902	19.99	18.76	38.75	46.00	7.25	AVG	L1	PASS
5.280	32.66	18.79	51.45	60.00	8.55	QPK	L1	PASS
5.280	15.52	18.79	34.31	50.00	15.69	AVG	L1	PASS

8.7 ANTENNA APPLICATION

8.7.1 Antenna Requirement

Standard	Requirement
FCC CRF Part15.203	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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

8.7.2 Result

PASS.

- The EUT has 1 antenna: one an External antenna for WIFI 2.4G, the gain is 1.52 dBi,

Note: Antenna uses a permanently attached antenna which is not replaceable.
 Not using a standard antenna jack or electrical connector for antenna replacement
 The antenna has to be professionally installed (please provide method of installation)

Which in accordance to section 15.203, please refer to the internal photos.

*** End of Report ***

声 明

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