RF Test Report

Applicant	:	Kaonbroadband CO., LTD
Product Name	:	WiFi6E XGS-PON Gateway
Trade Name	:	KAON
Model Number	:	PG2494
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Received Date	:	Apr. 08, 2022
Test Period	:	Apr. 30 ~ May 14, 2022
Issued Date	:	Jun. 13, 2022

Issued by

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 334025, Taiwan (R.O.C.)
Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range : 9 kHz to 40 GHz
Test Firm MRA designation number: TW0010

Note:
1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Revisions	Revised By
00	Jun. 08, 2022	Initial Issue	Nicole Chu
01	Jun. 10, 2022	Update 4.7 chapter (P.29) Update 5.3 chapter (P.120, P124, P136)	Nicole Chu
02	Jun. 13, 2022	Update 4.7 chapter (P.29) Update 5.2 chapter (P.53)	Nicole Chu

Verification of Compliance

Applicant	:	Kaonbroadband CO., LTD
Product Name	:	WiFi6E XGS-PON Gateway
Trade Name	:	KAON
Model Number	:	PG2494
FCC ID	:	2AXCW-PG2494
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	A Test Lab Techno Corp. No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Fly Lu

(Fly Lu)

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1 General Information

1.1. Summary of Test Result

Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(b)(3)	Max. Output Power	PASS	-----
15.247(a)(2)	6 dB RF Bandwidth	PASS	-----
15.247(e)	Maximum Power Spectral Density	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----
15.203	Antenna Requirement	PASS	-----

Decision Rule

■ Uncertainty is not included.

□ Uncertainty is included.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
KDB 662911 D01 v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)

1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conducted Emission	150 kHz ~ 30 MHz	2.7 dB
Radiated Emission	9 kHz ~ 30 MHz	2.2 dB
	30 MHz ~ 1000 MHz	5.1 dB
	1000 MHz ~ 18000 MHz	5.2 dB
	18000 MHz ~ 26500 MHz	4.6 dB
	26500 MHz ~ 40000 MHz	4.6 dB
Conducted Output Power	1.1 dB	
RF Bandwidth	4.7 %	
Power Spectral Density	1.1 dB	

2 EUT Description

Applicant	Kaonbroadband CO., LTD 884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea			
Product Name	WiFi6E XGS-PON Gateway			
Trade Name	KAON			
Model Number	PG2494			
Models different description	All models are electrically identical, different model names are for marketing purpose.			
FCC ID	2AXCW-PG2494			
Operate Freq. Band	Frequency Range (MHz)	Modulation	Channel Bandwidth	Data Rate 400 GI (ns)
IEEE 802.11b	2412 ~ 2462	DSSS	20 MHz	Up to 11 Mbps
IEEE 802.11g	2412 ~ 2462	OFDM	20 MHz	Up to 54 Mbps
IEEE 802.11n 2.4 GHz 20 MHz	2412 ~ 2462	OFDM	20 MHz	Up to 288.8 Mbps
IEEE 802.11n 2.4 GHz 40 MHz	2422 ~ 2452	OFDM	40 MHz	Up to 600 Mbps
IEEE 802.11n 2.4 GHz 20 MHz	2412 ~ 2462	OFDM (256QAM)	20 MHz	Up to 346.8 Mbps
IEEE 802.11n 2.4 GHz 40 MHz	2422 ~ 2452	OFDM (256QAM)	40 MHz	Up to 800 Mbps
IEEE 802.11ax 2.4 GHz 20 MHz	2412 ~ 2462	OFDMA	20 MHz	MCS11
IEEE 802.11ax 2.4 GHz 40 MHz	2422 ~ 2452	OFDMA	40 MHz	MCS11
Antenna information	ANT	Model Number	Type	Max. Gain (dBi)
	ANT-0	SW25DEC100P	Internal PCB Antenna	1.9
	ANT-1/2/3	SW25DEC200P	Internal PCB Antenna	1.9
	Directional Gain			4.63
Antenna Delivery	See section 3.1			
Operate Temp. Range	0 ~ +40 ℃			
EUT Power Rating	DC 12 V, 3.33 A			

Frequency Band	Max. RF Output Power (W)
IEEE 802.11b	0.357
IEEE 802.11g	0.345
IEEE 802.11n 2.4 GHz 20 MHz	0.340
IEEE 802.11n 2.4 GHz 40 MHz	0.157
IEEE 802.11n (256QAM) 2.4GHz 20MHz	0.343
IEEE 802.11n (256QAM) 2.4GHz 40MHz	0.159
IEEE 802.11ax_HE20:	0.346
IEEE 802.11ax_HE40:	0.161

Beamforming on

Frequency Band	Max. RF Output Power (W)
IEEE 802.11n 2.4 GHz 20 MHz	0.326
IEEE 802.11n 2.4 GHz 40 MHz	0.153
IEEE 802.11n (256QAM) 2.4GHz 20MHz	0.337
IEEE 802.11n (256QAM) 2.4GHz 40MHz	0.155
IEEE 802.11ax_HE20:	0.343
IEEE 802.11ax_HE40:	0.157

3 Test Methodology

3.1. Mode of Operation

In the test report use EUT model: PG2494 to operate testing.

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Pre-Test Mode
Mode 1: Transmit Mode
Mode 2: IEEE 802.11b Continuous TX Mode
Mode 3: IEEE 802.11g Continuous TX Mode
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz(64QAM) Continuous TX Mode
Mode 5: IEEE 802.11n 2.4 GHz 40 MHz(64QAM) Continuous TX Mode
Mode 6: IEEE 802.11n 2.4 GHz 20 MHz(256QAM) Continuous TX Mode
Mode 7: IEEE 802.11n 2.4 GHz 40 MHz(256QAM) Continuous TX Mode
Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode
Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode

Final-Test Mode
Mode 1: Transmit Mode
Mode 2: IEEE 802.11b Continuous TX Mode
Mode 3: IEEE 802.11g Continuous TX Mode
Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode
Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes.

Note 1: This product supports normal mode and Beamforming on mode. According to power table, the normal mode is worst power. So, normal mode has to test and record results for Conducted.

Note 2: Investigation has been done on all the possible configurations for searching the worst cases (2.4 GHz HE20/HE40 covers 64QAM/256QAM). The table is a list of the test modes show in this test report.

Note 3: IEEE 802.11ax test results only support Full RU。

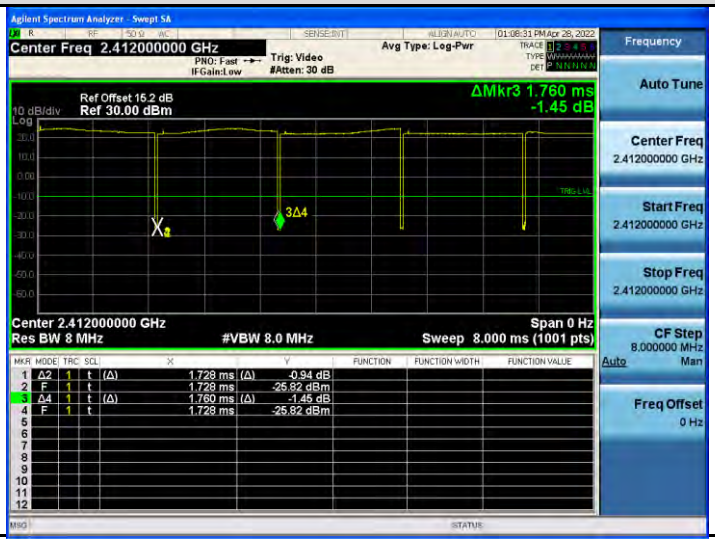
Test Mode	ANT-0	ANT-1	ANT-2	ANT-3	ANT-0+1+2+3
Mode 2	V	V	V	V	V
Mode 3	V	V	V	V	V
Mode 4	V	V	V	V	V
Mode 5	V	V	V	V	V
Mode 6	V	V	V	V	V
Mode 7	V	V	V	V	V
Mode 8	V	V	V	V	V
Mode 9	V	V	V	V	V

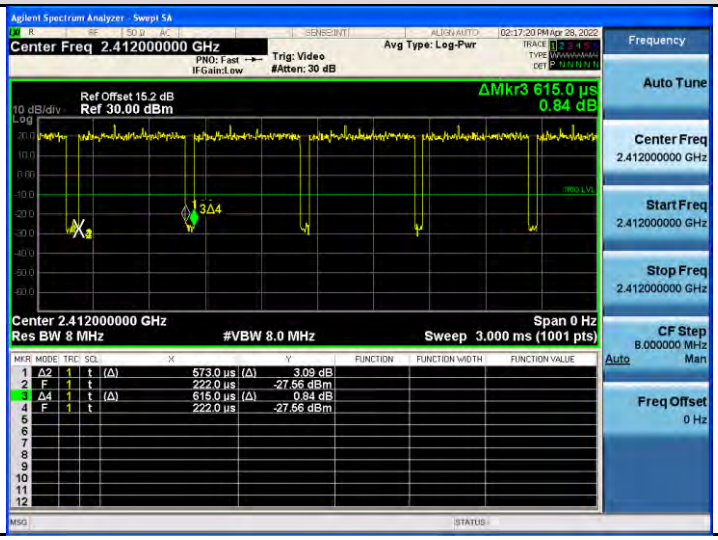
Test Mode	Antenna Delivery	Data Rate (Mbps)	Test Channel
Mode 2	4TX (CDD)	1	1, 6, 11
Mode 3	4TX (CDD)	6	1, 6, 11
Mode 4	4TX (CDD / Beamforming on)	26	1, 6, 11
Mode 5	4TX (CDD / Beamforming on)	54	3, 6, 9
Mode 6	4TX (CDD / Beamforming on)	26	1, 6, 11
Mode 7	4TX (CDD / Beamforming on)	54	3, 6, 9
Mode 8	4TX (CDD / Beamforming on)	19.5	1, 6, 11
Mode 9	4TX (CDD / Beamforming on)	40.5	3, 6, 9

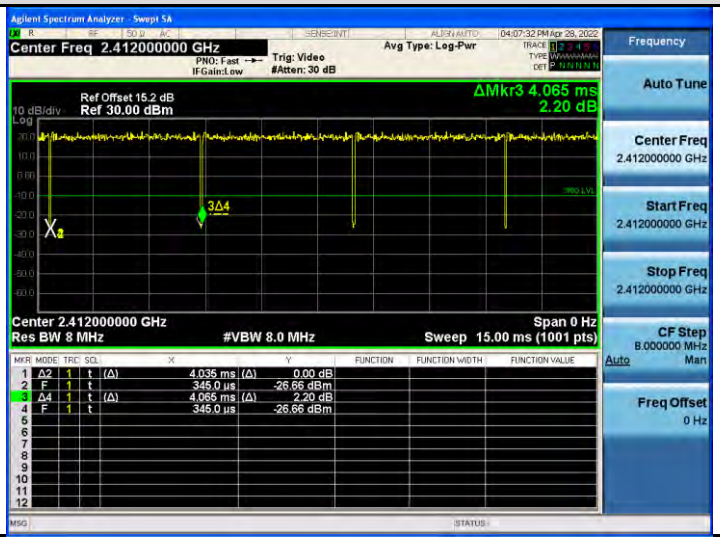
Duty cycle

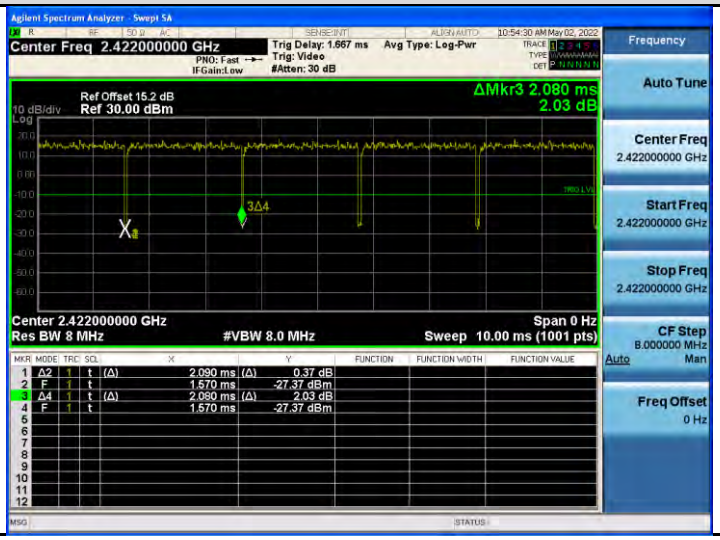
Test Mode	Frequency (MHz)	on time (ms)	on+off time (ms)	Duty cycle	Duty Factor (dB)	1/T Minimum VBW (kHz)
Mode 2	2412	1.728	1.760	0.982	0.080	0.010
Mode 3	2412	0.573	0.615	0.932	0.307	1.745
Mode 8	2412	4.035	4.065	0.993	0.032	0.010
Mode 9	2422	2.080	2.090	0.995	0.021	0.010

Duty Cycle Graphs

Mode 2: IEEE 802.11b Continuous TX mode	
On+off time	

Mode 3: IEEE 802.11g Continuous TX mode	
On+off time	

Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode	
On+off time	

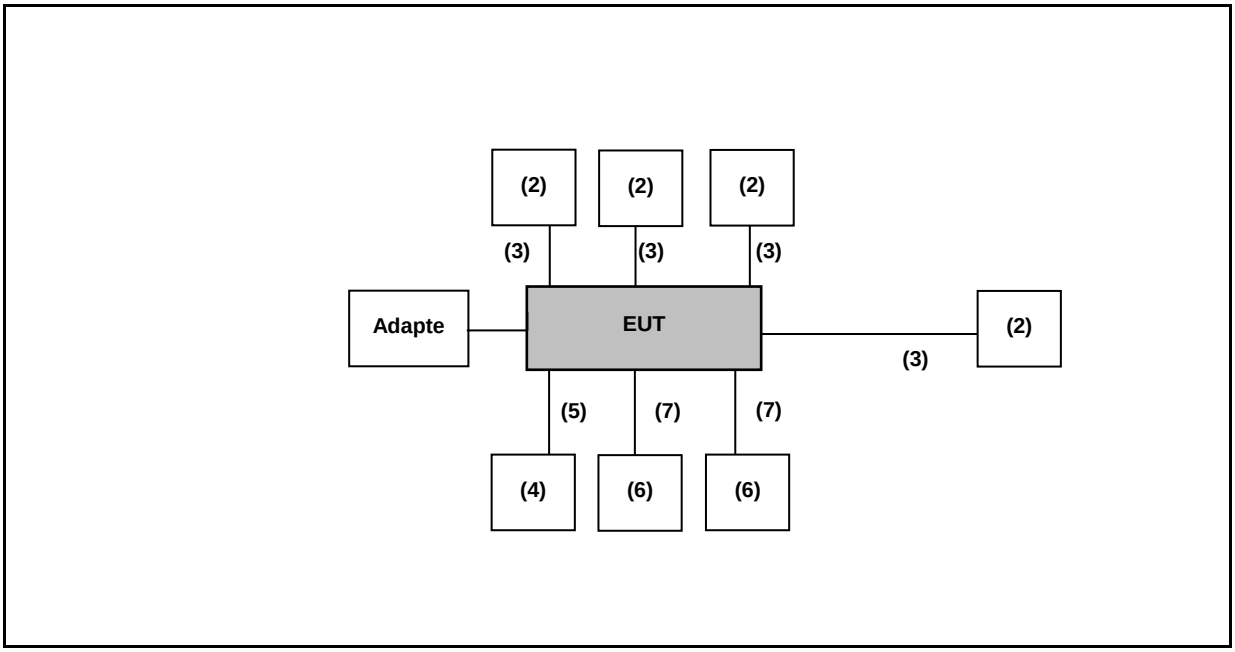
Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode	
On+off time	

3.2. EUT Test Step

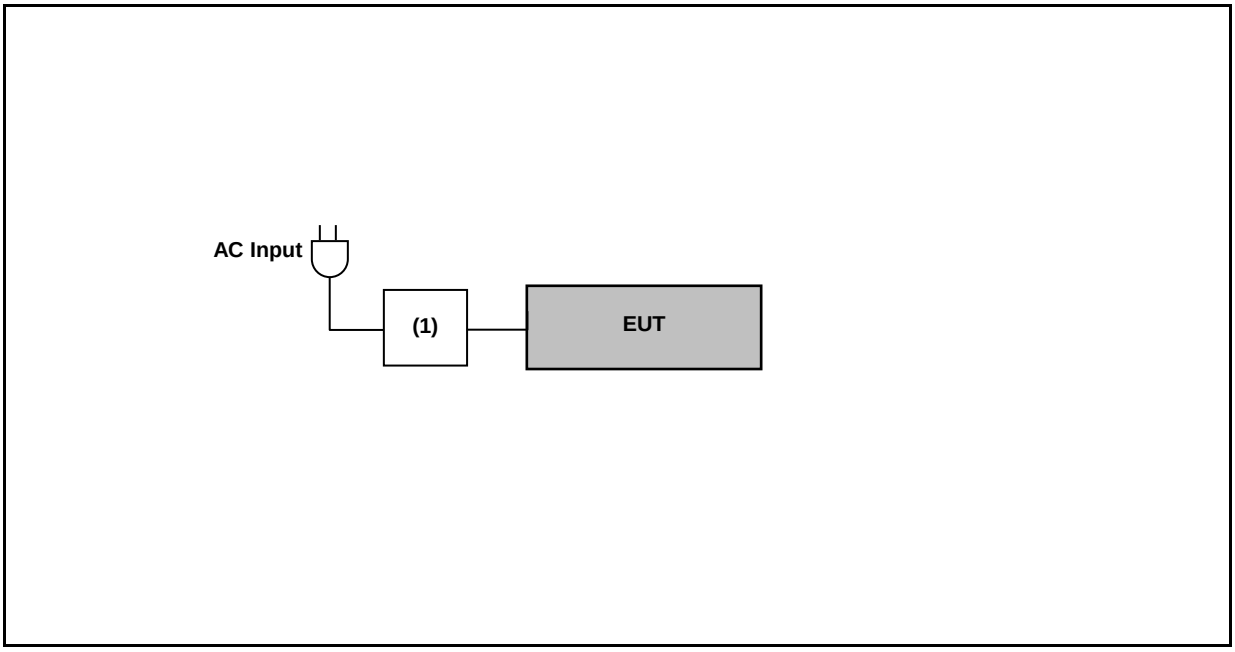
1.	Setup the EUT shown on “Configuration of Test System Details”.
2.	Turn on the power of all equipment.
3.	Turn on TX function.
4.	EUT run test program.

3.3. Configuration of Test System Details

Conduction Emission



Radiated Emission



Product		Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	ASUS	UX410UQ	---	---
(2)	Notebook	ASUS	P1448U	---	---
(3)	LAN Cable	TATUNG	CAT6E	---	---
(4)	HDD	Transcend	TS1TSJ25A3K-RU	---	---
(5)	USB Cable	Transcend	TS1TSJ25A3K-RU	---	---
(6)	Telephone	TENTEL	K-762	---	---
(7)	RJ11	TENTEL	K-762	---	---

3.4. Test Instruments

For Conducted Emission
Test Period: May 14, 2022
Testing Engineer: Chi Chang

Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Test Receiver	R&S	ESCI	100367	May 21, 2021	1 year
☐	Test Receiver	R&S	ESCI	100722	Nov. 02, 2021	1 year
☐	Test Receiver	R&S	ESCI	101000	Nov. 26, 2021	1 year
☒	LISN	R&S	ENV216	101040	Apr. 06, 2022	1 year
☒	LISN	R&S	ENV216	101041	Apr. 15, 2022	1 year
☒	RF Cable	Woken	00100D1380194M	TE-02-03	May 28, 2021	1 year
☒	Software	EZ EMC	1.1.4.3	N/A	N.C.R.	---

For Conducted
Test Period: May 04 ~ May 10, 2022
Testing Engineer: Brian Lin

Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Power Sensor	Anritsu	MA2411B	1126022	Sep. 03, 2021	1 year
☒	Power Meter	Anritsu	ML2495A	1135009	Sep. 03, 2021	1 year
☐	Power Sensor	Agilent	N1921A	MY45241957	Dec. 06, 2021	1 year
☐	Power Meter	Agilent	N1911A	MY45101619	Dec. 06, 2021	1 year
☐	Spectrum Analyzer (10 Hz~26.5 GHz)	Keysight	N9010B	MY59071418	Mar. 16, 2022	1 year
☒	Spectrum Analyzer (9 kHz~26.5 GHz)	Agilent	N9010A	MY48030518	Jul. 23, 2021	1 year
☐	Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	Sep. 09, 2021	1 year
☐	Spectrum Analyzer (3 Hz~50 GHz)	Agilent	N9030A	MY53120541	Jan. 05, 2022	1 year
☐	Temperature & Humidity Chamber	TAICHY	MHU-225LA	980729	Mar. 30, 2021	1 year
☐	Signal Generator	Keysight	N5182B	MY53052569	Apr. 20, 2021	1 year
☐	Signal Generator	Keysight	N5182BX07	MY59360221	Apr. 20, 2021	1 year
☐	Bluetooth Tester	R&S	CBT	100350	Mar. 17, 2021	2 years
☐	Wireless Connectivity Tester	R&S	CMW270	102208	Jun. 02, 2021	1 year
☐	Power Supply	KEITHLEY	2303	4045290	Jan. 19, 2022	1 year
☐	RF Communication Test Set	HP	8920A	3344A03297	Aug. 10, 2021	1 year

Note: N.C.R. = No Calibration Request.

For Radiated Emissions

Test Period: Apr. 20 ~ Apr. 30, 2022

Testing Engineer: JS Liao

Radiation test sites		Semi Anechoic Room				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Spectrum Analyzer (10 Hz~44 GHz)	Keysight	N9010A	MY52221312	Jan. 13, 2022	1 year
☐	Spectrum Analyzer (3 Hz~50 GHz)	Agilent	N9030A	MY53120541	Jan. 05, 2022	1 year
☐	Amplifier (100 kHz~1.3 GHz)	Agilent	8447D	2944A11119	Jan. 14, 2022	1 year
☐	Amplifier (100 kHz~1.3 GHz)	Agilent	8447D	2944A10961	Jul. 06, 2021	1 year
☒	Preamplifier (10k Hz~3000 MHz)	EMCI	EMC001330	980862	Nov. 30, 2021	1 year
☐	Amplifier (1 GHz~26.5 GHz)	Agilent	8449B	3008A02237	Oct. 21, 2021	1 year
☒	Pre Amplifier (1~26.5 GHz)	Agilent	8449B	3008A02455	Jul. 12, 2021	1 year
☐	Preamplifier (1 GHz~26.5 GHz)	EMCI	EMC012645SE	980289	Jan. 13, 2022	1 year
☐	Preamplifier (26.5 GHz~40 GHz)	EMCI	EMC2654045	980028	Aug. 19, 2021	1 year
☐	Loop Antenna (9 kHz~30 MHz)	COM-POWER CORPORATION	AL-130	121014	Apr. 07, 2021	1 year
☐	Trilog Broadband Antenna (30 kHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	01146	Jul. 19, 2021	1 year
☐	Trilog Broadband Antenna (30 kHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	416	Nov. 17, 2021	1 year
☐	Broadband Horn Antenna (1 GHz~18 GHz)	Schwarzbeck Mess-Elektronik	9120D	02207	Jul. 09, 2021	1 year
☒	Broadband Horn Antenna (1 GHz~18 GHz)	Schwarzbeck Mess-Elektronik	9120D	9120D-550	Aug. 24, 2021	1 year
☒	Broadband Horn Antenna (18 GHz~40 GHz)	Schwarzbeck Mess-Elektronik	9170	9170-320	Aug. 24, 2021	1 year
☐	Horn Antenna (18 GHz~40 GHz)	ETS	3116	00086467	Dec. 03, 2021	1 year
☒	Microwave Cable	EMCI	EMC104-SM-SM-13000	170814	Feb. 18, 2022	1 year
☒	Microwave Cable	SUHNER	suflex104	313229/4	Fed. 18, 2022	1 year
☐	Microwave Cable	EMCI	EMC102-KM-KM-14000	151001	Feb. 18, 2022	1 year
☒	Cable	EMCI	EMCCFD400-NM-NM-6000	210902	Feb. 18, 2022	1 year
☐	RF Cable (30-1000 MHz)	EMCI	EMC104-N-N-2000	TE01-2	Feb. 18, 2022	1 year
☐	RF Cable (30-1000 MHz)	EMCI	EMC104-N-N-6000	TE01-1	Feb. 18, 2022	1 year
☐	RF Cable (30-1000 MHz)	EMCI	EMC 106-SM-NM-1000	171219 (TE01-3)	Feb. 18, 2022	1 year
☐	Bluetooth Tester	R&S	CBT	100350	Mar. 17, 2021	2 years
☐	Wireless Connectivity Tester	R&S	CMW270	102208	Jun. 02, 2021	1 year
☐	Power Supply	KEITHLEY	2303	4045290	Jan. 19, 2022	1 year
☒	Software	EZ EMC	1.1.4.4	N/A	N.C.R.	---

Note: N.C.R. = No Calibration Request.

3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

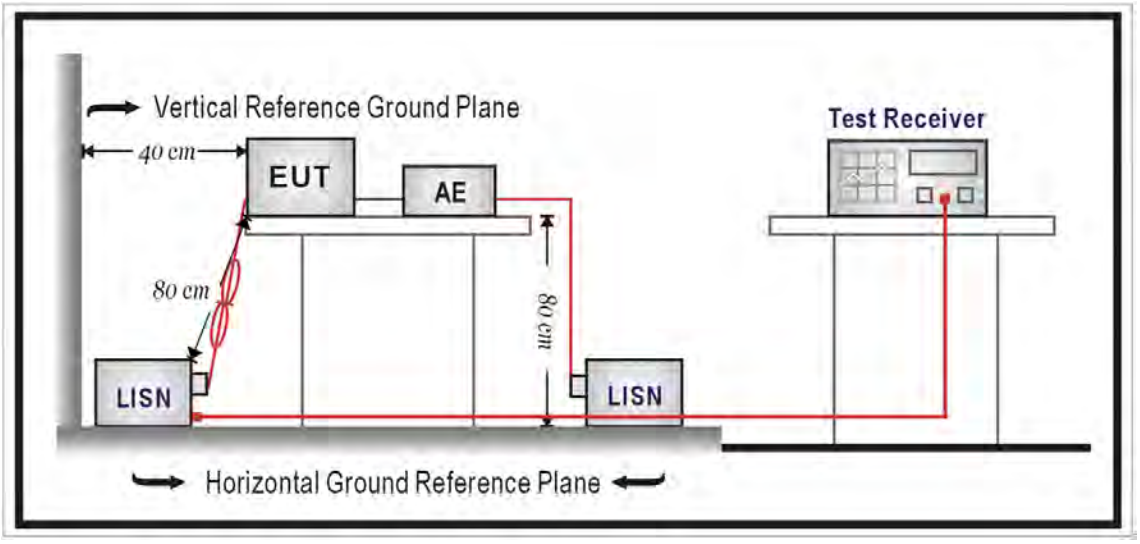
4 Measurement Procedure

4.1. AC Power Line Conducted Emission Measurement

■ **Limit**

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

■ **Test Setup**



■ **Test Procedure**

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 Ω// 50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 Ω// 50 uH coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.2. Radiated Emission Measurement

■ **Limit**

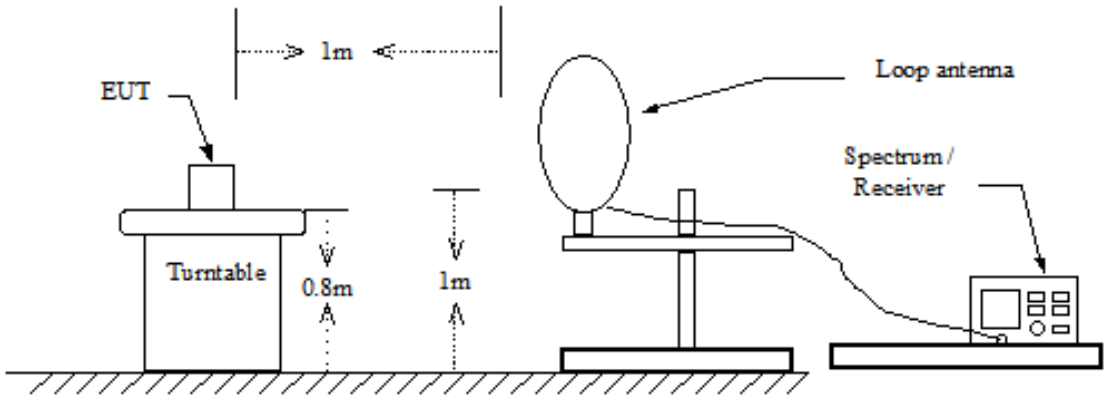
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meters)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

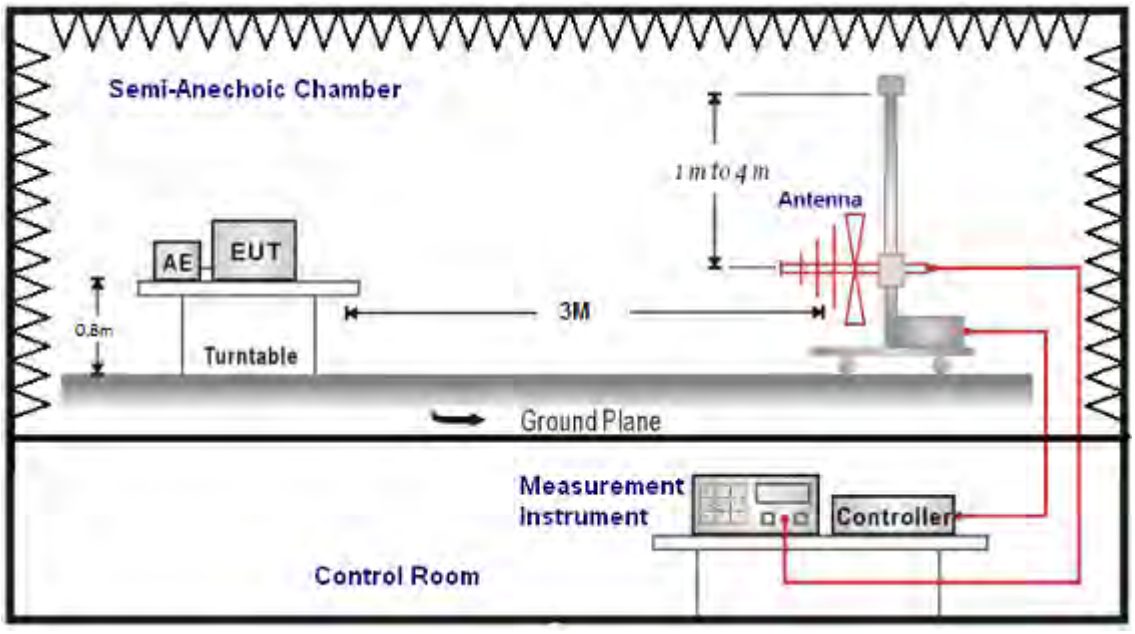
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

■ **Setup**

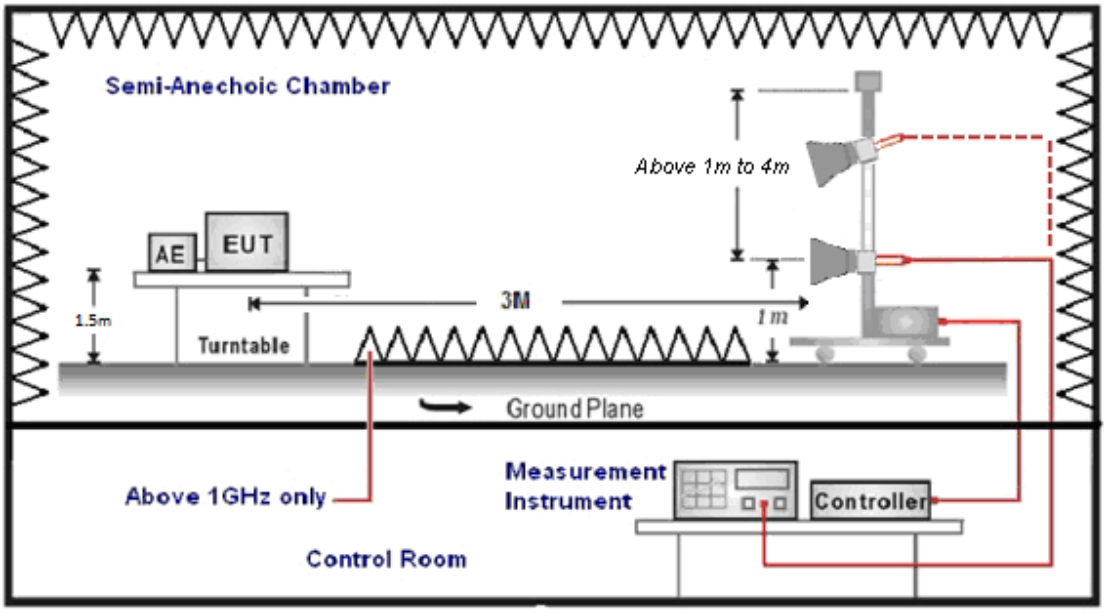
9 kHz ~ 30 MHz



Below 1 GHz



Above 1 GHz



■ **Test Procedure**

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements when Duty cycle >0.98 / 1/T for average measurements when Duty cycle <0.98. A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 –26.5 GHz at a distance of 3 meter. The antenna at an angle toward the source of the emission. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer’s 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)
FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.
P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)
The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:
(a) For fundamental frequency : Transmitter Output < +30 dBm
(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

4.3. Maximum Conducted Output Power Measurement

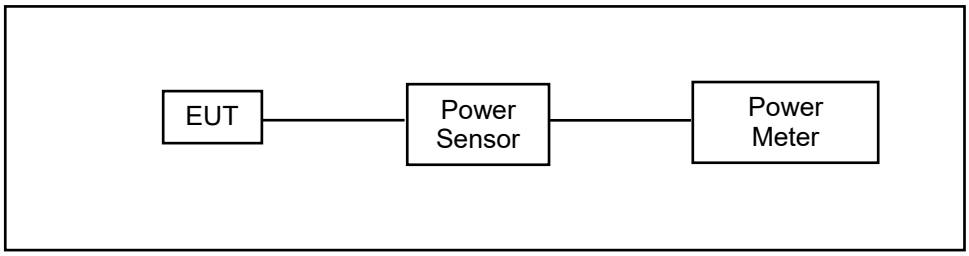
■ **Limit**

For systems using digital modulation in the 2400-2483.5 MHz, the limit for maximum output power is 30 dBm.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz /
IEEE 802.11ax 2.4 GHz 20 MHz / IEEE 802.11ax 2.4 GHz 40 MHz

■ **Test Setup**



■ **Test Procedure**

The testing follows the Measurement Procedure of ANSI C63.10:2013 section 11.9.2.3.2 Method AVGPM.

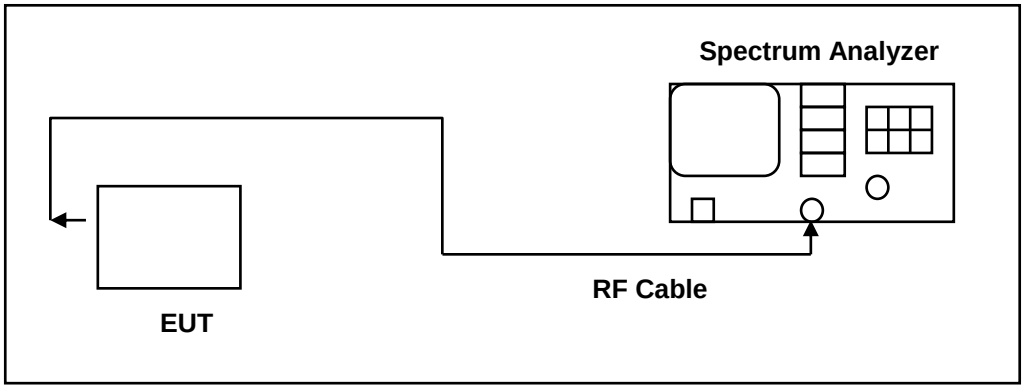
The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor.

4.4. 6 dB RF Bandwidth Measurement

■ **Limit**

6 dB RF Bandwidth: Systems using digital modulation techniques may operate in the 2400–2483.5 MHz bands. The minimum 6 dB band-width shall be at least 500 kHz.

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.8.2 option2 for compliance to FCC 47CFR 15.247 requirements.

6 dB RF Bandwidth: The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A peak output reading was taken, a DISPLAY line was drawn 6 dB lower than peak level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel low, middle, high)

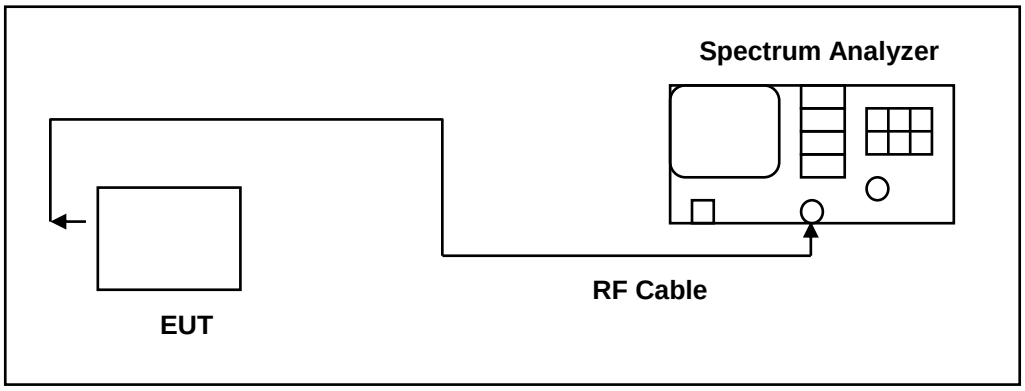
4.5. Maximum Power Spectral Density Measurement

■ **Limit**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz /
IEEE 802.11ax 2.4 GHz 20 MHz / IEEE 802.11ax 2.4 GHz 40 MHz

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.10.2 Method PKPSD for compliance to FCC 47CFR 15.247 requirements.

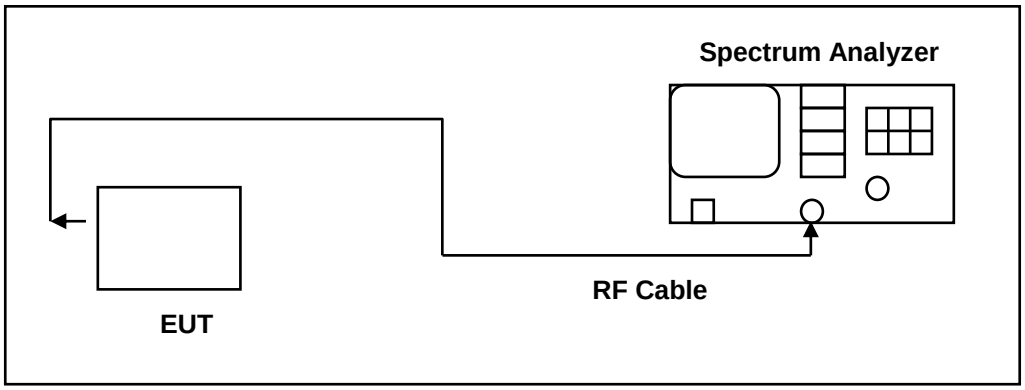
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 × RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.6. Out of Band Conducted Emissions Measurement

■ **Limit**

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 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

■ **Test Setup**



■ **Test Procedure**

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 30 dBbelow that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.
All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band.
The test was performed at 3 channels.

4.7. Antenna Measurement

■ **Limit**

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

■ **Antenna Description**

See section 2 – antenna information.

■ **Directional Gain Calculated**

Directional Gain = 10*log{[10^(G1/10)+10^(G2/10)+⋯+10^(Gn/10)]/NANT}

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	1.9
IEEE 802.11g	1.9
IEEE 802.11n 2.4 GHz 20 MHz	1.9
IEEE 802.11n 2.4 GHz 40 MHz	1.9
IEEE 802.11n (256QAM) 2.4GHz 20MHz	1.9
IEEE 802.11n (256QAM) 2.4GHz 40MHz	1.9
IEEE 802.11ax_HE20:	1.9
IEEE 802.11ax_HE40:	1.9

Beamforming on

Directional Gain = GANT + Array Gain

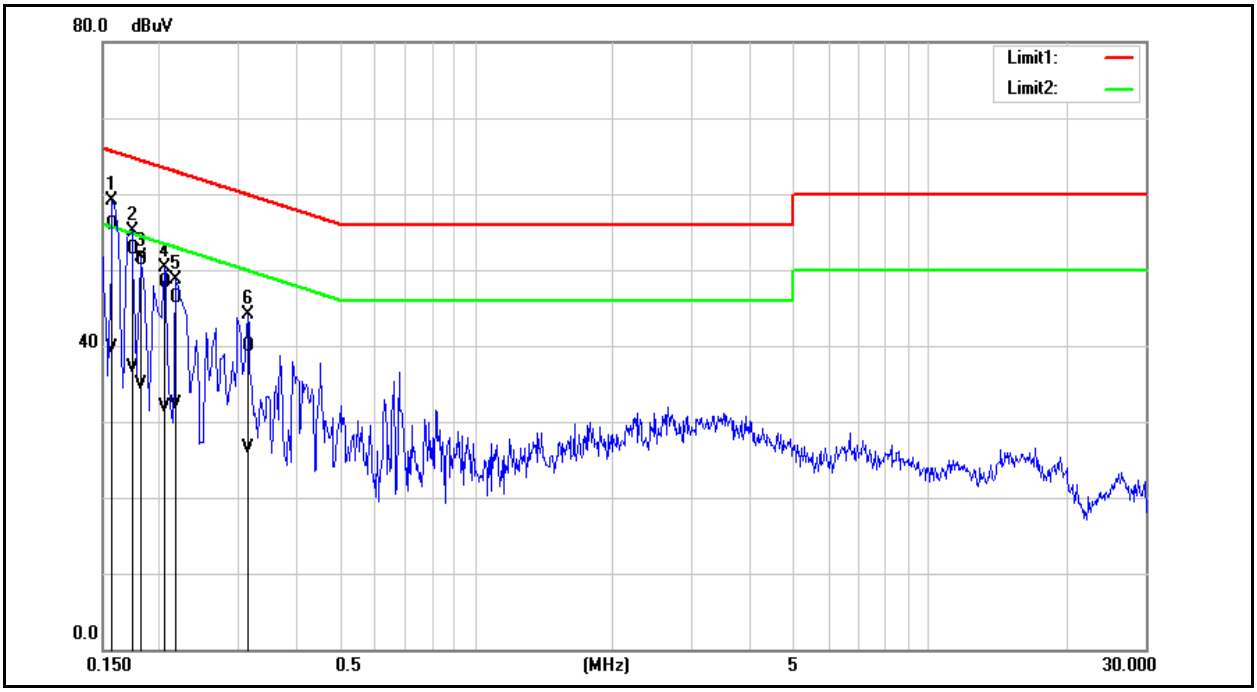
Array Gain is the actual measurement.

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11n 2.4 GHz 20 MHz	4.63
IEEE 802.11n 2.4 GHz 40 MHz	4.63
IEEE 802.11n (256QAM) 2.4GHz 20MHz	4.63
IEEE 802.11n (256QAM) 2.4GHz 40MHz	4.63
IEEE 802.11ax_HE20:	4.63
IEEE 802.11ax_HE40:	4.63

5 Test Results

5.1. Conducted Emission

Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			

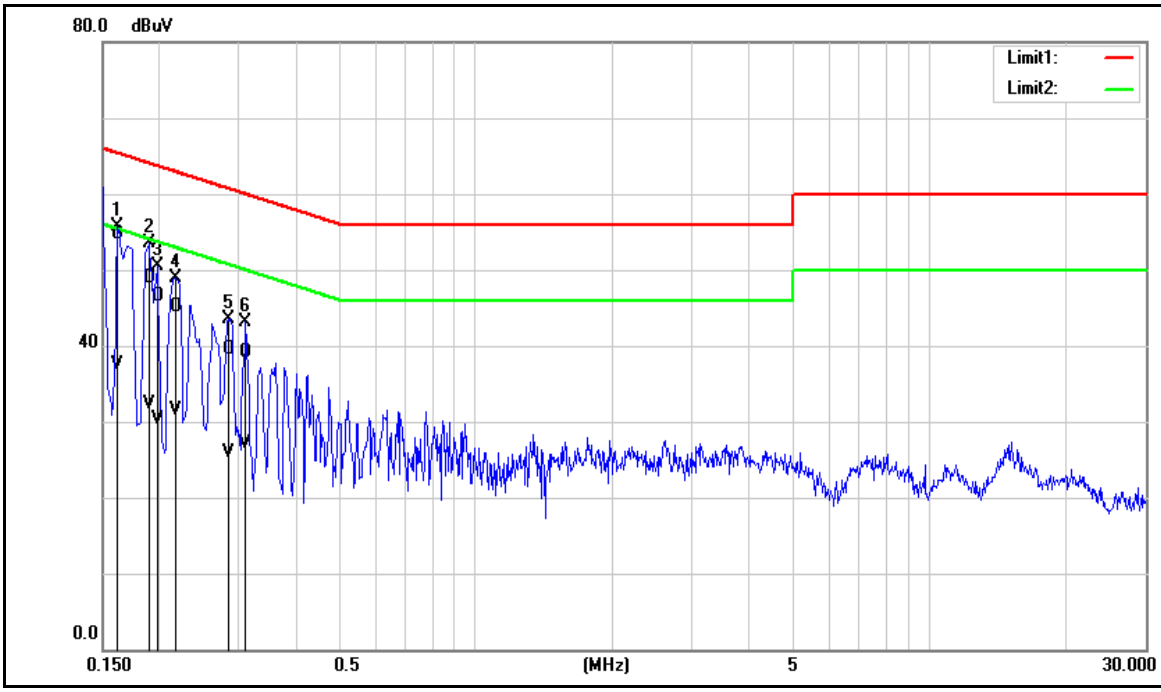


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1580	46.26	30.01	9.60	55.86	39.61	65.57	55.57	-9.71	-15.96	Pass
2	0.1740	43.13	27.56	9.60	52.73	37.16	64.77	54.77	-12.04	-17.61	Pass
3	0.1820	41.78	25.35	9.60	51.38	34.95	64.39	54.39	-13.01	-19.44	Pass
4	0.2060	38.80	22.32	9.60	48.40	31.92	63.37	53.37	-14.97	-21.45	Pass
5	0.2180	36.80	22.62	9.60	46.40	32.22	62.89	52.89	-16.49	-20.67	Pass
6	0.3140	30.40	16.85	9.60	40.00	26.45	59.86	49.86	-19.86	-23.41	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.247	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1620	45.06	27.79	9.66	54.72	37.45	65.36	55.36	-10.64	-17.91	Pass
2	0.1900	39.34	22.67	9.66	49.00	32.33	64.04	54.04	-15.04	-21.71	Pass
3	0.1980	36.85	20.57	9.66	46.51	30.23	63.69	53.69	-17.18	-23.46	Pass
4	0.2180	35.42	21.75	9.66	45.08	31.41	62.89	52.89	-17.81	-21.48	Pass
5	0.2860	29.78	16.32	9.66	39.44	25.98	60.64	50.64	-21.20	-24.66	Pass
6	0.3100	29.44	17.42	9.66	39.10	27.08	59.97	49.97	-20.87	-22.89	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

5.2. Conducted Test Results

Maximum Conducted Output Power Measurement

Test Mode	Frequency (MHz)	RF Power setting in Test Software				Test Software Version
		ANT-0	ANT-1	ANT-2	ANT-3	
Mode 2	2412	21.0	21.0	21.0	21.0	Putty
	2437	21.0	21.0	21.0	21.0	
	2462	20.0	20.0	20.0	20.0	
Mode 3	2412	20.0	20.0	20.0	20.0	
	2437	23.0	23.0	23.0	23.0	
	2462	19.0	19.0	19.0	19.0	
Mode 4	2412	19.0	19.0	19.0	19.0	
	2437	23.0	23.0	23.0	23.0	
	2462	18.0	18.0	18.0	18.0	
Mode 5	2422	15.0	15.0	15.0	15.0	
	2437	17.0	17.0	17.0	17.0	
	2452	15.0	15.0	15.0	15.0	
Mode 6	2412	19.0	19.0	19.0	19.0	
	2437	23.0	23.0	23.0	23.0	
	2462	18.0	18.0	18.0	18.0	
Mode 7	2412	15.0	15.0	15.0	15.0	
	2437	17.0	17.0	17.0	17.0	
	2462	15.0	15.0	15.0	15.0	
Mode 8	2412	19.0	19.0	19.0	19.0	
	2437	23.0	23.0	23.0	23.0	
	2462	18.0	18.0	18.0	18.0	
Mode 9	2422	15.0	15.0	15.0	15.0	
	2437	17.0	17.0	17.0	17.0	
	2452	15.0	15.0	15.0	15.0	

Beamforming on

Test Mode	Frequency (MHz)	RF Power setting in Test Software				Test Software Version
		ANT-0	ANT-1	ANT-2	ANT-3	
Mode 4	2412	19.00	19.00	19.00	19.00	Putty
	2437	23.00	23.00	23.00	23.00	
	2462	18.00	18.00	18.00	18.00	
Mode 5	2422	15.00	15.00	15.00	15.00	
	2437	17.00	17.00	17.00	17.00	
	2452	15.00	15.00	15.00	15.00	
Mode 6	2412	19.00	19.00	19.00	19.00	
	2437	23.00	23.00	23.00	23.00	
	2462	18.00	18.00	18.00	18.00	
Mode 7	2412	15.00	15.00	15.00	15.00	
	2437	17.00	17.00	17.00	17.00	
	2462	15.00	15.00	15.00	15.00	
Mode 8	2412	19.00	19.00	19.00	19.00	
	2437	23.00	23.00	23.00	23.00	
	2462	18.00	18.00	18.00	18.00	
Mode 9	2422	15.00	15.00	15.00	15.00	
	2437	17.00	17.00	17.00	17.00	
	2452	15.00	15.00	15.00	15.00	

Test Mode	Frequency (MHz)	Data Rate	Average Output Power										
			Measurement Results										Limit
			ANT-0		ANT-1		ANT-2		ANT-3		ANT-0+1+2+3		
			dBm	W	dBm	W	dBm	W	dBm	W	dBm	W	dBm
Mode 2	2412	1 M	19.45	0.088	19.68	0.093	19.32	0.086	19.57	0.091	25.53	0.357	≤ 30.00
	2437		19.29	0.085	19.36	0.086	19.03	0.080	19.30	0.085	25.27	0.337	≤ 30.00
	2462		18.01	0.063	18.09	0.064	17.92	0.062	18.05	0.064	24.04	0.254	≤ 30.00
Mode 3	2412	6 M	16.64	0.046	16.71	0.047	16.55	0.045	16.66	0.046	22.66	0.185	≤ 30.00
	2437		19.32	0.086	19.64	0.092	19.03	0.080	19.44	0.088	25.38	0.345	≤ 30.00
	2462		15.41	0.035	15.52	0.036	15.33	0.034	15.51	0.036	21.46	0.140	≤ 30.00
Mode 4	2412	26 M	15.65	0.037	15.89	0.039	15.47	0.035	15.79	0.038	21.72	0.149	≤ 30.00
	2437		19.35	0.086	19.44	0.088	19.02	0.080	19.36	0.086	25.32	0.340	≤ 30.00
	2462		14.45	0.028	14.69	0.029	14.25	0.027	14.49	0.028	20.49	0.112	≤ 30.00
Mode 5	2422	54 M	14.02	0.025	14.14	0.026	13.79	0.024	14.05	0.025	20.02	0.100	≤ 30.00
	2437		15.89	0.039	16.09	0.041	15.85	0.038	15.98	0.040	21.97	0.157	≤ 30.00
	2452		13.85	0.024	13.93	0.025	13.55	0.023	13.88	0.024	19.83	0.096	≤ 30.00
Mode 6	2412	26 M	15.68	0.037	15.96	0.039	15.50	0.035	15.91	0.039	21.79	0.151	≤ 30.00
	2437		19.37	0.086	19.47	0.089	19.07	0.081	19.39	0.087	25.35	0.343	≤ 30.00
	2462		14.47	0.028	14.72	0.030	14.27	0.027	14.52	0.028	20.52	0.113	≤ 30.00
Mode 7	2422	54 M	14.03	0.025	14.15	0.026	13.81	0.024	14.07	0.026	20.04	0.101	≤ 30.00
	2437		15.92	0.039	16.13	0.041	15.91	0.039	16.01	0.040	22.01	0.159	≤ 30.00
	2452		13.88	0.024	13.95	0.025	13.57	0.023	13.90	0.025	19.85	0.097	≤ 30.00
Mode 8	2412	MCS0	15.72	0.037	15.98	0.040	15.52	0.036	15.95	0.039	21.82	0.152	≤ 30.00
	2437		19.41	0.087	19.51	0.089	19.09	0.081	19.45	0.088	25.39	0.346	≤ 30.00
	2462		14.52	0.028	14.65	0.029	14.31	0.027	14.57	0.029	20.53	0.113	≤ 30.00
Mode 9	2422	MCS0	14.05	0.025	14.19	0.026	13.85	0.024	14.12	0.026	20.07	0.102	≤ 30.00
	2437		15.98	0.040	16.17	0.041	15.95	0.039	16.05	0.040	22.06	0.161	≤ 30.00
	2452		13.91	0.025	13.98	0.025	13.62	0.023	13.95	0.025	19.89	0.097	≤ 30.00

Note: The relevant measured result has the offset with cable loss already.

Beamforming on

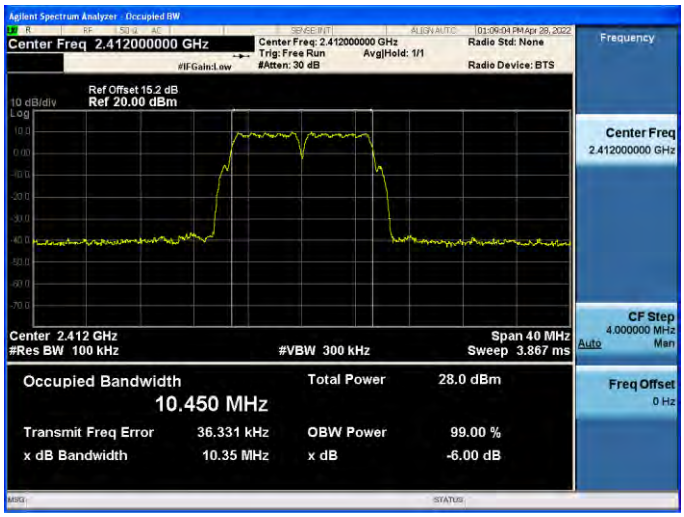
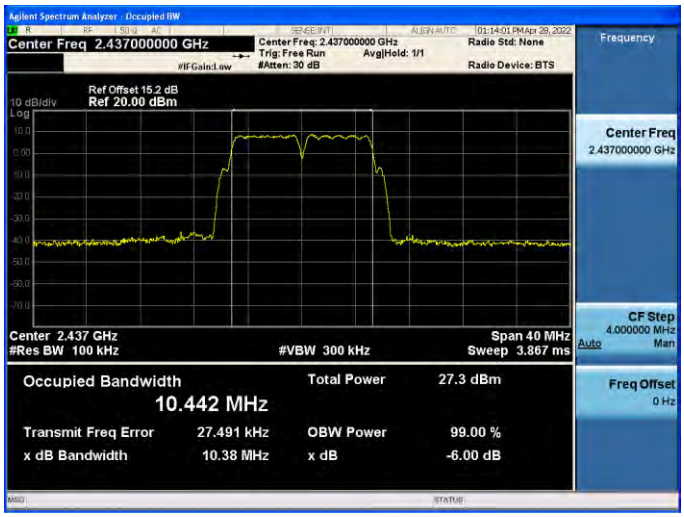
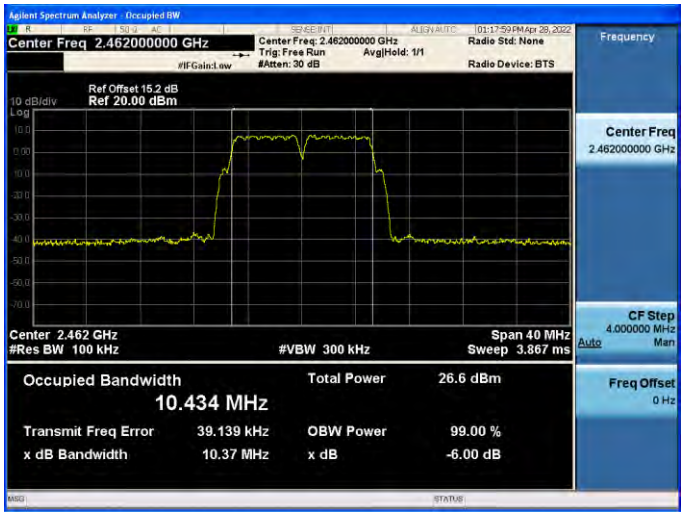
Test Mode	Frequency (MHz)	Data Rate	Average Output Power										
			Measurement Results										Limit
			ANT-0		ANT-1		ANT-2		ANT-3		ANT-0+1+2+3		
			dBm	W	dBm	W	dBm	W	dBm	W	dBm	W	dBm
Mode 4	2412	26 M	15.61	0.036	15.80	0.038	15.35	0.034	15.75	0.038	21.65	0.146	≤ 30.00
	2437		19.15	0.082	19.28	0.085	18.77	0.075	19.23	0.084	25.13	0.326	≤ 30.00
	2462		14.39	0.027	14.45	0.028	14.13	0.026	14.43	0.028	20.37	0.109	≤ 30.00
Mode 5	2422	54 M	13.82	0.024	13.93	0.025	13.69	0.023	13.87	0.024	19.85	0.097	≤ 30.00
	2437		15.81	0.038	15.96	0.039	15.68	0.037	15.89	0.039	21.86	0.153	≤ 30.00
	2452		13.74	0.024	13.85	0.024	13.45	0.022	13.81	0.024	19.74	0.094	≤ 30.00
Mode 6	2412	26 M	15.64	0.037	15.84	0.038	15.44	0.035	15.82	0.038	21.71	0.148	≤ 30.00
	2437		19.31	0.085	19.39	0.087	18.95	0.079	19.32	0.086	25.27	0.337	≤ 30.00
	2462		14.44	0.028	14.48	0.028	14.17	0.026	14.51	0.028	20.42	0.110	≤ 30.00
Mode 7	2422	54 M	13.89	0.024	13.97	0.025	13.75	0.024	13.92	0.025	19.90	0.098	≤ 30.00
	2437		15.88	0.039	15.99	0.040	15.76	0.038	15.94	0.039	21.91	0.155	≤ 30.00
	2452		13.79	0.024	13.89	0.024	13.52	0.022	13.84	0.024	19.78	0.095	≤ 30.00
Mode 8	2412	MCS0	15.68	0.037	15.92	0.039	15.47	0.035	15.87	0.039	21.76	0.150	≤ 30.00
	2437		19.38	0.087	19.46	0.088	19.05	0.080	19.41	0.087	25.35	0.343	≤ 30.00
	2462		14.48	0.028	14.57	0.029	14.25	0.027	14.54	0.028	20.48	0.112	≤ 30.00
Mode 9	2422	MCS0	13.95	0.025	14.03	0.025	13.78	0.024	13.99	0.025	19.96	0.099	≤ 30.00
	2437		15.91	0.039	16.04	0.040	15.81	0.038	15.97	0.040	21.95	0.157	≤ 30.00
	2452		13.84	0.024	13.93	0.025	13.58	0.023	13.87	0.024	19.83	0.096	≤ 30.00

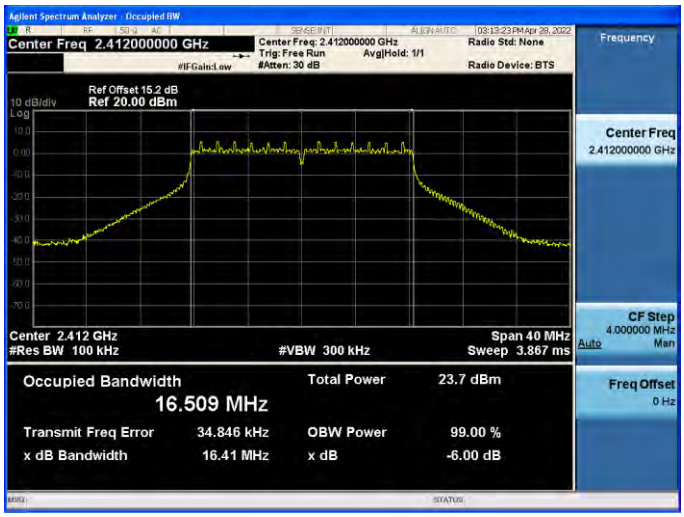
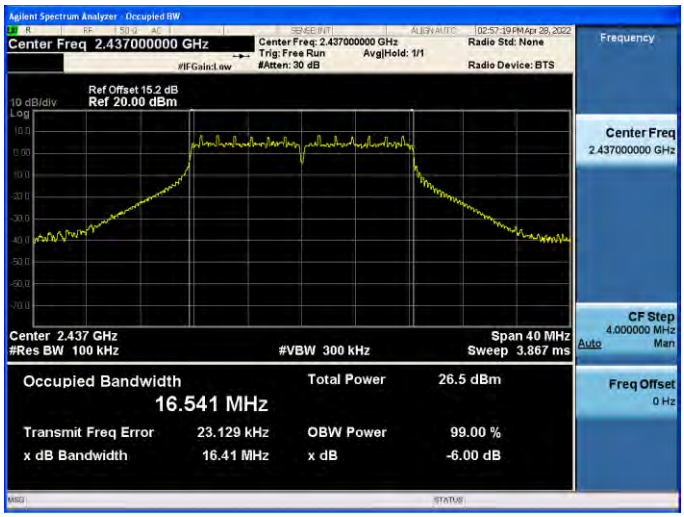
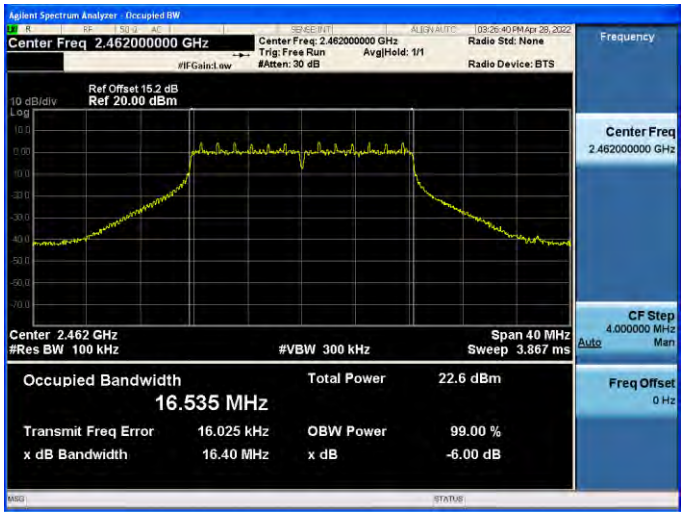
Note: The relevant measured result has the offset with cable loss already.

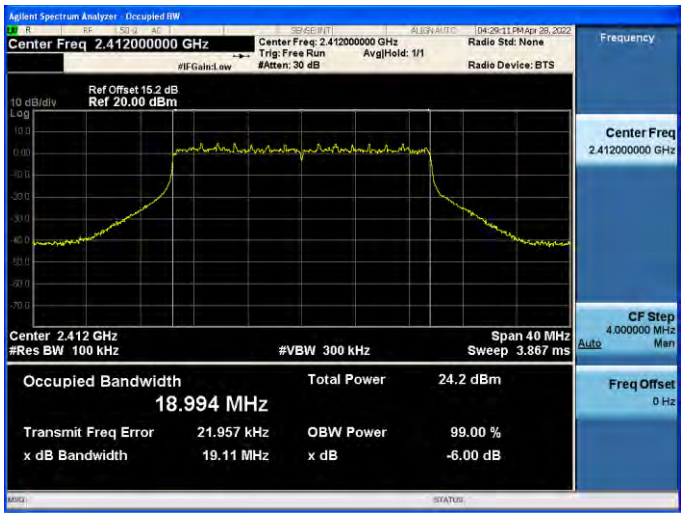
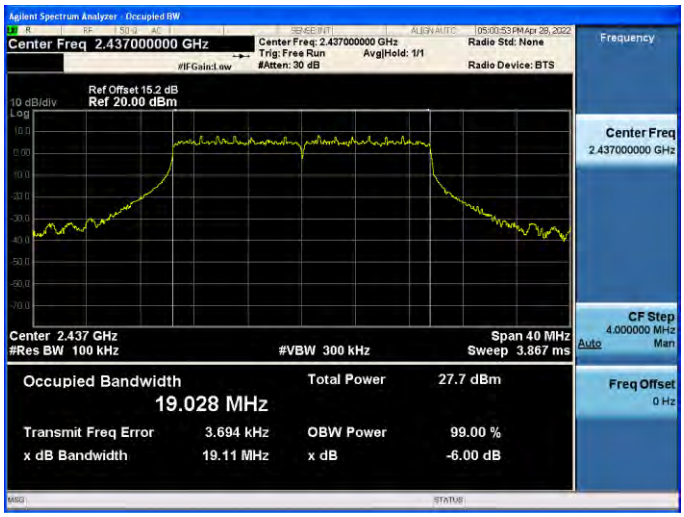
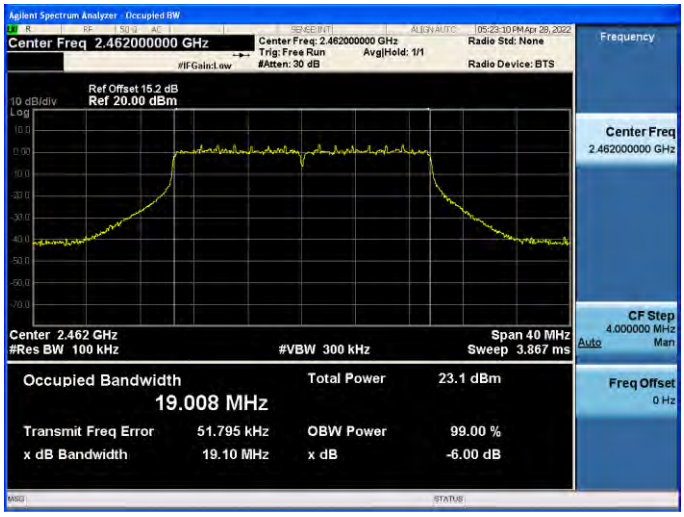
6 dB RF Bandwidth Measurement

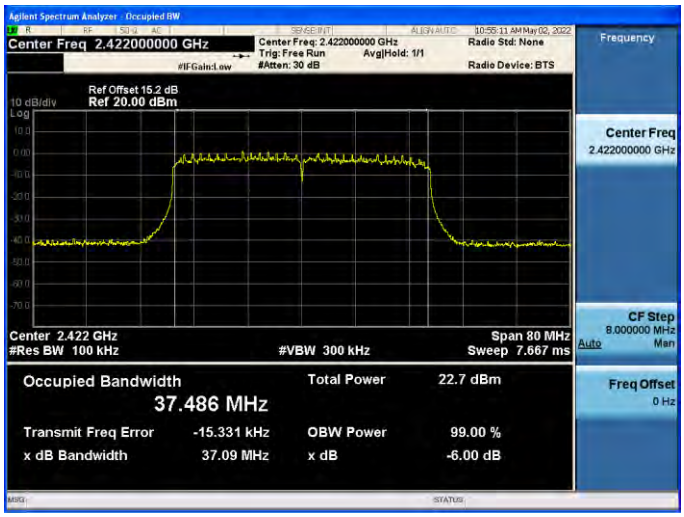
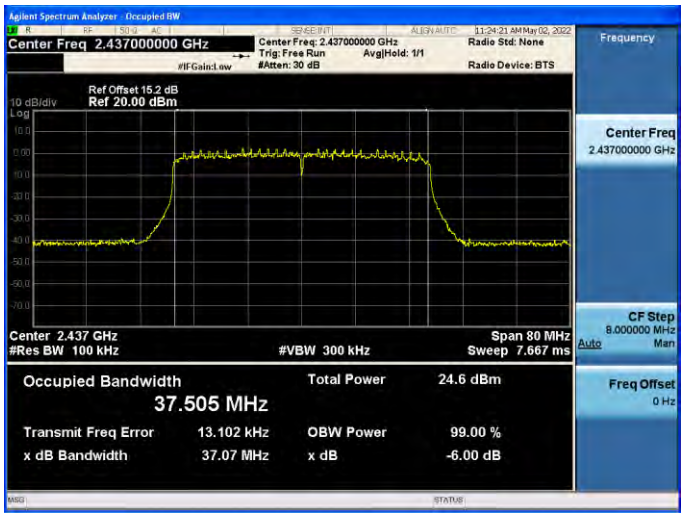
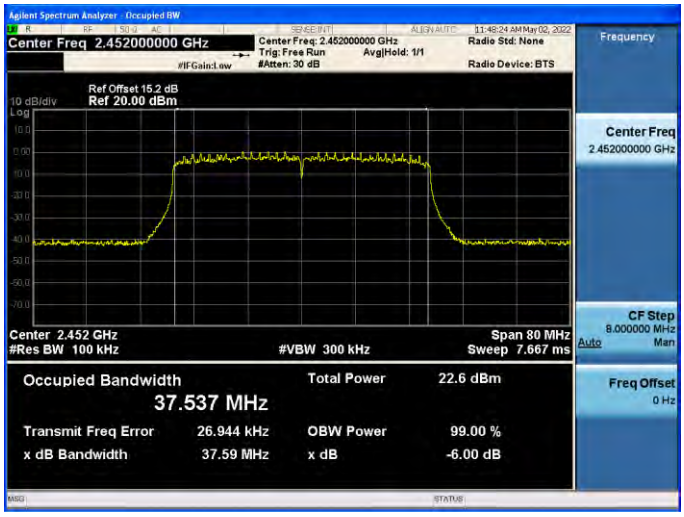
Test Mode	Frequency (MHz)	Measurement (kHz)				Limit (kHz)
		ANT-0	ANT-1	ANT-2	ANT-3	
Mode 2	2412	10350	10300	10410	10400	≥ 500
	2437	10380	10380	10320	10330	≥ 500
	2462	10370	10400	10340	10390	≥ 500
Mode 3	2412	16410	16410	16410	16420	≥ 500
	2437	16410	16390	16410	16410	≥ 500
	2462	16400	16400	16420	16420	≥ 500
Mode 8	2412	19110	19110	19050	19080	≥ 500
	2437	19110	19110	19070	19090	≥ 500
	2462	19100	19090	19040	19090	≥ 500
Mode 9	2422	37090	36730	36760	36810	≥ 500
	2437	37070	37060	37090	37570	≥ 500
	2452	37590	37390	37660	37640	≥ 500

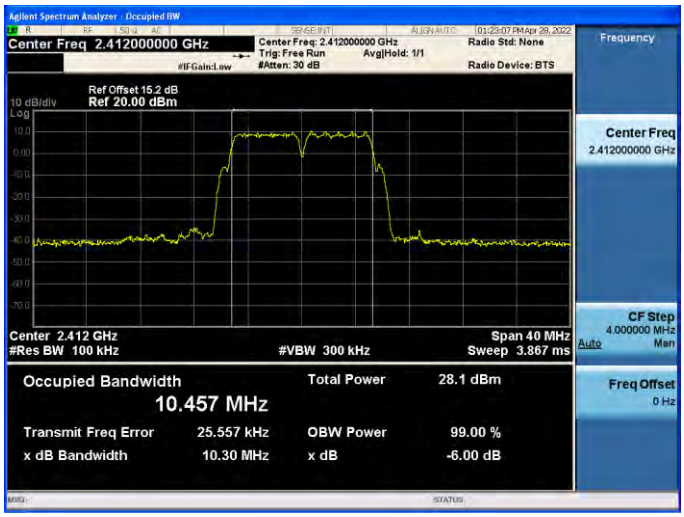
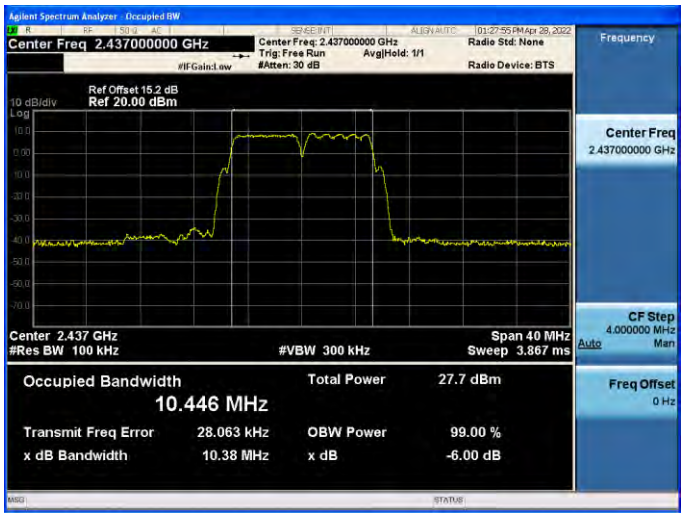
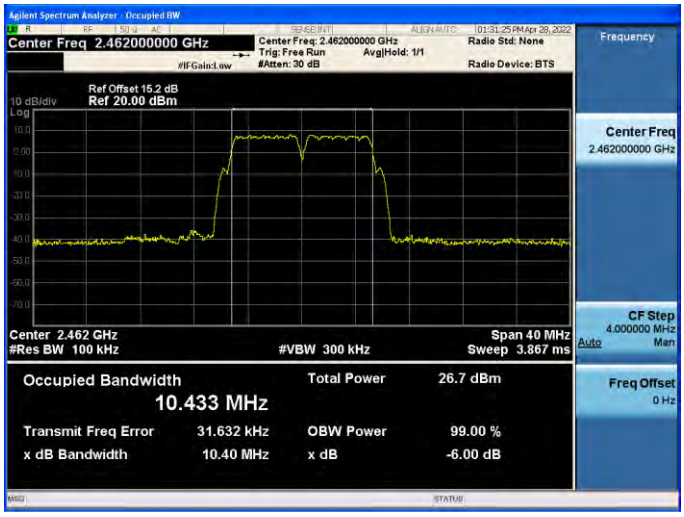
■ **Test Graphs**

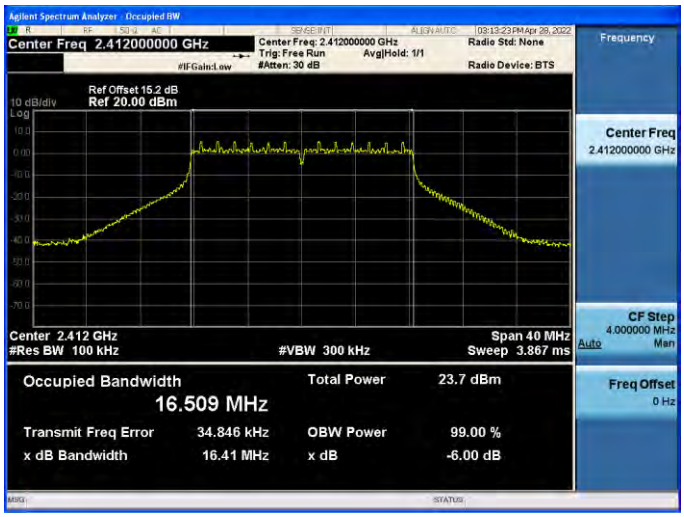
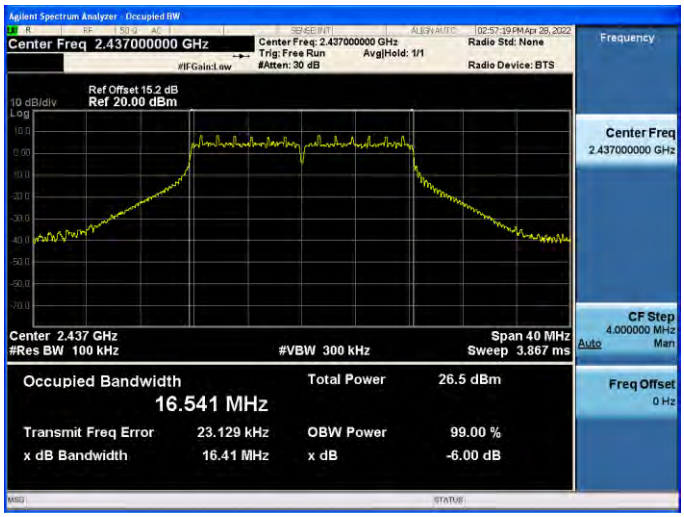
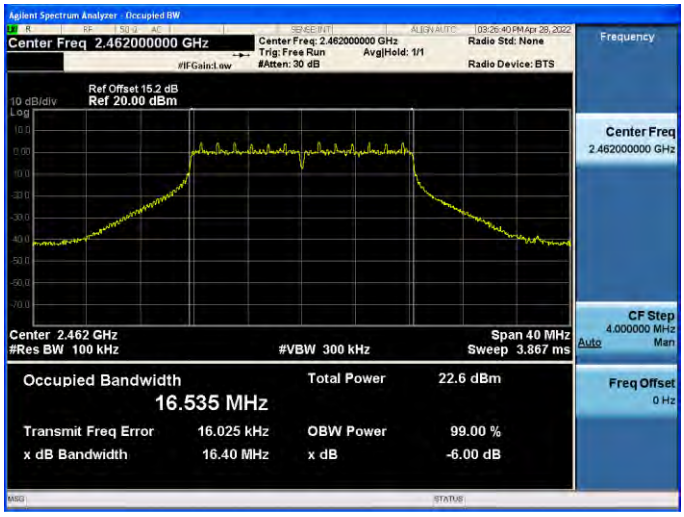
Mode 2: IEEE 802.11b Continuous TX mode_ANT-0	
2412 MHz	
2437 MHz	
2462 MHz	

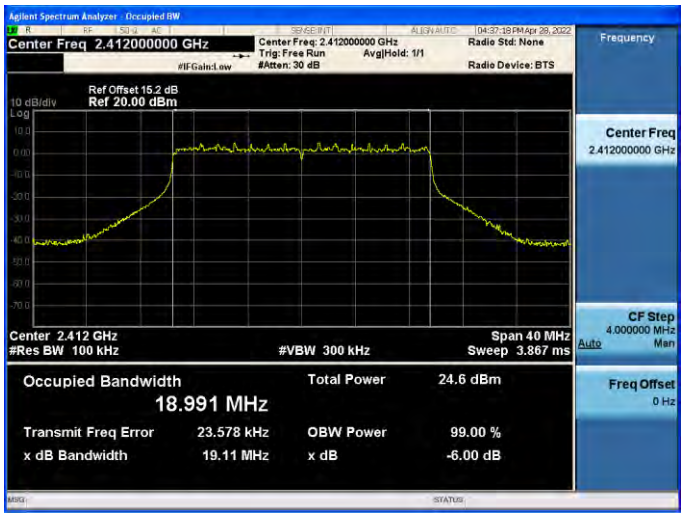
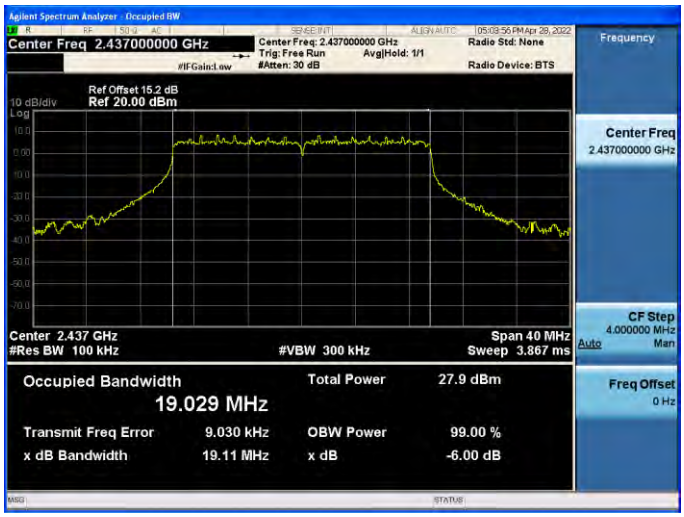
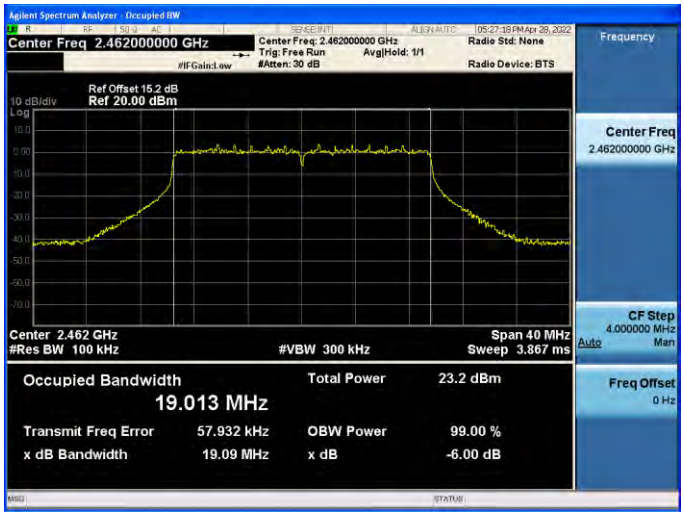
Mode 3: IEEE 802.11g Continuous TX mode_ANT-0	
2412 MHz	
2437 MHz	
2462 MHz	

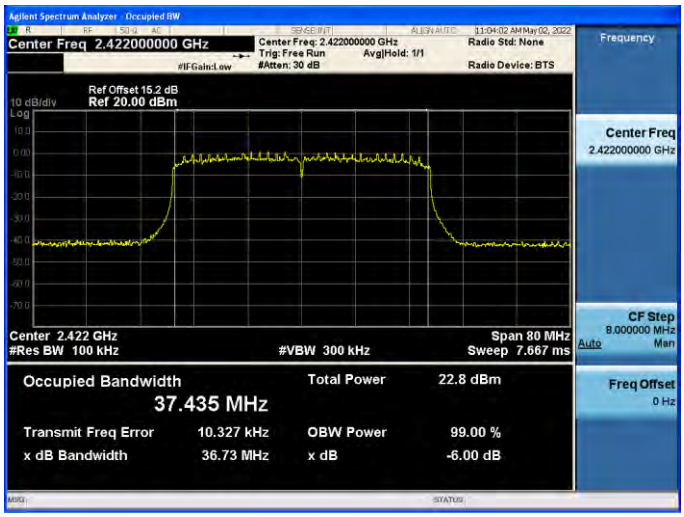
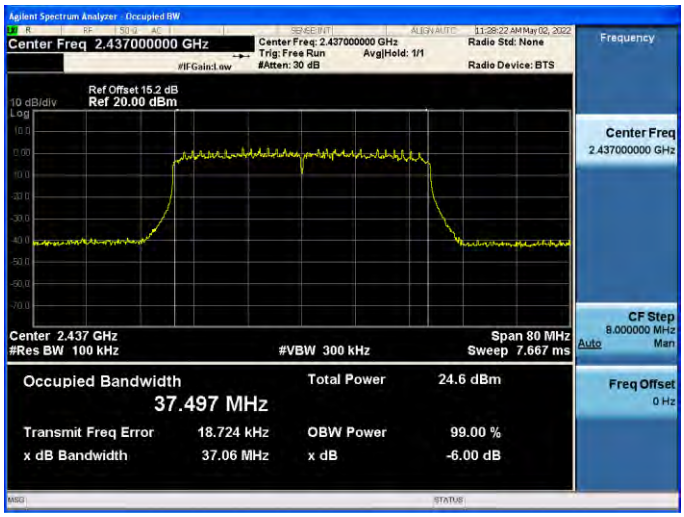
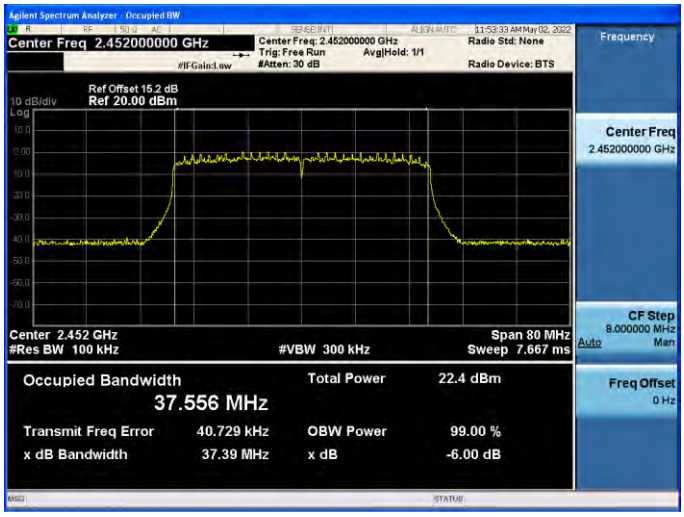
Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode_ANT-0	
2412 MHz	
2437 MHz	
2462 MHz	

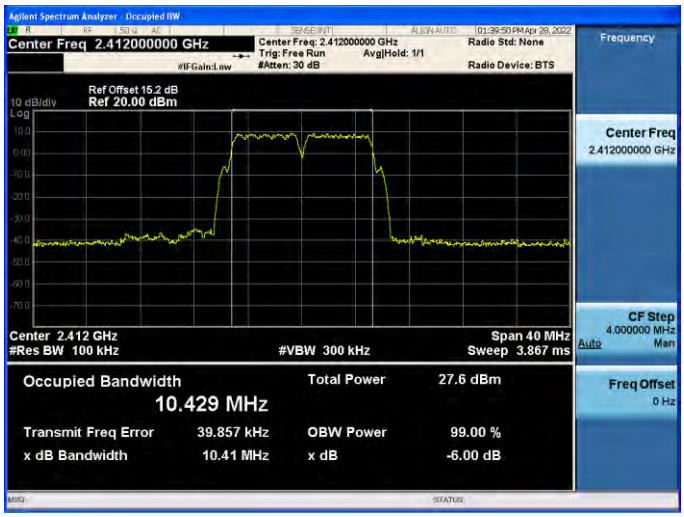
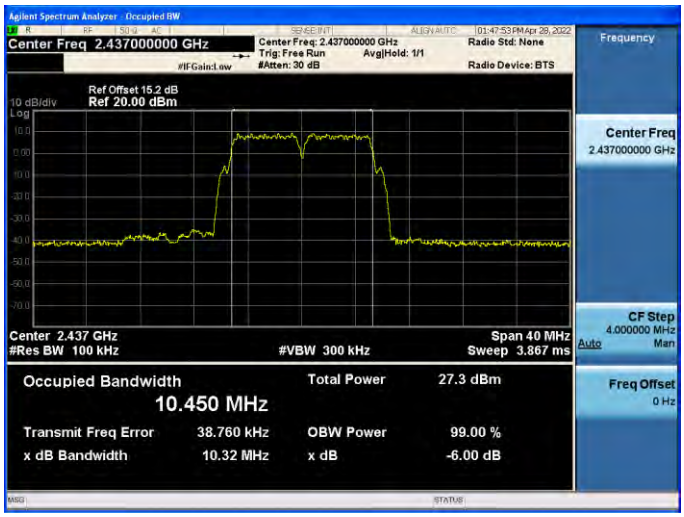
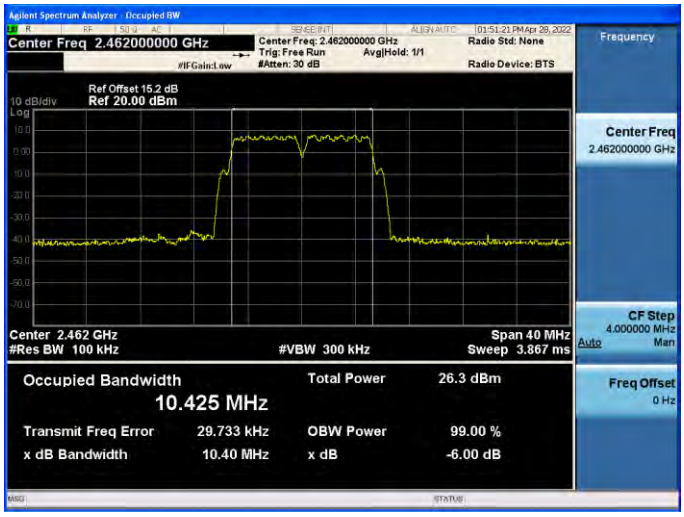
Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode_ANT-0	
2422 MHz	
2437 MHz	
2452 MHz	

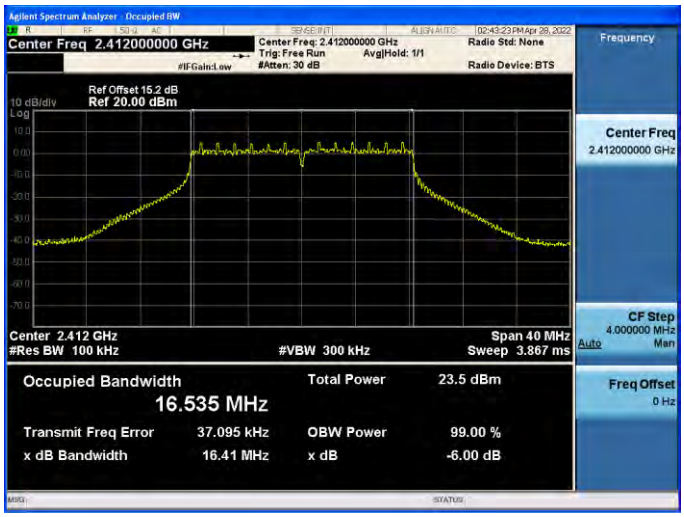
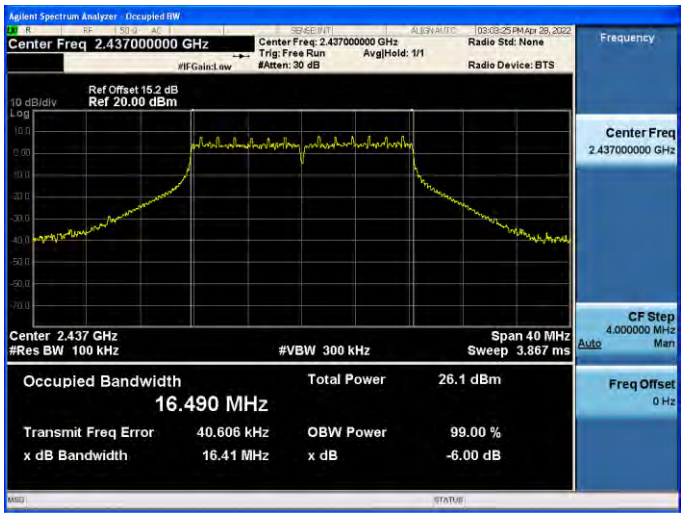
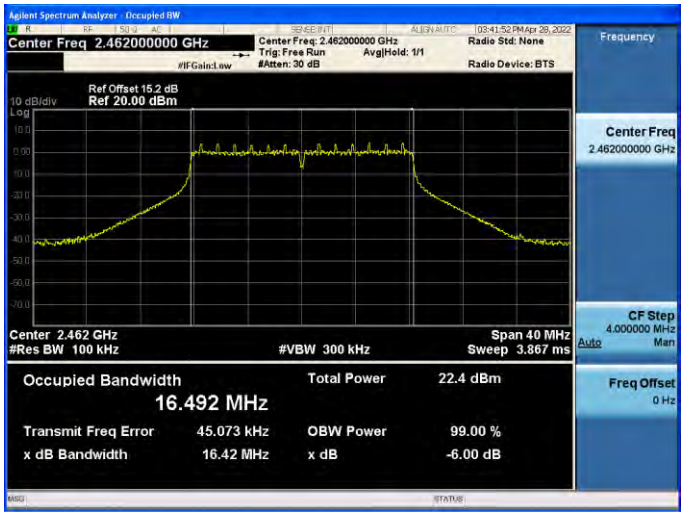
Mode 2: IEEE 802.11b Continuous TX mode_ANT-1	
2412 MHz	
2437 MHz	
2462 MHz	

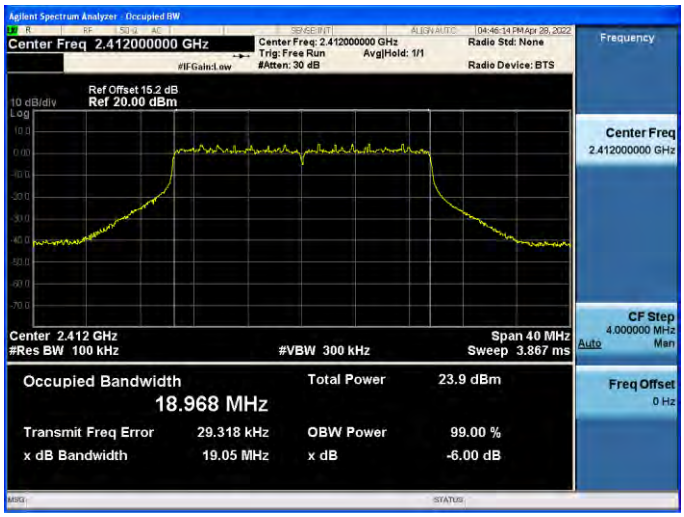
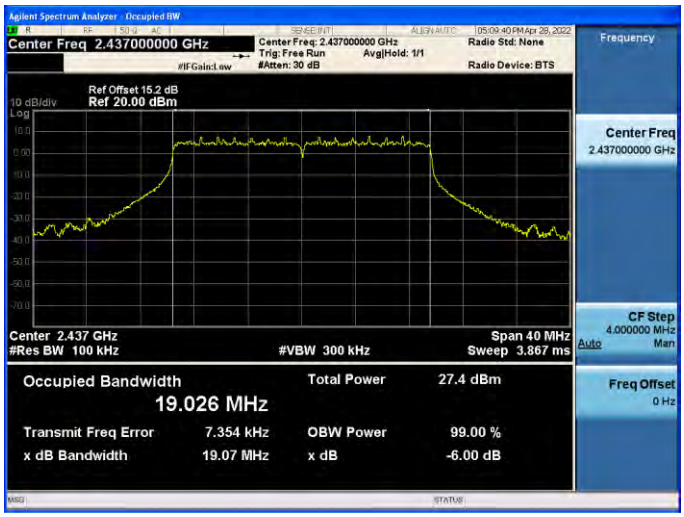
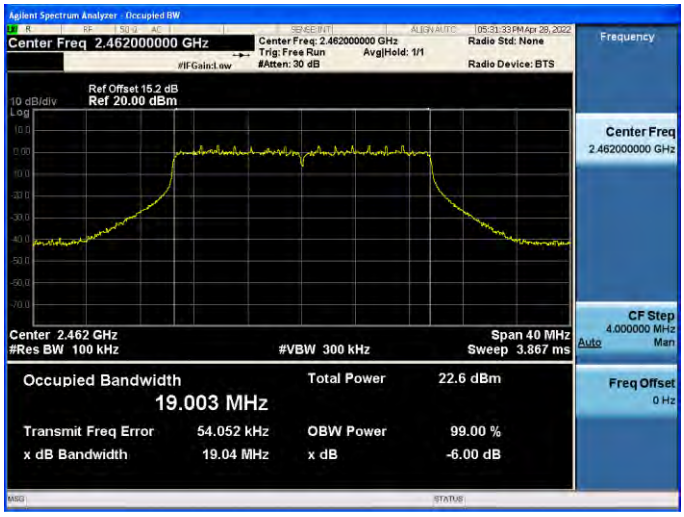
Mode 3: IEEE 802.11g Continuous TX mode_ANT-1	
2412 MHz	
2437 MHz	
2462 MHz	

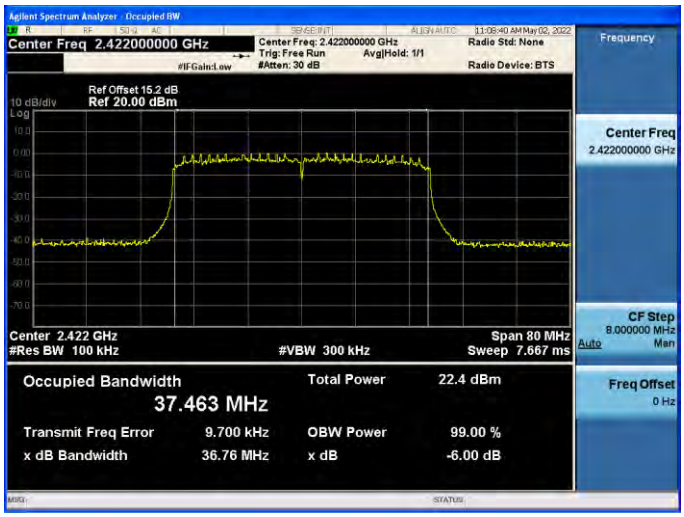
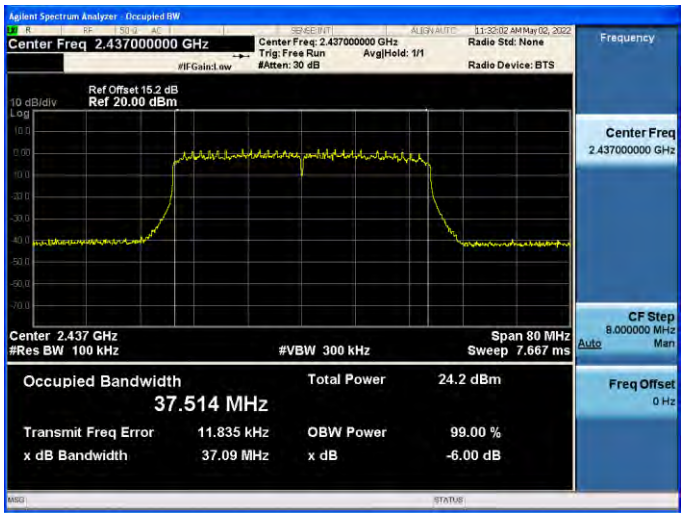
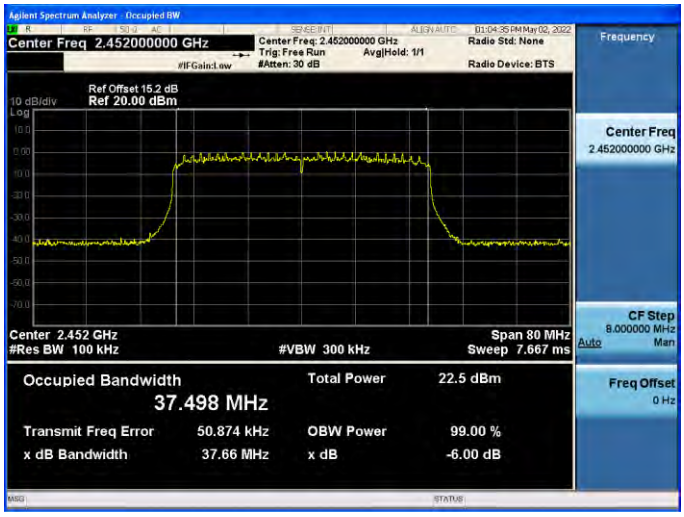
Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode_ANT-1	
2412 MHz	
2437 MHz	
2462 MHz	

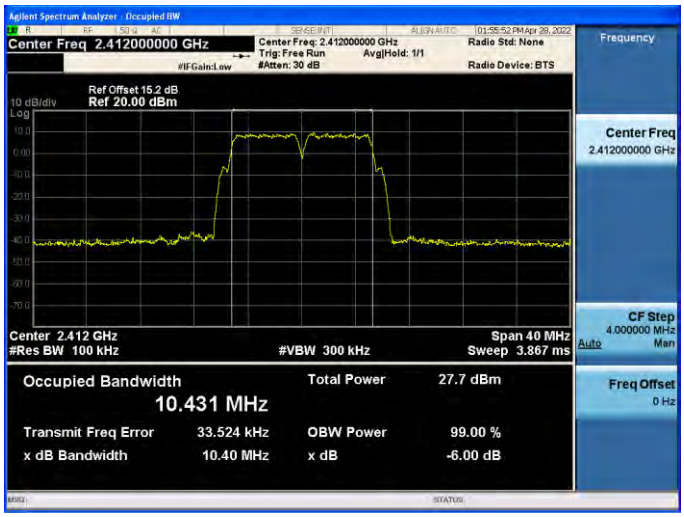
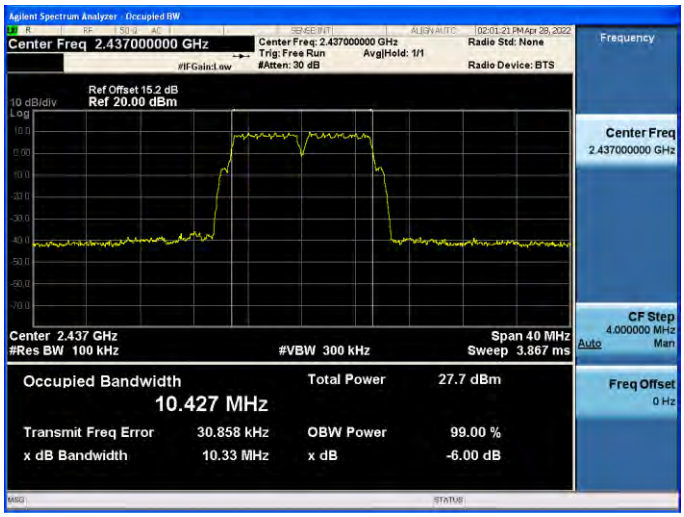
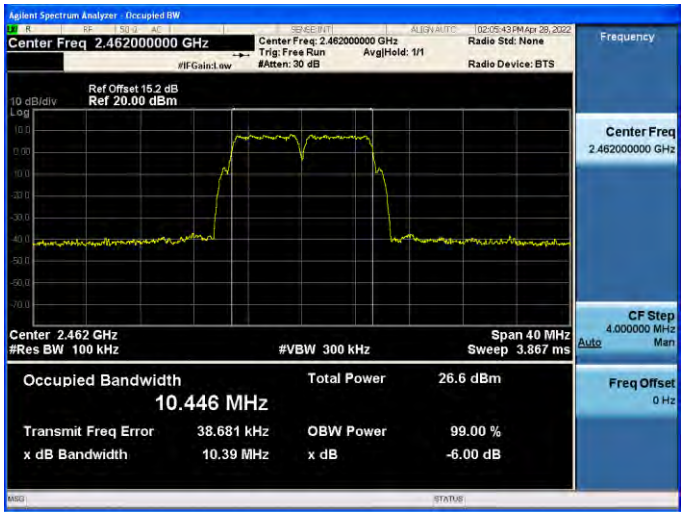
Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode_ANT-1	
2422 MHz	
2437 MHz	
2452 MHz	

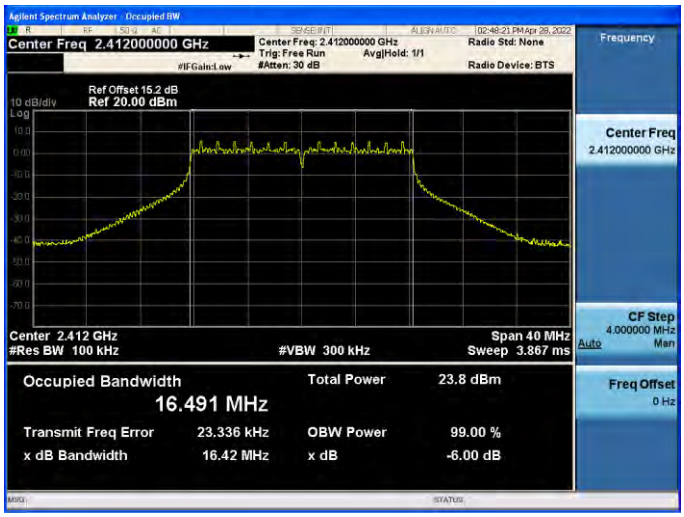
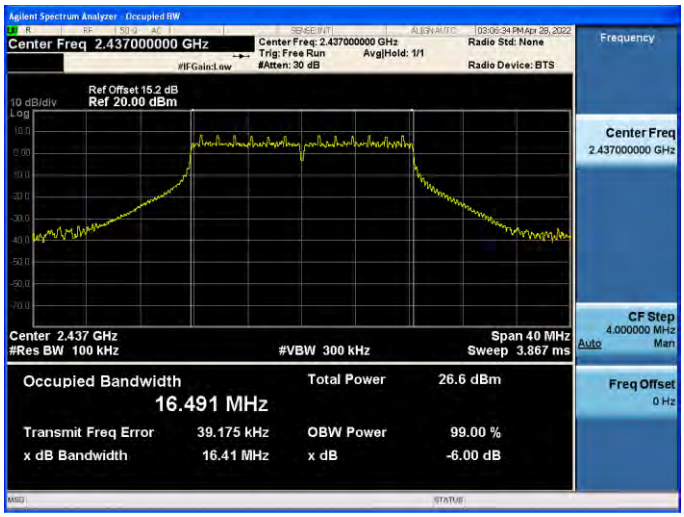
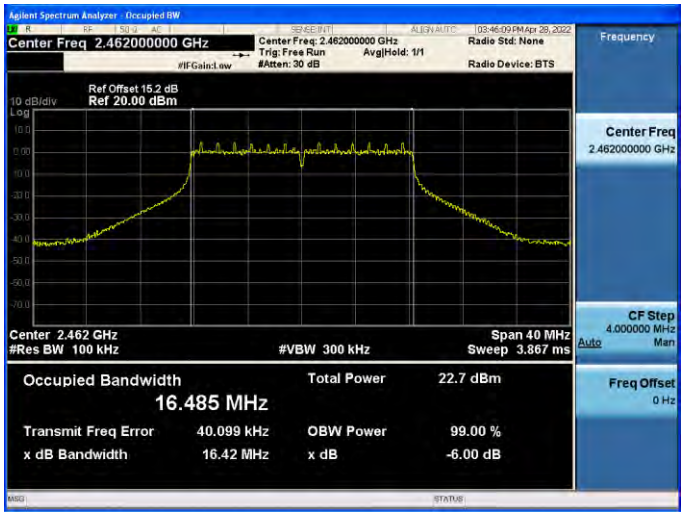
Mode 2: IEEE 802.11b Continuous TX mode_ANT-2	
2412 MHz	
2437 MHz	
2462 MHz	

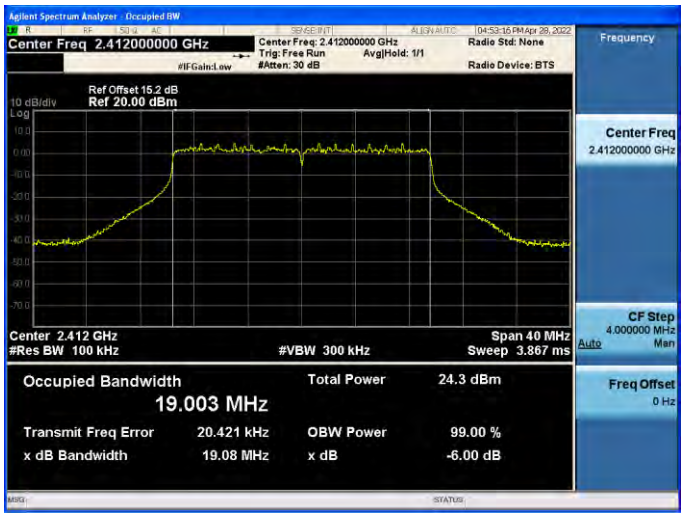
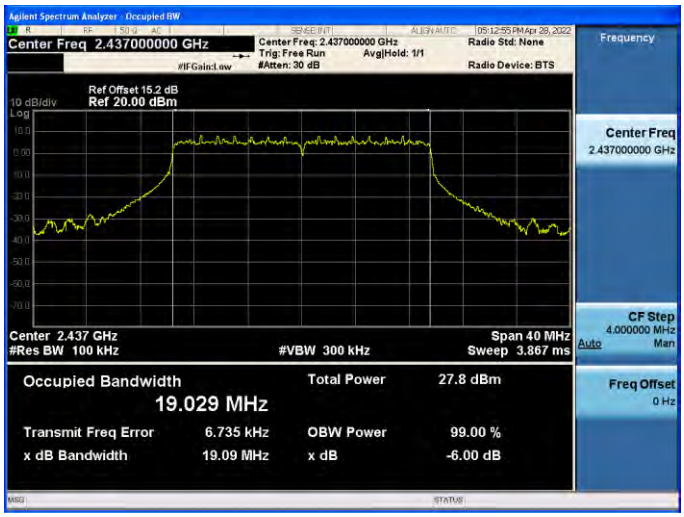
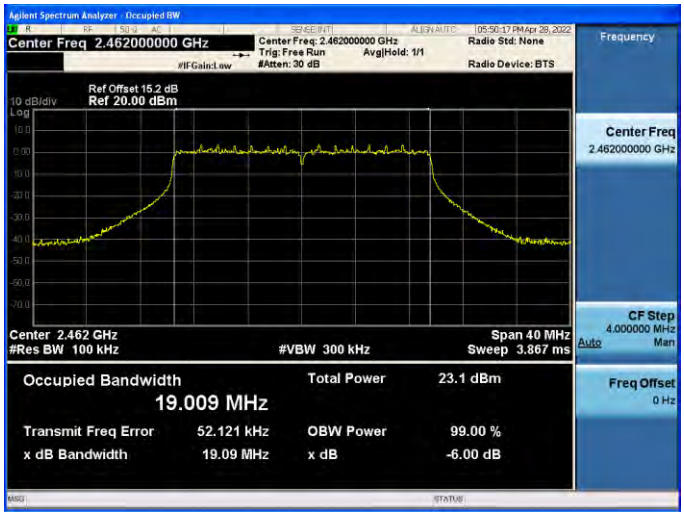
Mode 3: IEEE 802.11g Continuous TX mode_ANT-2	
2412 MHz	
2437 MHz	
2462 MHz	

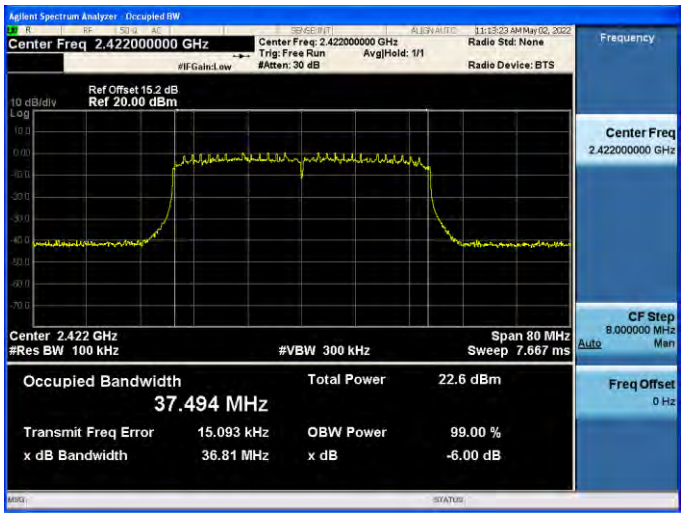
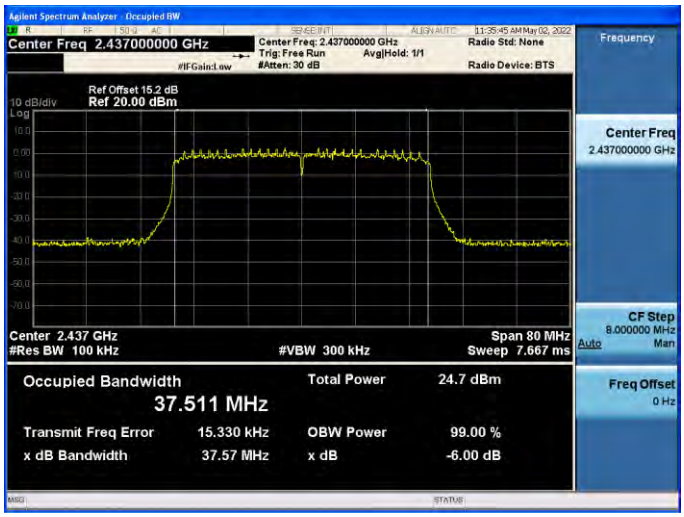
Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode_ANT-2	
2412 MHz	
2437 MHz	
2462 MHz	

Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode_ANT-2	
2422 MHz	
2437 MHz	
2452 MHz	

Mode 2: IEEE 802.11b Continuous TX mode_ANT-3	
2412 MHz	
2437 MHz	
2462 MHz	

Mode 3: IEEE 802.11g Continuous TX mode_ANT-3	
2412 MHz	
2437 MHz	
2462 MHz	

Mode 8: IEEE 802.11ax 2.4 GHz 20 MHz Continuous TX Mode_ANT-3	
2412 MHz	
2437 MHz	
2462 MHz	

Mode 9: IEEE 802.11ax 2.4 GHz 40 MHz Continuous TX Mode_ANT-3	
2422 MHz	
2437 MHz	
2452 MHz