Certificate #4312.01

TEST REPORT

Product Name:	In-Wall Wi-Fi Access Point
Trade Mark:	GRANDSTREAM
Model No. / HVIN:	GWN7624
Report Number:	220216022RFC-1
Test Standards:	FCC 47 CFR Part 15 Subpart C RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	YZZGWN7624
IC:	11964A-GWN7624
Test Result:	PASS
Date of Issue:	July 29, 2022

Prepared for:

Grandstream Networks, Inc.
126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

Prepared by:

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Date: July 29, 2022

Version

Version No.	Date	Description
V1.0	July 29, 2022	Original

CONTENTS

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Grandstream Networks, Inc.
Address of Applicant:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA
Manufacturer:	Grandstream Networks, Inc.
Address of Manufacturer:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	In-Wall Wi-Fi Access Point		
Model No. / HVIN:	GWN7624		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Sample Received Date:	February 17, 2022		
Sample Tested Date:	March 21, 2022 to April 29, 2022		

1.2.2 Description of Accessories

None

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Band:	2400 MHz to 2483.5 MHz	
Frequency Range:	2412 MHz to 2462 MHz	
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20, IEEE 802.11n-HT40	
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM (64-QAM, 16-QAM, QPSK, BPSK)	
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS15 IEEE 802.11n-HT40: Up to MCS15	
Number of Channels:	IEEE 802.11b: 11 IEEE 802.11g: 11 IEEE 802.11n-HT20: 11 IEEE 802.11n-HT40: 7	
Channel Separation:	5 MHz	
Antenna Type:	Chain 0	Dipole Antenna
	Chain 1	Dipole Antenna
Antenna Gain: (Provided by the customer)	Chain 0	2.5 dBi
	Chain 1	3.0 dBi
Maximum Avg Power:	SISO_ Chain 0	IEEE 802.11b: 19.77 dBm IEEE 802.11g: 16.49 dBm
	SISO_ Chain 1	IEEE 802.11b: 18.93 dBm IEEE 802.11g: 15.31 dBm

	MIMO_ Chain 0+1	IEEE 802.11n-HT20: 17.62 dBm IEEE 802.11n-HT40: 13.46 dBm
Normal Test Voltage:	120V~60Hz	

1.4 OTHER INFORMATION

Operation Frequency Each of Channel	
IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20	**f = 2407 + 5k MHz, k = 1,…,11**
IEEE 802.11n-HT40	**f = 2407 + 5k MHz, k = 3,…,9**
Note: **f** is the operating frequency (MHz); **k** is the operating channel.	

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	DELL	Latitude 3400	16238087894	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Ethernet Cable	RJ45	1.5 Unshielded without ferrite	UnionTrust
2	Antenna Cable	SMA	0.1 Meter	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen,China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories
CAB identifier: CN0032

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9kHz-150kHz	±3.2 dB
2	Conducted emission 150kHz-30MHz	±2.7 dB
3	Radiated emission 9kHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.9 dB
5	Radiated emission 1GHz-18GHz	± 4.8 dB
6	Radiated emission 18GHz-26GHz	± 5.1 dB
7	Radiated emission 26GHz-40GHz	± 5.1 dB
8	Conducted spurious emissions	± 2.7 dB
9	RF Power, Conducted	± 0.68 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	2.4 GHz: ± 6.5 x 10^{-8}
12	Transmission Time	± 0.19 %

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart C Test Cases			
Test Item	**Test Requirement**	**Test Method**	**Result**
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (b) (4) RSS-Gen Issue 5, Section 6.8	N/A	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013 Clause 6.2	PASS
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3) RSS-247 Issue 2, Section 5.4(d)	ANSI C63.10-2013 Clause 11.9.1.3	PASS
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) RSS-247 Issue 2, Section 5.2(a)	ANSI C63.10-2013 Clause 11.8.1	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, Section 6.7	PASS
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e) RSS-247 Issue 2, Section 5.2(b)	ANSI C63.10-2013 Clause 11.10.2	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d) RSS-247 Issue 2, Section 5.5	ANSI C63.10-2013 Clause 11.11	PASS
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-Gen Issue 5, Section 6.13/8.9/8.10	ANSI C63.10-2013 Clause 11.11 & Clause 11.12	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-247 Issue 2, Section 5.5	ANSI C63.10-2013 Clause 11.13	PASS

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	Euroshiedpn-CT001270-1317	22-Jan-2021	21-Jan-2024
☒	Receiver	R&S	ESIB26	100114	5-Nov-2021	4-Nov-2022
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	11-Nov-2021	10-Nov-2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	11-Nov-2021	10-Nov-2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	11-Nov-2021	10-Nov-2023
☒	Preamplifier	HP	8447F	2805A02960	5-Nov-2021	4-Nov-2022
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	17-Apr-2022	16-Apr-2024
☒	Pre-amplifier	ETS-LINDGREN	00118385	00201874	6-Nov-2021	5-Nov-2022
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	14-Nov-2020	13-Nov-2022
☒	Pre-amplifier	ETS-LINDGREN	00118384	00202652	17-Nov-2020	16-Nov-2022
☒	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	6-Nov-2021	5-Nov-2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	Receiver	R&S	ESR7	101181	5-Nov-2021	4-Nov-2022
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	5-Nov-2021	4-Nov-2022
☒	LISN	R&S	ESH2-Z5	860014/024	5-Nov-2021	4-Nov-2022
☒	Test Software	Audix	e3	Software Version: 9 20151119i		

RF Conducted Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	22-Apr-2021	21-Apr-2022
					15-Apr-2022	14-Apr-2023
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	5-Nov-2021	4-Nov-2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	5-Nov-2021	4-Nov-2022

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	48V	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
AC Power Line Conducted Emission	24.1	46	101.1	220116022-B01/3	David Zhang
Conducted Peak Output Power	25.3	54	102.3	220116022-A01/2	Hank Wu
6dB Bandwidth & Occupied Bandwidth					
Power Spectral Density					
Conducted Out of Band Emission					
Radiated Spurious Emissions	21.3	52	100.2	220116022-A02/2	Lucas Ouyang
Band Edge Measurements (Radiated)	21.3	52	100.2		

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11b	2412 MHz to 2462 MHz	Channel 1	Channel 7	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11g	2412 MHz to 2462 MHz	Channel 1	Channel 7	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT20	2412 MHz to 2462 MHz	Channel 1	Channel 7	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT40	2422 MHz to 2452 MHz	Channel 3	Channel 7	Channel 9
		2422 MHz	2437 MHz	2452 MHz

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11b IEEE 802.11g	1Tx/1Rx	1. Keep the EUT in continuously transmitting or receiving with modulation test single.
IEEE 802.11n-HT20 IEEE 802.11n-HT40	2Tx/2Rx	2. Keep the EUT in continuously transmitting or receiving with modulation test single.

Power Setting (Provided by the customer)				
Mode	Channel	Frequency (MHz)	Chains	
			Chain 0	Chain 1
IEEE 802.11b	1	2412	26	28
	6	2437	2A	2C
	11	2462	25	29
IEEE 802.11g	1	2412	21	21
	6	2437	25	25
	11	2462	24	1E
IEEE 802.11n-HT20	1	2412	1F	
	6	2437	22	
	11	2462	1D	
IEEE 802.11n-HT40	3	2422	18	
	6	2437	19	
	9	2452	16	

Test Software (Provided by the customer)
Test software name: QA Tool

4.4 PRE-SCAN

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

Mode	Worst-case data rates
IEEE 802.11b	1 Mbps
IEEE 802.11g	6 Mbps
IEEE 802.11n-HT20	MCS0
IEEE 802.11n-HT40	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

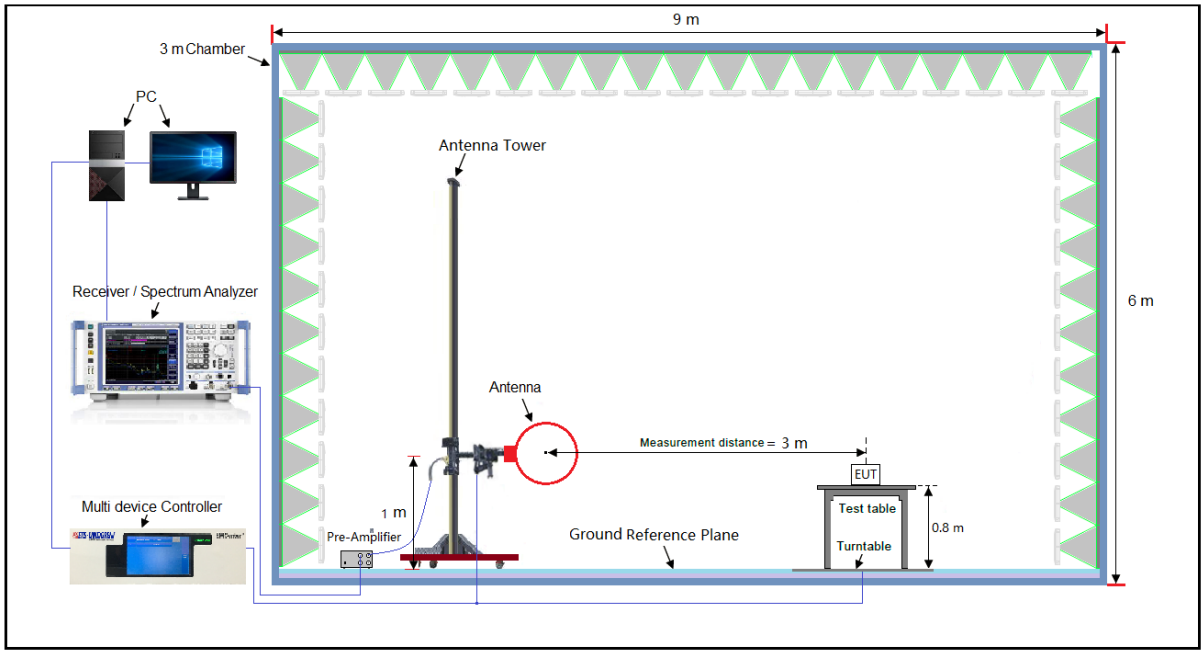


Figure 2. 30MHz to 1GHz

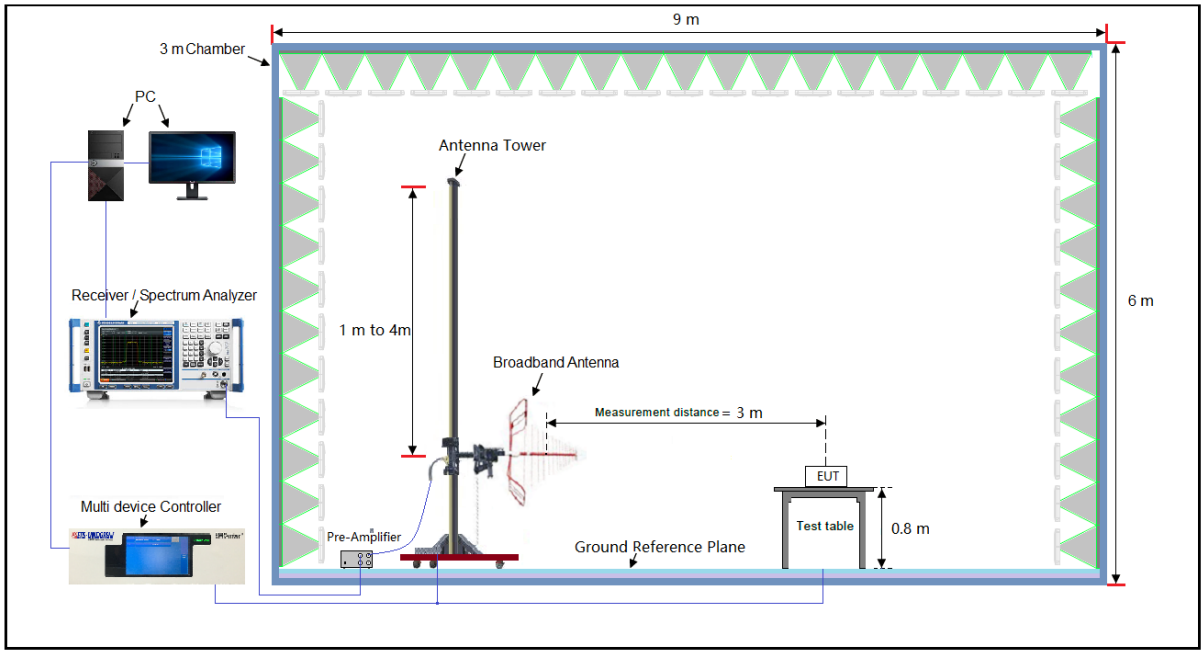
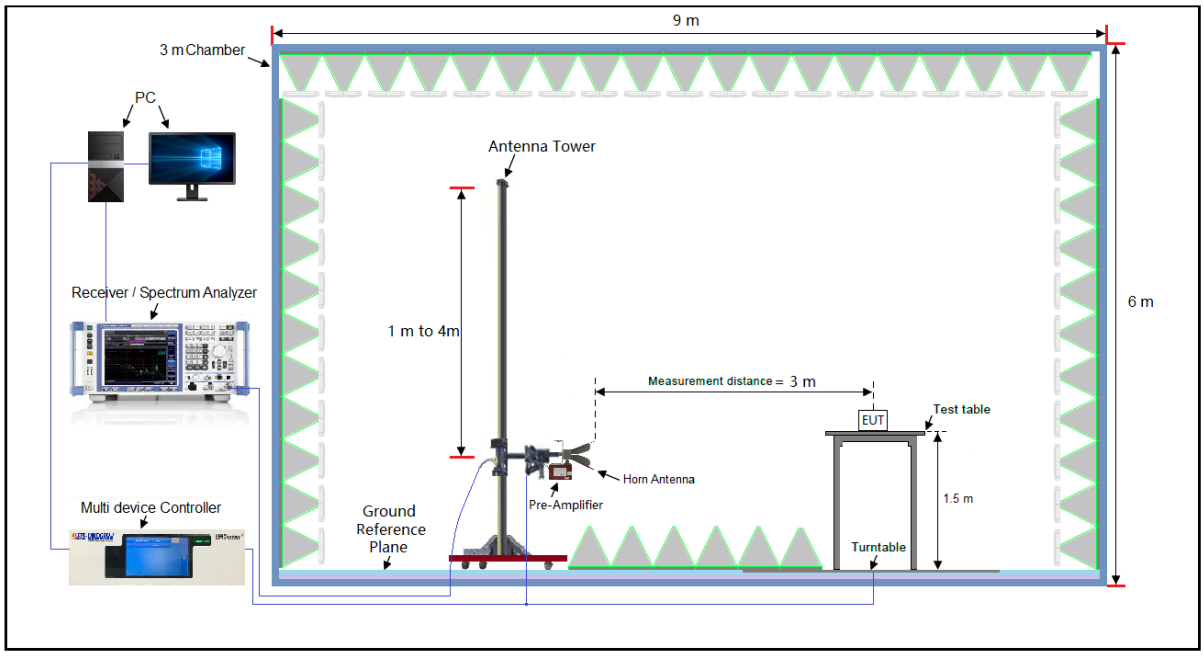
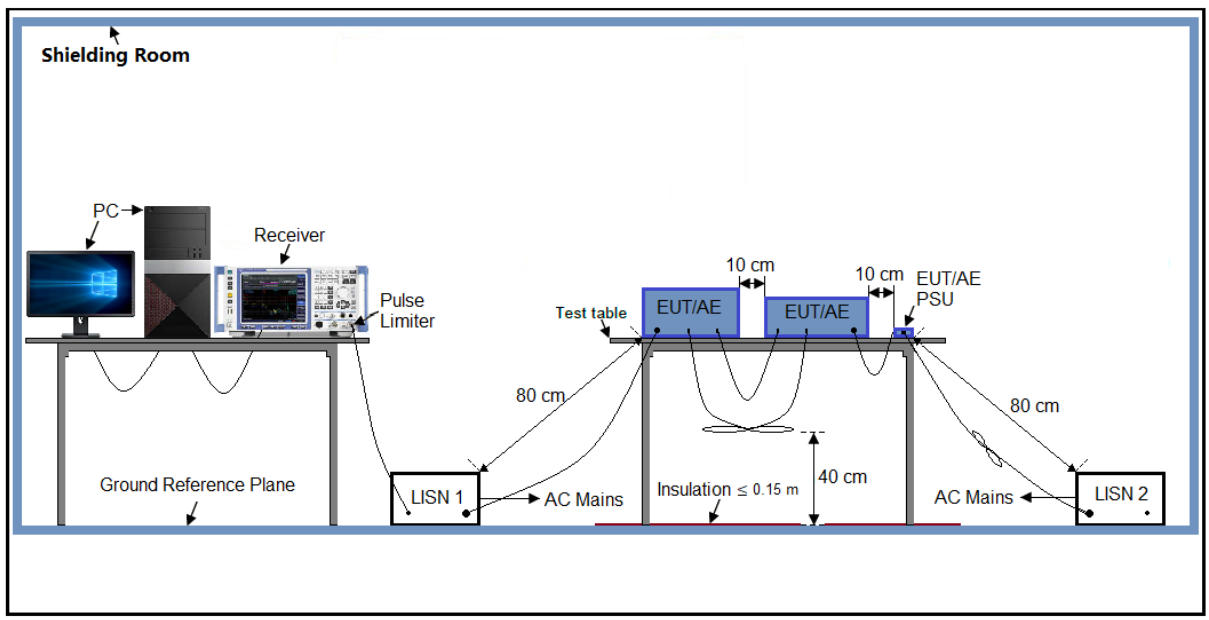


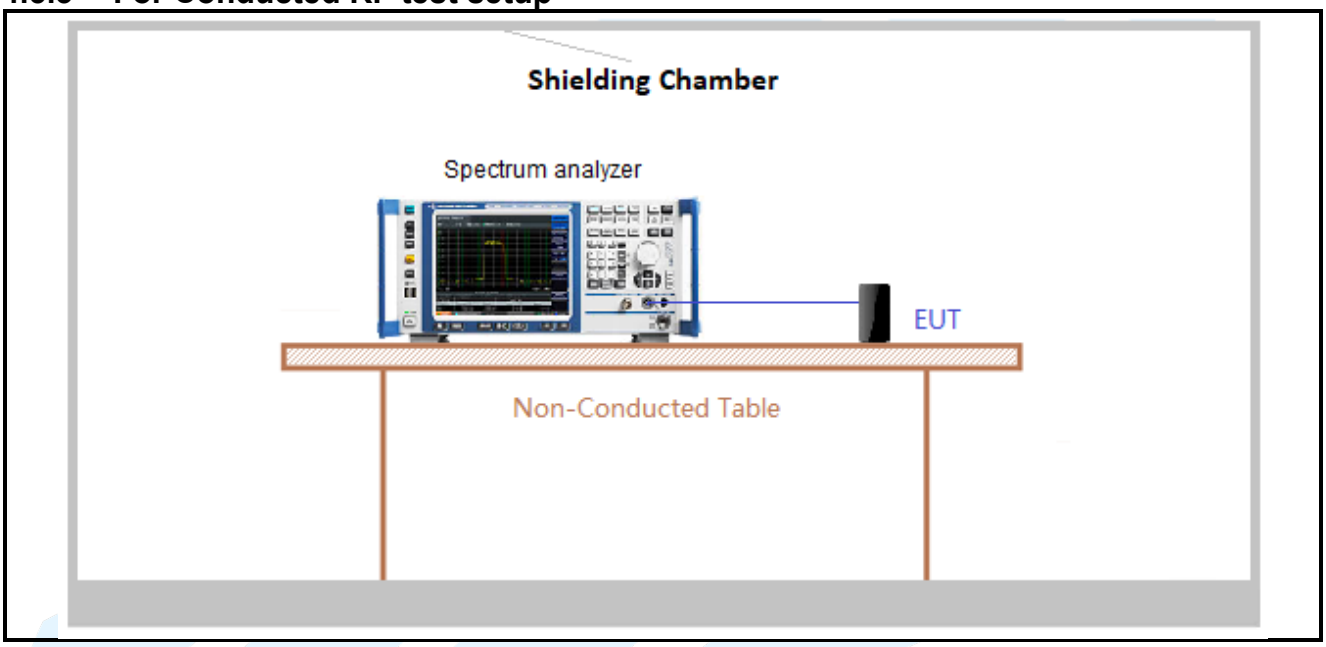
Figure 3. Above 1GHz



4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis
	1TX	Chain 1	Y axis
	2TX	Chain 0+1	Y axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 11.6.

Test Results

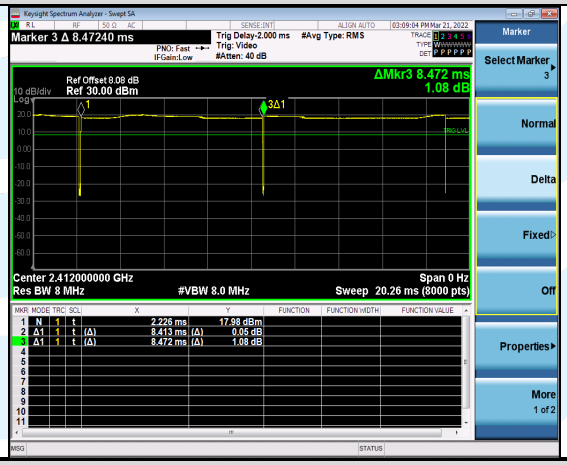
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11b	1	8.413	8.472	0.99	99.30	0.00	0.01	-0.06
IEEE 802.11g	6	1.400	1.510	0.93	92.72	0.33	0.71	-0.66
IEEE 802.11n-HT20	MCS0	1.310	1.460	0.90	89.73	0.47	0.76	-0.94
IEEE 802.11n-HT40	MCS0	0.640	0.770	0.83	83.12	0.80	1.56	-1.61

Remark:

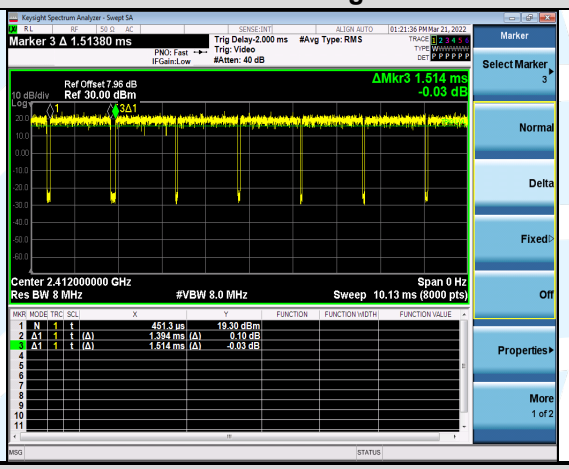
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plots as follows

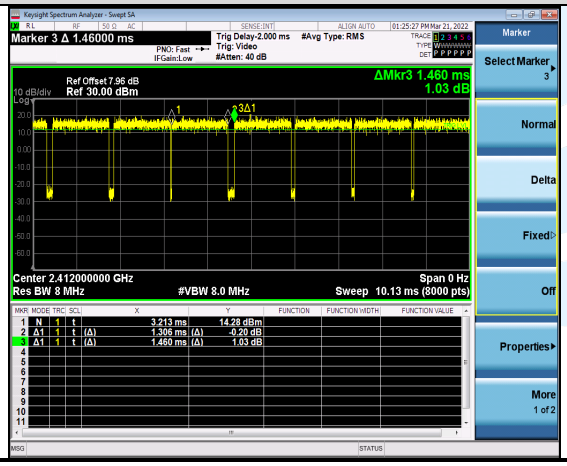
IEEE 802.11b



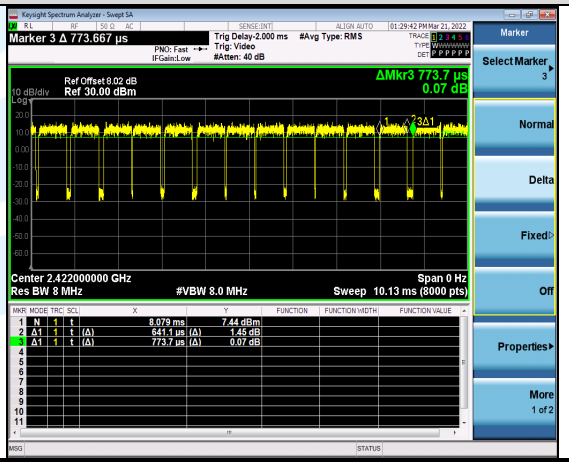
IEEE 802.11g



IEEE 802.11n-HT20



IEEE 802.11n-HT40



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
6	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules
7	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: 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, 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. **15.247(b) (4) requirement:** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **RSS-Gen Issue 5, Section 6.8 requirement:** According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns.
EUT Antenna:
Both antenna in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other, the best case directional gain of the antenna is 5.76 dBi (See section 5.3).

5.3 CONDUCTED OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart C Section15.247 (b)(3)
RSS-247 Issue 2, Section 5.4(d)

Test Method: ANSI C63.10-2013 Clause 11.9.1.3

Limit: For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Test Procedure:
1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
2. Measure out each test modes' peak or average output power, record the power level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results:

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	17.96	≤30.00	PASS
	Ant2	2412	17.20	≤30.00	PASS
	Ant1	2437	19.77	≤30.00	PASS
	Ant2	2437	18.93	≤30.00	PASS
	Ant1	2462	17.25	≤30.00	PASS
	Ant2	2462	17.57	≤30.00	PASS
11G	Ant1	2412	14.63	≤30.00	PASS
	Ant2	2412	13.49	≤30.00	PASS
	Ant1	2437	16.49	≤30.00	PASS
	Ant2	2437	15.31	≤30.00	PASS
	Ant1	2462	13.26	≤30.00	PASS
	Ant2	2462	14.94	≤30.00	PASS
11N20MIMO	Ant1	2412	13.76	≤30.00	PASS
	Ant2	2412	12.77	≤30.00	PASS
	total	2412	16.30	≤30.00	PASS
	Ant1	2437	15.01	≤30.00	PASS
	Ant2	2437	14.17	≤30.00	PASS
	total	2437	17.62	≤30.00	PASS
	Ant1	2462	12.89	≤30.00	PASS
	Ant2	2462	11.76	≤30.00	PASS
	total	2462	15.37	≤30.00	PASS
11N40MIMO	Ant1	2422	10.22	≤30.00	PASS
	Ant2	2422	8.61	≤30.00	PASS
	total	2422	12.50	≤30.00	PASS
	Ant1	2437	11.41	≤30.00	PASS
	Ant2	2437	9.21	≤30.00	PASS
	total	2437	13.46	≤30.00	PASS
	Ant1	2452	8.81	≤30.00	PASS
	Ant2	2452	7.51	≤30.00	PASS
	total	2452	11.22	≤30.00	PASS

Remark:
1. Total (Chain 0+1) = 10*log [($10^{\text{Chain 0/10}}$) + ($10^{\text{Chain 1/10}}$)]
2. Directional gain and the maximum conducted output power limit see table below:

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)
2400 MHz to 2483.5 MHz	2.50	3.00

According to the list of antenna information above, antenna gains are not equal and the maximum antenna gain is 3.00 dBi.
According to KDB 662911VDO1 v02r01, for power measurements on IEEE 802.11 devices,
Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4; so the
Directional gain = GANT MAX + Array Gain =3.0dBi < 6 dBi
So, the maximum output power limit does not need to be reduced.

According to KDB 662911VDO1 v02r01, for power spectral density (PSD) measurements on IEEE 802.11 devices, the
Array Gain = 10 log (NANT/NSS) dB;
So, the
Directional gain = GANT MAX + 10 log (NANT/NSS) = 3 + 10 log (2/1) = 6.01dBi > 6 dBi
So, the maximum power spectral density limit should be reduced (6.01 -6) dBi = 0.01 dBi.

5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) RSS-247 Issue 2, Section 5.2(a) RSS-Gen Issue 5, Section 6.7
Test Method:	ANSI C63.10-2013 Clause 11.8.1 RSS-Gen Issue 5, Section 6.7
Limit:	For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz
Test Procedure:	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer. Use the following spectrum analyzer settings: **6dB Bandwidth** a) Set RBW = 100 kHz. b) Set the video bandwidth (VBW) ≥ 3 x RBW. c) Detector = Peak. d) Trace mode = max hold. e) Sweep = auto couple. f) Allow the trace to stabilize. g) 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. **Occupied Bandwidth** a) Set RBW = 1% to 5% of the occupied bandwidth b) Set the video bandwidth (VBW) ≥ 3 x RBW. c) Detector = Peak. d) Trace mode = max hold. e) Sweep = auto couple. f) Allow the trace to stabilize. Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
Test Setup:	Refer to section 4.5.3 for details.
Instruments Used:	Refer to section 3 for details
Test Results:	

6dB Bandwidth:

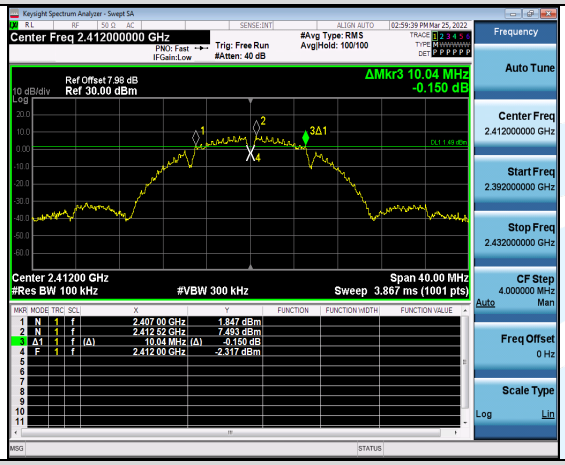
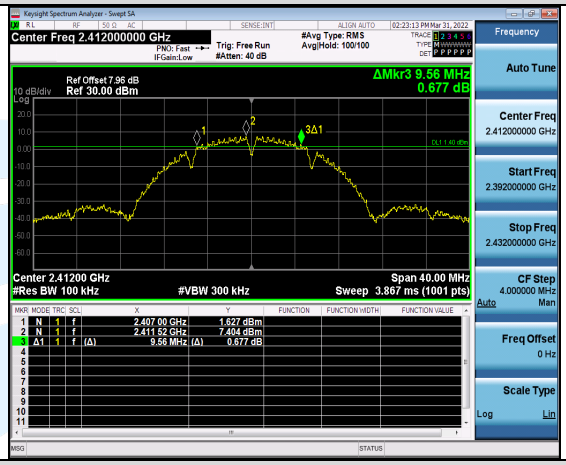
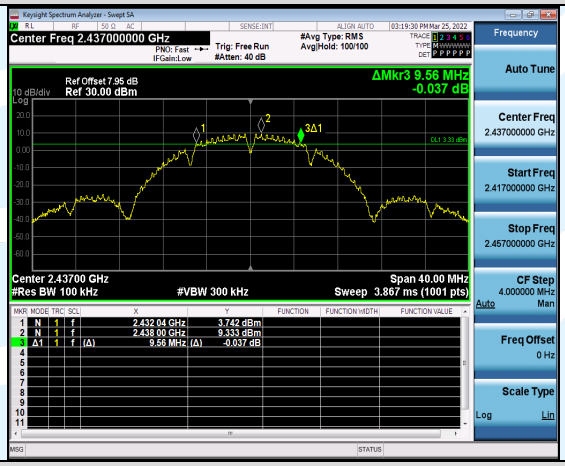
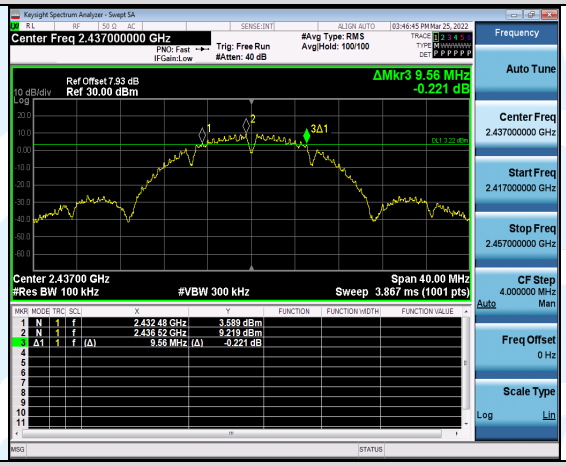
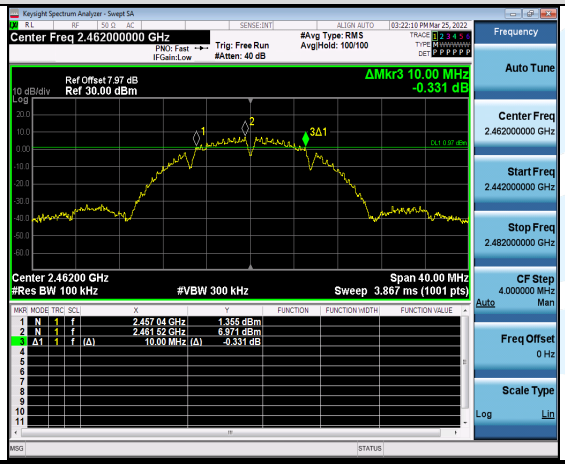
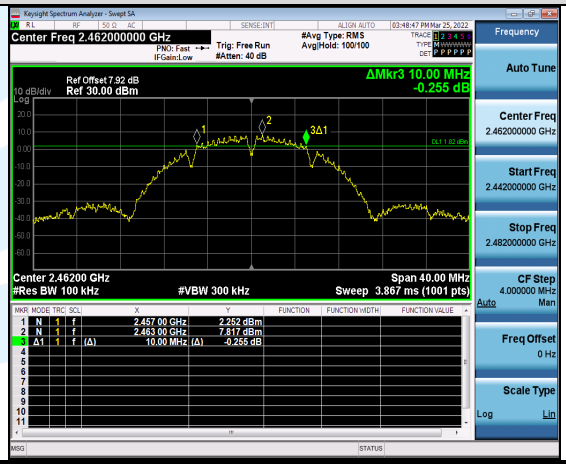
Test Mode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit [MHz]	Verdict
11B	Ant1	2412	10.040	2407.000	2417.040	≥0.5	PASS
	Ant2	2412	9.560	2407.000	2416.560	≥0.5	PASS
	Ant1	2437	9.560	2432.040	2441.600	≥0.5	PASS
	Ant2	2437	9.560	2432.480	2442.040	≥0.5	PASS
	Ant1	2462	10.000	2457.040	2467.040	≥0.5	PASS
	Ant2	2462	10.000	2457.000	2467.000	≥0.5	PASS
11G	Ant1	2412	15.160	2404.440	2419.600	≥0.5	PASS
	Ant2	2412	15.080	2404.520	2419.600	≥0.5	PASS
	Ant1	2437	13.880	2430.680	2444.560	≥0.5	PASS
	Ant2	2437	13.400	2431.120	2444.520	≥0.5	PASS
	Ant1	2462	15.040	2454.520	2469.560	≥0.5	PASS
	Ant2	2462	13.880	2454.480	2468.360	≥0.5	PASS
11N20MIMO	Ant1	2412	15.120	2404.480	2419.600	≥0.5	PASS
	Ant2	2412	15.680	2403.880	2419.560	≥0.5	PASS
	Ant1	2437	15.040	2429.480	2444.520	≥0.5	PASS
	Ant2	2437	14.440	2430.120	2444.560	≥0.5	PASS
	Ant1	2462	15.080	2454.480	2469.560	≥0.5	PASS
	Ant2	2462	15.040	2453.880	2468.920	≥0.5	PASS

11N40MIMO	Ant1	2422	33.840	2405.680	2439.520	≥0.5	PASS
	Ant2	2422	32.560	2404.480	2437.040	≥0.5	PASS
	Ant1	2437	32.480	2420.760	2453.240	≥0.5	PASS
	Ant2	2437	33.840	2419.480	2453.320	≥0.5	PASS
	Ant1	2452	33.840	2434.480	2468.320	≥0.5	PASS
	Ant2	2452	35.040	2434.480	2469.520	≥0.5	PASS

Occupied Bandwidth:

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	14.546	2404.702	2419.248	---	---
	Ant2	2412	14.473	2404.753	2419.226	---	---
	Ant1	2437	14.833	2429.577	2444.410	---	---
	Ant2	2437	14.734	2429.624	2444.358	---	---
	Ant1	2462	14.490	2454.713	2469.203	---	---
	Ant2	2462	14.488	2454.726	2469.214	---	---
11G	Ant1	2412	16.891	2403.525	2420.416	---	---
	Ant2	2412	16.951	2403.542	2420.493	---	---
	Ant1	2437	16.994	2428.486	2445.480	---	---
	Ant2	2437	17.021	2428.407	2445.428	---	---
	Ant1	2462	16.859	2453.548	2470.407	---	---
	Ant2	2462	16.920	2453.488	2470.408	---	---
11N20MIMO	Ant1	2412	17.826	2403.130	2420.956	---	---
	Ant2	2412	17.681	2403.188	2420.869	---	---
	Ant1	2437	17.889	2428.074	2445.963	---	---
	Ant2	2437	17.650	2428.200	2445.850	---	---
	Ant1	2462	17.813	2453.074	2470.887	---	---
	Ant2	2462	17.613	2453.210	2470.823	---	---
11N40MIMO	Ant1	2422	35.971	2403.999	2439.970	---	---
	Ant2	2422	36.021	2404.012	2440.033	---	---
	Ant1	2437	35.978	2418.998	2454.976	---	---
	Ant2	2437	36.062	2418.995	2455.057	---	---
	Ant1	2452	35.960	2434.009	2469.969	---	---
	Ant2	2452	36.012	2434.005	2470.017	---	---

The test plots as follows:
6 dB Bandwidth

IEEE 802.11b	
SISO_ Chain 0	SISO_ Chain 1
Channel 1	
	
Channel 6	
	
Channel 11	
	

IEEE 802.11g	
SISO_ Chain 0	SISO_ Chain 1
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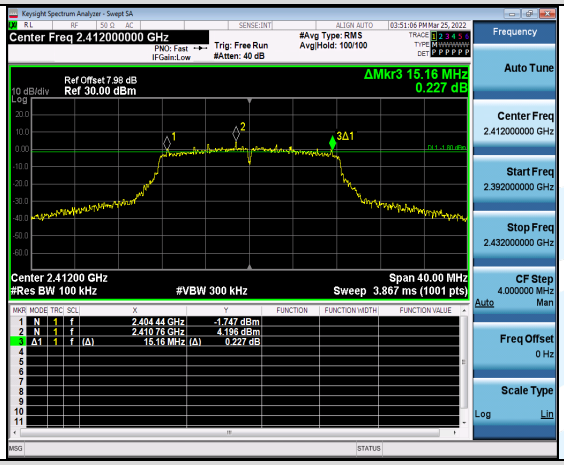
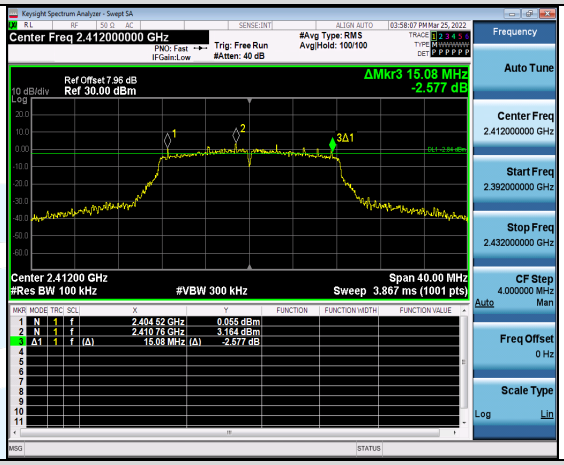
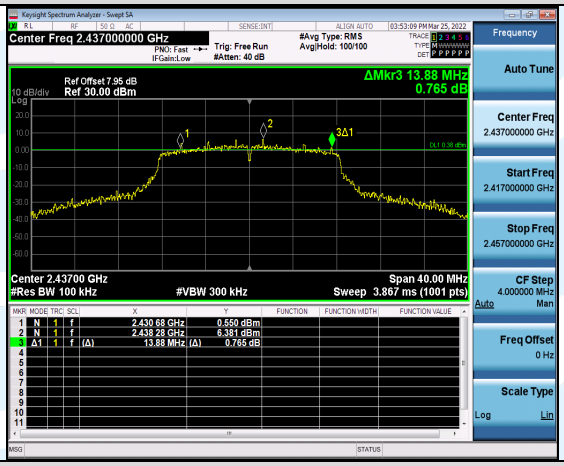
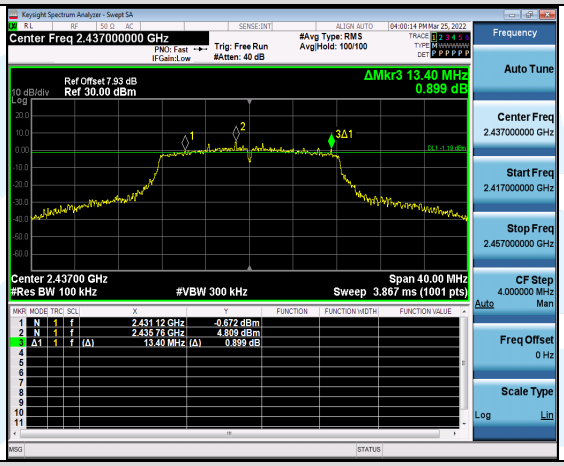
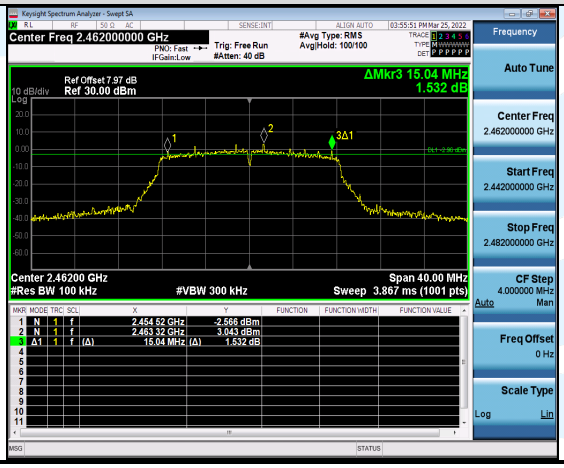
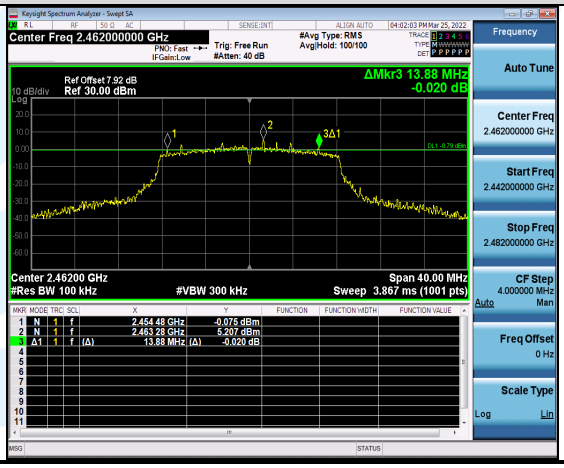
	
Channel 6	
	
Channel 11	
	

IEEE 802.11n-HT20	
MIMO_ Chain 0	MIMO_ Chain 1
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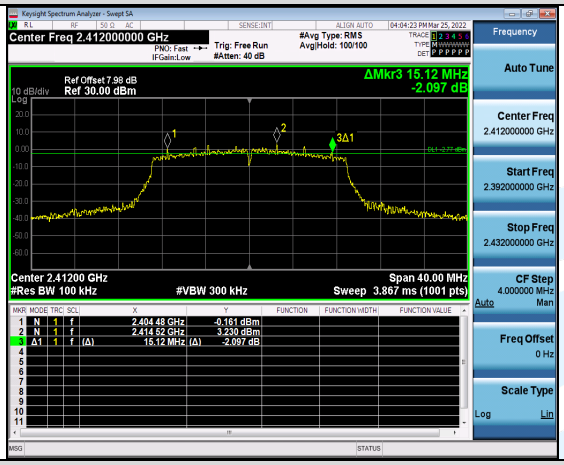
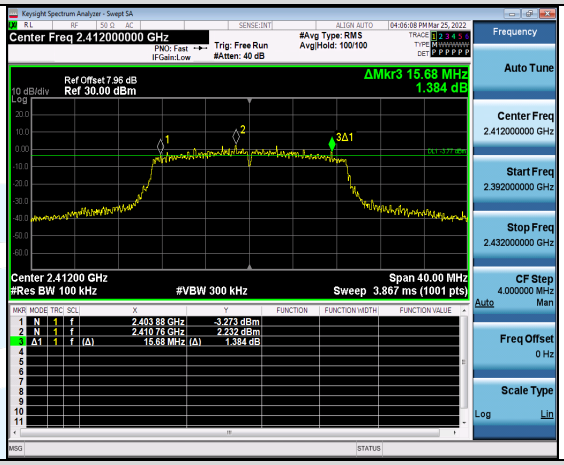
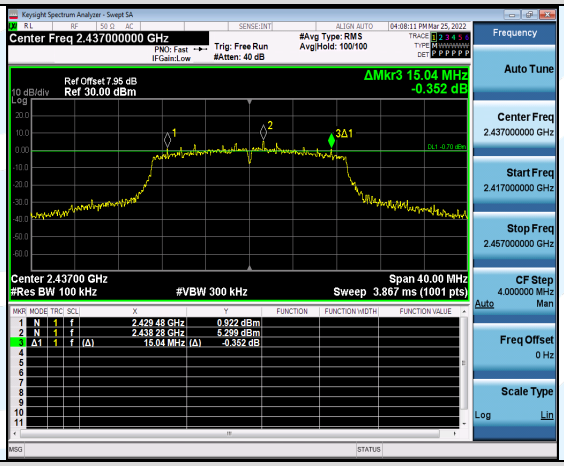
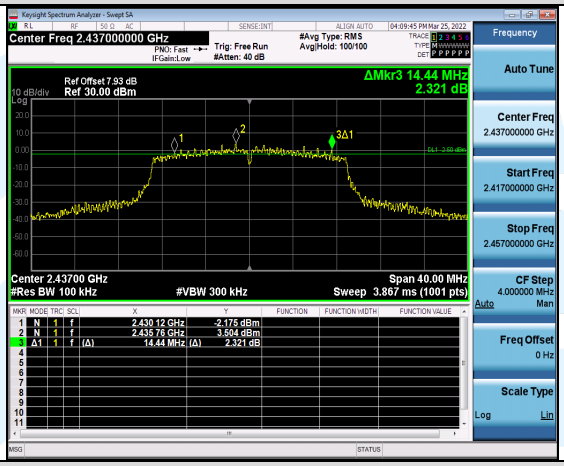
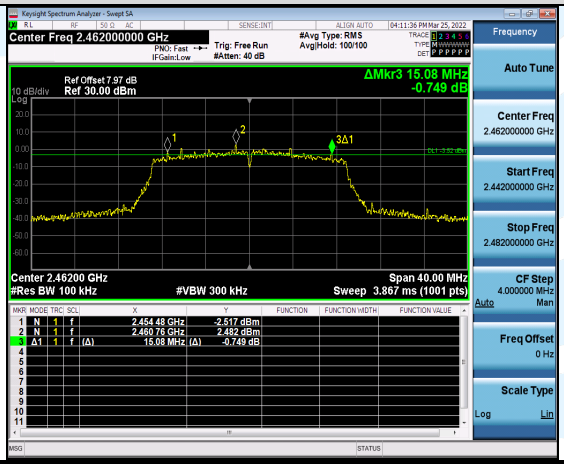
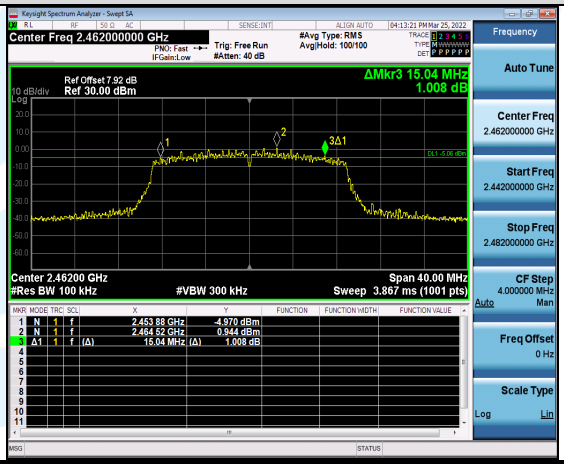
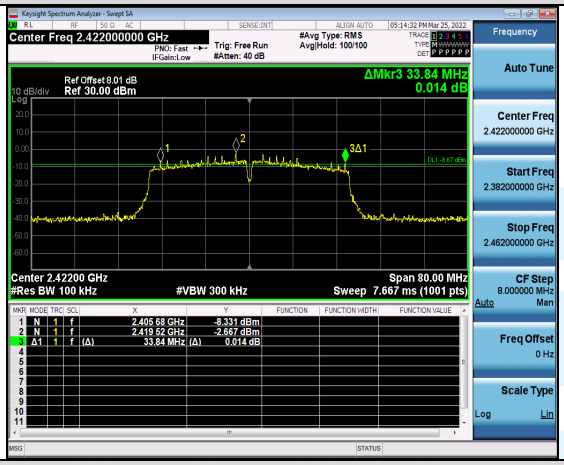
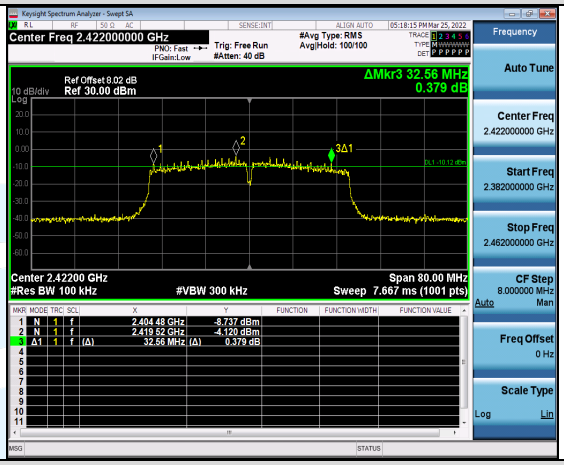
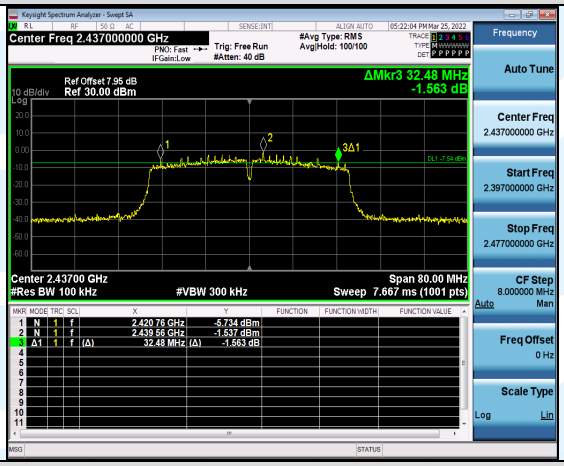
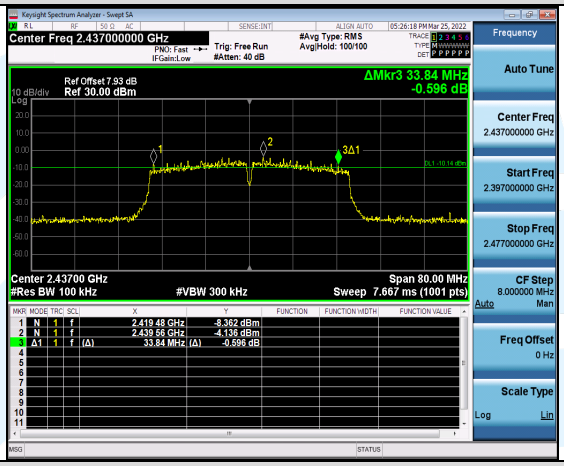
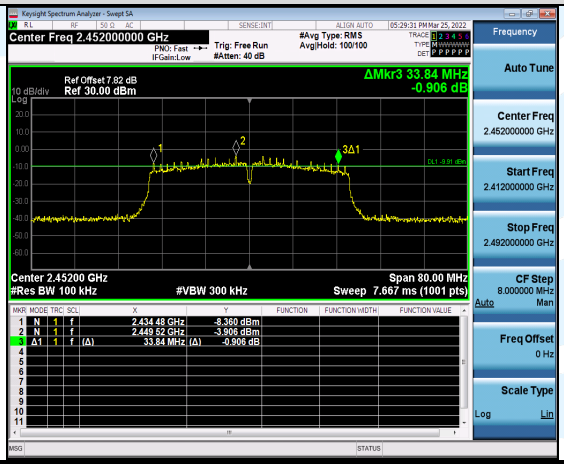
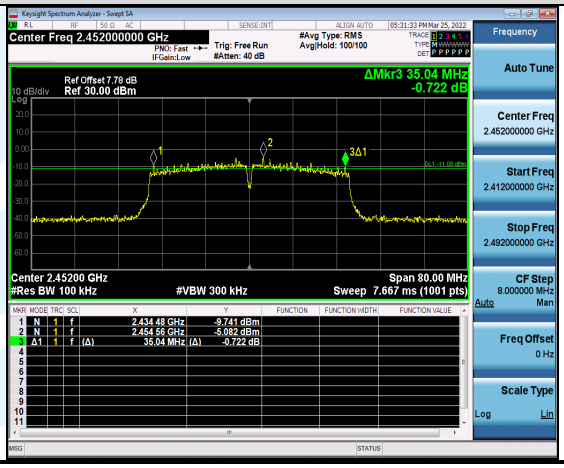
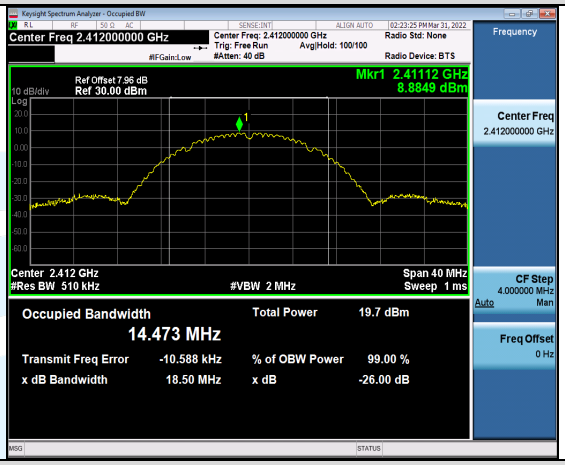
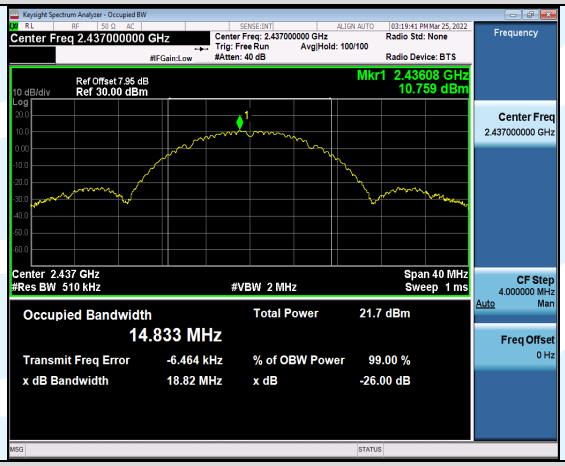
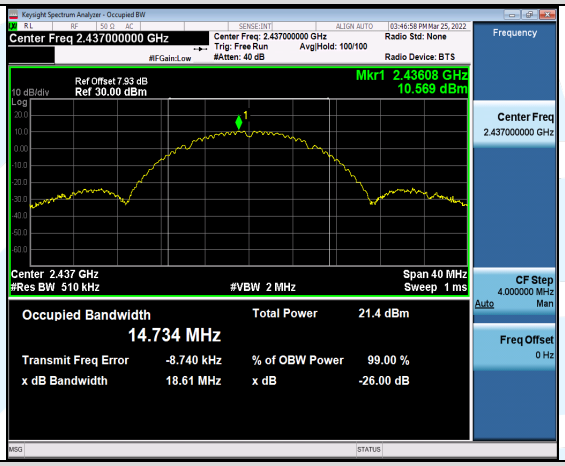
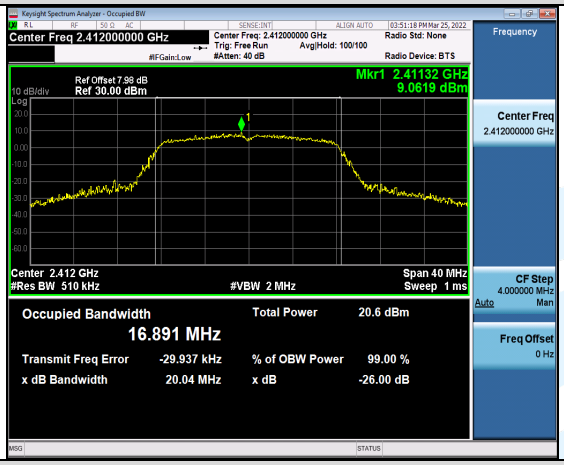
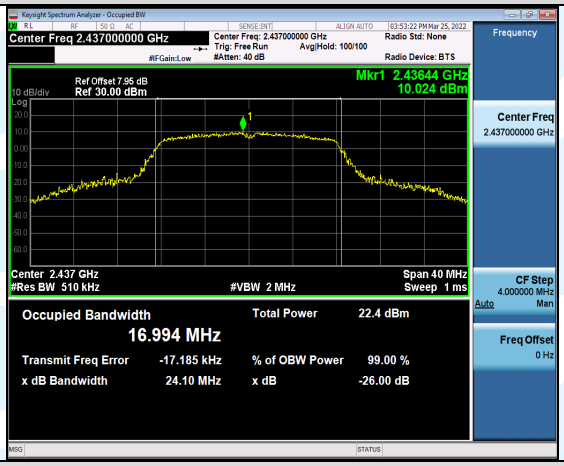
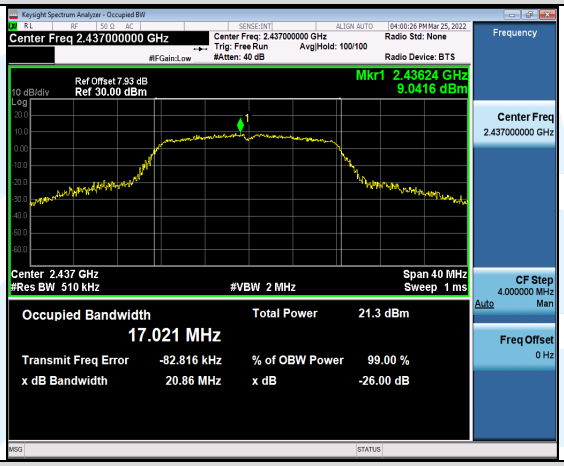
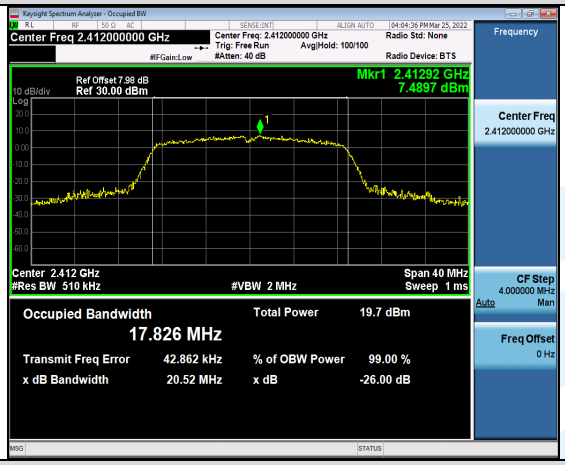
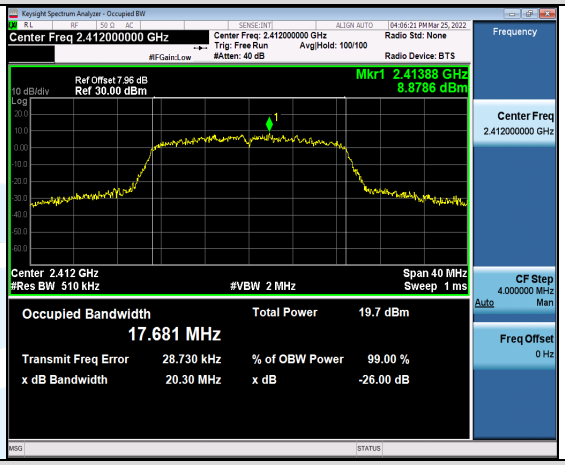
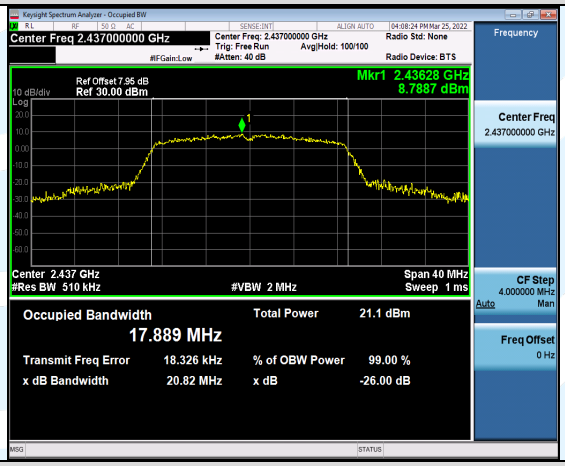
	
Channel 6	
	
Channel 11	
	

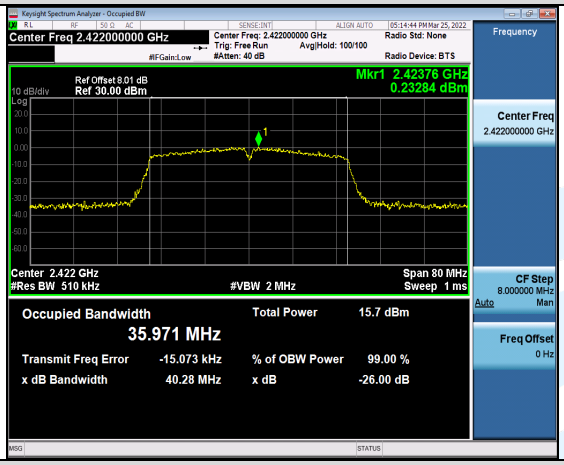
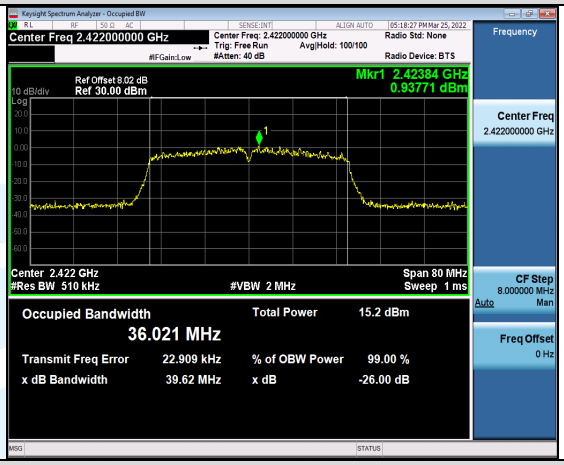
IEEE 802.11n-HT40	
MIMO_ Chain 0	MIMO_ Chain 1
Channel 3	
	
Channel 6	
	
Channel 9	
	

Occupied Bandwidth

IEEE 802.11b	
SISO_ Chain 0	SISO_ Chain 1
Channel 1	
	
Channel 6	
	
Channel 11	
	

IEEE 802.11g	
SISO_ Chain 0	SISO_ Chain 1
Channel 1	
	
Channel 6	
	
Channel 11	
	

IEEE 802.11n-HT20	
MIMO_ Chain 0	MIMO_ Chain 1
Channel 1	
	
Channel 6	
	
Channel 11	
	

IEEE 802.11n-HT40	
MIMO_ Chain 0	MIMO_ Chain 1
Channel 3	
	
Channel 6	
	
Channel 9	
	

5.5 POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (e)
RSS-247 Issue 2, Section 5.2(b)

Test Method: ANSI C63.10-2013 Clause 11.10.2

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

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ⩾ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results:

Test Mode	Antenna	Channel	Result [dBm/30kHz]	Result [dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-4.43	-14.43	≤7.99	PASS
	Ant2	2412	-5.36	-15.36	≤7.99	PASS
	Ant1	2437	-2.62	-12.62	≤7.99	PASS
	Ant2	2437	-3.51	-13.51	≤7.99	PASS
	Ant1	2462	-5.24	-15.24	≤7.99	PASS
	Ant2	2462	-4.79	-14.79	≤7.99	PASS
11G	Ant1	2412	-9.09	-19.09	≤7.99	PASS
	Ant2	2412	-10.15	-20.15	≤7.99	PASS
	Ant1	2437	-6.97	-16.97	≤7.99	PASS
	Ant2	2437	-8.45	-18.45	≤7.99	PASS
	Ant1	2462	-10.4	-20.4	≤7.99	PASS
	Ant2	2462	-8.65	-18.65	≤7.99	PASS
11N20MIMO	Ant1	2412	-10.04	-20.04	≤7.99	PASS
	Ant2	2412	-10.72	-20.72	≤7.99	PASS
	total	2412	-7.36	-17.36	≤7.99	PASS
	Ant1	2437	-8.47	-18.47	≤7.99	PASS
	Ant2	2437	-9.07	-19.07	≤7.99	PASS
	total	2437	-5.75	-15.75	≤7.99	PASS
	Ant1	2462	-10.54	-20.54	≤7.99	PASS
	Ant2	2462	-10.68	-20.68	≤7.99	PASS
	total	2462	-7.60	-17.6	≤7.99	PASS
11N40MIMO	Ant1	2422	-16.9	-26.9	≤7.99	PASS
	Ant2	2422	-18.52	-28.52	≤7.99	PASS
	total	2422	-14.62	-24.62	≤7.99	PASS
	Ant1	2437	-15.5	-25.5	≤7.99	PASS
	Ant2	2437	-17.54	-27.54	≤7.99	PASS
	total	2437	-13.39	-23.39	≤7.99	PASS
	Ant1	2452	-17.96	-27.96	≤7.99	PASS
	Ant2	2452	-19.15	-29.15	≤7.99	PASS
	total	2452	-15.50	-25.5	≤7.99	PASS

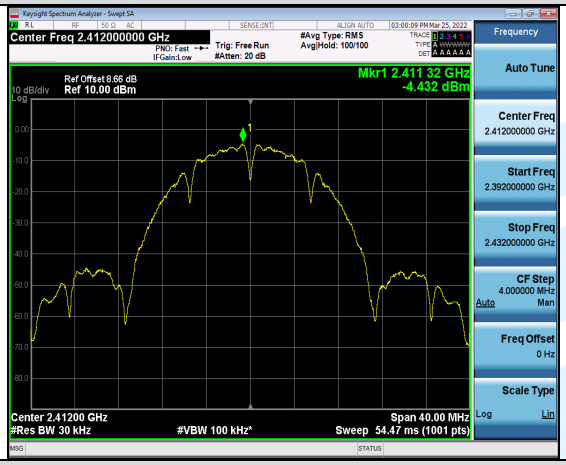
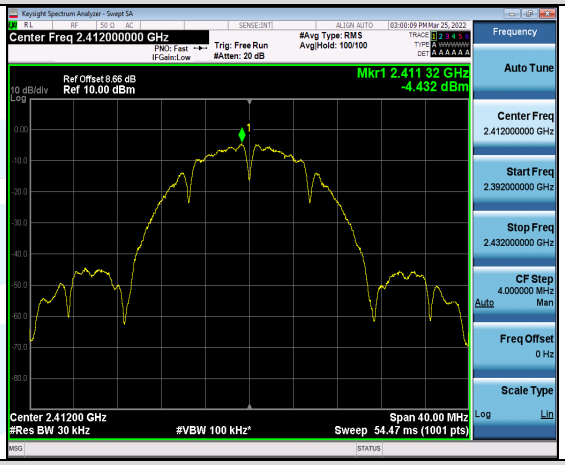
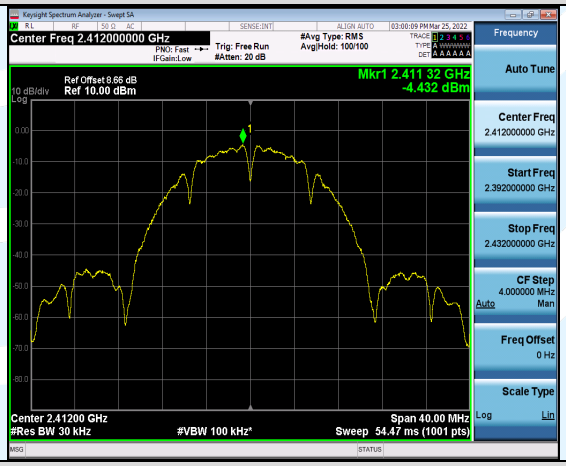
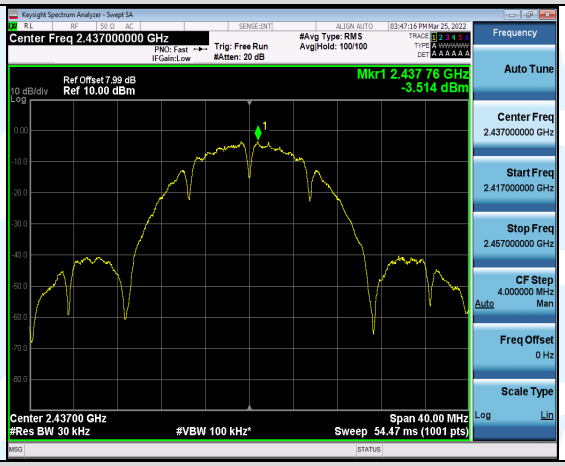
Remark:
1. Power with Duty Factor = Measured Power + Duty Cycle Factor
2. Total (Chain 0+1) = 10*log [($10^{Chain\ 0/10}$) + ($10^{Chain\ 1/10}$)]
3. Directional gain and the maximum conducted power spectral density limit see table below:

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)
2400 MHz to 2483.5 MHz	2.50	3.00

According to the list of antenna information above, antenna gains are not equal and the maximum antenna gain is 3.00 dBi.
According to KDB 662911VDO1 v02r01, for power measurements on IEEE 802.11 devices,
Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4; so the
Directional gain = GANT MAX + Array Gain =3.0dBi < 6 dBi
So, the maximum output power limit does not need to be reduced.

According to KDB 662911VDO1 v02r01, for power spectral density (PSD) measurements on IEEE 802.11 devices, the
Array Gain = 10 log (NANT/NSS) dB;
So, the
Directional gain = GANT MAX + 10 log (NANT/NSS) = 3 + 10 log (2/1) = 6.01dBi > 6 dBi
So, the maximum power spectral density limit should be reduced (6.01 -6) dBi = 0.01 dBi.

The test plots as follows:

IEEE 802.11b	
SISO_ Chain 0	SISO_ Chain 1
Channel 1	
	
Channel 6	
	
Channel 11