

TEST REPORT

Product Name: IP Phone
Trade Mark: GRANDSTREAM
Model No.: GRP2614
HVIN: GRP2614V3
Report Number: 2403089982RFC-4
Test Standards: FCC 47 CFR Part 15 Subpart E
RSS-247 Issue 3
RSS-Gen Issue 5
FCC ID: YZZGRP2614V3
IC: 11964A-GRP2614V3
Test Result: PASS
Date of Issue: June 25, 2024

Prepared for:

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

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
**Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and
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UTTR-RF-RSS247-V1.1

Version

Version No.	Date	Description
V1.0	June 25, 2024	Original



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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:	IP Phone		
Model No.:	GRP2614		
HVIN:	GRP2614V3		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n/ax	
		Bluetooth V5.0	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac/ax
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac/ax
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac/ax
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac/ax
Sample Received Date:	March 8, 2024		
Sample Tested Date:	April 12, 2024 to May 16, 2024		

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

1.2.2 Description of Accessories

Adapter (1)	
Model No.:	GQ12-120100-AU
Input:	100-240V~50/60Hz 0.4 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

Adapter (2)	
Model No.:	F12US1200100A
Input:	100-240V~50/60Hz 0.5 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

Adapter (3)	
Model No.:	DCT12W120100US-A2
Input:	100-240V~50/60Hz 0.3 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

Cable(1)	
Description:	Ethernet Cable
Cable Type:	Unshielded without ferrite
Length:	1.5 Meter

Cable(2)	
Description:	Phone Cord
Cable Type:	Unshielded without ferrite
Length:	2.5 Meter

Others	
1x Handset, 1x Phone Stand	

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)				
	5250 MHz to 5350 MHz (U-NII-2A)				
	5470 MHz to 5725 MHz (U-NII-2C)				
	5725 MHz to 5850 MHz (U-NII-3)				
Frequency Ranges:	5180 MHz to 5240 MHz				
	5260 MHz to 5320 MHz				
	5500 MHz to 5720 MHz				
	5745 MHz to 5825 MHz				
Support Standards:	IEEE 802.11a/n/ac/ax				
TPC Function:	Not Support				
DFS Operational mode:	Slave without radar Interference detection function				
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ax: OFDM/ OFDMA ^{Note 1} (1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK)				
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20: 20 MHz				
	IEEE 802.11n-HT40/ac-VHT40/ax-HE40: 40 MHz				
Data Rate:	IEEE 802.11a: Up to 54 Mbps				
	IEEE 802.11n-HT20: Up to MCS7				
	IEEE 802.11n-HT40: Up to MCS7				
	IEEE 802.11ac-VHT20: Up to MCS8				
	IEEE 802.11ac-VHT40: Up to MCS9				
	IEEE 802.11ax-HE20/HE40: Up to MCS11				
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 2 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40				
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 2 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40				
	5470 MHz to 5725 MHz: 12 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 6 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40				
	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 2 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40				
Antenna Type:	PCB Antenna				
Antenna Gain: (Provided by the customer)	5150 MHz to 5250 MHz: 4.5 dBi				
	5250 MHz to 5350 MHz: 4.5 dBi				
	5470 MHz to 5725 MHz: 4.5 dBi				
	5725 MHz to 5850 MHz: 4.5 dBi				
Maximum conducted output power (dBm):		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	15.55	15.73	16.98	16.57
	IEEE 802.11n-HT20:	15.61	15.78	17.11	16.70
	IEEE 802.11n-HT40:	17.94	17.90	17.40	16.67
	IEEE 802.11ac-VHT20	15.63	15.80	17.12	16.70
	IEEE 802.11ac-VHT40	17.87	17.84	17.38	16.63

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	IEEE 802.11ax-HE20	15.66	15.81	17.20	16.72
	IEEE 802.11ax-HE40	17.98	17.91	17.45	16.80
Maximum EIRP (dBm):		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	19.77	20.23	21.48	21.07
	IEEE 802.11n-HT20:	20.11	20.28	21.61	21.20
	IEEE 802.11n-HT40:	22.44	22.40	21.90	21.17
	IEEE 802.11ac-VHT20	20.13	20.30	21.62	21.20
	IEEE 802.11ac-VHT40	22.37	22.34	21.88	21.13
	IEEE 802.11ax-HE20	20.16	20.31	21.70	21.22
	IEEE 802.11ax-HE40	22.48	22.39	21.95	21.30
Normal Test Voltage:	12Vdc				
Note 1: The customer declaration that OFDMA modulation supports only the SU mode.					

1.4 OTHER INFORMATION

Operation Frequency Each of Channel				
	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20 IEEE 802.11ax-HE20	$f = 5000 + 5k, k = 32 + 4n$			$f = 5000 + 5k,$ $k = 145 + 4n$
	$n = 1, \dots, 4$	$n = 5, \dots, 8$	$n = 17, \dots, 27$	$n = 1, \dots, 5$
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40 IEEE 802.11ax-HE40	$f = 5000 + 5k, k = 30 + 8n$			$f = 5000 + 5k,$ $k = 143 + 8n$
	$n = 1, 2$	$n = 1, \dots, 5$	$n = 9, \dots, 13$	$n = 1, 2$
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	FCC ID	Supplied by
Notebook	Lenovo	B40-80	MP12NEQ6	UnionTrust	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust	UnionTrust
Wireless Home Router	SAGEMCOM	FAST5280	253703944	VW3FAST5280	UnionTrust
Key-Press Attenuator	Huaxin	KT2.5-90/1S-2S	UTTL-EN023	N/A	UnionTrust
4 Way Divider	WOKEN	0120A040560002D	UTTL-EN028	N/A	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.3 Meter	UnionTrust

1.6 TEST LOCATION

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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	± 4.6 dB
5	Radiated emission 1GHz-18GHz	± 4.4 dB
6	Radiated emission 18GHz-26GHz	± 4.6 dB
7	Radiated emission 26GHz-40GHz	± 4.6 dB
8	Conducted spurious emissions	± 2.7 dB
9	RF Power, Conducted	± 0.68 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	± 6.4 x 10 ⁻⁸
12	Transmission Time	± 0.19 %

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart E Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203 FCC 47 CFR Part 15 Subpart E Section 15.407(a)(1) (2) RSS-Gen Issue 5, Section 6.8	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 3 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 3 Section 6.2.4.1	KDB 789033 D02 v02r01 Section C.2	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, section 6.7	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 3 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a (Method PM)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 3 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 3 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 3 Section 6.3	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS
Disclaimer and Explanations: The declared of product specification and data (e.g. antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.			

For Dynamic Frequency Selection

Test Case	Result
Channel Availability Check Time	N/A ^{Note 1}
U-NII Detection Bandwidth	N/A ^{Note 1}
Channel Closing Transmission Time	PASS
Channel Move Time	PASS
DFS Detection Threshold	N/A ^{Note 1}
Non- Occupancy Period	N/A ^{Note 1}
Note: 1) The EUT is slave, NA In this whole report not applicable.	

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3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	3m SAC	ETS-LINDGREN	3m	Euroshiedpn-CT001270-1317	11-Nov-2023	10-Nov-2026
☒	Receiver	R&S	ESIB26	100114	27-Oct-2023	26-Oct-2024
☒	Spectrum Analyzer	R&S	FSV40-N	101653	14-Apr-2023	13-Apr-2024
					29-Mar-2024	28-Mar-2025
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	30-Oct-2023	29-Oct-2024
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	30-Oct-2023	29-Oct-2024
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	30-Oct-2023	29-Oct-2024
☒	Preamplifier	HP	8447F	2805A02960	31-Oct-2023	30-Oct-2024
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G186	27-Oct-2023	26-Oct-2024
☒	Double-Ridged Waveguide Horn Antenna	ETS-LINDGREN	3117-PA	00201541	16-Apr-2023	15-Apr-2024
					01-Apr-2024	31-Mar-2025
☒	Pre-amplifier	ETS-Lindgren	00118385	00201874	31-Oct-2023	30-Oct-2024
☒	Double-Ridged Waveguide Horn Antenna	ETS-LINDGREN	3116C-PA	00202652	30-Oct-2023	29-Oct-2024
☒	Pre-amplifier	ETS-Lindgren	00118384	00202652	30-Oct-2023	29-Oct-2024
☒	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	1316.3003K07-101181-K3	27-Oct-2023	26-Oct-2024
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	27-Oct-2023	26-Oct-2024
☒	LISN	R&S	ESH2-Z5	860014/024	27-Oct-2023	26-Oct-2024
☒	LISN	ETS-Lindgren	3816/2SH	00201088	27-Oct-2023	26-Oct-2024
☒	Test Software	EZ-EMC	EZ-CON	Software Version: EMC-CON 3A1.1		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	EXA Spectrum Analyzer	KEYSIGHT	N9020A	MY51286807	27-Oct-2023	26-Oct-2024
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	27-Oct-2023	26-Oct-2024
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	27-Oct-2023	26-Oct-2024

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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	12	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temp. (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
26 dB emission bandwidth	24.7	51.2	99.9	S202403082835-ZJA01/4	Allen Zhou
6 dB bandwidth					
Occupied Bandwidth					
Maximum conducted output power					
Peak Power Spectral Density					
Dynamic Frequency Selection					
Radiated Emissions and Band Edge Measurement	23.9	57.7	100.1	S202403082835-ZJA01/4	Fire Huo
AC Power Line Conducted Emission	22.4	59.6	100.2		Linson Xie

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists			
		Lowest(L)	Middle(M)	Highest(H)	Straddle band
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20 IEEE 802.11ax-HE20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48	--
		5180 MHz	5220 MHz	5240 MHz	--
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64	--
		5260 MHz	5300 MHz	5320 MHz	--
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140	Channel 144
		5500 MHz	5580 MHz	5700 MHz	5720 MHz
	5725 MHz to 5850 MHz	Channel 149	Channel 157	Channel 165	--
		5745 MHz	5785 MHz	5825 MHz	--
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40 IEEE 802.11ax-HE40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46	--
		5190 MHz	--	5230 MHz	--
	5250 MHz to 5350 MHz	Channel 54	--	Channel 62	--
		5270 MHz	--	5310 MHz	--
	5470 MHz to 5725 MHz	Channel 102	Channel 110	Channel 134	Channel 142
		5510 MHz	5550 MHz	5670 MHz	5710 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159	--
		5755 MHz	--	5795 MHz	--
		--	5775 MHz	--	--

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11a/n/ac/ax	1Tx/1Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting(Provided by the customer)

Power Setting: not applicable, test used software default power level.

Test Software

Test software name: Putty

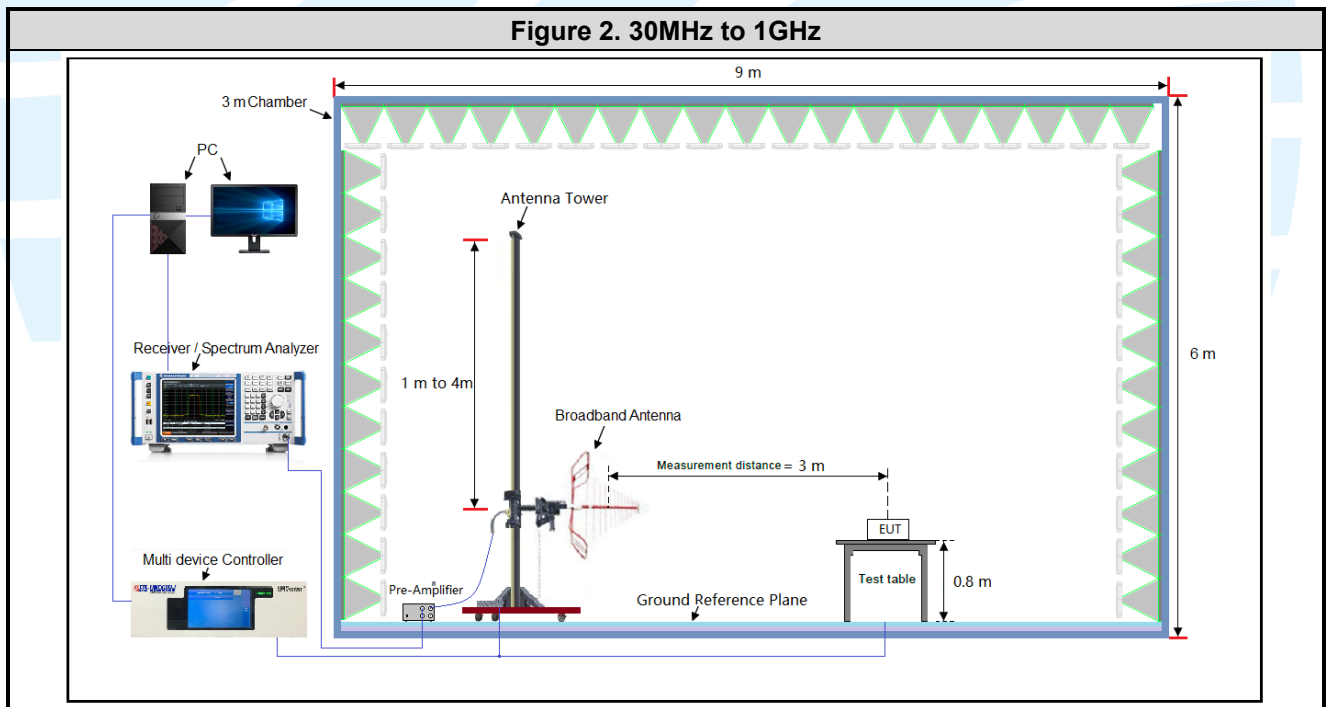
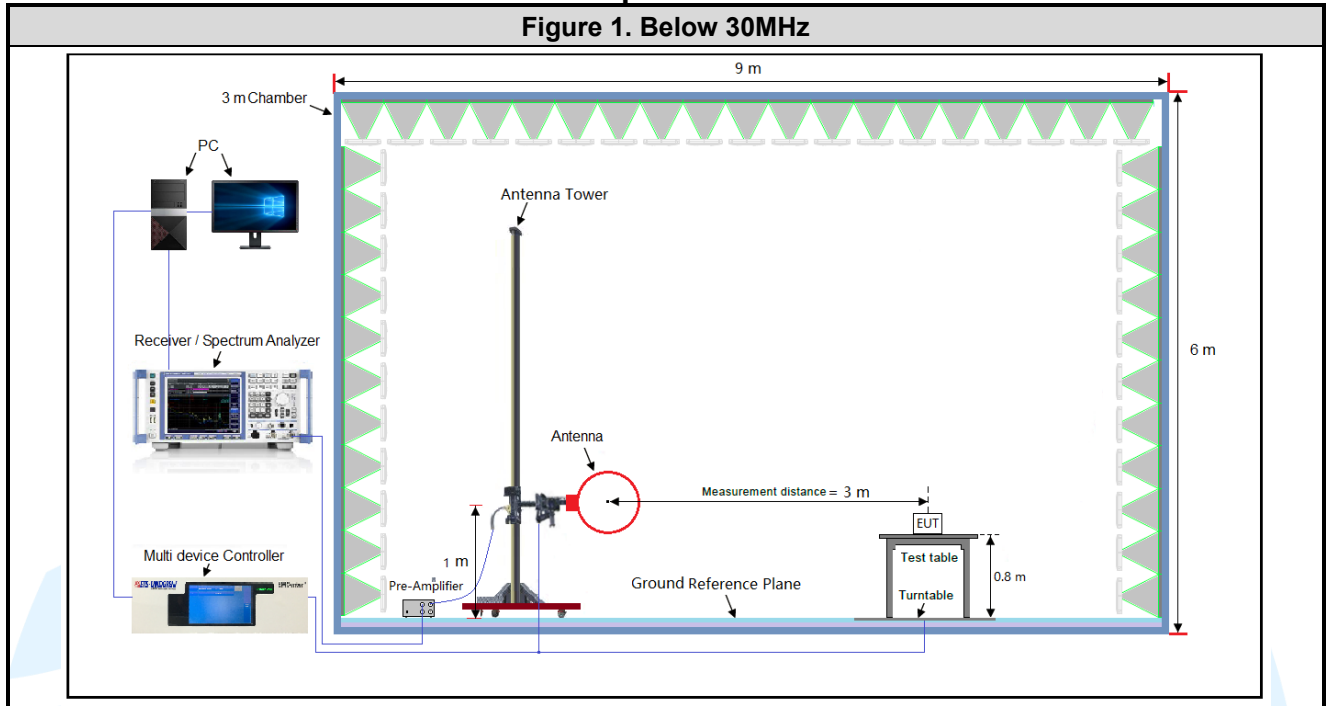
4.4 PRE-SCAN

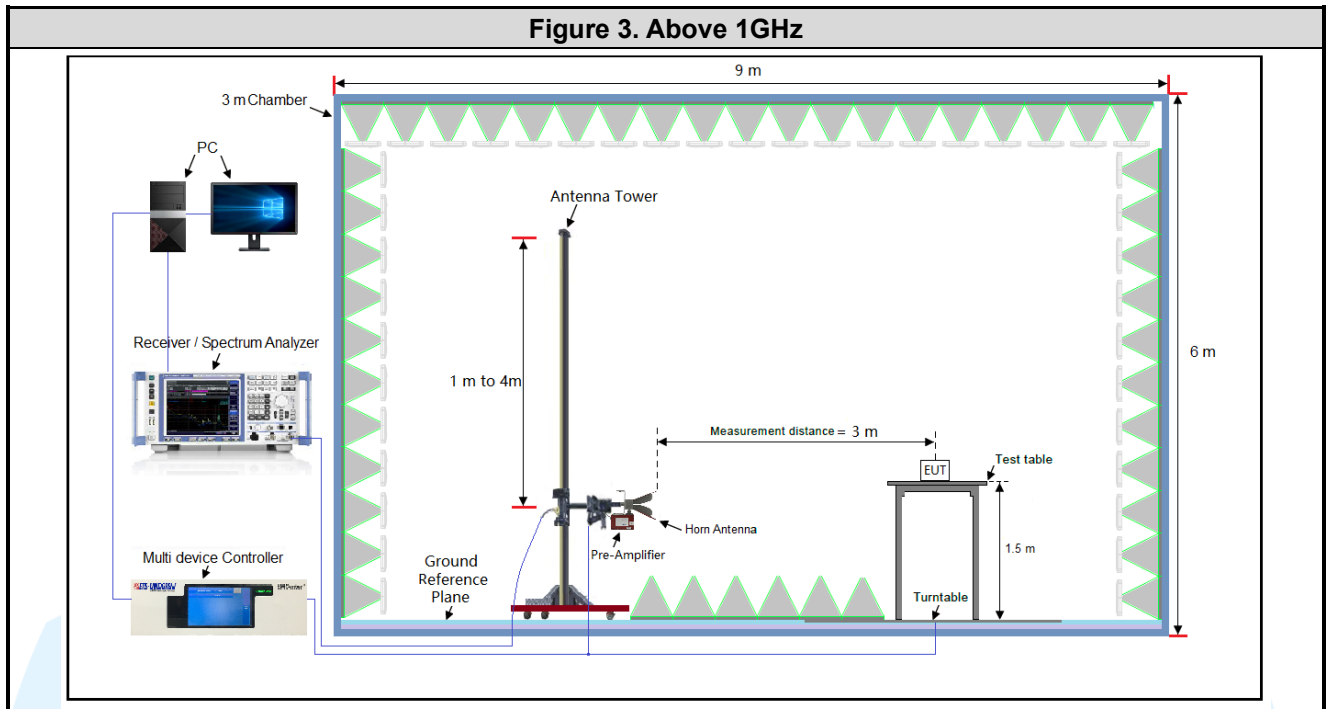
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

Mode	Worst-case data rates
IEEE 802.11a	6 Mbps
IEEE 802.11n-HT20	MCS0
IEEE 802.11n-HT40	MCS0
IEEE 802.11ac-VHT20	MCS0
IEEE 802.11ac-VHT40	MCS0
IEEE 802.11ax-HE20	MCS0
IEEE 802.11ax-HE40	MCS0

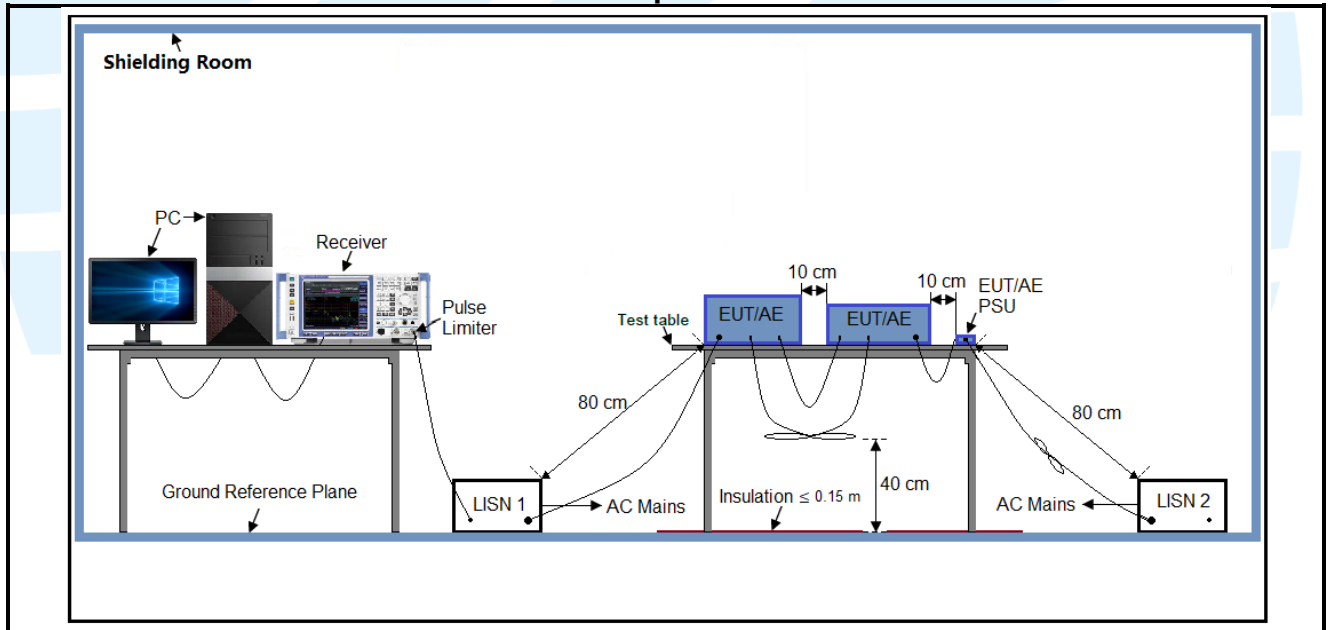
4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

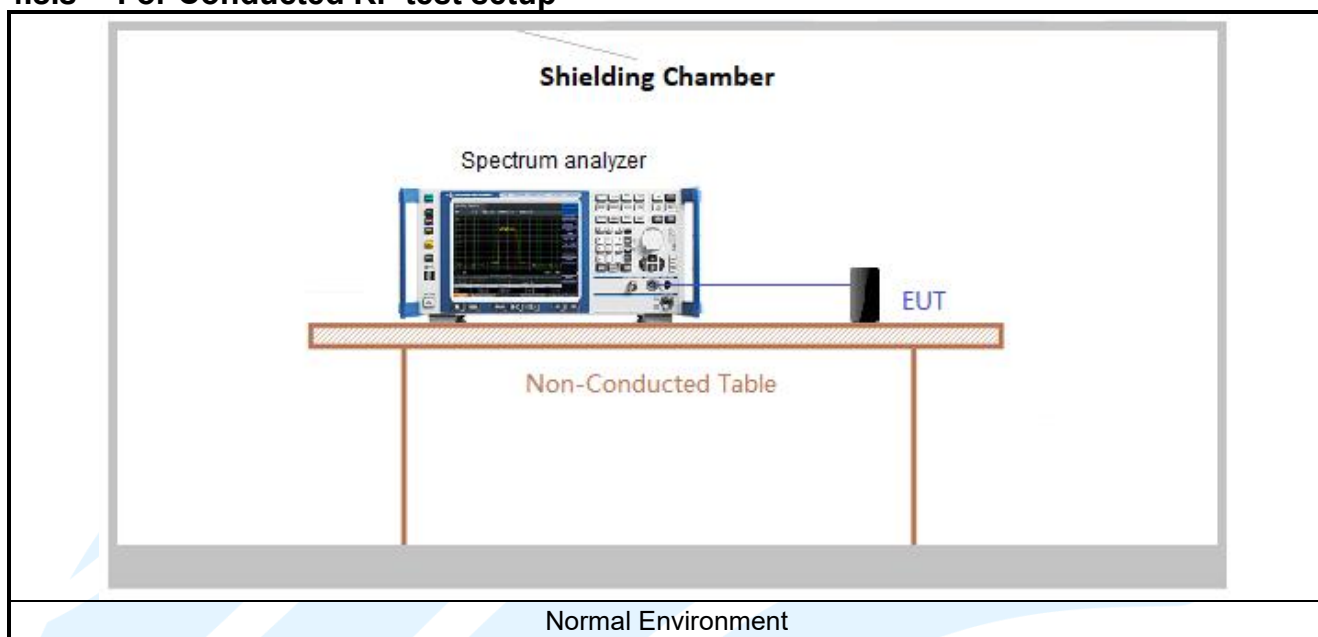




4.5.2 For Conducted Emissions test setup



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.

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 12.2.

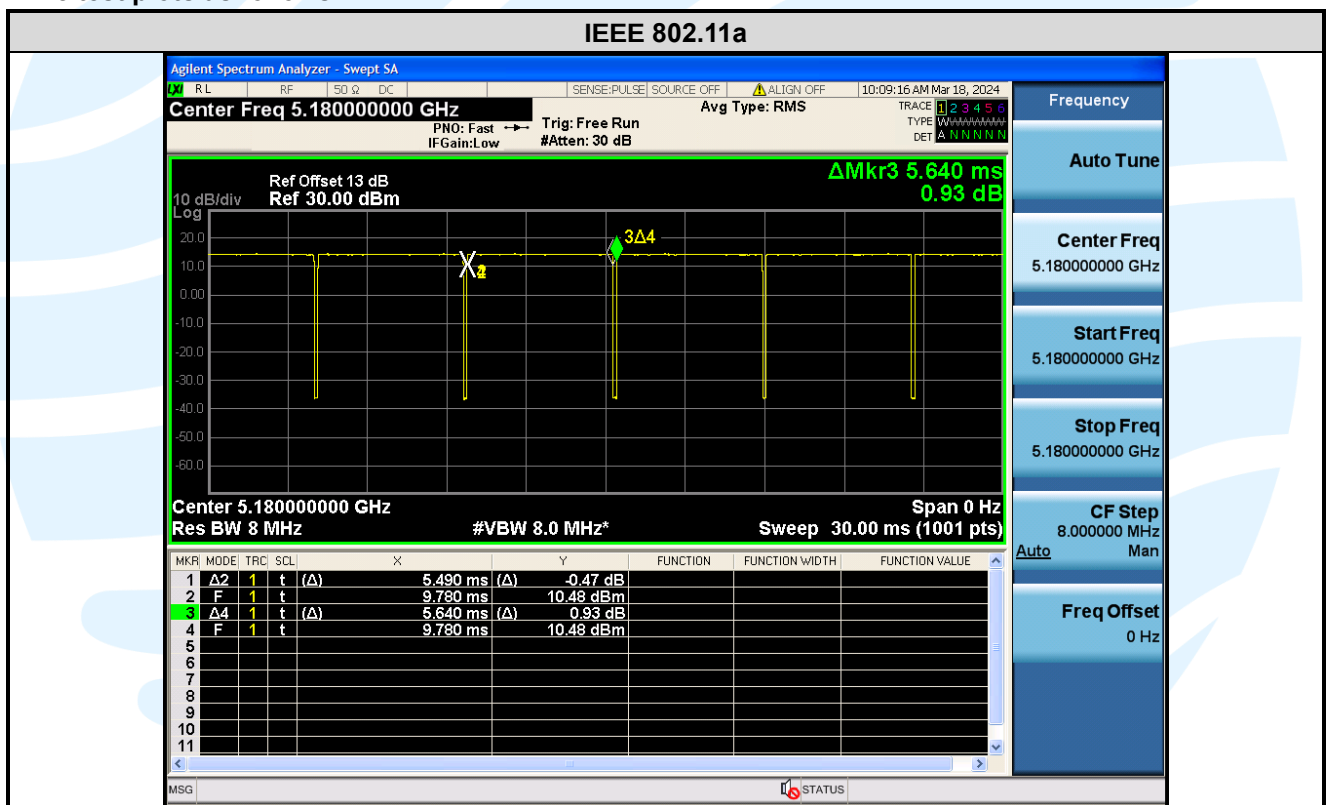
Test Results

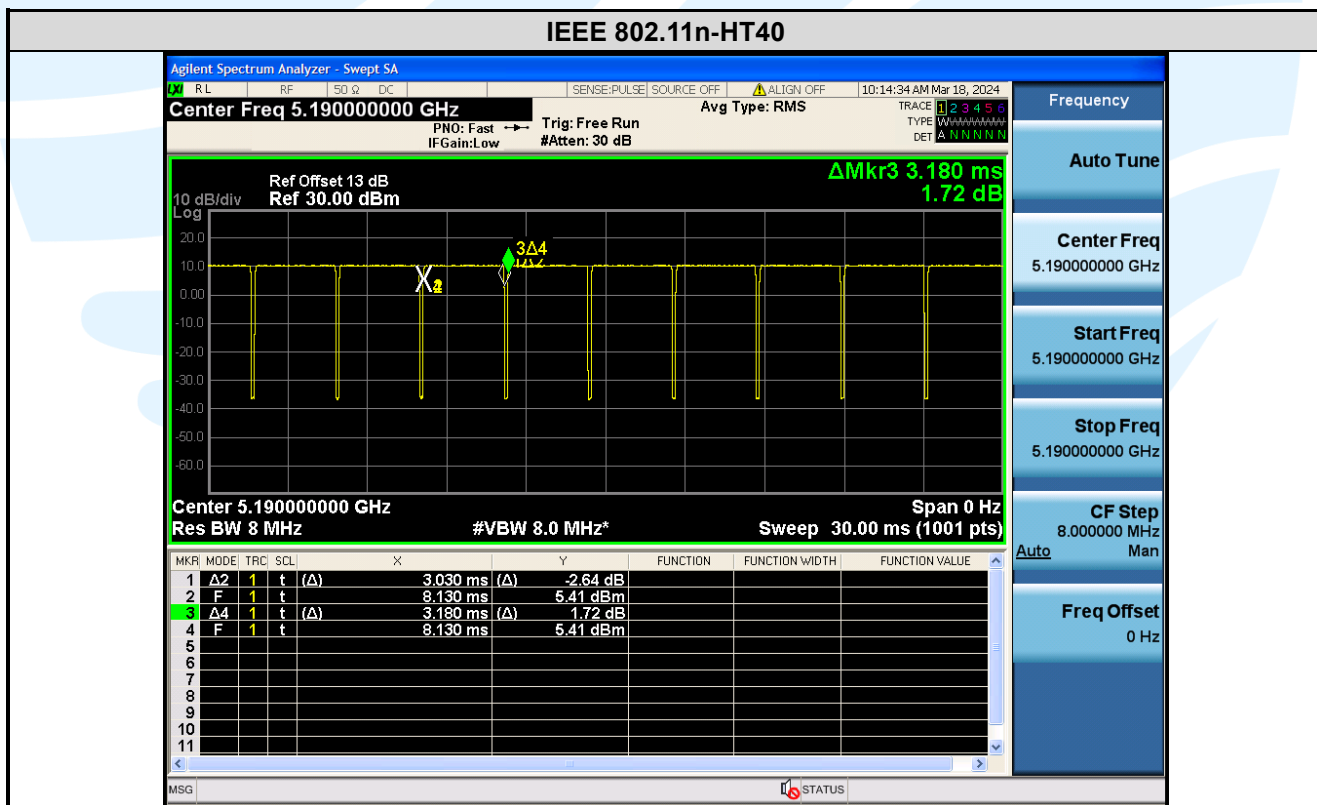
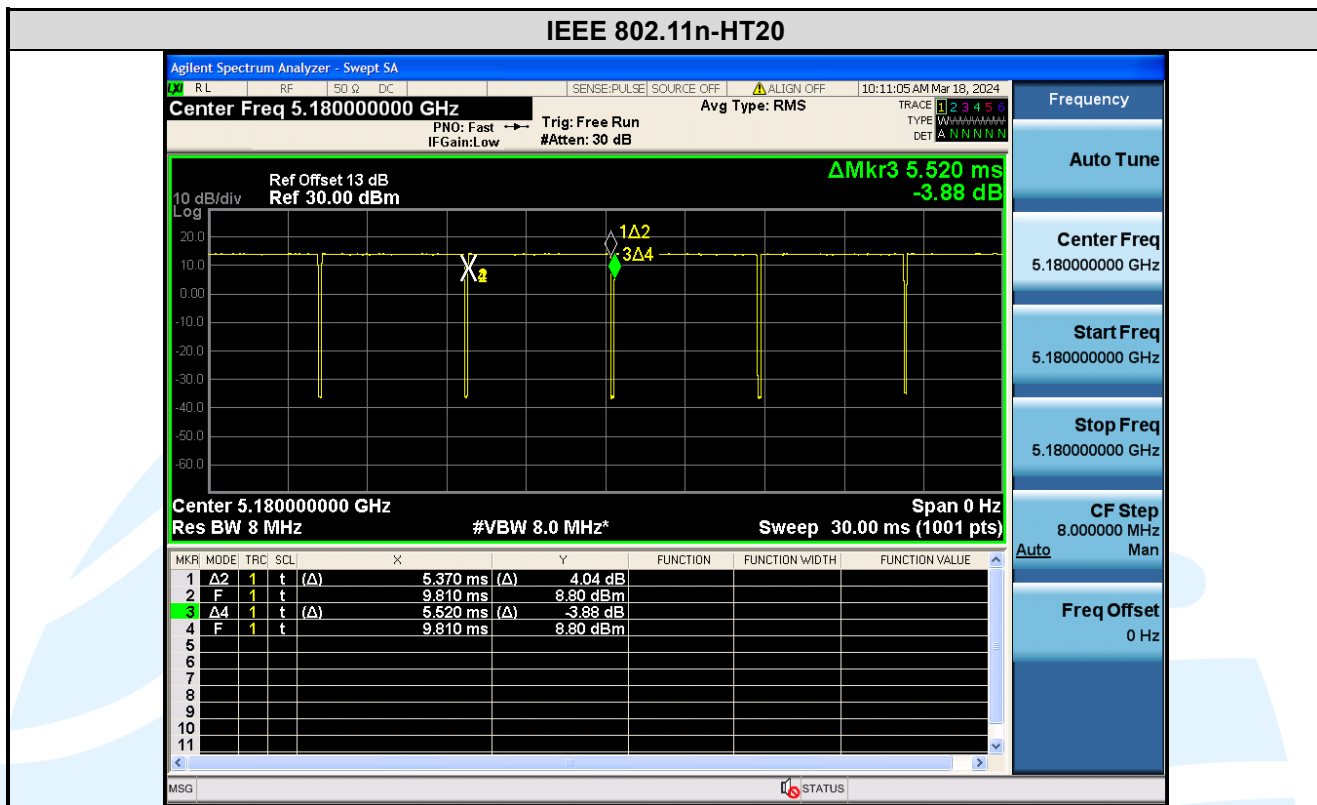
Mode	Data Rates	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T Minimum VBW (kHz)
IEEE 802.11a	6 Mbps	5.490	5.640	0.97	97.34	0.12	0.18
IEEE 802.11n-HT20	MCS 0	5.370	5.520	0.97	97.28	0.12	0.19
IEEE 802.11n-HT40	MCS 0	3.030	3.190	0.95	94.98	0.22	0.33
IEEE 802.11ac-VHT20	MCS 0	5.370	5.550	0.97	96.76	0.14	0.19
IEEE 802.11ac-VHT40	MCS 0	5.160	5.310	0.97	97.18	0.12	0.19
IEEE 802.11ax-HE20	MCS 0	4.650	4.800	0.97	96.88	0.14	0.22
IEEE 802.11ax-HE40	MCS 0	4.620	4.770	0.97	96.86	0.14	0.22

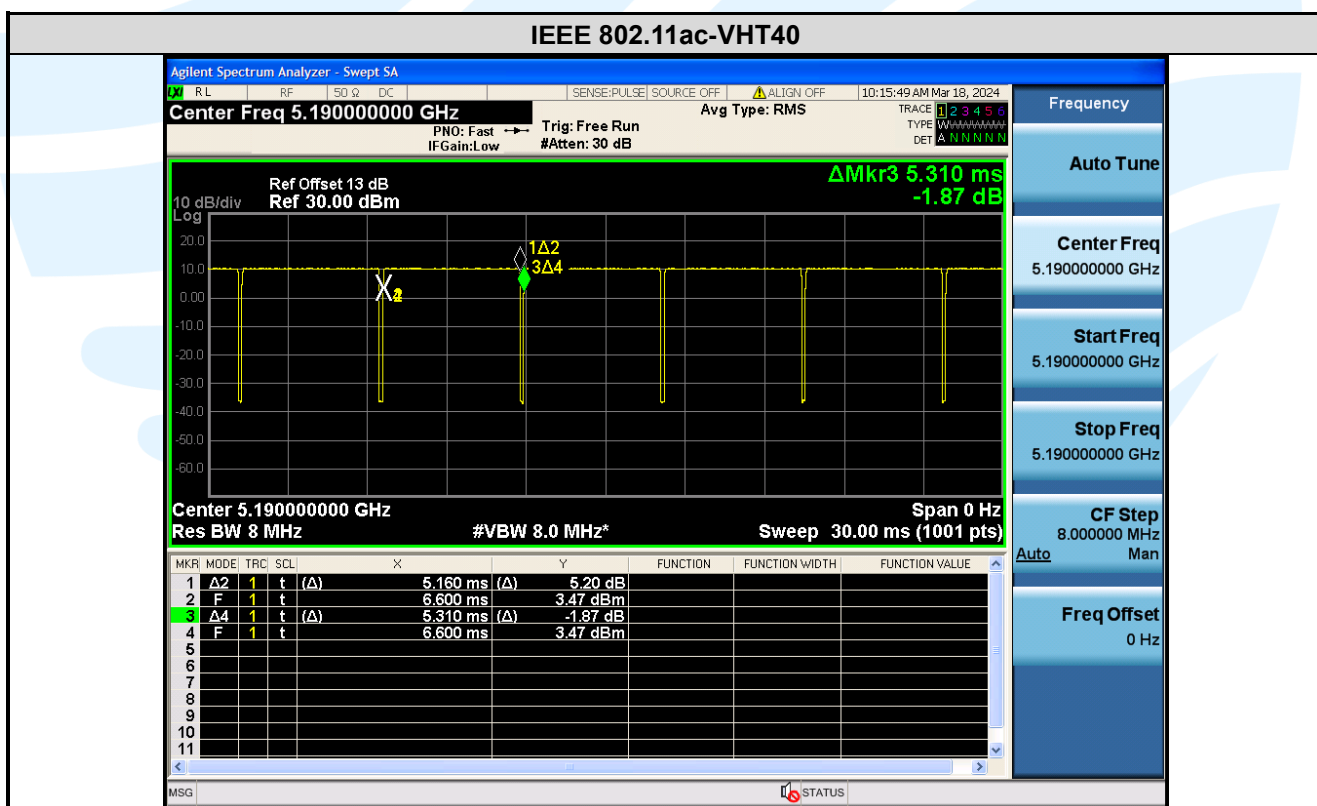
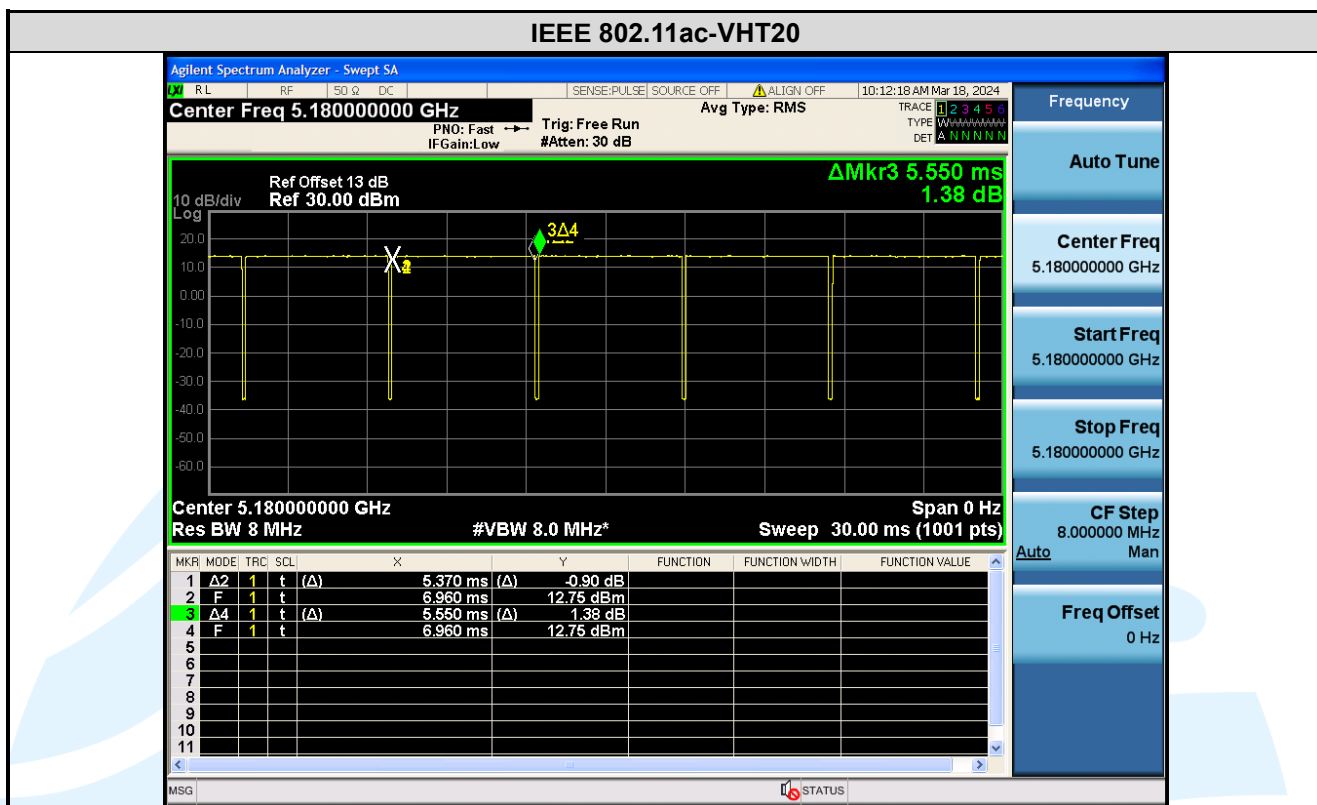
Remark:

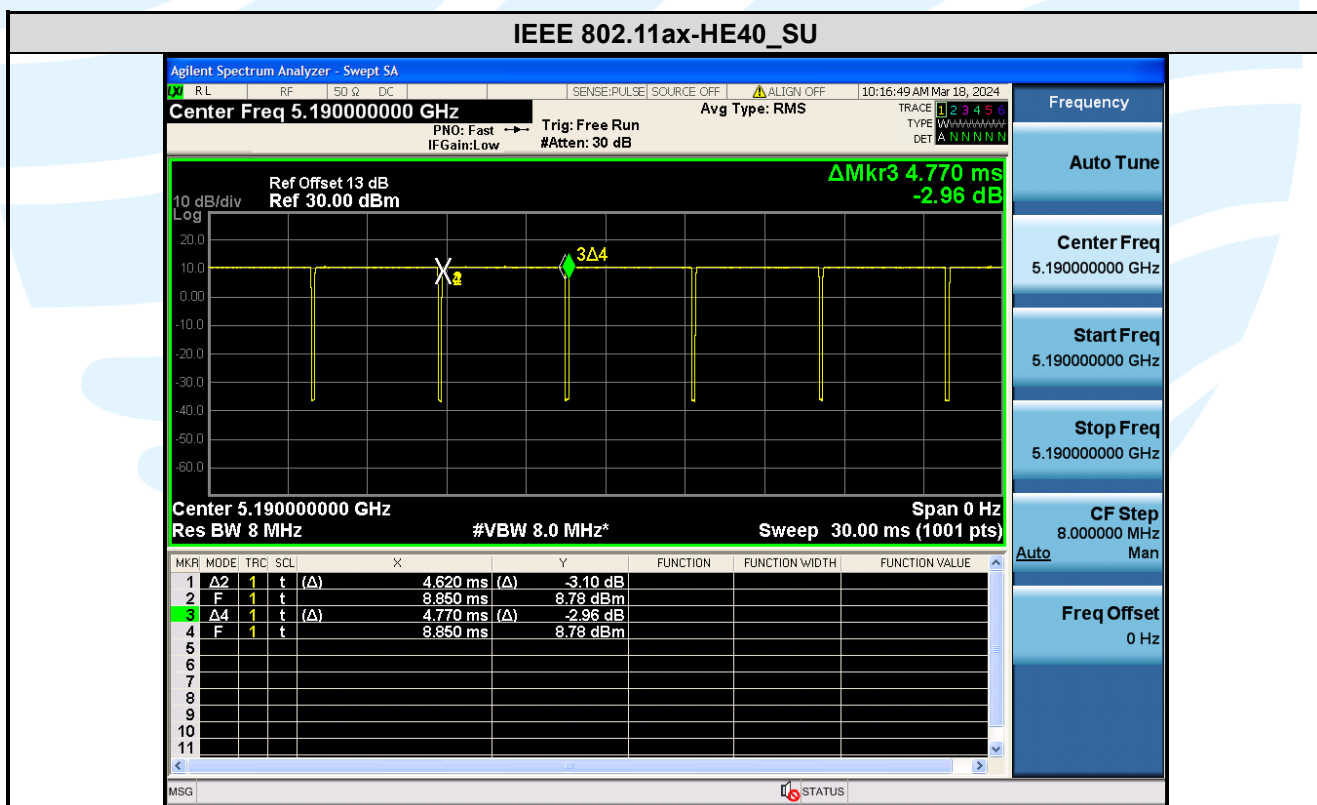
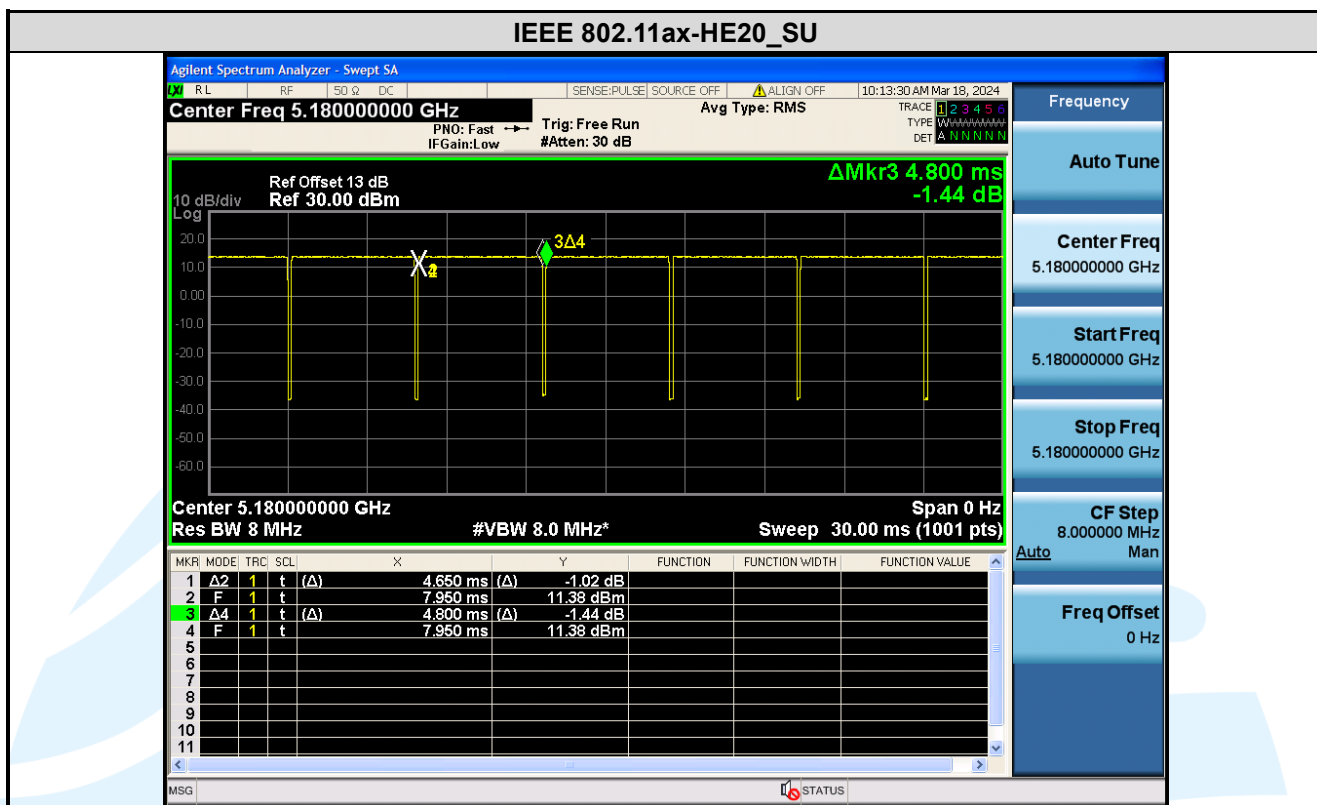
- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = $10 * \log(1/\text{Duty cycle})$;
- 3) Average factor = $20 \log_{10} \text{Duty Cycle}$.

The test plots as follows









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 3	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 Unlicensed Wireless Devices
6	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E
7	KDB 905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
8	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection
9	KDB 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability

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. 15.407(a)(1) (2) requirement: The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the 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: Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 4.5 dBi.

5.326 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)
RSS-247 Issue 3 Section 6.2.1.2
Test Method: KDB 789033 D02 v02r01 Section C.1
Limit: None; for reporting purposes only.
Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.

Spectrum analyzer according to the following Settings:

- a) Set RBW = approximately 1 % of the emission bandwidth.
- b) Set the VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

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 Mode: Link mode
Test Results: Please refer to Appendix A

5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (e)
RSS-247 Issue 3 Section 6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section C.2

Limit: Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

6dB Bandwidth

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 * \text{RBW}$.
- 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) $\geq 3 \times \text{RBW}$.
- 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 Mode: Transmitter mode

Test Results: Please refer to Appendix A

5.5 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 3 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section E.3.a (Method PM)

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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UTTR-RF-RSS247-V1.1

Limits: RSS-247 Issue 3

1. Frequency band 5150-5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. Frequency band 5250-5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

- a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
- b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

- a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW/MHz	for $0^\circ \leq \theta < 8^\circ$
ii. $-13 - 0.716 (\theta - 8)$ dBW/MHz	for $8^\circ \leq \theta < 40^\circ$
iii. $-35.9 - 1.22 (\theta - 40)$ dBW/MHz	for $40^\circ \leq \theta \leq 45^\circ$
iv. -42 dBW/MHz	for $\theta > 45^\circ$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

- b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:
 - i. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or
 - ii. devices shall implement a method to permanently reduce their e.i.r.p. via a firmware feature in the event that the Department requires it. The test report must demonstrate how the device's power table can be updated to meet this firmware requirement. The manufacturer shall provide this firmware to update all systems automatically in compliance with the directions received from the Department.

3. Frequency bands 5470-5600 MHz and 5650-5725 MHz

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. Frequency band 5725-5850 MHz

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices

operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint³ systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

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 Mode: Transmitter mode

Test Results: Pass

Test Data:

Gain and the maximum output power limit.
RSS-247 Issue 3

Frequency Band	Antenna Gain (dBi)	Power Limits (dBm)
U-NII-1	4.5	23.0
U-NII-2A	4.5	24.0
U-NII-2C	4.5	24.0
U-NII-3	4.5	30.0

FCC 47 CFR Part 15 Subpart E

Frequency Band	Antenna Gain (dBi)	Power Limits (dBm)
U-NII-1	4.5	24.0
U-NII-2A	4.5	24.0
U-NII-2C	4.5	24.0
U-NII-3	4.5	30.0

Frequency band 5150-5250 MHz**RSS-247 Issue 3:**

For IEEE 802.11a, the minimum 99% emission bandwidth is 17.071Hz

$10 \text{ dBm} + 10\log_{10}(17.071) = 22.32 \text{ dBm} < 23 \text{ dBm}$

So the 22.32 dBm limit applicable

For IEEE 802.11n-HT20/ ac-VHT20/ax-HE20, the minimum 99% emission bandwidth is 18.077 MHz

$10 \text{ dBm} + 10\log_{10}(18.077) = 22.57 \text{ dBm} < 23 \text{ dBm}$

So the 22.57 dBm limit applicable

For IEEE 802.11n-HT40/ ac-VHT40/ax-HE40, the minimum 99% emission bandwidth is 36.443 MHz

$10 \text{ dBm} + 10\log_{10}(36.443) = 25.62 \text{ dBm} > 23 \text{ dBm}$

So the 23 dBm limit applicable

Frequency band 5250-5350 MHz**RSS-247 Issue 3:**

For IEEE 802.11 a, the minimum 99% emission bandwidth is 17.050MHz

$11 \text{ dBm} + 10\log_{10}(17.050) = 23.32 \text{ dBm} < 24 \text{ dBm}$

So the 23.32 dBm limit applicable

For IEEE 802.11n-HT20/ ac-VHT20/ax-HE20, the minimum 99% emission bandwidth is 18.085 MHz

$11 \text{ dBm} + 10\log_{10}(18.085) = 23.57 \text{ dBm} < 24 \text{ dBm}$

So the 23.57 dBm limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ax-HE40, the minimum 99% emission bandwidth is 36.448 MHz

$11 \text{ dBm} + 10\log_{10}(36.448) = 26.62 \text{ dBm} > 24 \text{ dBm}$

So the 24 dBm limit applicable

EIRP:

For IEEE 802.11 a/n-HT20/ac-VHT20/ax-HE20, the minimum 99% emission bandwidth is 17.021MHz

$17 \text{ dBm} + 10\log_{10}(17.050) = 29.32 \text{ dBm}$

$29.32 \text{ dBm} > 27 \text{ dBm}$

So the 27 dBm limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ax-HE40, the minimum 99% emission bandwidth is 36.427 MHz

$17 \text{ dBm} + 10\log_{10}(36.448) = 32.62 \text{ dBm} > 27 \text{ dBm}$

So the 27 dBm limit applicable

FCC 47 CFR Part 15 Subpart E:

For IEEE 802.11 a/n/ac/ax, the minimum 26 dB emission bandwidth is 21.57 MHz

$11 \text{ dBm} + 10\log_{10}(21.57) = 24.34 \text{ dBm} > 24 \text{ dBm}$

So the 24 dBm limit applicable

Frequency bands 5470-5725 MHz (RSS-247 Issue 3 Not including 5600-5650 MHz)**RSS-247 Issue 3:**

For IEEE 802.11 a, the minimum 99% emission bandwidth is 17.094 MHz

$11 \text{ dBm} + 10\log_{10}(17.094) = 23.33 \text{ dBm} < 24 \text{ dBm}$

So the 23.33 dBm limit applicable

For IEEE 802.11n-HT20/ac-VHT20/ax-HE20, the minimum 99% emission bandwidth is 18.028 MHz

$11 \text{ dBm} + 10\log_{10}(18.028) = 23.56 \text{ dBm} < 24 \text{ dBm}$

So the 23.56 dBm limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ax-HE40, the minimum 99% emission bandwidth is 36.432 MHz

$11 \text{ dBm} + 10\log_{10}(36.432) = 26.61 \text{ dBm} > 24 \text{ dBm}$

So the 24 dBm limit applicable

EIRP:

For IEEE 802.11 a/n-HT20/ac-VHT20/ax-HE20, the minimum 99% emission bandwidth is 17.094 MHz
 $17 \text{ dBm} + 10\log_{10}(17.094) = 29.33 \text{ dBm}$
 $29.33 \text{ dBm} > 27 \text{ dBm}$
 So the 27 dBm limit applicable

For IEEE 802.11 n-HT40/ac-VHT40/ax-HE40, the minimum 99% emission bandwidth is 36.432 MHz
 $17 \text{ dBm} + 10\log_{10}(36.432) = 32.61 \text{ dBm} > 27 \text{ dBm}$
 So the 27 dBm limit applicable

FCC 47 CFR Part 15 Subpart E:

For IEEE 802.11 a/n/ac/ax, the minimum 26 dB emission bandwidth is 21.42 MHz
 $11 \text{ dBm} + 10\log_{10}(21.42) = 24.31 \text{ dBm} > 24 \text{ dBm}$
 So the 24 dBm limit applicable

Mode	Band	Channel	CONDUCTED AVG POWER				EIRP			
			Meas Value (dBm)	Corr'd Value (dBm)	FCC Limit (dBm)	ISED Limit (dBm)	EIRP (dBm)	FCC Limit (dBm)	ISED Limit (dBm)	Result
IEEE 802.11a	U-NII-1	36	15.43	15.55	24.00	--	20.05	--	22.32	Pass
		44	14.88	15.00	24.00	--	19.50	--	22.32	Pass
		48	15.15	15.27	24.00	--	19.77	--	22.32	Pass
	U-NII-2A	52	15.34	15.46	24.00	23.32	19.96	--	27.00	Pass
		60	15.61	15.73	24.00	23.32	20.23	--	27.00	Pass
		64	15.37	15.49	24.00	23.32	19.99	--	27.00	Pass
	U-NII-2C	100	16.86	16.98	24.00	23.33	21.48	--	27.00	Pass
		116	16.58	16.70	24.00	23.33	21.20	--	27.00	Pass
		140	16.53	16.65	24.00	23.33	21.15	--	27.00	Pass
		144	16.33	16.45	24.00	23.33	20.95	--	27.00	Pass
	U-NII-3	149	16.45	16.57	30.00	30.00	21.07	--	--	Pass
		157	16.21	16.33	30.00	30.00	20.83	--	--	Pass
		165	15.32	15.44	30.00	30.00	19.94	--	--	Pass
IEEE 802.11n-HT20	U-NII-1	36	15.49	15.61	24.00	--	20.11	--	22.57	Pass
		44	14.97	15.09	24.00	--	19.59	--	22.57	Pass
		48	15.26	15.38	24.00	--	19.88	--	22.57	Pass
	U-NII-2A	52	15.43	15.55	24.00	23.57	20.05	--	27.00	Pass
		60	15.66	15.78	24.00	23.57	20.28	--	27.00	Pass
		64	15.43	15.55	24.00	23.57	20.05	--	27.00	Pass
	U-NII-2C	100	16.99	17.11	24.00	23.56	21.61	--	27.00	Pass
		116	16.68	16.80	24.00	23.56	21.30	--	27.00	Pass
		140	16.64	16.76	24.00	23.56	21.26	--	27.00	Pass
		144	16.39	16.51	24.00	23.56	21.01	--	27.00	Pass
	U-NII-3	149	16.58	16.70	30.00	30.00	21.20	--	--	Pass
		157	16.34	16.46	30.00	30.00	20.96	--	--	Pass
		165	15.42	15.54	30.00	30.00	20.04	--	--	Pass
IEEE 802.11n-HT40	U-NII-1	38	17.72	17.94	24.00	--	22.44	--	23.01	Pass
		46	17.19	17.41	24.00	--	21.91	--	23.01	Pass
	U-NII-2A	54	17.62	17.84	24.00	23.57	22.34	--	27.00	Pass
		62	17.68	17.90	24.00	23.57	22.40	--	27.00	Pass
	U-NII-2C	102	16.69	16.91	24.00	24.00	21.41	--	27.00	Pass
		110	16.24	16.46	24.00	24.00	20.96	--	27.00	Pass
		134	17.18	17.40	24.00	24.00	21.90	--	27.00	Pass
		142	16.28	16.50	24.00	24.00	21.00	--	27.00	Pass
	U-NII-3	151	16.45	16.67	30.00	30.00	21.17	--	--	Pass
		159	15.85	16.07	30.00	30.00	20.57	--	--	Pass
IEEE 802.11ac-VHT20	U-NII-1	36	15.49	15.63	24.00	--	20.13	--	22.57	Pass
		44	14.94	15.08	24.00	--	19.58	--	22.57	Pass

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UTTR-RF-RSS247-V1.1

Mode	Band	Channel	CONDUCTED AVG POWER				EIRP			Result
			Meas Value (dBm)	Corr'd Value (dBm)	FCC Limit (dBm)	ISED Limit (dBm)	EIRP (dBm)	FCC Limit (dBm)	ISED Limit (dBm)	
	U-NII-2A	48	15.24	15.38	24.00	--	19.88	--	22.57	Pass
		52	15.41	15.55	24.00	23.57	20.05	--	27.00	Pass
		60	15.66	15.80	24.00	23.57	20.30	--	27.00	Pass
		64	15.43	15.57	24.00	23.57	20.07	--	27.00	Pass
	U-NII-2C	100	16.98	17.12	24.00	23.56	21.62	--	27.00	Pass
		116	16.39	16.53	24.00	23.56	21.03	--	27.00	Pass
		140	16.62	16.76	24.00	23.56	21.26	--	27.00	Pass
		144	16.38	16.52	24.00	23.56	21.02	--	27.00	Pass
	U-NII-3	149	16.56	16.70	30.00	30.00	21.20	--	--	Pass
		157	16.31	16.45	30.00	30.00	20.95	--	--	Pass
		165	15.41	15.55	30.00	30.00	20.05	--	--	Pass
IEEE 802.11ac-VHT40	U-NII-1	38	17.75	17.87	24.00	--	22.37	--	23.01	Pass
		46	17.23	17.35	24.00	--	21.85	--	23.01	Pass
	U-NII-2A	54	17.69	17.81	24.00	24.00	22.31	--	27.00	Pass
		62	17.72	17.84	24.00	24.00	22.34	--	27.00	Pass
	U-NII-2C	102	16.71	16.83	24.00	24.00	21.33	--	27.00	Pass
		110	16.26	16.38	24.00	24.00	20.88	--	27.00	Pass
		134	17.26	17.38	24.00	24.00	21.88	--	27.00	Pass
		142	16.32	16.44	24.00	24.00	20.94	--	27.00	Pass
	U-NII-3	151	16.51	16.63	30.00	30.00	21.13	--	--	Pass
		159	15.92	16.04	30.00	30.00	20.54	--	--	Pass