Certificate #4312.01

RF EXPOSURE EVALUATION REPORT

Product Name:	High-Performance AX6000 Wi-Fi 6 Access Point
Trade Mark:	GRANDSTREAM
Model No.:	GWN7664E
Report Number:	2401259035RFC-4
Test Standards:	FCC 47 CFR Part 1 Subpart I
FCC ID:	YZZGWN7664E
Test Result:	PASS
Date of Issue:	May 28, 2024

Prepared for:

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

Prepared by:

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Date: May 28, 2024

Version

Version No.	Date	Description
V1.0	May 28, 2024	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

Product Name:	High-Performance AX6000 Wi-Fi 6 Access Point		
Model No.:	GWN7664E		
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	
	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
		5 850 MHz to 5 895 MHz	IEEE 802.11a/n/ac/ax
Sample Received Date:	January 25, 2024		
Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.			

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

For 2.4 GHz ISM Band of Wi-Fi		
Frequency Band:	2400 MHz to 2483.5 MHz	
Frequency Range:	2412 MHz to 2462 MHz	
Support Standards:	IEEE 802.11b/g/n-HT20/n-HT40/ax-HE20/ax-HE40	
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ax: OFDMA[Note 1] (1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20/HT40: Up to MCS31 IEEE 802.11ax-HE20/ HE40: Up to MCS11	
Number of Channels:	IEEE 802.11b/g/n-HT20/ax-HE20: 11 IEEE 802.11n-HT40/ax-HE40: 7	
Channel Separation:	5 MHz	
Antenna Type: (Provided by the customer)	Antenna 0	PIFA Antenna
	Antenna 1	PIFA Antenna
	Antenna 2	PIFA Antenna
	Antenna 3	PIFA Antenna
Antenna Gain: (Provided by the customer)	Antenna 0	4.21 dBi
	Antenna 1	3.55 dBi
	Antenna 2	3.78 dBi
	Antenna 3	3.85 dBi

For 5 GHz U-NII Bands of Wi-Fi					
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)				
	5850 MHz to 5895 MHz (U-NII-4)				
Frequency Ranges:	5180 MHz to 5240 MHz				
	5260 MHz to 5320 MHz				
	5500 MHz to 5700 MHz				
	5745 MHz to 5825 MHz				
	5845 MHz to 5885 MHz				
Support Standards:	IEEE 802.11a/n/ac/ax				
TPC Function:	Support				
DFS Operational mode:	Master				
Type of Modulation:	IEEE 802.11a/n: OFDM (64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ax:OFDMA (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				
	IEEE 802.11ac-VHT80/ax-HE80: 80 MHz				
	IEEE 802.11ac-VHT160/ax-HE160: 160 MHz				
Data Rate:	IEEE 802.11a: Up to 54 Mbps				
	IEEE 802.11n: Up to MCS31				
	IEEE 802.11ac-VHT20: Up to MCS8				
	IEEE 802.11ac-VHT40/VHT80/VHT160: Up to MCS9				
	IEEE 802.11ax-HE20/HE40/HE80/HE160: Up to MCS11				
Number of Channels:	5150 MHz to 5350 MHz: 8 for 802.11a/n-HT20/ac-VHT20/ax-HE20 4 for 802.11n-HT40)/ac-VHT40/ax-HE40 2 for 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
	5470 MHz to 5725 MHz: 12 for 802.11a/n-HT20/ac-VHT20/ax-HE20 6 for 802.11n-HT40)/ac-VHT40/ax-HE40 3 for 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
	5725 MHz to 5895 MHz: 8 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 4 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40 2 for IEEE 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
Antenna Type: (Provided by the customer)	Antenna 0	PIFA Antenna			
	Antenna 1	PIFA Antenna			
	Antenna 2	PIFA Antenna			
	Antenna 3	PIFA Antenna			
Antenna Gain (dBi): (Provided by the customer)	**Antenna**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3/4**
	Antenna 0	5.26	5.26	5.26	5.26
	Antenna 1	4.61	4.61	4.61	4.61
	Antenna 2	5.05	5.05	5.05	5.05
	Antenna 3	4.74	4.74	4.74	4.74

1.4 OTHER INFORMATION

None.

1.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product, according to the specifications of the manufacturers. It must comply with the requirements of the following standards:

FCC 47 CFR Part 1 Subpart I

All test items have been performed and recorded as per the above standards

1.6 DEVIATION FROM STANDARDS

None.

1.7 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.8 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

2. EQUIPMENT LIST

Please refer to the RF test report.

3. MPE EVALUATION

3.1 REFERENCE DOCUMENTS FOR EVALUATION

No.	Identity	Document Title
1	FCC 47 CFR Part 1 Subpart I	PROCEDURES IMPLEMENTING THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969
2	KDB 447498 D01 General RF Exposure Guidance v06	RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES
3	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

3.2 MPE COMPLIANCE REQUIREMENT

3.2.1 Limits

3.2.1.1 FCC 47 CFR Part 1 Subpart I

According to §1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Times $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

Limits for General Population / Uncontrolled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Times $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	**1**	30

Note: f = frequency in MHz: * = Plane-wave equivalents power density.

3.2.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

3.3 MPE CALCULATION METHOD

FCC 47 CFR Part 1 Subpart I

$S = PG/4\pi R^2 = EIRP/4\pi R^2$

S = power density (in appropriate units, e.g., mw/cm^2)

P = power input to the antenna (in appropriate units, e.g., mw)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor is normally numeric gain.

R = 20cm distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

3.4 MPE CALCULATION RESULTS

Note: *For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.*

3.4.1 For WLAN

For Wi-Fi function, operating at 2412MHz to 2462 MHz for IEEE802.11b/g/n/ax and
operating at 5150 MHz to 5250 MHz for IEEE802.11a/n/ac/ax and
operating at 5250 MHz to 5350 MHz for IEEE802.11a/n/ac/ax and
operating at 5470 MHz to 5725 MHz for IEEE802.11a/n/ac/ax and
operating at 5725 MHz to 5895 MHz for IEEE802.11a/n/ac/ax.

3.4.1.1 Antenna Type:

PIFA Antenna

Antenna Gain:

Antenna 0: 2412MHz to 2462 MHz: 4.21dBi
Antenna 1: 2412MHz to 2462 MHz: 3.55dBi
Antenna 2: 2412MHz to 2462 MHz: 3.78dBi
Antenna 3: 2412MHz to 2462 MHz: 3.85dBi

Antenna 0: 5150 MHz to 5250 MHz: 5.26dBi
5250 MHz to 5350 MHz: 4.61dBi
5470 MHz to 5725 MHz: 5.05dBi
5725 MHz to 5895 MHz: 4.74dBi

Antenna 1: 5150 MHz to 5250 MHz: 5.26dBi
5250 MHz to 5350 MHz: 4.61dBi
5470 MHz to 5725 MHz: 5.05dBi
5725 MHz to 5895 MHz: 4.74dBi

Antenna 2: 5150 MHz to 5250 MHz: 5.26dBi
5250 MHz to 5350 MHz: 4.61dBi
5470 MHz to 5725 MHz: 5.05dBi
5725 MHz to 5895 MHz: 4.74dBi

Antenna 3: 5150 MHz to 5250 MHz: 5.26dBi
5250 MHz to 5350 MHz: 4.61dBi
5470 MHz to 5725 MHz: 5.05dBi
5725 MHz to 5895 MHz: 4.74dBi

3.4.1.2 Results for FCC 47 CFR Part 1 Subpart I

For SISO (1TX/1RX) Mode

Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Max. Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)	
SISO	IEEE 802.11b	2412	0/1/2/3	19.5	1	4.21	24.71	295.8012	1	0.0588
		2437	0/1/2/3	20.5	1	4.21	25.71	372.3917	1	0.0741
		2462	0/1/2/3	19.5	1	4.21	24.71	295.8012	1	0.0588
	IEEE 802.11g	2412	0/1/2/3	17.5	1	4.21	22.71	186.6380	1	0.0371
		2437	0/1/2/3	18.5	1	4.21	23.71	234.9633	1	0.0467
		2462	0/1/2/3	17.5	1	4.21	22.71	186.6380	1	0.0371
	IEEE 802.11a	5180-5240	0/1/2/3	21	1	5.26	27.26	532.1083	1	0.1059
		5260-5320	0/1/2/3	21	1	5.26	27.26	532.1083	1	0.1059
		5500-5700	0/1/2/3	21	1	5.26	27.26	532.1083	1	0.1059
		5745-5825	0/1/2/3	21	1	5.26	27.26	532.1083	1	0.1059
		5845-5885	0/1/2/3	17	1	5.26	23.26	211.8361	1	0.0421

For MIMO (4TX/4RX) Mode

Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)		Value	Limit
MIMO (4TX/4RX)	IEEE 802.11n-HT20 802.11ax-HE20	2412&2462	0	16	1	4.21	21.21	132.1296	1	0.0263	0.1152	1
			1	17	1	3.55	21.55	142.8894	1	0.0284		
			2	17	1	3.78	21.78	150.6607	1	0.0300		
			3	17	1	3.85	21.85	153.1087	1	0.0305		
	IEEE 802.11n-HT20 802.11ax-HE20	2437	0	16	1	4.21	21.21	132.1296	1	0.0263	0.1152	1
			1	17	1	3.55	21.55	142.8894	1	0.0284		
			2	17	1	3.78	21.78	150.6607	1	0.0300		
			3	17	1	3.85	21.85	153.1087	1	0.0305		
	IEEE 802.11n-HT40 802.11ax-HE40	2422 & 2452	0	16	1	4.21	21.21	132.1296	1	0.0263	0.0969	1
			1	16	1	3.55	20.55	113.5011	1	0.0226		
			2	16	1	3.78	20.78	119.6741	1	0.0238		
			3	16	1	3.85	20.85	121.6186	1	0.0242		
	IEEE 802.11n-HT40 802.11ax-HE40	2437	0	16	1	4.21	21.21	132.1296	1	0.0263	0.0969	1
			1	16	1	3.55	20.55	113.5011	1	0.0226		
			2	16	1	3.78	20.78	119.6741	1	0.0238		
			3	16	1	3.85	20.85	121.6186	1	0.0242		
MIMO (4TX/4RX)	IEEE 802.11n-HT20 802.11ac-VHT20 802.11ax-HE20	5180-5240	0	16	1	5.26	22.26	168.2674	1	0.0335	0.1314	1
			1	17	1	4.61	22.61	182.3896	1	0.0363		
			2	16	1	5.05	22.05	160.3245	1	0.0319		
			3	16	1	4.74	21.74	149.2794	1	0.0297		
		5260-5320	0	9	1	5.26	15.26	33.5738	1	0.0067	0.0313	1
			1	11	1	4.61	16.61	45.8142	1	0.0091		
			2	10	1	5.05	16.05	40.2717	1	0.0080		
			3	10	1	4.74	15.74	37.4973	1	0.0075		
		5500-5700	0	9	1	5.26	15.26	33.5738	1	0.0067	0.0294	1
			1	10	1	4.61	15.61	36.3915	1	0.0072		
			2	10	1	5.05	16.05	40.2717	1	0.0080		
			3	10	1	4.74	15.74	37.4973	1	0.0075		
		5745-5825	0	16	1	5.26	22.26	168.2674	1	0.0335	0.1671	1
			1	18	1	4.61	23.61	229.6149	1	0.0457		

Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)		Value	Limit
			2	18	1	5.05	24.05	254.0973	1	0.0505		
			3	17	1	4.74	22.74	187.9317	1	0.0374		
		5845-5885	0	12	1	5.26	18.26	66.9885	1	0.0133	0.0493	1
			1	12	1	4.61	17.61	57.6766	1	0.0115		
			2	12	1	5.05	18.05	63.8263	1	0.0127		
			3	12	1	4.74	17.74	59.4292	1	0.0118		
MIMO (4TX/4RX)	IEEE 802.11n-HT40 802.11ac-VHT40 802.11ax-HE40	5190-5230	0	18	1	5.26	24.26	266.6859	1	0.0531	0.1773	1
			1	17	1	4.61	22.61	182.3896	1	0.0363		
			2	18	1	5.05	24.05	254.0973	1	0.0505		
			3	17	1	4.74	22.74	187.9317	1	0.0374		
		5270-5310	0	10	1	5.26	16.26	42.2669	1	0.0084	0.0349	1
			1	11	1	4.61	16.61	45.8142	1	0.0091		
			2	10	1	5.05	16.05	40.2717	1	0.0080		
			3	11	1	4.74	16.74	47.2063	1	0.0094		
		5510-5670	0	11	1	5.26	17.26	53.2108	1	0.0106	0.0442	1
			1	11	1	4.61	16.61	45.8142	1	0.0091		
			2	12	1	5.05	18.05	63.8263	1	0.0127		
			3	12	1	4.74	17.74	59.4292	1	0.0118		
		5755-5795	0	16	1	5.26	22.26	168.2674	1	0.0335	0.1391	1
			1	17	1	4.61	22.61	182.3896	1	0.0363		
			2	16	1	5.05	22.05	160.3245	1	0.0319		
			3	17	1	4.74	22.74	187.9317	1	0.0374		
		5715-5875	0	13	1	5.26	19.26	84.3335	1	0.0168	0.0621	1
			1	13	1	4.61	18.61	72.6106	1	0.0144		
			2	13	1	5.05	19.05	80.3526	1	0.0160		
			3	13	1	4.74	18.74	74.8170	1	0.0149		
	IEEE 802.11ac-VHT80 802.11ax-HE80	5210	0	17	1	5.26	23.26	211.8361	1	0.0421	0.1577	1
			1	18	1	4.61	23.61	229.6149	1	0.0457		
			2	17	1	5.05	23.05	201.8366	1	0.0402		
			3	16	1	4.74	21.74	149.2794	1	0.0297		
		5290	0	10	1	5.26	16.26	42.2669	1	0.0084	0.0370	1

Operating Mode	Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value	MIMO	
	(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)		Value	Limit
		1	11	1	4.61	16.61	45.8142	1	0.0091		
		2	11	1	5.05	17.05	50.6991	1	0.0101		
		3	11	1	4.74	16.74	47.2063	1	0.0094		
IEEE 802.11ac-VHT80 802.11ax-HE80	5530	0	11	1	5.26	17.26	53.2108	1	0.0106	0.0392	1
		1	11	1	4.61	16.61	45.8142	1	0.0091		
		2	11	1	5.05	17.05	50.6991	1	0.0101		
		3	11	1	4.74	16.74	47.2063	1	0.0094		
	5775	0	17	1	5.26	23.26	211.8361	1	0.0421	0.1657	1
		1	17	1	4.61	22.61	182.3896	1	0.0363		
		2	17	1	5.05	23.05	201.8366	1	0.0402		
		3	18	1	4.74	23.74	236.5920	1	0.0471		
	5855	1	13	1	5.26	19.26	84.3335	1	0.0168	0.0621	1
		2	13	1	4.61	18.61	72.6106	1	0.0144		
		3	13	1	5.05	19.05	80.3526	1	0.0160		
			13	1	4.74	18.74	74.8170	1	0.0149		
IEEE 802.11ac-VHT160 802.11ax-HE160	5250	0	18	1	5.26	24.26	266.6859	1	0.0531	0.1904	1
		1	17	1	4.61	22.61	182.3896	1	0.0363		
		2	19	1	5.05	25.05	319.8895	1	0.0636		
		3	17	1	4.74	22.74	187.9317	1	0.0374		
	5570	0	12	1	5.26	18.26	66.9885	1	0.0133	0.0500	1
		1	11	1	4.61	16.61	45.8142	1	0.0091		
		2	12	1	5.05	18.05	63.8263	1	0.0127		
		3	13	1	4.74	18.74	74.8170	1	0.0149		
	5815	0	11	1	5.26	17.26	53.2108	1	0.0106	0.0392	1
		1	11	1	4.61	16.61	45.8142	1	0.0091		
		2	11	1	5.05	17.05	50.6991	1	0.0101		
		3	11	1	4.74	16.74	47.2063	1	0.0094		

3.4.2 Simultaneous Multi-band Transmission MPE Analysis

3.4.2.1 List of Mode for Simultaneous Multi-band Transmission

No.	Configurations	Support/Not Support
1	2.4G _WLAN + 5G _WLAN	Support

3.4.2.2 Results for transmit simultaneously

FCC 47 CFR Part 1 Subpart I

No.	Configurations	Maximum MPE Value			Limits
		2.4G WLAN	5G WLAN	Transmit simultaneously	
1	2.4G _WLAN + 5G _WLAN	0.1059	0.1904	0.2963	1

Note:

According to KDB 447498 D01 General RF Exposure Guidance v06, At the transmit simultaneously calculation method is as follows:

Transmit simultaneously MPE = Σ of MPE ratios

MPE ratios = Field strengths or power density / MPE limit at the test frequency

APPENDIX 1 PHOTOS OF TEST SETUP

N/A

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal Photos.

*** End of Report ***

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