Certificate #4312.01

RF EXPOSURE EVALUATION REPORT

Product Name:	802.11ax Wi-Fi 6 Access Point
Trade Mark:	GRANDSTREAM
Model No.:	GWN7660E
Report Number:	2307186039RFC-4
Test Standards:	FCC 47 CFR Part 1 Subpart I
FCC ID:	YZZGWN7660E
Test Result:	PASS
Date of Issue:	September 6, 2023

Prepared for:

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

Prepared by:

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Version

Version No.	Date	Description
V1.0	September 6, 2023	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:	802.11ax Wi-Fi 6 Access Point		
Model No.:	GWN7660E		
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
Sample Received Date:	July 17, 2023		
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(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 MCS15 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	PCB Antenna
	Antenna 1	PCB Antenna
Antenna Gain: (Provided by the customer)	Antenna 0	4.52 dBi
	Antenna 1	4.66 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)				
Frequency Ranges:	5180 MHz to 5240 MHz				
	5260 MHz to 5320 MHz				
	5500 MHz to 5700 MHz				
	5745 MHz to 5825 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 MCS15				
	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: 11 for 802.11a/n-HT20/ac-VHT20/ax-HE20 5 for 802.11n-HT40)/ac-VHT40/ax-HE40 2 for 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
	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 1 for IEEE 802.11ac-VHT80/ax-HE80				
Antenna Type: (Provided by the customer)	Antenna 0:	PCB Antenna			
	Antenna 1:	PCB Antenna			
	Antenna 2:	PCB Antenna			
Antenna Gain (dBi): (Provided by the customer)	**Antenna**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	Antenna 0:	4.76	4.76	4.76	4.76
	Antenna 1:	5.21	5.21	5.21	5.21
	Antenna 2:	5.31	5.31	5.31	5.31

1.4 OTHER INFORMATION

Test channels for 2.4 GHz ISM Band of Wi-Fi				
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 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11g	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT20 IEEE 802.11ax-HE20	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT40 IEEE 802.11ax-HE40	2422 MHz to 2452 MHz	Channel 3	Channel 6	Channel 9
		2422 MHz	2437 MHz	2452 MHz

Test channels for 5 GHz U-NII Bands of Wi-Fi				
Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
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
		5500 MHz	5580 MHz	5700 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
		5510 MHz	5550 MHz	5670 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
IEEE 802.11ac-VHT80 IEEE 802.11ax-HE80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 MHz to 5350 MHz	--	Channel 58	--
		--	5290 MHz	--
	5470 MHz to 5725 MHz	Channel 106	--	--
		5530 MHz	--	--
	5725 MHz to 5850 MHz	--	Channel 155	--
		--	5775 MHz	--
IEEE 802.11ac-VHT160 IEEE 802.11ax-HE160	5150 - 5350 MHz	Channel 50		
		5250 MHz		
	5470 - 5725 MHz	Channel 114		
		5570 MHz		
	5725 - 5850 MHz			

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/4πR^2= EIRP/4πR^2

S = power density (in appropriate units, e.g., mw/cm2)

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 5850 MHz for IEEE802.11a/n/ac/ax.

3.4.1.1 Antenna Type:

PCB Antenna

Antenna Gain:

Chain 0: 2412MHz to 2462 MHz: 4.52dBi
Chain 1: 2412MHz to 2462 MHz: 4.66dBi

Chain 0: 5150 MHz to 5250 MHz: 4.76dBi
5250 MHz to 5350 MHz: 4.76dBi
5470 MHz to 5725 MHz: 4.76dBi
5725 MHz to 5850 MHz: 4.76dBi

Chain 1: 5150 MHz to 5250 MHz: 5.21dBi
5250 MHz to 5350 MHz: 5.21dBi
5470 MHz to 5725 MHz: 5.21dBi
5725 MHz to 5850 MHz: 5.21dBi

Chain 2: 5150 MHz to 5250 MHz: 5.31dBi
5250 MHz to 5350 MHz: 5.31dBi
5470 MHz to 5725 MHz: 5.31dBi
5725 MHz to 5850 MHz: 5.31dBi

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 avg output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)	
SISO	IEEE 802.11b	2412-2462	Ant 0,Ant1	22	1	4.66	27.66	583.4451	1	0.1161
	IEEE 802.11g	2412&2462	Ant 0,Ant1	18	1	4.66	23.66	232.2737	1	0.0462
		2437	Ant 0,Ant1	20	1	4.66	25.66	368.1290	1	0.0732
	IEEE 802.11a	5180-5240	Ant 0,Ant1, Ant2	21	1	5.31	27.31	538.2698	1	0.1071
		5260-5320	Ant 0,Ant1, Ant2	20	1	5.31	26.31	427.5629	1	0.0851
		5500-5700	Ant 0,Ant1, Ant2	20	1	5.31	26.31	427.5629	1	0.0851
		5745-5825	Ant 0,Ant1, Ant2	20	1.5	5.31	26.81	479.7334	1	0.0954

For MIMO (3TX/3RX) Mode

Operating Mode		Freq.	Ant.	Declared maximum conducted avg 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 (2TX/2RX)	IEEE 802.11n-HT20 802.11ax-HE20	2412 & 2462	Ant 0	13	1	4.52	18.52	71.1214	1	0.0141	0.0287	1
			Ant 1	13	1	4.66	18.66	73.4514	1	0.0146		
	IEEE 802.11n-HT20 802.11ax-HE20	2437	Ant 0	19	1	4.52	24.52	283.1392	1	0.0563	0.1145	1
			Ant 1	19	1	4.66	24.66	292.4152	1	0.0582		
	IEEE 802.11n-HT40 802.11ax-HE40	2422 & 2452	Ant 0	12	1	4.52	17.52	56.4937	1	0.0112	0.0228	1
			Ant 1	12	1	4.66	17.66	58.3445	1	0.0116		
	IEEE 802.11n-HT40 802.11ax-HE40	2437	Ant 0	19	1	4.52	24.52	283.1392	1	0.0563	0.1145	1
			Ant 1	19	1	4.66	24.66	292.4152	1	0.0582		
MIMO (3TX/3RX)	IEEE 802.11n-HT20 802.11ac-VHT20 802.11ax-HE20	5180-5240	Ant 0	19	1.5	4.76	25.26	335.7376	1	0.0668	0.2167	1
			Ant 1	19	1.5	5.21	25.71	372.3917	1	0.0741		
			Ant 2	19	1.5	5.31	25.81	381.0658	1	0.0758		
		5260-5320	Ant 0	12	1.5	4.76	18.26	66.9885	1	0.0133	0.0432	1
			Ant 1	12	1.5	5.21	18.71	74.3019	1	0.0148		
			Ant 2	12	1.5	5.31	18.81	76.0326	1	0.0151		
		5500-5700	Ant 0	12	1.5	4.76	18.26	66.9885	1	0.0133	0.0432	1
			Ant 1	12	1.5	5.21	18.71	74.3019	1	0.0148		
			Ant 2	12	1.5	5.31	18.81	76.0326	1	0.0151		
		5745-5825	Ant 0	19	1	4.76	24.76	299.2265	1	0.0595	0.1931	1

Operating Mode		Freq.	Ant.	Declared maximum conducted avg 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
			Ant 1	19	1	5.21	25.21	331.8945	1	0.0660		
			Ant 2	19	1	5.31	25.31	339.6253	1	0.0676		
MIMO (3TX/3RX)	IEEE 802.11n-HT40 802.11ac-VHT40 802.11ax-HE40	5190-5230	Ant 0	18	2	4.76	24.76	299.2265	1	0.0595	0.1931	1
			Ant 1	18	2	5.21	25.21	331.8945	1	0.0660		
			Ant 2	18	2	5.31	25.31	339.6253	1	0.0676		
		5270-5310	Ant 0	14	1	4.76	19.76	94.6237	1	0.0188	0.0611	1
			Ant 1	14	1	5.21	20.21	104.9542	1	0.0209		
			Ant 2	14	1	5.31	20.31	107.3989	1	0.0214		
		5510-5670	Ant 0	14	1.5	4.76	20.26	106.1696	1	0.0211	0.0685	1
			Ant 1	14	1.5	5.21	20.71	117.7606	1	0.0234		
			Ant 2	14	1.5	5.31	20.81	120.5036	1	0.0240		
		5755-5795	Ant 0	19	1	4.76	24.76	299.2265	1	0.0595	0.1931	1
			Ant 1	19	1	5.21	25.21	331.8945	1	0.0660		
			Ant 2	19	1	5.31	25.31	339.6253	1	0.0676		
	IEEE 802.11ac-VHT80 802.11ax-HE80	5210	Ant 0	19	1	4.76	24.76	299.2265	1	0.0595	0.1931	1
			Ant 1	19	1	5.21	25.21	331.8945	1	0.0660		
			Ant 2	19	1	5.31	25.31	339.6253	1	0.0676		
		5290	Ant 0	13	2	4.76	19.76	94.6237	1	0.0188	0.0611	1
			Ant 1	13	2	5.21	20.21	104.9542	1	0.0209		
			Ant 2	13	2	5.31	20.31	107.3989	1	0.0214		
	IEEE 802.11ac-VHT80 802.11ax-HE80	5530	Ant 0	13	1	4.76	18.76	75.1623	1	0.0150	0.0486	1
			Ant 1	13	1	5.21	19.21	83.3681	1	0.0166		
			Ant 2	13	1	5.31	19.31	85.3100	1	0.0170		
		5775	Ant 0	19	1.5	4.76	25.26	335.7376	1	0.0668	0.2167	1
			Ant 1	19	1.5	5.21	25.71	372.3917	1	0.0741		
			Ant 2	19	1.5	5.31	25.81	381.0658	1	0.0758		
	IEEE 802.11ac-VHT160 802.11ax-HE160	5250	Ant 0	11	1	4.76	16.76	47.4242	1	0.0094	0.0306	1
			Ant 1	11	1	5.21	17.21	52.6017	1	0.0105		
			Ant 2	11	1	5.31	17.31	53.8270	1	0.0107		
		5570	Ant 0	11	1.5	4.76	17.26	53.2108	1	0.0106	0.0343	1
			Ant 1	11	1.5	5.21	17.71	59.0201	1	0.0117		

Operating Mode		Freq.	Ant.	Declared maximum conducted avg 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
			Ant 2	11	1.5	5.31	17.81	60.3949	1	0.0120		

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	0.1161	0.2167	0.3328	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 ***
