RF EXPOSURE EVALUATION REPORT

Product Name:	Mid-Tier 802.11ac Wi-Fi Access Point
Trade Mark:	GRANDSTREAM
Model No. / HVIN:	GWN7602
Report Number:	191025009RFC-3
Test Standards:	FCC 47 CFR Part 1 Subpart I RSS-102 Issue 5
FCC ID:	YZZGWN7602
IC:	11964A-GWN7602
Test Result:	PASS
Date of Issue:	December 2, 2019

Prepared for:

Grandstream Networks,Inc.
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Prepared by:

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Date: December 2, 2019

Version

Version No.	Date	Description
V1.0	December 2, 2019	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

Product Name:	Mid-Tier 802.11ac Wi-Fi Access Point		
Model No. / HVIN:	GWN7602		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Production Unit		
EUT Supports Function:	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
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Software Version:	1.0.0.4		
Hardware Version:	V1		
Sample Received Date:	October 25, 2019		
Sample Tested Date:	October 25, 2019 to November 23, 2019		

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, 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 MCS7 IEEE 802.11n-HT40: Up to MCS7		
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	PCB Antenna	
	Chain 1	PCB Antenna	
Antenna Gain:	Chain 0	3.0 dBi	
	Chain 1	3.5 dBi	
Directional gain:	6.26 dBi		
Maximum Peak Power:	MIMO_ Chain 0+1		IEEE 802.11b: 25.43 dBm IEEE 802.11g: 25.99 dBm IEEE 802.11n-HT20: 25.76 dBm IEEE 802.11n-HT40: 25.76 dBm
Maximum e.i.r.p:	MIMO_ Chain 0+1		IEEE 802.11b: 28.72 dBm IEEE 802.11g: 29.27 dBm

		IEEE 802.11n-HT20: 29.04 dBm IEEE 802.11n-HT40: 29.06 dBm

For 5 GHz U-NII Bands of Wi-Fi				
Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)			
	5 725 MHz to 5 850 MHz (U-NII-3)			
Frequency Ranges:	5180 MHz to 5240 MHz			
	5 745 MHz to 5 825 MHz			
Support Standards:	IEEE 802.11a/n/ac			
TPC Function:	Not Support			
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)			
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)			
	IEEE 802.11ac: OFDM(64QAM, 16QAM, QPSK, BPSK)			
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz			
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz			
	IEEE 802.11ac-VHT80: 80 MHz			
Data Rate:	IEEE 802.11a: Up to 54 Mbps			
	IEEE 802.11n-HT20: Up to MCS15			
	IEEE 802.11n-HT40: Up to MCS15			
	IEEE 802.11ac-VHT20: Up to MCS8			
	IEEE 802.11ac-VHT40: Up to MCS9			
	IEEE 802.11ac-VHT80: Up to MCS9			
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80			
	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80			
Antenna Type:	Chain 0	PCB Antenna		
	Chain 1	PCB Antenna		
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 3.5 dBi		
		5725 MHz to 5850 MHz: 3.5 dBi		
	Chain 1	5150 MHz to 5250 MHz: 3.0 dBi		
		5725 MHz to 5850 MHz: 3.0 dBi		
Maximum conducted output power (dBm):	**MIMO_Chain 0+1**		**U-NII-1**	**U-NII-3**
	IEEE 802.11a:		17.03	21.37
	IEEE 802.11n-HT20:		17.28	20.52
	IEEE 802.11n-HT40:		17.81	21.01
	IEEE 802.11ac-VHT20:		17.38	20.64
	IEEE 802.11ac-VHT40:		17.70	20.91
	IEEE 802.11ac-VHT80:		12.78	16.83
Maximum EIRP (dBm):	**MIMO_Chain 0+1**		**U-NII-1**	
	IEEE 802.11a:		20.28	
	IEEE 802.11n-HT20:		20.54	
	IEEE 802.11n-HT40:		21.06	

	IEEE 802.11ac-VHT20:	20.63
	IEEE 802.11ac-VHT40:	20.95
	IEEE 802.11ac-VHT80:	16.01

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	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT40	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	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 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	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5725 MHz to 5850 MHz	--	Channel 155	--
		--	5775 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
RSS-102 Issue 5

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	RSS-102 Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
3	KDB 447498 D01 General RF Exposure Guidance v06	RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES

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.

3.2.1.2 RSS-102 Issue 5

According to RSS-102 Issue 5, 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.

According to RSS-102 Issue 5, 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.
RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2}\ f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

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 = 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 2472 MHz for IEEE802.11b/g/n and
operating at 5150 MHz to 5250 MHz for IEEE802.11a/n/ac and
operating at 5725 MHz to 5850 MHz for IEEE802.11a/n/ac.

3.4.1.1 Antenna Type:
Chain 0: PCB Antenna
Chain 1: PCB Antenna

3.4.1.2 Antenna Gain:
Chain 0: 2412MHz to 2462 MHz: 3.0 dBi
5150 MHz to 5250 MHz: 3.5 dBi

5725 MHz to 5850 MHz: 3.5 dBi

Chain 1: 2412MHz to 2462 MHz: 3.5 dBi
5150 MHz to 5250 MHz: 3.0 dBi
5725 MHz to 5850 MHz: 3.0 dBi

For MIMO mode (2Tx/2Rx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports can be used alone. The transmit signals are correlated with each other.

The directional gain = G_{ANT} + 10 log(N_{ANT}) dBi = 1.72 + 10 log(2) = 6.26 dBi

3.4.1.3 Results for FCC 47 CFR Part 1 Subpart I

For MIMO (2TX/2RX) Mode

Operating Mode		Freq.	Declared maximum conducted average output power	Max. positive Tolerance according manufacturer	Directional Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)	
MIMO (2TX/2RX)	IEEE 802.11b	2412-2462	25	5	6.26	36.26	4226.6861	1	0.8409
	IEEE 802.11g	2412-2462	28	2	6.26	36.26	4226.6861	1	0.8409
	IEEE 802.11n-HT20	2412-2462	27	3	6.26	36.26	4226.6861	1	0.8409
	IEEE 802.11n-HT40	2422-2452	28	2	6.26	36.26	4226.6861	1	0.8409
	IEEE 802.11a	5180-5240	20	2	6.26	28.26	669.8846	1	0.1333
		5745-5825	20	2	6.26	28.26	669.8846	1	0.1333
	IEEE 802.11n-HT20	5180-5240	20	2	6.26	28.26	669.8846	1	0.1333
		5745-5825	20	2	6.26	28.26	669.8846	1	0.1333
	IEEE 802.11n-HT40	5190-5230	20	2	6.26	28.26	669.8846	1	0.1333
		5755-5795	20	2	6.26	28.26	669.8846	1	0.1333
	IEEE 802.11ac-VHT20	5180-5240	20	2	6.26	28.26	669.8846	1	0.1333
		5745-5825	20	2	6.26	28.26	669.8846	1	0.1333
	IEEE 802.11ac-VHT40	5190-5230	20	2	6.26	28.26	669.8846	1	0.1333
		5755-5795	20	2	6.26	28.26	669.8846	1	0.1333
	IEEE 802.11ac-VHT80	5210	16	2	6.26	24.26	266.6859	1	0.0531
		5775	16	2	6.26	24.26	266.6859	1	0.0531

3.4.1.4 Results for RSS-102 Issue 5

For MIMO (2TX/2RX) Mode

Operating Mode		Freq.	Declared maximum conducted average output power	Max. positive Tolerance according manufacturer	Directional Gain	Calculated maximum EIRP	Declared maximum EIRP	Limit
		(MHz)	(dBm)		(dBi)	(dBm)	(W)	(W)
MIMO (2TX/2RX)	IEEE 802.11g	2412-2462	25	5	6.26	36.26	4.2267	5.35
	IEEE 802.11b	2412-2462	28	2	6.26	36.26	4.2267	5.35
	IEEE 802.11n-HT20	2412-2462	27	3	6.26	36.26	4.2267	5.35
	IEEE 802.11n-HT40	2422-2452	28	2	6.26	36.26	4.2267	6.35
	IEEE 802.11a	5180-5240	20	2	6.26	28.26	0.6699	7.35
		5745-5825	20	2	6.26	28.26	0.6699	8.35
	IEEE 802.11n-HT20	5180-5240	20	2	6.26	28.26	0.6699	9.35
		5745-5825	20	2	6.26	28.26	0.6699	10.35
	IEEE 802.11n-HT40	5190-5230	20	2	6.26	28.26	0.6699	11.35
		5755-5795	20	2	6.26	28.26	0.6699	12.35
	IEEE 802.11ac-VHT20	5180-5240	20	2	6.26	28.26	0.6699	13.35
		5745-5825	20	2	6.26	28.26	0.6699	14.35
	IEEE 802.11ac-VHT40	5190-5230	20	2	6.26	28.26	0.6699	15.35
		5755-5795	20	2	6.26	28.26	0.6699	16.35
	IEEE 802.11ac-VHT80	5210	16	2	6.26	24.26	0.2667	17.35
		5775	16	2	6.26	24.26	0.2667	18.35

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 ***