

FCC RF EXPOSURE REPORT

FCC ID: TE7HC2220G1UV1

Project No. : 1904C065
Equipment : AC2200 Home Wi-Fi System
Model Name : HC2220-G1u
Series Model : N/A
Applicant : TP-Link Technologies Co., Ltd.
Address : Building 24(floors1,3,4,5) and 28(floors1-4)
Central Science and Technology Park,
Shennan Rd, Nanshan, Shenzhen, China

According : FCC Guidelines for Human Exposure IEEE
C95.1 & FCC Part 2.1091

B T L I N C .

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Certificate #5123.02

REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue.	Jul. 16, 2019
R01	Updated the antenna description which does not affect the test result.	Aug. 15, 2019

1. GENERAL SUMMARY

Equipment : AC2200 Home Wi-Fi System
Brand Name : tp-link
Test Model : HC2220-G1u
Series Model : N/A
Applicant : TP-Link Technologies Co., Ltd.
Manufacturer : TP-Link Technologies Co., Ltd.
Address : Building 24(floors1,3,4,5) and 28(floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China
Factory : TP-Link Technologies Co., Ltd.
Address : Building 24(floors1,3,4,5) and 28(floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China
Date of Test : Apr. 17, 2019~Jun. 18, 2019
Test Sample : Engineering Sample No.: D190403890
Standards : FCC Title 47 Part 2.1091, OET Bulletin 65 Supplement C

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-3-1904C065) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of A2LA according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

2. MPE CALCULATION METHOD

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi^2} = \frac{EIRP}{4\pi^2}$$

where:

S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Antenna Specification:

For 2.4G:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1		N/A	PIFA	I-PEX	4.36
2		N/A	PIFA	I-PEX	4.36

Note: This EUT supports CDD, and all antennas have the same gain,

- (1) For Non Beamforming function, Directional gain= $G_{ANT} + \text{Array Gain}$,
For power spectral density measurements, Array Gain= $10\log(N_{ANT}/N_{SS})$ dB
Directional gain= $4.36 + 10\log(2/1) = 7.37$. So, the power density limit is $8 - 7.37 + 6 = 6.63$
For power measurements, Array Gain = 0 dB ($N_{ANT} \leq 4$), so the Directional gain=4.36.
- (2) For Beamforming function, Beamforming gain: 3 dB, so Directional gain= $3 + 4.36 = 7.36$
Then, the output Power limit is $30 - 7.36 + 6 = 28.64$ the power density limit is $8 - 7.36 + 6 = 6.64$

For 5G:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
1		N/A	PIFA	I-PEX	3.81	UNII-1
2		N/A	PIFA	I-PEX	3.81	UNII-1
1		N/A	PIFA	I-PEX	4.57	UNII-3
2		N/A	PIFA	I-PEX	3.61	UNII-3

Note: This EUT supports CDD, and antenna gains are not equal for UNII-3, all antennas have the same gain for UNII-1, so

- (1) Non-Beamforming function for UNII-1,
For power spectral density measurements, $N_{ANT} = 2$, $N_{SS} = 1$.
So Directional gain = $G_{ANT} + \text{Array Gain} = 10 \log(N_{ANT}/N_{SS})$ dB = $3.81 + 10\log(2/1) = 6.82$.
Then, the UNII-1 power spectral density limit is $17 - 6.82 + 6 = 16.18$
For power measurements, Array Gain = 0 dB ($N_{ANT} \leq 4$), so the Directional gain=3.81.
- (2) Non-Beamforming function for UNII-3,
Directional gain = $10\log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N]$ dBi, that is
Directional gain = $10\log[(10^{4.57/20} + 10^{3.61/20})^2 / 2]$ dBi = 7.11; So, the UNII-3 output power and power spectral density limit is $30 - 7.11 + 6 = 28.89$.
- (3) Beamforming function for UNII-1, Beamforming gain: 3dB, So,
the UNII-1 Directional gain = $3 + 3.81 = 6.81$. Then,
the UNII-1 output power limit is $30 - 6.81 + 6 = 29.19$
the UNII-1 power density limit is $17 - 6.81 + 6 = 16.19$
- (4) Beamforming function for UNII-3, Beamforming gain: 3dB, So,
Directional gain = $3 + 4.57 = 7.57$. Then, the UNII-3 output power and power spectral density limit is $30 - 7.57 + 6 = 28.43$

3. TEST RESULTS

For 2.4GHz Non Beamforming:

Directional gain (dBi)	Antenna Gain (numeric)	Max. Average Output Power (dBm)	Max. Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
4.36	2.7290	26.57	453.9416	0.24658	1	Complies

For 2.4GHz Beamforming:

Directional gain (dB)	Antenna Gain (numeric)	Max. Average Output Power (dBm)	Max. Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
7.36	5.4450	26.72	469.8941	0.50927	1	Complies

For 5GHz UNII-1 Non Beamforming:

Directional gain (dBi)	Antenna Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.81	2.4044	26.47	443.6086	0.21230	1	Complies

For 5GHz UNII-1 Beamforming:

Directional gain (dB)	Antenna Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
6.81	4.7973	26.37	433.5109	0.41395	1	Complies

For 5GHz UNII-3 Non Beamforming:

Directional gain (dBi)	Antenna Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
7.11	5.1404	26.38	434.5102	0.44458	1	Complies

For 5GHz UNII-3 Beamforming:

Directional gain (dB)	Antenna Gain (numeric)	Max. Output Power (dBm)	Max. Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
7.57	5.7148	26.02	399.9447	0.45494	1	Complies

For the max simultaneous transmission MPE:

Power Density (S) (mW/cm ²)	Power Density (S) (mW/cm ²)	Total	Limit of Power Density (S) (mW/cm ²)	Test Result
2.4GHz	5GHz			
0.50927	0.45494	0.96421	1	Complies

Note: The calculated distance is 20 cm.

Output power including tune up tolerance (tune up tolerance: 0.5dBm).

End of Test Report