

RF Exposure Evaluation Report

APPLICANT : TP-LINK CORPORATION PTE. LTD.,
EQUIPMENT : AX1500 Wi-Fi 6 Portable Router
BRAND NAME : tp-link
MODEL NAME : TL-WR1502X
FCC ID : 2BCGWWR1502X
STANDARD : 47 CFR Part 2.1091

The product evaluation date was started from Dec. 06, 2023 and completed on Dec. 06, 2023. We, Sporton International Inc. (Shenzhen), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International Inc. (Shenzhen), the test report shall not be reproduced except in full.



Approved by: Si Zhang

Sporton International Inc. (Shenzhen)

1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055

People's Republic of China



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**Revision History**

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA3N0708	Rev. 01	Initial issue of report.	Dec. 19, 2023
FA3N0708	Rev. 02	Updated Applicant and manufacturer information	Jan. 09, 2024



1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Testing Laboratory			
Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-SZ	CN1256	421272

Applicant	
Company Name	TP-LINK CORPORATION PTE. LTD.,
Address	7 Temasek Boulevard #29-03 Suntec Tower One, Singapore 038987

Manufacturer	
Company Name	TP-LINK CORPORATION PTE. LTD.,
Address	7 Temasek Boulevard #29-03 Suntec Tower One, Singapore 038987

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	AX1500 Wi-Fi 6 Portable Router
Brand Name	tp-link
Model Name	TL-WR1502X
FCC ID	2BCGWWR1502X
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 WLAN 5GHz 802.11ax HE20/HE40/HE80
Antenna Type	WLAN: PIFA antenna
HW Version	V1.0
SW Version	1.0.0 Build 20231018 rel.70140
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This device support beamforming for WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80 /HE20/HE40/HE80.
3. WLAN2.4GHz/WLAN5GHz all support SISO and MIMO mode, we chose MIMO tune up power to perform MPE calculation conservatively.

Comments and Explanations:

1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

Antenna Gain:

WLAN	Ant.1	Ant.2
WLAN2.4GHz	2.00	2.00
WLAN5.2GHz	3.00	3.00
WLAN5.3GHz	2.78	2.78
WLAN5.5GHz	3.00	3.00
WLAN5.8GHz	2.71	2.71

**3. Maximum RF average output tune up power among production units****<2.4GHz WLAN >**

Mode		Maximum Average Power (dBm)		
		Ant.1	Ant.2	Ant.1+2
2.4GHz	802.11b	24.00	24.00	27.00
	802.11g	24.00	24.00	27.00
	802.11n-HT20	24.00	24.00	27.00
	802.11n-HT40	18.50	18.50	21.50

<5GHz WLAN >

Mode		Maximum Average Power (dBm)		
		Ant.1	Ant.2	Ant.1+2
5.2GHz	802.11a	26.00	26.00	29.00
	802.11n-HT20	26.00	26.00	29.00
	802.11n-HT40	26.00	26.00	29.00
	802.11ac-VHT20	26.00	26.00	29.00
	802.11ac-VHT40	26.00	26.00	29.00
	802.11ac-VHT80	20.00	20.00	23.00
	802.11ax-HE20	26.00	26.00	29.00
	802.11ax-HE40	26.00	26.00	29.00
5.3GHz	802.11a	20.00	20.00	23.00
	802.11n-HT20	20.00	20.00	23.00
	802.11n-HT40	20.98	20.98	23.98
	802.11ac-VHT20	20.00	20.00	23.00
	802.11ac-VHT40	20.98	20.98	23.98
	802.11ac-VHT80	20.00	20.00	23.00
	802.11ax-HE20	20.00	20.00	23.00
	802.11ax-HE40	20.98	20.98	23.98
5.5GHz	802.11a	20.00	20.00	23.00
	802.11n-HT20	20.00	20.00	23.00
	802.11n-HT40	20.98	20.98	23.98
	802.11ac-VHT20	20.00	20.00	23.00
	802.11ac-VHT40	20.98	20.98	23.98
	802.11ac-VHT80	20.98	20.98	23.98
	802.11ax-HE20	20.00	20.00	23.00
	802.11ax-HE40	20.98	20.98	23.98
5.8GHz	802.11a	25.00	25.00	28.00
	802.11n-HT20	25.00	25.00	28.00
	802.11n-HT40	25.00	25.00	28.00
	802.11ac-VHT20	25.00	25.00	28.00
	802.11ac-VHT40	25.00	25.00	28.00
	802.11ac-VHT80	25.00	25.00	28.00
	802.11ax-HE20	25.00	25.00	28.00



	802.11ax-HE40	25.00	25.00	28.00
	802.11ax-HE80	25.00	25.00	28.00

Note: WLAN2.4GHz/WLAN5GHz all support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.

<For Beamforming mode>**<5GHz WLAN >**

Mode		Maximum Average Power (dBm)
		Ant.1+2
5.2GHz	802.11ac-VHT20	28.00
	802.11ac-VHT40	28.00
	802.11ac-VHT80	23.00
	802.11ax-HE20	28.00
	802.11ax-HE40	28.00
	802.11ax-HE80	23.00
5.3GHz	802.11ac-VHT20	23.00
	802.11ac-VHT40	23.98
	802.11ac-VHT80	23.00
	802.11ax-HE20	23.00
	802.11ax-HE40	23.98
	802.11ax-HE80	23.00
5.5GHz	802.11ac-VHT20	23.00
	802.11ac-VHT40	23.98
	802.11ac-VHT80	23.98
	802.11ax-HE20	23.00
	802.11ax-HE40	23.98
	802.11ax-HE80	23.98
5.8GHz	802.11ac-VHT20	28.00
	802.11ac-VHT40	28.00
	802.11ac-VHT80	28.00
	802.11ax-HE20	28.00
	802.11ax-HE40	28.00
	802.11ax-HE80	28.00

Note: This device support beamforming for WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80 /HE20/HE40/HE80.

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

<For CDD/MIMO mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
2.4GHz WLAN	2412.0	2.00	27.00	29.000	794.328	0.158	1.000	0.158
5.2GHz WLAN	5180.0	3.00	29.00	32.000	1584.893	0.315	1.000	0.315
5.3GHz WLAN	5260.0	2.78	23.98	26.760	474.242	0.094	1.000	0.094
5.5GHz WLAN	5500.0	3.00	23.98	26.980	498.884	0.099	1.000	0.099
5.8GHz WLAN	5745.0	2.71	28.00	30.710	1177.606	0.234	1.000	0.234

<For Beamforming mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
5.2GHz WLAN	5180.0	6.01	28.00	34.010	2517.677	0.501	1.000	0.501
5.3GHz WLAN	5260.0	5.79	23.98	29.770	948.418	0.189	1.000	0.189
5.5GHz WLAN	5500.0	6.01	23.98	29.990	997.700	0.199	1.000	0.199
5.8GHz WLAN	5745.0	5.72	28.00	33.720	2355.049	0.469	1.000	0.469

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. WLAN2.4GHz and WLAN5GHz chose the higher SISO gain as MIMO gain to perform MPE calculation.
3. Chose the maximum power to do MPE analysis.
4. The gain calculation method of WLAN beamforming mode is referenced to KDB 662911.

5.2. Collocated Power Density Calculation

WLAN2.4GHz Power Density / Limit	WLAN5GHz Power Density / Limit	Σ (Power Density / Limit) of WLAN2.4GHz + WLAN5GHz
0.158	0.501	0.659

Note:

1. For collocation analysis, choose the highest (power density/limit) among WLAN 5GHz MIMO mode and Beamforming mode.
2. According to the EUT characteristic, WLAN 5GHz and WLAN 2.4GHz can transmit simultaneously.
3. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN2.4GHz + WLAN5GHz.
4. Considering the WLAN2.4GHz module collocation with the WLAN5GHz transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant.

Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

-----THE END-----