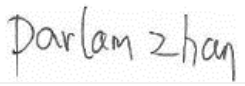
1 Cover Page

RF Exposure Evaluation Report

Application No.:	SHCR2501000043HS
FCC ID:	2BFI4AL550
Applicant:	Shanghai MediWorks Precision Instruments CO., Ltd.
Address of Applicant:	No.7, Ming Pu Phase 2, No. 3279 San Lu Road, Min Hang District, 20110, Shanghai, China
Manufacturer:	Shanghai MediWorks Precision Instruments CO., Ltd.
Address of Manufacturer:	No.7, Ming Pu Phase 2, No. 3279 San Lu Road, Min Hang District, 20110, Shanghai, China
Factory:	Shanghai MediWorks Precision Instruments CO., Ltd.
Address of Factory:	No.7, Ming Pu Phase 2, No. 3279 San Lu Road, Min Hang District, 20110, Shanghai, China
Equipment Under Test (EUT):	
EUT Name:	Optical Biometer
Model No.:	AL550
Add Model No.:	AL551, AL552
Trade Mark:	MediWorks
Standard(s) :	FCC Rules 47 CFR §2.1093 KDB 447498 D04 interim General RF Exposure Guidance v01
Date of Receipt:	2025-01-07
Date of Test:	2025-01-13 to 2025-01-22
Date of Issue:	2025-01-22
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2025-01-22	/

Authorized for issue by:				
Tested By				
		Bill Wu/Project Engineer		
Approved By				
		Parlam Zhan / Reviewer		

2 Contents

3 General Information

3.1 General Description of E.U.T.

Power supply:	AC 100-240V,50/60Hz

3.2 Technical Specifications

2.4GHz WiFi

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz;802.11n(HT40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK);802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Number of Channels:	802.11b/g/n(HT20):11;802.11n(HT40):7
Channel Spacing:	5MHz
Antenna Type:	Antenna 1: PIFA Antenna Antenna 2: PIFA Antenna
Antenna Gain:	Antenna 1: 3.29 dBi Antenna 1: 3.29 dBi (Provided by manufacturer) Directional gain: 6.30dBi
Date Rate:	802.11b:1/2/5.5./11Mbps 802.11g:6/9/12/18/24/36/48/54Mbps 802.11n:MCS0-MCS7

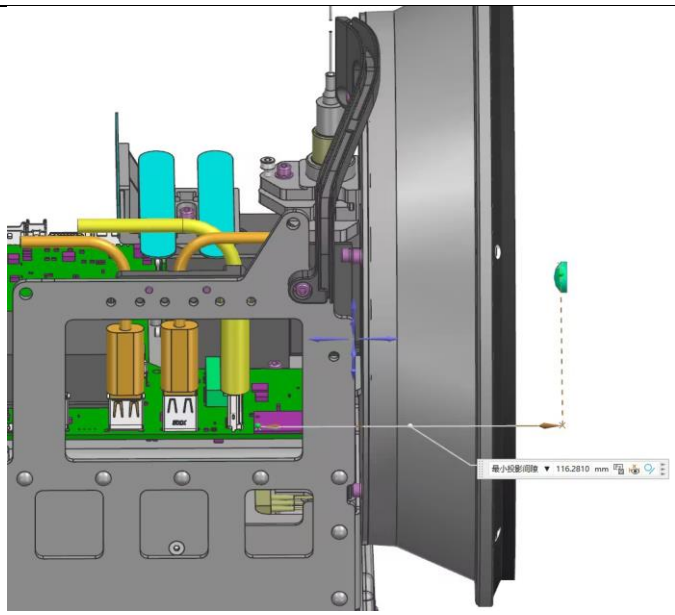
5GHz WiFi

Operation Frequency:	Band	Mode	Frequency Range(MHz)	Number of channels
	UNII Band I	802.11a/n(HT20)/ac(HT20)	5180-5240	4
		802.11n(HT40)/ac(HT40)	5190-5230	2
		802.11ac(HT80)	5210	1
	UNII Band II-A	802.11a/n(HT20)/ac(HT20)	5260-5320	4
		802.11n(HT40)/ac(HT40)	5270-5310	2
		802.11ac(HT80)	5290	1
	UNII Band II-C	802.11a/n(HT20)/ac(HT20)	5500-5700	11
		802.11n(HT40)/ac(HT40)	5510-5670	5
		802.11ac(HT80)	5530~5610	2
	UNII Band III	802.11a/n(HT20)/ac(HT20)	5745-5825	5
		802.11n(HT40)/ac(HT40)	5755-5795	2
		802.11ac(HT80)	5775	1
Modulation Type:	802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)			
Date Rate:	802.11a:6/9/12/18/24/36/48/54Mbps			

	802.11n:MCS0-MCS7 802.11ac:VHT MCS0-MCS7
Channel Spacing:	802.11a/n(HT20)/ac(HT20): 20MHz 802.11n(HT40)/ac(HT40): 40MHz 802.11ac(HT80): 80MHz
Antenna Gain:	Antenna 1: 4.03 dBi Antenna 2: 4.03 dBi (Provided by manufacturer) Directional gain: 7.04dBi
Antenna Type:	Antenna 1: PIFA Antenna Antenna 2: PIFA Antenna
TPC Function:	Not support
DFS Function:	Slaver without radar detection

3.3 Separation Distance

Separation distance between the antenna to person (R):	11.6cm
Remark: This minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. R has been stated in user manual.	



3.4 Test Location

All tests were performed at:
SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch
588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.
Tel: +86 21 6191 5666
Fax: +86 21 6191 5678
No tests were sub-contracted.
Note:
1. SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

3. Sample source: sent by customer.

3.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

- **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory Company Number: 8617A

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4 RF Exposure Test Exemptions

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

4.1 RF Exposure Test Exemptions for single RF sources

4.1.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

4.1.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz. The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, **R must be at least $\lambda/2\pi$**, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table B.1—Thresholds For Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R^2
1.34	–	30	35.6 m	–	1.6 m	3,450 R^2/f^2
30	–	300	1.6 m	–	159 mm	3.83 R^2
300	–	1,500	159 mm	–	31.8 mm	0.0128 R^2f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R^2
Subscripts L and H are low and high; λ is wavelength. R:Separation distance between the antenna to person						

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least λ/2π. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

Limit calculation				
Frequency range	Frequency(MHz)	λ/2π(m)	R(m)	Threshold ERP(W)
1.34~30MHz	13.56	3.5229	3.6000	243.167
300~1500MHz	**433**	0.1103	0.6000	1.995
1500~100000MHz	**2462**	0.0194	0.2000	0.768
1500~100000MHz	**5825**	0.0082	0.2000	0.768

4.1.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.

As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of §1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from **0.5cm to 40cm** and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{\text{th}}\ (\text{mW}) = \begin{cases} ERP_{20\ \text{cm}}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ \text{cm}} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases} \quad (\text{B.2})$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ \text{cm}}\sqrt{f}}\right)$$

and *f* is in GHz, d is the separation distance (cm), and $ERP_{20\text{cm}}$ is per Formula (B.1).

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
0.3~1.5	**0.915**	1.474	**0.5**	**8.133**
1.5~6	**2.462**	1.903	**11.6**	**1085.111**
1.5~6	**5.85**	2.091	**11.6**	**979.522**

4.2 RF Exposure Test Exemptions for Simultaneous Transmission

The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluatedk term) shall be used to determine exemption for simultaneous transmission. In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a}\frac{P_i}{P_{\text{th},i}} + \sum_{j=1}^{b}\frac{ERP_j}{ERP_{\text{th},j}} + \sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k} \le 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for Pth, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

Pi = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluatedk = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limitk = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from § 1.1310 of this chapter.

5 Measurement and Calculation

5.1 Maximum transmit power

2.4GHz WiFi

The Power Data is based on the RF Test Report SHCR250100004301

Test Mode	Antenna	Channel	Power [dBm]	Power [mW]
11B	Ant1	2412	14.39	27.48
	Ant2	2412	14.13	25.88
	Ant1	2437	**14.71**	**29.58**
	Ant2	2437	14.05	25.41
	Ant1	2462	14.42	27.67
	Ant2	2462	14.50	28.18
11G	Ant1	2412	12.48	17.70
	Ant2	2412	12.94	19.68
	Ant1	2437	12.52	17.86
	Ant2	2437	13.06	20.23
	Ant1	2462	12.68	18.54
	Ant2	2462	12.91	19.54
11N20MIMO	Ant1	2412	9.24	8.39
	Ant2	2412	9.21	8.34
	total	2412	12.24	16.75
	Ant1	2437	10.14	10.33
	Ant2	2437	8.80	7.59
	total	2437	**12.53**	**17.91**
	Ant1	2462	8.37	6.87
	Ant2	2462	8.95	7.85
	total	2462	11.68	14.72
11N40MIMO	Ant1	2422	8.44	6.98
	Ant2	2422	9.09	8.11
	total	2422	11.79	15.10
	Ant1	2437	8.41	6.93
	Ant2	2437	8.77	7.53
	total	2437	11.60	14.45
	Ant1	2452	7.94	6.22
	Ant2	2452	8.41	6.93
	total	2452	11.19	13.15

5GHz WiFi:

The Power Data is based on the RF Test Report SHCR250100004302

Test Mode	Antenna	Channel	Power [dBm]	Power [mW]
11A	Ant1	5180	13.14	20.61
	Ant2	5180	13.58	22.80
	Ant1	5220	12.18	16.52
	Ant2	5220	12.87	19.36
	Ant1	5240	11.76	15.00
	Ant2	5240	12.64	18.37
	Ant1	5260	11.49	14.09
	Ant2	5260	12.54	17.95
	Ant1	5300	**14.28**	**26.79**
	Ant2	5300	12.05	16.03
	Ant1	5320	14.08	25.59
	Ant2	5320	11.68	14.72
	Ant1	5500	12.16	16.44
	Ant2	5500	11.64	14.59
	Ant1	5580	12.62	18.28
	Ant2	5580	12.54	17.95
	Ant1	5700	11.06	12.76
	Ant2	5700	11.55	14.29
	Ant1	5745	12.86	19.32
	Ant2	5745	10.37	10.89
	Ant1	5785	12.59	18.16
	Ant2	5785	10.20	10.47
	Ant1	5825	12.47	17.66
	Ant2	5825	10.47	11.14
11N20MIMO	Ant1	5180	11.27	13.40
	Ant2	5180	10.78	11.97
	total	5180	14.04	25.35
	Ant1	5220	10.71	11.78
	Ant2	5220	10.24	10.57
	total	5220	13.49	22.34
	Ant1	5240	10.11	10.26
	Ant2	5240	9.96	9.91
	total	5240	13.05	20.18
	Ant1	5260	9.91	9.79
	Ant2	5260	10.10	10.23
	total	5260	13.02	20.04
	Ant1	5300	9.05	8.04
	Ant2	5300	9.41	8.73
	total	5300	12.24	16.75
	Ant1	5320	9.03	8.00
	Ant2	5320	9.05	8.04
	total	5320	12.05	16.03
	Ant1	5500	9.87	9.71
	Ant2	5500	9.29	8.49
	total	5500	12.60	18.20
	Ant1	5580	11.04	12.71
	Ant2	5580	10.49	11.19
	total	5580	13.78	23.88
	Ant1	5700	9.82	9.59
	Ant2	5700	10.05	10.12
	total	5700	12.95	19.72
	Ant1	5745	8.14	6.52

	Ant2	5745	8.48	7.05
	total	5745	11.32	13.55
	Ant1	5785	7.53	5.66
	Ant2	5785	7.62	5.78
	total	5785	10.59	11.46
	Ant1	5825	7.71	5.90
	Ant2	5825	7.87	6.12
	total	5825	10.80	12.02
11N40MIMO	Ant1	5190	12.23	16.71
	Ant2	5190	12.13	16.33
	total	5190	15.19	33.04
	Ant1	5230	11.83	15.24
	Ant2	5230	12.00	15.85
	total	5230	14.93	31.12
	Ant1	5270	11.54	14.26
	Ant2	5270	11.61	14.49
	total	5270	14.59	28.77
	Ant1	5310	10.97	12.50
	Ant2	5310	11.15	13.03
	total	5310	14.07	25.53
	Ant1	5510	12.00	15.85
	Ant2	5510	11.45	13.96
	total	5510	14.74	29.79
	Ant1	5590	11.77	15.03
	Ant2	5590	11.11	12.91
	total	5590	14.46	27.93
	Ant1	5670	11.06	12.76
	Ant2	5670	10.61	11.51
	total	5670	13.85	24.27
	Ant1	5755	10.56	11.38
	Ant2	5755	11.31	13.52
	total	5755	13.96	24.89
	Ant1	5795	10.19	10.45
	Ant2	5795	11.46	14.00
	total	5795	13.88	24.43
11AC20MIMO	Ant1	5180	12.15	16.41
	Ant2	5180	11.79	15.10
	total	5180	**14.98**	**31.48**
	Ant1	5220	11.04	12.71
	Ant2	5220	11.62	14.52
	total	5220	14.35	27.23
	Ant1	5240	10.68	11.69
	Ant2	5240	11.26	13.37
	total	5240	13.99	25.06
	Ant1	5260	10.29	10.69
	Ant2	5260	11.20	13.18
	total	5260	13.78	23.88
	Ant1	5300	9.86	9.68
	Ant2	5300	10.83	12.11
	total	5300	13.38	21.78
	Ant1	5320	9.89	9.75
	Ant2	5320	10.89	12.27
	total	5320	13.43	22.03
	Ant1	5500	10.61	11.51
	Ant2	5500	11.24	13.30
	total	5500	13.95	24.83

	Ant1	5580	11.41	13.84
	Ant2	5580	11.67	14.69
	total	5580	14.55	28.51
	Ant1	5700	9.47	8.85
	Ant2	5700	10.46	11.12
	total	5700	13.00	19.95
	Ant1	5745	7.80	6.03
	Ant2	5745	9.12	8.17
	total	5745	11.52	14.19
	Ant1	5785	7.67	5.85
	Ant2	5785	8.83	7.64
	total	5785	11.30	13.49
	Ant1	5825	7.31	5.38
	Ant2	5825	8.47	7.03
	total	5825	10.94	12.42
11AC40MIMO	Ant1	5190	11.10	12.88
	Ant2	5190	11.76	15.00
	total	5190	14.45	27.86
	Ant1	5230	10.61	11.51
	Ant2	5230	11.34	13.61
	total	5230	14.00	25.12
	Ant1	5270	10.75	11.89
	Ant2	5270	11.11	12.91
	total	5270	13.94	24.77
	Ant1	5310	9.74	9.42
	Ant2	5310	10.78	11.97
	total	5310	13.30	21.38
	Ant1	5510	10.68	11.69
	Ant2	5510	11.43	13.90
	total	5510	14.08	25.59
	Ant1	5590	11.09	12.85
	Ant2	5590	11.24	13.30
	total	5590	14.18	26.18
	Ant1	5670	9.84	9.64
	Ant2	5670	10.37	10.89
	total	5670	13.12	20.51
	Ant1	5755	7.32	5.40
	Ant2	5755	8.34	6.82
	total	5755	10.87	12.22
	Ant1	5795	7.00	5.01
	Ant2	5795	8.13	6.50
	total	5795	10.61	11.51
11AC80MIMO	Ant1	5210	10.02	10.05
	Ant2	5210	10.13	10.30
	total	5210	13.09	20.37
	Ant1	5290	8.76	7.52
	Ant2	5290	9.71	9.35
	total	5290	12.27	16.87
	Ant1	5530	10.32	10.76
	Ant2	5530	10.78	11.97
	total	5530	13.57	22.75
	Ant1	5610	10.30	10.72
	Ant2	5610	10.57	11.40
	total	5610	13.45	22.13
	Ant1	5775	7.84	6.08
	Ant2	5775	8.94	7.83

	total	5775	11.44	13.93

5.2 RF Exposure Calculation

For single RF source :

	Evaluation method	Separation distance between the antenna to person (R)
☐	Blanket 1 mW Blanket Exemption	Regardless of separation distance
☐	MPE-based Exemption(ERP)	R≥(λ/2π)
☒	SAR-based Exemption(P_{th})	1085.111mW for WiFi 2.4G @11.6cm 979.522mW for WiFi 5G @11.6cm

Band	Frequency Band (MHz)	Max power (dBm)	Ant Gain (dBi)	EIRP (dBm)	Max EIRP (mW)	Limit (mW)	Distance R (cm)	Result	Ratio
WLAN 2.4GHz SISO	2412-2462	14.71	3.29	18.00	63.10	1085.111	11.6	Pass	0.058
WLAN 2.4GHz MIMO	2412-2462	12.53	6.30	18.83	76.38	1085.111	11.6	Pass	**0.070**
WLAN 5GHz SISO	5250-5350	14.28	4.03	18.31	67.76	979.522	11.6	Pass	0.069
WLAN 5GHz MIMO	5150-5250	14.98	7.04	22.02	159.22	979.522	11.6	Pass	**0.163**

The 2.4GHz WiFi,5GHz WiFi modules can transmit simultaneously, but the maximum rate of MPE is 0.070+0.163=0.233≤1.So the device is exclusion from SAR test

Remark: we used the maximum power between the conducted power and ERP/EIRP to perform RF exposure exemption evaluation.

--End of the Report--