

RF EXPOSURE REPORT

Report No.: DDT-B21081103-1E02

Applicant	:	Beijing Orion Star Technology Co., Ltd.
Applicant Address	:	Room A-2570, 2nd Floor, No. 30, Shixing Street, Shijingshan District, Beijing China.
Equipment Under Test	:	AI Delivery Robot
Model No.	:	OS-R-DR01
Trade Mark	:	ORIONSTAR
FCC ID	:	2A3BD-OSRDR01
Manufacturer	:	Beijing Orion Star Technology Co., Ltd.
Manufacturer Address	:	Room A-2570, 2nd Floor, No. 30, Shixing Street, Shijingshan District, Beijing China.

Issued By: Tianjin Dongdian Testing Service Co., Ltd.

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REPORT

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Test Report Declare

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Standard Used:

KDB447498 D01 General RF Exposure Guidance v06

We Declare:

The equipment described above is tested by Tianjin Dongdian Testing Service Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Tianjin Dongdian Testing Service Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided **test compliance** with the requirement of the above FCC standards.

Report No:	DDT-B21081103-1E02		
Date of Receipt:	Sep. 13, 2021	Date of Test:	Sep. 13, 2021 ~ Oct. 15, 2021

**Prepared By:**

Leon Li

Leon Li/Engineer**Approved By:**

Aaron Zhang

Aaron Zhang/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Tianjin Dongdian Testing Service Co., Ltd.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Revision History

Rev.	Revisions	Issue Date	Revised By
---	Initial issue	Oct. 15, 2021	

1. General information

1.1. Description of Equipment

EUT Description	AI Delivery Robot						
Model Number	OS-R-DR01						
Trade Mark	ORIONSTAR						
IMEI	860195052149025						
Serial Number	Radiation: K02ECNC0AA021822728A Conduction: K02ECNC0AA021822Q24C						
Hardware Version	OS-R-DR01S						
Software Version	Orionstar 6.17						
Frequency band	UMTS	Tx (MHz)		Rx (MHz)	Supported Channel Bandwidth		
	Band II	1850-1910		1930-1990	5MHz		
	Band IV	1710-1755		2110-2155	5MHz		
	Band V	824-849		869-894	5MHz		
	E-UTRA	Duplex Mode	Tx (MHz)	Rx (MHz)	Supported Channel Bandwidth		
					1.4	3	5
					10	15	20
	Band 2	FDD	1850-1910	1930-1990	☑	☑	☑
	Band 4	FDD	1710-1755	2110-2155	☑	☑	☑
	Band 5	FDD	824-849	869-894	☑	☑	☑
	Band 7	FDD	2500-2570	2620-2690	---	---	☑
	Band 12	FDD	699-716	729-746	☑	☑	☑
	Band 13	FDD	777-787	746-756	---	---	☑
	Band 25	FDD	1850-1915	1930-1995	☑	☑	☑
	Band 26	FDD	814-849	859-894	☑	☑	☑
	Band 38	TDD	2570-2620	2570-2620	---	---	☑
	Band 41	TDD	2496-2690	2496-2690	---	---	☑
	WLAN_1 2.4G	Frequency (MHz)			Supported Channel Bandwidth		
	IEEE 802.11b	2412-2462			20MHz		
	IEEE 802.11g	2412-2462			20MHz		
	IEEE 802.11n-HT20	2412-2462			20MHz		
	IEEE 802.11n-HT40	2422-2452			40MHz		
	WLAN_1 5G	Frequency (MHz)			Supported Channel Bandwidth		
	IEEE 802.11a	5180-5240 5260-5320 5500-5700 5745-5825			20MHz		
	IEEE 802.11n-HT20	5180-5240 5260-5320 5500-5700 5745-5825			20MHz		
	IEEE 802.11n-HT40	5190-5230 5270-5310 5510-5670 5755-5795			40MHz		
	IEEE 802.11ac-HT20	5180-5240 5260-5320 5500-5700 5745-5825			20MHz		

	:	IEEE 802.11ac-HT40	5190-5230 5270-5310 5510-5670 5755-5795		40MHz	
	:	IEEE 802.11ac-HT80	5210 5290 5530 5775		80MHz	
	:	WLAN_2 2.4G	Frequency (MHz)		Supported Channel Bandwidth	
	:	IEEE 802.11b	2412-2462		20MHz	
	:	IEEE 802.11g	2412-2462		20MHz	
	:	IEEE 802.11n-HT20	2412-2462		20MHz	
	:	IEEE 802.11n-HT40	2422-2452		40MHz	
UMTS Release	:	Release 8				
UMTS Power class	:	Class 3				
E-UTRA Release	:	Release 10				
E-UTRA UE Category	:	Category 4				
Type of modulation	:	UMTS	WCDMA: UL: BPSK DL: QPSK			
	:	E-UTRA	UL: QPSK&16QAM DL: QPSK&16QAM			
	:	IEEE 802.11b	DSSS (CCK, DQPSK, DBPSK)			
	:	IEEE 802.11g	OFDM (64QAM, 16QAM, QPSK, BPSK)			
	:	IEEE 802.11n HT20, HT40	OFDM (64QAM, 16QAM, QPSK, BPSK)			
	:	IEEE 802.11a	OFDM (64QAM, 16QAM, QPSK, BPSK)			
	:	IEEE 802.11ac HT20, HT40, HT80	OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)			
Smart Condition	:	WCDMA	☒ SISO ☐ MIMO ☐ Diversity			
	:	E-UTRA	☒ SISO ☐ MIMO ☐ Diversity			
	:	WLAN_1 2.4G	☒ SISO (802.11b/g/n) ☒ MIMO (802.11n) ☐ Diversity (802.11b/g/n)			
	:	WLAN_1 5G	☒ SISO (802.11a/n/ac) ☒ MIMO (802.11n/ac) ☐ Diversity(802.11a/n/ac)			
	:	WLAN_2 2.4G	☒ SISO (802.11b/g/n) ☐ MIMO (802.11n) ☐ Diversity (802.11b/g/n)			
Antenna Type	:	WCDMA & E-UTRA & WLAN_1: Fixed Internal Dedicated FPCB Antenna WLAN_2: Fixed Internal ROD Antenna				
Antenna Information	:	Mode	Band	Antenna1	Antenna2	MIMO
	:	WCDMA	Band II	3.79dBi	N/A	N/A
			Band IV	4.13dBi	N/A	N/A
			Band V	-1.51dBi	N/A	N/A
	:	E-UTRA	LTE Band2	3.79dBi	N/A	N/A
			LTE Band 4	4.13dBi	N/A	N/A
			LTE Band 5	-1.51dBi	N/A	N/A
			LTE Band 7	4.32dBi	N/A	N/A
			LTE Band 12	1.11dBi	N/A	N/A
LTE Band 13			1.11dBi	N/A	N/A	

		LTE Band 25	3.76dBi	N/A	N/A
		LTE Band 26	-1.51dBi	N/A	N/A
		LTE Band 38	4.32dBi	N/A	N/A
		LTE Band 41	4.32dBi	N/A	N/A
	WLAN_1 2.4G	IEEE 802.11b	1.32dBi	0.37dBi	N/A
		IEEE 802.11g	1.32dBi	0.37dBi	N/A
		IEEE 802.11n HT20, HT40	1.32dBi	0.37dBi	3.88dBi
	WLAN_1 5G	IEEE 802.11a	2.88dBi	1.55dBi	N/A
		IEEE 802.11n HT20, HT40	2.88dBi	1.55dBi	5.28dBi
		IEEE 802.11ac HT20, HT40, HT80	2.88dBi	1.55dBi	5.28dBi
	WLAN_2 2.4G	IEEE 802.11b	2.00dBi	N/A	N/A
		IEEE 802.11g	2.00dBi	N/A	N/A
		IEEE 802.11n HT20, HT40	2.00dBi	N/A	N/A
Power Supply	Internal battery				

1.2. Assess laboratory

Tianjin Dongdian Testing Service Co., Ltd.

Address: Building D-1, No. 19, Weisi Road, Microelectronics Industrial Park Development Area, Tianjin, China., 300385

Tel: +86-22-58038033, <http://www.ddttest.com>, Email: ddt@dgdtdt.com

NVLAP (National Voluntary Laboratory Accreditation Program) CODE: 500036-0

CNAS (China National Accreditation Service for Conformity Assessment) CODE: L13402

FCC Designation Number: CN5004; FCC Test Firm Registration Number: 368676

ISED (Innovation, Science and Economic Development Canada) Company Number: 27768

Conformity Assessment Body Identifier: CN0125

VCCI Facility Registration Number: C-20089, T-20093, R-20125, G-20122

2. RF Exposure Evaluation

2.1. Requirement

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

Limits for General Population/Uncontrolled Exposure

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
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
300-1,500			f/300	<6
1,500-100,000			5	<6
(ii) 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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

f = frequency in MHz. * = Plane-wave equivalent power density.

Note1: Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure.

Note2: General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

2.2. Calculation method

$$E(\text{V/m}) = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } S(\text{mW/cm}^2) = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (mW)

G = EUT Antenna numeric gain (numeric)=

d = Separation distance between radiator and human body (m)

The formula can be changed to

We can change the formula to:

$$S = \frac{30 \times P \times G}{377 \times d^2} \quad \text{or, } d = \sqrt{\frac{30 \times P \times G}{377 \times S}}$$

From the peak EUT RF output power, the minimum mobile separation distance, $d=0.2$ m, as well as the gain of the used antenna, the RF power density can be obtained.

2.3. Estimation result

Mode	Band	Output power (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (Linear)	MPE Value (mW/cm ²)	MPE ratio	MPE Limit (mW/cm ²)
WCDMA	Band II	25	316.23	3.79	2.39	0.150564	0.150564	1.00
	Band IV	25	316.23	4.13	2.59	0.162825	0.162825	1.00
	Band V	25	316.23	-1.51	0.71	0.044434	0.080888	0.55
E-UTRA	LTE Band2	25	316.23	3.79	2.39	0.150564	0.150564	1.00
	LTE Band 4	25	316.23	4.13	2.59	0.162825	0.162825	1.00
	LTE Band 5	25	316.23	-1.51	0.71	0.044434	0.080888	0.55
	LTE Band 7	25	316.23	4.32	2.70	0.170106	0.170106	1.00
	LTE Band 12	25	316.23	1.11	1.29	0.081231	0.174315	0.47
	LTE Band 13	25	316.23	1.11	1.29	0.081231	0.156816	0.52
	LTE Band 25	25	316.23	3.76	2.38	0.149527	0.149527	1.00
	LTE Band 26	25	316.23	-1.51	0.71	0.044434	0.081882	0.54
	LTE Band 38	25	316.23	4.32	2.70	0.170106	0.170106	1.00
	LTE Band 41	25	316.23	4.32	2.70	0.170106	0.170106	1.00
WLAN1_2.4G ANT1	IEEE 802.11b	19	79.43	1.32	1.36	0.021415	0.021415	1.00
	IEEE 802.11g	16	39.81	1.32	1.36	0.010733	0.010733	1.00
	IEEE 802.11n HT20	16	39.81	1.32	1.36	0.010733	0.010733	1.00
	IEEE 802.11n HT40	10	10.00	1.32	1.36	0.002696	0.002696	1.00

WLAN1_2.4G ANT2	IEEE 802.11b	19	79.43	0.37	1.09	0.017208	0.017208	1.00
	IEEE 802.11g	16	39.81	0.37	1.09	0.008624	0.008624	1.00
	IEEE 802.11n HT20	16	39.81	0.37	1.09	0.008624	0.008624	1.00
	IEEE 802.11n HT40	10	10.00	0.37	1.09	0.002166	0.002166	1.00
WLAN1_2.4G MIMO	IEEE 802.11n HT20 MIMO	19	79.43	3.88	2.44	0.038612	0.038612	1.00
	IEEE 802.11n HT40 MIMO	13	19.95	3.88	2.44	0.009699	0.009699	1.00
WLAN1_5G ANT1	IEEE 802.11a	14	25.12	2.88	1.94	0.009699	0.009699	1.00
	IEEE 802.11n HT20	14	25.12	2.88	1.94	0.009699	0.009699	1.00
	IEEE 802.11n HT40	9	7.94	2.88	1.94	0.003067	0.003067	1.00
	IEEE 802.11ac HT20	16	39.81	2.88	1.94	0.015372	0.015372	1.00
	IEEE 802.11ac HT40	9	7.94	2.88	1.94	0.003067	0.003067	1.00
	IEEE 802.11ac HT80	9	7.94	2.88	1.94	0.003067	0.003067	1.00
WLAN1_5G ANT2	IEEE 802.11a	14	25.12	1.55	1.43	0.007140	0.007140	1.00
	IEEE 802.11n HT20	14	25.12	1.55	1.43	0.007140	0.007140	1.00
	IEEE 802.11n HT40	9	7.94	1.55	1.43	0.002258	0.002258	1.00
	IEEE 802.11ac HT20	16	39.81	1.55	1.43	0.011317	0.011317	1.00
	IEEE 802.11ac HT40	9	7.94	1.55	1.43	0.002258	0.002258	1.00
	IEEE 802.11ac HT80	9	7.94	1.55	1.43	0.002258	0.002258	1.00
WLAN1_5G	IEEE 802.11n HT20 MIMO	17	50.12	5.28	3.37	0.033629	0.033629	1.00
	IEEE 802.11n HT40 MIMO	11	12.59	5.28	3.37	0.008447	0.008447	1.00
	IEEE 802.11ac HT20 MIMO	19	79.43	5.28	3.37	0.053299	0.053299	1.00
	IEEE 802.11ac HT40 MIMO	11	12.59	5.28	3.37	0.008447	0.008447	1.00
	IEEE 802.11ac HT80 MIMO	11	12.59	5.28	3.37	0.008447	0.008447	1.00

WLAN2_2.4G	IEEE 802.11b	18	63.10	2.00	1.58	0.019894	0.019894	1.00
	IEEE 802.11g	17	50.12	2.00	1.58	0.015802	0.015802	1.00
	IEEE 802.11n HT20	15	31.62	2.00	1.58	0.009971	0.009971	1.00
	IEEE 802.11n HT40	16	39.81	2.00	1.58	0.012552	0.012552	1.00

Maximum Simultaneous transmission MPE Ratio for Main communication and WLAN1 and WLAN2:

Maximum Simultaneous transmission MPE Ratio for WCDMA and WLAN2:

Maximum MPE ratio WCDMA	Maximum MPE ratio WLAN2_2.4G	Σ MPE ratios	Limit	Results
0.162825	0.019894	0.182719	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for E-UTRA and WLAN2:

Maximum MPE ratio E-UTRA	Maximum MPE ratio WLAN2_2.4G	Σ MPE ratios	Limit	Results
0.174315	0.019894	0.194209	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for WLAN1_2.4G and WLAN2:

Maximum MPE ratio WLAN1_2.4G	Maximum MPE ratio WLAN2_2.4G	Σ MPE ratios	Limit	Results
0.021415	0.019894	0.041309	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for WLAN1_5G and WLAN2:

Maximum MPE ratio WLAN1_5G	Maximum MPE ratio WLAN2_2.4G	Σ MPE ratios	Limit	Results
0.053299	0.019894	0.073193	1.000	Pass

Note: The estimation distance is 20 cm.

Conclusion: No SAR evaluation required since transmitter power is below FCC threshold.

END OF REPORT