

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

RF Exposure evaluation**Report Reference No.....: GTS20240108009-1-3****FCC ID.: 2BEE4-E150**

Compiled by

(position+printed name+signature) : File administrators Peter Xiao

Supervised by

(position+printed name+signature) : Test Engineer Evan Ouyang

Approved by

(position+printed name+signature) : Manager Jason Hu

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Representative Laboratory Name.: Shenzhen Global Test Service Co.,Ltd.

Address: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

Applicant's name.....: Shanghai Orange Box Digital Technology Co., Ltd.

Address: Room 3As126, 4th Floor, No. 1155, Fangdian Road, Pudong District, Shanghai, China

Test specification

Standard.....: **47CFR §1.1310 Basis and purpose**
47CFR §2.1091 Radiofrequency radiation exposure evaluation: mobile devices
KDB447498 D01 General RF Exposure Guidance v06

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF: Dated 2014-12

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Test item description: Industrial Data Gateway

Trade Mark.....: Q CUBE

Manufacturer: Shanghai Orange Box Digital Technology Co., Ltd.

Model/Type reference: E150

Listed Models: N/A

Modulation Type.....: IEEE 802.11a /802.11b/802.11g/802.11n/802.11ac

Operation Frequency.....: From 2412MHz to 2462MHz, 5180MHz to 5240MHz, 5745MHz to 5825MHz

Hardware Version: H2.0

Software Version.....: N/A

Rating.....: DC 24.0V or DC 24V Adapter From AC120V/60Hz

Result: **PASS**

TEST REPORT

Test Report No. :	GTS20240108009-1-3	Mar. 12, 2024
		Date of issue

Equipment under Test : Industrial Data Gateway

Model /Type : E150

Listed model : N/A

Applicant : **Shanghai Orange Box Digital Technology Co., Ltd.**

Address : Room 3As126, 4th Floor, No. 1155, Fangdian Road, Pudong District, Shanghai, China

Manufacturer : **Shanghai Orange Box Digital Technology Co., Ltd.**

Address : Room 3As126, 4th Floor, No. 1155, Fangdian Road, Pudong District, Shanghai, China

Test Result:	PASS
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The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1. SUMMARY

1.1 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

● /	Length (m) :	/
	Shield :	/
	Detachable :	/

1.2 Product Description

Product Name:	Industrial Data Gateway
Trade Mark:	Q CUBE
Model/Type reference:	E150
List Model:	N/A
Model Declaration	N/A
Power supply:	DC 24.0V or DC 24V Adapter From AC120V/60Hz
Hardware Version	H2.0
Software Version	N/A
Sample ID	GTS20240108009-1-S0001-1#& GTS20240108009-1-S0001-2#
2.4GWLAN	
WLAN Operation frequency	IEEE 802.11b: 2412-2462MHz IEEE 802.11g: 2412-2462MHz IEEE 802.11n HT20: 2412-2462MHz
WLAN Modulation Type	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK)
Channel number:	11 Channel for IEEE 802.11b/g/n(HT20)
Channel separation:	5MHz
WIFI(5.2G/5.8G Band)	
Frequency Range	5180-5240MHz, 5745MHz to 5825MHz
Channel Number	4 Channels for 20MHz bandwidth(5180-5240MHz) 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5210MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT20: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT40: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT80: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	External Antenna, 2.00 dBi(Max.) for 2.4G Band and 2.00 dBi(Max.) for 5G Band

2. TEST ENVIRONMENT

2.1 Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

2.2 Test Facility

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

CNAS (No. CNAS L8169)

Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)

Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

Industry Canada Registration Number. is 24189.

FCC Designation Number is CN1234.

FCC Registered Test Site Number is165725.

2.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

2.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.57 dB	(1)

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. METHOD OF MEASUREMENT

3.1 Applicable Standard

According to §1.1307(b)(1), systems operating under the provisions of this 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

3.2 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 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498 D01 General RF Exposure Guidance v06 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3.3 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
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 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

F=frequency in MHz

*=Plane-wave equivalent power density

3.4 MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S=power density

P=power input to 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

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 100%-see the User manual, and the EUT is a wireless device used in a mobile application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum mobile separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna is 2.00dBi for WLAN, and the power drift from Turn-up Procedure provided by manufacturer as following states, the RF power density can be obtained.

3.5 Antenna Information

E150 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 1	WLAN ANT1	External antenna	2.4 – 2.5 GHz 5.0 – 6.0 GHz	2.00dBi (Max.) for 2.4G band 2.00dBi (Max.) for 5G band

4. Conducted Power Results

2.4GWLAN

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
802.11b	01	2412	14.09
	06	2437	14.53
	11	2462	14.69
802.11g	01	2412	18.46
	06	2437	18.95
	11	2462	18.96
802.11n(HT20)	01	2412	18.13
	06	2437	18.60
	11	2462	18.61

5.2GWLAN

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
802.11a	36	5180	10.18
	40	5200	11.21
	48	5240	13.64
802.11n20	36	5180	11.12
	40	5200	11.18
	48	5240	11.46
802.11n40	38	5190	12.20
	46	5230	12.19
802.11ac20	36	5180	12.98
	40	5200	13.30
	48	5240	13.52
802.11ac40	38	5190	12.03
	46	5230	12.52
802.11ac80	42	5210	12.27

5.8GWLAN

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
802.11a	149	5745	12.41
	157	5785	12.90
	165	5825	12.63
802.11n20	149	5745	13.54
	157	5785	14.11
	165	5825	14.04
802.11n40	151	5755	10.72
	159	5795	11.34
802.11ac20	149	5745	11.93
	157	5785	12.43
	165	5825	12.34
802.11ac40	151	5755	10.75
	159	5795	11.29
802.11ac80	155	5775	11.18

5. Manufacturing Tolerance

2.4GWLAN

IEEE 802.11b (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	14.00	14.00	14.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	18.00	18.00	18.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	18.00	18.00	18.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0

5.2GWLAN

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.00	11.00	13.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.00	11.00	11.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n VHT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	12.00	12.00	
Tolerance $\pm$ (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.00	13.00	13.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	12.00	12.00	/
Tolerance $\pm$ (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	/	/
Target (dBm)	12.00		
Tolerance $\pm$ (dB)	1.0	/	/

5.8GWLAN

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.00	12.00	12.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.00	14.00	14.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n VHT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	10.00	11.00	/
Tolerance $\pm$ (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.00	12.00	12.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	10.00	11.00	/
Tolerance $\pm$ (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	/	/
Target (dBm)	11.00	/	/
Tolerance $\pm$ (dB)	1.0	/	/

6. Measurement Results

6.1 Standalone MPE Evaluation

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

2.4GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
802.11b	15.00	31.6228	2.00	1.5849	0.0100	1.0000
802.11g	19.00	79.4328	2.00	1.5849	0.0250	1.0000
802.11n(HT20)	19.00	79.4328	2.00	1.5849	0.0250	1.0000

5.2GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
802.11a	14.00	25.1189	2.00	1.5849	0.0079	1.0000
802.11n20	12.00	15.8489	2.00	1.5849	0.0050	1.0000
802.11n40	13.00	19.9526	2.00	1.5849	0.0063	1.0000
802.11ac20	14.00	25.1189	2.00	1.5849	0.0079	1.0000
802.11ac40	13.00	19.9526	2.00	1.5849	0.0063	1.0000
802.11ac80	13.00	19.9526	2.00	1.5849	0.0063	1.0000

5.8GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
802.11a	13.00	19.9526	2.00	1.5849	0.0063	1.0000
802.11n20	15.00	31.6228	2.00	1.5849	0.0100	1.0000
802.11n40	12.00	15.8489	2.00	1.5849	0.0050	1.0000
802.11ac20	13.00	19.9526	2.00	1.5849	0.0063	1.0000
802.11ac40	12.00	15.8489	2.00	1.5849	0.0050	1.0000
802.11ac80	12.00	15.8489	2.00	1.5849	0.0050	1.0000

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;
3. According to ANSI C63.10: 2020 Clause 6.4.4.2, $E_{0.2m} = E_{3m} + 40 \log (3/0.2)$;

7. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB447498 D01 General RF Exposure Guidance v06.

.....End of Report.....