



# FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: **LTE cube**

Model: **E5180s-517**

Report No.: **SYBH(Z-SAR)001092014-2**

FCC ID: **QISE5180S-517**

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DATE	2014-09-20	2014-09-20

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※ ※ **Modified History** ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2014-09-20	Cheng Jiawen



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# 1 EUT Description

Device Information:			
DUT Name:	LTE cube		
Type Identification:	E5180s-517		
Device Type :	Mobile Device		
FCC ID:	QISE5180S-517		
Device Phase:	Identical Prototype		
Exposure Category:	Uncontrolled environment/general population		
Hardware Version :	CL1E5180SM07 &CL1E5180SR		
Software Version :	21.270.13.01T.00		
Antenna Type :	Internal Antenna, External Antenna		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,UMTS Band V/IV/II,LTE band V/IV/II/VII, WiFi 2.4G		
Test Modulation	GSM(GMSK/8PSK),UMTS(QPSK),LTE(QPSK/16QAM),WiFi(OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM850	824-849	869-894
	GSM1900	1850-1910	1930-1990
	UMTS Band V	824-849	869-894
	UMTS Band IV	1710-1755	2110-2155
	UMTS Band II	1850-1910	1930-1990
	LTE Band V	824-849	869-894
	LTE Band IV	1710-1755	2110-2155
	LTE Band II	1850-1910	1930-1990
	LTE Band VII	2500-2570	2620-2690
	WiFi 2.4G	2400-2500	2400-2500



## 1.1 General Description

E5180s-517 LTE/DC-HSDPA/WCDMA/EDGE/GPRS/GSM mutli-mode 9 bands LTE cube is subscriber equipment in the LTE/UMTS/GSM system and support WiFi 802.11/b/g/n. E5180s-517 implement such functions as RF signal receiving/transmitting, LTE/HSPA/WCDMA and EDGE/GPRS/GSM protocol processing, data service etc. It provides USIM card interface, RJ45/RJ11 Ethernet interface and two external antenna interface. E5180s-517 has four internal antennas as default.



## 2 Test specification(s)

ANSI Std C95.1-1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991)
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 4 of March 2010))
KDB 447498 D01	General RF Exposure Guidance v05r02

## 3 Testing laboratory

Test Site	The Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	Zone K3,Huawei Industrial Base, Bantian Industry Area, Longgang District, Shenzhen, Guangdong, China
Telephone	+86 755 28780808
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State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310 A2LA TESTING CERT #2174.01

## 4 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

## 5 Application details

Start Date of test	2014-09-20
End Date of test	2014-09-20

## 6 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%



## 7 RF Exposure Requirements

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled 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. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

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

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.



**Table: Limits For Maximum Permissible Exposure (MPE)**

<b>(A) Limits for Occupational/controlled Exposure</b>				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
<b>(B) Limits for General Population/uncontrolled Exposure</b>				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	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	

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

Where:

S = power density

P = power input to the antenna

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

R= distance to the centre of radiation of the antenna



$$\text{EIRP} = \text{P} * \text{G}$$

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.



## 8 RF Exposure Evaluation

### 8.1 Operation in GSM850

(uplink: 824-849MHz, downlink: 869-894MHz)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	GSM CS	35.00	0.80	35.8	475.24	20	0.095	0.549	<b>PASS</b>
	1TS*(1/8)	35.00	0.80	35.8	475.24	20	0.095	0.549	<b>PASS</b>
	2TS*(2/8)	35.00	0.80	35.8	950.47	20	<b>0.189</b>	0.549	<b>PASS</b>
	3TS*(3/8)	33.00	0.80	33.8	899.56	20	0.179	0.549	<b>PASS</b>
	4TS*(4/8)	31.00	0.80	31.8	756.78	20	0.151	0.549	<b>PASS</b>
External antenna	GSM CS	35.00	0.80	35.8	475.24	20	0.095	0.549	<b>PASS</b>
	1TS*(1/8)	35.00	0.80	35.8	475.24	20	0.095	0.549	<b>PASS</b>
	2TS*(2/8)	35.00	0.80	35.8	950.47	20	<b>0.189</b>	0.549	<b>PASS</b>
	3TS*(3/8)	33.00	0.80	33.8	899.56	20	0.179	0.549	<b>PASS</b>
	4TS*(4/8)	31.00	0.80	31.8	756.78	20	0.151	0.549	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.189 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.549 mW/cm<sup>2</sup> at 824MHz, so we can conclude it is into compliance.



## 8.2 Operation in GSM1900

(uplink: 1850-1910MHz, downlink: 1930-1990MHz)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	GSM CS	32.00	0.80	32.8	238.18	20	0.047	1.000	<b>PASS</b>
	1TS*(1/8)	32.00	0.80	32.8	238.18	20	0.047	1.000	<b>PASS</b>
	2TS*(2/8)	32.00	0.80	32.8	476.37	20	<b>0.095</b>	1.000	<b>PASS</b>
	3TS*(3/8)	30.00	0.80	30.8	450.85	20	0.090	1.000	<b>PASS</b>
	4TS*(4/8)	28.00	0.80	28.8	379.29	20	0.075	1.000	<b>PASS</b>
External antenna	GSM CS	32.00	0.80	32.8	238.18	20	0.047	1.000	<b>PASS</b>
	1TS*(1/8)	32.00	0.80	32.8	238.18	20	0.047	1.000	<b>PASS</b>
	2TS*(2/8)	32.00	0.80	32.8	476.37	20	<b>0.095</b>	1.000	<b>PASS</b>
	3TS*(3/8)	30.00	0.80	30.8	450.85	20	0.090	1.000	<b>PASS</b>
	4TS*(4/8)	28.00	0.80	28.8	379.29	20	0.075	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.095 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1850MHz, so we can conclude it is into compliance.



### 8.3 Operation in UMTS Band V

(uplink: 824-849MHz, downlink: 869-894MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	0.549	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	0.549	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.549mW/cm<sup>2</sup> at 824MHz, so we can conclude it is into compliance.

### 8.4 Operation in UMTS Band IV

(uplink: 1710-1755MHz, downlink: 2110-2155MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1710MHz, so we can conclude it is into compliance.



### 8.5 Operation in UMTS Band II

(uplink: 1850-1910MHz, downlink: 1930-1990MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1850MHz, so we can conclude it is into compliance.

### 8.6 Operation in LTE Band V

(uplink: 824-849MHz, downlink: 869-894MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	0.549	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	0.549	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.549mW/cm<sup>2</sup> at 824MHz, so we can conclude it is into compliance.



### 8.7 Operation in LTE Band IV

(uplink: 1710-1755MHz, downlink: 2110-2155MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1710MHz, so we can conclude it is into compliance.

### 8.8 Operation in LTE Band II

(uplink: 1850-1910MHz, downlink: 1930-1990MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1850MHz, so we can conclude it is into compliance.



### 8.9 Operation in LTE Band VII

(uplink: 2500-2570MHz, downlink: 2620-2690MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Internal antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>
External antenna	25.70	0.80	26.50	446.68	20	<b>0.089</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.089 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 2500MHz, so we can conclude it is into compliance.

### 8.10 Operation in WiFi 2.4G SISO

(uplink: 2400-2500MHz, downlink: 2400-2500MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
Antenna 1	20.70	1.50	22.20	165.96	20	<b>0.033</b>	1.000	<b>PASS</b>
Antenna 2	20.70	1.50	22.20	165.96	20	<b>0.033</b>	1.000	<b>PASS</b>

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer.

According to the Table, we can conclude the max power density level at 20 cm is 0.033 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 2400MHz, so we can conclude it is into compliance.



## 9 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table(A) and Table(B). To comply with the MPE, the fraction of the MPE in terms of  $E^2$ ,  $H^2$  (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

The product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
1	WiFi 2.4G MIMO
2	GSM/UMTS/LTE + WiFi 2.4G SISO
3	GSM/UMTS/LTE + WiFi 2.4G MIMO

Note: The LTE Internal antenna and LTE External antenna cannot transmit simultaneously.



**9.1 Estimation for WIFI 2.4G MIMO**

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
Antenna 1	20.70	1.50	22.20	165.96	20	0.033	1.000	0.066	<b>PASS</b>
Antenna 2	20.70	1.50	22.20	165.96	20	0.033	1.000		

**9.2 Estimation for GSM850 & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	GSM850	0.189	0.549	0.377	<b>PASS</b>
	WiFi 2.4G SISO	0.033	1.000		
2	GSM850	0.189	0.549	0.410	<b>PASS</b>
	WiFi MIMO with Antenna 1	0.033	1.000		
	WiFi MIMO with Antenna 2	0.033	1.000		

**9.3 Estimation for GSM1900 & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	GSM1900	0.095	1.000	0.128	<b>PASS</b>
	WiFi 2.4G SISO	0.033	1.000		
2	GSM1900	0.095	1.000	0.161	<b>PASS</b>
	WiFi MIMO with Antenna 1	0.033	1.000		
	WiFi MIMO with Antenna 2	0.033	1.000		

**9.4 Estimation for UMTS Band V & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	UMTS Band V	0.089	0.549	0.195	<b>PASS</b>
	WiFi 2.4G SISO	0.033	1.000		
2	UMTS Band V	0.089	0.549	0.228	<b>PASS</b>
	WiFi MIMO with Antenna 1	0.033	1.000		
	WiFi MIMO with Antenna 2	0.033	1.000		



**9.5 Estimation for UMTS Band IV & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	UMTS Band IV	0.089	1.000	0.122	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	UMTS Band IV	0.089	1.000	0.155	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		

**9.6 Estimation for UMTS Band II & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	UMTS Band II	0.089	1.000	0.122	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	UMTS Band II	0.089	1.000	0.155	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		

**9.7 Estimation for LTE Band V & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	LTE Band V	0.089	0.549	0.195	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	LTE Band V	0.089	0.549	0.228	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		

**9.8 Estimation for LTE Band IV & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	LTE Band IV	0.089	1.000	0.122	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	LTE Band IV	0.089	1.000	0.155	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		



**9.9 Estimation for LTE Band II & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	LTE Band II	0.089	1.000	0.122	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	LTE Band II	0.089	1.000	0.155	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		

**9.10 Estimation for LTE Band VII & WIFI 2.4G**

No.	Mode	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Calculation result	Conclusion
1	LTE Band VII	0.089	1.000	0.122	<b>PASS</b>
	WIFI 2.4G SISO	0.033	1.000		
2	LTE Band VII	0.089	1.000	0.155	<b>PASS</b>
	WIFI MIMO with Antenna 1	0.033	1.000		
	WIFI MIMO with Antenna 2	0.033	1.000		

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.

Therefore the product also meets the requirements under multiple sources condition.

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