

# **Report on Independent Verification of FWG Devices**

## **Background**

For some years now FWG has been working on a range of carbon based devices for the storage of energy. These range from high power to low energy devices with supercapacitor like behaviour to high energy battery like devices.

FWG has deliberately pursued a phased program as part of an IP protection strategy. It is the intent of FWG to 'roll out' these devices starting with a baseline device and building forward from there as we progress within the market space.

## **Testing**

### **Scope**

The testing has been limited, at this stage, to a 'phase one device' and covers the main area of concern of the deliverables of these devices.

### **Devices Tested**

5 single cell devices were tested measuring 25mm x 80mm x 0.170mm. The combined mass of the device, less the case, being 0.4g. The case has been excluded on the basis that the completed device is in a bipolar arrangement and only 1 cell per device was tested. In addition, the case was significantly overbuilt as conditions related to transport and handling that may have resulted in damage were taken into consideration.

### **Testing House**

SGS UK was selected as the test house. SGS is a world leader in testing and offers over 140 years' experience, providing a broad range of services to clients around the globe.

### **Procedures**

Procedures were carried out in accordance with various aspects of protocols contained in the EU Draft White Paper for Test methods for improved battery cell understanding - Version 3.0

### **Results**

The results as per the SGS test report, attached, indicate the energy density of the device as being 53.31 Wh/kg

## **Conclusion**

FWG recognise the limit of the report and that further testing and certifications are needed. These results were looked for as a first important milestone and were dictated by economic considerations. More expansive characterisation is needed.

### Table of Normalised Results

Sample number	Discharge Capacity mAh	Mass of device g	Device voltage v	Device Energy mWh	Device energy normalised to mass mWh/g
1	19.97	0.34	1.8	17.97	52.22
2	22.13	0.37	1.8	19.92	54.14
3	22.03	0.37	1.8	19.83	53.24
4	21.29	0.36	1.8	19.16	53.72
5	21.21	0.36	1.8	19.09	53.26
		Average		<u>19.19</u>	<u>53.31</u>

Notes:

- 1 extended sigmoid discharge curve was noted
- 2 calculated energy assumed linear discharge voltage

**Test Report****Report No.: SZES191001599901****Date: 2019-11-29**

Applicant : FWG Ltd.  
Unit 4/5 City Business Park, Nrashwood Close, Canterbury, Kent, England. CT1 1DX  
FWG Ltd.

Manufacturer: FWG Ltd.  
Unit 4/5 City Business Park, Nrashwood Close, Canterbury, Kent, England. CT1 1DX

Factory: FWG Ltd.  
Unit 4/5 City Business Park, Nrashwood Close, Canterbury, Kent, England. CT1 1DX

Test object / Model : Supercapacitor Cell / --

Test specifications / Commission test according to applicant's requirement  
Test standard:

Purpose of examination: Test according to the test specification provided by applicant.

Test result/ Conclusion: See the below pages for detail

Remark: Test results reported relate only to the items being tested.

Jerry Xiao  
Project Reviewer  
Safety Laboratory

Sunny Guan  
Project Engineer



SGS-CSTC Standards Technical Services Co., Ltd.  
Shenzhen Branch Inspection & Testing Laboratory

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No.1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, China 518057 t (86-755) 26012053 f (86-755) 26710594 www.sgs.com.cn  
中国·深圳·科技园中区M-10栋一号厂房 邮编: 518057 t (86-755) 26012053 f (86-755) 26710594 sgs.china@sgs.com

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**Test Report**

**Report No.: SZES191001599901**

**Date: 2019-11-29**

**1. General product description:**

Supercapacitor Cell

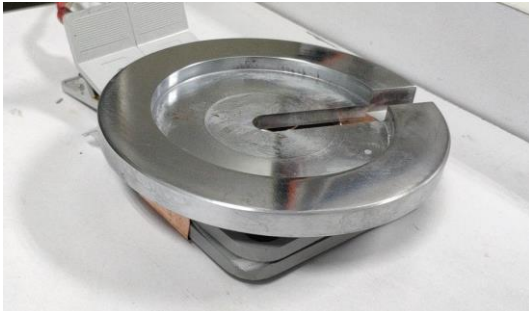
**2. Test description:**

Possible test case verdicts:

- test case does not apply to the test object: N/A (Not Applicable)
- test object does meet the requirement: P (Pass)
- test object does not meet the requirement: F (Fail)

The tests were done in the Electrical Safety Laboratory of SGS-CSTC in Shenzhen.  
 Test item was received on 2019-10-11  
 Tests were performed from 2019-10-11 to 2019-10-30.

**3. Test procedure and results:**

Test method:		
DUT is charge by using the charging voltage 1.8V and charging current of 0.1A, until the charging current to 0.0025A. And then discharge at constant current of 0.04A down to a specified final voltage of 0V. Record to open voltage and discharge capacity.		
Test result:		
Sample No.	Open voltage	Discharge Capacity
#1	0,000 V	19,97 mAh
#2	0,033 V	22,13 mAh
#3	0,023 V	22,03 mAh
#4	0,110 V	21,29 mAh
#5	0,125 V	21,21 mAh
DUT setup:		
		



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**NOTES TO THIS TEST REPORT**

1. The following language(s) of marking(s) and instruction sheets were submitted during the test application:
  - English
  - Throughout this report a comma is used as the decimal separator.

According to the standard, instruction sheets and other texts required by the standard should be written in the official language(s) of the country in which the product is to be sold. The applicant should ensure that the product in future production fulfils the receptive standard requirements.

2. The components performed satisfactorily during testing and are considered to be suitable for use in the sample tested. Acceptances of the safety critical components and materials were based on:
  - the certification record(s) and/or test report submitted by the applicant; or
  - component / material tested with the appliance

--- End of Report ---



SGS-CSTC Standards Technical Services Co., Ltd.  
Shenzhen Branch Inspection & Testing Laboratory

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