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.

Prepared 29.11.2019

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		19.19	53.31

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

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Test Report **Report No.: SZES191001599901**
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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:

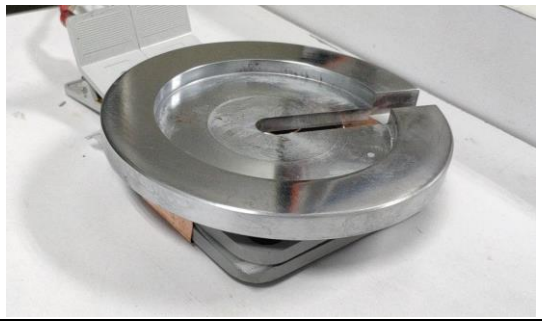
Test method:

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 ---

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