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Performance of SK-Ecat prototype on a six hours period.

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Abstract

As part of the contract between the Department of Physics and Leonardo Corporation have been carried out some measurements of the performance of an SK-Ecat prototype. This technical report contains the results of the measures done on this prototype and should be used in the internal R&D process of Leonardo Corporation and does not constitute an industrial certification.

1 Introduction

The prototype under review (See figure 1) was looking like small white box with a square base with side 7 cm and 9 cm in height was superimposed on another silver parallelepiped, with base 9 x 7 cm and height 2. Some wires entered in the upper part and two groups of cables, red and black came out of the lower one. The weight of the whole prototype was about 250g. It was not possible to inspect the inside, but it was observed that during operation, cold white light came out of the base.

The prototype was connected to several control electronics boards that were powered by a grid-connected power supply.

Wires outgoing from the system were connected directly to a load resistor cooled in an insulating oil bath. The load resistor was a commercial type model "Arcol 21.10 GB HS 150 1 R J".[3]

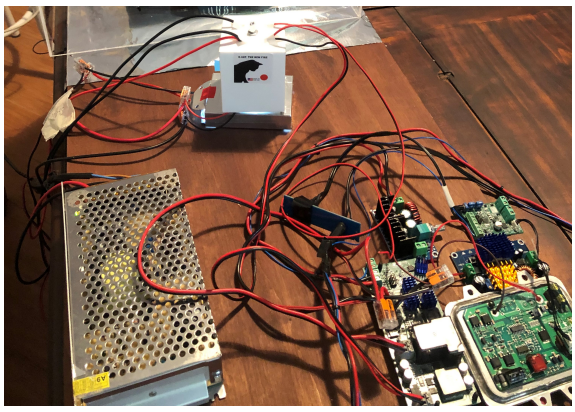

Figure 1: Image of the SkEcat prototype with the control electronics and the power supply.

2 Measures

The measurements that were made involved the power input and output from the system. Input power was measured directly from the 220V 50Hz outlet using an industrial power meter. Output power measurements were made using a high-precision FLUKE 189 multimeter. [1] A second multimeter, with a lower accuracy was used occasionally for checking and gave results perfectly

compatible with the first one. The first measurement that was made was the actual value of the load resistance.

Measure	Value	Unit
Cables resistance	0.4	Ω
Total resistance	1.4	Ω
Load resistance	1.0 +/- 0.2	Ω

Table 1: Measure of the load resistance a value of 1Ω that matches the nominal value of the resistor.

Given the low value of the load resistance it was decided not to introduce an ammeter in series to the circuit in order not to affect the experimental conditions. From the measurement of the voltage drop at the resistor terminals the current and power dissipation can be easily obtained.

The input power, measured using an industrial wattmeter[2], was measured first by disconnecting the apparatus from the power supply and then with the apparatus on so that losses due to the power supply could be subtracted. Surprisingly, it was found that the net absorption was too low to be measured being less than the sensitivity of the instrument.

During the functioning of the apparatus the wattmeter has always been in operation reporting a constant power absorption.

Measure	Value	Unit	Cos Φ
No-load power	0.8	W	0.05
Power in operation	0.6	W	0.06

Table 2: Measurement of the power absorbed by the prototype. The power was too low to be measured by the industrial wattmeter used. Considering the precision of the wattmeter used the two values are compatible.

The potential drop at the ends of the resistor was measured continuously throughout the measurements for a period of about six hours. A small potential drop at the ends of the resistor was measured even with the apparatus turned off.

Measure	Value	Unit
Voltage drop (11.10)	11.4	V
Voltage drop (11.50)	11.6	V
Voltage drop (12.15)	11.7	V
Voltage drop (14.32)	11.7	V
Voltage drop (16.02)	11.7	V
Voltage drop (17.12)	11.7	V
Off Voltage	≈ 0.12	V

Table 3: Voltage drop at the resistor leads for Ecat SKL. The value was almost constant during the measure period. Six data points are reported. The instrument precision was 1mV. A small dependence of the measure on the ambient light was noted.

3 Final considerations

The prototype under examination seem to generate a power of about 100W while absorbing less then 1W. The origin of the emitted power is unknown to the author of this report. As it appears from the measurements made a total of $\approx 624Wh$ of energy was produced. Noting then that the total volume is $567cm^3 = 0.563L$ and the total weight is about 250g it can be found that the energy density of the prototype seem to exceed the gravimetric and volumentric energy densities of known batteries[4].

Declaration of no Conflict of Interest

The author declares that there is no potential conflict of interest or any relationship of a financial or personal nature with any person, firm, or organization that would inappropriately influence the conduct and results of this work.

References

[1] FLUKE. *187-189 User Manual*. URL: https://dam-assets.fluke.com/s3fs-public/187_189_umita0200.pdf. (accessed: 03.11.2021).

[2] handsontec. *D52-2047 User Manual*. URL: https://www.handsontec.com/dataspecs/Instruments/DIN%20Rail%20Power%20Meter.pdf. (accessed: 19.07.2021).

[3] RS. *Resistor data sheet*. URL: https://docs.rs-online.com/8b3e/0900766b815a22a3.pdf. (accessed: 03.11.2021).

[4] University of Washington. *Li-Ion Batteries*. URL: https://www.cei.washington.edu/education/science-of-solar/battery-technology/. (accessed: 08.11.2021).

A Photos of the SKL Ecat at the measure site.

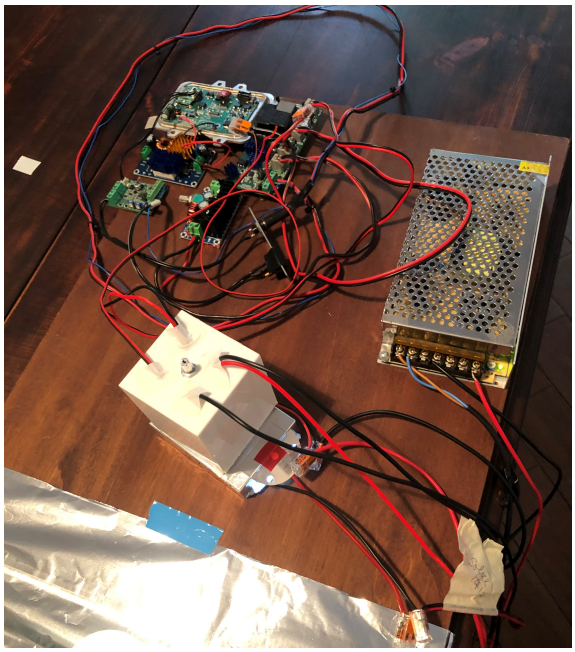

Figure 2: Image of the SkEcat prototype with the control electronics and the power supply.

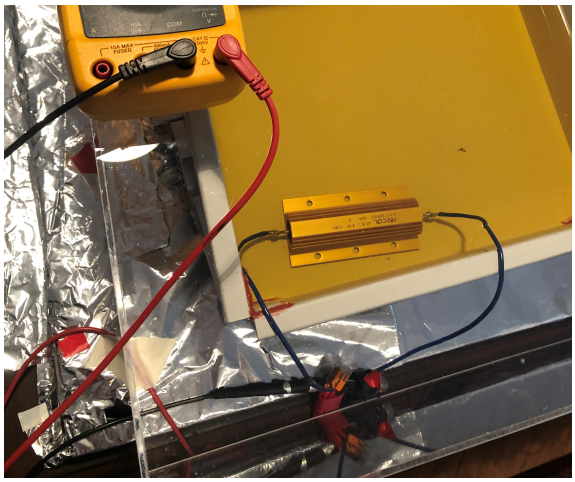

Figure 3: The load resistor in the oil bath.

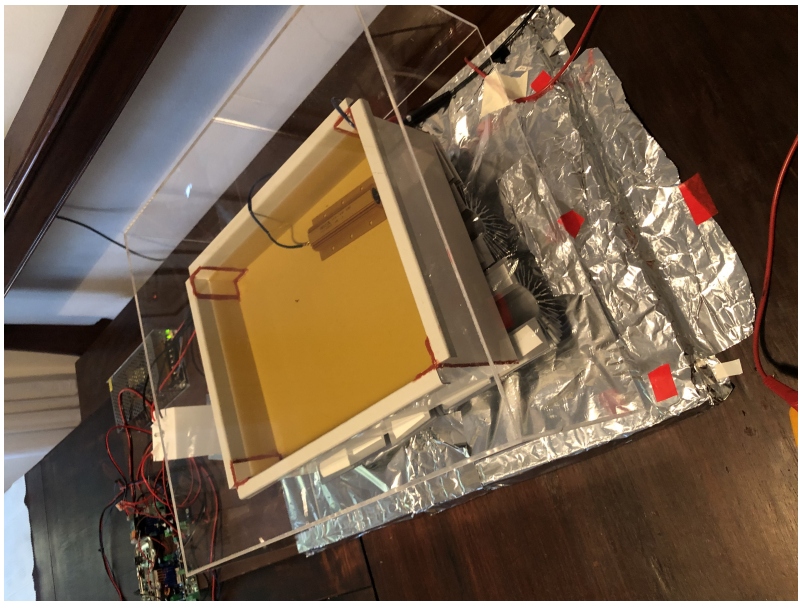

Figure 4: An overview of the setup.