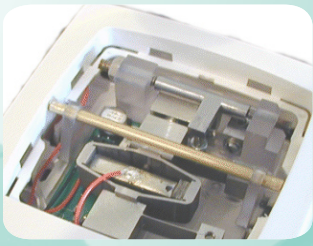


Shock Energy Harvesting SEH-APA60SM



Objective

Mechanical energy can be transformed into electrical energy thanks to the direct piezoelectric effect. CEDRAT TECHNOLOGIES has developed a complete mechanism based on the APA 60 SM actuator and on an optimized rectifier to produce electrical energy from a **mechanical shock**. When pressed by a finger, this mechanism produces enough electricity to supply an RF transmitter.

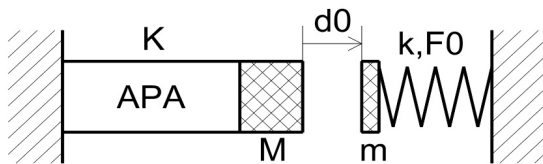


Figure 1: Scheme of the system.

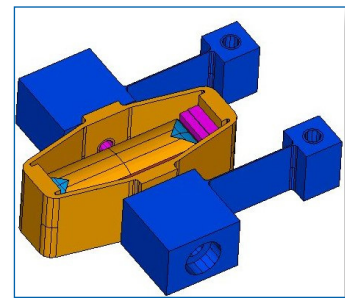


Figure 2: APA 60SM with leads.

Description

The mechanism is made of an APA 60 SM, a hammer, a spring and a detent. Thanks to their high energy density, their reliability, and their tuneable stiffness, APA[®] actuators are definitely suitable for shock energy harvesting.

The complete mechanism action can be divided into three phases:

- First, at the beginning of the movement, the spring is bent thanks to the detent mechanism.
- Second, once it is bent enough, the spring unbends, speeding up the hammer which shocks the APA[®]. This indirect principle was preferred to a direct shock in order to control the amount of mechanical energy transferred to the APA[®] actuator. The goal is to increase reliability and performances.
- Because of the shock, the APA[®], which is in a free-free configuration, vibrates like a diapason. These vibrations generate oscillating forces on the piezo-ceramic stack. The free-free assembly was chosen to apply maximal forces and strain on the ceramic. These oscillating strains on the ceramic generate AC voltage, which is adapted by a rectifier to supply a RF transmitter in this application.

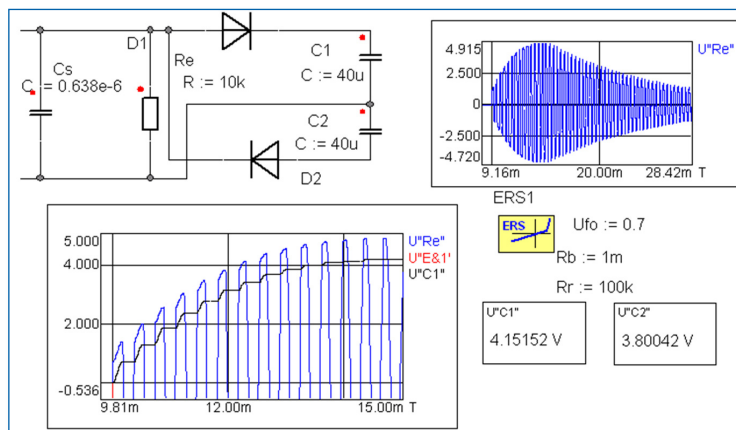
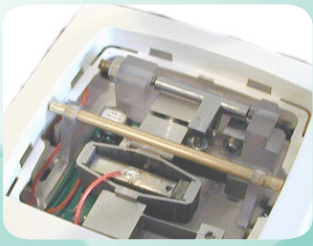


Figure 3: Simulation with electronic.

Shock Energy Harvesting SEH-APA60SM



Experimental result

The experimental results complied with the expectations. The SEH-APA 60SM enables an energy transfer during more than 40 ms. The first shock is followed by rebounds that improve the overall efficiency. The synchronicity between these rebounds and the voltage decrease is optimized in order to reduce peak to peak voltage.

Performances

References	Unit	APA60SM based SEH system
Technological baseligne		APA60SM
Bend force	N	3,25
Hammer stroke	mm	1
Storage energy	mJ	1,7
Maximal voltage	V	2,08
Load supply duration (U>1V)	ms	40

Table 1: Characteristics of the SEH-APA 60SM.

Remarks

- CEDRAT TECHNOLOGIES can develop specific SEH mechanisms to fulfill specific requirements,
- CEDRAT TECHNOLOGIES designs specific rectifiers optimized for such application.
- High efficiency energy harvesting is possible using resonant system, see "Vibration energy harvesting" technological leaflet.

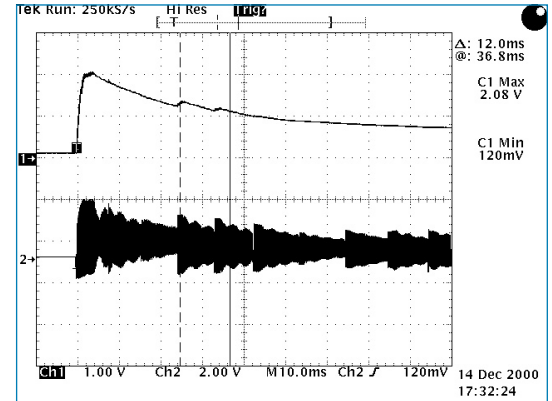


Figure 4: Output voltage, the effect of the rebounds are clearly visible.

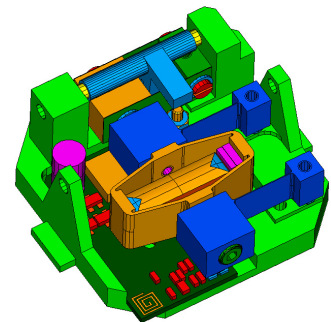


Figure 5: CAD drawing of SEH-APA 60SM.

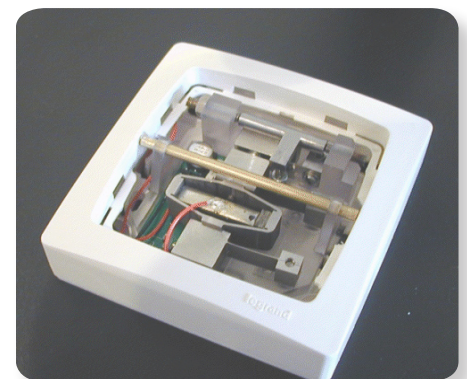


Figure 6: Complete mechanism set up in a switch (Courtesy of Legrand).

For more information, please contact:

CEDRAT TECHNOLOGIES
15 Chemin de Malacher - Inovalée
38246 Meylan Cedex - France
actuator@cedrat.com
Phone: +33 (0)4 76 90 50 45 - Fax: +33 (0)4 56 38 08 30