

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.

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 prefered 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.

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

Fig. 1: APA 60SM with leads.



Fig. 2: Scheme of the system.



Fig. 3: Simulation with electronic.



rebounds are clearly visible.

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EXPERIMENTAL RESULT



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PERFORMANCES

REFERENCES	UNIT	APA60SM BASED SEH SUSTEM
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



Fig. 5: CAD drawing of 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.



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