Battery-less Energy Harvester
The SAFA9-OEMG

- **Remote Control applications without Batteries.**
- **Supplied ready to use; with optional AC or regulated DC outputs.**
- **SAFA (Slow Action Fast Action) system of generator operation.**
- **No mechanical springs; operation based on magnetic force field spring-like action for spherical generator magnet angular displacement.**

Description

The SAFA9-OEMG series of battery–less generators operate at an average mechanical resonant frequency of 420 rads/sec., generating a damped sinewave of 67 Hertz. There are no mechanical springs and the generator's spherical rotatable magnet is held stationary until displacement, into either slow action or fast action, when 'trip trigger' action is actuated.

How it works

Description of operation…..The Transmitter.

The energy harvester uses DEAK/ISM ENIGMA patented technology to provide a simple and reliable power generator connected to an RFS (RF Solutions, Ltd.) RF Transmitter which transmits a 433 MHz unique data transmission on each press of the switch.
The unit is completely self contained and requires no connections or servicing.

The SAFA9-OEMG series are new types of energy harvesting generators. Their method of generating electrical energy is based on a class of homogeneous second order differential equations. The sinusoidal waveform rings down under the influence of the exponential variation of the base of the natural logarithmic system. See (Fig. 1). By definition the generator is also seen as a mechanical oscillator and this mechanical oscillation that in turn produces the damped sinewave is controlled by magnetic spring (*no mechanical springs used*) action between the spherical generator rotatable magnet and the adjacent focus magnet set.

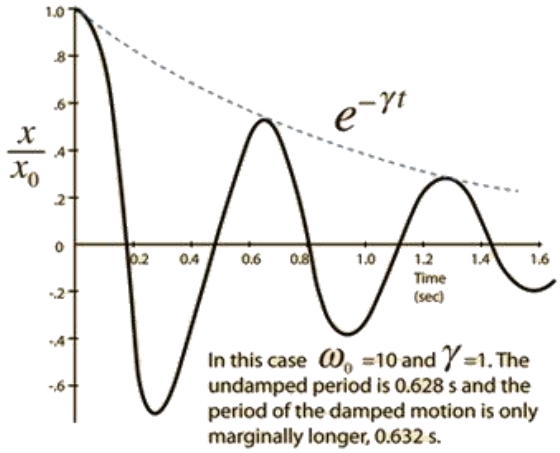
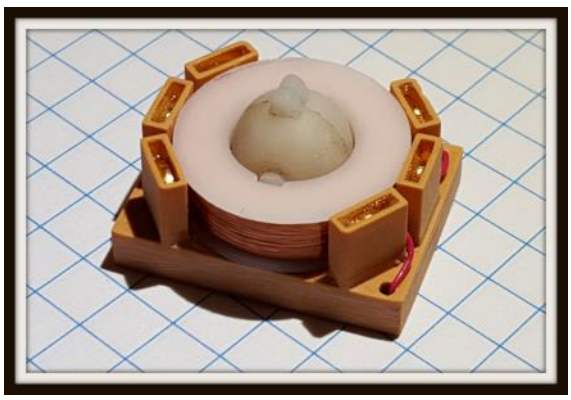
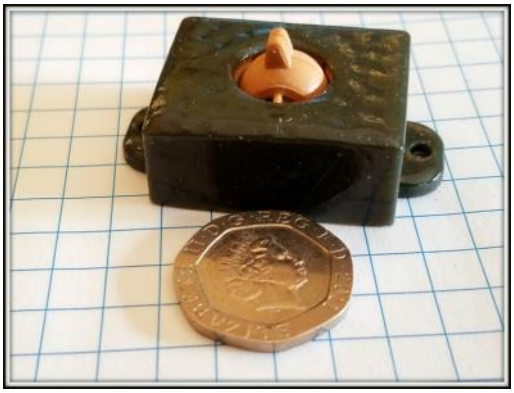


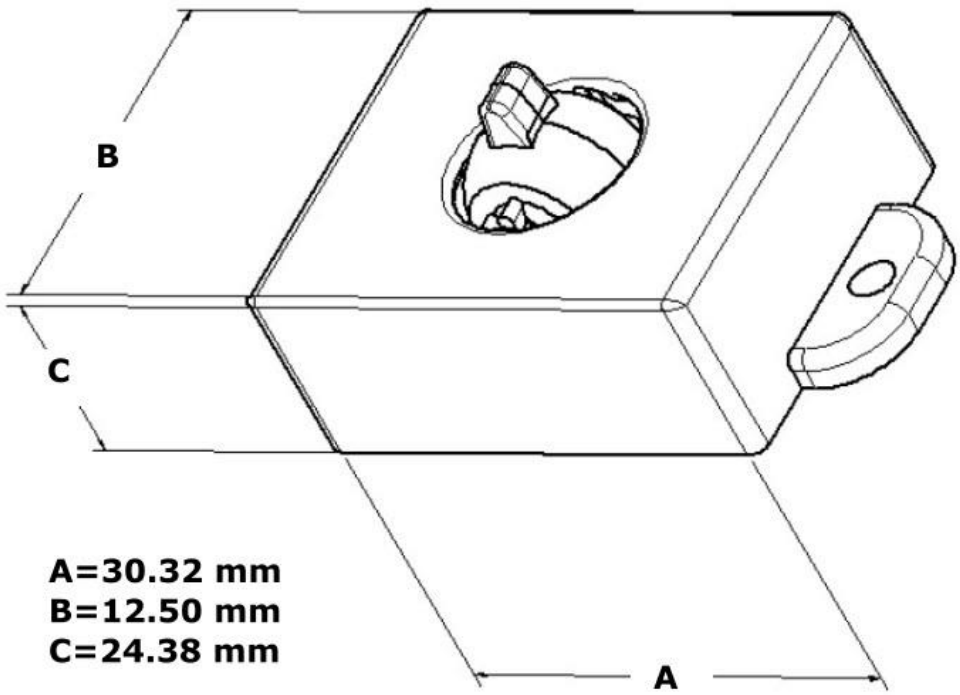
Fig. 1

The resulting electrical energy output is that of a damped sinusoidal waveform (Fig. 2); the same type of waveform for the motion of a pendulum, a swing, a spring, and a bouncing ball.





Mechanical Dimensions



Power Output of the SAFA9 Energy Harvesting Generator is 10 milliwatts (dummy load of 100 Ohms); 3.3Vdc @ max 0.030 Amps. (regulated on trans-mitter board).

The SAFA9 Energy Harvesting Generator AC output with ring down time to 2 volts of 300 milliseconds.

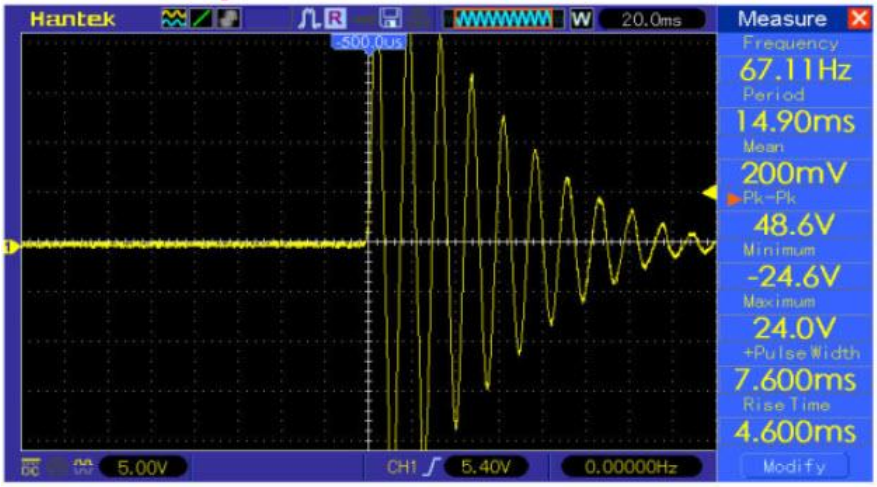


Fig. 2

Technical Specifications:

Operating temperature: -25 - 70°C
Storage Temperature: -25 - 85°C

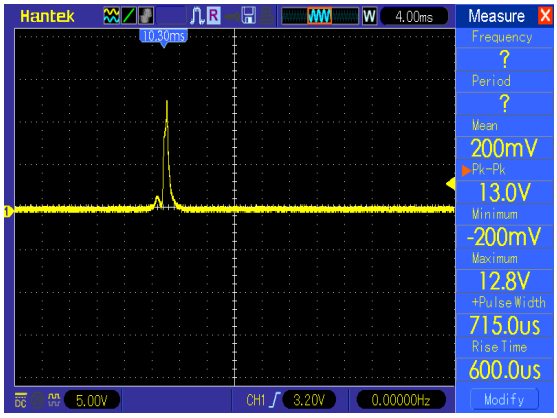
SAFA9-OEMG Output

Electrical Characteristics SAFA9 Energy Harvesting generator (regulated on transmitter)	Min	Typical	Max	Units
Peak Voltage Generated @ 67 Hertz		24		Vac (damped)
DC voltage generated by optional regulator		3.3		Vdc
Time of Voltage Out to 2 Vac ring down		300		mSecs
Time of regulated 3.3 Voltage Out		120		mSecs
Operating Force		2		N

Appendix: A Comparison of Energy Harvesters

Currently, there are several suppliers of energy harvesting products; Comepi, ISM ENIGMA/RF ENIGMA, Enocean, and Cherry considered in this comparison.
The RF ENIGMA and Comepi systems produce most power (See Fig. 2), as a comparison we have measured the Enocean and Cherry energy outputs and shown them below as a direct comparison.

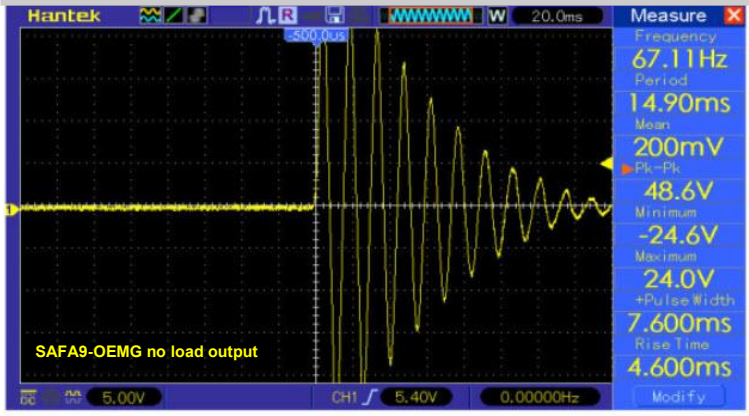
Enocean PTM210 output

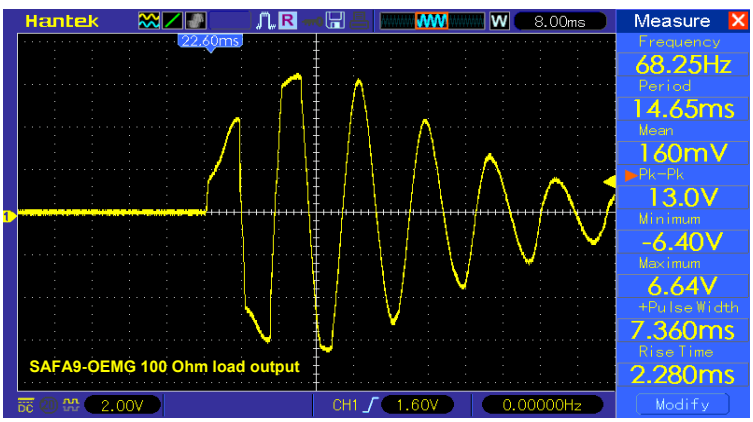


Cherry AFIS Energy Output

The following table provides a comparison of each of the technologies and performances

SAFA9-OEMG no load and 100 Ohm load output





KAPRION Transmitters
FSK Modules

FEATURES:

- **FM Radio Transmitters**
- **Available 433/868 MHz**
- **Transmit Range up to 250 meters**
- **Miniature Package**
- **No adjustable Components**
- **Very Stable Operating Frequency**
- **Operates at –20 to +85°C**
- **EMC Compliant for use in Europe**
- **FCC Compliant for use in USA (Currently being certified)**

Applications

- **Wireless Security Systems**
- **Car Alarms**
- **Remote Gate Controls**
- **Remote Sensing**
- **Data Capture**

Description:

These miniature RF modules provide a cost effective high performance FM Radio data link at 433.92MHz. The modules uses no adjustable components ensuring very reliable operation.

These modules have been designed specifically to be powered from Energy Harvesting Generators because of their small size and low power requirements they use a high speed proprietary RF Protocol to provide a reliable RF Link.

This transmitter and receiver pair enables the simple implementation of a data link at distances up to 75 metres in-building and 250 metres open ground.

The modules have been approved for operation with Europe and USA within FCC part 15.