

# Vibration Energy Harvesting Education Kit

Energy harvesting from ambient vibrations can be used to supply wireless sensors nodes, eliminating the need for batteries. Spring-mass-damper systems driven at resonance are commonly used to boost the external vibration displacement and hence to generate reasonable output power levels in the milliwatt range. Since the quality factor of the generator should be high in order to achieve a high output power, it is mandatory to tune the resonant frequency of the generator to the frequency of the external vibration, otherwise the output power drops significantly.

The presented vibration harvester education kit helps understanding (i) the resonance characteristics of general spring-mass-damper systems and (ii) the electrical characteristics of the corresponding transduction mechanism. The inductive conversion principle has been chosen due to its robustness and the potential to provide an output power in the milliwatt range.

Fig. 1 shows the assembled harvester without top cover. Since the resonant frequency of the mechanical system depends on the spring constant and the mass, these two parameters can be changed individually. Three



Fig. 1: Inductive energy harvesting system for educational and research purposes

## Technical Specification

- Eigen-frequency adjustable in 9 discrete steps: 25 - 70 Hz
- Integrated power management
- Buffer capacitance: 100  $\mu\text{F}$
- Regulated output: 3.3 V
- Minimum load for stable output voltage: 9 k $\Omega$
- Power output: 1.2 mW
- Excitation amplitude: 2  $\text{m/s}^2$

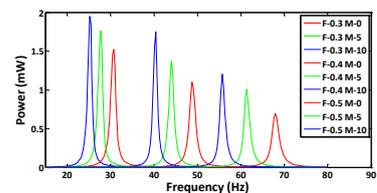


Fig. 2: Adjustable Eigen-frequency

springs with thicknesses of 0.3 mm, 0.4 mm and 0.5 mm and two additional masses of 5 g and 10 g allow nine different resonant frequencies ranging from 25 Hz to 70 Hz (Fig. 2).

The integrated power management board includes several

switches, a standard micro USB connector, a rectifier, a 100- $\mu\text{F}$  buffer capacitor and a charge pump providing a regulated 3.3 V output voltage. Via three individual switches, it is possible to observe the voltage at different nodes (coil, rectifier, buffer and charge pump).