

Energy Harvester

Converts low-level vibrations into usable electricity.

Ferro Solutions has developed novel energy harvesting devices based on unique combinations of magnetic materials and patent-pending designs. In many cases, energy harvesters can take the place of batteries and eliminate the need for costly labor to replace batteries. Ferro Solutions' energy harvesters are capable of creating usable electricity from low-level vibrations, power that is sufficient to run sensors, RF transmitters, micro-motors, and other electrical devices.

The FS Energy Harvester (FSEH) is a **remote, independent power source** that never needs to be replaced. It can be used in any device or environment that has vibrations or a changing magnetic field. Because the harvesters are so sensitive and efficient, they can generate electricity from vibrations that are barely noticeable to the human touch. When not used immediately, this electricity can be stored in a super capacitor for use at a later time. This means that the FS Energy Harvester can replace batteries in many situations by providing devices with a **continuous, nearly endless supply of electricity**.

FS Energy Harvesters provide power for wireless transceivers, sensors, and other electronic devices in many applications, including:

- Equipment Health Monitoring
- Building & Process Automation
- Metering & Utilities
- Transportation (Rail, Trucking, Shipping)
- Automobiles
- HVAC

Use the FS Energy Harvester where you are using or considering the use of wireless technologies to greatly reduce the total cost of ownership by eliminating the labor needed to replace batteries. These characteristics of the FSEH provide **savings for the end-user** and a **new degree of freedom to designers and product engineers**.

Specific applications for the FSEH include powering duct-mounted or machine-mounted sensors and wireless transmitters in HVAC or automation systems, powering devices in automobiles, trucks, or trains, and powering remote colonies of sensors and wireless transmitters in aircraft and ships. FS Energy Harvesters can also be used in flow meters and can be embedded in heavy machinery to power sensors and transmitters of diagnostic data.

The US Navy funded initial research for the FSEH and is interested in its further development to power a new type of wireless Health Monitoring System for their ships and submarines that is cost effective, easy to install and easy to maintain.

Output

While other energy harvesting devices exist, FS is the first to generate milliWatts of power from input vibrations of a few tens of milli-*g* with a device the size of a pack of gum. Competitors generate microwatts from a similar size device, meaning we generate 10 to 100 times the power with the same input energy.

The current FSEH generates 9.3 mW from a cylinder measuring approximately 1.8 inches in diameter and height. Input vibrations are measured as *g* where 1*g* is equal to the force of the earth's gravity. Tapping on a table creates small vibrations that become recognizable to the human touch at approximately 0.02 *g*, or 20 milli-*g*.

Input Vibrations at 21 Hz	Power Output in milliWatts
20 milli- <i>g</i>	0.4 mW
50 milli- <i>g</i>	2.4 mW
100 milli- <i>g</i>	9.3 mW

In an environment with vibrations of 21 Hz and 100 milli-*g*, the current FSEH has an energy density of 2.0 mW per cubic inch. Doubling the volume of the

device will double the power created. Power output scales linearly with increased vibration frequency and quadratically with increased acceleration (*g*).

Energy density can be improved by designing a harvester for your specific device and operating environment.

Factors to consider when discussing your energy harvester needs include the power requirements of your devices, the space available at your device location, and the cycle of the available vibrations.

Ferro Solutions is poised to play a key role in the technologies that will insure increased safety, security and reliability for systems in the 21st century. Talk to Ferro Solutions about designing an Energy Harvester to help increase your cost-effectiveness, flexibility and competitive advantage.

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