



INDUSTRIAL TECHNOLOGIES PROGRAM

Low-Cost Vibration Power Harvesting for Wireless Sensors

Vibration power empowers wireless networks to boost industrial productivity

A new device can harness the vibration energy from a host structure and provide DC power to existing industrial wireless sensors – eliminating the need for batteries. Through a DOE Small Business Innovation Research (SBIR) grant, KCF Technologies developed this vibration power harvesting device that is now available in the Power Harvesting Demonstration Pack WSK100. The device essentially functions as a self-charging power source with unlimited service life, which will greatly expand the use of wireless sensors throughout U.S. industry.

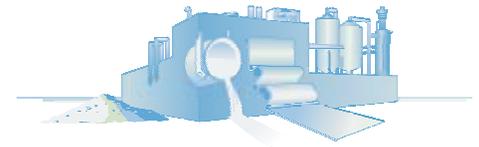
The industrial market for wireless sensors is growing rapidly but may be constrained by implementation costs and compatibility with

existing wireless networks. Typical wireless sensors and transmitters depend on batteries, which results in periodic maintenance to change the battery. Maintenance costs for battery use in wireless sensor applications are estimated at \$80-\$500 per replacement, including labor, which exceeds the sensor's cost.

KCF Technologies' innovation was recognized with a "Best of Sensors Expo" Award in 2008. The harvester-powered sensor was honored as one of the most promising and exciting technologies on display out of nearly 200 products at the annual Sensors Expo & Conference in Rosemont, IL.



Power harvesting is an enabling technology for some wireless sensor applications, particularly where batteries are undesirable. Size: Ø63 x 67 mm cylinder.



Benefits for Our Industry and Our Nation

- Reduces life-cycle costs 70% by eliminating wires and batteries
- Reduces sensor installation costs by an estimated \$1,000 to \$3,000
- Provides a service life of about 15 years
- Compatible with existing wireless sensors
- Eliminates downtime and costs associated with battery maintenance
- Enables sensor placement in infrequently accessed locations
- Expands sensing capabilities for machinery and equipment to increase safety and security
- Harnesses power from low vibration levels
- Increases data transmission capabilities for wireless sensors in high-vibration settings
- Reduces industrial pollution via continuous wireless sensing in harsh environments

Applications in Our Nation's Industry

- Pulp processing and paper printing
- Condition Based Maintenance (CBM)
- Diagnostics in industrial power generation and transmission systems, chemical processing plants, and production assembly lines
- Monitoring building and transportation system environments
- Refrigeration and HVAC systems
- Power generation facilities

Project Description

KCF Technologies developed an alternative to finite-life batteries for powering existing wireless sensor networks. The technology harvests energy from industrial vibrations and eliminates the costs of battery replacement, maintenance, and downtime.

Barriers

This research project overcame several technical hurdles, including:

- Lowering the cost of the vibration power-harvesting device
- Supplying sufficient power for existing wireless sensors
- Ensuring the technology was not overly sensitive to vibration frequency or amplitude

Results

The vibration power harvesting research project delivered stand-alone energy harvesting circuits and devices for specific industrial wireless node applications. The vibration power harvester is incorporated into KCF Technologies Power Harvesting Demonstration Pack, which includes:

- Set of three wireless sensor nodes with integrated vibration power harvesters; sensor board with onboard temperature, acceleration, and super capacitor voltage sensors; and 5V ratiometric external pressure sensor
- USB dongle that receives and transmits data from the sensor network to host computer
- Ultra-compact touchscreen PC with installed software for out-of-the-box operation

Commercialization

The vibration power harvester developed through the DOE SBIR grant is now commercially available as part of the KCF Technologies Power Harvesting Demonstration Pack. The market for this new technology is expected to grow proportionally with the expanding wireless sensor market.

Project Partners

KCF Technologies
(Lead Research Organization)
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Penn State University
State College, PA

RLW, Inc.
State College, PA

York Johnson Controls
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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

POWER OUTPUT - VPH100				POWER OUTPUT - VPH300			
CHARACTERISTIC		TYPE	UNIT	CHARACTERISTIC		TYPE	UNIT
0.3 mm/s @ 120HZ 0.023 g	Center	0.1	mW	0.3 mm/s @ 360HZ 0.072 g	Center	0.3	mW
	50% Power BW	0.6	Hz		50% Power BW	1.5	Hz
0.5 mm/s @ 120 Hz 0.039 g	Center	0.3	mW	0.5 mm/s @ 360 Hz 0.120 g	Center	1.6	mW
	50% Power BW	0.8	Hz		50% Power BW	2.5	Hz
1.0 mm/s @ 120 Hz 0.077 g	Center	1.5	mW	1.0 mm/s @ 360 Hz 0.239 g	Center	4.1	mW
	50% Power BW	1.1	Hz		50% Power BW	5.0	Hz

Detailed specifications for user-selected frequency ranges

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