

BROADBAND VIBRATIONAL ENERGY HARVESTERS

Power your sensors without wires or batteries

Get Data From Anywhere There are Vibrations

The modern world runs on data. But getting power to the sensors that collect data from the physical world has been a barrier to the “smartness” of our machines and our cities. Running wires is often unfeasible. And batteries remain the costliest form of energy, and require frequent replacement.

Pyro-E AMPS™ (Auto-Modulating Power Source) piezoelectric vibrational energy harvesters solve the sensor power problem, creating power almost anywhere vibrations exist. The first and only device that can harvest vibrational energy across a broad frequency band, AMPS delivers more power more reliably than any other technology at a fraction of the cost of battery power.

The Broadband Breakthrough

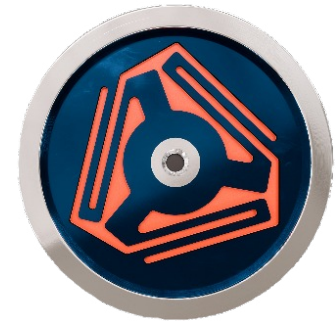
AMPS’ patented broadband harvesters produce more than 10 times the power of competitive devices in any environment.

Where other devices only capture vibrational energy directly around a resonant frequency, AMPS non-linear vibration amplifiers capture energy in a wide band around the resonant frequency, yielding an order of magnitude more energy to convert to electricity.

The AMPS power management circuitry uses multiple power point tracking (MPPT) and other proprietary circuits to convert the harvested vibrational energy into electrical power with an ultra-high 78-82% efficiency – three times more efficient than competitive chipsets. The result: more power when and where you need it, and lots of it.

Beyond Sensors

A single AMPS is the ideal battery replacement for sensors and other devices excited by vibration or fluid flow. Combine multiple AMPS and you can generate power in the kilowatt to megawatt range using energy from the wind, waves, and vehicles.



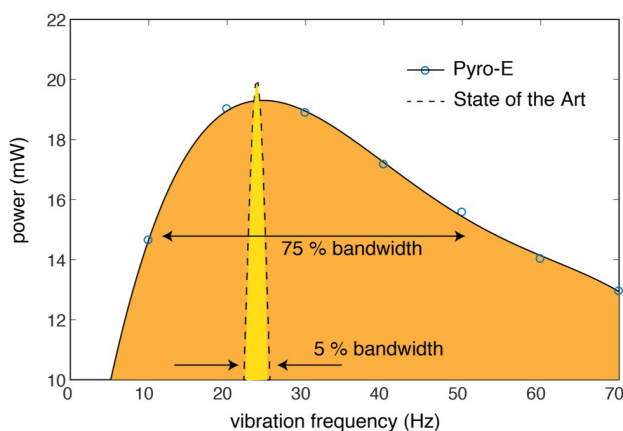
Pyro-E AMPS™ (Auto-Modulating Power Source) efficiently harvests vibrational energy to deliver power to your devices for 10+ years.

AMPS: THE NEXT GENERATION OF POWER

- 1/20th the cost of batteries
- Small size and low mass
- 10+ year lifetime
- High peak current
- Selectable output
- Temperature tolerant
- Ruggedized
- Lubricant-free

Use AMPS-powered sensors to:

- Lower maintenance costs
- Increase visibility into asset health
- Better forecast parts and labor needs
- Reduce unplanned downtime
- Save on energy costs
- Reduce your carbon footprint



Pyro-E energy harvesters can harvest vibrational energy across a wide bandwidth spectrum, delivering more power more reliably than the previous state of the art.

AMPS Specifications

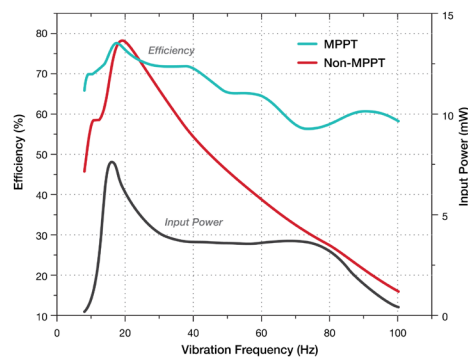
Physical Specifications*	AMPS-S	AMPS-L
Mass (g)	30	150
Height (in/cm)	1.3 / 3.3	2.1 / 5.3
Diameter (in/cm)	2.0 / 5.1	3.2 / 8.1
Force Limit (N)	100	300
Maximum Temperature (°F/C)	250 / 121	250 / 121
Impact at break (g)	20	20
Water resistance	IP67	IP67
Operating life (cycles)	1 million	1 million
Operating life (yrs)	10	10
Shelf life (yrs)	20	20
Case Material	SS304	SS304
Performance Specifications*	AMPS-S	AMPS-L
Nominal power (mW)	20	200
Nominal frequency (Hz)	350	420
Peak Current (A)	0.5	1,2
Voltage (V)	2.5 -4.2	2.5 -4.2

*Specifications shown are per device; you can deploy multiple AMPS to attain larger power outputs. We can custom-design AMPS harvesters to match your unique specifications; please contact us to learn more.

Comparison: AMPS vs. Lithium-Ion Batteries

Pyro-E AMPS energy harvesters offer a superior alternative to batteries for most applications, offering much lower costs and eliminating the need for frequent battery replacement.

Performance	AA Li-ion Battery	Pyro-E AMPS
Energy Source	Chemical Storage	Vibration
Capacity @ 1.8V	3500 mAh	600 mAh/day
Capacity @ 3.3V	1900 mAh	363 mAh/day
Life @ 10mA	350 hours	10+ years
Life @ 100mA	40 hours	10+ years



AMPS' Maximum Power Point Tracking provides high-efficiency power generation across a wide band of vibrational frequencies.

From Vision to Design in 60 Days



AMPS devices are highly customizable to optimize power generation for a wide variety of use cases. We can deliver your AMPS solution as a standalone device or work with your team to develop a complete integrated and certified solution incorporating your sensors or other devices into the desired form factor. In most cases, we can deliver a working product for your evaluation within 60 days of receiving your initial vibrational energy waveforms.

Interested in how much energy you could reclaim from the vibrations of your machine or location? E-mail us a representative excitation waveform, and we will return a full energy report within 3 business days. For more information on how to use AMPS in your product or project, contact us at info@pyro-e.com, call us at +1 (510) 578-8849, or visit www.pyro-e.com.

About Pyro-E

Pyro-E designs and deploys solid-state technologies for energy harvesting applications. The company's AMPS™ (Auto-Modulating Power Supply) products give engineers and builders the ability to power sensors and other devices for ten or more years without wires or batteries, by harnessing the natural and manmade vibrations all around us. By providing businesses, government and researchers the ability to collect more data using reclaimed energy, Pyro-E is helping build a better understanding of our world. Founded in 2012 by CEO Kevin Lu, PhD, Pyro-E has brought together experts in materials science, fluid dynamics, power electronics and mechanical engineering to develop its patented technologies.