XIDAS IOT

VP3 Vibration Perpetual Power Pod

Vibration-based energy harvesting battery

With significant funding from the US National Science Foundation, Xidas IoT introduces the everlasting IoT battery solution.

This perpetual power pod integrates energy harvesting technology that captures the energy from small vibrations in the environment (such as industrial machinery) and converts it into electrical power that trickle charges a specialized on-board battery. Through disruptive electromagnetic transducer design, proprietary analog boost circuitry, and specialized battery integration, the VP3 provides sensors with up to 20 years of lifetime. Leveraging decades of 3D manufacturing research, Xidas delivers a cost-effective solution to the IoT market's biggest issue: **battery life**.

Up to 20-year lifetime for sensors*

Up to 10 mW of direct battery power generation from vibrations with less than 1 g of acceleration

Small profile (54 mm diameter x 42 mm height)

Power handling accommodates all wireless technologies

- Low-current devices (BLE, ZigBee, LoRa, Sigfox, NB-IoT)
- High-current operation (WiFi, Cellular)

Plug-and-Play

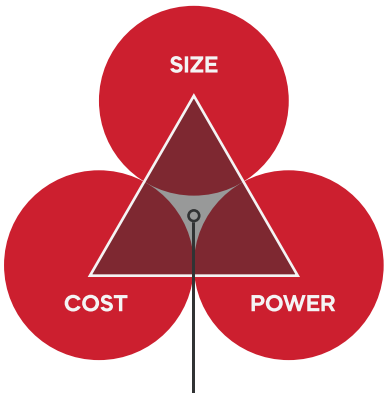
- Output easily integrated with existing equipment
- No conditioning circuitry required
- Seamless charging/discharging

Ruggedized design

- Sturdy, waterproof IP67 enclosure
- –20 to +85°C temperature range

Power, Size, and Cost Value Triangle

Wireless sensors have unique power signatures that put a strain on regular batteries. With the increase in intelligent sensing, sensors can capture and analyze machine signatures, monitor for alarms and environment, be network aware and transmit to customers networks. This results in power requirements ranging from small current drains when monitoring to large pulses when transmitting, dropping battery output voltages to unusable levels in undetermined times and considerably shortening standard battery lifecycles. Current battery-driven wireless sensors only have lifetimes of 1 to 2 years, resulting in expensive maintenance costs associated with replacement.



Estimated cost of one battery replacement

● = Time
● = Cost

● Identify & locate	30 (minutes)
● Paperwork & logistics	30 (minutes)
● Pull repair stock items	15 (minutes)
● Traveling to & locating devices	30 (minutes)
● Power module change	5 (minutes)
● Return & verify operation	40 (minutes)
● Disposal of old batteries	15 (minutes)
● Total time in minutes	165 (minutes)
● Hourly labor rate	$85
● **Labor cost**	**$233.75**
● Consumables / other costs	$15.00
● Inventory cost of spares	$45.00
Total	**$293**
Cost over 10 years (two-year battery life cycle)	**$1,465**

Vibration energy harvesting solutions have been available for over a decade. However, they have not been widely accepted within the IoT community because the majority of machines from which energy can be harvested vibrate at very low frequencies and at very low accelerations. To properly power IoT sensors, these energy harvesters need to provide at least 1 mW of power. Traditional electromechanical solutions can harvest this energy, but have been too large and extremely expensive (7 to 10x the cost of wireless sensors). The smaller, more cost-effective piezoelectric energy harvesters, unfortunately, have not been able to generate enough power from the frequencies and g's of wireless IoT applications.

Xidas perpetual power pod with integrated energy harvesting throws all these limitations out the window. Our **"value triangle"** makes the product an ideal replacement to standard batteries for IOT wireless sensors—**high power output combined with small size combined with affordability**. We've done the engineering for you to support your sensors for decades. All you have to do is provide a natural vibration source. The Xidas perpetual power pod can even run for weeks when the energy harvesting source is removed (i.e. train/truck/ship is parked, or machine being monitored shuts down due to maintenance or power outages).

Industrial Design

Leveraging the latest engineering simulation tools and modelling, coupled with accelerated aggressive testing, the Xidas perpetual power pod is designed and tested for a 20-year life. This industrial perpetual battery also has a wide temperature range (–20 to +85°C), is rugged and waterproof (IP67), making it an ideal energy harvesting companion for any wireless sensor application.

Integration into Existing and New Wireless Sensors

The VP3 offers several output options that make the battery truly **plug-and-play**. For instance, Pin 4 provides a regulated output voltage with no conditioning so your sensor can plug right into it just like a normal battery and you are ready to go! For applications with higher current demands (>150 mA peaks), Pin 5 gives you access to the system voltage, going up to 4.1 V.

Xidas also provides a line to monitor the amount of current going into the battery (being harvested) as well as going out. You will always know the status of the battery life.

The internal guts of the Xidas perpetual power pod is very modular, with three distinct modules: electromagnetic transducer, analog boost circuitry, and specialized wide-temperature high pulse rechargeable battery. This on-board battery allows the device to power a sensor even when vibration energy is not available.

We encourage leading sensor companies to work with us to integrate these components into your sensors, hence increasing the life and value of your solutions without adding significant cost. For example, leverage our small energy harvesting transducer and integrate with your own power condition circuitry with/without an additional battery based on your existing design and application. Or simply integrate your sensor circuitry into these building blocks. Xidas also provides engineering services that can aid in the integration or development of your energy harvesting wireless sensor.

Electromagnetic transducer	Vibration perpetual power pod	Conventional D-size battery

How to Order

VP3 – XX – X.X

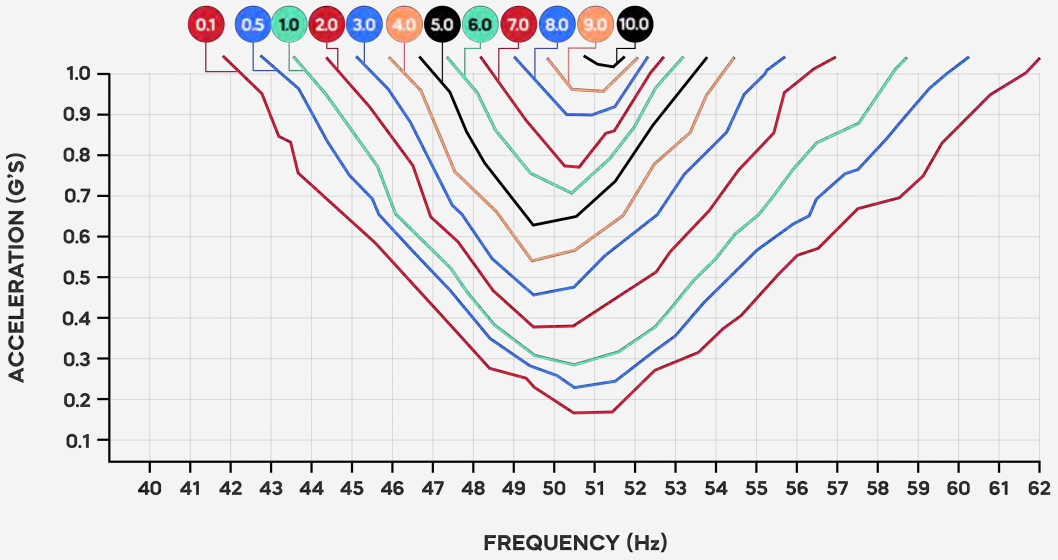
- XX: SPECIFY YOUR RESONANT FREQUENCY (i.e. 30 Hz)
- X.X: SPECIFY YOUR OUTPUT VOLTAGE (i.e. 1.8 V, 2.5 V, OR 3.3 V)

Vibration Energy Harvester Specifications

*If the average power consumption of the sensor is less than the energy harvesting power output at the desired frequency and acceleration, a 20-year lifetime can be achieved.

VP3-50

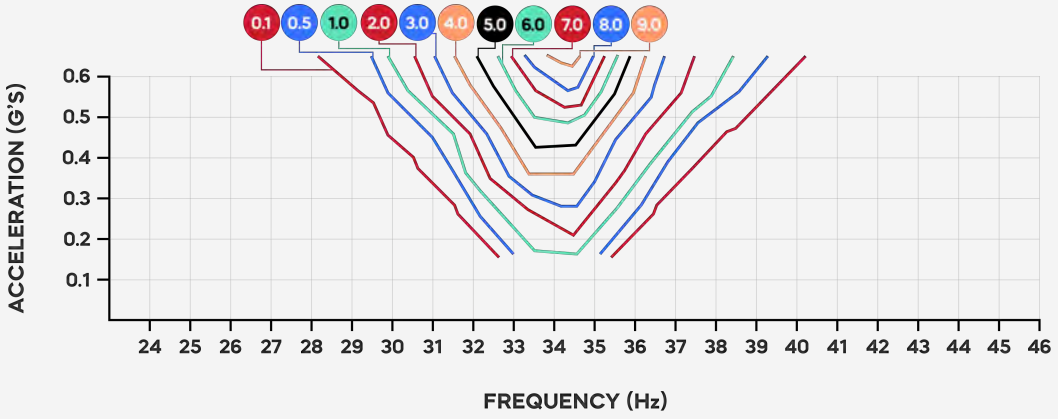
Tuned for 50 Hz resonant frequencies



VIBRATION ACCELERATION	POWER OUTPUT
0.2 g	1 mW
0.6 g	5 mW
1 g	10 mW

VP3-30

Tuned for 30 Hz resonant frequencies



Contact the factory to tune for other resonant frequency.

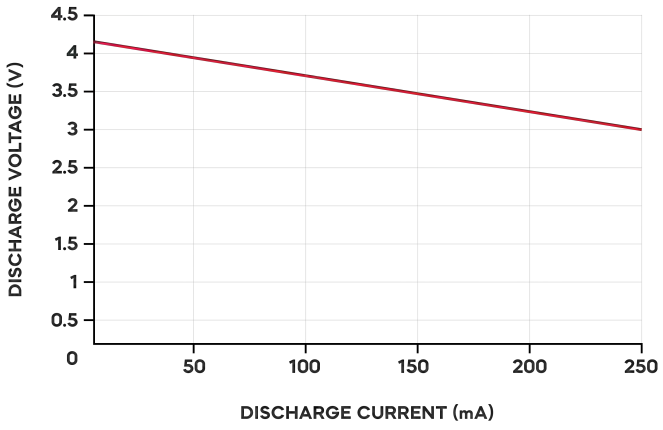
VIBRATION ACCELERATION	POWER OUTPUT
0.2 g	2 mW
0.4 g	5 mW
0.6 g	9 mW

Overall Specifications

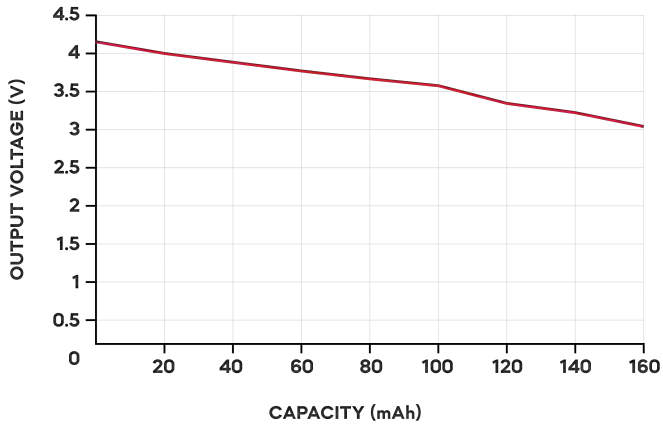
SIZE	54 mm diameter x 42 mm height
ENCLOSURE	IP 67
MOUNTING	1/4” stud mount or adhesive
OPERATING TEMPATURE	-20 to +85°C
OUTPUT	1.8 V, 2.5 V, or 3.3 V
I/O CONNECTIONS	**Pin 1** ground return **Pin 2** charging power monitor (0.1 Ω shunt resistor to ground) **Pin 3** 5VDC @ 50 mA charging input voltage (e.g., from USB) (for recharge if unit is stored for long periods of time) **Pin 4** regulated output voltage, factory set (1.8 V, 2.5 V, or 3.3 V @ 150 mA) **Pin 5** system output voltage (4.1 to 3.0 V @ 250 mA max)
CAPACITY (ON-BOARD BATTERY)	160 mAh (@ 22°C)

ON-BOARD BATTERY

Discharge Voltage by Current (@22°C)



Capacity Curve for 50mA Discharge (@22°C)



Target Applications

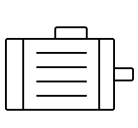
Eliminating the need of wiring and cabling for sensors does wonders. You can now throw away high installation costs and add monitoring capabilities to places and things you couldn't before. No matter the sensing application, the biggest problem with wireless sensors is power... batteries die. Replacing several batteries every few years can be a huge maintenance headache that prohibits the implementation of these next generation systems. Not anymore with Xidas IoT's battery solutions.

Power wireless sensors for machine condition monitoring (predictive maintenance)

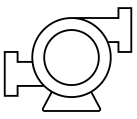
Industrial plants no longer have to monitor and repair their machinery through a labor-intensive preventative maintenance approach, which is costly. This is when maintenance workers routinely diagnose and repair the assets on a scheduled basis. Preventative maintenance expenses include the cost of routine service parts, cost of routine service labor, production loss due to frequent equipment downtime, cost of managing preventative maintenance programs, and cost of determining effectiveness of routine maintenance.

Predictive maintenance uses sensors that monitor and transmit plant machinery condition (data) to the cloud where it is analyzed utilizing machine learning to predict maintenance needs. In this approach, the health and condition of motors, pumps, blowers, fans, compressors, conveyor belts, gearboxes, and other machinery is consistently examined and supervised to ensure operation runs properly. Bearing defects, misalignments, imbalances, looseness, and other deficiencies that lead to failures can be detected.

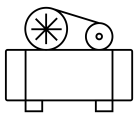
Predictive maintenance can reduce the time required to plan maintenance by 20–50%, increase equipment uptime and availability by 10–20%, and reduce overall maintenance costs by 5–10%. The VP3 is perfect for powering the sensors used for industrial asset condition monitoring; efficiently harvesting the vibration from these machines to power the mounted wireless sensors.



MOTORS

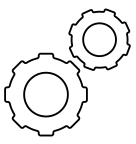


PUMPS

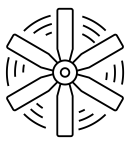


COMPRESSORS

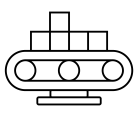
CHILLERS



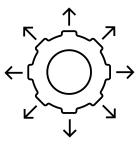
GEARBOXES



FANS & BLOWERS



CONVEYER BELTS



AUTOMATION

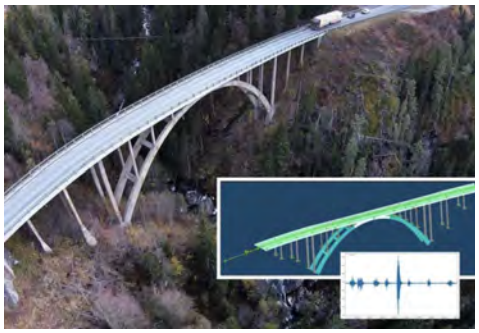
Power wireless sensors for train condition monitoring

Train maintenance still rely on visual inspections and preventive measures, which make it hard to identify faults in time and satisfy maintenance needs. Scheduled preventive maintenance and parts replacement are based on running time and distance, and is often combined with infrequent and simple visual inspections. This method of maintenance is not always able to identify and detect emerging faults, which result in breakdowns between planned maintenance occasions.

Another issue is so called "no fault found" situations. This is when maintenance follows a passenger's complaints about poor ride comfort and trys to re-produce the fault. The maintenance crews are not guaranteed to identify the cause of the issue, due to lack of available data and details from initial reports. Often, the wrong components may end up being serviced.

Wireless sensors can be used for wheel, axle box, and gear box condition monitoring on a train. Frequent data collection and analysis of these assets can provide insight on sub-optimal performance, detect potential malfunctions, and ultimately avoid bumpy rides for passengers. The VP3's industrial design makes it ideal to perpetually power sensors used to monitor train components!

Power wireless sensors on other vibrating surfaces



The potential and use cases for IoT wireless sensors are endless. If there is a vibrating source nearby, then Xidas IoT's Vibration Perpetual Power Pod provides the sensor with an extremely long lifetime. This completely eliminates the hassle of replacing the battery every few years. Imagine powering a sensor from the vibrations of a bridge, an HVAC unit, a truck/vehicle, etc. The possibilities are endless.

Trucks

GPS fleet management, including all of the sensors

Construction Equipment

Wind Turbines

Combine early warning, security and responses like shutouts/ shutoffs in new turbine designs and ability to optimize performance and to better predict maintenance needs.

Pipelines

Oil/gas pipeline monitoring has a major importance on safe and effective logistics of oil and gas products.

Pumpjacks

Mechanically lift liquid out of the well if not enough bottom hole pressure exists for the liquid to flow all the way to the surface.