

TECHNICAL INSIGHTS  
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**ARTICLE ON AMBIENT MICRO LLC  
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## **AMBIENT POWER SUPPLY FOR DEFENSE APPLICATIONS**

Warfighters employ wireless systems for persistent surveillance. Such wireless systems consist of many sensors that require continuous power supply. Batteries are normally deployed to power sensors in wireless monitoring systems. Replacement and maintenance issues of batteries pose a problem in wireless sensor networks (WSNs). Hence, researchers across the globe are exploring alternate technologies that eliminate the need for batteries in a WSN. Energy harvesting or power harvesting or power management techniques seem to be viable solutions for applications that require constant power and where replacing battery is difficult. Along these lines, harvesting power using ambient energy is gaining importance in many fields that deploy wireless monitoring systems. Universities are actively engaged in exploring possible energy harvesting sources and techniques. There are very few manufacturers in this domain who have developed commercial energy harvesting models for different application segments, and few others are still in the process of developing prototypes.

Ambient Micro LLC of Hawaii is one such company that develops multisource ambient power supply (MS-AMPS) for sensor devices. Established in the year 2001 as HawaiiWave Technologies LLC, it received a six month research and development contract in late 2004, through the Office of Naval Research (ONR) and the Hawaii Technology Development Venture (HTDV) to explore the prospectus of RF energy technology for various applications that deploy sensors. The company was reorganized as Ambient Micro LLC in October 2005. Again in November 2005, it obtained a follow-on award of \$300,000 through HTDV/ONR to develop prototype of ambient power supply using multiple energy sources. The development efforts of Ambient Micro were boosted by a grant amount of \$100,000 from Air Force Research Lab under small business innovation research (SBIR) contract in developing an ambient power supply for powering micro-electromechanical systems (MEMS) sensors in unmanned aerial vehicle (UAV) applications.

The ambient power supply developed by Ambient Micro uses different sources of energy such as solar, thermal, RF, and vibrations. The available energy is harnessed and converted to electricity to charge the battery or to power the sensor. The prototype consists of a sensing unit, a signal conditioning and voltage regulation unit. The sensing unit is classified into direct current (DC) transducer and alternating

current (AC) transducer based on the nature of input energy. RF and vibration energy fall under AC transducer, while solar and thermal energy fall under DC category. Depending on the input source, the input signal is conditioned using an amplifier, filter, or an appropriate unit before it is available for use. The output DC is regulated using a suitable voltage regulator. The circuit also comprises a battery charge controller unit, which controls the amount of charge that needs to flow into the battery. It is essential to have a controller unit because the input is varying in nature. The output of the charge controller unit is regulated and sent for powering the sensor or for charging the battery.

Figure 1 shows Ambient Micro's MS-AMPS circuit.

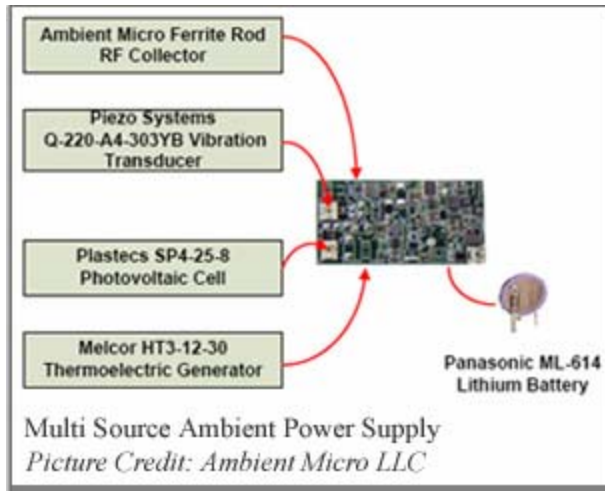
The ambient power supply unit was tested for performance using different sources of energy. Test results indicate that harvesting energy from multiple ambient sources can yield constant output power supply. The prototype developed can effectively combine different sources of energy to produce electric power. Such a device can minimize the battery capacity and size requirements. Typically, MS-AMPS can replace a battery of 3 volt to 4 volt application such as lithium ion cells, AA and AAA battery packs, says John Langley, chief technical officer at Ambient Micro.

MS-AMPS can increase the total power and the reliability of the system. It does not involve any maintenance and it also poses reduced environmental traces. Scalability and distributed configuration are other features, which make it unique. Prolonged battery life, small size, and lightweight are the key features of Ambient Micro's MS-AMPS that meets the power demands of WSNs in defense field.

Some of the applications in the defense sector includes UAV, autonomous underwater vehicle, robotic systems, WSNs for force protection, and improvised explosive device detection, intelligence surveillance system, logistics tracking, condition-based maintenance, and vehicle health monitoring and unmanned ground and marine sensors. Other potential application segments are identification transponders on railway cars, Safety of Life At Sea search tracking buoys, intrusion sensor networks, industrial process monitors, and asset tracking tags on small machinery.

With the successful demonstration of the technology, Ambient Micro received a second round grant of \$750,000 from Air Force Research Lab under SBIR phase II

contract to develop MS-AMPS for wireless MEMS health monitoring sensors and UAV. Backed up by strong government funding, Ambient Micro's MS-AMPS is expected to open up new avenues in the field of self-powered wireless networks and commercial products are expected soon.



**Fig-1**

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