Heat replaces batteries to power wireless sensors, meters and actuators

Energy saving countermeasures, the optimization of processes and predictive maintenance scheduling require the condition monitoring of the involved plant, installation or machine.

This measurement data can be collected by the use of distributed, smart sensors. In case cabling the sensors is not feasible, due to practical or costs reasons, wireless electronics can be used as retrofit alternative. However, this introduces the question how to power this wireless equipment.
Primary batteries are the standard power supply for many consumer applications, where their limited lifetime and frequent maintenance is no major issue. This situation can be different when considering hundreds or thousands of installed wireless sensors, meters or actuators in a commercial building, factory or industrial installation. This small energy crisis can be solved by using modern "micro energy harvesting" solutions. Various ambient sources are available to generate energy, like light, motion, radio waves or heat.

An autonomous system, based on a thin-film thermogenerator chip, operates already from small temperature gradients of five degrees Celsius. A wireless, thermoharvesting architecture combines existing energy efficient electronics (Ultra Low-Power microcontrollers and radio chips), compact and low-power sensors (temperature, magnetic field, humidity, gas, pressure, etc.) and an industry-specific or proprietary radio protocol (KNX /rf, Zigbee, Z-Wave, wireless Hart, ISA100, Bluetooth LE, etc.).

The system operates in "duty-cycle mode" and requires only a minimum amount of electrical energy. A crucial function has the voltage convertor (DC Booster), which up-converts the uncontrolled output voltage of the thermogenerator to a fixed level. The DC Booster, in combination with the thermogenerator, determines at which temperature gradient the system starts to operate and its efficiency. The end application determines the power supply parameters like the size and type of the energy storage device (e.g. super capacitor, thin-film battery).

Heat energy may come from a heat- or air-condition installation, hot liquid or steam in a pipe, friction heat from a motor or robot gearbox, resistive heat by a current though a busbar or switchgear, but also kitchen equipment and even the human body.

Autonomous "install and forget" solutions related to Machine-to-Machine communication (M2M), internet of things (IoT), smart sensors and smart metering are thereby real.

The ultimate goal is to reduce the energy consumption of a system or installation, to optimize the performance of a production process or to schedule predictive maintenance ("Condition Based Maintenance").

Objectives

- Understand the principle of thermoelectric “micro energy harvesting”
- Examples and case-studies of autonomous equipment, powered by thermal energy harvesting
- Architecture of an autonomous, thermal power supply
- How to qualify the fit of thermal energy harvesting and how to get started

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