

# **Non-conventional energy harvesting and power supply**

(new methods for supplying sensors and smart grids and a future concept for signaling and power supply through single wire or through the earth as propagation medium)

## **Abstract**

Most often the process of energy harvesting is associated with the ambient power sources (light, temperature gradients and kinetic energy). This energy however doesn't need to be naturally produced (sunlight, wind, solar or other heating sources) but is available by the artificial sources (artificial lighting, fans, machinery vibrations, electromagnetic emissions).

Our research revealed some unusual ways to harvest energy by utilizing the expected potential differences (of the neutral conductor) in some types of electrical networks. Moreover in some cases there is not only energy available to power small electronic devices, but also means for measuring fully or partially the electrical network load, thus giving the opportunity for decision making and smart load/network management.

Technical details will be revealed on how different problems were solved, including rectifier design, voltage drop avoidance and step-up transformer design. Additional circuits that offer non-conventional low-power supply will be discussed. Comparison will be made against some monolithic power management IC.

Following the nature of the topic the presentation will pass to some unconventional/conceptual methods for single-wire signaling and power transfer. The current achievements will be presented together with the results of our own practical research. Next is a general conclusion for the possibilities for wireless ground/marine signaling and energy transmission. It is backed up by patents and real work by different researchers and enthusiasts.

Although electrical engineering knowledge is sufficient, some knowledge of RF engineering will be helpful for understanding the single-wire and wireless concepts.

## **Key points**

- Brief overview of the common energy harvesting methods.
- Overview of some of the LV electrical network types.
- Opportunities for doing power measurements through the potentials of the neutral conductor.
- Ways for load management and decision making in smart and non-smart grids.
- The Neutral as a low-impedance power source.
- Possibilities for energy harvesting from the neutral conductor via the protective earth.
- Utilization of ultra-low voltage sources.
- Tricking the (diode's) voltage drop faced with ultra-low voltage AC sources.
- Solution for emergency power supply.
- Single wire earth return.
- Conceptual one-wire signaling and power supply.
- Conceptual "wireless" signaling and power supply through the earth.

## Short biography



**KALOYAN MIHAILOV** is currently a PhD student in the Faculty of Telecommunications at the Technical University of Sofia, guided by Prof Stan Valtchev. Has received his MSc degree in 2012 and continued scientific developments of energy harvesting, low power supplies, low-power sensors and wireless sensor networks. Research and development was successfully conducted on single-wire galvanic energy transmission system (non-inductive, non-capacitive). 2006-2014 administrator and owner of Bulgaria's largest alternative energy discussion boards website.

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Best graduate (MSc) of 1974, Technical University Sofia (TUS), in semiconductor and electronics technology, military service in radars, researcher in medical equipment and power converters and laser supplies, Auxiliary Director of the Centre of Robotics of TUS. In 1987 worked in TU Delft as Assistant Professor, since 1988 Assistant Professor in TUS (Power Supplies and Converters), Deputy Dean of TUS. Working on HF resonant power converters, IEEE Meritorious Paper Award, 1997, Best Paper Award from PEMC2014. Since 1994, teaching and consulting in Portugal and in the Netherlands. Based on a versatile experience, the research includes energy conversion, energy harvesting, wireless energy transfer, electric vehicles, energy management and storage, smart grids, tunnel FET devices and biosensors. He is now the International General Chair of the IEEE-PEMC2016 conference and Invited Full Professor of Burgas Free University.