

**Abstract:**

Shakil Sulaiman, Dalhousie University

Research Advisor: Dr. Larry Hughes

Category: Alternative Energy & Sustainability

The design and implementation of a low-cost device for measuring and recording household-appliance power-consumption

The conservation and management of energy is an important topic today because of growing concerns over energy security issues, notably the availability, affordability, and acceptability of energy. Studies have shown that when consumers are aware of the electricity consumption of their appliances, up to 15% energy reduction can be achieved. In order to address these concerns and improve people's awareness of their electricity usage, this poster describes a low-cost tool for measuring and recording the power consumption of most 110VAC household appliances by creating a time-series profile. The time-series can be reviewed later and compared with other appliances using, for examples, graphs generated using Excel. The device offers features that cannot be exhibited by other similar competitor commercial products such as the Kill-a-Watt energy monitor, where the information are only available for viewing and the corresponding readings are not recorded.

The device contains a socket into which the plug of an appliance is inserted: a voltage sensor circuit then records the instantaneous voltage (V), while the current sensor circuit to sense the current flow (I). The collected information from the two sensors is then transferred to the data acquisition module where it is processed and filtered to obtain the active power (P), apparent power (S), voltage (V_{rms}), current (I_{rms}), and the power factor (P.F) which are written to an SD card for future examination.

A prototype of the device has been developed and tested on several home appliances including a washing machine, microwave oven, room-heater, toaster, and refrigerator. All results show accuracy greater than 98% for the appliances monitored. For example, when the refrigerator was turned on, the device showed that the compressor draws around 100 W during the refrigeration cycle and starts every five minutes, while the microwave's defrost cycle required nearly 950 W every ten minutes and the power factor was found to be stable and less than 1 with nearly six times occurrence of the transient current impulse. The toaster had a power factor of 1, proving that it is a purely resistive device, meaning that all power entering the toaster was consumed (the time-series of the power consumption showed there were no losses).

The time-series data collected by the device has other possible uses; for example, it could be used by home-energy auditors to measure appliance electricity consumption in order to compare it with known standards. In other cases, the data could be made available to a smart-home controller to allow the scheduling of an unknown appliance. It can also be used for educational purpose to show the power consumption difference between resistive, capacitive, inductive and electronic circuit appliances.