Design of Smart card based Single phase Prepaid Energy Meter

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Abstract: Energy meter is an electronic device used to calculate the electrical energy consumed by electrically powered device. In earlier days the energy meter used in India were electromechanical in nature but gradually they are replaced by digital and electronic meters. Even though it is useful, the present system of postpaid billing is a tedious process and also there is a scope for incorrect reading. This project aims at the design of a smart card based single phase prepaid energy meter prototype.

1. Introduction

The direct energy calculation is possible with the help of electronic energy meters. The function of energy meter is to measure the amount of electrical energy consumed by an electrically powered device. The operation of electronic energy meters is, it continuously measures the instantaneous voltage (V) and current (I). The product of these two gives the instantaneous electrical power (W) which is then integrated against time to get energy used.

\[ W = V \times I \]

Prepaid energy meter is designed such that consumers can recharge their energy meters for an amount of their choice. Once this amount expires the connection will be terminated automatically, from within the meter itself.

2. Prepaid System Architecture

The most significant module of this Energy Meter is the energy metering IC. The smart card can be used for recharging the Energy meter. When Smart card comes in the vicinity of the meter, the units that have been recharged on the card is read by the Energy meter with the help of the smart card reader and stored in the energy meter. As the energy is consumed, the unit starts decreasing and displayed on the LCD. The user gets an indication of low credit. If the user fails to recharge the card and all the units are consumed, the supply will be cut off. Once recharges again, the connection is resumed.

3. System Design

This paper proposes a microcontroller based single phase prepaid Energy meter using microcontroller from Texas instruments. MSP430 series microcontroller has been used as the Energy meter IC. The schematic of energy meter has been done in ORCAD and software been developed in Embedded C and compiled by the IAR workbench compiler. The below figure shows the hardware architecture of the Energy meter.

Figure 1. Prepaid System Architecture

Figure 2. Functional block diagram of prepaid meter
4. Results

The schematic of the circuit has been done using ORCAD CAPTURE CIS. The output of the session window of ORCAD is as follows.

Figure 3. Flowchart of Prepaid metering system

Figure 4. Session log window

The results for the calculation of RMS voltage and current are shown in figures below.

Figure 5. Displaying Current on the evaluation board LCD

Figure 6. Displaying Voltage on the evaluation board LCD

5. Conclusion

For this system design, a detailed study of energy meters, various types of energy metering ICs presently available, has been done. By considering various aspects of our design MSP430F6736 microcontroller IC is chosen for the purpose. The block level system design was done with all the features of Prepaid energy meter. Then the circuit design of the required system was completed and schematic diagram was drawn using ORCAD with this design. The energy computation has been done using Embedded C language in the IAR workbench IDE tool. Then the firmware has been downloaded to the evaluation board EVM430-F6736 and tested. Future work includes implementation of the overall system using the evaluation module and the smart card interface.

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7. References


