Spread Spectrum Techniques for an Intelligent Energy Meter

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ABSTRACT

The intelligent energy meter designed by us is basically a digital energy meter, which uses single-phase energy metering IC. This metered reading is brought to the database of electricity board through the “echo model”, which is identified as a suitable model for the house hold power lines among the existing power line channel models. This is followed by studies on the utilization of different robust spread spectrum techniques like code division multiplexing (CDM), Orthogonal frequency division multiplexing (OFDM) and COFDM (Combined) for data communication over the selected channel model. The results of the study are conducted, particularly in respect of bit error rate (BER) performance and spectral efficiency.

Keywords: BER, CDMA, OFDM, COFDM

INTRODUCTION

Power line communication has been the main focus of much research work since the liberalization of the telecommunication markets. With the growing interest in power line communications the scope of possible applications also increased. Although many applications are in vogue, we wanted to concentrate on communication data pertaining to energy consumption to the main electricity office for billing purposes.

In this context, it may be mentioned that in our country there are two types of meters available: analog and digital. Conventional meters are analog in nature and these are still being used. The basic principle of such meters involves two coils—one the voltage coil and the other current coil to measure the corresponding quantities. The product of these two, along with the power factor, gives us the power consumed. The power is measured directly from a rotating disc, which drives a decade counter. Next comes the digital meter. The underlying principle is the same, but the quantities here are digitized by appropriate circuitry and the power consumed is displayed in the LED/LCD display provided. The digital meter has the advantage of a digital readout, that is, it can be used as the input data for digital communication which the analog
meter does not have. At present both meters have an inherent disadvantage. They both require an individual/agent to physically come and take down the readings and report to the household/office the amount one has to pay. The proposed technology being developed removes the need for an individual/agent to physically read the consumer data (Sankaranarayan & Merlin, 2001). The proposed meter has the ability to send the reading directly to the controlling authorities through the power lines. The following describes a low cost, high accuracy watt-hour meter based on ADE7751. The meter described is intended for use in single phase, two wire distribution systems. However the design can easily be adapted to suit specific regional requirements. Then we provide the details of the hardware set up used at the consumer side and the development of a channel model, describing the echo model and noise characteristics of an in-house power line channel. Next we deal with the mode of transmission over the simulated power line channel. This mainly deals with the studies on the utilization of the promising code division multiplexing (CDM) and orthogonal frequency division multiplexing (OFDM) for the data communication over the selected channel model. The results of the study so conducted, particularly in respect of bit error rate (BER) performance and spectral efficiency.

**SINGLE PHASE ENERGY METERING IC**

The functional block diagram of ADE7751 (Analog, n.d.) is as shown in Figure 1 is a high-accuracy, fault-tolerant electrical energy measurement IC that is intended for use with 2-wire distribution systems. The part specifications surpass the accuracy requirements as quoted in the IEC1036 standard. The only analog circuitry used in the ADE7751 is in the ADCs and reference circuit. All other signal processing (e.g., multiplication and filtering) is carried out in the digital domain. This approach provides superior stability and accuracy over extreme environmental conditions and over time.

The ADE7751 incorporates a novel fault detection scheme that warns of fault conditions and allows the ADE7751 to continue accurate billing during a fault event. The ADE7751 does this continuously, monitoring both the phase and neutral (return) currents. A fault is indicated when these currents differ by more than 12.5%. Billing is continued using the larger of the two currents.

The ADE7751 supplies average real power information on the low-frequency outputs F1 and F2. These logic outputs may be used to directly drive an electromechanical counter or interface an MCU. The CF logic output gives

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*Figure 1. Functional block diagram of ADE 7751 (Analog, n.d.)*

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