Electronic Energy Meter

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In order to accurately measure the electronic energy used for an electronic energy meter, suitable hardware and software have to be designed. Meanwhile, the problem of the distorted current waveform from loads needs to be considered. The aim of this project is to design a sample meter that can accurately display real voltage, current, power, and energy used during one day.

Generally, one electronic energy meter consists of hardware and software. Specifically, elements of hardware include the power supply, interface circuit, suitable launch pad with microcontroller (single chip) and a liquid crystal display (LCD).

Figure 1. The Block Diagram of External Hardware

Initially, the Figure 1 showed all elements of hardware which can support alternating voltage and current sources from the mains (UK’s standard socket). The voltage source can support 240 Volts and 12 Amperes (Root-Mean-Square). Thus, maximum values could be assumed as ±400 Volts and ±20 Amperes. The sensor box would switching voltage and current by output production of 1Volts/100Volts and 1Volts/10Amperes. As a result, the voltage and current were switched to ±4Volts (voltage source) and ±2Volts (current source) by the sensor box.

Figure 2. The Voltage signal switching circuit  Figure 3. The Current signal switching circuit

Secondly, the interface circuit used to connect the sensor box and the launch pad. The feature of the interface circuit which is to switch output signal from sensor box to the input working signal which are able to used for the launch pad and microcontroller(0 ~ 3.6 Volts). Therefore, Figure 2 and Figure 3; showed that the voltage and current signal would be switched to 0-2V which is in the range of working voltage.

Figure 4. The MSP430 launch pad with the LCD [boosterpackdepot.com]

Moreover, there is a example model of real launch pad and LCD used in this project has showed in Figure 4.

Then, the switched signals have been showed in Figure 5 and Figure 6. It is clearly to see that the real voltage and current input signal of 2.08 Volts (voltage rms) and 1.88 Volts (current rms). Because there is limited error caused by the value of resistors cannot match the results of calculation.

Figure 5. The waveform of Voltage Input Signal  Figure 6. The waveform of Current Input Signal

Additionally, there is also a distorted problem of the waveform of the current source when some loads connected with the sensor box. Figure 7 showed that the waveform of voltage has normal sine wave (channel 2), but the waveform of current source has irregular sine wave (channel 1) when adjusting loads.

Figure 7. The waveform of Voltage and Current sources

Thus, the frequency of the power supply is 50Hz. The sampling frequency of 10K Hz of the current waveform can be sampled to avoid the distorted and display all parameters more accurately.

Figure 8. The Block Diagram of Paced Loop

Finally, the principle of the software is the paced loop. Figure 8 showed the block diagram of the program.

In conclusion, hardware and software were designed to deal with the problem of the current waveform and accurately display real voltage, current, power and energy used in one day.

References: