

Smart Electricity Meters

ANUGREH KHOSLA

Anugreh.khosla@gmail.com

Abstract: The growing cost of electricity and the shortage of the same has put in minds of many engineers to design something which can enable an individual to use electricity according to his/her pocket. Along with this these meters also help to avoid the misuse of the electricity which indeed is one of the major concerns of the country today.

Keywords: SECSM(smart electricity cum safety meters), prep(prepaid), embd(embedded), MCU(microcontrol unit)

Introduction: Smart electricity meters aim to interface the digital energy meters To recharge units and convert the meters into a prepaid meter. This Technology enables us to stop the electricity misuse. Conventional Meters present a month end bill which is to be taken care of whereas The smart meters enable the usage of the electricity according to one's Own pocket. Just like the conventional mobile recharges, smart meters Need to be recharged for a specific amount and the units of electricity Can be used according to the amount recharged. These meters also Provide with alarms which makes a user know when the amount is To be recharged again for the continuation of the electricity use and It cuts the electricity supply when the amount balance reaches to a Nil value. The alarms can be set by the users according to their own Convenience which marks certain kind of recharge value after which The alarm buzzes.

Study area(components):

The pre energy meters mostly involve the rigorous use of the embdd Systems which in turn is a combination of hardware and software designs to meet specific needs with performance in a given time frame. Embd systems are generally the subsystems which are used with a big system to enhance the functioning of the big system.

Use of the Microcontroller:

Pre meters involve within themselves the use of the microcontrollers. They are the general purpose devices which are generally meant to read data, perform arithmetic and controls the operation of a machine. MCU is a single use chip used for controlling other devices and hence named so. The program is generally contained either in the EPROM within the same chip. The main objective of using

controllers are basically of there smaller size, reliability and cheap costs.

Microcontroller typically consists of pins such as the Interrupt controller, chip flash, chip RAM, timers, serial ports, bus controllers.

Crystal Oscillator:

Apart from the microcontroller , the pre meter consists of a crystal oscillator which basically helps in the generation of the clock pulses by which all the internal operations are synchronized. There are pins in it which helps to connect a resonant network to form an oscillator. Its typical maximum frequency is 16 MHz and the lowest is 1MHz. A crystal oscillator is generally used at a frequency of 11.0592 MHz.

DTMF decoder:

The decoder is a full Dual tone multiple frequency receiver with less than 35mW power consumption and an industrial temperature range which incorporates within itself the use of the quartz crystal or the ceramic resonators. They have the special adjustable acquisition and the release times with power down and inhibit modes.

They are basically used for decoding a particular signal which is attached to the matching of two frequencies and thus when the two frequencies match ,the respective signal is released accordingly. It basically enables us to decode the call that provides the balance in the pre meter automatically.

Decimal Decoder:

Along with the DTMF, we also use the decimal decoder which basically helps us to decode 4 binary-coded inputs into one of the 16 mutually exclusive outputs. It also helps in demultiplexing function by distributing data from one input line to any one of the 16 outputs.

It has a typical propagation delay and a typical power dissipation of 170mW.The decimal decoder is basically attached with the microcontroller to interface with the DTMF decoder.

Along with this we also have many components which are used in the power supply circuitry.

1. Transformers(Dual supplies, 500ma current)
2. Rectifier Diodes (IN 4007)
3. Regulators: generating +5V and 1 a regulator.

Relays:

In order to enable a circuit to be isolated from the system only under faulty conditions, protective relays are used because they are sensitive, have high speed and are very selective.

The types of the relays which we can use for the meters are:

1. **Electromagnetic attraction type:** actuated by DC or AC quantities.
2. **Electromagnetic induction type:** operation depends upon EMI.
3. **Thermal relays:** Depends upon the heating effect of elective current.
4. **Distance relays:** Depends upon the ratio of voltage to current.

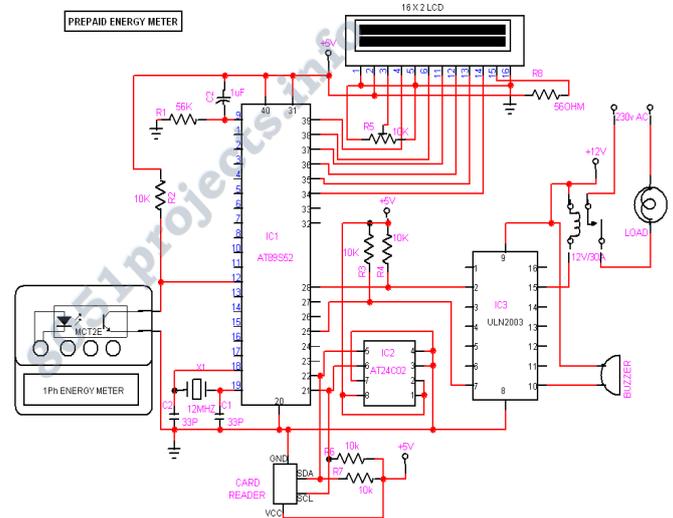
WORKING PRINCIPLE:

The pre meters incorporates within themselves the use of a LCD screen which displays the balance amount every time and also apart from this shows the unit consumption too and puts the output to zero when the balance is nil. Now for the continuation of the electricity, one must recharge the unit from the mobile phone which can be done by going to the shop and requesting for a recharge of a desired amount. The recharge can be done by dialling a particular GSM number and when the handset is automatically on, the amount is transferred in the digital code. This data is decoded by the circuit and the value is added in the unit. This added value shows up in the LCD screen automatically after the successful recharge. Whenever the electricity is not to be consumed, the circuit can be easily switched off which marks the open switch for the circuit using the relays which in turn stop the unit consumption reading and hence no energy is consumed.

When the recharge amount reaches a particular alarming value which is generally set up by the consumer, an alarm is switched on which warns the consumer for the recharge to be done before the circuit gets disconnected. This alarm is basically an indication that the recharge must be done. If in case the balance reaches a nil value, in this case, the circuit gets completely disconnected and the power supply is switched off till the time the requested and the desired recharge is not done.

We can also initiate a use of the memory feedback option. With the help of this memory feedback, it is possible to

record all the last details and are visible on the LCD screen. After the recharged has been done, the supply is again switched on which in turn switches on the memory and recalls the last detail by the auto feedback logic which in turn then connects the electric circuit back.



The figure above shows the circuit diagram of a prepaid energy meter along with the components which are used and are connected in a proper systematic order.

The figure shows the microcontroller AT89S52, alarm buzzers, LCD screens and also other connected components.

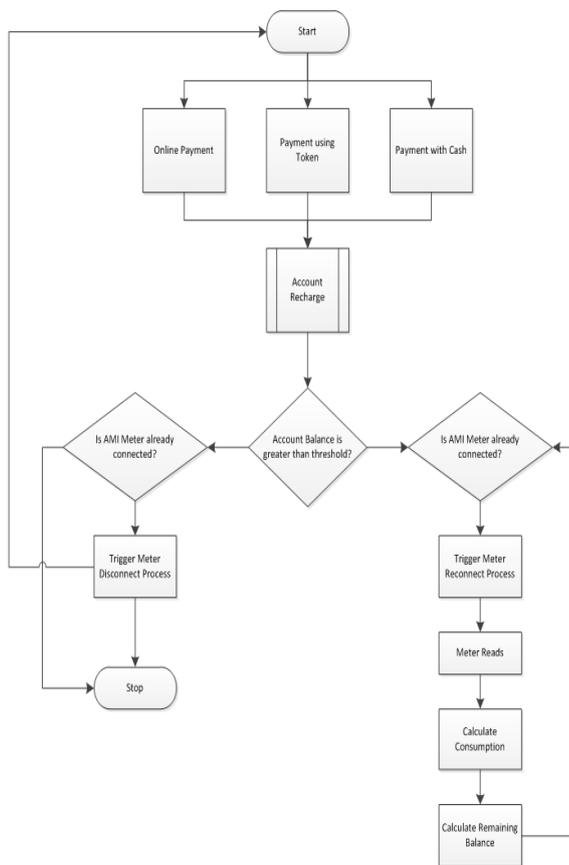
The decoders used in the SECSM uses a digital counting technique to determine the frequencies of limited tones and to verify that these tones correspond to standard DTMF frequencies.

Separation of the low group and high group tones is achieved by applying the dual tone signal to the inputs of two 9th- order switched capacitor band pass filters. The bandwidth of these filters correspond to bands enclosing the low group and high group tones. The filter section also incorporates notches at 350 Hz and 440Hz which provides excellent dial tone rejections. Each filter output is followed by a single order switched capacitor section which smoothes the signals prior to limiting which is generally performed by high gain comparators. The comparators are provided with a hysteresis to prevent detection of unwanted low level signals and noise.

The circuit also uses the internal clock circuitry which is completed with the addition of standard television color burst crystal or ceramic resonator having a resonant frequency of 3.57957 MHz. The circuit shows a buffered oscillator output that can be used to drive clock inputs of other devices

Before the registration of the decoded tone pair, the receiver checks for a valid signal duration. This check is generally provided by an external RC time constant to rise as the capacitor discharges. The pre meters comprise of the Steering circuits which work in reverse to validate interdigit pause between the signals. Thus, as well as rejecting signals too short to be considered valid, the receiver can tolerate signal interruptions too short to be considered a valid pause. This capability together with capability of selecting steering time constants externally, allows the designer to tailor performance to meet a wide variety of system requirements.

FLOW DIAGRAM:



The above shown flow diagram tells us how exactly the operation is carried out, starting from the payment modes for the recharge to the checking of amount greater than threshold values which is considered as the minimum sufficient required balance to the starting of the meter operations and then carrying out with the same process again.

Conclusion: In the present time of 21st century, we have no space for errors or faults either in any technical system or in the general applications.

Prepaid energy meter is an advantageous concept for the future. It facilitates the exemption from the electricity bills.

The word “Pre-Paid” means “pay before use” is one of the advantageous and a glooming feature of this whole new concept.

Pre meters are used to make the ongoing supply of electricity to homes, offices e.t.c.

The most important factor and feature of this concept is avoiding the misuse of electricity which is such an important and a scarce energy source. Pre meters actually allow people to consume electricity to the amount which is required and is not wasted.

Pre meters have found a very important place in many foreign countries and are successful in all spheres be it homes or offices or large multiplexes.

In the future, this concept will be highly used and utilized by every country looking at the current statistics of the population growth and the need for electricity.

Acknowledgement:

The satisfaction that accompanies the successful completion of any task would be incomplete without mentioning people who made it possible.

I would like to express my deepest gratitude to Mr. NT Markad, for being an erudite mentor for enlightening guidance which was vital for the study of the pre meters.

Last but not the least, I am thankful to the almighty for enabling me to learn and study so much and to present the outcome of the learning in this form.

References:

- i. M.Mazidi, J.Mazidi, McKinley, “The 8051 Microcontroller and Embedded Systems”
- ii. *Microprocessors and interfacing- DOUGLAS.V.HALL.*
- iii. http://www.atmel.com/dyn/resources/prod_documents/doc1919.pdf
- iv. <http://www.scribd.com/doc/58220244/gbac-2-gsm-based-automobile-control>
- v. <http://www.datasheetarchive.com/gh%20311%20in terfacing%20with%208052>
- vi. <http://www/8051projects.net/comment.php?comment.news.133>
- vii. <http://www.solderingpoint.com/ttl/ttl.php/96>
- viii. www.wikipedia.com
- ix. <http://www.energycentral.com/gridtandd/metering/articles/2679/Smart-Meters-as-Prepaid-Meters/>
- x. www.electronics-control.info/8051prog.htm