

# Smart Energy Meter

Jithin Jose K<sup>#1</sup>, Leneesh Mohan<sup>#2</sup>, Nijeesh U K<sup>#3</sup>, Tony C Benny<sup>#4</sup>

<sup>#</sup>Mar Athanasius College Of Engineering, Department Of Electrical And Electronics,  
Kothamangalam, Ernakulam, Kerala, India

**Abstract— It is a difficult job for the electricity board officials to manually take meter readings and calculate bill as it is time consuming and requires man power. Billing consumers for energy consumption is not uniform. It is a tedious job for the electricity board official to manually go and take meter readings of big industrialists and reset their maximum demand after recording it. Even the latest energy meter is not tamper proof. Hence considering all these factors it is possible to design an energy meter that is tamper proof, supports automatic metering and billing system, and at the same time helps in finding the fault location of transmission lines. The same meter can be used to take the readings of industrialist which sends these readings to a secured data location and automatically reset it after recording it. Considering all these features that can be done by a single energy meter it is called a SMART ENERGY METER.**

**Keywords— smart energy metering, automatic billing, PIC, RF module, power theft**

## I. INTRODUCTION

Energy meter billing is an important part of energy distribution. Each time a person from the authority side come and collect the meter reading and produce the bill to the consumer. The problem with this system is that it requires man power, time consuming and causes error. So there comes the scope of a "SMART ENERGY METER" which will provide bill to consumer both as an SMS along with other in-built features such as tamper proof, fault detection etc..The proposed energy meter utilizes a GSM module to transfer energy consumed to the authority side. Similarly authority side also uses these GSM service to send back the bill. Electricity stealing is also common issue now. The main disadvantage of mechanical meter was it was less reliable, less accurate and non-tamper proof. Even the present day

electronic energy meters used by electricity board is not completely tamper proof. The proposed energy meter also have the feature of detecting faults in the distribution system, made by checking the status of supply at distribution transformer and that at consumer.

## II. WORKING AND CIRCUIT DIAGRAM

An electronic energy meter is presented in this paper which is capable to communicate with central distribution office to provide great facility. Current transformer (CT) is attached with line to measure current flowing through the load and a

voltage divider network is connected to the line to measure terminal voltage of load. Then it multiplies them to get power in that instant. Then it processes these values of power to calculate the total power consumed by load. Automated billing of energy meter is made possible by connecting a GSM modem to the energy meter. As the authorities request for the units of energy consumption the same is send to them through GSM service from the energy meter. Once the value reaches the board they prepare a bill and send this to the registered mobile number of the consumer also a hard copy of the bill is mailed to the address if the registered consumer. The bill is prepared using a thermal printer which requires no ink at all, thus saving of money.

Automatic connection and disconnection can be done by passing a code such as a password from the board based on bill payment of the consumer through the GSM module. Once this code reaches the microcontroller at the consumers end the supply to the load can be turned off or turned on.

In case of industrial consumers the maximum demand has to be recorded by a higher official from the board. Then this person has to official reset this maximum demand after recording it. This is a time consuming as well as a tedious job. Hence it is possible for the energy meter to transmit this data to the board and store it in a special register. This register can only be opened by a higher official from the board. This can be done by communicating the maximum demand with the board through GSM module. This detail with the energy meter serial number is stored in a particular register of the boards microcontroller and can be only accessed by an higher official using his password. Once this procedure is done then the maximum demand of the industrial consumer is reset.

Detecting a fault in distribution system can be done by communicating between the distribution transformer and the consumer's energy meter. If there is supply in the transformer and no supply in the consumers end it means that there is a line fault between the consumer and the distribution transformer. This communication is done with a RF transmitter and receiver kept at two sides. When this communication interrupts energy meter will send an SMS to authorities and they can take necessary action.

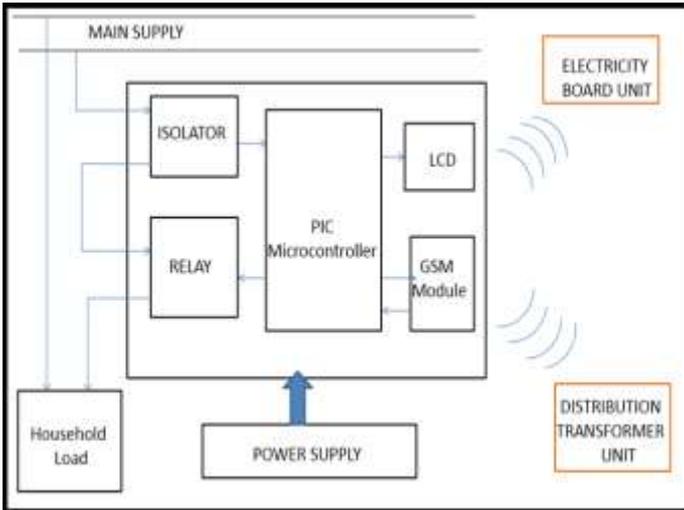


figure 1: Block diagram of energy meter

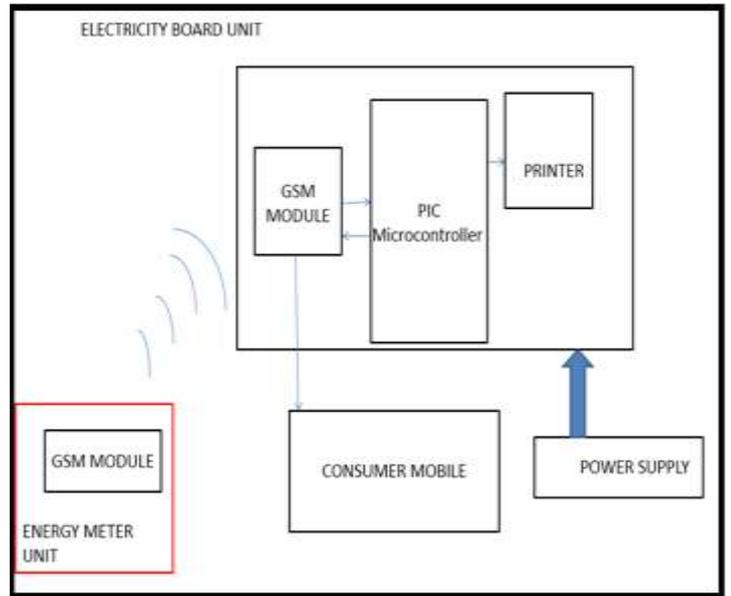


Figure 2: Block diagram of billing station section

Door sensors are used to prevent energy meter tampering. Once the door of meter is opened door sensor send a high signal to microcontroller’s pin, which in turn sends message to utilities.

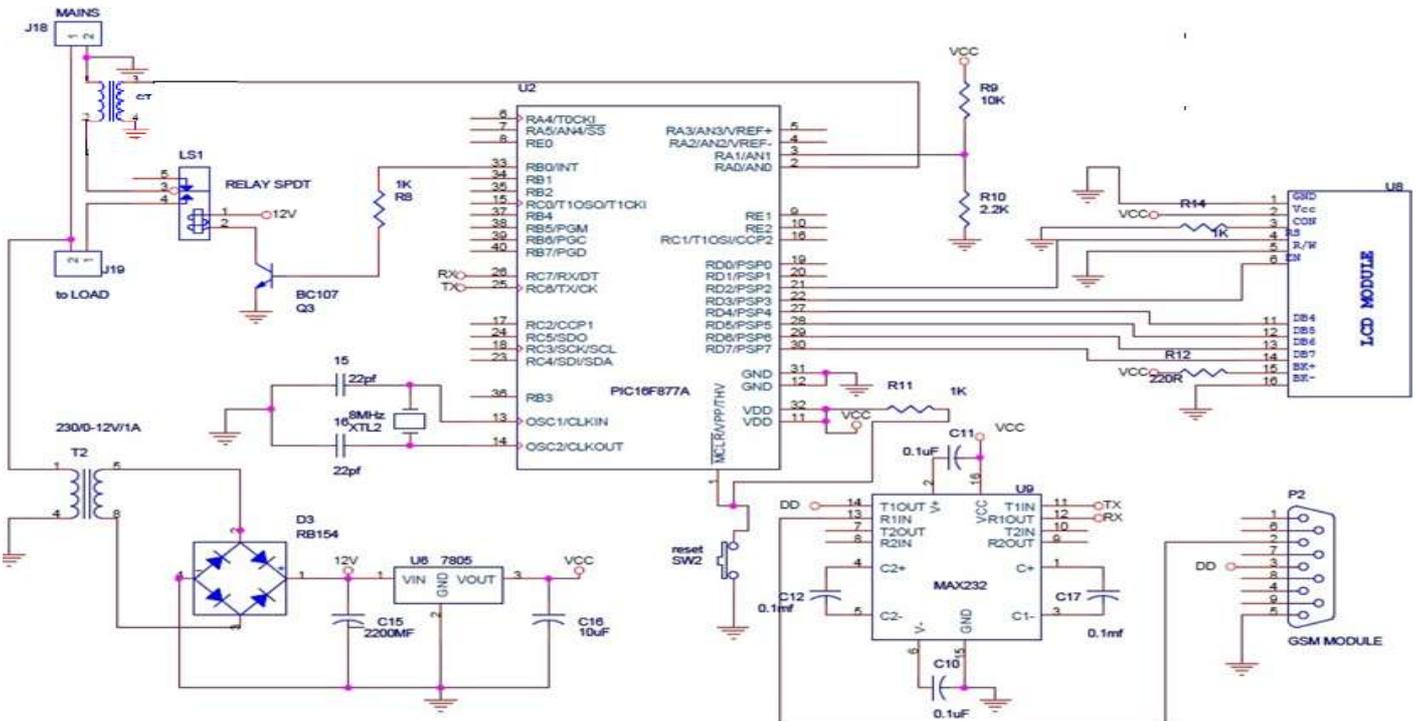


Figure 3: Circuit diagram of energy meter

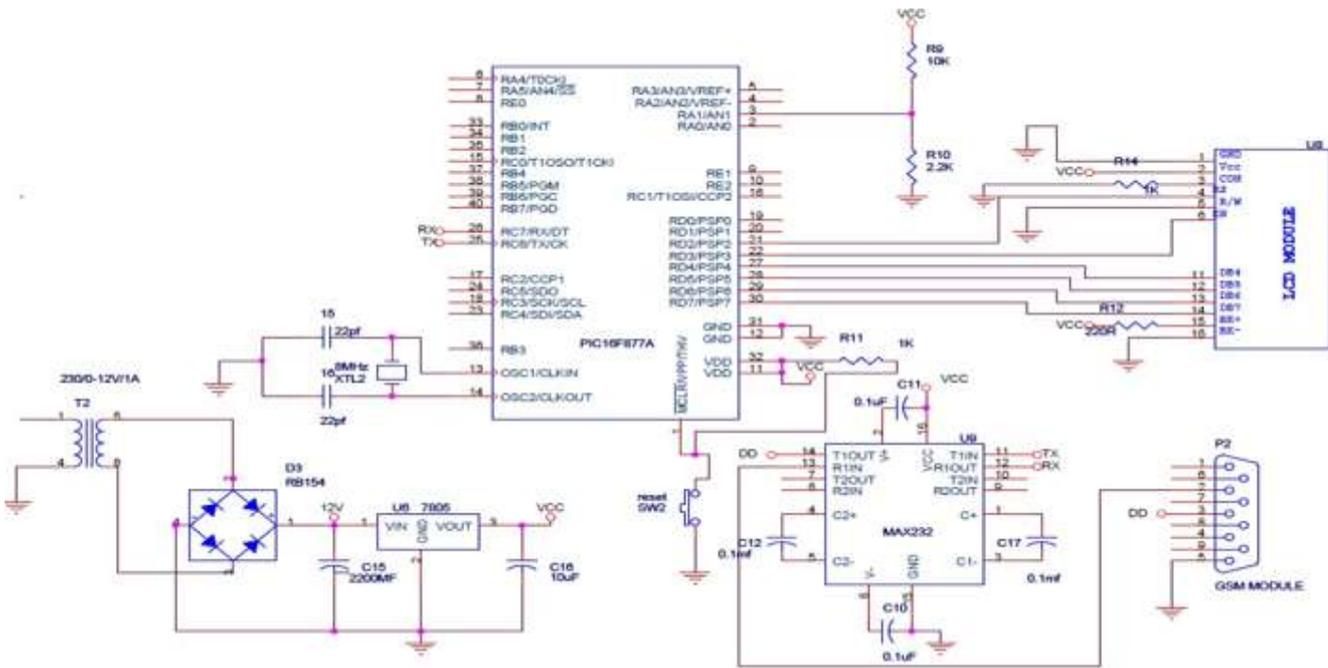


Figure 4: Circuit diagram of billing station section

### III. HARDWARE

#### a) Microcontroller PIC 16 F877P

The microcontroller unit used here is a PIC16F877A . The core controller is a mid-range family having a built-in SPI master. 16F877A have enough I/O lines for current need. It is capable of initiating all intersystem communications. The master controller controls each functions of the system with a supporting device. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (IC) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

#### b) 16x2 Character LCD

liquid crystal display (LCD) is a at panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals(LCs). LCs do not emit light directly. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no actual liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer. In most of the cases the liquid crystal has double refraction. The surface of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular

direction. This treatment typically consists of a thin polymer layer that is uni-directionally rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing. Electrodes are made of a transparent conductor called Indium Tin Oxide (ITO).

#### c) GSM Module

A GSM modem is a specialized type of modem which accepts a SIM card and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, (here we use serial connection) or it may be a mobile phone that provides GSM modem capabilities. A GSM modem exposes an interface that allows applications such as SMS to send and receive over the modem interface. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. Any phone that supports the "extended AT command set" for sending/receiving SMS messages can be supported by the Now SMS/MMS Gateway. Note that not all mobile phones support this modem interface.

#### d) MAX 232

The MAX 232 IC is used in this project to make interface between microcontroller and GSM modem. This IC is a dual

driver/receiver includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept  $\pm 30$ -V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments Lin ASIC library.

e) *Relay*

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

f) *Buzzer*

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. It is used for beep an alarm during overload.

#### IV. CONCLUSIONS

The complete working model of a smart energy meter was built which uses existing GSM system. The model satisfactorily worked with a two lamp load. Automatic meter reading and billing can be explained well using the system. Financial losses of electricity board can be minimized. Labour charges and effort can be reduced. The error, time delay that occurs due to manual metering can be avoided to a great extent. Electrical line fault detection has been made easy for the electricity board. Finally but not the least this type of meter supports remote metering which is the future of energy meters.



Figure 5: Hardware of energy meter



Figure 6: Hardware of billing station section

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