INTRODUCTION

- The scope of the project work is to introduce advanced technology in converting dc voltage into ac voltage and introducing prepaid energy metering concept.

- The energy meter used in this project work produces pulses according to the load and this meter is converted as prepaid energy meter using smart card, hence this meter can be called smart energy meter.

- This kind of smart energy meters also can be installed at each and every house, where the state electricity department going to supply the conventional energy. Now a days energy Measurement and electric energy pilferage detection has become prime importance for the state electricity department.
INTRODUCTION

✓ With the help of this project work lot of Manpower can be reduced and power pilferage can be controlled.

✓ The overall system can be called as AMR (Automatic Meter reading) system, the main advantage of AMR system is that the consumed energy price can be calculated and at the same time price (amount in rupees) can be displayed automatically.

✓ Finally the simplest form of smart metering is a display meter, which allows consumers to monitor consumption in money terms rather than kWh.
Preface

- For Spilt Meter

Metering Unit

Communicaton Cable

Monitor Unit
- **Metering Unit Of Split Meter**
  - Power
  - Infrared com
  - Credit indicator
  - Terminal Block
  - Pulse Indicator
  - Monitor unit com
  - System checking
  - Infrared Port
  - Terminal Cover
Monitor Unit of Split Meter

- LCD
- Button
- IC card socket
DISPLAY

- **LCD**

  - Relay status indication
  - Data code
  - Data bits
  - Unit
  - Currency symbol
Data code: The data code is located on the left side, the first character of 9 digits. It shows different indication codes, each code represents a kind of data.

Unit: When the displayed data is electric energy, it is kWh.

Data bits: The data content consists of 8 digits character and radix point.

Prompt information and alarm information displayed on LCD.
Three Phase Split Meter

- Metering Unit
- Communication Cable
- Monitor Unit
- Customer house
CPU card is adopted as customer card. And ESAM security module in meter is provided to carry out 3DES encryption authorization. One meter corresponds to one card to achieve perfect security.
CPU card has function of data readback. It is convenient for management department to monitor the customer’s Consumption status.
The meter has a tri-color LED to indicate the available credit levels clearly and directly.
Three levels alarm threshold

Three levels alarm threshold can be set:

- Available credit is enough
- Available credit $\leq 30\%$, not enough
- Available credit $\leq 20\%$
- Available credit $\leq 10\%$, meter may be cut off soon
Communication function

The meter is equipped with an infrared interface, via the port, can perform following operations: credit loading, relay controlling, load threshold programming etc.
SPECIFICATION

- **Working voltage**: 165V----276V
- **Insulation test**: ≥2KV AC/1min
- **Power consumption of each phase**:
  - voltage circuit ≤2W (2VA)
  - current circuit ≤2VA
- **Voltage pulses withstand**: 6000V
- **Life Span**: 15 years
- **Dimension**: 260mm*150mm*90mm
- **Weight**: About 2.3kg
- **Dimensions of Monitor unit**: 100mm*88mm*50mm
  - **Weight**: about 0.2kg
Electronic meters advantages

- High accuracy over a wide current dynamic range
- Reliability and robustness
- Flexibility of design
- Automatic Meter Reading (AMR)
- More easily enable new functionalities
- Multi tariff billing
- Tamper proofing
- Prepayment meters
- Power out range detection
- Power factor detection
- Easily reconfiguration, upgrade
- Do not use gears that wear out or magnets that saturate with DC current
- Do not require precision mechanics or have large tolerance variations over temperature
BASE UNIT

12V REGULATOR

5V REGULATOR

PWM OSCILLATOR

DRIVE STAGE USING POWER TRANSISTORS

LATCH

DIGITAL DISPLAY

MEMORY CARD DESIGNED WITH EEPROM

MCRO-CONTROLLER

DIGITAL PULSE GENERATOR

ELECTRONIC ENERGY METER

+24V

+12V

Main output Transformer

Load 500Watts Maximum

Relay Contact

Relay
RECHARGING UNIT
PWM OSILLATOR

- 24V DC is converted into 230VAC by using PWM based inverter.

- In this IC 3524, the internal linear saw-tooth oscillator is frequency programmable by resistor ‘RT’ and capacitor ‘CT’ which are connected to Pins 6 and 7 of the IC.

- To tune the frequency, in addition to 100K resistor, 50K potentiometer is connected. The oscillator frequency

  \[ f_{out} = \frac{1}{RT \times CT}. \]
PWM OSILLATOR

- The inverting input of Error amplifier (Pin No.2) is fed from V ref, built in 5V regulator through a voltage divider of two 4.7K resistors. This +5V regulator is available inside the IC.

The voltage at Pin NO.2 is \[ 5V \times \frac{4.7K}{4.7K + 4.7K} = 2.5V \]
PWM OSILLATOR

The basic concept of pulse width Modulation

✓ The switching of $+V_{sat}$ and $-V_{sat}$ is, whenever the inverting input is slightly more than Non-inverting input voltage, the output will be in $-V_{sat}$.

✓ If the non-inverting voltage is slightly more over the inverting input voltage, the output voltage will be $+V_{sat}$.

% duty Cycle = $\frac{T_{on}}{Total} \times 100\%$
In the circuit, 2N 5296 general-purpose NPN switching transistors are used to drive the driver transformer.

The output of the driver transformer is used to drive the power transistors.

For this, class ‘B’ push-pull stages are used in pre-driver stage and driver stage.

A great deal of this distortion introduced by the Non-linearity of the dynamic transfer characteristic can be eliminated by push-pull configuration.
The energy consumption measurement is carried out with the help of energy metering IC AD 7751.

By continuously monitoring both the phase and neutral (return) currents. A fault is indicated when these currents differ by more than 12.5%. The billing is continued using the larger of the two currents.

The output on the F1 and F2 is the frequency signal proportional to the energy consumption. This is calibrated as 1600 pulses per unit of electric energy consumption.
The built-in two ADCS digitize the voltage signals from the current and voltage transducers. For current signal, the current transformers (CTS) are used, two CTS are used for this purpose one is connected in series with the phase and the other one is connected in series with the neutral.

For voltage signal, the phase voltage is attenuated with the help of potential divider. For this, four numbers of 100K resistors are connected in series.
ELECTRONIC ENERGY METER

- The power is proportional to voltage, & proportional current in a fixed duration so that the energy consumed,

- i.e Energy = V * I * t.

- The frequency information on F1 and F2 in the form of active low pulses. The result is an output frequency, which is proportional to the average real power.

Freq = \(\frac{5.74 \times VIA \times VIB \times \text{Gain} \times F}{VREF2}\)
The output of energy Metering Circuit (F1 and F2) are fed to full wave bridge rectifier to convert into proportional dc voltage according to the frequency input.

This dc voltage is fed to the lamp source through the transistor driver stage.

The glowing of lamp depends upon the input signal fed by the Metering circuit.

To feed dc voltage to the lamp source, a separate step down transformer is designed, whose output voltage is an ac voltage, rectified into dc with the help of center-tapped full wave rectifier.
This dc voltage is a source of lamp supply and the ON and OFF of the lamp depends upon the ac signal produced by the AD7751 based metering circuit.

To drive the lamp source, cascaded transistors are used to increase the power handling capacity.
ADVANTAGES OF EEM

1. Accuracy
2. Low Current Performance
3. Low Voltage Performance
4. Installation
5. Tamper
Why Prepayment – Energy Supplier?

- Pay before use
- Keep customers on supply
- Recover money owed (debt)
- Lower Overheads
- No bill production
- No bill distribution
- No need to chase payments
- No further actions such as disconnections
Social Acceptability
Customer responsible for Disconnection
Load and Demand Side Management
Limit load
Load based
Time based
Why Prepayment – The Customer?

- >80% Mobile phones used in India are prepaid
- Flexible Payment Solution
- Pay to suit your income status
- Daily, Weekly, Monthly Budgeting
- Show true cost of consumption and money Left
- Reduce consumption when income is tight – make money last
- Reduce waste – conserve energy
Why Prepayment – The Customer?

- No Bills
- No hidden surprises
- No having to find the money
- No billing errors
- No socially unacceptable disconnections
DISADVANTAGES

✓ The main disadvantage of the system is, because of huge electronic hardware involved in the system, the overall system consumes more electric energy.

✓ Remedy: When the system is converted into engineering module, the bulky hardware can be converted into a small-integrated chip. When the hardware is minimized naturally the system consumes less power.

✓ Since it is a prototype module, because of huge hardware the system occupies more space.

✓ The consumer or the electrical department has to spend more amounts for installing this kind of smart energy meters. Economically it is not advised.
COMPONENTS

1) AT89c51 Microcontroller
2) AD7751 Energy metering IC
3) SG3524 Regulating Pulse Width Modulation
4) AT93c46 3-Wire serial EEPROM IC
5) LM555 Timer IC
6) Voltage regulator
7) 74LS573 Octal Transparent D-type Latch
8) Relays
9) LDR
10) LCD Display
11) Current transformer
12) Main Output Transformer
CONCLUSIONS

- Advanced electricity meters that generate consumption data enabling customers to see when they are using energy, to manage that use more efficiently.

- To save money by adjusting energy use in response to price signals.

- To save money, the consumed energy corresponding price is displayed for the consumer benefits.

- This project work has been taken up which serves the purpose of energy monitoring and controlling by implementing prepaid system.

- It is hoped that this work helps the electrical engineers for better energy management and its utility in the distribution system for economic liability of the electrical companies.
QUERIES
THANK YOU