MICROCONTROLLER BASED MAXIMUM DEMAND CONTROL

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ABSTRACT

Power is measured in instantaneous quantities, while energy is the integral of power over time. For example, a 100 W light bulb absorbs 100 W of power. If operated for one hour, that light bulb absorbs 100 W – hours of energy. Maximum demand is the maximum instantaneous power consumed over a specified window of time. In the case of that 100 W bulb, as it is switched on and off, the instantaneous demand goes from zero to 100 W to zero, etc. Not very interesting. But if that bulb is operated in parallel with a second 100 W light bulb that is left on all the time, the demand will switch instantaneously between 100 W and 200 W, and the maximum demand of the combination will be 200 W. Now, the way this is applied is that electric distribution utilities often include demand as one of the factors used to determine the bill the consumer receives. In addition to measuring integrated energy consumption over the billing period (typically a month), they also measure demand. Rather than measure truly instantaneous values, they actually measure energy over a short window of time, and then divide the energy consumed during that interval by the length of the interval to arrive at an effective peak value for the interval.

Keyword: - *MDI, Power factor, Penalty, Load management*

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1. INTRODUCTION

The greatest average value of the power, apparent power, or current consumed by a customer of an electric power system, the averages being taken over successive time periods, usually 15 or 30 minutes in length.It is the greatest demand of load on the power station during a given period, i.e., the maximum of all the demands that have occurred during a given period (may be a day, may be an hour, etc.).

1.1 Objective

MICROCONTROLLER BASED MAXIMUM DEMAND CONTROLLER is a microcontroller based project. Many companies in the mining, automobile, textile and paper industry have to pay an additional charge over and above the normal charge for units of electricity consumed as maximum demand charge. This charge often forms a large part of the bill which can be tracked at times to only one 30 minute instance of high power usage. This is because the utility company charges a penalty when the factory draws more power than the contracted maximum demand. The maximum power consumed in factories over a calculated period of time, which is normally anywhere between 8 to 30 minutes is known as maximum demand. In many countries, 15 minutes is considered as the most common time period. There are three terms that appear on majority of the company electric bills, Active energy consumption(kWh), reactive energy consumption(kvarh) and Maximum demand. Traditionally companies have concentrated their energy saving efforts on two terms,Reduction of Kilowatt Hour Consumption and Improving the electrical systems Power Factor.

1.3 Organization Report

- The report of auditorium automation with smart security system include total five chapter the very first chapter contains introductions of project and how we get motivated to do this project.
- The second chapter contains literature survey. Which include the previous workdone.
- The third chapter is system module in which the block diagram is explained along with each separate block. Each block of the block diagram is explained with their feature, specifications, advantages, application etc.
- The fourth chapter is the conclusion of the project

2. LITERATURE SURVEY

Maximum demand controller is a device designed to meet the need of industries conscious of the value of load management. Alarm is sound when the demand approaches a preset value. If corrective action is not taken the controller switches off non critical loads in a sequence.

Review of Literature:

High-tension (HT) consumers have to pay a maximum demand charge in addition to the usual charge for the number of units consumed. This charge is usually based on the highest amount of power used during some period (say 30 minutes) during the metering month. The maximum demand charge often represents a large proportion of the total bill and may be based on only one isolated 30 minute episode of high power use

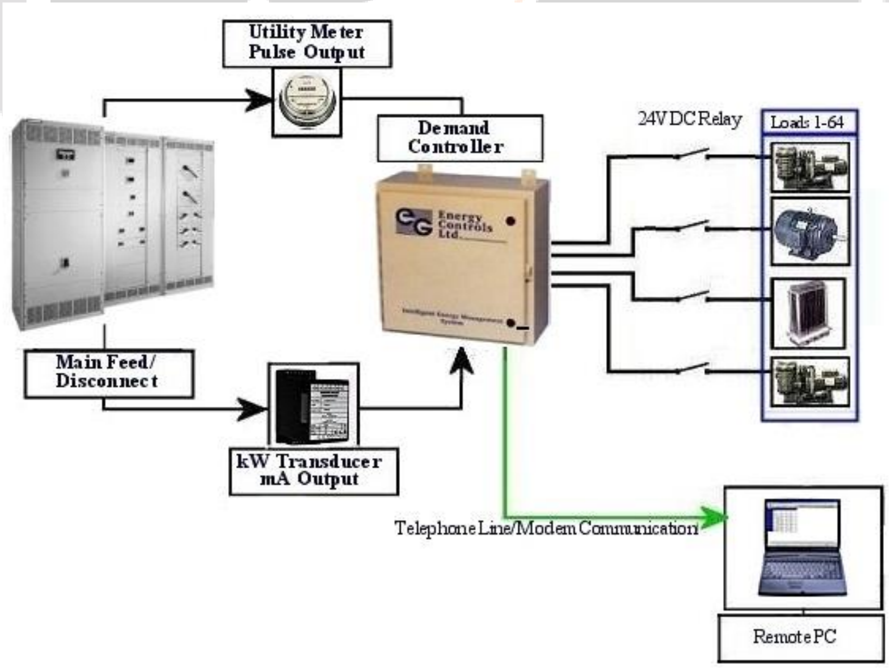


Fig1. Working model of MD Controller

3. SYSTEM MODELING

3.1SystemBlockDiagram

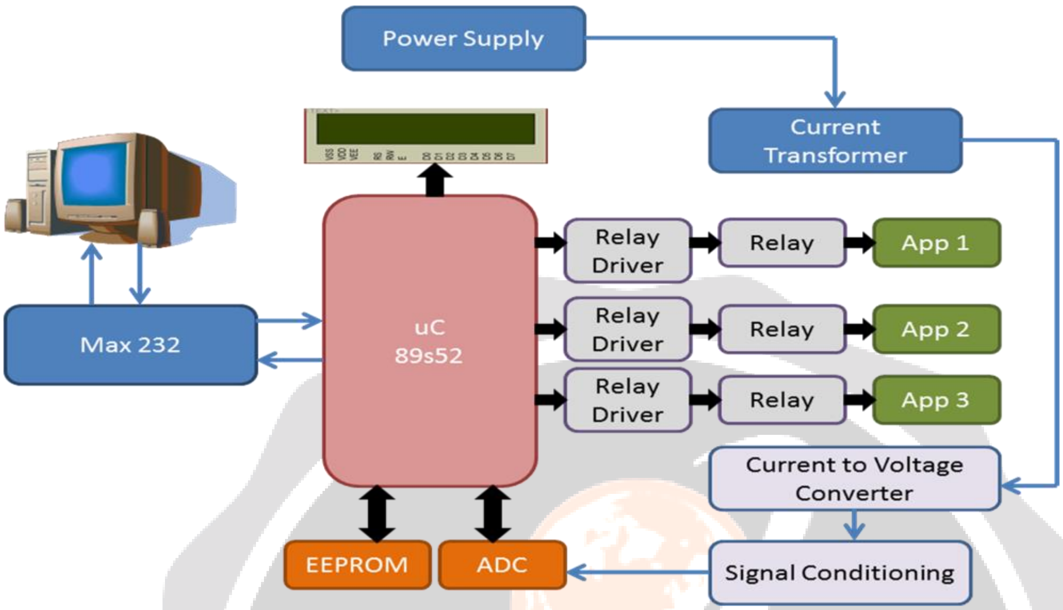


Fig.2. Block diagram of Maximum Demand Controller

3.2 Block Diagram Description:

3.2.1 Microcontroller :

The controller is the heart of entire system, and the whole system should be analyzed in selecting the proper controller. We will be using ATMEL's AT89S52 microcontroller. It is a 40 pin microcontroller with 128 bytes RAM & 4kb flash memory.

3.2.2 ADC:

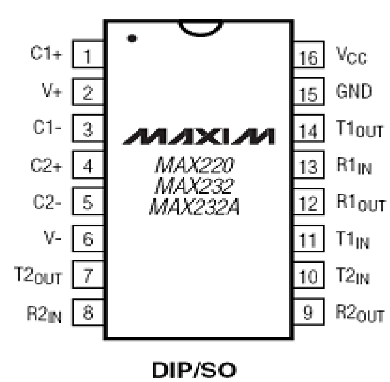
Analog to digital conversion is an electronic process in which continuously variable (analog) signal is changed, without alternating its essential contents, into multilevel (digital) signal. It compares the analog input voltage to know reference voltage and then produces a digital representation of this analog input. Output of an ADC is digital binary code. By its nature, an ADC introduces quantization error. This is the simply the information that is lost, because for continuous analog signal there are an infinite no of voltages but only a finite no of ADC digital codes. The more digital code that the ADC can resolve the more resolution it has and the less information lost to quantization error.

3.2.3 MAX 232:

MAX 232 is a line driver intended for RS 232 protocol. It works on 5V but for RS 232 protocol it generates ±12 volts. So basically it requires converting 5 volts to ±12 volts, for which it has inbuilt Voltage Doubler circuit & a Voltage Inverter circuit. For these two inbuilt circuits we require to provide external capacitors.

Features of MAX232:

- Superior to Bipolar
- Operate from Single +5V Power Supply (+5V and +12V—MAX231/MAX239)
- Low-Power Receive Mode in Shutdown (MAX223/MAX242)



- Meet All EIA/TIA-232E and V.28 Specifications
- Multiple Drivers and Receivers
- 3-State Driver and Receiver Outputs Open-Line Detection (MAX243)

3.1.4 Relay and Relay Driver Section:

Relays are devices which allow low power circuits to switch a relatively high Current/Voltage ON/OFF. For a relay to operate a suitable **pull-in & holding current** should be passed through its coil. Generally relay coils are designed to operate from a particular voltage often its 5V or 12V. Over here we have used a 12v relay with which we can switch 5A load current. This relay is also commonly known as CUBE Relay. The relay basically consists of five terminals, two of them are used for the coil & the remaining three consists of a common pole & one Normally Closed (NC) & Normally Open Pole.

3.1.5 LCD:

A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly.The 2 X16 Parallel LCD is an 8 bit or 4 bit parallel interfaced LCD. This unit allows the user to display text, numerical data and custom created characters. Liquid Crystal Display (LCD) which we have used is 2x16 LCD i.e. two lines each with 16 characters. We have used the LCD in 8 bit mode i.e. 8 data lines are required. Other than 8 data line one RS, one RW & one Enable line is also required.

Features of LCD:

- 5 x 8 dots with cursor
- Standard Type
- Uses HD44780 Controller
- Works with almost any Microcontroller
- Great Value Pricing
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

fig.3. LCD

3.1.7 Current transformer:

Current transformers (CTs) are an indispensable tool to aid in the measurement of AC current. They provide a means of scaling a large primary (input) current into a smaller, manageable output (secondary) current for measurement and instrumentation. A CT utilizes the strength of the magnetic field around the conductor to form an induced current on its secondary windings. This indirect method of interfacing allows for easy installation and provides a high level of isolation between the primary circuit and secondary measurement circuits. CTs are available in various sizes, designs and input ranges and output signal types.

4. PERFORMANCE ANALYSIS:

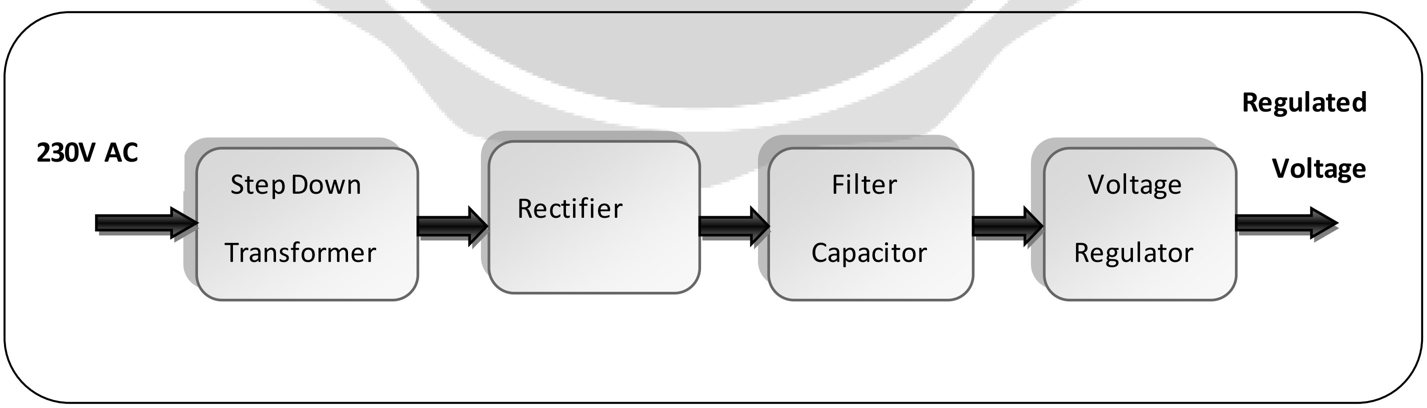
4.1 Design Stages

Our project design consists of power supply section. Power supply section consist of step down transformer rectifier, filter circuit and voltage regulator. Detailed explanation of each block as follows:

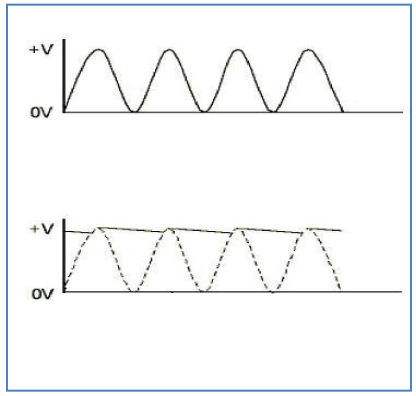
4.1.1 Power Supply Design Details:

Power supply is supply of electrical power. A device or system that supplies electrical or other types of energy to an output load is called a **power supply unit** or **PSU**. There are different types of power supplies e.g. Battery power supply, unregulated power supply, linear or regulated power supply etc.All digital circuits require regulated power supply. In this article we are going to learn how to get a fixed regulated positive supply from the mains supply.

Fig3. Below shows the basic block dig of fixed regulated power supply.



We require 5 volts for microcontroller, LCD, EEPROM & approximately 12 volts for the Relay. These voltages are generated from 230v line voltage. Initially a step down Transformer is used to step down 230volts to 9volts, so a 0-9V; 500ma step down transformer is used. The output of the step down transformer is also AC, we convert this AC voltage into DC by using a Full wave bridge rectifier consisting of Diodes D1, D2, D3 & D4. During the positive half cycle diodes D1 & D4 conduct whereas in the negative half cycle diodes D2 & D3 conduct thus the diodes keep switching the transformer connections so we get positive half cycles in the output.. Even though half wave & full wave rectifier give DC output, none of them provides a constant output voltage. For this we require to smoothen the waveform received from the rectifier. This can be done by using a capacitor at the output of the rectifier this capacitor is also called as “FILTER CAPACITOR” or “SMOOTHING CAPACITOR” or “RESERVOIR CAPACITOR”. Even after using this capacitor a small amount of ripple will remain.We place the capacitor at the output of the rectifier the capacitor will charge to the peak voltage during each half cycle & then will discharge its stored energy slowly through the load while the rectified voltage drops to zero, thus trying to keep the voltage as constant as possible. If we go on increasing the value of the filter capacitor then the Ripple will decrease. But then the costing will increase. The value of the Filter capacitor depends on the current consumed by the circuit, the frequency of the waveform & the accepted ripple.



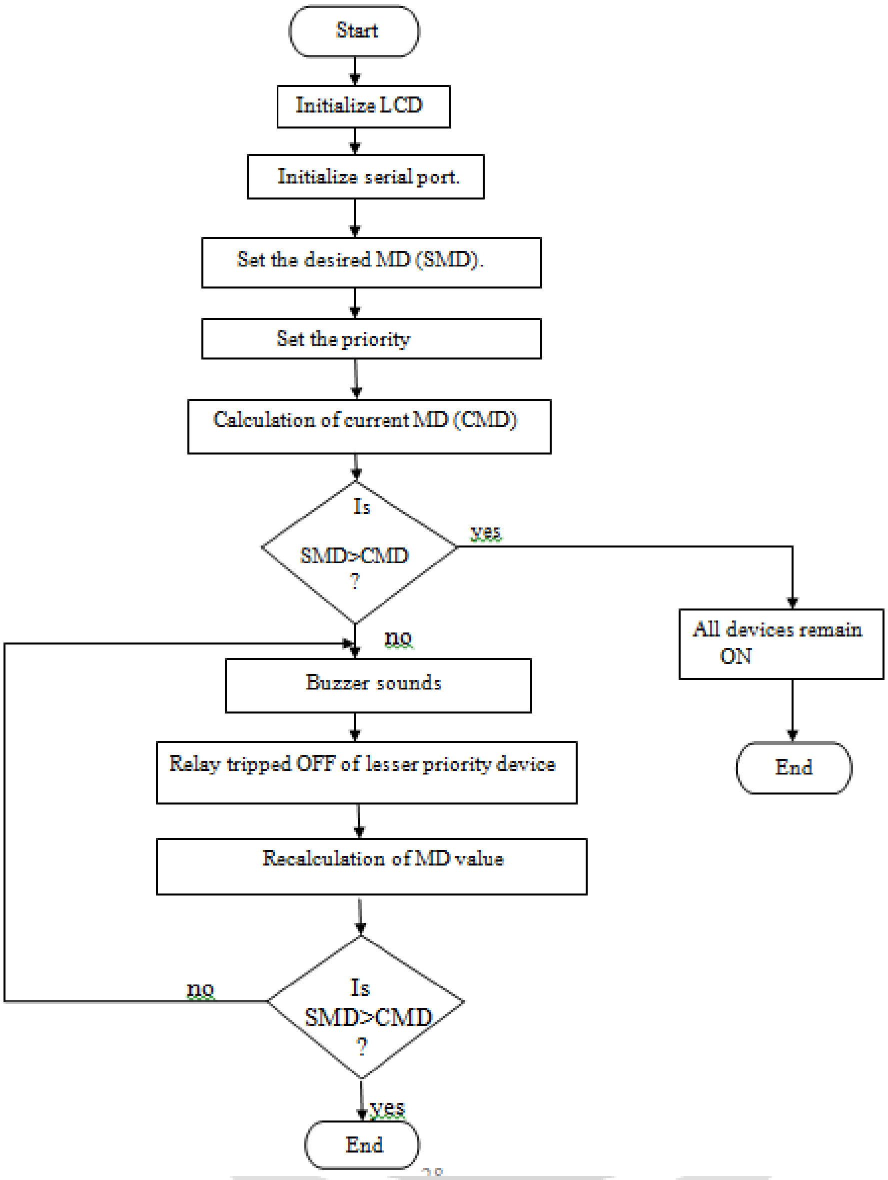
$$C=V_r*F/I$$

Where,

V_r= accepted ripple voltage.(should not be more than 10% of the voltage) .I= current consumed by the circuit in Amperes. F= frequency of the waveform.

After filtering the rectifier output the signal is given to a voltage regulator. The maximum input voltage that can be applied at the input is 35V.Normally there is a 2-3 Volts drop across the regulator so the input voltage should be at least 2-3 Volts higher than the output voltage. If the input voltage gets below the Vmin of the regulator due to the ripple voltage or due to any other reason the voltage regulator will not be able to produce the correct regulated voltage. We require 5V output so we use IC 7805 where 78 indicates that it’s a positive series & the 05 indicates the output voltage. Another capacitor C4 is used after the voltage regulator, this is used to remove any ripples or noise generated in the V_{cc}. D7 is an LED used to indicate the Power Status. For our all IC we required 5 volt dc supply which can be generated by step down transformer, full wave bridge rectifier, filter condenser and voltage regulator IC 7805. 12 volt supply for relay is generated separately using the same procedure as abov

4.2.2 Flow Chart



5. CONCLUSION

A good record of the load pattern is obtained which enables accurate predictions and better load distribution. The capital outlay for maximum demand control is low. With good maximum demand indication, it is possible to create awareness of where and when power is used and consequently gets greater power utilization. The data obtained from the MDI controller may be used for the design and development of Smart Grid. Helpful for prediction of estimated load in large load dispatch centre. Proper utilization of electrical power during off peak period. The data obtained from the MDI controller is useful for the automation of Distribution system.

5.1 Advantages

- Reduce contracted power and adjust the levels of power required.
- Prevent maximum demand penalties.

- Reduces man power
- Control of power consumption by monitoring the readings.

5.2 Applications

- Maximum Demand Controller is a device designed to meet the need of industries conscious of the value of load management. Alarm is sounded when demand approaches a preset value. If corrective action is not taken, the controller switches off non-essential loads in a logical sequence.
- An electrical demand control program is highly recommended in the processes with an operation that has large variations in the maximum demand and low load factors, such as smelting, mining, automotive, textile and paper companies, among others.
- **5.3 Future Scope**
- The energy consumption in residential sector is increasing daily. Tariff applicable in industries ensures that they manage their load efficiently during peak period using MD controller. There is need for load management to be exercised by the domestic users as well hence we can configure the MD Controller according to the domestic design.
- MD Controller can be implemented through wireless techniques by using RFID method which can further reduce the implementation complexity of installation. It can also be more mobilized by implementing the set up using GPRS.Power factor can be improved

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