MAXIMUM DEMAND CONTROLLER FOR HT INDUSTRY

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Abstract

This paper is developed to maintain the relationship between the power protection and requirement. In our country power generation is always lesser than the requirement. Ultimately distribution of the generated power to the users constantly is a big work. In these circumstances EB limits the power to the industrial user. The EB's predefined time duration is 30 minutes; a day consists 48 electrical cycles and 60 days for metering. If the user exceeds the EB limit the user will be penalized to a heavy cost for a particular predefined duration. To overcome this problem we can use a computer to monitor the power allotted and power consumed by the user at each moment. The loads will be tripped of automatically whenever the actual comes close to the demand.

Index Terms: PIC Microcontroller, Maximum Demand, HT Industry, Visual Basic

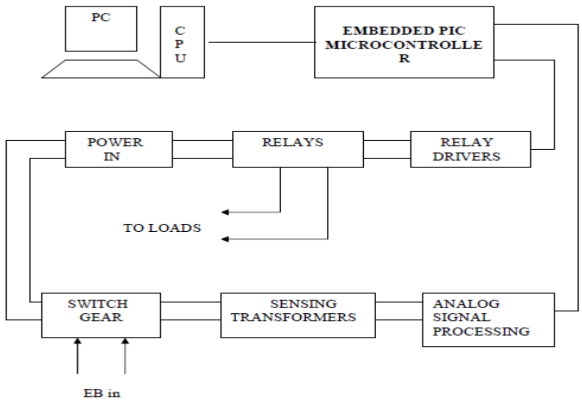
I. INTRODUCTION

Electrical energy aids in the development of technology. All new technological advancements in commercial, domestic and industrial sectors are established with the electrical resource. Thus, electrical energy is the need of the hour to support the rapid developments in the world. Considering the actual scenario, electrical energy is not generated to meet the increasing demand, as it is dynamic in nature and production cannot be increased every day. It requires a lot of planning and execution based on the requirements. So, this leaves a huge gap between generation and consumption of electrical power. This gap can be bridged by disconnecting the loads during peak hours. But this will lead to inconvenience for the consumers. This situation can be overcome by using the available electrical power efficiently.

High tension consumers use large loads for their production purposes. They are allotted with the maximum demand from the electricity board. Maximum Demand is the highest amount of power drawn from the grid by the consumer during any 30 minutes of the billing period. It is their responsibility to maintain their consumption within limits. If they fail to do so, they are subjected to heavy penalties. It is difficult to monitor the consumption manually and it may lead to errors, resulting in additional charges in bills, which is very large. Thus it is very essential to control the maximum demand.

The loads can be classified into vital and non-vital a load which assists in fixing their priorities. A solution to prevent the occurrence of additional charges, is by controlling the loads based on priorities with respect to time. A 16F877A microcontroller is used for controlling the loads automatically. Thus, the electrical demand of the world is satisfied economically by scheduling the maximum demand rather than increasing the generation of electrical power.

II. DESIGN OF SYSTEM HARDWARE



A. Hardware Design

The single board is designed around the PIC Micro controller to accomplish the above mentioned system requirements. The hardware section is divided into three subsections as follows:

(1) PIC Micro controller
(2) Max 232
(3) Power supply unit

B. PIC Microcontroller 16F877A

The PIC Micro controllers are supported with a full range of hardware and software development tools. The used PIC16F877A device comes in 40-pin package To communicate with the PIC we are using RS232 port of the computer. So we have to initialize the port before using it. To initialize and to communicate with the PIC, the file COM.C defines and uses several functions. The functions and their definitions are given below.

Features:

- RISC architecture: Only 35 instructions to learn.
- 35 input/output pins
- 256 bytes EEPROM memory
- Enhanced USART module: Supports
- RS-232 and RS-485.

C. MAX 232

The Max 232 is a dual RS-232 receiver / transmitter that meets all EIA RS232C specifications while using only a +5V power supply. It has 2 onboard charge pump voltage converters which generate +10V and –10V power supplies from a single 5V power supply. It has four level translators, two of which are RS232 transmitters that convert TTL\ CMOS input levels into + 9V RS232 outputs. The other two level translators are RS232 receivers that convert RS232 inputs to 5V
TTL\CMOS output level. These receivers have a nominal threshold of 1.3V, a typical hysterisis of 0.5V and can operate upto + 30V input.

1. Suitable for all RS232 communication
2. +12V power supplies required.
3. Voltage quadrapular for input voltage upto 5.5V (used in power supply Section of computers, peripherals, and modems).

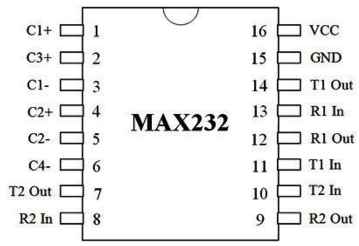
Three main sections of MAX232 are

1. A dual transmitter
2. A dual receiver
3. +5V to + 10V dual charge pump voltage converter.

Features of MAX232:

- Operate from Single +5V Power Supply
- Operates up to 120 kbit/s.
- Multiple Drivers and Receivers

DC and microcontroller (μC) operates on 5V DC. The current in the loads is sensed by the current transformer and is given to the signal conditioning unit. The appropriate signal is given to the



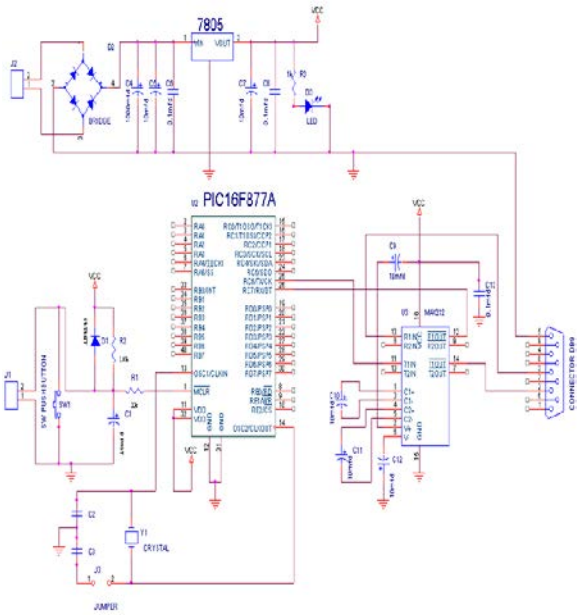
Consists of a common pole & one Normally Closed (NC) & Normally Open pole.

D. Power Supply Section

The MAX232 power supply section has 2 charge pumps the first uses external capacitors C1 to double the +5V input to +10V with input impedance of approximately 200Ω. The second charge pump uses external capacitor to invert +10V to –10V with an overall output impedance of 45Ω.

The best circuit uses 22μF capacitors for C1 and C4 but the value is not critical. Normally these capacitors are low cost aluminium electrolyte capacitors or tantalum if size is critical. Increasing the value of C1 and C2 to 47μF will lower the output impedance of +5V to+10V doubler by about 5Ω and +10V to -10V inverter by about 10Ω. Increasing the value of C3 and C4 lowers the ripple on the power supplies thereby lowering the 16KHz ripple on the RS232 output. The value of C1 and C4 can be lowered to 1μF in systems where size is critical at the expense of additional impedance at –10V input.

From the circuit it can be seen that the reference analog supply after being regulated by the 9v regulator enters the Zener diode through the resistance R4 where it is again regulated to 5v since the Zener diode used here has a cut off of 5v. Thus we have a double regulated completely filtered analog reference source. R6 is a potential divider used for setting the dynamic response range of the reference supply. This means that the reference 5v can be used as it is or it can be made into a fraction of the 5v for example 1v so that readings in this range can be read with more precision. This is because the ADC has 10 bit resolution which can be totally used for representing the 1v rather than 5v.

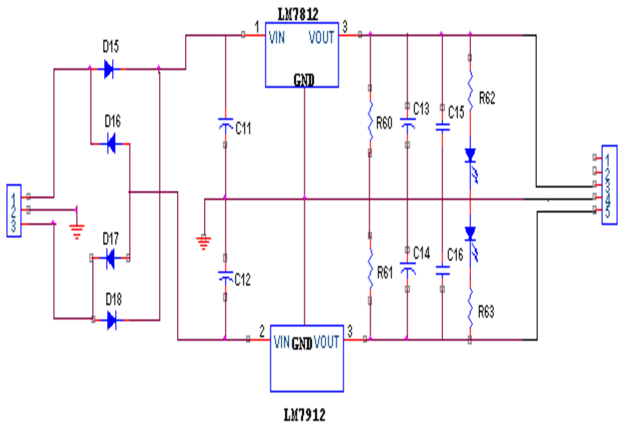


The pins 2-5, 7-10, 35 and 36 are used as the 10 channels of the ADC. To these pins the analog inputs to be processed by the ADC are given. Y1 is the crystal oscillator used. It is of 10 MHz and gives a baud rate of 9600 bits/s. The capacitors C2 and C3 are used as decoupling capacitors to remove the high frequency noise signals.

The capacitor C1 is in the off condition when power is switched off. When the power is switched on or reset then this capacitor gets charged through the resistor R2 and then through R1 this appears at the MCLR pin of the PIC. This is the memory clear pin and thus the memory is cleared and is ready for use as soon as power is switched on. S1 is the synchronous switch which is also used for the same operation and for PC and PIC synchronous operation.

E. Power Supply Unit:

As we all know any invention of latest technology cannot be activated without the source of power. So it this fast moving world we deliberately need a proper power source which will be apt for a particular requirement. All the electronic components starting from diode to Intel IC's only work with a DC supply ranging from -+5v to -+12v. We are utilizing for the same, the cheapest and commonly available energy source of 230v-50Hz and stepping down, rectifying, filtering and regulating the voltage. This will be dealt briefly in the forth-coming sections.



F. Instrument Transformers:

Instrument transformers are used in the measurement and control of alternating current circuits. Direct measurement of high voltage or heavy currents involves large and expensive instruments, relays,and other circuit components of many designs. The use of instrument transformers, however, makes it possible to use relatively small and inexpensive instruments and control devices of standardized designs. Instrument transformers also protect the operator, the measuring devices and the control equipments from the dangers of high voltage. the use of instrument transformers results in increased safety, accuracy and convenience.

There are two distinct classes of instrument transformers

(1) Potential transformer

(2) Current transformer

Potential Transformers:

The potential transformer operates on the same principle as a power or distribution transformer. The main difference is that the capacity of a potential transformer has ratings from 100 to 500 volt amperes (VA). The low voltage side is usually wound for 115 V.The load on the low voltage side usually consists of not only the potential coils of various instruments but may also include the potential coil of relays and other control equipments. In general the load is relatively light and is not necessary to have PT's with a capacity greater than 100 to 500 VA.The high voltage primary winding of a PT has the same voltage rating as the primary circuit .Assume that it is necessary to measure the voltage of a 3.3KV ,single phase line.

The primary of the PT is rated at 3.3KV and the low voltage secondary is rated at 110V.The ratio between the primary and the secondary winding is: 3300/110 or 30/1

A voltmeter connected across the secondary of the PT indicates a value of 110V.To determine actual voltage on the higher voltage circuit, the instrument readings of 110V must be multiplied by 30. 110*30=3300V.In some cases , the voltmeter is calibrated to indicate the actual value of voltage on the primary side.As a result,the operator is not required to apply the multiplier to the instrument reading and the possibility of error is reduced. This PT has subtractive polarity.(All instrument PT's now manufactured have subtractive polarity).One of the secondary leads of the transformers in figure is grounded to eliminate high voltage hazards. PT's have highly accurate ratios between the primary and secondary voltage values. Generally the error is less than 0.5%.

Current Transformers:

Current transformers are used so that ammeters and the current coils of other instruments and relays need not be connected directly to high voltage lines. In other words, these instruments and relays are insulated from high voltages. CT's also step down the current in a known ratio. The use of CT means that relatively small and accurate instruments, relays and control devices of standardized design can be used in circuits.

The CT has separate primary and secondary windings. The primary winding which consists of few turns of heavy wire ,wound on a laminated iron core is connected in series with one of the line wires. The secondary winding consists of a greater number of turns of a smaller size of wire. The primary and secondary windings are wound on the same core. The current rating of the primary winding of a CT is 100 A. The primary winding has three turns and the secondary winding has 60 turns. The secondary winding has the standard current rating of 5A; therefore the ratio between the primary and secondary current is 100/5 or 20/1.The primary current is 20 times greater than the secondary current. Since the secondary winding has 60 turns and the primary winding has 3 turns ,the secondary winding has 20 times as many turns as the primary winding. For a CT, then the ratio of primary to secondary currents is inversely proportional to the ratio of primary to secondary turns.

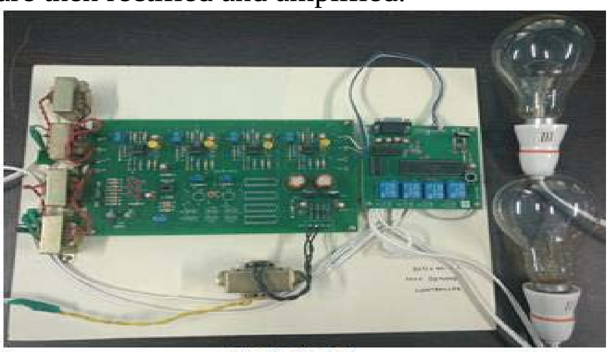
In figure Ct is used to step down current in a 3300V , single phase circuit. The CT is rated at 100 to 5 A and the ratio of current step down is 20 to 1.In other words, there are 20 A in the primary winding for each ampere in the secondary winding.If the ammeter at the secondary indicates 4A,the actual current in the primary is 20 times this value i.e80 A.

The CT in the figure has polarity markings in that the two high voltage primary leads are marked H1 and H2 and the secondary leads are marked X1 and X2.When H1 is instantaneously positive ,X1 is positive at the same moment.Some CT manufacturers mark only the H1 and X1 leads.When connecting the CT's in circuits ;the H1 lead is connected to the line lead feeding from the source while the H2 lead is connected directly to the ammeter.Note that one of the secondary leads is grounded as a safety precaution to eliminate high voltage hazards.

III. RESULTS & DISCUSSION

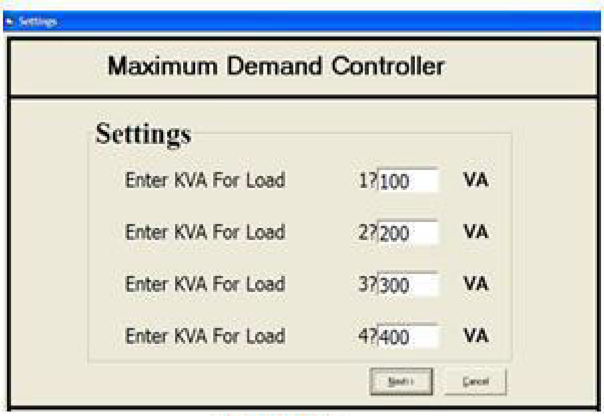
The implementation of the concept of Maximum Demand Controller has been illustrated below.

STAGE 1: Lamps are considered as the loads in this illustration. The loads are connected to the network. Potential and Current transformers monitor the voltage and current values which are then rectified and amplified.



STAGE 1.

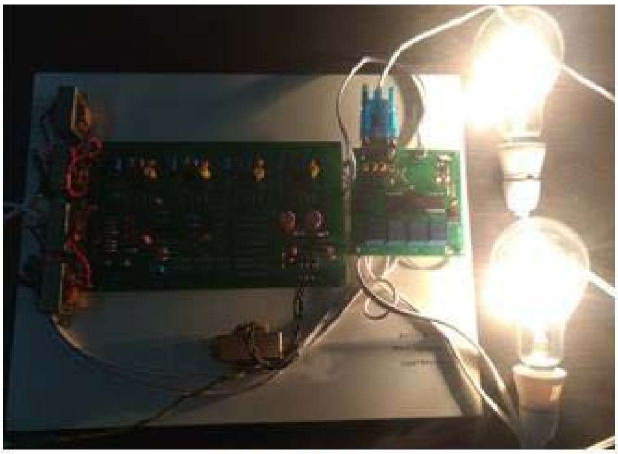
STAGE 2: Limits are assigned to the loads in this dialogue box.



STAGE 2.

LOADS	VA SETTINGS
Load 1	100 VA
Load 2	200 VA
Load 3	300 VA
Load 4	400 VA

STAGE 3: Time period of 10 minutes has been assigned. When the timer is ON, the loads are connected to the network. This is considered as the normal working condition.

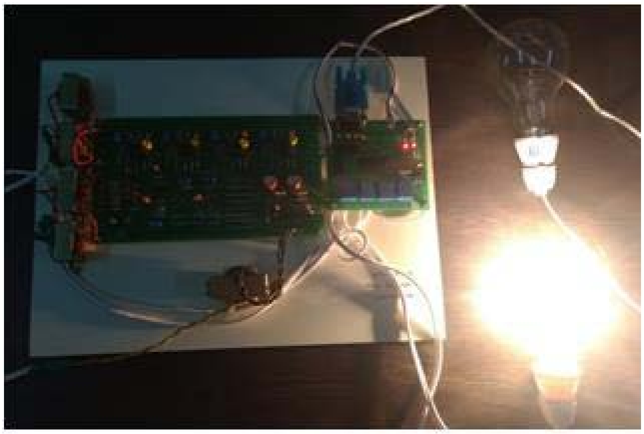


STAGE 3.

STAGE 4: The voltage and current values are displayed in the dialogue box. Integrated and instantaneous VA values are also calculated and displayed instantaneously. The status of each load can also be identified. Database gives the detailed account on the power consumption. On-Line graph displays the voltage and current values with respect to time. Voice commands can also be activated to notify the status of the tripped loads.

STAGE 5: When the load reaches its limit, it is automatically tripped.

Note: The lowest priority load is tripped first



STAGE 5.

IV. CONCLUSION

Maximum Demand Controller is used to maintain the maximum demand of the high tension industries within limits, which is designed using a 16F877A microcontroller. In order to maintain the maximum demand, the loads are tripped based on the priorities given using a program logic written in Visual Basic 6.0. The loads are then automatically switched on after the peak periods, thus contributing to an interrupt free operation in the industries. The loads are controlled in every cycle of the billing period. It enhances the operating efficiency of the industry as overloading is reduced during peak hours and contributes stability in the power system. It also prevents them from paying heavy penalties when they exceed the maximum demand allotted.

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