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MINIMIZING PENALTY IN INDUSTRIAL POWER FACTOR CORRECTION BY ENGAGING APFC UNIT

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ABSTRACT:

The objective of this paper is implemented a new technology for power factor correction of 3 phase induction motor as correction of power factor is essential. So we need to find out the cause of power loss and correct the power system.In this study, many small rating capacitors are connected in parallel and a reference power factor is set as desired value into the microcontroller. The starting of capacitor is more impracticable then we used appropriate number of static capacitor is automatically connected according to the directive of microcontroller be corrected the power factor near to unity. Voltage and current transformers have been connect for transforming load voltage and current respectively to bring them in specific working range of microcontroller. It is proven in this action that phase difference between voltage and currentcan be determine using zero crossing detector,opto-coupler and the basicfunction of microcontroller(AT89C51).The major advantages and disadvantages are highlighted and the field of application is found.

KEYWORD: ***Power factor correction, static capacitor, relay, transformer, microcontroller.***

I. INTRODUCTION

In the country like India, energy scrape is one of the major anxiety. In the industrial sector various motoring load are frequently running and generating the inductive load.so the power factor in this system get reduce due to the inductive reactor. Similarly the power factor is the invisible factor, which cause a great loss of electrical energy and also damage the electrical equipment.Power factor value measure how much

main efficiency is influenced by both phase angle in between voltage and current and harmonics of load current. So the APFC(automatic power factor correction) device is a very helpful device for improving efficient transmission of active power. The power factor is nothing but the cosine angle between voltage and current.Automatic power factor correction device read power factor from the line voltage and line current by demonstrative the delay in the advent of current signal with respect to voltage signal from the function generator with high accuracy by using an internal timer .This time value are calibrated as phase angle and respective power factor. Then the value aredisplay in LCD module.Power factor is a ratio of KW and KVA.KW is an actual load power and KVA is the apparent load power .It is a major of how effectively the current is being converted into useful work output. The signicances of high power factor has been identified by the residentialand commercial sector for their ownbenefits. The Reactive power does not included in the electrical bill so far this cause dissipation power loss at the load which output to anincrement of electricity bill charge .Penalty charge is one of the issue occurring if the power system is low.They are

1) Losses in transformer
2) Voltage drop at secondary of the transformer
3) Considerable voltage drop
4) Extra loss in feeder cable.
5) Deficiency of effective capacitive of cable.
6) The data labeled in Table 1 have been concluded after a Asian wide Power Quality survey undertaken by the Asian Copper Institute in 2002. Other data is ABB experience data.

A. POWER FACTOR THEORY

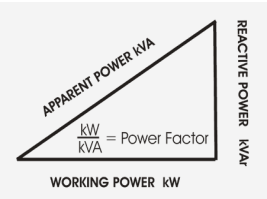


Fig. 1. Power Triangle

Active power:The active power is the real power delivered to the loads such as motors, lamps etc. The actual amount of power being consumed or dissipated in a circuit is called active power .it is measured in watt and it's denoted by P.

Reactive power: The reactive power is used just for the purpose of producing magnetic field for the flow of active power.It is measured in volt-Ampere-reactive (VAR) it denoted by Q.

Apparent power:The apparent power is the combination of the active and reactive power.it is a product ofpharos voltage and current. It measured in volt-ampere.

Power factor:Power factor is defined as the ratio between the active powers (KW) to the total apparent power (KVA) consumes by an AC electrical devices and complete electrical installation.

Power Factor= Active Power / Aparant Power

It denotes of how efficiently electric power is converted into useful work. A pure power factor due to an inductive load can be corrected by the addition of power factor correction by static capacitor. So power factor is also defined as the cosine of the phase difference between current and voltage.

B.CAUSES OF LOW POWER FACTOR

The low power factor is mainly due to the fact that most of the power loads are inductive the current islagging. Socapacitor is connected to load parallel with the load for leading power.These inductive load constitute your system. Most inductive equipment has nameplate with operating data, including its power factor.

C.POWER FACTOR CORRECTION

Low Power factor is reason by inductive loads. Inductive loads postulate the current to create a magnetic field that produces the desired work. The effect is an enhancement in reactive and apparent power and a decrease in the power factor, or efficiency, of a system. Since the power factor is defined as the ratio of KW to KVA, we see that low power factor results when KW is small in relation to KVA. An inductive load includes transformers, induction motors, and induction generators, high intensity discharge lighting. These inductive loads constitute your distribution system. This increase in reactive power results in large angle between KW and KVA. This large angle decreases the power factor. The efficiency of inductive equipment and system power factor will vary depending on its manufacturer, design, size and age. Most inductive equipment has a nameplate with operating data, inclusive its power factor at rated load.

II. PRINCIPAL

The current and voltage signal are accrues from the main ac line by using current transformer and potential transformer this acquired signal are then pass on the zero crossing detectors. The bridge rectifier for both current and voltage signal transpose the analog signal to the digital signal.

Automatic power factor correction device (APFC) is developed based on the microcontroller IC 8051. The voltage and changed into square wave using zero crossing detector. The difference is premeditated with high precision by using internal timer. Microcontroller sends out the signal switching unit that will switchon the value of capacitor. The capacitor banks are switched as per the calibration in step.

III. PROPOSED WORKED

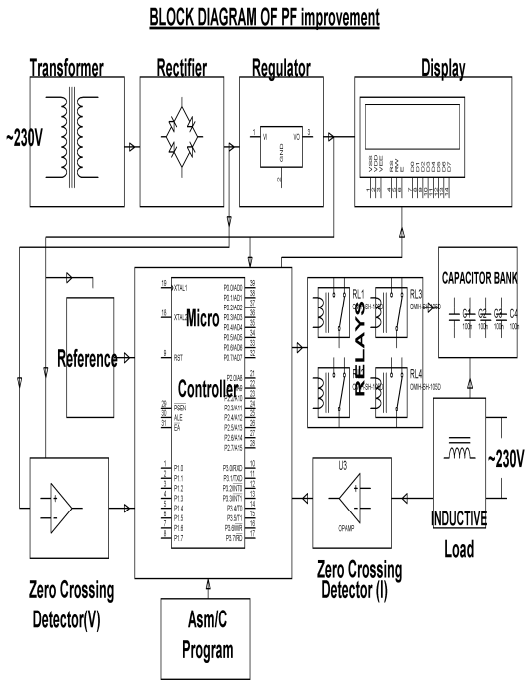


Fig.2.Block Diagram Of APFC Unit

A. POWER SUPPLY

In power supply we are using step-down transformer. The 230 V ac input supply is given to the primary of the transformer. Transformer is an electromechanical static device which transforms power from one circuit to another without changing its frequency. Due to the magnetic effect of the coil the flux induced in the primary is transferred to the secondary coil.

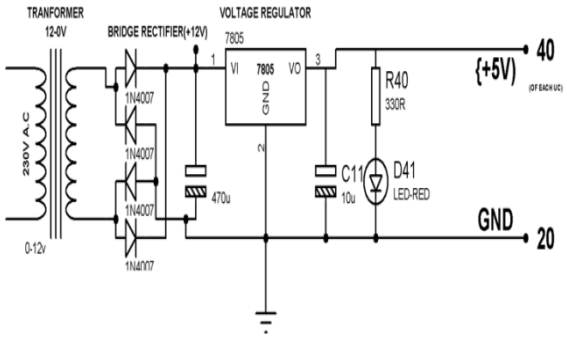


Fig.3. Power supply of microcontroller

B.RECTIFIER

The main function of the rectifier is to convert the ac voltage to the dc output. The diode is a primary component in most of the rectifier circuits since it conducts in one direction. This property of diode convert the sinusoidal voltages with zero average value into waveforms that contains both ac and dc components (pulsating dc). It is anfull wave bridge rectifier.

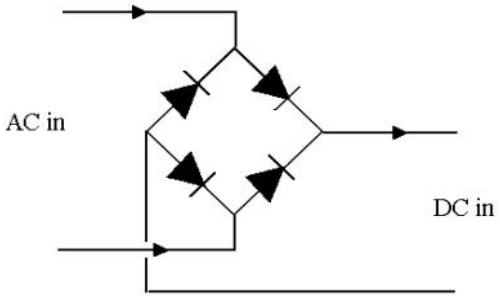


Fig. 4.Full Wave bridge Rectifier

C. VOLTAGE REGULATOR

The main function of the voltage regulator is to convert the variable output DC voltage into the constant DC voltage which is required for the supply for the microcontroller and zero crossing detector.

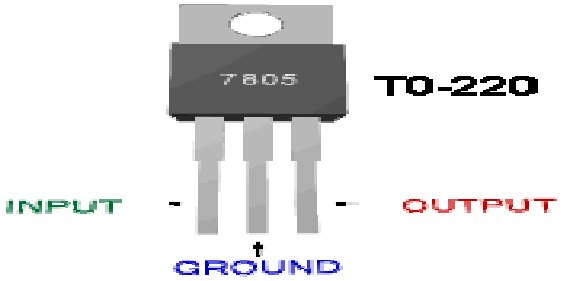


Fig. 5. 7805 Voltage Regulator

D.ZERO CROSSING DETECTORS

The zero crossing detector circuit is an important application of the op-amp comparator circuit. It can also be called as sine to square wave convertor. It is used todetect sine wave zero crossing from positive half cycle to negative half cycle. The mention voltage with which the input voltage is to be compared, must be made zero.

E.MICROCONTROLLER

Microcontroller is an IC chip that executes programs for controlling other devices or machines. It is a micro (small size as an integrated circuit chip) device which is used for control of other devices and machines, that's why it is calledmicrocontroller. It is a microcontroller having RAM, ROM and I/O ports.

8051 microcontroller is applied in automatic power factor correction panel. The microcontroller receives the load current in the line and gives the signal to the relay driver and simultaneously connects the capacitors as per the requirement.

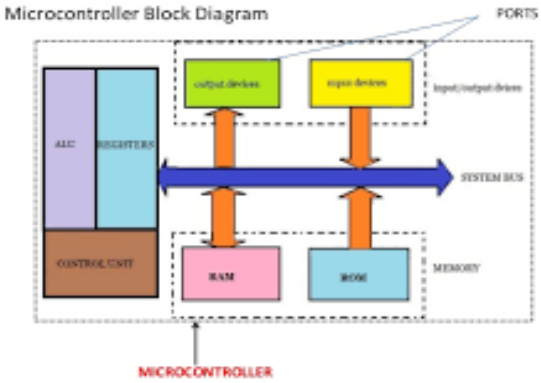


Fig. 6.Internal Structure Of 8051 Microcontroller

F.RELAY

A relay is an electrically operated switch. Huge relays utilization an electromagnet to serve a switching mechanism mechanically, but other operational principles are also used. Relays are used where it is essential to monitoring a circuit by a low-power signal or where several circuits must be controlled by one signal. Current flowing through the coil of the relay makes a magnetic field which magnetizes a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw switch

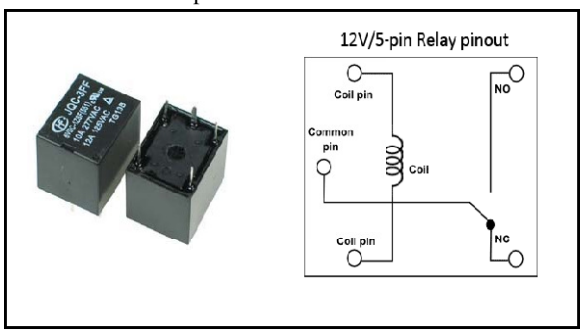


Fig. 7. Reay Unit

G. RELAY DRIVER

Relay Driver is interfaced with the microcontroller output. It is used to drives the multiple relays as per the compensation required. Relay driver IC used in this project is ULN2003.

H.LCD

LCD stands for liquid crystal display. It is a flat panel display or other electronic phenomenon display that uses the light modulating properties of liquid crystals. LCD is used to show the present power factor. 16x2 LCD is connected with 8051 microcontroller. It is receivable in a 16 pin package with back light, protest correspondence function and each dot matrix has 5×8 dot resolution

.Fig.8. LCD (Liquid Crystal Display)

I.CAPACITOR BANK

Capacitors can be included for compensation of power factor through relay. A capacitor bank is a cluster of separate capacitors of the

common rating that are connected in series or parallel with each other to store electrical energy. The emergebank is then used to counteract or accurate a power factor lag or phase shift in an ac power capacitor does. They are designed to store electrical energy the most common use of a capacitor bank instead of ac power supply error correction is in industrialenvironments which use a major number of transformers and electric motors.

The actual capacitor in farad of a capacitor bank can be calculated using the followingequation.

C= VAR /2*3.14FVr2

Where, VAR = capacitor unit rating

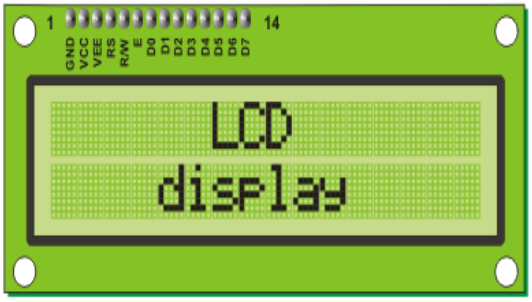
C= capacitor in farad

F= Frequency

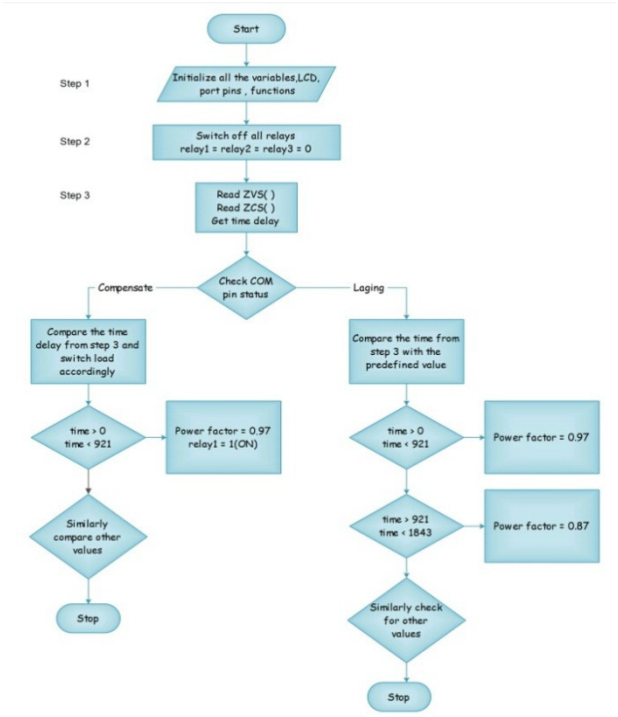
Vr = capacitor unit rated voltage.

IV.*RELATION OF CAPACITOR WITH POWER FACTOR*

power. Table 1 describes the common loads appear in general industrial systems and their typical power factor. In universal, pow As majority power system has inductive load thus normally only lagging power factor occurs hence capacitors are used to compensate by producing leading current to the load to reduce the lagging current, there by shrink the phase angle distance between the real power and apparent er capacitors shall be Y connected on the three phase distribution feeder. Grounding the neutral is necessary for the fuses to convey in case of any event of capacitor fault.Standard capacitors available are 50,100,150,200,300 and 400 KVAR. Since capacitors can be connected more than one per phase in order to increase the bank size, it is recommended to select two or at most three capacitor unit sizes to avoid stocking the sizes. In a fixed capacitor designed, one should at first calculates desired power factor value before attempting to implement one implementing fixed capacitor can nearly correct the power factor around 94% to 96%. When using switched capacitor to correct the power factor of a circuit, the switch control is set to close the bank onto the line when the load KVAs equal to two-thirds of the banks rated KVAR. This scheme is tend to reduce loss by driving the line leading with first turn on before it is turn off, this is referred as the "two-thirds rule". Taking a daily load cycle, compare with fixed capacitor bank, switching capacitor bank is generally uneconomical thus it is essential to take accounting of the cost of install.



V.FLOWCHART



A. *ALGORITHM FOR CONTROL SCHEME*

Step 1- Set the user define lower and upper power factor (LPF & UPF).

Step 2- congregation the user defines threshold value of current (TUC).

Step 3- Find out power factor.

Step 4- Find out significance of current.

Step 5- if significance of current is less than TUC, take no action and go to step 3**.**

Step 6- if the concernment of power factor is between LPF and UPF take no action and go to step 3.

Step 7- if the concernment of power factor is less than LPF switch on the next off capacitor and wait for 1.0 seconds. Go to step 3**.**

Step 8- If the significance of power factor is more than UPF or as leading, switch off the first on capacitor and wait for 1.0 second**.** Go to step 3. B.ON/ OFF OF CAPACITOR For the equally utilization of capacitors, we have chosen a method. In this systemon/ off of capacitor.

VI. HARDWARE RESULTS AND DISCUSSION

CASE 1: Resistive load when resistive load is ON, as shown in Fig. There is no phase relay between current and voltage signals and they are in phase. In this case the power factor would be 0 .9 as referenced value so there is no insertion of capacitors In case of resistive load the V and I are in phase so there is no insertion of capacitors to improve power factor .The load monitoring of resistive load by microcontroller is shown on LCD.

CASE 2: When chock (inductive load) is ON: There is phase delay between voltage and current signals, Microcontroller senses the Delay produced by the load, and according to the delay it instill the desired value of capacitor to improve the power factor of the system. When the desired value of the capacitors added the required reactive power to the system, the current and voltage waveforms are in phase. After the insertion of required value of capacitor, the V and i zero cross detector signals are also in phase in accordance with the set referenced.

VI.CONCLUSION

This paper dispense the technique used to overcome the power loss due to low power factor indefinite with same residential and small industrial unit. The static capacitor is used in industries to improve the power factor in industry and distribution lines.Inthis project weusecapacitor only whenpower factor is low an otherwise they can be reduce from the line. Thus it not only improves the power factor but also increase the line capacity, efficiency. The power factor of any distributed line can also be improve in low cost and small rating capacitors.

In that microcontroller algorithm incorporates switching capacitances inline automatically through solid state relay.

VII.FUTURE ENHANCEMENTS

The automotive power factor correction using capacitive load banks is very efficient as it reduces the cost by decreasing the power drawn from the supply. As it operates automatically, manpower are not required and this Automated Power factor Correction using capacitive load banks can be used for the industries purpose in the future. In future PWM techniques can be employed in this scheme. Along with power factor correction also speed control can be done in future. In future, Work can be done for harmonics reduction**.**

VIII.ACKNOWLEDGEMENT

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