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3-Phase power factor corrector

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Abstract: ***In AC systems the power factor has very much importance. The cosine of the angle between voltage & current is called as POWER FACTOR. Depending upon the nature of load the power factor is termed as LAGGING, LEADING or UNITY. Lagging for inductive loads, leading for capacitive loads & unity for resistive loads. In industries the motors operated are of inductive nature which has lagging power factor. The lagging power factor causes poor voltage regulation, large copper losses etc. Hence it is important to have improved power factor for efficient working of systems. Purpose of this project is to correction of power factor, so that efficiency of the equipment can be increase.***

Keywords: *3-Phase power supply, Power factor, Reactive power, Active power, Capacitor, Contactor.*

I. INTRODUCTION

POWER FACTOR is the ratio between the useful (true) powers (kW) to the total (apparent) power (kVA). Consumed by an item of A.C. electrical equipment or a complete electrical installation. It is a measure of how efficiently electrical power is converted into useful work output.

$$\text{Power Factor (pf)} = \frac{\text{Real Power (kW)}}{\text{Apparent Power (kVA)}}$$

A poor power factor is usually the result of a significant phase difference between the voltage and current at the load terminals, or it can be due to a high harmonic content or a distorted current waveform. A poor power factor is generally the result of an inductive load such as an induction motor, a power transformer and ballast in a luminaire, a welding set or an induction furnace.

Power factor is depends on types of load. Lagging power factor for Inductive load, leading power factor for Capacitive load and unity power factor for Resistive load. Range of power factor is in between either 0 or 1. Generally unity power factor (1) is not possible due losses.

II. COMPONENTS TO BE USEDLIST OF COMPONENT

1. MicrocontrollerAT-89S52 40 pin
2. 2x16 LCD
3. 12-0-12 AC Transformer (500mA)
4. Diodes -- 4007-2
5. Capacitor-- 470mf/100mf
6. 5v Regulator 7805 with heat sink
7. LM358 dual operation amplifier
8. PT -- 230v/12 VAC
9. CT -- 1:5000,
10. Relay – SPDT
11. Contactor

III. DEFINITION

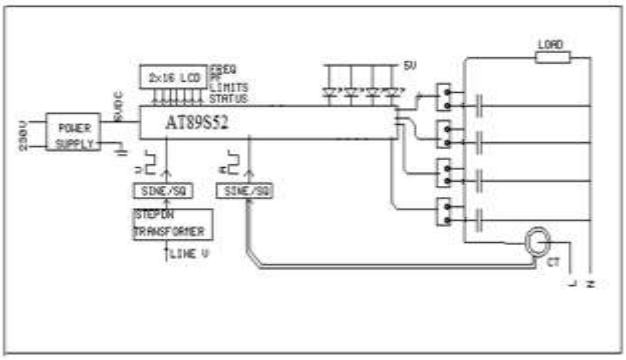
- Power factor correction is defined as cosine angle between Voltage and Current. Its also defined as ratio of Real Power(kW) and Apparent Power(kVA).

Apparent Power = S = P + j Q	VA
Real Power = P = |V||I| cos (θ)	W
Reactive Power = Q = |V||I| sin (θ)	VAR
Power Factor = PF = cos (θ)	

- There are two parts in our project one is controller part and another one is power part.

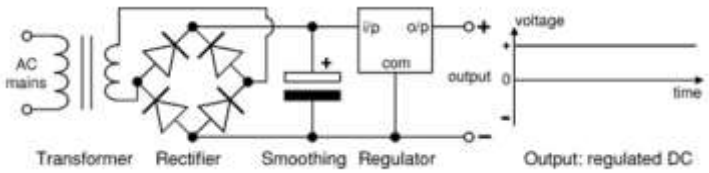
IV. Block Diagram

(CONTROLLER PART)



POWER SUPPLY

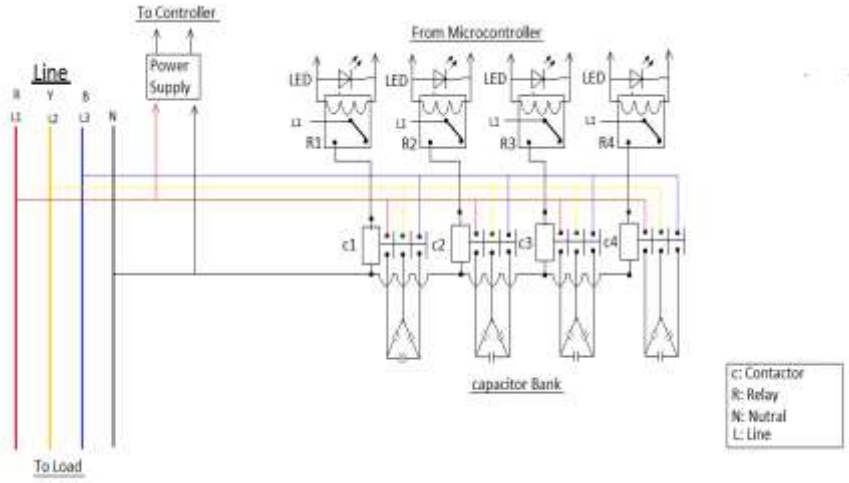
Transformer + Rectifier + Smoothing capacitor + Regulator:



- Controller works on +5v DC supply. If we use 5v DC battery for supplying microcontroller, it will discharge soon so we have to fix this problem. The solution is to use rectifier circuit. The whole arrangement is as soon in above figure.
- Above figure consists one transformer. The transformer is of single phase step down type transformer. The supply is taken from the three phase power supply. The secondary winding is connected to the rectifier circuit input. The transformer will step down the voltage at 12v to 15v.
- The rectifier circuit is used to convert the AC power into DC power. The AC power which is taken from the output of transformer is converted into DC power. We have to convert this power into DC because the microcontroller operates only on DC power. But the output from the rectifier is not directly applied to the controller.
- It is because the output from the rectifier is not pure DC. It is pulsating DC. It means there is a part of AC power is still there in the power. We have to filter this pulsating DC. A capacitor is used for this purpose. The capacitor is named as 'Smoothing Capacitor'. This capacitor will bypass the AC portion from the power and will not allow the DC portion to pass through it.

- The next thing the controller requires is constant DC power supply. The output from the filter is not constant. We need +5V DC constant. For regulating the power we have used an IC which is 7805. With the help of this IC the DC power is regulated. Means we will get regulated +5V DC supply in output of the IC 7805.

V. POWER DIAGRAM



- As shown in figure, the capacitor bank is connected with the contactor. Each bank is connected with an individual contactor. The phase terminal of the contactor is connected with the NC terminal of the relay as shown in figure. The relays are also connected one per capacitor bank. The neutral terminals of all the contactors are connected to the neutral of the supply shown in figure.
- The Common terminals of all the relays are connected with single phase supply. this single phase supply is taken from the three phase supply which is given to load. Now when the relay gets signal from microcontroller the relay operate and change its position from NO to NC.
- This will energize the contactor. Because when the relay operates the contact of relay will be at NC terminal which is connected with the phase terminal of the contactor. So the contactor coil will get energized and the plunger of the contactor will get attracted towards the coil. Due to this the capacitor bank will get connected to the line. It will be connected in parallel with the load. So due to this the power factor of the load is improved.
- Another single phasing taping is taken from the three phase supply which is given to the controller through transformer and rectifier to provide the DC +5V to the microcontroller. This arrangement is known as power supply.
- The method for improving the power factor we have used is Static Capacitor. We have connected the capacitor bank in parallel with load. We can connect the capacitor bank also in series with load. Then it will be the capacitor booster method, which we haven't used. In capacitor bank, capacitors are connected in delta connection. We can also connect the capacitors in star connection.

VI. REFERENCES

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