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 ijirset@gmail.com

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Power Saver for Industries and Commercial Applications

Sudarshan Jadhav¹, Abhijit Kotkar², Sandip Jadhav³, Prof. Kirti Kulkarni⁴, HOD Deepak Kadam⁵

Department of Electrical Engineering, MET's Institute of Engineering, Nashik, India

ABSTRACT: The power factor correction of electrical loads is a common problem to almost all the industrial sector. Most of the loads draw a certain quantity of active power together with reactive power from the mains. The Active power (kW) actually performs the work whereas the reactive power (KVAR) could be interpreted as an undesirable burden on the supply. Automatic Power Factor Controller (APFC). Here we are going to use capacitor (KVAR) as per the requirement in the line. The control unit checks for the (KVAR) requirement in the running KW load and even if the load is changed the control unit selects the appropriate capacitor bank to keep the power factor to unity.

KEYWORDS: Power factor, system, Industry, Power factor.

I. INTRODUCTION

Pure resistive loads convert the Electrical Power to another form viz., Heat, Light or Mechanical Power. For, these types of loads, which have no Inductive or capacitive components, the voltage and current wave form, intersect the "Zero" co-ordinate at the same point. For such Resistive loads, the voltage and current are set to be "In-Phase the Active power (kW) actually performs the work whereas the reactive power (KVAR) could be interpreted as an undesirable burden on the supply. The Micro-controller AT89C52 is the heart of the circuit. It takes the readings of voltage and current, which is converted, into digital form by A to D converter.

The controller even checks for the zero cross over for calculating the phase difference of the voltage and current. Further it controls the capacitor banks for maintaining the power factor to unity and it also displays the readings for voltage, current, Power factor, no. of bank switched on the LCD display. The general Industrial Scenario with the present day's trend on Energy Saving Devices like AC/DC Drives, Soft Starter, UPS etc., lead to underutilization of the available power. To overcome this and to avail Quality Power, a suitable Power Quality System needs to be considered taking into account Power Quality Issues viz., Power Factor, Harmonics etc. For Industries like spinning mills, rice mills the reactive power requirement is steady and constant. Such types of Industries fall under constant Load Pattern. The variation for such loading pattern is very minimal. The industrial motors are subject to different loads based on the production capacity. Hence, the loading on the motors varies from time to time. These loads are termed as Varying Loads. The varying loads involve differing instantaneous Power Factor, effectively meaning varying lagging Reactive Power (KVAR).

II. LITERATURE SURVEY

The general Industrial Scenario with the present day's trend on Energy Saving Devices like AC/DC Drives, Soft Starter, UPS etc., lead to underutilization of the available power. To overcome this and to avail Quality Power, a suitable Power Quality System needs to be considered taking into account Power Quality Issues viz., Power Factor, Harmonics etc. The general Industrial Conditions prevalent are listed below and the appropriate System needs to be selected accordingly.

Nature of Load:

Most of the loads are basically Inductive in nature and these Inductive loads operate at a maximum load factor of 80% i.e., a 1 HP Motor will be loaded only up to 0.8 HP at any given instance. But the overall Operational Factor of these Loads will be as low as 20% to 40% depending on the application i.e., for the 1 HP Motor, the continuous pattern of load will be only around 0.2 to 0.4 HP but with the peak loading of 0.8 HP. There are special loads like Pressing, Welding Machines, Shears etc., where the load variation is from 0% to 80% in which case 0.8 HP is applied for a short period and the motor will be running at no load in other periods. . In all industries, combination of standard running motors and special application oriented motors will be operating together.

Constant Load Pattern:

For Industries like spinning mills, rice mills the reactive power requirement is steady and constant. Such types of Industries fall under constant Load Pattern. The variation for such loading pattern is very minimal.

Varying Load Pattern:

The industrial motors are subject to different loads based on the production capacity. Hence, the loading on the motors varies from time to time. These loads are termed as Varying Loads. The varying loads involve differing instantaneous Power Factor, effectively meaning varying lagging Reactive Power (KVAR).

Dynamically Varying Load Pattern:

Highly oscillating / fluctuating Loads are termed as dynamically varying Loads. Dynamically Varying Loads like Welding machines are known to have extremely wide fluctuations and consume large amounts of reactive power. Power factor correction is a frequently misunderstood topic. Improper techniques can result in over-correction, under-correction, and harmonic resonance, so it is necessary to select the correct system and apt sizing for Reactive Power Compensation. Following loading patterns are considered for the selection of Suitable Capacitor/Reactive Power Compensation System. For Steady Loads, the Capacitors can be connected across the terminals. A correctly sized capacitor installed in parallel to each individual Inductive Loads like Motor etc., improves the Power Factor. When load levels are high, a shunt capacitor system is highly beneficial. However, when the load drops off, the capacitor poses more harm to the System compared to its benefits. An excess of capacitance in service can lead to higher than desired voltages, excessively leading power factors, and resonance phenomena.

Precautions:

The capacitor power rating must not be over-dimensioned to avoid self-excitation. The recommended value is 85% of the no-load magnetizing KVAR. Wherever Motor with high centrifugal mass is used, further care should be applied to select the correct sizing. Generally shunt connected capacitors can cause excitation thereby producing dangerous over-voltage at the time of switching OFF. This can cause damage to the Capacitor and Motor. The Type of switching devices shall also be considered as appropriate while connecting the capacitors on the motor terminals. Wherever critical devices are used, the capacitors shall be preferably connected before the Switch Gear and separate contact should be provided to connect these capacitors. In such case, interlock or timer must be incorporated in the control system to prevent the capacitors switching ON again, before discharging. In the case of Star – Delta Switch or Star - Delta Contactors, the capacitors shall be switched ON in the delta condition.

Features required for Fixed Connection of Capacitors

The Capacitors shall be of Heavy Duty, Dry type, and MPP design with low wattage losses. The Capacitors shall be guaranteed for specific harmonic withstanding capability. The Over current withstanding capability of the capacitors should be 2 times the rated current continuously and 350 times the rated current during short peak operation. It should be built with specific features like Pressure Disconnect or, Anti-Loosening terminals etc.

Drawbacks of direct Connections:

Danger of Excess Capacitance/leading Power Factor operation at light load conditions It is not easy to install the capacitors directly to inductive load due to switching surges of the load and other phenomenon associated with capacitors such as discharge time, self – excitation etc.

Danger of Resonance Offers low impedance to Harmonics. Hence frequent failures are possible when Capacitors are connected in a System containing harmonics.

Banked Capacitors/Banked Capacitors with Protection MCBs: Banked Capacitors are used wherever the KVAR Requirement is high and loading pattern is constant like in a Spinning Mill. Banked Capacitors are also available with Protection MCBs, which protects the Capacitors in case of any abnormal conditions.

Manual Switched Banked Capacitors: Manually switched Banked Capacitors are used wherever it is necessary to operate each step of the Capacitor bank individually in a manual fashion depending on the KVAR requirement like in an Industry where the machines are operated based on 25%, 50%, and 100% loading. Each capacitor circuitry pertaining to the particular loading pattern can be operated individually through Capacitor Duty contactors and Push Buttons for Switching ON and OFF.

Auto Switched Banked Capacitors: These types of Capacitor Banks are commonly used for Individual Motor Compensation, wherein the Capacitor is switched ON after a period of delay from the Switching ON of the Motor. The



delay is basically introduced, since the Inrush current of Induction Motor is usually 7 to 9 times higher than the rated current. Hence, to avoid such higher magnitude currents through the capacitor, time delay is introduced through a timer circuit.

Varying loads: The present day electrical networks cater to a variety of loads like UPS, Soft Starter etc. which dynamically fluctuates and creates waveforms distortion thereby necessitating an apt APFC System, which is self-adaptable with short reaction times for extremely fluctuating power levels.

III. METHODOLOGY

Inductive devices like motors or transformers load generators, supply lines and electrical distribution systems with reactive current as well as active current. Capacitors are used for power factor correction and use in filters, which are able to prevent most of this reactive current from reaching power generation/transmission plant. The PFC controller comprises of the voltage sensing, current sensing, A to D converter, Display unit, micro-controller etc. The PFC controller continuously monitors the voltage, current and the respective zero cross over for calculating the power factor. Now, if the load is connected and the power factor changes i.e. if it lags the controller senses the same immediately and switches the capacitor bank one by one making the power factor near to unity. If the load is removed at that time the power factor is more than 1 so the controller senses the same and removes the capacitor to make it unity. The Micro-controller AT89C52 is the heart of the circuit. It takes the readings of voltage and current, which is converted, into digital form by A to D converter.

The controller even checks for the zero cross over for calculating the phase difference of the voltage and current. Further it controls the capacitor banks for maintaining the power factor to unity and it also displays the readings for voltage, current, Power factor, no. of bank switched on the LCD display.

• **BLOCK DIAGRAM:**

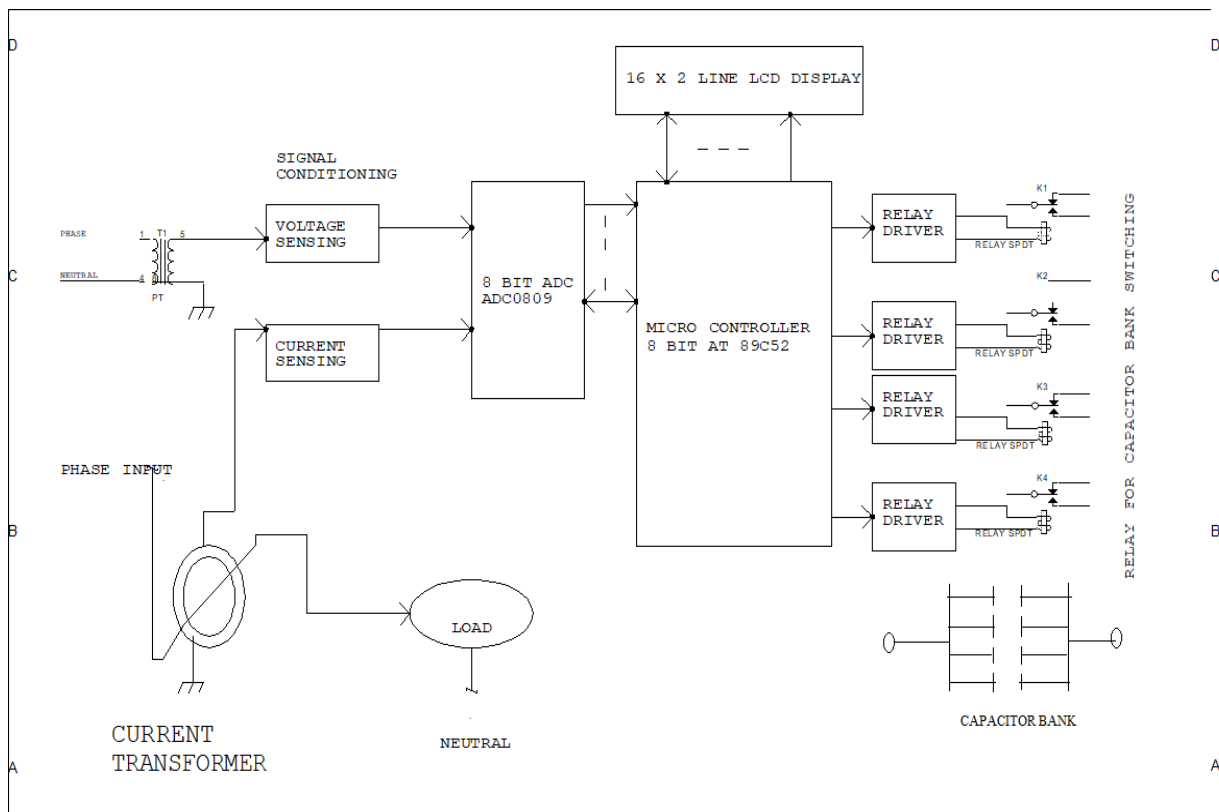


Fig 1: Block diagram



Thermistor Module:

The Microcontroller controls the thermistors for switching in and out the capacitor. The thermistors are totally isolated from the controller by using up to couplers for applying the gate signal.

Current Harmonic Detector:

This block consists of an analog circuitry using comparator for detecting the current harmonics in the line. It gives signal to the controller whenever the content of harmonics increases.

Voltage sensing and signal conditioning:

This block senses the phase-to-phase voltage and then converts the same in to appropriate form using operational amplifier so that it can be given to the ADC.

Current sensing and signal conditioning:

This block senses the current with the help of CT and converts this current into voltage. This voltage is converted in to appropriate form using operational amplifier so that it can be given to the ADC.

Keypad:

Keypad is nothing but 4 switches used to enter different values. The four switches perform the functions such as increment and decrement of values. All the switches are directly interfaced to the micro controller to do the further processing.

Analog to digital converter:

The ADC0809 is used for converting the analog voltage signal coming from voltage signal conditioning circuit, from CT etc. It accepts the analog inputs from various blocks and gives the digital output of the same to the microcontroller for performing various calculations.

LCD display:

We have interfaced a 16 x 2line LCD display for displaying the various parameters.

Capacitor Module:

Here we have used four delta-connected capacitors, which are added parallel to the line as per Kvar requirement.

IV. CONCLUSION

Thus we have studied various methods of improving the power factor and their drawbacks. We have also designed the system for reducing the drawbacks of the existing system. The different method of switching the capacitors in 3 phase line is also studied. We have also seen different benefits of the system and the requirement of the user. Our project is design to fulfill a certain aim i.e. to correct the power factor in 3 phase line automatically, which can be installed for dynamically changing loads. Thus we are going to implement this project practically by reducing the switching period of capacitors, using static devices like SCRs, thermistors etc. Thus this project has a lot of scope in future that has to be implemented and checked..

• **FUTURE SCOPE**

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REFERENCES

1. en.wikipedia.org/wiki/Power_factor_correction
2. Jones,L.D.;Blackwell,D.(1983)“EnergySaverPowerFactorControllerforSynchronousMotors”,IEEETransactions onPowerApparatusandSystems,Volume:5,Issue:5,Pages:1391-1394.
3. KeithHarker(1998).“PowerSystemCommissioningandMaintenancepractice.”London:InstitutionofElectricalEngineers.



4. Stephen, J.C. (1999). "Electric Machinery and Power System Fundamentals." 3rd ed. United States of America: McGraw-Hill Companies, Inc.
5. Barsoum, Nader (2007) "Programming of PIC Micro-Controller for Power Factor Correction" IEEE Conference on Modeling & Simulation, Pages: 19-25.



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