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Three Phase Reactive Power Compensator & Power Factor Correction by using Static VAR Compensator (SVC).

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***Abstract*— A lower power factor increases losses and a penalty is inflicted by the benefit. In modern industry, the implementation of the automated method can suffer a decrease in power factor due to the use of different electrical equipment which requires more reactive power. Significant savings in utility energy cost can be understood by keeping up with the average monthly power factor close to the unit. What mentioned before the defect is overcome the defect is overcome by the power factor correction. Power factor correction is technology to reduce the unwanted effects of electrical loads that create a power factor of less than one. In this paper, an correction of the power factor the module that monitors the power factor and is built it and corrects the power factor. Power factor correction is a way to reduce the unwanted harmful effects of electrical loads that makes the power factor less than one. It is at this that the power factor correction unit is built which monitors the power factor and corrects the power factor. The phase difference between voltage and the current is determined using zero-crossing detectors with some basic function of a microcontroller.**

Keywords- power factor, capacitor bank, relay, microcontroller, rectifier, current transformer, potential transformer

I. INTRODUCTION

Thepower quality in the AC system is of much interest because, from the rapidly growing numbers of electronic equipment, High voltage power systems, and power electronics, everybody commercial and industrial installation in India are great an electrical load that is likely to be inductive. This causes the power factor to lag which gives a high penalty to the consumer. The high penalty case is dealt with before power factor control. Power factor control is the method of reducing the unwanted impact of energy causing loads to factor down to less than one.

In AC circuits, the power factor can be described as an Actual (real) power ratio doing the work and Apparent power supplied to the circuit. Reality energy is characterized by the ability of the circuit to be on perform work at a specified time. Mover, it is clear that the power is nothing but the product of the voltage and current of the circuit.

Power factor can reach values in the range of 0 to 1. Power factor tends to zero when all exponents are present only reactive ability known as an inductive load. Likewise, P.F. is one when only real power exists in the present, known as the resistive load correct P.F. is nothing but adjusting the electrical circuit so that the power is the factor can be changed near 1. Improve the power factor close to 1 compensates for the reactive force present in the electrical circuit hence most of the energy present would be real energy. Hence, this reduces the power line losses. The power factor correction can be associated with an electrical energy source to enhance the efficiency system along with the stability of the transmission network. Moreover, to achieve cost reduction, the improvement can be made through electricity suppliers charging for individual electricity customers.

II. STATIC VAR COMPESATOR (SVC)

Astatic VAR compensator (SVC) is a group of electrical devices to provide fast-acting reactive power to high voltage electricity transmission networks. SVC are parts of the flexible AC family of transmission system devices, which regulate voltage, power factor harmonics, and stabilize the system. The static VAR compensator doesn't have a moving part (other than the internal switchgear). Before the invention of SVC, power factor compensation was the preserve of large rotating machines such as synchronous capacitors or transformer capacitor banks.

The SVC is an automated impedance matching device, designed to bring the system closer to the unity power factor. SVCs are used in two main situations:-

- Connected to the power system, to regulate the transmission voltage ("Transmission SVC")
- Connected near large industrial loads, to improve power quality("Industrial SVC")

In transmission applications, SVC is used to regulate the network voltage. If the reactive load of the system is capacitive (leading) then SVC will use thyristor controlled reactor to consume VARs from the system, thus providing a high voltage to a system. By connecting the thyristor controlled reactor, which is continuously variable leading or lagging power.

In industrial applications, SVCs are typically placed near high and rapidly varying loads, such as arc furnaces, where they can smooth flicker voltage.

III. VARIOUS METHODE OF POWERFACTOR IMPROVEMENT

There are three main ways to improve power factor:-

- **Capacitor Banks.**
- **Synchronous Condensers.**

- **Phase Advancers.**

Capacitor Banks:-

Improving the power factor means reducing the phase difference between voltage andcurrent. Since the majority of loads are inductive, theyrequire some amount of reactive power to function.

A capacitor or group of capacitors installed in parallel with the load provides this reactive power. It acts as a source of local reactive energy, thus less reactive energy flows through the line. Capacitor banks reduce the phase difference between voltage and current.

Synchronous Condensers;-

Synchronous capacitors are three-phase synchronous motors with no load attached to their shift.

The asynchronous motor has the characteristics of operation under either leador lags powerfactor or unit dependingon excitation. For inductiveloads, a synchronous capacitor is connected towards the load side and is highly excited.

Synchronous capacitors make it act like a capacitor. It draws delayed current from the supply or supplies reactive power.

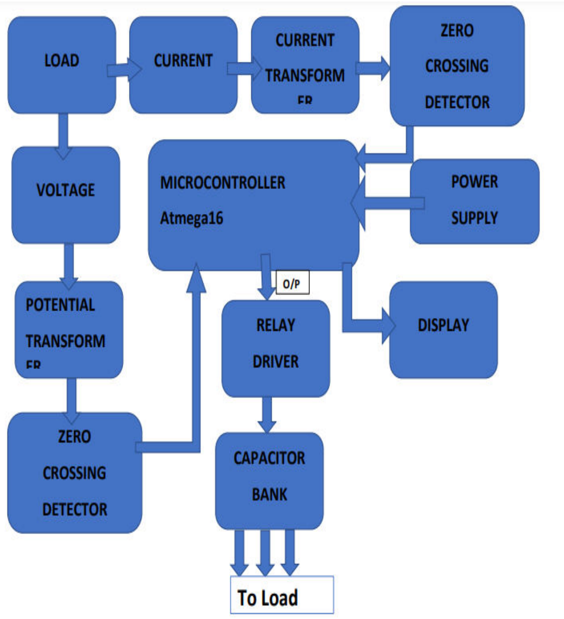
Phase Advancers:-

This AC exciter is mainly used to optimize the Power Factor induction motor.

They are installed on the motor shaft and connected to the rotor circuit of the motor. It improves the power factor by providing the exciting ampere of windings to produce the desired flux at the specified slip frequency.

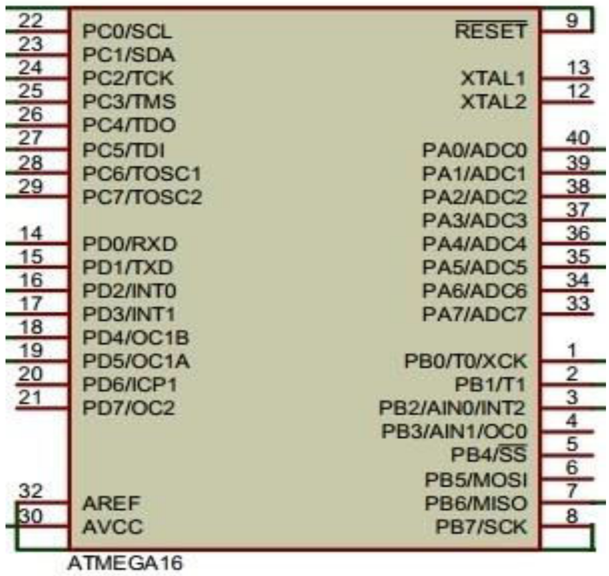
Moreover, if the number of ampere cycles is increased, it can be made to operate at the main power factor.

IV. BLOCK DIAGRAM



V. MICROCONTROLLER

This microcontroller has 40 pins and each pin has its importance. In these 40 pins, I/O pins are 32. And these are categorized into 4 ports. Each port having 8 I/O pins.



- **4 PORT-A 8 pin (pin 33-40)**
- **1 PORT-B pin (pin 1-8)**
- **3 PORT-C 8pin (pin 22-29)**
- **2 PORT-D 8 pin (pin 14-21)**

PORT-A:-

Here, PIN 33to 40 are coming to PORT-A. This port A acts as an analog input to the A/D converter. Port A can be used as an 8-bit bidirectional I/Oport. It has an internal pull-up resistor.

PORT-B:-

It has pins from 1 to 8. This port B is used for I/O bidirectional pins.

PORT-C:-

This port c having eight I/O bidirectional pins.

PORT-D:-

Port D pins can be used as input or output pins. The extra peripherals like PWM channels, time/counter, USART are connected to this port.

RESET:-

Pin 9 is for Reset pin.

Pin 10:-

This pin is used for power supply purposes. By this pin, a power supply of 5V can be connected to the microcontroller.

Pin 12 & Pin 13:-

High clock pulses can be generated by a crystal oscillator. And this crystal oscillator is connected to these pins. This microcontroller work at the 1MHz frequency.

VI. COMPONENTS USED& FEATURES

1) **ATmega16:-**
- High Performances.
- 16K Bytes of In-System Self-programmable Flash program memory.
- 512 Bytes EEPROM.
- 1K Byte Internal SRAM
- 8-channel, 10-bit ADC.

2) **LCD Display:-**
- The operating Voltage is 4.7 to 5.3V.
- The current Consumption is 1mA without a backlight.
- Alphanumerical LCD module.
- Consists of 2 rows and each row can print 16 characters.
- Each character is built by a 5* 8-pixel box.
- Work on both 8*bit and 4-bit.

3) **Voltage Regulator IC.(7805):-**
- 5V positive voltage regulator.
- The minimum input voltage is 7V.
- The maximum input voltage is 25V.
- The operating current (IQ) is 5mA.
- Internal Thermal overload and short circuit current limiting protection are available.

4) **Transistor (BC547):-**
- The gain of DC (hFE)=800A.
- Continuous Ic (Collector current)=100mA.
- VBE(Emitter base voltage)=6V.
- IB(Base current)=5mA.
- The polarity of the transistor is NPN.
- The transistor frequency is 300MHz.

5) **C.T. & P.T.:-**
- The main electrical characteristics of CT are:
  *Rating voltage, primary current, and factor.
  *Ratio.
  *Accuracy class.
  *Burden power.
  *Magnetizing curve.
- Characteristics of PT are:
  *Effect of secondary current or VA.
  *Effect of power factor of secondary burden.
  *Effect of frequency.
  *Effect of primary voltage.

6) **Diode (1N4007):-**
- Characteristics:-
  * Maximum Recurrent Peak Reverse Voltage 1000V.
  *Maximum RMS Voltage700V.
  *Maximum DC Blocking Voltage 1000V.
  *Average Forward Current 1.0A.
  *Peak Forward Surge Current 30A.
  *Maximum Instantaneous Forward Voltage 1.0V.
  *Maximum DC Reverse Current At Rated DC Blocking Voltage 5.0μA @ 25▫C.

7) **Relays:-**
- Trigger Voltage (Voltage across coil):-5V DC.
- Trigger Current (Nominal current):-70mA.
- Maximum AC load current:-10A @ 250/125V AC.
- Maximum DC load current:-10A @ 30/28V DC.
- Compact 5-pin configuration with plastic molding.
- Operating time:-10msec Release time:-5msec.
- Maximum switching:-300 operating/time.

VII. CONCLUSION

This project is implemented to automatically correct powerfactors. The microcontroller used helps to sense the Power Factorby monitoring the load of the system, and according to thelagging behavior of PF because of type of load, it will performthe control action by switching capacitor bank throughdifferent relays and improves the Power Factor of the load.By improving Power Factor electricity bill can be reduced.

VIII. ACKNOWLEDGEMENT

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