

Effect of Power Factor on Equipment's and it's Improvement

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ABSTRACT: The use of electronic power equipment and high-voltage systems has increased, adding more harmonics to the grid. In order to reduce the contamination of harmonics and increase the transmission performance, correction of the power factor needs to be performed. For power factor correction, a variety of techniques have been suggested. The paper defined and planned the method of using a Programmable Interface Circuit (PIC) chip to create the power factor corrector of a 3-phase power system. The value of power factor of the load is sensed and measured by sensors and PIC. The data is sent to an algorithm and capacitors are then triggered according to the algorithm's performance. The lag power factor and lead power factor are also shown on an oscilloscope LCD monitor and also turned on by the capacitor. This will help to compensate for the reactive power and contribute to an improvement in the power factor that is closer to unity, thereby improving the power system's performance.

KEYWORDS: Real power, reactive power, PIC microcontroller, Oscilloscope, Power factor, Capacitor Banks, Pulse Width Modulation.

I. INTRODUCTION

The power factor is called the ratio of actual power to reactive power consumed by an electrical load. It is an indication of the effect of load current on the device supply and is a measure of the efficiency of current being turned into useful work or real power. A lower power factor means that the apparent power supplied to the load is greater than the actual power consumed by the load because of these currents, there would be losses in the supply and distribution system. A load with a unit power factor means that the device loading is highly effective and that there are equivalent losses with a power factor of half[1]. A large phase difference between current and voltage could lead to a poorer power factor due to various factors, such as power transformers, lighting ballasts, induction or welder furnaces. The paper will focus on designing and implementation of correction of power factor by using a microcontroller chip of PIC, determination of the system's power factor, generating proper action for calculating the capacitor to get back the power lost during the designing of the project. The problems arising due to lower power factor as discussed. The main source of getting capacitive reactance is capacitor and it supplies negative power. The relationship between real power and reactive power is given in Figure 1 in the form of a power triangle[2].

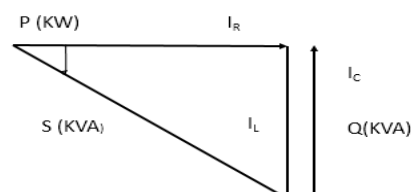


Figure 1: Power Triangle

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Power systems have shunt-connected capacitors and provide the device with leading VARs as needed. Because most inductive loads are inductive in nature, the impact of lagging loads needs to be eliminated by a leading power factor. The first step in installing fixed capacitors is to decide the power factor before the capacitor banks are designed, but only 94 percent of the efficiency is limited. To increase the efficiency up to 96%, switched capacitor banks are used. Whenever the switched capacitor is being used the control of switching capacitor is assigned to close bank connection as soon as the power reaches to two-thirds of the power supply. The three phase system has capacitors installed in an isolated insulating metal box called a capacitor bank. The capacitor on load side has the same voltage as on the supply voltage, thus initial voltage is zero practically in the three phase bank of capacitors connected in the delta having its neutral grounded. The capacitor current will lead voltage by 90 degrees. In Figure 2, the relationship between the current peak and the capacitor voltage at the initial time is given. The voltage across the capacitor will overshoot and increase by three times across the switch gap if there is a voltage shift. The same behavior could be found in the first current zero as this will cause an interruption and normal maximum voltage will increase to three times around the capacitor [1].

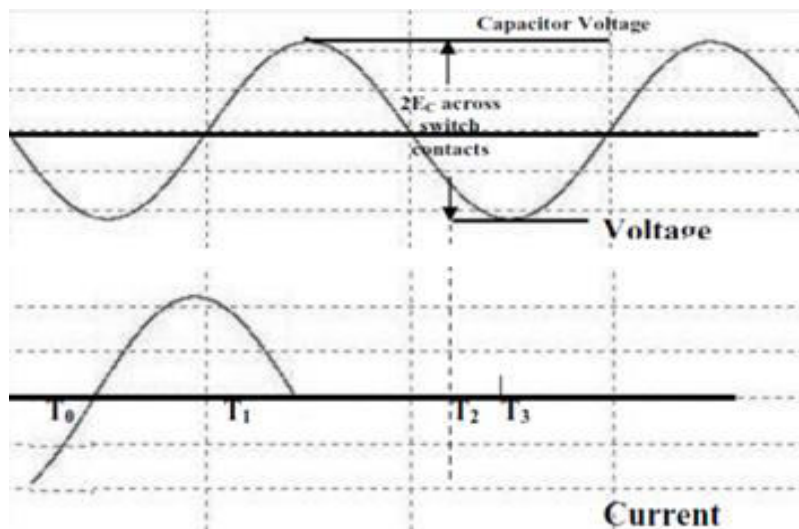


Figure 2: Graph of voltage and current at the contacts of switch

Here, T_0 is the start of the switch, T_1 is the first zero current, T_2 is the half cycle after T_1 T_3 is the first zero current when the switch is fully opened. Switch touch will appear four times after half a cycle, as seen in Figure 3. The time span of the overshoot is counter striking for the circuit.

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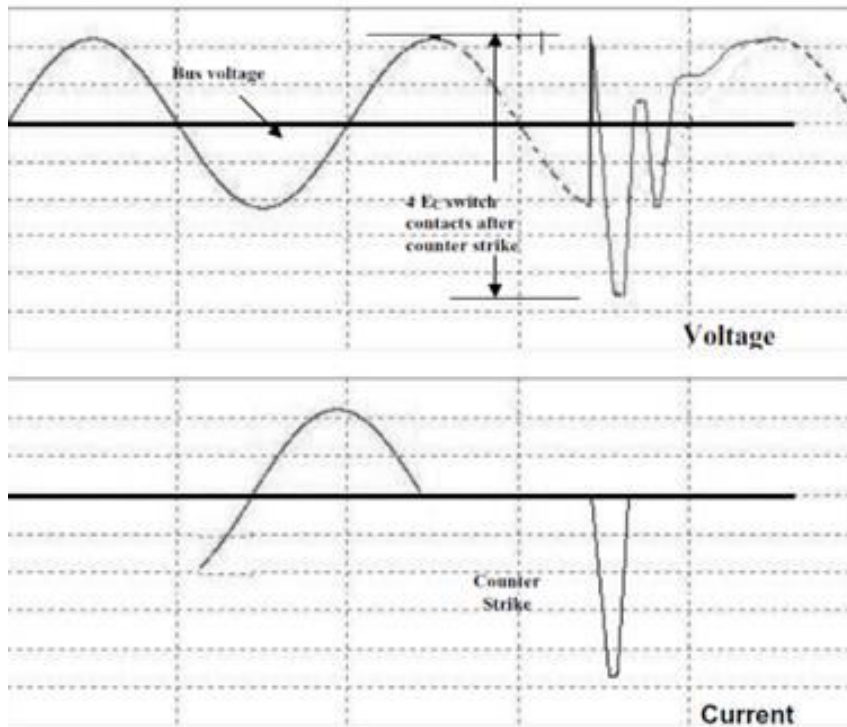


Figure 3: Difference between line and capacitor voltage causes strike

II. LITERATURE REVIEW

The writers Anant Kumar Tiwari, Durga Sharma, Vijay Kumar Sharma have developed a self-adjustable power-factor corrector that always tries to make the system's power factor equal to unity. The automatic power factor corrector is used to provide the unity power factor using capacitive banks [2]. Authors Nagarajan M and Kandasamy have designed a correction unit for power factor correction from 0 to 1 having frequency of 0.1 and operable upto 500 Hz of frequency. The PIC measures the power factor through sensors and then data is sent over the algorithm as input to and then capacitors were used for supplying the requisite vars as per the output from the algorithm [3]. In paper [4] the power quality has been improved by tracking load power factor continuously. When the power factor is reduced, capacitances of required value are inserted and for this purpose a microcontroller is used. In paper [5] AhsanShahid has designed a programmable interface controller chip to get the efficiency with lowest cost. The language being used is C and the compiler is MicroC. Authors in [6] have demonstrated work in which ZCD, opto-couplers and EX-OR gates along with an arduino microcontroller have been used to calculate the phase difference between voltage and current. [7] Authors Ravi and et. al. has proposed a technique for design and development of one phase power factor correction using a micro-controller chip which is an Arduino Uno and ATmega328 as The microcontroller and the use of reactive power injection capacitors. A variety of power factor correction techniques were suggested in[8] by using a PIC chip and some algorithm to cause the switching capacitors to compensate the reactive VARs to bring the power factor to 1. In Writers [9], Md. ShahriaRifatet. Al. has described a cost effective and simple scheme of power factor measurement and correction by using PIC microcontroller and by using algorithms several capacitors are used to supply the reactive power. The lag-lead power factor is displayed on an LCD along with the number of capacitors.

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III. CONCLUSION

Power factor is one of the most critical aspects of utilities and they are involved in minimizing losses due to lower power factor that can increase due to various other variables such as harmonics in the system. Therefore, a microcontroller-based PIC chip was used with the use of a software algorithm for single and three-phase systems. This device attempted to increase the load-side power factor closer to unity in a 500 Hz range of service. The phase difference between the voltage phasor and the current phasor has been continuously measured and tracked for measurement and comparison, thereby allowing greater precision and adaptability in reactive power compensation. Since it can work without any human intervention, this method has very high efficiency. As these require a large amount of space, the proposed system can be used on systems based on inverters or synchronous motors. In order to increase its use in numerous other power facilities, financing also needs to be handled for potential use.

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