ABSTRACT

Demand of electrical energy is increasing day by day and power quality is one of the buzzword nowadays in Myanmar. Customer awareness of power quality, electronics load sensitivity and automation of industrials are pushing hard to improve power quality as never before. Power factor improvement is one of the common ways to improve the quality of power in effective way. Researching power factor controller enhance the deployment of voltage sensing technique with potential transformer, current sensing technique with current transformer, zero crossing detection of voltage and current signals, zener voltage regulation, PIC microcontroller based control system and relay driver system. Voltage and current were sensed by potential and current transformers to evaluate the deviation of voltage and current signals with zero crossing detection circuits respectively. Microcontroller is fed voltage and current signals to determine the quality of power system and implement the relays to keep the power factor as high as possible by switching capacitors to improve power factor of the system.

KEYWORDS: potential transformer, current transformer, zero crossing detector, power factor controller

I. INTRODUCTION

Power factor of an AC electrical power system is expressed as the ratio of the real power, P flowing to the load to the apparent power, S in the circuit. On the other hand, power factor is the relationship of current and voltage of AC distribution system. Theoretically, unity power factor voltage and current are inphase, low power factor called lagging, is caused by inductive load and high power factor called leading is caused by capacitive load. Power factor Controller has 4 main portions implemented, signal sensing, signal analysing and signal determining and switching configuring.

II. Features of the Power factor controller

Hence, main objective of power factor controller is to maintain the power quality as good as possible, controller ability should have 2 inputs and 1 output totally, voltage level sensing, current level sensing and compensating power quality of the system. Figure 2 shows the proposed system to control the power quality of the system.

Potential and Current transformers are being used to set up signal detecting section to know voltage and current level of the power system in real time. One of the operational amplifier configurations, comparator circuit, is used to analyze when voltage and current signals are changing polarities for time deviation of the system. Microcontroller based control system evaluate the power factor of the proposed system according to the input data and encode the decision signal to drive the correct switching arrangement of the relays. Finally capacitor bank provide the required shortage reactive power by the instruction of relay driver switching system. Simulation and analysis are being performed sequentially and evaluated correctly.

Instrument transformers, PT and CT sense voltage and current level of the system and convert into voltage and current signal respectively. Voltage signal is controlled by rectifying as input of the crossing point analysis of comparator, as current crossing point detection. Crossing time
signals are being fed controller for power factor determination algorithm of microcontroller after noise cancellation by filters. Control algorithm of microcontroller evaluates the value of power factor by supported voltage and current signals, and displayed out at the monitor, LCD display. On the other hand, control algorithm supports the decision to realy driver to control the relay switchings properly for improvement of reactive power as power quality enhancement. Comparator, LCD, microcontroller, driver and realys work in DC power and DC power supply system is not being calculated in detail. Overall system have implemented and simulated the result of the output and controlled to be acceptable reliability. Portion by portion implementations are shown sequencially.

III. Control system configuration

A. Voltage and Current Signal Sensing

Proposed system deploy potential transformer getting voltage signal from the power system. Potential transformer (PT), also called instrument transformer, is being used in power systems to step down primary voltages to lower secondary potential output voltage level. Transformer can be easily measured by the ordinary low voltage instrument like a voltmeter, wattmeter and energy meters. Potential transformers are connected across or parallel to the line. This special type of transformer allows a meter to take readings from electrical service connections with a higher voltage rating than the meter is normally capable of handling without at potential transformer.

Current Transformer(CT) is also type of instrument transformer, that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter.

B. Analysis of Power Factor Signal

Due to different type of arrangement, the current transformer is often referred to as a "series transformer" as the primary winding, which never has more than a very few turns, is in series with the current carrying conductor supplying a load.

Designing of proposed system is being favored rather than component value calculation.

C. Power Factor Determination by Microcontroller

Signals from PT and CT are also directly provide for timing by filtering RC filter for voltage and C filter for current respectively.
Figure 6 Microcontroller for Power Factor Determination

Zero crossing signals are also provided to controller, voltage signals to pin 33 and current signals to pin 34. Pin 35 to Pin 40 are connected with 20x4 LCD display for power factor monitoring. Pin 21, 22, 29 and 30 are connected to relay driver IC ULN2003A. Figure 7 show the algorithm of power factor evaluation and correction of the proposed system.

Algorithm start configuring LCD Display. Signals and data are declared for implementation. Voltage and current signal are waiting and counter is started once first voltage and current signals are detected. Second zero crossing signals are also waiting and calculate power factor once detected.

D. Power Factor Improvement

The following figure shows input waveform of voltage and current with phase difference. Both of the signals are fed to zero crossing detectors, which give square waves in digital format. These digital waveforms are used by microcontroller to calculate power factor. Microcontroller takes decision to switch appropriate capacitors to compensate for power factor.
V. Discussion and evaluation
Efficiency of DC power supply is acceptable enough to drive the controller and to supply zero crossing detectors. Zener regulation and capacitor filter circuits are also working in good manner. PIC microcontroller input output and timing are all seamlessly set up. In the system relay drivers work well but no security and safety for relay driver and capacitors switching.

VI. CONCLUSION
Power factor controller is good for using with capacitor bank where several inductive load utilizing places, as industrial and enterprise.

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References