Power Factor Correction by Continuous Monitoring

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Abstract—The Purpose of this paper is realizing another advancement for power factor improvement of 3 arrangeenrollment motor and also for single stage acknowledgment motor , as upgrade of force factor is critical for present day and private zones and to make control factor as close as solidarity without standing up to discipline from electrical distributers. As we presumably am mindful in endeavors a huge part of motor which is commonly used is selection motor and acknowledgment motor having low power factor besides. Home mechanical assemblies which are all things considered used are all things considered having low power factor. From this time forward there is need of force ascertain improvement occurrence of family mechanical assemblies and furthermore in present day reason. Enrollment motor is most comprehensively used motors in organizations .As name of this motor decides this motor having low power factor. In this way there is need of power factor upgrade.

Index Terms:A.C–Alternating current, D.C–DirectCurrent, P.F–power factor , P.F.C-power factor correction, ZCD-Zero Cross Detectors,, P.T-Potential Transformer.C.T-Current transformer,A.T-Auto Transformer

I. INTRODUCTION

Any oneengine that works on exchanging current requires apparent power, but apparent power is expansion of active power and reactive power. Apparent power is the power which is really destroyed by the heap. Reactive power is the power requested by the heap and came back to the power source. Theeasiestest approach to determine control factor is —POWER FACTORis the proportion between the helpful control whose unit is KW to the aggregatecontrol whose unit is KVA consumed by an A.C electrical motor.Power factor is a proportion of how feasibleelectrical power is used to do a precious task. The perfect power factor is unity. In theevent that power factor is short of what one it implies that overabundance control is required to perform or accomplish the genuine work.

A.Advantages of power factor improvement

- It Increase theefficiency of system and devices.
- It has Low Voltage Drop.
- It diminishes the size of a conductor and cable which reduces cost of the Cooper
- It decreases Line Losses (Copper Losses) I2R .
- Appropriate Size of Electrical Machines (Transformer, Generators etc)
- It Eliminates the penalty of low power factor from theElectric Supply Company
- Better usage of power system, lines and generators etc.
- It saves energy, rating and the cost of theelectrical devices and equipment is reduced.

B.Idea to improve power factor

The fundamental idea for Power factor improvement of a motor or circuits.A capacitor in parallel is connected with the devicewhich has low power factor.

A standard technique to improve for power factor alteration is to make compensation in which static capacitors are utilized for power factor change. At any rate for this circumstance Care should be taken while applying power factor changea form control with the objective that the capacitors should not presented to brisk on-off conditions.

C.Working of Capacitors

Byspeaking to true power and reactive power at sides of right edge we can decide theapparent power from the power triangle rule:

(Apparent power)^2 = (Active power)^2+ (Reactive power)^2

Or (KVA)^2 = (KW)^2+ (KVAR)^2

To reduceApparent power, all out current prerequisite for some random load, one must need to abbreviate the line that speaks to the KVAR. This is accurately what capacitors do. The proportion of

real capacity to obvious power is generally communicated in rate and is called control factor.

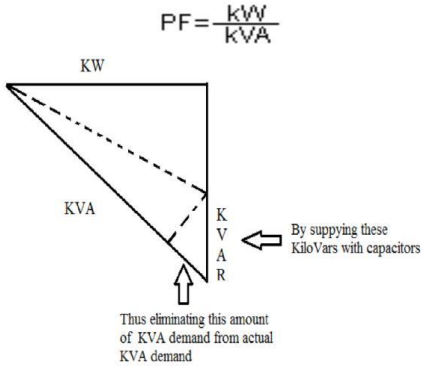


Fig-1. Power Triangle

II. METHODS OF POWER FACTOR CORRECTION (P.F.C)

A. Static compensation

In this method of power factor improvement, static capacitors are connected in parallel with the device which works on low power factor. These static capacitors provideleading current which eliminates(totally or approximately) lagging inductive component of load current and improve load circuits power factort to improve the system of good efficiency.

Advantages:

- It reduces losses in static capacitor
- Low maintance cost
- Works in normal condition
- It doesn't require foundation of installation
- It has light weight so it is easy to install

Disadvantages:

- Its age lies between 8 to 10 years.
- It cause switching surges on the system.
- Once the capacitors spoiled,then repairing is costly.

B. Synchronous condensor

when a synchronous engineoperates at no load and at over animated condition then it is called synchronous condenser. Precisely when a synchronous condenser is over revive then it gives driving current and works like capacitor. Right when a synchronous condenser related crosswise over supply then it gives driving present and halfway disposes of responsive section and thusly improve control factor.

Generally,it is used to improve the power factor in large industries.

Advantages:

- It has long life(almost 25 years).
- It is highly reliable.
- It doesn't generate harmonics.
- The faults can be removed easily.

Disadvantages:

- Its maintance cost is high.
- It generates noise.
- It requires auxillary device.

C Phasor advancer

Thisis a simple ac excitor which is connected on the main shaft of the motor and work with the motor's rotor circuit for power factor improvement.This technique of power factor improvement is used to improve poer factor of induction motor in the industries.

Advantages:

- It is easily utilized where synchoronous motor is unacceptable.
- Lagging reactive power drawn by the mototr is sufficiently reduced because theexciting amperes turns are supplied at slip frequency.

Disadvantage:

- Phasoradvancer is not economical for motors below 200 H.P.(about 150 H.P)

B. APFC conspire

In my task I m going to utilize system which is called altered control factor change. This framework endless supply of regular checking of the structures parameters, for example, voltage and current with the utilization of potential transformer and current transformer independently. Through steady watching stageimprovement between the two will be figuredcontineously and depending before a crowd

of people separate correspondingly fitting stage of capacitors will be turned on or off in the structure with the genuine target to re-design control factor as near as individuality.

As there is no moving part in capacitors in this way exchanging mishap are less as show up contrastingly in connection to that of static double time in like way no additional engine is required for effect factor change and hence cost is spectacularlyly less as emerge from that of effect factor fix by synchronous condenser method.

COMPONENTS, FUNCTIONAL BLOCK DIAGRAM AND SCHEMATIC DIAGRAM

A. Main components

Main components used in this scheme for automatic power factor correction using microcontroller have following components.

1. Auxiliary power Supply: Transformer
   Bridge rectifier
   Voltage regulator IC 7805
2. Microcontroller(AT-megaA8)
3. LCD Display
4. Capacitor Bank
5. Potential transformer & current transformer
6. Relay & relay driver IC
7. Zero Cross Detector

B. Functional Block Diagram

Zero intersection of voltage and current waveform from line is disnified by zero cross detector from potential transformer and current transformerindividually. dependent on stagecontradiction among voltage and ebb and flow microcontroller conveys the flag to switch on capacitor through hand-off driver IC and improves control factor.

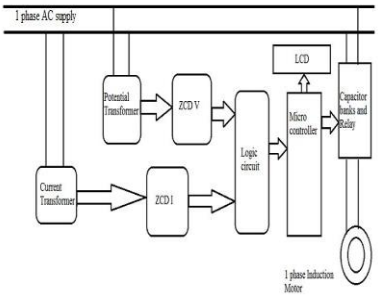


Fig 2 Block Diagram of System

C. Schematic Diagram

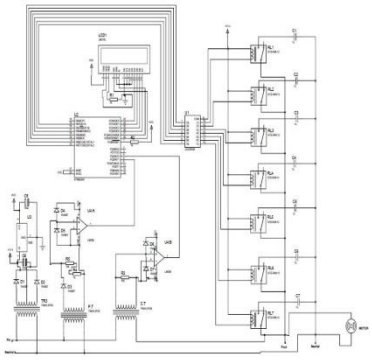


Fig-3 Schematic Diagram of System

Description of Microcontroller: AVR AT mega 8LATmega8 is a low-control CMOS 8-bit microcontroller in light of the AVR RISC engineering. By governing intense directions in a solitary clock cycle, the ATmega8 accomplishes throughout moving toward 1 MIPS for every MHz,modifying the framework fashioner to streamline control utilization as opposed to handling speed. The AVR center joins a rich guidance set with 32 universally useful working registers. All the 32 registers are specificllylinked with the Arithmetic Logic Unit.highly-flexile and cost-effective solution to many embedded control components. The ATmega8 AVR is backup with afull piece of program and system development tools, including C compilers, macro assemblers, program debugger.

Features:-

1. it has8K bytes of In-System Programmable Flash with Read-While-Write capabilities.
2. It has 512 bytes of EEPROM, 1K byte of SRAM.
3. It has 23 general purpose I/O lines.
4. It has 32 general purpose working registers.
5. Three flexible Timer/Counters with compare modes. Internal and external interrupts.
6. It has A serial programmable USART.
7. It has A byte oriented Two-wire Serial Interface.
8. A 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy.
9. A programmable Watchdog Timer with Internal Oscillator.

E. Pin Configuration

Pin Descriptions

1. VCC-Digital supply voltage. .
2. GND-Ground.
3. Port B (PB7-PB0)- Port B is a 8-bit bi-directional I/O port with inward draw up resistors (chose for each piece).

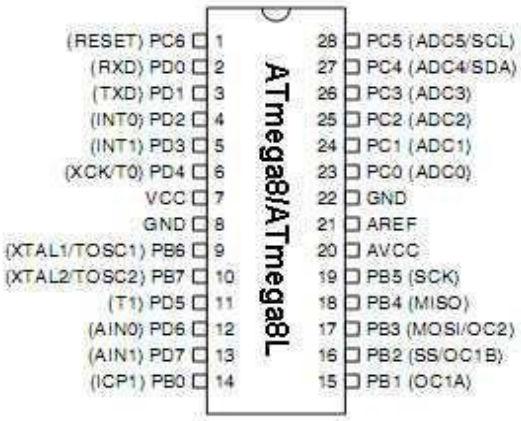


Fig-4. Pin configuration of at mega 8L microcontroller

4. Port C (PC5-PC0)- Port C is a 7-bit bi-directional I/O port with inward draw up resistors (chose for each piece).

5.PC6/RESET-If the RSTDISBL Fuse is modified, PC6 is utilized as an I/O stick. In theevent that the RSTDISBL Fuse is un customized, PC6 is utilized as a Reset input. A low level on this stick for longer than the base heartbeat length will produce a Reset, regardless of whether the clock isn't running.

6. Port D (PD7-PD0)-Port D is an 8-bit bi-directional I/O port with internal pull-up resistors.

7. RESET-Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if simulators, In-Circuit emulators, and evaluation kits. the clock is not running. Shorter pulses are not guaranteed togenerate a reset.

8. AVCC-AVCC is the supply voltage stick for the A/D Converter, Port C (3-0), and ADC (7-6). It ought to be remotely associated with VCC, regardless of whether the ADC isn't used. On the off chance that the ADC is utilized, it must be linked with VCC through a low-pass channel. Note that Port C (5-4) uses computerized supply voltage, VCC.

9. AREF-AREF is the simple reference stick for the A/D Converter.

10. ADC7-6 In the TQFP and QFN/MLF bundle, ADC7-6 fills in as simplepart to the A/D converter. These pins are controlled from the simple supply and fill in as 10-bit ADC channels.

IV. METHODOLOGY

The methodology on which my paper based is making of three main parts.

A. Auxiliary power supply

An extension rectifier linked crosswise over fundamental line which changes over AC flag to DC. A capacitor is linked at yield of rectifier to get pured DC. It givesextension rectifier is +12V yet as microcontroller chips away at +5V henceforth supply of this scaffold rectifier is additionally given to IC 7805(Voltage controller IC) which gives settledsupply voltage +5V. A capacitor is linked at supply of IC 7805 with theend goal to get unadulterated DC voltage.

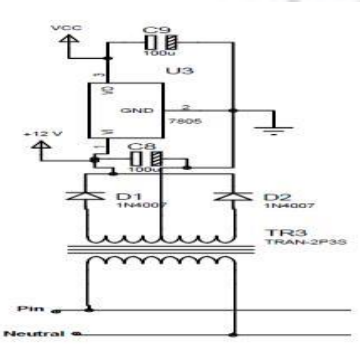


Fig-5. Auxiliary power Supply

B. Zero cross detector (ZCD)

Thecurrent and voltage flag arequqntized from the principle AC line by using C.T and P.T individually.Thesupply of these CT and PT's are given to Op-Amp LM 358 the mix of P.T's and OP-Amp frames zero cross locator (ZCD V) additionally blend of current transformer and OP-Amp shapes zero cross detector(ZCD I).these zero cross finders entirely changes over both current and voltage waveforms to square wave and distinguishes zero intersection of voltage and current.

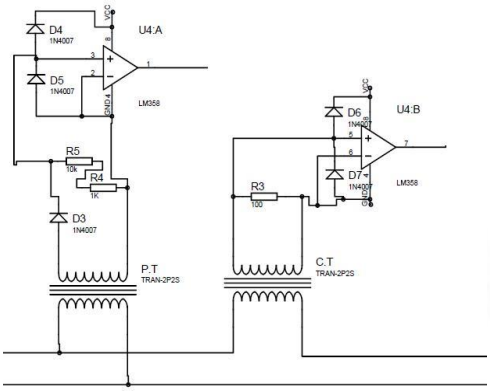
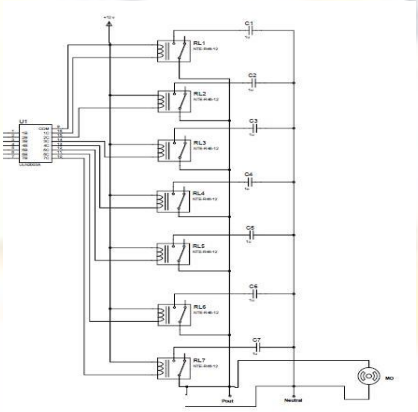


Fig-6. Circuit of Zero Cross Detector

C. Capacitor and relay matrix

dependentt on zero intersection of voltage and



current wave microcontroller either turns on or turns **Fig-7 Connections of Capacitor & Relay Matrix Circuit**

off rexact number of capacitors through electromagnetic transfers. What's more, control factor is appeared on LCD show for different load.

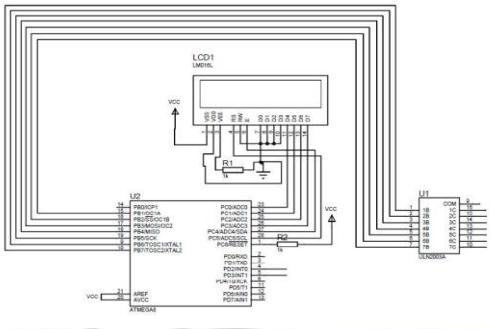


Fig-8 Interfacing of Atmega-8L microcontroller to LCD and Relay Driver IC ULN 2803 [2]

C. Interfacing of Microcontroller to LCD and Relay Driver IC

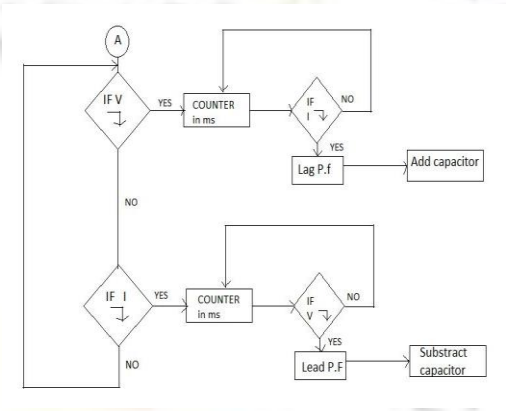


Fig-9. Flow Chart for system

E. Motors Parameters

1 phase Induction motor 0.75KW/1Hp
230 volt, 7.5amps
1420

F. PCB 3D View and PCB Design

PCB 3D view

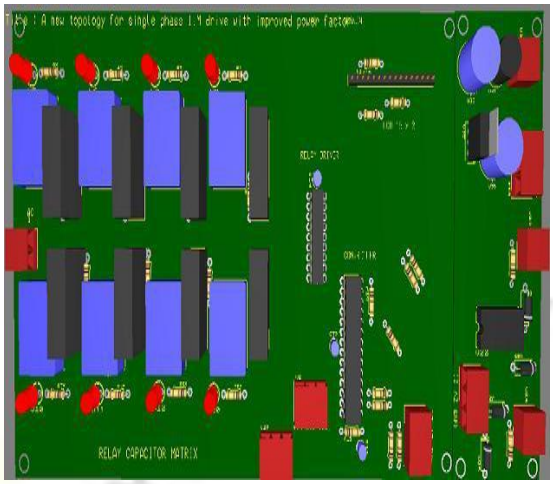


Fig-10 Proposed 3-D View of System

PCB Design

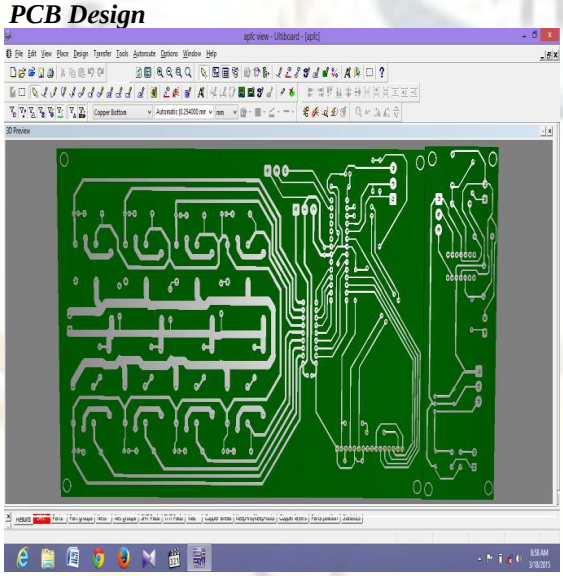


Fig-11. PCB Design of System

G. Zero Cross Detector Waveforms

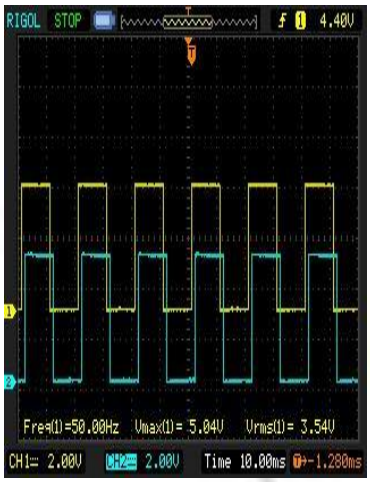


Fig-12. ZCD Waveform Viewed at CRO at lagging Power Factor

Load	P.F (Before APFC Circuit)	P.F (After APFC circuit)
NO LOAD	0.3389	0.89
0.5KW	0.6320	0.9619
1KW(FULL LOAD)	0.6620	0.9745

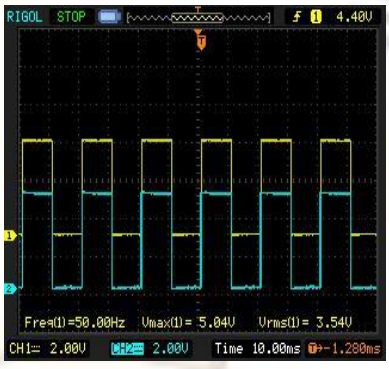


Fig- 13. ZCD Waveform Viewed at CRO after power factor correction

V. OBSERVATION TABLE

I. Before APFC Circuit Insertion

Above table shows power factor of Induction motor Drive before APFC circuit insertion under various loading condition.

Load	W(watts)	V (Volts)	I (Amps)	P.F
NO Load	50*8=400	236	5	0.339
0.5 KW	110*8=880	236	5.9	0.632
1KW (Full load)	128*8=1000	236	6.4	0.662

II. after APFC Circuit Insertion

Load	W(watts)	V(Volts)	I (Amps)	P.F
NO Load	50*8=400	236	1.9	0.892
0.5 KW	105*8=840	236	3.7	0.962
1KW (Full load)	115*8=920	236	4	0.974

Table shows P.F of I.M after APFC circuit insertion. Under

VI.RESULT

Comparative observation of Power factor of Induction Motor Drive before APFC circuit insertion And After APFC Circuit insertion

Fig-14. Pictorial view of system a lagging power factor

Before insertion of APFC circuit Power factor of induction motor at no load is observed as 0.3389, while after insertion of APFC circuit power factor gets improve to 0.89. While at full load i.e. at 1KW after insertion of APFC circuit power factor gets improve to 0.974 by 53 Microfarad provided by capacitors.

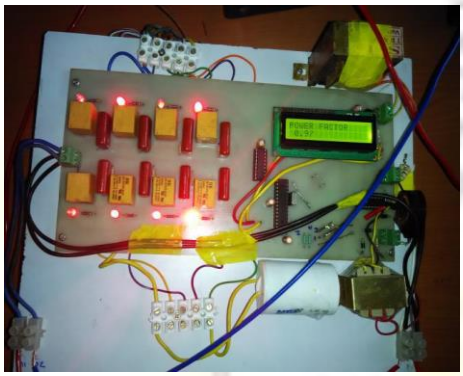


Fig-15 Pictorial View of System with Improved Power factor.

VII. CONCLUSIONS

This paper oversees advancetechnique for power factor improvement by using microcontroller. As Switching of capacitors are done usually thus we get progressively orrect result, Power factor cure techniques makes structureenduring and considering improvement in power factor its capability increases. Power factor change plan can be connected with organizations, control structures and moreover in domestic reason. The utilization of microcontroller reduce the price. By using microcontroller typical feature can be controlled and

the use of extra hard items, for instance, clock, RAM, ROM and information yield ports reduces.

VIII. FUTUREENHANCEMENTS

The vehicle control factor cure using capacitive load banks is very capable as it decreases the cost by reducing the power drawn from the supply. Therefore, works are not required and this Automated Power factor Correction using capacitive load banks can be used for theventure reason later on. In future PWM techniques can use this order. Nearby power factor review moreover speed control must be possible to imagine in future. In future, Work might beattainableto sound decline

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