Innovative Journal for Opportunities and Development in Science & Technology,
Volume 2,Issue 1, Dec.2021
Paper Id: – IJ2021V2I1 -12A-C,
ISSN 2582-6026

A REVIEW ON POWER FACTOR CONTROLLING USING MICROCONTROLLER

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ABSTRACT: Power quality is a key factor in all industrial many more applications. An industry need to maintain certain power quality standard during day-to-day work for variety of applications. Power quality of electricity provided by is additionally indispensable perspective. The best power quality serves to the general creation and disposes of any kind of specialized issues decreasing expense of energy. The mains power factor is one of the significant boundary which chooses the nature of force. Whenever the need of responsive power turns out to be more, power factor diminishes, lessening the effectiveness of force . Hence , there is need to add capacitance of required esteem when power factor goes beneath the predefined esteem ideally 0.92. Expansion of required capacitors decrease the misfortunes further developing influence factor. The paper proposes carefully controlled geography for performing Automatic power factor adjustment to further develop power quality. The plan and reproduction of Automatic power factor amendment framework utilizing Arduino UNO microcontroller has been introduced in the paper .The framework power factor has been observed utilizing power factor transducer followed by Arduino microcontroller which control the exchanging of capacitor banks to receptive power and bring power factor near to unity enhancing power quality. The simulation result also presented in the paper.

Index Terms- Power Factor, Power Factor Transducer, Power quality,Arduino UNO microcontroller, capacitors.

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I. INTRODUCTION

Power Quality (PQ) defines "Concept of powering and earthing electrical/electronic equipment in a way which isappropriate to functioning of the equipment and compatible with wiring system including other interfaced equipment [1].PQ shows the capacity of electrical gear to consume the energy being provided to it. PQ relies upon a few elements like voltage droop, enlarge, interference, homeless people, THD (Total Harmonic Distortion), variety in recurrence, Power Factor (PF), and so on. PF is one of the principal boundary influencing PQ consequently rationale is improvement in PF for upgrading PQ. In electrical power circulation, PF is indicated as the proportion of genuine power (kW) applied to the heap to the clear power (kVA) of the circuit [1]. It might likewise characterize as the cosine of the point between the voltage and current in AC circuitwhich is known as PF [2]. Fig.1 shows the PF triangle where three powers i.e. active (kW), reactive (kVAR) and apparent(kVA) are employed. The real power is called active power which is actual amount of power being used and is measuredin watts. The apparent power is the multiplication of voltage and current and is measured in Volt-Amp (VA). While power utilized in AC system is called reactive power and is measured in KVAR. PF is given by equation (1) below.

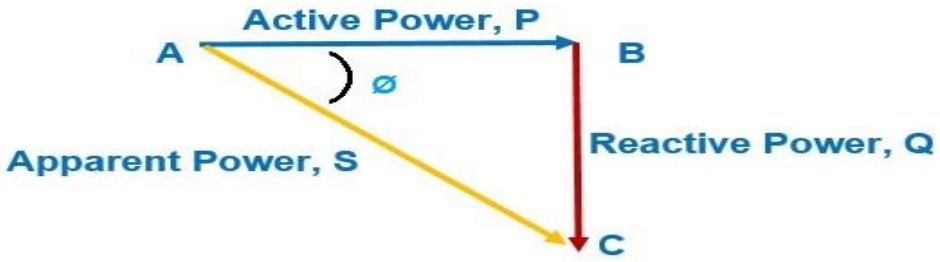

Fig. 1. Power Factor Triangle

PF (Cos Φ) = Real power/ Apparent power. .....(1)

In industries, most of the loads are inductive loads like induction motors including Variable Frequency Drives (VFD), incandescent lamps, induction furnaces, electronic ballast, industrial heating appliances and electromagnets, etc. Also Light Emitting Diode (LED) lamp, Uninterruptible Power Supply (UPS) and various nonlinear loads causes poor PF. Due to poor PF, the I2R losses gets increased and power system becomes less efficiency.

In industrial applications, most of the equipment machines have been coupled with various types of motors viz. induction motors, DC motors, synchronous motors, slip ring motors, etc. which draws lagging PF with the mains. Because of lagging PF of the order of 0.6 to 0.7, the current drawn by the mains increases which effectively increase the losses in power distribution system which finally contributes to heating of the equipment including cable, contactors, terminals, bus bar, etc. Mostly non linear loads are coupled with power

electronics system which induces harmonics inthe system and degrades the overall PF by introducing Distortion Factor (DF). In lieu of above discussions, the need of improving PF to a level at least 0.9 is recommended and can be achieved by connection of various rating of capacitor banks to the mains. Besides, if PF is poor, the utilities charge heavy penalties from consumers/users which is undesirable.

Hence, it is necessary to improve PF employing several methods like synchronous condenser, phase advancer, static capacitors, etc. [3]. Analog as well as digital techniques are available for automatic improvement in PF in the system, however, digital technique using microcontroller has been considered in this paper.

II. DESIGN CONSIDERATIONS OF THE SYSTEM

The proposed circuit design is related with Automatic PFCorrection (APFC) utilizing power capacitor banks becomes highly techno-economical. The PF transducer has been used detection of PF rather than using conventional combination of Current Transformer (CT) and Potential Transformer (PT) along with Zero Crossing Detectors (ZCD). The input from CT and PT has been fed to PF transducer which derives the PF and provides isolated signals in terms of either voltage (0-5 Volts DC) or current (4-20mAmp DC) proportional to PF. The isolation between input and output is around 1500 Volts RMS. The analog signal from PF transducer can be used as feedback to the closed loop control circuit. It has been preferred to use capacitor bank connected indelta rather than single individual capacitors. It is required todesign the capacitor banks of adequateKVAR capacities which can be switched ON to meet the PF demand, however, the leading PF should be avoided [4]. As the capacitors are sensible to over voltages, hence, while calculating the KVAR ratings of capacitor banks, the design voltage of system istaken 25-30% more than its rated value. For protection ofcapacitor banks from over voltages/surges, an over voltage relay has been considered with suitable settings. Discharg resistors are connected across each capacitor for discharge the capacitor safely without flashover after switching OFF its power supply [5]. The appropriate power capacitors with suitable dielecric has been chosen. An LED display is used for indicating the present PF of the system and improved PF.The PF improvement results into several advantages like increases efficiency of the system, reduces demand chargesin creses carrying capability, reduction in power losses, upgrade the power quality, etc. [6].In proposed system schematic, PF gets evaluated using microcontroller, then according to pre-set value, capacitor banks have been introduced into system and PF is improved.

III. METHODS OF POWER FACTOR IMPROVEMENT

Following are the some of the method of PF improvement:

A. Over excited synchronous motor

Synchronous motor when operates at no load condition inover-excited state, then it is called as synchronous condenser. Whenever synchronous motor runs in over-excited situation, leading current is drawn from the source and eliminates the reactive component and PF is improved. By changing the field excitation, the magnitude of current drawn can change. The main advantage of using synchronous condenser is that the PF improvement is smooth. The synchronous condenser is more advanced technique of improving PF, but Pimprovement below 500 KVAR is not economical.

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Therefore, it is generally used in large industries. Fig. 2(a) indicate PF improvement using synchronous condenser and Fig. 2(b) indicate corresponding phasor diagram [7]Synchronous motor when operates at no load condition inover-excited state, then it is called as synchronous condenser.

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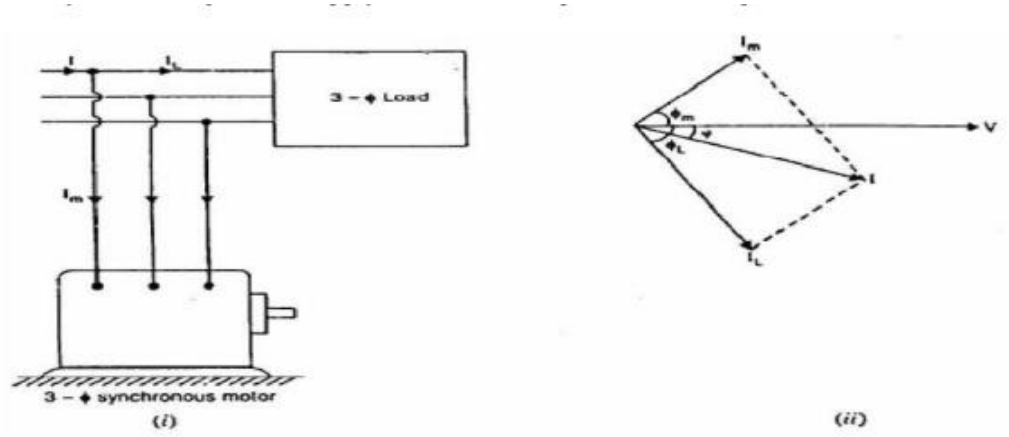

Fig:

Fig. 1 Over excited synchronous motor

B. Phase Advancer

Phase Advancer circuit is used to improve the PF ininduction motor only. The induction motor cause poor PFbecause its stator winding draw exciting current lagging supply voltage by 90°. In phase advancer exciting ampere turns are provided from different AC source which overcome the exciting current from the stator of induction motor. The phase advancer circuit is mounted on rotor shaft of motor.and connected to rotor circuit and provides extra ampere turns at slip frequency to motor during starting period or load period and improve PF. The disadvantage of the system it only used for induction motor PF improvement.

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IV. PROPOSED SYSTEM DESIGN

The proposed design accepts 3 phase 415 V, 50 Hz mainssupply and current and voltage signals are obtained from PF transducer corresponding to system PF. The output of PF transducer is fed to microcontroller. The Arduino UNOmicrocontroller is heart of the system which reads the valueand takes action by giving signals to relay if the PF is lessthan pre-set value. Initially relay contacts are normally open,when relay gets signal from microcontroller, electromagneticfield forces the solenoid to move up and contacts of powercontactor are made. Once the contact is made, the capacitorgets connected in parallel with the load and PF is improved.

v. HIGHLIGHTS OF ARDUINO UNO DEVICE ARDUINO UNO ATMEGA 328.

Biasing voltage is 5 Volts DC. However, the allowable voltage may be from 7 Volts to 12 Volts DC. The input biasing voltage ranges from 6 to 20 Volts DC. The chip have 14 digital and 6 analog I/O pins having 40 mA DC current for each pin. A DC current for 3.3 Volts pin is 50 mA. An ICis having Flash Memory of 32 KB, SRAM of 2 KB and EEPROM of 1 KB. A 16 MHz is Clock (CLK) speed for IC board. Arduino Programming: The Arduino Uno IDE software tool is to be installed into Personal Computer (PC)/Computer Workstation by interfacing Arduino board to PC with USB cable. Follow the instructions like open Arduino IDE tochoose right board by selecting Tools–>Board>Arduino Uno and find out right Port by choosing Tools–>Port. This board may be programmed with the help of Arduino programming language based on wiring. For activating Arduino chip and flashing the LED on the microcontroller board, dump the program code by choosing Files–>Examples.>Basics.>Flash. When the programming codes gets dumped into IDE then press the button ‘upload’on top bar. Once the above procedure gets completed, observe LED flash on the Arduino Uno board.

VI. CONCLUSION

In this paper, the most important power quality parameter like PF improvement has been introduced and discussed in detail. Important methods available for PF improvement have been described giving relevant details. Paper presents one of the geographies used to beat power misfortunes because of low PF. Paper portrays the plan contemplations of Pf rectification gear utilizing computerized strategies like consolidating microcontroller for estimation and checking of displayed electrical burden. Paper features ACload voltage and burden current estimation by accuracy PFtransducer and its separated result signal is corresponding to the framework PF. Because of the utilization of refined PF transducer, the framework turns out to be more adaptable, basic and straight. An Arduino Uno microcontroller based programmed PFimprovement/remedy circuit configuration has been effectively recreated utilizing reproduction instrument. In reproduction programming apparatus, PF has been determined/assessed utilizing math activity block and demonstrated in show. The reproduction and estimated PFresults are seen as very close and gives agreeable results.The recreation results introduced in the paper are empowering and henceforth equipment execution of microcontroller based programmed PF improvement/correction is proposed to validate the simulated result. With the help of purposed digitally controlled APFC system, the overall power quality upgradation/enhancement has been achieved systematically. The PF has been successfully improved to 0.9 and

above
with the methods. Such system can be implemented inindustrial applications.

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