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Phase transfer switch with power factor correction

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ABSTRACT

In the present scenario of three phase application, if low voltage is available in any one of the three phases and needs equipment to work in normal voltage, then the phase contacts must be changed manually. The product developed will solve the problems related to three phase applications. The main aim of this product is to provide an uninterrupted power supply for three-phase loads even in the failure of a phase in a three-phase system. The product is very useful in those industries, factories, home spaces and offices where the continuous supply of electricity is needed. Normally three phase supply if one or two-phase fails, power will not be there in the gadget connected to that particular failed phase(s), to avoid these failures, we bring intelligent three phase changer with Arduino, which shifts power from alive phase to the failed phase(s) instantaneously, thus keeps all the circuits alive.

Keywords— Transformer, Rectifier, Relay, Arduino UNO

1. INTRODUCTION

Power instability and phase failure have become a serious problem in developing countries like India to improve their economic condition. Almost all of the companies; industrial, commercial and also domestic loads are run by the public power supply which associates different problems for example: imbalance among the phases, phase failure or some times complete power shut down occurs due to various types of technical problems occurred in the power generation, transmission and distribution system. Most of the power consumers use single phase equipment for the operational purpose which is greatly affected if there is unbalance voltages, under voltages or overvoltages. A significant amount of time would be required for the manual switchover the operation and as a result, serious trouble could be associated with the machines or in the production process. Moreover, a standby manpower would always be required to change over the supply voltage line to overcome these challenges, automatic phase changing system could be implemented. Here, an automatic phase changer circuit has been simulated.

2. THE NEED FOR OUR PROJECT

Three phase selector with power factor improvement is designed for automation of phase change during phase failure or total power failure in any of three phases in order to safeguard consumer appliances from the epileptic power supply and to improve factor automatically whenever power factor falls below a certain level.

In most cases, many manufacturing companies, whether they are domestic or industrial, which employs single phase equipment for its operation sometimes experience challenges during failure in power supply. And also we know those inductive loads are the main reason for low power factor in the power system. By improving the power factor of power system automatically using a capacitor bank, power system efficiency can be improving. The automated system is developed using Arduino to solve these issues.

3. SYSTEM CONFIGURATION

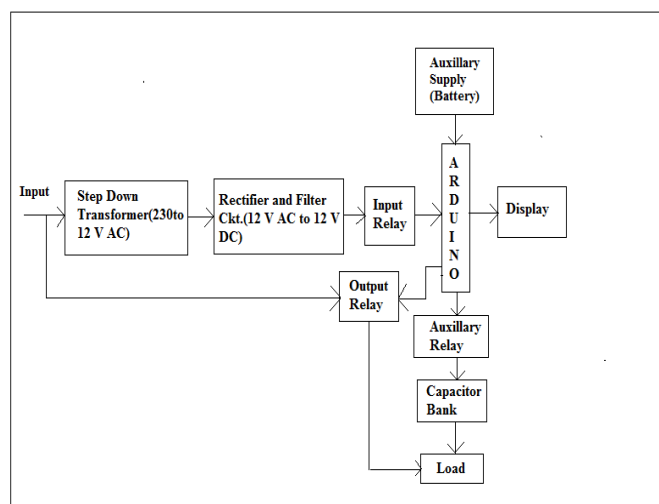


Fig. 1: Block Diagram

The above block diagram consists of following major ingredients of such a project:

- Transformer
- Rectifier circuit
- Relay
- Arduino
- Capacitor bank
- LCD Display
- Voltmeter
- Phase sequence meter

3.1 Forgetting continuous three phase output

We use three steps down transformer, each for a single line that is R Y B respectively.

Rating of a step-down transformer 12-0-12 volt that is in between phase and neutral we get 12volt supply and two phases we get 24volt supply.

3.1.1 How to use a centre tapped transformer: A primary voltage will be induced in the primary coil (I1 and I3) and due to magnetic Induction, the voltage will be transferred to the secondary coil. Here in the secondary coil of a centre tapped transformer, there will be an additional wire (T2) which will be placed exactly at the centre of the secondary coil, hence the voltage here will always be zero. If we combine this zero potential wire (T2) with either T1 or T2, we will get a voltage of 12V AC. If this wire is ignored and the voltage across T1 and T2 is considered then we will get a voltage of 24V AC.

After that, we added rectifier and filter circuit by using a diode and capacitor for each transformer. Rectifier circuit convert AC to DC and filter reduces ripple content then we get 12volt DC supply.

3.1.2 Centre tapped full wave rectifier circuit: During the positive cycle, diode D1 conducts and during negative cycle diode D2 conducts. As a result, both half cycles are allowed to pass through the average output DC voltage is almost twice of the DC voltage of half wave rectifier.

3.1.3 Filter circuit: The working of the filter circuit is to short the ripples and block the DC component so that it flows through another path and is available across the load. This can be given to the relay circuit which is normally open type. When the relay is normally open then Arduino will not get 12 volt supply.

3.1.4 Relay: Relay are the most commonly used switching device in electronics. Relay has three terminals, which are common, NO and NC. If relay contacts to NO the load remain disconnected before trigger and if connected to NC the load remains connected before trigger. When one of the three phases is cut off or it gets faulted then respective relay of this phase is closed and it gives supply to Arduino to sense single phase then it gives the command to output relay to give it auxiliary three phase supply to the output side.

3.2 For poor power factor

The auxiliary relay used for power factor improvement purpose it also normally open type. When the power factor is below 0.8 it gives the command to Arduino and it gives the signal to capacitor bank to connect the circuit capacitor bank to improve power factor.

3.3 Indication circuit

• **Indicators:** It indicates input and output status of each phase that is it shows input and output in sequence R Y B.

- **Phase sequence meter:** When the push button is pressed for time of 30 sec it indicates a sequence of three phase
- **Voltmeter:** By using selector switch it indicates a voltage between two live phases on the voltmeter.
- **Display:** The function of display is to displayed power factor and cut off phase on screen.

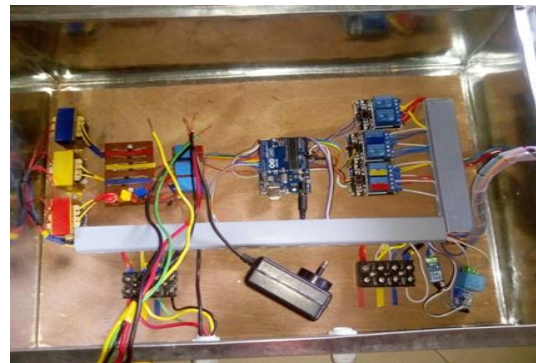


Fig. 2: Model

4. SIMULATION

```
int irr=A0;
int iry=A1;
int irb=A2;
int orr=5;
int ory=6;
int orb=7;
int irr=0;
int irry=0;
int irbb=0;

void setup()
{
  pinMode(irr,INPUT);
  pinMode(iry,INPUT);
  pinMode(irb,INPUT);
  PinMode (Orr, OUTPUT);
  pinMode(ory,OUTPUT);
  pinMode(orb,OUTPUT);
}

void loop()
{
  irr=digitalRead(irr);
  irry=digitalRead(iry);
  irbb=digitalRead(irb);
  if (irr==0)
  {
    digitalWrite(orr,HIGH);
    delay(1000);
  }
}
```

```
if (iryy==0)
{
digitalWrite(ory,HIGH);
delay(1000);
}
if (irbb==0)
{
digitalWrite(orb,HIGH);
DELAY(1000);
}
```

5. CONCLUSION

The Automatic Phase Changer (APC) is a circuit which changes the phase automatically. Thus it can find its applications in household, hospital and even in the industry for emergency load.

The target power factor was also improved much better from 0.88 to approximately 0.99 almost unity when compared to its absence, thus reducing the effect of high power bills and heavy penalties from electricity boards.

6. BENEFITS

- Small and medium scale industry.
- Residential apartment.
- Factories opening with single phase machinery.
- Hospital, banks, institutions.
- It automatically supplies voltage in case of power factor or low voltage to two of three incoming phases.

7. FUTURE ENHANCEMENT

The automotive power factor correction using a capacitor load bank is very efficient as it reduces the cost by decreasing the power drawn from the supply. As it operates automatically manpower are not required and this automated power factor correction using capacitor load banks can be used for the industries purpose in the future

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