Automatic Phase Detection & Switching Circuit for a 3 Phase Supply System

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Abstract— With increase in the numbers of equipment to make our day to day life more easy and comfortable, requirement and consumption of electrical energy has increased. To fulfil this need without any interruptions even during the faulty condition of supply system, we will provide an alternate supply by automatic switching between the Electrical converter and three phase supply for any one phase of it.

Key words: Automatic, Phase Detection, Switching Circuit, Backup Supply

I. INTRODUCTION

In any system the desire for uninterrupted supply is always present. For better performance and efficiency we wish to have continuous power supply 24*7. And to fulfil that requirement of a system.

Whenever there is power cut, one out of three phases fails. So in such situation we are using an automatic phase detector to identify and differentiate the failed phase.

There after we are using inverter as a backup supply supported with a battery.

Hence, when there will be power failure, the automatic phase detector will detect the blown off phase and give backup supply and save the equipments from shutting down. will minimize the damages to lives and losses in the equipment.

Since it has its own monitoring system and its switching requires no human contact with the switch, thus eliminating human error.

The automatic change over switch reduces its change over timing to the minimum due to its fast response to power outage.

Maintenance of high quality of service through its fast and prompt response.

It can be used in any place where alternative power is needed to complement the main power supply.

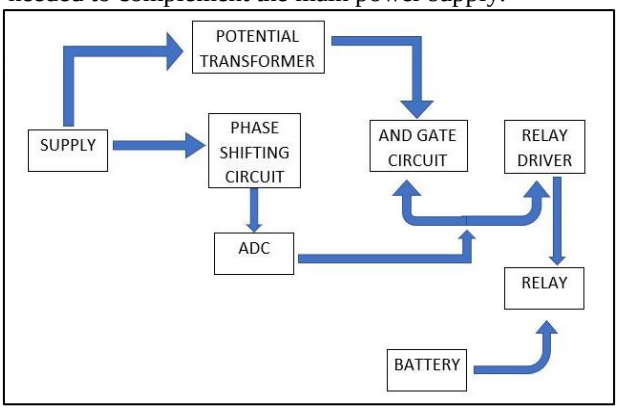

Fig. 1: Flow Diagram

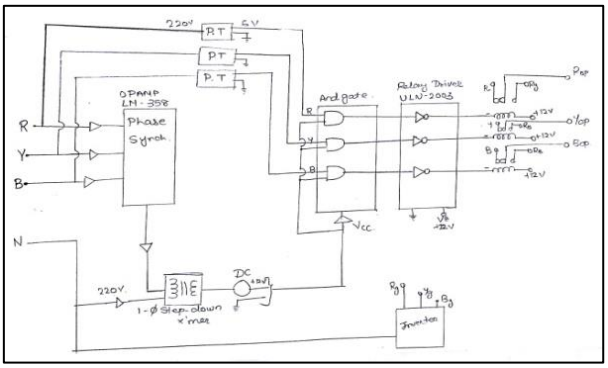

Fig. 2: Circuit Diagram

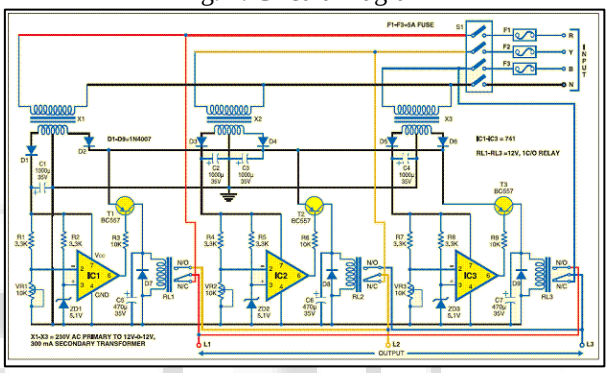

Fig. 3: Auto Phase Shifting Circuit

A. Potential Transformer

Potential transformer is a voltage step-down transformer which reduces the voltage of a high voltage circuit to a lower level for the purpose of measurement. These are connected across or parallel to the line which is to be monitored. The basic principle of operation and construction of this transformer is similar to the standard power transformer. In common, the potential transformers are abbreviated as PT.

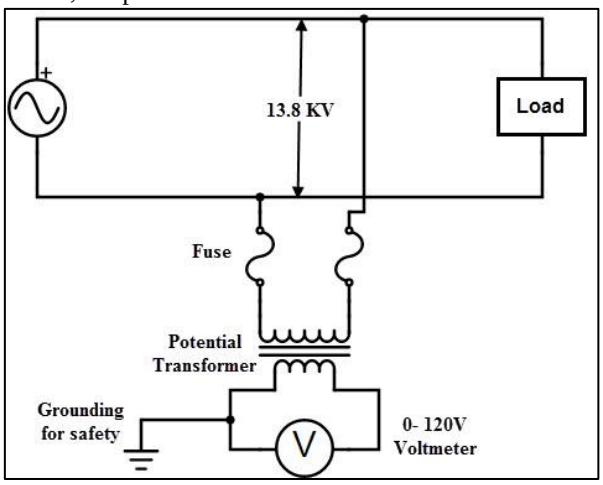

Fig. 4: Potential Transformer

The primary winding consists of a large number of turns which is connected across the high voltage side or the

line in which measurements have to be taken or to be protected. The secondary winding has lesser number of turns which is connected to the voltmeters, or potential coils of wattmeter and energy meters, relays and other control devices. These can be single phase or three phase potential transformers. Irrespective of the primary voltage rating, these are designed to have the secondary output voltage of 110 V.

Since the voltmeters and potential coils of other meters have high impedance, a small current flows through the secondary of PT. Therefore, PT behaves as an ordinary two winding transformer operating on no load. Due to this low load (or burden) on the PT, the VA ratings of PTs are low and in the range of 50 to 200 VA. On the secondary side, one end is connected to the ground for safety reasons as shown in figure.

B. Step Down Transformer

A Step down Transformer is a type of transformer, which converts a high voltage at the primary side to a low voltage at the secondary side. If we speak in terms of the coil windings, the primary winding of a Step down Transformer has more turns than the secondary winding. The following image shows a typical step down transformer.

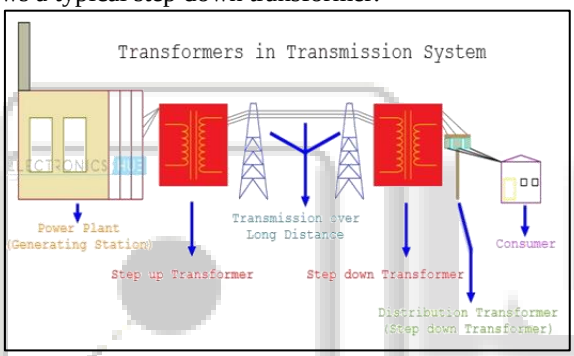

Fig. 5: Step Down Transformer

C. Relays

The Single Pole Double Throw SPDT relay is quite useful in certain applications because of its internal configuration. It has one common terminal and 2 contacts in 2 different configurations: one can be Normally Closed and the other one is opened or it can be Normally Open and the other one closed. So basically you can see the SPDT relay as a way of switching between 2 circuits: when there is no voltage applied to the coil one circuit "receives" current, the other one doesn't and when the coil gets energised the opposite is happening.

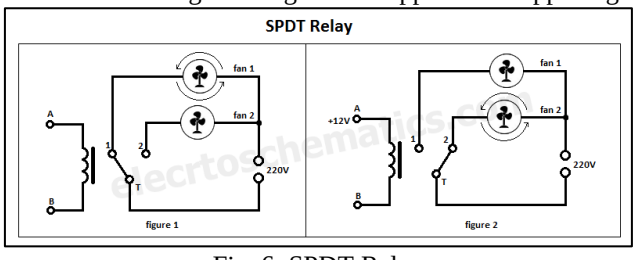

Fig. 6: SPDT Relay

D. Relay Drivers

A Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF which is connected to 220V mains supply. The required current to run the relay coil is more than can be supplied by various integrated circuits like Op-Amp, etc. Relays have unique properties and are replaced with solid state switches that are strong than solid-state devices. High current capacities, capability to stand ESD and drive circuit isolation are the unique properties of Relays.

The relay driver uln2003 ic is a high voltage and current darlington array ic, it comprises of 7-open collector darlington pairs with common emitters. A pair of darlington is an arrangement of two bipolar transistors. This IC belongs to the family of ULN200x ICs and various types of this family interface to various logic families. This ULN2003 IC is for 5V TTL and CMOS logic devices. These ICs are used as relay drivers as well as to drive a wide range of loads, line drivers, display drivers etc. This IC is also normally used while driving Stepper Motors. The pairs of darlington in ULN2003 is esteemed at 500mA and can withstand peak current of 600mA.In the pin layout, the i/ps & o/ps are provided reverse to each other. Each driver also has a suppression diode to dissipate voltage spikes while driving inductive loads

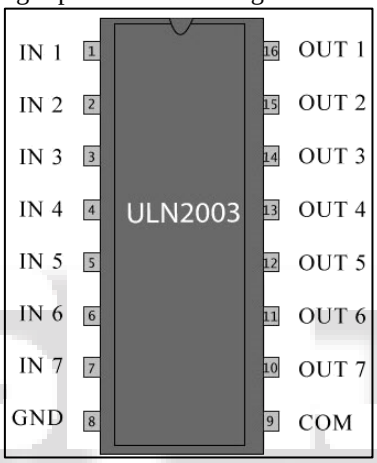

Fig. 7: ULN2003 Relay Driver

E. And Gate

The AND gate is a basic digital logic gate that implements logical conjunction - it behaves according to the truth table to the right. A HIGH output (1) results only if all the inputs to the AND gate are HIGH (1). If none or not all inputs to the AND gate are HIGH, a LOW output results. The function can be extended to any number of inputs

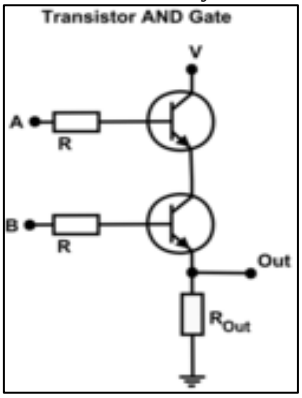

Fig. 8: AND Gate IC

F. MCT2E

The MCT2E series of opto-coupler devices each consist of gallium arsenide infrared LED and a silicon NPN

phototransistor. They are packaged in a 6-pin DIP package and available in wide-lead spacing. Features:

- Isolation test voltage 5000 VRMS
- Interfaces with common logic families
- Input-output coupling capacitance < 0.5 pF
- Industry standard dual-in-line 6 pin package
- Compliant to RoHS directive 2002/95/EC

The opto-coupler usually found in switch mode power supply circuit, read relay driving, industrial controls, digital logic inputs and in many electronic equipments

1) Application of MCT2E

It is a combination of 1 LED and a transistor. Pin 6 of transistor is not generally used and when light falls on the base-emitter junction then it switches and pin5 goes to zero.

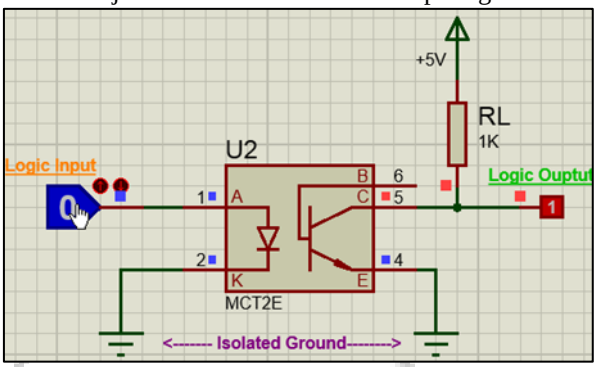

Fig. 9: MCT2E

G. Darlington

This transistor is also called as a Darlington pair, contains of two BJTs that are connected to deliver a high current gain from a low base current. In this transistor, the emitter of the i/p transistor is connected to the o/p of the base of the transistor and the collectors of the transistor are wired together. So, the i/p transistor amplifies the current even further amplifies by the o/p transistor. Darlington transistors are classified into different types by Power Dissipation, Max CE Voltage, Polarity, Min DC Current Gain and Type of Packaging. The common values of max CE voltage are 30V, 60V, 80V & 100V. The max CE voltage of Darlington transistor is 450V and power dissipation can be in the range of 200mW to 250mW.

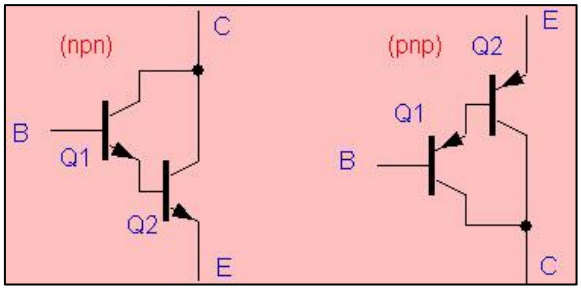

Fig. 10: Darlington IC

H. Timer IC (7805)

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

1) 7805 IC Rating

- Input voltage range 7V- 35V
- Current rating $I_{c=}$ 1A
- Output voltage range $V_{Max=5.2V}$, $V_{Min=4.8V}$

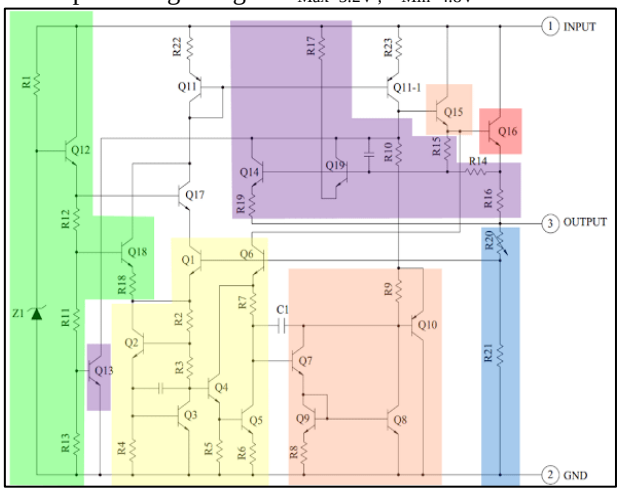

Fig. 11: Schematic Diagram of 7805 IC

I. JK FLIP FLOP

The JK flip flop is basically a gated SR flip-flop with the addition of a clock input circuitry that prevents the illegal or invalid output condition that can occur when both inputs S and R are equal to logic level "1". Due to this additional clocked input, a JK flip-flop has four possible input combinations, "logic 1", "logic 0", "no change" and "toggle". The symbol for a JK flip flop is similar to that of an *SR Bistable Latch* as seen in the previous tutorial except for the addition of a clock input.

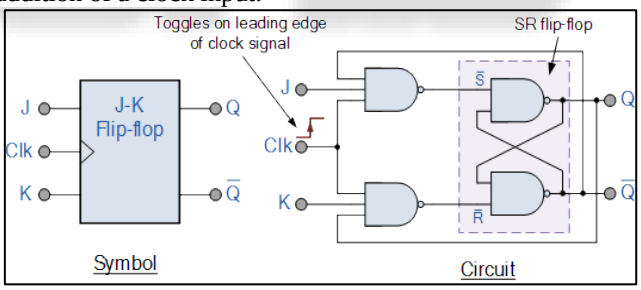

Fig. 12: JK Flip Flop

J. IRFZ 44N

IRFZ44N belongs to the family of MOSFET. MOSFET family is divided into two major types i.e. N-channel MOSFET's and P-channel MOSFET's. IRF-Z44N belongs to the N-channel MOSFET family. Similar to the other transistor it has three terminals named as Gate, Drain and Source. They are denoted by the alphabets G, D and S respectively. It is covered by a plastic body and uses "Tench Technology". Its features include very low on state resistance, high speed processing technology, completely avalanche rated etc. push pull applications and full bridge are few of its real life applications.

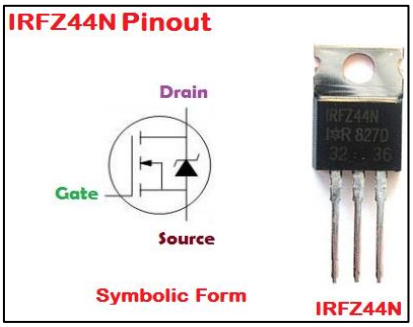

Fig. 13: MOSFET IRFZ 44N

II. REMARKS

[1] The phase shift circuits produce phase shifts that depend on the frequency and maintain a constant gain. These circuits are also called constant-delay filters or all-pass filters. That constant delay refers to the fact the time difference between input and output remains constant when frequency is changed over a range of operating frequencies.

[2] The step-down transformers have a very important function in power system. They lower the voltage level and adapt it for energy consumers.

[3] SPDT relay as a way of switching between 2 circuits: when there is no voltage applied to the coil one circuit "receives" current, the other one doesn't and when the coil gets energised the opposite is happening.

[4] It is difficult to use a number of relays with transistors, so, relay driver IC ULN2003A can be used for availing more relays.

[5] Mct2e high electrical isolation between the input and output terminals allowing relatively small digital signals to control much large AC voltages, currents and power.

