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Implementationof Single Phasing, Over Voltage, Under Voltage, Protection of Three Phase Appliances without Using Microcontroller

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ABSTRACT
This paper tends to develop for protection for costly appliances which require three-phase AC supply for operation. Failure of any of the phases or sudden change in voltage makes the appliance prone to erratic functioning and may even lead to failure. Hence it is of paramount importance to monitor the availability of the three-phase supply and proper voltage supply and switch off the appliance in the event of failure of one or two phases or if required voltage level is not available. The power to the appliance should resume with the availability of all phases of the supply with proper voltage level. The main advantage of this protector circuit is that it protects three-phase appliances from failure of any phase as well as from fluctuation of voltage. The concept in future can be extended to developing a mechanism to send message to the authority via SMS by interfacing GSM modem. Details description of all types of faults is given below.
KEYWORD:555 Timer, voltage Regulator (LM 7809), over voltage, under voltage, Relay, Transformer(230V -12V AC).

I. INTRODUCTION

Various studies have shown that anywhere from 50%, to as high as 80%, of faults in three phase appliance are due to failure in any phase or because of inadequate voltage level.Three phase appliances generally suffers from under voltage, overvoltage or tripping of any phase.

It is of paramount importance to monitor the availability of the three-phasesupply and switch off the appliancein the event of failure of one or twophases. The power to the appliance should resume with the availability ofall phases of the supply with certaintime delay in order to avoid surges and momentary fluctuations.It requires three-phase supply, three 12V relays and a timer IC NE555 along with 230V coil contactor having four poles. Relay act as a sensing device.The relays are connected in such a way that the combination of the relays forms a logical AND gate connected serially.

Sudden fluctuation is also very big problem in industries.It can also damage the three phase appliance. So to protect the three phase appliance at industries a comparator LM 324 is used. Details description of all types of faults is given below.

II. VOLTAGE REGULATOR

The LM78XX/LM78XXA series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a Wide range of applications. Each type employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be usedwith external components to obtain adjustable voltages and currents.

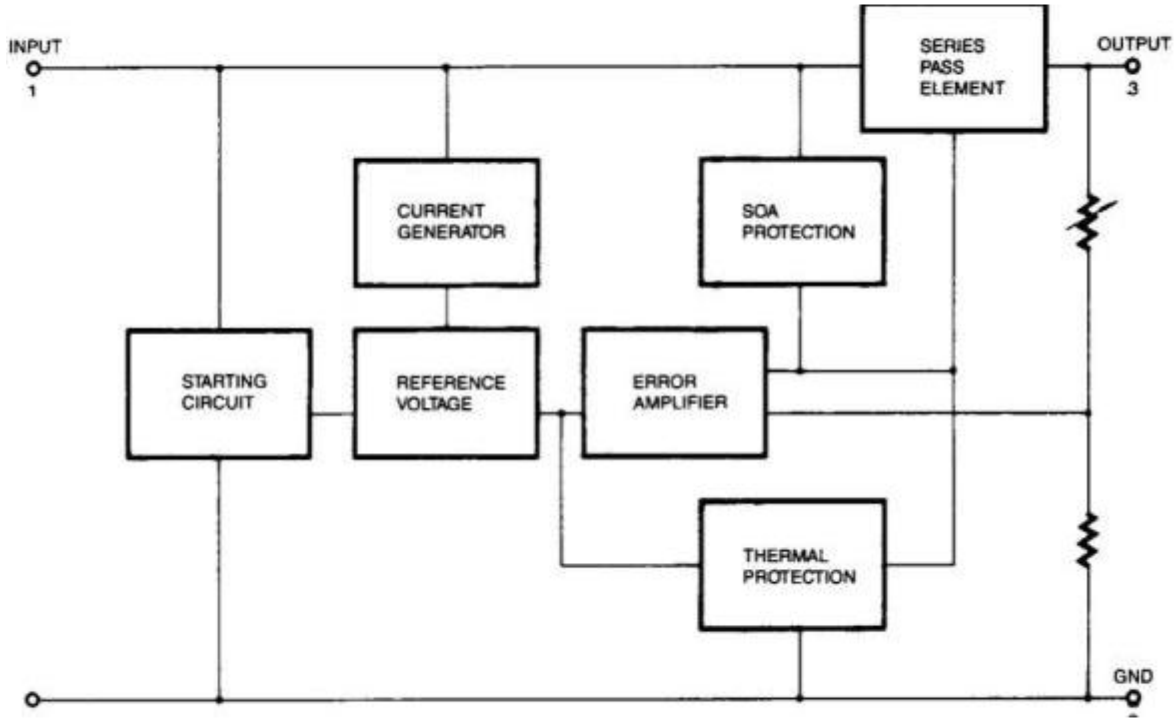


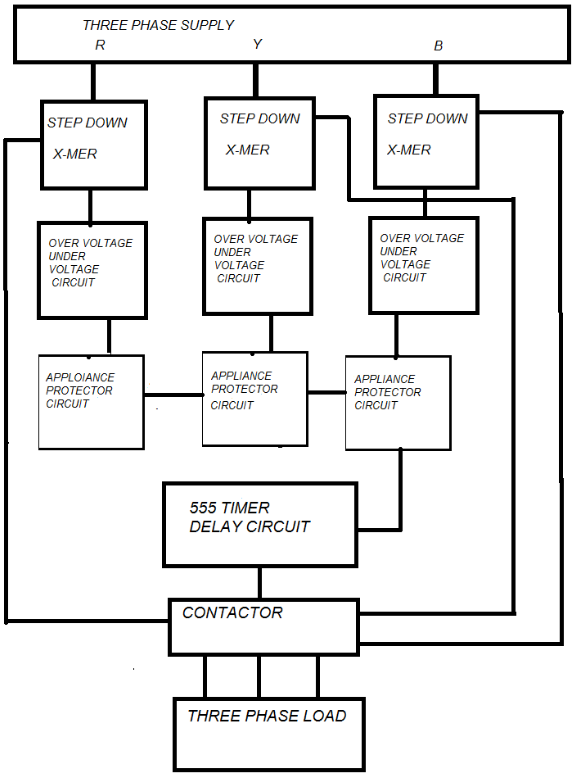
Fig1 (a) Block diagram of voltage regulator

Parameter	Symbol	Value	Unit
Input Voltage (for V_O = 5V to 18V) (for V_O = 24V)	V_I V_I	35 40	V V
Thermal Resistance Junction-Cases (TO-220)	$R_{\theta JC}$	5	°C/W
Thermal Resistance Junction-Air (TO-220)	$R_{\theta JA}$	65	°C/W
Operating Temperature Range (KA78XX/A/R)	T_{OPR}	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Fig1 (b) Absolute Maximum Rating

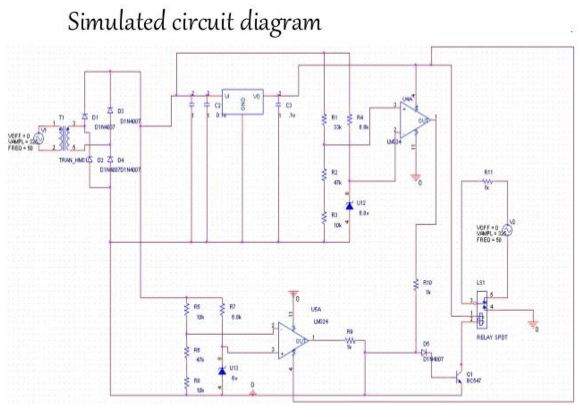
It has some features:
• Output Current up to 1A.
• Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V.
• Thermal Overload Protection.
• Short Circuit Protection.
• Output Transistor Safe Operating Area Protection

III. BLOCKDIAGRAM



IV. SIMMULATION

SIMMULATION OF OVER VOLTAGE AND UNDER VOLTAGE CIRCUIT



V. Working principle

FOR TRIPPING OF ANY PHASE

As we give three phase supply to the circuit: R phase passes through the step-down transformer X1. This step-down transformer reduces the voltage to 12V AC. Rectifier circuit rectifies the 12V AC to 12V DC. As the output appear at rectifier circuit 1 then LED glows. Rectifier circuit 1 gives the 12V DC to coil of relay RL1. When coil of relay RL1 gets triggered its pole connects to the NO.Then phase Y given to pole of relay RL1 passes to transformer X2 through NO. Then Y phase passes from the step-down transformer X2. This step-down transformer reduces the voltage to 12V AC. Rectifier circuit rectifies the 12V AC to 12V DC. As the output appear at rectifier circuit 2 then LED glows. Rectifier circuit 2 gives the 12V DC to coil of relay RL2. When coil of relay RL2 gets triggered its pole connects to the NO.Then phase B given to pole of relay RL2 passes to transformer X3 through NO. Then B phase passes through the step-down transformer X3. This step-down transformer reduces the voltage to 12V AC. Rectifier circuit rectifies the 12V AC to 12V DC. As the output appear at rectifier circuit 3 then LED glows. Rectifier circuit 3 gives the 12V DC to 555 timer. This 555 timer produces the delay to produce the output at pin 3 in order to avoid surges and momentary fluctuations. The time delay can be adjusted by the variable resistor connected at pin 6. The output at pin3 is given to the base of transistor.

This output is given to coil of relay RL3 through collector of transistor. When coil of relay RL3 gets triggered its pole connects to the NO. Then phase B given to pole of relay 3 passes to coil of 4pole contactor RL4 through NO.

When coil of contactor gets triggered it connects the three-phase supply to the load. When any one or two phase gets failure in three phase supply then this circuit fails in above operation. As the circuit fails in operation 4-Pole contactor RL4 automatically disconnects the three-phase supply to load.

FOR OVER VOLAGE AND UNDER VOLTAGE

In overvoltage and under voltage protection system of 3 phase appliance, protects the appliance from overvoltage and under voltage. Operational amplifier IC LM324 is used here as a comparator. IC LM324 consists of four operational amplifiers, of which only two operational amplifier is used in the circuit.

The unregulated power supply is connected to the series combination of resistors R1 and R2 and pot meter VR1. The same supply is also connected to a 6.8V zener diode through resistor R3. Preset VR1 is adjusted such that for the normal supply of 180V to 240V, the voltage at the non-inverting terminal of operational amplifier N1 is less than 6.8V. Hence the output of the operational amplifier is zero and transistor T1 remains off. The relay, which is connected to the collector of transistor T1, also remains deenergised. As the AC supply to the electrical appliances is given through the normallyClosed (N/C) terminal of the relay, the supply is not disconnected during normal operation.When the AC voltage increases beyond240V, the voltage at the non-inverting terminalof operational amplifier N1 increases. The voltage at the inverting terminalstill 6.8V because of the zenerdiode. Thus now if the voltage at pin 3 of the operational amplifier is higher than 6.8V, the output of the operational amplifier goes high to drive transistor andhence energies relay RL. Consequently, the AC supply is disconnected and electrical appliances turn off. Thus the appliances are protected against over-voltage which is higher than the rated voltage.

Now let's consider the under-voltage condition. When the line voltage is below180V, the voltage at the inverting terminal (pin 6) of operational amplifier N2 is less than the voltage at the non-inverting terminal(6V). Thus the output of operational amplifier N2 goes high and it energies the relay through transistor. The AC supply is disconnected and electrical appliances turn off. Thus the appliances are protected against under-voltage. IC1 is wired for a regulated 12V supply. Thus the relay energies in two conditions: first, if the voltage at pin 3 of IC2 is above 6.8V, and second, if the voltage at pin 6 of IC2 is below 6V. Over-voltage and under-voltage levels can be adjusted usingpresets VR1 and VR2, respectively.

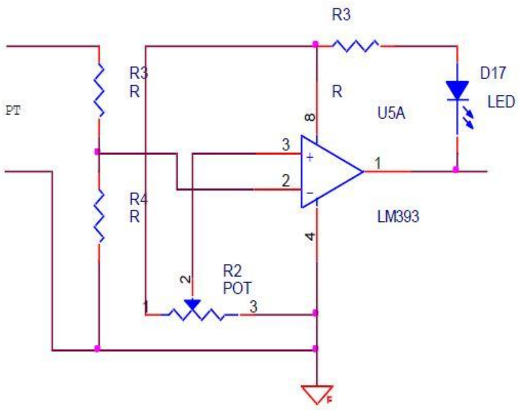


Fig Circuit diagram of overvoltage protection

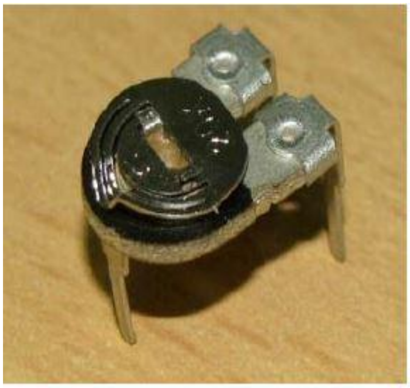


Fig. Preset to set value

VI. HARDWARE TESTING

1. Conductivity Test:

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

Devices that can be used to perform continuity tests include multi meters which measure current and specialized continuity testers which are cheaper, more basic devices, generally with a simple light bulb that lights up when current flows.

An important application is the continuity test of a bundle of wires so as to find the two ends belonging to a particular one of these wires; there will be a negligible resistance between the "right" ends, and only between the "right" ends.

This test is the performed just after the hardware soldering and configuration has beencompleted. This test aims at finding any electrical open paths in the circuit after the soldering. Many a times, the electrical continuity in the circuit is lost due to improper soldering, wrong and rough handling of the bread board or PCB, improper usage of the soldering iron, component failures and presence of bugs in the circuit diagram. We use a multi meter to perform this test. We keep the multi meter in buzzer mode and connect the ground terminal of the multi meter to the ground. We connect both the terminals across the path that needs to be checked. If there is continuation then you will hear the beep sound.

2. Power ON Test:

This test is performed to check whether the voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode. Remember that this test is performed without ICs. Firstly, if we are using a transformer we check the output of the transformer; whether we get the required 12V AC voltage (depends on the transformer used in for the circuit). If we use a battery then we check if the battery is fully charged or not according to the specified voltage of the battery by using multimeter.

Then we apply this voltage to the power supply circuit. Note that we do this test without ICs because if there is any excessive voltage, this may lead to damaging of ICs. If a circuit consists of voltage regulator then we check for the input to the voltage regulator (like 7805, 7809, 7815, 7915 etc) i.e., are we getting an input of 12V and a required output depending on the regulator used in the circuit. EX: if we are using 7805 we get output of 5V and if using 7809 we get 9V at output pin and so on.

This output from the voltage regulator is given to the power supply pin of specific ICs. Hence we check for the voltage level at those pins whether we are getting required voltage. Similarly, we check for the other terminals for the required voltage. In this way we can assure that the voltage at all the terminals is as per the requirement.

VII. TESTING AND RESULTS

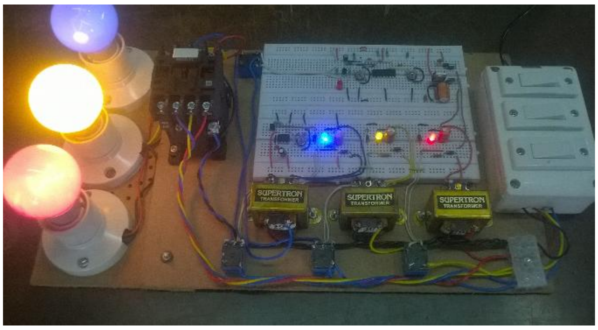


Fig Practical circuit

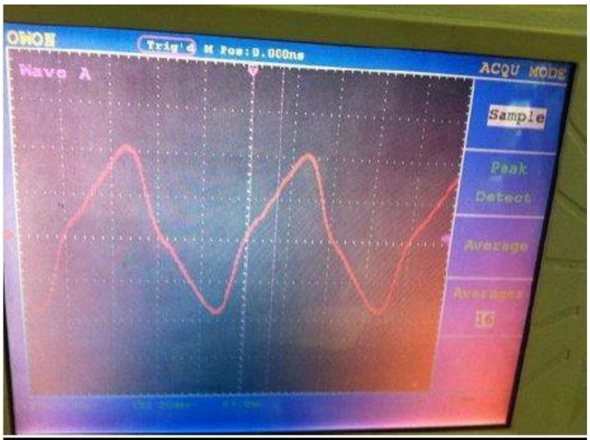


Fig input voltage waveform

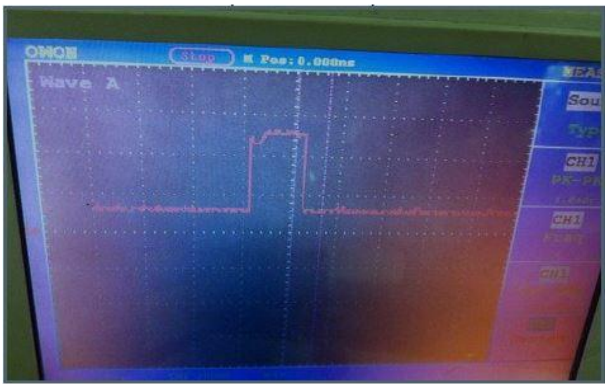


Fig output voltage of 12V dc supply
(astable mode)

VIII. Conclusion

This project is designed in the form of Hardware for three single phase transformers 230v to 12V of output to develop an automatictripping mechanism for the three phasesupply system while single phasing, under voltage or over voltage occur. Protection from these fault improves appliances lifetime and efficiency.

Three phase appliance include three phase induction motor which can be protected by using the above mentioned method.

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