Over voltage and under voltage control using relay essay sample

INTRODUCTION

The protection system is one o the important aspect on which major manufacturers is concentrating. The companies like L&T, SIMENS etc. The protection system not only provides durability to the equipment but also avoid hazards. The protection system is one of the major fields in the electrical engineering. There are different types of protection systems out of that very common and important one is the voltage protection system. Normally all the electrical equipments are specified with a specific voltage range for its safe operation. When ever those equipments are applied with a voltage more then the upper specified limit the system may draw excess current which may cause to burn the equipment. The equipment is designed to withstand a specific voltage when ever the voltage goes beyond the limit value then automatically the insulations used in that equipment get punctured and cause a damage to the equipment.

Similarly whenever the equipment is applied with a voltage lower then the lower specified voltage it draws excess current to maintain the efficiency. The out put may not be proper and the equipment may damage. The over voltage and under voltage relay in combination protect the device from fluctuation of voltage. This type of relay provides the equipment complete protection against undesired voltage condition. The over voltage and under voltage relay is one of the important protective relays which is used in the practical application at industries to protect motors transformers and other electronic and electrical equipment and power system.

DESIGN PRINCIPLE:

The over voltage and under voltage relay is designed using potential

transformers (PT). There is a PT used to sample the line voltage and converts into DC value. The DC value obtained at the rectifier and filter out put is analogous to the AC line voltage amplitude. The filter is designed with a time constant more then five time period (5T). The sampling voltage obtained at the rectifier filter out put of the PT changes after 5T only. In this manner the sampling voltage is made resistant to the effects of spics. The sampled voltage is feed to two different comparators having reference voltages analogous to the under voltage and over voltage setting. Whenever the sample voltage goes beyond the reference voltage set for over voltage condition then comparator output goes high and a fault condition is detected. Similarly whenever the sample voltage goes bellow the reference voltage set for under voltage condition in the other comparator the output goes high and a fault condition is detected. The outputs of both the comparators are feed to a logic gate to indicate the fault condition when ever any of the comparator issues a fault decision. The out put of the logic gate is feed to the bistable / latch and then relay driver and buzzer driver to protect the equipment from the fault condition and indicate the fault occurrence by blowing the buzzer.

CIRCUIT DESCRIPTION

a. Power supply

Circuit connection: – In this we are using Transformer (0-12) v, 1Amp, IC 7812, diodes IN 4007, LED & resistors. Here 230V, 50 Hz ac signal is given as input to the primary of the transformer and the secondary of the transformer is given to the bridge rectification diode. The o/p of the diode is given as i/p

to the IC regulator (7812) through capacitor (1000mf/35v). The o/p of the IC regulator is given to the LED through resistors.

Circuit Explanations: – When ac signal is given to the primary of the transformer, due to the magnetic effect of the coil magnetic flux is induced in the coil(primary) and transfer to the secondary coil of the transformer due to the transformer action.” Transformer is an electromechanical static device which transformer electrical energy from one coil to another without changing its frequency”. Here the diodes are connected in a bridge fashion. The secondary coil of the transformer is given to the bridge circuit for rectification purposes.

During the +ve cycle of the ac signal the diodes D2 & D4 conduct due to the forward bias of the diodes and diodes D1 & D3 does not conduct due to the reversed bias of the diodes. Similarly during the –ve cycle of the ac signal the diodes D1 & D3 conduct due to the forward bias of the diodes and the diodes D2 & D4 does not conduct due to reversed bias of the diodes. The output of the bridge rectifier is not a power dc along with rippled ac is also present. To overcome this effect, a capacitor is connected to the o/p of the diodes (D2 & D3). Which removes the unwanted ac signal and thus a pure dc is obtained. Here we need a fixed voltage, that’s for we are using IC regulators (7805 & 7812).” Voltage regulation is a circuit that supplies a constant voltage regardless of changes in load current.” This IC’s are designed as fixed voltage regulators and with adequate heat sinking can deliver output current in excess of 1A. The o/p of the bridge rectifier is given as input to the IC regulator through capacitor with respect to GND and thus a fixed o/p is obtained. The o/p of the IC regulator (7805 & 7812) is given to

the LED for indication purpose through resistor. Due to the forward bias of the LED, the LED glows ON state, and the o/p are obtained from the pin no-3.

b. Under voltage/over voltage detector

In this section our aim is to detect the line varying voltage.

The line voltage (230vac) coming from the mains is to be step down that voltage with the help of a step down transformer. If the line voltage varies, the step down voltage also varies in accordance with the input voltage. Due to the mutual induction of the transformer, if the primary winding of the transformer voltage is more the flux induced is more and the secondary voltage is more. Similarly, if the primary winding of the transformer voltage is less the flux induced is less and the secondary voltage is less. In this way under/over voltage occurs.

The above figure shows a half-wave rectifier, in which it will converts ac to dc voltage. We can vary the voltage with the variable load resistance (10k) The sample voltage can be calibrated by varying the load resistance RL The important part of this design to sample the voltage accurately as an replica of the line voltage. The step down transformer samples the line voltage at a reduced signal voltage Vac = (N2/N1)*VL

The DC voltage after the half wave rectifier is approximately Vm due to the charging of the capacitor, this capacitor voltage represents the line voltage. The time constant of the circuit is defined by C*RL. The time constant of the circuit must be more then five times of the time period of the signal. RC> 5T. If the RC value is less the 5T then the sample voltage fluctuates

unnecessarily, if the RC value is too high the sampling response becomes too slow. Operation: The output of the signal sampling voltage (3v) goes to the input of both of the comparator. In the first comparator we have set the voltage say 3. 5Vto the non-inverting terminal. In this case non-inverting terminal is greater than the inverting terminal. That means output of the first comparator is LOW. At present under temperature can(t be done because the room temperature will be always available If we want(s to do under temperature, we have to vary or change the set point which is connected to the inverting terminal of that comparator. Similarly, for the second comparator we have set the voltage say 4V to the inverting terminal. In this case inverting terminal is greater than the non-inverting terminal that means output of the second comparator is HIGH.

If the temperature increases, the corresponding voltage will increase say 4. 5V. That voltage goes to the input of both of the comparator. In the first comparator we have set the voltage say 3. 5Vto the non-inverting terminal. In this case inverting terminal is greater than the non- inverting terminal. That means output of the first comparator is HIGH this means that over temperature has occurred. Similarly, for the second comparator we have set the voltage say 4V to the inverting terminal. In this case non- inverting terminal is greater than the inverting terminal that means output of the second comparator is LOW.

c. NOR gate

OR GATE

The OR gate is also called as “ any or all” gate. The OR gate is the combinational logic circuit which has only one output and may have any

number of inputs. The output is when any one or more than one of the input is 1 and the output is 0 only when all the input is 0.

In the above figure, a diode OR gate is shown. It is clear from this circuit if at A +5v input is applied, it will forward biased transistor diode-1 and the output voltage at C will be +5v i. e., if input A is 1, the output C will also be 1 irrespective of input B. similarly, if input to B is 1, the output at C will also be 1, irrespective of input to A. the output C will be 0 only when both the diodes are non-conducting i. e. both input are 0 i. e. A= 0 and B= 0

NOT GATE

INTRODUCTION:

The application of the transistors is not limited solely to the amplification of the signals. Through proper design transistors can be used as switches for computers and control applications. The network of figure-01 (a) can be employed as an inverter in computer logic circuitry. Note that the output voltage Vc is opposite to the applied to the base or input terminal. In addition note the absence of dc supply connected to the base circuit. The only dc source is connected to the collector or output side, and for computer applications is typically equal to the magnitude of the “ high” side of the applied signal – in this case 5V.

OPERATION:

Proper design for the inversion process requires that the operating points switch from cut-off to saturation along the load line depicted in above figure (b). For our proposes we will assume that IC = ICEO = 0mA, when IB = 0μA

(an excellent approximation in light of improving construction techniques), as shown in above figure (b). In addition, we will assume that VCE = VCE sat = 0V.

When Vi = 5v, the transistor will be " ON" and design must insured that the network is heavily saturated by a level of IB greater than that associated if the IB curve appearing near the saturation level. In the above figure (b), this requires that IB > 50μA. The saturation level for the collector current for the circuit is defined by,

IC = VCC – VCE / RC

= 5V – 0. 2V / 10K

= 480μA

The level of IB in the active region just before saturation results can be approximated by the following equation,

IB min ≈ IC sat / βdc

= 480μA / 300

= 1. 6μA

For the saturation level we must therefore insure that the following condition is satisfied: IB max > IC sat / βdc

For the network of the above figure (b), when Vi = 5v the resulting level of IB is Assume

IB = 100μA

5v – RB IB – 0. 7v = 0

RB (max) = 4. 3 / 100μA = 43kΩ

RB (min) = 4. 3 / IB(max) = 1kΩ

Which is satisfied. Certainly any level of IB greater than 16μA will pass through a Q- point on the load line that is very close to the vertical axis.

d. Bistable / Latch

Introduction

The latch is the electronics device which stores the state even if the input is with drawn. So this ca be started as a single memory unit. The latch can be designed in many ways by using a discreet component or flip-flop or a IC known as 555 timer, The Latch designed using 555 timer IC is quite stable.

Ckt Connection:

The threshold voltage pin-6 of IC555 is connected to ground and the trigger pin-2 a pull-up resistor 10k is connected to VCC normally.

Whenever the threshold voltage is low, the output of the comparation-1 infernally, the output of the flip-flop goes low. And the input of the comparator – 2 internally high than 1/3 Vcc, the output will remain in ‘ LOW’ sate.

Whenever a negative edge trigger voltage will appear at the trigger pin-2, internally the output of the comparator – 2 goes high, the flip-flop will remain in high state and it will latch that output. Until we have to reset that IC through reset pin-4 to ground.

Operation

The 555 timer IC contain two comparators at its input, one end of the comparator is connected to the 1/3 Vcc and 2/3 Vcc respectively. The other two terminal of both the comparator are named as trigger and threshold. The

output of these two comparators are connected to a S-R flip –flop in which output toggles when the inputs are dissimilar i. e. 1, 0 or 0, 1. The Bistable design gas two inputs, one as trigger input to change the state and the other is to reset the output. The input signal is connected to the trigger pin and the threshold is grounded. It means the output of the comparator to which 2/3 Vcc is connected and threshold (ground) is kept at fixed output. When the trigger pin is issued with an input which is less than 1/3 Vcc then automatically the comparators output toggles and hence the flip flop output toggles and the output of the 555 timer IC is set. The output remains in the state until unless the reset input is pulled down to ground.

e. Relay driver

In this section we have taken electro magnet relay to control the electrical appliances we have taken a 12v relay whose resistance is 400Ω which requires 30mA current to drive or to make it ‘ ON’ / ‘ OFF’.

The output of the flip-flop is given as input to the relay driver (as we know, the output of the flip-flop is a TTL IC which gives a output current 50µA. Therefore, we need a driver ckt to drive the relay.

The driver is configured as a transistor acts as a switch. Whenever the base voltage is high through a base resistance 1. 5 K and the collector is connected to the relay coil, which as a resistance Rc 400Ω, the transistor comes to saturation condition i. e. ‘ ON’ state because the emitter current will flow to the collector region, which makes the coil as electro magnet.

The relay driver is design by using a BC547 transistor . The relay used here having the specification as follows ❖ Coil resistance = 400ohm

❖ Coil voltage= 12Vdc

❖ Contact capacity= 230V, 7A

The above specification indicates that the coil requires 12V dc and 200mA current dc. The TTL can’t supply more then 20µA current. So driver section is very much required. BC547 has a typical current gain of 200 and maximum current capacity of 1A. So a typical base current of 10 (A can trigger to on the relay. ELECTRO MAGNETIC RELAY

These are very much reliable devices and widely used on field. The operating frequency of these devices are minimum 10-20ms. That is 50Hz – 100Hz. The relay which is used here can care 25mA currents continuously. The electromagnetic relay operates on the principle magnetism. When the base voltage appears at the relay driver section, the driver transistor will be driver transistor will be driven into saturation and allow to flow current in the coil of the relay, Which in turn create a magnetic field and the magnetic force produced due to that will act against the spring tension and close the contact coil. Whenever the base voltage is withdrawn the transistor goes to cutoff . So no current flow in the coil of the relay. Hence the magnetic field disappears so the contact point breaks automatically due to spring tension. Those contact points are isolated from the low voltage supply, so a high voltage switching is possible by the help of electromagnetic relays. The electromagnetic relays normally having 2 contact points. Named as normally closes (NC), normally open (NO). Normally closed points will so a short CKT

path when the relay is off. Normally open points will so a short CKT path when the relay is energized.

f. Buzzer driver

The buzzer driver consists of a buzzer & its driving ckt. It works on the principle of transistor action (Transistor acts as a switch). When the base voltage is high, the transistor comes to saturation i. e. in ON condition, which drives the buzzer because a small emitter current will flow. Similarly, when the base voltage is low, the transistor does not come to saturation i. e. OFF condition, which does not drives the buzzer.

FUTURE EXPANSION

This project is designed with limitation to time and cost. The over voltage and under voltage relay that is designed here can be modified to interface multiple parameters such as temperature and current etc. The interface of micro controller can make the system more versatile and smarter.

CONCLUSION

The over voltage and under voltage relay that is designed here in the laboratory and tested in the laboratory condition. And found to be operating satisfactory the set points are set at the limiting value and the practical tripping of the relay is within the limits of experimental errors.