

## DESIGN OF A LOW COST SERVO CONTROLLED VOLTAGE STABILIZER

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### ABSTRACT

Many types of voltage stabilizers are available in market. In these stabilizers the output is changed manually with switch to maintain the output voltage constant. During the peak period this manual operation of stabilizer has to be done frequently. This paper presents a low cost servo controlled voltage stabilizer which rectifies this problem.

**KEYWORDS:** Servo Controlled, Stabilizer, Voltage

### INTRODUCTION

Excessive voltage variations are highly dangerous for the sophisticated Electrical and Electronic Equipment such as electro-medical equipment, computers, communication equipment & systems, process controllers etc [1]. This equipment requires a specified contact stabilized voltage source for their desired optimum operation. The small variations in the input voltage are highly dangerous. Also, servo controlled voltage stabilizers are most suitable for twenty four hours continuous process plants where breakdowns due to fluctuation results in heavy financial losses occur [3]. They are also used for domestic and industrial applications [4].

In general, a servo voltage stabilizer has simple construction consisting of a variac, ac motor, simple electronic sensing circuitry, relays, buck/boost transformer and impulse transformer [5]. We use similar type of components in a cost effective sense in achieving the stabilizing signal.

While the provision of Indian electricity Act required that power supply voltages should not drop or rise more than four percent, we find voltage fluctuations taking the 230 volts mains supply, apply voltages to as low as 170 volts or as high as 270 occasionally. With enormous increase in loads connected to a distribution transformer, the electricity suppliers now find it exceedingly difficult to maintain the voltage within the updated values. And that has necessity and use of automatic voltage stabilizer for almost every instrument. Even domestic appliances like refrigerator and T.V. sets need a stabilizer before connecting power to them, not to speak of computers and other expensive equipment.

With the wide spread use of switched mode power supplies, color television sets today have eliminated the need for a voltage stabilizer. But it is preferable to employ one even for them, to safeguard against momentary voltages over 270V and below 170V on the mains.

### IMPLEMENTATION

This paper aims in maintaining a constant output voltage. The conventional voltage stabilizers are used for feeding controlled voltages to appliances, where the voltage predominantly varies during peak loads. These voltage stabilizers normally use one or two relays and voltages stabilized in two steps. The other type of stabilizers available in the market is manually operated. In such stabilizers the output is changed manually with switch to maintain the output voltage

constant. During the peak period this manual operation of stabilizer has to be done frequently. This problem is solved by servo controlled voltage stabilizer efficiently. With this circuit it is possible to keep output voltage constant even if the mains voltage goes to a maximum or minimum value.

We have also incorporated both manual and automatic methods of voltage stabilization. A protection circuit is also provided with this circuit to isolate the circuit from mains supply from reaching the appliances, the voltage exceeds or falls below a certain predetermined value as shown in the figure.

Figures 1 and 2 shown below are the block diagram and circuit diagram of the voltage stabilizer connected to an appliance or load. The stabilizers size increase generally with its rating, which is given in KVA.

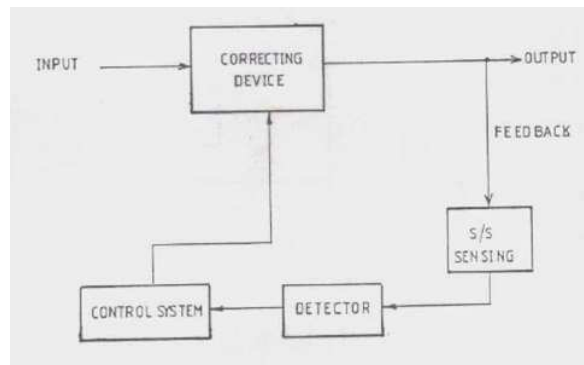


Figure 1: Block Diagram of Proposed Servo Controlled Voltage Stabilizer

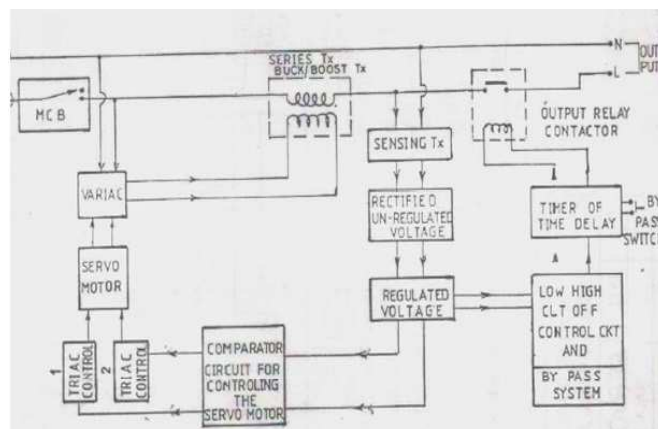


Figure 2: Circuit Schematic of Proposed Servo Controlled Voltage Stabilizer

## HARDWARE CIRCUIT COMPONENTS

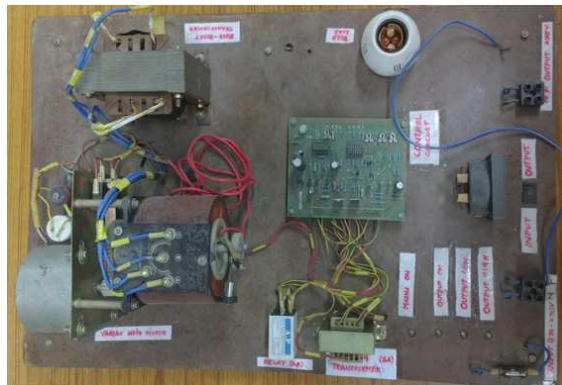
The components that we have used in the present servo controlled voltage stabilizer are listed in table 1.

Table 1: Components in Servo Controlled Voltage Stabilizer

1.	AC Servomotor:	Input: 230V Frequency: 50Hz,1-Phase Speed: 60rpm Torque: 3kg-Cm
2.	Relay:	Contact 6a/250v Coil: 12v, D.C. 300 ohms
3.	Sensing Transformer:	230V/ (15v-0-15v), 1a

Table1 cont		
4.	Adjustable Voltage Regulator:	LM723
5.	Comparators:	LM324
6.	Rectifier	AC to DC converter
7.	Gear mechanism:	Gear Ratio 20:1
8.	Auto transformer:	270V/5A

The disadvantage of using autotransformer lays in the direct electrical connection between the low tension and high tension sides. If primary supplied at high voltage, then an open circuit in the common winding would result in the appearance of dangerously high voltages on the persons working there. Thus a suitable protection must be provided against such an occurrence. If the ratio transformation  $k$  differs far from unity, the economic advantages of auto transformer over two winding transformer decreases. The hardware circuit implemented is shown in figure 3.



**Figure 3: Hardware Circuit**

The servo controlled voltage stabilizer employs a adjustable precision grade voltage regulator LM723. With this circuit it is possible to get a voltage regulation of +1 or -1 volt .This circuit works for a voltage range of 170 to 250 volts. If the voltage is beyond these limits a protection circuit called under/over voltage protection is provided to protect the main circuit from damages. In this circuit ac servo motor is used to drive knob of auto transformer, but for higher ratings of servo motor a buck boost transformer can be used and accordingly the output voltage is either bucked or boosted.

## CONCLUSIONS

We have successfully implemented a servo controlled voltage stabilizer that works for a voltage range of 170 to 250 volts efficiently. Also the cost of the developed system is under two thousand five hundred Indian rupees which is cost effective in present day market scenario. For higher rated servo motors, a buck boost transformer can be used and in accordance the output voltage is either increased or decreased.

## REFERENCES

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