Voltage Sensing Circuit

With protective shutdown switch for extremities

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Introduction:-

The following circuit is designed to sense voltage and detect when it surpasses a predefined bound. It disconnects the power lines when such an event occurs.

The power should remain off for at least five minutes after the voltage enters the reconnection bound, to make sure that it has settled down in the specified range and future disconnections are unlikely.

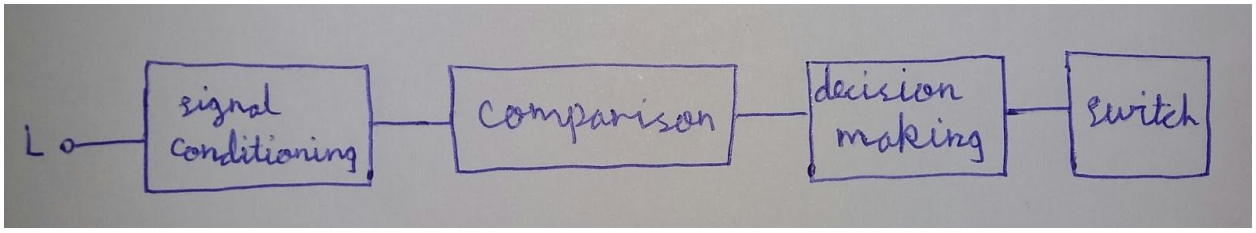
This is done to protect sensitive devices from power instability. We note here that a preferred solution would be a stabilizer, however if instabilities aren't frequent and continuous operation isn't critical for the device, we believe that a stabilizer is not the ideal solution for economic reasons, which is the motivation behind the development of this product.

Specifications:-

Sudanese power lines are 220 VAC, accordingly, the boundaries were chosen to be 200 and 250 VAC with %5 tighter boundaries for reconnection.

The response time of the product should be minimized (< 1 second) to avoid damage to the protected device. With a five minute delay for the aforementioned reasons.

Preliminary design:-



1\ Signal conditioning:-

Typical signal conditioning circuits are based on one of two concepts:

a. Transformers:

1. Advantages:
   They can increase or decrease voltage with very high efficiencies. They can deliver high power making them ideal for power applications.
2. Disadvantages:
   Heavy, bulky, noisy and expensive.

b. Voltage dividers:

1. Advantages:
   Small, light , cheap and accurate.
2. Disadvantages:
   They can only decrease power, they are inefficient and not suitable for power applications.

2\ Comparator:-

Here are three possible ways for comparing signals

a. Electronic comparator:

1. Advantages:
   Fast, accurate, reliable and power efficient.
2. Disadvantage:
   Can only compare to one reference and isn't suitable for power applications.

b. Bridge circuit:

1. Advantages:
   Simple, sensitive, and suitable for high power applications.
2. Disadvantages:
   Generates an analog output.

c. ADC:

1. Advantages:
   Can compare to multiple references and produces digital output.
2. Disadvantages:
   Complicated and expensive.

3\ Decision making and timer:-

The decision making will be done by logic gates. The timer will be achieved by one of two methods:

a. Analog method:

1. Advantages:
   Simple, fairly accurate.
2. Disadvantages:
   Impractical for long delays and incompatible with gates.

b. Digital method:

1. Advantages:
   Accurate, reliable and compatible with logic gates.
2. Disadvantages:
   More expensive and complicated.

4\ Switch:-

Three electrical switches will be discussed:

a. Transistor:

1. Advantages:
   Fast and power efficient.
2. Disadvantages:
   Not suitable for power applications.

b. Relay:

1. Advantages:
   Suitable for power applications.
2. Disadvantages:
   Slow and power inefficient.

c. Latching relay:

1. Advantages:
   Suitable for power application and efficient.
2. Disadvantages:
   Slow.