# Introduction:

Voltage fluctuations are known to cause issues and damage to electronic devices. It causes lights to flicker or glow brighter. Display screen may flicker as well.  There are also some instances when electronic equipment, such as a computer, will fail to start up. In addition, voltage fluctuations can cause computer systems to lose data, while televisions or radios may experience interference. This power problem can have a significant effect on the lifespan of incandescent bulbs, since they are designed for a specific voltage. Even a 10 percent voltage drop normally will not in itself cause a computer's volatile random-access memory to fail. But it will probably cause the computer to hover on the brink of failure, and any additional decrease, however brief, could well cause a crash that erases the computer's memory.

Obviously, voltage fluctuations can either be voltage drops or voltage surges. There are generally two types of loads, resistive and inductive.

Voltage drops are mainly dangerous in case of inductive loads, a motor for example. When the voltage is low enough then the load will draw more current to meet its rated power. The higher current, the more the heat generated and it may burn the wiring, insulation and the motor.

Voltage surges come in two basic varieties: spikes, also called transients, which typically last from a nanosecond (a billionth of a second) to a microsecond (a millionth of a second), and surges, which are longer voltage surges, lasting into milliseconds (a thousandth of a second).

When you apply a high enough voltage, you can effectively cause dielectric breakdown of the gate of MOSFETs, causing the MOSFET to no longer be able to switch/control current flow and electrons being able to freely flow between the source and drain.

Related to heat, if you increase the current due to increasing voltage, a chain reaction of current and heat increasing may causing a burnout of the device.

# Literature Review:

To prevent the different types of issues cause by voltage surges or voltage drops, a voltage sensor is used. A voltage sensor is a [sensor](https://www.electrical4u.com/sensor-types-of-sensor/) is used to calculate and monitor the amount of [voltage](https://www.electrical4u.com/voltage-or-electric-potential-difference/) in an object.

This voltage sensor to be designed will sense when the voltage goes above or below the range, then it will disconnect the supply from the load to prevent damage.

Before the voltage is compared to detect whether it lies in the required range or not, signal processing is required. More specifically the voltage of the signal needs to be stepped down to a value acceptable to the comparator being using (OpAmp), the comparator also needs the voltage to have 0Hz frequency (DC voltage) so the signal needs to be rectified. With rectification comes the issue of ripple voltage which means the voltage wouldn’t be exactly constant at one value, to solve that issue a capacitor known as a filter is used.

To compare the voltage to the required range, a comparator which is an Operational Amplifier is used. Then the output is taken to a logic gate to make a decision, based on the output of the logic gate being fed into a delay circuit, a decision to turn off or on the power source is taken.

Lastly, after the decision is made, the power supply needs to be turned off or back on depending on the decision.

## Stepping down of signal:

### Option 1: Using a step-down transformer.

Pros:

* Losses are much smaller in comparison to other methods
* Isolation of ground
* No moving parts

Cons:

* Distortion
* Expensive compared to voltage divider circuit
* Bulky
* Could be noisy
* Not good for outdoor use due to possible corrosion

### Option 2: Voltage divider circuit.

Pros:

* Very simple to design
* Only component required are resistors
* No moving parts

Cons:

* Measurements are only as accurate as the components used
* Resistance dividers introduce a small power loss
* Ratio may be affected by voltmeter resistance which causes uncertainty

## Rectification of signal:

### Option 1: Half wave rectifier

Pros:

* Circuit is simple
* Less diodes needed than full wave rectifier
* Low cost

Cons:

* Low power output due to power being delivered during one half of cycle
* Low rectification frequency due to power being delivered during one half of cycle
* If smooth DC is required 3 to 4 times filter capacitance is needed compared to full wave rectification

### Option 2: Full wave rectifier

Pros:

* Higher efficiency than half wave rectifier
* Larger DC power output in comparison
* Utilizes both halves of the AC waveform
* Easier to provide smooth DC output due to higher ripple frequency

Cons:

* Circuit is more complicated than half wave rectifier
* More costly than half wave rectifier
* Not suitable for small voltages

### Option 3: Bridge rectifier

Pros:

* Higher efficiency than half wave and full wave rectifier
* The output wave form is continuous
* Less filtering is required

Cons:

* More complicated than half wave and full wave rectifiers
* More costly

## Filtering of the ripple voltage:

* Only one option: Using smoothing capacitors

## Comparing the voltage to required range:

* Only one option: Using an OpAmp circuit

## Decision making logic:

* OR gate
* RC delay circuit

Switching circuit on and off:

### Option 1: Electromechanical relay:

Pros:

* Low cost
* Large variety
* Durable
* Safer

Cons:

* Slower switch time
* Limited contact lifetime
* Take up large space

### Option 2: Reed relay:

Pros:

* Reliable
* Small and lightweight
* Low power consumption
* Leakage current much lower

Cons:

* Sensitive to magnetic fields
* Sensitive to large surges
* Sensitive to vibration

### Option 3: Solid state relay

Pros:

* Very long life cycle
* No contact bounce
* High performance
* No noise

Cons:

* Usually fail in the closed mode
* More expensive

# Preliminary design:

Switching

Decision Making

Signal conditioning

Comparison

Power supply