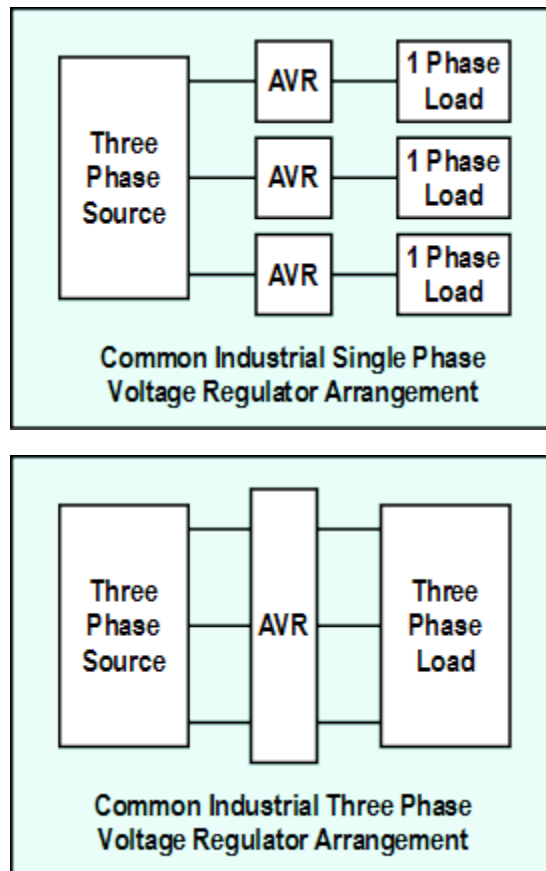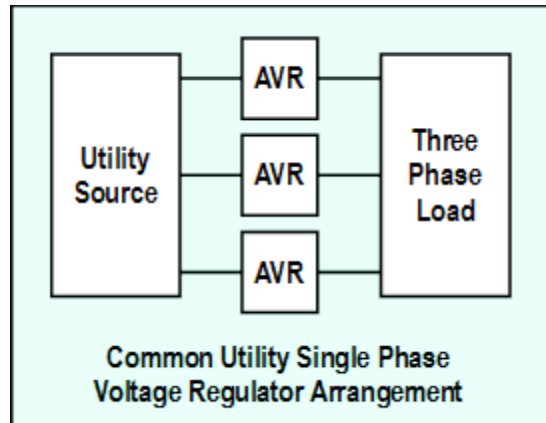Automatic Voltage Regulator (AVR) :

1-Utilization:

The use of AVRs (Automatic Voltage Regulators) with your appliance is important because it regulates the output voltage supplied to your appliance. through voltage regulation, the AVR protects your appliance from damage caused by high and low voltage fluctuations.

Essentially, an AVR prolongs the usage life and reliability of your appliances
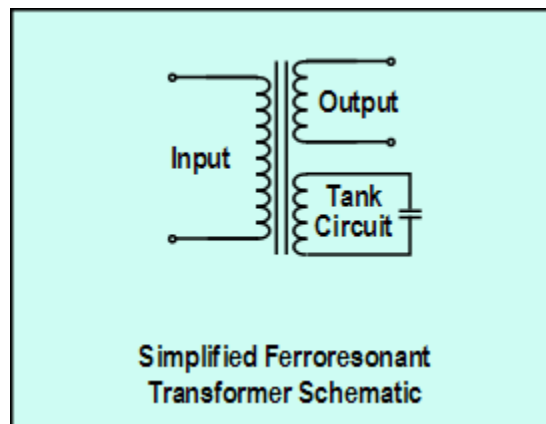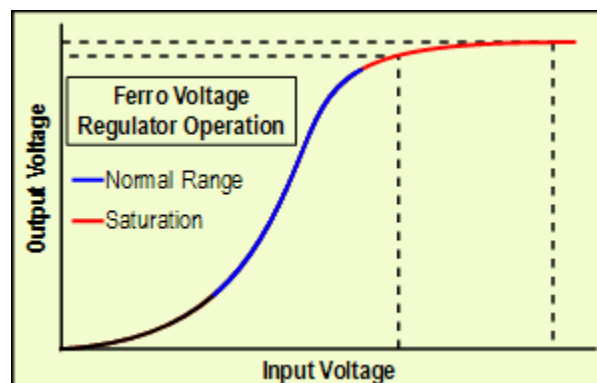
2-Installation Methods:

Common Industrial Single Phase
Voltage Regulator Arrangement

Common Industrial Three Phase
Voltage Regulator Arrangement

Common Utility Single Phase
Voltage Regulator Arrangement

3-Types:

a-Constant Voltage Transformer (Ferro) AVR:
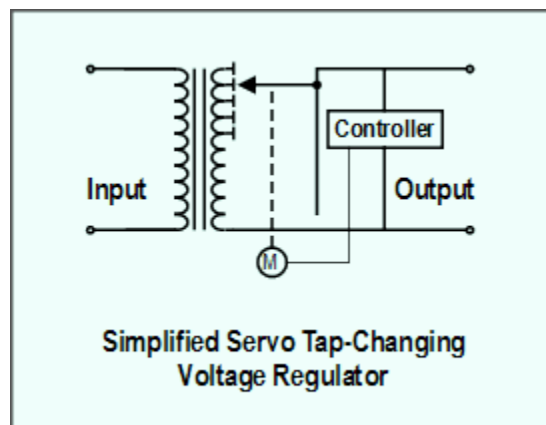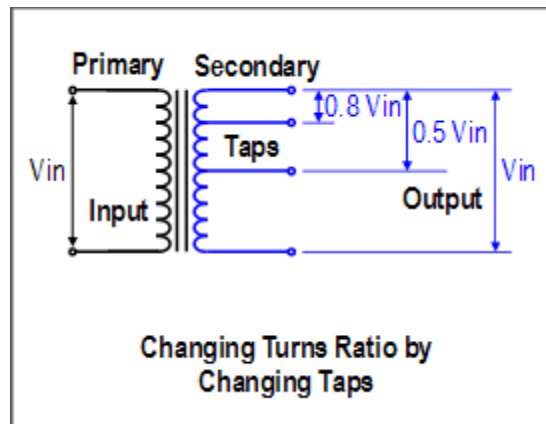

Simplified Ferroresonant
Transformer Schematic

The CVT (ferro) uses the unique principle of ferroresonance: operation of a transformer in the region of magnetic saturation. When the iron core of a transformer is in saturation, relatively large changes in winding current results in very small changes in magnetic flux. Winding current and magnetic flux are proportional to the input and output voltage, respectively. This means that relatively large changes in input voltage result in small changes in output voltage: this being the fundamental purpose of an automatic voltage regulator.

Blue area is the Saturation region

b-The Mechanical (Type) Voltage Regulator:

Primary   Secondary

Taps

Vin

Input

↕0.8 Vin

0.5 Vin

Output

Vin

**Changing Turns Ratio by
Changing Taps**

Input

Controller

Output

M

**Simplified Servo Tap-Changing
Voltage Regulator**
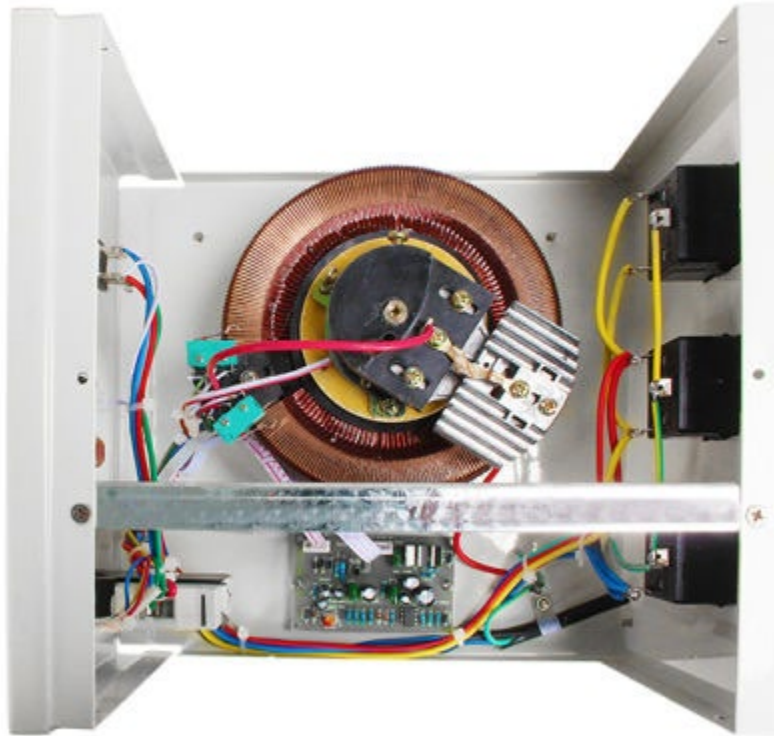
Servo-motor type AVRs makes use of a servo motor and a carbon brush to adjust the input voltage to output voltage mechanically

Servo-motor type AVR are recommended for sensitive equipment

Sensitive electronic equipment refers to devices that are easily damaged by sudden voltage irregularities. These include devices such as medical equipment, dental and laboratory equipment

Pros:

The servo-motor type AVR provides more precise voltage regulation compared to relay-types because it adjusts mechanically to ensure your output voltage is always at 220V

The servo-motor type AVR has a faster response time. Expect the servo-motor type AVR to respond within milliseconds of +/- 1% voltage deviation

Cons:

Servo-motor type AVRs are more expensive as the servo motor itself costs a lot more versus the electronic components of a relay-type AVR


Maintenance:

1-Get the carbon replaced, as it can get worn out from all the voltage adjustment movement.

2-Submit your servo-motor for maintenance and calibration to readjust the voltage setting.

c-Electronic Tap Switching Voltage Regulator:

Relay-type AVRs makes use of an electronic circuit and set of relays/transistors to keep the output voltage within a certain range of value

Essentially, the electronic circuit compares the input voltage to the desired output voltage. When there is a marked deviation, the circuit switches on the desired relay to connect to the desired output voltage tap

Every time you hear a click from your relay-type AVR, that's the sound of the relay switching from one voltage range to another

Simplified Series Transformer Electronic
Tap Changing Voltage Regulator
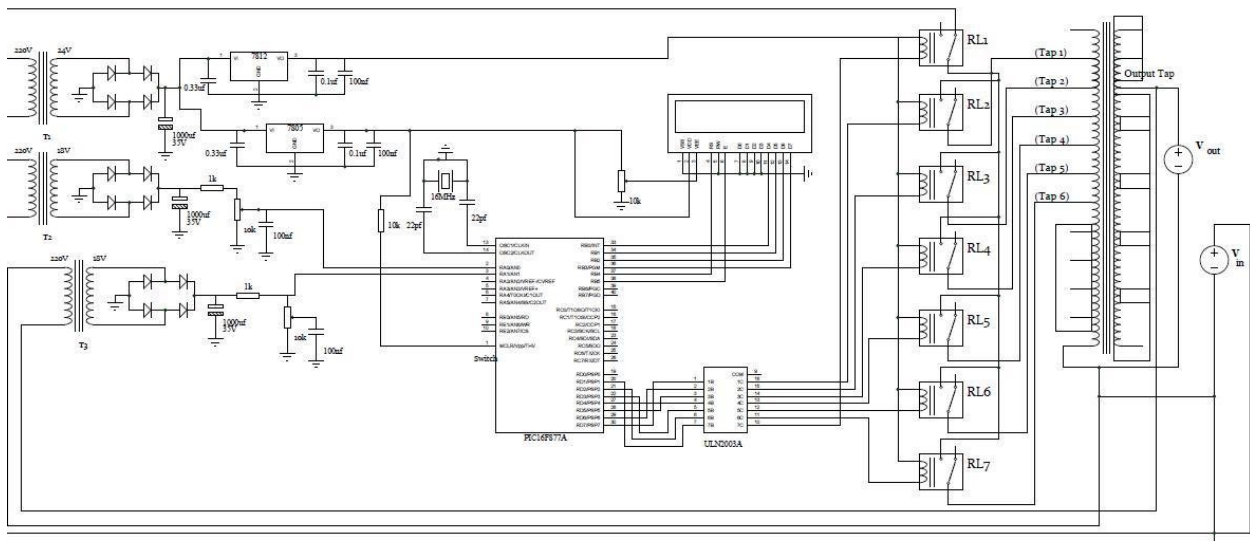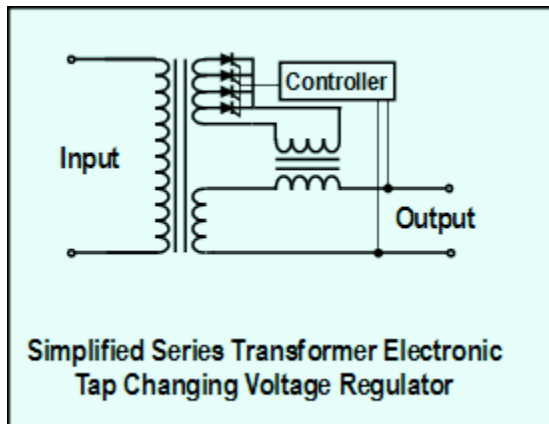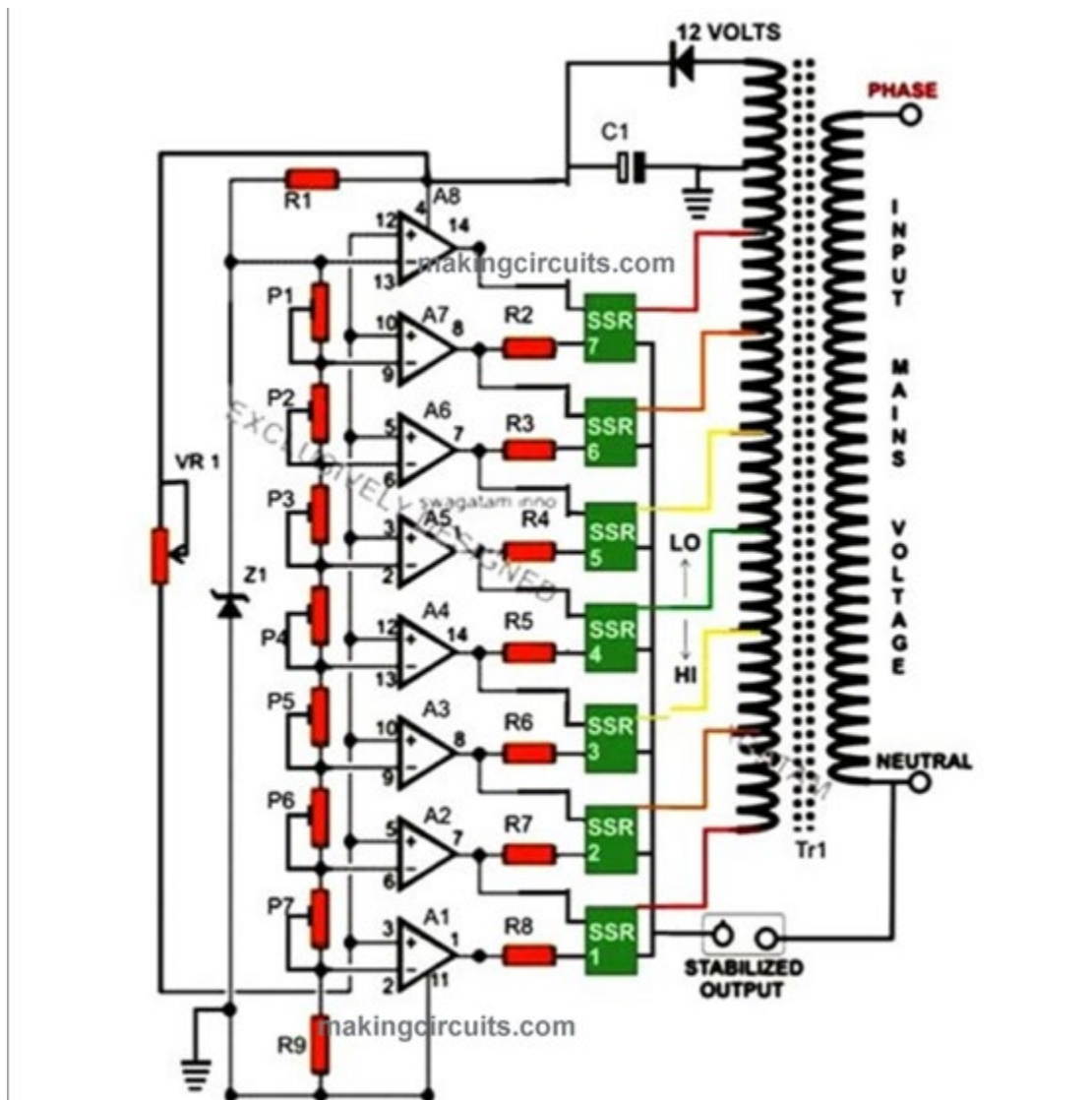
Pros:

Relay-type AVR is made up of electronic components (circuit, relay/transistor). As such, compared to a servo motor AVR, it is cheaper, lighter and more compacts:

Cons:

Relay types AVR adjusts the output voltage in discrete "steps." Essentially, when a certain input voltage is registered, the relay will indicate whether the AVR should step-up or step-down the voltage by a set value (vs the servo-motor type mechanical finetuning). This makes it less precise in voltage regulation vs the servo-motor type

The relay-type AVR has a slightly slower response time: relay-type AVRs will respond within 1 second of +/- 7% voltage deviation. NOTE: 1 second can make a huge difference for extremely sensitive electronic components, so a servo-motor type would be better for very sensitive appliances

4-Selection Parameters:

1. VOLTAGE REGULATION Optimal voltage regulation is achieved when the value of voltage is equivalent to all electrical equipment loads. Several factors can affect voltage regulation, including wire and cable size and type, transformer reactance and cables, motor starter, circuit design, and power factor. Regardless of these potential obstacles, voltage regulation must be selectable to an accuracy of ±1%. This requirement eliminates three-phase unbalance problems and minimizes voltage deviations.

2. INPUT VOLTAGE RANGE The first step in selecting the best automatic voltage regulator is specifying your input voltage range. The input voltage range should be broad and shifted because line voltages drop more than they increase. This feature allows for more low correction, rather than high correction. It also allows the automatic voltage regulator to be more configurable to all buck or boost, giving it maximum voltage correction for extreme cases.

3. LOW IMPEDANCE Impedance is the resistance of a component to the flow of electrical current, measured in ohms. The goal of an automatic voltage regulator is to achieve low impedance. Interaction between the load current and source impedance can cause low voltage, harmonic distortion, and voltage unbalance. Ideally, your automatic voltage regulator would avoid all of this if it had low impedance.

4. LOAD COMPATIBILITY Voltage regulation solutions must be compatible with the specified load to ensure its operation and to avoid interfering with the operation of other loads connected to the same power source. High performing automatic voltage regulators should be able to handle loads with high starting currents, all power factors, and high crest factors. To prevent instability, the regulator's speed of response must be designed to work with the electronic power supplies used in much of today's equipment.

5. VOLTAGE ACCURACY The primary job of an automatic voltage regulator is to make voltage levels more accurate, but what is the optimal accuracy level for your application? Voltage accuracy is dependent on the critical load requirement. Typically, automatic voltage regulators function in circuits where voltage regulation can not be achieved by changing the size of the conductor. The five characteristics listed above are critical for an automatic voltage regulator to perform reliably in demanding applications. In applications where voltage impulses, spikes, and transients are a significant concern, you should also consider Transient Suppression as a critical feature.