



# **SNS COLLEGE OF TECHNOLOGY**

**(An Autonomous Institution)**



## **UNIT-IV- Power Quality Conditioners for Smart Grid**



# Power Quality Conditioner in smart grid



What is a power conditioner?

Power conditioning is a process that is done to improve the power quality, it does the conditioning of the power.

The power conditioner is also called a line conditioner, so basically it is used to provide quality power to the electrical load equipment.

We know that many electronic devices are used in many industries and these devices are really sensitive so in order to carry out the industrial operations properly good power quality is required



# Power Quality Conditioners



The power conditioners are able to handle power quality problems such as voltage sags, transients, interruption, voltage fluctuations, etc. There is an AC power conditioner which would provide good quality AC power to the sensitive electrical equipment. Mostly this type of power conditioner is used for office or in-home. So the AC power conditioner can do the surge protection and also the noise filtering.



# Functions of Power Quality conditioner



## What are the functions of a power conditioner?

The major function of a power line conditioner is to take the power and to make changes in the power according to the machinery. The surge suppressor is an example for the power conditioner, voltage spikes could happen during the thunderstorm, the surge protector would be able to prevent the flow of electricity to the equipment and thus it can prevent the damage of the equipment.

- It would provide the proper amount of voltage and current so that the load equipment would operate properly
- It would provide proper power transmission between the utility and the microgrid
- It would isolate each microgrid and the utility grid from the noises and disturbances
- Combine with the energy storage system
- It takes part in energy creation, it would do the conversion of the DC power by solar panels to AC



# Types of power quality conditioners



- Distribution static compensator
- Active power filters- Shunt active power filters, Series active power filters, and Hybrid active power filters
- Unified power quality conditioner

## **Distribution static compensator (DSTATCOM)**

The distributed static compensator is widely used to compensate the linear, nonlinear, balanced, and unbalanced loads. It has a voltage converter, coupling transformer, and a DC storage device. The DC voltage will be converted by the voltage converter to an AC voltage and this voltage will have a similar phase as the AC system. The active and reactive power transfer between the system and the DSTATCOM can be controlled by varying the phase and magnitude of DSTATCOM voltage. So with the help of this, we can generate active and reactive power according to the requirement.

## **Major functions of the DSTATCOM**

- Correction of power factor
- Regulation and compensation of the reactive power voltage
- Harmonics can be removed
- Flicker suppression
- System control



# Types of power quality conditioners



The DSTATCOM can be connected to the non-linear dynamic loads, the voltage source converter section would create a current waveform with proper magnitude, frequency, and shape. The transformer which is in the compensation system would add and scale this created waveform and place it in the load current. The response time of the DSTATCOM is really quick and thus it can eliminate the power quality problems.

The DSTATCOM can be widely used for compensation purposes, transmission loss reduction, and also would be able to improve the electric grid operation all of this is achieved due to the ability of the DSTATCOM to supply the active power effectively.



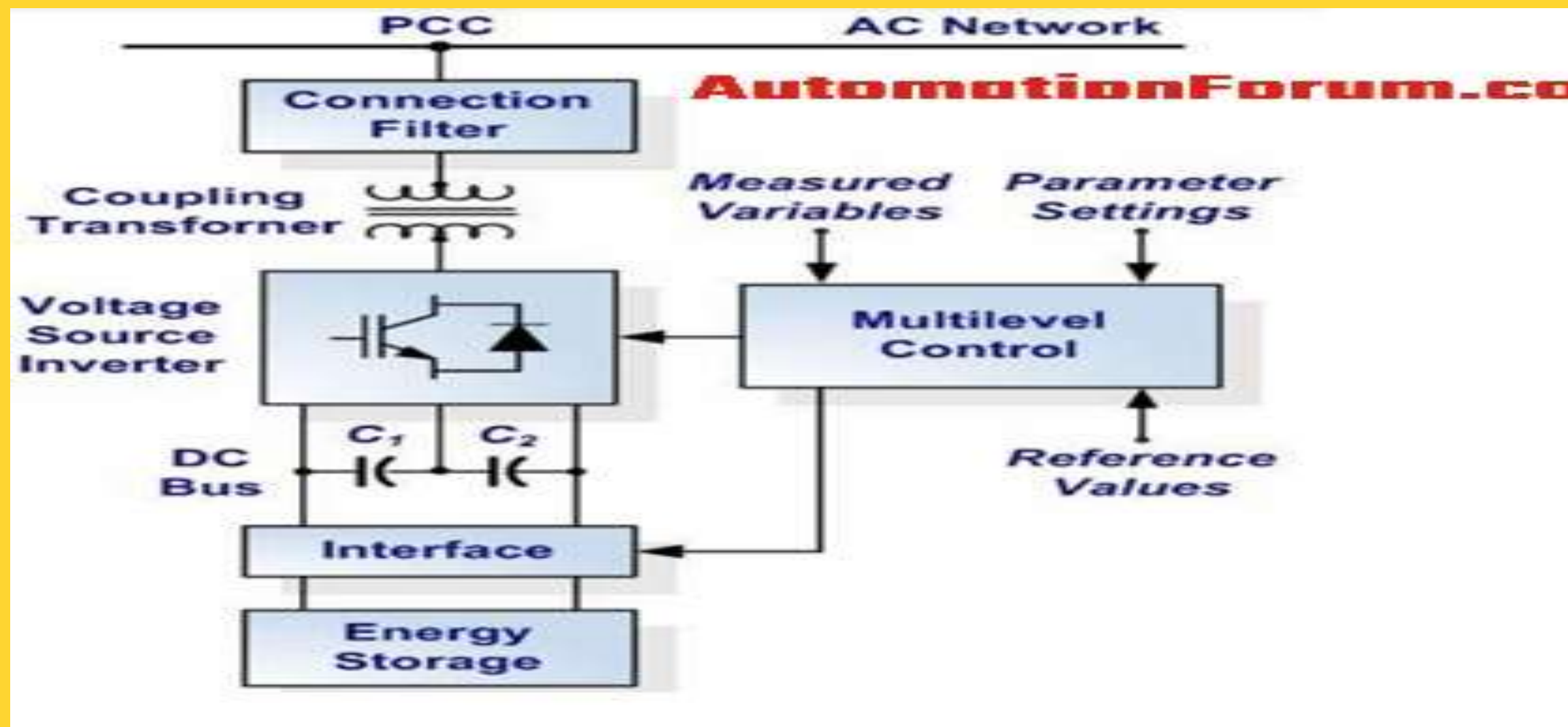
# Advantages of DSTATCOM



- It is used to regulate the system voltage
- Reduction of the voltage harmonics and load compensation
- It can mitigate the voltage dips
- The magnitude and the phase angle compensation could be achieved by adding the proper active or reactive power
- Protection of the utility transmission and the distribution system in case of any voltage sags, flickers.
- Immunity against transients
- It can prevent the voltage sags from the nonlinear loads
- It can easily exchange the reactive power with the distribution system without using any reactor or capacitor.
- The size of the compensation system is reduced



# Types of power quality conditioners







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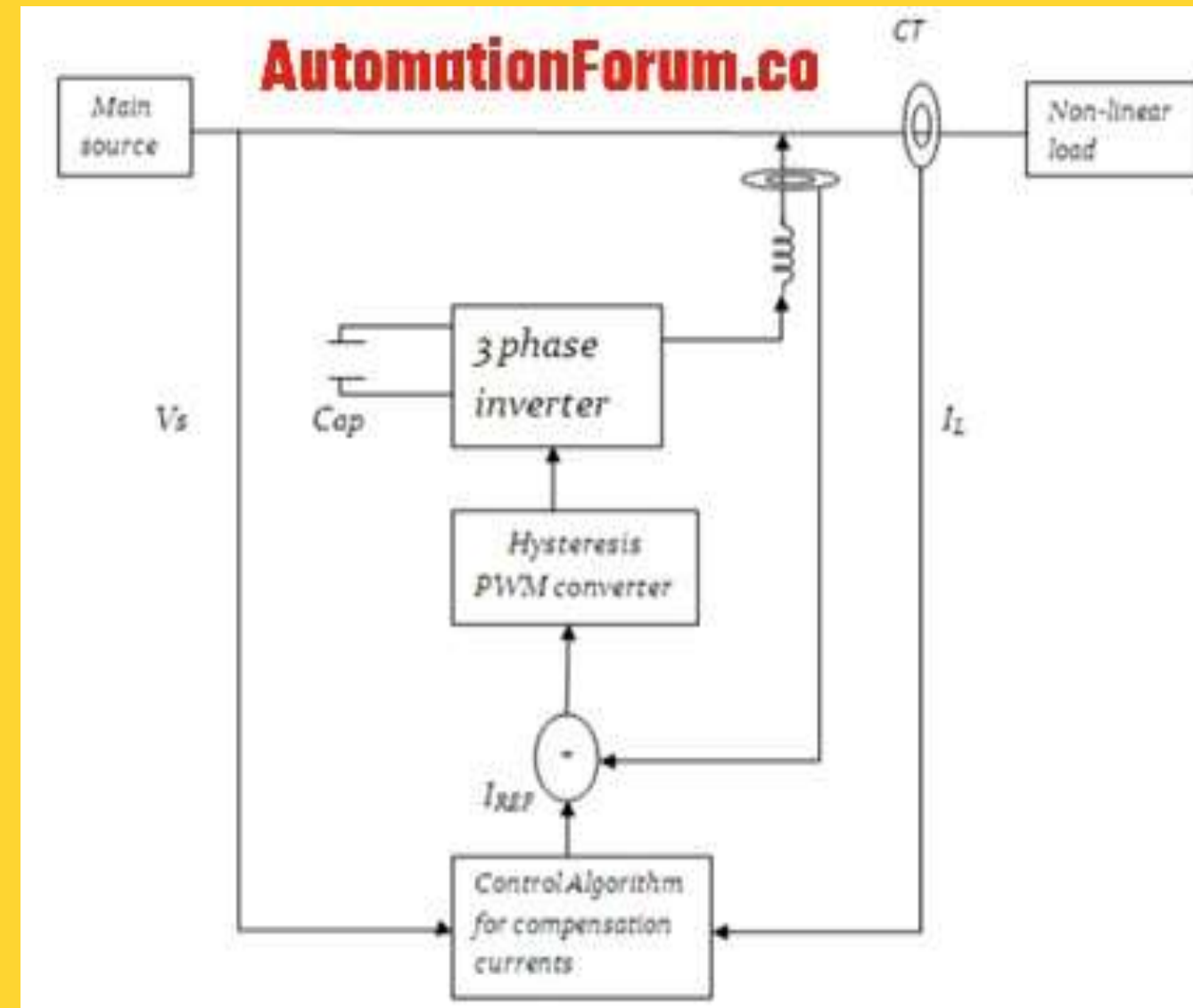


**Active power filters** The electronic power filters are electronic circuits that would pass a certain band of frequency and would reject the frequency which is not in this band. This type of power filter can compensate for the harmonics without using any reactive power. This type of filter would compensate for the voltage or current harmonics by injecting the harmonic signal measured. The injected voltage or current harmonic signals into the power system network would have the same magnitude and different phase, of the measured harmonic signal.

This device has a bridge rectifier and it would eliminate the harmonic current with the help of the switched-mode power converter. A compensation current will be created by the power converter and this would be useful to handle the non-linear load. This device has a capacitor to store energy and also has a voltage source inverter.



# Types of power quality conditioners





# Types of power quality conditioners



## Shunt active power filter

This type of power filter would operate by imposing equal and opposite harmonic compensating current to the improper load. This would operate as a source of current by laying or adding the harmonic component which is generated by the load but it will be phase shifted. We can connect this type of active power filter against any load to do the power compensation.

## Series active power filters

This type of filter can compensate for the current system distortion which is caused by the nonlinear loads. This type of active filter would impose high impedance by creating a voltage that has the same frequency of the harmonic component of the nonlinear load which is to be removed. This device would act as a controlled voltage source.



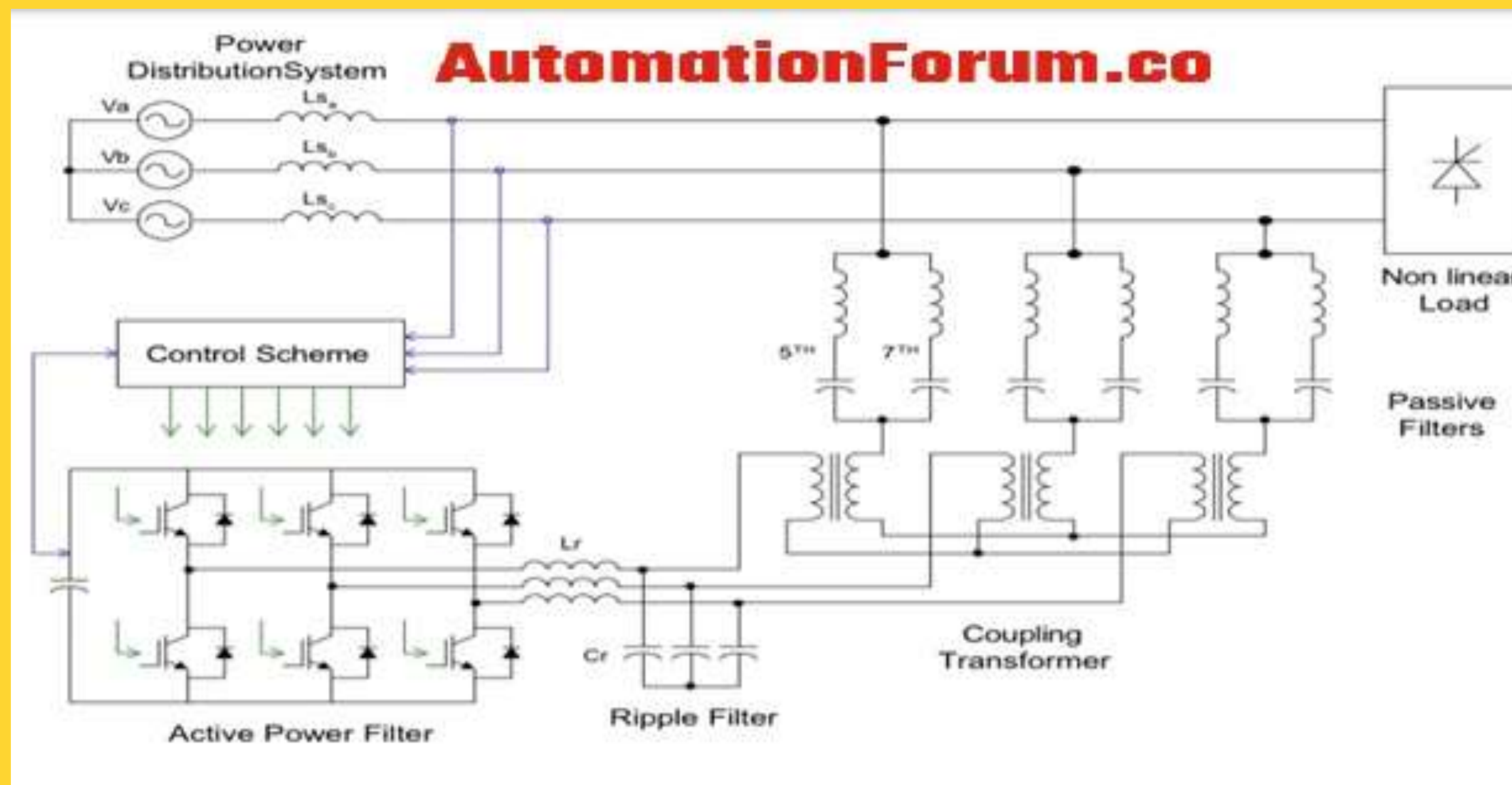
# Types of power quality conditioners



**Hybrid active power filter:** This type of power filter operates by controlling the amplitude of the voltage component across the coupling transformer. So by doing this the power factor of the power distribution system can be adjusted. There will be a higher voltage across the filter capacitor due to the control of the load power factor. This type of power filter will be very useful for power conditioning.



# Types of power quality conditioners





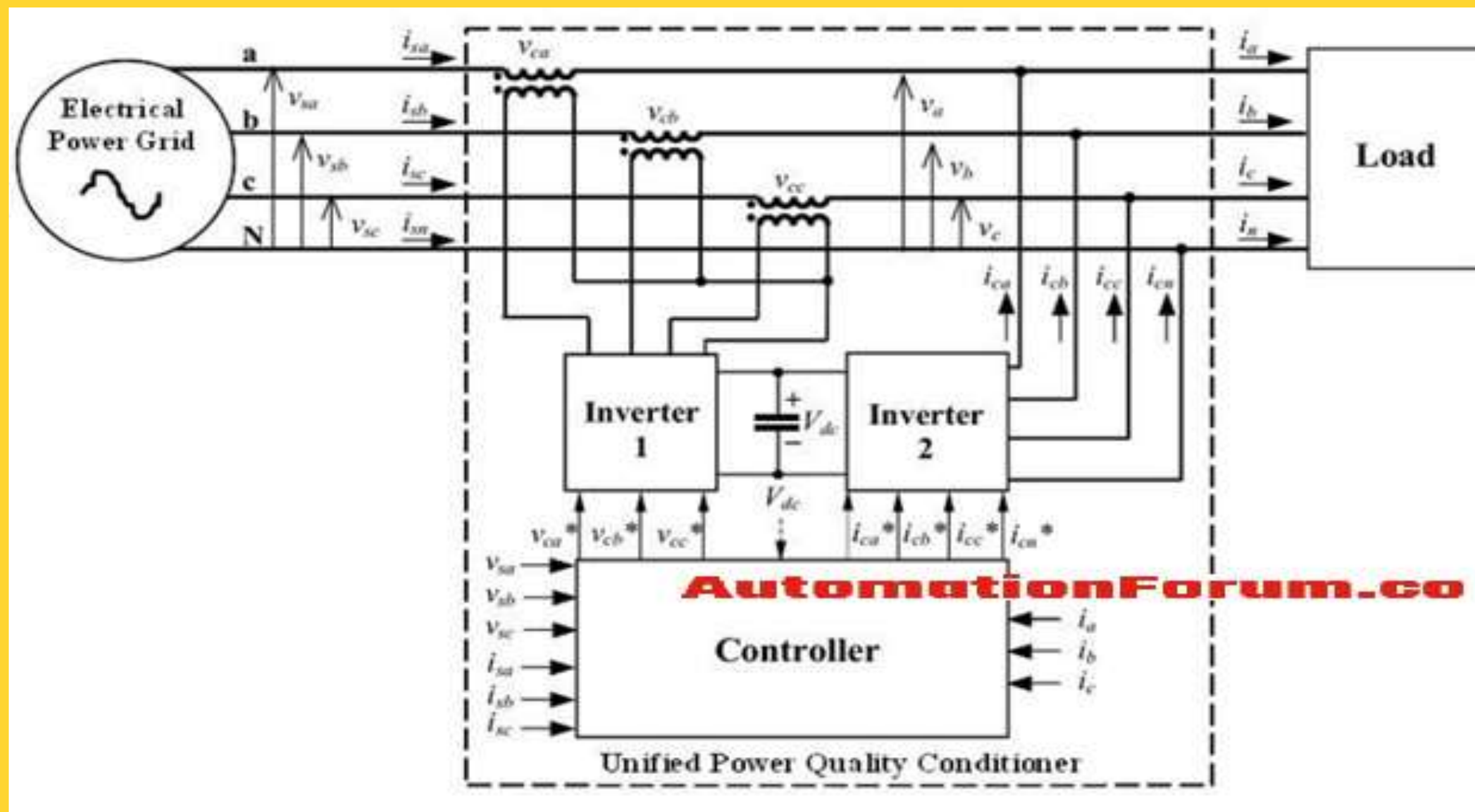
# Types of power quality conditioners



**UNIFIED POWER QUALITY CONDITIONER:**The UPQC is a combination of shunt and series active power filters. The shunt and series power filter are used to compensate for the source current and also to mitigate the problems in the source voltage. So by using a UPQC we can solve most of the power quality problems. This device is composed of two voltage source inverters and it is connected to the capacitor. One of the voltage inverters will be connected in series with the AC line and another one will be connected in parallel to the AC line. The UPQC would decrease the harmonics in the supply current and because of this, the current quality can be improved. This device can compensate for the voltage distortion and also the voltage imbalance.



# Types of power quality conditioners





# Types of power quality conditioners



## Advantages of active harmonic filter

- Compensation of harmonics
- All the unwanted harmonics are removed by using a single filter
- The power system stability is improved because there is no parallel resonance
- Dynamic performance and operates according to the change in the load
- These devices can be programmed in a way that it can remove the harmonics without compensating the reactive power
- It can be programmed to remove a specific number of harmonics





# THANK YOU