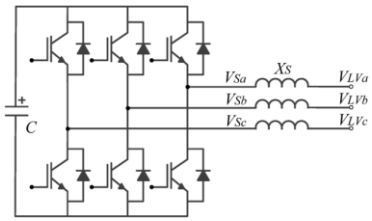
STATCOM

OPERATION PRINCIPLE

The STATCOM (static synchronous compensator) is an electrical device for providing fast-acting reactive power on electricity transmission networks. STATCOM's are part of the Flexible AC transmission system device family (FACTS), regulating voltage and stabilizing the system.

The STATCOM is a voltage source converter (VSC)-based device, with the voltage source behind a reactor. The voltage source is created from a DC capacitor; PWM Inverters using Insulated Gate Bipolar Transistors (IGBT) create a sinusoidal waveform from a DC voltage source with a typical chopping frequency of approximately one kHz.



In the case of two AC sources, which have the same frequency and are connected through a series reactance, the power flows will be:

- Active or Real Power flows from the leading source to the lagging source.
- Reactive Power flows from the higher to the lower voltage magnitude source.

Consequently, the phase angle difference between the sources decides the active power flow, while the voltage magnitude difference between the sources determines the reactive power flow. Based on this principle, a STATCOM can be used to regulate the reactive power flow by changing the output voltage of the voltage-source converter with respect to the system voltage.

MODES OF OPERATION

The STATCOM can be operated in different modes:

Voltage Control: The STATCOM will provide the required reactive power to maintain a pre-set voltage at PPC.

Power Factor Control: The STATCOM will provide the required reactive power to maintain a pre-set power factor at the PPC.

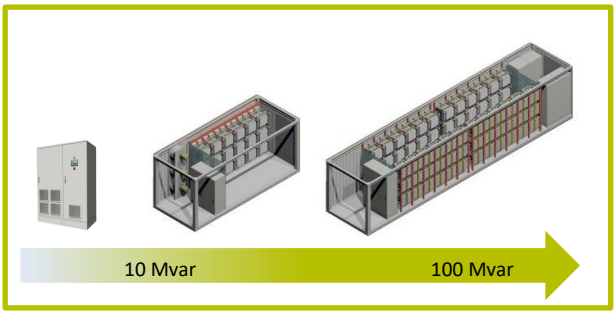
Phase Unbalance Compensation: As the control of each phase is made independently the equipment can operate in "negative phase sequence" to correct both voltage and current unbalance up to 100%.

Flicker Mitigation: Due to the very fast response time of the STATCOM, the voltage flicker is mitigated.

Low Voltage Ride Through: The STATCOM can provide full reactive current up to 0,2pu for 1 second (more if external power supply is added) during the LVRT event. The typical overload is 150% for 1 second.

JEMA STATCOM SOLUTIONS

Jema can provide both a LV and MV STATCOM solution, the LV STATCOM solution is suitable for cases where several Mvar are required, the MV STATCOM solution is for higher power ratings and is based on a modular multilevel converter.



The LV STATCOM units are available from 500kvar up to 3Mvar, the MV STATCOM container units are available from 6Mvar up to 40Mvar, for higher ratings several units can be put in parallel.

The LV STATCOM is air cooled and the MV STATCOM comes in both air and water cooled version and is integrated in a standard 20ft or 40ft container.

Jema can provide the complete solution including matching transformers, filters, UPS and switched capacitor banks (MSC) if required.

STUDIES AND SUPPORT

Jema can assist the customer in the selection of the STATCOM and provide simulation models in DigSILENT and PSS®E.

The STATCOM can also be supervised remotely for trouble shooting and receiving alarms.

STATCOM

	MMC 10	MMC 20	MMC 30	MMC 40
Reactive Power	-/+10 Mvar	-/+20 Mvar	-/+30 Mvar	-/+40 Mvar
Connection voltage	Up to 33kV			
Overload	150% 1 s			
Reactive compensation window (from 0.9 to 1.1 pu voltage)	-10 Mvar inductive up to +10 Mvar capacitive	-20 Mvar inductive up to +20 Mvar capacitive	-30 Mvar inductive up to +30 Mvar capacitive	-40 Mvar inductive up to +40 Mvar capacitive
Fixed reactive power compensator (capacitor bank)	Up to 10Mvar	Up to 20Mvar	Up to 30Mvar	Up to 40Mvar
Frequency	50Hz/60Hz tolerance +/-5%			
Harmonic distortion	<3%			
Efficiency	95% (including transformer and auxiliaries)			
Cooling	Water cooling			
Temperature	0-40 ºC			
Altitude	<1000 m			
Transformer	Outdoor oil			
Power system shelter	Standard 20 feet container		Standard 40 feet container	
IP protection	IP54			

APPLICATIONS & BENEFITS

There are several applications and benefits of dynamic static var compensators. Most common examples are given here:

1. Voltage stabilization

Variable load conditions can cause sudden voltage sags or surges which can lead to grid faults. Reactive power consumption of the connecting lines and loads may lead to voltage collapse in a weak and heavily loaded system

2. Increase transmission capacity, or increase traction power capacity

By compensating for the reactive power flows the transmission capacity of the grid can be increased.

3. Fault Ride Through (FRT)

For some wind turbines (SCIG and DFIG) it is difficult to comply with the grid code requirement to stay connected to the grid during a grid fault. Induction generators need to be magnetized quickly after the fault to avoid over-speed of the generator rotor.

4. Power factor correction

At some grid interconnection points between the transmission and distribution grids a power factor of one is required.

5. Power factor correction

Some grid operators require that the wind or solar farm is capable of controlling the reactive power at any time.

6. Flicker reduction (Heavy industry)

An electrical arc furnace (EAF) produces voltage fluctuation due to the variations of the active and reactive furnace load, known as voltage flickers.

7. Phase balancing in railways sectors

The single-phase traction power supply to the catenary causes a phase unbalance at the three-phase grid connection.