

STATCOM

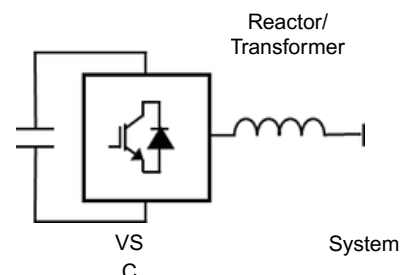
Static Synchronous Compensator





What is a STATCOM?

A STATCOM (Static Synchronous Compensator) is a shunt-connected device that uses an **IGBT-based Voltage Source Converter** to provide fast and **precise reactive power compensation**. It generates a controllable AC voltage and connects to the grid through a reactor or step-up transformer, enabling rapid injection or absorption of reactive power to stabilize voltage.



Its advanced design ensures full reactive support even at low voltages, low harmonic distortion, and optional features like **active harmonic filtering**, making it ideal for industrial and utility applications.

Benefits of this Technology



Power Factor Correction

Enhances power system efficiency by maintaining an optimal power factor, reducing energy losses and penalties.



Flicker Mitigation

Reduces voltage fluctuations caused by dynamic loads, ensuring smoother and more consistent power delivery.



Voltage Stability

Maintains stable voltage levels during load variations and grid disturbances, ensuring reliable system operation.



Active Harmonic Filtering

Eliminates harmful harmonic distortions in the power system, ensuring compliance with grid codes and improving power quality.



Unbalance Correction

Compensates for unbalanced loads by redistributing power, improving system performance and reducing equipment wear.

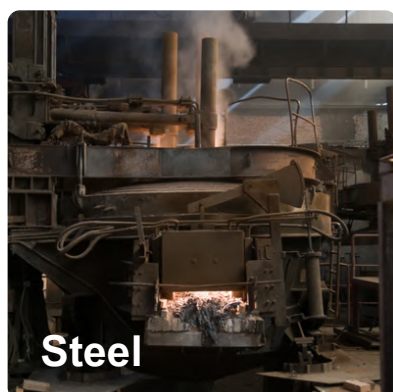


Increased Productivity

Minimizes downtime, protects sensitive equipment, and boosts system efficiency, reducing costs and increasing productivity. For EAFs, STATCOMs improve voltage stability, cutting power-on time.

Applications

Proper selection and configuration of equipment can offer substantial benefits.



Steel

Improve power quality by **mitigating flicker and harmonics** while **reducing power-on time** in electric arc furnaces (EAFs), leading to **increased productivity** and energy efficiency.



Mining

Stabilize voltage fluctuations caused by high-power loads, ensuring **reliable operation** of critical machinery



Renewables

Mitigates voltage fluctuations, ensures stability, and **complies with grid requirements** in wind and solar power plants.



T&D

Improves **voltage stability**, **reduces losses**, and enhances transfer capacity.



Data Centers

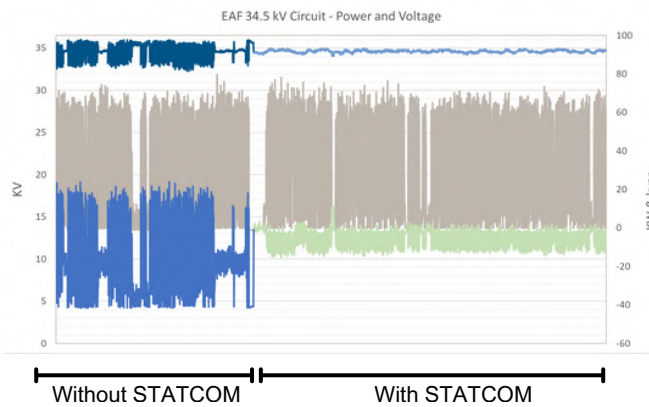
Ensures stable voltage and power quality, **minimizing downtime** and improving efficiency.



Heavy Industry

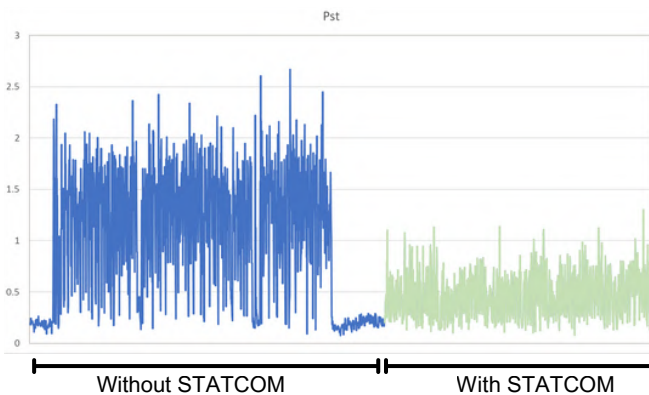
Enhances **power factor correction** and **mitigates harmonic distortion** in heavy industries.

STATCOM at Work



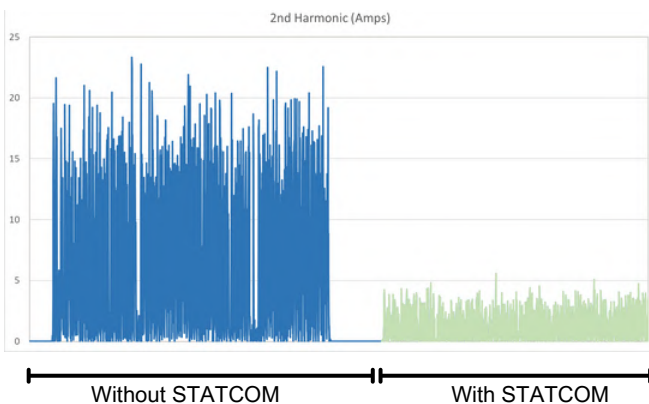
Improved voltage and reactive power control

By dynamically compensating reactive power in real time, voltage stability is significantly improved.



Reduced flicker

As a result of the STATCOM's fast response time, flicker levels are reduced at the PCC to comply with grid requirements.



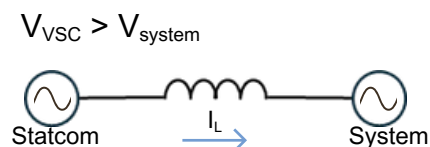
Mitigated 2nd harmonic

The second harmonic is significantly reduced, unlike an SVC, which not only lacks the capability to mitigate it but may even increase it.

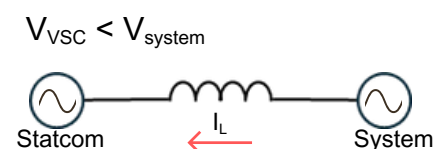
Principles of Operation

A STATCOM operates based on the principle of injecting or absorbing reactive current into the grid. This is achieved by regulating the output voltage of the VSC:

Reactive Power Generation: When the VSC output voltage is higher than the grid voltage, STATCOM delivers reactive power to the grid.



Reactive Power Absorption: When the VSC output voltage is lower than the grid voltage, STATCOM absorbs reactive power from the grid.



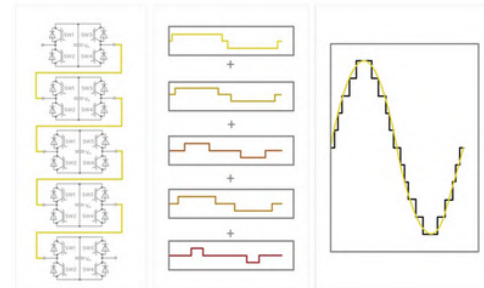
The control system dynamically adjusts the output voltage magnitude and phase angle to respond to grid demands in real time.

Control Modes

Control Mode	Description
Constant Reactive Power	In constant reactive power mode, the STATCOM delivers or absorbs a fixed amount of reactive power (vars), regardless of voltage fluctuations. This mode is ideal for systems where a consistent level of reactive compensation is needed to support power factor correction or manage reactive power flow in coordination with other devices in the network.
Constant Power Factor	In constant power factor mode, the STATCOM adjusts its reactive output dynamically to maintain a target power factor at the point of connection. This is particularly useful in industrial applications where maintaining a specific power factor is critical for avoiding utility penalties or for ensuring efficient operation of equipment.
Constant Voltage	In constant voltage mode, the STATCOM continuously monitors and regulates the bus voltage by injecting or absorbing reactive power as needed. This mode offers real-time voltage stabilization, making it ideal for systems exposed to fluctuating loads, such as electric arc furnaces, or for weak grid connections where voltage support is essential.

Modular Multilevel Converters

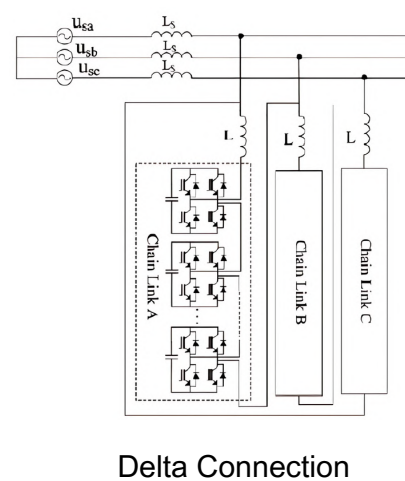
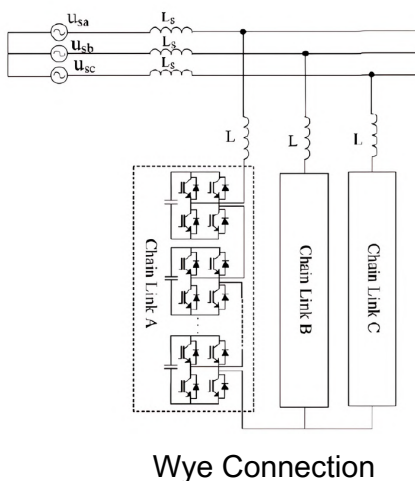
Our STATCOMs are built on a **Modular Multilevel Converter (MMC) topology** with Pulse Width Modulation (PWM) control, resulting in significantly **lower switching and conduction losses** compared to conventional converter designs. This architecture ensures high efficiency across a wide operating range and enables precise, smooth voltage waveforms.



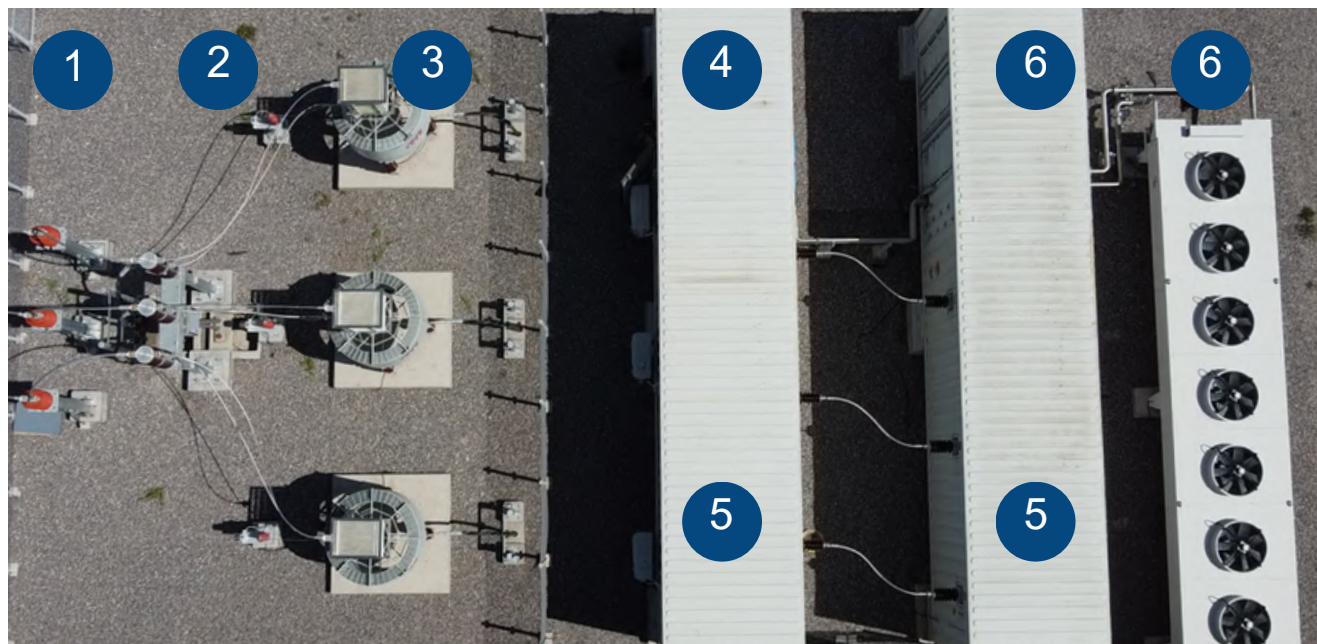
The use of PWM also allows for active harmonic filtering, reducing the need for external filters and improving overall power quality. These features make our STATCOMs particularly well-suited for environments with stringent power quality requirements, such as steel mills, renewable plants, and industrial facilities with sensitive or rapidly changing loads.

STATCOM Topology

Two inverter topologies are available: Wye connection for applications where only balanced compensation is required (more economical). And Delta connection to provide balanced and unbalanced correction as required.



Main Components



1

Incoming Section

Equipped with a friendly HMI interface, our STATCOM offers ease of operation and multifunctional control settings. The system features remote real-time.

2

Starting System

The starting system is designed to safely energize the system and protect its power electronics during the initial startup. This system consists of a bypass breaker and a pre-charge resistor.

3

Coupling reactor or transformer

It limits the current flow, ensuring stable operation and protecting power electronic components, while also matching the VSC's output voltage to the grid. Additionally, it filters high-frequency harmonics generated by the VSC.

4

Protection and Control

The C&P system ensures optimal reactive power compensation, harmonic filtering, flicker mitigation, unbalance correction, and system stability. It monitors grid conditions, adjusts the STATCOM's output as needed, and protects against faults and abnormal conditions, ensuring reliable and efficient operation.

5

Power modules

Comprises the Voltage Source Converter (VSC) and the DC Energy Storage. The VSC Converts DC voltage into an AC waveform using power electronic switches (e.g., IGBTs or IGCTs). The DC energy Storage provides a stable DC voltage source for the VSC.

6

Cooling System

It ensures reliable operation by maintaining optimal temperatures. Two typical options are air-to-water and water-to-water systems. Air-to-water uses a heat exchanger to cool the liquid coolant with air. Water-to-water transfers heat to an external water source, such as a cooling tower.

System Capabilities

Our STATCOM solutions feature a **Modular Multilevel Converter (MMC)** topology with integrated **active harmonic filtering**, delivering advanced voltage control and superior power quality.

They can **connect directly to medium voltage systems up to 69 kV** without the need for a step-up transformer, making them ideal for industrial operations and renewable energy applications.

For higher voltage levels, a step-up transformer is seamlessly integrated into the system architecture to ensure optimal performance and full compliance with project specifications.

Power

Any

Voltage

2.4 – 69 kV
Higher voltages with step-up transformer

Type

Indoor
Outdoor

Connection

Wye
Delta

IGBT

Wire bond
Press Pack

Cooling

Air - Water
Water - Water

Installation

Containerized
Electrical room
Metal enclosed

Service

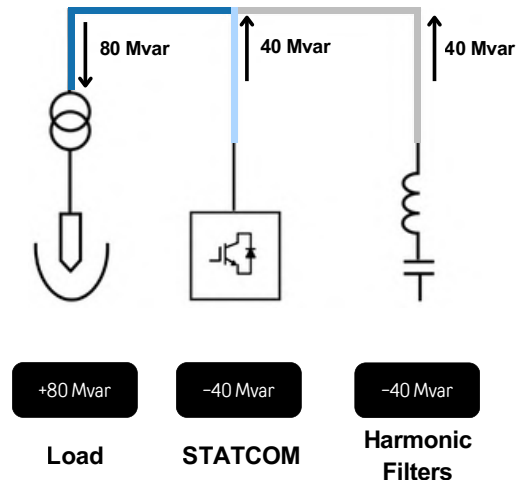
Outdoor
Indoor



Hybrid Statcom

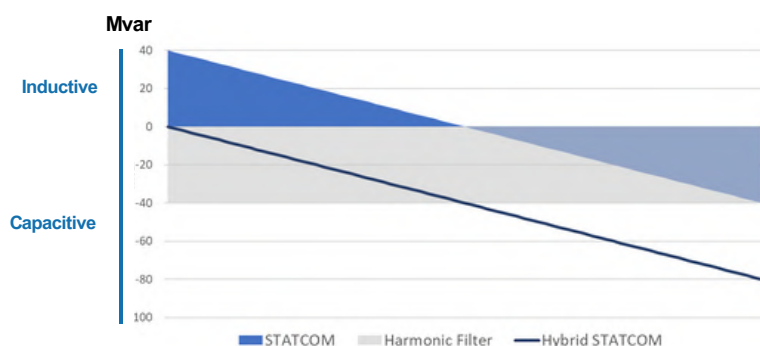
When symmetrical compensation is not required, combining passive compensation with a STATCOM is referred to as a hybrid solution. Thanks to the STATCOM's ability to both absorb and deliver reactive power, it can complement passive elements, with the total reactive power capacity being the sum of the passive compensation and the STATCOM's nominal rating.

In the picture on the right, a 40 MVAR harmonic filter is combined with a 40 MVAR STATCOM, resulting in a total maximum reactive power capacity of 80 MVAR."



Dynamic compensation

For dynamic compensation, a hybrid STATCOM offsets the reactive power demanded by the load by absorbing excess reactive power delivered by the harmonic filter under low-load conditions, or by injecting reactive power and supplementing the output of the harmonic filters, as shown in the picture below.



A hybrid STATCOM is a cost-effective solution that combines fast dynamic response with lower-cost passive compensation.

Main benefits:

- Reduced CAPEX
- Ability to leverage existing infrastructure
- Smaller converter size and lower losses
- Optimized system design

Experience

Our experience applying systems in every industry enables Southern States to meet our customer's specific needs.



Mining
6 MVAR STATCOM



Galvanized steel
4 MVAR STATCOM



Rolling mill
15 MVAR STATCOM



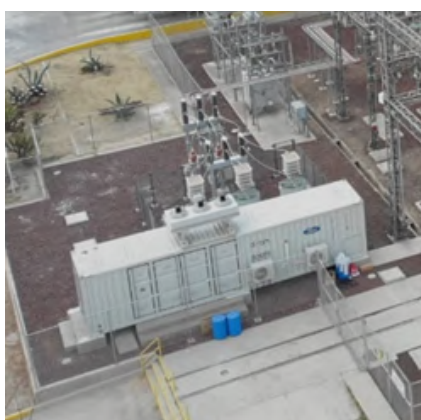
Steel (EAF)
320 MVAR STATCOM



Steel (EAF)
120 MVAR STATCOM



Steel (EAF)
40 MVAR STATCOM



Automotive
4 MVAR STATCOM



Steel (EAF)
75 MVAR SVC



Steel (EAF)
110 MVAR

Southern States, LLC
30 Georgia Avenue
Hampton, GA 30228
P: 770.946.4562

