



MEDIUM-VOLTAGE REACTIVE POWER COMPENSATION

Power Made **Reliable**

Static Synchronous Compensator (STATCOM)

± 600 kvar to ± 3600 kvar · 3 kV – 35 kV

Dynamic capacitive and inductive reactive power compensation with maximum regulating dynamics — built on a modular 3-level IGBT platform for voltage stabilisation, power factor correction and load-flow optimisation in public and industrial distribution networks.

Optimal Reactive Power Control in Distribution Networks

The energy market is undergoing significant change — market liberalisation, the integration of new energy resources and the need for efficient regulation of energy flow. Global climate protection requirements and effective CO₂ reduction are driving the conversion of traditional network structures towards innovative distribution networks with dynamic load-flow regulation at a variety of levels.

RE&D STATCOM provides a high-performance platform for making this a reality, enabling efficient implementation of voltage stabilising and load-flow optimising measures with high requirements for regulating dynamics. The systems are based on a scalable power electronics platform with **3-level IGBT inverters**, enabling innovative solution approaches for dynamic regulation tasks in medium-voltage distribution networks.

Modular Power Scaling

Modular architecture scales to 7.2 Mvar, with a compact design giving high installation versatility.

Low Harmonic Emissions

Low harmonic current emissions through active built-in compensation, with optional ACF functionality.

Fault Ride Through

Faults of up to 250 ms duration do not cause the STATCOM to shut down.

Customer-Specific Interface

Operating interface tailored to the customer over a PLC-based system controller with HMI.

Multi-Level Redundancy

Redundancy at several levels — both at power module and at individual IPU level.

Power Factor Improvement

Dynamically improves power factor at the grid connection, reducing operating costs and ensuring compliance.



Containerised STATCOM installation alongside distributed generation — dynamic voltage support at the point of connection

Why STATCOM over conventional

compensation: a voltage source converter sources or sinks reactive current continuously and within milliseconds, with no switching steps, no resonance risk with the network, and full rated output retained at reduced network voltage.



Walk-in STATCOM building with external cooling plant — factory-built and tested before delivery to site

±3600

KVAR PER SYSTEM

3–35 kV

NETWORK VOLTAGE

10–40 ms

RESPONSE TIME

250 ms

FAULT RIDE THROUGH

< 2.1%

LOSS, ACTIVE PART

Regulating Functions

Voltage Regulation

Reactive Power Regulation

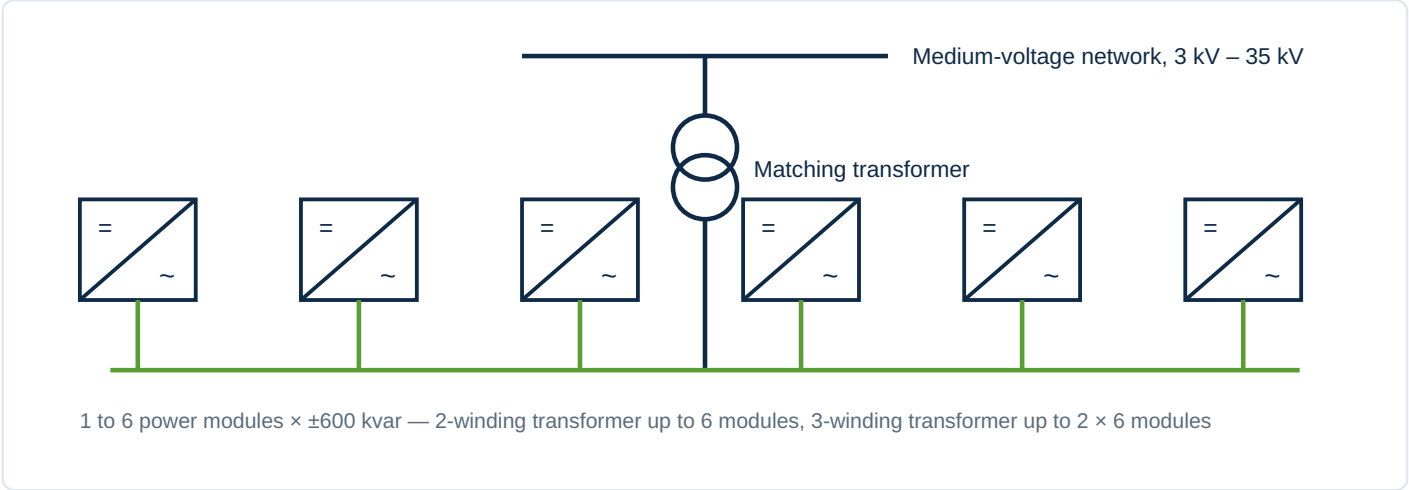
Power Factor Correction

Flicker Mitigation

Active Harmonic Filtering (Optional ACF)

A Modular Platform, Scaled to the Application

RE&D STATCOM has a modular design. It is based on IGBT power units (IPU) with a rated current of **125 A** and a rated voltage of up to **690 V**. These are combined in cabinets to form power modules of **±600 kvar**, up to six of which can be combined into a complete system with a power of **±3600 kvar**. An integrated control cabinet unit with a circuit breaker completes the system.



Typical overview connection diagram of a STATCOM system — it contains from 1 to a maximum of 6 power modules, paralleled on the 690 V collector busbar and connected to the network through the matching transformer

Scaling and Ratings

Power modules	2	3	4	5	6
Compensation (kvar)	1200	1800	2400	3000	3600
Rated current at 690 V (A)	1000	1500	2000	2500	3000
Width, active part (mm)	2200	3000	3800	4600	5400
Weight (kg)	1700	2400	3100	3880	4500

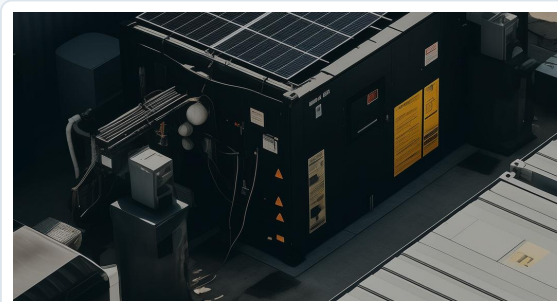
Depth 800 mm and height 2000 mm throughout. Power module 800 × 800 × 2000 mm (2200 mm with optional base).

Build Standard

- **IGBT power unit (IPU)** — 125 A rated current, up to 690 V rated voltage.
- **Power module** — IPUs combined in a cabinet to give ±600 kvar.
- **Control cabinet** — integrated unit with circuit breaker completes the system.
- **Expandability** — 2-winding transformer up to 6 power modules; 3-winding transformer up to 2 × 6 power modules (7.2 Mvar).
- **Cooling** — air cooling with variable-speed fans as standard; liquid cooling to an external system optional.
- **Enclosure** — IP20 standard, IP21 to IP54 optional, RAL 7035 light grey.

Factory-Built, Site-Proven

The active part is assembled and tested as a complete unit before despatch, so site work is limited to positioning, cable termination and commissioning. Containerised and walk-in building arrangements are available where indoor switchroom space is unavailable, with the matching transformer, control cabinet and cooling plant integrated into the same delivery.



Twelve IGBTs, Half the Voltage Stress, Lower Losses

The 3-level circuit of RE&D STATCOM systems is based on twelve IGBTs, whereas the conventional 2-level version has only six. The special circuitry halves the voltage loads on the power semiconductors. This leads to lower losses while also allowing use in grids with a higher intermediate circuit voltage, and enables the generation of higher peak currents — required for filtering harmonics with a higher bandwidth.

- **Lower output current ripple** than a 2-level architecture. The divided intermediate circuit and larger number of IGBTs create an additional third switching state at the output.
- **More compact network and EMC filters** at the same switching frequency, reducing losses as a result.
- **10 kHz switching frequency** in a low-loss design.
- **Losses** < 2.1% of the compensation maximum, < 1.8% in typical operation, < 0.4% at idle and < 100 W in standby.
- **DC film capacitors** in the voltage intermediate circuit.

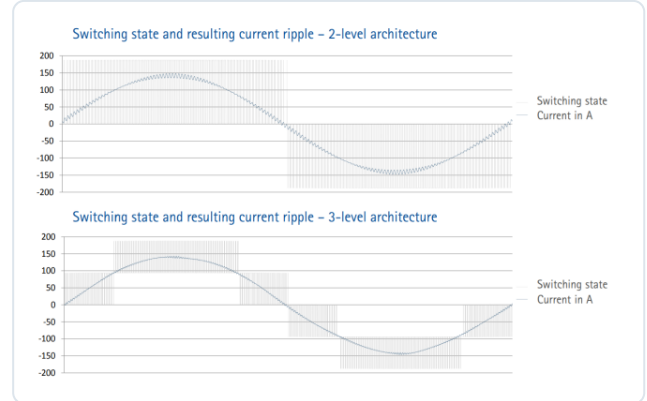


Fig. 1 — Switching states and resulting current ripple in 2-level and 3-level architecture

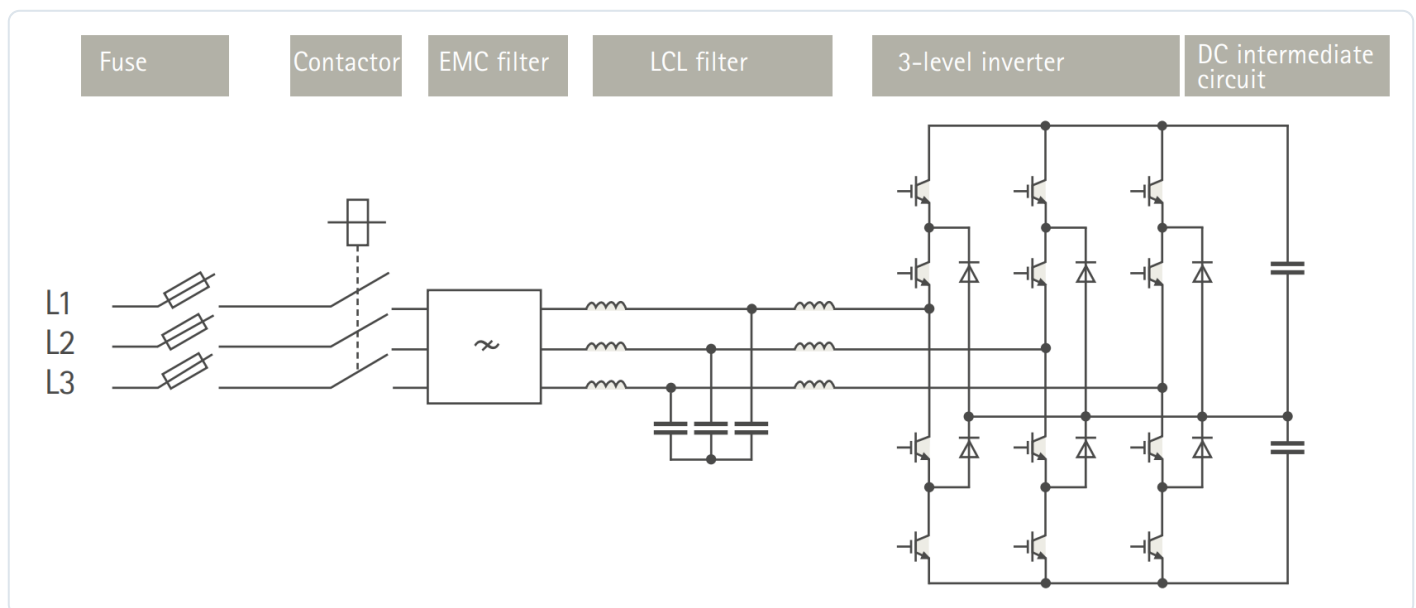


Fig. 2 — Circuit diagram of the 3-level architecture: fuse, contactor, EMC filter, LCL filter, 3-level inverter and DC intermediate circuit

Higher Bandwidth Filtering

Higher achievable peak currents allow harmonic filtering across a wider bandwidth — optional ACF covers the 2nd to 51st harmonic at 50 Hz, or 2nd to 41st at 60 Hz.

Grid Compatibility

Halved semiconductor voltage stress permits operation on grids with a higher intermediate circuit voltage, without derating the active part.

EMC and standards: EN 55011 Class A1 (industrial environment). Designed and built to EN 50178, EN 61439-1, EN 61439-2, EN 61000-6-2, EN 61000-6-4 and EN 55011.

Voltage Source Converter Operating Principle

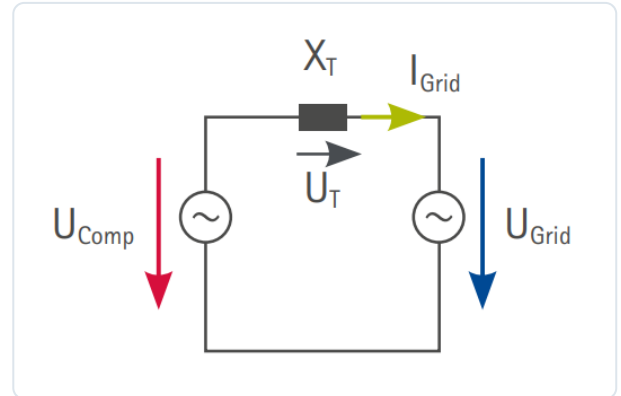
RE&D STATCOM systems are based on a voltage source converter (VSC) connected to the grid through an inductance and a transformer. Once the STATCOM is operating, two distinct general operating states exist. In both cases the grid voltage is assumed constant ($U_{Grid} = \text{const}$).

Capacitive Operation

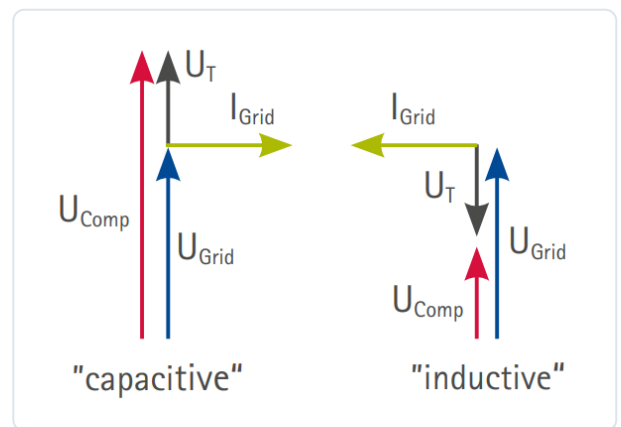
- $U_{Comp} > U_{Grid}$ — vector U_T points in the same direction as U_{Comp} .
- Current I_{Grid} flows in a positive direction; the system feeds **capacitive** current into the network and the voltage increases.

Inductive Operation

- $U_{Comp} < U_{Grid}$ — vector U_T points in the direction opposite U_{Comp} .
- Current I_{Grid} flows in a negative direction; the system feeds **inductive** current into the network and the voltage drops.



Equivalent circuit — compensator voltage, transformer reactance X_T and grid voltage



Phasor relationships in capacitive and inductive operation

Control, Visualisation and Service

Operation via Industrial Control System (PLC) with HMI

Parameterisation of system parameters · command input for operating the system · visualisation of the system configuration including equipment states · visualisation of measured values · display of event and error messages.

Service via Touch Panel

Parameterisation of hardware parameters · status and error messages in plain text · ability to switch languages at any time · password protection.

SCADA Integration

An interface is provided for integrating the STATCOM system into a higher-level station layer (SCADA). Ethernet (TCP/IP), various fieldbus systems including Profibus and Modbus, and a potential-free configurable digital I/O interface for status messages.

Web Interface and Logging

The system can also be operated using a web-based interface via the internal web server — no additional software required. Logs are saved to an SD card for export in the event of service.

Internal Control Computer

Two Digital Signal Processors

Ethernet TCP/IP

Profibus

Modbus

Digital I/O

Web Server

Dynamic Reactive Power, Matched to the Application

RE&D STATCOM systems make it possible to provide dynamic fundamental harmonic reactive power — capacitive and inductive — across one broad power range, adapted to the respective customer application. RE&D has the resources to design STATCOM systems to meet specific customer needs and to integrate the systems into the respective application.



ROLLING MILLS



**OFFSHORE
TECHNOLOGY**



TRACTION SYSTEMS



MINING



WIND AND PV PARKS



PAPER INDUSTRY



TESTING FACILITIES



LOGISTICS

Other Applications

- Stabilising weak system voltages
- Reducing transmission losses
- Increasing transmission capacity
- Reducing voltage fluctuations
- Improving power factor
- Reducing harmonic current
- Preventing flicker
- Stabilising the voltage during and after faults in the grid

Delivered as a Complete Solution

Engineering

Network studies, sizing and integration design against the site's existing distribution architecture and compliance obligations.

Supply and Installation

Factory-built and tested active part, matching transformer, control cabinet and switchgear, commissioned on site by RE&D / SDE engineers.

Lifetime Service

Planned maintenance, remote monitoring, spares and obsolescence management across the installed base, supported from the UK and US.

RE&D STATCOM — Specification

Specification	RE&D STATCOM
ELECTRICAL	
Rated voltage	3 kV – 35 kV with matching transformer
Grid frequency	50 Hz / 60 Hz
Regulating functions	Voltage regulation; reactive power regulation
Additional functions	Optional ACF functionality: 2nd–51st harmonic (50 Hz) / 2nd–41st harmonic (60 Hz)
Power loss for active part	< 2.1% of the compensation maximum; < 1.8% during typical operation; < 0.4% at idle; < 100 W in standby
Switching frequency	10 kHz (low-loss design)
Measuring transformer	Grid/load measurement: 3-phase voltage measurement, 2-phase or 3-phase current measurement. STATCOM measurement: 2-phase or 3-phase current measurement
Inverter	3-level IGBT with voltage intermediate circuit (DC film capacitors)
Number of power modules	2 3 4 5 6
Compensation	1200 kvar 1800 kvar 2400 kvar 3000 kvar 3600 kvar
Rated current (690 V)	1000 A 1500 A 2000 A 2500 A 3000 A
GENERAL	
Power module dimensions (approx. W × D × H)	800 × 800 × 2000 mm; 800 × 800 × 2200 mm with optional base
STATCOM (active part) including cable infeed dimensions (approx. W × D × H)	2200 × 800 × 2000 3000 × 800 × 2000 3800 × 800 × 2000 4600 × 800 × 2000 5400 × 800 × 2000 mm
Weight (approx.)	1700 kg 2400 kg 3100 kg 3880 kg 4500 kg
Control	Internal control computer with two digital signal processors
System setup and display	Using HMI with graphical display, or internal web server (TCP/IP) and PC — no additional software required
Response time	Application-dependent, typically 10 – 40 ms
Interfaces	Ethernet (TCP/IP); various fieldbus systems including Profibus and Modbus; digital I/O interface (potential-free, configurable) for status message
Colouring	Standard: RAL 7035 light grey (other colours and designs on request)
Cooling	Standard: air cooling with variable-speed fans. Optional: liquid cooling with connection to an external cooling system
IP degree of protection	Standard: IP20. Optional: IP21 .. IP54
Ambient conditions	Maximum ambient temperature without power reduction: 40 °C. Recommended ambient temperature during continuous operation: < 25 °C. Minimum operating temperature: 0 °C, relative humidity: maximum 95%. Transport / storage: –20 °C .. 70 °C
Expandability	2-winding transformer: up to 6 power modules. 3-winding transformer: up to 2 × 6 power modules
EMC class	EN 55011, Class A1 (industrial environment)
Standards	EN 50178, EN 61439-1, EN 61439-2, EN 61000-6-2, EN 61000-6-4, EN 55011

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