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Sitras SFC plus

Static frequency converter for
AC traction power supply

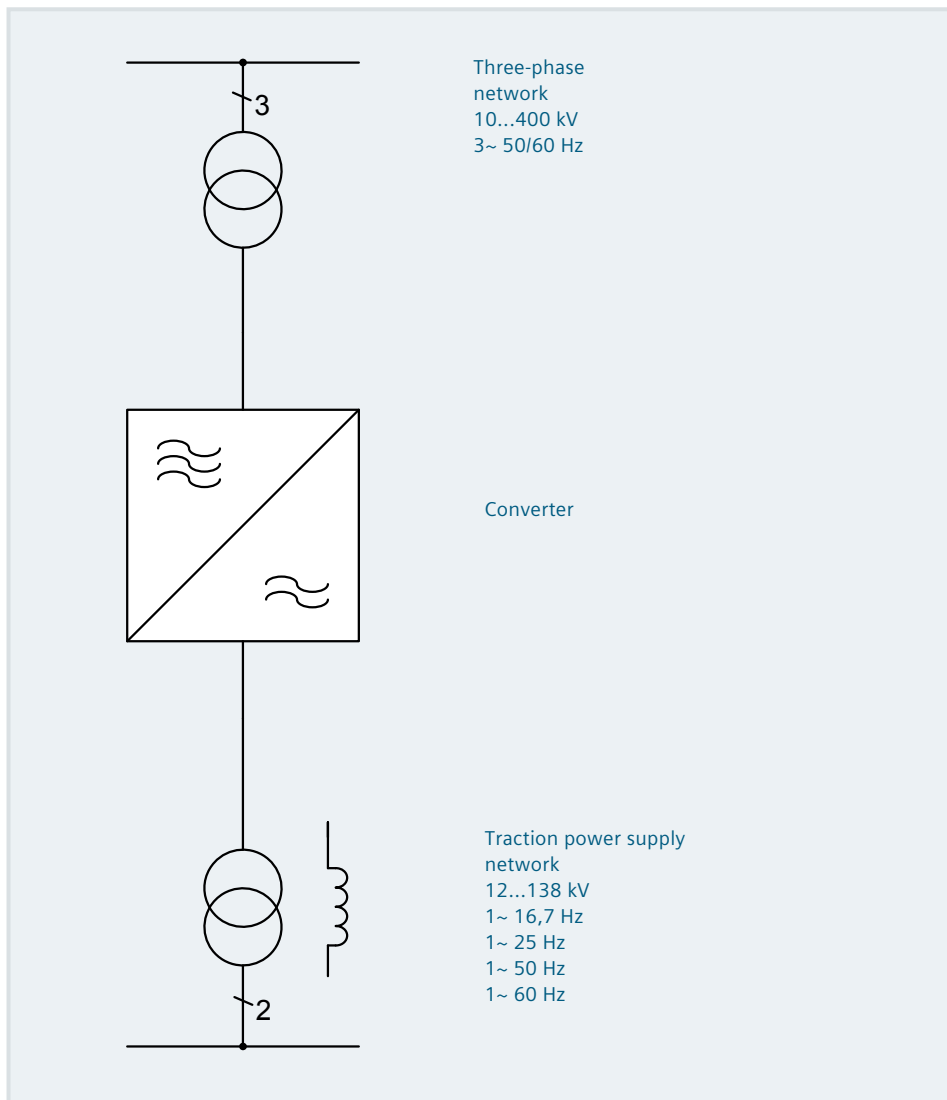
[siemens.com/rail-electrification](https://www.siemens.com/rail-electrification)

Sitras® SFC plus type static frequency converters supply single-phase traction power networks from three-phase networks.

Features

- Innovative multilevel traction converter concept reduces
 - noise emission
 - space requirement
 - maintenance effort
- High degree of efficiency over the entire operating range for optimized use of the primary energy
- High availability due to possibility of redundancy in the converter power circuit
- Modular converter ensures ideal adaptation to customer requirements
- Universal application for central and decentralized traction power supply systems

Function



Block diagram

The static frequency converter is a modular multilevel direct converter.

It essentially consists of only one converter that directly couples the two networks.

The three-phase AC voltage is directly converted into a single-phase AC voltage with different frequency.

Due to the multilevel technology no traction transformer is needed to feed the overhead contact line.

Features

Power rating

- Modular concept enables a design with block capacities of 12 to 120 MW
- Parallel connection of blocks for
 - increased redundancy
 - total power rating of up to 600 MW attainable

Electrical properties

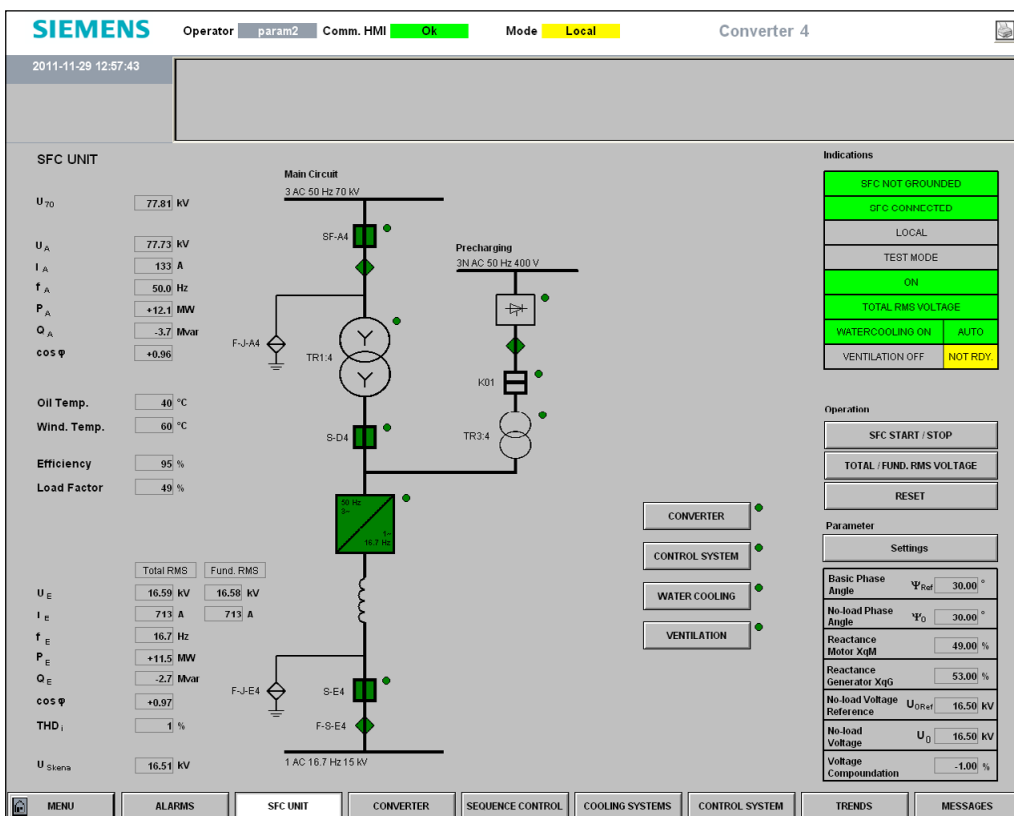
- Overload capability
- Short-circuit current significantly higher than nominal current (selectivity is retained)
- Favorable supply system reactions:
 - due to the generation of an output voltage with small voltage steps that is comparable to that of a generator
 - no extra filters are needed on the three-phase side and the railway side
- Power recovery function is provided inherently without additional equipment
- No complementary energy storage units (i.e. no uncontrolled oscillations in the series resonant circuits during system disturbances)
- Stored energy is distributed to a large number of power modules (i.e. a fault remains limited to the easy-to-replace power module)
- Redundancy possible in the power circuit

Design

- Compact, space-saving and flexible system layout
- Container solutions available
- Simple single-circuit cooling system for cooling the converter
- Multilevel technology means fewer components are required compared with conventional systems
- Use of service-proven components and materials offers high reliability and robustness

Operating modes

- Variable-frequency operation for supplying central networks
- Fixed-frequency operation for supplying decentralized networks
- Phase-shift operation on failure of the three-phase network (the traction voltage is stabilized by providing reactive power)



Operating screen converter block

Main components

Multilevel converter

The converter forms a B6 configuration comprising three phases each with two branches.

A branch consists of power modules connected in series with connected module capacitor. The number of power modules connected in series determines the power rating of the converter.



Modular multilevel direct converter

Three-phase transformer

A standard dual-winding transformer is used as a three-phase transformer. The multilevel technology enables secondary voltages to be used in the medium voltage range.

Open-loop and closed-loop control

SIMATIC TDC, the reliable Siemens multiprocessor system, is used as open-loop and closed-loop control system. It controls all components which are assigned to a converter. The closed-loop control system converts the reference values for the converters into switching commands for semiconductor valves. The converter block is operated by the proven SIMATIC WinCC system.

Protection

Standard protection devices protect the components, e.g. transformers and cables, against impermissible operating states such as overvoltage, overcurrent and overtemperature.

The traction converter is protected as follows:

- Overcurrent protection is provided by the control of each converter block.
- In case of short-circuits in the traction power supply network, the converter limits the current to the maximum short-circuit current and can continue operation without interruption

Traction transformer / Output reactor

A simple traction transformer with a primary and secondary winding is used for feeding a high-voltage network of the railway.



Traction transformer

If traction power is to be supplied directly into the contact line, a traction transformer will not be needed because of the high output voltages of the multilevel converter. The converter is then decoupled from the traction power supply network by means of an output reactor.

Station control system

In the case of systems with multiple converters, a higher-level station control system can be used which specifies the operating mode and output power of the individual converter blocks. At the same time, the individual converter blocks are actuated so that the highest degree of efficiency is attained with an optimized number of start/stop operations.

In normal operation, the entire system is operated unmanned and is also controlled and monitored by the remote control center. Remote control acts on the system control which in turn issues the control commands to the individual converter blocks.

If the remote control fails, the converter system can be operated locally via the system control.



Output reactor

References

Static frequency converters made by Siemens have been used successfully around the world since 1994.

Sitras SFC plus converter are already in service in Germany, Austria, Switzerland and Sweden. In the USA and in Norway Sitras SFC plus converters are under construction.



Nuremberg (Germany)



Uttendorf (Austria)



Winkeln (Switzerland)



Häggvik (Sweden)

Technical data

Sitras SFC plus		
Nominal power	[MW]	12...120
3-phase connection	[kV]	
• Input voltage	[Hz]	≥ 10
• Input frequency		50 / 60
• Power factor $\cos \varphi$		adjustable
1-phase connection	[kV]	
• Output voltage	[Hz]	12...138
• Output frequency		16.7 / 25 / 50 / 60
• Power factor $\cos \varphi$		adjustable

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

For more information about industrial security, please visit:
<http://www.siemens.com/industrialsecurity>.

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