

## SINAMICS SM150



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# SINAMICS SM150

## Medium-Voltage Converters

### SINAMICS SM150

#### Overview



SINAMICS SM150

Water-cooled regenerative SINAMICS SM150 converters are available as single or multi-motor drives with the standard medium voltage IGCT power semiconductors. With multi-motor drives, a common DC bus enables the direct exchange of energy in generator and motor applications.

IGCT converters are available for the following voltage and power ranges:

Rated output voltage	Max. continuous power (without overload capability)	Power (175% overload capability)
3.3 kV	10 MVA to 28 MVA	5 MVA to 17 MVA

The rated output in the concrete application will depend on the necessary load cycle. The transient maximum outputs are 10.5 MVA, 20 MVA and 30 MVA.

#### Global use

SINAMICS SM150 converters are manufactured to international standards and regulations, making them ideally suited for global use. These converters are also available in a marine version (meeting the requirements of all major classification organizations).

#### Benefits

- Compact design and high flexibility in configuration ensures easy plant integration
- Easy operation and monitoring on the convenient operator panel
- Easy and reliable operation through integrated maintenance functions: the converter signals early and automatically if maintenance is required or components need to be exchanged
- High robustness and reliability due to the use of IGCT power semiconductors in the high power range and fuseless design combined with intelligent reaction to external disturbances
- Can be easily integrated into automation solutions due to PROFIBUS interface supplied as standard and various analog and digital interfaces
- High level of service-friendliness through innovative power section design with compact phase modules and easy access to all components
- Assists system cost effectiveness by enabling reactive power to be made available to other drives given suitable configuration

#### Design

Active Line Modules and Motor Modules share an almost identical structure with both the single-motor and the multi-motor drive. Phase modules in which IGCTs, diodes etc. are grouped together in one compact system are used in both.

#### Single-motor drive

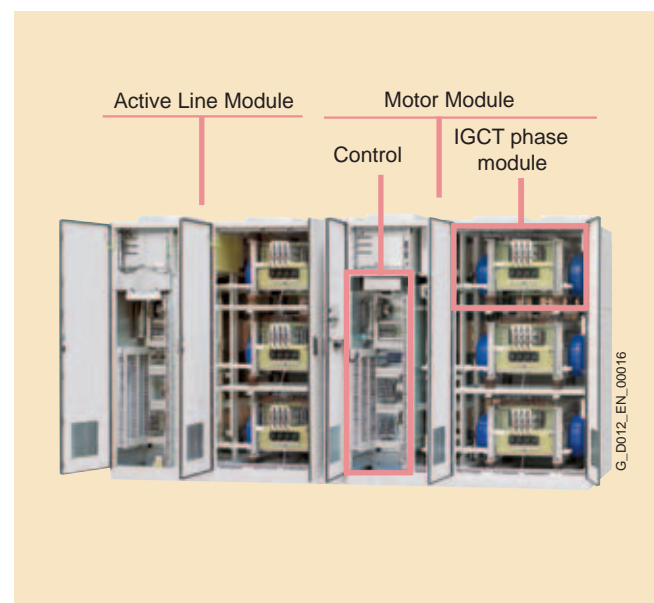
With a single-motor drive, one Active Line Module and one Motor Module are connected "back-to-back" in the basic circuit via a DC link.

For higher output ratings, two or three complete converter units with isolated DC links are operated in parallel.

#### Multi-motor drive

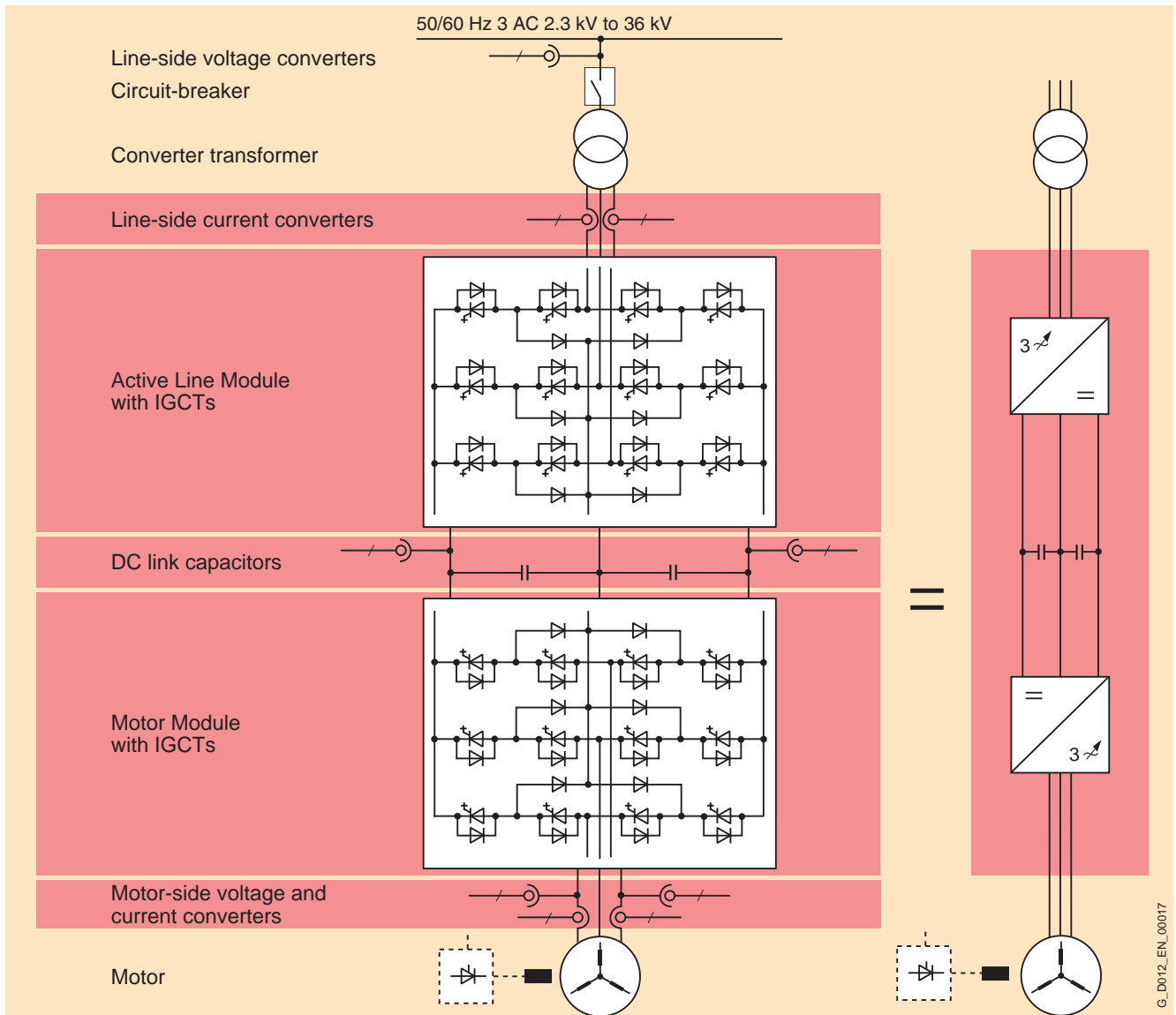
With multi-motor drives, up to four power sections are operated on the common DC bus. In addition to the Active Line Module, three Motor Modules with three motors can be operated on the common DC bus with utilization of the direct exchange of energy.

The converter consists of cabinet units for the Active Line Module and for the Motor Module. One of three phase modules and the control section in the Motor Module cabinet are highlighted in the illustration.



SINAMICS SM150, internal arrangement (without cooling unit)

Design (continued)



Block diagram

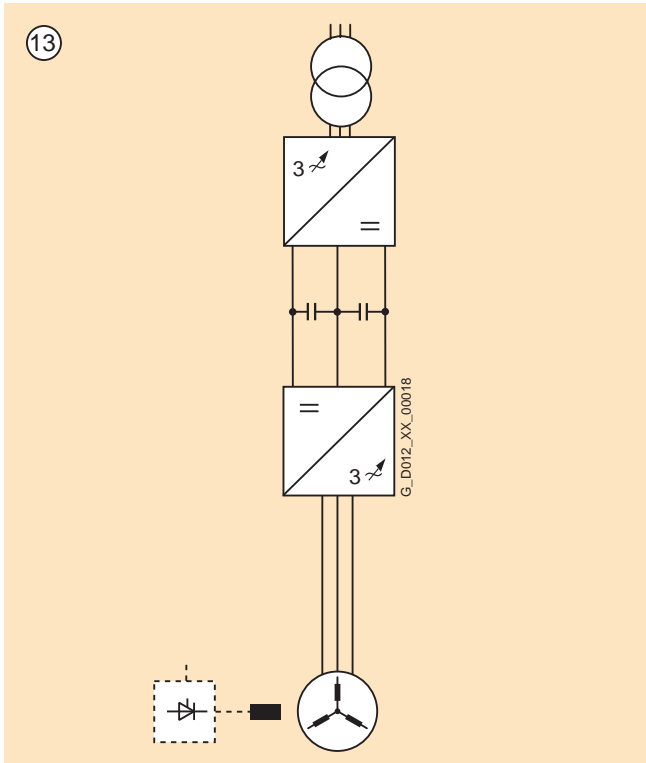
# SINAMICS SM150 Medium-Voltage Converters

## SINAMICS SM150

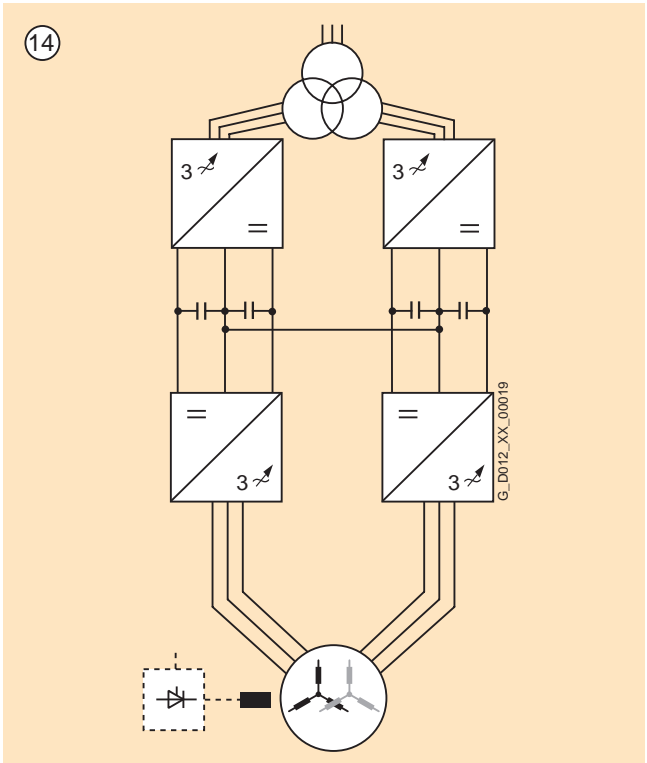
### Design (continued)

The following circuit designs are available for SINAMICS SM150.

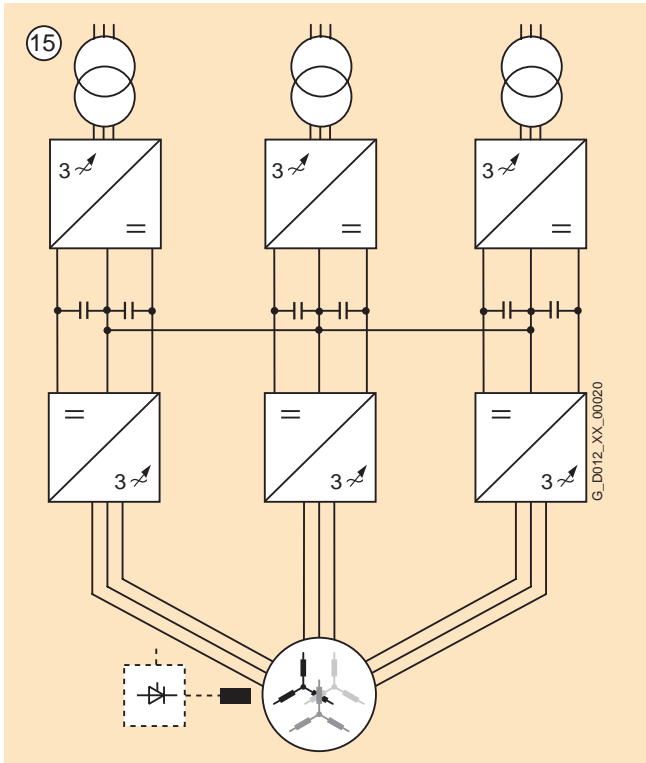
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Basic circuit



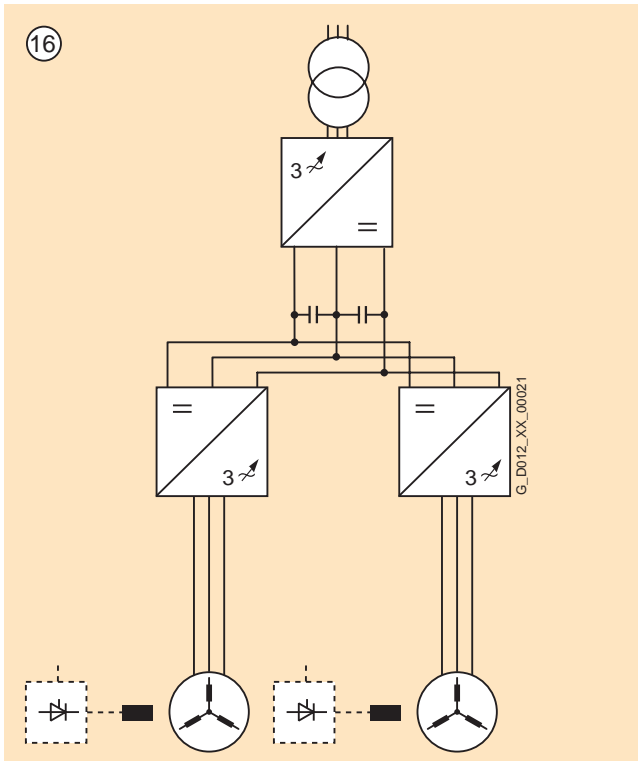
Power increased by parallel connection of two converter units (additionally reduction of line harmonic distortions) <sup>1)</sup>



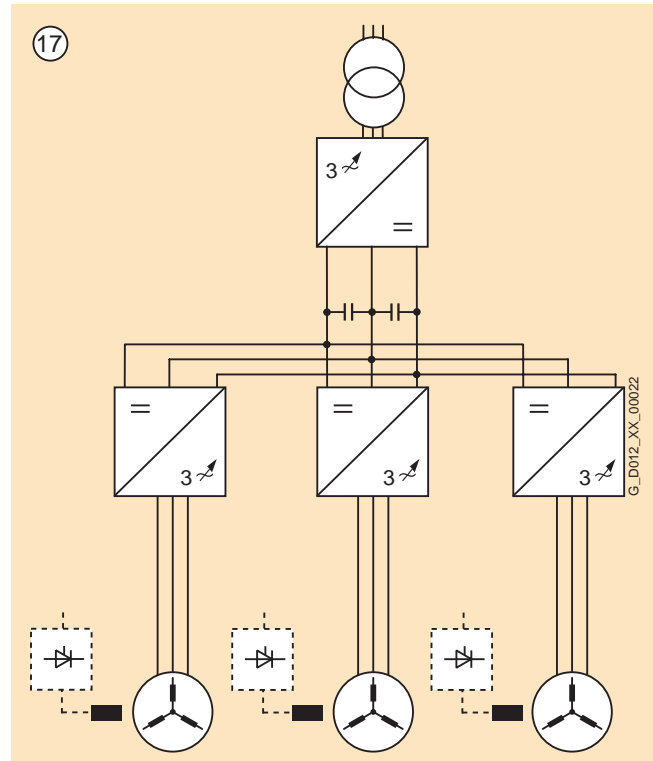
Power increased by parallel connection of three converter units (additionally reduction of line harmonic distortions) <sup>1)</sup>

1) Requires a motor with isolated winding systems.

### Design (continued)



DC bus configuration with two motors on common DC link



DC bus configuration with three motors on common DC link

On the DC bus configurations with two or three motors, energy can be exchanged through the common DC link with alternate operation as a motor and generator. This results in savings in the Active Line Module, the transformers and the circuit-breakers. These configurations are used mainly for single-stand cold rolling mills with a coiler and for transmission test stands.

# SINAMICS SM150

## Medium-Voltage Converters

### SINAMICS SM150

#### Function

##### Characteristic features

SINAMICS SM150	
<b>Line Module (line-side rectifier)</b>	
Active Line Module (four-quadrant operation)	Standard
<b>Motor Module (motor-side inverter)</b>	
Voltage range	3.3 kV
Power range (typ.)	5 MVA to 28 MVA
Cooling method	
• Water cooling	Standard
Control modes	
• Induction motor	Standard
• Synchronous motor, separately excited	Option
• Synchronous motor, permanently excited	Option
DC bus configuration with several Motor Modules on one common DC bus	Standard

##### Software and protection functions

SINAMICS SM150	Description
Closed-loop control	<p>The motor-side closed-loop control is realized as a field-oriented closed-loop vector control which can be operated as a speed or torque control as required. The closed-loop vector control achieves the dynamics of a DC drive. This is made possible by the fact that the current components forming the torque and flux can be controlled precisely and independently of each other. Prescribed torques can thus be observed and limited accurately. In the speed range from 1:10, the field-oriented closed-loop control does not require an actual speed value encoder.</p> <p>An actual speed value encoder is required in the following cases:</p> <ul style="list-style-type: none"> <li>• High dynamics requirements</li> <li>• Torque control/constant torque drives with setting range &gt; 1:10</li> <li>• Very low speeds</li> <li>• Very high speed accuracy</li> </ul>
Setpoint input	The setpoint can be defined internally or externally; internally as a fixed, motorized potentiometer or jog setpoint, externally via the PROFIBUS interface or an analog input of the customer's terminal block. The internal fixed setpoint and the motorized potentiometer setpoint can be switched over or adjusted using control commands via all interfaces.
Ramp-function generator	A user-friendly ramp-function generator with separately adjustable ramp-up and ramp-down times, together with adjustable rounding times in the lower and upper speed ranges, improves the control response and therefore prevents mechanical overloading of the drive train. The ramp-down ramps can be parameterized separately for emergency stop.
$V_{dc\ max}$ controller	The $V_{dc\ max}$ controller automatically prevents overvoltages in the DC link if the set ramp-down ramp is too short, for example. This can also extend the set ramp-down time.
Kinetic buffering (KIP)	Line voltage failures are bridged to the extent permitted by the kinetic energy of the drive train. The speed drops depending on the moment of inertia and the load torque. The current speed setpoint is resumed when the line voltage returns.
Automatic restart (option)	The automatic restart switches the drive on again when the power is restored after a power failure or a general fault, and ramps up to the current speed setpoint.
Flying restart	The flying restart function permits bumpless connection of the converter to a rotating motor.
Diagnostics functions	<ul style="list-style-type: none"> <li>• Self-diagnostics of control hardware</li> <li>• Non-volatile memory for reliable diagnostics when the power supply fails</li> <li>• Monitoring of HV-IGBTs with individual messages for each slot</li> <li>• User-friendly on-site operator panel with plain text messages</li> </ul>
Operating hours and switching cycle counter	The operating hours of the fans are detected and logged so that preventive maintenance or replacements can be performed. The switching cycles of the circuit-breaker are detected and added up, to form the basis of preventive maintenance work.
Operator protection	The cabinet doors of the power sections are fitted with electromagnetic locks. This prevents the cabinet doors from being opened while hazardous voltages are present inside the cabinet.

### Function (continued)

#### Software and protection functions

SINAMICS SM150	Description
EMERGENCY STOP button	<p>The converters are equipped as standard with an EMERGENCY STOP button with protective collar which is fitted in the cabinet door. The contacts of the pushbutton are connected in parallel to the terminal block so they can be integrated in a protection concept on the plant side. EMERGENCY STOP category 0 is set as standard for an uncontrolled shutdown (DIN EN 60204-1/VDE 0113-1 (IEC 60204-1)). The function includes voltage disconnection of the converter output through the circuit-breaker. Consequently the motor coasts down.</p> <p>EMERGENCY STOP category 1 is optionally available for a controlled shutdown.</p>
Insulation monitoring	The converters feature insulation monitoring of the whole galvanic network from the secondary side of the transformer to the stator windings of the motor.
I/O monitoring	<p>An extensive package of options for I/O monitoring (from the transformer and the motor through to the auxiliaries) is available.</p> <p>In addition it is possible to monitor the temperature with thermocouples or PT100 resistors.</p>
Thermal overload protection	<p>A warning message is issued first when the overtemperature threshold responds. If the temperature rises further, either a shutdown is carried out or automatic influencing of the output current so that a reduction in the thermal load is achieved. Following elimination of the cause of the fault (e.g. improvement of ventilation), the original operating values are automatically resumed.</p> <p>In the case of water-cooled converters, the water temperature and flow rate are detected at several points in the cooling circuit and evaluated. An extensive self-diagnostics protects the converter and reports faults.</p>
Grounding switch (option)	<p>If grounding on the line or motor side is required for safety and protection reasons, a motor operated grounding switch can be ordered.</p> <p>For safety reasons, the converter controller locks these grounding switches against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.</p>

#### SIMATIC OP 177B operator panel



The SIMATIC OP 177B operator panel is fitted into the cabinet door of the SINAMICS SM150 for operation, monitoring and commissioning.

It has the following features and characteristics:

- 5.7" STN touch display
- Context-dependent operations by touch, permanently available functions can be selected using individual keys
- Non-volatile message buffer, no battery

English and German are available as operator panel languages.