

The Reliable Medium-Voltage Drive with IGBTs

SINAMICS GM150 and SM150 Medium-Voltage Drives



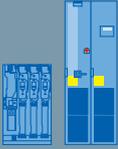
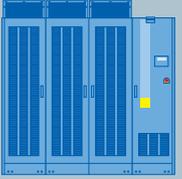
SINAMICS drives

Answers for industry.

SIEMENS

SINAMICS – the optimum drive for each and every application

The drive family for drive solutions that are fit for the future

Low voltage						Medium voltage
For basic applications	For demanding applications			For sophisticated applications		For applications with high power ratings
						
SINAMICS G110	SINAMICS G120	SINAMICS G120D	SINAMICS G130/G150	SINAMICS S120	SINAMICS S150	SINAMICS GM150/SM150/GL150
V/f control	V/f control/vector control			V/f control/vector control/servo control		V/f control/vector control
0.12–3 kW	0.37–90 kW	0.75–7.5 kW	75–1,500 kW	0.12–4,500 kW	75–1,200 kW	0.8–120 MW
Pumps, fans, conveyor belts	Pumps, fans, conveyor belts, compressors, mixers, crushers, extruders			Production machines – e.g. packaging, textile and printing machines, paper machines, plastics machines, machine tools, plants and process lines		Test stands, crosscutters, centrifuges
Standard engineering tools SIZER – for simple planning and engineering STARTER – for fast commissioning, optimization and diagnostics						

The SINAMICS family offers the optimum drive for each and every drive application – and all of the drives can be engineered, parameterized, commissioned and operated in a standard fashion.

SINAMICS – can tackle any drive application

- Wide range of power ratings from 0.12 kW to 120 MW
- Available in low-voltage and medium-voltage versions
- Standard functionality using a common hardware and software platform
- Standard engineering using just two tools for all drives: SIZER for engineering and STARTER for parameterization and commissioning
- High degree of flexibility and combinability

Medium-voltage drives from Siemens:

The reliable and complete range

Medium-voltage drive converter series	ROBICON Perfect Harmony	SINAMICS GM150 (IGBT)	SINAMICS GM150 (IGCT)	SINAMICS SM150	SINAMICS GL150
Power range	150 kW–120 MW	800 kW–9 MW	10 MW–27 MW	5 MW–30MW	6 MW–120 MW
Application range	General-purpose applications	General-purpose applications	General-purpose applications	Sophisticated applications	General-purpose applications
Motors	Induction and synchronous motors	Induction and synchronous motors	Induction and synchronous motors	Induction and synchronous motors	Synchronous motors
Energy recovery	–	–	–	Yes (Active Infeed)	Yes (LCI)
Multi-motor drives	–	–	–	Yes	–
Semiconductor technology	LV-IGBT (cell topology)	HV-IGBT	IGCT	IGCT	Thyristor (LCI)
Typical applications	Pumps, fans, compressors, extruders, kneaders, mixers, crushers, agitators, conveyor systems, presses, ESP, retrofit	Pumps, fans, compressors, extruders, kneaders, mixers, crushers, agitators, conveyor systems, marine drives, presses, wire rod mills		Rolling mills, mine hoists, conveyor systems, test stands	Compressors, fans, pumps, extruders, ships' drives, starting converters for blast furnaces

The benchmark when it comes to medium-voltage drive systems

Siemens is the undisputed No. 1 in medium-voltage drives and around the globe sets the benchmark in this sector – and not only involving power ratings and market share. Our portfolio is also second to none around the globe:

- All voltage classes from 2.3 to 13.8 kV
- A seamless range of power ratings from 150 kW to 120 MW
- All levels of dynamic response and performance
- Single-motor drives and multi-motor systems
- Harmonized and coordinated systems with synchronous and induction motors
- Motor speeds from 10 to 15,000 rpm in the Megawatt range

The decisive plus when it comes to experience

Everywhere where it involves the highest degree of availability, an uncountable number of users have been depending on medium-voltage drive converters

from Siemens since decades – and that worldwide. The reason for this lies in the reliability of our drive systems that has become almost legendary. And all of this didn't just happen by chance – it is the result of our many years of experience, our power of innovation and our extensive know-how.

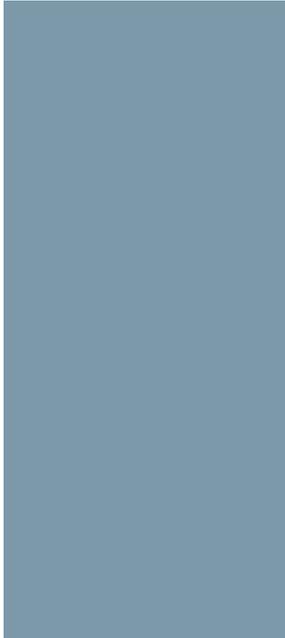
- From 1969: Variable-speed medium-voltage drive systems with current-source DC link converters
- 1994: The cell topology of ROBICON Perfect Harmony revolutionized medium-voltage drives
- 1996: "Pioneered" the use of high-rating voltage-source DC link converters in rolling mills
- 1998: "Pioneered" the use of high-voltage IGBTs for medium-voltage drive converters
- 2003: Worldwide the highest rating high-speed drives (65 MW) with LCI for compressors of a gas liquification plant
- 2005: Highest rating drive with voltage-source DC link converters in a cell-type topology (65/45 MW) used in an LNG plant (LNG = Liquefied Natural Gas)

Well-proven as basis

Based on well-proven technological concepts, we are continually developing our medium-voltage drives. The result: Increasingly higher reliability and operational reliability and safety, continually more compact types of construction, continually lower energy requirement and service and maintenance costs as well as increasingly simpler handling: From engineering through installation, integration and commissioning up to operator control.

Always the optimum solution

We offer you the optimum solution for any conceivable drive application in the medium-voltage range. We have the widest range of drive converter technology that we can draw on: From load-commutated drive converters using thyristors through voltage-source DC link converters with HV-IGBTs or IGCTs up to cell topology drive converters. For the latter, medium voltage is generated at the output by connecting low-voltage cells in series.



SINAMICS medium-voltage drives with IGCT semiconductors

Applications and typical sectors



SINAMICS GM150

SINAMICS GM150 is the single-motor drive for applications involving square-law and constant load characteristics without regenerative feedback into the line supply. These are especially pumps, fans, compressors, extruders, mixers, crushers and ships' drives.

Typical sectors where SINAMICS GM150 is used:

- Oil and gas
- Chemical and petrochemical
- Mining
- Basic materials industry
- Water, wastewater
- Marine
- Cement

SINAMICS GM150 at a glance

- Power ratings from 9 to 27 MW¹
- Induction and synchronous motors
- Single-motor drives without energy recovery
- Integrated maintenance functions
- Factory-tested interaction between the motor and drive
- Simple integration into automation systems

SINAMICS SM150

The SINAMICS SM150 medium-voltage drive is used for sophisticated single- and multi-motor drive applications. It distinguishes itself as a result of its high dynamic performance with maximum control precision. It also is suitable for 4-quadrant operation with active regenerative feedback into the line supply.

Typical applications include:

- Cold and hot rolling mills
- Mine hoists
- Test stands
- Conveyor systems
- Transrapid magnetic levitation railway

SINAMICS SM150 at a glance

- Power ratings from 5 to 30 MW
- Induction and synchronous motors
- Single- and multi-motor drives
- Voltage-source DC link drive using IGCTs
- Highest dynamic performance with maximum precision
- 4-quadrant operation with active energy recovery
- Brief line supply dips are buffered
- Ideal for direct power exchange between regenerating and motoring applications
- Active Infeed can optionally supply capacitive reactive power to compensate other loads
- Line supply power factor can be continuously set
- Factory-tested interaction between the motor and drive
- Can be simply integrated into automation systems

¹ From 0.6 to 9 MW using HV IGBTs

The best way to combat production downtimes: Maximum plant availability



Plant availability through absolute reliability

Siemens is the leading supplier of medium-voltage drives globally and clearly understands the high priority given to plant availability. This is the reason that SINAMICS GM150 and SM150 distinguish themselves as a result of their outstanding ruggedness. Having proven themselves in the high power range IGCT semiconductors is one of the ways that this is achieved. The drives also have a rugged design so that they can operate in challenging industrial environments – and continue to run even under critical operating conditions.

The drive units are equipped with integrated maintenance functions so that a fault doesn't even develop in the first place. The drive automatically outputs a signal early on if maintenance is required or components have to be replaced.

One example is the ion exchanger for the liquid-cooled drive units. The analog conductivity measurement continually checks the mode of operation of the ion exchanger. When its capacity is depleted, it outputs a signal well in advance. The concept of integrated maintenance functions means that components can always be replaced or other maintenance work carried out at the optimum point in time – for instance during a routine inspection.

As a consequence, non-scheduled plant downtimes with lost production and expensive on-site service calls are a thing of the past. The extensive system test ensures minimum downtimes when modernizing. Advantage: A short start-up phase when commissioning and ramping up production.



Modular design for the highest degree of service friendliness

In the unlikely event that a SINAMICS GM150 or SM150 develops a fault, then this can be easily resolved. This is because the individual power modules can be easily accessed from the front and can be simply replaced with just a few manual operations without requiring any special tools. This is all complemented by a global service network and smooth spare parts logistics.

High dynamic performance and high efficiency

When it comes to dynamic performance and process quality, SINAMICS GM150 and SM150 distinguish themselves through the expanded vector control with ROTOS (Reduced Optimized Task Oriented Switching). This is a gating technique

with a high dynamic performance and optimized pulse patterns. It guarantees sinusoidal currents and the best voltage utilization – but at the same time low switching frequencies. The result: A high efficiency and operation that reduces the stress on the motor. SINAMICS SM150 sets standards when it comes to dynamic performance, torque and line current quality, ruggedness to handle critical operating situations, motor noise and overall efficiency. This drive precisely controls the speed and torque to the required value – even when the load quickly changes.

Simplicity itself

SINAMICS GM150 and SINAMICS SM150 have user-friendly operator panels for simple operator control and visualization. They can also be simply integrated into the overall plant – thanks to their compact design and the high degree of flexibility when it comes to connections

and mounting. With their high energy efficiency and low maintenance requirements, SINAMICS medium-voltage drives have low operating costs and their low noise level means that noise-reducing measures are not required. Both of these drive units are optimally designed to use Siemens motors. They are manufactured in compliance with international Standards and regulations and are therefore admirably suited for applications anywhere around the globe.

SINAMICS GM150 and SINAMICS SM150 can be seamlessly integrated into higher-level automation systems – either through the PROFIBUS interface provided as standard or analog and digital interfaces.

With or without energy recovery: Can be freely selected for each project

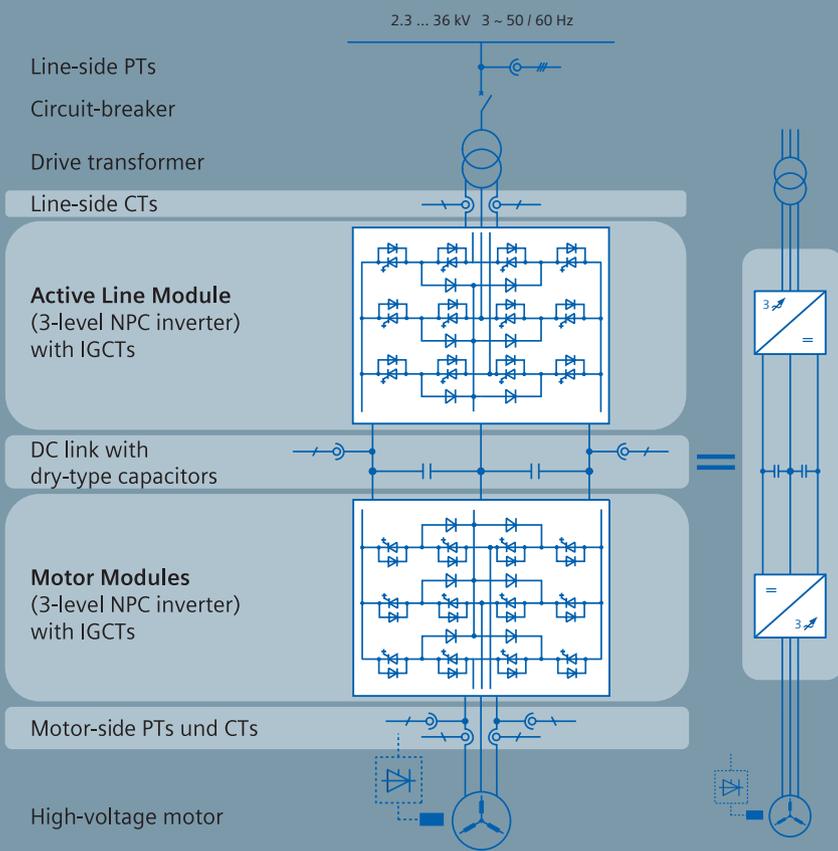


SINAMICS GM150: For drive applications without energy recovery

As a result of its high performance, maximum availability and simple handling, SINAMICS GM150 is the perfect fit for pumps, fans, compressors, extruders, mixers or crushers. In fact any single-motor drive application where regenerative feedback into the line supply is not required. It precisely complies with the requirements of the particular sector thanks to its whole raft of features. For instance, teleservice is possible. This makes a lot of sense for pumps or compressors used in the oil and gas industry that are often located in remote regions. The GM150 is also in its element when driving high-speed compressors at up to 15,000 rpm. Its compact design and low weight are especially interesting in marine engineering – and the same goes for its low noise level. The possibility of implementing redundant drive configurations can be of benefit anywhere as this further increases the reliability and availability of the complete plant or installation.

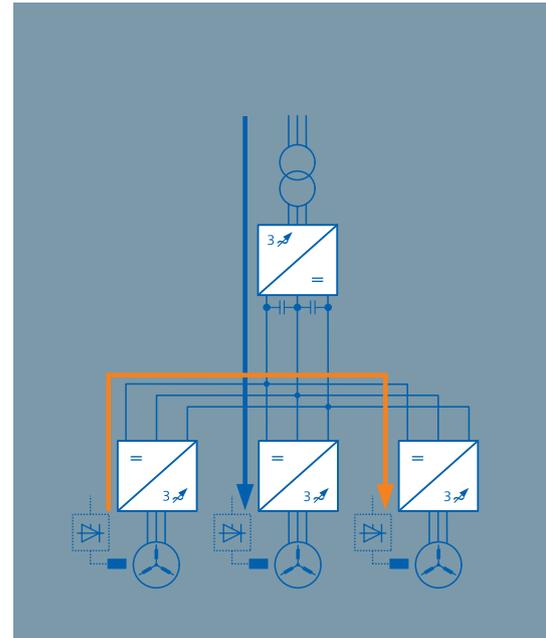
SINAMICS SM150: Capable of energy recovery through Active Infeed

SINAMICS SM150 is especially at home in mine hoists and test stands. Its power unit is also used in Transrapid, the magnetic levitation railway. All of these involve applications where the drive occasionally goes into the regenerative mode as it frequently changes between accelerating and braking. 4-quadrant operation with regenerative feedback into the line supply is required. For these applications, it sometimes also makes sense to couple several drive axes to form a coordinated system. The Active Infeed – the infeed/regenerative feedback unit with which SINAMICS SM150 is equipped as standard – fulfills the requirement for “4-quadrant operation with regenerative feedback”. Fast vector control in conjunction with the optimized gating technique ensures almost sinusoidal line currents. This applies both when motoring as well as when regenerating.



left: Design of the SINAMICS SM150 power unit

right: DC bus configuration with three motors connected to a common DC link



Insensitive to line supply fluctuations and line supply dips

The constant DC link voltage – that decouples the motor from the line supply voltage – plays a role in achieving the high degree of security against failure. In this case, the drive operates as a step-up controller with a higher DC link voltage than the peak value of the line supply voltage. This makes the drive system insensitive to line voltage fluctuations. The highest precision of the driven load is guaranteed even when connected to weak line supplies. The controlled converter switches the current independent of the line supply. This allows brief line supply dips to be buffered and the drive system can continue to run.

A freely selectable line supply power factor permits reactive power compensation

With our Active Infeed, the line supply power factor can be freely selected. No reactive power is drawn for the standard setting where the line supply power factor = 1. Different settings allow either an inductive or capacitive reactive current to be fed into the line supply – over wide limits – and can therefore be used to compensate for loads with a reactive power connected to the same line supply. This reduces drawing reactive power from the power supply utility that is penalized with high tariffs. It also eliminates having to use compensation systems that are required for conventional infeed units.

For multi-motor drives, up to four motors can be operated on a common DC link. This reduces the space, lowers installation costs and the number of components – which in turn further increases the availability of the complete plant.

For multi-motor drives, power is exchanged along the common DC bus

SINAMICS SM150 is predestined for multi-motor drives in the multi-Megawatt class. For instance, these drives can be found in rolling mills where the various roll drives and winders must be coordinated. As a consequence, power can be exchanged between motoring and regenerating drive axes along the DC busbar which feeds the inverters for all of the connected motors. If energy is regenerated when one motor brakes, then this energy can be supplied along the DC busbar to the motors that are still driving. This results in significant energy saving for the complete plant.

System competence across the board: Drives and motors from Siemens

Many years of experience and a broad portfolio

Siemens is the No. 1 supplier of medium-voltage drive systems in the world. This is both in market share as well as the extensive portfolio. This wide-ranging portfolio addresses every conceivable medium-voltage application in industry and the infrastructure: All performance levels, all voltage classes and all power ratings from 200 kW up to 120 Megawatts.

Coordinated medium-voltage drive systems for rolling mill drives and mine hoists as well as a vast number of pumps, fans, compressors, extruders, mixers and crushers have been running reliably for years. They require little maintenance and help save energy. Siemens assigns topmost priority to the highest reliability with minimum maintenance costs. This is clearly reflected in development and the quality standards in production. This applies to both individual products and complete systems.

Every Siemens drive system increases the productivity through minimum maintenance costs, maximum availability and low operating costs.

Siemens motors – a wide selection for maximum reliability

Siemens offers the optimum motor for each and every drive application. Whether synchronous or induction motor, slow-speed rotors with a high number of poles, high-speed direct drives, standard motors or tailored customer and industry-sector solutions. And it goes without saying that a perfectly harmonized

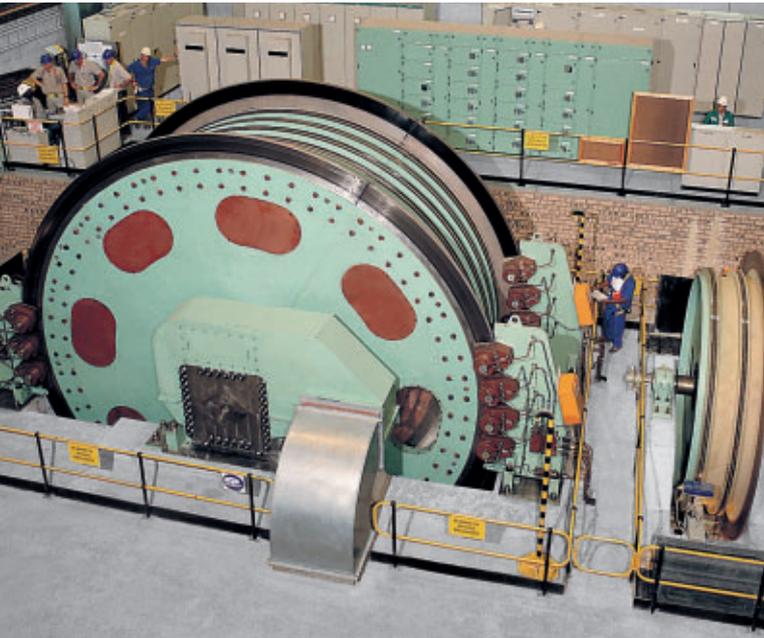


system is obtained when these motors are used together with a SINAMICS GM150 or SM150 drive.

High-voltage motors from Siemens are generally designed and manufactured according to IEC – in compliance with ANEMA for the North American market. These motors are also available according to standards such as API. For motors used in medium-voltage drive systems, enclosure, bearings, active parts, ventilation and cooling system are perfectly coordinated with one another to achieve maximum availability. The materials and components used and the production techniques are also carefully selected with this objective in mind. For high-rating high-voltage motors, the Micalastic insulation system is used. This has proven itself worldwide over many years. An important component is the VPI (Vacuum Pressure Impregnation) technique that is harmonized to the insulation design. This insulation technique allows the motor to

be connected directly to the line supply and to a drive. The insulation has a high switching and reversing strength as a result of the high winding overhang stiffness and excellent corona shielding. All of this – together with the extremely high mechanical strength and thermal endurance – ensures an extremely long winding lifetime. The bearings also have extremely long lifetimes and require hardly any maintenance.

In extreme situations, even the most technically sophisticated motor can be subject to stressing for which it was not originally designed. This is the reason that our motors are equipped as standard with bearing and winding monitoring devices just in the unlikely case that a fault does develop. For instance, motors in the



Megawatt range running at speeds of up to 15,000 rpm can handle the enormous forces that are generated due to their rotor technology that is unique worldwide:

Solid rotors that can handle even the highest centrifugal forces and shaft-mounted fans with a high-velocity profile protect the motor against overheating.

Typical system partners for the SINAMICS GM150 include standard induction and synchronous motors for pumps, fans, compressors, extruders, mixers, crushers and ships' drives. The Siemens portfolio also includes motors for special drive applications where SINAMICS SM150 controls their speed. These motors are especially used for main rolling mill drives and mine hoists. The rolling mill motors distinguish themselves as a result of their high overload capability and extreme mechanical stability. Motors for mine hoists are directly integrated into the cable drum.

Siemens synchronous motors

Power ratings	5–30 MW
Voltage	3.3 kV
Shaft heights	710–1,250 mm
Speed	up to 6,300 rpm
Pole number	2–24
Degree of protection	IP55
Explosion protection	Ex n, Ex p, dust explosion protection
Cooling	Air/water heat exchanger
Bearings	Sleeve bearings, active magnetic bearings
Special versions	Main rolling mill drives, drives for mine hoists

Siemens induction motors

Power ratings	Up to 30 MW
Voltage	3.3 kV
Shaft heights	710–1,250 mm
Speed	Up to 15,000 rpm
Pole number	2–10
Degree of protection	IP55
Explosion protection	Ex n, Ex p, dust explosion protection
Cooling	Air/water heat exchanger
Bearings	Sleeve bearings, active magnetic bearings
Special versions	High-speed direct drives

Generally available voltage and power range for high-voltage synchronous and induction motors: voltages from 2 to 13.2 kV, for synchronous motors, power ratings up to over 100 MW.

SINAMICS GM150 (IGCT) and SM150 – technical data

Specifications	
Power connection	Closed-loop control
<ul style="list-style-type: none"> Line supply voltage: GM150: 2 x 1.7 kV +/- 10% SM150: 3.3 kV +/- 10% Frequency: 50/60 Hz +/- 10% Line supply power factor: GM150: > 0.96 SM150: 1 (can be continually set) Either from the top or bottom 	<ul style="list-style-type: none"> Vector control with and without speed encoder Induction motors and separately excited or permanent-magnet synchronous motors can be operated (excitation equipment is separately available) Speed accuracy: +/- 0.01 % with speed encoder, +/- 0.2 % without speed encoder Torque accuracy: +/- 2 % Field-weakening range: Induction motors: 1:3 Synchronous motors: 1:4 Maximum output frequency: 250 Hz
Motor connection	Standards
<ul style="list-style-type: none"> Motor voltage: 3.3 kV Either from the top or bottom 	<ul style="list-style-type: none"> IEC, EN, CE
Auxiliary power supply	Standard features
<ul style="list-style-type: none"> 1-ph. 230 V 50/60 Hz and 3-ph. 400 V AC 50/60 Hz 	<ul style="list-style-type: none"> Flying restart Kinetic buffering Automatic restart Operating hours counter for the circuit-breaker Maintenance functions STARTER software for user-friendly commissioning and diagnostics at the PC
Line-side rectifier	Control I/O
<ul style="list-style-type: none"> GM150: 12-pulse or optional 24-pulse diode rectifier without regenerative feedback SM150: Line-side converter capable of regenerative feedback 	<ul style="list-style-type: none"> Analog inputs: 2¹ Analog outputs: 2¹ Digital inputs: 4¹ Digital inputs/outputs (bidirectional): 24¹ Digital outputs (relay): 2¹ Inputs for PT100: 3¹ Speed encoder (optional) Communications: PROFIBUS-DP or PROFINET
Motor-side inverter	Selection of additional options
<ul style="list-style-type: none"> 3-level inverter (PWM) in NPC topology with IGCT power semiconductors in compact phase modules 	<ul style="list-style-type: none"> Output reactors Marine duty Braking modules Teleservice module Anti-condensation heating Additional I/O modules Additional PT100 temperature relay Redundant configurations Grounding breaker at the input and output Circuit-breaker at the drive output Control of auxiliaries Safe Torque Off (certified) Different heat exchanger versions
Efficiencies	
<ul style="list-style-type: none"> GM150: 99.1 % SM150: 99.0 % 	
Cooling	
<ul style="list-style-type: none"> Water-cooling with integrated heat exchanger and redundant pumps as standard 	
Degrees of protection	
<ul style="list-style-type: none"> IP43 (optional up to IP54) 	
Ambient conditions	
<ul style="list-style-type: none"> Temperature: +5–40°C (41–104°F), up to 45°C (113°F) with derating Installation altitude: Up to 1,000 m (3,300 ft), up to 4,000 m (13,200 ft) with derating Humidity: < 85 % (moisture condensation not permissible) 	
Noise	
<ul style="list-style-type: none"> 75 dB (A) at a distance of 1 m (3 ft) from the drive unit 	
Safety functions (list is not complete)	
<ul style="list-style-type: none"> Short-circuit, ground fault monitoring Overcurrent, overvoltage and undervoltage monitoring Line supply failure monitoring Overtemperature monitoring (drive and motor) Overspeed protection, anti-stall protection (motor) Cooling circuit monitoring Self-diagnostics of the closed-loop control and power unit 	

GM150 IGCT

Rated output current	Rated power	Shaft output ²		Rated input current	Order No. (MLFB) ³	Configuration
		kW	hp			
A	kVA			A		
1,750	10,000	9,000	12,000	2 x 1,550	6SL3835-2LN41-8AA0	A
2 x 1,400	16,000	13,000	18,000	2 x (2 x 1,240)	6SL3835-2LN42-8AA0	B
2 x 1,750	20,000	18,000	24,000	2 x (2 x 1,550)	6SL3835-2LN43-6AA0	B
3 x 1,400	24,000	20,000	27,000	3 x (2 x 1,240)	6SL3835-2LN44-2AA0	C
3 x 1,750	30,000	27,000	36,000	3 x (2 x 1,550)	6SL3835-2LN45-4AA0	C'

SM150 single-motor drives

Rated output current	Rated power	Shaft output ⁴		Rated input current	Order No. (MLFB) ³	Configuration
		kW	hp			
A	kVA			A		
1,750	10,000	10,000	13,000	1,770	6SL3845-7NN4[-][JAA0	D
2 x 1,750	20,000	20,000	26,000	2 x 1,770	6SL3845-7NN4[-][JAA0	E
3 x 1,750	30,000	30,000	39,000	3 x 1,770	6SL3845-7NN4[-][JAA0	F

SM150 multi-motor drives (examples)

Rated output current	Rated power	Shaft output ⁴		Rated input current	Order No. (MLFB) ³	Configuration
		kW	hp			
A	kVA			A		
2 x 1,750	2 x 10,000	2 x 10,000	2 x 13,000	1,770	6SL3845-7NN4[-][JAB0	G
3 x 1,750	3 x 10,000	3 x 10,000	3 x 13,000	1,770	6SL3845-7NN4[-][JAC0	H
4 x 1,750	4 x 10,000	4 x 10,000	4 x 13,000	1,770	6SL3845-7NN4[-][JAD0	J
3 x 1,750	3 x 10,000	3 x 10,000	3 x 13,000	2 x 1,770	6SL3845-7NN4[-][JAF0	K
4 x 1,750	4 x 10,000	4 x 10,000	4 x 13,000	2 x 1,770	6SL3845-7NN4[-][JAG0	L
2 x 1,750	2 x 10,000	2 x 10,000	2 x 13,000	2 x 1,770	6SL3845-7NN4[-][JAF0	M
1 x (2 x 1,750)	1 x 20,000	1 x 20,000	1 x 26,000			

¹ Additional through optional expansion modules

² Values referred to the data of a typical induction motor

³ Please contact your sales partner to complete the configuration

⁴ Values referred to the data of a typical synchronous motor

SINAMICS GM150 (IGCT) and SM150 – technical data

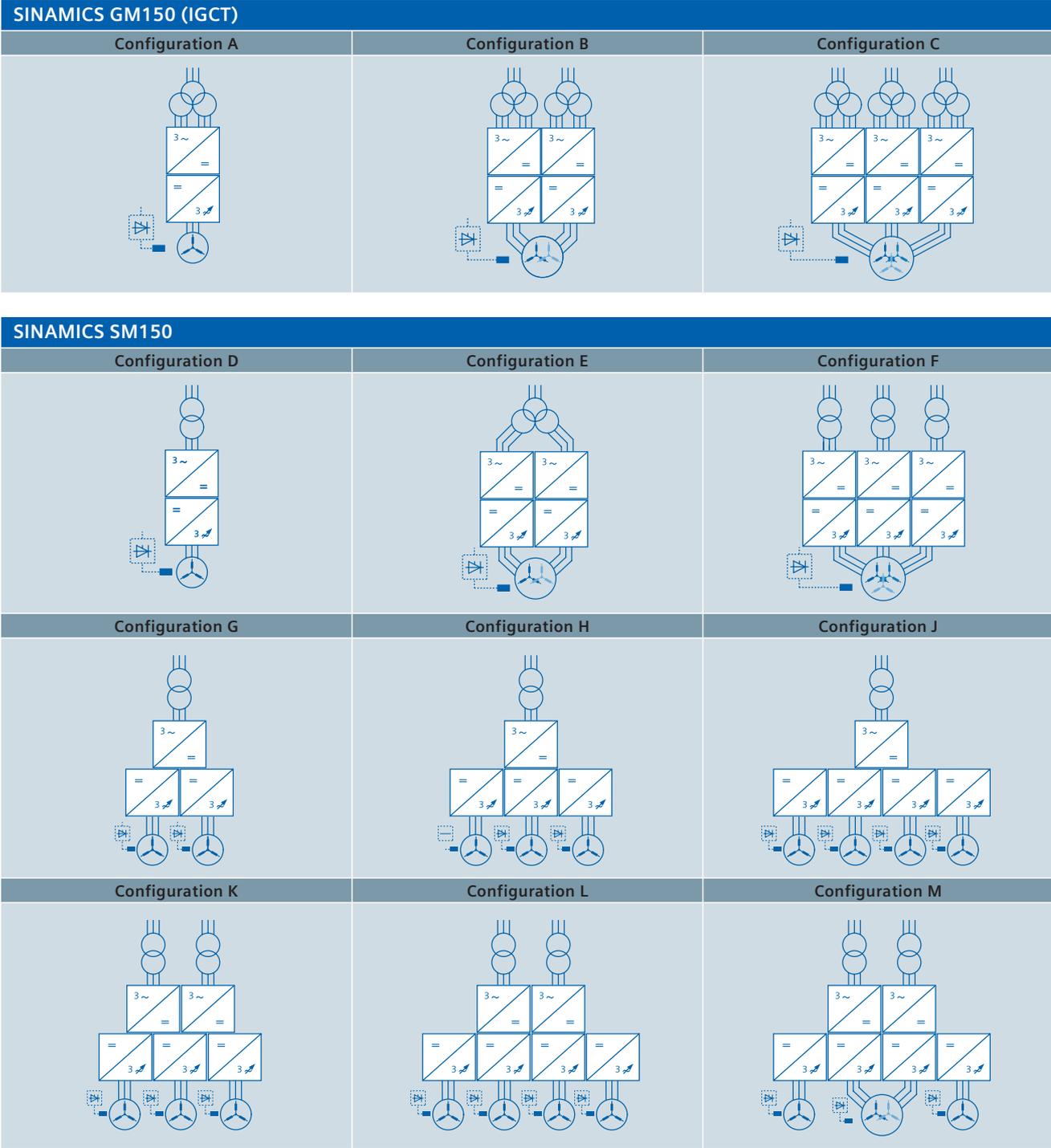
Dimensions

Configuration	Width		Height		Depth		Weight kg
	mm	inch	mm	inch	mm	inch	
A	5,300	208.7	2,540	100	1,600	63	5,400
B	9,400	370.1	2,540	100	1,600	63	9,800
C	14,300	563	2,540	100	1,600	63	15,000
C'	14,800	582.7	2,540	100	1,600	63	15,400
D	6,100	240.2	2,540	100	1,600	63	6,400
E	11,200	441	2,540	100	1,600	63	11,800
F	16,300	641.8	2,540	100	1,600	63	17,200
G	8,900	350.4	2,540	100	1,600	63	9,300
H	11,700	460.7	2,540	100	1,600	63	12,200
J, K	14,000	551.2	2,540	100	1,600	63	13,500
L, M	16,300	641.8	2,540	100	1,600	63	16,200

Configuration examples

SINAMICS GM150 (IGCT)	SINAMICS SM150
<ul style="list-style-type: none"> • Configuration A (10 MVA) • Voltage: 3.3 kV • Dimensions without options 	<ul style="list-style-type: none"> • Configuration D (10 MVA) • Voltage: 3.3 kV • Dimensions without options

Power unit configurations



www.siemens.com/sinamics-gm150
www.siemens.com/sinamics-sm150

Additional informations on SINAMICS is provided under
www.siemens.com/sinamics

The adresses and contact partners are provided under
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