New Impetus –
Drive Technology for the Chemical Industry

Drives for the chemical industry

Answers for industry.
Danger of explosion, aggressive atmospheres and extreme temperatures:

Drive and automation technology in the chemical industry must fulfill the highest safety requirements in order to protect man, the environment and the machine. We have an extensive drive portfolio for you that is predestined to address the widest range of applications. Whether converter or distributed drive technology, whether standard, low-voltage motors or special customized versions – your requirements define our solution. This also involves the special drives from Loher – the Siemens daughter company – and gear units from Flender. With our products and systems, we can provide you with an efficient basis for your plant to ensure maximum safety and the highest degree of productivity over the complete life cycle. Not only this, scalable from just a few kilowatts up into the high megawatt range. Last but not least, our energy-efficient drive systems provide you with a significant cost-saving potential when it comes to your operating costs.

Setting standards in the chemical industry – with the comprehensive drive portfolio from Siemens
Our complete portfolio for the chemical industry includes a wide range of products and systems. We apply the following three levers to configure our drive solutions even more efficiently across the board.

At home in the chemical industry: Converters
In the chemical industry – with its multitude of pumps, fans, compressors, mixers, agitators and extruders – it certainly pays off to control motors from converters for variable-speed operation. This guarantees precise pumping and dosing, reduces the stress on the mechanical system and pipes and permits up to 70% of the energy to be saved. Our SINAMICS and DYNAVERT T product families and the sector-specific converter from Loher fully address the special requirements of the chemical industry. Rugged, reliable and low-maintenance, they distinguish themselves as a result of their extremely simple handling, menu-prompted commissioning tools and documented factory setting.

For use in the chemical industry, our converters are also equipped with NAMUR functions and NAMUR terminal strips. The PROFIBUS profile PROFIdrive 4.1, “Process technology” mode can be used in operation. Protective separation (PELV) is also guaranteed. Sine-wave output filters and dv/dt filters are available to limit the voltage peaks and rates of rise. The flexible PLC functionality of the inputs and outputs allows signal exchange between the device and the control to be optimally adapted. This applies both to analog as well as digital signals. PTC thermistor shutdown for explosion-protected motors in Zones 1 and 2 has been specifically integrated for applications in hazardous zones.

Motors that can now perform even better
Our seamless program of motors and geared motors encompasses a power range from 0.12 W to 100 MW. In addition to standard industrial motors, for the chemical industry, we also supply explosion-protected motors in all of the applicable types of protection up into the high megawatt range. These are complemented by motors with anticorrosion paint finishes that are resistant to chemicals, energy-saving motors with an especially high degree of efficiency – when required, also in conjunction with explosion protection, NEMA motors for the North American market as well as motors to individual specifications.

And, last but not least, we can also offer you our Loher CHEMSTAR motors in a design specific for the chemical industry: With a high-quality paint finish, resistant to chemicals, galvanized fan cowl – and when required, with corrosion-resistant stainless steel screws and bolts. Loher CHEMSTAR motors can be used in the widest range of locations and processes in a chemical plant as a result of the wide operating temperature range that extends from –55°C to +70°C – even in zones with dust and gas. Special shaft seals that provide protection against water and dust allow these motors to be simply installed outdoors. Double protection can be achieved by combining two types of protection for applications in extremely explosive areas. The motors have complete sector-specific documentation, including ATEX certificates for the chemical and petrochemical industries.

Always a part of Totally Integrated Automation
All of the Siemens drive systems for the chemical industry can be simply integrated into the automation environment as part of Totally Integrated Automation via PROFIBUS/PROFINET. The standard and unified automation platform allows all plant operations to be vertically and horizontally integrated – for the best possible optimization of complete plants and systems. This is how you can reduce your total cost of ownership and sustainably improve your competitiveness. The drive systems can be seamlessly connected to the SIMATIC PCS 7 process control system: via DriveES PCS 7 using preconfigured driver blocks and faceplates.
Effectively save costs: using energy-efficient drive and power management systems

Pumps, fans and compressors: The chemical industry is characterized by so-called fluid flow machines, which, without some specific measures, are real energy guzzlers. The cost-saving potential is appropriately high. We can offer you a focused energy management that allows you to significantly reduce your operating costs and at the same time reduce the level of stress on the environment and climate. Here, energy management ensures, as continuous process, that the energy demand of your plant or system is continually reduced. This concept is based on the following phases – identify, evaluate and realize. We can offer you perfect solutions for each one of these phases.

Identify: Track down energy guzzlers using the optimum hardware and software
In the first phase, our innovative Power Management software – combined with intelligent power monitoring devices or communication-capable switching and protection devices with integrated measuring function – support you to improve the transparency of your energy demand and quality as well as to secure high availability of your power distribution system.
You can continually measure electric energy values as a result of the communication-capable components with integrated measuring function, such as the power monitoring devices SENTRON PAC3200 and SENTRON PAC4200, the circuit breakers SENTRON, the motor management system SIMOCODE pro as well as the soft starters SIRIUS and the converters SINAMICS.
Our Power Management add-ons SIMATIC WinCC powerrate or SIMATIC PCS 7 powerrate continually acquire the energy data, archive this, process it further, allocate it to cost centers and monitor power peaks and times with the lowest demand. A higher degree of transparency and load management allow energy and operating costs to be reduced by up to 20%.
To track down and identify all of the energy-saving potential in operation, our experts can offer you our Energy Optimization Service (EOS). This service supports operational energy management and assesses all of the energy processes and types used in the overall plant along with secondary plants and subsystems.
Evaluate: Precisely calculate energy-saving potential and payback time using SinaSave
In the second phase, the SinaSave energy-saving program calculates the energy-saving effects – based on your plant parameters – and the cost-effectiveness of possible measures for the specific application. The payback time is obtained from the monthly overall saving of the application and the purchase and installation costs, e.g. for a new motor or converter. The payback time is frequently just a few months. High-efficiency motors and geared motors as well as low- and medium-voltage converters are integrated in the current version of SinaSave.

Realize: Save up to 70% using energy-efficient drive systems
In the last phase, the most important lever to drastically reduce the energy demand is applied: the motor operating mode. There is a high level of energy-saving potential, especially for applications involving fluid flow machines – pumps, fans and compressors. Why? When the flow rate for a fluid flow machine is conventionally controlled using mechanical elements, the motor continually operates at its rated speed that is required for the maximum flow rate. In practice, this only occurs infrequently. The result: Excess energy is wasted. This type of operation also has a negative impact on the drive and production process as a result of the high temperature and vibration levels involved.
Our variable-speed drives with converters offer the optimum solution here. The energy is optimally used as variable-speed drives always adapt the speed – and therefore the energy drawn – quickly and precisely to the actual demand. Depending on the plant characteristic, energy consumption can be reduced by up to 70%.
At the same time, the soft starting and stopping relieves the stress on the mechanical system and ensures a significantly longer lifetime of the complete drive train. Torque surges and pressure surges (water hammer) in piping systems are a thing of the past. Further, we can offer you devices with additional energy-saving functions – for instance, the "Energy-saving" function that automatically shuts down the motor if it is not required.

Measures that actually impact the motor efficiency are just as effective – especially for applications with a high number of operating hours each year. Here, we can offer you high-efficiency geared motors and motors with efficiency class IE2 (International Efficiency, comparable with EFF1*) – across the board up to 375 kW – the standardized limit of the classification. When compared to conventional motors, these energy-saving motors are convincing with up to 40% lower losses. As a consequence, they can have payback times of just a few months.
The area of validity of the new international efficiency standard IEC 60034-30 also includes explosion-protected motors. This is the reason that Loher has specifically developed a new series of flameproof encapsulated motors (type of protection Ex d) in the high IE2 efficiency class.
These high-efficiency Ex d motors cover a power range from 0.75 to 375 kW and are available as 2-, 4- and 6-pole motors as well as for 50 and 60 Hz operation.

* Energy Efficiency Class 1, according to the voluntary agreement between the European Commission and CEMEP (European Committee of Manufacturers of Electrical Machines and Power Electronics)
SINAMICS drive family: the optimum drive for every application

SINAMICS converters offer the optimum drive for each and every application in the chemical industry and offer a whole raft of convincing advantages: Safety Integrated functions, energy recovery, communications capability via PROFIBUS and PROFINET, high degree of ruggedness and simple engineering. Positioning and motion control functions can be implemented in the drive or by using a separate control system. And, specifically for the chemical industry: SINAMICS G150 and G130 – as well as G120 inverters, the new modular and highly rugged unit to address the power range up to 250 kW.

**SIZER and STARTER**, the two engineering tools for the SINAMICS family, consequentially follow the general SINAMICS philosophy: The highest degree of standardization, flexibility and scalability. Both of these tools are based on a standard operator concept and are optimally tailored to meet the demands when engineering and commissioning drives:

- SIZER supports you when planning and engineering – no matter which drive application you have to implement
- STARTER is predestined for commissioning, optimizing and troubleshooting all SINAMICS drives

**SINAMICS drive family – technological highlights**

- Wide range of power ratings from 120 W up to 120 MW
- Available in both low- and medium-voltage versions
- Standard functionality using a common hardware and software platform
- One standard engineering for all drives – using just two tools: SIZER for engineering and STARTER for parameterizing and commissioning
- High degree of flexibility and combinability
- Completely standardized when it comes to engineering, parameterizing, commissioning and operator control

We can offer you the SINAMICS GM150 as well as ROBICON Perfect Harmony drive converters for those drive applications that require several megawatts and that exceed the potential of the converters described in the following.

For more information, please go to: www.siemens.com/sinamics
SINAMICS G120 inverters: high performance into the medium-power range

Our SINAMICS G120 inverter is the efficient solution for the power range up to 250 kW. It has a modular design, is equipped with Safety Integrated functionality, can be used in the widest range of applications and offers different communication types. The VIK-NAMUR application has been specifically implemented in the PROFIdrive profile 4.1 for the chemical industry – supported by SINAMICS G120. What is especially convincing: The energy-optimized regenerative feedback capability of the PM250 and PM260 power units as well as an extremely rugged design that can handle even the toughest of industrial environments.

Typical applications
SINAMICS G120 inverters are suitable for many applications in the chemical industry: Wherever a wide bandwidth of functions and flexibility is demanded. For instance, for mixers and agitators, in the processing area or for foil machines in the plastics sector.

Functional basis
• Modular system comprising a Power Module and Control Unit
• Silicon carbide power semiconductors (690 V)
• High volume/power density
• High overload capability
• Quiet motor operation
• Long motor cables
• 4 skippable frequencies reduce the stress on machinery if resonance points are present
• Automatic restart and flying restart function that reduces the stress on the motor
• 3 drive data sets
• Free function blocks
• Load torque monitoring
• Electrical isolation fulfills PELV requirements

Technological highlights
• Optimum energy recovery from the motor when it regenerates:
  – significantly improved efficiency when compared to conventional inverters
  – braking resistors are eliminated, a line commutating reactor is not required
  – lower connection cross section
• High degree of ruggedness using an innovative cooling concept; the power electronics are cooled using heat sinks, the other electronics are convection-cooled
• Optional Safety Integrated functionality
  – Safe Torque Off
  – Safe Stop 1
  – Safely Limited Speed
• Standard high drive quality even during sudden load changes as a result of the vector control (speed/torque)
• Maximum controlled torque even at the lowest speeds, both without encoder as well as with pulse encoder evaluation
• Integrated sine wave output filter (PM260)
• Extensive fault protection, e.g. by evaluating the motor temperature for motor protection and temperature monitoring of the power unit
• Communication via PROFIBUS with VIK-NAMUR application in the PROFIdrive profile 4.1 or via USS with RS485 or RS232
• Prompted commissioning using the STARTER software
In addition: a wide range of commissioning options using the Basic Operator Panel (BOP), Intelligent Operator Panel (IOP) and Micro Memory Card (cloning option) – therefore units can be simply and quickly replaced.

SINAMICS G120 – an overview of the technology

<table>
<thead>
<tr>
<th>Voltage and power ranges</th>
<th>PM240: 380 – 480 V ±10% 3 AC 0.37 kW to 250 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM250: 380 – 480 V ±10% 3 AC 7.5 kW to 90 kW</td>
<td></td>
</tr>
<tr>
<td>PM260: 660 – 690 V ±10% 3 AC 7.5 kW to 55 kW</td>
<td></td>
</tr>
<tr>
<td>Line frequency</td>
<td>47 Hz to 63 Hz</td>
</tr>
<tr>
<td>Output frequency</td>
<td>0 to 650 Hz</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>HO: –10 °C to + 50 °C; LO: 0 °C to + 40 °C</td>
</tr>
<tr>
<td>Closed-loop process control</td>
<td>Internal PID controller, auto-tuning</td>
</tr>
<tr>
<td>Control types</td>
<td>Vector Control, FCC, multipoint characteristic Vf, closed-loop torque control</td>
</tr>
<tr>
<td>Inputs</td>
<td>Up to 9 DI, 2 AI; fail-safe: 9 standard DI + 2 fail-safe DI</td>
</tr>
<tr>
<td>Outputs</td>
<td>Up to 3 DO, 2 AO</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20</td>
</tr>
<tr>
<td>Safety Integrated</td>
<td>Safe Torque Off (STO), Safe Stop 1 (SS1), Safely Limited Speed (SLS)</td>
</tr>
<tr>
<td>Link to the automation</td>
<td>SIMATIC PCS 7 – the ideal partner for your process automation</td>
</tr>
</tbody>
</table>
The chemical industry module for SINAMICS G120: the ideal supplement for the chemical industry

In order to fulfill the special demands and requirements of the chemical industry, you require inverters with 400 V, 500 V as well as 690 V. This is possible by supplementing the G120 by the associated module for the chemical industry (CM240NE). This includes, among other things, an ATEX-certified PTC thermistor evaluation as well as a terminal strip that is compliant with NAMUR specifications. The chemical industry module is combined with a Power Module and the CU240S DP-F Control Unit from the SINAMICS G120 series of inverters. The Control Unit is equipped with integrated safety-relevant functions and a PROFIBUS DP interface.

**Functional basis**
- Thermal Motor Protection (TMP) using an integrated thermistor (PTC), including protective separation
- NAMUR terminal strip
- Electrical isolation fulfills PELV requirements

**Technological highlights**
- Isolated analog values in the chemical industry module
- Isolated binary inputs and outputs in the Control Unit
- Protective separation between the sensor cable and the housing and all other connections with longer creepage distances and air clearances according to EN 60664-1
- Certified power disconnection (94/9/EC [ATEX 95]) of the inverter without a main contactor
- Forced inverter inhibit (Emergency Stop function via STO)
- Terminal strip according to NAMUR NE37
- Energy recovery capability of the PM250/PM260 Power Modules
- In addition for the PM260 Power Module: EMC line filter and sine wave filter
- Compact, modular inverter
SINAMICS G150 and G130 drive converters: for high-rating single-motor drives

Standard solutions with high power ratings are simply implemented in the chemical industry using our SINAMICS G150 and G130 drive converters. The G150 cabinet unit – for the power range from 75 up to 1500 kW is available in two versions: With sufficient mounting space for all of the available options or as especially space-saving solution. The G130 chassis unit is convincing in the power range from 75 to 800 kW and comprises a Power Module and Control Unit; these are either separately mounted or assembled as one unit.

Typical applications
SINAMICS G150 and G130 drive converters are ideal for high-rating single-motor drives without energy recovery. In the chemical industry, they are especially used for pumps, fans, compressors, extruders, mixers and crushers.

Functional basis
• Simple installation
• Compact enclosure
• Prompted commissioning
• Load torque monitoring
• High overload capability
• Automatic restart
• 4 skipable frequencies reduce the stress on machines if resonance points are present
• Flying restart to reduce the stress on the rotating motor
• Free function blocks
• Prepared for connection to IT line supplies
• Electrical isolation fulfills PELV requirements
• dv/dt filter to limit the voltage peaks and gradients

Technological highlights
• Compact and quiet thanks to state-of-the-art IGBT power semiconductors and an innovative cooling concept:
  – up to 70% smaller footprint than for conventional drive converters
  – noise values are only 69 db(A) when operated at full load

• Available depending on the requirement: Cabinet units with or without line connection components as well as chassis units
• Increased plant and system availability thanks to a service-friendly concept with good accessibility and a transparent, modular design
• Can be easily integrated into higher-level automation systems – via the PROFIBUS or PROFINET interface and various analog and digital interfaces
• Simple commissioning and parameterization, menu-prompted at the AOP 30 user-friendly operator panel with graphics-capable LCD display and plain text display
• Communications via PROFIBUS with VIK-NAMUR application in the PROFIdrive profile 4.1

Additional SINAMICS drive converters
SINAMICS G150 are predestined for voltages up to 690 V and power ratings up to 1500 kW. This means that they cover a wide range of standard drive tasks involving high power ratings in the chemical industry. On the other hand, for coordinated drives, the braking energy that is generated must be fed back into the line supply – e.g. for conveyor belts, foil machines, man-made fiber plants and packaging machinery. Here, an additional SINAMICS series comes into its own: SINAMICS S120 is designed for multimotor drives and is capable of four-quadrant operation. For drive tasks that require several megawatts – for instance, for very large mixers or extruders – medium-voltage drive converters are the most cost-effective solution, such as our SINAMICS GM150 and ROBICON Perfect Harmony.

SINAMICS G130 and G150 – an overview of the technology

<table>
<thead>
<tr>
<th>Voltage and power ranges</th>
<th>SINAMICS G130</th>
<th>SINAMICS G150</th>
</tr>
</thead>
<tbody>
<tr>
<td>380 – 480 V, ±10% 3AC</td>
<td>110 kW – 560 kW</td>
<td>110 kW – 900 kW</td>
</tr>
<tr>
<td>500 – 600 V, ±10% 3AC</td>
<td>110 kW – 560 kW</td>
<td>110 kW – 1,000 kW</td>
</tr>
<tr>
<td>660 – 690 V, ±10% 3AC</td>
<td>75 kW – 800 kW</td>
<td>75 kW – 1,500 kW</td>
</tr>
</tbody>
</table>

| Operating temperature | 0 °C to + 50 °C |
| Process control       | Internal PID controller (auto-tuning) |
| Control types         | Vector Control with or without encoder or V/f control |
| Inputs                | 8 digital inputs, 4 bidirectional digital inputs/outputs, 2 analog inputs, 1 PTC/KTY input, optional NAMUR terminal strip |
| Outputs               | 2 analog outputs, 2 relay outputs |
| Degree of protection  | IP00/IP20 (dependent on the type) | IP20 (optional: IP21, IP23, IP43 and IP54) |
| Integrated safety functions | Safe Torque Off (STO), Safe Stop 1 (SS1) |
| Link to the automation | SIMATIC PCS 7 – the ideal partner for your process automation |
DYNAVERT T drive converters: specifically for the chemical and petrochemical industries

Loher specifically developed the DYNAVERT T series of drives to address the demands of the chemical and petrochemical industries. This series offers you the highest degree of reliability, service friendliness and long service life. All of the sector-specific features are integrated as standard – from the NAMUR terminal strip through PELV up to the dv/dt filter. DYNAVERT T is ATEX certified for motors in hazardous zones. And with a power range from 2.2 to 3900 kW, this series of drive units is available in all of the voltages typical for the sector – it goes without saying, also in 500 V and 690 V.

Typical application locations
DYNAVERT T is designed for typical applications in the chemical and petrochemical industries: pumps, fans, compressors, extruders, mixers, crushers and conveyor belts. It is adapted to the requirements when operating explosion-protected motors.

Functional basis
• Optimized pulse pattern for low noise and minimized losses
• Generous connection space to accept cable cross sections dimensioned according to NAMUR
• Compact dimensions when completely equipped
• Radio interference suppression
• Long motor cables up to 300 m typically possible using the integrated dv/dt filter
• Wide input voltage range
• Drive units for 500 V and 690 V line supply voltage that can be connected to non grounded line supplies (IT line supplies)
• ATEX certified for motors in hazardous zones
• Can be adapted to customer requirements using the extensive modular system
• Water-cooled units up to IP55: “in atmospheres that are damaging to machinery”

Technological highlights
• ATEX-certified shutdown concept allows a plant or system to be safely shut down without using a main contactor – this also applies when operating motors in hazardous zone 1, without having to change or modify the dimensions – for significant cost-saving potential on the plant side
• The cable lengths made possible by the dv/dt filter make it easier to design plants and systems, especially in hazardous zones
• Wide range of function options – such as line synchronization or process/voltage/current or torque control
• Self-learning IMS software for parameterizing, commissioning and diagnostics. All parameters can also be read in the offline mode
• In the online mode: an oscilloscope function with eight analog and various digital signals
• Direct water cooling from 200 kW and above for almost all water qualities as the parts and components through which water flows are manufactured out of stainless steel
• Integrated in the SIMATIC PCS 7 process control system using driver blocks and faceplates specifically designed for the purpose allows the drive to be controlled from the PCS 7 control room and all operating data to be visualized via PROFIBUS

DYNAVERT T – an overview of the technology

<table>
<thead>
<tr>
<th>Voltage and power ranges</th>
<th>380 – 480 V 3AC 2.2 kW – 630 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 – 600 V 3AC 2.2 kW – 800 kW</td>
<td></td>
</tr>
<tr>
<td>660 – 690 V 3AC 2.2 kW – 3,900 kW</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>0 to 55 °C (for direct water cooling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line frequency</td>
<td>47 ... 63 Hz</td>
</tr>
<tr>
<td>Output frequency</td>
<td>... 250 Hz</td>
</tr>
<tr>
<td>Closed-loop process control</td>
<td>Internal PID controller, auto-tuning</td>
</tr>
<tr>
<td>Control types</td>
<td>Vector Control with/without encoder, V/f control, torque control, process control (n/m)</td>
</tr>
<tr>
<td>Inputs</td>
<td>9 digital inputs, 2 analog inputs</td>
</tr>
<tr>
<td>Outputs</td>
<td>2 analog outputs, 3 relay outputs</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20, IP21, IP54, IP55</td>
</tr>
<tr>
<td>Link to the automation</td>
<td>PROFIBUS DP, Modbus, integration into PCS 7 using special faceplates and driver blocks</td>
</tr>
</tbody>
</table>
Explosion-protected motors: maximum safety with the highest efficiency

Motors must fulfill the highest safety standards in the aggressive atmospheres that are typical for the chemical industry in order to protect man, the environment and machines – just like our explosion-protected motors. Extremely rugged, they operate even under the most extreme conditions for enormous lengths of time and disturbance-free – for maximum safety and the highest efficiency in operation. The range of products from Siemens and Loher complement one another to provide a seamless portfolio. This portfolio is second to none worldwide. All applicable types of protection up into the megawatt range, for extreme requirements also with double protection. Further, the explosion-protected motors are available as high-efficiency motors in the new IE2 efficiency class or in specific types of construction and cooling types such as water jacket cooling.

**Type range**
- Standard and unified series manufactured out of gray cast iron for standard and explosion-protected motors
- VIK version is optionally available
- Type of protection, “increased safety” – “e”
- Type of protection “flameproof enclosure” – “d”
- Type of protection “pressurized enclosure” – “p”
- Type of protection “non-sparking” – “n”
- Dust explosion protection (Zones 22 and 21)
- For exceptional requirements, double protection in Ex e and Ex d as well as gas/dust

**Quality-tested**
Our explosion-protected motors have been developed, manufactured and certified in accordance with the EU Directive 94/9/EC (ATEX 95). Further, they have the other country-specific certificates such as NEPSI (China), CCOE (India) and Rostekhnadzor (Russia). Additionally, they have been tested by the Physikalisch-Technische Bundesanstalt (PTB) or by the Deutsche Montan Technologie GmbH (DMT). This means that they provide certified reliability and efficiency for each drive task.

<table>
<thead>
<tr>
<th>Type of protection “e”</th>
<th>Type of protection “d”</th>
<th>Type of protection “p”</th>
<th>Type of protection “n”</th>
<th>Dust explosion protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power range in kW</td>
<td>0.12 ... 3,500</td>
<td>0.25 ... 4,000</td>
<td>100 ... 100,000</td>
<td>0.09 ... 100,000</td>
</tr>
<tr>
<td>Frame size in mm</td>
<td>63 ... 800</td>
<td>71 ... 800</td>
<td>355 ... 1,250</td>
<td>63 ... 1,250</td>
</tr>
<tr>
<td>Number of poles</td>
<td>2/4/6</td>
<td>2/4/6/8</td>
<td>2/4/6/8</td>
<td>2/4/6/8</td>
</tr>
<tr>
<td>Temperature Class</td>
<td>T1 ... T4</td>
<td>T1 ... T6</td>
<td>T1 ... T4</td>
<td>T3</td>
</tr>
<tr>
<td>Types of protection</td>
<td>II 2 G Ex e acc. to IEC/EN 60079-0 IEC/EN 60079-7</td>
<td>II 2 G Ex de IIC acc. to IEC/EN 60079-0 IEC/EN 60079-1</td>
<td>II 2 G Ex p IIC acc. to IEC/EN 60079-0 IEC/EN 60079-7</td>
<td>II 3 G Ex nAll acc. to IEC/EN 60079-15</td>
</tr>
<tr>
<td>Directive</td>
<td>94/9/EC (ATEX 95)</td>
<td>94/9/EC (ATEX 95)</td>
<td>94/9/IEC (ATEX 95)</td>
<td>94/9/IEC (ATEX 95)</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP55, IP56 (non-heavy-sea), IP65, on request up to IP68</td>
<td>IP55, IP56 (non-heavy-sea), IP65, on request up to IP68</td>
<td>IP55, on request, higher</td>
<td>IP55, IP56 (non-heavy-sea), IP65, on request up to IP68</td>
</tr>
<tr>
<td>Voltages</td>
<td>All of the prevalent voltages</td>
<td>All of the prevalent voltages</td>
<td>All of the prevalent voltages</td>
<td>All of the usual voltages</td>
</tr>
<tr>
<td>Frequency in Hz</td>
<td>50 and 60 Hz</td>
<td>50 and 60 Hz</td>
<td>50 and 60 Hz</td>
<td>50 and 60 Hz</td>
</tr>
<tr>
<td>Type of construction</td>
<td>All of the prevalent types of construction</td>
<td>All of the prevalent types of construction</td>
<td>All of the usual types of construction</td>
<td>All of the usual types of construction</td>
</tr>
<tr>
<td>Cooling type</td>
<td>t.e.f.c.</td>
<td>t.e.f.c., water-jacket cooled</td>
<td>Air-air/air-water heat exchanger</td>
<td>t.e.f.c., water-jacket cooled, air-air/air-water heat exchanger</td>
</tr>
<tr>
<td>Temperature class</td>
<td>155 (F) utilized to 130 (B)</td>
<td>155 (F) utilized to 130 (B), for converter operation 155 (F), utilized to 155 (F)</td>
<td>155 (F) utilized to 130 (B)</td>
<td>155 (F) utilized to 130 (B)</td>
</tr>
</tbody>
</table>
Maximum efficiency in the chemical industry:
innovative industrial controls...

Our communication-capable motor starters SIRIUS are the optimum choice when switching, protecting or starting motors in the chemical industry. From the high number of switching operations for pump applications without pressure reservoir up to softly starting large fans: Our direct, reversing and soft starters cover the complete range. Whether centrally used in the control cabinet or directly in the field – our motor starters have optional integrated intelligent monitoring functions including preventive maintenance as well as Safety Integrated functionality.

### For use in the control cabinet
- Basic contactor/circuit breaker combinations up to pre-wired load feeders 3RA1 (up to 45 kW)
- Especially cost-effective compact starters 3RA6 (up to 15 kW)
- Space-saving motor starters for the distributed ET 200S I/O that are quickly installed (up to 7.5 kW)

### For use in the field
- Motor starters M200D: the ideal solution for conveyor technology (up to 5.5 kW)
- Space-saving motor starters for the distributed ET 200pro I/O that are quickly installed (up to 5.5 kW)
- Especially cost-effective motor starters SIRIUS MCU (up to 5.5 kW)
- Motor starters ECOFAST as direct, reversing or soft starters for mounting on the motor (up to 5.5 kW)

Last but not least, our motor starters can be simply connected to the automation level via AS-Interface, PROFIBUS or PROFINET.

### Soft start-up and ramp-down
In many applications, soft start-up and ramp-down is a real alternative to direct or star-delta starting – from both a technical and cost-effective perspective. Unpleasant secondary effects, such as mechanical knocking in the machine or voltage dips in the line supply can be specifically avoided by using soft starters. Available in a seamless range, the family of the soft starters SIRIUS addresses all of the standard and high-feature applications relating to motor starting.

### The soft starters SIRIUS 3RW44 up to 1200 kW to meet high requirements
The soft starters SIRIUS 3RW44, the compact all-rounder, can also handle difficult start-up and ramp-down operations in the chemical industry with the highest degree of functionality, e.g. when it comes to high-rating compressors.
- From the integrated bypass contact system through the electronic overload relay up to equipment overload as well as thermistor motor protection
- SIRIUS 3RW44 can be simply integrated into higher-level control controls via the PROFIBUS DP module
- Using the Soft Starter ES software, communications can be configured in a user-friendly fashion via PROFIBUS. This supports simple parameterization, monitoring and diagnostics of the Soft Starter

### The soft starters SIRIUS 3RW40 up to 250 kW with integrated motor overload relay
In a somewhat more compact design, the soft starters SIRIUS 3RW40 come into their own when it comes to starting explosion-protected motors.
- From their functionality and from a price perspective, they are optimized to replace star-delta starters
- Integrated status and fault monitoring functions offer a wide range of diagnostic options: Four LEDs and three relay outputs ensure differentiated monitoring and diagnostics of the drive at the device – providing information about the operating state as well as e.g. line or phase failure, missing load, thermal overload or equipment faults
- They are suitable for starting explosion-protected motors with type of protection “increased safety” “e” according to Directive 94/9/EC
Powerful, simple and flexible: the motor management system SIMOCODE pro

SIMOCODE pro is the flexible and modular motor management system for low-voltage motors that can be simply and directly connected to a higher-level automation system via PROFIBUS DP. From a functional perspective, it addresses all of the requirements between the motor feeder and the automation system. Further, in just one compact system, it combines all of the necessary protection, monitoring and control functions for each motor feeder. The main task is to secure the highest availability of the application. As a consequence the process control quality is increased but at the same time, the costs are reduced – from the planning through installation up to operation or maintenance of a system. Clearly focusing on actual and future requirements, this new generation of the motor management system from Siemens packs a wide range of features:

- Multifunctional, electronic full motor protection, independent of the automation system
- Integrated control functions
- Detailed operating, service and diagnostics data
- Open communications via PROFIBUS DP
- Can be used in SIVACON motor control centers to provide a compact system with a high packing density of up to 48 motor feeders per section
- ATEX certified – Ex I (M2), Ex II (2) GD
- Standard software tools (including SIMOCODE ES, PCS 7 library SIMOCODE pro) for simple integration into the PCS 7 process control system

Efficient and standard power distribution

As part of Totally Integrated Power, at the low-voltage level, we can offer you our switchboards SIVACON as well as the switching, protection and measuring devices SENTRON and power management add-ons for safe, reliable and efficient power distribution:

- With SIVACON type-tested switchboards and busbar trunking systems for safe power transmission and reliable power distribution
- With the versatile and communication-capable circuit breakers SENTRON to safely protect and switch systems and loads
- With the switch disconnectors SENTRON that can be simply and quickly installed to safely disconnect/switch systems and loads – either with or without fuses
- With the power monitoring devices SENTRON PAC3200 and SENTRON PAC4200 to precisely acquire electrical measured values and energy
- With the innovative power management add-ons SIMATIC PCS 7 powerrate and SIMATIC WinCC powerrate to ensure transparency and to monitor the power distribution and costs

This extensive portfolio permits leading-edge power concepts to be created and efficient energy purchasing – to reduce your power and operating costs by up to 20%.
Optimally set up for the chemical industry: with mechanical drive components

The global market for industrial drive technology is characterized by the fact that electrical and mechanical drive components are growing together. Our portfolio for the chemical industry is rounded off by geared motors, gear units and couplings. Our drive components are convincing as a result of the highest efficiencies as well as first-class quality. Further, they can be combined in a modular fashion for almost any torque range and are compatible across all of the series.

**MOTOX geared motors**

Our range of MOTOX geared motors offers solutions for process-related applications that must frequently comply with the explosion protection directive 94/9/EC (ATEX 95). The gear units are equipped with reinforced bearings and a suitable flange – for a long service lifetime and high shaft loads.

- **Agitator gear units** are implemented as helical geared motors. All of the ratios of the basic series can be used. These gear units have generously dimensioned end bearings that can absorb high radial or axial loads.
- **MOTOX offset shaft and helical bevel geared motors** equipped with mixer flange are used for mixing systems. Both series are available with either solid or hollow shafts and can reliably withstand high shaft loads.
- **MOTOX cooling tower geared motors** are designed for cooling industrial water or for climate control systems in rugged environments. They are characterized by the high degree of operational safety and reliability.
- **Available as helical, helical bevel, helical worm or offset shaft gear units**, the range of MOTOX geared motors is in conformance with directive 94/9/EC (ATEX 95) and offers explosion protection in Categories 2 and 3.

**CAVEX industrial worm gear units/geared motors**

The CAVEX range of gear units/geared motors offers, in addition to the actual standard range, a whole raft of individual solutions for the chemical industry. The drives are in conformance with directive 94/9/EC (ATEX 95) and offer explosion protection in Categories 2 and 3.

- Drives either have a solid or hollow shaft
- A wide range of gear unit and motor options are available
- The CAVEX double gear unit (CAVEX+MOTOX) is used for lower output speeds

**Gear units and couplings**

On the mechanical side, Flender gear units and couplings complete our range of products and systems for the chemical industry. They have already been used for over 30 years in this sector in the widest range of applications: Whether gear units for agitators, aeration or water worm pumps. They are especially quiet and distinguish themselves as a result of the high efficiency, reinforced bearings and the fact that they are absolutely oil-tight. In conjunction with our ARPEX and N-EUPEX couplings, that have especially proven themselves for drives that are used to transport and pump aggressive and hot media, they form a technically well-proven solution that is also environmentally friendly. Both the gear unit as well as the couplings can be implemented according to directive 94/9/EC (ATEX 95).
### Overview table – converters for the chemical industry

<table>
<thead>
<tr>
<th></th>
<th>SINAMICS G120</th>
<th>SINAMICS G130/G150</th>
<th>MICROMASTER</th>
<th>DYNAVERT T</th>
<th>SINAMICS GM150</th>
<th>SINAMICS GL150</th>
<th>ROBICON Perfect Harmony</th>
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</thead>
<tbody>
<tr>
<td>Power range in kW</td>
<td>0.37 – 250</td>
<td>0.12 – 250</td>
<td>2.2 – 3,900</td>
<td>600 – 27,000</td>
<td>6,000 – 120,000</td>
<td>150 – 120,000</td>
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<tr>
<td>Voltage classes in V</td>
<td>380 – 480</td>
<td>380 – 690</td>
<td>380 – 500</td>
<td>2,300 – 4,160</td>
<td>1,800 – 12,000</td>
<td>2,300 – 13,800</td>
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<tr>
<td>Cooling concept</td>
<td>Cooling using</td>
<td>Cooling using</td>
<td>Air- and liquid-</td>
<td>Air- and liquid-</td>
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<tr>
<td>Degrees of protection</td>
<td>IP20</td>
<td>IP20, IP21, IP31, IP54</td>
<td>IP20</td>
<td>IP20, IP41, IP54, IP55</td>
<td>IP20, IP41, IP54, IP55, IP56</td>
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<tr>
<td>Specific features for the chemical industry</td>
<td>Chemical industry module: NAMUR terminal strip, PROFIBUS profile PROFIdrive 4.1, protective separation PELV, integrated sine wave filter</td>
<td>NAMUR terminal strip, PROFIBUS profile PROFIdrive 4.1, protective separation PELV, dv/dt filter</td>
<td>NAMUR terminal strip, PROFIBUS profile PROFIdrive 4.1, protective separation PELV, dv/dt filter</td>
<td>NAMUR terminal strip, protective separation PELV</td>
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<td></td>
<td>ATEX-certified PTC thermistor shutdown for explosion-protected motors (Zones 2 and 1), thermal motor protection (TMP)</td>
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<td>ATEX-certified PTC thermistor shutdown for explosion-protected motors (Zones 2 and 1), ATEX-certified for motors in hazardous zones</td>
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<tr>
<td>Integration in the PCS 7 process control system</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<td></td>
<td>Low-voltage induction and synchronous motors</td>
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</tbody>
</table>

### Overview table – motors for the chemical industry

<table>
<thead>
<tr>
<th></th>
<th>Low-voltage motors (standard)</th>
<th>Low-voltage motors (Zone 1)</th>
<th>High-voltage motors (standard)</th>
<th>High-voltage motors (Zone 1)</th>
<th>MOTOX geared motors</th>
<th>CAVEX geared motors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power range in kW</td>
<td>0.12 – 4,000</td>
<td>0.12 – 4,000</td>
<td>200 – 100,000</td>
<td>200 – 100,000</td>
<td>0.12 – 200</td>
<td>0.12 – 200</td>
</tr>
<tr>
<td>Voltage classes in V</td>
<td>230 – 690</td>
<td>230 – 690</td>
<td>2,000 – 13,200</td>
<td>2,000 – 13,200</td>
<td>230 – 690</td>
<td>230 – 690</td>
</tr>
<tr>
<td>Shaft heights in mm</td>
<td>63 – 630</td>
<td>63 – 630</td>
<td>350 – 1,250</td>
<td>350 – 1,250</td>
<td>Gear unit frame size 18 – 188</td>
<td></td>
</tr>
<tr>
<td>Speeds in rpm</td>
<td>Up to 12,000</td>
<td>Up to 12,000</td>
<td>Up to 15,000</td>
<td>Up to 15,000</td>
<td>0.1 ... approx. 700</td>
<td>0.01 ... approx. 300</td>
</tr>
<tr>
<td>Types of protection</td>
<td>Optional Ex n All (Zone 2) or dust Ex (Zone 21/22)</td>
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<td>Ex e II, Ex de IIC, Ex d IIC, Ex e II, Ex p II</td>
<td>Ex e II, Ex de IIC, Ex d IIC, Ex e II, Ex p II, Dust Ex Zone 1. As well as double protection Ex d and Ex e’ and gas/dust</td>
<td>Ex n All, Ex de IIC, Ex d IIC, Ex e, Dust-Ex</td>
<td>Ex n All, Ex de IIC, Ex d IIC, Ex e, Dust-Ex</td>
</tr>
<tr>
<td>Cooling concept</td>
<td>t.e.f.c., water-jacket cooling</td>
<td>t.e.f.c., water-jacket cooling</td>
<td>t.e.f.c., air-air-water heat exchanger</td>
<td>t.e.f.c., air-air-water heat exchanger</td>
<td>Self-ventilated, force-ventilated</td>
<td>Self-ventilated, force-ventilated</td>
</tr>
<tr>
<td>Certifications</td>
<td>CE, CCC, UL, CSA, KEMKO, ABNT/INMETRO, CNS14400, PSE-Mark</td>
<td>CE</td>
<td>CE</td>
<td>ATEX, NEPSI, CCOE, GOST/Rostekhnadzor</td>
<td>ATEX, NEPSI, CCOE, GOST/Rostekhnadzor</td>
<td>ATEX, GOST/Rostekhnadzor</td>
</tr>
<tr>
<td>System partner on the converter side</td>
<td>SINAMICS G120, SINAMICS G130, SINAMICS G150, MICROMASTER, DYNAVERT T</td>
<td>SINAMICS G120, SINAMICS G130, SINAMICS G150, MICROMASTER, DYNAVERT T</td>
<td>SINAMICS GM150, SINAMICS GL150, ROBICON Perfect Harmony</td>
<td>SINAMICS GM150, SINAMICS GL150, ROBICON Perfect Harmony</td>
<td>SINAMICS G120, MICROMASTER, SIMATIC ET 200</td>
<td>SINAMICS G120, MICROMASTER, SIMATIC ET 200</td>
</tr>
</tbody>
</table>

* non-heavy-sea
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