Putting the right spin on efficiency

From a single source: Drive and automation solutions for pumps, fans and compressors

Pumps, fans and compressors
Everything for pump, fan and compressor applications from a single source

Pumps, fans and compressors are absolutely essential in the widest range of sectors: Whether in water supply and water treatment, the chemical and pharmaceutical industry, the production of mineral oil or plastics or in building systems. No matter how different the requirements of the individual applications are, for the solution, one thing counts especially: the efficient implementation. And it is precisely here that we can support you. In all of the essential requirements of the tasks that you have to perform.

From a single source, we can provide you with all of the drive and automation components that you require for pump, fan or compressor applications. Further, we focus our efforts to help you in creating an optimum design and competently support you when it comes to implementing concepts that are fit for the future. We accompany you over the complete life cycle of the application with service & support – naturally also around the globe.

The added value of our portfolio

• Higher degree of productivity and cost-effectiveness through a seamless and integrated product portfolio and comprehensive solutions
• Lower operating costs by minimizing the energy requirement as well as maintenance costs
• Secured plant availability due to the higher product quality, reliable support and fast spare parts service
• High security of investment through a tailored range of services – including training courses
• Many options for changes or expansions using scalable solutions and modular system components

Advantages for OEMs

• High degree of cost-effectiveness through a good price-performance ratio
• Global availability of products and systems through global pre- and after-sales service and support
• User-friendly selection of components using integrated tools
• Maximum efficiency and lifetime based on innovative drive and automation products from a single source
• Products and systems tailored to the particular application
• Simple and fast installation and commissioning using a set of standard engineering and commissioning tools
• Support of global standards and certificates such as IEC, UL, CCC, ATEX and marine certification

Advantages for the plant operating company

• Minimized operating costs by implementing energy-saving concepts
• High degree of cost-effectiveness through products and systems with a long lifetime
• Lower noise levels through quiet drive systems
• Full transparency as a result of numerous diagnostic functions in products and systems that are harmonized with one another
• Maximum security for the future as a result of the long-term availability of spare parts
• Global standards and certificates are supported such as IEC, UL, CCC, ATEX, marine engineering

Whether machine builder or plant operating company – both profit to the same extent from our comprehensive training programs and the possibility to integrate the widest range of components in the world of Totally Integrated Automation.
Pumps: Activating efficiency ...

Pumps are used in many sectors – the chemical industry, pharmaceutical, oil and gas, food and beverage, textiles, paper, mining and water and wastewater. In all of these sectors, they transport and pump the widest range of liquid substances. Reliable, disturbance-free and efficient operation is always the decisive issue – both for regulated as well as non-regulated pumps. High-efficiency motors are the basis for achieving this. Motor management systems ensure the protection, control and acquisition of the energy usage. Especially in the partial load range, frequency converters significantly reduce the energy consumption. Soft starters reduce inrush currents and pressure fluctuations and, in turn, reduce the mechanical stress placed on valves and throttles in piping systems.

How you profit from our products

- Flexible process control through fast and precise adaptation of the flow rate
- Operation that minimizes equipment load levels: Minimizing pressure surges, low cavitation levels
- Extensive range of functions for various tasks such as dry-running protection, cascading
- Low-maintenance requirements of the components used
- High system availability and long lifetime
- Energy-saving potential through high-efficiency motors and speed control
- Complete product range for hazardous zones
- Reliable torque transmission
- Safety-relevant shutdown of pumps according to SIL 2/3 possible

Centrifugal pumps
Centrifugal pumps are positive displacement machines that increase the energy level using an impeller.
- Rotating accelerators
- Submersible motor pumps
- Side-channel pumps
- Non-clogging pumps
- Centrifugal pumps (single- or multi-stage)

Reciprocating pumps
Reciprocating pumps are used to pump liquids and gases.
- Dosing pumps
- Radial piston pumps
- Axial piston pumps

Rotary pumps
Rotary positive-displacement pumps are mainly used to transport plastic masses and dispersions.
- Excentric worm pumps
- Gear pumps
- Screw pumps
- Impeller blade cells
... using pressure boosting stations as an example

In piping systems that comprise several pumps and possibly a higher-level control system, the pressure boosting station ensures that a constant pressure is reliably maintained, even when usage levels fluctuate. Our products – which are perfectly coordinated with one another – provide the necessary drive in pressure boosting stations. In addition to powerful motors, couplings, motor management systems, motor starters and frequency converters, we can also offer you our compact SIMATIC S7-200 Micro PLC. This PLC allows you to implement customized automation solutions that can be quickly and simply modified and expanded.

Special features of our products for a pressure boosting station

**Motors**
Energy-saving potential through:
- Energy-efficient motors for IEC and NEMA standards
- Variable-speed control using frequency converters to continually control the flow rate
- Cascading pumps using soft starters (for the base load) and frequency converters for the highest degree of efficiency and availability

**Couplings**
- Versions with expansion sleeves allow pumps to be serviced on site
- Damping capability and appropriate torsional spring stiffness minimize component stress levels
- Optional: “Fail-safe-Design” or “without fail-safe device”
- Low operating costs through long service intervals

**Frequency converters, soft starters / motor starters, monitoring relays and motor management systems**
- Minimize pressure surges in piping systems through soft starting and stopping
- Low cavitation
- Dry-running protection function and monitoring filter clogging are integrated in our frequency converters and motor management systems, therefore eliminating additional sensors
- Power failure monitoring
- Automatic restart after a power failure
- Direction of rotation monitoring and correction
- Suppression of critical speeds
- Level/leakage monitoring
- Thermistor motor protection to protect motors against overheating
- Cascading of pump units
- Energy-saving mode in controlled operation

**Communication**
- Simple connection of frequency converters and motor starters to the supervisory control system via integrated communication interfaces such as PROFINET, PROFlenergy, PROFIBUS, AS-Interface or USS/RS485 interface

**Control**
- PID controller for closed-loop pressure control in the SIMATIC S7 controller
- Limit value monitor for shutdown thresholds in the control

Pressure boosting station (booster)
Fans are used in the widest range of industrial sectors – in building systems, water and wastewater, chemical, paper and mining. Fans move atmospheric air as positive displacement machines. High energy efficiency and quiet operation are important parameters. The power demand of a fan increases by the square of the speed which means that they have special characteristics that must be taken into account.

How you profit from our products

• Flexible process control by quickly and precisely adapting the flow rate
• Operation with reduced equipment stress: Minimizing pressure surges
• Extensive functionality/range for various tasks – also specifically tailored for fan applications
• Low-maintenance requirements of the components used
• High plant availability (Example: belt monitoring) and long lifetime
• Energy-saving potential through our high-efficiency motors and closed-loop speed control
• Reliable torque transmission by specifically harmonizing the components used to avoid inadmissibly high torque loads that are caused by power-on/changeover operations in the drive transmission train

Radial fans
The air is drawn-in in parallel to the drive axis, deflected through 90° by the rotation of the rotor and then radially discharged.

Axial fan
The rotor axis is in parallel to the air flow.
... for air handling systems

Air handling systems are responsible for distributing and regulating the air in buildings and industrial plants. They include the fans for the air intake and discharge, heating and cooling equipment, heat exchangers, filters as well as air dehumidifiers and air humidifiers. Specifically designed for use with fans and blowers, our optimally harmonized products secure a perfect room climate. High-performance motor management systems, motor starters and frequency converters interact perfectly with the controls, switchgear, flow measuring systems and sensors.

Special features of our products for an air handling system

Motors
Energy-saving potential through:
• Energy-efficient motors for IEC and NEMA standards
• Variable-speed control using AC drives to continually control the flow rate

Couplings
• A rugged design guarantees disturbance-free operation
• Damping capability and appropriate torsional spring stiffness minimize component stress levels
• Best balance quality for vibration-free operation

Frequency converters, soft starters / motor starters, monitoring relays and motor management systems
• Automatic restart after a power failure
• Flying restart to connect to the spinning motor
• Suppression of critical speeds
• Drive belt monitoring
• Closed-loop pressure and temperature control
• Load monitoring
• Recording operational measured values
• Power failure monitoring
• Direction of rotation and speed monitoring
• Detecting no-load operation, monitoring air filter clogging

Control
• Simple connection of frequency converters and motor starters to the supervisory control system via integrated communication interfaces such as PROFINET, PROFIenergy, PROFIBUS, AS-interface or USS/RS485 interface
• Storage of various profiles, e.g. for day/night control of actuators

Operator control and visualization
• Display of measured values and system states
Compressors: Increasing productivity ...

Compressors are used in a wide variety of applications – climate control and refrigeration systems, chemical and pharmaceutical industries, oil and gas, water and wastewater, general machinery constructions, food and beverage industry, mining and paper. Their task is to pump and compress gases to almost any pressure level. In addition to fulfilling general requirements regarding the efficiency – availability and a high power density are also decisive factors. This is where our compact motors with increased power come in – to drive all types of compressors. They comply with international efficiency specifications.

How you profit from our products

• Flexible process control through fast and precise adaptation of the flow rate or the pressure
• Operation that minimizes equipment stress levels: Ultrasonic compression surges are minimized
• Flexible implementation for each and every application: We offer the full range – from standard products up to customized solutions
• Low-maintenance requirements of the components used
• High plant availability and long lifetime
• Energy-saving potential through high-efficiency motors and speed control
• Complete product range for hazardous zones
• Reliable torque transmission

Refrigeration compressors
Refrigeration compressors are used to compress the cooling medium in refrigeration systems to maintain rooms at certain temperatures and for refrigerated display cabinets and chilled distribution depots.
• Scroll compressor
• Reciprocating compressor
• Screw compressor

Air compressors
Air compressors are used for ventilation systems, pneumatic controls and to transport solids, liquids and gases, industrial production facilities, bottle blowing, air for breathing and medical applications.
• Roots blower
• Side-channel blower
• Scroll compressor
• Rotary compressor
• Reciprocating compressor
• Screw compressor

Gas compressors
Gas compressors are used in the basic materials and process industries – e.g. for air separation plants, blast furnace blowers and ammonia plants. Furthermore, they are also required for gas liquefaction and when pumping gas.
• Reciprocating compressor
• Radial compressor
• Axial compressor
... using chillers as an example

Chillers – comprising a compressor, condenser, relief valve and heat exchanger – are refrigeration machines that are used to control the climate of buildings. Here, they produce the cold water for air conditioning systems. Our perfectly harmonized products ensure the necessary low temperatures when operating chillers. Powerful motors, couplings, soft starters, motor management system and frequency converters interact perfectly with the controls, switchgear, flow measuring systems and sensors.

Special features of our products for a chiller

Motors
Energy-saving potential through:
• Energy-efficient motors for IEC and NEMA standards
• Variable-speed operation using AC drives that can be used to continuously control the pressure
• Customized hermetic or semi-hermetic motors
• Reduced starting current at increased starting torque using special winding designs

Couplings
• Damping capability and appropriate torsional spring stiffness minimize component stress levels
• Fail-safe couplings can be optionally supplied
• Best balance quality for vibration-free operation even at high speeds
• Maintenance-free series

Frequency converters, soft starters / motor starters, monitoring relays, motor management systems
• Setting the optimum operating point
• High overload capability
• Optimum speed adaptation for load peaks
• Filter monitoring
• Soft starting to reduce machinery stress levels
• Reduction of the inrush current when starting the compressor
• Power failure monitoring
• Direction of rotation and speed monitoring

Communication
• Simple connection of frequency converters and motor starters to the supervisory control system via integrated communication interfaces such as PROFINET, PROFenergy, PROFIBUS, AS-Interface or USS/RS485 interface

Control
• Precise pressure monitoring using control and sensor systems
• PID controller for closed-loop pressure control in the SIMATIC S7 controller
• Limit value monitor for shutdown thresholds in the control
Energy-efficient drive concepts for pumps, fans and compressors

Siemens can offer you the right lever when it comes to reducing costs and increasing the efficiency of your pump, fan and compressor applications: We can provide you with energy-saving motors with a high efficiency that save you valuable kilowatt hours. Soft starters help to reduce current peaks, and frequency converters save energy by adapting the system to the optimum operating point. Depending on the particular application, each concept can offer its own specific advantages.

No two applications are the same. This is why various approaches make sense in order to achieve maximum energy efficiency, cost-effectiveness and the best possible operational management. The optimum drive solution depends on the individual pumping profile and the control precision required. Siemens can provide you with the solution that offers the maximum energy efficiency for the specific pumping profile of your particular plant.

Electric motors, frequency converters and motor starters represent effective levers for achieving a higher energy efficiency for pump, fan and compressor drive systems. Energy-saving motors with premium efficiency are especially advantageous for the continuous operation of equipment, as the efficiency reduces the energy consumption over the complete operating time. Additional cost savings can be achieved by dimensioning the drive system in line with the actual requirements. This applies both for new plants and systems as well as the optimization and modernization of existing ones.

An overview of the usual drive concepts used:

- **Throttle control:**
  - Continuous operation as circuit-breaker/contactor combination
  - Closed-loop control using an electromechanical throttle valve
  - Motor continuously runs at its rated speed
  - Simplest and most favorably priced version regarding capital investment costs
  - Makes economic sense for flow quantities close to the maximum with low requirements on the control quality

- **2-level control with soft starter:**
  - Advantageous for fluctuating amounts removed, e.g. for tank level control
  - Avoids frequent switching operations through long switch-on and switch-off phases (the off phases are the most favorable state from an energy-related perspective)
  - Avoids hard surges and reduces the stress on the mechanical components
  - Very low energy consumption with optimum efficiency
  - Very low installation, procurement, maintenance and operating costs
• **Soft starter/frequency converter cascade:**
  – Multi-motor drive, optimized for the base load
  – Suitable for strongly fluctuating flow rates
  – Drive solution comprising soft starter-frequency converter combination; the frequency converter is used to make the fine adjustment
  – Up to 60% energy saving when compared to a throttle control
  – Optimally uses the advantages of the soft starter and the frequency converter

• **Pure frequency converter-based control:**
  – Applications where flow rates intensively fluctuate, and where it is also necessary to provide precise process control
  – Lower usage by adapting to the optimum operating point
  – Up to 70% energy saving when compared to a throttle control
  – Suitable for processes with high control accuracy and speed

Depending on the particular application, the 2-level control, cascade or closed-speed control promise enormous energy-saving potential when compared to mechanical throttles. The energy consumption of drives for fluid-flow machines can, in an extreme case, be slashed by up to 70%. Not only do you profit from this, but also our environment: This is because a drive system optimized from the energy perspective also plays a role in sustainably reducing CO₂ emissions.
Intrinsically safe, distributed I/O
The intrinsically safe version of the SIMATIC ET 200iSP distributed I/O can be used in hazardous zones with gas or dust atmospheres. ET 200iSP can be installed in Zones 1/21 and 2/22, and the connected sensors and actuators can even be installed up to Zone 0/20 – which means directly in the highly explosive medium. PROFIBUS is used for communications between the field devices and the process control and automation system. Conventional distribution boards, sub-distribution boards and Ex-barriers are simply no longer required for the individual signals.

Switchgear, sensors and motor management
For hazardous zones, we can also offer explosion-protected SIRIUS circuit-breakers, SIRIUS overload relays with ATEX certification, SIRIUS soft starters for soft starting and stopping as well as the SIMOCODE pro motor management system for explosion-protected motors installed in Zones 1 and 2.

Explosion-protected drive technology
As market leader in the area of motors, we can offer you a complete range of explosion-protected motors as well as the corresponding drives: from 90 W up to over 100 MW, either in a standard or customized version. All motors are available in the appropriate type of protection for gas and dust:

- Dust explosion protection in Zones 21 and 22
- Ex n for gas explosion protection in Zone 2
- Ex e, Ex d and Ex p for gas explosion protection in Zone 1

For special requirements, e.g. for pumps installed on liquid-gas tankers, we also supply motors in double explosion protection. In this case, double protection in Ex e and Ex d is the safest solution. We provide a combination of gas and dust explosion protection for other hazardous zones. Our explosion-protected motors are also available as high-efficiency versions, with efficiency class IE2 across the board from 0.75 to 375 kW. For the mechanical drive train installed in these types of hazardous zones, we can offer you gear units and couplings as well as MOTOX geared motors in an ATEX 95 version and in conformance with Directive 94/9/EC.

Maximum safety in explosive atmospheres
We also have a seamless portfolio when it comes to pump, fan and compressor applications in hazardous zones. We can address Zones 2 and 1 for gas atmospheres as well as Zones 22 and 21 for dust atmospheres. Some examples are provided in the following.
Comprehensive – our portfolio at a glance

Motors
Our range of SIMOTICS motors for pumps, fans and compressors extends from standard motors up to sector-specific and customized solutions. Our motors cover voltages from 230 V up to 13.2 kV and power ratings from 0.09 kW up to 100 MW and higher. Our standard motors are available in efficiency classes IE2 and IE3 according to IEC 60034-30, which allows considerable amounts of energy to be saved and also reduces the stress on plants and systems. They are available up to 690 V for line supply and drive operation. The pump motors with fixed bearing on the drive side and integrated PTC thermistors guarantee maximum availability. Depending on the type being used, compressor motor service factors of up to 1.25 are possible. Standard fan concepts can be created – thanks to the standard, noise-optimized and force-ventilated motors from 0.09 to 200 kW. The bearing design sets itself apart as a result of the outstanding low vibration characteristics, a long service life and low maintenance costs. An additional cooling circuit inside the transmission ensures a uniform temperature distribution. This reduces the thermal load and increases the operational reliability. Examples of sector-specific and customized motors include high-temperature and low-temperature motors, motors specifically designed for use in chemically corrosive environments and high-speed motors that even reach speeds of up to 15,000 rpm well into the Megawatt range. Our range of motors is also seamless when it comes to explosion protection: We cover all of the usual types of protection – Ex n, Ex e, Ex d, Ex p and dust explosion protection. Our portfolio also includes double-protection: Gas/dust or Ex e and Ex d. Our explosion-protected motors are also available as high-efficiency versions, with efficiency class IE2 across the board from 0.75 to 375 kW. Our motors are certified worldwide, e.g. in compliance with CSA, UL, etc.

Geared motors
Our wide portfolio of reliable MOTOX geared motors is the ideal solution wherever low speeds and high torques are required. The high efficiencies of the gearboxes as well as the use of energy-saving motors with IE2 efficiency ensure effective operation of the plant or system. Their modular design as well as various types of construction and mounting versions facilitate extremely flexible installation. These geared motors can be optimally combined with SINAMICS converters as well as SIRIUS motor starters. We can offer you extensive application know-how to simplify your engineering and installation.

Couplings
Couplings from Siemens set quality standards. Our engineers select the optimum solution for your particular application, whether as standard coupling from a wide range of modular components, or a special coupling adapted to your particular application. In the torque range from 15 up to 1,500,000 Nm, our standard range of couplings fulfills ATEX95 and API 610/671 specifications as well as the requirements of various marine classification societies such as DNV or GL. References from around the world clearly verify our competence as a global partner. Our service and supply network means that we are always close to our customers to provide them with professional support and top class service anywhere in the world.
Frequency converters
Siemens has the optimum frequency converters for drive concepts that are fit for the future and which address every requirement in building technology, the water industry and process industry. SINAMICS G110 is used in basic applications in the lower power range. SINAMICS G120P was especially developed in the power range up to 90 kW to address the industrial environment as well as for HVAC applications. The SINAMICS G120 is the perfect solution for fan systems up into the average power range; it is also available in a version capable of energy recovery. SINAMICS G130 chassis units and SINAMICS G150 cabinet units have been specifically designed for single-motor, high-rating drives that do not require any energy recovery – for example, pump, fan and compressor drives. In the medium voltage range, for power ratings up to 120 MW, we have our SINAMICS GM150, SINAMICS GL150 and ROBICON Perfect Harmony drive systems. With our ROBICON Perfect Harmony, we also offer a transformer, power unit and closed-loop control, all accommodated in just one compact unit. Its innovative concept ensures the highest availability values. DYNAVERT T frequency converters are optimally suited to address sector-specific applications, especially in the chemical industry and power utility sector. All SINAMICS drives are simply commissioned using standard tools.

Motor starters
Our communication-capable SIRIUS motor starters are the optimum choice when it comes to switching, protecting and starting motors. Direct, reversing and soft starters cover the complete range – from a high number of switching operations for pump applications without pressure accumulator up to softly starting large fans. Whether centrally installed in the control cabinet or directly in the field – our motor starters have optional integrated intelligent monitoring functions that include preventive maintenance as well as Safety Integrated functionality. From basic SIRIUS contactor combinations (star-delta starting) through SIRIUS pre-wired, fuseless load feeders (direct starters) and compact 3RA6 starters up to motor starters for the SIMATIC ET 200S and ET 200pro distributed I/O systems as well as the M200D single-motor starters in a high degree of protection – and all of our motor starters are especially compact and can be quickly installed. Whether via AS-Interface, IO-Link, PROFIBUS or PROFINET, with PROFIenergy, our motor starters can be simply integrated into the automation environment. Our motor starters always provide you with a solution that is optimally tailored to your particular application.

Soft starters
Low-voltage soft starters are used whenever a particular motor-driven machine requires soft starting and/or stopping – for instance when the motor cannot start with its full power. Our SIRIUS 3RW soft starters with a power range of up to 200 kW are the ideal solution, for example, to avoid belt slip on fans or to avoid pressure surges (water hammer) in pumping systems. Further, they prevent undesirable side effects such as high mechanical loads in the machine and voltage dips in the line supply. 3RW44 soft starters can be controlled via PROFIBUS DP, and extensive diagnostic and measured values can be read out.
Motor management system

SIMOCODE pro is the flexible, modular motor management system for low-voltage constant-speed motors. It is the preferred solution to protect and control pumps, fans and compressors. It can be simply and directly connected to higher-level automation systems via the PROFIBUS DP interface. From a functional perspective, it addresses all of your needs between the motor feeder and automation system. In just one compact system, it combines all of the necessary protection, monitoring and control functions for every motor feeder. The range of functions extends from simple current, voltage and power recording, detection of the direction of rotation and belt slip or breakage. Other functions include monitoring pumps for dry-running operation, filter clogging, flow rates and filling levels. Further, the system can be flexibly expanded by digital ground fault detection and temperature modules.

By combining SIMOCODE pro with a fail-safe digital module, you profit from well-proven motor management functions and integrated safety technology in one system. The requirements laid down in standards IEC 61508/62061 and ISO 13849-1 for functional safety up to SIL 3 and/or PL e are fulfilled for this purpose.

Relays

SIRIUS relays have everything for your motor feeder. Whether compact time relays or reliable monitoring relays, especially low-profile coupling relays, plug-in relays, low-noise power relays or interface converters. With their display, freely selectable limit values and a whole raft of parameterization options, our relays ensure optimum line supply, load and application-related setpoint monitoring and higher plant availability. The user-friendly range of relays offers a multitude of diagnostic and monitoring functions – and can be used for a vast range of applications: For instance, SIRIUS 3UG4 monitoring relays to automatically correct the direction of rotation by making a distinction between supply faults and incorrect phase sequence. Applications include monitoring the line supply of permanently installed and transportable equipment, such as HVAC compressors, refrigerated containers, cranes or compressors on construction sites. Using active current monitoring, they can also be used to monitor loads connected to the motor – for instance, to detect when a pump is running under no-load conditions or is blocked.

Temperature monitoring relays reliably check ambient and process temperatures, e.g. to monitor the temperature in electrical cabinets or coolant temperatures. Thermistor motor protection devices protect motors against overheating, e.g. also due to restricted cooling as a result of broken fans or clogged filters.

A large percentage of the monitoring relays are also available for IO-Link: In addition to the autonomous monitoring functions, data and measured values can also be transferred to the control system. Parameterization can now also be carried out from a local and central location. As a result of the data alignment and automatic reparameterization, it is extremely easy to replace a device when this becomes necessary.
Power distribution
With our SIVACON 8PS switchgear and busbar distribution systems, SENTRON circuit-breakers and load disconnectors, SENTRON multi-function measuring devices as well as a power management system, we offer you everything for an efficient and integrated power distribution. All of this is based on Totally Integrated Power. Our communication-capable circuit-breakers, power management software packages and the state-of-the-art SIMOCODE pro motor management system are integrated in Totally Integrated Automation – our seamless and integrated basis to implement customized automation solutions.

Controls, I/O, software
SIMATIC controllers are synonymous with the highest degree of flexibility and scalability – with standard or fault-tolerant controllers, compact devices, distributed or PC-based automation solutions. SIMATIC technology is available in different mechanical designs to cost-effectively address your technological tasks such as counting, metering, cam control, closed-loop control and motion control: From loadable software blocks through technology controllers up to control systems. In order to guarantee the safety of man and machine, the fail-safe SIMATIC Safety Integrated system is embedded in the standard automation. With SIMATIC software, we can offer you a universal configuring and programming environment for SIMATIC controllers, including operator control and visualization systems. SIMATIC fully supports your engineering workflow with the STEP 7 basis package and a host of engineering tools. The modular SIMATIC ET 200 range of I/O devices permits distributed solutions to be configured – e.g. also for pumps, fans and compressors: Compact or modular, with digital I/O interfaces or complete distributed systems with drive technology – either accommodated in control cabinets or directly installed in harsh industrial environments.
Communication
Within the scope of Totally Integrated Automation, connections can be very simply configured – also across different networks and all systems. In order to transition from PROFINET to PROFINET, or vice versa, only the communications processor has to be replaced. The user program does not have to be changed and there are no additional engineering costs. For open and integrated industrial communications, SIMATIC NET offers solutions for each and every need:

• PROFINET – the recognized standard for the field area
• PROFINET – the international Ethernet standard for real-time communications down to the field level
• PROFenergy, a profile on PROFINET for standard commands to specifically shut down loads in non-operational times to save energy

Operator control and visualization
SIMATIC HMI offers a finely graduated range of products. These extend from HMI devices and visualization software for machine-level operator control and monitoring up to scalable SCADA systems to address a vast range of requirements in process visualization.

Measuring transmitters
SITRANS P, series Z are compact single-range measuring transducers to measure both absolute and relative pressure. SITRANS P ZD is a configurable pressure transducer with a display that is available with either radial or axial connection to the process. Both series are suitable for measuring pressure and absolute pressure of gases, liquids and steam. They distinguish themselves as a result of the high long-term stability, minimal characteristic deviation, wide measurement ranges – with stainless steel or ceramic membrane – as well as their rugged stainless steel connections and casings. On the temperature side, SITRANS T addresses the complete range of temperature transducers and sensors.
The overall approach: Totally Integrated Automation

With Totally Integrated Automation, Siemens is the only manufacturer that offers a seamless portfolio of products, systems and solutions that are perfectly coordinated with one another. These are used to create seamless and integrated automation solutions for pump, fan and compressor applications. All of the sub-steps as well as the information flow across all production levels – from the field level up to the company supervisory level – can be fully integrated. This means more productive engineering, efficiency and a higher degree of profitability across all processes. As a result of the consequential integration and unification, Totally Integrated Automation also plays a significant role in minimizing costs over the complete life cycle – and reduces the complexity of industrial plants and systems.
Being used successfully: Some application examples

Efficient pump drives for an irrigation project in the south of Portugal

The challenge
The Alentejo region in the south of Portugal is known for its severe summer drought conditions. Profitable agriculture is only possible here thanks to extensive irrigation provided by Empresa de Desenvolvimento e Infra-Estruturas do Alqueva (EDIA), who place a lot of emphasis on sustainability – especially when it comes to pump drives. The most important requirement: The drives must be in a position to continually adapt the flow rate to the prevailing water demand, which fluctuates depending on the temperature, humidity of the soil and the growth phase of the plants – without wasting any energy.

Solution
Siemens equipped the pumping stations with variable-speed drive systems. Example: Brinches Laje bei Serpa is a pumping station designed for a flow rate of 3 m³/s to irrigate 12,000 hectares. A total of 10 low-voltage motors were installed, whose speed is controlled by SINAMICS G150 frequency converters. The drives were linked with the SIMATIC S7 automation devices, local and remote monitoring systems, the instrumentation as well as low-voltage switchgear via industry communication systems.

Advantages
• Energy consumption was slashed by a double-digit percentage as a result of the high motor efficiencies and variable-speed operation
• Valuable resources are carefully used through precise, flexible process control
• High system availability thanks to the reliable components that are perfectly coordinated with one another
• Complete solution that perfectly addresses customer and project-specific requirements of the irrigation projects

Variable-speed flow control in the Adelsdorf water treatment plant

The challenge
The pumping system comprised a large worm screw running at a fixed speed and a small worm screw running at two speeds. As a result of the amount of wastewater being processed, the smaller worm screw was mainly in use. The mechanical return stop in the gear units used meant that the speed of the worm screws was not able to be adapted. The objective was to be able to continually control the flow rate and to have the two screw conveyors redundant.

Solution
The motors were redimensioned and motors with a smaller power rating are now operated from the frequency converters. In addition, they were equipped with holding brakes in order to prevent the worm conveyors from turning backwards. 1LE1 energy-saving motors and SINAMICS G120 frequency converters were used and an IOP (Intelligent Operator Panel) was used for the operating control. The simple connection to the existing SIMATIC control system, flexibility when assigning parameters as well as the possibility of transferring a wide range of process data to the control system all spoke in favor of the SINAMICS series.

Advantages
• Use of frequency converters: Improved process quality through the more precise closed-loop flow rate control of the worm conveyors
• Both worm screws can be redundantly used
• Energy-saving using high-efficiency motors and speed control
• The efficiency of the overall system was increased by a minimum of 30 %
• The use of the IOP operator panel reduces the number of components
• Personnel can also view the IOP values locally – or they can be called up in the process control system
Variable-speed pump drives for the state water utility of Baden-Wuerttemberg

**The challenge**
The state water utility of Baden-Wuerttemberg (LW) is one of the largest long-distance water supply utilities in Germany. More than three million people are supplied with drinking water through a long-distance network of pipes extending over 770 km. The ground water capture locations must be flexibly operated to maintain the high quality of the drinking water supply. This means that every water capture location must be able to precisely supply the water quantity that is required for the correct mixing ratio and therefore the optimum drinking water quality.

**Solution**
In order to be able to flexibly and efficiently manage its ground water capture locations, the water utility company uses variable-speed pump drives. Reliable SINAMICS G150 frequency converters that are simple to handle control the pump speed. These frequency converters are integrated into the central supervisory control via the existing SIMATIC control systems.

**Advantages**
- More precise closed-loop flow control and shorter response times compared to mechanical control concepts
- Significantly less energy is required
- Operation that reduces stress on the mechanical equipment – operator-friendly concept with a clear, transparent structure
- More space in the control room through a more compact design
- The pump system is controlled from the central control room, which has been seamlessly integrated into the existing automation environment

Sophisticated filter for the Mongstad refinery

**The challenge**
Liquid propane gas is stored in the Mongstad refinery located on the west coast of Norway. From there it is pumped into tanker ships. The variable-speed pumps operate completely immersed in the propane gas – which places high demands on the frequency converters being used. Not only do they have to be extremely reliable, but they also have to be perfectly harmonized with the special motors integrated in the pump – and they must provide an especially clean sinusoidal output voltage.

**Solution**
The frequency converter cabinet was equipped with an IHV (Integrated High Voltage) filter to ensure disturbance-free operation of the 6 kV special motors submerged in the propane gas caverns. These filters generate an almost sinusoidal 6 kV output voltage – without current and voltage spikes – from the pulsed 2.3 kV output voltage of the voltage source DC link converter.

**Advantages**
- High availability through safe and reliable operation of the special submersed motor
- Compact design as a step-up transformer and maintenance-intensive mechanical reactors are eliminated
- Pressure surges are avoided and energy is saved as a result of the variable-speed operations
Some more successful case studies: Solutions for fans

Drying and waste fiber fans for the fiberboard plant belonging to Fiberboard GmbH in Baruth

The challenge
For the newly constructed fiberboard plant belonging to Fiberboard GmbH in Baruth, Germany, a standard drive solution for the whole plant was required for the fans used in the drying process as well as the waste fiber fans. This solution should have low energy requirements, ensure high plant availability and facilitate optimum process control.

Solution
The fans associated with the pre- and post-drying were equipped with Siemens low-voltage motors from 560 up to 2400 kW; their speed is controlled using SINAMICS frequency converters. Also the waste fiber fans, which must quickly remove any waste fiber material, are also equipped with Siemens low-voltage motors and SINAMICS converters. This system reaches its rated speed in just 9 seconds.

Advantages
- Improved interaction and lower costs for the operating company through a plant-wide drive solution from a single source
- Low-energy demand for the complete drying process using variable-speed fan operation
- Short response time of the waste fiber fans prevents material backup
- Reliable drive technology that is simple to operate

Fresh air blower and induction blower for a biomass heating station in Ilmenau

The challenge
A biomass heating station generates environmentally-friendly power and heat from old wood for Ilmenau – located near the Thuringian Forest, Germany. For the combustion process in the biomass boiler, fresh air must be fed in using fans and the smoke that is generated during the combustion process must be drawn out using induction blowers.

Solution
In order to be able to precisely control the combustion process with short response times, but at the same time keeping operating costs low, the fresh air fan and the induction blower are equipped with variable-speed drive systems.

MICROMASTER 440 frequency converters control the speed of the fresh air fans that have smaller power ratings, while SINAMICS G150 frequency converters are used for the induction blowers. The drive systems are integrated into the higher-level automation system via SIMATIC S7-400. The SIMATIC WinCC visualization system ensures the necessary level of transparency of the complete system.

Advantages
- More precise control of the air feed and discharge when compared to mechanical control concepts
- Significantly less energy is required
- Operation with low stress on the plant – simple commissioning and handling
- More space in the control room through a more compact design
- Optimum process visualization and operator control functionality via the central control room as the new system is seamlessly integrated into the existing automation environment
Solutions for compressors

Downhole drilling with compressed air at the St. Gotthard

The challenge
The new trans-Alpine railway tunnel (NEAT) – better known as the Gotthard tunnel – represents one of the most ambitious traffic projects in Switzerland. Miners using compressed air are working hundreds of meters below the Alps at the Sedrun construction site – from a geological perspective, a real challenge. In order to effectively support the tunnel construction, downhole drilling is used.

Solution
Kaeser screw compressors and a 3000-liter compressed-air tank installed on the carriages of the tunnel railway have been installed for downhole drilling.

Siemens motors are the core of the main compressor drive. The SIGMA Control and all of the switchgear and communication components also come from the comprehensive Siemens portfolio.

Advantages
• Especially effective drilling through a geologically challenging zone
• Completely reliable in a working environment that tends to be dirty and dusty
• Particles in the air that are drawn in can be better processed as a result of the slow-running operation and the generously dimensioned reservoir of cooling and lubricating liquid when compared to fast running systems
• No transmission losses due to the maintenance-free 1:1 direct drive
• Optimum compressor technology – based on products and systems that are perfectly harmonized and coordinated with one another

High-speed 22 MW compressor drives for the West-East Pipeline in China

The challenge
In the densely populated Yangtze Delta, including the huge city of Shanghai, the quickly growing energy demand was to be addressed. And to reduce the CO₂ emissions, coal was to be replaced as the main source of energy. A decisive step in achieving this: Increasing the capacity of the West-East Pipeline from 12 to 17 billion cubic meters of natural gas per year. This pipeline is over 4000 km long and connects the natural gas reserves in Xinjiang (the most western province of China) with the main areas of population. This was to be achieved with new powerful compressor stations, which were to set themselves apart through maximum reliability and efficiency with minimum maintenance costs.

Solution
The three stations – Yumen, Pu Xian, Zhengzhou – are equipped with a total of five identical 2-pole synchronous motors with pressurized enclosures Ex p for gas explosion protection, Zone 1. Each of these motors has a power rating of 22 MW and a rated speed of 4800 rpm. As a result of the highspeed, the compressor can be directly coupled to the motor without using a gearbox. Rugged, load-commutated SINAMICS GL150 medium-voltage converters employing thyristor technology control the motor speed; these converters have been specifically tailored to operate high-rating synchronous motors.

Advantages
• Especially low-maintenance and reliable drive solution
• High degree of efficiency
• More flexible process control through variable-speed operation
• Very quiet and emission-free compressor station
More information:

Motors:
www.siemens.com/motors
www.siemens.com/international-efficiency

Geared motors
www.siemens.com/gearedmotors

Couplings:
www.siemens.com/couplings

Converters:
www.siemens.com/sinamics

Motor starters:
www.siemens.com/sirius-motorstarter

Soft starters:
www.siemens.com/sirius-starting

Motor management system:
www.siemens.com/simocode

Relays:
www.siemens.com/senlaiys

Power management system:
www.siemens.com/powermanagementsystem

Low-voltage power distribution:
www.siemens.com/sivacon
www.siemens.com/sentron

Controllers, I/O, software:
www.siemens.com/simatic
www.siemens.com/micro-automation

Communication:
www.siemens.com/PROFIBUS
www.siemens.com/PROFINET

Operator control and visualization:
www.siemens.com/hmi

Sensor systems:
www.siemens.com/sitans

 Totally Integrated Automation:
www.siemens.com/tia

Energy-saving:
www.siemens.com/energysaving

Service & Support:
www.siemens.com/automation/service&support

The information provided in this brochure contains merely general descriptions or performance characteristics, which, in case of actual use, do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

Any product names mentioned may be trademarks or product designations of Siemens or their suppliers, whose use by third parties for their own purposes may infringe the rights of the trademark owners.