



SIEMENS

# Take control of every machine

**SIMOTION:** the powerful motion control system  
for all requirements.

[siemens.com/simotion](https://www.siemens.com/simotion)

# The SIMOTION motion control system can simply handle any discipline

State-of-the-art machines must continually fulfill even higher requirements. Optimum product quality, higher productivity with ever-increasing cycle rates and maximum availability with minimum life cycle costs are demanded. The consequence – electronic components are replacing mechanical ones. Not only this, a wider range of tasks has to be tackled, higher numbers of axes controlled and shorter innovation cycles must all be addressed along with keeping up with quickly changing market demands. Machine price?

Operating costs? It goes without saying that these must be kept as low as possible.

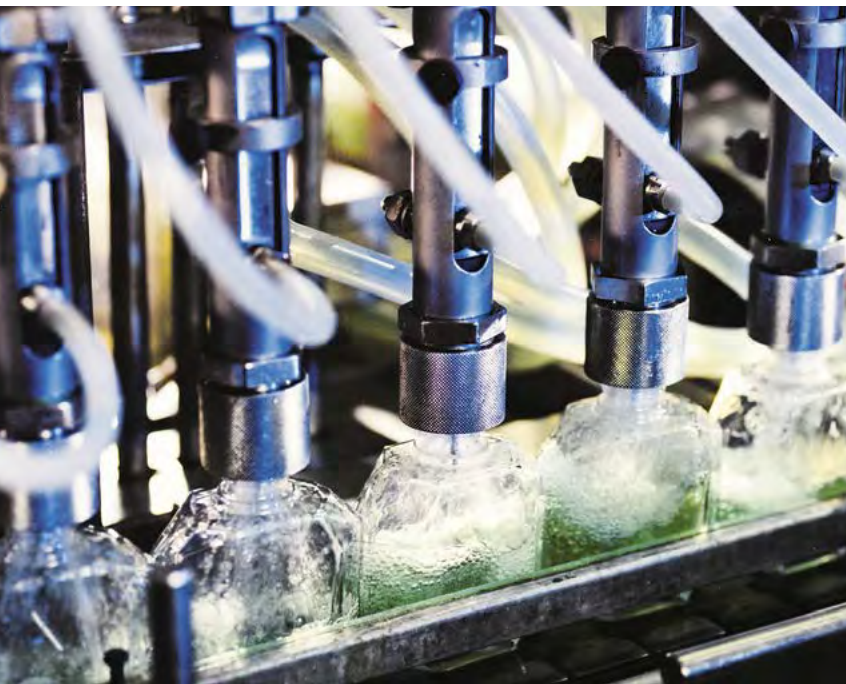
Our answer to this complex range of issues – no matter what requirements you place on your machine: SIMOTION. The scalable motion control system offers you the highest degree of flexibility. It allows central or distributed machine concepts to be realized as well as PC, controller and drive-based solutions.

No matter what your application is, with SIMOTION you can depend on user-friendly engineering and fast commissioning – a precise jump to increase your level of competitiveness.









#### **One system. From a single source.**

Using SIMOTION, you can automate even the most complex machines with the highest efficiency. The motion control system offers a whole raft of tools, which supports you over the complete life cycle of a machine. Already in the development phase, these simplify planning and provide valuable diagnostics functions for commissioning.

The overall concept has one objective: to achieve the highest degree of simplicity. This is because the more complex the requirements, the simpler it must be to handle the solution.

With SIMOTION, you can depend on significantly shorter development and engineering times. As a consequence, your machines are launched faster into the market. At the same time, you profit from high cycle rates as interfaces are reduced – with guaranteed optimum product quality.

#### **Every degree of freedom for higher flexibility**

The modular design of our leading-edge motion control system addresses the trend towards increasingly modular machine concepts: With just a few modules, many different machine versions can be implemented and scaled – assuming, of course, that every module has its own embedded intelligence. This is the reason why our SIMOTION software covers all functions, and with PROFINET and PROFIBUS, offers the optimum interfaces for communication between the various modules.

This means that you profit from our wide range of powerful and innovative standard automation and drive components based on a common platform. Further, when implementing your application, you can select between several platforms and programming languages. The advantage: high-performance machines with a higher degree of flexibility, shorter mechanical design and commissioning times with lower machine costs!





Thanks to the perfectly harmonized hardware and software modules, with SIMOTION you can rely on an almost unlimited degree of flexibility. When all is said and done, the system proves itself day in, day out in the widest range of sectors:

- Packaging industry
- Plastics industry
- Glass industry
- Wood processing
- Metal forming technology
- Textiles
- Printing
- Converting
- Lightweight construction
- Renewable energies
- General machinery construction

SIMOTION facilitates:

- High performance, flexible and innovative machine designs
- High cycle rates with a maximum product quality
- Lower costs over the complete life cycle
- Shorter time to market



# Three strategies for your success: hardware, software and engineering that are perfectly harmonized with one another

Motion control is becoming increasingly significant when designing machines that control complex, fast and precise motion. With SIMOTION, a new system philosophy was selected in order to keep the control of tasks as simple and flexible as possible: motion control has been merged with PLC and technology functions. This concept allows axes and machines to be controlled using just one system. Technology functions provide support – for instance, the closed-loop pressure control for hydraulic axes.

This completely eliminates interface problems between individual components, often critical from a time perspective. This reduces the programming and diagnostics time for the complete machine. With SIMOTION, you can enjoy the same level of user-friendliness as you would with a PLC system.

## Unified, integrated engineering with a complete system

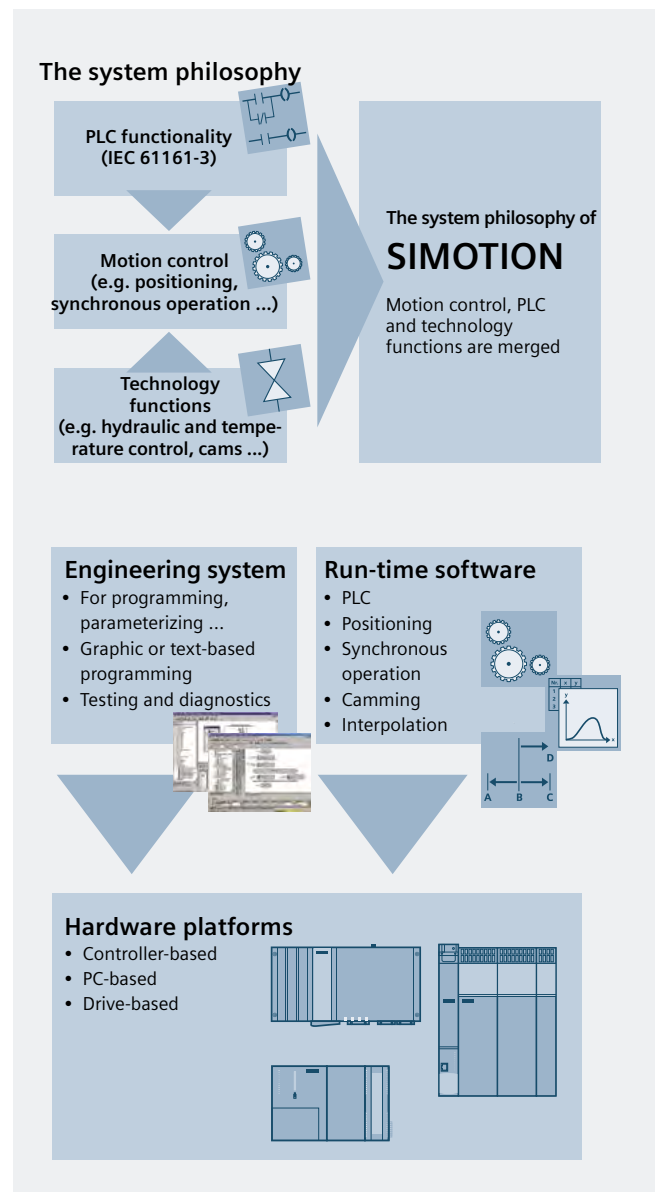
The SIMOTION system comprises three components: the engineering system, run-time software and hardware platforms. With SCOUT, SIMOTION not only offers an integrated, seamless engineering system, but it also provides all of the tools required for programming and parameterizing, testing and commissioning as well as diagnostics – all from a single source.

## Run-time software – simply program motion control

The run-time software has a modular structure, and comprises a PLC according to IEC 61131-3 and optional functions, such as positioning, synchronous operation, output cam and interpolation. These functions are available as additional commands. As a consequence, you can generate motion sequences just as simply and flexibly as a PLC program. Being able to be freely programmed – in conjunction with the excellent motion control functions – SIMOTION is the ideal automation platform for all production machines where motion has to be controlled.

## The optimum platform for every machine type

You can select from three hardware platforms in order that you also have every degree of freedom in the application. You decide which platform suits your machine the best. Once applications and software modules have been created with the engineering system, they can be used on all three platforms. The various platforms can also be combined with one another. Once generated, a program can run in the drive, in the PC and in the controller without incurring any additional costs.





# Three platforms – one goal: maximum flexibility



## The compact solution: SIMOTION D directly in the drive

A perfect symbiosis: SIMOTION D is directly integrated into SINAMICS S120 as a control module. This not only saves valuable space, but ensures that the system has an outstanding dynamic performance. SIMOTION D is available in two mechanical designs – as single-axis system

- SIMOTION D410-2 with multi-axis option (blocksize format), and as multi-axis system
- SIMOTION D4x5-2 in four performance versions for up to 128 axes (booksize format).

These options guarantee the highest degree of scalability and flexibility. These options guarantee the highest degree of scalability and flexibility. Motion control and technology functions as well as PLC and closed-loop drive control are integrated in a compact module. This means that this device not only controls the various motion sequences, but also the complete machine. Depending on the SIMOTION D version, SIMATIC HMI devices can be connected via PROFINET, PROFIBUS or ETHERNET for visualization and operation. Distributed I/O are connected via PROFINET or PROFIBUS.

### Optimally suited for:

- Compact machines
- Distributed automation concepts
- Modular machines
- High-speed axis couplings

### SIMOTION offers:

- Simple and fast engineering
- Application-orientated hardware platforms
- A flexible, scalable system and therefore the highest security for your investment



## The modular solution: SIMOTION C for the widest range of applications

With four onboard interfaces for analog or stepping drives as well as several digital inputs and outputs, SIMOTION C240 is an especially flexible controller in an S7-300 mechanical design. Further, a SIMOTION C240/C240 PN can be expanded using I/O modules from the SIMATIC S7-300 range. Two PROFIBUS ports with PROFIdrive and an Industrial Ethernet connection ensure perfect communications with other parts of the machine. With the distributed architecture, drives and I/O can be connected through PROFIBUS or PROFINET (C240 PN). Further, the bus systems can be used for communications with operator devices – for example, from the SIMATIC HMI range – or with higher-level controls such as SIMATIC S7. SIMATIC HMI panels as well as PCs with WinCC flexible or OPC interfaces can be used as operator systems.

### Optimally suited for:

- The highest degree of freedom when selecting drives
- A wide range of process signals
- Retrofit applications using integrated analog interfaces



## The open solution: SIMOTION P – PC-based motion control

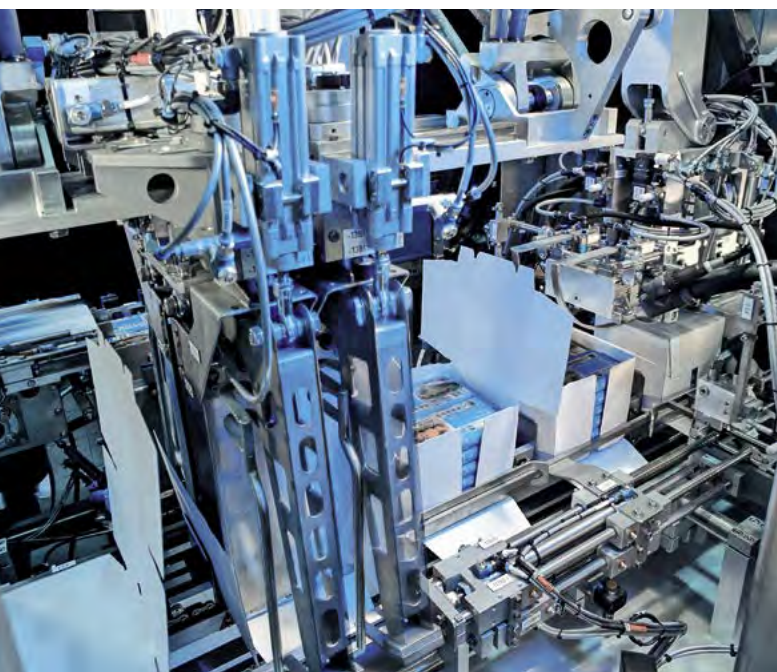
Comprehensive motion control functionality compactly integrated in an embedded industrial PC: SIMOTION P320-4 SIMOTION P320-4 is a powerful, ultra-compact and maintenance-free industrial PC that has clearly proven itself under harsh application conditions. SIMOTION P320-4 combines the ruggedness of a PLC with the comprehensive motion control functionality of SIMOTION. SIMOTION P320-4 is available in two powerful versions:

- SIMOTION P320-4 E (Embedded) processor: Intel i3 processor (3<sup>rd</sup> generation), operating system: Windows Embedded Standard 7
- SIMOTION P320-4 S (Standard) processor: Intel i7 processor, memory: solid-state disk (SSD), operating system: Windows 7 Ultimate

In addition to SIMOTION applications, other PC applications can be processed at the same time. Several industrial flat panel versions – with different screen sizes – can be operated from a keyboard, mouse or touchscreen. The drives are decentrally connected via PROFINET.

### Optimally suited for:

- Applications that require an open PC environment
- Applications with short controller cycles, for example, for hydraulic systems
- Ultra-compact applications that require that the control and visualization run on a single hardware platform
- Extensive data management, evaluation and logging

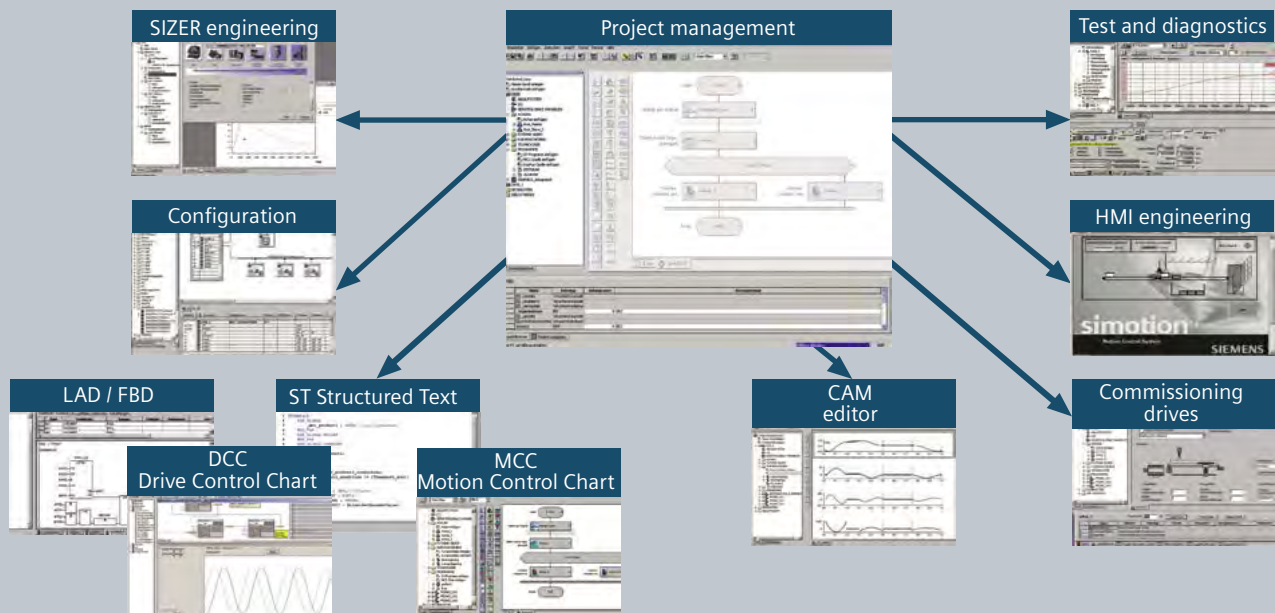


## One tool – all tasks: the SIMOTION SCOUT engineering system

With the SCOUT engineering system, we placed the highest significance on its user-friendliness so that you can fully utilize the performance of SIMOTION.

Just one system is used for engineering the motion control, PLC and technology functions as well as configuring the drives. Configuring, programming, testing and commissioning: Everything can be graphically handled from just one workbench. In conjunction with intelligent user navigation, a context-sensitive help and the automatic consistency check, SIMOTION significantly simplifies programming motion control solutions, especially for entry level personnel. Further, all of the tools belonging to SCOUT are integrated in the user interface to make engineering even more efficient. SCOUT can be used as standalone tool, or in conjunction with SIMATIC STEP 7.





### One system – one data management

All of the information belonging to a machine, such as configuration data, programs, motion profiles and drive data are saved in just one project. When a drive is commissioned, the necessary data can be simply called from the central project management.

### Components are perfectly selected – from the drive to the control

Using the simple to operate SIZER software configuration tool, not only can the drive devices and motors be selected and dimensioned, but also the supplementary components necessary for the particular drive solution defined – up to the appropriate cables. The software has been designed to address the solution-oriented perspective of the user, and using intelligent functions and resources, simplifies the complete engineering process to create a complete drive solution with the required specifications. SIZER navigates users step-by-step when engineering the drive solution. The status in the drive engineering workflow is graphically displayed. Every engineering step is performed using screen forms.

As all of the various drive tasks are to be addressed, basic load characteristics as well as complex load and travel curves can be entered into the system. Further, based on the functionality of CAD Creator, you can quickly access all motor-specific 2D/3D dimension data.

### Fast project generation

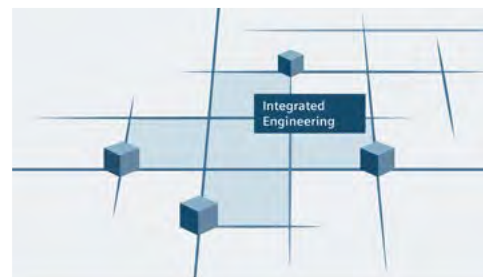
With the SIMOTION easyProject project generator, you can create a loadable and runnable engineering project especially simply and quickly. Predefined basic and modular machine functions can be integrated in new as well as

also in existing SCOUT projects. More detailed information is provided in the sector solutions section.

### SIMOTION SCOUT in the TIA Portal

With the integration of SIMOTION in the TIA Portal, engineering has become even simpler and more efficient through:

- The merger of hardware and network configuration in one, consistent editor
- Intuitive and fully graphic configurators
- User-friendly HMI connection
- Reuse of existing SIMOTION applications



Integrated Engineering  
Significant savings in time, money and effort

### SIMOTION SCOUT – the highlights:

- Simplest handling
- All of the engineering functions in one system
- All of the components are quickly configured
- Powerful commissioning and diagnostic functions

# Simply practical: Programming

SIMOTION provides you with every degree of freedom when it comes to programming. This is because the system can speak several “languages” at the same time. In addition to the ladder diagram (LAD), function block diagram (FBD) and the text-based high-level language ST (Structured Text according to IEC 61131), motion sequences can also be programmed using Motion Control Chart (MCC). Expanded control tasks can be easily implemented in a structured fashion using Drive Control Chart (DCC).



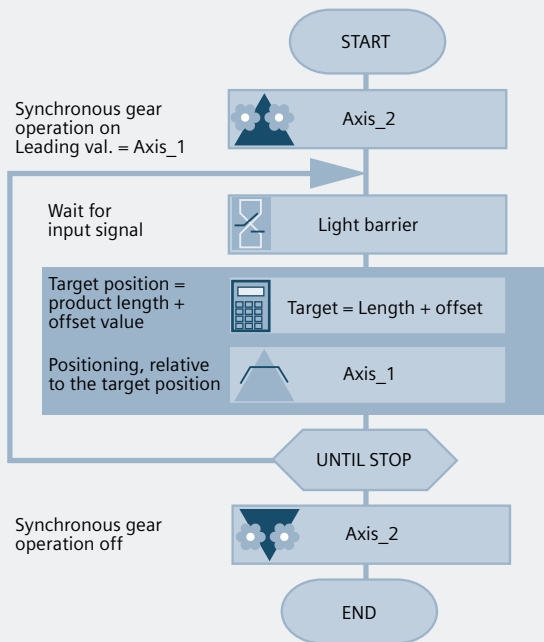
## Graphic programming – with MCC

The intuitive user prompting of MCC – Motion Control Chart – makes it easier to program even the most complex motion functions. The machine sequence is clearly and transparently shown using a flow diagram. In addition to motion control commands, there are also commands to access I/O, logic and arithmetic operations, sub-routine calls and even commands to control the program flow.

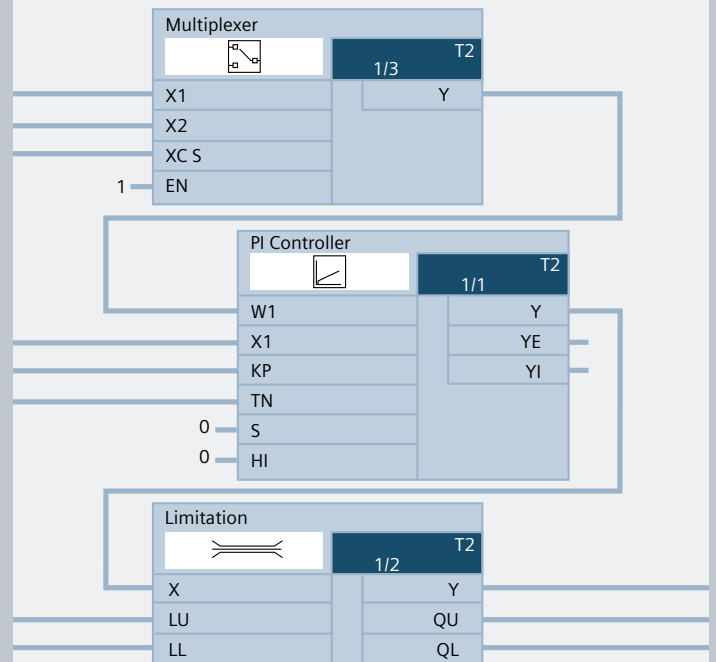
## Proven standards from the PLC environment: LAD and FBD

A high-performance editor is available both for programming in LAD as well as in FBD. In addition to standard logic functions, all of the motion control and technology functions can be used in LAD/FBD. Blocks programmed in other SIMOTION languages can be simply called. Further, when programming with LAD or FBD, users can profit from user-friendly functions such as declaring variables “on the fly” and the automatic syntax check. Further, programs can be toggled between LAD and FBD displays at any time.





Programming example with Motion Control Chart (MCC)



Configuration example of Drive Control Chart (DCC)

### One standard – also for motion control: PLCopen

The PLCopen blocks for motion control, integrated in the system, are especially suitable for programming in a PLC-type view. They are saved in the command library and can be used in all of the languages. LAD or FBD is most suitable – especially for entry-level personnel. In addition to certified single- and multi-axis blocks, extended functions are also available.

### Highest efficiency when structuring the program: Structured Text ST

Using Structured Text ST, the complete functionality and flexibility of the SIMOTION system can be used in an environment that is suitable for high-level languages. This results in extremely efficient programming. Blocks generated in ST can be called in all of the other SIMOTION languages at any time.

### Easy-to-configure technology functions: Drive Control Chart DCC

It is extremely simple to configure open-loop and closed-loop control functions using the DCC Editor. Multi-instance-capable function blocks are selected from a predefined library and are graphically interlinked with one another by dragging and dropping them. With DCC, there are no restrictions regarding the number of functions that can be used. The block library includes a wide selection of closed-loop control, arithmetic and logic blocks – as well as extensive open-loop and closed-loop control functions. Open-loop and closed-loop control structures configured using DCC are transparently displayed.

Once generated, charts can be simply called, re-used and combined with other program sections in order to form a complete program.

### Cam editor for an even higher degree of user-friendliness:

The basic scope of SCOUT includes editors, which can be used to create cams in tabular form or as polynomial segments. Using a graphically supported wizard, cams can be very easily configured in compliance with VDI2143. Complex motion relationships can also be simply and graphically programmed using the SIMOTION CamTool cam editor.

### High-performance and flexible: C/C++ programming

Using C/C++ programming in the Windows environment, additional functions and function blocks can also be created in user libraries (SIMOTION Clib Studio). These can be used in all SIMOTION languages (MCC, LAD, FBD, ST, DCC).

As a consequence, the system can be expanded to include additional functions and performance features, including know-how protection.

#### Effective programming in all languages:

- Automatic completion (autocomplete)
- Tooltip
- Table editing with functions similar to the office environment
- Search/replace
- Fast entry into programming using MCC
- Simple PLC programming using LAD and FBD

# Highest functionality: the run-time system

Using SIMOTION, a wealth of motion tasks associated with different machines can be very simply handled – this is also made possible using a special architecture developed for the run-time system. Basic functions – such as the PLC functionality – are already integrated in every SIMOTION device.

The performance can be expanded to specifically address the application using technology packages and function libraries. Technology packages provide complete functions, for instance for motion control or temperature control. On the other hand, the function libraries include standard functions for frequently required tasks. It goes without saying that you can also create your own libraries with functions that you have generated yourself. The combination of technology packages, function libraries and run-time system results in the unique functionality of SIMOTION: Scalability, flexibility and expandability – from commissioning through operation up to maintenance.

## Scalable

- Using various function levels as well as software modules and technology packages
- From basic control functions up to complete mechatronic sequences

## Flexible

- Using an integrated, freely programmable PLC acc. to IEC 61131-3
- Using technology packages that can be freely instantiated with an extensive command set
- Through the possibility of operating servo, vector, stepping and hydraulic drives

## Expandable

- Using standard functions in the function libraries

## High performance

- As a result of the powerful real-time operating system with task-oriented execution levels (from isochronous to sequential)
- For short terminal-terminal and terminal-axis response times
- For high machine cycle rates

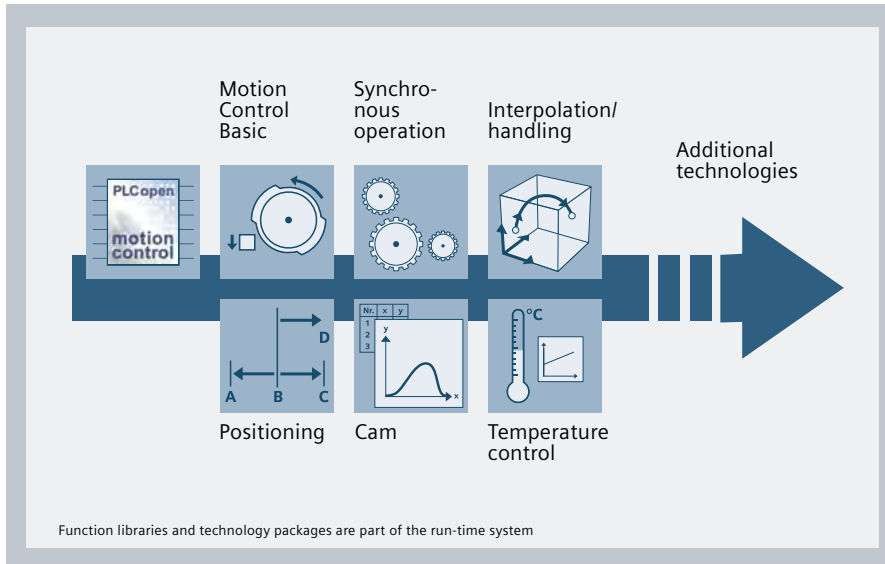
## Technology in objects

The object-oriented system philosophy of SIMOTION offers scalable motion control functionality – from output cams and cam tracks, through positioning, synchronous operation and camming up to 3-D path interpolation with transformations for a wide range of handling kinematics. Basis for motion control are the so called technology objects (TOs). These include axis, synchronous object, path object, cam, output cam, measuring input and external encoder.

The TOs facilitate a very simple view of technology functions – and are generated, configured and parameterized using user-friendly input screens. Technology objects handle complex motion control and high-performance closed-loop control of the axes. They are simply addressed in the user program using preconfigured system functions and system variables.

A fast controller clock cycle is decisive for high-speed applications. Servo drives with Dynamic Servo Control (DSC) can be implemented with position controller clock cycles of 125 µs – and hydraulic drives with position controller and pressure/force controller cycles of 250 µs. Axes can be especially effectively optimized as a result of the comprehensive range of options to influence the control (e.g. a speed controller reference model).





### Seamlessly synchronous

All motion control components (SIMOTION, drives, bus system, I/O modules with precise timing, synchronous user programs) operate in absolute clock synchronism. This means that the input signals from the I/O and the drives are sensed in synchronism with the processing cycle in the control – and are therefore available in the user program with absolutely precise timing. This synchronism is ensured using an isochronous fieldbus (PROFINET or PROFIBUS), essentially acting as the master clock cycle generator for the complete machine.

For distributed, modular systems, the bus clock cycle is transferred to a second bus line, subordinate to the SIMOTION, without requiring any additional overhead. This means, for instance, that synchronized axes can be synchronized with one another on almost any number of coupled controls. Further, these can also operate with different application and control clock cycles. This facilitates scalable solutions and therefore also large axis groups – and at the same, time modular machine concepts can be implemented based on standard components.

### The resulting advantages:

- High accuracy and repeatability even for fast machine cycles
- High product quality and productivity through optimized machine cycles as a result of deterministic system components and short cycle times
- High dynamic performance through constant deadtimes and high gain factors in the control loops

# Simple commissioning: configuring, testing and diagnostics



## **Simply harmonized: configuring the axes**

Axis handling is also significantly easier than with conventional systems as a result of wizards that navigate the user through the process. Intelligent axis objects can be set up in the software. They include all of the relevant information – such as the axis name, the connection of the associated drive, encoder type with resolution, closed-loop position control parameters and even the mechanical axis system data – which can be saved and visualized. Any type of axis can be addressed and information about its operating state can be called using the user program. SINAMICS drives and I/O are simply and symbolically assigned from a selection list – and communication is automatically setup between SIMOTION and the drive.

## **Everything at a glance at the axis control panel**

SCOUT also has an integrated axis control panel that can be used to simply commission the various axes. This can be used to traverse, test and optimize any axis using the commissioning PC – also without a user program.

## **Simple commissioning: testing and diagnostics**

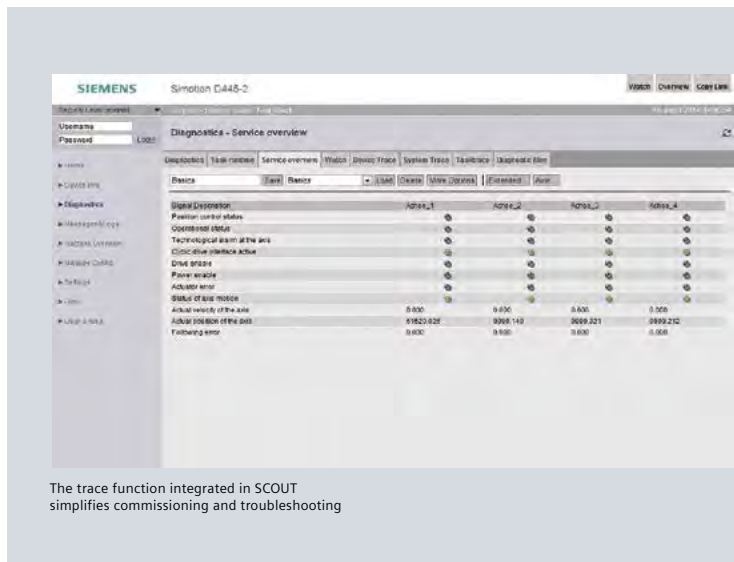
To commission the user program, SCOUT offers test and diagnostic functions that are used in the PLC environment, for example displaying the status of blocks and variables and setting break points. In addition to these test and diagnostic functions, the trace function, which is also integrated in SCOUT, significantly simplifies commissioning and troubleshooting – also across several SIMOTION CPUs. As a consequence, program variables, the position actual value and the following error can be simultaneously recorded in the shortest system clock

cycle, for instance. The data that has been acquired can also be saved and when required compared with more recent traces. Further, the automatic controller settings, measuring functions, function generator, FFT analysis and the display of the frequency response as Bode diagram simplify commissioning and optimization of the machine.

## **Including diagnostic and test functions**

Extensive support during commissioning, testing, diagnostics, service and maintenance ensures short optimization times, minimized downtimes when faults occur, maximum process transparency and therefore an even higher productivity. Tool tips show actual values, data types and comments of the variables directly in the program sources. The status program provides more detailed information: variable values are displayed exactly as they are generated at the particular code location when the program is being executed. Further, break points with defined, adjustable system responses facilitate effective debugging. And last but not least, variables from all project elements (also across several devices) can be displayed and controlled together in a watch table that can be structured as required.

Further, all SIMOTION systems have an integrated diagnostics buffer that records important events (e.g. module and CPU faults, alarms) in the sequence in which they occur; users are also directly navigated to where the fault is.



### Comparison functions for projects

Components associated with different projects can be compared down to the finest detail – in fact, even for the graphic programming languages MCC and LAD/FBD.

- Online-offline comparison allows the target device and project to be aligned with one another
- Offline-offline comparison allows projects to be merged

### SIMOTION IT: Internet-based diagnostics, maintenance and operation

Using SIMOTION IT, you can access data that previously was only able to be read out by the programmer. And assuming the appropriate authorization, you can also modify this data. All you need is a PC with a standard browser and an Ethernet cable. And the browser is simply transformed into a diagnostic tool and HMI in one: In addition to the standards (variable list, diagnostics buffer etc.), from the axis overview up to the run-time trace with graphic display and measurement cursor, you obtain a wealth of information about the status of the machine – both locally as well as using remote access via a secure tunnel from anywhere in the world. This means that manufacturers can maintain their own machines without having to actually be on-site.

Further, accessing all the process value analyses, going far beyond existing diagnostic pages of the HMI, represents an important information source for minimizing downtimes and basis for future updates.

### Advantages of SIMOTION IT

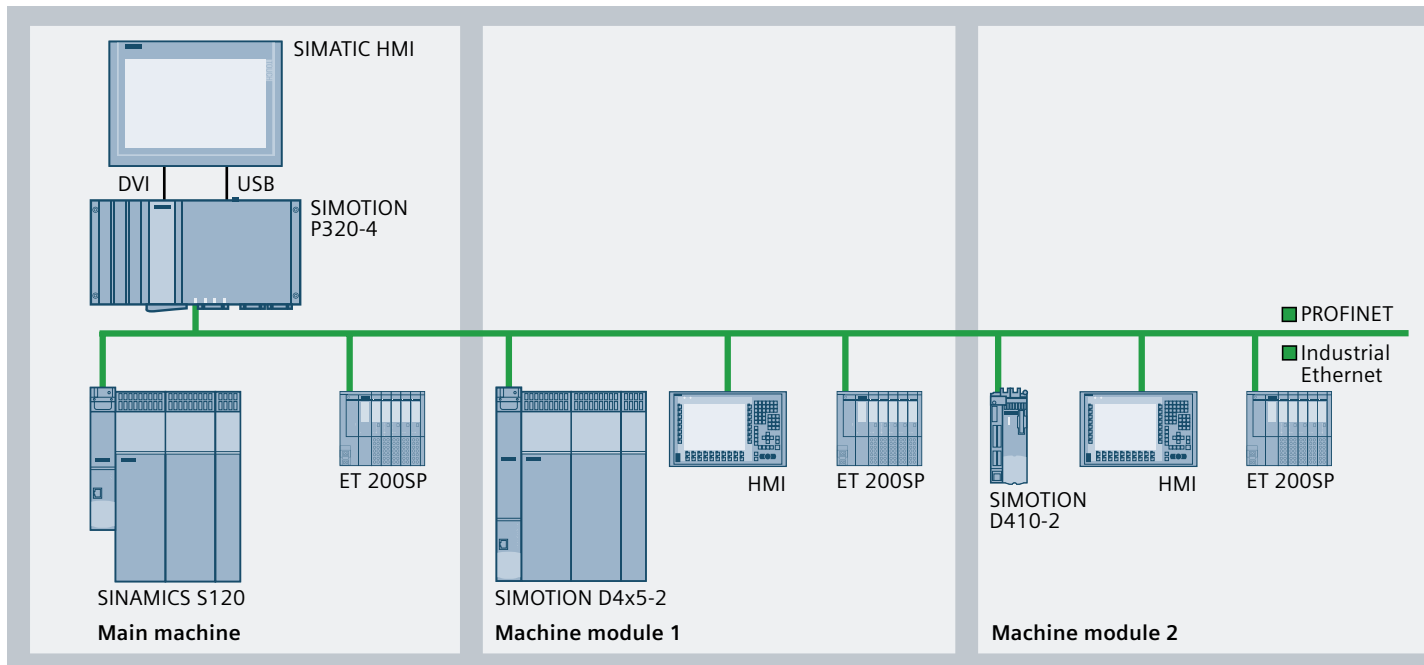
- Higher machine availability through shorter downtimes
- Faster diagnostics and troubleshooting
- Diagnostics without engineering system and project
- Simple upgrade installation
- All data for optimization and maintenance work
- Access to versions, variables and system states (e.g. alarms, faults, utilization level)
- Web-based machine management and operation
- Based on HTML and XMLA
- JAVA applications are possible via the integrated server
- The widest range of JAVA applications can run on the control system
- Comprehensive range of safety functions (e.g. security level, user management, access protection)

#### SIMOTION permits:

- Simple and flexible configuration and programming of motion control tasks
- Fast and transparent graphic comparison of the configuration
- Highest performance and synchronism of the components
- Fast commissioning and short downtimes through extensive diagnostic functions
- Diagnostics, maintenance and operation through the Internet
- Application-specific pages in the customer layout



# SIMOTION and the SINAMICS S120 drive system: a perfect team

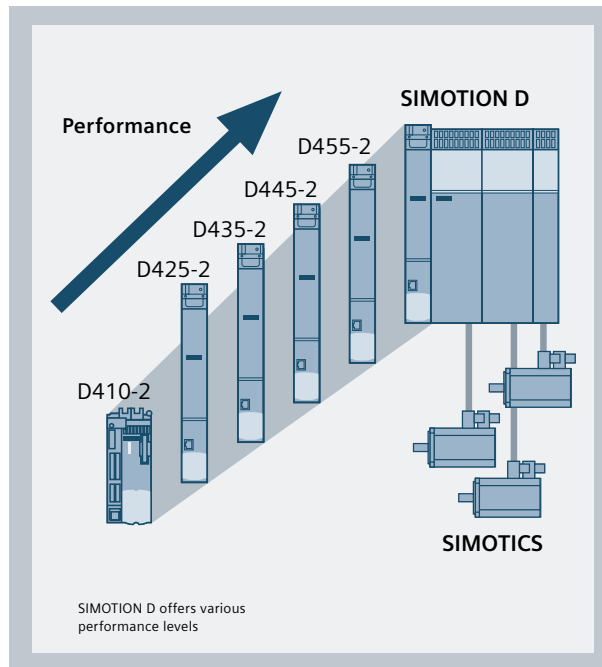


The modular SINAMICS S120 drive system is used for high-performance applications in industrial machinery and plant construction. With a wealth of components and functions that are optimally harmonized with one another, it can be optimally adapted to address your particular requirements. SINAMICS S120 can be used for high-performance single-motor drives and coordinated drives (multi-axis applications) with vector functionality for the highest torque precision or servo functionality for the highest dynamic performance. SIMOTICS motors for motion control applications extend from servomotors, main motors (synchronous or induction), linear motors up to torque motors.

SINAMICS S120 is available in different types of construction and covers the range of power ratings from 0.25 up to 4500 kW for supply voltages 1AC 230 V, 3AC 380–480 V and 3AC 500–690 V.



SIMOTION D410-2 DP, snapped onto a SINAMICS S120 Power Module



### SIMOTION P and SIMOTION C with SINAMICS S120

SIMOTION P and SIMOTION C handle the automation of the complete machine or machine module. The closed-loop drive control is realized in the SINAMICS S120, which communicates with SIMOTION via PROFINET or PROFIBUS DP.

### SIMOTION D and SINAMICS S120

Motion control tasks are becoming increasingly more complex – and the requirements placed on precision and speed are increasing as well. SIMOTION D was created by integrating SIMOTION into the high-performance SINAMICS S120 drive system. This means that SIMOTION D is the response to the challenge of having to control many coordinated axes with high cycle rates. This is made possible by the distributed automation structure, where the machine is split up into various axis groups – each with its own SIMOTION system. Further, you benefit from a compact machine design. With SIMOTION D, different performance versions are available. Whether as single-axis system with multi-axis option SIMOTION D410-2, which can be directly snapped onto the SINAMICS S120 PM340 Power Module in the blocksize format, or as scalable multi-axis system SIMOTION D4x5-2 in four different performance versions in the booksize format. The highest degree of scalability and flexibility makes it simpler for you to adapt the automation to address the requirements of your particular machine.

### SINAMICS Safety Integrated for the drives

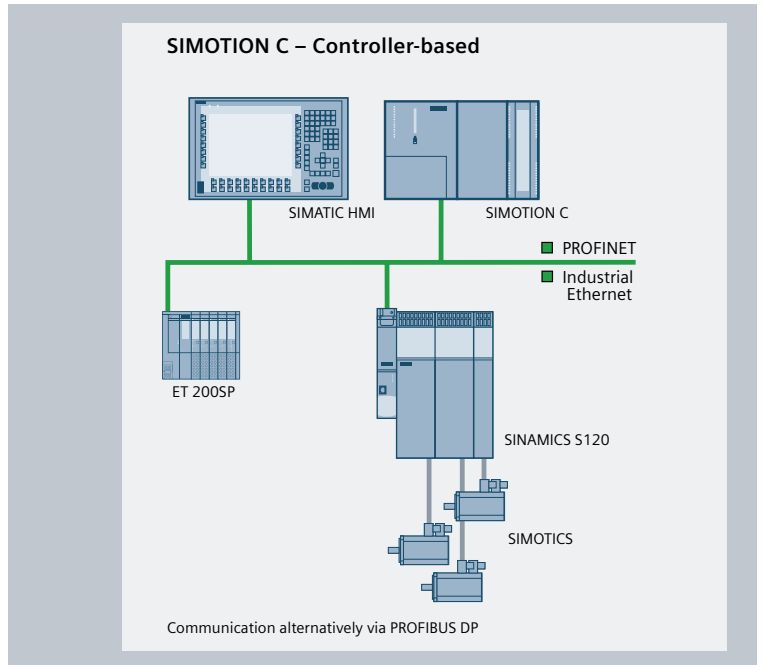
In conjunction with SINAMICS S120, also for SIMOTION, the complete range of presently available integrated safety functions is available for applications up to SIL 2 (IEC 61508), Category 3 and PL d (EN ISO 13849-1):

- Safe Torque Off (STO)
- Safe Stop 1 (SS1)
- Safe Stop 2 (SS2)
- Safe Operating Stop (SOS)
- Safely-Limited Speed (SLS)
- Safe Speed Monitor (SSM)
- Safe Direction (SDI)
- Safely-Limited Position (SLP)
- Safe Position Transfer (SP)
- Safe Brake Control (SBC)
- Safe Brake Test (SBT)

Innovative safety concepts can be cost-effectively implemented based on this extensive range of safety functions.

Two SIMOTION D4x5-2 Control Units are also available in SIPLUS versions for use in harsh operating conditions (such as corrosive gas atmospheres).

# SIMOTION: full flexibility for machine concepts

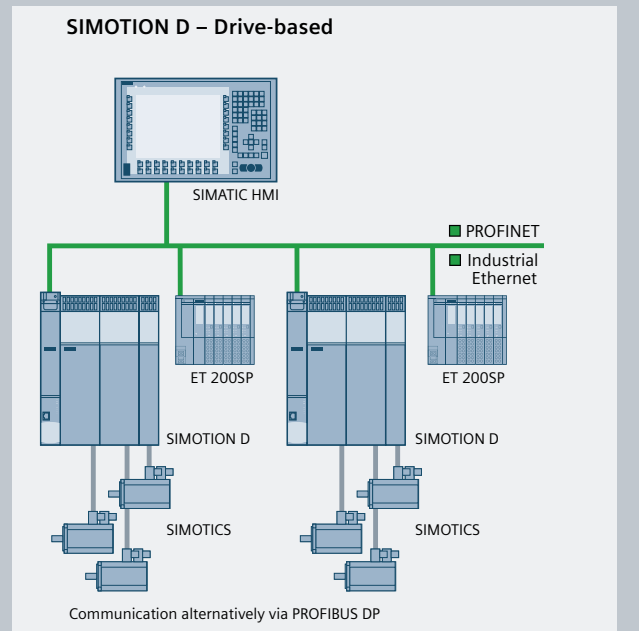
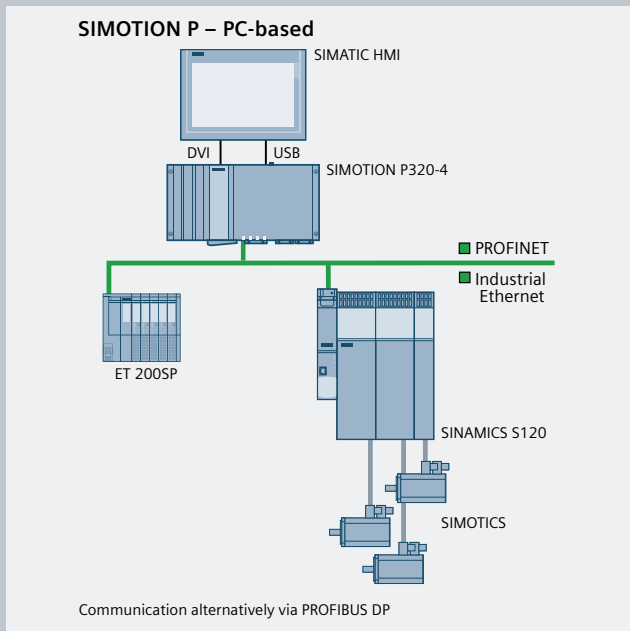


Three SIMOTION hardware platforms provide you with the required flexibility to optimally adapt your motion control system to your machines.

## **Machines with servo drives ...**

... are completely controlled by SIMOTION, for example using a SIMOTION C240 PN. This device processes all of the input/output signals and coordinates the motion of the various servo drives. The process signals are connected via central I/O at the controller or using distributed I/O stations connected to PROFINET or PROFIBUS DP. The system is optimally supplemented by SINAMICS S120 servo drives, for example. A SIMATIC operator panel is used for operating control and visualization, which is connected to the controller via PROFINET, Ethernet or PROFIBUS DP.





### For modular machines ...

... SIMOTION can fully leverage its complete flexibility. This is because the different machine segments can be controlled from a SIMOTION system, even from different SIMOTION platforms. For instance, one segment with a servo drive and distributed I/O, can be controlled from SIMOTION P – the industry PC.

Another segment and an autonomous module, which also has several servo drives and distributed I/O, is controlled from a SIMOTION C controller. Solutions based on SIMOTION D can also be directly integrated in the drive. SIMOTION systems and servo drives are synchronized via PROFINET/PROFIBUS DP with PROFIdrive.

The user interface on SIMOTION P can be very simply configured using WinCC flexible. It is also possible to engineer the HMI application using other tools. OPC is used to connect the system and variables.

### Multi-axis applications

Machines with many axes represent a challenge for any motion control system. This is because the system and bus load increases with each additional axis. SIMOTION addresses this issue using a distributed automation architecture. The machine is subdivided into various modules, which in turn are each controlled from a SIMOTION system.

The individual systems are connected with one another via PROFINET or PROFIBUS DP. The bus load is now significantly lower, which means that machines with many axes, involving complex functions and high demands on the performance can be automated. The SIMOTION D drive-based version is especially suitable as a result of its compact design and fast communication within the axis group.

### Hydraulic applications ...

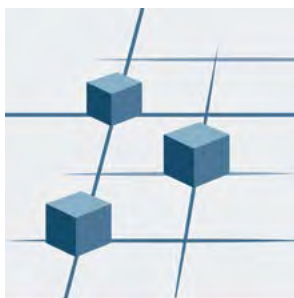
... with their high-speed control loops for position and pressure control can be implemented using the fast, distributed ET 200S I/O; these are preferably connected to SIMOTION via PROFINET, therefore permitting the shortest control cycles. In addition to electric drives, this also allows hydraulic drives to be synchronized with one another – the ideal basis for seamless and integrated automation solutions such as e.g. conveyor belts and press lines.

# SIMOTION: the system with a link to the future



## **TIA: everything at a glance**

The open system architecture covers the entire production process and offers maximum interoperability across all automation components. This is made possible by consistent data management, global standards, and uniform hardware and software interfaces. These shared characteristics minimize engineering time. The result: lower costs, reduced time to market, and greater flexibility. SIMOTION is an integral component of Totally Integrated Automation (TIA). With TIA, Siemens is the only manufacturer that offers an integrated and seamless basis to implement customized automation solutions – across all sectors, from goods in to products out.



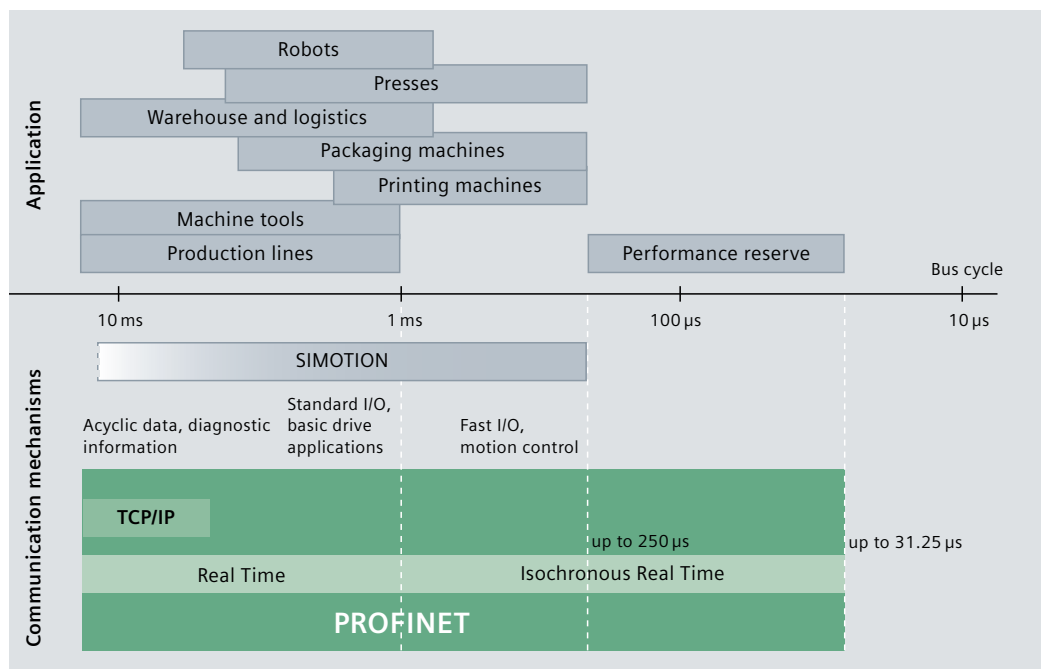
Totally Integrated Automation:  
Efficient interoperability of all automation components

## **PROFIBUS: the fieldbus proven worldwide**

In the meantime, with 40 million installed nodes, PROFIBUS has proven itself as fieldbus across the board. For motion control applications, several SIMOTION devices can be quickly and reliably linked via PROFIBUS at the process level.

## **PROFINET: company-wide automation – seamless connectivity**

The unique level of integration and seamlessness of TIA can be implemented with PROFINET, the open and non-proprietary Industrial Ethernet standard. PROFINET can be used to simply implement extremely fast isochronous drive controls – and TCP/IP communications can be used at the same time without any restrictions.



PROFINET offers outstanding performance. Already today, you can implement all of your applications with PROFINET. With cycle times of 31.25 μs, the PROFINET standard for Simotion offers sufficient reserve to address your requirements in the future.

### Motion Control via PROFINET:

#### if your machine needs even higher performance

PROFINET is the open and innovative Industrial Ethernet standard that meets all requirements of the automation environment.

Fast motion control applications require precise and deterministic data exchange. For isochronous closed-loop drive control, this is realized by using PROFINET with Isochronous Real-Time (IRT). The different cycles of a system (reading in actual values, network, CPU processing and setpoint output) – also for standard TCP/IP data traffic running in parallel – are synchronized.

The short PROFINET cycle times make it possible to increase the productivity of machines and to guarantee product quality through high clock cycle precision. Isochronous real-time communication and standard IT communication can run in parallel on the same cable without mutually disturbing each other. PROFINET uses standard TCP/IP for parameterizing, configuring and diagnostics. The Ethernet standard means that PROFINET can operate at high data rates. As a consequence, flexible configurations with many drives and SIMOTION devices are possible. Using PROFINET with IRT, several SIMOTION controllers can be synchronously coupled with their associated drives. This means that large plants and systems with almost any number of synchronized drives can be implemented.

PROFINET offers increased system availability by applying media redundancy, i.e. the network is configured using a ring-type topology. If communication is interrupted in

only a part of the ring, this means that the communication can re-establish itself in the shortest time using the redundant path. As a consequence, plant downtimes can be avoided and the necessary maintenance as well as repair work can be carried out at the opportune time without being subject to time pressure.

For motion control applications, PROFINET in ring-type topologies offers extended media redundancy which operates bumplessly without any reconfiguration time. When communication is interrupted (e.g. broken cable) the process continues without interruption.

### PROFIdrive: the well proven drive interface

The PROFIdrive drive profile from PI (PROFIBUS & PROFINET International) defines the functional interface between controls and drives for PROFINET and for PROFIBUS. PROFINET users who are already operating drives using PROFIBUS benefit from this: When changing over from PROFIBUS to PROFINET, the user program does not have to be changed.

SIMOTION permits simpler handling and:

- Perfect integration into every automation solution through TIA
- Optimal compatibility with all of the usual standards



# SIMOTION: The basis for integrated high-performance sector solutions

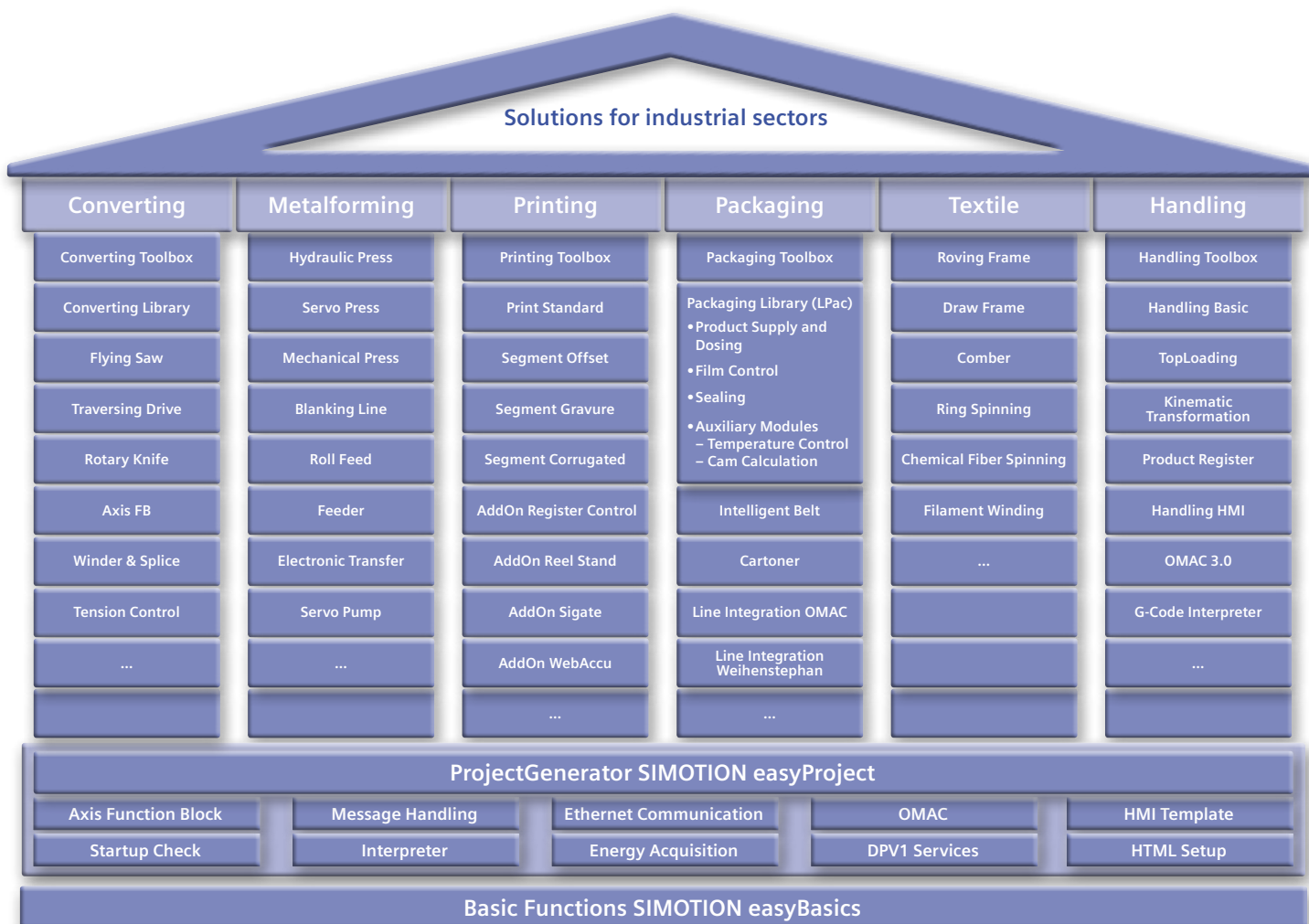
Modern machines place the highest demands on automation and drive technology. Innovative technologies are demanded in order to continually increase and optimize the productivity. Further, there is a clear trend towards flexible, modular concepts as well as state-of-the-art solutions for service, maintenance and connection to supervisory control systems. The demand for low engineering and operating costs makes it imperative to have seamless and integrated automation concepts – from the field up to the company supervisory level.

With PROFINET, SIMOTION and the SINAMICS S120 drive system, Siemens offers the perfect basis to reliably fulfill all of these requirements.

## **Well-conceived down to the finest detail: modular machine concepts**

SIMOTION and PROFINET create the prerequisites for modular and scalable machine concepts that simultaneously allow the implementation of high-speed control loops. For instance, these are absolutely necessary for hydraulic applications in metal-forming machines. The design of modular machines is based on standard hardware and software components. The modules can be easily handled, simply adapted to specific requirements and separately tested. Finally, they can be easily interlinked with one another to create individual machine versions.

This innovative approach has already proven itself in numerous industries such as in the printing-machine industry. This approach allows a flexible and quick response to changing market and customer requirements. Deterministic real time and short cycle times ensure optimized machine cycles – and in turn, constant high product quality and productivity. Not only this, the integrated, seamless networking using just one single bus system reduces the operating costs. Redundant concepts secure a high machine and plant availability.



### Sector solutions with SIMOTION

Requirements placed on seamlessly integrated solutions, standard handling and engineering – as well as a high degree of flexibility to address individual solutions in industry sectors – are continuously on the rise. For this reason automation concepts – that fully comply with customer-specific requirements in each sector and that enable you as machine builder to implement them quickly and reliably – are demanded. Based on modular and reusable blocks, the objective is to create the highest percentage of machine applications. A great variety of proven and well-documented function modules are available for SIMOTION. These form the basis to create customized solutions with low associated costs. You profit from pre-configured functions, which can be freely combined to address the individual requirements of your machine. The modules are simply parameterized instead of being programmed, which would otherwise be a complex time-consuming task. There are also included additional diagnostic and service pages for the web server integrated in SIMOTION – or operator screen forms coordinated with the application for the WinCC flexible visualization system. The function modules are available at no charge through a sector-specific toolbox. For example, the Packaging Toolbox includes basis, technology and application modules as standard, which allows a wide range of applications to be addressed in the packaging machine domain.

#### Comprehensive information ...

... on our skill sets in the various sectors within the framework of SIMOTION is available under [www.siemens.com/simotion](http://www.siemens.com/simotion)

### Project generator SIMOTION easyProject : significantly higher efficiency

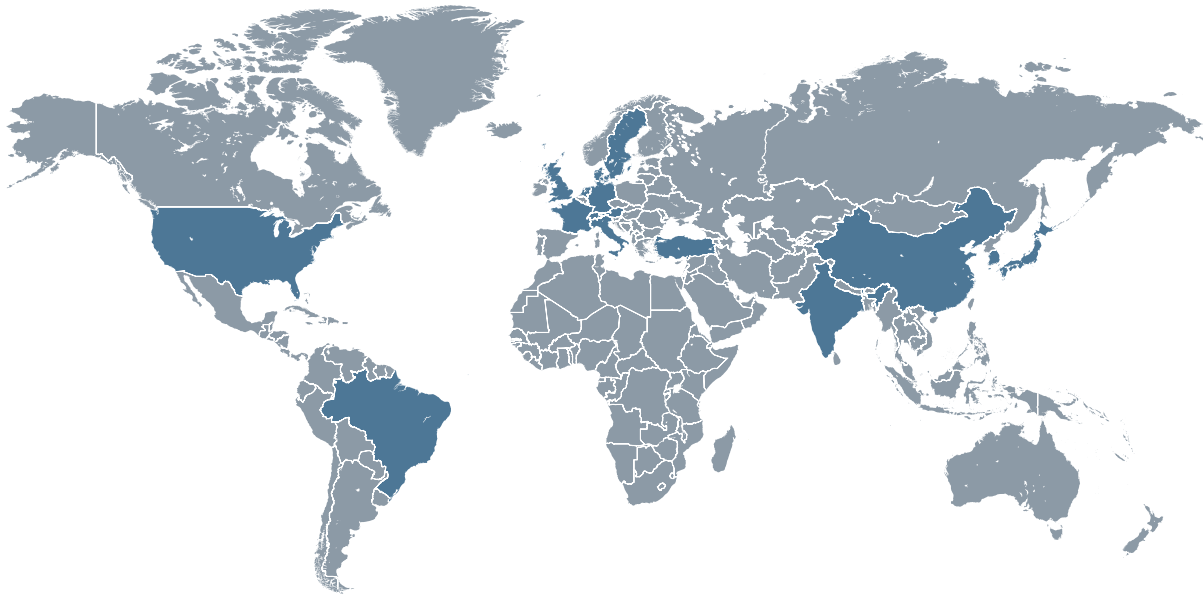
SIMOTION easyProject is a tool that significantly speeds up the generation of a standard project basis for machine applications. Time and costs can potentially be slashed by up to 80 %.

#### Highlights:

- Creation of a new project or even integration into an existing project
- Flexible selection of predefined basic and modular machine modules, which can be combined to immediately create a runnable project
- Standardized, maintenance-friendly application structure
- Automatic module configuration using the selected hardware
- Connection to HMI via predefined modules (e.g. message handling)
- HTML pages, which support commissioning and service via SIMOTION IT, are automatically generated for each module
- Use of standards (e.g. OMAC, PLCopen, OPC-XML)
- Modularization of machine functions according to the international ISA-88 standard

Further, SIMOTION easyProject is structured so that you can also integrate your own blocks into this generic workflow to automatically generate applications.

# Our support services: the team at your side



Our support team is there to support you in every area so that the automation of your machine runs as efficiently and smoothly as possible.

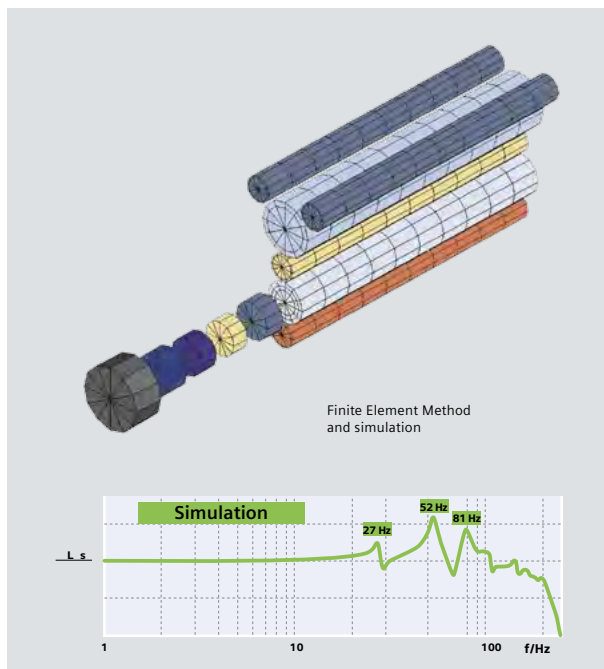
## **Competent application support for your sector**

The Siemens portfolio addresses the complete automation environment – from drive technology through machine control systems, including software systems. Our specialists know and understand the various industry sector requirements from a large number of successful projects. They apply this experience to develop innovative ideas and user-specific machine concepts hand in hand with the machinery OEMs. Our specialists and application support personnel accompany your projects, on-site, from the initial planning through commissioning – from the original idea up to the operational machine. In turn, they are supported from a series of Application Centers in Germany, Italy, the US and China.

Application support includes the following range of services:

- Selecting the optimum solution packages from our product portfolio
- Developing and providing customer-specific add-ons
- Providing support during testing and commissioning





### **Mechatronic Support: for a harmonized system**

Mechatronic machine concepts are based on mechanical elements, electric drive systems and motion control software. The more perfect these three components are harmonized with one another, the higher the efficiency of the complete system. We have many years of experience in these three areas and we can support you by being able to simulate your entire machine. With our mechatronic support, we can optimize the precision and productivity of your machines – both for existing as well as new machines. Machine concepts can first be compared, changed and optimized – also with new mechatronic components. The results obtained are secured and proven through simulation as this precisely emulates the real machine.

### **Service from Siemens: you can depend on it**

Siemens offers dependable service worldwide. From the hotline to personal service 24 hours a day. Customers receive precisely the help and support that they require. This support ranges from quick information on a simple problem up to having a qualified technician on-site for competent service.

More information on application support:  
[www.siemens.com/motioncontrol/apc](http://www.siemens.com/motioncontrol/apc)

More information on mechatronic support:  
[www.siemens.com/motioncontrol/mechatronic](http://www.siemens.com/motioncontrol/mechatronic)

# An overview of data, functions, features

SCOUT engineering system	
Workbench concept	All of the tools have been integrated, uniform look & feel, predominantly graphics-based tools, wizards, consistency checks, central data management
Programming PLC, motion control and technology functions	All using the same languages, even in the same program
Programming languages	IEC 61131 languages: Structured Text, ladder diagram and function block diagram as well as Motion Control Chart and Drive Control Chart. <sup>1)</sup> Motion control functions for all languages as system functions as well as certified PLCopen blocks are available
Variables	Elementary data types (bit, time, string, numerical data type) as well as user-defined data types (arrays, structures, enumerations, etc.)
Cam configuration	Tables or polynomials according to VDI 2134, up to the 6th order, graphic cam editor (optionally, using the CamTool), import/export (e.g. Excel)
Know-how protection for user blocks	Possible, with password
Libraries	System and user libraries
Loading the application	Via PROFINET, PROFIBUS or Industrial Ethernet or using a card reader, directly to a memory card (SIMOTION C, D, P320-4)
Commissioning the drive	Integrated in SCOUT
Commissioning the axis	Axis wizards for simple parameterization, axis control panel, automatic controller setting, trace (oscilloscope function), measuring functions, etc.
Program test and diagnostics	System states, program status, variable status and control, cross-reference list, trace (drive variables, PLC variables), graphic program tracking in MCC, break points

<sup>1)</sup> Drive Control Chart (DCC) is not available in the TIA Portal

SIMOTION run-time system	
Output cams	High-precision individual output cams and cam tracks, switching cams, distance-distance cams, distance-time cams with max. switch-on length, dynamic cams, counting cams
Axes	Virtual axes, speed axis, positioning axis, synchronous axis, path axis, cam axis, electric and hydraulic drives, stepping drives, pressure control/pressure monitoring
Measuring inputs	High-precision measuring inputs – e.g. for print-mark control, flying measurement, etc.
Cams	Cams can be scaled, offset and changed over while in motion; cams can be calculated and changed from the user program, the number and size only depend on the available system resources
Interpolation	Linear, circular and polynomial interpolation in 2-D and 3-D, including transformations for various handling kinematics

SIMOTION hardware platforms			
	SIMOTION C	SIMOTION P	SIMOTION D / SIPLUS D <sup>6)</sup>
Memory medium for user data	Micro Memory Card	CFast 4 Gbyte	Compact Flash Card
RAM (work memory)	67 Mbyte from production version ≥ G and V4.4	256 Mbyte	D410-2: 96 Mbyte D425-2: 64 Mbyte D435-2: 86 Mbyte D445-2: 160 Mbyte D455-2: 320 Mbyte
Retentive memory	107 Kbyte	364 Kbyte	D410-2: 108 Kbyte D425-2/D435-2: 364 Kbyte D445-2/D455-2: 512 Kbyte
Minimum clock cycle time for a user task	0.5 ms	1 ms/0.25 ms <sup>5)</sup>	D410-2: 1/0.5 ms <sup>2)</sup> D4x5-2: 0.5/0.25 ms <sup>3)</sup>
Max. number of axes <sup>6)</sup>	32	128	D410-2: 8 (typically 2 to 3) D425-2: 16    D435-2: 32 D445-2: 64    D455-2: 128
Integrated drive control (Servo / Vector / V/f)	–	–	D410-2: 1/1/1 D4x5-2: 6/6/12
PROFINET IO interfaces, number	C240: - C240 PN: 1 (3 ports)	P320-4: 1 (3 ports)	D410-2 DP: – D410-2 DP/PN: 1 (2 ports) D4x5-2 DP: – D4x5-2 DP/PN: 1 (3 ports) <sup>4)</sup>
PROFIBUS DP interfaces, number	2	P320-4: 2 optional	D410-2 DP: 2 D410-2 DP/PN: 1 D4x5-2: 2
Ethernet interfaces	1	P320-4: 1	D410-2: 1 D4x5-2 DP: 3 D4x5-2 DP/PN: 2
Additional interfaces	–	Additional PC interfaces	Test sockets
Onboard inputs/outputs	18 DI, 8 DO	–	D410-2: 5 DI, 8 DI/DO, 3 F-DI (= 6 DI), 1 F-DO (= 1 DO), 1 AI (U/I) D4x5-2: 12 DI, 16 DI/DO
Additional inputs/outputs	Central or distributed via PROFINET, PROFIBUS	Via PROFINET or PROFIBUS	Via PROFINET, PROFIBUS or DRIVE-CLiQ
Drive interface, digital	Via PROFINET or PROFIBUS with PROFIdrive	Via PROFINET or PROFIBUS with PROFIdrive	Via PROFINET or PROFIBUS with PROFIdrive; via DRIVE-CLiQ
Drive interface, analog <sup>1)</sup>	C240: 4 drives (analog or stepping) integrated C240/ C240 PN: ADI 4 or IM 174	ADI 4 or IM 174 (requires the PROFIBUS option)	D410-2/D4x5-2: ADI 4 or IM 174

1) Hydraulic drives also via ET 200 I/O; stepping drives also via IM 174; ADI 4 and IM 174 are connected via the PROFIBUS interface

2) 1 ms when using the TO axis and the integrated drive control

3) 0.5 ms in conjunction with integrated SINAMICS S120 drives; 0.25 ms in conjunction with run-time levels SERVO<sub>fast</sub> and IPO<sub>fast</sub> (only D435-2 DP/PN, D445-2 DP/PN and D455-2 DP/PN)

4) Optional second PROFINET interface via CBE30-2 (4 ports)

5) 0.25 ms for fast I/O and hydraulic drives, connected via PROFINET IO

6) SIMOTION D435-2 DP/PN and D455-2 DP/PN are also available as SIPLUS version for use under harsh application conditions (e.g. in harmful gas atmospheres)

Components that can be used with SIMOTION	
<b>Drives</b>	
Siemens drives	For example SINAMICS S110/S120
Third-party drives	Via PROFINET IO or PROFIBUS DP with PROFIdrive
Via analog setpoint interface	All drives with analog ±10 V setpoint interface and RS422 incremental encoder or SSI absolute encoder
<b>HMI systems</b>	SIMATIC OP/TP 177B, MP 177, OP/TP/MP 277, MP 377 SIMATIC Mobile Panel 177/277; SIMATIC Panel PC 277/477/577/677/877 PCs with any visualization software and OPC/OPC XML
<b>I/O</b>	SIMATIC ET 200M, ET 200S, ET 200SP, ET 200eco, ET 200eco PN, ET 200pro All certified PROFINET IO devices and PROFIBUS DP standard slaves

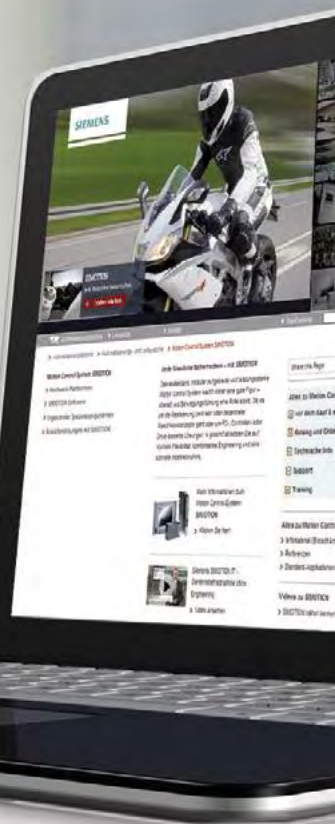


There's more to it  
[siemens.com/simotion](http://siemens.com/simotion)

## The scalable motion control system to address all requirements

- > Flexibility by being able to freely select the platform
- > Motion control, PLC and technology in one system
- > PROFINET for a higher degree of machine flexibility and productivity

Here you can watch videos on everything to do with the motion control system SIMOTION.



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