SIMATIC Controllers

The innovative solution for all automation tasks

Brochure · April 2008
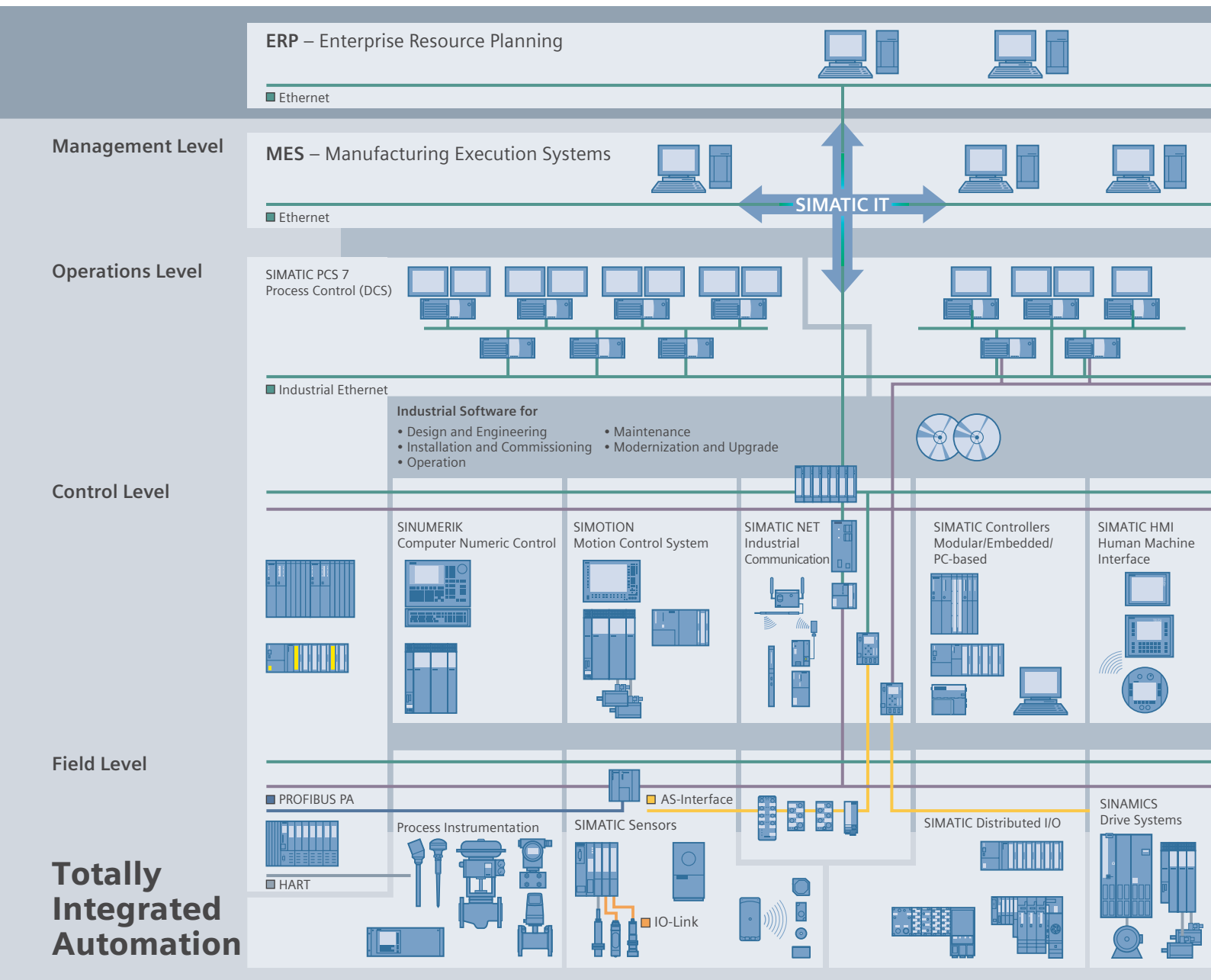
SIMATIC

www.siemens.com/automation

SIEMENS

Totally Integrated Automation

ERP – Enterprise Resource Planning

■ Ethernet

Management Level

MES – Manufacturing Execution Systems

SIMATIC IT

■ Ethernet

Operations Level

SIMATIC PCS 7
Process Control (DCS)

■ Industrial Ethernet

Industrial Software for
- Design and Engineering
- Installation and Commissioning
- Operation
- Maintenance
- Modernization and Upgrade

Control Level

SINUMERIK
Computer Numeric Control

SIMOTION
Motion Control System

SIMATIC NET
Industrial Communication

SIMATIC Controllers
Modular/Embedded/
PC-based

SIMATIC HMI
Human Machine
Interface

Field Level

■ PROFIBUS PA

■ AS-Interface

■ HART

Process Instrumentation

SIMATIC Sensors

■ IO-Link

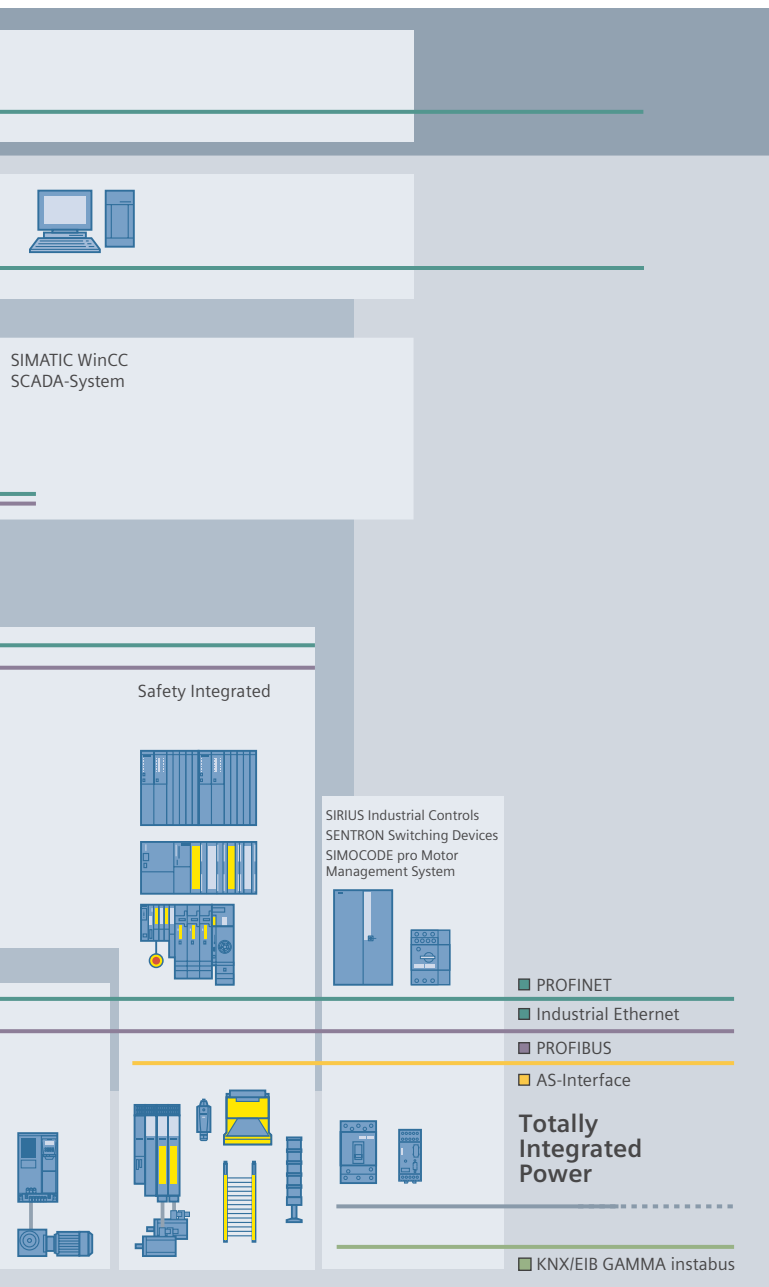SIMATIC Distributed I/O

SINAMICS
Drive Systems

Totally Integrated Automation

With Totally Integrated Automation (TIA), Siemens is the only supplier of an integrated range of products and systems for automation in all sectors – from incoming goods to outgoing goods, from the field level, through the control level to the manufacturing execution system (MES) and as far as the connection to the enterprise resource planning level (ERP, e. g. SAP).

By integrating safety functions into TIA, the standard and safety-oriented automation are combined into one integrated overall system. The advantage: significant cost savings for both plant constructors and operators.

Contents

SIMATIC WinCC
SCADA-System

Safety Integrated

SIRIUS Industrial Controls
SENTRON Switching Devices
SIMOCODE pro Motor
Management System

■ PROFINET

■ Industrial Ethernet

■ PROFIBUS

□ AS-Interface

**Totally
Integrated
Power**

■ KNX/EIB GAMMA instabus

SIMATIC is a core part of Totally Integrated Automation and its range includes numerous standardized products and systems – such as the SIMATIC Controllers presented in this brochure. Whether you prefer a conventional PLC, an embedded or a PC-based automation solution: Our complete range of SIMATIC Controllers covers solutions for all application areas – and offers the performance capability and flexibility you need.

Introduction

Automation with SIMATIC Controllers

You need optimal solutions for every application area to enable you to automate your machines and plants economically and flexibly. This applies in plant construction and mechanical equipment manufacture as much as in the production or process industries and in one-off production or standard production.
The answer is: SIMATIC Controllers.

Your objectives: Staying ahead of the competition

Markets are on the move more than ever and product life cycles are getting shorter all the time. You as a plant builder or mechanical equipment manufacturer are faced with continuously increasing demands, such as higher production performance, compliance with safety guidelines, and optimization of diagnostics as well as service and maintenance friendliness – for all machine sizes and versions. You increase the productive power of your machines either by reducing the machine cycle times or by equipping your machine with new functions. In response to the competition, you must also minimize your development and production costs – as well as your development and delivery times.

Highlights

- More productive performance thanks to high-speed CPUs – even for complex computing and communication functions

- Problem-free implementation of additional functions such as technology functions for motion control, acquisition and intermediate archiving of quality data, or the connection of a higher-level MES system

- More flexibility through open automation on rugged industrial PCs

- More compact machines thanks to smaller controller dimensions, a host of integrated functions, and cabinet-free operation

- Reduction in time-to-market thanks to efficient engineering software, optimal integration with Totally Integrated Automation and user programs that are easy to reuse on all SIMATIC Controllers

- Time and cost savings during installation and at startup thanks to distributed automation

- Compliance with high safety requirements with only one system for standard and safety applications

- Higher machine and plant availability thanks to fault-tolerant configurations and powerful diagnostics functions

- Fit for global use thanks to comprehensive SIMATIC support and service in over 190 countries worldwide
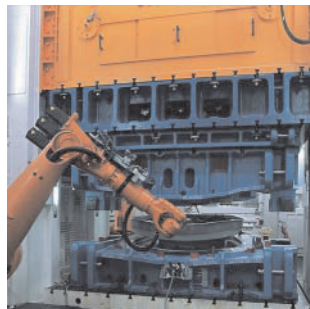
The strategy for your success:
Solutions based on Totally Integrated Automation

Totally Integrated Automation is our comprehensive range of products and systems for all sectors that helps you to reach your individual solution faster and with less effort. All the individual components are characterized by high performance power and perfect interaction. This results in significantly shorter design, test and startup phases for you, and it reduces the operating costs of your plant. And Totally Integrated Automation also offers you decisive benefits when it comes to the fast modernization of existing plants.

Our offer: The power you need

SIMATIC Controllers are an essential component of Totally Integrated Automation. The extensive range of products makes it possible to find the right solutions for the most diverse application areas – in cost-sensitive standard production as well as in plant building and special mechanical equipment manufacture, where reduction of the engineering and startup costs plays a crucial role.

Your benefit:
The best possible equipment for all requirements

SIMATIC Controllers are a safe investment for the future: They enable you to respond promptly, flexibly and economically to new challenges.

Innovative and compatible

Continuous innovation guarantees sustained market success for your machines and plants. And these innovation steps become easier if you can exploit previous investments for new machine generations too.

For this reason, we develop the SIMATIC Controllers continuously and compatibly – always keeping your current user requirements in view.

Almost 40 years ago Siemens developed and manufactured the first programmable logic controller. This experience is reflected in the SIMATIC S7. Well over a million of the latest generation of innovative controllers are already in use around the world.

Product range

The individual desires of your customers are your priority. To meet this priority, you must also be able to adapt the automation system quickly to the most varied requirements and machine versions. With SIMATIC Controllers, you always achieve the necessary degree of flexibility.

Whether you want open-loop control "only", or you also want to cover other additional automation applications such as visualization, technology or data archiving – we always have the right solution for you! And with a unique level of integration in engineering, communication and diagnostics.

Controllers	Description
SIMATIC Modular Controllers	
	The modular SIMATIC Controllers have been optimized for control tasks and specially designed for ruggedness and long-term availability. They can be flexibly expanded at any time using plug-in I/O modules, function modules, and communications modules. Depending on the size of the application, the right controller can be selected from a wide range according to performance, quantity frameworks, and communications interfaces. The modular controllers can also be used as fault-tolerant or fail-safe systems.
SIMATIC Embedded Automation	
	The SIMATIC Embedded Automation products utilize the openness of PC-based systems and offer an increased level of ruggedness. The controller and PC applications run on the same rugged platform – without the use of rotating parts like hard disks or fans. The operating system used is tailored and optimized to the hardware architecture in each case. SIMATIC Embedded Automation products are ready to use and can be installed direct on DIN rails or at the machine on-site.
SIMATIC PC-based Controllers	
	The SIMATIC PC-based Controllers can run on standard PC systems either as pure software PLCs or as slot PLCs in the form of a plug-in card. Any PC applications, operator control and monitoring tasks, as well as technological functions can simply be combined here to form an overall automation solution. The extensive resources of an industrial PC, such as its user memory, are exploited here.

Our SIMATIC Controllers are based on different hardware and software architectures. You have a free choice among different designs and different CPU performance classes.

You can run your user programs on the different but mutually compatible device types without costly adaptation. This saves programming overhead and familiarization time. You thus secure your software investments, and at the same time, you can respond flexibly to the most varied market requirements.

Benefits	Areas of application
SIMATIC Modular Controllers	
• Ready to use • Long-term compatibility and availability • Can be used in harsh environments • Modular expandability and scalability • Vibration-resistant • Maintenance-free	• Control with centralized and distributed I/O • Technological tasks • Fault-tolerant control • Fail-safe control
SIMATIC Embedded Automation	
• Ready to use • Multifunctional • Vibration-resistant • Maintenance-free • Customer-specific versions	• Control, operator control and monitoring • Technological tasks • Integration of user programs • Integration of C-/C++ programs • Data exchange via OPC
SIMATIC PC-based Controllers	
• Flexible in use • Open in hardware and software configuration • Use of existing PC resources • Benefiting from constant PC innovations • Multifunctional • Customer-specific PC versions	• Control, operator control and monitoring • Technological tasks • Data acquisition and archiving • Link to PC hardware and software • Integration of C/C++ programs • Data exchange via OPC

Product range

Modular Controllers		
LOGO! Logic module for switching and controlling	■ Simple automation in industry, trade and utility building as a replacement for mechanical switchgear ■ Simplest possible programming with LOGO! Soft Comfort ■ Component part of Micro Automation More information about LOGO! under **www.siemens.com/logo**	
SIMATIC S7-200 The low-cost micro system	■ For series mechanical equipment manufacture or as a stand-alone solution ■ Easy-to-learn engineering software STEP 7 Micro/WIN ■ Component part of Micro Automation More information about SIMATIC S7-200 under **www.siemens.com/s7-200**	
SIMATIC S7-300 The modular PLC for system solutions in the manufacturing industry	■ Compact design, mounting on DIN rail ■ Many functions are integrated into the CPU (I/O, technology functions, PROFIBUS/PROFINET connection) ■ Maintenance-free thanks to data retentivity on Micro Memory Card*) ■ Isochronous mode on PROFIBUS ■ Failsafe versions	
SIMATIC S7-400 The Power PLC for system solutions in the manufacturing and process industries	■ Rack system with various rack types ■ Extremely high-speed processing and communication performance ■ Changes to the configuration during operation ■ Isochronous mode on PROFIBUS ■ Fail-safe and fault-tolerant versions ■ Hot swapping	
SIMATIC C7 Compact unit comprising controller and panel	■ Complete machine control in the smallest possible space ■ Turnkey, compact installation direct at the machine ■ Can be expanded with S7-300 modules ■ Maintenance-free thanks to data retentivity on Micro Memory Card*)	
SIMATIC ET 200 Bit-modular, distributed I/O system with local intelligence	■ Design with degree of protection IP20 (in the control cabinet) and IP65/67 (without control cabinet) ■ Module replacement during operation ■ Failsafe version ■ Maintenance-free thanks to data retentivity on Micro Memory Card*)	

*) without battery

Embedded Automation

NEW

SIMATIC S7-mEC RTX

Embedded Controller in
S7-300 design

- Combination of modular S7-300 controller and embedded PC technology
- Fanless and diskless S7-300 design
- Centralized I/O expansion
- Configuration and programming as for S7-300 with STEP7

**SIMATIC
Microbox 427B-RTX,
427B-HMI/RTX**

Turnkey,
rail-mounted PC
with software PLC

- Fan-free and diskless platform
- Real-time capable and deterministic software PLC on Windows XP Embedded
- Data retentivity through integrated SRAM

**SIMATIC
Microbox 420-T**

Turnkey, rail-mounted PC
with software PLC and
Motion Control

- Fan-free and diskless platform
- Real-time capable and deterministic software PLC on Windows XP Embedded
- PLCopen-compliant Motion Control functions
- Data retentivity through integrated SRAM

**SIMATIC
Panel PC 477B-HMI/RTX**

Turnkey Panel PC with software PLC and
visualization software

- Control as well as operation and monitoring on a single fan-free and diskless platform
- Real-time capable and deterministic software PLC on Windows XP Embedded
- Operator input using touch screen or membrane keyboard
- Data retentivity through integrated SRAM

**SIMATIC
WinAC MP 277/377**

Software PLC on a multi-functional platform

- Control as well as operation and monitoring on a single fan-free and diskless platform
- Software PLC with real-time and deterministic capability on Windows CE
- Operator input using touch screen or membrane keyboard
- Data retentivity through integrated SRAM

PC-based Controllers

SIMATIC WinAC

Software or slot PLC –
open, flexible and reliable

- Open, PC-based control based on Windows
- Software PLC for greater flexibility and openness – even for real-time and deterministic requirements
- Slot PLC for increased availability and operational safety

System features
Engineering

Powerful tools for optimizing engineering

For your automation solutions, you require software that provides you with optimal support for your specific applications. All the components used must work together without any problems and they must be usable within as short a familiarization period as possible. SIMATIC Software is the universal configuring and programming environment for all SIMATIC Controllers, operator control and monitoring systems, and process control systems. All tools are perfectly matched and support you in the most varied tasks. Standardized user prompts facilitate familiarization with the software thus saving time and costs.

Integrated software for effective engineering

SIMATIC software with the basic package STEP 7 and numerous engineering tools supports the complete production cycle – from configuration all the way to commissioning, testing, and service.

STEP 7 encompasses both the hardware configuration of the plant, and the parameterization of the modules, so no more hardware settings have to be made. With STEP 7, the interconnections within a project are established using a graphical operator interface. STEP 7 contains the central tool for project management: the SIMATIC Manager. The SIMATIC Manager does not view just one CPU, but the overall system – regardless of how many controllers, drives and HMI devices the solution comprises. The connections can be drawn across the entire project with STEP 7.

Graphic configuring of the connections

Structured programming makes it significantly easier to design a user program. It is subdivided into clear, easily tested units called blocks. A large library of standard blocks makes program creation extremely efficient.

Reduced familiarization costs thanks to standard languages

For creating the user program, the three basic languages Statement List (STL), Ladder Diagram (LAD), and Function Block Diagram (FDB), and the high-level languages Structured Text (ST) and Sequential Function Chart (SFC) are available. They comply with IEC 61131-3 and are used worldwide as an international standard.

For larger applications, the task-oriented Engineering Tools are recommended:
• S7-SCL (ST)
  Structured Control Language is a high-level textual language for programming complex algorithms and mathematical functions, or for tasks in the area of data processing.
• S7-GRAPH (SFC)
  for graphical configuring of sequential controls.
  S7-GRAPH is used for describing sequences with alternative or parallel steps.
• S7-PLCSIM
  for simulating a controller including control and process. With S7-PLCSIM, it is possible to test a program prior to loading it onto the PLC of the plant.
• S7-HiGraph
  for automating function units with state diagrams. Using this method, states and step enabling conditions are described graphically.
• CFC (Continuous Function Chart)
  The technology chart for graphical interconnection of complex functions, such as in process engineering.

Once created, programs can be easily used on different platforms or ported to different controllers thanks to the compatibility of the machine code.

Easy to use – the software for Micro Automation

STEP 7 Micro/WIN software for the micro PLCs SIMATIC S7-200 and LOGO! Soft Comfort for the LOGO! logic module is especially easy to learn and program. Applications can be implemented simply and quickly, for example, configuring of visualization tasks and control of drives on the S7-200.

Flexibility also during operator control and monitoring

The SIMATIC software even helps to save costs during operation. Clear visualization, clear message hierarchies and intuitive operation characterize the SIMATIC Human Machine Interface (HMI) in particular. Since the configuring tools for controller and HMI access the same database, your configuring overhead is reduced to a minimum thanks to SIMATIC WinCC flexible.

Reduced installation and maintenance overhead

Premium Studio offers all of the important software tools for automation technology. The DVD includes comprehensive engineering and runtime software for SIMATIC and SINUMERIK – e.g. STEP 7 Professional, WinCC flexible, etc. The DVD also contains the following: graphical programming languages, HMI software, offline simulation, and software for integrating the drive technology. The user does not have to install and configure every software tool individually. Instead, he defines the language and configuration once centrally. This selection is then automatically adopted for all of the selected software tools.

CAx: SIMATIC product data in electronic form

Automatic data transfer from and to planning/design tools saves time, minimizes potential sources of error, and provides for the fusion of the disciplines of electrical planning and automation. The technical and commercial data as well as the dimension drawings of the SIMATIC Controllers are available on CD-ROM (CAx data):
• Technical specifications in accordance with the ECAD component standard (e.g. size, weight) for the bid phase
• Commercial data (e.g. order number, price – following import of prices from the national CA01 Catalog, the interactive catalog on CD-ROM) in the bid phase
• Device drawings for creating documentation
• Device dimension drawings for integrating in design drawings (for control cabinet configuration, for example)
• Device connection descriptions as macros for circuit diagrams

They can easily and conveniently be exported in different formats.

Integrated software for effective engineering

Data storage on the CPU

The memory card makes it possible to store user programs and any other data on the CPU. This has the advantage that in the event of service work or system expansion, the executable programs as well as the entire project, including all comments and symbols, are available locally. When using high-level languages or graphical engineering tools, the program source is available in the original form or graphically. In addition, it is possible to store your own operating instructions, manuals and machine documentation in all common file formats directly on the CPU.

You can find further information in the brochure *SIMATIC Software* and on the Internet under **www.siemens.com/simatic-software**

Diagnostics

Minimize downtimes through integrated diagnostics

Increases in productivity are being achieved more and more through savings in costs. In this context, the focus is increasingly on maintenance. The emphasis here is on rectifying faults quickly in order to prevent costly downtimes – with the lowest possible personnel outlay.

Ideally, the operating personnel should also perform part of the maintenance tasks. The operating personnel are on-site, they are familiar with the procedures and can intervene quickly. This saves time and reduces costs. If additional professional maintenance personnel are needed, it is important that the right specialist is called in. This prevents expensive services being wasted by sending several specialists to the plant to cover all eventualities. This can only be achieved if clear fault diagnostics are obtained first. Fault diagnostics can be implemented using intelligent diagnostic tools and with comprehensive functionality.

Intelligent diagnostic tools
• speed up the configuration of fault messages,
• enable significantly faster and more accurate error diagnostics during operation
  and
• offer suggestions for fault rectification.

Experience has shown that approximately 80% of all faults occur on the equipment units of the production installations. PLC components are only affected in 20% of the cases.

Process diagnostics

Diagnostics that detect and indicate faulty states in the process allow problems to be rectified quickly where they arise. Process diagnostics are plant-specific and cannot therefore be integrated into the PLC hardware or firmware. They are programmed by the manufacturer of the production plant and integrated into the user program. It is necessary to use diagnostic tools here (S7-PDIAG, for example) that significantly reduce the development costs and that provide a wide range of functions during normal operation.

Functions for diagnosing process faults are configured in an efficient and time-saving way in the SIMATIC Controllers instead of using high-overhead programming. This reduces the costs of implementing process diagnostics for the manufacturer and the operator profits from increased plant availability.

System diagnostics

Internal diagnostics that indicate any faults in the system are standard today. SIMATIC Controllers provide particularly effective integral system diagnostics for signaling system faults of this type.

All SIMATIC Controllers have extensive functions for system diagnostics. Memory faults, short-circuits, wire breaks or module failures can be quickly detected and corrected in this way.

Signaling of system errors
STEP 7 supports the diagnostics of system errors with the function "System error signaling". Components are also scanned here that are connected to the PLC over PROFIBUS or PROFINET. In a parameterization screen form, the sequence, contents and structure of the error message are combined to suit requirements without the need for any programming.

The fault text can be taken in this case from Hardware Config or, in the case of fieldbus stations from the GSD (device data) file. STEP 7 generates the necessary STEP 7 function blocks and calls them in the user program.

Detailed system diagnostics
System diagnostics also include functions for detecting hardware and program errors that can be used during installation and commissioning of the plant.
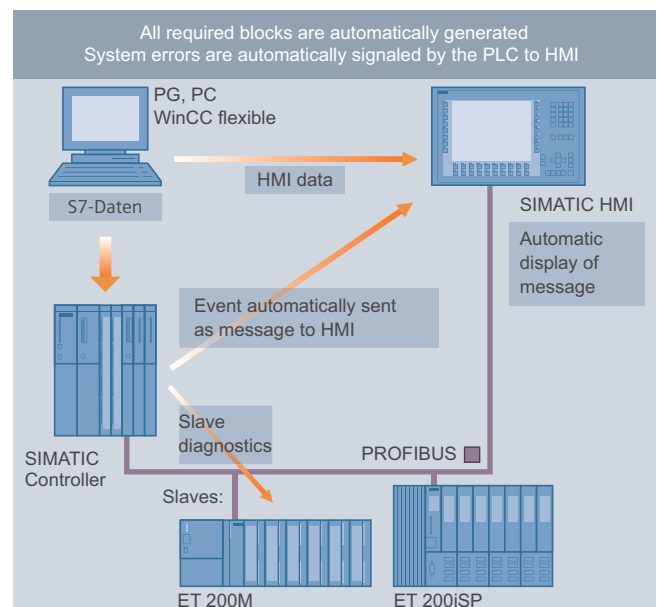
System diagnostics with SIMATIC

During normal operation, detailed error analyses can be conducted using the programming device or the PC. The following functions are provided by the STEP 7 configuration tool "Hardware Config" for the diagnostics of hardware errors:

- Overview diagnostics:
  The topology of the controller is displayed graphically in a window. The module status is displayed in this window providing additional information at a glance without the need to switch to other tools.
- Detailed diagnostics:
  When more detailed information is required, a detailed window that contains comprehensive error details in plaintext about the individual modules can be called directly from the overview.
- Status Force:
  Inputs and outputs can be directly monitored and controlled from the topology view.

All errors are entered in a diagnostics buffer on the CPU. In the case of critical errors, the CPU is switched to the STOP state and all I/O output signals are deactivated.

Increased availability for SIMATIC Industrial PCs
The system availability of embedded and PC-based systems can be enhanced by means of the SIMATIC PC DiagMonitor software option. This software is able to recognize and diagnose PC problems at an early stage and to monitor the temperature. It also features an operating hours counter.

Advantages of Totally Integrated Automation

In combination with the SIMATIC WinCC visualization software and WinCC flexible, the error messages can be automatically displayed on the HMI system of the plant. The error message generated in
STEP 7 and called in the user program is sent to the HMI system automatically.

STEP 7 and the SIMATIC HMI systems have a common database, so the same plain text error messages will be displayed in STEP 7 and on the HMI system.

TeleService

Thanks to TeleService, systems can be diagnosed, values can be set, and data can be transferred from any part of the world. TeleService contributes significantly to reduce travel and personnel costs for service calls and has therefore been a standard tool in automation for a long time.

Remote connections with TeleService can be used for remote maintenance and remote linking.
- Remote maintenance permits access to a CPU with STEP 7
- A remote link is a connection for data transmission

TeleService also allows text messages to be sent through SIMATIC Controllers.

Accessing operator panels and PCs

WinCC flexible/Sm@rtService is available for remotely accessing operator panels and PCs using WinCC flexible Runtime. Machines and systems can also be remotely maintained from any normal PC with standard browser:
- Operating and monitoring via the Internet/intranet
- Event-controlled signaling of error statuses via e-mail or text message
- Service and maintenance functions (download of projects/ upload of recipes)
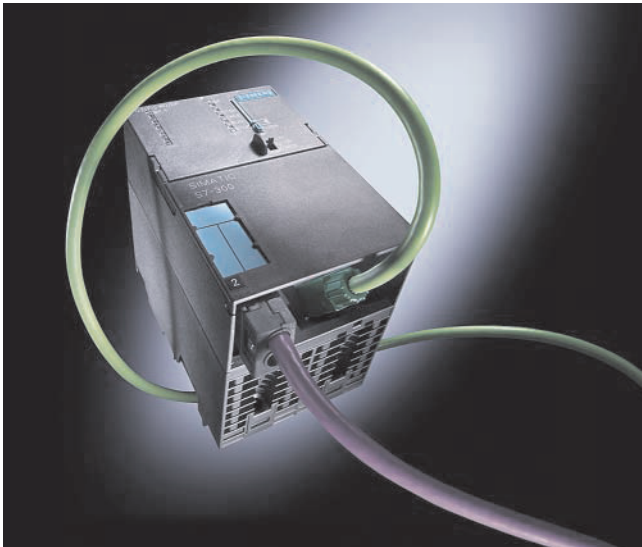
Communication

Unrestricted flow of information in the entire network

In order to get to the market more quickly, you must reduce the integration costs for your machine and plant controllers.

To optimize process and production processes, your customers want a transparent flow of information from the corporate management level right down to the field level.

The key to both requirements is integrated, standardized communication.

That's why SIMATIC Controllers use the standards that are most widely used in industry: Industrial Ethernet/PROFINET, PROFIBUS, AS-Interface and Internet technology.

S7-300 and...

... S7-400 with PROFIBUS and PROFINET interface

System-wide integration

All SIMATIC components speak the same language. Connections can therefore be configured very easily – even across network boundaries. The communications functions of SIMATIC Controllers enable data areas to be transmitted among the nodes of a network. Any programming devices and panels connected to the network can also access the SIMATIC Controllers.

To change from PROFIBUS to Industrial Ethernet, you simply have to replace the communications processor or the CPU in your configuration – without intervening in the user program and without additional engineering overhead.

Industrial Ethernet down to the field level

As a cross-vendor Industrial Ethernet standard for automation, PROFINET offers integrated real-time communication. This enables the connection of field devices via Industrial Ethernet as well as communication between controllers. S7-300 and S7-400 now also support the connection of distributed I/O via PROFINET – as well as PROFIBUS.

Into the office world with OPC

The standardized OPC interface (OLE for Process Control) gives Windows-based applications direct access to the process data in devices from different manufacturers. No special driver software is required for this. This significantly reduces the integration costs. This facility can be used, for example, for visualization or for connecting the SIMATIC Controllers with SIMATIC IT to MES applications (Manufacturing Execution Systems).

Web services keep you informed at all times and at all locations

The possibilities of the Internet make service and maintenance significantly simpler. By using CPUs with integrated PROFINET interface or communications processors with IT functionality, you can use your standard web browser to access the diagnostics information of your control components. If these CPs are used, the SIMATIC Controllers can be used to send e-mails, e.g. for fault reporting to recipients worldwide. Remote programming over the telephone network (ISDN) is also possible.

The following bus systems are available for SIMATIC:

- **Industrial Ethernet** (IEEE 802.3 and 802.3u) – the international standard for area networking is today's number one network in the LAN environment with a share of more than 80%. Powerful communications networks with long ranges can be established via Industrial Ethernet.
- **PROFINET** – the international standard uses Industrial Ethernet and real-time communication right down to the field level. If existing IT standards are fully utilized, PROFINET even permits isochronous motion control applications to be implemented via Industrial Ethernet.
- **PROFIBUS** (IEC 61158 / EN 50170) – the international standard for the field area is the world market leader in fieldbuses. It is the only fieldbus to allow communication both in manufacturing applications and in process-oriented applications. This opens up communications possibilities with a host of partners, from the SIMATIC Controller to the field devices of other manufacturers. Communication with existing SIMATIC S5 or SIMATIC 505 systems is also possible.
- **AS-Interface** – as a low-cost alternative to the cable harness – connects sensors and actuators via twisted-pair cable.
- **KNX** (EN 50090, ANSI EIA 776) is the global standard for building automation.
- **Point-to-point connection** – as the simplest form of communication between two nodes. Special protocols such as RK 512, 3964(R), and ASCII are used here.
- **Multi-point interface** (MPI) – the low-cost solution for communication with PG/PC, HMI systems and other automation systems, e.g. SIMATIC S7. Up to 125 MPI nodes with up to 12 Mbit/s can be connected for exchanging process data between different controllers (global data communication), for example, or for operator control and monitoring without programming overhead.
- **Networks** are set up via controls or links.

Further information can be found in the brochure
Industrial Communication for Automation
and on the Internet under
www.siemens.com/automation/simatic-net
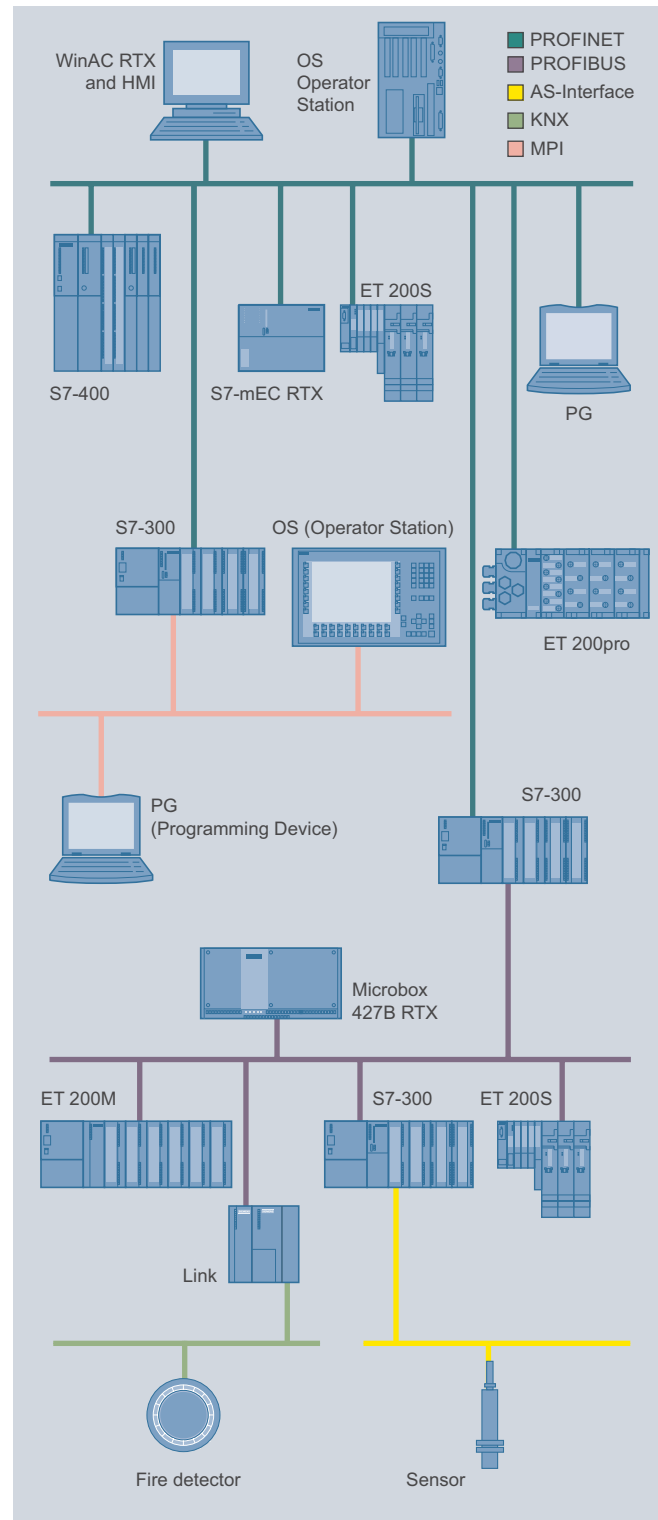
SIMATIC Controllers can be connected to all networks (either via integrated interfaces or via communication processors)

Communication

Connection to all standard bus systems

Connection of field devices to the controllers is supported by AS-Interface, PROFIBUS DP, and PROFINET I/O. For this purpose the controller can be connected either via the interface integrated on the CPU or using special communication processors (CPs). KNX and other bus systems can be reached via PROFIBUS gateways.

Data exchange with other programmable controllers or intelligent partners (PCs, computers, etc.) is implemented via MPI interface, PROFIBUS or Industrial Ethernet. The MPI interface on each CPU allows on the one hand, simple cyclic data exchange (without acknowledgement) and on the other hand, programmed exchange of larger data volumes (with and without acknowledgement).

For simple communications functions such as connecting printers, scanners or third-party devices, point-to-point connections via CPs are used.

Interfaces integrated direct into the CPUs enable you to set up a powerful communication landscape using common bus technology, for operator control and monitoring and PG functions, for example. There are sufficient resources for connecting a large number of HMI devices. With the help of a routing function, a programming device connected to any point on the network can reach all nodes on that network.

CPUs with integral PROFINET interface on the S7-300/400 are predestined for Component Based Automation as well as for programming and HMI over Industrial Ethernet. They also allow the control of distributed field devices connected direct to Industrial Ethernet. Dispensing with the otherwise necessary communications processor results in lower procurement costs and other space benefits.

Communications interface modules can be used optionally in some S7-400 CPUs in order to adapt these to the requirements of the application in hand. By plugging such interface modules into the free slots of the CPU, additional DP lines can be established as master or slave.
Their functionality corresponds to that of the integral interface.

The distributed I/O is configured, like the centralized I/O, with STEP 7, thus saving engineering overhead. PROFIBUS and PROFINET also allow parameterization and optimization of field devices during operation, resulting in shorter machine retooling times. Detailed device diagnostics additionally reduce plant downtimes.

PROFINET – the open Industrial Ethernet standard

Integrated communication from the field level up to the control level is currently one of the most important demands placed on automation.

Standardized connection systems, uniform network management, IT access mechanisms and comprehensive diagnostics facilities mean that savings can be expected in all phases of planning, commissioning and operation.

The advantages provided by rugged fieldbuses and by the standardized IT functionality of Industrial Ethernet should be utilized for uniform communication.

PROFIBUS International (PI) has defined PROFINET as a universal standard which opens up new facilities for the field level:
• IT integration
• Distributed automation
• Utilization of Industrial Wireless LAN
• Real-time
• Transfer of larger amounts of data

PROFINET (in accordance with IEC 61158 / 61784) is the open Industrial Ethernet standard for industrial automation and uses the TCP/IP standards.

PROFINET enables the implementation of distributed automation structures, the integration of simple distributed field devices on Industrial Ethernet, and the operation of isochronous motion control applications. Applications based on PROFIBUS can be integrated via a proxy.

Apart from the time-critical input/output communication, PROFINET also allows standard TCP/IP communication on the same line. Both the CPUs with integrated PN interface and the communication processors support this functionality.
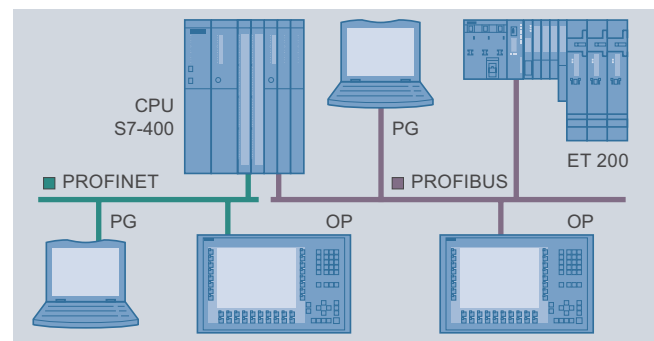

Integrated interfaces of the S7-400 CPUs for direct connection to PROFI-NET and PROFIBUS DP (PG = Programming device, OP = Operator panel)

PROFINET I/O

PROFINET I/O is used to directly connect distributed field devices to Industrial Ethernet. Using the proven PROFIBUS configuration method with STEP 7, these field devices (I/O devices) are assigned to a central controller (I/O controller). Existing modules or devices can continue to be used with PROFINET-capable interfaces or links, thus safeguarding investments. An IO Supervisor serves HMI and diagnostics purposes (overview and detailed diagnostics). The following products configured with STEP 7 are available for this:

- Interface module for connecting ET 200S, ET 200pro as I/O device directly to PROFINET.
- CPU modules as I/O controllers, in order to edit process signals and connect field devices directly to PROFINET:
  - CPUs of the S7-300
  - CPUs of the S7-400
  - CPUs of ET 200S and ET 200pro
  - S7-mEC RTX
  - Microbox 427B
  - Panel PC 477B
  - WinAC RTX
- Communications processors expand S7-300/400 with additional Industrial Ethernet interfaces in order to connect field devices as I/O devices to PROFINET.
- IE/PB link PN I/O as PROFINET proxy, for connecting existing PROFIBUS devices transparently to PROFINET as I/O devices.
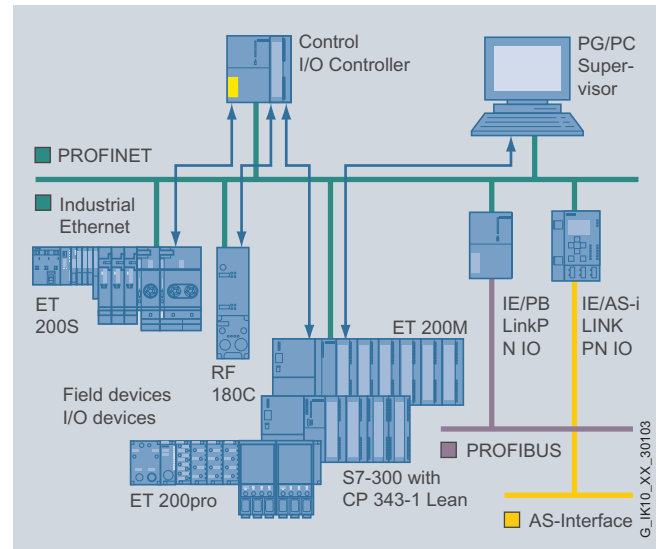
*PROFINET I/O: Distributed field devices to Industrial Ethernet*

PROFINET CBA

PROFINET CBA also supports distributed automation with the help of component engineering (Component Based Automation). Modularization of plants results in benefits with regard to standardization, expandability and reusability The S7-300 CPUs, S7-400 CPUs and WinAC RTX with PN interface are also available for this purpose. Reusable, intelligent technological modules, including their unique interfaces, are created with STEP 7. SIMATIC iMap is used for configuring the entire system through graphic interconnection of these modules and for simple diagnostics.
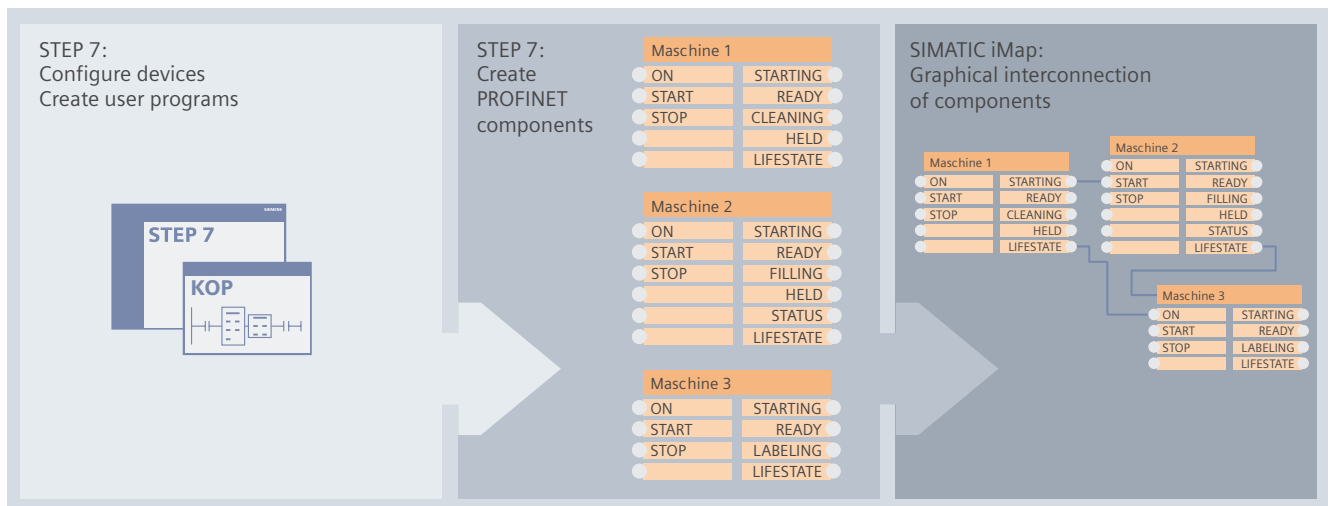
PROFINET CBA: for distributed automation

Safety engineering

Factory | Process
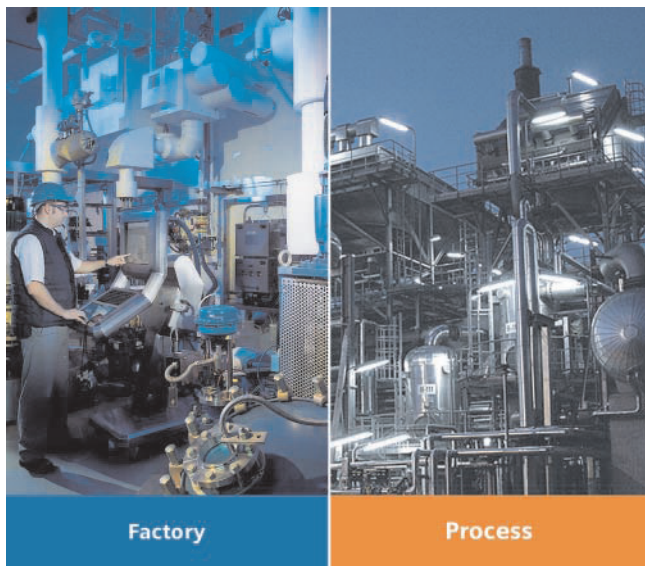
Seamless safety for personnel, machinery and the environment

Accidents and damage caused by faults in machines or systems must be prevented as far as possible. Laws regarding safety at the workplace and protection of the environment are becoming increasingly strict worldwide. Today, different products and systems are frequently used for safety-related functions (electromechanical) and standard tasks (classic PLCs). Conventional wiring and the use of special safety buses increase the wiring overhead on the one hand and the engineering outlay on the other hand; fault diagnostics may take up more time and availability is reduced.

That's why more and more machine manufacturers and plant operators are using automation components for safety-related tasks. The safety of people, machines and the environment thus depends on the correct functioning of the automation systems. The same high demands that are placed on safety-related electromechanical components are therefore placed on safety-related electronic systems as well. Systematic as well as random errors must be controlled.

SIMATIC Safety Integrated highlights

In the case of SIMATIC Safety Integrated, **one** controller handles both standard tasks and safety-related tasks with **one** shared I/O system. Only **one** shared bus cable is required. Only **one** software is required for engineering.

Safety Integrated as a component of Totally Integrated Automation

With Safety Integrated, Siemens as one-stop provider of automation engineering is offering a complete and integrated safety program. As a component part of Totally Integrated Automation, Safety Integrated enables an integrated safety system from the sensors, through the controllers, right up to the drives. Thanks to the integration of safety technology functions into the automation world of Totally Integrated Automation, standard automation and safety automation have become one integrated overall system. This also generates considerable cost savings – for machine manufacturers as well as for plant operators.

Key features of SIMATIC Safety Integrated

SIMATIC Safety Integrated comprises the failsafe SIMATIC Controllers as well as I/O and engineering modules within the product range of Safety Integrated. If a fault occurs, the application can be flexibly transferred into a safe state and retained in that safe state. These failsafe controllers are based on time-proven standard PLCs. The PROFIsafe profile has been added to both PROFIBUS and PROFINET for safety-related communication. Safety-related and standard communication are now possible over only one standard bus cable. With PROFINET, safety-related communication is also ensured in wireless networks.
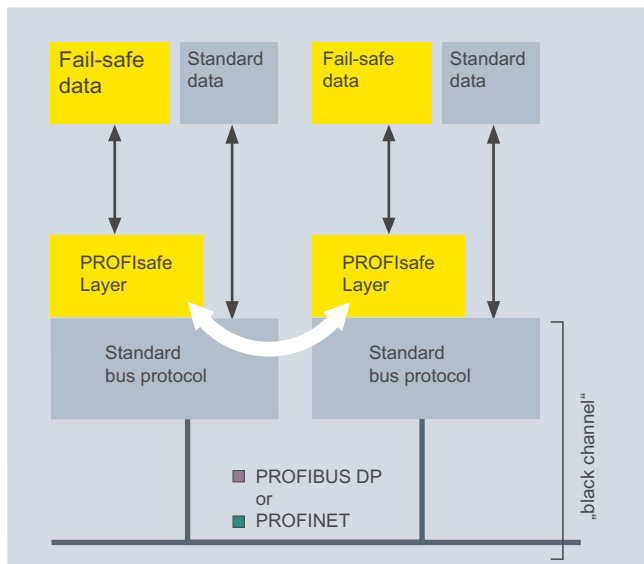
Safety-related and standard data are transmitted over the same bus cable using the PROFIsafe profile. "Black channel" means that safety-related communication does not depend on the bus system and the lower-level network components.

The engineering for safety functions and standard functions is carried out with the same engineering tools (STEP 7) – supported by off-the-shelf FBs with certification from the German Technical Inspectorate (TÜV).

In a SIMATIC Controller the safety technology is thus seamlessly integrated into standard automation. This simplifies operation of the overall plant for the operating personnel, and training costs as well as engineering costs are reduced.

Thanks to the fine-grained structure of the failsafe I/Os, safety technology is only applied where actually required. Combining safety components and standard components is no problem, as well as the coexistence of safety-related and non-safety-related programs in one controller. Thanks to the open standards PROFIBUS, PROFINET and PROFIsafe, it is easy to connect the failsafe fieldbus devices of other manufacturers.

Product range

For the primary applications in manufacturing and process automation, SIMATIC Safety Integrated offers a scalable range of failsafe controllers, all using shared I/O and communication. All important standards and regulations are complied with, for example:
• IEC 61508 (up to SIL 3), IEC 61511,
• EN 954-1 (up to Category 4),
• NFPA 79-2002,
• NFPA 85.

The relevant TÜV certificates document compliance with the standards and regulations. Thus the worldwide use of SIMATIC Safety Integrated for the protection of people, machines, and the environment is made possible.

For **factory automation**, the CPUs 315F, 317F and 319F of the S7-300, CPU 416F of the S7-400 as well as the IM 151-7 F-CPU and the IM 151-8F PN/DP CPU of the ET 200S are available.

They are based on the respective standard CPUs. Various protective mechanisms have been added to their hardware and operating system for executing safety programs. The entire programming of the safety-related program is done by STEP 7 in the standard languages LAD and FBD. The software package "S7 Distributed Safety" supports the configuration of the failsafe I/Os and the programming using preconfigured, certified blocks.

The fault-tolerant CPUs 412H, 414H and 417H of the S7-400 are available for use in the **process industry**.

Safety-oriented applications in the process industry require a special software package "S7 F-Systems". One CPU can solve failsafe applications with SIL 3. For expanded system availability, two redundant CPUs can be used to meet demands for fail-safety and fault tolerance. Program design is carried out with the Safety Matrix or Continuous Function Chart (CFC) as well as certified function blocks. "S7 F-Systems" supports the configuration of the safety-related I/O and programming of the logic.

You can find further information in the brochures
Safety Integrated for Factory Automation and
Safety Integrated for Process Automation
and on the Internet at
www.siemens.com/safety-integrated
www.siemens.com/process-safety

Fault tolerance

Chemical industry

**High-availability systems
enable operation without downtimes**

As the degree of automation increases in industrial plants, the availability of the implemented systems becomes more and more important. Automation system faults or disturbances result in unproductive and therefore expensive downtimes on the one hand and high restart costs on the other. Thanks to their redundant structure, high-availability automation systems can ensure that the production process continues even after a fault has occurred.

In addition, systems of this type also support operation of the plant without requiring the presence of supervisory or maintenance personnel. The higher purchase prices of fault-tolerant systems are negligible when compared with the potential for savings in the event of a fault.

Airports

The master controller (Station A) controls the high-availability area under no-fault conditions The backup controller (Station B) also has access to this high-availability area. If the master fails, the backup controller takes over control of the high-availability area.

The high-availability area is therefore available even in the event of a fault. Both controllers can also operate standard I/O without demands for high availability, i.e. one controller can control the normal area as well as the high-availability area.
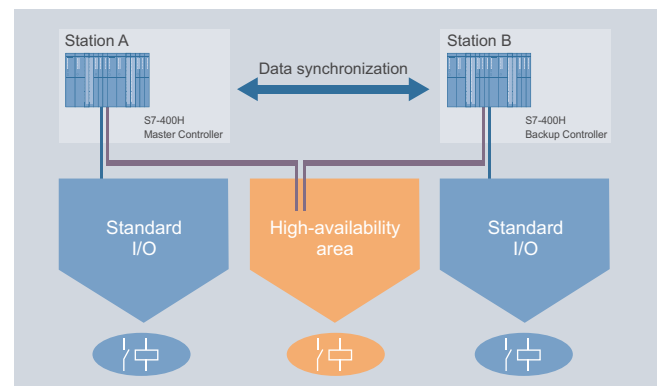
Configuration of a fault-tolerant system

The S7-400H is a high-performance solution for all processes:
- Three H CPUs of the S7-400 with hardware-based synchronization
- Powerful solution without any loss of information and a high level of engineering support without additional programming overhead

Further information is available on the Internet at
www.siemens.com/S7-400H

Technology

Glass industry

Including technology and motion control

Counting and measuring, cam control, closed-loop control and motion control – technological tasks in different combinations and of varying complexity must be solved in almost every machine or plant.

The demand is for the highest level of precision, dynamic response and processing speed. SIMATIC Controllers solve every technology or motion control task with components tailored for the purpose: from low-cost software solutions for individual axes right up to high-performance modules for synchronous operation, path control and multi-axis applications.

In all cases, you configure in a user-friendly way via intuitive dialogs in the same software environment as for standard PLC tasks.

You can find further information in the brochure *SIMATIC Technology* and on the Internet under
www.siemens.com/simatic-technology

Examples of the diverse tasks you can solve with SIMATIC Technology:

Counting/measurement
- Counting pulses up to 500 kHz
- Measuring path lengths, speeds, frequencies and cycle durations
- Dosing

Closed-loop control
- Temperature control, pressure control, flow control
- Step controllers, pulse controllers and continuous controllers
- Fixed-setpoint control, follow-up control, cascade control, ratio control and hybrid control
- Ready-parameterized or flexibly programmable control structures
- Controller optimization

Cam controls
- Path-dependent switching
- Time-dependent switching
- Dynamic derivative action

Motion Control
- Position detection with incremental or absolute encoders
- Positioning with rapid traverse/creep speed or controlled positioning
- Electronic gear
- Cam disk
- Multi-axis interpolation
- Control of hydraulic axes

SIMATIC Technology represents the greatest possible freedom in the choice of design and scalability of the hardware and software, at the best price-performance ratio.

Advantages of SIMATIC Technology						
Solution	**CPU-integrated functions**	**Loadable function blocks (on the CPUs)**	**Parameterizable ET 200S function modules**	**Parameterizable function modules**	**Technology controllers**	**Freely-configurable application modules**
Usage	For compact machines with few axes and counter/control channels	For positioning or closed-loop control applications solved with software on CPUs	The right technology expansion for distributed machine concepts	The intelligent solution for extremely high requirements with regard to accuracy and dynamic response	Additional computing power for drive-level technological functions	For demanding technology tasks that require the greatest possible flexibility
Benefits	No additional hardware or software	Software solutions for the flexible use of just about all SIMATIC hardware platforms	Solving technological tasks with distributed configurations and bit-modularity	Specialized or universal solution with wide function range	Motion control in accordance with the PLCopen standard integrated into STEP 7	Individually adaptable at the highest processing speed

Isochronous mode

High-speed and precise processing operations

SIMATIC S7-400,S7-300 and WinAC RTX permit that decentralized automation solutions can rely on high-speed processes and achieve maximum precision.

Applications subject to such requirements include:
- Motion Control
- Synchronous operation
- Closed-loop controls
- Software-based cam control systems
- Measuring at several measuring points
- Speed and
- Flow measurement

This makes faster production possible while simultaneously increasing quality. This is enabled by the isochronous mode system function (not on fault-tolerant CPUs).

The principle of the isochronous mode

This refers to synchronization of signal acquisition and output by means of distributed I/Os, signal transmission over PROFIBUS and program processing with the cycle of the equidistant PROFIBUS. The result is a system which acquires and processes its input signals and outputs its output signals at constant intervals. S7-400, S7-300 and WinAC RTX thus ensure exact reproducibility and defined process response times, as well as equidistant and synchronous signal processing with decentralized I/O devices.

The exact chronological reproducibility of all processes allows even fast processes to be handled safely. A comprehensive range of components which support the isochronous system function is available to solve many applications in the areas of motion control, measuring and controlling.
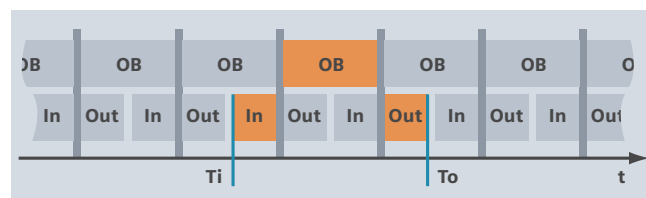
Distributed automation structure with isochronous, deterministic time characteristics (OB = Organization block)
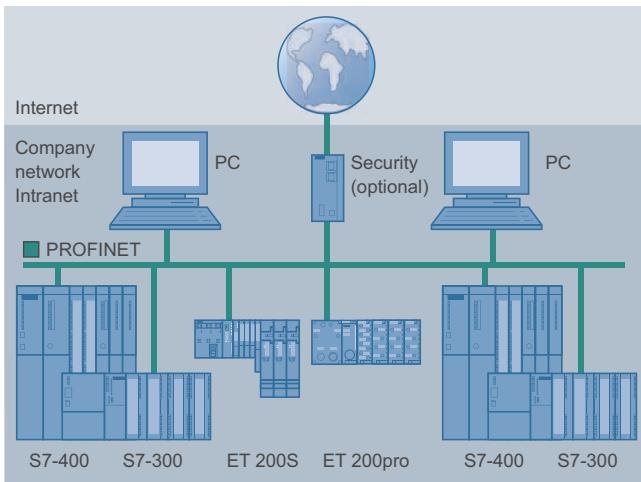
Features

- The user program is *synchronized* with I/O processing. Synchronized means all processes are coordinated over time, and all input data are acquired at a defined point (Ti). The output data also become effective at a defined point (To). The input and output data are synchronized with the system cycle right up to the terminals. The data of one cycle are always processed in the next cycle.
- The input and output data are processed *equidistantly*. Equidistance means all input data are always read in at the same intervals and output data are always output at the same intervals.
- All input and output data are transferred *consistently*. Consistency means all the data of the process image belong together logically and chronologically.

Features and application of isochronous mode	
Features	**Application**
Actual value acquisition and setpoint output ...	
...**take place synchronously**, that is, simultaneously for all inputs and outputs in order to generate consistent process images.	■ Synchronous applications become more **accurate**, since the respective positions are measured simultaneously. ■ Time-linked signals can be even be spatially distributed **using decentralized I/O** devices, e.g. start signals on multiple assemblies where the time sequence is important. ■ The I/O image is **consistent in itself** thanks to simultaneous acquisition and synchronous transfer. This enables, for example, ratio generation of several analog values (e.g. several pressure values in a press).
...**are equidistant**, that is, always at the same intervals	■ Calculations from the difference of actual values, e.g. with speed measurement or flow measurement. ■ Proportioning operations. ■ Closed-loop control loops can also be connected via distributed I/O.

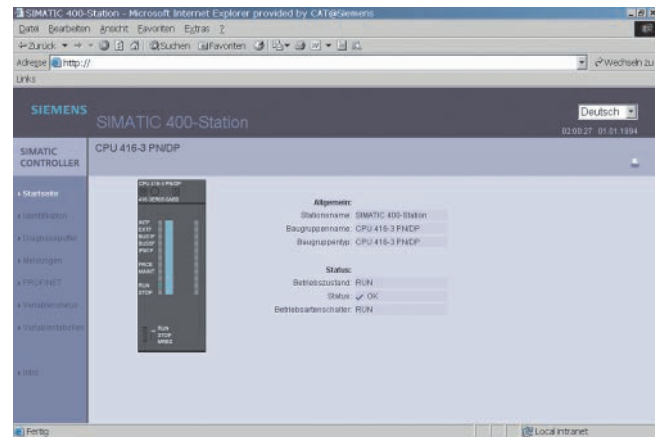# Integrated web server for diagnostics from any location

S7-300/S7-400 CPUs with integrated PROFINET interface offer web server functionality and permit diagnostics from any location via the Industrial Ethernet network. Any web clients, such as PCs, Multi Panels, or PDAs, can use a standard Internet browser and have read-access to the diagnostics data of a PN-CPU that functions as a server for the web pages. For this purpose, a web client must first be linked to a PN-CPU via Industrial Ethernet. Thus access to CPUs is not restricted to the standard method using STEP 7. Diagnostics can also be implemented via the Internet depending on the respective IT infrastructure of the company.

Representation of a PN-CPU in the Internet browser (example here: S7-400)

Access via Industrial Ethernet network to PN-CPU with web server

The following diagnostic information, for example, can be called up via the network:
- Module identification of CPU
  (e.g. station name, module name, order number, firmware version)
- Operating status of the CPU
  (e.g. status of the mode selector switch)
- Diagnostics buffer of CPU with plain text entries
- Tag status and tag tables configured in STEP 7
- **NEW** Module status
  (status of the station, e.g. modules in the rack and nodes connected via bus)
- Configured plain text messages
  (signaling of system error)
- Ethernet parameters and statistics
  (IP address, MAC address, sent packages)
- **NEW** Display of network topology

The web server integrated in the CPU offers the following advantages:
- User-friendly access to diagnostics information of the CPU during start-up and operation from any location. This increases the plant availability and minimizes downtimes.
- No additional hardware or software is required:
  - The web pages are accessible via the integrated PROFINET interface of the CPU.
  - Each standard Internet browser, e.g. Internet Explorer, can display the web pages.
- Optimized display even for Multi Panels and Personal Digital Assistants (PDA) with lower resolution

There is a graded security concept for the web server:
- For security reasons, the CPU only has read-access to the web server, i.e. it is not possible to write data to the CPU using web mechanisms.
- If read-access is to be authorized, the CPU can be protected against unauthorized access by using a SCALANCE S module.

If the web server function of the CPU is not required, the integrated web server can also be switched off completely when configuring using the configuration software STEP 7.

Operator control and monitoring

Panels – Operator panels to suit all demands

Using SIMATIC HMI, our comprehensive solution for operator control and monitoring, you can master the process and keep your machines and plants running optimally. Regardless of the industry or application, SIMATIC operator panels provide the interface between man and machine and offer maximum transparency. Rugged, compact and versatile – they may be integrated into any production and automation system at any time. Key words such as *mobile* or *stationary*, *Touch* or *Key*, *PROFIBUS* or *Industrial Ethernet/ PROFINET* indicate diversity.
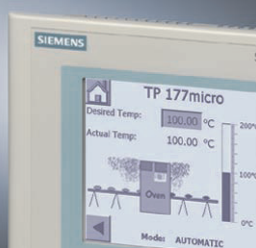
SIMATIC Panels are available as pure HMI devices, as Multi Panels with embedded operating system for additional system resources, and combined with an S7-300 controller as a SIMATIC C7 compact control system. They are scalable in price and performance as well as in their degree of openness and expandability.

The performance power of the SIMATIC Panels is crucially determined by their software: SIMATIC WinCC flexible. WinCC flexible permits the configuration of all SIMATIC Panels – user-friendly and with a clear structure. WinCC flexible is scalable to match the different performance levels of the panels.

SIMATIC Panels communicate via open interfaces with just about any automation system. The combination with SIMATIC Controllers generates special benefits: The shared database dispenses with the need for coordination when configuring, thus saving time and money. During operation, SIMATIC Panels support especially effective system diagnostics and so contribute to increased plant availability.

You will find additional information in the brochures *SIMATIC Panels, SIMATIC Panel PC, SIMATIC WinCC flexible* and on the Internet under
www.siemens.com/simatic-hmi

Operator panels in various performance classes

Push Button Panels	Micro Panels	Mobile Panels	Touch Panels/ Operator Panels	Multi Panels
The bus-compatible alternative to conventional keypad operator panels. They are preassembled and ready for use. Configuring software is not required. Adaptations are performed on the device itself by means of parameterization.	Tailored to applications with the SIMATIC S7-200 Micro PLC for automation tasks in the lower performance range. They are available as text displays, but also as operator and touch panels with graphic display.	The portable operator panels facilitate operator control and monitoring at the actual scene of the event with direct access and visual contact to the process. A wireless version with full safety function is also available for use in tough industrial environments.	For the efficient operation and monitoring of machines in various performance classes – either as Touch Panels (TP) with touch-sensitive displays or as operator panels (OP) with membrane keyboards.	The main characteristics of Multi Panels (MP) are their high performance, openness and expandability. They also allow the integration of several automation tasks on one platform. WinAC MP is available as an option for control functions.

**Panel PCs – rugged, powerful industrial PCs
with brilliant displays**

SIMATIC Panel PCs enable optimal visualization and process-ing of your production procedures in a harsh industrial environment.

Rugged front panels in modern industrial design are available with brilliant displays in sizes of 12" and 15" as touch or key versions as well as 17" and 19" as touch versions.

The high degree of protection and compact construction are well suited for application next to the machines in production and process automation – world-wide thanks to international certification:
• SIMATIC Panel PC 477B:
  Very compact, rugged and maintenance-free
• SIMATIC Panel PC 577B:
  Industrial functionality at an attractive price
• SIMATIC Panel PC 677B:
  Maximum performance for harsh industrial applications

**SIMATIC WinCC flexible –
Flexibility in any HMI application, from Micro Panel to PC**

The WinCC flexible engineering software allows integrated configuring of all SIMATIC operator panels right up to PC-based visualization workstations.

WinCC flexible is available in several versions with progressive levels of price and performance, which are optimally tailored to the individual classes of operator panels.

WinCC flexible is the logical further development of SIMATIC ProTool/Pro. Existing ProTool projects are compatible and can simply be taken over and used for a project with WinCC flexi-ble, thereby guaranteeing security of investment.

Reusable objects can be stored in a structured format in librar-ies. WinCC flexible already provides a host of scalable and dynamically variable objects. Faceplates can be constructed from simple image objects on a customer-specific or project-specific basis. Changes to these faceplates only have to be performed at one central location.

The fundamental structure of an HMI project can be deter-mined with a few mouse clicks at the start of the project with support from configuration wizards. Table-based editors sim-plify the generation and processing of similar types of object, e.g. for tags, texts or messages.

Complex configuration tasks such as the definition of motion paths or the setup of the fundamental operator prompting system are simplified by means of graphical configuration.
• Innovative configuration interface based on the latest software technologies
• Function block libraries: Faceplates are freely definable and reusable, and they can be modified centrally
• You can configure intelligent tools such as graphic naviga-tion and motion objects graphically, and configure bulk data conveniently (e.g. variable editor) etc.
• Extensive language support for worldwide use:
  - Manage 32 languages in one project
  - Text library for multilingual texts and automatic translation
  - Simple import/export of texts for translation
• Transfer the complete configuration from SIMATIC ProTool

Individually expandable with options:
• Sm@rt-Client/Server concepts
• Service and diagnostics over the Internet
• OPC server communication
• Process diagnostics
• Logging and tracking of operator actions and configuration changes
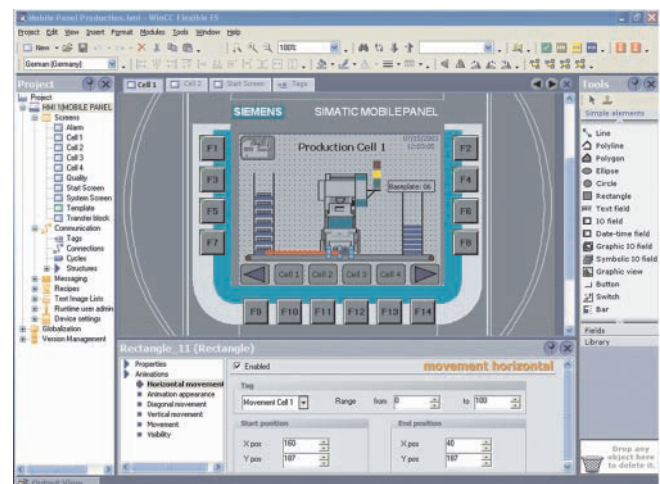
User interface of WinCC flexible

Selection guide

SIAMTIC Modular Controllers	
SIMATIC S7-200	**SIMATIC S7-300**

	SIMATIC S7-200	SIMATIC S7-300	
SIMATIC product range			
Brief description	Modular micro controllers for control tasks in the low-end performance range	Modular controllers for system solutions in manufacturing automation in the low to mid-performance range	
Product range	• 5 compact CPUs	• 7 standard CPUs • 6 compact CPUs • 5 fail-safe CPUs • 2 technology CPUs	
Spare parts guaranteed for	10 years	10 years	
Temperature range	0...55 °C [1]	0...60 °C [2]	
Performance			
Execution time for bit operation, min.	0.22 µs	0.01 µs (CPU 319)	
Memory			
Work memory, max.	Program 24 KB, data 10 KB	1400 KB (CPU 319)	
Load memory/mass storage, max.	Memory cassette 256 KB	Micro Memory Card 8 MB	
Backup, max.	Program on EEPROM, dynamic data on integral capacitor or opt. on battery module	Program and data on Micro Memory Card (maintenance-free)	
I/O			
I/O address area, max.	128 / 120 digital, 30 / 15 analog	8192/8192 bytes	
Centralized - I/O integrated in CPU - I/O modules on CPU	 ● ●	 ● (compact CPU) ●	
Distributed - I/O modules on PROFIBUS		 All ET 200 I/O devices	
- I/O modules on PROFINET		ET 200S, ET 200pro, ET 200M	
Technology functions			
Loadable function blocks	●	●	
Basic functions integrated in CPU	●	● (compact CPUs)	
Special modules, plugged in centrally	●	●	
Technology controllers		● (technology CPUs)	
Isochronous mode		●	
Safety/availability			
Fail-safety		● (F-CPUs)	
Fault tolerance			
Configuration changes during operation (CiR)			
Connection/disconnection of centralized I/O during operation (hot swapping)			
HMI functions			
Integrated			
PC functions			
C/C++ link			
Data acquisition and archiving			
Expandable with PC standard hardware			
Integration of PC standard HW/SW			
Engineering			
Configuration/programming software	STEP 7 Micro/WIN	STEP 7 / STEP 7 Professional	
Programming languages	LAD, FBD, STL	LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC	
Configuration of integral HMI functions			
Communication			
MPI	●	●	
PtP	● (Freeport)	● (also via CP)	
AS-Interface	● (via CP)	● (via CP)	
PROFIBUS	● (via CP as DP slave)	● [4] (also via CP)	
PROFINET		● (also via CP)	
Others integrated	Freeport, PPI, via CP: Ind. Ethernet		
Web server		● (PN-CPUs)	

SIMATIC S7-400	SIMATIC ET 200 with CPU		SIMATIC C7
	ET 200S	ET 200pro	
Modular controllers for system solutions in manufacturing and process automation in the medium to upper performance ranges	Distributed, modular I/O system with local intelligence		S7-300 controller and operator panel as all-in-one unit
	With degree of protection IP20	With degree of protection IP65/67	
• 9 standard CPUs • 2 fail-safe CPUs • 3 fault-tolerant CPUs	• 3 standard CPUs • 2 fail-safe CPUs	• 1 standard CPU	• 3 versions (various CPU/Panel combinations) • Customized design on request
10 years	10 years		10 years
0...60 °C [3]	0...60 °C [2]	-25...55 °C	0...50 °C [3]
0.018 µs (CPU 417)	0.1 µs		0.1 µs
	ET 200S	ET 200pro	
30 MB (CPU 417)	128 KB [5]	256 KB	128 KB
Memory card 64 MB	Micro Memory Card 8 MB		Micro Memory Card 8 MB
Program and data by means of backup battery or program by means of MC FEPROM	Program and data on Micro Memory Card (maintenance-free)		Program and data on Micro Memory Card (maintenance-free)
	ET 200S	ET 200pro	
16384/16384 bytes	244/244 bytes	2048/2048 bytes	2048/2048 bytes
			●
●	●	●	●
All ET 200 I/O devices	All ET 200 I/O devices		All ET 200 I/O devices
ET 200S, ET 200pro, ET 200M	ET 200S, ET 200pro, ET 200M		ET 200S, ET 200pro, ET 200M (via CP)
●	●	●	●
			●
●	●	●	●
●		●	
	ET 200S	ET 200pro	
● (F-CPUs/FH-CPUs)	●		
● (H/FH-CPUs)			
●			
●	●		
●			
			● (Touch Panel or Operator Panel)
STEP 7 / STEP 7 Professional	STEP 7 / STEP 7 Professional		STEP 7 / STEP 7 Professional
LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC	LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC		LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC
			WinCC flexible (C7-613: STEP7)
	ET 200S	ET 200pro	
●	●	●	●
● (via CP)			● (via CP)
			● (via CP)
● (also via CP)	●	●	● (also via CP)
● (also via CP)	●	●	● (via CP)
● (PN-CPUs)	● (PN-CPUs)	●	

[1] With SIPLUS components, also for extended temperature range -25...+70 °C and aggressive atmosphere/condensation (www.siemens.com/siplus) [2] As [1], but temperature range -25...+60 °C [3] With SIPLUS components also for aggressive atmosphere/condensation (www.siemens.com/siplus) [4] For technology CPU additionally PROFIdrive [5] 192 KB with "F" version
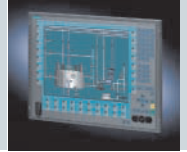
Selection guide

SIMATIC Embedded Automation				
S7-mEC RTX	**Microbox 427B-RTX, 427B-HMI/RTX**	**Microbox 420-T**	**Panel PC 477B-HMI/RTX**	

SIMATIC product range				
Brief description	Modular controller in S7-300 design (fanless, diskless) with Win XP embedded and software PLC	Embedded rail PC (fanless, diskless) with Win XP embedded and software PLC	Embedded rail PC (fanless, diskless) with Win XP embedded, software PLC and technological functions	Embedded Panel PC (fanless, diskless) with Win XP embedded, software PLC and HMI
Product range	Standard product	Standard product Customized design/OEM product on request		Panel PC with 12"/15"/ 19", Key or Touch, Customized design/OEM product on request
Spare parts guaranteed for	5 years	5 years	5 years	5 years
Temperature range	0...50 °C	0...50 °C	0...50 °C	5...45 °C
Performance				
Execution time for bit operation, min.		0.01 µs (Pentium M 1.4 GHz)	0.01 µs (PIII 933 MHz)	0.01 µs (Pentium M 1.4 GHz)
Memory				
Work memory, max.	1 GB RAM	1 GB RAM	512 MB RAM	1 GB RAM
Load memory/mass storage, max.	2 GB Flash Disk	2 or 4 GB CF card	1, 2 GB CF card	2 or 4 GB CF card
Buffer, max.	Control data (256 KB SRAM) without UPS, all data with UPS	Control data (128 KB SRAM) without UPS, all data with UPS	Control data (30 KB SRAM) without UPS, all data with UPS	Control data (128 KB SRAM) without UPS, all data with UPS
I/O				
I/O address area, max.	16384/16384 bytes	16384/16384 bytes	2048/2048 bytes	16384/16384 bytes
Centralized - I/O integrated in CPU - I/O modules on CPU	●	● (via PCI-104, ODK)	● (8 DO) 	● (via PCI-104, ODK)
Distributed - I/O modules on PROFIBUS	● *)	All ET 200 I/O devices		
- I/O modules on PROFINET	ET 200S/pro/M			
Technology functions				
Loadable function blocks	●	●	●	●
Basic functions integrated in CPU				
Special modules, plugged in centrally				
Technology controllers			●	
Isochronous mode		●	●	●
HMI functions				
Integrated	● optional *)	● (427B-HMI/RTX)		●
PC functions				
C/C++ link	● (via ODK)	● (via ODK)	● (via ODK)	● (via ODK)
Data acquisition and archiving	● (large volumes of data)	● (large volumes of data)	● (large volumes of data)	● (large volumes of data)
Expandable with PC standard hardware	● (max. 3 PCI-104 cards)*)	● (max. 3 PCI-104 cards)		● (max. 3 x PCI-104)
Integration of PC standard HW/SW	● (via ODK, OPC) *)	● (via ODK, OPC)	● (via ODK, OPC)	● (via ODK, OPC)
Engineering				
Configuration/programming software	STEP 7 / STEP 7 Professional			
Programming languages	LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC			
Configuration of integral HMI functions		WinCC flexible (optional)		WinCC flexible
Communication				
MPI				
PtP		● (via CP distributed)	● (via CP distributed)	● (via CP distributed)
AS-Interface				
PROFIBUS		●	● 1)	●
PROFINET	●			
Others integrated	Industrial Ethernet, USB	Ind. Ethernet, USB, RS232, DVI/VGA		
Web server				

SIMATIC PC-based Controllers			
SIMATIC WinAC MP 277/377		**WinAC Soft PLC**	**WinAC Slot PLC**
MP 277	MP 377		
Software PLC on multifunctional platform (without fan, without hard disk) with Windows CE		S7 controller as software PLC for PC with Windows operating system	S7 controller as PCI plug-in card for PC with Windows operating system
Standard product Customized design and OEM product on request		1 software PLC WinAC RTX 2008	2 Slot PLCs
10 years			5 years
0...50 °C		PC-dependent	PC-dependent
		0.004 µs (P 4, 2.4 GHz)	0.04 µs (WinAC Slot 416)
256 KB	512 KB	PC main memory [3]	3.2 MB
		PC mass storage	64 MB memory card
Control data (128 KB MRAM) without UPS	Control data (256 KB MRAM) without UPS	All data with UPS [4]	All data
4096/4096 bytes	8192/8192 bytes	16384/16384 bytes	16384/16384 bytes
		● [2]	● [2]
All ET 200 I/O devices			
		ET 200S/pro/M	
●		●	●
		●	●
● (Multi Panel)		● (can be installed on PC)	● (can be installed on PC)
		● (via ODK)	
●		● (very large volumes of data)	
		● (PC-dependent)	
		● (via ODK, OPC)	
STEP 7 / STEP 7 Professional		STEP 7 / STEP 7 Professional	
LAD, FBD, STL, S7-Graph (SFC), S7-SCL (ST), S7-HiGraph, CFC			
WinCC flexible Standard, Advanced			
●			●
		● (via CP distributed)	● (via CP distributed)
●		● (via CP in PC)	●
		● (via CP in PC)	
Ind. Ethernet, USB, RS232		PC interfaces	PC interfaces

*) Available soon ¹⁾ For Microbox 420-T with additional PROFIdrive ²⁾ Via PC cards and ODK ³⁾ Non-paged memory
⁴⁾ 128 KB with certain SIMATIC PCs without UPS or WinAC NV 128

SIMATIC Modular controllers
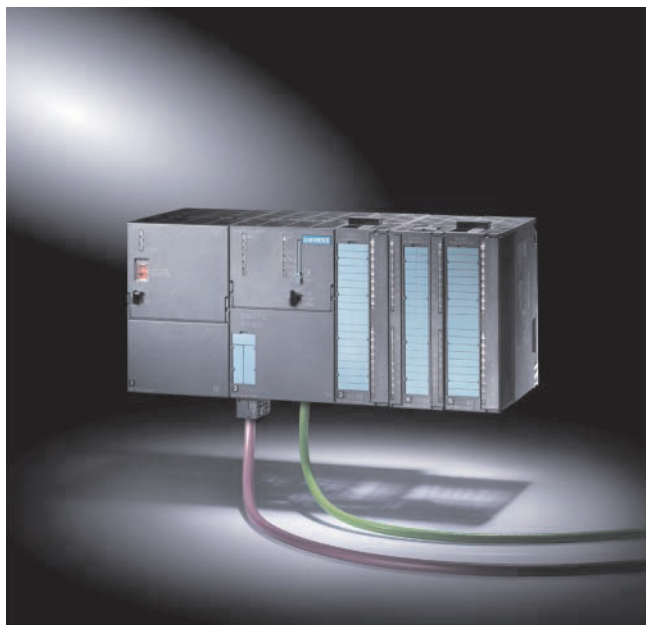
SIMATIC S7-300

*Production in the automobile industry –
automated with the SIMATIC S7-300*

SIMATIC S7-300: The modular controller for innovative system solutions in the manufacturing industry

SIMATIC S7-300 is the best-selling controller of the *Totally Integrated Automation* spectrum with a host of successful reference applications worldwide from the most varied industrial sectors, such as:

• Manufacturing engineering
• Automotive industry
• General machine construction
• Special-purpose machine manufacturing
• Standard mechanical equipment manufacture, OEMs
• Plastics processing
• Packaging industry
• Food, beverages and tobacco industries
• Process engineering

SIMATIC S7-300 for innovative system solutions in the manufacturing industry

Highlights

The SIMATIC S7-300 has been designed for innovative system solutions with the focus on manufacturing engineering, and as a universal automation system, it represents an optimal solution for applications in centralized and distributed configurations:

■ The ability to integrate powerful CPUs with Industrial Ethernet/PROFINET interface, integrated technological functions, or fail-safe designs make additional investments unnecessary.

■ The S7-300 can be set up in a modular configuration without the need for slot rules for I/O modules. There is a wide range of modules available both for the centralized and the distributed configuration with ET 200M.

■ The Micro Memory Card as a data and program memory makes a backup battery superfluous and saves maintenance costs. In addition, an associated project, including symbols and comments, can be stored on this memory card to facilitate service calls.

■ The Micro Memory Card also enables simple program or firmware updates without a programming device. The Micro Memory Card can also be used during operation for storing and accessing data, e.g. for measured value archiving or recipe processing.

■ In addition to standard automation, safety technology and motion control can also be integrated in an S7-300.

■ Many of the S7-300 components are also available in a SIPLUS version for external environmental conditions, e.g. extended temperature range (-25 ... +60 °C) and for use where there is aggressive atmosphere/condensation. More detailed information available at **www.siemens.com/siplus**

Design

Design

The S7-300 enables space-saving and modular configurations. In addition to the modules, only a DIN rail is required for hooking in the modules and screwing them into place. This results in a rugged and EMC-compatible design. The build-as-you-go backplane bus can be expanded by simply plugging in additional modules and bus connectors.

The varied range of the S7-300 can also be used for central expansions or the construction of distributed structures with ET 200M; thereby producing very cost-effective spare parts handling.

Expansion options

If the automation task requires more than 8 modules, the central controller (CC) of the S7-300 can be expanded using expansion units (EUs) Up to 32 modules can be used in the central rack and up to 8 per expansion unit. Interface modules (IMs) handle communication between the individual racks autonomously. In the case of plants covering wide areas, CCs/EUs can also be installed at greater distances from each other (up to 10 m).

In a single-tiered configuration, this results in a maximum configuration of 256 I/O, and in multi-tiered configurations up to 1024 I/O. In distributed configurations with PROFIBUS DP, 65536 I/O connections are possible (up to 125 stations, such as ET 200M via IM 153). The slots are freely addressable, that is, there are no slot rules.

The extensive range of S7-300 modules is also used in distributed automation solutions. The ET 200M I/O system that has the same construction as the S7-300 can be connected via Interface modules not only to PROFIBUS but also to PROFINET.
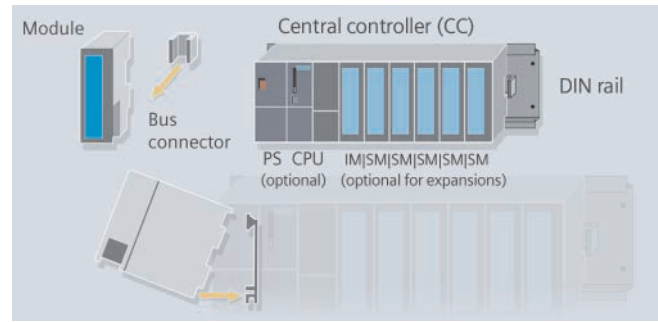
Structure of the S7-300: space-saving, modular and simple
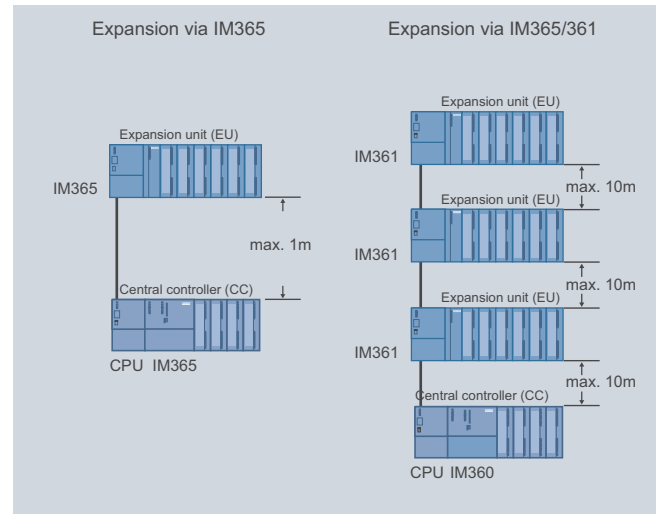
Centralized expansion of the S7-300 with up to 32 modules

| Components for SIMATIC S7-300			
	Components	**Special feature**	**Order number core**
Rack	Mounting rail	160 to 2000 mm	6ES7 390-1....
Interface module	IM 360	Send IM for CC, for up to 3 EUs	6ES7 360-3A...
	IM 361	Receiver IM for EU, for connecting to IM 360	6ES7 360-3C...
	IM 365	Expansion with 1 EU	6ES7 365-0B...
Power Supply	PS 307 (2 A)	120/230 V AC	6ES7 307-1BA..
	PS 305 (2 A) [1]	24-110 V DC	6ES7 305-1BA..
	PS 307 (5 A) [1]	120/230 V AC	6ES7 307-1EA..
	PS 307 (10 A) [2]	120/230 V AC	6ES7 307-1KA..

[1] As SIPLUS component also for extended temperature range -25 °C to +60 °C and aggressive atmosphere/condensation [2] As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)

CPU range

A graded CPU range with a wide performance range is available for configuring the controller. Thanks to their high processing speed, the CPUs enable short machine cycle times. The narrow module width results in a compact controller design or a small control cabinet.

The CPUs are available from a width of only 40 mm. Fail-safe CPUs are available for safety-oriented applications. The PROFIsafe profile for safe communication via PROFIBUS and PROFINET allows the integration of safety-related functions into standard automation environments.

Compact CPUs with widths of 80 or 120 mm also offer integral I/O and integral technological functions. This onboard I/O (digital/analog) and the technological functions save additional investments in other modules.
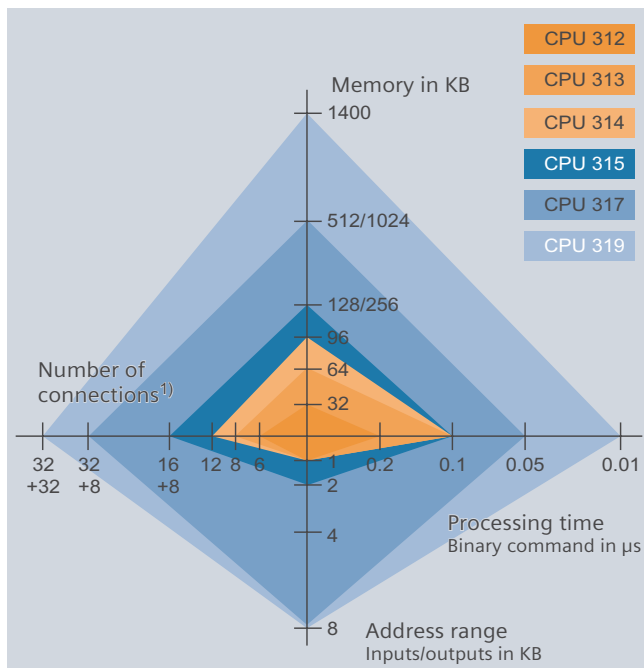
Six performance classes of the S7-300 CPUs

1) Connections stand for internal resources of the CPU for the communication with PGs/OPs and over blocks. The standard bus communication and the PtP coupling do not require connections. The PN-CPUs offer 8 additional connections for TCP/IP, UDP, and ISO-on-TCP.

Applications include the following:

- High-speed counting/measuring with direct access to the hardware counter
- Simple positioning with direct control of the MICROMASTER frequency inverter
- PID control with integral function block

This range is rounded off by a special technology CPU with powerful technological functions, especially for motion control.

Together with the integral digital I/O and equidistant and isochronous mode on PROFIBUS DP, off-the-shelf, PLCopen-compliant motion control functions enable the flexible motion control of several (even linked) axes.

Micro Memory Card

The Micro Memory Card is a compact medium that meets the highest industrial requirements, especially ESD protection and mechanical ruggedness.

The system-tested Micro Memory Card allows more write cycles than conventional memory cards and offers know-how protection because the serial number can be read out by the program.

High performance CPU 319-3 PN/DP with integrated PROFINET interface

Useful additional functions:

- Simpler and faster upgrade due to firmware update via network.
- Resetting of all settings to the factory settings using the hardware switch (Reset to Factory).

Version	CPU	Isochronous mode on the PROFIBUS	Integrated interfaces	Integral I/O	Integrated technological functions
Standard CPUs					
	CPU 312, 314 [1]		MPI		
	CPU 315-2 DP [1]		MPI, DP		
	CPU 315-2 PN/DP [1]	●	DP/MPI, PROFINET		
	CPU 317-2 DP	●	DP/MPI, DP		
	CPU 317-2 PN/DP [1]	●	DP/MPI, PROFINET		
	CPU 319-3 PN/DP	●	DP/MPI, DP, PROFINET		
Failsafe CPUs					
	CPU 315F-2 DP [1]		MPI, DP		Fail safety with PROFIsafe profile
	CPU 315F-2 PN/DP	●	DP/MPI, PROFINET		
	CPU 317F-2 DP [1]	●	DP/MPI, DP		
	CPU 317F-2 PN/DP	●	DP/MPI, PROFINET		
	CPU 319F-3 PN/DP	●	DP/MPI, DP, PROFINET		
Compact CPUs					
	CPU 312C [1]		MPI	Digital	• Counting • Closed-loop control • Frequency measurement • Pulse width modulation • Pulse generator
	CPU 313C [1]		MPI	Digital, analog	
	CPU 313C-2 PtP		MPI, PtP	Digital	
	CPU 313C-2 DP [1]		MPI, DP	Digital	
	CPU 314C-2 PtP		MPI, PtP	Digital, analog	As above, and additionally • Positioning
	CPU 314C-2 DP [1]		MPI, DP	Digital, analog	
Technology CPUs					
	CPU 315T-2 DP	●	DP/MPI, DP(DRIVE)	Digital	• Synchronous operation • Travel to fixed stop • Print mark correction • Cam control • Controlled positioning
	CPU 317T-2 DP	●	DP/MPI, DP(DRIVE)	Digital	

[1] As SIPLUS component also for extended temperature range -25 ... +60 °C and aggressive atmosphere/condensation (www.siemens.com/siplus)

Technical specifications for standard CPUs

CPU	CPU 312	CPU 314 [1]	CPU 315-2 DP [1]	CPU 315-2 PN/DP [1]	CPU 317-2 DP	CPU 317-2 PN/DP [1]	CPU 319-3 PN/DP
Dimensions (mm)	40 x 125 x 130		40 x 125 x 130	80 x 125 x 130	80 x 125 x 130		120 x 125 x 130
Order number core: 6ES7	312-1AE.	314-1AG.	315-2AG.	315-2EH.	317-2AJ.	317-2EK.	318-3EL.
Memory							
Work memory	32 KB	96 KB	128 KB	256 KB	512 KB	1 MB	1.4 MB
Instructions	10 K	32 K	42 K	84 K	170 K	340 K	470 K
Processing times							
Bit operation	0.2 µs	0.1 µs	0.1 µs		0.05 µs		0.01 µs
Word operation	0.4 µs	0.2 µs	0.2 µs		0.2 µs		0.02 µs
Fixed-point operation	5 µs	2 µs	2 µs		0.2 µs		0.02 µs
Floating-point operation	6 µs	3 µs	3 µs		1 µs		0.04 µs
Bit memories/timers/counters							
Bit memory	128 bytes	256 bytes	2048 bytes		4096 bytes		8192 bytes
S7 timers/counters	128/128	256/256	256/256		512/512		2048/2048
IEC timers/counters	●	●	●		●		●
Address areas							
I/O (bytes)	1024/1024	1024/1024	2048/2048		8192/8192	8192/8192	8192/8192
I/O process image (bytes)	128/128	128/128	128/128		256/256	2048/2048	2048/2048
Digital channels (central)	256	1024	1024		1024	1024	1024
Analog channels (central)	64	256	256		256	256	256
DP interfaces							
DP master systems internal / CP 342-5	○ / ●		● / ○		● / ●	● / ●	● / ●
DP slaves			●		●	●	●
PROFINET interface							
PROFINET CBA				●		●	●
PROFINET I/O				●		●	●
PROFINET with IRT							● [3]
TCP/IP				●		●	●
UDP				●		●	●
ISO-on-TCP (RFC 1006)				●		●	●
Web server				●		●	●
Data set gateway [2]							●

[1] As SIPLUS component also for extended temperature range -25 ... +60 °C and aggressive atmosphere/condensation (www.siemens.com/siplus)

[2] For explanation, see page 48 bottom right

[3] Updating times up to 250 µs

Technical specifications Compact CPUs

CPU	CPU 312C [1]	CPU 313C [1]	CPU 313C-2 PtP	CPU 313C-2 DP [1]	CPU 314C-2 PtP	CPU 314C-2 DP [1]
Dimensions (mm)	80 x 125 x 130	120 x 125 x 130			120 x 125 x 130	
Required front connector	1 x 40-pin	2 x 40-pin	1 x 40-pin		2 x 40-pin	
Order number core: 6ES7	312-5BE.	313-5BF.	313-6BF.	313-6CF.	314-6BG.	314-6CG.
Memory						
Work memory	32 KB	64 KB			96 KB	
Instructions	10 K	21 K			32 K	
Processing times						
Bit operation	0,2 µs	0,1 µs			0,1 µs	
Word operations/ fixed-point operations/ floating-point operations	0,4/5/6 µs	0,2/2/3 µs			0,2/2/3 µs	
Bit memories/timers/counters						
Bit memory	128 bytes	256 bytes			256 bytes	
S7 timers/counters	128/128	256/256			256/256	
IEC timers/counters	●	●			●	
Address areas						
I/O (bytes)	1024/1024	1024/1024	1024/1024		1024/1024	
Process I/O image	128/128 bytes	128/128 bytes	128/128 bytes		128/128 bytes	
Digital channels (central)	266	1016	1008		1016	
Analog channels (central)	64	253	248		253	
Integrated functions						
Counter (incremental enc.)	2 incr.enc., 24 V/10 kHz	3 incr.enc., 24 V/30 kHz			4 incr.enc., 24 V/60 kHz	
Pulse outputs (PCM)	2 channels, max. 2.5 kHz	3 channels, max. 2.5 kHz			4 channels, max. 2.5 kHz	
Frequency measurement	2 channels max. 10 kHz	3 channels max. 30 kHz			4 channels max. 60 kHz	
Open-loop positioning					SFB for positioning, 1 axis via 2 DO, AO	
Integrated "Controlling" FB	PID controller	PID controller			PID controller	
Integrated I/O						
Digital inputs	10 x 24 V DC; all channels can be used for process interrupts	24 x 24 V DC; all channels can be used for process interrupts	16 x 24 V DC; all channels can be used for process interrupts		24 x 24 V DC; all channels can be used for process interrupts	
Digital outputs	6 x 24 V DC, 0.5 A	16 x 24 V DC, 0.5 A	16 x 24 V DC, 0.5 A		16 x 24 V DC, 0.5 A	
Analog inputs		4: ± 10 V, 0..10 V, ± 20mA, 0/4..20 mA; 1: 0..600 Ω, PT100			4: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA; 1: 0..600 Ω, PT100	
Analog outputs		2: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA			2: ± 10 V, 0..10 V, ± 20 mA, 0/4.-20 mA	
DP interface						
DP master systems int./ CP 342-5	○ / ●	○ / ●	○ / ●	● / ●	● / ●	● / ●
DP slave				●		●
PtP interface						
Properties			RS485/422		RS485/422	
Protocol driver			3964 (R), RK512, ASCII		3964 (R), RK512, ASCII	

[1] As SIPLUS component also for extended temperature range -25 ... +60 ℃ and aggressive atmosphere/condensation (www.siemens.com/siplus)

Technical specifications for failsafe CPUs

Fail-safe CPU	CPU 315F-2 DP [1]	CPU 315F-2 PN/DP	CPU 317F-2 DP [1]	CPU 317F-2 PN/DP	CPU 319F-3 PN/DP
Dimensions (mm)	40 x 125 x 130	80 x 125 x 130	80 x 125 x 130		120 x125 x130
Order number core: 6ES7	315-6FF.	315-2FH.	317-6FF.	317-2FK.	318-3FL.
Memory					
Work memory	192 KB	256 KB	1 MB		1.4 MB
Instructions	36 K (F instr.)	50 K (F instr.)	200 K (F instructions)		280 K (F instr.)
Processing times					
Bit operation	0.1 µs		0.05 µs		0.01 µs
Word operation	0.2 µs		0.2 µs		0.02 µs
Fixed-point operation	2 µs		0.2 µs		0.02 µs
Floating-point operation	3 µs		1 µs		0.04 µs
Bit memories/timers/counters					
Bit memory	2048 bytes		4096 bytes		8182 bytes
S7 timers/S7 counters	256/256		512/512		2048/2048
IEC timers/IEC counters	●		●		●
Address areas					
I/O (bytes)	2048/2048		8192/8192	8192/8192	8192/8192
I/O process image (bytes)	128/128		256/256	2048/2048	2048/2048
Digital channels (central)	1024		1024	1024	1024
Analog channels (central)	256		256	256	256
DP interfaces					
DP master systems internally/CP	● / ●		● / ●		● / ●
DP slave	●		●		●
PROFINET interface					
PROFINET CBA		●		●	●
PROFINET I/O		●		●	●
PROFINET with IRT					● [3]
TCP/IP		●		●	●
UDP		●		●	●
ISO-on-TCP (RFC 1006)		●		●	●
Web server		●		●	●
Data set gateway [2]					●

NEW PROFINET with IRT

NEW Data set gateway [2]

[1] As SIPLUS component also for extended temperature range -25 … +60 ℃ and aggressive atmosphere/condensation (www.siemens.com/siplus)

[2] For explanation, see page 48 bottom right

[3] Updating times up to 250 µs

Technical specifications for technology CPUs

Technology CPU	CPU 315T-2 DP	CPU 317T-2 DP
Dimensions	160 x 125 x 130	160 x 125 x 130
Required front connector	1 x 40-pin	1 x 40-pin
Order number core: 6ES7	315-6TG.	317-6TJ.
Memory		
Work memory	128 KB	512 KB
Instructions	42 K	170 K
Processing times		
Bit operation	0.1 µs	0.05 µs
Word operations/fixed-point operations/ floating-point operations	0.2/2/3 µs	0.2/0.2/1 µs
Bit memories/timers/counters		
Bit memory	4096 bytes	4096 bytes
S7 timers/S7 counters	256/256	512/512
IEC timers/IEC counters	●	●
Address areas		
I/O address area	2048/2048 bytes	8192/8192 bytes
Process I/O image	128/128 bytes	256/256 bytes
Digital channels (central)	256	256
Analog channels (central)	64	64
DP interfaces		
DP master systems internal / CP 342-5	● / ●	● / ●
DP slave	●	●
Integrated I/O		
Digital inputs	4 x 24 V DC; for BERO evaluation, for example	
Digital outputs	8 x 24 V DC, 0.5 A: for high-speed cam switching functions	
Integrated functions	Gearbox synchronism and curve synchronism Travel to fixed stop Registration mark correction via measuring probe Path- or time-dependent cam switching Controlled positioning	

Module range

The multi-facetted module range of S7-300 allows modular customization to suit the most varied tasks. S7-300 supports multi-facetted technological tasks and offers exhaustive communication options. Apart from the CPUs with integrated functions and interfaces, there is a wide range of special modules in S7-300 design for technology and communication.

Technology

Function modules are intelligent modules that independently execute the technological tasks and thus reduce the load on the CPU. They are used when a high level of accuracy and dynamic response is required.

Controller module FM 355-2

Communication

Communication processors are used for connecting S7-300 to the different bus systems / communication networks as well for point-to-point link.

CP 343-1 communications processor

Function modules		
Technological function	**Channels / Axes**	**Module**
Counting, measuring, proportioning, position detection (incremental)	1	FM 350-1
Counting, measuring, proportioning	8	FM 350-2 [3]
Cam controls	1	FM 352
High-speed binary logic operations	1	FM 352-2
PID control (continuous)	4	FM 355C
PID control (step/impulse)	4	FM 355S
Temperature control (continuous)	4	FM 355-2C
Temperature control (step/impulse)	4	FM 355-2S
Positioning (rapid traverse/creep feed)	2	FM 351
Position detection (SSI)	3	SM 338
Positioning (with stepper drives)	1	FM 353
Positioning (with servo drives)	1	FM 354
Positioning, path control, interpolation, synchronization	4	FM 357-2
Isochronous connection of drives via PROFIBUS	4	IM 174

Communications processors	
Bus system / communication network	**Module**
AS-Interface (master) [2]	CP 343-2 CP 343-2 P
PROFIBUS DP [2]	CP 342-5
	CP 342-5 FO (for fiber-optic conductors)
PROFIBUS FMS [2]	CP 343-5
PROFINET / Industrial Ethernet [2]	CP 343-1 Lean
	CP 343-1
	CP 343-1 Advanced (with IT functionality)[1]
Point-to-point link	CP 340 [4] CP 341 [4]
WAN	TIM 3V-IE TIM 3V-IE Advanced

[1] The IT functionality offers
- Creation of proprietary Web pages with any HTML tool, with simple assignment of the process variables of the S7 to the HTML objects
- Monitoring of the S7 via Web pages with a standard browser
- Sending of e-mails from the user program of the S7 through function calls
- Remote programming, maintenance and diagnostics via the telephone network (e.g. ISDN)

You can find further information in the brochure *SIMATIC Technology* and on the Internet at

www.siemens.com/simatic-technology

[2] Further information can be found in the brochure *Industrial Communication* and on the Internet at

www.siemens.com/automation/simatic-net

[3] As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)

[4] As SIPLUS component also for extended temperature range -25 ... +60 °C and aggressive atmosphere/condensation

Point-to-point link

Point-to-point link via communications processors (CPs) is an extremely powerful and low-cost alternative to bus systems. The advantage of point-to-point links over bus systems is especially pronounced when only a few (RS 485) devices are to be connected to the SIMATIC S7.

The CPs can also economically connect third-party systems to the SIMATIC S7. Thanks to the great flexibility of the CPs different physical transmission media, speeds or even customized transmission protocols can be implemented.

The CPs have a rugged plastic housing with LEDs for displaying operating states and faults.

For each CP, there is a configuring package on CD with electronic manual, parameterization screen forms and standard function blocks for communication between the CPU and the CP.

The configuring data are stored in a system data block stored in the CPU. When modules are replaced, the new module is therefore immediately ready for use.

The interface modules for the S7-300 are available in three versions, each with one interface for the different physical transmission media.
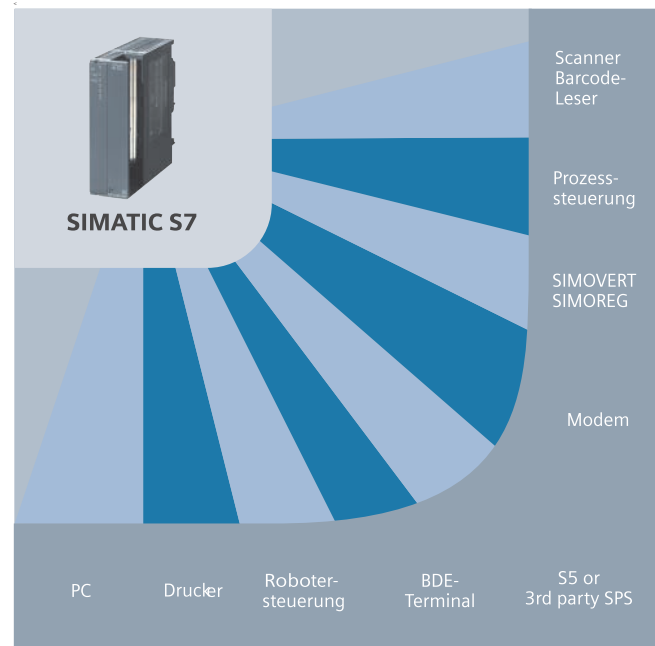
Point-to-point links for SIMATIC S7-300

Technical data for point-to-point link		
Application	**Low-cost entry version**	**Powerful computer connection, loadable protocols**
Transmission rate	Low (19200 bit/s)	High (76800 bit/s)
Loadable protocols		MODBUS master (6ES7340-1AA.), MODBUS slave (6ES7340-1AB.), Data highway (6ES7340-1AE.)
Module	**CP 340**	**CP 341**
Order number core: 6ES7	340-1.	341-1.
Physical transmission media		
RS 232C (V.24)	CP 340-1A	CP 341-1A
20 mA (TTY)	CP 340-1B	CP 341-1B
RS 422/485 (X.27)	CP 340-1C	CP 341-1C
Integrated transmission protocols		
ASCII	●	●
Printer driver	●	●
3964 (R)	●	●
RK 512		●

Overview of point-to-point links for S7-300

Module range

Signal modules

Signal modules are the interface of the SIMATIC S7-300 to the process. A host of different digital and analog modules provide exactly the inputs/outputs required for each task.

Digital and analog modules differ as regards the number of channels, voltage and current ranges, electrical isolation, diagnostics and alarm functions, etc.

In all the module ranges named here, SIPLUS components are also available for extended temperature range -25...+60 °C and aggressive atmosphere/condensation (www.siemens.com/siplus).

Easy installation

The sensors/actuators are connected through front connectors. These are available for the following connection methods:

- Screw connection
- Spring loaded
- Fast Connect (insulation displacement)

When a module is replaced, the connector is simply plugged into the new module of the same type; the wiring is retained. The coding of the front connector avoids mistakes.

Fast connection

Connection with SIMATIC TOP connect is even simpler and faster (not for the onboard I/O of the compact CPUs). Preassembled front connectors with single cores and a complete plug-in modular system comprising a front connector module, connecting cable and terminal block are available.

High packing density

The high number of channels on the modules provides for the space-saving design of the S7-300. Modules are available with 8 to 32 channels (digital) or 2 to 8 channels (analog) per module.

Simple parameterization

The modules are configured and parameterized using STEP 7, and there are no inconvenient switch settings to be made. The data are stored centrally and, following module replacement, they are automatically transferred to the new module so that no setting errors can occur. No software upgrade is required when using new modules. A configuration can be copied as often as required, e.g. for standard machines.

Diagnostics, interrupts

Many modules additionally monitor signal acquisition (diagnostics) and the signals from the process (process interrupt). This makes it possible to react immediately to process errors, e.g. wire breaks or short circuits, and any process event, e.g. rising or falling edge at a digital input. The response of the controller can easily be parameterized in STEP 7.
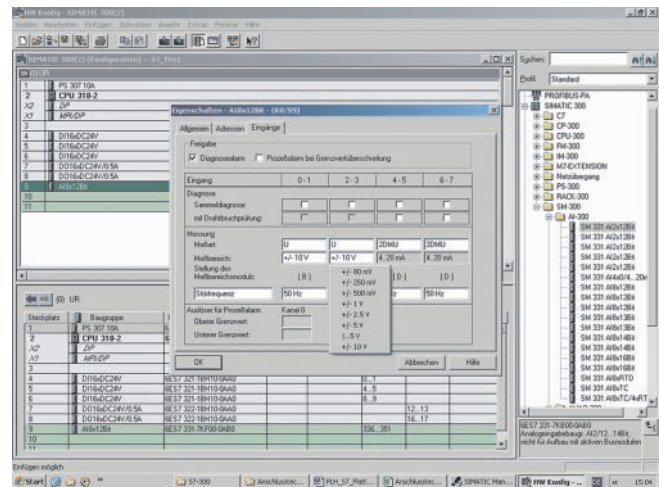
Parameterization of an analog input module

Special modules

For test and simulation, the simulation module can be plugged into the S7-300. It enables simulation of encoder signals via switches and indicates output signals via LEDs.

The module can be plugged in anywhere regardless of slot rules. The dummy module reserves a slot for an unconfigured signal module. When the module is installed later, the mechanical configuration and address assignment of the overall configuration remain unchanged.

On the following pages you will find criteria for selecting the appropriate signal module for each application.

Digital inputs

Module	Voltage range	Number of channels
SM 321	24 V DC	16, 32, 64
SM 321	48-125 V DC	16
SM 321	24/48 VUC	16
SM 321	120/230 V AC	8, 16, 32

Analog inputs

Module	Measuring range	Resolution	Number of channels
SM 331	Voltage	Up to 16 bits	2, 8
SM 331	Current (also HART)	Up to 16 bits	2, 8
SM 331	Resistance	Up to 16 bits	1, 4, 8
SM 331	Thermocouple elements	Up to 16 bits	2, 8
SM 331	Resistance thermometer	Up to 15 bits	1, 4, 8

Digital inputs/outputs

Module	Voltage range	Number of channels
SM 323	24 V DC	8 or 16 DI and DO
SM 327	24 V DC	8 DI and 8 DX (parameterized as input or output)

Analog inputs/outputs

Module	Measuring range	Resolution	Number of channels
SM 334	Voltage	Up to 13 bits	2, 4
SM 334	Current	8 bits	4
SM 334	Resistance	13 bits	4
SM 334	Resistance thermometer	15 bits	4
SM 335	Voltage	14 bits	4
SM 335	Current	14 bits	4

Digital outputs

Module	Voltage range	Current range	Number of channels
SM 322	24 V DC	0.5A	8, 16, 32, 64
SM 322	24 V DC	2 A	8
SM 322	48-125 V DC	1.5A	8
SM 322	120/230 V AC	1A	8, 16, 32
SM 322	120/230 V AC	2 A	8
SM 322	UC (relay)	0.5A-5A	8, 16

Analog outputs

Module	Measuring range	Resolution	Number of channels
SM 332	Voltage	Up to 16 bits	2, 4, 8
SM 332	Current (also HART)	Up to 16 bits	2, 4, 8

You can find detailed information on S7-300 signal modules in the appendix.

Signal module SM 332-1

SIMATIC S7-400

SIMATIC S7-400: The Power Controller for system solutions in the manufacturing and process industries

Within the Controller family, the SIMATIC S7-400 is designed for system solutions in the manufacturing and process automation.

Typical applications:
• Automotive industry
• Standard mechanical equipment manufacture incl. custom mechanical equipment manufacture
• Warehousing systems
• Building engineering
• Steel industry
• Power generation and distribution
• Paper and printing industries
• Woodworking
• Textile manufacture
• Pharmaceuticals
• Food, beverages and tobacco industries
• Process engineering, e.g. water and wastewater utilities
• Chemical industry and petrochemicals

Highlights

The following features make the SIMATIC S7-400 the most powerful PLC:

■ The S7-400 is especially suitable for data-intensive tasks in the process industry. High processing speeds and deterministic response times guarantee short machine cycle times on high-speed machines in the manufacturing industry. The high-speed backplane bus of S7-400 ensures efficient linking of central I/O modules.

■ The S7-400 is used preferably to coordinate overall plants and to control lower-level communications lines with slave stations; this is guaranteed by the high communication power and the integral interfaces.

■ The power of the S7-400 is scalable thanks to a graded range of CPUs; the capacity for I/O is almost unlimited.

■ The power reserves of the CPUs enable new functions to be integrated without further hardware investment, e.g. processing of quality data, user-friendly diagnosis, integration into higher-level MES solutions or high-speed communication via bus systems.

■ The S7-400 can be structured in a modular way without any slot rules; there is a widely varied range of modules available both for centralized configurations and distributed structures.

■ The configuration of the distributed I/O of the S7-400 can be modified during operation. In addition signal modules can be removed and inserted while live (hot swapping). This makes it very easy to expand the system or replace modules in the event of a fault.

■ The storage of the complete project data including symbols and comments on the CPU simplifies service and maintenance calls.

■ Safety technology and standard automation can be integrated into an S7-400 controller; the plant availability can be increased by the redundant set-up of the S7-400.

■ Many of the S7-400 components are also available in a SIPLUS version for external environmental conditions, e.g. extended temperature range (-25 ... +60 °C) and for use where there is aggressive atmosphere/condensation. More detailed Information available at **www.siemens.com/siplus**

Use in a brewery...

Design

Modularity

An important feature of the S7-400 is its modularity. The powerful backplane bus of the S7-400 and the DP communication interfaces that can be plugged directly onto the CPU allow the high-performance operation of many communication lines.

This permits, for example, the division into one communications line for HMI and programming tasks, one line for high-performance and equidistant motion control components, and one "normal" I/O fieldbus. Additionally required connections to MES-/ERP systems or the Internet via SIMATIC IT can also be implemented.

...or in the textile industry

The S7-400 can be expanded centrally or in a distributed configuration depending on the task. Add-on devices and interface modules are available centrally for this purpose. Distributed expansion is possible over the PROFIBUS or PROFINET interfaces integrated in the CPUs. If required, communication processors (CPs) can also be used.

Design

An S7-400 system basically comprises a rack, power supply, and central processing unit. It can be installed and expanded in a modular way. All modules can be positioned freely next to the power supply plugged in on the left. The S7-400 has a rugged design without a fan. Signal modules can be hot-swapped.

A multi-faceted module range can be used for central expansions as well as for simple configuration of distributed topologies with ET 200. This results in very cost-effective spare parts handling.

Simple installation of the SIMATIC S7-400 through hooking in the modules

In addition to the standard mounting racks, aluminum mounting racks with 9 and 18 slots are also available. These aluminum racks are highly resistant to unfavorable environmental conditions, and they are more rigid and around 25% lighter.

CPU range

There is a graded range of CPUs from the entry-level CPU right up to the high-performance CPU for configuring the controller.

All CPUs control large quantity structures; several CPUs can work together in a multicomputing configuration to boost performance. Thanks to their high processing speed and deterministic response times, the CPUs enable short machine cycle times.

The different CPUs are distinguished by, for example, RAM, address range, number of connections and execution time. As well as the standard CPUs, there are also two fail-safe and two fault-tolerant CPUs available.
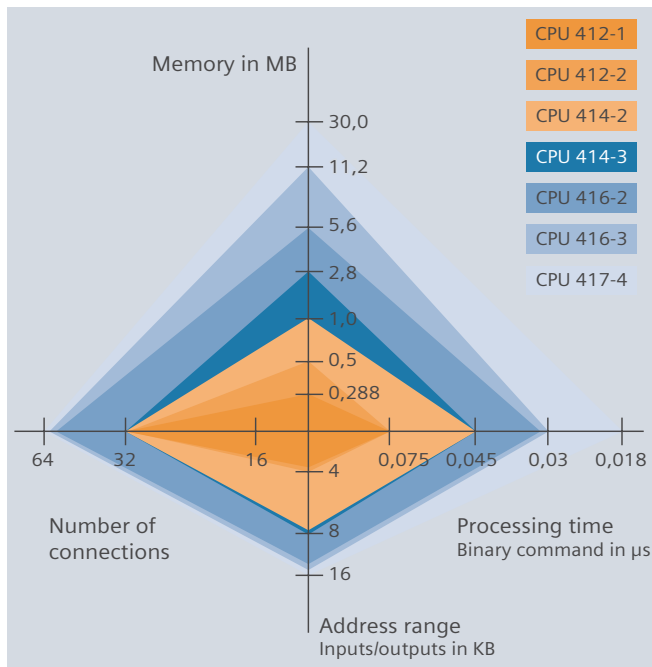
CPU range of the S7-400 Standard CPUs

Multicomputing

Multicomputing, that is, the simultaneous operation of several CPUs in one S7-400 central controller, offers users different benefits:
• The overall performance of an S7-400 can be shared by means of multicomputing. For example, complex tasks in technologies such as open-loop control, computing or communication can be split and assigned to different CPUs. Each CPU is assigned its own, local I/O for this purpose.
• Some tasks can also be disconnected from each other in multicomputing, that is, one CPU processes the time-critical process tasks and another handles the non-time-critical tasks.

In multicomputing operation, all CPUs behave like a single CPU, that is, when one CPU goes to STOP, the others are also halted. The actions of several CPUs can be coordinated selectively by instruction via synchronization calls.

In addition, data exchange between the CPUs takes place at an extremely high speed via the "global data" mechanism.

Performance

The S7-400 is characterized not only by short response times, but also by large performance reserves. Extremely short response times can be achieved in this way even when simultaneous communication is required or other unforeseen loads occur. This makes specified response times possible, for example the response time of an output signal to a change in an input signal.

Additional functions can also be integrated without any further hardware investment. Examples of new functions include the saving and processing of quality data, user-friendly diagnostics or vertical integration into higher-level MES solutions. The improved communication performance enables high-speed communication over Industrial Ethernet as well as efficient connection of the field level via PROFIBUS, for example with isochronous tasks.

Diagnostics

The intelligent diagnostics system of the CPUs continuously monitors the functional capability of the system and the process, and registers faults and specific system events; the user's own diagnostics messages can also be added.

The diagnostics can be used to determine whether the module's signal acquisition (in the case of digital modules) or analog processing (analog modules) is fault-free. When a diagnostics message is pending (e.g. "No encoder supply"), the module triggers a diagnostics interrupt.

The CPU then interrupts execution of the user program and runs the relevant diagnostics interrupt block. Process signals can be monitored, and responses to signal changes can be triggered via process interrupts.

Technical specifications S7-400 CPUs

CPU	CPU 412-1	CPU 412-2	CPU 414-2	CPU 414-3	CPU 414-3 PN/DP
Dimensions (mm)	25 x 290 x 219			50 x 290 x 219	
No. of slots	1			2	
Order number core: 6ES7	412-1XJ.	412-2XJ.	414-2XK.	414-3XM.	414-3EM.
Work memory					
Integrated	288 KB	512 KB	1 MB	2.8 MB	
Instructions	48 K	84 K	170 K	460 K	
For program	144 KB	256 KB	512 KB	1.4 MB	
For data	144 KB	256 KB	512 KB	1.4 MB	
Processing times					
Bit operation	0.075 µs		0.045 µs		
Word operation	0.075 µs		0.045 µs		
Fixed-point operation	0.075 µs		0.045 µs		
Floating-point operation	0.225 µs		0.135 µs		
Bit memories, timers, counters					
Bit memory	4 KB		8 KB		
S7 timers/counters	2048 / 2048		2048 / 2048		
IEC timers/counters	●		●		
Address areas					
I/O	4 KB / 4 KB		8 KB / 8 KB		
Process I/O image	4 KB / 4 KB		8 KB / 8 KB		
Digital channels	32768 / 32768		65536 / 65536		
Analog channels	2048 / 2048		4096 / 4096		
DP interfaces					
Number of DP interfaces	1 (MPI/DP)	1	1	2	1
Number of DP slaves	32	64	96	96 each	125 each
Plug-in interface modules				1 x DP	1 x DP
PN interfaces					
Number of PN interfaces					1 (2 ports)
PROFINET I/O					●
PROFINET with IRT `NEW`					●
PROFINET CBA					●
TCP/IP					●
UDP					●
ISO-on-TCP (RFC 1006)					●
Web server					●
Data set gateway `NEW`					●

CPU	CPU 416-2	CPU 416F-2	CPU 416-3 [1]	CPU 416-3 PN/DP [1]	CPU 416F-3 PN/DP	CPU 417-4 [1]
Dimensions (mm)	25 x 290 x 219		50 x 290 x 219			50 x 290 x 219
No. of slots	1		2			2
Order number core: 6ES7	416-2XN.	416-2FN.	416-3XR.	416-3ER.	416-3FR.	417-4XT.
Work memory						
Integrated	5.6 MB		11.2 MB			30 MB
Instructions	920 K	560 K F instructions	1840 K		1120 K F instructions	5 M
For program	2.8 MB		5.6 MB			15 MB
For data	2.8 MB		5.6 MB			15 MB
Processing times						
Bit operation	0.03 μs					0.018 μs
Word operation	0.03 μs					0.018 μs
Fixed-point operation	0.03 μs					0.018 μs
Floating-point operation	0.09 μs					0.054 μs
Bit memories, timers, counters						
Bit memory	16 KB					16 KB
S7 timers/counters	2048 / 2048					2048 / 2048
IEC timers/counters	●					●
Address areas						
I/O	16 KB / 16 KB					16 KB / 16 KB
Process I/O image	16 KB / 16 KB					16 KB / 16 KB
Digital channels	131072 / 131072					131072 / 131072
Analog channels	8192 / 8192					8192 / 8192
DP interfaces						
Number of DP interfaces	1	1	2	1	1	3
Number of DP slaves	125	125	125 each	125 each	125 each	125 each
Plug-in interface modules			1 x DP	1 x DP	1 x DP	2 x DP
PN interfaces						
Number of PN interfaces				1 (2 ports)	1 (2 ports)	
PROFINET I/O				●	●	
PROFINET with IRT				●	●	
PROFINET CBA				●	●	
TCP/IP				●	●	
UDP				●	●	
ISO-on-TCP (RFC 1006)				●	●	
Web server				●	●	
Data set gateway				●	●	

NEW — PROFINET with IRT

NEW — Data set gateway

[1] As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)

Memory concept, buffering, special functions

Data/program memory

All CPUs of the S7-400 have a separation between data memory and program memory. This division of the work memory provides a performance boost of 100% in some constellations. Whereas a standard processor has to access its RAM at least twice, the S7-400 special processor accesses the code memory and data memory simultaneously in the same cycle. There are also separate code and data buses for this purpose. This provides the user with additional performance power!

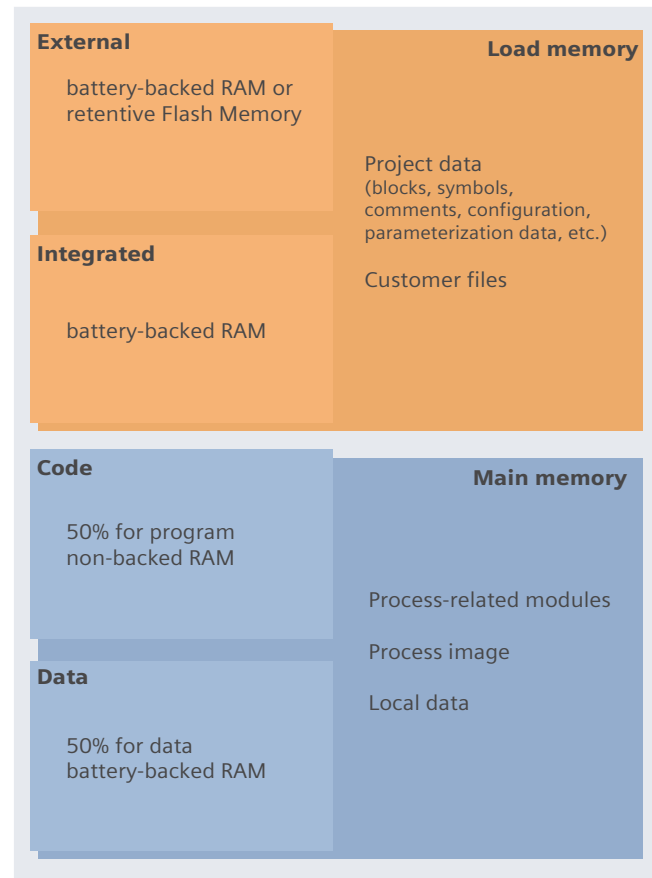The size of the work memory is determined CPU that can be selected from a finely graded range of CPUs.

The integral load memory (RAM) is sufficient for small to medium-sized programs. For larger programs, the load memory is enlarged by plugging in RAM or FEPROM memory cards (64 KB to 64 MB).

With the 64 MB RAM memory card, it is possible to store the contents of the entire work memory of even the largest CPU. This RAM memory is backed up using a battery of the power supply. RAM memory cards are used especially in cases where, for example, the user program has to be modified frequently during the startup phase. RAM memory cards enable faster saving than FEPROM memory cards, and any number of write cycles.

For retentive storage without backup battery, there are plug-in FEPROM memory cards available whose data are retained even after the card has been disconnected.

Backup battery

The power supply modules of the S7-400 have a battery compartment for one or two backup batteries, depending on the type. If the supply voltage via the backplane bus fails, this battery backs up the set parameters and the memory contents (RAM) in CPUs and parameterizable modules and thus permits a restart of the CPU after a voltage failure using the saved parameters. Both the power supply module and the backed-up modules monitor the operating voltage and indicate when the battery is empty.

External	Load memory
battery-backed RAM or retentive Flash Memory	Project data (blocks, symbols, comments, configuration, parameterization data, etc.)
Integrated	Customer files
battery-backed RAM	

Code	Main memory
50% for program non-backed RAM	Process-related modules
Data	Process image
50% for data battery-backed RAM	Local data

Memory types of the SIMATIC S7-400

Special functions

The S7-400 CPUs have some highly useful special functions:
- Simpler and faster upgrade due to firmware update via network
- Resetting of all settings to the factory settings using a hardware switch (Reset to Factory)
- Additional write-protection (for e.g. no component download from PC to CPU) via a system function
- Optional know-how protection by reading the serial number of the memory card, so that it is ensured that the program runs only with the particular memory card

An integrated data record gateway permits integrated access to data records across different bus systems and network boundaries e.g. a control-level PC can communicate via PROFINET with a lower-level S7-400 controller and the field devices connected to it via PROFIBUS.

Configuration in RUN

Changes to the configuration during operation

Modifications or expansions are also required during operation of a plant (section), such as implementation of additional sensors or actuators, reparameterization of I/O modules (e.g. choosing of other interrupt limits). Possible applications are non-stop requirements, that is, in continuous processes that cannot be shut down or whose production cannot be interrupted: process plants or manufacturing plants with high restart costs.

With SIMATIC S7-400, hardware configuration changes can be carried out during operation of a plant without any adverse effects. CiR (Configuration in RUN) enables plant expansions and conversions during the operational phase.

Benefits

- CiR enables plant expansions and optimizations. Expansion and conversion of a plant can be made during operation of the process. These changes to the plant are reaction-free. This means expansions and conversions can be carried out faster and at lower cost.
- In addition, modifications in RUN enable an extremely flexible response to process changes and process optimizations.
- The time needed for the conversion of plants with no non-stop requirements can also be reduced through changing and reconfiguring during RUN because the plant does not have to be re-initialized or synchronized due to hardware configuration changes.

Application

Changes to the hardware configuration in RUN are possible with distributed I/O. All standard CPUs of the S7-400 can be used, as well as the S7-400H fault-tolerant CPUs in stand-alone operation.

CiR processes can be carried out with the following DP masters:
- CPU via integral Interfaces
- CP 443-5 ext (from V5.0)
- IF 964 DP interface module

S7-400H CPUs in redundant configurations can be modified during operation using the H-CiR function.

Functions

The following hardware configuration changes can be carried out during plant operation:
- Addition of distributed I/O nodes (PROFIBUS DP and PROFIBUS PA slaves), e.g. for establishing an additional process line
- Adding of I/O modules in the ET 200M distributed I/O system, e.g. for implementing additional sensor technology
- Undoing changes, that is, field devices (DP/PA slaves) and modules that have been added can be removed again

Reparameterization of I/O modules in the ET 200M I/O system, e.g. replacing parts when using a sensor with another specification, or for selecting other interrupt limits
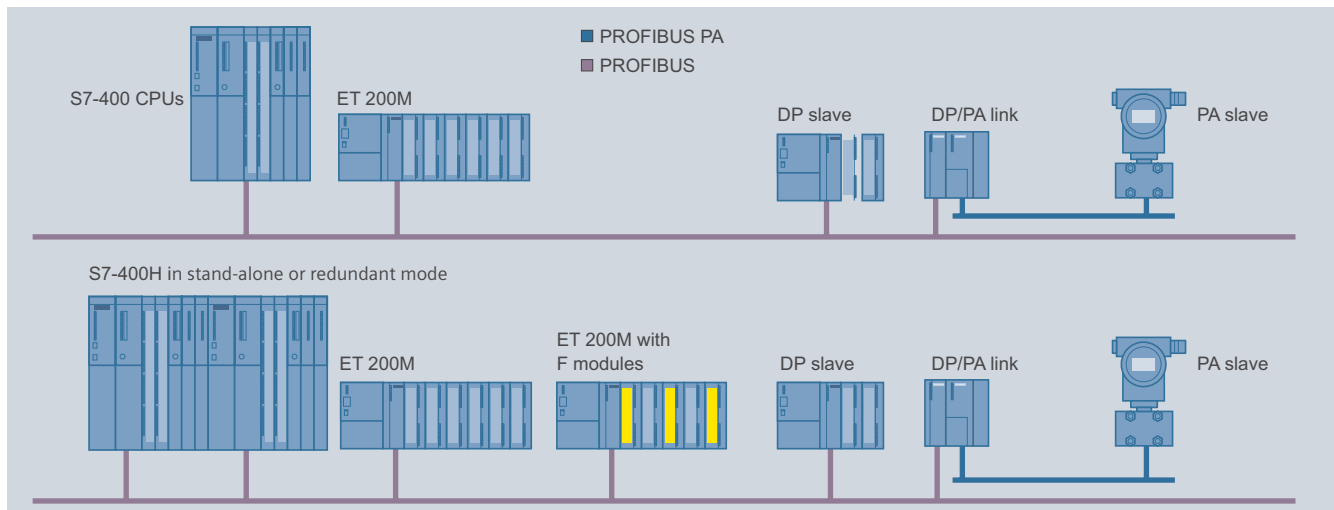
Range of modules that can be added to or removed from a plant during operation with an S7-400 as master

Module range

The multi-facetted module range of S7-400 allows modular customization to suit the most varied tasks. S7-400 supports multi-facetted technological tasks and offers exhaustive communication options. There is a wide range of special modules in S7-400 design technology and communication.

Function module FM 452

Communications processor CP 443-1 Advanced

Technology

Function modules are intelligent modules that independently execute the technological tasks and thus reduce the load on the CPU. They are used when a high level of accuracy and dynamic response is required.

Function modules		
Technological function	**Channels / Axes**	**Module**
Counting, measuring, proportioning, position detection (incremental)	2	FM 450 [3]
Cam controls	1	FM 452
PID control (continuous)	16	FM 455C
PID control (step/impulse)	16	FM 455S
Positioning (rapid traverse/creep feed)	3	FM 451
Positioning (with stepper and servo drives)	3	FM 453
Freely configurable PLC, control, motion control and technology tasks	Any	FM 458-1 DP

You can find further information in the brochure SIMATIC Technology and on the Internet at **www.siemens.com/simatic-technology**

Communication

Communication processors are used for connecting S7-400 to the different bus systems / communication networks as well for point-to-point coupling.

Communications processors	
Bus system / communication network	**Module**
PROFIBUS DP [2]	CP 443-5 Extended
PROFIBUS FMS [2]	CP 443-5 Basic [3]
PROFINET / Industrial Ethernet [2]	CP 443-1 Advanced (with IT functionality) [1] [3]
Point-to-point link	CP 440 CP 441

[1] The IT functionality offers:
- Creation of proprietary Web pages with any HTML tool, with simple assignment of the process variables of the S7 to the HTML objects
- Monitoring of the S7 via Web pages with a standard browser
- Sending of e-mails from the user program of the S7 through function calls
- Remote programming, maintenance and diagnostics via the telephone network (e.g. ISDN)

[2] Further information can be found in the brochure *Industrial Communication* and on the Internet at **www.siemens.com/automation/simatic-net**

[3] As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)

Point-to-point link

Point-to-point link via communications processors (CPs) is an extremely powerful and low-cost alternative to bus systems.

The advantage of point-to-point links over bus systems is especially pronounced when only a few (RS 485) devices are to be connected to the SIMATIC S7.

The CPs can also easily link third-party systems to the SIMATIC S7. Thanks to the great flexibility of the CPs, different physical transmission media, transmission rates or even customized transmission protocols can be implemented.

The CPs have a rugged plastic housing with LEDs for displaying operating states and faults.

For each CP, there is a configuring package on CD with electronic manual, parameterization screen forms and standard function blocks for communication between the CPU and the CP.

The configuring data are stored in a system data block stored in the CPU. When modules are replaced, the new module is therefore immediately ready for use.

With the S7-400 point-to-point link modules, adaptation to the physical transmission media is achieved by plugging in the relevant interface submodules, without the need for external converters.
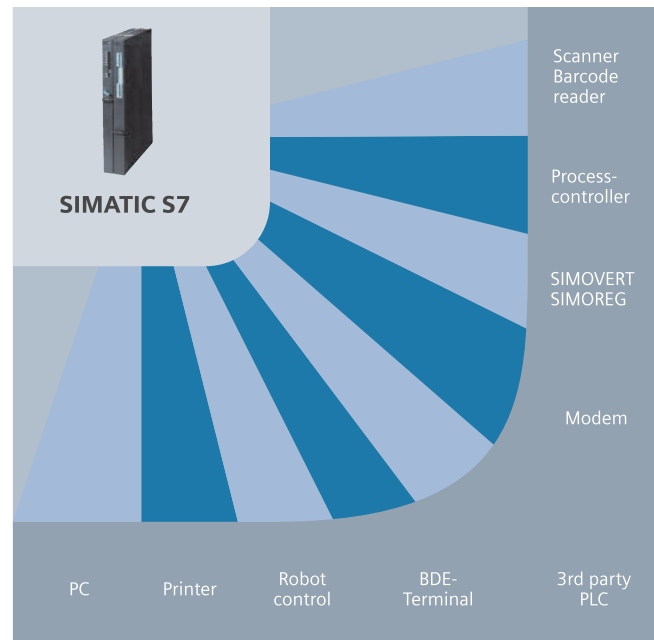
Point-to-point links for SIMATIC S7-400

Technical data for point-to-point link			
Application	**High-speed response with low data volumes**	**Connection**	
		Low-cost with a variable interface	**High-speed with two variable interfaces**
Transmission rate	High (115200 bit/s)	Low (38400 bit/s)	High (115200 bit/s)
Loadable protocols (Order number core: 6ES7340-)			MODBUS Master (-1AA.), MODBUS Slave (-1AB.), Data Highway (-1AE.)
Module	**CP 440**	**CP 441-1**	**CP 441-2**
Order number core: 6ES7	440-1.	441-1.	441-2.
Physical transmission media			
RS 232C (V.24)		All transmission methods, all interface modules, plug-in, serial	
20 mA (TTY)			
RS 422/485 (X.27)	● (up to 32 nodes)		
Integrated transmission protocols			
ASCII	●	●	●
Printer driver		●	●
3964 (R)	●	●	●
RK 512			●

Module range

Signal modules

Signal modules are the interface of the controller to the process. A host of different digital and analog modules provide exactly the inputs/outputs required for each task. Digital and analog modules differ as regards the number of channels, voltage and current ranges, electrical isolation, diagnostics and alarm functions, etc.

However, the S7-400 signal modules are only a subset of the modules that can be connected to the S7-400 via PROFIBUS DP. Centrally connected signal modules can be connected and disconnected during operation. This makes module replacement extremely easy.

In all the module ranges listed here, SIPLUS components are also available for aggressive atmospheres/condensation. (www.siemens.com/siplus)

Easy installation

The sensors/actuators are connected through front connectors. When a module is replaced, the connector is simply plugged into the new module of the same type; the wiring is retained. The coding of the front connector avoids mistakes. The S7-400 is also able to detect whether the front connector is plugged in.

Fast connection

SIMATIC TOP connect makes connection even simpler and faster. Preassembled front connectors with single cores and a complete plug-in modular system comprising a front connector module, connecting cable and terminal block are available.

High packing density

The high number of channels on the modules is a reason for the space-saving design. For example, modules with 8 to 32 digital channels or 8 to 16 analog channels are available.

Simple parameterization

The modules are configured and parameterized using STEP 7, and there are no inconvenient switch settings to be made. The data are stored centrally and, following module replacement, they are automatically transferred to the new module so that no setting errors can occur. No software upgrade is required when using new modules. A configuration can be copied as often as required, e.g. for standard machines.

Diagnostics, interrupts

Many modules additionally monitor signal acquisition (diagnostics) and the signals from the process (process interrupt. e.g. edge evaluation) This makes it possible to react immediately to process errors, e.g. wire breaks or short circuits, and any process event, e.g. rising or falling edge at a digital input. The response of the controller can easily be programmed with STEP 7. On the digital input modules, several interrupts per module are possible.
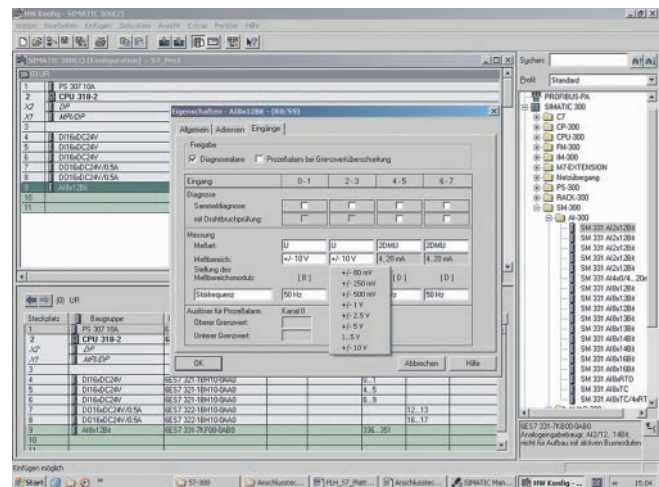
Parameterization of an analog input module

On the following pages you will find criteria for selecting the appropriate signal module for each application.

Digital inputs

Module	Voltage range	Number of channels
SM 421	24 V DC	16, 32
SM 421	24-60 VUC	16
SM 421	120/230 VUC	16, 32

Analog inputs

Module	Measuring range	Resolution	Number of channels
SM 431	Voltage	Up to 16 bits	8, 16
SM 431	Current	Up to 16 bits	8, 16
SM 431	Resistance	Up to 16 bits	4, 8
SM 431	Thermocouple elements	Up to 16 bits	8, 16
SM 431	Resistance thermometer	Up to 16 bits	4, 8

Digital outputs

Module	Voltage range	Current range	Number of channels
SM 422	24 V DC	0.5A	32
SM 422	24 V DC	2 A	16
SM 422	120/230 V AC	2 A	16
SM 422	UC (relay)	5A	16

Analog outputs

Module	Measuring range	Resolution	Number of channels
SM 432	Voltage, current	13 bits	8

You can find detailed information on S7-400 signal modules in the appendix.

SM 421 signal module

SIMATIC S7-400H

Hot standby with SIMATIC S7-400H

High-availability SIMATIC S7-400H

The SIMATIC S7-400H is a controller with two H CPUs of the same type; in the event of a fault, changeover takes place from the master system to the standby station. It is suitable for high-availability processes with *hot standby requirements* (processes with changeover times shorter than 100 ms).

Synchronization

The method of event-driven synchronization supports fast and bumpless changeover to the redundant CPU in the event of a fault. It resumes processing at the point of interruption without any loss of information or interrupts. The operating system ensures that all commands, which if executed independently would produce different states in the two systems, operate in synchronism. No programming or parameterization has to be performed by the user for this purpose.

Features of the SIMATIC S7-400H

Design
The central devices can be configured in two different ways:
• When the subunits have to be completely separated from each other for availability reasons, it is appropriate to use two standard racks (UR1 and UR2). Each rack accommodates one CPU and one power supply (PS). If extremely high availability is required, two redundant power supply modules can be used. The distance between the two racks can be up to 10 km.
• Two CPUs, each with either a single or a redundant power supply, are plugged into the UR2-H rack with a segmented backplane bus. This supports an extremely compact configuration.
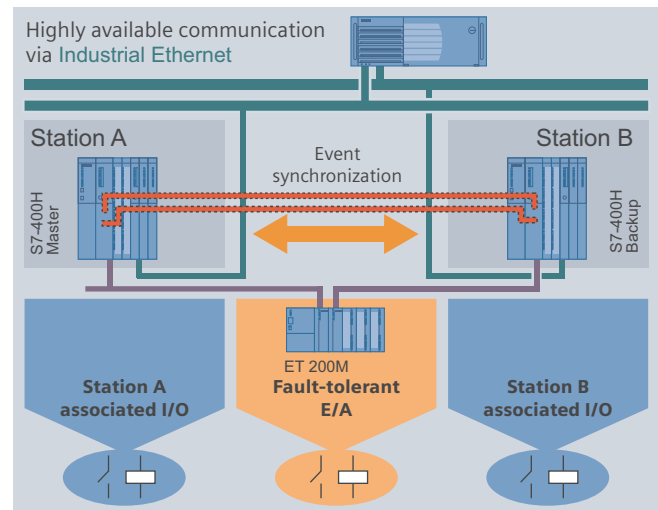
I/O
Depending on the type of connection, the following I/O components can be used:
• All PROFIBUS slaves for single-sided connection
• ET 200M for switched and redundant connection

Highlights

■ Performance-oriented solution for time-critical processes

■ Synchronized hardware solution without information loss

Topology of the S7-400H with two controllers and the associated I/O (standard and high-availability)

Engineering
Programming is possible, as in the case of a standard system, in all STEP 7 programming languages. The programs can easily be ported from standard systems to a redundant system and vice-versa. When the program is loaded, it is automatically distributed onto the two redundant CPUs. The functions and configurations specific to redundancy are parameterized using the S7 H-Systems option package (integrated into STEP 7 Version 5.3 or higher). The planning engineer is free to concentrate solely on controlling the process.

Diagnostics/module replacement
Apart from the standard diagnostic functions, the following functions are also available:
• With the integrated self-diagnostics functions, the system detects and signals errors before they can affect the process. They enable the faulty components to be identified and replaced quickly which speeds up repairs.
• All components can be replaced during normal operation (online repair). When a CPU is replaced, all the current programs and data are automatically reloaded. It is also possible to modify the program during normal operation, e.g. changing and reloading function blocks
• Changes can also be made to the configuration during normal operation, e.g. adding or removing DP slaves or modules, changing the memory configuration of the CPU.

Fault-tolerant CPUs

Three CPUs are available for the SIMATIC S7-400H to suit different performance requirements.

Apart from high volumes, the H-CPUs are also characterized by high performance.

This is not only visible in a high processing speed, but also in a large communication output. Furthermore, an integrated memory type that detects and automatically corrects memory cells corrupted through external influences is also used. The H-CPUs now also permit a firmware update via the network.

Technical data for H-CPUs			
CPU	**CPU 412-3H**	**CPU 414-4H** [2]	**CPU 417-4H** [2]
Dimensions (mm)	50 x 290 x 219	50 x 290 x 219	50 x 290 x 219
No. of slots	1	1	1
Order number core: 6ES7	412-3HJ.	414-4HM.	417-4HT.
Work memory			
Integrated	768 KB	2.8 MB	30 MB
Instructions	128 K	460 K	5 M
For program	512 KB	1.4 MB	15 MB
For data	256 KB	1.4 MB	15 MB
Processing times			
Bit operation	0.075 µs	0.045 µs	0.018 µs
Word operation	0.075 µs	0.045 µs	0.018 µs
Fixed-point operation	0.075 µs	0.045 µs	0.018 µs
Floating-point operation	0.225 µs	0.135 µs	0.054 µs
Bit memories, timers, counters			
Bit memory	8 KB	8 KB	16 KB
S7 timers/counters	2048 / 2048	2048 / 2048	2048 / 2048
IEC timers/counters	●	●	●
Address areas			
I/O	8 KB / 8 KB	8 KB / 8 KB	16 KB / 16 KB
Process I/O image	8 KB / 8 KB	8 KB / 8 KB	16 KB / 16 KB
Digital channels	65536 / 65536	65536 / 65536	131072 / 131072
Analog channels	4096 / 4096	4096 / 4096	8192 / 8192
Interfaces			
DP	1 [1]	2 [1]	2 [1]
Sync modules	2	2	2

[1] *An interface can either be used as a PROFIBUS DP or as an MPI (Multipoint Interface)*
[2] *As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)*

Sync modules

The three H-CPUs are connected by means of fiber-optic cables and "Sync modules" that can be directly plugged into the CPU. This means that no slot in the rack is lost and that communication is extremely fast. The Sync modules can be replaced with the voltage applied.

There are two types of Sync modules:

• For Sync cables up to 10 m in length
• For Sync cables up to 10 km in length with the CPUs 414-4H or 417-4H for applications in which the subunits have to be set up at some distance

I/O

I/O interface

The I/O can be connected to suit the availability requirements. The following types of connection are available:

1. Single-sided connection (normal availability) for all PROFIBUS slaves, e.g. ET 200M, ET 200S, ET 200eco
2. Switched connection (increased availability) for ET 200M
3. Redundant connection (fault-tolerant) for ET 200M
These configurations can also be mixed.

Y link

With the help of the Y link, a subordinate I/O station with various field devices can be easily connected to a redundant PROFIBUS DP system, e.g. an S7-400H with two DP master systems.

In the event of a fault, the Y link switches over the complete I/O line bumplessly to the active bus channel of the redundant H system.

The Y link supports connection of most types of PROFIBUS slave:
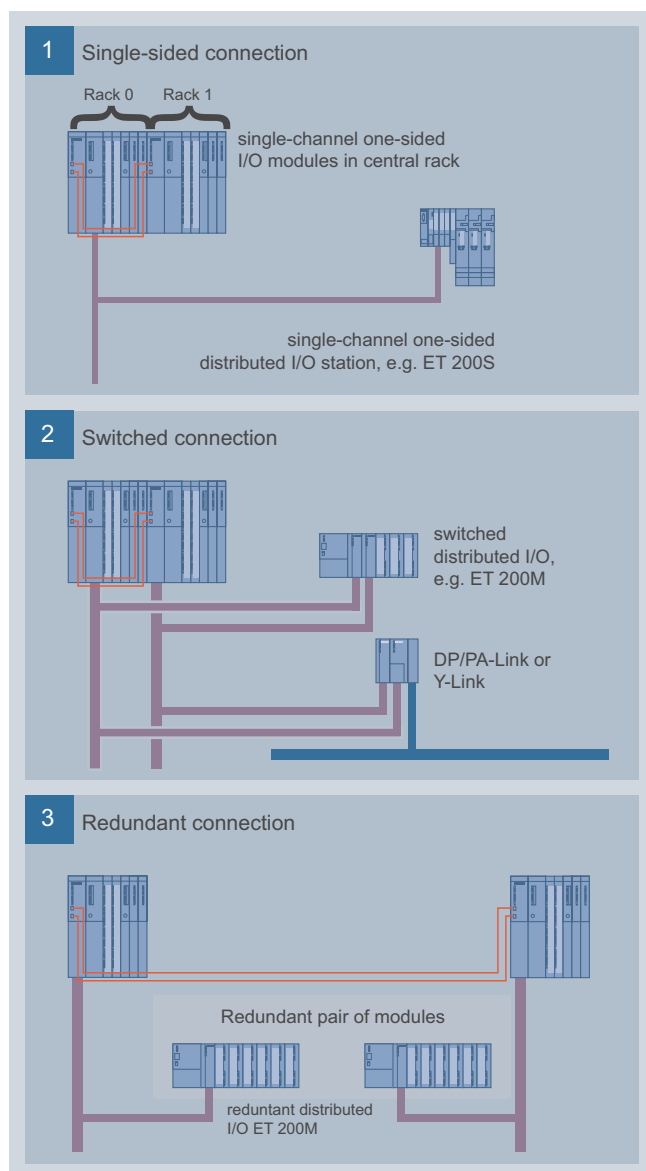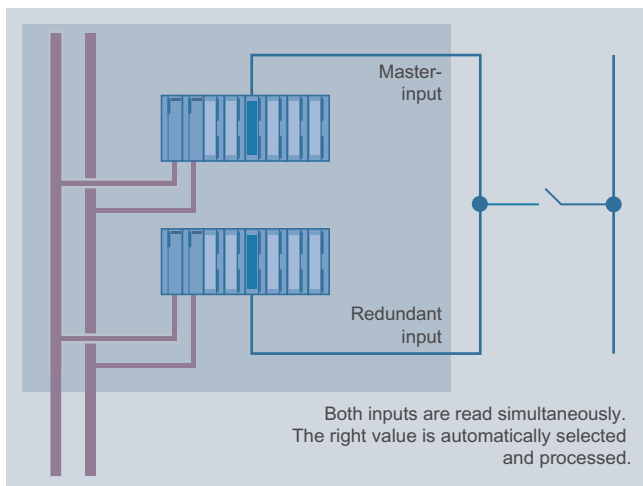

I/O connection of S7-400H
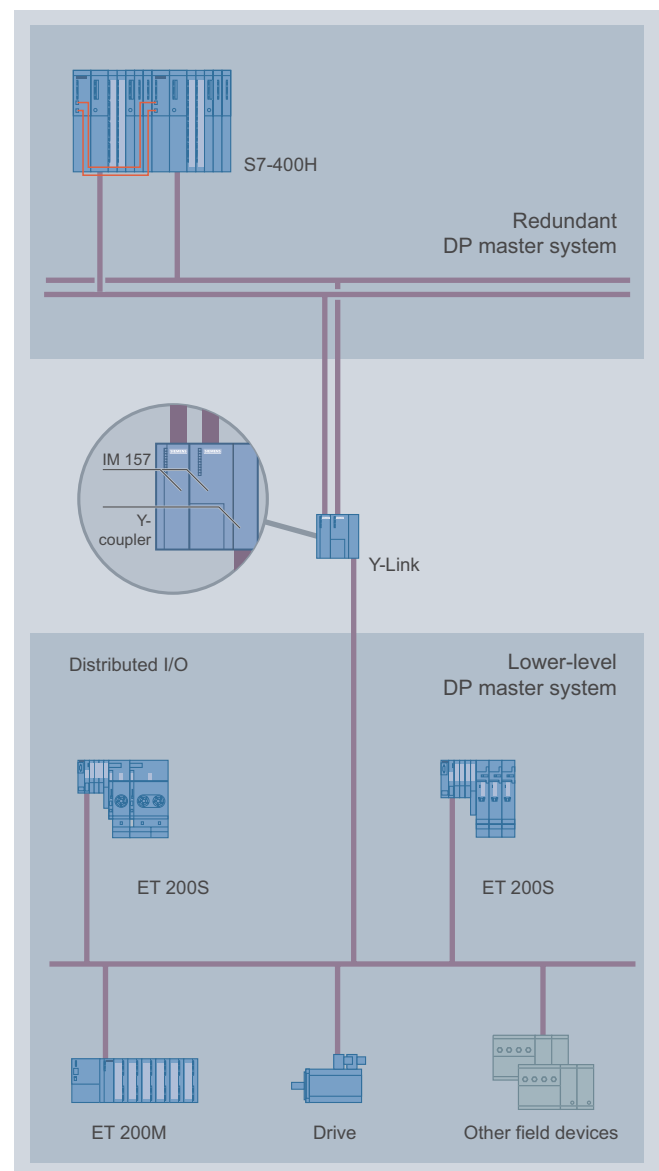
Connection of a lower-level bus system to the S7-400H via the Y link

Redundant I/O

Principle of redundant I/O

Redundant I/Os are input and output modules that are redundantly configured and operated. Maximum availability is offered by the implementation of redundant I/O because in this manner, failure of a CPU, a PROFIBUS line and a signal module is compensated for. During normal operation, both modules are active, i.e. in the case of redundant inputs, the values of the shared sensor are read in by two modules, the result is compared and made available to the user as a unified value for further processing.

Scalable availability

The availability is scalable in accordance with the redundant I/O configuration:

1. Each module in a separate rack with redundant connection to PROFIBUS or
2. Each module in a separate rack with single connection to PROFIBUS or
3. Both modules in one rack.

Master-input

Redundant input

Both inputs are read simultaneously.
The right value is automatically selected
and processed.

Principle of redundant I/O

In the case of redundant outputs, the value calculated by the user program is output by both modules.

In the event of a fault, e.g. if one of the two input modules fails, the defective module is no longer addressed, the fault is signaled and processing continues with the intact module only.
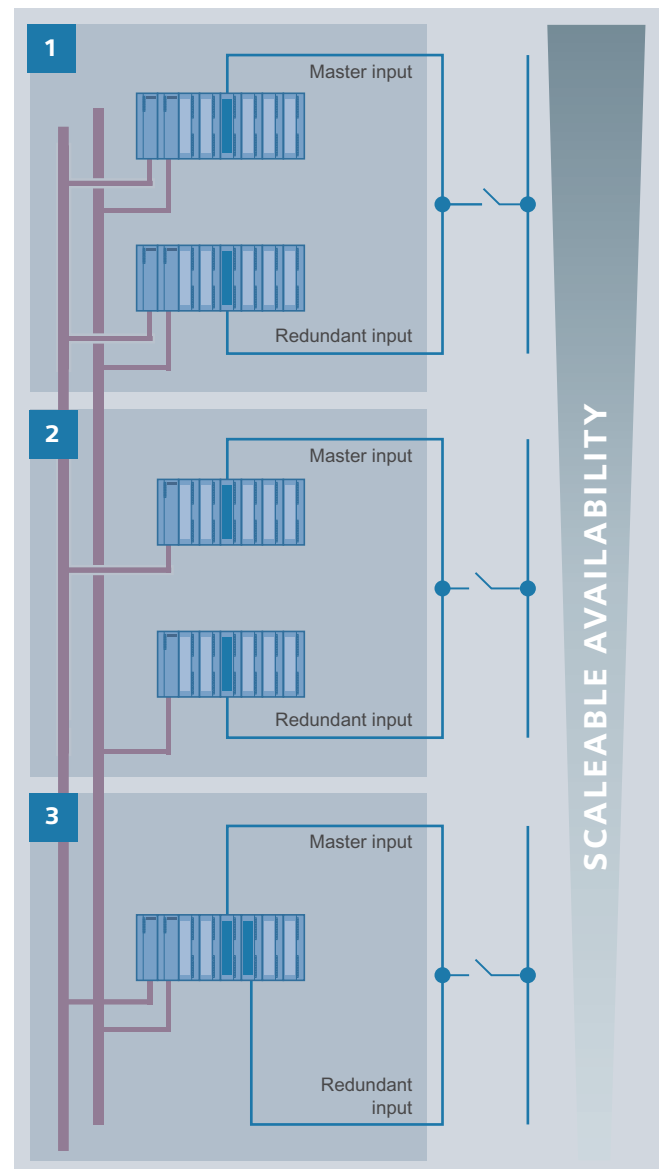
Following repair, which may be carried out online, both modules can be addressed again.

Numerous signal modules of the S7-300 (for distributed configurations with ET 200M) are available for redundant operation. The prerequisite is STEP 7, Version 5.3 or higher with the option package "S7 H systems" integrated.

1 Master input

Redundant input

2 Master input

Redundant input

3 Master input

Redundant input

SCALEABLE AVAILABILITY

Scalable availability of the redundant I/O

Communication

High availability also applies to communication. Depending on the network topology, redundant connections can be created and activated automatically in the event of a fault.

Highly available communication is implemented in the S7-400H using double CPs that are connected to the PC using the software package S7-REDCONNECT.

In the event of a fault, the highly available communication link takes over automatically and invisibly as far as the user is concerned.
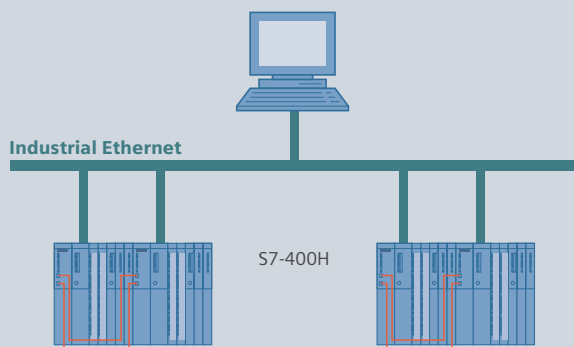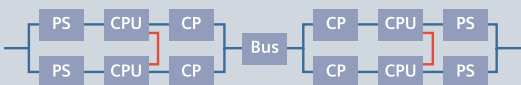
Process industry

Traffic tunnel

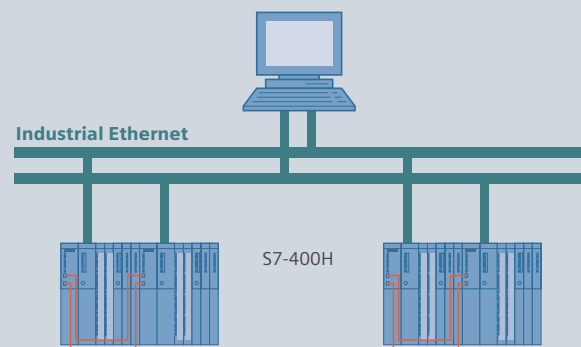**1** Highly-available communication with standard bus

2 Highly-available communication with redundant bus and standard CPs (communication processors)

Industrial Ethernet

S7-400H

Equivalent redundancy circuit diagram:

PS — CPU — CP — [Bus] — CP — CPU — PS
PS — CPU — CP — CP — CPU — PS

Industrial Ethernet

S7-400H

Equivalent redundancy circuit diagram:

PS — CPU — CP — Bus — CP — CPU — PS
PS — CPU — CP — Bus — CP — CPU — PS

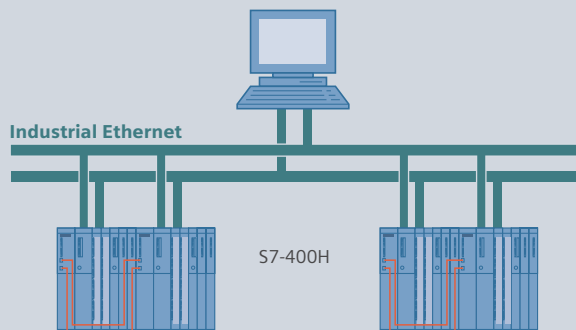*The bus is safely installed and not at risk of failure. Failure of one component per device will be tolerated.*

The same configuration as in Figure 1, but the bus is redundantly configured, i.e. failure of the bus can also be tolerated.

Process industry
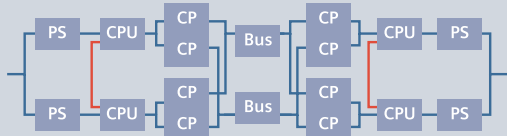
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3 Highly-available communication with redundant bus and redundant CPs
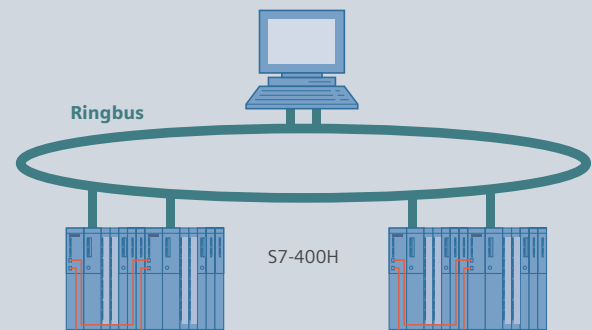

Industrial Ethernet

S7-400H

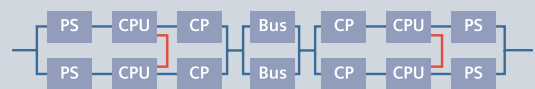Equivalent redundancy circuit diagram:

The same configuration as in Figure 2, but the CPs are also redundantly configured. In this case, failure of the bus and one more component per device can be tolerated.

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4 Highly-available communication with ring bus

Ringbus

S7-400H

Equivalent redundancy circuit diagram:

In this configuration, fail-safety of the bus is achieved using the ring structure. Failure of one additional component can also be tolerated.

SIMATIC C7

SIMATIC C7 family

SIMATIC C7 compact control systems –
PLC and Operator Panel in a single unit

Do you want to implement a complete machine control with operator panel in a single device?

The SIMATIC C7 compact control systems have been optimized precisely for such applications and combine a controller from the S7-300 family with integral inputs/outputs and a SIMATIC Panel in a single device. This makes it possible to implement complete, yet still expandable, machine controls in the smallest possible space and at low cost (hardware and engineering outlay).

The controller section comprises a CPU, I/O and interface for expanding the I/O; a line-oriented or pixel-graphics OP is used as the operator panel, depending on the type.

Highlights

As a compact control system – PLC and OP (operator panel) in a single unit – SIMATIC C7 offers the following decisive benefits:

■ Space savings: the compact design reduces the installation space required direct at the machine.

■ Time savings: the turnkey complete solution reduces the engineering overhead for design, installation and wiring, for example.

■ Cost savings: purchase costs are up to 20% lower than those for a comparable modular solution – the control cabinet can frequently be smaller or can be dispensed with entirely, or the C7 unit is integrated direct into the operator panel.

■ Flexibility: thanks to easy expandability with all S7-300 modules, the C7 devices are open to extensive and demanding automation solutions.

■ System integration: as a component part of Totally Integrated Automation, SIMATIC C7 is optimally integrated into the Siemens automation environment.

Application areas for C7 compact control systems include:
• General machine construction (especially series machine construction)
• Special-purpose machine manufacturing
• Plastics and textile machines
• Woodworking machinery and many other applications

Compact control system SIMATIC C7
SIMATIC Panel and S7-300 in one system

SIMATIC Panel   S7-300   SIMATIC C7
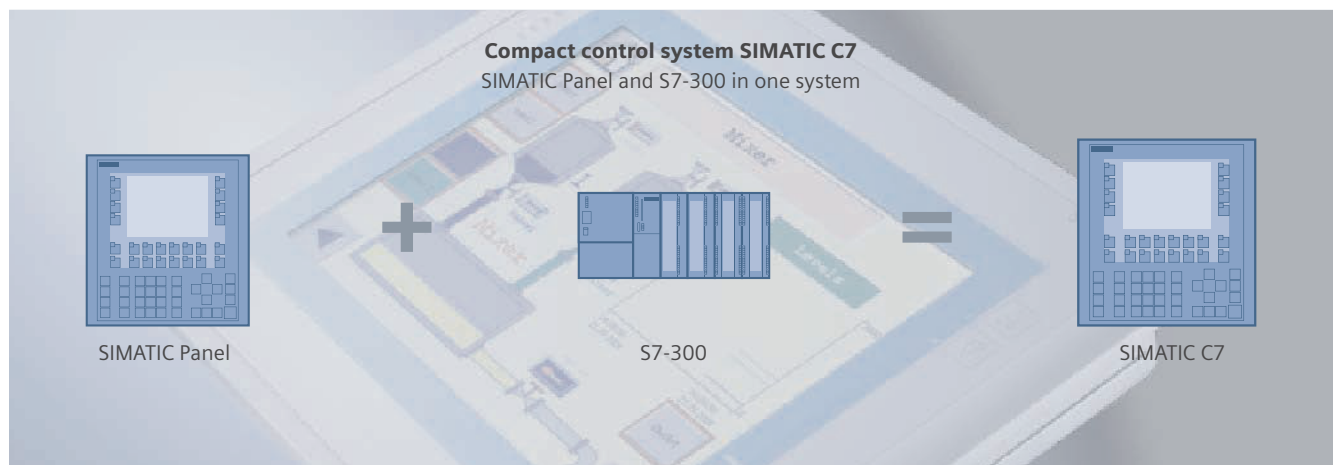
SIMATIC Panel and S7-300 in one unit

Industrial compatibility

The SIMATIC C7 devices are universal thanks to their high level of industrial suitability and they are characterized by:
- High EMC
- High resistance to shock and vibration
- Ambient temperature up to 50 °C with fan-free operation
- Compliance with national and international standards to DIN, UL, CSA, FM, ISO 9001 and ship building certifications.

Transparent distillation process thanks to clear display on SIMATIC C7

Selection tool for C7 control systems			
C7 control system	**C7-613** [2]	**C7-635 Touch**	**C7-635 Key** [2]
CPU	CPU 313C	CPU 314C-2 DP	
CPU user memory	64 KB	96 KB	
PLC programming	STEP 7	STEP 7	
I/O	24 DI / 16 DO 4 AI + 1 PT100 2 AO	24 DI / 16 DO 4 AI + 1 PT100 2 AO	
Functions	Counter, frequency measurement, pulse outputs, closed-loop control	Counter, frequency measurement, pulse outputs, positioning, closed-loop control	
Interfaces	MPI	MPI DP (master or slave)	
Panel		TP 170B (6")	OP 170B (6")
Display Resolution	4 x 20 characters	Vector graphics (monochrome) 320 x 480 pixels	
HMI configuration	STEP 7 and parameterization support [1]	WinCC flexible Compact or higher	

[1] *In the low-cost C7-613 control system, the HMI configuration is also performed with STEP 7 – no WinCC flexible is necessary. Editing of display texts is made as simple as possible with a new parameterization support (can be installed from STEP 7 V5.2). The data blocks with the parameters and variables for the STEP 7 project of the C7-613 are created direct from these parameterization dialogs. The parameterization support is a component part of Configuration Tools SIMATIC C7-613 from V 2.0.*

[2] *As SIPLUS component also for aggressive atmosphere/condensation (www.siemens.com/siplus)*

Design

All SIMATIC C7 devices stand out due to a range of important design features.

Housing/installation

- Rugged, compact plastic or aluminum housing[1] with IP65 degree of protection (front)
- Can be installed in operator panels, control cabinets or on gantries.
- Permanent wiring with terminal blocks, that is, problem-free device replacement for service purposes

Front panel

- Rugged membrane keyboard
- Easy-to-read, backlit LC display, graphics, blue mode or color[1]
- LEDs to indicate PLC status and operating mode

Interfaces

- Powerful communication by means of the MPI multi-point interface
- Printer interface [1], e.g. for documentation of production data and quality assurance
- PROFIBUS DP [1] can be parameterized per software as master or slave, 12 Mbit/s
- Interface for user-friendly expansion with modules from the S7-300 range (external or direct on the backplane bus of the C7)

Integral I/O

- Digital inputs
- Digital outputs
- Analog inputs
- Analog outputs

Integrated technological functions

- Counters
- Pulse outputs
- Frequency measurement
- Controlled positioning [1]
- Closed-loop control

[1] depending on the C7 version

Customized design

The SIMATIC C7 compact control systems are also available in customized design. This is of benefit if the appearance of the compact control systems has to be adapted to suit the machine or plant.

The design can be modified in different ways:
- Customized company logo
- Special color scheme:
  Any RAL or Pantone colors are available for the company logo, front membrane and front frame
- Customized key labeling

Customized company logo

Special color: Optional RAL or Pantone colors are available for company logo, front membrane and front frame

Customized key inscriptions
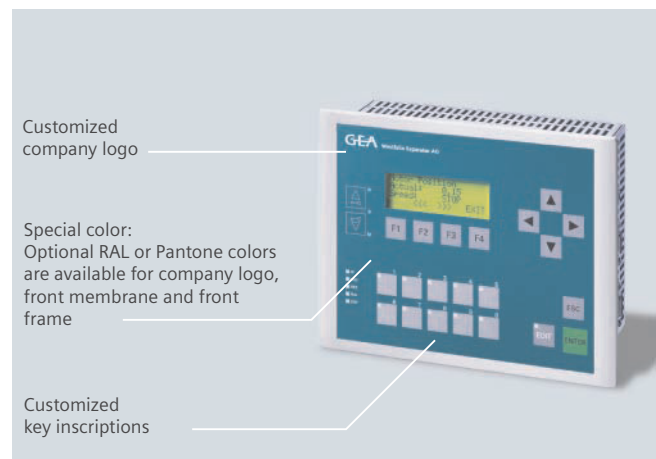
C7 compact control systems with customized design for adapting to the machine or plant
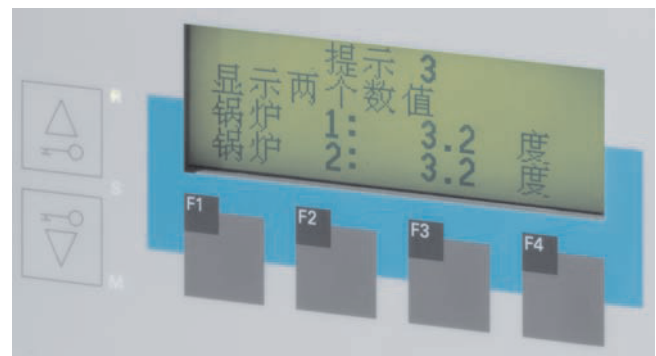
International character sets improve the export chances of machines equipped with SIMATIC C7

Control/HMI functions

Open-loop control with integral controller

An S7-300 CPU is used as the integrated controller, offering the following functions:
- High-speed instruction execution:
  Execution times from 0.1 µs enable extremely short machine cycle times.
- Maintenance-free:
  Retentive data management on the micro memory card (MMC) enables freedom from maintenance because there is no backup battery.
- Diagnostics functions:
  The intelligent diagnostics system facilitates troubleshooting and reduces plant downtimes. C7-635 supports the PROFIBUS DPV1 standard; parameterization and optimization of field devices during operation allow short retooling times.
- Password protection:
  Password protection enables effective protection of the PLC know-how against unauthorized copying and modification.
- Technological tasks:
  High-speed actual value acquisition, with direct access to hardware counters and inputs for the functions counting and frequency measurement, enables high dynamic response for, say, positioning tasks. The positioning functions allow direct control of the MICROMASTER frequency inverters in conjunction with the integral analog output.

Operator control and monitoring with integral panel

The panel of the C7 units enables diverse HMI functions:
- Status and fault messages:
  Provide the operator with important information about the current process sequence, e.g. for remedying faults or for maintenance purposes.
- Display of pictures:
  Pixel-graphics displays enable realistic visualization of the machine to be monitored. The process data can be presented in the form of bar charts, trend curves or state diagrams for a quick overview.
- User menu:
  User-specific menus can be defined for adapting the operator input sequence to the application.
- Limit monitoring and password protection:
  Configurable limit values and passwords improve the security of operator inputs for safe process control.
- Configurable printer protocol:
  Printers connected directly log data quickly and simply, for quality verification, for example (not C7-613).
- Online language change:
  All texts can be stored in several languages. This facilitates startup and service in international use (also Cyrillic and Asian characters).
- Display of statuses of the integral inputs/outputs.
- Recipe management:
  Many different recipes can be managed simultaneously (not C7-613).
- Key or Touch:
  The Touch devices enable intuitive operator control and monitoring thanks to their touch screens, and they significantly reduce the costs of familiarizing operating personnel. Simple, self-explanatory graphic buttons make operation easier and prevent operator errors. Key devices with membrane keyboard have been developed for applications in strongly contaminated environments.
- Data backup:
  Slot for memory module to back up the configuration and recipe data records (micro memory card).
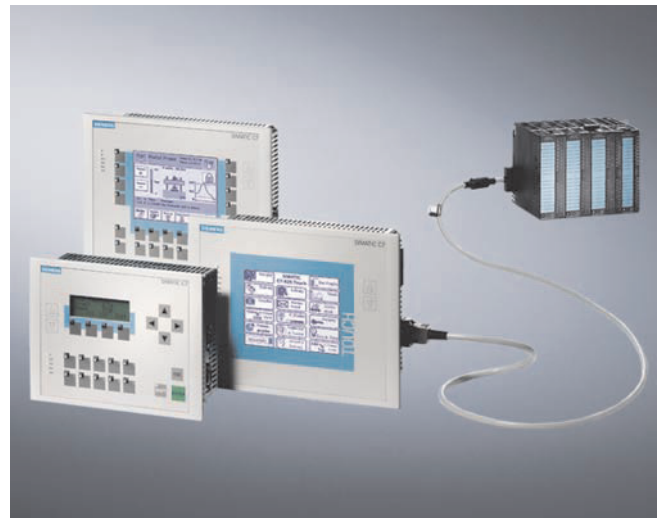
Expansion

Flexible expansion facilities

Different variants with graded performance and the comprehensive module spectrum of SIMATIC S7-300 support accurate adaptation of SIMATIC C7 to the respective task.

The compact control systems can be upgraded as the scope of tasks increases and at any time by using additional modules (Function Module FM, Communications Processor CP, I/O). This means AS-Interface and PROFINET (Industrial Ethernet) can be connected as well as PROFIBUS DP.
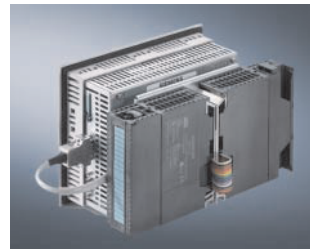
Without interface module

The C7-613 and C7-635 compact control systems can be expanded with up to four S7-300 modules (FM, CP, I/O) direct on the backplane of the C7. There is a choice of two I/O expansion sets for this purpose so that expansion is possible with up to four modules in deep design and up to two modules in flat design. An interface module (IM) is not required. This retains the compact design.
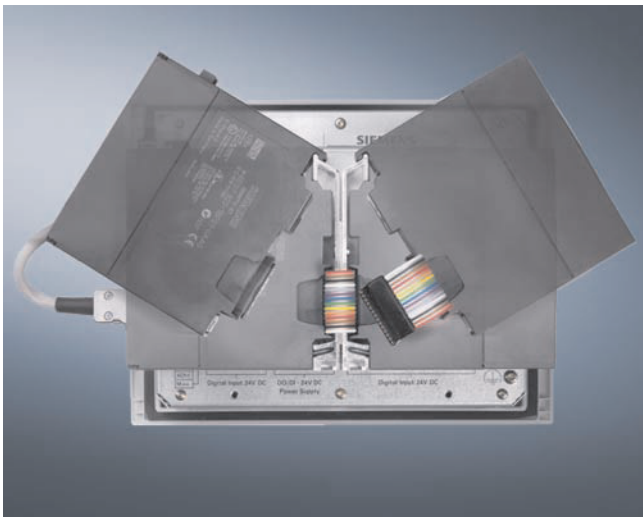
Alternatively, an expansion with up to four S7-300 modules using a 1.5 m I/O cable is possible. This also does not require an interface module (IM). In addition, the 1.5 m I/O cable provides greater mechanical leeway at installation.

Expansion of C7-613, C7-635 with I/O cable (1.5m)

I/O in flat designI/O in deep design

Hooking in the I/O

With interface module

Special interface modules enable additional expansions with I/O.

IM 360/361 interface module

To enable individuals solutions, the C7-635 compact control systems can also be expanded externally with up to 24 modules from the SIMATIC S7-300 range. Up to 8 modules can be plugged into each rack[1].

With its extensive range of I/O, PROFIBUS can, of course, also be used for distributed expansion – in the case of the ET 200M also in S7-300 design.

[1] The C7-635 must be expanded externally at the C7 using the IM 360. The expansion racks are connected via the IM 361 interface module.
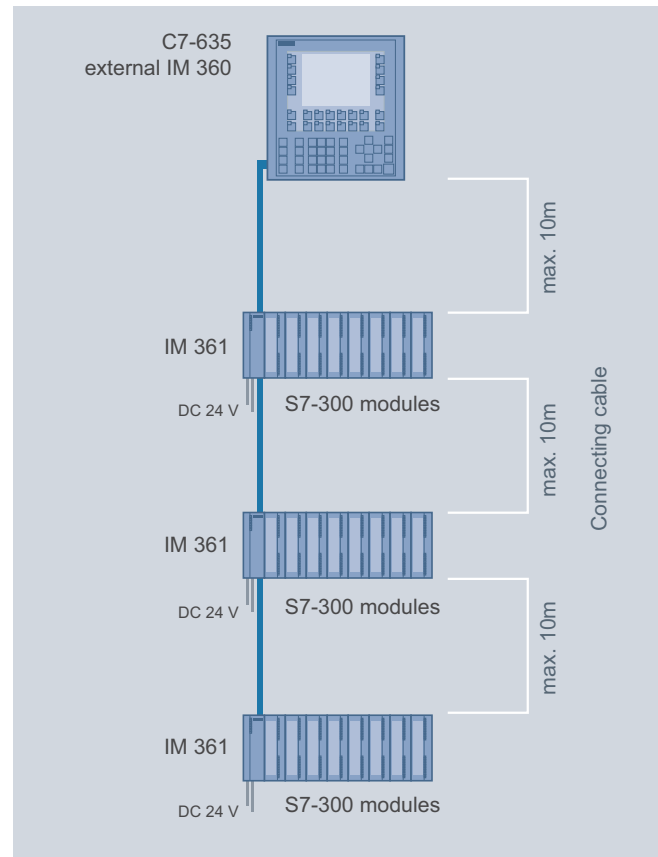
Expansion with IM 360/361 and I/O cable (3x10m) on C7-635

Technical specifications SIMATIC C7

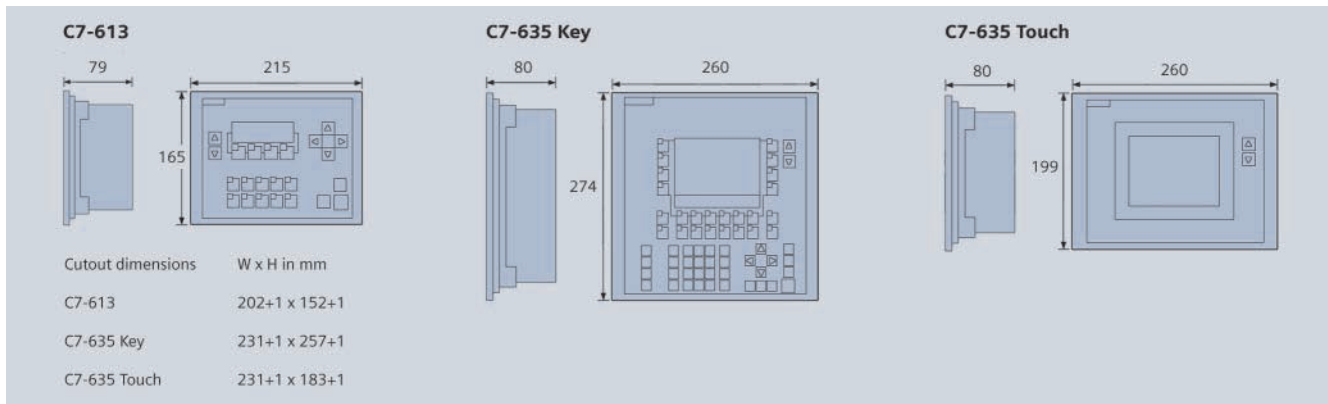| C7 compact control system	C7-613	C7-635 Touch	C7-635 Key
Order number core: 6ES7	613-1CA.	635-2EB.	635-2EC.
General data			
Degree of protection to IEC 60529	Front: IP65, housing: IP20	Front: IP65, housing: IP20	
Degree of protection in accordance with NEMA	NEMA 4X	NEMA 4X	
Approvals, certifications	EN 61131-2 (IEC 1131-2); UL Listing UL 508; Canadian Standard Association (CSA) to Standard C22.2 Number 142; FM approval, FM standards No. 3611, 3600, 3810 Class I, Div. 2 Group A, B, C, D; DIN/ISO 9001 certification of production and development		
Device dimensions (W x H x D in mm)	215 x 165 x 79	260 x 199 x 79	260 x 274 x 79
Cutout dimensions (W x H in mm)	202 x 152	231 x 183	231 x 257
Controller-specific data			
Memory			
Work memory	64 KB	96 KB	
Instructions	21 K	32 K	
Maximum number of blocks	512 FC, 512 FB, 511 DB	512 FC, 512 FB, 511 DB	
Bit memory	256 bytes	256 bytes	
S7 timers/counters	256/256	256/256	
Processing times			
Bit operation	0.1 µs	0.1 µs	
Word operation	0.2 µs	0.2 µs	
Fixed-point operation	2 µs	2 µs	
Floating-point operation	3 µs	3 µs	
Integrated I/O			
Digital inputs (DI)	24 x 24 V DC; all channels can be used for process interrupts	24 x 24 V DC; all channels can be used for process interrupts	
Digital outputs (DO)	16 x 24 V DC; 0.5 A	16 x 24 V DC; 0.5 A	
Analog inputs (AI)	4: ± 10 V, 0...10 V, ± 20 mA, 0/4 - 20 mA; 1: 0...600 Ω, Pt100	4: ± 10 V, 0...10 V, ± 20 mA, 0/4 - 20 mA; 1: 0...600 Ω, Pt100	
Analog outputs (AO)	2: ± 10 V, 0...10 V, ± 20 mA, 0/4 - 20 mA	2: ± 10 V, 0...10 V, ± 20 mA, 0/4 - 20 mA	
Integrated functions			
Counters	3 increm. encoders 24 V/30 kHz	4 incremental encoders 24 V/60 kHz	
Pulse outputs	3 channels PCM max. 2.5 kHz	4 channels pulse-width modulation (PWM) max. 2.5 kHz	
Frequency measurement	3 channels max. 30 kHz	4 channels max. 60 kHz	
Open-loop positioning		SFB for positioning, 1 axis via 2 DO, AO	
Closed-loop control	PID controller	PID controller	
Expansions			
S7-300 rack	max. 4	max. 24	
Suitable FMs	4	8	
Suitable PtP CPs	2	8	
Suitable LAN CPs	1	10	

C7 compact control system	C7-613	C7-635 Touch	C7-635 Key
Interfaces			
PROFIBUS DP interface		1	
DP connection (master/slave)	1 (CP 342-5)	1 (integrated, master/slave), 1 (CP 342-5)	
Programming, configuring			
Programming software	STEP 7	STEP 7	
HMI configuring	STEP 7 and parameterization support	WinCC flexible Compact or higher	
Panel-specific data			
Display			
Type	LC display	STN display, blue mode touch screen	STN display, blue mode
Lines x characters per line	4 x 20		
Character height	5 mm		
Resolution in pixels		320 x 240	320 x 240
Size		5.7"	5.7"
Graphics	Character graphics (within the scope of the character set)	Pixel graphics (vector graphics)	
Others			
Number of soft keys/ function keys	4/10		14/10
Messages	128	2000 [1]	
Process images	128	500 [1]	
Recipes		100 [1]	
Online languages	3 [2]	5 [2]	
Real-time clock	Hardware clock, battery-backed	Software clock, without battery backup	
Printer port		RS232	

[1] *Values valid for WinCC flexible*

[2] *Also Cyrillic, Chinese, Taiwanese and many more*

C7-613

Cutout dimensions	W x H in mm
C7-613	202+1 x 152+1
C7-635 Key	231+1 x 257+1
C7-635 Touch	231+1 x 183+1

C7-635 Key

C7-635 Touch

SIMATIC ET 200

SIMATIC ET 200S – the all-rounder with the comprehensive range of products for distributed automation
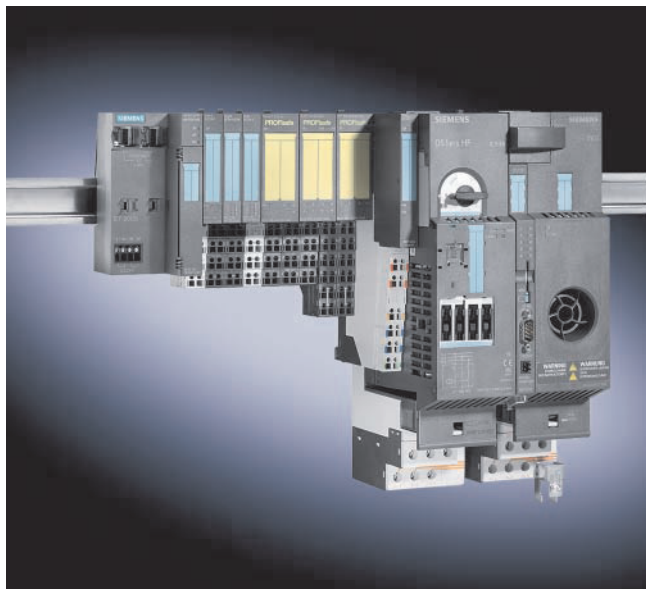
SIMATIC ET 200S with PROFIBUS connection, I/O modules, motor starters and frequency converters

SIMATIC ET 200S is the multifunctional, highly modular I/O system with IP20 degree of protection that can be exactly tailored to the automation task. Thanks to its rugged construction, it can also be used under conditions of high mechanical stress.

Various interface modules are available for interfacing to the PROFIBUS and/or PROFINET bus systems. Interface modules with an integral CPU[1] transfer the computing power of an S7-300 CPU directly into the I/O device. They take the load off the central controller and the fieldbus and facilitate a rapid response to time-critical signals.

The interface modules with CPU functionality can be used in stand-alone mode as well as for distributed automation solutions with a medium-sized program. They correspond to a CPU 314 and enable distributed preprocessing of the production data locally – even in the failsafe version. They communicate with the higher-level programmable controller over the coexistent MPI/PROFIBUS DP slave interface.

Highlights

- Discretely modular configuration with multi-wire connection

- Multifunctional thanks to a wide range of modules

- Also available as expandable block I/O with integral DI/DO: SIMATIC ET 200S COMPACT

- Use in areas subject to explosion hazard (Zone 2)

Distributed automation solutions increasingly involve not just digital and analog signals, but also technological functions, motor starters, frequency converters or a pneumatic interface. The bit-modular ET 200S offers a comprehensive module range to implement the tasks:
- Technology modules
- Motor starter
- Frequency converter
- Pneumatic interface
- IQ-Sense sensor modules
- Fail-safe I/O modules

[1] *Currently only available for PROFIBUS*
[2] *As SIPLUS component also for extended temperature range -25 ... +60 °C and aggressive atmosphere/condensation (www.siemens.com/siplus)*
[3] *With master module*
[4] *3-port-switch*

| Technical data for Interface Module ET 200S			NEW	
Interface module	IM 151-7 CPU/CPU FO	IM 151-7 F-CPU [2]	IM 151-8 PN/DP CPU	IM 151-8F PN/DP CPU
PROFIBUS	Copper/FO	Copper	● [3]	● [3]
PROFINET			Copper [4]	Copper [4]
Number of modules	63	63	63	63
Station width	2 m	2 m	2 m	2 m
CPU functionality	CPU 314	CPU 314	CPU 314	CPU 314
Fail-safety		●		●
Firmware update	Micro Memory Card	Micro Memory Card	Bus, Micro Memory Card	Bus, Micro Memory Card
Order number core: 6ES7 151-	7AA. / 7AB.	7FA.	8AB.	8FB.

SIMATIC ET 200pro – modular and multifunctional

SIMATIC ET 200pro is an extremely small, rugged and high-performance I/O system with IP65/67 degree of protection. It does not require a control cabinet and can be directly mounted on the machine. Its modular and time-saving structure allows flexible, customized, distributed automation solutions to be implemented.

ET 200pro can be connected to well-proven fieldbuses such as PROFIBUS or to PROFINET, the open Industrial Ethernet standard for company-wide automation.

Highlights

■ Modular design with an extremely compact housing

■ Multifunctional thanks to a wide range of modules

■ Easy installation
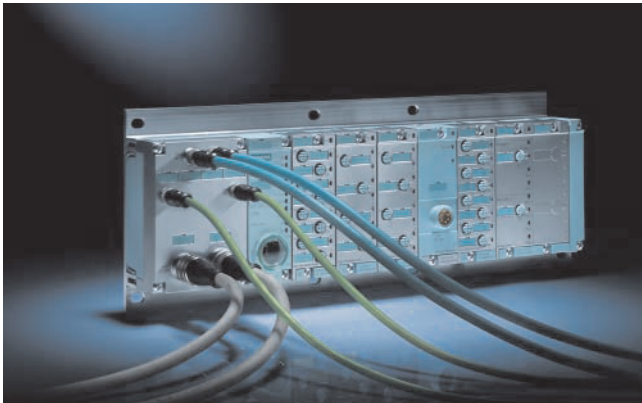
SIMATIC ET 200pro with PROFINET interface and I/O modules

The interface module IM154-8 CPU with CPU functionality is based on the CPU 315-2 PN/DP and offers the same quantitative framework and functions. The IM154-8 CPU has two communication interfaces,

- one combined MPI/PROFIBUS DP interface, and
- one PROFINET interface with three ports.

ET 200pro CPU module

The IM 154-8 CPU supports both PROFINET IO (up to 128 IO devices can be connected) and PROFINET CBA, as well as PROFIBUS DP (as master for up to 124 slaves).

The IM 154-8 CPU is not only compatible with the programs of the S7-300 CPUs, but it also offers a high degree of data retentivity (protection against voltage failure). A separate LED signals maintenance alarms. Modules can be replaced easily thanks to the Micro Memory Card. Firmware can be updated over the network.

Furthermore, a web server functionality for information, status, diagnostics, clock synchronization via the Ethernet (NTP) is available. The open Ethernet communication (TCP/IP, UDP, ISO-on-TCP) permits reliable and high-speed data exchange. Isochronous mode is possible on the PROFIBUS.

Further information can be found in the brochure *SIMATIC ET 200* or on the Internet at

www.siemens.com/et200

SIMATIC Embedded Automation

Introduction

SIMATIC Embedded Automation combines different tasks:
- Control
- Technology
- Operator control and monitoring
- Data processing
- Communication

on one shared, compact and rugged embedded platform. Strict real-time requirements are also met.

In addition, this platform is flexible and can be effectively integrated into an overall solution. Including close links with data processing or logistics systems, as well as connection to technological tasks such as motion control or vision systems.

Thanks to their fan-free and disk-free design, the SIMATIC Embedded Automation products can be used direct at the machine in harsh environments.

Customized versions increase flexibility and openness even further, and tap into additional application areas.

SIMATIC Embedded Automation facilitates automation solutions based on Multi Panels or embedded PC hardware.

SIMATIC Embedded Automation products are combinations of hardware and software that have been pre-configured as turn-key solutions for specific automation tasks. They combine the openness of PC-based controllers with the ruggedness of conventional controllers. In addition, they boast flexible software installed on powerful, scalable hardware in an open, compact combination.

The devices do not require fans and a Compact Flash card (CF card) is used instead of a hard disk. Microsoft Windows XP Embedded is used as the operating system.

The products can be supplied with display, operator control elements, technology, and HMI software already integrated, along with interfaces to fieldbuses and Industrial Ethernet. This provides a rugged, compact and low-cost device for data-intensive tasks.

Spare parts are available for five years due to the short service life of the chip sets, operating systems, and service packs used. This is significantly more than for standard PCs, but not as long as for classic SIMATIC products.

SIMATIC Multi Panels likewise require no fans or hard disks and use Microsoft Windows CE as the operating system. They are characterized by their high industrial capability and are used predominantly at the machine level. SIMATIC Multi Panels with WinAC MP 2007 optimally combine both control and HMI functions in one device.

Embedded Automation products				
Product	Control	Operator control and monitoring	Technology and motion control	Openness and expandability
Versions without display				
SIMATIC S7-mEC RTX	●●	◗	◗	●
SIMATIC Microbox 427B-RTX	●●	◗	◗	●●
SIMATIC Microbox 427B-HMI/RTX	●●	●	◗	●●
SIMATIC Microbox 420-T	●	◗	●●	●●
Versions with display				
SIMATIC Panel PC 477B-HMI	◗	●●	◗	●●
SIMATIC Panel PC 477B-HMI/RTX	●●	●●	◗	●●
SIMATIC WinAC MP 277/377	●	●●		●

NEW

The distributed IO devices are connected via PROFIBUS DP.

●● = Main functionality
● = Secondary functionality
◗ = Optional retrofit

The SIMATIC Embedded PC versions are pre-configured turn-key systems. Like all other SIMATIC Controllers, they are configured and programmed with STEP 7 – both via PROFIBUS and Industrial Ethernet.

These are the advantages of the Embedded PC versions.

Rugged and maintenance-free

SIMATIC Embedded PC versions are rugged and maintenance-free. They thus enhance system availability and reduce standstill times.

- Fan-free and disk-free, i.e. no rotating parts, instead an industry-standard Compact Flash (CF) card as the memory medium
- Retentivity of certain data areas without uninterruptible power supply (UPS)
- Pre-installed software that is impervious to operator errors and viruses
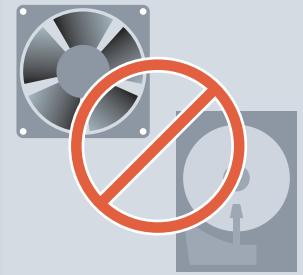
Compact and space-saving

SIMATIC Embedded PC versions are extremely compact, enabling space-saving installation.

- Max. mounting depth 75 mm *)
- The pre-configured Windows XP Embedded operating system offers the familiar PC user interface and has been optimized for automation tasks

75 mm
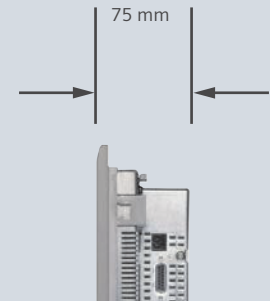
Open and flexible

SIMATIC Embedded PC versions are open and flexible, making it easy to integrate other applications and connect external hardware.

- Integration of C/C++- or VB programs (Visual Basic)
- Integration of typical standard Windows applications, e.g. for further processing of data via OPC server
- Connection of third-party systems via OPC server
- Installation of Embedded PC hardware, e.g. PCI-104 expansion cards
- Connection of USB devices, e.g. printers, monitors
- Easy integration into existing automation or IT environments via integral Industrial Ethernet and PROFIBUS interface
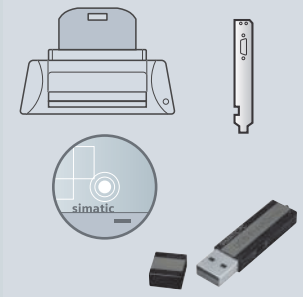
NEW SIMATIC S7 modular Embedded Controller (S7-mEC RTX)
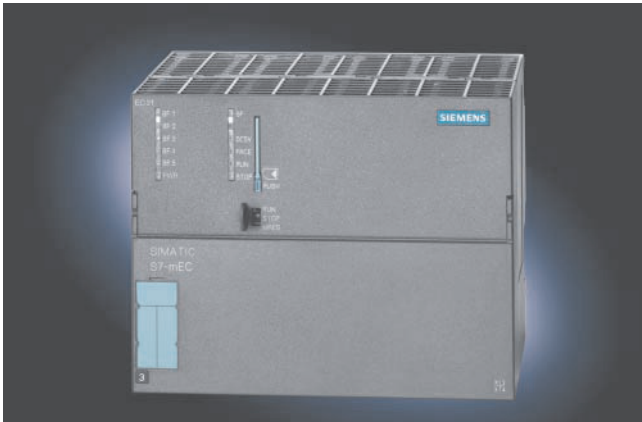
S7 modular Embedded Controller in S7-300 design

SIMATIC S7-mEC RTX is a modular controller in S7-300 design with the latest embedded PC technology. This embedded controller combines the advantages of the tried and tested modular S7 controller with PC technology in one new device.

On the one hand, SIMATIC S7-mEC RTX stands out due to:
- Maximum ruggedness without fan or hard disk
- Modularity and scalability, e.g. central expansion with S7-300 I/O
- Commissioning as for S7-300 by automation specialists, PC knowledge not required

On the other hand, S7-mEC RTX offers:
- Standard Windows XP embedded PC operating system and standard PC interfaces
- Latest embedded PC technology
- Openness in software and hardware (integration of standard Windows XP applications and standard PC 104 cards)

The modular embedded controller is particularly suitable for applications in which both control and data processing are of major importance. The most important applications of the S7-mEC RTX are in special and series machine building, which apart from the control task also integrate additional automation tasks, e.g. HMI, on one hardware platform. This means that centralized expandability with the standard SIMATIC I/O is still possible. In addition, the performance and openness of current PC technology can be fully exploited.

In addition to Windows XP Embedded, S7-mEC RTX has an integrated controller execution level system. Programming and diagnostics – as with all other SIMATIC controllers – are performed with STEP 7. The I/O bus interface enables signal modules (SM) and interface modules (IM) to be operated.

Operator control and monitoring can be performed with installed HMI Runtime on a SIMATIC Thin Client which has access to S7-mEC RTX data by means of standard TCP/IP mechanisms. Distances of 100 m or more can be spanned without difficulty.

For machine-level visualization, WinCC flexible Runtime must be installed on S7-mEC RTX. In other expansion stages, WinCC flexible Runtime is already pre-installed and S7-mEC RTX can be expanded with standard PC modules.
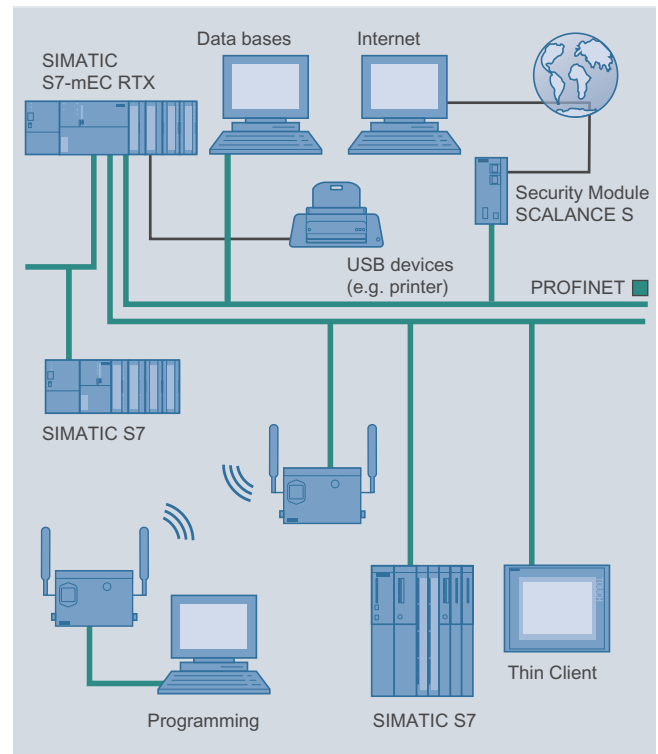
S7-mEC RTX connection options via PROFINET and USB

Highlights

- Combination of modular S7-300 Controller and embedded PC technology

- Fanless and diskless S7-300 design

- Centralized I/O expansion

- Configuration and programming as for S7-300 with STEP7

- Simple integration of PC applications into the controller

- Data retentivity through integrated SRAM

Technical specifications of S7 modular Embedded Controller	
Feature	S7-mEC RTX
Design	Modular, fanless, expandable controller in S7-300 design
Processor	Intel CoreDuo 1.2 GHz
Main memory	1 GB SDRAM DDR2
Retentivity	256 KB without UPS
Operating system	Windows XP embedded
Software PLC	WinAC RTX 2008
Flash Disk	2 GB
Micro Memory Card	Yes (also Multi Media Card)
Interfaces	2x PROFINET (2 Ports), 1x Ethernet, 2x USB 2.0, mouse, keyboard, monitor via USB
Order number core	6ES7 677-1DD.

SIMATIC Microbox 427B-RTX, 427B-HMI/RTX

Turnkey Microbox 427B-RTX

Technical specifications of Microbox 427B-RTX, 427B-HMI/RTX	
Feature	**Microbox 427B-RTX Microbox 427B-HMI/RTX**
Intel processors	Celeron M 900 MHz with 512 MB work memory Celeron M 1 GHz with 1 GB work memory Pentium M 1.4 GHz with 1 GB work memory
Compact Flash	2 GB or 4 GB (in combination with 3 processors, 6 hardware versions are possible)
Retentivity	128 KB without UPS
Interfaces	1 x PROFIBUS 2 x Industrial Ethernet 4 x USB 2.0
PC cards	Max. 3 x PCI-104
Operating system	Windows XP Embedded SP2
Software PLC	WinAC RTX
HMI software	WinCC flexible with 128, 512 or 2048 PowerTags incl. archives and recipes
Additional software in scope of delivery	SOFTNET-S7 Lean incl. OPC server
Order No. core	6ES7 675-1C.

SIMATIC Microbox 427B is a turnkey rail PC with high industrial capability (degree of protection IP20) and is available in two versions:
• Microbox 427B-RTX and
• Microbox 427B-HMI/RTX

It combines
• the Microbox PC 427B,
• the WinAC RTX software PLC
• the SOFTNET S7 Lean communications package and
• the Runtime of the WinCC flexible HMI software (only with Microbox 427B-HMI/RTX version)

Microbox 427B-RTX or 427B-HMI/RTX are recommended when the following demands are made on the automation solution:
• Compact use without operator input
• Use with detached screen
• Machine-level installation
• User-specific hardware and software
• Integration of different tasks (control, technology, data processing) on one hardware

The software PLC WinAC RTX and the HMI software WinCC flexible (for Microbox 427B-HMI/RTX) are already installed and pre-configured:
• The software PLC WinAC RTX handles the actual control task and execution of the user program.
• WinCC flexible Runtime allows machine-level visualization of up to 2048 PowerTags including archives and recipes.

Up to 128 KB of retentive data are stored on an integral, non-volatile memory without an uninterruptible power supply (UPS). Full retentivity of all process values can be achieved with a commercially available UPS.

The integral OPC server allows open access to all process values. Any visualization or data processing systems can be connected to WinAC RTX via this interface. C/C++ programs can be integrated into the PLC cycle via ODK – under real-time conditions as well.

The Software PLC is programmed with STEP 7 via the integral Industrial Ethernet or PROFIBUS interface. The SOFTNET-S7 Lean communications package is installed for this purpose.

Three status LEDs for RUN, STOP and group error indicate the operating status of WinAC RTX.

Highlights

■ Fan-free and disk-free design
■ Software PLC with real-time and deterministic capability
■ Data retentivity through integrated SRAM

SIMATIC Microbox 420-T

Microbox 420-T with PROFIBUS interfaces

SIMATIC Microbox 420-T is a turnkey rail PC (IP20) with integrated technology. It combines
• the Microbox PC 420,
• the WinAC RTX software PLC with technology functions,
• PLCopen-compliant motion control modules, as well as
• the SOFTNET PG communications package.

Microbox 420-T is ideal if technology and motion control functions have to be executed on one platform in addition to control tasks. It is used especially with coupled motion sequences of several axes. It enables primarily complex, synchronized motion sequences such as geared synchronous motion, cam disks and print mark correction, as well as position-controlled single-axis positioning. The synchronous axes can be coupled to a virtual master or a real master.

The integral motion control functions are identical with those of the technology CPUs of the S7-300. The user program is compatible with all other S7 controllers. The S7-Technology optional package based on STEP 7 is used for parameterizing and configuring the technology.

Highlights

■ Fan-free and disk-free design
■ Software PLC with real-time and deterministic capability
■ PLCopen-compliant motion control functions
■ Isochronous drive control via PROFIBUS DP(DRIVE) interface
■ Data retentivity through integrated SRAM

Microbox 420-T is characterized by a compact design with a high-speed I/O (8 fast cam outputs) and the following interfaces:
• Isochronous PROFIBUS DP(DRIVE) interface for dynamic movement control of several linked axes or individual axes
• PROFIBUS DP interface for connecting other SIMATIC components, e.g. PG, OP, S7 controllers and distributed I/O
• Standard PC interfaces, such as Industrial Ethernet and USB for open networking and connecting external devices

Technical specifications of Microbox 420-T	
Feature	Microbox 420-T
Processor	Intel Pentium III, 933 MHz
Work memory	512 MB
Compact Flash	1 GB
Retentivity	30 KB without UPS
Digital outputs	8
Axes	32
Cam disks	32
Output cams	32
Probes	16
External encoders	16
Interfaces	2 x PROFIBUS: DP (DRIVE) isochronous, DP 2 x Industrial Ethernet 4 x USB 2.0
Operating system	Windows XP Embedded SP1
Software PLC	WinAC RTX
Software packages included in the scope of supply	SOFTNET PG OPC server
Order No. core	6ES7 675-3AG.

As a ready-to-run product, Microbox 420-T contains the pre-configured Windows XP Embedded operating system as well as pre-installed software and enabled licenses. WinCC flexible Runtime can be installed later.

The integral OPC server allows open access to all process values. Any visualization or data processing systems can be connected to WinAC RTX via this interface. C/C++ programs can be integrated into the PLC cycle via ODK.

SIMATIC Panel PC 477B-HMI/RTX

The SIMATIC Panel PC 477B is a compact device and combines ruggedness and high reliability with the openness of a PC. The following software is already pre-configured and ready to start up:
- the WinAC RTX software PLC
- the Runtime HMI software WinCC flexible, as well as
- the SOFTNET S7-LEAN communications package.

The SIMATIC Panel PC 477B-HMI/RTX is the perfect, turnkey solution for applications where operation, visualization and control tasks have to be performed on just one compact device. As a scalable and expandable device, it is suitable where
- use directly at the machine and
- flexible adaptation of the application

are required.

The Panel PC 477B-HMI/RTX is available with brilliant 12", 15" and 19" displays with touch or key control. All device versions are available from stock. The low mounting depth of 75 mm (100 mm for the 19" Touch) allows the Panel PC 477B-HMI/RTX to be operated even where space is restricted.
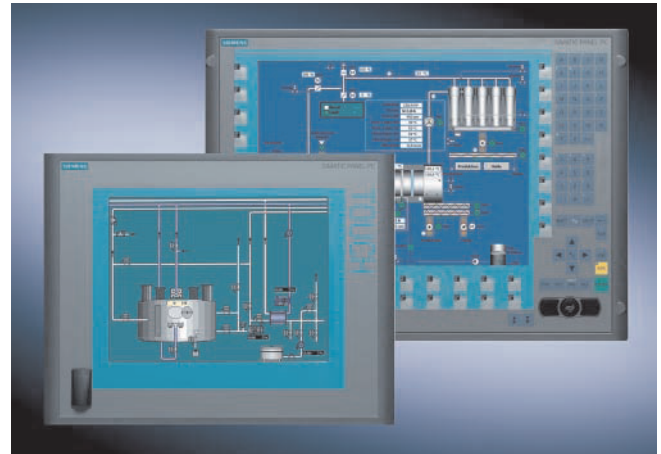
SIMATIC Panel PC 477B-HMI/RTX with touch or key operation

Technical specifications of the Panel PC 477B-HMI/RTX	
Feature	**Panel PC 477B-HMI/RTX**
Processor	Intel Celeron M 1.0 GHz
Work memory	1 GB
Compact Flash	1 GB, 2 GB, 4 GB
Displays	12" TFT color display 800 x 600 (Key or Touch) 15" TFT color display 1024 x 768 (Key or Touch) 19" TFT color display 1280 x 1024 (Touch)
Retentivity	128 KB without UPS
Interfaces	1 x PROFIBUS or PROFINET 2 x Industrial Ethernet 5 x USB 2.0 (1 at front)
PC cards	Max. 3 x PCI-104
Operating system	Windows XP Embedded SP2
Software PLC	WinAC RTX
HMI software	WinCC flexible with 128, 512 or 2048 PowerTags incl. archives and recipes
Software packages included in the scope of supply	SOFTNET-S7 Lean incl. OPC server
Order No. core	6ES7 676-.

The Software PLC WinAC RTX and the HMI software WinCC flexible 2007 are already installed and pre-configured:

- The software PLC WinAC RTX handles the actual control task and execution of the user program.
- WinCC flexible 2007 Runtime allows machine-level visualization of up to 2048 PowerTags including archives and recipes.

As with the Microbox 427B-RTX, access to process values via the integrated OPC server and the integration of C/C++ programs are possible – even under real-time conditions. For further details, see Microbox 427B-RTX.

Up to 128 KB of retentive data are stored on an integral, non-volatile memory without an uninterruptible power supply (UPS). Full retentivity of all process values can be achieved with a commercially available UPS.

Configuring is carried out using the engineering software WinCC flexible. The simple user interface of WinCC flexible permits extremely efficient operation:

- Libraries offer preconfigured objects and reusable faceplates
- Intelligent tools permit project management and graphical configuration
- Extensive support of multilingual configurations
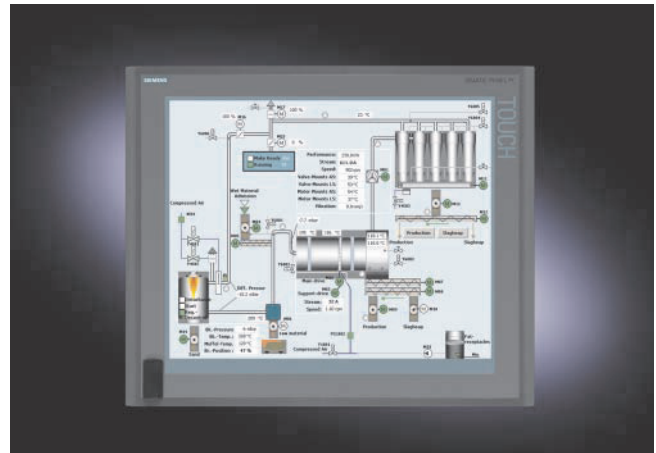
SIMATIC Panel PC 477B-HMI/RTX with 19" display

Highlights

- Fan-free and disk-free design

- Software PLC with real-time and deterministic capability

- HMI runtime software with archives and recipes

- Controlling and visualizing via touch screen or membrane keyboard

- Data retentivity through integrated SRAM

The Panel PC 477B-HMI is an additional variant of the Panel PC 477B. It contains the runtime part of the WinCC flexible HMI software but does not include the WinAC RTX software PLC.

SIMATIC WinAC MP 277/377

SIMATIC WinAC MP 2007 is the new software PLC running under Windows CE for the SIMATIC Multi Panels 277 and MP 377. WinAC MP 2007 is suitable for small and medium-size applications in which maximum performance is not essential. WinAC MP 2007 is a good alternative for price-sensitive applications, in which the stability and ruggedness of a hardware solution are still essential.

WinAC MP 2007 is closely aligned with a hardware CPU and is installed on the rugged and fanless Multi Panels 277 and 377.
• The smaller version is optimized for MP 277 and has similar quantity structures to the CPU 315.
• The larger version is optimized for MP 377 and has similar quantity structures to the CPU 317.

The Multi Panels with touch or key functionality are available with display sizes between 8" and 19" and offer both real-time and deterministic behavior via Windows CE.

WinAC MP 2007 uses familiar tools such as STEP 7 (V5.4/SP1 or higher) and WinCC flexible (Standard or higher from Version 2007). This means that a switch is possible at any time without any training overhead for new tools. The user interface of WinAC MP 2007 is also supplied in the form of a "SIMATIC HMI example project". ET 200 modules (from I/O modules to technology modules) are connected as I/O via PROFIBUS.

Timers, counters, flags and data blocks are retentive as in the case of a hardware CPU . This is ensured by the multi panel hardware without uninterruptible power supply (UPS). All data (operating system, HMI data, PLC data, archive, recipes, licenses, etc.) can be transferred with one keystroke to a standard memory medium (SD card, Multi Media Card, USB stick).

Highlights

■ Software PLC on Windows CE basis

■ One optimized version each for SIMATIC Multi Panel 277 and 377

■ Economical solution for all applications in combination with a rugged hardware platform

■ Ideal for machine-level tasks, saving space and money

■ Simple service concept by means of backup/restore of all data on standard storage media
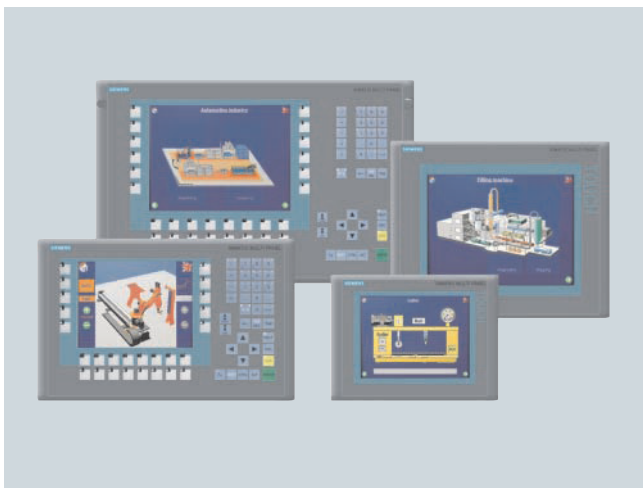
SIMATIC Multi Panels MP 277 with 8" and 10" displays
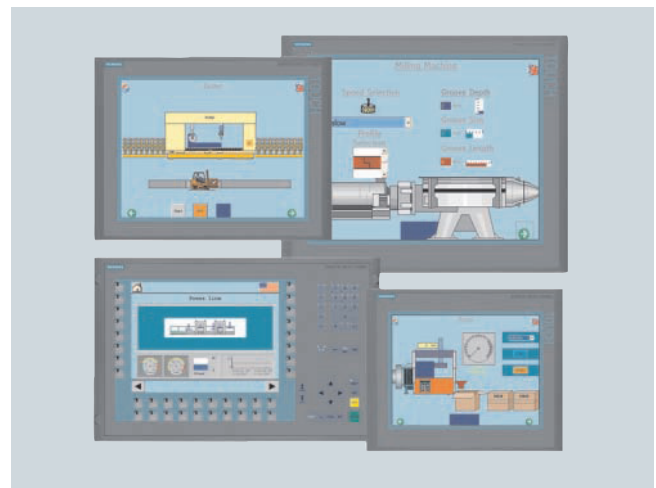
SIMATIC Multi Panels MP 377 with 12", 15" and 19" displays

Technical specifications for WinAC MP 2007		
Features	**WinAC MP 277**	**WinAC MP 377**
Hardware platform		
Order No. core	6ES7 671-5EF.	6ES7 671-7EG.
Panel	MP 277 8" (Touch, Key), MP 277 10" (Touch, Key)	MP 377 12" (Touch, Key), MP 377 15" (Touch), MP 377 19" (Touch)
Integrated work memory	256 KB	512 KB
Operating system	Windows CE 5.0	
PLC programming software	STEP 7 V5.4 SP1 or higher	
Visualization software	WinCC flexible 2007 Standard, Advanced	
I/O		
Inputs/outputs	2 KB each	8 KB each
Bit memory	2 KB	4 KB
Timers	256	512
Counters	256	512
Retentive data	128 KB	256 KB
Interfaces		
PROFIBUS master	CP 5611 integrated, up to 12 Mbit/s	
PROFIBUS slaves	max. 32	
Industrial Ethernet	Integrated	
Other interfaces	PC/CF card, USB	

PC-based control with SIMATIC WinAC

SIMATIC WinAC is the PC-based control system from Siemens and is available in two versions – as a slot PLC with hardware support or as a software PLC *). Thanks to their short innovation cycles and favorable price/performance ratio, PCs are used today not just in the office world but also increasingly for automation tasks such as operator control and monitoring and data processing. Frequently, this does not exhaust the resources of these increasingly powerful devices. So why not open-loop and closed-loop control with the PC as well?
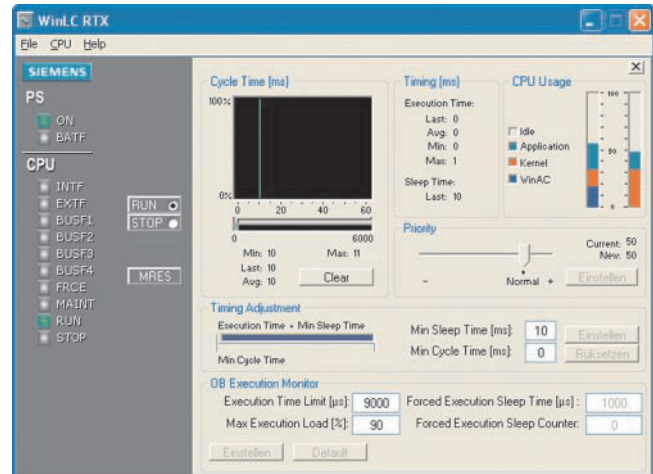
Thanks to the ruggedness of industrial PCs, this is no problem. And the openness of the PC allows simple connection of all the necessary hardware and software components. Optimal system integration on the one hand, and openness to third-party components on the other are not a contradiction with Totally Integrated Automation (TIA). So what could be more obvious than to solve all tasks in a single device and thus utilize the benefits of PC-based technology within TIA?

A SIMATIC S7 is integrated into the PC to produce a cost-optimized total solution in which all the components are available from a single source, if desired. Developers and users profit here from the experience and the global service network of the market leader Siemens and from the high quality of the SIMATIC products and systems. PC-based controllers are configured and programmed with the STEP 7 standard software, in exactly the same way as S7 Controllers. User programs can run on a PLC (programmable controller) or a PC according to customer wishes, and finished S7 programs can be adopted for PC-based solutions.

Operator interface of SIMATIC WinAC

Open, PC-based control based on Windows

SIMATIC WinAC enables control on the PC. WinAC – the SIMATIC S7 in the PC – is eminently suitable when, in addition to control and visualization functions, tasks with high data volumes and high-speed technological functions have to be solved on a PC platform. SIMATIC WinAC can easily be combined with any non-Siemens components and integrated into the office world via the standard OPC (OLE for Process Control) interface. SIMATIC WinAC hardware and software can be used on SIMATIC PCs and on most commercially available PCs with the Professional versions of Windows 2000/XP. The latest PC trends and operating system versions are supported.

Use of SIMATIC know-how

WinAC is programmed with the usual SIMATIC programming tools – with STEP 7 or, if required, also with the field-proven Engineering Tools such as the IEC 61131-3-compliant languages S7-SCL (textual high-level language) or S7-GRAPH (graphical configuring for sequential controls).

All configuration information for a PC-based application are created, managed and saved centrally. In doing so, both centralized engineering via Industrial Ethernet or PROFIBUS and engineering on target are possible, with STEP 7 then installed direct on the control PC.

SIMATIC WinAC is code-compatible with SIMATIC S7-400, that is, program sections created for SIMATIC S7-300 and S7-400 can continue to be used in WinAC and vice versa. Existing investments in software are thus protected. In conjunction with the familiar and field-proven configuring using STEP 7, accumulated SIMATIC know-how can be used extremely well with WinAC.

Highlights

- Cost savings through integration of all automation components on the industrial PC (IPC)

- Utilization of the continuous level of innovation and performance improvement of PCs

- Simple communication through low-cost, integral network interfaces

- Simple use of business software (e.g. MS Office) and creation of proprietary user software with powerful software tools (C++, VB, etc.)

- Wide, standardized range of hardware

- Large choice of products

- Investment security in the use of IPCs with long-term availability

*) PLC stands for "Programmable Logic Controller"

Simple integration of technological functions

SIMATIC WinAC also enables simple integration of technological functions for, say, counting, positioning and closed-loop control tasks.

On the one hand, there are intelligent function modules of the SIMATIC ET 200 distributed I/O devices available for this that are connected via PROFIBUS DP or PROFINET IO.

On the other hand, different SIMATIC software packages enable the solution of simple technological tasks such as standard PID control for general closed-loop control purposes, and Easy Motion Control with its block library in accordance with the PLCopen Motion Control standard for traversing linear or rotary axes.

## Open data interfaces to the office world and other PC applications

SIMATIC WinAC offers an open data interface to the standard software of the office world for vertical integration on the basis of OPC. In the case of visualization and data processing, simple and symbolic access to the process data can be made via this open interface. The integral SIMATIC NET OPC server enables vendor-independent industrial communication with all OPC client applications such as visualization systems from other manufacturers.

SIMATIC WinCC and WinCC flexible can be connected via a SIMATIC interface to enable use of extensive diagnostics functions and of the shared database, for example. PG/OP communication allows connection of SIMATIC programming devices and operator panels.

In addition, SIMATIC WinAC also enables simple horizontal integration of technological applications such as barcode readers, image processing, measured value acquisition, and numerical controls. A supplementary product (ODK, Open Development Kit) is available for this purpose, providing access to all hardware and software components of the PC thanks to the integration of C/C++ programs into the WinAC control program, and thus enabling a high degree of flexibility.
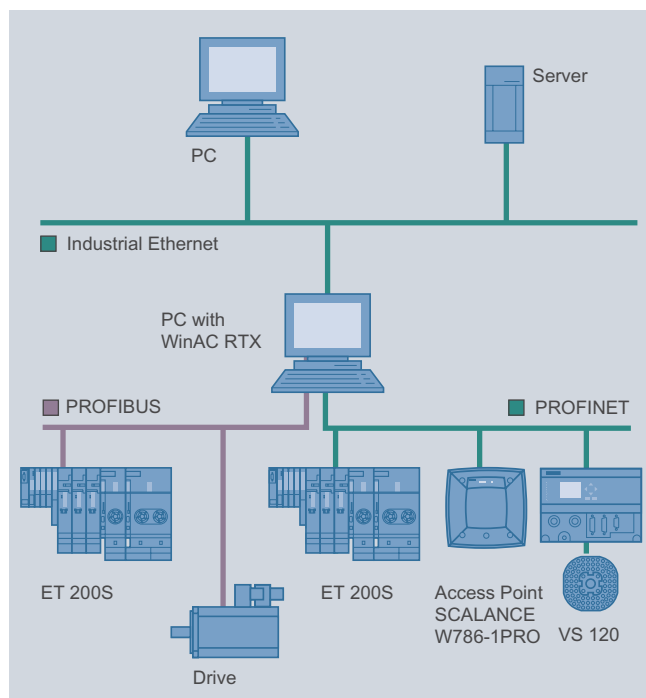
Example of a controller configuration with SIMATIC WinAC on Industrial Ethernet and PROFIBUS
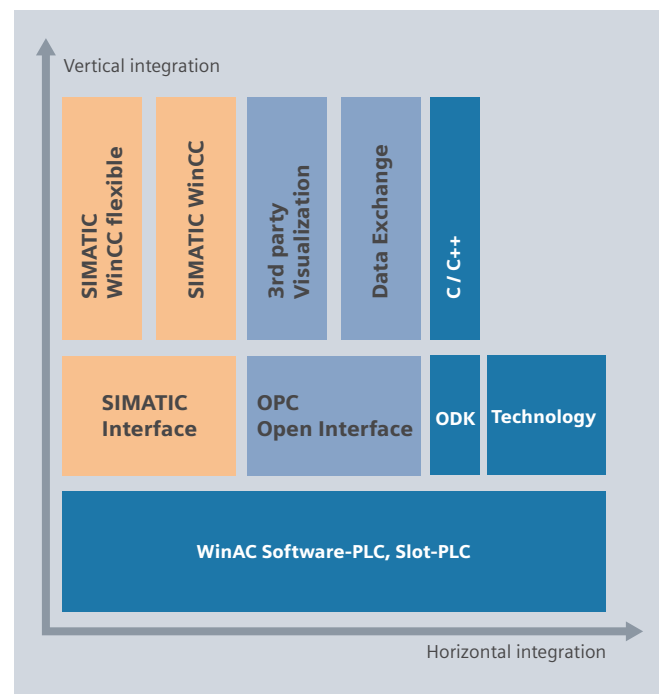
SIMATIC WinAC offers open data interfaces for vertical and horizontal integration of other applications
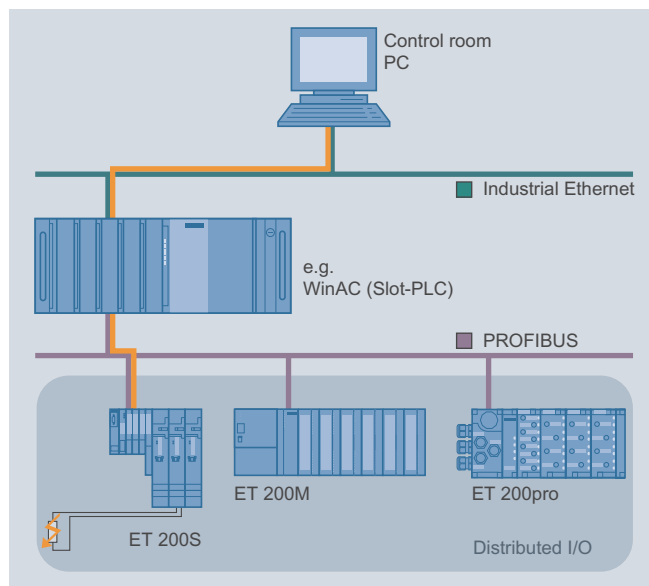
SIMATIC WinAC

The highest possible performance and use of the PC work memory

With SIMATIC WinAC Software PLCs, your PC-based automation solution profits from the high performance power of modern PCs. High processor clock rates result immediately in a high-performance WinAC solution. Using the PC work memory effectively removes any size restrictions on your user programs.

Communication and diagnostics across all levels

SIMATIC WinAC offers the full performance range of S7 Communication with S7 controllers and other WinAC stations over the PROFIBUS and Industrial Ethernet/PROFINET networks. Any data areas can be sent and received with S7 Communication. WinAC stations are handled identically to other S7-CPUs here. An extremely flexible network concept can be implemented with the help of several independent PROFIBUS connections (e.g. CP 5613) and by activating/deactivating PROFIBUS slaves. Support of PROFIBUS DP V1 also allows the integration of intelligent field devices with complex functions. Direct access to all DP slaves and their components from a central control desk across network boundaries is possible with SIMATIC WinAC especially for diagnostics purposes – even for remote diagnostics via Teleservice. This powerful routing function indicates the status of the individual (sub)modules of the slaves distributed on-site, that is, faults can be diagnosed precisely in the control room.

PC-based Automation Competence Centers

Our Competence Centers offer you a comprehensive range of selective services – from workshops and feasibility studies to the handling of specific development tasks.

Weltweite Kompetenz in PC-based Automation

Competence Center für PC-based Automation

Köln **Mailand** **Shanghai**

Competence Center for PC-based Automation

- Northern Europe: CCCologne@siemens.com
- Southern Europe: CCMilano@siemens.it
- Asia: pcba@pek1.siemens.com.cn

For diagnostics purposes, direct access to the I/O level of the I/O devices is possible from the control desk using WinAC

Highlights

WinAC (Windows Automation Center) – the PC-based control solution of Totally Integrated Automation – offers decisive benefits:

- Open, PC-based control based on Windows
- Use of SIMATIC know-how
- Simple integration of technological functions
- Open data interfaces to the office world and other PC applications
- The highest possible performance and use of the PC work memory
- Communication and diagnostics across all levels

SIMATIC WinAC Slot PLC

Enhanced availability and operational safety

SIMATIC WinAC Slot PLC

Up to four Slot PLCs (one PCI slot each) can be operated in one PC. In addition, a Software PLC can also be combined with up to three Slot PLCs. An automation solution can thus be structured more compactly with fewer PCs, thus reducing space requirements and hardware costs.

The firmware is updated immediately by downloading a file without having to store it on a memory card. Loading the firmware in the installed state from any PC memory medium (hard disk, USB stick, CD-ROM) simplifies and accelerates service and maintenance.

WinAC Slot is available in two different versions:
*   WinAC Slot 412 based on the CPU 412-2 with 128 KB memory for code and 128 KB memory for data
*   WinAC Slot 416 based on the CPU 416-2 with 1.6 MB memory for code and 1.6 MB memory for data

The WinAC Slot PLCs are used when increased availability and operational safety are required in PC-based solutions.

The performance and instruction sets of the WinAC Slot PLCs are based on the powerful S7-400 CPUs and enable control independently of Windows.

The Slot PLCs are capable of instruction-specific restart and continue the user program immediately from the point of interruption. Thanks to an external 24V supply, the user program of the Slot PLC can be processed completely independently of the PC. Thanks to battery backup, all data areas can be retentive. Thanks to the rugged configuration and deterministic behavior, applications with increased availability and operational safety can be implemented.

The Slot PLCs have an integral MPI/DP interface and a DP interface for communication with other CPUs and for connecting distributed I/O, for example. In addition, the Slot PLCs support the isochronous mode functionality to enable distributed solutions for high-speed, time-dependent tasks. Programs can be archived and dearchived via the hard disk of the PC.
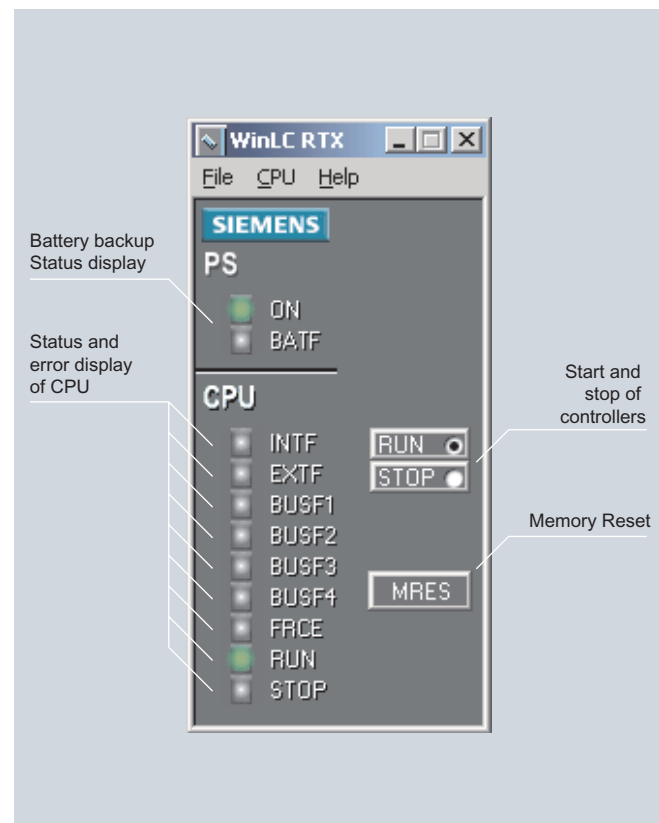
The WinAC Panel on the PC offers the display and operator input functions of the Slot PLC – comparable with those of an S7-CPU.


The operator interface of WinAC corresponds to the display and operator elements of a SIMATIC S7-CPU

SIMATIC WinAC Software PLC

**SIMATIC WinAC RTX 2008 –
Increased flexibility and openness**

WinAC RTX 2008 is used when high performance, high data volumes and at the same time hard real time are required for the automation task. The optimized runtime system supports the processing of extensive and demanding PC applications in parallel with the control task. It runs under Windows XP Professional or embedded and uses the real-time core Ardence RTX to guarantee real time and deterministic behavior.
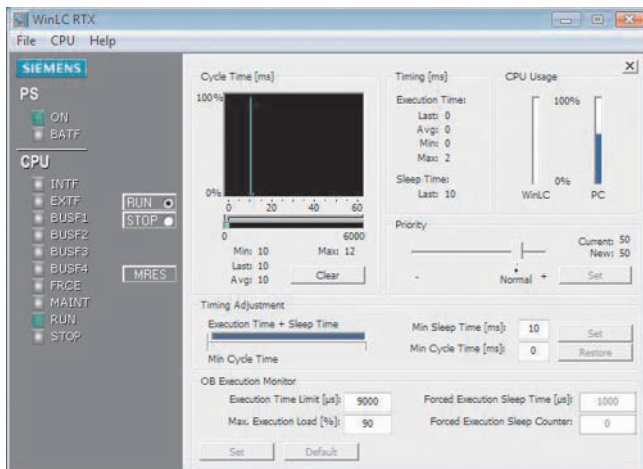
Operator interface for establishing the priorities of control program and Windows application
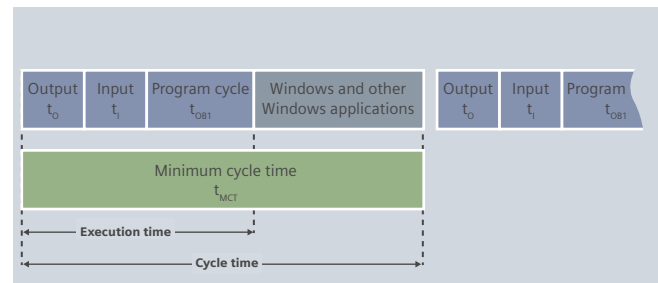
Deterministic behavior of WinAC RTX through a constant cycle time with reserve for Windows after execution of the control program

The performance of WinAC RTX 2008 can be scaled across the PC platform. Applications range from machine-level control tasks with rugged embedded PCs to high-end applications on PCs with the latest technology.

In particular, the use on embedded PC platforms such as the SIMATIC Microbox PC 427B with Windows XP Embedded results in cost-effective and very rugged solutions. The Microbox PC 427B is characterized by its diskless and fanless operation.

WinAC RTX 2008 uses the main memory of the PCs and offers program backup on the hard disk. Non-cyclic data such as production parameters or recipe data can be stored permanently on the PC's hard disk with the help of system functions (SFC 82 – 84). In addition, all data can be held retentively in conjunction with an uninterruptible power supply (UPS).

Real-time behavior *means the response to process events takes place within a specific time. The priority of the control program compared to the Windows applications running in parallel can also be specified.*

Deterministic behavior *means the control program is executed in a fixed cycle and any Windows applications running in parallel will be interrupted if required – such as in drive controls, for example. The time remaining after execution of the control program at the end of the cycle time is available to Windows.*

The I/O is connected via PROFIBUS DP at up to 12 Mbit/s via the integral DP interface of the SIMATIC PCs or via communications processors (CP 5611 A2/5613 A2). Up to four PROFIBUS lines can be operated with up to 500 slaves.

NEW In addition it is possible to connect the I/O via PROFINET. This requires either the integrated Ethernet interface of the SIMATIC PC or a CP 1616 (PCI) or CP 1604 (PCI-104) communications processor.
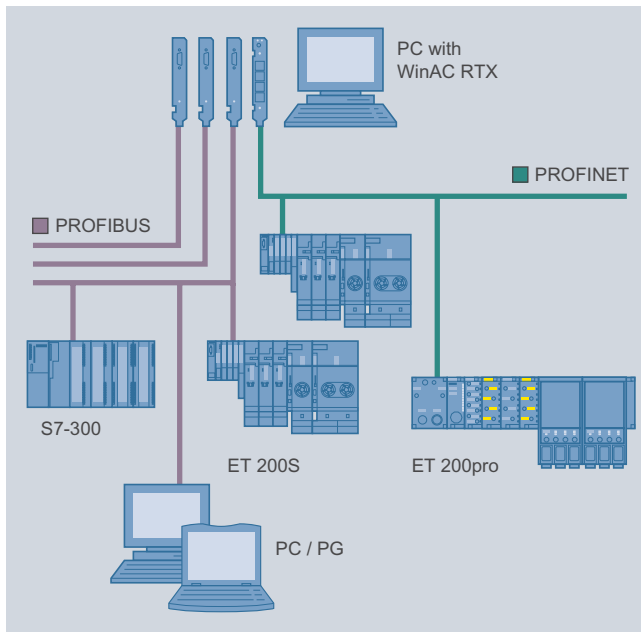
SIMATIC WinAC RTX 2008 can operate up to four independent PROFIBUS lines for connecting the I/O

In addition, with its PROFIBUS interfaces WinAC RTX 2008 also supports the system function isochronous mode. With isochronous mode, high-speed, time-dependent applications such as closed-loop controls can also be implemented with distributed I/O. This means that in addition to the control job other functions can be integrated into a PC or smaller, more economical PCs can be used for the same job.

On exiting, WinAC RTX 2008 saves all the data declared as retentive to the hard disk. In order to ensure a defined shutdown of the Software PLC in the event of an unexpected failure of the PC voltage supply, an uninterruptible power supply (UPS, e.g. SITOP DC UPS) can be used.

SIMATIC PCs with integrated, non-volatile memory enable up to 128 KB of retentive data to be stored in the event of voltage dip, regardless of the file system.

For SIMATIC PCs without integrated, non-volatile memory, the **NEW** WinAC NV128 plug-in card is available. This enables up to 128 KB of retentive data to be stored. Depending on the version of the PC, however, the use of a UPS may be necessary.

Open Development Kit (ODK)

Integrating special tasks

PC-based solutions typically include technological tasks such as image processing, measured value acquisition and numerical controls. The new WinAC option Open Development Kit (ODK) allows flexible use of all PC resources from the control program via three different interfaces in order to provide high-performance expansion of the PLC functionality. All the operating system functions and system resources of Windows are available to the programmer for this purpose, also providing access to external hardware and software components.

The new ODK version integrates the functions of the previous supplementary packages ODK (old version for the Software PLCs) and T-Kit (for the Slot PLCs) into a single development package. Software developments can therefore be used repeatedly because such software can now be used on all WinAC PLCs. The new ODK version is also compatible with the predecessor versions so that existing applications can continue to be used.

An ODK application is developed with a standard development environment for C-/C++ programming, such as Microsoft Visual Developer's Studio. This provides the application developer with the familiar environment tailored to Windows applications.

C++ programming knowledge is not required for integrating such applications into the WinAC control program. The ODK applications can be used like normal system functions in the STEP 7 program.

Developers of C++ applications can get support from the WinAC Competence Center:
www.siemens.com/pcbasedautomation/cc

WinAC ODK offers three interfaces for the following applications:
- Custom Code Extension Interface (CCX) for calling your own C/C++ programs from the WinAC control program
- Shared Memory Extension Interface (SMX) for high-speed WinAC data exchange with Windows applications
- Controller Management Interface (CMI) for integrating the WinAC Panel functionality into a Windows application

The table shows which interfaces are available for which WinAC versions:

ODK interfaces of the WinAC versions		
	Soft	Slot
Custom Code Extension (CCX)	●	
Shared Memory Extension (SMX)	●	●
Controller Management (CMI)	●	●

Custom Code Extension Interface (CCX)

ODK includes an application wizard and a class library for simple programming in Microsoft Visual C++. The C++ program running outside WinAC is called via the CCX from the PLC program with the help of two system functions (SFC 65_000, SFC 65_001). The C program can be executed in three different ways:

- Synchronously, that is, processed as part of the PLC cycle
- Asynchronously, that is, started by the PLC program and terminated in the background
- Continuously, that is, processed parallel to the PLC program

This allows diverse applications to be implemented.
Some examples include:
- Connection of fieldbus cards to WinAC
- Integration of robot control software into WinAC
- Direct access to Windows file system
- Implementation of special communications protocols
- Complex calculations for control of the quality of packaging film
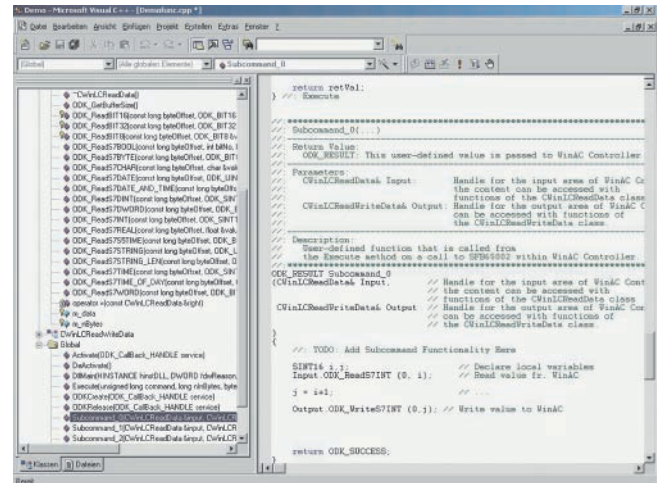
Operator interface of the application wizard with class libraries and C++ program
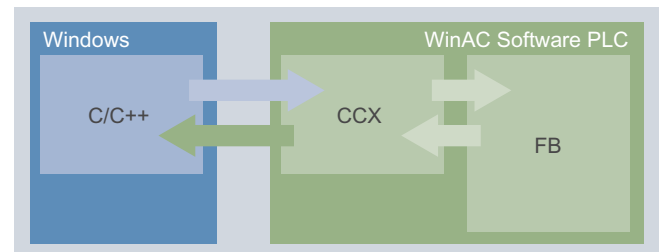
The Custom Code Extension Interface (CCX) offers the facility of calling C/C++ programs from the control program of the WinAC Software PLC

Open Development Kit (ODK)

Shared Memory Extension Interface (SMX)

Via SMX, ODK supports the development of applications requiring data exchange between Windows applications such as Visual C++ and the WinAC PLCs, as is the case, for example, in closed-loop control or image processing tasks. This data exchange is especially fast via the a dual-port RAM (DPR) or shared memory, accessed by both the external C++ program and the PLC program. ODK includes libraries for reading and writing to this DPR according to the polling method. From the viewpoint of the WinAC PLC, the DPR represents a 4KB I/O area that can be accessed with load/transfer commands.

Typical applications of the SMX:
• Connection of motion control systems
• Connection of systems for measured data acquisition and analysis
• Transfer and backup of large volumes of production and quality data
• Direct and high-performance integration of an order database
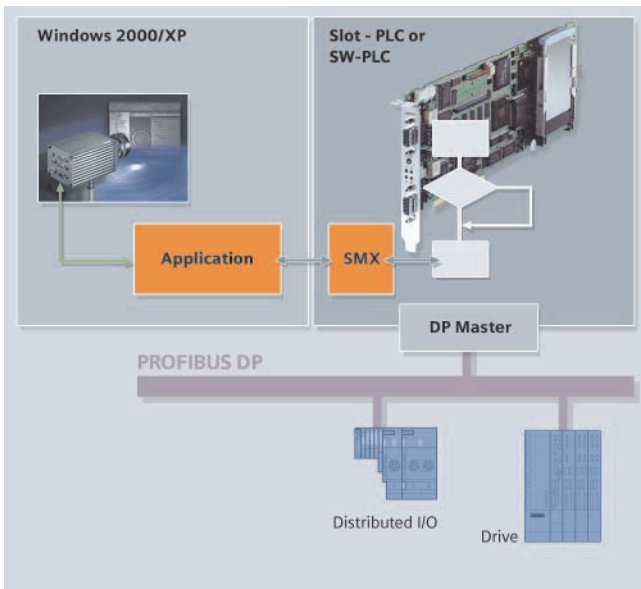
The Shared Memory Extension Interface (SMX) enables data exchange between Slot PLCs or Software PLCs and Microsoft applications

Controller Management Interface (CMI)

With ODK, the function of the WinAC Panels can be integrated into a Windows application (see figure). For this purpose, the CMI provides the application with the following functions of the WinAC Panel:
• LED status
• Start and stop of the PLC
• Subsequent loading of programs

Application examples:
• Integration of the WinAC Panel into an HMI application
• Remote operation of the PLC
• Implementation of specific user rights
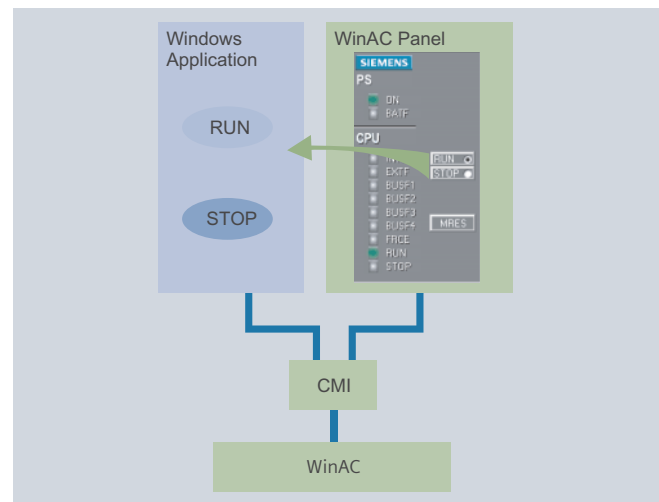
The Controller Management Interface (CMI) integrates the WinAC Panel functionality into a Windows application

Technical specification SIMATIC WinAC

PC-based control	Software PLC	Slot PLC	
	WinAC RTX 2008	**WinAC Slot 412 V4.0**	**WinAC Slot 416 V4.0**
Order No. core: 6ES7	671-0RC.	673-2CC.	673-6CC.
Basic features			
RAM (integral) (code/data)	PC memory (non-paged memory)	192 KB/192 KB	1.6 MB/1.6 MB
Number of inputs/outputs in total	16/16 KB	4/4 KB	16/16 KB
Bit memory	16 KB	4 KB	16 KB
S7 counters/timers	2048/2048	2048/2048	2048/2048
Plug-in memory card		●	●
Number of blocks (FBs, FCs, DBs)	Limited only by available PC RAM	256, 256, 511	2048, 2048,4095
Multiprocessor operation	1 Software PLC and up to 3 Slot PLCs	Up to four Slot PLCs	
PLC programming software	STEP 7 from V5.4 SP4, Engineering Tools (optional)	STEP 7 V5.2 or higher, Engineering Tools (optional)	
Retentivity			
with UPS	All data[1]		
with PS Extension Board and battery		All data	
Instruction execution times			
Bit operation	0.004 µs	0.1 µs	0.04 µs
Integer operation	0.003 µs	0.1 µs	0.04 µs
Floating-point operation	0.004 µs	0.3 µs	0.12 µs
Reference platform	Pentium 4, 2.4 GHz	PC-independent	PC-independent
Deterministic	●	●	●
DP connections			
Total	4	2	
Integrated		2	
CP5611/integrated interface of SIMATIC PC, max.	1		
CP5613-A2 max.	4		
CP1616/1604	1		
Integrated PROFINET interface SIMATIC PC	1		
Integrated Ethernet interface Microbox PC	1		
Communications functions			
PG/OP communication	●	●	
S7 Communication	●	●	
Process data access via OPC	●	●	
Technology			
SIMATIC FM	FM 350/351/352/ 353/354/355	FM 350/351/352/ 353/354/355	
Easy Motion Control	●	●	
C/C++ link	● with ODK	● with ODK	
Operator control and monitoring via SIMATIC interface			
SIMATIC WinCC/WinCC flexible	●	●	
Operating system			
Windows 2000 Professional		● (>= SP3)	
Windows XP Professional	● (SP1 or SP2)	● (SP1 or SP2)	
Windows XP Embedded	● (on XPe images of the SIMATIC PC)		

[1] *128 KB with specific SIMATIC PC without UPS*

Technical specifications

S7-300 digital inputs

Module type	Digital inputs SM 32x					
Special features of this module	Module with programmable input delay and comprehensive diagnostics; suitable for isochronous mode.	Simple, low-cost module for recording frequently required signals	Simple, economically priced module for the acquisition of frequently required signals with high channel density	Simple, low-cost module for recording frequently required signals	Simple, economically priced module for the acquisition of frequently required signals with high channel density	Universal, scalable I/O module; 8-bit channel-specific, programmable as input or output
Type of voltage	Direct voltage DC					
Suitable for	Switches and 2, 3 or 4-wire proximity switches (BEROs)					
Input voltage	24 V					
Diagnostics capability	●					
Interrupt capability	●					
Input delay	0.1 - 20 ms[1]	Typ. 3 ms (fixed)				
Number of channels	16	16	32 | 64	8 DI / 8 DO	16 DI / 16 DO	8 DI / 8 DX
Galvanic isolation: Number of groups	1	1	2 | 4	1	1	1
Order No. core: 6ES7	321-7BH0.	321-1BH0.	321-1BL0. | 321-1BH0. [2]	323-1BH0.	323-1BL0.	327-1BH0.

Module type	Digital inputs SM 32x				
Special features of this module	Source input module	Very fast module, especially for isochronous applications	NAMUR inputs and other comprehensive control functions, in particular for use in a process-oriented environment	Recording high direct voltages, e.g. as they occur in power plants or engine test stands	16 single-channel isolated channels; possible for recording both direct and alternating voltages
Type of voltage	Direct voltage DC				Universal voltage UC
Suitable for	Switches and 2, 3 or 4-wire proximity switches (BEROs)		NAMUR sensor	Switches and 2, 3 or 4-wire proximity switches (BEROs)	
Input voltage	24 V			48 to 125 V	24/48 V UC
Diagnostics capability			●		
Interrupt capability			●		
Input delay	typ. 3 ms fixed	0.05 ms fixed	3 ms fixed	10 ms fixed	<6 ms fixed
Number of channels	16	16	16	16	16
Galvanic isolation: Number of groups	1	1	2	8	16
Order No. core: 6ES7	321-1BH5.	321-1BH10-.	321-7TH00-.	321-1CH20-.	321-1CH00-.

Module type	Digital inputs SM 32x			
Special features of this module	Direct detection of AC voltages up to 230 V AC; 4-grouping	Direct detection of AC voltages up to 120 V AC at a high channel density	Direct detection of AC voltages up to 230 V AC; 2-grouping	Direct detection of AC voltages up to 230 V AC; single-channel isolated
Type of voltage	Alternating voltage AC			
Suitable for	Switches and 2, 3 or 4-wire AC proximity switches			
Input voltage	120/230 V	120 V	120/230 V	
Diagnostics capability				
Interrupt capability				
Number of channels	16	32	8	
Galvanic isolation: Number of groups	4	4	4	8
Order No. core: 6ES7	321-1FH0.	321-1EL0.	321-1FF0.	321-1FF1.

[1] parameterizable

[2] Connection with detached terminal block

S7-300 digital outputs

Module type	Digital inputs SM 32x					
Special features of this module	Simple, economically priced module for standard applications	Very fast module, especially for isochronous applications	Simple, low-cost module for standard applications with high packing density	Simple, low-cost module for recording frequently required signals	Simple, economically priced module for the acquisition of frequently required signals with high channel density	Universal, scalable I/O module; 8-bit channel-specific, programmable as input or output
Type of voltage	Direct voltage DC					
Suitable for	Solenoid valves, DC contactors and signal lamps					
Output voltage	24 V					
Output current	0.5 A		0.5 A	0.3 A	0.5 A		
Diagnostics capability						
Interrupt capability						
Number of channels	16		32	64	8 DI / 8 DO	16 DI / 16 DO	8 DI / 8 DX
Galvanic isolation: Number of groups	2		4	1	2	1
Order No. core: 6ES7	322-1BH0.	322-1BH1.	322-1BL0. | 322-1BP. [1]	323-1BH0.	323-1BL0.	327-1BH0.

[1] Connection with detached terminal block

Module type	Digital inputs SM 32x			
Special features of this module	Comprehensive diagnostics functions; integrated diode for redundant interconnection of the outputs	Comprehensive control functions, in particular for use in a process-oriented environment; integrated diode for redundant interconnection of the outputs	8-channel output module for the switching of high currents (2 A)	Switching of high direct voltages (125 V DC; 1.5 A), as they occur in power plants or engine test stands
Type of voltage	Direct voltage DC			
Suitable for	Solenoid valves, DC contactors and signal lamps			
Output voltage	24 V			48 to 125 V
Output current	0.5 A		2 A	1.5 A
Diagnostics capability	●			
Interrupt capability	●			
Number of channels	8	16	8	
Galvanic isolation: Number of groups	1	4	2	2
Order No. core: 6ES7	322-8BF0.	322-8BH0.	322-1BF0.	322-1CF0.

Module type	Digital inputs SM 32x								
Special features of this module	TRIAC module for the electronic switching of high currents and voltages; wear-free compared to relay		8-channel TRIAC module with single-channel isolated outputs; wear-free compared to relay module; diagnostics and substitute values are parameterizable	Switching of high voltages and currents with high channel density	Universal relay output module that covers a broad range of applications	Universal relay output module with up to 2 A at 230 V AC	Universal relay output module with up to 5 A at 230 V AC; switching of higher outputs is thus possible	Relay module with integrated RC quenching circuit; diagnostics and substitute values are parameterizable	16 channels single-channel, electrically isolated; diagnostics and substitute values are parameterizable
Type of voltage	Alternating voltage AC				UC (relay)				
Suitable for	AC/DC magnetic coils, contactors, motor starters, miniature motors and indicator lights								
Output voltage	120/230 V				DC: 24 to 120 V AC: 24 to 230 V	24 V to 120 V DC 48 to 230 V AC			24 V/ 48 V
Output current	1 A		2 A	1 A	2 A	2 A	5 A		0.5 A
Diagnostics capability			●					●	●
Interrupt capability									●
Number of channels	16	8	8	32	16	8	8	8	16
Galvanic isolation: Number of groups	2	2	8	4	2	4	8	8	16
Order No. core: 6ES7	322-1FH0.	322-1FF0.	322-5FF0.	322-1FL0.	322-1HH0.	322-1HF0.	322-1HF1.	322-5FF0.	322-5GH0.

S7-300 analog inputs

Module type	Analog inputs SM 33x								
Special features of this module	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling		High-resolution and high-precision module for detecting currents and voltages		Low-cost, universal hybrid module for the acquisition and output of currents and voltages	Universal hybrid module for measuring voltages, resistances and temperatures by means of resistance-type transmitters (RTD) and for the output of voltages	Hybrid module for high-speed applications, such as plastics machines; integrated comparator	Universal module that covers all prevalent measurement ranges (no TC measurement) and thus simplifies spare parts handling	Very fast module that operates according to the principle of current value encryption; suitable for isochronous applications
Voltage measuring range Encoders	± 80 mV ± 250 mV ± 500 mV ± 1 V ± 2.5 V		± 5 V ± 10 V 1 to 5 V		0 to 10 V		± 1 V ± 2.5 V ± 10 V 0 to 2 V 0 to 10 V	± 10 V ± 50 mV ± 500 mV 1 to 5 V ± 1 V ± 5 V 0 to 10 V	± 1 V ± 5 mV ± 10 V 1 to 5 V
Diagnostics capability	●			●			●		●
Interrupt capability	●			●			●		●
Operating error	± 1%		± 0.1%	± 0.1%	± 0.9%	± 0.7%	± 0.15%	± 0.6%	± 0.4%
Number of channels	8	2	8	8	4	2	4	8	8
Galvanic isolation: Number of groups	4	1	4	4	1	1	4	1	1
Resolution	max. 14 bits + sign	max. 14 bits + sign	15 bits + sign	15 bits + sign	8 bits	12 bits + sign	13 bits + sign	12 bits + sign	13 bits + sign
Conversion time per channel (at 50 Hz)	22 ms	22 ms	65 ms	83 ms [2]	100 µs	85 ms	200 µs	60 ms	52 µs [1]
Order No. core: 6ES7	331-7KF0.	331-7KB0.	331-7NF0.	331-7NF1.	334-0CE0.	334-0KE0.	335-7HG0.	331-1KF0.	331-7HF0.

Module type	Analog inputs SM 33x								
Special features of this module	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling		High-resolution and high-precision module for detecting currents and voltages		Low-cost, universal hybrid module for the acquisition and output of currents and voltages	Hybrid module for high-speed applications, such as plastics machines; integrated comparator	Universal module that covers all prevalent measurement ranges (no TC measurement) and thus simplifies spare parts handling	Very fast module that operates according to the principle of current value encryption; suitable for isochronous applications	Supports communications with HART-capable field devices; high channel density and thus a low price
Current measuring range Encoders	± 3.2mA, ± 10 mA, ± 20 mA, 0 to 20 mA, 4 to 40 mA		0 to 20 mA 4 to 20 mA ± 20 mA		0 to 20 mA	±10 mA 0 to 20 mA 4 to 40 mA	± 20 mA 0 to 20 mA 4 to 20 mA		± 20 mA 0 to 20 mA 4 to 20 mA HART
Type of connection	2-wire and 4-wire transducers				4-wire transducers		2-wire and 4-wire transducers		
Diagnostics capability	●			●		●		●	●
Interrupt capability	●			●		●		●	●
Operating error	± 1%		± 0.3%	± 0.1%	± 0.8%	± 0.25%	± 0.5%	± 0.3%	± 0.15%
Number of channels	8	2	8	8	4	4	8	8	8
Galvanic isolation: Number of groups	4	1	4 (8)	4	1	1	1	1	1
Resolution	max. 14 bits + sign	max. 14 bits + sign	15 bits + sign	15 bits + sign	8 bits	13 bits + sign	12 bits + sign	13 bits + sign	15 bits + sign
Conversion time per channel (at 50 Hz)	22 ms	22 ms	65 ms	83 ms [2]	100 µs	200 µs	60 ms	52 µs [1]	65 ms
Order No. core: 6ES7	331-7KF0.	331-7KB0.	331-7NF0.	331-7NF1.	334-0CE0.	335-7HG0.	331-1KF0.	331-7HF0.	331-7TF0.

[1] Independent of the set interference frequency suppression

[2] In 4-channel mode 10 ms

Module type	Analog inputs SM 33x				
Special features of this module	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling		High-resolution and high-precision module for recording temperatures via resistance-type transmitters (RTD) including characteristic-curve linearization based on the Russian GOST standard	Universal hybrid module for measuring voltages, resistances and temperatures by means of resistance-type transmitters (RTD) and for the output of voltages	Universal module that covers all prevalent measurement ranges (no TC measurement) and thus considerably simplifies spare parts handling
Resistance measuring range of encoders	150 Ω, 300 Ω, 600 Ω			10 kΩ	600 Ω, 6 kΩ
Type of connection	2-/3-/4-wire connection				
Diagnostics capability	●				
Interrupt capability	●				
Operating error	± 1%		± 0.1%	± 3.5%	± 0.5%
Number of channels	4	1	8	4	8
Galvanic isolation: Number of groups	4	1	4	2	1
Resolution	max. 14 bits + sign	max. 14 bits + sign	max. 15 bits + sign	12 bits + sign	12 bits + sign
Conversion time per channel (at 50 Hz)	23 ms	23 ms	80 ms	170 ms	132 ms
Order No. core: 6ES7	331-7KF0.	331-7KB0.	331-7PF0.	334-0KE0.	331-1KF0.

Module type	Analog inputs SM 33x							
Special features of this module	Universal hybrid module for measuring voltages, resistances and temperatures by means of resistance-type transmitters (RTD) and for the output of voltages	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling		High-resolution and high-precision module for recording temperatures via resistance-type transmitters (RTD) including characteristic-curve linearization based on the Russian GOST standard	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling		High-resolution and high-precision module for recording temperatures via thermocouples (TC) including characteristic-curve linearization based on the Russian GOST standard	Universal module that covers all prevalent measurement ranges (no TC measurement) and thus considerably simplifies spare parts handling
Temperature measuring range Encoders	Pt 100 (-120 to +130 °C)	Pt 100 Ni 100 (-200 ... +385 °C) standard or climate		Pt: 100; 200; 500; 1000; Ni: 100; 120; 200; 500; 1000; Cu 10 (-200 to +850 °C and -120 to +130 °C)[1]	Thermocouples types E, N, J, K, L		Thermocouples type B, C, E, N, J, K, L, R, S, T, U [2]	Pt 100 (-120 to +130 °C); Ni 100; Ni 1000; LG-Ni 1000; (standard or depending on climate)
Diagnostics capability		●						
Interrupt capability		●						
Operating error	± 1%			± 0.1%	± 1%		± 0.1%	± 1%
Number of channels	4	4	1	8	8	2	8	8
Galvanic isolation: Number of groups	2	1	1	4	4	1	4	1
Resolution	max. 14 bits + sign			15 bits + sign	max. 14 bits + sign		15 bits + sign	12 bits + sign
Conversion time per channel (at 50 Hz)	170 ms	23 ms		80 ms	22 ms	44 ms	95 ms	110 ms
Order No. core: 6ES7	334-0KE0.	331-7KF0.	331-7KB0.	331-7PF0.	331-7KF0.	331-7KB0.	331-7PF1.	331-1KF0.

[1]) *Characteristic curves in accordance with GOST 6651-94,*

[2]) *Characteristic curves in accordance with GOST P8.585.2001*

S7-300 analog outputs

Module type	Analog outputs SM 33x						
Special features of this module	Universal analog output module	Universally applicable analog output module; economical thanks to high channel density	High-speed module with high resolution and accuracy; suitable for isochronous mode	Low-cost, universal hybrid module for the acquisition and output of currents and voltages	Universal hybrid module for measuring voltages, resistances and temperatures by means of resistance-type transmitters (RTD) and for the output of voltages	Hybrid module for high-speed applications, such as plastics machines; integral comparator
Output range	0 to 10 V, 1 to 5 V, ± 10 V				0 to 10 V		0 to 10 V ± 10 V
Diagnostics capability	●						●
Interrupt capability	●						●
Operating error	± 0.5%			± 0.12%	± 0.6%	± 1%	± 0.5%
Number of channels	2	4	8	4	2		4
Galvanic isolation: Number of groups	1	1	1	4	1		1
Resolution	11 bits + sign			max. 15 bits + sign	8 bits	12 bits	max. 13 bits + sign
Conversion time per channel	< 0.8 ms			> 1.6 ms	0.5 ms	0.5 ms	>0.8 ms
Order No. core: 6ES7	332-5HB0	332-5HD0.	332-5HF0.	332-7ND0.	334-0CE0.	334-0KE0.	335-7HG0.

Module type	Analog outputs SM 33x					
Special features of this module	Universal analog output module	Universally applicable analog output module; economical thanks to high channel density	High-speed module with high resolution and accuracy; suitable for isochronous mode	Low-cost, universal hybrid module for the acquisition and output of currents and voltages	Supports communications with HART-capable field devices; low price per channel thanks to high channel density
Output range	± 20 mA, 0 to 20 mA, 4 to 20 mA			0 to 20 mA	0 to 20 mA HART 4 to 20 mA HART
Diagnostics capability	●				●
Interrupt capability	●				●
Operating error	± 0.6%		± 0.18%	± 1%	± 0.2%
Number of channels	2	4	8	4	2	8
Galvanic isolation: Number of groups	1	1	1	4	1	1
Resolution	11 bits + sign			max. 15 bits + sign	8 bits	15 bits + sign
Conversion time per channel	< 0.8 ms			1,6 ms	0.5 ms	50 ms
Order No. core: 6ES7	332-5HB0.	332-5HD0.	332-5HF0.	332-7ND0.	334-0CE0.	332-8TF0.

Fail-safe S7-300 digital modules, standards and approvals

Failsafe digital modules	Digital input SM 326 F [1]	Digital input SM 326 F (NAMUR)	Digital output SM 326 F [1]	Digital output SM 326 F (PM) [1]	Analog input module SM 336 F
Number of inputs resp. outputs	up to 24 (1-channel for SIL 2 sensors); up to 12 (2-channel for SIL 3 sensors)	8 (1-channel) 4 (2-channel)	10	8 x current sinking/ sourcing	6 (15 bits)
Input or output voltage	24 V DC	NAMUR	24 V DC	24 V DC	
Interrupts	Diagnostics interrupt	Diagnostics interrupt	Diagnostics interrupt	Diagnostics interrupt	Diagnostics interrupt
Input current/ output current			2 A per channel at signal "1"	2 A per channel at signal "1"	0/4 to 20 mA, HART
Order No. core: 6ES7	326-1BK.	326-1RF.	326-2BF.	326-2BF	336-4GE.

[1]) as SIPLUS component also for extended temperature range -25 °C to +60 °C and aggressive atmosphere/condensation (*w w w . s i e m e n s . c o m / s i p l u s*)

SIMATIC S7-300 complies with the following national and international standards *)	The failsafe CPUs comply *additionally* with the following standards
DIN, EN, IEC	IEC 61508 (SIL 3)
CE	EN 954 (Category 4)
UL certificate	NFPA 79-2002, NFPA 85
cULus certificate	UL 1998, UL 508 and UL 991
FM class 1 div. 2; group A, B, C and D temperature group T4 (≤ 135 °C)	
GOST	
C-Tick	
EU Directive 94/9/EC (ATEX 100a)	
ISA-S71.04 severity level G1, G2, G3	
Shipbuilding certification from • American Bureau of Shipping • Bureau Veritas • Det Norske Veritas • German Lloyd • Lloyds Register of Shipping	
Max. permissible environmental temperature: 60 °C for all components	
Earthquake protection	

*) At present, the SIPLUS S7-300 also complies with Standard EN50155 (Railroad Standard) and is designed for the extended temperature range down to -25 °C (www.siemens.com/siplus)

S7-400 digital inputs/outputs

Module type	Digital inputs SM 421				
Special features of this module	Module for the acquisition of very fast signals with parameterizable input delay and process alarms; diagnostics	Simple, economically priced module for the acquisition of frequently required signals with high channel density	Direct acquisition of DC and AC voltages at high channel density		Suitable for DC and AC voltage; can be implemented as active high and active low module
Type of voltage	DC		UC		
Input voltage	24 V		120 V	120/230 V	24 to 60 V
Diagnostics capability	●				●
Interrupt capability	●				●
Input delay	0.05 ms to 3 ms [1]	3 ms fixed	<25 ms fixed		0.5 ms to 20 ms [1]
Number of channels	16	32	32	16	16
Galvanic isolation: Number of groups	2	1	4	4	16
Order No. core: 6ES7	421-7BH.	421-1BL.	421-1EL.	421-1FH.	421-7DH.

[1] parameterizable

Module type	Digital inputs SM 422				
Special features of this module	Simple, economically priced module for standard applications	Simple, economically priced module for standard applications with high channel density	Extensive diagnostics functions; parameterizable substitute values	Electronic switching of high currents and voltages; no wear compared to relay output	Universal relay output group
Type of voltage	DC			AC	Relay
Output voltage	24 V			120/230 V	5-125 V DC
Output current	2 A	0.5 A		2 A	5 A
Diagnostics capability			●	●	
Interrupt capability			●		
Number of channels	16	32	32	16	16
Galvanic isolation: Number of groups	2	1	4	4	8
Order No. core: 6ES7	422-1BH.	422-1BL.	422-7BL.	422-1FH.	422-1HH.

S7-400 analog inputs

Module type	Analog inputs SM 431					
Special features of this module	Simple module for current and voltage measurement; high channel density	Universal module for current, voltage and resistance measurement	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling	Very fast analog value conversion with current value encryption; therefore suitable for acquisition of fast signals	Universal module, covering the most common measurement ranges; high resolution and precision; high channel density	High resolution and highly precise measurement of temperatures with thermocouples (TC); available as an option: Plug with integrated temperature compensation; single-channel, electrically isolated
Voltage measuring range Encoders	±1 V 1 to 5 V	±1 V ±10 V 1 to 5 V	± 80 mV ± 250 mV ± 500 mV ±1 V ±2.5 V ±5 V ±10 V 1 to 5 V	±1 V 1 to 5 V ±10 V	±25 mV, ±50 mV, ±80 mV, ±250 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V, 1 to 5 V	
Diagnostics capability					●	
Interrupt capability					●	
Operating error	≤ ± 1%	< ± 1%	< ± 0.38%	< ± 0.9%	< ± 0.35%	< ± 0.3%
Number of channels	16	8			16	8
Galvanic isolation: Number of groups	1	1			1	8
Resolution	12 bits + sign		13 bits + sign		15 bits + sign	
Conversion time per channel (50 Hz)	65 ms	25 ms	23 ms	52 µs [1]	23 ms	20 ms
Order No. core: 6ES7	431-0HH.	431-1KF0.	431-1KF1.	431-1KF2.	431-7QH.	431-7KF0.

Module type	Analog inputs SM 431					
Special features of this module	Simple module for current and voltage measurement; high channel density	Universal module for current, voltage and resistance measurement	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling	Very fast analog value conversion with current value encryption; therefore suitable for acquisition of faster signals	Universal module, covering the most common measurement ranges; high resolution and precision; high channel density	High resolution and highly precise measurement of temperatures with thermocouples (TC); available as an option: Plug with integrated temperature compensation; single-channel, electrically isolated
Current measuring range Encoders	4 to 20 mA ±20 mA		4 to 20mA 0 to 20mA ±20 mA	4 to 20mA ±20 mA	4 to 20mA 0 to 20mA ±5 mA ±10 mA ±20 mA	4 to 20mA 0 to 20mA ±5 mA ±10 mA ±20 mA ±3.2 mA
Diagnostics capability					●	
Interrupt capability					●	
Operating error	≤ ± 0.65%	≤ ± 1%	≤ ± 0.35%	≤ ± 0.8%	≤ ± 0.3%	≤ ± 0.5%
Number of channels	16	8			16	8
Galvanic isolation: Number of groups	1	1			1	8
Resolution	12 bits + sign		13 bits + sign		15 bits + sign	
Conversion time per channel (50 Hz)	65 ms	25 ms	23 ms	52 µs [1]	23 ms	20 ms
Order No. core: 6ES7	431-0HH.	431-1KF0.	431-1KF1.	431-1KF2.	431-7QH.	431-7KF0.

[1] *Independent of the set interference frequency suppression*

S7-400 analog inputs

Module type	Analog inputs SM 431			
Special features of this module	Universal module for current, voltage and resistance measurement	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling	Very fast analog value conversion with current value encryption; therefore suitable for acquisition of fast signals	Universal module, covering the most common measurement ranges; high resolution and precision; high channel density
Resistance measuring range Encoders	0 - 600 οημσ	0 - 48 Ω, 0 to 150 Ω, 0 to 300 Ω, 0 to 600 Ω, 0 to 6000 Ω	0 - 600 Ω	0 - 48 Ω, 0 to 150 Ω, 0 to 300 Ω, 0 to 600 Ω, 0 to 6000 Ω
Diagnostics capability				●
Interrupt capability				●
Operating error	$\leq \pm 1.25\%$	$\leq \pm 0.5\%$	$\leq \pm 1\%$	$\leq \pm 0.4\%$
Number of channels	4			8
Galvanic isolation: Number of groups	1			1
Resolution	13 bits	14 bits		16 bits
Conversion time per channel (50 Hz)	25 ms	23 ms	52 µs [1]	23 ms
Order No. core: 6ES7	431-1KF0.	431-1KF1.	431-1KF2.	431-7QH.

Module type	Analog inputs SM 431		
Special features of this module	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling	Universal module, covering the most common measurement ranges; high resolution and precision; high channel density	High resolution and highly precise measurement of temperatures with thermocouples (TC); available as an option: Plug with integrated temperature compensation; single-channel, electrically isolated
Thermocouple types	B, E, N, J, K, L, R, S, T, U		
Diagnostics capability		●	
Interrupt capability		●	
Operating error	$\leq \pm 14.8K$	$\leq \pm 11.5K$	$\leq \pm 3.5K$
Number of channels	8	16	8
Galvanic isolation: Number of groups	1		8
Resolution	14 bits	16 bits	
Conversion time per channel (50 Hz)	20/23 ms	6/21/23 ms	–
Order No. core: 6ES7	431-1KF1.	431-7QH.	431-7KF0.

Module type	Analog inputs SM 431		
Special features of this module	Universal module covering the most common measurement ranges and therefore greatly simplifying spare parts handling	Universal module, covering the most common measurement ranges; high resolution and precision; high channel density	High resolution and highly precise measurement of temperatures with the resistance temperature detector (RTD); single-channel, electrically isolated
Resistance thermometer types	Pt 100; 200; 500; 1000 Ni 100; 1000 [2]	Pt 100; 200; 500; 1000 Ni 100; 1000 [2]	
Diagnostics capability		●	
Interrupt capability		●	
Operating error	$\leq \pm 5.7K$	$\leq \pm 4.9K$	$\leq \pm 1K$
Number of channels	4	8	
Galvanic isolation: Number of groups	1		8
Resolution	14 bits	16 bits	
Conversion time per channel (50 Hz)	20/23 ms	6/21/23 ms	--
Order No. core: 6ES7	431-1KF1.	431-7QH.	431-7KF1.

[1] Independent of the set interference frequency suppression

[2] Standard and climate in each case

S7-400 analog output modules, standards and approvals

Module type	Analog outputs SM 432
Special features of this module	Universal analog output module
Voltage	±10 V, 0 to 10 V, 1 to 5 V
Current	±20 mA, 0 to 20 mA, 4 to 20 mA
Diagnostics capability	
Interrupt capability	
Operating error	U: ± 0.5% I: ± 1%
Number of channels	8
Galvanic isolation: Number of groups	1
Resolution	12 bits + sign
Conversion time per channel	< 420 µs
Order No. core: 6ES7	432-1HF.

The SIMATIC S7-400 complies with the following national and international standards	The failsafe CPUs comply *additionally* with the following standards
DIN, EN, IEC	IEC G1508 (SIL3)
CE	EN 954 (Category 4)
UL certificate	NFPA 79-2002, NFPA 85
CSA certificate	UL 1998, UL 508 and UL 991
FM class 1 div. 2; group A, B, C and D, temperature group T4 (<=135 °C)	
GOST	
C-Tick	
EU Directive 94/9/EC (ATEX 100a)	
ISA-S71.04 severity level G1, G2, G3	
Shipbuilding certification from • American Bureau of Shipping • Bureau Veritas • Det Norske Veritas • German Lloyd • Lloyds Register of Shipping	
Max. permissible environmental temperature: 60 °C for all components	
Earthquake protection	

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