As one of the leading international process control systems, SIMATIC PCS 7 with its functional variety, flexibility, and performance of the current version 7.1 has the potential for implementation of innovative solutions that meet the special challenges of the process industry. Since function spectrum and application area extend far beyond the limits of a typical process control system, SIMATIC PCS 7 opens undreamed of possibilities and many new perspectives.

SIMATIC PCS 7 benefits from its seamless integration in Siemens Totally Integrated Automation (TIA), a complete range of matched products, systems, and solutions for all hierarchy levels of industrial automation – from the enterprise management level, to the control level, all the way down to the field level. This enables uniform, customer-specific automation in all sectors of manufacturing, process, and hybrid industry.
An essential advantage of the consistency of the product and system spectrum and the solutions based upon this spectrum is that faster and more precise control sequences, as well as integrated security functions of shared hardware, engineering, and engineering tools can be used for automation of continuous and discontinuous processes. Perfect interplay of all components makes it possible for you to sustainably produce in higher quality and to establish new products significantly faster on the market.

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Seven advantages

The homogenous and integrated SIMATIC PCS 7 process control system, with its unique scalable architecture and outstanding system characteristics, is an ideal basis for cost-effective implementation and economical operation of process control plants.

Specifically extended by the seamless integration of additional functions, SIMATIC PCS 7 offers far more than a typical process control system:

- Asset management
- Automation of batch processes
- Control of material transportation
- Safety
- Advanced Process Control
- Telecontrol
- Energy management
- Industrial security
- Evaluation/management of process data
- IT system interfacing

This is further underlined by the following seven advantages:

- Reduction of total cost of ownership through integration
- High performance and quality coupled with efficient engineering, reliability, and availability
- Flexibility and scalability – from small laboratory system to large plant networks
- Protected investment thanks to incremental modernization of Siemens systems and third-party systems
- Safety & security – integrated safety technology and comprehensive industrial security for reliable protection of personnel and environment, as well as process and plant
- Continuous technological innovation – from the world’s leading provider of automation technology
- Local service and support through a global network of experts and authorized partners
Reduction of total cost of ownership through integration

Integration is a special strength of SIMATIC PCS 7. It significantly influences optimization of all enterprise processes over the entire life cycle of a plant, and thus it significantly influences reduction of total cost of ownership (TCO). There are many facets of integration in the context of SIMATIC PCS 7:

**Horizontal integration in Totally Integrated Automation**

Totally Integrated Automation (TIA) from Siemens is a seamless offering of perfectly matched products, systems, and solutions for all hierarchy levels of industrial automation. In TIA, SIMATIC PCS 7 is horizontally embedded in the uniform automation of an enterprise’s entire process chain – from inbound to outbound logistics.

In this regard, SIMATIC PCS 7 is particularly responsible for automation of the primary processes. But there is more. SIMATIC PCS 7 can also integrate auxiliary facilities and the existing electrical infrastructure, such as low-voltage and medium-high switchboards.

Since TIA guarantees compatibility of further developments, continuity is always ensured. This offers the plant owner investment security as it enables him to extend and modernize his plant over the entire life cycle.

**Vertical integration in hierarchical communication**

SIMATIC PCS 7 can be integrated in the hierarchical communication of an enterprise via standardized interfaces for direct data exchange on the basis of international industrial standards and via internal system interfaces. In this manner, process data can be made available at any time and any location within the company for evaluation, planning, coordination, and optimization of operational procedures, production processes, and business processes.

SIMATIC PCS 7 supports the system interfacing to SIMATIC IT, the Manufacturing Execution System from Siemens. SIMATIC IT can be used to record data in real-time from the ERP and control levels, to model all the manufacturing know-how, and to precisely define the operating processes.

The OpenPCS 7 system interface based on OPC specifications (Openness, Productivity, Collaboration) allows easy exchange of data with higher-level systems for production planning, process data evaluation, and management (OPC clients).

The plant can be operated and monitored via the Internet/intranet using a PCS 7 Web Server. The PCS 7 Web Server collects the data of subordinate OS servers, and makes it globally available for remote monitoring, operation, diagnostics, and maintenance. Web access is subject to the same access protection mechanisms as the client in the control room.

Hierarchical enterprise communication extends from the management level to the operation/process level and control level to the field level. The following field components are integrated in this communication:

- Process instruments and analyzers
- Weighing and dosing systems
- Drives (motor starters, motor circuit breakers, frequency converters)

This means that system diagnostics as well as efficient maintenance with the Maintenance Station are optimally supported for plant level SIMATIC PCS 7 Asset Management.

Reduction of operating costs over the entire life cycle of the plant
Integration of additional functionality into the process control system

Depending on the process-typical automation or customer-specific requirements the process control system can be functionally extended with additive hardware/software for special automation tasks, for example

- Maintenance Station (Asset Management)
- Advanced Engineering System (collaboration with CAD/CAE planning)
- SIMATIC BATCH (batch process automation)
- SIMATIC Route Control (material transport control)
- Safety Integrated for Process Automation (functional safety)
- Advanced Process Control (APC)
- SIMATIC PCS 7 TeleControl
- Energy management

All of these additional functions are seamlessly integrated in SIMATIC PCS 7.

A common central Engineering System with a uniform, matched, range of tools for integrated system configuration minimizes configuration effort.

Convenient, system-wide, uniform process visualization facilitates training as well as orientation and enables fast and focused operator intervention in the process operation as needed.

Integration of additional technical standards

SIMATIC PCS 7 is also capable of integrating technical standards that are not anchored in TIA. One example in this regard is the FOUNDATION Fieldbus H1 (FF-H1) that is established in specific industries, and which can be integrated in the control system via PROFIBUS. Hardware configuration and detailed diagnostics of the FF-H1 components are system conformant in this regard. Integration of the FF-H1 components in SIMATIC PCS 7 Asset Management is guaranteed.

Integration of authorized SIMATIC PCS 7 add-on products

Modularity, flexibility, scalability, and the openness of SIMATIC PCS 7 offer optimal prerequisites for integrating supplemental components and solutions in the Process Control System in an applicative manner and thus extend and round out its functionality.

Many supplementary components have been developed by Siemens as well as by external partners as add-ons for the SIMATIC PCS 7 process control system. These hardware and software products authorized by the system manufacturer enable cost-effective implementation of SIMATIC PCS 7 for special automation tasks.
High-performance and quality combined with efficient engineering, reliability, and availability

There is no doubt that perfect interaction of the extremely high-performance and high-quality SIMATIC system components is a major factor in the global success of SIMATIC PCS 7. They are extremely reliable, and can also satisfy increased availability requirements when operated redundantly.

Proof of the high performance, quality and availability of SIMATIC PCS 7 is primarily provided by:

High-performance SIMATIC PCS 7 Industrial Workstations for systems at the operating and process levels such as Engineering System, Operator System, Maintenance Station, or other systems with modern Intel architecture, fast Core 2-Duo processors, large memory configuration, and excellent graphics for 1 to 4 monitors. All installed components are premium quality, have high MTBF values, and are suitable for 24-hour continuous operation in office and industrial environments at temperatures ranging from 5 to 40 °C.

Low-cost client alternatives for operation and monitoring and for SIMATIC BATCH on the basis of compact BOX and Microbox PCs

Broad range of modular and scalable automation systems (controllers) with finely graduated performance and matched memory capacity, all with outstanding processing speed and excellent communication performance even for high-availability, safety-related, and fault-tolerant applications

Microbox automation system as compact and extremely rugged controller alternative for use at plant level for the low to mid-performance range

High communication performance
  • Fast electrical/optical Fast Ethernet and Gigabyte Ethernet networks for plant bus and terminal bus
  • Versatile fieldbus architectures for process and manufacturing production areas:
    For connection of sensors/actuators via distributed remote I/Os, or for direct connection of field devices/process devices and instruments including power supply, even in hazardous areas or for high availability and safety

Short engineering and turnaround times for system-wide uniform hardware and software configuration with the central Engineering System:
  • Technology-oriented configuration without special programming knowledge – with numerous ready-to-use blocks and process tag types, organized in I&C libraries
  • Effective system functions that minimize engineering effort, particularly if there are many similar configuration sequences (bulk engineering)
  • System-side support for sharing configuration tasks
  • Numerous automatic configuration steps (auto-engineering) as well as compiling and loading in one pass
  • Controlled access and change verification
  • High-performance version management with version comparison and version history
  • Advanced Process Control functions
  • Advanced Engineering System for rationalization of engineering and for data exchange with host planning systems
Extremely user-friendly, scalable operator system with numerous functions with a high level of operational reliability, optional redundancy

- As single-user system for up to 5,000 Process Objects (PO), or as multiple station system with up to 12 servers/server pairs, each with 8,500 POs and up to 32 clients per server/server pair
- Integrated user administration with access control and electronic signature
- Short screen selection and update times (< 2 s)
- Modifiable in running operation, selective redundant server
- High-performance message processing with up to 150,000 configurable messages/alarms per single station/server
- Intelligent alarm management for selecting and filtering relevant messages
- Integrated, high-performance archive system for short-term archival of up to 10,000 archive tags, expandable with long-term archive for up to 120,000 archive tags, also redundant

Flexible configuration of redundancy at all levels of the control system

SIMATIC PCS 7 supports redundant configurations on the

- **Operating/process level**
  Redundant configurations possible for single-user and multiple station systems. With a multiple station system, up to 32 clients (OS/Batch/Route Control) can access the data of 1 to 12 servers/pairs of servers (OS/Batch/Route Control). In the case of configurations with redundant pairs of servers, the clients are switched over to the backup server in the event of a fault.

  The following types of server can also be configured as redundant pairs of servers:

  - OS Server
  - Central Archive Server (CAS)
  - Batch Server
  - Route Control Server
  - Maintenance Station Server
  - TeleControl OS Server

  With regard to availability, ring topologies (especially redundant double rings) should be favored for client-server/server-server communication (terminal bus) and for plant communication between the systems of the operating/process level and the control level (plant bus).

Compact runtime and complete systems
with excellent price/performance ratio for automation at process level for subprocesses and autonomous small plants – optionally with integrated or separate controller
• **Control level**
  Based on the two configuration variants "Single Station" (one CPU) and "Redundancy Station" (two redundant CPUs), the modularity of the fault-tolerant automation systems allows flexible scaling of the availability by means of:
  - Double or quadruple (Redundancy Station only) power supply
  - Double or quadruple (Redundancy Station only) plant bus communication

• **Field level**
  Various redundant topologies can be implemented at the field level depending on the operating environment (hazardous zone). ET 200M/SP remote I/O stations or field/process devices directly connected on the PROFIBUS PA/FOUNDATION Fieldbus H1 (FF-H1) are connected to the fault-tolerant redundancy station via redundant PROFIBUS DP networks.

In the case of fieldbus configurations with direct linking and feeding of field/process devices via PROFIBUS PA/FF-H1, the ring topology offers the maximum availability and flexibility.

The ET 200M distributed I/O also supports module-granular and channel group-discrete redundancy. A sensor or actuator can thus be connected to two channels which are distributed on two redundant modules in separate stations.

Flexible Modular Redundancy (FMR) additionally allows separate definition of the degree of redundancy for automation system, fieldbus communication, and I/O. In this way, individual fault-tolerant architectures can be implemented which are precisely tailored to a task and which can tolerate several faults occurring simultaneously.
Flexibility and scalability – from a small laboratory system to a large plant network

SIMATIC PCS 7 users lastingly profit from a modular system platform based on standard SIMATIC components. Its uniformity enables flexible scaling of hardware and software, as well as perfect interaction within the system, but also perfect interaction beyond system limits.

Scalability means more than just cost advantages in planning, engineering, commissioning, and operation, particularly in the area of service and training. The uniform system-wide engineering for the entire system platform ensures that engineering data once created can be used permanently.

The architecture of the SIMATIC PCS 7 Process Control System is designed in such a manner that instrumentation and control can be configured in accordance with customer requirements and optimally matched to the dimensions of the plant. SIMATIC PCS 7 instrumentation and control can be subsequently expanded or reconfigured with ease if there is an increase in capacity or a technological modification. If the plant grows, then SIMATIC PCS 7 simply grows along with it! Provision of expensive reserve capacity is unnecessary.

The scalability applies for all levels of the system. Just on the control level alone there are multiple function-compatible automation systems with graduated price/performance ratios that are available to the user:

- Compact SIMATIC PCS 7 AS RTX Microbox automation system
- Modular automation systems of the S7-400 range as standard, fault-tolerant and safety-related systems

The automation performance can be optimally matched to the requirements of the plant/unit. Thus expensive excess capacity is avoided.

The Microbox automation system is the starter system for the low to mid-performance range of SIMATIC PCS 7. This classification is based on the fact that the performance does not just depend on the CPU’s computing power, but also on the communication performance, expandability, and functional aspects such as S7 routing, Configuration in Run, redundancy, safety etc.

SIMATIC PCS 7 has attractive compact systems for use at plant level for the automation of subprocesses and autonomous small plants:

- SIMATIC PCS 7 BOX RTX with integrated WinAC RTX software controller
- SIMATIC PCS 7 BOX, can be combined with a separate external controller (AS)

The engineering (ES) in this case is either part of the system functionality or concentrated in a central engineering system. Accordingly, the two basic types are distinguished further in:

- ES/OS system with ES + OS or ES + OS + AS functionality
- OS Runtime system with OS or OS + AS functionality

The compact systems with approx. 60 process tags are at the bottom end of the quantity framework scale of the SIMATIC PCS 7 process control system. This scale extends up to a distributed multiple station system with a client/server architecture and up to 60 000 process tags for automation of a very large production plant or a plant network at a production site. This corresponds approximately to a scale ranging from 100 to 120 000 I/Os.
Protected investment thanks to incremental modernization of Siemens systems and third-party systems

There are a variety of motivating factors for modernizing existing processes and plants. Whether these factors are higher productivity and quality, lower costs, shorter product introduction times, or environmentally compatible production processes and technologies based on optimum use of raw materials and energy. To reach these goals, processes must be optimized and systems and plants must be modernized and extended. A coordinated, incremental modernization strategy ensures that the value of the installed base relative to hardware, application software, and know-how of operating and maintenance personnel is retained and increased.

Siemens therefore offers a wide range of innovative products and solutions for its own control systems for migration to SIMATIC PCS 7, e.g. for

- TELEPERM M
- APACS+/QUADLOG
- SIMATIC PCS/TISTAR
- OpenPMC

Formative for the Siemens migration strategy is a successive procedure that permits modernization of the installed base without system discontinuity, and if possible without shutting down the plant, and in the process limiting expenditures for new investments. This strategy can be adapted to the special conditions of the respective plant and it is flexible relative to the plant operator’s specifications. It is always aimed at maximizing the overall return on assets.

However, that’s not all: Building on a migration portfolio with a variety of innovative products, tools, and services that have been proven in practice, Siemens can also offer migration solutions for control systems from other vendors, for example for systems from ABB, Bailey or Honeywell. Thus users of these control systems also have the opportunity to rely on the worldwide leading SIMATIC technology, and can safeguard their automation technology investments for the future.
Integrated safety technology and comprehensive industrial security for reliable protection of personnel and environment as well as process and plant

In the process industry flammable, highly explosive, or harmful substances and mixtures are often the raw material, intermediate products, or final products of a process. Handling such substances or mixtures requires extreme care and unusual safety measures because plant malfunctions or faults could have fatal effects for personnel and environment, machines, and plants.

Thus the objective of safety technology from Siemens is to neutralize existing hazard potential through technical equipment, or to restrict possible effects to a tolerable minimum. With "Safety Integrated for Process Automation", a comprehensive product and service offering is available for implementation of fault-tolerant applications in the process industry.

Based on the safety-related system from Siemens, "Safety Integrated for Process Automation" offers overall safety-related functionality, from sensors to controllers all the way to actuators.

Hacker attacks, computer viruses, worms, Trojans – these are the negative side effects of the advancing standardization and open, global networking. The hazard potential that this represents for the plant control systems has increased geometrically.

The threats posed by malicious programs or unauthorized persons is not limited to network overloads or failures and theft of passwords or data. Unauthorized process automation intervention and intentional sabotage are conceivable. The possible consequences would not be limited to material damage, but would also pose hazards for personnel and the environment.

To protect against these threats SIMATIC PCS 7 offers a trend-setting industrial security concept and comprehensive solutions to safeguard a processing plant, based on a staggered security architecture (defense in depth). The particularity of this concept is its holistic approach. It is not restricted to use of individual security methods (e.g. encryption) or devices (e.g. firewalls). Rather its strengths are the interaction of a host of security measures in the plant network.
Continuous technological innovations – from the world’s leading provider of automation technology

The prerequisite for innovation, and consequently the prerequisite for sustainable economic success is investment in research and development. As the trendsetter, Siemens particularly considers sustainability when developing new, innovative products and technologies. This is demonstrated by the increased use of renewable energies, the efficient utilization of available energies and raw materials, and the avoidance or minimization of environmental pollution.

Siemens is already the world’s largest supplier of environmental technologies, and wishes to increase this prominence even further through consistent development of the environmental portfolio. Now that the company already had sales of 28 billion euros for products and solutions from the environmental portfolio (green products) in the 2010 fiscal year, it is the defined goal to increase the share of sales to 40 billion euros by the 2014 fiscal year.

The research and development activities of the Siemens Industry sector are targeting in energy-saving and resource-saving processes in the own company as well as a wide range of products and solutions for efficient energy management in the process industry. Using qualified energy and environmental consulting, savings potentials can be identified and exploited on this basis together with customers.

In addition to the aspect of sustainability, the trend toward merging of virtual product/production planning and automation particularly define the innovations in the Siemens Industry sector. This leads to increased flexibility and allows substantial saving of time and costs for development, market launching and production.

Through integration of the engineering for products and production, product data becomes available for the digital planning, simulation and control of production processes. Using automation technology and industrial software, the complete value chain of industrial production is optimized. Industrial customers from the production and process industries can then reduce the market launch time for new products by up to 50%.

Siemens is currently carrying out worldwide research with approximately 30,100 employees at 178 locations in more than 30 countries, and is cooperating with research institutions of leading universities. In the 2010 fiscal year, the Siemens investments for research and development amounted to approximately 4 billion euros. Within this period, employees could file applications for a total of 8,800 inventions. The share of the Industry sector was 40%.

The enormous innovation energy of Siemens is also evident in the total of 57,900 active patents. Thus Siemens is at position 3 in Germany, at position 2 in Europe, and at position 13 in the USA of the patent statistics.
Local service and support through a global network of experts and authorized partners

When you choose SIMATIC PCS 7 from Siemens, you have opted for a strong, reliable partner that is at your side with an immense reserve of process automation know-how and experience.

Siemens has established a tightly woven network of experts to support its process control system customers throughout the world. This network includes system specialists from Siemens as well as highly-qualified external partners who provide first-class service and support in more than 190 countries around the world.

Due to their local presence they are optimally familiar with regional particularities; they are in direct contact with their customers, and they can react very quickly and with flexibility to enquiries from these customers. Their performance offerings are aligned to the overall life cycle of a plant, from planning and configuration, to commissioning and production, to modernization, or shutdown. The differentiated performance spectrum extends from the 24/7 helpline to support for commissioning, maintenance or upgrades, from repair/spare parts service to extensive technical consulting.

Because the field of process control technology is in a constant state of further development, ongoing continuing education is indispensable. This not only applies for our customers, it also applies for system specialists and local partners. This is why Siemens offers professional, target-group oriented training courses at training centers in more than 60 countries, or directly on-site at the plant.

Through its close cooperation with partners and system integrators, Siemens sees a key to success in process automation. In order to expand and intensify this collaboration, Siemens has created a Solution Partner program with a bandwidth that is currently unique on the market. Thus outstanding skills in the areas of technology and application are perfectly combined with experience and comprehensive product and system know-how.
Engineering System

System-wide engineering with the central engineering system

The use of a central engineering system with a uniform and matched range of tools minimizes the configuration overhead. The engineering tools for the application software, the hardware components and the communications functions are called from a central project manager (SIMATIC Manager). This is also the basic application for the creation, management, saving and documentation of a project.

The architecture of the Engineering System depends on how the SIMATIC PCS 7 project is processed:

- Locally, on a central engineering station
- In the engineering network (concurrent engineering)

The powerful SIMATIC PCS7 Industrial Workstations in single station or server versions provide an optimum basis for this architecture together with the Windows XP Professional/Server 2003 operating system. These can be used in the office sector as well as in industrial environments, and can control up to four process monitors via a multi-monitor graphics card.

The basis for the license definition and billing unit for the SIMATIC PCS 7 engineering is the number of configurable process objects (PO).

The licensing of the engineering software is oriented toward the following main applications of the engineering system:

- Use as a classic, exclusively engineering station; engineering of unlimited POs (cannot be used for OS productive operation; 2-hour OS test operation possible)
- Use as combined engineering/operator station; scalable engineering and runtime POs

The software licenses of the combined ES/OS station contain the corresponding volume of runtime licenses for AS and OS in addition to the licenses for the engineering. The number of POs can be subsequently increased at any time by means of engineering Power Packs.

The basic functionality covered by the standard software can be expanded if necessary depending on the project-specific task and its implementation.
Engineering toolset

The complete functionality for the system-wide and project-oriented engineering – which is also the basis for asset management of the I&C equipment – is available to the planning engineer as an optimally coordinated engineering toolset. This comprises tools for effective engineering of the following components and functions:

- Control system hardware including I/O and field devices
- Communication networks
- Automation functionality for continuous and batch processes (AS engineering)
- HMI functionality (OS engineering)
- Safety applications (Safety Integrated for Process Automation)
- Diagnostics and asset management functionality
- Batch processes, automated with SIMATIC BATCH
- Material transport, controlled by SIMATIC Route Control
- Collaboration with higher-level CAD/CAE planning tools (Advanced Engineering System)

SIMATIC Manager

The SIMATIC Manager is the integration platform for the engineering toolset as well as the configuration basis for all engineering tasks of the SIMATIC PCS 7 process control system. All aspects of the SIMATIC PCS 7 project are managed, archived and documented here.

Technologists as well as process and production engineers can plan and configure in the environment they are familiar with by utilizing the engineering toolset designed for technological needs and the predefined blocks and charts. The hardware required for use in a SIMATIC project – such as automation systems, communication components and process I/Os – is stored in an electronic catalog, and is configured and parameterized using the HW Config configuration tool.

In order to implement the automation logic, predefined function blocks are linked to other blocks in the graphic configuration tool CFC. This is easy to learn and quick to accomplish even by technologists without any programming experience.

Standardized function blocks (process tag types) are available for typical devices/components in an I&C library. The planning engineer need only select the predefined blocks, position them in the working area, link them graphically, and assign parameters.

Component view: hardware configuration with HW-Config

Using the Advanced Engineering System for data exchange with higher-level planning systems it is possible to achieve significant rationalization effects through automatic generation of the hardware configuration and multiple usage of standardized process tags.

The uniform database of the engineering system guarantees that data which have been entered once are available system-wide.

Complete SIMATIC PCS 7 projects or all applications of a project can be compiled and loaded into the target systems in one operation. The engineering system automatically ensures the correct sequence. A central dialog displays and controls the operation.

Selective changes to the configuration can be loaded online into the corresponding system components. Short turnaround times result in short waiting times for the commissioning engineer and have a positive impact on the commissioning costs. Changes to the configuration which are relevant to automation systems can be debugged in a test system before being downloaded into the target system of the running plant.

The SIMATIC Manager supports the various tasks when creating a plant project by providing the following project views:

- Component view (HW Config)
  Configuration of hardware, such as automation systems, bus components, or process IO
- Process object view
  Central development environment for all aspects of process tags/process objects
Engineering software

Process object view

The process object view of the SIMATIC Manager supports the work carried out by a process engineer by providing a universal view of the process tag. It shows the plant hierarchy of the plant (presented in tree form) in combination with a tabular view of all aspects of the process tag/object (general data, blocks, parameters, signals, messages, picture objects, archive tags, hierarchy folders, equipment properties and global declarations). This provides the technologist with fast orientation.

All objects in the marked branch of the hierarchy are displayed in the table so that they can be directly processed with user-friendly edit, filter, replace, import and export functions. A special test mode offers the facility for testing process tags and CFCs online and for starting them up.

The OS areas and the picture hierarchy for process control, as well as the SIMATIC PCS 7 asset management, can be derived from the plant hierarchy. Furthermore, this also forms the basis for plant-oriented identification of process objects.

Group displays can be positioned in pictures by means of the picture hierarchy, and automatically linked to subordinate images. The configuration engineer only has to ensure the correct positioning. Since the number of group display fields and their semantics can be configured, it is also possible to implement customized alarm configurations.

Using the process object view, “Smart Alarm Hiding” can also be configured. This refers to the dynamic hiding of alarms that, under certain plant conditions, are of less importance to the safe and interference-free operation of the plant. Depending on the operating status of a unit (startup, service, etc.), messages of the technological blocks grouped in this unit are shown or hidden according to the preceding configuration. By checking various option boxes in the alarm matrix of the process object view, you can define the show/hide status of the alarms individually for as many as 32 operating states. Although hidden alarms are not signaled visually and audibly, they are still logged and archived as before.

Continuous Function Chart (CFC)

The CFC editor is the tool for graphical configuration and commissioning of continuous automation functions. Pre-engi-neered function blocks can be positioned, configured and interconnected within CFCs with the support of powerful autorouting and integral configuration of HMI messages. Special configuration techniques such as chart-in-chart for implementing hierarchical charts or the multiple usage of chart block types (chart compiled as block type) and SFC types (standardized sequential controls) in the form of instances offer an additional rationalization potential.
When creating a new CFC, a new runtime group with the same name as the chart is created. All the blocks that are subsequently entered in the chart are automatically added to this runtime group. Each block is therefore already assigned runtime properties when inserting, and configuration engineers can optimize these properties by means of modifications in the runtime editor or by using algorithms.

The algorithm first determines the optimum block sequence separately for each runtime group, and then the optimum sequence of runtime groups.

In addition to convenient editing functions, the scope of CFC functions also includes powerful test and commissioning functions as well as individually configurable documentation functions.

Sequential Function Chart (SFC)

The SFC editor is used for the graphical configuration and commissioning of sequential controls for batch production operations. It possesses convenient editing functions as well as powerful test and commissioning functions.

Using a sequential control, basic automation functions usually created using CFC are controlled and selectively processed by means of changes in operating mode and status. Depending on the subsequent use, the sequential controls can be created either as a SFC or SFC type.

SFC

The SFC can be used to implement sequential controls which can be applied once and which access several partial areas of the production plant.

Each SFC contains standardized inputs and outputs for status information and for control by the user program or the user. The SFC can be positioned and interconnected as a block in the CFC. The required CFC block I/Os are selected by simple operations and connected to the steps or transitions of the step sequences.

A status manager conforming to ISA-88 enables the configuration of up to 8 separate sequencers within a single SFC, e.g. for states such as HOLDING or ABORTING, for SAFE STATE, or for different operating modes.

SFC type

SFC types are standardized sequential controls which can be applied repeatedly and which access one partial area of the production plant. They can be organized in libraries, and handled like normal function blocks, i.e. they can be selected from a catalog and positioned, interconnected and parameterized as an instance in a CFC chart. Changes to the original automatically result in corresponding changes in all instances. An SFC type may contain up to 32 sequences. Using the function “Create/update block icons”, a block icon is automatically positioned and interconnected in the associated process display for all SFC instances with HMI features.
Engineering System

Engineering software

![Examples of OS standard displays (faceplates) from the SIMATIC PCS 7 Advanced Process Library, Valves](image)

**Process Control Libraries**

The use of library elements plays a major role in minimizing the amount of engineering required and thus also the project costs.

Two I&C libraries are integrated in the standard engineering software of SIMATIC PCS 7:

- SIMATIC PCS 7 Standard Library
- Advanced Process Library

Preconfigured and tested blocks, faceplates and symbols are organized in these libraries and form the basic elements for the graphic configuration of automation solutions.

The comprehensive range of blocks can be categorized as follows:

- Blocks for mathematical operations, analog and digital logic
- Interlocking blocks
- Technological function blocks with integral display, operation and signaling functions, e.g.:
  - Standard Control and Advanced Process Control blocks
  - Motor and valve blocks
  - Counter blocks
  - Dosing blocks
- Blocks for integration of field devices
- Operator control and monitoring blocks
- Signaling and diagnostics blocks

Furthermore, preconfigured process tag types for process equipment such as pumps, valves, dosing units and controllers (cascade, split-range) etc. extend the scope of library elements.

**Advanced Process Library**

The Advanced Process Library (APL) is a further development of the SIMATIC PCS 7 Standard Library, based on the extensive experience of planning engineers and plant operators, and taking into account current NAMUR recommendations and PI specifications. New and improved functionalities as well as visually attractive GUIs for a high level of operator convenience facilitate and also force interaction of operators with the plant. Some examples include:

- **New operating modes:**
  - "Local" for integration and application of local control options
  - "Out of service" for deactivating a process tag for maintenance and service
- **New faceplate views:** "Preview" with status information on the I/O signals, the automatic control, and possible/permissionable operator inputs; "Memo view" for temporary information for operators
- Convenient interlocking blocks with initial signal information, can be directly called from the technological function blocks (e.g. from a motor block)
- Improved protection against maloperations as result of additional grading of user privileges
- Improved operator prompting: tacking of operator input window simplifies repeated, successive operations
- Flexible scaling of functions in the library blocks
- Commissioning support through direct simulation on the operator station
- Explicit enabling/disabling of operations for a process tag for individual operator stations of the plant using the function "Local operator enabling"
- "Small version" with reduced scope of functions and space requirements compared to the "Large version" of motor, valve, analog-value monitoring and digital-value monitoring blocks
- Function for coordination of multiple access operations, e.g. of SFC/SIMATIC BATCH, to equipment such as valves, dosing units or pumps

**Graphics designer and faceplate designer**

The project data for engineering of the operator systems are organized with the SIMATIC Manager. All the data relevant to operation and monitoring of a process tag are generated automatically during definition of the automation function. A powerful graphics designer is available for the generation of process displays.

In addition to the standard faceplates, the faceplate designer can be used to generate customized faceplates for operation and monitoring of process tags or plant components. Block symbols can be conveniently interconnected to process tags using drag & drop.
Shared configuration tasks

Concurrent engineering
With concurrent engineering, multiple project engineers can work concurrently on one project in CFC and SFC, without having to split the project up into sub-projects beforehand. During commissioning, for example, charts can be used in the online (debug) mode and at the same time changes can be made to the project.

The project is localized on one of the participating Engineering Stations, the project server. The Engineering Stations working as "Project Clients" can access the project data via LAN/WAN. CFC and SFC charts can be opened and viewed by multiple project engineers concurrently. However, the system rejects concurrent write accesses to the database.

Every Engineering Station in the network (project server/client) is able to download configuration data to a SIMATIC PCS 7 subsystem provided it has the required communication connections.

Multiproject engineering
Multiproject engineering permits division of a complex project into several subprojects in accordance with technological criteria in order to allow several teams to work on the project in parallel. To achieve this, a host "Multiproject" is defined in the SIMATIC Manager. The individual projects can be added or removed from a multiproject at any time.

The technological division and combination of projects is supported by the Branch & Merge functions. For the charts or units copied into another project for editing, cross-project interconnections, typically e.g. for interlocks, become textual interconnections. When merging, textual interconnections – even ones which you have entered yourself – can be closed at the press of a button. Charts with the same name in the original object are overwritten.

Central configuration functions for multiprojects help to reduce the configuration overhead. For example, a hierarchy folder can be created in the current project and also automatically in all other projects. It cannot be modified there, but objects can be inserted. All block types used in a multiproject can also be updated centrally.

The subprojects in a multiproject are stored on a central server and moved to the local engineering stations for editing. The engineering performance is thus unaffected by network access.
Engineering software

Access check and change verification

SIMATIC Logon, the user administration and access control function integrated into the engineering system, offers the plant operator excellent system support when verifying changes in combination with the detailed recordings in the change logbook.

With SIMATIC Logon, the administrator can divide users into groups with different access rights and control the access to data in this way. Configurable modification reports allow the recording of all access operations to the engineering system as well as all online changes concerning the automation systems, operator systems, SIMATIC BATCH or SIMATIC Route Control.

If you link the modification reports during the evaluation with the data of SIMATIC Logon, it is possible to verify clearly who has made a particular change and at what exact time this was done. This is a great help when complying with special sector-specific requirements such as FDA 21 CFR Part 11 or GAMP.

Version Cross Manager

The Version Cross Manager is a user-friendly tool for determining the differences between various versions of individual projects or multiprojects by:

- Tracing missing, additional or differing objects by comparing hardware configuration, communication, plant hierarchy, CFCs/SFCs, SFC details, block types, alarms, global variables, signals and run sequences
- Graphic display of comparison results in a combination of tree and tabular formats
- Clear hierarchical structuring according to the plant hierarchy of the plant
- Color-coded identification of the differences

Version Trail

The SIMATIC Version Trail which operates together with SIMATIC Logon is suitable for version assignment of libraries, projects and multiprojects. During archiving, SIMATIC Version Trail creates a version history with the following information:

- Version
- Version name
- Date and time
- Users
- Comment

This version history can be displayed and printed. Individual versions can be retrieved from the version history, and used further. SIMATIC Logon organizes the access protection.

Comparison of project versions using the Version Cross Manager

SIMATIC PCS 7 Advanced Engineering System (AdvES)

Using the AdvES, consulting engineers and planning offices as well as end customers can significantly reduce their configuration and commissioning costs while simultaneously improving the engineering quality.

The AdvES which can be called in the SIMATIC Manager from a SIMATIC PCS 7 project expands the functionality for plant configuration in cooperation with higher-level CAD/CAE planning tools. It acts as a link between standard engineering tools from the SIMATIC PCS 7 Engineering Toolset (CFC, HW Config, plant hierarchy) and tools for basic and detailed planning, e.g. EPlan, ELCAD or SmartPlant.

AdvES uses various data import options in order to collect existing engineering data from the SIMATIC PCS 7 process control system and from process tag and signal lists in Microsoft Excel format and to prepare these for utilization in the SIMATIC PCS 7 engineering system.

Data from process tag and signal lists can be automatically imported into AdvES. Integrated change management supports the repeated importing of modified data from Microsoft Excel. AdvES recognizes process tags in Excel lists after the first assignment, automatically assigns them to process tag types of any PCS 7 project library, and then generates the following data:

- PCS 7 process tag instances with signal and parameter settings
- Plant hierarchy (PH)
- Hardware configuration

Inconsistencies can be detected quickly by means of plausibility and data consistency checks, displayed in a log, and then eliminated in a targeted manner.
Advanced Engineering, overview of functions

Manual processing functions for editing plant hierarchies and process tags as well as for interconnection of signals between process tags allow completion of the imported data. Special editors for mass data processing offload the project engineer from time-consuming routine work.

With the support of integrated design templates, the different table views of the AdvES data can also be displayed as reports and printed.

Summary of basic AdvES functions:

- Import of system planning data and SIMATIC PCS 7 engineering data
- Processing functions for the manual completion of imported data
- Simple interconnection of several process tags
- Generating of process tags from signal and process tag lists
- Generation of hardware configurations from signal lists
- Batch processing of process tags, signals, and parameters
- Automatic plausibility and consistency check
- Transfer of data into the SIMATIC PCS 7 Engineering System
- Reports on documentation updates

Import/Export Assistant

Through application of the principle of multiple usage of process tag types and example solutions, the Import/Export Assistant (IEA) can be used for rational engineering of mass data.

Following exporting of the PCS 7 project, the data can be altered, duplicated or adapted using the IEA editor or a spreadsheet program such as Microsoft Excel. Reimporting is carried out subsequently.

Subsequent update of this data is possible with the parameters optimized during commissioning.

Extended rename

When renaming objects, links affecting the visualization (picture objects or variables in archives and scripts) are also changed accordingly. This function offers an enormous rationalization potential, especially for plants with repeated structures or plants requiring validation.

For example, if a completely configured and tested unit is copied together with all charts, sequential controls and pictures, and if the copied charts/pictures are subsequently renamed, all internal connections are automatically adapted. In this manner, complex units or complete production lines can be reproduced in the shortest possible time.

Project documentation

The integral reporting system can be used to document the engineering project in accordance with standards. The project report comprises:

- Mimic diagrams and picture objects with properties, events, actions, and direct links
- Variables, properties, and communication links
- Message classes, message blocks, and messages
- Archive tags, and configuration data for archives
- User groups and users
- Source text of actions/functions
- Texts of text library
- Basic Process Control configuration data

The project data can be freely-structured, edited in the form of standardized circuit manuals, and printed in a uniform layout. You can incorporate your own cover sheets, layouts, graphics, logos or title block data. A convenient output control function allows you to select a complete project or individual parts of a project for printing.
Engineering of intelligent field devices and field components using the SIMATIC PDM Process Device Manager

SIMATIC PDM (Process Device Manager) is a universal, vendor-independent tool for the configuration, parameterization, commissioning, diagnostics and servicing of intelligent field devices (sensors and actuators) and field components (remote I/Os, multiplexers, control room devices, compact controllers), which in the following sections will be referred to simply as devices. Using one software, SIMATIC PDM enables the processing of more than 2 000 devices from Siemens and over 200 vendors worldwide on one homogeneous GUI. Parameters and functions for all supported devices are displayed in a consistent and uniform fashion independent of their communications interface.

From the viewpoint of device integration, SIMATIC PDM is the most powerful open device manager available in the world. Devices which previously were not supported can be integrated in SIMATIC PDM at any time by simply importing their device descriptions (EDD). This provides security and saves investment, training and consequential costs.

SIMATIC PDM can be integrated in the asset management. The Process Device Manager then provides more detailed information for all devices described by means of an Electronic Device Description (EDD), e.g.:

- Detailed diagnostics information (manufacturer information, information on error diagnostics and troubleshooting, further documentation)
- Information on changes (audit trail report)
- Parameter information

Possible applications

- Integrated in the SIMATIC PCS 7 engineering system
  - SIMATIC PDM PCS 7
  - SIMATIC PDM PCS 7-FF with support for the FOUNDATION Fieldbus H1
- Stand-alone as a service tool on mobile PCs
  - SIMATIC PDM Single Point for one single field device (point-to-point coupling)
  - SIMATIC PDM Service for enhanced servicing

Core functions

- Adjustment and modification of device parameters
- Comparing (e.g. project and device data)
- Validation of data input
- Device identification and testing
- Device status indication (operating modes, alarms, states)
- Simulation
- Diagnostics (standard, detail)
- Export/import (parameter data, reports)
- Commissioning functions, e.g. measuring circuit tests of device data
- Device replacement (lifecycle management)
- Global and device-specific change log for user operations (audit trail)
- Device-specific calibration reports
- Graphic presentations of echo envelope trends, trend displays, valve diagnostics results etc.
- Document manager for integration of up to 10 multimedia files
Support of system management

SIMATIC PDM supports the operative system management in particular through:

- Uniform presentation and operation of devices
- Indicators for preventive maintenance and servicing
- Detection of changes in the project and device
- Increasing the operational reliability
- Reducing the investment, operating and maintenance costs
- Graded user privileges including password protection

Device Integration

SIMATIC PDM supports all devices described by EDD (Electronic Device Description). Based on EN 50391 and IEC 61804, EDD is the most widely used standardized technology for device integration. At the same time it is the directive of the established organizations for

- PROFIBUS (PNO: PROFIBUS user organization)
- HART (HCF: HART Communication Foundation)
- FF (Fieldbus Foundation)

The devices are integrated in SIMATIC PDM through a company-specific EDD, through the current HCF catalog, or through the current Fieldbus Foundation catalog. To achieve improved transparency, they can be managed in project-specific device catalogs.

PROFIBUS devices are described in the EDD in terms of functions and construction using the Electronic Device Description Language (EDDL). Using this description, SIMATIC PDM automatically creates its user interface with the specific device data. The range of devices of the catalog integrated in SIMATIC PDM can be updated and expanded simply by importing the manufacturer's device-specific EDD.

Fieldbus Foundation provides pre-defined device descriptions (standard DD) for the basic functions of specific field device types. The basic functions are implemented using various standard function and transmission blocks.

User interface

Using SIMATIC PDM it is very easy to navigate in highly complex stations such as remote I/Os and even down to the connected field devices. The GUI satisfies the requirements of the VDI/VDE GMA 2187 and IEC 65/349/CD directives. Due to expansion of the EDDL, it is also possible to display image elements in an excellent manner. Even complex devices with several hundred parameters can be represented clearly and processed quickly.

Communication

SIMATIC PDM supports several communication protocols and components for communicating with devices that have the following interfaces:

- PROFIBUS DP/PA interface
- FF interface (SIMATIC PDM PCS 7)
- HART interface
- Modbus interface
- Special interface from Siemens

Routing

From the central engineering system of the SIMATIC PCS 7 process control system it is possible with SIMATIC PDM to reach every EDD-parameterizable device in the field plant-wide through the various bus systems and remote I/Os. SIMATIC PDM can thus perform the following from a central position:

- Read diagnostics information from the devices
- Modify device settings
- Adjust and calibrate devices
- Monitor process values
- Generate simulation values
- Reassign device parameters
Engineering System highlights

- Central hardware and software configuration which is uniform throughout the system through use of one engineering system
  - User-friendly GUI
  - Configurable modification reports
  - Parameterization of communication without complex configuring
  - Same configuration for redundant and non-redundant plants
  - Integrated configuration for field devices and safety-related applications

- Integral user administration with access control

- Central dialog for compilation and loading of all AS, OS and SIMATIC BATCH modifications
  - Optimization of all steps and summary in a dialog with execution check
  - Compilation and loading in one run with minimum turnaround times

- Online loading of selective configuration modifications into the corresponding system components

- Technology-oriented configuration without requiring special programming skills
  - Functional hierarchy with up to 8 levels, organized according to plants, units and technical equipment
  - Hardware-independent engineering: AS assignment and I/O modules can be subsequently selected
  - Area-oriented OS compilation and loading of the server-relevant data
  - Expandable on industry-specific basis using standard data exchange interfaces

- Process object view for display and processing of all aspects of process tags/objects
  - Convenient editing in tables
  - Project library with process tag types and import/export functions
  - Online mode for testing and commissioning of process tags and CFCs

- Shared configuration tasks: Concurrent Engineering or Multiplan Project Engineering with Branch & Merge

- Customized alarm configuration through free configuration of up to 8 group display fields

- Configuration-dependent hiding of alarms for specific operating states

- Configurable archive tags (archiving, long-term archiving, no archiving)

- Special SFC functionalities
  - SFC type: standardized sequential control for multiple use, application of SFC instances as block in the CFC
  - SFC for sequential controls for single use, also with chart I/Os
  - Status management conforming to ISA-88 for configuration of separate sequences for statuses such as HOLDING, ABORTING or SAFE STATE

- Advanced Process Control functions with integrated blocks and templates

- Reduction in engineering and validation overhead through:
  - Libraries with predefined, standard blocks, faceplates, and symbols: PCS 7 Standard Library and Advanced Process Library
  - Pre-assembled charts from the library
  - Project library for process tag types with import/export function in the process object view
  - Simple duplication of units by copying, renaming and compilation
  - Type-instance concept with central modification option for all instances
  - Import/export assistant for mass data configuration (bulk engineering)
  - Central updating of all block types used in a multi-project
  - Numerous automatic configuration steps (Auto Engineering)

- High-performance version management with version comparison and version history

- Identification of MIS/MES-relevant information for interfacing to SIMATIC IT

- Automatic generation of diagnostics displays for the maintenance station on the basis of the project data

- PCS 7 Advanced ES for data exchange with planning tools

- Implementation of digital production planning through integrated engineering workflow with Comos planning tools
Operator system

Safe and user-friendly process control with the SIMATIC PCS 7 Operator System

The operator system of the SIMATIC PCS 7 process control system permits user-friendly and secure execution of the process by the operating personnel. Operators can monitor the process sequence using various views, and intervene as necessary. The operator system architecture is extremely variable and can be flexibly adapted to different plant architectures and customer requirements.

The basis is formed by perfectly coordinated operator stations for single-user systems (OS Single Stations) and for multiple station systems with client/server architecture.

Operator stations

All operator stations are based on modern SIMATIC PCS 7 Industrial Workstations optimized for use as OS single station, OS client or OS server.

The SIMATIC PCS 7 Industrial Workstations are characterized by powerful PC technology combined with the Microsoft Windows XP Professional or Server 2003 operating system. They can be used in harsh industrial environments or also in offices.

Standard components and interfaces from the PC world offer generous scope for system-, customer- or sector-specific options and expansions.

The connection of as many as 4 process monitors via an optional multi-monitor graphics card in the OS single station or in the OS client permits the user-friendly control of several plant areas from one operator station.

The system software of the operator stations is scalable, based on the number of process objects (PO):

<table>
<thead>
<tr>
<th>Number of process objects</th>
<th>250</th>
<th>1,000</th>
<th>2,000</th>
<th>3,000</th>
<th>5,000</th>
<th>8,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Per OS single station</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>- Per OS server of a client/server system</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Within the defined limits, the number of POs can be increased by means of PowerPacks to allow for higher requirements or system expansions.

Single-user system (OS single station)

In a single-user system architecture, all operator control and monitoring functions for a complete project (plant/unit) are concentrated in one station. This OS single station can be operated on the plant bus together with other single-user systems or in parallel with a multiple station system. Redundant operation of two OS single stations is also possible (SIMATIC PCS 7 Single Station Redundancy).

The OS single station can be connected to the Industrial Ethernet plant bus in two ways:

- CP 1613 A2/CP 1623 communication module for communication with a maximum of 64 automation systems of any type
- Simple 10/100/1000 Mbit/s Ethernet network card and Basic Communication Ethernet for communication with up to 8 automation systems (single stations)

Two 10/100/1000 Mbit/s Ethernet RJ45 ports are also integrated onboard for use as desired.

Multiple station system with client/server architecture

A multiple station system consists of operator terminals (OS clients) which receive data (project data, process values, archives, alarms and messages) from one or more OS servers over a terminal bus. The terminal bus can share the transmission medium with the plant bus or it can be designed as a separate bus (Ethernet with TCP/IP).

In this architecture, redundant OS servers may be set up to meet higher availability requirements. Critical applications are monitored by health check for software faults. If a fault is detected, switchover to the redundant system is triggered. Synchronization of the redundant OS servers takes place automatically and at high speed.

SIMATIC PCS 7 Operator Station
Multiple station system with client/server architecture

OS clients can access the data of not only one OS server/server pair, but of several at the same time (multi-client mode). This makes it possible to divide a plant into technological units and to distribute the data accordingly to various OS servers/pairs of servers.

In addition to scalability, the advantage of distributed systems is the ability to decouple plant areas from each other, which results in higher availability.

SIMATIC PCS 7 supports multiple station systems with up to 12 servers or 12 redundant pairs of servers. In multi-client mode, OS clients can access data from one or more of the 12 servers/pairs of servers in parallel (up to 32 OS clients simultaneously can access all).

The OS servers are designed in addition with client functions which permit them to access the data (archives, messages, tags, variables) from the other OS servers of the multiple station system. This means that process graphics on one OS server can also be linked with variables on other OS servers (area-independent displays).

Like the OS single stations, the OS servers can be connected to the plant bus using a CP 1613 A2/CP 1623 communication module or a simple Ethernet network card. Two 10/100/1000 Mbit/s Ethernet RJ45 ports are integrated onboard and can be used for connecting to the terminal bus.

Performance and technical specifications

The SIMATIC PCS 7 Operator System is optimized for processing large quantities of data. It impresses by means of its simple and intuitive operation and its high performance – even with large quantity frameworks.

Many individual measures reduce the system load and improve the image selection and updating times, e.g.:

- Combination of status and analog values with alarm information into expanded status displays
- Suppression of nuisance alarms and triggering of renewed transmission via acknowledgment
- Data transmission from the automation system only following changes instead of with every cycle
- Blocking/enabling of messages for individual process tags or all tags of an area
- Hiding messages, depending on the operating state of the unit

---

**Operator system**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. number of OS servers/pairs of servers</td>
<td>12</td>
</tr>
<tr>
<td>Max. number of automation systems per OS server/pair of servers</td>
<td>64</td>
</tr>
<tr>
<td>Max. number of OS clients in multi-client mode</td>
<td>32 (per multiple station system)</td>
</tr>
<tr>
<td>Max. number of monitors per operator station with multi-channel operation</td>
<td>4</td>
</tr>
<tr>
<td>Max. number of OS areas</td>
<td>64</td>
</tr>
<tr>
<td>Max. number of windows per monitor</td>
<td>1 to 16 (adjustable)</td>
</tr>
<tr>
<td>Number of trends per trend window</td>
<td>10</td>
</tr>
<tr>
<td>Selection time for OS area display (100 process symbols)</td>
<td>&lt; 2 s</td>
</tr>
<tr>
<td>Max. number of process objects</td>
<td></td>
</tr>
<tr>
<td>- Per OS single station</td>
<td>5 000 POs</td>
</tr>
<tr>
<td>- Per OS server</td>
<td>8 500 POs</td>
</tr>
<tr>
<td>Max. number of configurable messages per server</td>
<td>150 000</td>
</tr>
<tr>
<td>Number of process tags</td>
<td></td>
</tr>
<tr>
<td>- Per OS single station</td>
<td>approx. 3 000</td>
</tr>
<tr>
<td>- Per OS server</td>
<td>approx. 5 000</td>
</tr>
<tr>
<td>- Per multiple station system</td>
<td>approx. 60 000</td>
</tr>
<tr>
<td>Integral high-performance archive system (circular buffer), based on Microsoft SQL server, for:</td>
<td></td>
</tr>
<tr>
<td>- Process value archiving (per OS server/single station)</td>
<td>Approx. 1 000/s</td>
</tr>
<tr>
<td>- Message archiving (per OS server/single station)</td>
<td>Continuous load approx. 10/s Message burst approx. 3 000/4 s</td>
</tr>
<tr>
<td>Long-term archiving</td>
<td></td>
</tr>
<tr>
<td>- Process data archiving with StoragePlus</td>
<td></td>
</tr>
<tr>
<td>- Process data of one server</td>
<td>Process data from up to 4 single stations, servers or pairs of servers Approx. 1 000/s Approx. 1 600/s</td>
</tr>
<tr>
<td>- Process data of all servers</td>
<td></td>
</tr>
<tr>
<td>- Process data archiving with Central Archive Server CAS</td>
<td></td>
</tr>
<tr>
<td>- Process data of one server</td>
<td>Process data from up to 11 servers/pairs of servers Approx. 1 000/s Approx. 10 000/s</td>
</tr>
<tr>
<td>- Process data of all servers</td>
<td></td>
</tr>
</tbody>
</table>

1) If every OS client has access to all OS servers/pairs of servers
A standard view and a server view are available for the technological representation of a process cell, each with variously designed area overviews. Features provided in both views include:

- Message line for the last received message, configurable for priority-based display of message with highest message class or priority
- Date, time and name of the operator
- Area overview; number of displayed areas depends on resolution: up to 36 (lowest/XGA), up to 144 (highest/WQXGA)
- Working area for plant displays and movable windows for faceplates, trends, messages etc.
- System function keys

Based on this, the operator can combine and save individual image compositions, and recall them later.

The operator system software supports the representative functional display of the plant with a high-quality and modern design; depending on the versions of the graphics controller and process monitor, display is possible in:

- 4:3/5:4 formats with resolutions of 1024 x 768 to 1600 x 1200
- 16:9/16:10 panorama formats with resolutions of 1680 x 1050 to 2560 x 1600

The global appearance can be set using predefined or user-specific designs (color palette, colors, styles, optical effects, etc.). These central design settings can be changed locally for each picture object. In addition, the design can be fundamentally influenced using a wide range of attractive elements provided in the Engineering System for OS configuration:

- Object palettes with styles, controls, standard objects and smart objects
- Global symbol library with standardized display objects
- Symbols and faceplates from the I&C libraries: PCS 7 Standard Library and Advanced Process Library

Graphical user interface

The predefined GUI of the operator system has all the features typical of a control system. It is multilingual, clearly structured, ergonomic and easy to understand. Operators can survey the process extremely easily, and rapidly navigate between different views of the plant. The system supports them in this process with hierarchical display structures that can be configured as required. These facilitate the direct selection of lower-level areas during process control. The current position within the hierarchy can always be seen in a window of the Picture Tree Manager.

Mimic diagrams and process tags can also be called directly by their name, or by a “Loop-in-alarm” starting from a selected message. An online language selector permits the user to change the display language during runtime.
TrendControl for table displays and trend views

The TrendControl function permits operators to display archived values of archive tags from the process value archive as well as online values of process tags from the tag management in relation to time (table/trend window) or in relation to another value (function window). The time can be defined statically or dynamically (in relation to the actual system time) as:

- Start and end times
- Start time and period
- Start time and number of measuring points

All TrendControls have scrolling functions and a function for directly selecting the start or end.

During runtime, operators can individually adapt the TrendControls functions which have already been predefined during plant configuration, and save the settings globally or user-specific. They are able to change the data link during runtime, and to access other data. It is also possible to integrate exported archive databases online.

The displayed data can be processed further by:
- Exporting per CSV file
- Output in a predefined print job

Table window
- Display of one or more process value columns in relation to a time column
- Each line displays the process values recorded at a particular time
- Several separate time/value relations can be combined in a table
- Options for adaptation during runtime:
  - Shifting, showing and hiding columns
  - Modification of time data
  - Manual modification of values, and archiving of modified values

Trend window
- One or more time axes correlate with one or more value axes (linear, logarithmic, percentage or freely-configurable scales)
- Freely-selectable number of displayed trends
- Individual configuration of styles and colors, possibly with value-dependent change in color
- Grid lines and rulers for improvement of readability
- Trends can be grouped in one window with common time and value axes
- Several trends windows can be linked for comparison purposes (common time axis, zoom, scroll bar and ruler)
- Options for adaptation during runtime:
  - Enlarging of window section
  - Shifting of section along the time and value axis
  - Shifting, showing and hiding of time and value axes of individual trends
  - Showing/hiding of trend, and fetching into foreground
  - Changing the displayed time interval

Function window
- Display of process values in relation to other process values, e.g. pressure depending on temperature
- Fixed or dynamic value range with linear or logarithmic scaling for X and Y axes
- Displayed time range can be defined separately for each trend
- Optional consideration of setpoint trends from user archives
- Properties, functions and configuration options largely identical to trend window

Ruler window
TrendControls can also be combined with a ruler window. It shows additional information in three views depending on the selection of a time or time range in the trend/table window using rulers:

- Coordinate window with X and Y coordinates of the trend points at the points of intersection of the rulers
- Statistics range window with the values in the selected range
- Statistics window with statistical information on the selected range: minimum, maximum, average, standard deviation, integral
AlarmControl function for message display and processing

Up to 150,000 messages can be configured per OS single station/OS server:

- Predefined system messages, triggered by a system event
- Individual or group messages, initiated by a change in process states
- Operator input messages, resulting from the manual operation of objects

The message system integrated in the operator system records these process messages and local events, saves them in message archives, and displays them in various standardized lists by means of the freely-configurable AlarmControl function (message window):

- Entered state list: currently present, unacknowledged messages
- Acknowledged list: currently present, acknowledged messages
- Exited state list: unacknowledged messages, but already exited
- Operator list: current and archived operator input messages
- Process control list: current and archived I&C messages
- Chronicle: all currently present and archived messages arranged in chronological order
- List of manually or automatically suppressed messages
- List of messages to be suppressed when they occur

The lists can be selected by the operator in the toolbar. They have an integral scrolling function, and display:

- Each message in a message line
- Message state and color according to the configured message class (e.g. fault requiring acknowledgment) and message type (e.g. alarm or warning)
- Selected message blocks, each in a separate column:
  - System blocks: System data such as date and time, priority, triggering CPU/station, user name, loop-in-alarm, message state (incoming/outgoing), acknowledgment status (acknowledged/not yet acknowledged, duration from "incoming" to "outgoing/acknowledged")
  - Process value blocks: Current process value at time of message, e.g. temperature
  - User text blocks: 255 characters of text, e.g. message text with fault location and cause of malfunction
- Status and information text represented as symbol

Parallel to the display, all messages recorded during runtime and their changes in state can be documented in chronological order in a message sequence log.

Flexible setting options for audible output and priorities which can be defined using signal variables additionally support the signaling of messages through a sound card or by controlling external horns via a signal module.

Operators can individually adapt the AlarmControl function during runtime by filtering, selecting or sorting the display according to the contents of individual message blocks, e.g. chronologically according to message priority or fault location, and save the settings globally or user-specific. It is also possible to integrate exported archive databases online.

The displayed data can be processed further by:

- Exporting per CSV file
- Output in a predefined print job

After a power failure, the last messages (e.g. 60) can be reloaded from the message archive to the message window. Thus, when the system is restarted, the last message map prior to the power failure is reconstructed.
With large quantity frameworks and a high number of messages, the following measures can be used to noticeably reduce the operator workload by reducing the relevant messages and improving transparency:

- Visual and audible hiding of messages which are of reduced importance in certain situations for the safe and fault-free operation of the plant, e.g. operating messages (logging and archiving are not influenced):
  - Dynamically, i.e. depending on preconfigured definition for up to 32 operating states (Smart Alarm Hiding)
  - Manually, for a limited period
- Assignment of priorities using up to 16 message priorities as additional attribute to the known message classes
- Intentional blocking and enabling of messages from an individual process tag or all process tags of the display/area by the operator in the event of faults on a sensor/actuator or during commissioning (recording of blocking and enabling in the operator activity log)

The “Loop-in-alarm” and “Select display using process tag” functions support the quick evaluation and elimination of faults. Using “Loop-in-alarm”, the operator can jump directly from a message selected in the message window to the mimic diagram with the object which caused the fault, and can then call up the associated faceplate (loop display) through the process tag whose block symbol is colored (cyan). The faceplate window (loop display) can be anchored so that it remains visible even when the display is changed.

Group displays visually signal the messages currently present in the mimic diagram. They do not provide information on whether messages are disabled or not.

The last received message is displayed at the top of the standard view. Using the button “Extended message line”, the AlarmControl function can be displayed as a window with all received messages. A list of all messages currently present with maximum priority 16 can also be directly called using a button.

**Reporting and logging system**

Whereas the reporting system is provided to document the project during its configuration, the logging system is used to print out the data recorded during operation in a clear manner. Different types of predefined logs are available:

- Message sequence log
- Message and archive log
- Measured value log
- Operator activity log
- System message log
- User log

However, a page layout editor can be used to create completely new page layouts or to individually adapt predefined ones. Log objects to be printed are simply selected from the editor’s object palette, positioned and configured.

The log objects are categorized as follows:

- Higher-level log objects, e.g.:
  - Static objects (circle, rectangle, etc.)
  - Dynamic objects that are assigned current values during output
  - System objects (date/time, project name, etc.)
  - Special runtime log objects
- OS-specific log objects, e.g.:
  - Control objects (windows for messages, tables, trends, functions, and user data)
  - Current value of a process tag
  - Contents of user archives
  - Embedded layout
  - Hardcopy
- Log objects for integration of external data, e.g.:
  - CSV provider (CSV data as table or trend)
  - ODBC data source (field as text or table)
  - COM provider (COM objects as text, table or image)

The current data of the log defined in the page layout is output on the printer by means of a predefined or self-generated print job. Prior to output on the printer, the logs can be saved in EMF format and displayed as a preview on the screen. Print jobs can be started manually, time-driven or event-driven. Operators are able to scan the status of the print jobs online.
The SFC visualization function of the operator system enables display and operation of the sequential controls configured with the SFC editor in the same way as on the engineering system. This does not involve any extra configuration effort.

In an overview display it is possible, for example, to open step and transition displays and to present step comments or dynamically supplied step enabling conditions.

Central user management, access protection and electronic signatures

With the integrated SIMATIC Logon, the operator system has central user administration with access control that complies with the validation requirements of 21 CFR Part 11. The administrator can divide the users into groups and assign differently defined access rights (roles) to these groups. The operator obtains the specific rights when logging on within the scope of the access control.

Apart from the keyboard, an optional chip card reader, for example, can be used as the logon device. In addition, SIMATIC Logon offers the "electronic signature" function.

Sign-of-life monitoring

With the "Sign-of-life monitoring function", the operator system is able to monitor the correct operation of all subordinate systems connected to the plant bus. A graphical plant configuration display shows the status of each monitored component. Additional functionality in this respect is offered by the SIMATIC PCS 7 Maintenance Station.

Clock synchronization

Together with a SICLOCK time generator, the operator system of the SIMATIC PCS 7 process control system can implement system-wide synchronization on the basis of UTC (Universal Time Coordinated). This feature is especially beneficial for widely distributed plants present in different time zones, e.g. pipelines.
OS archiving

An integral component of the OS software of OS single stations and OS servers is a high-performance archiving system that is configurable at runtime for the short-term archiving based on the Microsoft SQL server technology. It is used for recording process data (typical period of between 1 and 4 weeks) and alarms/events (typical period 2 months) in short-term archives.

Subject to time or event-driven, data – as well as OS reports and batch data from SIMATIC BATCH – can be swapped out of the short-term archive to a long-term archive.

Two alternatives with different features are available for the OS long-term archiving:

- **StoragePlus**
  - More economical version for the lower performance range;
  - for the archiving of about 1,600 values/s from as many as four single stations, servers or pairs of servers
- **Central Archive Server (CAS)**
  - High-performance version for archiving about 10,000 values/s from as many as 11 servers or pairs of servers

During long-term archiving with StoragePlus, the archived data can be visualized by means of the StoragePlus viewer.

The operator can display the data swapped out to the central archive server directly on the OS clients or with the StoragePlus viewer of the CAS.

For both long-term archiving systems, data selection is supported by integral filter functions. Alarms and process data can be shown in table form, and process data also in graphic form. Tables of process data can be exported in CSV format for processing in other Windows applications, e.g. Microsoft Excel.

The archive tags defined as a common billing unit for short-term and CAS long-term archiving are available in the form of cumulative count relevant licenses “SIMATIC PCS 7 Archive”. If no CAS is used, these archive licenses are installed on the OS single stations and OS servers of the plant. Otherwise they are only installed on the CAS, from whose tag inventory the OS single stations and OS server “debit” their archive tags. The short-term archive is limited to 10,000 archive tags, while the CAS long-term archive is limited to 120,000 archive tags.

The SIMATIC PCS 7 Industrial Workstations are the hardware platforms for the StoragePlus computer and the central archive server. Both are nodes on the terminal bus and have no connection to the plant bus.

The central archive server can also have a redundant design. This increases the availability of the long-term data that are accessible from the OS clients or the OpenPCS 7 station. SIMATIC BATCH currently does not yet archive the batch data on both CAS systems. Through automatic archive synchronization, however, the batch data is available after archiving to both CAS systems.

With the aid of additional hardware and software for the corresponding operating system, e.g. with a DVD writer and appropriate software, the data managed in StoragePlus and in the central archive server can be backed up on commercially available storage media, e.g. DVDs.
Operation and monitoring via World Wide Web

The PCS 7 Web server can be used to operate and monitor a system via intranet/Internet. The PCS 7 Web Server uses the mechanisms of a multi-client for accessing the subordinate OS servers, and makes the project data globally available via intranet/Internet. For this purpose it uses the Web View Publisher to convert mimic diagrams and scripts into a form suitable for display with the Internet Explorer.

When carrying out operation and monitoring via the World Wide Web, the operator can access project data made available by the SIMATIC PCS 7 web server via the PCS 7 web client. The PCS 7 web client uses Internet Explorer and plug-ins which can be installed via the World Wide Web.

Using a PCS 7 web client, the plant can be operated in the same manner as with a PCS 7 OS client. The user must log on to the PCS 7 web client in the same way as a PCS 7 OS client and the rules for assigning rights are also identical. The input operations made on the PCS 7 web client are recorded in the OS operating log.

With regard to licensing, a distinction is made between the following constellations:

- **Standard**
  Up to 50 PCS 7 web clients access the data of a PCS 7 web server over intranet/Internet. The server license required for this is scalable for 3, 10, 25 or 50 PCS 7 web clients.

- **Diagnostics**
  One or only a few PCS 7 web clients have access to several PCS 7 web servers for remote operation, diagnostics or monitoring. Each system involved requires a PCS 7 Web diagnostics license (server/client).

The integrated OS user management guarantees a high level of security when the PCS 7 Web Server accesses the OS servers. Corresponding to the safety requirements of the plant, further extensive protective measures can be implemented according to the SIMATIC PCS 7 safety concept.
Maintenance Station

Plant Asset Management with the Maintenance Station

The Maintenance Station supplements SIMATIC PCS 7 with a valuable instrument for minimizing the total cost of ownership of a plant.

If one considers the total maintenance involved in an enterprise then the Maintenance Station is focused on the area of Plant Asset Management. Asset management for plant engineering is the administration and management of plant equipment, particularly the I&C equipment, as well as all activities and measures that serve to retain or increase the value of a plant.

This includes the following maintenance strategies:

- **Corrective maintenance**: Response to existing fault and diagnostics messages
  - Failures are risked or minimized by redundant configurations
  - Maintenance in the form of a repair or replacement
- **Preventative maintenance**: Preventative diagnostics and maintenance
  - Appropriate maintenance measures are initiated before a fault even occurs
  - Maintenance in the form of time-dependent or status-dependent maintenance (dependent on degree of wear)
- **Predictive maintenance**: Predictive diagnostics for timely detection of potential problems and to determine the remaining service life.

While the plant operator obtains all relevant information that is necessary for focused intervention in a process via the operator system, maintenance and service personnel can check the hardware components of the automation system (assets) and process their diagnostic messages and maintenance requests using the Maintenance Station.

For this the Maintenance Station offers access to:

- Components of the process control system: Intelligent field devices and I/O modules, fieldbus, controller, network components, and plant bus, as well as servers and clients of the operator systems
- Assets that do not belong directly to the process control system, such as pumps, motors, centrifuges, heat exchangers (mechanical assets) or control loops – represented by proxy objects in which the diagnostics rules are stored

**Typical maintenance cycle**

A typical maintenance cycle has the following actions:

- Monitoring of the status of a component or device:
  - Recording of diagnostics information via network components and PC basic devices per OPC coupling
  - Intelligent sensors detect and signal impending failures long before the actual failure
- Signaling of "maintenance required" in:
  - Group display
  - Symbol graphics of affected components/devices, e.g. of a sensor
  - Alarm log
- Navigation to component/device with "maintenance required", and information on specific data such as process tag number, mounting location, and device type
- Display of detailed diagnostic information (depending on device type and vendor), e.g.
  - Error description
  - Error cause
  - Trend statement
  - Operating instruction
- Evaluation, commenting and, if applicable, changing the priority of the "maintenance required"
- Initiation of a maintenance measure per maintenance request and tracking of execution; symbolic visualization of current status of maintenance measure
- Conclusion of maintenance measure; all status displays are reset to their normal state
All activities are documented on the Maintenance Station without gaps – automatically and without additional configuration overhead.

Architecture

For asset management, the Maintenance Station uses hardware and software components of the Engineering System (ES) and Operator System (OS). As a result of the close interlacing, ES, OS, and Asset Management functions execute on common hardware. Such a multi-functional station cannot only be used for asset management, but also for system engineering or HMI.

Depending on the project-specific SIMATIC PCS 7 architecture, the Maintenance Station can be implemented on the basis of a SIMATIC PCS 7 BOX, a SIMATIC PCS 7 Single Station, or on the basis of a client/server combination. In client/server combinations, the Maintenance Station server can also have a redundant design. In this case, they must be configured like redundant OS servers.

Message system, GUI, picture hierarchy and operator prompting are oriented according to the HMI philosophy of the operator system. The diagnostics data of all assets are displayed on uniform faceplates whose functions and information depend on the components. This means that working with the Maintenance Station is simple and intuitive, complex familiarization is not required.

The diagnostics screens structured according to the process cell hierarchy with the operating states of the SIMATIC PCS 7 components can be displayed on the Maintenance Station and also on the OS clients. More detailed diagnostic information determined by SIMATIC PDM is also displayed on the faceplates of these stations. However, enhanced online diagnostics functions in conjunction with HW Config can only be called from the Maintenance Station.

The user management and access control for the Maintenance Station is handled by SIMATIC Logon integrated in SIMATIC PCS 7.

Configuration

For asset management, the Maintenance Station uses the relevant data from the hardware and software project of the application which is generated during the standard configuration with the Engineering System. Simply by pressing a button, these data are derived with system support from the project data of the application, and the diagnostics screens are generated. The procedure is simple, and no additional overhead is required for configuration of the asset management:

- Generation of the hardware and software project of the application
- System-supported generation of the diagnostics screens with all components present in the project, including the picture hierarchy according to the project's hardware structure
- Compilation of the configuration data, and downloading to the operator station and Maintenance Station with subsequent test and commissioning phase.

The names of imported images, symbols, etc. can be permanently changed for further use in the maintenance project.

Conformity to international standards, specifications, and recommendations

Asset Management with the SIMATIC PCS 7 Maintenance Station conforms to international standards, specifications, and recommendations. It takes into account the NAMUR requirements (standardization association for measurement and control in chemical industries) defined for systems for asset management at plant level and for status messages from field devices:

- NAMUR recommendation NE91 (requirements for systems for Asset Management at plant level)
- NAMUR recommendation NE105 (requirements for the integration of fieldbus devices in engineering tools)
- NAMUR recommendation NE107 (status messages from field devices): "Device failure", "Maintenance required", "Function check"

In addition, it follows the IEC 61804-2 for describing devices by means of the Electronic Device Description Language (EDDL) and specifications made by the PROFIBUS & PROFINET International (PI) organization, e.g.:

- PROFIBUS Profile Guidelines Identification & Maintenance Functions
- PROFIBUS PA Profile for Process Control Devices
Asset Management function characteristics

As the system interface to the maintenance engineer, the Maintenance Station provides integrated maintenance functions and information.

Standard diagnostics functions
Starting from the overview display, the maintenance engineer can navigate to the diagnostics screens of the subordinate hardware levels in order to obtain information on the diagnostics status of individual plant areas or components. If a fault is signaled in the overview display, the "loop in alarm" function permits rapid switching to the diagnostics faceplate of the associated component. The information is filtered according to the area of responsibility of the user.

The following information can be offered:

- Display of diagnostics status determined by the system
- Information on the component, such as process tag name, manufacturer or serial number
- Display of diagnostics messages of a component
- Visualization of type and current state of initiated maintenance measure

Information on mechanical assets
For mechanical assets without self-diagnostics (pumps, motors, etc.), the AssetMon function block can determine inadmissible operating states from various measured values and their deviations from a defined normal status. These are displayed as a maintenance alarm on the Maintenance Station. It is also suitable for implementing individual diagnostic structures, project-specific diagnostics rules, and condition monitoring functions.

In addition to this, individual asset management blocks are available with which maintenance engineers can monitor plant components such as pumps, heat exchangers or control valves. An example of this is the PumpMon function block with faceplates for monitoring and analysis of centrifugal pumps. The Premium Service "Asset Management" additionally provides comprehensive consulting for maintenance engineers and support during commissioning.

Extended information for assets according to IEC 61804-2
Additional information can be called for assets described by the electronic device description (EDD) according to IEC 61804-2. This information is automatically read out of the components and made available by SIMATIC PDM in the background.

- Detailed diagnostics information
  - Device-specific information from the vendor
  - Information on fault diagnostics and troubleshooting
  - Additional documentation
- Results of internal condition monitoring functions
- Status information (e.g. local operation, local configuration changes)
- Display of modification logbook (audit trail) of the component with all entries on the persons, times and types of operator intervention on the component
- Parameter view of the assets (display of parameters saved in the component and in the project; if required, also differences between them)
Visualization of the maintenance information

The hierarchical structuring of information and the uniform symbols support the overview, facilitate orientation, and permit the maintenance engineer to rapidly access detailed information starting from the plant overview.

The symbol set defined for asset management with the SIMATIC PCS 7 Maintenance Station contains symbols which identify the diagnostics status of the devices/components, the relevance of the maintenance request, and the status of the maintenance measure.

Group displays in the plant overview visualize the diagnostics status of the subordinate structures/components according to a type of traffic light with red, yellow or green.

Diagnostics screens represent the status of components and subordinate devices/components through standardized symbols. These contain the following elements:

- Bitmap of component
- Tag identification of component
- Maintenance state display
- Group display for diagnostics status of subordinate components

Clicking an element in the symbol display either opens the subordinate hierarchy level or a component faceplate. The component faceplate offers various views of the associated component with further device-specific information, e.g. an identification, message or maintenance view.

For additional information, see: www siemens com simatic pcs7 plant asset management

Asset Management highlights

- Instrument for minimization of the total cost of ownership for the complete lifecycle of the plant
- Diagnostics and maintenance management for the components of the process control system and for mechanical assets such as pumps, motors or heat exchangers
- Homogenous integration of maintenance functionality in SIMATIC PCS 7
- Maintenance station as system interface for maintenance engineer
- Same look & feel as with process control on the operator system
- Uniform display of diagnostics and maintenance status throughout the plant
- Automatically generated overview of ID data with firmware and software versions for planning upgrades
- AssetMon function block for mechanical assets, individual diagnostics, and condition monitoring functions
- Additive function blocks with faceplates for plant components such as pumps, heat exchangers or control valves as well as Premium Service for consulting and maintenance support
- Recording of changes in configurations and parameters of EDD-based devices in the change log
- Generation of overviews on diagnostics statuses
- Consideration of international standards and directives
Automation systems

Scalable performance for every requirement

The SIMATIC PCS 7 process control system offers a wide range of automation systems whose performances are finely matched to one another within wide limits.

The range can be categorized as follows in accordance with the design:

- SIMATIC PCS 7 AS RTX Microbox automation system with software controller
- Modular automation systems of the S7-400 range with hardware controller

SIMATIC PCS 7 AS RTX Microbox automation system

The SIMATIC PCS 7 AS RTX represents the starter system for the low to mid-performance range of SIMATIC PCS 7. As a result of its exceptional physical properties and small dimensions, it is particularly suitable for small applications and at plant level as an excellent alternative to standard automation systems of the S7-400 series.

The compact and rugged automation system based on the SIMATIC Microbox PC 427C has been designed for maintenance-free 24-hour continuous operation at ambient temperatures up to 55 °C. Since there are no fans or rotating storage media, it is resistant to vibration and shock.

The SIMATIC PCS 7 AS RTX is supplied with an AS Runtime license for 100 POs (expandable up to 2 000 POs). The Windows XP Embedded operating system, the WinAC RTX controller software, and the SIMATIC PC DiagMonitor diagnostics software are pre-installed on a 4 GB CompactFlash card. The system is configured using the SIMATIC PCS 7 Engineering System.

ET 200 remote I/O systems with connected sensors/actuators and field devices/process devices on PROFIBUS DP/PA can be connected over a PROFIBUS DP interface which also supports routing. Two 10/100/1000 Mbit/s Ethernet RJ45 interfaces for plant bus communication allow integration in a SIMATIC PCS 7 plant network.

Parameterizable monitoring functions for program execution/watchdog, processor and board temperatures, as well as enhanced diagnostics/messages (e.g. runtime meter, system status) can be recorded and evaluated via SIMATIC PC DiagMonitor and PCS 7 Maintenance Station or signaled by LED.

Modular automation systems of the S7-400 range

Components

With consideration of the price/performance ratio, selected components of the SIMATIC S7-400 are combined in bundles depending on the task. These "AS bundles" are available in two versions:

- Individual components bundled per system in one delivery
- Preassembled and tested all-in-one systems (no extra charge compared to delivery of individual components)
They are configured by selecting predefined ordering units. Depending on the configuration as Single Station or Redundant Station, an AS bundle is equipped with the following components:

- 1 or 2 racks with 9 or 18 slots
- 1 or 2 SIMATIC S7-400 CPUs, RAMs from 0.768 to 30 MB
- 1, 2 or 4 power supplies 24 V DC or 120/230 V AC, each without backup batteries
- 1 or 2 memory cards with 1 to 64 MB RAM
- 1, 2 or 4 interface modules for Industrial Ethernet plant bus (via CP or integrated in CPU)
- Additive PROFIBUS communications processors (by means of configurator up to 4 per Single Station, up to 8 per Redundant Station)
- 4 Sync modules for a range up to 10 m or 10 km, and 2 fiber-optic Sync cables

Each AS bundle is combined with a SIMATIC PCS 7 AS Runtime license for 100 process objects (PO). The number of POs can be extended with cumulative Runtime licenses for 100, 1 000 or 10 000 POs.

Up to 8 PROFIBUS interfaces (single or redundant) can be configured for an automation system. By default the CPU of the automation systems comes with an onboard PROFIBUS DP fieldbus connection. Depending on the type of CPU, 1 or 2 further PROFIBUS DP interfaces are possible using additive IF 964-DP interface modules. PROFIBUS communications cards can be additionally fitted if required.

The AS firmware can be updated by means of a Flash EPROM memory card (8/16 MB) or from the central engineering system via the plant bus.

The following characteristics make the SIMATIC S7-400 predestined for use as a SIMATIC PCS 7 automation system:

- Modular, fan-free design
- Extremely rugged and expandable
- Single and redundant versions
- Comprehensive communication facilities
- Integral system functions
- Integrable safety functions (Safety Integrated)
- Simple linking of central or distributed I/O

In accordance with their functionalities, the modular automation systems of the S7-400 range can be classified into:

- Standard automation systems
- Fault-tolerant automation systems
- Safety-related automation systems

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<td>600</td>
</tr>
<tr>
<td>Analog outputs AO</td>
<td>10</td>
<td>40</td>
<td>40</td>
<td>50</td>
<td>110</td>
<td>180</td>
<td>220</td>
<td>400</td>
<td>400</td>
<td>220</td>
</tr>
<tr>
<td>Process objects (PO)</td>
<td>50</td>
<td>250</td>
<td>300</td>
<td>420</td>
<td>890</td>
<td>1 400</td>
<td>1 800</td>
<td>2 500</td>
<td>3 000</td>
<td>1 800</td>
</tr>
</tbody>
</table>

Typical mixed quantity frameworks for SIMATIC PCS 7 automation systems, based on the SIMATIC PCS 7 standard library
Automation systems

Standard automation systems
The standard automation systems are extremely rugged, and feature a high processing and communication performance.

The AS 414-3 and AS 414-3IE automation systems are low-cost, modular and scalable systems for applications with relatively small quantity frameworks.

Larger quantity frameworks are possible with the AS 416-2, AS 416-3, AS 416-3IE and AS 417-4 automation systems, and are mainly used starting with medium plant sizes.

In the AS 414-3IE and AS 416-3IE, the Industrial Ethernet interface is integrated in the CPU. They differ from the AS 414-3 and AS 416-3 with Industrial Ethernet CP 443-1 in terms of time synchronization (NTP instead of S7 synchronization).

If two separate power supply systems are used for supplying the plant, the availability of the standard automation systems can be increased by using two redundant power supplies.

Fault-tolerant automation systems
Fault-tolerant automation systems are used to reduce the risk of production failures. The higher investment costs are frequently negligible compared to the costs resulting from production failures. The higher the costs of a production failure, the more worthwhile it is to use a fault-tolerant system.

Fault-tolerant SIMATIC PCS 7 automation systems can be used on their own or together with standard and safety-related automation systems. In accordance with their basic design, they can be distinguished as:

- Single Stations:
  AS 412-3-1H, AS 414-4-1H and AS 417-4-1H with only one CPU
- Redundancy Stations:
  AS 412-3-2H, AS 414-4-2H and AS 417-4-2H with two redundant CPUs

The two redundant and electrically isolated subsystems of the Redundancy Station can be mounted on one compact rack with divided backplane bus or on two separate racks. The design with two racks allows physical separation of the redundant subsystems over a distance of up to 10 km, e.g. separated by a fireproof partition. As a result of the electrical isolation, the system is insensitive to electromagnetic interferences.
Flexible and scalable availability

The use of a fault-tolerant single station instead of a standard automation system provides the option for a redundant configuration at a later date.

A particular characteristic of the fault-tolerant SIMATIC PCS 7 automation systems is the flexible and scalable availability of various modules.

When planning a system, it is even possible with a Single Station to increase the availability at a specific point by means of redundant configuration of the power supply, or for the Industrial Ethernet communication module, and to combine these measures.

The Redundancy Station with its two redundant CPUs already offers a higher level of availability. It operates according to the 1-out-of-2 principle, where a switchover is made from the active subsystem to the standby subsystem in the event of a fault. Based on this, as with the Single Station the power supply or the Industrial Ethernet communication module can be doubled for each subsystem, and these measures can be combined.

Safety-related automation systems

Safety-related automation systems are used for critical applications in which an incident can cause danger to personnel, plant damage, or environmental pollution. These F/FH systems collaborate with safety-related F modules of the ET 200 distributed I/O systems or fail-safe transmitters connected directly via the fieldbus to detect not only faults in the process, but also their own, internal faults. They automatically bring the plant into a safe state in the event of a fault.
The safety-related automation systems are TÜV-certified and comply with the safety requirements up to SIL 3 in accordance with IEC 61508. They are based on the hardware of the AS 412H, AS 414H or AS 417H automation systems, which have been expanded by safety functions by means of S7 F Systems.

Analogous to the basic systems, two versions can be distinguished:

- **Single Station:**
  AS 412F/AS 414F/AS 417F with one CPU, safety-related
- **Redundancy Station:**
  AS 412FH/AS 414FH/AS 417FH with two redundant CPUs, safety-related and fault-tolerant

As a result of a redundant design of the power supply or of the Industrial Ethernet communication module, the availability of the safety-related Single/Redundancy Stations can be increased flexibly as with the fault-tolerant automation systems on which they are based.

In the multitasking systems, several programs can run simultaneously in one CPU: Basic Process Control (BPC) applications and safety-related applications. The programs are reaction-free, i.e. faults in the BPC applications have no effect on safety-related applications and vice versa. Special tasks with very short response times can also be implemented.

In the parallel processing of BPC and safety functions in one CPU, mutual interference is prevented by ensuring that the BPC programs and the safety-related programs are kept strictly separate and data is exchanged via special conversion function blocks. The safety functions are processed twice in different processor sections of the CPU by means of redundant, diverse instruction processing. Potential errors are detected by the system during the subsequent comparison of results.

Safety programs executed on different F/FH systems of a plant are also able to carry out safety-related communication with one another over the Industrial Ethernet plant bus.

The redundancy of the FH systems is only used to increase the availability. It is not relevant to processing of the safety functions or the associated fault detection.

---

**Highlights**

**Automation systems**

- Wide range of products in two designs and with finely graded performances:
  - Microbox automation system with software controller
  - Modular automation systems of the S7-400 range with hardware controller

**Microbox automation system**

- Compact and rugged system for use at plant level
- Resistant to vibration and shock since there are no fans or rotating storage media
- Maintenance-free 24/7 operation at ambient temperatures up to 55 °C

**Modular automation systems**

- Individually configurable AS bundles, available as:
  - Individual components bundled per station in one delivery
  - Pre-assembled and tested systems
- Flexible and scalable availability:
  - Standard systems as Single Station, optionally with redundant power supply
  - Fault-tolerant systems as Single/Redundancy Station, optionally with redundant power supply and/or redundant Industrial Ethernet communication for each system/subsystem
  - Safety-related systems as Single/Redundancy Station, optionally with redundant power supply and/or redundant Industrial Ethernet communication for each system/subsystem
- Redundancy Station with two electrically isolated subsystems:
  - One or two racks separated by up to 10 km
  - Simultaneous (synchronous) processing of identical user programs in the two CPUs
  - Bumpless switchover
- Changes to the configuration during operation
Communication

Fast and reliable communication with Industrial Ethernet for plant bus and terminal bus

SIMATIC NET

Through application of SIMATIC NET network components based on globally established standards, SIMATIC PCS 7 is provided with a powerful and rugged range of products for implementing integrated communications networks for reliable data exchange between the system components in different levels of a plant.

The SIMATIC NET products specially developed for industrial applications provide optimum suitability for plants in all sectors. They are matched to one another and meet the highest standards, especially in areas where they are subject to extreme influences, such as:

- Electromagnetic interference fields
- Corrosive liquids and atmospheres
- Explosion hazards
- High mechanical loads

The SIMATIC NET products ensure expandability and the protection of investments due to compatible further developments, as well as integration from inbound logistics to outbound logistics and from field devices up to the management information system.

Industrial Ethernet

The plant bus and the terminal bus for multiple station systems with client/server architecture are implemented with Industrial Ethernet, a powerful area and cell network for industrial applications in line with the international IEEE 802.3 standard (Ethernet).

In the various SIMATIC PCS 7 subsystems (ES, OS, AS, etc.), onboard interface modules, simple network cards or special communications processors (CP 1613 A2/CP 1623) are used as communication interfaces. For small systems, the "Basic Communication Ethernet" integrated in the SIMATIC PCS 7 Industrial Workstations permits economical operation of single stations and servers on the plant bus with simple network cards.

In medium and large plants characterized by high requirements, SIMATIC PCS 7 relies on powerful CP 1613 A2/CP 1623 communication modules as well as modern Gigabit and FastEthernet technology which combines the high security provided by optical rings with the scalable performance provided by switching technology and high transmission rates up to 1 Gbit/s.
SCALANCE X Industrial Ethernet switches

The communication nodes are integrated into the bus using Industrial Ethernet switches. The Industrial Ethernet switches from the SCALANCE X family are particularly suitable for this and offer scalable performance at an attractive price while supporting versatile configuration possibilities.

As a result of their interference resistance and high availability, optical rings are preferably used for the plant bus and terminal bus.

If particularly high availability requirements exist, it is also possible to distribute the communication on two redundant rings:

- With the terminal bus, the two rings are connected together by 2 pairs of SCALANCE X switches. Switches from the SCALANCE X-400, X-300 and X-200 IRT product lines have the "standby redundancy" function that is necessary in this regard. Each of the redundant servers and clients can be connected to both rings via two separate interface modules (redundant terminal bus adapter package).

<table>
<thead>
<tr>
<th>Industrial Ethernet switches</th>
<th>SCALANCE X-400 (up to 1 Gbit/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For electrical or optical gigabit rings (single and redundant):</td>
<td>SCALANCE X414-3E with 2 Gigabit Ethernet ports (electrical/optical), 12 electrical FastEthernet ports and optionally 4 optical FastEthernet ports; expandable with 8 electrical or 8 optical FastEthernet ports</td>
</tr>
<tr>
<td></td>
<td>SCALANCE X408-2 with 4 Gigabit Ethernet ports (electrical/optical) and 4 FastEthernet ports (electrical/optical)</td>
</tr>
</tbody>
</table>

| SCALANCE X-300 (up to 1 Gbit/s) |
|------------------------------|----------------------------------|
| For optical line, star or ring structures (up to 1 Gbit/s): | SCALANCE X307-3 (optical ports for glass multi-mode fiber-optic cable up to 750 m) |
| | SCALANCE X307-3LD (optical ports for glass single-mode fiber-optic cable up to 10 km) each with 3 optical Gigabit Ethernet ports and 7 electrical FastEthernet ports |
| | SCALANCE X308-2 (optical ports for glass multi-mode fiber-optic cable up to 750 m) |
| | SCALANCE X308-2LD (optical ports for glass single-mode fiber-optic cable up to 10 km) |
| | SCALANCE X308-2LH (optical ports for glass single-mode fiber-optic cable up to 40 km) |
| | SCALANCE X308-2LH+ (optical ports for glass single-mode fiber-optic cable up to 70 km) each with 2 optical Gigabit Ethernet ports, 1 electrical Gigabit Ethernet port and 7 electrical FastEthernet ports |
| For electrical line, star or ring structures (up to 1 Gbit/s): | SCALANCE X310 with 3 electrical Gigabit Ethernet ports and 7 electrical FastEthernet ports |
| For electrical line, star or ring structures (up to 100 Mbit/s): | SCALANCE X310FE with 10 electrical FastEthernet ports |

| SCALANCE X-200 IRT (up to 100 Mbit/s) |
|------------------------------|----------------------------------|
| For line, star or ring structures (electrical/optical, depending on type of port): | SCALANCE X204 IRT with 4 electrical ports |
| | SCALANCE X202-2 IRT with 2 electrical ports and 2 glass fiber-optic cable ports |
| | SCALANCE X202-2P IRT with 2 electrical ports and 2 POF (Polymer Optical Fiber) fiber-optic cable ports |
| | SCALANCE X201-3P IRT with 1 electrical port and 3 POF fiber-optic ports |
| | SCALANCE X200-4P IRT with 4 POF fiber-optic ports |

| SCALANCE X-200 (up to 100 Mbit/s) |
|------------------------------|----------------------------------|
| For electrical line, ring, or star structures: | SCALANCE X224 with 24 electrical ports |
| | SCALANCE X216 with 16 electrical ports |
| | SCALANCE X208 with 8 electrical ports |
| For optical line or ring structures: | SCALANCE X204-2 with 2 optical ports for glass multi-mode fiber-optic cable up to 3 km and 4 electrical ports |
| | SCALANCE X212-2 with 2 optical ports for glass multi-mode fiber-optic cable up to 3 km and 12 electrical ports |
| | SCALANCE X212-2LD with 2 optical ports for glass single-mode fiber-optic cable up to 26 km and 12 electrical ports |
| For star structures as well as line or ring structures with electrical and optical transmission links: | SCALANCE X206-1LD with 1 optical port for glass single-mode fiber-optic cable up to 26 km and 6 electrical ports |
• With the plant bus, the two rings are physically separate. One switch in each case takes over the function of the redundancy manager for each ring. The current switches from the SCALANCE X-400, X-300, X-200 IRT and X-200 product lines can be used as redundancy manager. The coupling partners connected to the two rings by means of two CPs per AS CPU and OS server are linked together logically when configuring with NetPro by using a fault-tolerant S7 connection (4-way redundancy).

**Industrial Wireless LAN (IWLAN)**

SIMATIC PCS 7 allows you to integrate mobile or stationary remote clients into the terminal bus via a SCALANCE W788-1PRO or W788-2PRO access point.

Via IWLAN, mobile remote clients (e.g. notebooks) can communicate with the access point using a WLAN interface module, and stationary remote clients in a desktop/tower housing can communicate using a SCALANCE W744-1PRO or W746-1PRO Ethernet client module.

The following applications can then be implemented:

• Use of additional remote OS clients (1 or 2 on IWLAN)
• Linking of web clients to a PCS 7 Web Server (up to 2 on IWLAN)
• Remote access to an engineering station with application of Remote Desktop or PC Anywhere, e.g. during commissioning

All components used are very rugged, apply state-of-the-art authentication and encryption procedures, and ensure high reliability of the radio channel.

### Technical specifications for Industrial Ethernet

<table>
<thead>
<tr>
<th>Plant bus/terminal bus</th>
<th>Industrial Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of nodes</td>
<td>1 023 per network segment (IEEE 802.3 standard)</td>
</tr>
<tr>
<td>Number of switches</td>
<td>up to 50</td>
</tr>
<tr>
<td>Length of the network</td>
<td>Electrical up to approx. 5 km Optical up to approx. 150 km</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree, ring, star</td>
</tr>
</tbody>
</table>

### Industrial Ethernet highlights

- Universally implementable:
  - In all sectors
  - In office environments as well as in harsh industrial environments
- Fast commissioning through:
  - Simple connection system
  - Local assembly using the FastConnect cabling system together with RJ45 technology
- EMC interference resistance through optical transmission media
- Continuous monitoring of network components through a simple yet effective signaling concept
- Plant-wide clock system for exact assignment of events within the complete plant
- High availability thanks to redundant network topologies
- Resistant to power failure through fast switchover to redundant system
- High flexibility through reaction-free expansion of existing plants
- Scalable performance with switching technology
- Modern and future-oriented network components, e.g. SCALANCE X Industrial Ethernet switches
- Investment security due to compatible developments
Fast and rugged fieldbus communication

Distributed peripherals such as remote I/O stations with their I/O modules, transmitters, drives, valves or operator terminals communicate with the automation systems at field level through a powerful real-time bus system.

This field communication is characterized by:

- Cyclic transmission of process data
- Acyclic transfer of alarms, parameters and diagnostics data

The universal PROFIBUS has proven itself as a rugged and reliable communication medium at field level. Based on the IEC 61158 and IEC 61784 standards, it can cover all requirements of the production and process industries using complementary transmission technologies, a uniform communication profile, and additive application profiles for typical device functions, e.g. PA Devices, PROFIdrive, PROFIsafe or PROFIenergy.

PROFIBUS DP

PROFIBUS DP is designed to provide high data transmission rates (up to 12 Mbit/s) and short response times (up to 1 ms) and is at the same time:

- Communication medium for data transmission between automation systems (controllers) and distributed I/O devices of the ET 200 series (remote I/Os), as well as field/process devices, drives, analyzers, CPUs/CPs, operator panels etc. that have a PROFIBUS DP interface.
- Integrator for the PROFIBUS PA fieldbus and FOUNDATION Fieldbus H1 which are typical in the process industry

Since PROFIBUS DP supports the HART protocol, it is also possible to integrate HART field devices into the PROFIBUS DP communication via HART remote I/Os.

The PROFIBUS DP is available for electrical or optical transmission:

- RS 485: Simple and low-cost electrical transmission system based on shielded two-wire cable
- Fiber-optic: Optical transmission system with glass or plastic fiber-optic cables, for fast transmission of large quantities of data in environments with high interferences or for covering long distances
With the aid of the fieldbus isolating transformer (RS 485-iS coupler) and the RS 485-iS electrical transmission technology, PROFIBUS DP can also be run as an intrinsically-safe fieldbus in all environments up to hazardous zone 1 or 21.

PROFIBUS PA and FOUNDATION Fieldbus H1

The direct connection of transmitters and actuators including power supply via the communication medium, as well as detailed diagnostics, are particularly relevant to the automation of industrial processes that frequently take place in corrosive, harmful, and hazardous environments.

Both the PROFIBUS PA fieldbus and the FOUNDATION Fieldbus H1 (FF H1) meet these requirements. Both fieldbuses are optimally suitable for directing integrating actuators and sensors in operating environments up to hazardous zone 1/21 or 0 into the process system. The intrinsically-safe transmission technology MBP (Manchester Coded; Bus Powered) provides the power supply to the field devices as well as digital data transmission with a constant transfer rate of 31.25 kbit/s over a two-wire cable.

The physical bus systems of PROFIBUS PA and FF H1 are largely identical in accordance with IEC 61158. Both can be integrated seamlessly in the SIMATIC PCS 7 process control system using PROFIBUS DP as link. PROFIBUS PA and FOUNDATION Fieldbus H1 thus profit equally from the higher-level PROFIBUS DP architecture. SIMATIC PCS 7 customers are therefore not limited to a specific fieldbus but can select this freely matching the optimum field instrumentation.

<table>
<thead>
<tr>
<th>Technical specifications</th>
<th>PROFIBUS DP</th>
<th>RS 485-iS</th>
<th>Fiber-optic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission</td>
<td>RS 485</td>
<td>RS 485-iS</td>
<td>Fiber-optic</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>9.6 kbit/s…12 Mbit/s</td>
<td>9.6 kbit/s…1.5 Mbit/s</td>
<td>9.6 kbit/s…12 Mbit/s</td>
</tr>
<tr>
<td>Cable</td>
<td>Two-wire shielded</td>
<td>Two-wire shielded</td>
<td>Plastic as well as multi-mode and single-mode glass-fiber</td>
</tr>
<tr>
<td>Type of protection</td>
<td>EEx(ib)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topology</td>
<td>Line, tree</td>
<td>Line</td>
<td>Ring, star, linear</td>
</tr>
<tr>
<td>Nodes per segment</td>
<td>32</td>
<td>32 1)</td>
<td>–</td>
</tr>
<tr>
<td>Nodes per network (with repeater)</td>
<td>126</td>
<td>126</td>
<td>126</td>
</tr>
<tr>
<td>Cable length per segment depending on transfer rate</td>
<td>1 200 m at max. 93.75 kbit/s</td>
<td>1 000 m at 187.5 kbit/s</td>
<td>1 900 m: standard</td>
</tr>
<tr>
<td></td>
<td>400 m at 500 kbit/s</td>
<td>200 m at 1.5 Mbit/s</td>
<td>1 900 m: EEx(ib)</td>
</tr>
<tr>
<td></td>
<td>100 m at 12 Mbit/s</td>
<td></td>
<td>1 000 m: EEx(ia)</td>
</tr>
<tr>
<td>Repeater for signal boosting with RS 485 networks</td>
<td>Max. 9</td>
<td>Max. 9 1)</td>
<td>Not relevant</td>
</tr>
</tbody>
</table>

1) Conforming to PROFIBUS installation guideline 2.262

<table>
<thead>
<tr>
<th>Technical specifications</th>
<th>PROFIBUS PA</th>
<th>FOUNDATION Fieldbus H1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission</td>
<td>MBP</td>
<td>MBP</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>31.25 kbit/s</td>
<td>31.25 kbit/s</td>
</tr>
<tr>
<td>Cable</td>
<td>Two-wire shielded</td>
<td>Two-wire shielded</td>
</tr>
<tr>
<td>Type of protection</td>
<td>EEx(ia/ib)</td>
<td>EEx(ia/ib)</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree, ring</td>
<td>Linear, tree, ring</td>
</tr>
<tr>
<td>Safety Integrated</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>Control in the field</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>Interoperability</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Field devices per segment/coupler</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Field devices per link</td>
<td>64</td>
<td>31</td>
</tr>
<tr>
<td>AFDs per segment/coupler</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Max. total current consumption of all field devices</td>
<td>1 A</td>
<td>1 A</td>
</tr>
<tr>
<td>Cable length per segment depending on transfer rate</td>
<td>1 900 m: standard</td>
<td>1 900 m: standard</td>
</tr>
<tr>
<td></td>
<td>1 900 m: EEx(ib)</td>
<td>1 900 m: EEx(ib)</td>
</tr>
<tr>
<td></td>
<td>1 000 m: EEx(ia)</td>
<td>1 000 m: EEx(ia)</td>
</tr>
</tbody>
</table>

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Fieldbus architectures

With the displayed fieldbus architectures, the network transition from PROFIBUS PA or FF H1 to PROFIBUS DP is via a link (PA link/FF link) which is equipped with one or two couplers.

A maximum of 5 bus segments can be operated via individual couplers on a PA link which can be equipped with up to 5 couplers (max. 3 for mixed configurations with ring or with coupler redundancy). Only 1 bus segment can be operated on the FF link which can be equipped with 2 couplers, independent of the configuration.

As a result of the identical physical bus systems, the same active field distributors AFS, AFD and AFDiS can be used for PROFIBUS PA and FF H1.

Linear architectures with single couplers

The field devices are integrated in a line segment via up to 8 active field distributors (AFD). Connection to the AFDs is made via short-circuit proof spur lines. The line segment can be connected to a single or redundant PROFIBUS DP via a link. The last AFD at the end of the line leading away from the link automatically activates its bus terminating resistor.

Linear architectures with redundant couplers

The active field splitter (AFS) is connected with a redundant coupler pair (2 x FDC 157) in the link. It interconnects a line segment with the respective active coupler. A coupler can be replaced during operation. The field devices are integrated in the line segment as described in the section "Line architecture with single coupler".

Ring architecture with coupler and media redundancy

Maximum availability can be achieved with a ring segment that is created by means of a redundant coupler pair (2 x FDC 157) in the link. Up to 8 active field distributors (AFD) integrate the FF field devices via short-circuit proof spur lines into this ring segment. The bus is terminated automatically and is immediately adapted in the event of changes or faults on the bus. An extension on the fieldbus or replacement of a coupler during operation is possible.

<table>
<thead>
<tr>
<th>Max. spur line length related to the total number of spur lines</th>
<th>IEC 61158-2</th>
<th>IEC 60079-27 (FISCO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of spur lines (1 device per spur line)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ 1 ... 12</td>
<td>120 m</td>
<td>60 m</td>
</tr>
<tr>
<td>■ 13 ... 14</td>
<td>90 m</td>
<td>60 m</td>
</tr>
<tr>
<td>■ 15 ... 18</td>
<td>60 m</td>
<td>60 m</td>
</tr>
<tr>
<td>■ 19 ... 24</td>
<td>30 m</td>
<td>30 m</td>
</tr>
<tr>
<td>■ 25 ... 31</td>
<td>1 m</td>
<td>1 m</td>
</tr>
</tbody>
</table>

Advantages of the ring architecture

- Maximum availability avoids unplanned plant downtimes
- Simple and safe installation
- Automatic termination
- Automatic, bumpless isolation of faulty subsegments
- Topology can be repaired or expanded during ongoing operation
Process I/O

The right solution for every requirement

SIMATIC PCS 7 offers a variety of possibilities for connecting peripheral devices as well as for acquisition and output of process signals via sensors and actuators.

- Analog and digital I/O modules of the SIMATIC S7-400 operated centrally in the automation system
- ET 200 remote I/O stations with an extensive range of cost-effective signal and function modules, connected over PROFIBUS DP to the automation system (AS)
- Direct fieldbus connection of operator terminals and intelligent, distributed field/process devices (including sensors/actuators), also redundant or in hazardous areas of zones 0, 1, 2 or 20, 21, 22.

SIMATIC S7-400 signal modules used centrally in the automation system have little significance in the context of SIMATIC PCS 7. These modules are at most an alternative to distributed I/Os for small applications or plants with limited distributed expansion.

In practice, automation in the field area is largely characterized by distributed process I/Os:

- ET 200 remote I/Os in conjunction with classic field/process devices and HART field devices
- Intelligent field/process devices directly on the PROFIBUS DP, PROFIBUS PA or FOUNDATION Fieldbus H1 fieldbuses

In addition to the wide technical bandwidth, the following properties characterize the distributed process I/Os:

- Modularity and uniformity
- Flexible adaptability to the plant structure
- Minimum cabling and engineering requirements
- Low commissioning, servicing and lifecycle costs

Standard process I/Os for SIMATIC PCS 7

The following standard process I/Os are recommended for the SIMATIC PCS 7 process control system for automation in the field area:

- Distributed I/O system ET 200M
- Distributed I/O system ET 200iSP
- Distributed I/O system ET 200S
- Distributed I/O system ET 200pro
- PROFIBUS PA devices with PA profile 3.0 or later

Additional process I/Os can be integrated into SIMATIC PCS 7 via the PROFIBUS using add-on blocks. Examples of this are devices of drive and weighing systems such as:

- SIMOCODE pro motor management system
- SINAMICS G120 frequency inverter
- SIWAREX U/FTA/FTC weighing systems

MTA terminal modules

Field devices, sensors and actuators can be connected simply, rapidly and reliably to I/O modules of the ET 200M remote I/O stations using MTA terminal modules (Marshalled Termination Assemblies). MTA versions are available for standard I/O modules as well as for redundant and safety-related I/O modules. The use of the MTA achieves a significant reduction in costs for cabling and commissioning and avoids wiring errors.

Modifications possible online

<table>
<thead>
<tr>
<th>I/O Type</th>
<th>Possible Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200M</td>
<td>Adding of ET 200M stations</td>
</tr>
<tr>
<td></td>
<td>Adding of I/O modules to the station</td>
</tr>
<tr>
<td></td>
<td>Changing the parameter settings of I/O modules</td>
</tr>
<tr>
<td></td>
<td>Parameterization of connected HART field devices with SIMATIC PDM</td>
</tr>
<tr>
<td>ET 200iSP</td>
<td>Adding of ET 200iSP stations</td>
</tr>
<tr>
<td></td>
<td>Adding of modules for the station</td>
</tr>
<tr>
<td></td>
<td>Reparameterization of modules</td>
</tr>
<tr>
<td></td>
<td>Parameterization of connected HART field devices with SIMATIC PDM</td>
</tr>
<tr>
<td>ET 200S</td>
<td>Adding of ET 200S stations</td>
</tr>
<tr>
<td>ET 200pro</td>
<td>Adding of ET 200pro stations</td>
</tr>
<tr>
<td>PROFIBUS DP,</td>
<td>Adding of PROFIBUS DP stations</td>
</tr>
<tr>
<td>PROFIBUS PA,</td>
<td>Adding of PA links and PA field devices</td>
</tr>
<tr>
<td>Foundation</td>
<td>Parameterization of PA or FF field devices with SIMATIC PDM</td>
</tr>
<tr>
<td>Fieldbus H1</td>
<td></td>
</tr>
</tbody>
</table>

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Use of the process I/Os for SIMATIC PCS 7

The graphic above shows the possibilities for connecting distributed SIMATIC PCS 7 process I/Os with consideration of different environmental conditions.

**Sensors/actuators, analyzers as well as weighing and dosing systems**

Siemens Sensors and Communication offers a comprehensive range of devices for operation with the SIMATIC PCS 7 process control system. These include, for example:

- Devices for measurement of pressure, flow, temperature or level
- Positioners
- Gas analyzers
- SIWAREX weighing systems

These devices are available in versions with PROFIBUS DPIPA interface and for HART communication. The majority of devices is already included in the device catalog of the SIMATIC PDM process device manager.

An overview of the current range of devices with additional information, technical specifications and ordering data is available at the following Internet site: [www.siemens.com/processinstrumentation](http://www.siemens.com/processinstrumentation)
# Distributed I/O systems

## Recommended devices for field automation

<table>
<thead>
<tr>
<th>I/O system</th>
<th>ET 200M</th>
<th>ET 200iSP</th>
<th>ET 200S</th>
<th>ET 200pro</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20</td>
<td>IP30</td>
<td>IP20</td>
<td>IP65/IP66/IP67</td>
</tr>
<tr>
<td>Design</td>
<td>Modular</td>
<td>Modular</td>
<td>Bit modular, expandable block</td>
<td>Modular</td>
</tr>
<tr>
<td>Mounting</td>
<td>Mounting rail</td>
<td>Mounting rail</td>
<td>Standard sectional rail</td>
<td>Mounting rail</td>
</tr>
<tr>
<td>Connection system for sensors/actuators</td>
<td>Single-wire connection Cage-clamp/screw-type connection, FastConnect, TopConnect</td>
<td>Multi-wire connection Cage-clamp/screw-type connection</td>
<td>Multi-wire connection Cage-clamp/screw-type connection, FastConnect</td>
<td>M8, M12, M23</td>
</tr>
</tbody>
</table>

## Special applications

<table>
<thead>
<tr>
<th>Safety</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>For use in hazardous areas</td>
<td>Zones 2, 22</td>
<td>Zones 1, 21</td>
<td>Zones 2, 22</td>
<td>–</td>
</tr>
<tr>
<td>Increased availability</td>
<td>Switched, redundant</td>
<td>Switched, redundant</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Temperature range</td>
<td>0 ... +60 °C 1)</td>
<td>-20 ... +70 °C</td>
<td>0 ... +60 °C 1)</td>
<td>-25 ... +55 °C</td>
</tr>
<tr>
<td>Vibration resistance (continuous)</td>
<td>1 g</td>
<td>1 g</td>
<td>2 g</td>
<td>5 g (module-dependent)</td>
</tr>
</tbody>
</table>

## Communication

| PROFIBUS (copper/fiber-optic) | • / – (12 Mbit/s) | • / – (1.5 Mbit/s) | • / • (12 Mbit/s) | • / • (12 Mbit/s) |

## System functions

| Permanent wiring | • (plugging and removal) | • | • | – |
| Hot swapping | • (with active backplane bus) | • | • | • |
| Expansion/configuration during ongoing operation | • / • | • / • | • / – | – / – |
| Diagnostics (module-dependent) | Channel-discrete | Channel-discrete | Channel-discrete | Channel-discrete |

## Functions

| Digital channels | • | • | • | • |
| Analog channels | • | • | • | • |
| incl. HART | • | • | – | – |
| Motor starter | – | – | • | – |
| Pneumatic interface | – | • | – | – |
| Technological functions | Counting/measuring, controlling, weighing | Counting, frequency measuring | Counting/measuring | – |

---

1) Also available as SIPLUS component for expanded temperature range -25 ... +60/70 °C and corrosive atmosphere/condensation (exact details at www.siemens.com/siplus)
## Drives

### Recommended devices

<table>
<thead>
<tr>
<th>Drives</th>
<th>SIMOCODE pro</th>
<th>SINAMICS G120</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Motor management system for constant-speed motors in the low-voltage range</td>
<td>Frequency converter for three-phase asynchronous and synchronous motors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Degree of protection</th>
<th>IP20 (module-dependent)</th>
<th>IP20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Modular</td>
<td>Modular (control unit, power unit)</td>
</tr>
<tr>
<td>Performance range</td>
<td>0.1 ... 700 kW</td>
<td>0.37 ... 250 kW</td>
</tr>
<tr>
<td>Voltages</td>
<td>Up to 690 V AC</td>
<td>380 ... 480 V or 660 ... 690 V AC ± 10 %</td>
</tr>
<tr>
<td>Rated motor currents</td>
<td>Up to 820 A</td>
<td>–</td>
</tr>
<tr>
<td>PROFIBUS communications</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Block library for integration in SIMATIC PCS 7</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Application

- Protection and control of motors
  - In hazardous areas for types of protection EEx e/d corresponding to ATEX directive 94/9/EC
  - With heavy-duty starting (paper, cement, metal and water industries)
  - In high-availability plants (chemical, oil, raw material processing industry, power plants)

- For universal use in all industrial and trade sectors
Batch automation with SIMATIC BATCH

Modular, flexible, scalable and fully integrated in SIMATIC PCS 7

SIMATIC PCS 7 always offers the right solution for attractively priced and effective automation of batch processes:

- SFC and CFC for simple automation tasks with parameterizable sequential controls
- SIMATIC BATCH with recipe-driven control strategies for flexible execution of simple or complex batch processes with changing control sequences

Modular architecture

SIMATIC BATCH can be configured as a single-user system or as a client/server system and can be used in plants of any size thanks to the modular architecture and multistage scalability.

With small batch applications, a SIMATIC PCS 7 BOX can be used together with a separate controller, e.g. a SIMATIC PCS 7 AS RTX.

However, characteristic for the automation of batch processes using SIMATIC BATCH are client/server architectures with which one batch server and several Batch Clients process a plant project together. The batch server can also be configured with redundancy in order to increase availability.

In addition to the SIMATIC PCS 7 industrial workstations, the more compact SIMATIC PCS 7 OS clients 627C and OS clients 427C can be used as Batch Clients.

Integration in SIMATIC PCS 7

SIMATIC BATCH is fully integrated in SIMATIC PCS 7. Connection to the production control level is supported by direct communication with SIMATIC IT or by an open interface to any manufacturing execution systems (MES).

The plant data can be configured entirely using the Engineering System. This passes on all data required for recipe creation to the batch server, making recipe processing possible separate from the Engineering System. Changes to the configuration which are made on the Engineering System are available to the batch server using an update function.

The batch server software usually runs on an autonomous server hardware (batch server), separated from the OS servers. Depending on the capacity utilization of the operator system, OS and batch server software can also be operated on shared server hardware (OS/batch server).

SIMATIC BATCH clients and OS clients can run on separate or common basic hardware.

SIMATIC BATCH uses SIMATIC Logon integrated in the process control system for central user administration and authentication, as well as for the “electronic signature” to release master recipes, formulas, and library objects through enabled Windows users/user groups. Individual configuration settings of the Batch Control Center and recipe editor are saved as a user-specific profile when logging off. This means that you can work in a familiar environment as soon as you log on again at any client in the plant.
Communication with the automation systems

Depending on the operating mode, SIMATIC BATCH communicates with the automation systems (AS) via the PCS 7 operator system (OS) or also directly via S7 DOS.

SIMATIC BATCH provides special faceplates for controlling and monitoring units and equipment phases. As a rule, instances of an SFC type are used as the interface to the lower automation level.

Operating modes for recipe processing

- **PC mode**: execution of complete recipe logic in the batch server
- **AS mode**: execution of unit recipe logic in the automation system:
  - Very fast step changing times
  - Improved deterministics during execution of a batch
  - Enhanced availability
- **Mixed mode**: parallel application of PC and AS modes in one batch

SIMATIC BATCH highlights

- Modular architecture with flexible scalability (hardware and software)
  - Optimum scaling to plant size and individual requirements
  - Grows with the plant configuration; no expensive spare capacities
- High availability thanks to redundant batch servers
  - No loss of batch data
  - Automatic synchronization of batch data
- **PC and AS modes**
- Homogenous integration of SIMATIC BATCH into the HMI strategy and the engineering of SIMATIC PCS 7 via system interface
  - No customized interfaces
  - No double configuring for batch-specific engineering data
  - OS Controls for integration in process displays
- Recipes independent of unit
  - Considerable simplification in recipe management and validation
  - Flexible control strategy and optimum plant utilization through modification of occupation strategy and assignment of units during batch runtime
- Flat and hierarchical recipes according to ISA-88.01
  - Creation of recipes oriented according to process engineering
  - Quick, easy and fault-minimized creation
- Importing and exporting of master recipes, formulas and library objects
- Saving and archiving in XML format as well as comprehensive reporting of batch data
  - Production becomes transparent and comprehensible
  - Reliable operator prompting, safe response to process faults
  - Viewer for archived batches
- Reduction in engineering and validation overhead through:
  - Type/instance concept of SFC
  - Separation of procedure and formula
  - ROP library and configuration independent of unit
  - Multiple usage, central modification
- Validation support according to 21 CFR Part 11 through:
  - Audit Trail (change log)
  - Free and system-aided versioning
  - Libraries with recipe operations and formulas
  - User administration with access protection and electronic signature
- Interfacing an SIMATIC IT or any other MES systems
Batch client functionality

**Batch Control Center**

Batch Control Center (BatchCC) is the "command center" for monitoring and controlling batch processes with SIMATIC BATCH. The data relevant to SIMATIC BATCH are managed using a GUI. The following tasks can be implemented with BatchCC:

- Reading in and updating the process cell data of the basic automation
- Definition of user privileges for all functions, for clients, or for units of SIMATIC BATCH
- Definition of material names and codes
- Management of master recipes
- Management of libraries with recipe elements (library operations)
- Editing of formula categories and management of associated formulas (parameter sets)
- Creation of master recipe from control recipe
- Modification/deletion/insertion of objects and structure elements (loops, transitions etc.) of the recipe online
- Exporting and importing of master recipes, formulas and library objects
- Creation of batches with master recipes
- Starting of batch processing and controlling of batches
- Monitoring and diagnostics of batch processing
- Changing assignment strategy and unit assignment online during batch runtime
- Recording and archiving of recipes and batch data
- Calling of SFC visualization directly from the control recipe

**Batch Planning**

BatchCC can be used to create production orders and batches individually. A greatly increased planning functionality is offered by the Batch Planning option with which the batches can already be planned in advance for a large number of production orders.

In addition to planning, the scope of functions include the modification, cancellation, deletion and release of batches.

**Batch OS Control**

Batch OS Controls output in the process display permit operation and monitoring of batch processes.
Recipe system, archiving and logging

Recipe Editor

The Recipe Editor is used for easy, intuitive creation and modification of master recipes and library operations. It possesses a GUI, processing functions for individual and grouped objects, and a structural syntax check. The basis for recipe creation are the batch objects created from the plant configuration using the SIMATIC PCS 7 Engineering System, e.g. units and equipment phases. The Recipe Editor can be called from BatchCC, or it can be started individually.

The following tasks can be performed with the Recipe Editor:

- Creation of new master recipes and library operations
- Modification of existing master recipes and library operations (changes to structures or parameters)
- Querying of statuses of the recipe objects and of process values in transition conditions
- Assignment of route control locations to the transport phases as transfer parameters (source, target, via), in order to direct products of one batch into other units (local or external plants)
- Configuring arithmetic expressions for calculating setpoints for transitions and recipe parameters from recipe variables and constants
- Documentation of master recipes and library operations
- Validation under inclusion of user-specific plausibility checks
- Selection of unit candidates through limitation of equipment properties
- Releasing master recipes and library operations for test or production

Recipe elements for handling of exceptions

Monitoring is possible during runtime by marking freely selectable recipe sections. It is possible to automatically react to evaluated events or faults using a command step or jump function.

Batch reports

Batch reports comprise all data required for the reproduction of batch process, for proof of the quality, and for compliance with statutory directives, including

- Identification data
- Control recipe data
- Effective production data
- Time sequence of steps
- Status messages, fault messages and alarms
- Operator interventions
- Process values

Recipe reports

The recipe reports contain the production data, e.g.

- Recipe header data
- Recipe topology
- Input material, output material and parameter lists
- Procedure rules

Viewer for archived batches

The batch data which is only accessible to authorized persons or systems can be saved in XML format – locally, on a network drive, or on a central archive server (CAS). It is insignificant whether the connected batches originate from a single SIMATIC BATCH plant or from several plants. The batches archived in this manner can be displayed again as a control recipe in the Batch Control Center using a Viewer.
Hierarchical and recipes not specific to the unit

Flat recipes

Flat recipes are suitable for simple applications with only a few units. With these recipes, the units are directly assigned to the recipe functions within the recipe procedure.

Hierarchical recipes according to ISA-88.01

SIMATIC BATCH and SIMATIC PCS 7 form a functional unit that fully covers the models described in the ISA-88.01 standard. The hierarchical recipe structure is mapped on the plant model as follows:

- Recipe procedure for controlling the process or production in a process cell
- Recipe unit procedure for controlling a process step in a unit
- Recipe operation/recipe phase to implement the process engineering task/function in an equipment module facility

Non-specificity and assignment of units

Creation of recipes that are not bound to a specific unit minimizes the engineering overhead and provides significant advantages for validation. During creation of the recipe, the recipe unit procedures are only assigned unit classes. The final assignment of the units is only carried out during runtime. In the cases of batches which run for a longer period and where the units are not to be already determined and occupied at the start of a batch, the assignment is only carried out at the time of use. Conflicts in the unit allocation are detected by the system, and displayed.

The following occupation strategies for unit assignments permit optimum orientation according to the specific plant situation:

- "Manual selection of unit" when the units are occupied
- "Preferred unit" for preselection at time of recipe creation
- Determination of "Unit unused for longest time" to achieve uniform utilization
- Assignment of unit to be used by means of "Process parameters" from external module (e.g. scheduler)

The occupation strategy can also be modified during the batch runtime, just like the unit assignment.
Rationalization of recipe creation and supporting of validation

Separation of procedure and formula

The flexibility achieved by recipes which are independent of specific units can be increased even further if the procedure and parameter sets (formulas) are separated from one another. Various master recipes can be created by linking several formulas using a recipe procedure. This enables central modification of procedures. The formula structure is determined by the formula category defined by the user.

Validation according to 21 CFR Part 11

SIMATIC BATCH particularly supports validation according to 21 CFR Part 11 through:

- Consistent standardization, e.g. with
  - Type/instance concept of SFC
  - Recipe creation independent of a specific unit
  - Separation of procedure and formula
  - Library recipe operations
- Audit Trail (change log):
  - Recording of changes in recipes and recipe operations (saved with modified object)
  - Recording of changes during production (in the batch report), including the operations of the individual control level belonging to the corresponding batch
- Free and system-aided versioning of recipes, formulas, and library elements
- Central user administration with access control through SIMATIC Logon
- Electronic signature for release of master recipes, formulas and library objects based on SIMATIC Logon

Furthermore, Siemens as a manufacturer of process control systems has specially trained personnel as well as many years of experience in quality management and plant validation.

Application Programming Interface (API)

The SIMATIC BATCH API Application Programming Interface is an open interface for customer-specific extensions. To program special industry-specific or project-specific applications it offers the user access to data and the functions of SIMATIC BATCH.

For additional information, see:
www.siemens.com/simatic-batch
SIMATIC Route Control (RC) expands the SIMATIC PCS 7 process control system with a sector-independent tool for the configuration, control, monitoring and diagnostics of material transport in pipeline networks or on conveyor belts.

With SIMATIC Route Control, users of SIMATIC PCS 7 are capable of automating not only their production processes and associated warehouses but also the material transport linking both areas.

SIMATIC Route Control is suitable for small plants with simple, static transport routes or also for plants in the medium and top performance ranges possessing comprehensive, complex routes or pipeline networks.

SIMATIC Route Control is particularly predestined for the following requirements:

- Frequent conversions and extensions of the transport network including actuators and sensors
- Transport routes with high flexibility, characterized by:
  - Regularly changing materials
  - Dynamic selection of the origin and destination of the material transport (including reversal of direction on bidirectional transport routes)
- Numerous simultaneous material transports
- Plant projects in combination with SIMATIC BATCH

This requirement profile particularly applies to plants with numerous branched pipelines or comprehensive tank farms typical for the chemical, petrochemical or food and beverage industries.

When transporting solid materials on conveyor belts, the sequence for switching actuators on and off can be cascaded using WAIT elements.

For additional information, see: www.siemens.com/simatic-pcs7/routecontrol
SIMATIC Route Control engineering

SIMATIC PCS 7 supports a Route Control server or pair of Route Control servers in the multiuser system which is limited to 12 servers/pairs of servers. In the case of multiple station systems with small quantity frameworks it is also possible to operate the Route Control Server, Batch Server and OS Server on shared basic hardware. However, availability will be higher and performance better if the subsystems are installed on separate servers or redundant pairs of servers.

A synonym for the Route Control client is the Route Control Center (RCC). It can be installed on an OS client, a batch client or separate client hardware.

SIMATIC Route Control can work together with the following controllers of the SIMATIC PCS 7 Process Control System:

<table>
<thead>
<tr>
<th>SIMATIC PCS 7 controller</th>
<th>Max. number of simultaneous material transports</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 416-3</td>
<td>up to 30</td>
</tr>
<tr>
<td>AS 417-4 and AS 417H</td>
<td>up to 300</td>
</tr>
</tbody>
</table>

In the mimic diagram of the SIMATIC PCS 7 operator system, each route block is represented by an RC block symbol and an RC faceplate. The selection of locations (synonyms: nodes, plant points) is facilitated by drop-down list boxes. Locations of partial routes and routes are parameters for requesting a material transport (source, destination, intermediate points/via) that mark the start and end of each partial route, and thus also mark the source and destination of a material transport.

For access control and for managing the graded user rights for engineering, operating and maintenance personnel, SIMATIC Route Control uses the SIMATIC Logon integrated in the process control system.

**Route Control Engineering**

The Route Control project engineering supplements the basic SIMATIC PCS 7 plant configuration with blocks from the PCS 7 standard library. Even existing SIMATIC PCS 7 plants are therefore easy to expand with SIMATIC Route Control.

Technological elements of relevance to control of material transport (RC elements) are adapted in the CFC editor using uniform interface blocks from the Route Control library.

The RC elements include:

- Control elements (actuators)
- Sensor elements (sensors)
- Parameter elements (setpoints)
- Connection elements (material information related to partial route)

Configuration with the Route Control engineering tool

Locations of partial or complete routes are configured in the SIMATIC Manager as "Equipment properties of units" and transferred to the RC project together with the other RC-relevant basic data of the SIMATIC PCS 7 project.

**Route Control library**

The Route Control library contains blocks for RC and transport route configuration and interface blocks for RC elements. It is provided in the catalog of the CFC editor.

**Route Control wizard**

The Route Control wizard constitutes the interface between the SIMATIC PCS 7 basic configuration supplemented with RC interface blocks and the actual RC configuration in the RC engineering tool. The wizard, which can be called up from the SIMATIC Manager menu, accepts the RC-specific configuration data of the SIMATIC PCS 7 project into the Route Control engineering. In doing so, it carries out a plausibility check, defines the AS-OS and AS-AS communication connections (NetPro and CFC), and configures the RC server signals.
Route Control Engineering tool

Once the RC-relevant basic data of a PCS 7 project have been adopted in an RC project, the next step is to configure the RC-specific objects with the Route Control Engineering tool:

- Partial routes: through division of the transport paths into partial routes, it is possible to increase the flexibility and reduce the configuring overhead by means of repeated application. Relevant partial route parameters: “bidirectional” and “priority” (lowest total of partial route priorities is decisive when searching for the overall route)
- Interconnections: through installation in a partial route, the RC elements acquire additional properties depending on their type (e.g. “close valve” in base position). These properties can be edited in configuration windows.
- Mode tables: Partial routes can be assigned technologically and product-specifically to mode tables, e.g. “cleaning” or “product transport”, with which the resulting quantity in the route search is restricted to the type of material transport.
- Function steps/sequence functions: Mode tables contain as many as 32 configurable technological sequence functions that determine the sequence of material transport by means of the RC elements interconnected in the partial routes, e.g. base position of the control elements, open transport valves, open origin valve, switch on pump.

Configuration of the partial routes and assignment of the RC elements to the partial routes are performed in a matrix of the Route Control engineering tool. With the aid of generic elements, objects or blocks generated on a user-specific basis can be integrated into the RC project and handled like RC elements.

Special configuration functions make it easier to perform repetitive routine work and extend the range of options for controlling material transport, e.g.:

- Exporting configuration data in the form of CSV files to Microsoft Excel, copying and editing the data there, and then re-importing the files into Route Control
- Controlling the joint use of partial routes by configurable function IDs
- Checking material compatibilities and interlocking partial routes in case of incompatible material sequences based on the material ID saved in the connection element of the partial route
- Injection of setpoints coming from the process at runtime into the route block (e.g. weighed quantity)

Route Control Center (RCC)

The RCC can be called from the RC faceplate of the route block or from the keyset on the operator station. It displays all route data and error information relevant to material transport in several coordinated views. Key functional features are:

- Overview of all RC elements and request details
- Selection of manual/automatic mode
- Operation of the selected material transport in manual mode:
  - Request, start, stop, continue and terminate material transport
  - Set/modify requirement parameters (locations, origin, destination, intermediate points)
  - Set/modify general properties (mode table, function ID, material ID and “ignore error”)
  - Enable/disable sequence functions
- Diagnostics of material transport request errors caused by locked RC elements, locked partial routes, inconsistent actuations or prohibited sequential material
- Diagnostics of currently running material transports:
  - Transport route status display shown in color and text in the route view of the RCC
  - Detailed analysis of feedbacks from RC elements
- Server functions: select RC server, display RC server status, update view
- Display of operator who has logged on
- Definition of route parameters (source, destination, material, function ID etc.), and saving and loading these settings with names
- Switchover between “AS in maintenance” and “AS in operation”
Route Control Server

After the transport network has been configured and the variants of a material transport tested, the Route Control project engineering data are transferred to the Route Control Server where they can then be activated at a suitable time. The new data are then considered when searching for a route.

The Route Control Server (RC Server) supplies the Route Control Clients (Route Control Centers) with the necessary data and transfers their operations to the automation systems.

If a material transport is waiting, a route is requested either via the controller or by the operator at the Route Control Center (RCC). Apart from specifying the source, destination and up to 10 optional locations, this also includes creating a start signal on the route control block of the automation system. The RC Server then starts the route search and, if possible, combines the statically defined partial routes into one complete transport route. From there on, Route Control takes over the control and monitoring of all RC elements involved in the transport route. The process cell control only has to switch the individual technological functions. When errors occur, the operator receives detailed diagnostics information about the cause, e.g. why the search for a transport route failed.

For maintenance purposes, an automation system can be specifically set to "in maintenance" (out of service). The material transports operating via this automation system are then completed, but no more new ones are permitted.

### SIMATIC Route Control highlights

- Flexible, modular architecture with scalable hardware and software components for single-user and multiple station systems
  - Optimum scaling to plant size and individual requirements
  - Grows with the plant configuration; no expensive spare capacities
- High availability thanks to redundant Route Control Servers
- Homogenous integration into the HMI strategy and the engineering of SIMATIC PCS 7
  - No customized interfaces
  - No double configuring
  - Subsequent integration into existing projects
- Can be combined with SIMATIC BATCH
- Plant transparency
  - Identical mapping of route network of the plant through partial routes
  - Simple assignment of RC elements to the partial routes using plant plans
- Fast response to plant modifications (e.g. additional valves) during configuration, commissioning or runtime
- Exclusive assignment of RC elements and partial routes involved in material transport
- Recording of route reports with filter functions, screen output and printer output
- Reduction in configuration overhead and commissioning times
  - Division into partial routes and their configuration through repeated application
  - Export of configuration data to Microsoft Excel, re-import of edited data from Excel
  - Reduction in complex, repeated tasks through RC wizard
  - Encapsulation of functionality from viewpoint of user program, control as entity
- Material transport using common partial routes (several origins or destinations with bumpless switchover facility)
- Consideration of material compatibilities to avoid undesired mixing or material sequences
- Offline testing for completeness during configuration, as well as for inconsistencies and undesired combinations
- Detailed diagnostics of material transport requirement faults and current material transport
- Static routes: Saved partial routes of a transportation process can be covered again following a renewed route request, e.g. for cleaning.
- Implementation of a sequence for switching on and off using cascaded control of actuators with WAIT elements, e.g. for conveyor belts

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The process industry frequently features complex production sequences where materials and mixtures which are explosive or dangerous to health are produced or processed. A fault or failure could have disastrous consequences.

Therefore the objective of Siemens safety technology is to minimize potential hazards for personnel, plant and environment by means of technical measures, without adversely affecting the production process. A reliable Safety Instrumented System (SIS) is therefore required which is able to automatically place the plant into a safe state should critical events occur, to continue operating it safely under defined conditions, and to limit any negative effects in the event of a safety-related event.

Safety Integrated for Process Automation provides a comprehensive range of products and services for safe, fault-tolerant applications in the process industry – based on the Siemens safety-related system. It offers complete safety-related functionality – extending from safe instrumentation for signal recording and conversion, to safe and fault-tolerant control, up to the actuator (e.g. positioner, valve, or pump).

The enormous potential of Safety Integrated for Process Automation can best be exploited in conjunction with SIMATIC PCS 7. Thanks to the modularity and the flexibility of the safety-related products this combination is extremely variable. It is not just the degree of integration of safety-related systems that can be individually defined in the process control system, it is also the degree of redundancy for controllers, fieldbus and process I/O (Flexible Modular Redundancy). Thanks to the reduced spatial requirements, the scope of hardware and wiring, as well as reduced mounting, installation and engineering overhead, the complete (common) integration of the safety-relevant systems in SIMATIC PCS 7 offers the greatest cost advantages viewed over the entire life-cycle of a plant.

Both the safety technology and the safety applications implemented with it are characterized by great efficiency and comply with both national and international standards, such as:

- IEC 61508 – basic standard for specifications, as well as for the design and operation of safety-related systems
- IEC 61511 – application-specific standard for the process industry

For additional information, see: 
www.siemens.com/simatic-pcs7/process-safety
# Safety Integrated for Process Automation with SIMATIC PCS 7

<table>
<thead>
<tr>
<th><strong>Safety Integrated for Process Automation – Product spectrum for SIMATIC PCS 7</strong></th>
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<tbody>
<tr>
<td><strong>Engineering</strong></td>
</tr>
<tr>
<td><strong>Automation systems AS</strong></td>
</tr>
<tr>
<td><strong>Automation systems AS 412F/FH</strong></td>
</tr>
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<td><strong>Automation systems AS 414F/FH</strong></td>
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<td><strong>Automation systems AS 417F/FH</strong></td>
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<td><strong>PROFIBUS with PROFIsafe</strong></td>
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<tr>
<td><strong>SIMATIC ET 200</strong></td>
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<td><strong>SIMATIC ET 200</strong></td>
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<td><strong>SIMATIC ET 200</strong></td>
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<td><strong>SIMATIC ET 200</strong></td>
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<tr>
<td><strong>Process instruments/ process devices</strong></td>
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<td><strong>Process instruments/ process devices</strong></td>
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<td><strong>Applications</strong></td>
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<td><strong>Applications</strong></td>
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<td><strong>Applications</strong></td>
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<tr>
<td><strong>Applications</strong></td>
</tr>
</tbody>
</table>
Engineering tools for safety functions

For configuration and programming of the safety-related AS 412F/FH, AS 414 F/FH and AS 417 F/FH, the F-block library in S7 F Systems and the SIMATIC Safety Matrix are available.

S7 F Systems with F-block library

The S7 F Systems engineering tool allows parameter assignment of the AS 412F/FH, AS 414 F/FH, and AS 417 F/FH as well as the safety-related F-modules from the ET 200 series. It supports configuration by means of functions for:

- Comparison of safety-related F-programs
- Recognition of changes in the F-program using the checksum
- Separation of safety-related and standard functions.

Access to the F-functions can be password-protected. The F-block library integrated in S7 F Systems contains predefined function blocks for generation of safety-related applications with the CFC or the Safety Matrix based on it. The certified F-blocks are extremely rugged and intercept programming errors such as division by zero or out-of-range values. Diverse programming tasks for detecting and reacting to errors can thus be omitted.

SIMATIC Safety Matrix

The SIMATIC Safety Matrix which can be used in addition to the CFC is an innovative safety lifecycle tool from Siemens, that can be used not only for the user-friendly configuration of safety applications, but also for their operation and service. The tool, which is based on the proven principle of a cause & effect matrix, is ideally suited to processes where defined statuses require specific safety reactions.

The Safety Matrix not only means that programming of the safety logic is significantly simpler and more convenient, but also much faster than in the conventional manner.

During the risk analysis of a plant, the configuration engineer can assign exactly defined reactions (effects) to events (causes) which may occur during a process. The possible process events (inputs) are initially entered in the horizontal lines of a matrix table comparable to a spreadsheet program, and then their type and quantity, logic operations, any delays and interlocks as well as any tolerable faults are configured. The reactions (outputs) to a particular event are then defined in the vertical columns.

The events and reactions are linked by simply clicking the cell at the intersection point of line and column. Using this procedure, the Safety Matrix automatically generates complex, safety-related CFC programs. Special programming knowledge is not required, and the configuration engineer can concentrate fully on the safety requirements of his plant.
Safety Integrated for Process Automation

In general, two design versions are differentiated across all architectural levels of a SIMATIC PCS 7 system based on Safety Integrated for Process Automation:

- Single-channel, non-redundant design
- Redundant, fault-tolerant design

These two design versions are highly variable and offer a wide scope for design with regard to different customer requirements. At the individual architectural levels (controller, fieldbus, distributed I/O), the configuration alternatives shown in the diagram are available, depending on the process I/O used.

Thus standard (basic process control) and safety related functions can be combined flexibly, not only in the area of the distributed I/O. Even at the controller level, they can combined in one system or separate. In addition, there are numerous possibilities arising from the use of flexible modular redundancy.

Safety-related automation systems

The safety-related SIMATIC PCS 7 automation systems are available in two design versions:

- Single Station AS 412F/AS 414F/AS 417F with only one CPU, safety-related
- Redundancy station AS 412FH/AS 414FH/AS 417FH with two redundant CPUs, safety-related and fault-tolerant

All these systems have multitasking capability, i.e. several programs can be executed simultaneously in one CPU, both basic process control applications and safety-related applications. Working together with the safety-related signal modules of the ET 200 distributed I/O systems or directly via fail-safe transmitters connected via the fieldbus, they detect faults both in the process and their own internal faults and automatically set the process cell to a safe state in the event of a fault. Safety programs executed on different automation systems of a plant are able to carry out safety-related communication with one another over the Industrial Ethernet plant bus.
Flexible Modular Redundancy (FMR)

Depending on the automation task and the associated safety requirements, the degree of redundancy may be defined separately for the controller, fieldbus and distributed I/O level, and coordinated with the field instrumentation. In this way, individual fault-tolerant architectures which are precisely tailored to the individual tasks can be implemented, and tolerate several faults occurring at once. As FMR provides redundancy only where it is actually required, comparatively more attractive and cost-effective applications are possible than with conventional redundancy architectures.

As shown in the example of a process cell with ET 200M distributed I/O, the total of the tasks can produce a mix of different degrees of redundancy within one architecture level (1oo1, 1oo2, 2oo3).
The standard PROFIBUS is used together with the PROFIsafe profile for safety-related communication between the CPU of the automation system and the safety-related process I/O. This solution supports operation of standard and safety-related components on the same bus. A separate and expensive safety bus is unnecessary.

### F-signal modules for ET 200M

<table>
<thead>
<tr>
<th>Number of inputs/outputs up to</th>
<th>24 (1-channel for SIL 2 sensors)</th>
<th>12 (2-channel for SIL 3 sensors)</th>
<th>Electrically isolated in groups of 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. achievable safety class according to IEC 61508/EN 954-1</td>
<td>1-channel/1oo1: SIL 2</td>
<td>2-channel/2oo2: SIL 3 (SIL 3 without isolating module)</td>
<td></td>
</tr>
<tr>
<td>Input/output voltage</td>
<td>24 V DC</td>
<td>NAMUR</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Input/output current</td>
<td>--</td>
<td>--</td>
<td>2 A per channel for &quot;1&quot; signal</td>
</tr>
<tr>
<td>Short-circuit proof encoder supply</td>
<td>4 for every 6 channels, isolated in groups of 2</td>
<td>8 for each channel, individually isolated</td>
<td>--</td>
</tr>
<tr>
<td>Redundancy mode</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
</tr>
<tr>
<td>Special features</td>
<td>Support of 20 ms time stamping (SOE)</td>
<td>Detection of signals from the Ex area</td>
<td>&quot;Keep last valid value&quot; parameter, channel-selective passivation</td>
</tr>
<tr>
<td>Module/channel diagnostics</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Dimensions</td>
<td>80 x 125 x 120</td>
<td>80 x 125 x 120</td>
<td>40 x 125 x 120</td>
</tr>
</tbody>
</table>

### Safety-related F-modules for ET 200ISP

<table>
<thead>
<tr>
<th>Number of inputs/outputs up to</th>
<th>8 (1-channel)</th>
<th>4 (2-channel)</th>
<th>4 (source/source output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. achievable safety class according to IEC 61508/EN 954-1</td>
<td>SIL 3 (1-channel/1oo1 and 2-channel/1oo2)</td>
<td>SIL 3 with 4 outputs</td>
<td>SIL 3 (1-channel/1oo1 with 1 module and 2-channel/1oo2 with 2 modules)</td>
</tr>
<tr>
<td>Input/output voltage</td>
<td>NAMUR</td>
<td>17.4 V DC</td>
<td>--</td>
</tr>
<tr>
<td>Input/output current</td>
<td>--</td>
<td>Max. 40 mA</td>
<td>4 ... 20 mA or 0 ... 20 mA</td>
</tr>
<tr>
<td>Short-circuit proof encoder supply</td>
<td>8 for each channel</td>
<td>--</td>
<td>4 for each channel</td>
</tr>
<tr>
<td>Special features</td>
<td>Support of time stamping, channel-selective passivation, internal diagnostics buffer, parameterizable diagnostics interrupt</td>
<td>Increased power through parallel connection of two outputs, short-circuit, overload and open-circuit monitoring, channel-selective passivation, internal diagnostics buffer, parameterizable diagnostics and diagnostics interrupt</td>
<td>HART communication in measuring range 4 ... 20 mA, internal diagnostics buffer, parameterizable diagnostics and diagnostics interrupt</td>
</tr>
<tr>
<td>Firmware update using HW Config</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Module/channel diagnostics</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Safety-related F-modules for ET 200S

|Number of I/Os | 4 (2-channel for SIL 3 sensors/1oo2), 8 (1-channel for SIL 2 sensors/1oo1) | 4 for 24 V DC | 4 A, current sinking/sourcing, up to SIL 3 |
|Input/output voltage | 24 V DC | 24 V DC | 24 V DC |
|Module and channel diagnostics | ● | ● | ● |
The PROFIsafe profile is implemented as an additional software layer within the devices/systems without modifying the communication mechanisms of the standard PROFIBUS. PROFIsafe expands the telegrams by additional information with which the PROFIsafe communication peers can recognize and compensate transfer errors such as delays, incorrect sequences, repetitions, losses, faulty addressing or data falsification.

Safety-related F-modules/submodules

The safety functions of the F/FH automation systems are perfectly matched to the safety-related I/O modules of ET 200M, ET 200iSP, ET 200S and ET 200pro.

Safety-related F-motor starter for ET 200S

Safety-related motor starters up to 7.5 kW, can be expanded by brake control module:
• F-DS1e-x direct-on-line starter
• F-RS1e-x reversing starter

Initiated by a switch-off signal, safety-related ET 200S motor starters can be selectively switched off by the series-connected PM-D F PROFIsafe power module. In addition to a circuit-breaker/contactor combination, the safety-related motor starters have a safe electronic evaluation circuit for fault detection.

If the contactor to be switched in the case of an emergency stop fails, the evaluation electronics detects a fault and deactivates the circuit-breaker in the motor starter in a safety-related manner.

PROFIBUS PA devices for safety shutdowns

The SITRANS P DSIII digital pressure transmitter which can be used on the PROFIBUS PA fieldbus is suitable for SIL 2 safety shutdowns conforming to IEC 61508/ IEC 61511-1. For this reason, Siemens has extended its standard instrument for measuring pressure, absolute pressure and differential pressure to include a PROFIsafe driver.

In a safety application, the pressure transmitter can be interconnected via PROFIBUS PA to an AS 412F/FH, AS 414F/FH or AS 417 F/FH. The digital input of the PROFIBUS PA SIPART PS2 electropneumatic positioner can be used for the safe shutdown.

With a redundant, multi-channel design, measuring circuits can also be implemented up to safety integrity level SIL 3.

Process safety highlights

■ Safety Integrated for Process Automation – the comprehensive product and service offering for safe, fault tolerant, and high-availability applications in the process industry
  – Easy implementation, operation, and maintenance of safety applications
  – Innovation safe thanks to high-level adaptability to changed conditions
  – Reliable elimination of dangers and risks

■ Homogenous integration of safety technology in the SIMATIC PCS 7 Process Control System
  – Processing of basic process control functions and safety functions in one controller: Safety level SIL 3, AK 6 with only one CPU is possible
  – Standard and safety-related communication between controller and I/O via a common fieldbus PROFIBUS with PROFIsafe – no separate safety bus
  – Mixed operation of standard and safety-related F-modules in ET 200 stations
  – Uniform data management for basic process control and safety-related automation, including process visualization and diagnostics – no complex data management

■ Integration of safety-related applications in the convenient process visualization on the SIMATIC PCS 7 operator station

■ Configuration of safety functions is part of the uniform system configuration with the PCS 7 Engineering System
  – S7 F systems, CFC, and SIMATIC Safety Matrix are anchored in the engineering toolset
  – Configuration of basic process control functions and safety functions with one engineering tool, the CFC
  – Safety Matrix for creation of safety functions without special programming skills – even faster, easier, and with more convenience than is possible with CFC

■ Automatic consideration of safety-related fault messages in process visualization, with identical time stamp

■ Uniform diagnostics and maintenance from sensor/actuator via automation system up to the operator system

■ Integration of safety-related technology in diagnostics and maintenance with the SIMATIC PCS 7 Maintenance Station

■ Minimization of total lifecycle costs
  – Reduction of costs for hardware, mounting, wiring, installation, engineering, and commissioning as the level of integration increases
  – Low acquaintance and training requirements as result of uniform system/tool landscape
  – Cost-effective stocking of spare parts through reduction of types and parts
With complex processes, control concepts based on PID controllers often reach their limits quickly. Advanced Process Control (APC) functions which enable a mathematical description even of complicated relationships between process parameters are integrated in the SIMATIC PCS 7 process control system and provide significantly more options. The application of these advanced control functions permits the following:

- Drastic reduction of undesirable variations in critical process variables
- Noticeable reduction in use of raw materials and consumption of energy
- Increase in throughput and product quality
- Reduction in demands placed on operating personnel

In addition to numerous basic control functions, e.g. PID control, cascade control, split range control and ratio control, the I&C libraries of SIMATIC PCS 7 also provide function blocks and templates for advanced control functions at no extra cost:

- Gain scheduling (GainSched)
- Override control
- Lead-lag/feed-forward control
- PID tuning
- Control performance monitoring (ConPerMon)
- Smith predictor
- Model-based predictive control (ModPreCon)

Using these standard solutions, complex APC applications can be implemented simply and cost-effectively even for small and medium-sized plants. A standardized APC process tag type selected from the library in accordance with the control requirement can be modified in a simple manner to allow problem-oriented determination of optimized solutions for special tasks.

Additional advanced control functions cannot only be linked over interfaces, as is normally the case, but they can also be integrated seamlessly into the process control system as add-on products, e.g.:

- Fuzzy Control++
- Soft sensors (Presto)
- Model-predictive multi-variable controller (INCA)
- Adaptive controller (ADCO)

**Gain scheduling**

The GainSched block enables infinite adjustment of the controller settings in non-linear processes depending on the operating point.

Similar to the polygon block, it can derive output variables at three operating points from a continuously measurable input variable (measured variable X) which describes the process status. These output variables serve as control parameters for a connected control block. Bumpless transitions between the operating points are achieved by linear interpolation. GainSched can therefore infinitely change the parameters of the combined PID controller depending on the response of the measured variable X.

- Suitable for non-linear processes
- Three complete parameter sets for three operating points
- Application examples:
  - Control of pH value (neutralization) with non-linear titration trend
  - Temperature control of boilers
  - Batch processes with chemical reactions (non-linear reaction kinetics)
Override control

With override control, the outputs of two or more controllers are connected to a common final controlling element. The decision concerning which controller actually has access to the final controlling element is made depending on the evaluation of the current process state.

- Two or more controllers share a final controlling element
- The decision concerning which controller is active can depend on:
  - Measurable output variables, e.g. one of the controlled variables
  - Manipulated variables of the controllers
- Application examples:
  - Primary controlled variable: flow
    Secondary controlled variable: pressure limiting (for safety reasons)
  - Primary controlled variable: steam pressure
    Secondary controlled variable: level

Lead-lag/feed-forward control

Feed-forward control can compensate a strong, measurable interference in advance so that the control is limited to model uncertainties and non-measurable interferences. The transfer function $g(s)$ for the effect of the measurable disturbance variable on the process can be determined with the controller in manual mode. It is then possible to derive the transfer function $c(s)$ for the control element for compensation of the disturbance variable.

- Compensation of strong, measurable interferences
- Interferences are eliminated before they have a negative effect
- Application examples:
  - Temperature control on an industrial furnace (disturbance variable: flow rate)
  - Concentration control in a stirring vat reactor (disturbance variable: inlet concentration)

PID tuning

Using experimental trial and error, a model of the process is initially generated using the PID Tuner integrated in the engineering system. Based on this, the most favorable controller settings can be determined by means of value optimization. It is possible to select either an optimum response to disturbance variable changes or an optimum response to setpoint changes.

- Optimization of PID control loops
- Can be used for standard PID controllers and blocks from user-specific libraries
- Simulation of closed control loops
- Application example: Optimization of PID controller settings in any applications
Control performance monitoring

The ConPerMon block is interconnected with setpoint, actual value, and manipulated variable of the control block (e.g. PID controller) and determines its control performance. Depending on the deviation from the comparison value, e.g. the control performance during commissioning, it can trigger a warning or an alarm. The faceplates of all control performance monitoring actions of a process cell or a unit can be combined to give an overview in OS screens. This enables problems to be detected early on, analyzed, and specifically corrected.

- Online monitoring of the control performance
- Identification of control loops in a plant according to the criteria:
  - Maximum urgency for optimization
  - Imminent fault
- Configurable alarm limits for standard deviation and overshoots for preventive maintenance and fast fault locating
- Graphic evaluation
- Application example: large plants with many control loops, e.g. refineries

Smith predictor

As an alternative to a model-based predictive controller, the Smith predictor can significantly improve the control performance of processes with long and relatively constant dead times. By eliminating the dead time component using a process model running parallel to the actual process, the controller can be designed for a process free of dead time, and set more effectively.

- For processes with long, known dead times which are usually constant; "internal model control" concept:
  - Process model runs parallel to the actual process
  - Feedback of virtual controlled variable free of dead time from the process model to the controller
  - Feedback of deviation between the measured actual value of the controlled variable and the virtual value with dead time at the model output
- Draft PI(D) controller:
  - Based on component of process model that is free of dead time
  - Allows significantly more precise controller setting
- Application examples:
  - Polymerization
  - Control of analyzed values (as result of dead time associated with analyses)
  - Temperature control through supply of water or heating steam as well as via external heat exchangers
Model-based predictive control (MPC)

The model-based predictive multi-variable controller ModPreCon separately analyses the behavior of up to four interdependent variables for complex processes over a longer period. The parameter matrix calculated from the results is then used by the ModPreCon for optimum control of these variables, and thus eliminates the disadvantageous interactions which occur with separate control of the interdependent variables.

- Most powerful APC function
- Scalable MPC applications:
  - Internal ("lean") MPC: up to 4 x 4
  - External "full-blown" MPC: more than 4 x 4
- "Lean" und "easy to use"; requires neither communication monitoring nor backup strategies
- Application examples:
  - 2 x 2 applications: two-material distillation, paper manufacture, two-tank system
  - 3 x 2 applications: steel bleaching process
  - 3 x 3 applications: loop-type bubble column, vaporizer, distillation column
  - 3 x 4 applications: cement mill
  - 4 x 4 applications: three-material distillation, LPG vaporizer, oven with 4 burners

For additional information, see:
www.siemens.com/simatic-pcs7/apc
Plants often extend over huge areas, especially in the water & wastewater and oil & gas industries. In such cases it is necessary to integrate outstations for monitoring and controlling highly remote units (usually with a small or medium degree of automation) into the control system of the complete plant. This is carried out by means of telecontrol protocols over a WAN (Wide Area Network).

Conventional solutions use process control systems for the more complex areas of the plant, and simpler Remote Terminal Units (RTU) for the outstations, and then combine these separately configured units in a host network control system. However, it is far more effective if the telecontrol center for the RTUs is directly integrated into the process control system using SIMATIC PCS 7 TeleControl. A network control system as a superimposed integration level is then superfluous. Uniform process control and totally integrated engineering for central and widely distributed units, together with simple and convenient data management, result in high efficiency with regard to operation and engineering.

Integration into the SIMATIC PCS 7 process control is possible in the form of an operator station in single station or server design (also redundant as option). An additional automation system for processing and routing TeleControl-specific data is unnecessary.

The PCS 7 TeleControl Operator Station is preferably used just for telecontrol functions (dedicated), but can also access central SIMATIC PCS 7 plant areas via an additional second channel in the case of small quantity frameworks (dual-channel operation).

There are no differences between central and remote automation with regard to operating philosophy and alarm response. Data from SIMATIC PCS 7 automation systems can be displayed together with data from the outstations of a telecontrol system on the OS clients in one process display. The data is obtained either from a server with dual-channel functionality or from two separate servers.
To enable engineering of the TeleControl Operator Station (single station/server), the functions of the central Engineering Station of the SIMATIC PCS 7 process control system are expanded by DBA technology (DBA) and the block library “SIMATIC PCS 7 TeleControl”. In addition to blocks for processing and display of process data, the library also contains blocks for diagnostics and for control of communication. These blocks support SIMATIC PCS 7 compliant operator control by means of symbols and faceplates, as well as the hierarchy of SIMATIC PCS 7 fault messages. If necessary, the library can be extended by new script-based block types specific to the project by using the DBA Type Editor.

For additional information, see: www.siemens.com/simatic-pcs7/telecontrol

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### Spectrum of outstations and integration versions

<table>
<thead>
<tr>
<th>Telecontrol protocol</th>
<th>SINAUT ST 7</th>
<th>Modbus</th>
<th>DNP3</th>
<th>IEC 870-5-101</th>
<th>IEC 870-5-104</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of communication</strong></td>
<td>Serial</td>
<td>Ethernet TCP/IP</td>
<td>Serial</td>
<td>Ethernet TCP/IP</td>
<td>Serial</td>
</tr>
<tr>
<td><strong>Interface on the PCS 7 TeleControl OS</strong></td>
<td>TIM 4R-IE</td>
<td>TCP/IP WAN router or/and TIM 4R-IE</td>
<td>TCP/IP converter – serial</td>
<td>TCP/IP WAN router</td>
<td>TCP/IP converter – serial</td>
</tr>
<tr>
<td><strong>RTU interface</strong></td>
<td>ET 200S with integral CPU (corresponds to S7-314)</td>
<td>–</td>
<td>IM 151-7 CPU or IM 151-8 PN/DP CPU as well as 1 SI module Modbus</td>
<td>IM 151-8 PN/DP CPU + S7OpenModbus software + TCP PN-CPU</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>IM 300/ S7-300F</td>
<td>TIM 3V-IE</td>
<td>CP 341</td>
<td>TIM 3V-IE DNP3</td>
<td>CP 341 + SIPLUS RIC library</td>
</tr>
<tr>
<td></td>
<td>SINAUT ST7, DNP3, Modbus, IEC 870-5-101, IEC 870-5-104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TIM 4R-IE</td>
<td>CP 441</td>
<td>CP 443 + SW library</td>
<td>TIM 4R-IE DNP3</td>
<td>CP 443 + SIPLUS RIC library</td>
</tr>
<tr>
<td></td>
<td>S7-400/ S7-400F</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>S7-400H/ S7-400FH</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Third-party station</strong></td>
<td>–</td>
<td>–</td>
<td>Depends on type of station</td>
<td>Depends on type of station</td>
<td>Depends on type of station</td>
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<tr>
<td><strong>Dialup lines</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Dedicated line and radio networks</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Master-slave</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Peer-to-peer</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Mesh networks</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Time tagging in RTU</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>RTU time synchronization</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Data buffering in RTU</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>S7 routing</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>International standard</strong></td>
<td>–</td>
<td>–</td>
<td>(many versions)</td>
<td>(many versions)</td>
<td>(many versions)</td>
</tr>
</tbody>
</table>

1) Data buffering is limited to two SIMATIC S7 data blocks. Depending on the SIMATIC CPU, this corresponds to approx. 800 to 3 200 buffered frames.

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### RTU category

<table>
<thead>
<tr>
<th>RTU category</th>
<th>RTU type&lt;sup&gt;2)&lt;/sup&gt;</th>
<th>Possible telecontrol protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small with up to approx. 30 I/Os</td>
<td>controller integrated in SIMATIC ET 200S</td>
<td>Modbus, IEC 870-5-101, IEC 870-5-104</td>
</tr>
<tr>
<td>Medium with up to approx. 100 I/Os</td>
<td>SIMATIC S7-300/S7-300F controller</td>
<td>SINAUT ST7, DNP3, Modbus, IEC 870-5-101, IEC 870-5-104</td>
</tr>
<tr>
<td>Large with up to approx. 500 I/Os</td>
<td>SIMATIC S7-400/S7-400F controller</td>
<td>SINAUT ST7, DNP3, Modbus, IEC 870-5-101, IEC 870-5-104</td>
</tr>
<tr>
<td></td>
<td>SIMATIC S7-400H/S7-400FH controller</td>
<td>DNP3, IEC 870-5-101, IEC 870-5-104</td>
</tr>
</tbody>
</table>

2) Also in version “SIPLUS extreme”, e.g. for environments with temperature from -25 °C to +70 °C, condensation, or medial loading
Energy management with SIMATIC PCS 7

Resources which are becoming scarcer, increasing energy prices, an increased sensitivity for environmental matters, and tighter statutory constraints significantly emphasize the importance of efficient energy management. All aspects concerning the generation, procurement, distribution, and consumption of energy must be considered.

Companies operating in the process industry must be able to plan, monitor and record their energy consumptions, to define and implement possible energy saving measures, and to prove the efficiency through regular evaluation of indicators.

Identification and evaluation of energy data

Transparency is a basic prerequisite for improving the energy balance, i.e. the measurement and recording of consumption data and the presentation of the flows of energy and media within the company. It is only possible to define potential savings and the required efforts when the consumption of each type of energy is known.

This is supported in the context of the SIMATIC PCS 7 process control system by:

- Basic power monitoring with SIMATIC PCS 7 standard functionality:
  - Data of process-related energies measured using process instruments, such as steam, cooling media or gas
  - Data provided directly by electric components such as circuit-breakers (SETRON), frequency converters (SINAMICS), motor starters (ET 200S) etc.
  - Data of other energy consumers measured using power monitoring devices of the SENTRON PAC range

- SIMATIC powerrate for analysis and evaluation of the flows of energy with automatic reporting
  - Recording of energy and performance data from the field using additional function blocks
  - Data preparation, data visualization per faceplate, and data archiving
  - Automatic assignment of energy consumptions/costs to cost centers, units or batches
  - Monitoring of performance limits according to process/user-specific definitions

- B.Data software for optimization of operational energy management with division and transfer to the accounting system in accordance with the causer
  - Company-wide transparency thanks to gap-free energy and material balancing of power generation and consumption plants
  - Generation of key performance indicators (KPIs) for reliable statements on raising the efficiency of energy generation, distribution, and consumption systems
  - Distribution of energy costs and revenues based on causer, and transfer of such to ERP systems (e.g. SAP R/3)
  - Production-based prediction of loads and requirements to improve planning security
  - Support of cost-effective purchasing of energy
Energy management with SIMATIC PCS 7

Optimization of energy utilization

SIMATIC PCS 7 and SIMATIC powerrate can be used to optimize the energy utilization such that previously unused resources can be accessed, and consumption peaks avoided. SIMATIC powerrate with the integrated load management function permits active monitoring of performance limits. SIMATIC PCS 7 standard blocks use the current consumption to calculate a prediction for the running 15-minute average, and compare this with defined limits. Consumers can be specifically switched off or on, for example, in order to smoothen larger peaks or to observe limits agreed by contract with the energy supplier. In the case of unstable power supplies, loads can also be rapidly disconnected in order to guarantee the operation of critical plant components using the remaining infeed capacity.

Furthermore, the optimization of processes using Advanced Process Control (APC) as well as plant-level asset management with the PCS 7 Maintenance Station provide a significant contribution to energy-efficient plant operation.

Energy saving with innovative technology

The application of low-energy motors or frequency converters is a further large potential for savings, especially with energy-intensive production processes, e.g. in the chemical or pharmaceutical industry.

Energy-saving motors

Energy-efficient motors have a power loss reduced by up to 42%. Since the share of energy costs in the total costs of a motor over its complete lifecycle is approximately 98%, enormous cost savings can be achieved for new plants or when modernizing existing plants.

For additional information, see: www.siemens.com/simatic-pcs7/energy-management
Industrial security
Comprehensive protective measures for I&C plants

Progressive standardization, opening and networking of control systems has been accompanied by an enormous increase in security risks for a process control plant. The potential dangers arising from destructive programs such as computer viruses, worms or Trojans as well as from access by unauthorized personnel range from network overloads or failures, theft of passwords and data, to unauthorized access to process automation. Apart from material damage, specifically targeted sabotage can also have dangerous consequences for personnel and the environment.

SIMATIC PCS 7 security concept

With its pioneering security concept, SIMATIC PCS 7 offers comprehensive solutions for protecting a process engineering plant which are based on a staggered security architecture (defense in depth). What is special about this concept is its holistic approach. It is not restricted to use of individual security methods (e.g. encryption) or devices (e.g. firewalls). Rather its strengths are the interaction of a host of security measures in the plant network.

The SIMATIC PCS 7 security concept comprises advice and recommendations (best practices) on the following topics:

- Generation of a network architecture with staggered security (defense in depth), combined with segmenting of the plant into security cells
- Network administration, assignment of IP addresses, and division into subnetworks
- Operation of process cells in Windows domains (Active Directory)
- Administration of Windows operator privileges and SIMATIC PCS 7 operator privileges; integration of SIMATIC PCS 7 operator privileges into the Windows administration
- Reliable control of time synchronization
• Management of security patches for Microsoft products
• Use of virus scanners and firewalls
• Establishment and operation of support and remote access (VPN, IPSec)

The security aspects and the recommendations for safeguarding the automation plant are described in detail in the manual "PCS 7 & WinCC Security Concept basic document" and the further detailed documents.

System support for the security concept

On the system side, SIMATIC PCS 7 supports implementation of guidelines and recommendations of the security concept by means of:

• Compatibility with current versions of the antivirus software: Trend Micro OfficeScan, McAfee ViruScan, and Symantec Norton AntiVirus
• Use of the local Windows firewall
• Automatic setting of security-relevant parameters such as DCOM, registry and Windows firewall already during setup
• User administration and authentication using SIMATIC Logon
• Integration of Industrial Security Modules SCALANCE S602, S612, S613
• Automation firewall
• Application whitelisting

SCALANCE S industrial security modules

The SCALANCE S602, S612 and S613 industrial security modules offer scalable security functions such as port filter, NAT, DHCP server, data encryption (IPSec), and VPN in a rugged, industrial-compatible design. They can be used, for example, to safeguard the cross-cell data exchange between components of automation and process control systems.

Automation firewall

The automation firewall is based on the Microsoft Threat Management Gateway 2010 and is provided with stateful inspection packet filters, application layer firewall, VPN gateway functionality, URL filtering, Web proxy, virus scan, and intrusion prevention. Depending on the plant size, it can be used as a front and back firewall or in a three-homed configuration. It thus protects the access point to the production environment e.g. from the office or intranet networks. The automation firewall is supplied preinstalled. A user-friendly configuration wizard is provided for setup.

Application whitelisting

Application whitelisting tools guaranteed that only trustworthy applications and programs are executed on a station of the SIMATIC PCS 7 process control systems. Application whitelisting thus offers further protection against malware in addition to the existing protective mechanisms.

Industrial security services

Siemens Industry Automation not only offers products and systems but also professional services and solutions for protection of industrial plants against the manifold threats to IT security. These industrial security services are not only oriented according to individual phases but are provided for the complete lifecycle of the plant.

The "Awareness Workshop" and "Assessment" services can be used to identify spheres of activity for an holistic security program. Specific consulting concerning secure plant configurations and concepts support customers in the individual planning of their I&C plant. Services for implementing and acceptance test support the protective measures. These also include the service for setting up and updating the automation firewall as well as for implementation of the application whitelisting concept.
Interfacing to IT systems
Evaluating and managing process data with OpenPCS 7

Systems for production planning, process data evaluation and management (OPC clients) that are at a higher level than the process control system can access SIMATIC PCS 7 process data by means of the OpenPCS 7 server.

The OpenPCS 7 server collects data for the OPC clients. Depending on the system configuration, these data may be distributed across different SIMATIC PCS 7 stations (OS server, central archive server CAS). It covers the distribution of data with respect to
- Period (OS1 / OS2 / ... / CAS)
- Location (OS1 / OS2 / ...)
- Redundancy (OS1 master / OS1 standby...)

The OpenPCS 7 interface is based on the OPC specifications (Openness, Productivity, Collaboration) that mainly make use of Microsoft’s DCOM technology (Distributed Component Object Model) for communication between the applications. It supports the following standardized access options:

OPC DA (data access server)
For read and write access to process values according to OPC specification OPC DA V1.00, V2.05a, V3.00.

As an OPC DA server, the OpenPCS 7 server provides other applications with current data from the OS data management. The OPC client can log itself on to ongoing changes or also write values.

OPC HDA (historical data access server)
For read-only access to archived process values according to OPC Specification OPC HDA V1.20

As an OPC HDA server, the OpenPCS 7 server provides other applications with historical data from the OS archive system. The OPC client, e.g. a reporting tool, can specifically request the required data by defining the start and end of a time interval. Numerous functions, e.g. variance, mean value or integral, already permit preprocessing by the HDA server and thus contribute toward reduction of the communications load.

OPC A&E (alarm & events server)
For read-only access to messages, alarms and events according to OPC Specification OPC A&E V1.10

As an OPC A&E server, the OpenPCS 7 server passes on OS messages together with all accompanying process values to the subscribers at the production and corporate management levels. They can of course also be acknowledged there. Filter mechanisms and subscriptions ensure that only selected, modified data are transmitted.

OPC "H" A&E (Historical Alarm & Events Server)
For read access to archived alarms and messages

Thanks to a Siemens extension of the OPC standard interface, the OpenPCS 7 server is able to transmit historic alarms and messages from the archive to subscribers in the production control and corporate control level.

OLE-DB
Simple, standardized direct access to the archive data in the Microsoft SQL server database of the operator system is possible with the OLE-DB. Through this, all OS archive data are accessible with the accompanying process values, message texts and user texts.
Integration and synchronization of all business processes with SIMATIC IT

Manufacturing Execution Systems (MES), such as SIMATIC IT from Siemens, enable effective integration of product processes and production planning systems. They offer support in each phase of production for coordinating all manufacturing-relevant resources and applications.

SIMATIC IT can be used to model the complete production know-how, to precisely define the operating processes, and to record data from the ERP and production levels in real-time. It is then possible to control processes more effectively, to minimize downtimes, production waste and rework, to optimize stock keeping, and to react rapidly and flexibly to different customer requirements.

Modeling of the business and production processes is transparent, understandable and independent of the control systems. Even complex business and production processes can easily be modeled. Subsequent changes can be incorporated efficiently and without difficulty.

Modeling of the business and production processes with SIMATIC IT facilitates effective protection of the know-how used, in addition to seamless documentation.

The plant and production models can be stored in libraries and then used again in other projects. This means they can be used at any location within the business for standardizing the processes. “Best practices” are therefore available throughout the company. This prevents implementation errors, provides security of investment, reduces introductory and maintenance costs and results in a significant shortening of the project duration.

SIMATIC IT’s product architecture and functionality are in conformance with ISA-95, the internationally recognized standard for Manufacturing Execution Systems and Manufacturing Operation Management.

SIMATIC IT bundles

SIMATIC IT consists of various components designed for dedicated tasks that are coordinated by the SIMATIC IT Production Modeler. The basic functions are implemented using SIMATIC IT components in the form of the following product bundles:

SIMATIC IT Plant Intelligence
Defines key performance indicators conforming to the plant model for realistic assessment of the plant.

SIMATIC IT Genealogy Management
For materials management in the entire company, taking into account the legal terms and conditions.

SIMATIC IT Order Management
For job management from planning to execution, including scheduling, dispatch, monitoring, and recording.

The product portfolio is completed with further bundles, such as SIMATIC IT Basic Tracking & Tracing, SIMATIC IT Basic Production Management or SIMATIC IT Production Suite.

Each bundle can be additionally extended by options such as:

- SIMATIC IT PDS-I (Predictive Detailed Scheduler - Interactive)
- SIMATIC IT Report Manager
- SIMATIC IT OEE-DM Option (Overall Equipment Efficiency / Down Time Management)
- SIMATIC IT SPC (Statistical Process Control)

The MES product range is completed by SIMATIC IT with components for special ISA-95 functions:

- SIMATIC IT Unilab
- SIMATIC IT Interspec
- SIMATIC IT XHQ
Compact systems

SIMATIC PCS 7 BOX - complete control system in compact design

SIMATIC PCS 7 BOX RTX compact system with portrait assembly kit

SIMATIC PCS 7 BOX enhances the SIMATIC PCS 7 range with low-price, rugged and space-saving industrial PC systems with versatile application options, e.g. as:

- Client in an operator system or in SIMATIC BATCH
- Compact process control system with system functionality for engineering (ES), automation (AS), HMI (OS)
- Runtime system with system functionality as above, but without engineering

In this context, the SIMATIC PCS 7 BOX compact systems are reduced to the last two applications listed above.

With the SIMATIC PCS 7 Engineering and Runtime software limited to 2000 process objects (PO), excellent physical properties, and small dimensions, they are predestined for automation at plant level for:

- Small applications/units in production processes
- Package units (enclosed subprocesses)
- Laboratories or institutes

Furthermore, they are also highly suitable as training systems for operators and service engineers.

The application of standard SIMATIC PCS 7 components ensures scalability and unlimited expansion without a change in compatibility. With increasing requirements, e.g. if a test system is subsequently to be operated as a productive system of larger scale, expansion with SIMATIC PCS 7 system components is possible without problem, as is integration into the production plant.

The differentiation in the product range is primarily with regard to the scope of automation functionality and thus the controller type:

- SIMATIC PCS 7 BOX RTX with integrated WinAC RTX software controller
- SIMATIC PCS 7 BOX, can be combined with a separate external controller:
  - PCS 7 AS RTX Microbox automation system
  - Modular automation system from the S7-400 range (AS 41x, AS 41xH or AS 41xF), as single or redundant station

The selection depends on the price/performance ratio and on the supported hardware and software functionalities.

The two basic types can be differentiated further depending on whether the engineering is concentrated in a central engineering system or integrated in the compact system:

- SIMATIC PCS 7 BOX RTX
  - ES/OS system with ES + OS + AS functionality
  - OS Runtime system with OS + AS functionality
- SIMATIC PCS 7 BOX
  - ES/OS system with ES + OS functionality
  - OS Runtime system with OS functionality

A complete process control system for small applications can be implemented by expanding with distributed process I/Os on the PROFIBUS fieldbus or FOUNDATION Fieldbus H1 (only in combination with modular automation systems from the S7-400 range). The ET 200M, ET 200iSP, ET 200S and ET 200pro remote I/O stations are supported by a comprehensive range of low-cost signal/function modules as well as field/process devices connected directly over the fieldbus.

The compact systems can be incorporated into the PCS 7 asset management using the integral SIMATIC PC DiagMonitor diagnostic software. Equipped as an ES/OS system with additional software licenses for SIMATIC PDM and SIMATIC PCS 7 Maintenance Station, a compact system can also be operated as a maintenance station.
Design versions

The compact systems are operated and monitored as standard using separate control units (mouse, keyboard, process Monitor).

An alternative design version with panel (photo on right) also permits operation and monitoring using a 19" TFT Touch Panel with a resolution of 1280 x 1024 pixels.
Migration of own and third-party systems
An investment for the future

Globalization and permanently increasing competition are forcing companies to continuously increase productivity and shorten product launch times. To achieve this, it is necessary to continuously optimize the engineering and process, with simultaneous observation of new industrial requirements and regulations.

Many systems and plants must now be expanded and modernized to ensure that companies can continue to provide products complying with market requirements. However, since the installed basis of hardware, application software and know-how of the operating and maintenance engineers represents an enormous value, the safeguarding of investments for companies operating the plants is always assigned a high priority during all modernization plans.

Experience has shown that the success of a migration process greatly depends on a technical solution optimally matched to customer requirements and the respective plant. Minimization of the technical and financial risks together with safeguarding of investments for as long a period as possible are always fundamental aspects. The different lifecycles of the various system components must also be considered, which currently vary from 5 years for PC-based workstations, 15 years for controllers, up to 25 years or more for input/output components and wiring.

Therefore Siemens does not consider its task to simply be the complete replacement of an existing system, but in the close collaboration with customers and their system integrators to produce an individual, future-oriented solution based on the state-of-the-art SIMATIC PCS 7 process control system – always under the directives:

- **Step-by-step** system innovation
- **Adaptable** to the specific conditions of the plant
- **Flexible** according to production requirements

Portfolio of the migration products

Siemens already recognized the significance of migration for process automation at an early point in time, and has offered a wide range of innovative migration products and solutions for its globally proven systems for many years already. Through consistent extension of this migration offering Siemens has become more and more capable of also modernizing legacy systems from other manufacturers with SIMATIC PCS 7. Right from the start, the principle of Siemens’ migration strategy is to modernize the existing installed base step-by-step without completely changing the system – if possible without a plant shutdown or with minimum production downtimes. In this manner, Siemens supports customers’ endeavors to achieve long-term safeguarding of investments and maximize return on assets.
Migration of own and third-party systems

Data Base Automation
Siemens’ expertise in the migration sector has continuously grown. The experience gained in numerous migration projects has been incorporated into new products and technologies which are even more efficient. A good example of this principle is “Database Automation” (DBA). Using DBA and a plug-in interface, it is possible to download configuration data and to display and configure it using a standardized user interface.

Thus DBA enables system-supported migration of uniform operator system data from different output systems. The results are uniform software quality, security, and traceability.
The migration of own process control systems with the modern SIMATIC PCS 7 is a matter of course for Siemens, and a significant component of the continued supplier/customer relationship. Siemens is additionally able to offer migration solutions for control systems from other vendors, e.g. for systems from ABB or Bailey.

With the migration experience gained over many years and using universal technologies such as DBA and OPC, Siemens can always develop additional migration products and solutions as necessary for the partial or complete modernization of other control systems using SIMATIC PCS 7.

Siemens works closely with the customer’s system integrators when implementing migration projects, for they have the know-how gained over many years and exactly know the plant as well as the customer’s requirements. This partnership is a guarantee for the companies operating plants that they will receive an optimum migration solution.

A further important aspect is that Siemens supports the migration products as well as the standard products by means of product updating and customer support. A special strength of Siemens compared to other migration providers is the ability to offer customers long-term support concerning expertise, servicing, and delivery of components, spare parts and upgrades.

Migration Support Centers provide the customer with additional support that extends beyond product support for:

- Development of migration concepts
- Quotation preparation
- Engineering/project handling

With the future-oriented SIMATIC PCS 7 process control system, innovative migration solutions and services, many years of expertise in process automation and migration, as well as continuous worldwide servicing, Siemens demonstrates its expertise and offers the security of a reliable partner.
Siemens Industry Automation and Drive Technologies offers comprehensive service and support to its customers worldwide for its products and systems. An experienced team of specialists directly on site will support you with bundled know-how for planning and implementation, commissioning, maintenance and modernization in more than 100 countries. Regular training courses and intensive contact among our employees – even across continents – guarantee a high quality for our services.

Online support

By using a Service & Support portal on the Internet, the very latest expert knowledge can be called from any country and at any time. The information is extremely versatile and, in addition to product support, also includes details on the services offered and on regional partners.

www.siemens.com/automation/service&support

Technical support

The competent technical support provides help for technical questions concerning products and systems by means of a wide range of adequate consulting services. Regional technical support is supported when handling technical inquiries by central technical support in Europe, the USA and Asia. Observation of the different times on the continents enables 24/7 consulting.

Since the handling of inquiries is carried out in an international, IT-based network, specialists have global access to the information available for an inquiry.

www.siemens.com/automation/support-request

Technical consulting

Experts provide support during planning and design of a project – covering detailed analysis of the current situation, definition of objectives, advice on products and systems, and design of the automation solution.
Field service

Specialists for commissioning and maintenance guarantee a trouble-free production startup as well as the availability of machines and plants. The assignments are coordinated by regional control centers which can be reached round-the-clock.

Spare parts and repairs

Since downtimes resulting from technical problems are associated with losses in revenue and additional costs, everything is done to avoid or minimize these.

Supported by a powerful logistics system, a global network of regional warehouses enables fast delivery of spare parts, in many countries also in combination with a spare parts emergency service.

If a repair is possible, this can be carried out in a Repair Center or by a mobile repair service – fast, reliably and with a high quality.

Optimization and modernization

Advancements during the operating phase frequently generate a new potential for optimization and modernization. Local Siemens experts provide expert, competent advice on new possibilities for increasing productivity and saving costs.

Training

Participation in professional training oriented according to target groups in more than 60 countries worldwide enables the acquisition of profound SIMATIC PCS 7 system knowledge as well as the expansion of existing know-how. In practice-oriented courses, participants receive excellent training directly from the manufacturer, and this enables them to efficiently use the process control system within the shortest possible time. The range of courses also includes special hands-on training by system specialists directly on site at the customer plant.

www.siemens.com/sitrain
Life cycle service

When making decisions concerning investments in new or innovative control technology, the associated costs must always be evaluated in relation to the total cost of ownership (TCO) of the plant. Support, maintenance, servicing, and modernization make a significant contribution to these costs. The short innovation cycles associated with the introduction of PC technology to process automation must also be taken into consideration. It is even more important to keep servicing costs transparent and plannable. Indispensable in this regard is a cost-optimized life cycle service which guarantees the functionality of the control technology for a defined time period.

The system software and the engineering of the SIMATIC PCS 7 based on standards are already designed to retain the upgrading capability throughout the complete life cycle of the plant. The hardware components are also subject to strict rules for a defined life cycle support.

By using active obsolescence management, Siemens takes into account the aging process of the I&C plants and supports its control system customers during the elaboration of specific substitute solutions as well as appropriate maintenance and spare parts strategies.

All these are ideal prerequisites for professional servicing with tailored service packages.

**Tailored life cycle service packages**

Service requirements are just as specific as the uniqueness of each process engineering plant. Based on many years of experience, the service specialists from Siemens have identified four fundamental requirement profiles and developed appropriate service modules which build upon each other:

- **Standard service**: Service and support, standby service, repair
- **Maintenance service**: Inspection and maintenance
- **Basis life cycle service**: Spare parts supply plus obsolescence management
- **Expanded life cycle service**: Update and upgrade service

These service modules can be expanded flexibly, e.g. by:

- Extended service times, e.g. 24/7 servicing
- Software update service
- Asset optimization
- Prioritized technical support
- Remote service

The scope of services agreed individually on the basis of service modules and additive supplementary services is stipulated in a contract. The contracts are flexible enough to allow adaptation in the event of plant modifications. The service contract management includes documentation, planning of measures, and performance controlling.

**Advantages of tailored life cycle service**

- Protection of investment
- Plannable modernization and service costs
- Improved plant availability
- Guarantee of spare parts availability
- Guarantee of service capability (including modernization or upgrade)
- Optimal technical system support
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