For System Solutions with Emphasis on Production Engineering

simatic
S7-300

SIEMENS

Introduction

The S7-300 is the most often sold SIMATIC controller which makes successful automation solutions possible. The S7-300 for system solutions with its main emphasis in production engineering provides a universal automation platform which means an optimum solution for your applications in centralized and distributed installations. Permanent innovation makes this automation platform continuously more valuable.

Application

The SIMATIC S7-300 offers solutions for the most diverse automation tasks in the following areas:

- Production engineering
- Automobile industry
- General machine construction
- Specialized machine construction
- Machine construction in series (all kinds of production machines) OEM
- Processing of plastics
- Packaging industry
- Food and tobacco industry
- Process engineering (e.g. water supply, building engineering)

Special applications

For special applications there are additional product designs available based on S7-300:

- Failsafe applications with a new failsafe S7-300F as well as corresponding I/O are now possible.
- Special outdoor components withstand extreme environmental conditions, e.g. through an expanded temperature range.
- At the same time, SIMATIC C7 complete units are available based on S7-300 CPUs with integrated HMI for configuring machine controls where space is very restricted.
- This spectrum is rounded off by a CPU in ET 200S configuring form with which distributed, intelligent preprocessing is possible.

Production line in the automobile industry

Engineering and diagnostics

The S7-300 is characterized by efficient configuring and programming which results in low energy costs.
SIMATIC engineering tools, normed to IEC 61131-3 also come into play.

In addition, high performance integrated system diagnostics functions assure a higher degree of controller availability thus resulting in increased productivity. Configurable process diagnostics functions for analyzing process errors in order to reduce downtimes and increase production are also available.

Introduction

Design

The S7-300 enables a space-saving modular configuration to machine controllers adapted to the task at hand, without taking slot rules into consideration. A fan is not necessary during operation. Apart from the modules, only a DIN rail is required where the modules are swung into place and secured by screws. A configuration is then possible which is robust and electro-magnetically compatible.

The backplane bus is integrated into the module and is assembled by insertion in the bus connector.
The diverse S7-300 module spectrum can be used for centralized expansions as well as for simple configuration of distributed structures with ET 200M; this results in a very cost-efficient spare-parts maintenance.

CPU spectrum

A graded CPU spectrum is available all the way up to high-performance CPUs for configuring the controller. The CPUs enable short machine clock-times through their efficient processing speeds.

Depending on the task at hand CPUs with integrated I/Os, integrated technological functions and integrated communications interfaces are available.
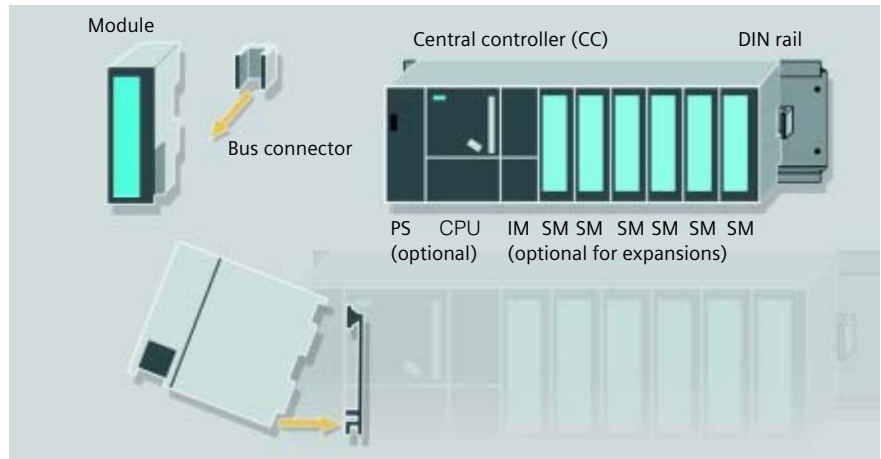
Configuration of the S7-300

CPU	Integrated I/O	Integrated technological functions	Integrated interfaces
CPU 312C	Digital	Counting	MPI
CPU 313	–	–	MPI
CPU 313C	Digital, analog	Counting	MPI
CPU 313C-2 PtP	Digital	Counting	PtP, MPI
CPU 313C-2 DP	Digital	Counting	DP, MPI
CPU 314	–	–	MPI
CPU 314C-2 PtP	Digital, analog	Counting, Positionieren	PtP, MPI
CPU 314C-2 DP	Digital, analog	Counting, positioning	DP, MPI
CPU 315	–	–	MPI
CPU 315-2DP	–	–	DP, MPI
CPU 316-2DP	–	–	DP, MPI
CPU 318-2DP	–	–	DP, MPI

Communication

Totally Integrated Automation

Totally Integrated Automation means: With a single, completely integrated and uniform system you can solve all your automation tasks! Every function is available from one vendor.

Distributed preprocessing (distributed intelligence) makes new concepts in the plant and machine construction possible with every advantage such as re-usability of the software, faster commissioning times and greater availability.

Of great significance in the system are **communication networks**:

Industrial Ethernet (IEEE 802-3 and 802.3u) –
the international standard for area and celll networking.

PROFIBUS (IEC 61158/EN 50170) –
the international standard for the cell and field area as well as PROFIBUS PA for intrinsic applications in process automation.

AS-Interface (EN 50295) –
the international standard for communication with sensors and actuators.

EIB (EN 50090, ANSI EIA 776) –
the world-wide standardized building installation system and basis for building automation.

MPI – Multi point interface –
for communication between CPUs, PG/PC and TD/OP.

Point-to-point coupling –
for communication between two nodes with special protocols. The point-to-point structure represents the simplest communication form. Different special protocols are used (e.g. RK 512, 3964(R) and ASCII).

Integration in the IT world

The S7-300 enables the modern IT world to be integrated into automation technology.

The following functions are possible using the insertable CP (CP 343-1 IT):

- Creating your own Web pages with random HTML tools whereby the process variables of the S7-300 are simply assigned to the HTML objects.
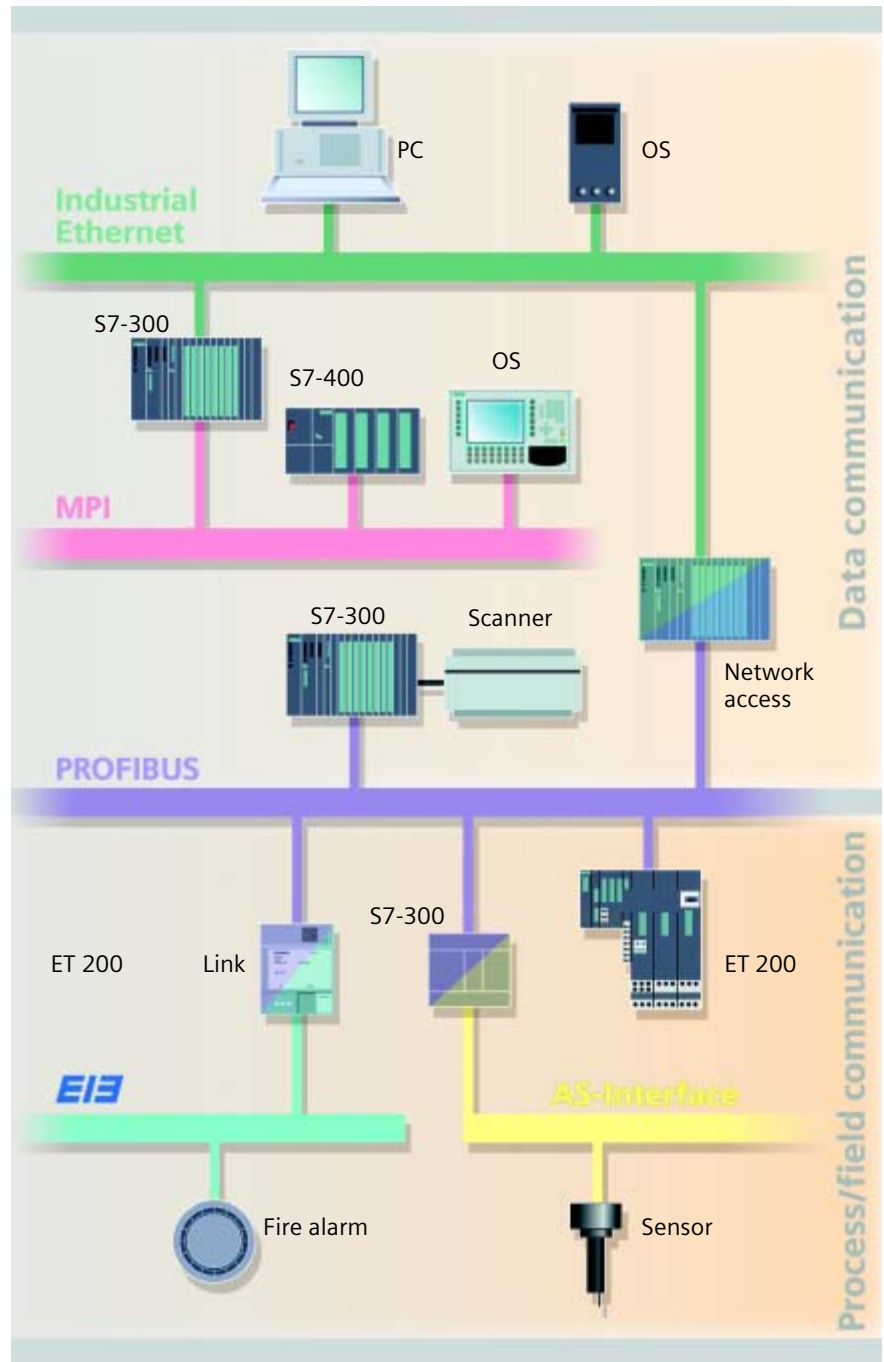
Communication options using the integrated interfaces of the SIMATIC S7-300

- Monitoring the S7-300 using these Web pages with a standard browser .
- Sending emails from the user profile of the S7-300 through FC calls.

- Remote programming through the TCP/IP using telephone entwork as well (e.g. ISDN).

Programming

The S7-300 is programmed with Basis-software STEP 7 or STEP 7 Lite. This enables the performance capability of the S7-300 to be used in a simple, user-friendly manner. Both contain functions for all phases of an automation project - from configuring to commissioning, testing and servicing.

STEP 7 Lite

The cost-efficient software STEP 7 Lite is available to achieve stand-alone applications with the SIMATIC S7-300.

STEP 7 Lite is characterized by very fast entry into programming and simple project handling.

Additional SIMATIC software packages, for example Engineering Tools, cannot be used. Programs which were generated with STEP 7-Lite, can also be processed using STEP 7.

STEP 7

STEP 7 is used for, among other things, larger or more complex applications, with which, e.g. programming with high-level languages or graphic concept languages (see Engineering Tools) takes place or the use of function or communications modules is required.

STEP 7 enables the use of additional SIMATIC software packages, for instance Engineering Tools.

Engineering Tools

Engineering Tools opens additional possibilies to program automation solutions in a user-friendly, task oriented manner. The following tools are available for programming:
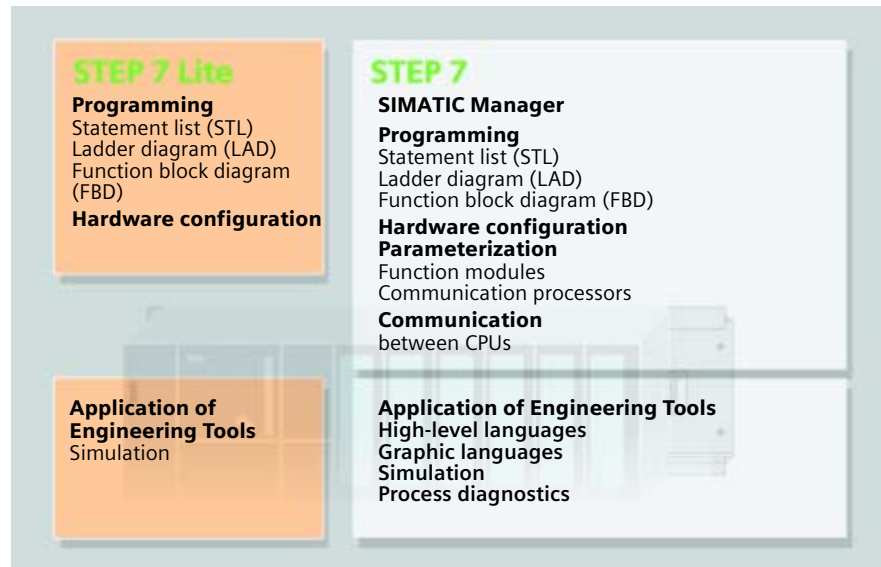
S7-SCL

(**S**tructured **C**ontrol **L**anguage), the high-level language based on PAS-CAL for programming SIMATIC S7/C7 controllers

S7-GRAPH

for graphic configuration of sequential controls for SIMATIC S7/C7

S7-HiGraph®

for graphic description of sequential or asynchronous processes with state graphs for SIMATIC S7/C7

STEP 7 and STEP 7 Lite scope of functions
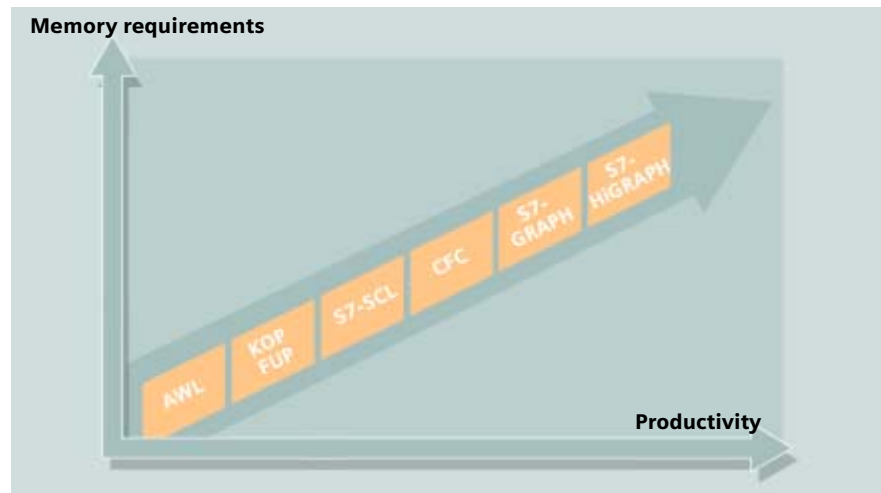
Memory requirements of Engineering Tools

CFC

(**C**ontinuous **F**unction **C**hart), the technological plan for graphic interconnection of complex functions for SIMATIC S7

The use of Engineering Tools is advantageous above all for larger, more complex applications and correspondingly greater CPUs.

CPUs/Engineering Tools

- All CPUs can be programmed in STL, LAD and FBD basic languages.

- Should the S7-SCL high-level language be used, CPUs 313C, 314 and above are recommended.

If graphic concept languages (S7-GRAPH, S7-HiGraph und CFC) are used, CPUs 314 and higher are recommended.

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CPUs - Features

Integrated interfaces

Interfaces which are integrated directly in the CPU enable a high-performance communications environment to be configured by using common bus technology.

Multi-point interface MPI

MPI is the cost effective solution for communication with PG/PC, HMI®-systems and additional SIMATIC S7/C7/WinAC automation systems. Up to 125 MPI nodes with 187.5 kbit/s can be connected:

- Transfer of process data between different controllers; in this way for example a CPU can access inputs and outputs of a third-party controller.
- HMI;
  HMI services are already integrated in the S7-300 operating system and transfer data to SIMATIC operator panels or operator stations without programming.

The MPI can also be also be used as a PROFIBUS DP interface and permits the configuration of two DP lines (for CPU 318-2DP only).

PROFIBUS DP

The SIMATIC S7-300 can be connected to the open PROFIBUS DP fieldbus (to EN 50170) in order to configure larger distributed structures. This opens communication possibilities to a number of partners from SIMATIC controllers to field devices from other manufacturers. Communication with existing SIMATIC S5 or SIMATIC 505 plants is possible with no problem.

Configuration of the distributed I/O takes place with STEP 7 similar to the centralized I/O thus saving engineering expense.

The S7-300 can in this way be used as a master or slave.

Common functions

HMI functions and PG functions are possible with both interfaces (MPI, DP), e.g. example programming with PG/PC over larger distances. In addition, one PG can operate several CPUs or several PGs can access a CPU.

With the help of a routing function, a PG, which is connected at a random point of the network, can reach all nodes of this network.

Additional functions can be realized with communications modules.
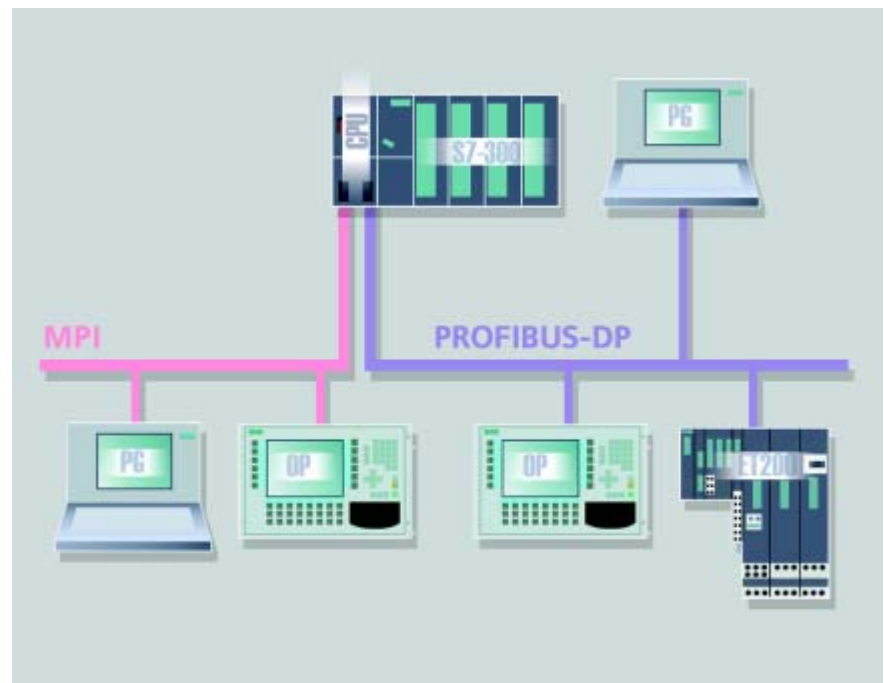
Connection options using the integrated interfaces of the S7-300 CPUs

CPUs - Innovation

The series of proven S7-300 CPUs is considerable enhanced by important innovations. Six compact CPUs as well as three new standard CPUs are available. These innovations lead to the following advantages:

Reducing machine clock times
Command runtimes which have been reduced to 1/3 or 1/4 enable decreased machine clock times and create the basis for higher productivity.

Reducing engineering costs
Due to larger quantity frameworks (e.g. more RAM) the new CPUs constitute a platform for the application of task oriented STEP 7 Engineering Tools, for example high-level languages such as SCL and the use of technologically oriented Runtime software, e.g. Easy Motion Control.

In addition, they simplify modular programmierung as well as re-usage of existing programs. Apart from generation, Engineering Tools also simplify program readability, maintenance and documentation. All-in-all engineering costs can be considerably reduced.

Reducing operating costs
The new CPUs reveal additional features which reduce plant operating costs. A micro-memory card (MMC) as data and memory storage makes a backup battery redundant thereby reducing a part of the maintenance costs.

A complete project including symbology and comments can also be stored on this MMC making servicing easier since no configuring data must be on the service unit. The MMC also makes program updating easy.

Reducing installation costs
The reduced module width of the new CPUs can be seen immediately. The new standard CPUs are only 40 mm instead of 80 mm wide; the compact CPUs "shrink" from 160/120 mm to 120/80 mm. This means that a more compact controller and possibly a more compact switching cabinet are possible.

Reducing procurement costs
Most CPUs have, in addition to the MPI interface, an added onboard interface. You have the choice between:
- a PROFIBUS DP interface configurable as DP master or as DP slave
- an additional serial interface (RS 422/485) for point-to-point coupling for diverse I/O stations, e.g. scanners and weighing systems

The new micro-memory card (MMC) offers a distinct price advantage as opposed to memory cards which have been used to date.

New compact CPU 314C-2 DP

Increased flexibility
The new CPUs provide better networking since more CPUs as well as operator control and monitoring devices can be hooked up.

An open system, which enables better parameterization and diagnostics of connected third-party systems using PROFIBUS supported by DP V1 functionality.

Moreover, it is possible to read and write the the micro-memory card (MMC) in Run mode, so that, for example, a measured-value archiving or recipe processing is possible.

CPU 315-2 DP

Moreover, the compact CPUs have integrated functions, so that many (additional) modules are redundant. These technological functions encompass e.g. counting, positioning and loop control as well as the corresponding on-board I/Os (digital or analog).

Fail-Safety with S7-300F

Fail-safe systems are used where the highest safety standards for personnel, machines and the environment must be guaranteed, i.e. accidents and damage as the result of an error must be avoided at all costs.

An additional SIMATIC fail-safe controller is now available with the S7-300F especially for safety-oriented and simultaneously distributed appplications in the production industry and burner technology.

The predominant feature of the S7-300F is the combination of standard plant automation and safety engineering in a single system. This means that not only "normal" communication but also safety-oriented communication (using the Profil PROFIsafe) with PROFIBUS DP between central controller and I/O takes place - intrinsic "normal" communication is not required. This fusion of standard and safety automation considerably reduces the expenditure for configuring and designing modern safety-oriented plants.

The S7-300F achieves the safety-oriented functions through an F-CPU as well as a fail-safe modules, which can be used in the S7-300 as well as in the ET 200M and ET 200S distributed I/O systems. A special library is available from the German Technical Inspectorate (TÜV) providing certified programming examples. The programming takes place with the standard LAD and FBD programming languages.

Fail-safe motor starters connected to ET 200S are available as an ideal supplement to the S7-300F.
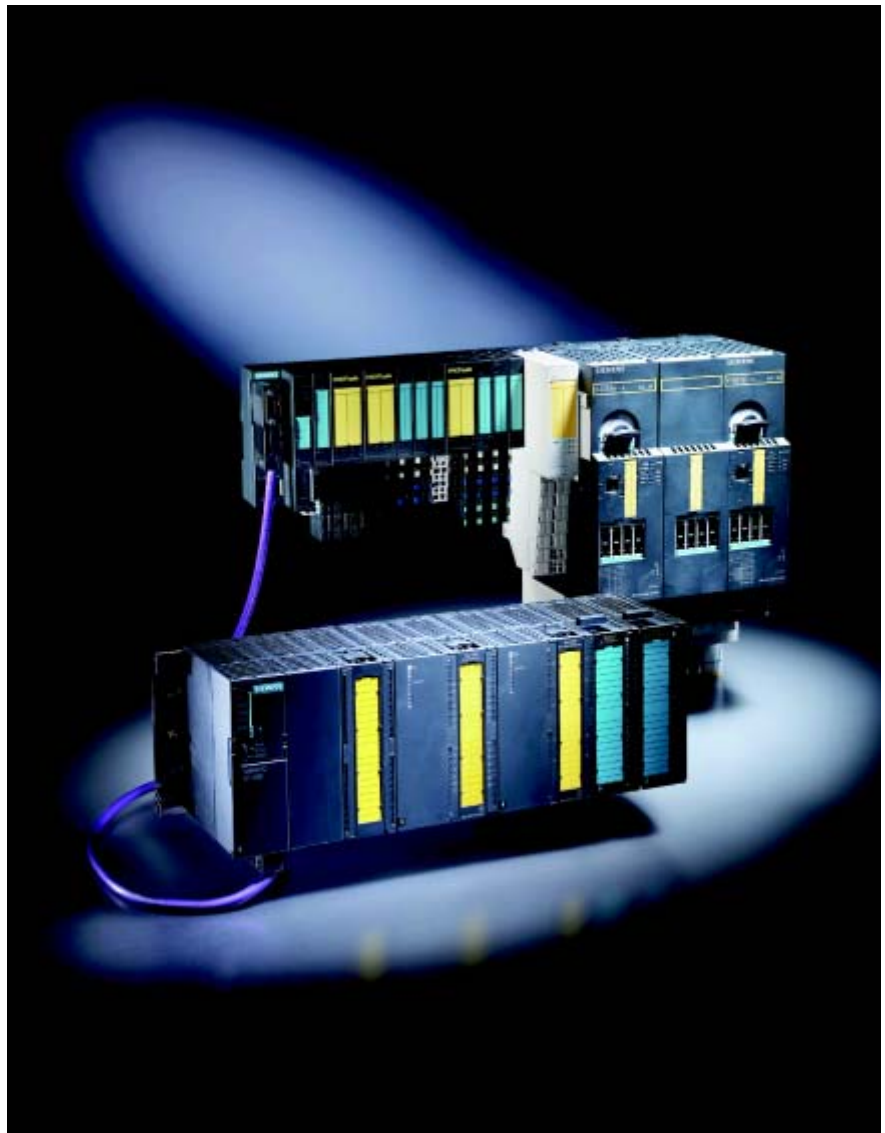
S7-300F with ET 200S I/O and motor starter

New Standard CPUs

	CPU 312	CPU 314	CPU 315-2 DP
	Start of delivery: 10/2002	**Start of delivery: 10/2002**	**Start of delivery: 10/2002**
Main memory (applications)	16 KByte/5 K statements	48 KByte/16 K statements	128 KByte/42 K statements
Backup: using MMC (6ES7953-8L...)	all blocks	all blocks	all blocks
Processing times ▪ Bit operations ▪ Word operation ▪ Fixed-point arithmetic ▪ Floating-point arithmetic	< 200 ns < 1.0 µs < 5 µs < 30 µs	< 100 ns < 0.5 µs < 3.5 µs < 15 µs	< 100 ns < 0.5 µs < 3.5 µs < 15 µs
Timers/counters ▪ Bit memories ▪ S7 timers/S7 counters ▪ IEC timers/IEC counters	1 Kbyte 128/128 yes	2 Kbyte 256/256 yes	16 Kbyte 256/256 yes
Number of blocks ▪ Number of loadable blocks (Sum of FCs + FBs + DBs) ▪ Range of numbers	1024 512 FC, 512 FB, 511 DB	1024 512 FC, 512 FB, 511 DB	1024 2048 FC, 2048 FB, 1023 DB
Organization blocks (OB)	free cycle (OB 1) real-time interrupt (OB 10) delay alarm (OB 20) time-triggered (OB 35) interrupt-triggered (OB 40) restart (OB 100) asyn. error (OB 80, 82, 85, 87) syn. error (OB 121,122)	free cycle (OB 1) real-time interrupt (OB 10) delay alarm (OB 20) time-triggered (OB 35) interrupt-triggered (OB 40) restart (OB 100) asyn. error (OB 80, 82, 85, 87) syn. error (OB 121,122)	free cycle (OB 1) real-time interrupt (OB 10) delay alarm (OB 20) time-triggered (OB 35) interrupt-triggered (OB 40) DPV1 restart (OB 54-56) restart (OB 100) asyn. error (OB 80, 82, 85-87) syn. error (OB 121,122)
Address ranges ▪ I/O address area ▪ I/O process image ▪ Digital channels ▪ Analog channels	1024 128/128 256 64	1024 128/128 1024 256	2048 128/128 1024 256
Expansions ▪ Racks ▪ Modules per rack	1 8	max. 4 8	max. 4 8
DP interfaces ▪ Number of DP lines int./CP 342-5 ▪ Equidistance ▪ Activation/deactivation of slaves ▪ Transmission speed ▪ No. of slaves per station ▪ lateral communication	– – – – – –	– – – – – –	1/1 yes yes 12 MBit/s 64 ja
Dimensions (mm)	40 x 125 x 130	40 x 125 x 130	40 x 125 x 130
Order No. group	6ES7312-1AD..	6ES7314-1AF..	6ES7315-2AG..

Compact CPUs

	CPU 312C	CPU 313C	CPU 313C-2 PtP
Main memory (applications)	16 Kbyte/4 K statements	32 Kbyte/10 K statements	32 Kbyte/10 K statements
Backup: using MMC (6ES7953-8L...)	all blocks	all blocks	all blocks
Number of blocks	64 FC, 64 FB, 63 DB	128 FC, 128 FB, 127 DB	128 FC, 128 FB, 127 DB
Program processing	free cycle (OB 1), real-time controlled (OB 10), delay alarm (OB 20), time-triggered (OB 35) interrupt-triggered (OB 40), restart (OB 100, 102), asyn. error (OB 80...82, 85, 87), syn. error (OB 121, 122)		
Processing times ▪ Bit operations ▪ Word operations	0.2 µs to 0.4 µs 1 µs	0.1 µs to 0.2 µs 0.5 µs	0.1 µs to 0.2 µs 0.5 µs
Bit memories/timers/counters ▪ Bit memories ▪ S7 timers/S7 counters ▪ IEC timers/IEC counters	1024 128/128 yes	2048 256/256 yes	2048 256/256 yes
Number of blocks per system	8	31	31
No. of central controllers/ expansion units (CC/EU)	1/0	1/3	1/3
Address ranges ▪ Total I/O address range ▪ I/O process range ▪ Total digital channels ▪ Total analog channels	1024/1024 byte 128/128 byte max. 256 max. 64/32	1024/1024 byte 128/128 byte max. 1024 max. 256/128	1024/1024 byte 128/128 byte max. 1024 max. 256/128
Integrated functions ▪ Counters ▪ Pulse outputs ▪ Frequency measurement ▪ Controlled positioning ▪ Integrated FBs "loop control"	2 incremental encoders 24 V/10 kHz 2 channel pulse-width modulation max 2.5 kHz 2 channels max. 10 kHz – –	3 incremental encoders 24 V/30 kHz 3 channel pulse-width modulation max 2.5 kHz 3 channels max. 30 kHz – PID controller	3 incremental encoders 24 V/30 kHz 3 channel pulse-width modulation max 2.5 kHz 3 channels max. 30 kHz – PIDcontroller
Integrated I/O ▪ Digital inputs ▪ Digital outputs ▪ Analog inputs ▪ Analog outputs	10; 24 V DC; all channels can be used for process alarms 6; DC 24 V, 0.5 A – –	24; 24 V DC; all channels can be used for process alarms 16; 24 V DC, 0.5 A 4: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA; 1: 0..600 Ω, PT100 2: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA	16; 24 V DC; all channels can be used for process alarms 16; 24 V DC, 0.5 A – –
DP interfaces ▪ No. of DP lines int./CP 342-5 ▪ No. of DP slaves per station ▪ Transmission speed ▪ Lateral communication ▪ Equidistance ▪ Activation/deactivation of slaves	– – – – – –	– – – – – –	– – – – – –
PtP interface ▪ Physics ▪ Protocol driver	– –	– –	RS485/422 3964 (R), ASCII
Dimensions (mm)	80 x 125 x 130	120 x 125 x 130	120 x 125 x 130
Required front connector	1 x 40 pol.	2 x 40 pol.	1 x 40 pol.
Order No. group	6ES7312-5BD..	6ES7313-5BE..	6ES7313-6BE..

Compact CPUs

	CPU 313C-2 DP	CPU 314C-2 PtP	CPU 314C-2 DP
Main memory (applications)	32 Kbyte/10 K statements	48 Kbyte/16 K statements	48 Kbyte/16 K statements
Backup: using MMC (6ES7953-8L...)	all modules	all modules	all modules
Number of modules	128 FC, 128 FB, 127 DB	128 FC, 128 FB, 127 DB	128 FC, 128 FB, 127 DB
Program processing	free cycle (OB 1), real-time controlled (OB 10), delay alarm (OB 20), time-triggered (OB 35), interrupt-triggered (OB 40), restart (OB 100, 102), asyn. erro (OB 80...82, 85, 87), syn. error (OB 121, 122), station failure/restoration (not with CPU 314C-2PtP, OB 86),		
Processing times ▪ Bit operations ▪ Word operations	0.1 µs to 0.2 µs 0.5 µs	0.1 µs to 0.2 µs 0.5 µs	0.1 µs to 0.2 µs 0.5 µs
Bit memories/timers/counters ▪ Bit memories ▪ S7 timers/S7 counters ▪ IECtimers/IEC counters	2048 256/256 yes	2048 256/256 yes	2048 256/256 yes
No. of blocks per system	31	31	31
Number of CC/EU	1/3	1/3	1/3
Address range ▪ Total I/O address range ▪ I/O process range ▪ Total digital channels[1] ▪ Total analog channels[1]	1024/1024 byte 128/128 byte max. 1024 max. 256/128	1024/1024 byte 128/128 byte max. 1024 max. 256/128	1024/1024 byte 128/128 byte max. 1024 max. 256/128
Integrated functions ▪ Counters ▪ Pulse outputs ▪ Frequency measurement ▪ Controlled positioning ▪ Integrated FBs "loop control"	3 incremental encoders 24 V/30 kHz 3 channel pulse-width modulation max. 2.5 kHz 3 channels max. 30 kHz – PID controller	4 incremental encoders 24 V/60 kHz 4 channel pulse-width modulation max. 2.5 kHz 4 channels max. 60 kHz SFB for positioning 1 axis using 2 DA, AA PID controller	4 incremental encoders 24 V/60 kHz 4 channel pulse-width modulation max. 2.5 kHz 4 channels max. 60 kHz SFB for positioning 1 axis using 2 DA, AA PID controller
Integrated I/Os ▪ Digital inputs ▪ Digital outputs ▪ Analog inputs ▪ Analog outputs	16; DC 24 V; all channels can be used for process alarms 16; 24 V DC, 0,5 A – –	24; DC 24 V; aall channels can be used for process alarms 16; 24 V DC, 0,5 A 4: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA; 1: 0..600 Ω, PT100 2: ±10 V, 0-10 V, ± 20mA, 0/4-20 mA	24; DC 24 V; all channels can be used for process alarms 16; 24 V DC, 0,5 A 4: ± 10 V, 0..10 V, ± 20 mA, 0/4..20 mA; 1: 0..600 Ω, PT100 2: ± 10 V, 0-10 V, ± 20 mA, 0/4-20 mA
DP interfaces ▪ No. of DP lines int./CP 342-5 ▪ No. of DP slaves per station ▪ Transmission speed ▪ Lateral communication ▪ Equidistance ▪ Activation/deactivation of slaves	1/1 32 12 MBit/s yes yes yes	– – – – – –	1/1 32 12 MBit/s yes yes yes
PtP interface ▪ Physics ▪ Protocol driver	– –	RS485/422 3964 (R), RK512, ASCII	– –
Dimensions	120 x 125 x 130	120 x 125 x 130	120 x 125 x 130
Required front connector	1 x 40 pin	2 x 40 pin	1 x 40 pin
Order No. group	6ES7313-6CE..	6ES7314-6BF..	6ES7314-6CF..

1) integrated + pluggable

Previous Standard CPUs

	CPU 313	CPU 314	CPU 315
Main memory (applications)	12 Kbyte 4 K statements RAM (integrated)	24 Kbyte 8 K statements RAM (integrated)	48 Kbyte 16 K statements RAM (integrated)
Backup: ▪ without battery ▪ with battery	72 byte; bit memories, counters, timers, data all modules	4 Kbyte; bit memories, counters, timers, data all modules	4 Kbyte; bit memories, counters, timers, data all modules
Number of blocks	128 FC, 128 FB, 127 DB	128 FC, 128 FB, 127 DB	192 FC, 192 FB, 255 DB
Program processing	free cycle (OB 1), interrupt triggered (OB 40), time controlled (OB 35), real-time controlled (OB 10), restart (OB 100)		
Processing times ▪ Bit operations ▪ Word operations	0.6 µs to 1.2 µs 2 µs	0.3 µs to 0.6 µs 1 µs	0.3 µs to 0.6 µs 1 µs
Bit memories/ timers/counters ▪ Bit memories ▪ S7 timers/S7 counters ▪ IEC timers/IEC counters	2048 128/64 yes	2048 128/64 yes	2048 128/64 yes
No. of blocks per system	8	32	
Number of CC/EU	1/0	1/3	
Address range ▪ Total I/O address range ▪ I/O process range ▪ Total digital channels[1] ▪ Total analog channels[1]	128/128 byte 32/32 byte max. 256 max. 64 inputs or 32 outputs	512/512 byte 128/128 byte max. 1024 max. 256 inputs or 128 outputs	512/256 Kbyte 128/128 byte max. 1024 max. 256 (max. 256 inputs or 128 outputs central)
DP interfaces ▪ Number of modules per system ▪ Number of CC/EU ▪ Number of DP lines per CPU (integrated interfaces/CP 342-5) ▪ Number of DP slave stations per CPU (integrated interfaces / CP 342-5) ▪ Transmission speed ▪ Internode communication supported ▪ Equidistance supported ▪ Activation/deactivation of DP slaves	– – – – – – – –	– – – – – – – –	32 1/3 – – – – – –
Dimensions (mm)	80 x 125 x 130	80 x 125 x 130	80 x 125 x 130
Order No. group	6ES7313-1AD..	6ES7314-1AE..	6ES7315-1AF..

Previous Standard CPUs

	CPU 315-2DP	CPU 316-2DP	CPU 318-2DP
Main memory (applications)	64 Kbyte 21 K statements RAM (integrated)	128 Kbyte 42 K statements RAM (integrated)	512 Kbyte, of which max. 256 Kbyte code and max. 256 Kbyte statements
Backup:			
▪ without battery	4 Kbyte; bit memories, counters, timers, data	4 Kbyte; bit memories, counters, timers, data	8 Kbyte; bit memories, counters, timers, data
▪ with battery	all modules	all modules	all modules
Number of blocks	192 FC, 192 FB, 255DB	512 FC, 256 FB, 511 DB	1024 FC, 1024 FB, 2047 DB
Program processing	free cycle (OB 1), interrupt-triggered (OB 40), time controlled (OB 35), real-time controlled (OB 10), restart (OB 100)		real-time interrupts (OB 10, 11) delay alarm (OB 20, 21) time-triggered (OB 32, 35) interrupt-triggered (OB 40, 41) background OB (OB 90) restart (OB 100) asyn. error (OB 80, 81, 82, 84 to 87) syn. error (OB 121, 122)
Processing times			
▪ Bit operations	0.3 μs to 0.6 μs	0.3 μs to 0.6 μs	0.1 μs
▪ Word operations	1 μs	1 μs	0.1 μs
Bit memories/ timers/counters			
▪ Bit memories	2048	2048	8192
▪ S7 timers/S7 counters	128/64	128/64	512/512
▪ IEC timersIEC counters	yes	yes	yes
DP interfaces			
▪ Number of modules per system	32	32	32
▪ Number of CC/EU	1/3	1/3	1/3
▪ Number of DP lines per CPU (integrated interfaces/CP 342-5)	1/1	1/1	2/2
▪ Number of DP slave stations per CPU (integrated interfaces / CP 342-5)	64/64	125/64	32 (MPI-SS), 125 (DP-SS)/64
▪ Transmission speed	12 Mbit/s	12 Mbit/s	12 Mbit/s
▪ Internode communication supported	yes; sender and receiver	yes; sender and receiver	yes; sender and receiver
▪ Equidistance supported	yes	yes	yes
▪ Activation/deactivation of DP slaves	yes	yes	available soon
Address ranges			
▪ Total I/O address range	1/1 Kbyte	2/2 Kbyte	8/8 Kbyte
▪ I/O process range	128/128 byte	128/128 byte	256/256 byte, can be expanded to 2048
▪ Total digital channels	max. 8192 (1024 central)	max. 16384 (1024 central)	max. 65536 (1024 central)
▪ Total analog channels	max. 512 (max. 256 inputs or max. 128 outputs central)	max. 1024 (max. 256 inputs or max. 128 outputs central)	max. 4096 (max. 256 inputs or 128 outputs central)
Dimensions (mm)	80 x 125 x 130	80 x 125 x 130	160 x 125 x 130
Order No. group	6ES7315-2AF..	6ES7316-2AG..	6ES7318-2AJ..

Module spectrum

The comprehensive range of modules enables modular adaptation of the S7-300 to a wide variety of applications.

The following are available:

- Digital and analog I/O modules for almost all types of signals, including interrupt processing and diagnostics
- Digital and analog Ex I/O modules for use in hazardous areas
- Function modules for counting/measuring, all sorts of positioning functions, cam control and loop control
- Communication modules for point-to-point coupling or bus communication using AS-Interface, PROFIBUS and Industrial Ethernet and IT functionality
- Load supply units which provide 24 V DC operating voltage
- Interface modules for connecting racks for multi-tier installation of the SIMATIC S7-300

Expansion options

Should the automation task require more than 8 modules, the central controller (CC) of the S7-300 can be expanded using expansion units (EU) (except for CPU 312 IFM, 312C and 313). Altogether up to 32 modules can be used, up to 8 per expansion unit.

Communication between the individual devices is carried out independently by interface modules (IM).

In the case of plants covering an extensive area, CC/EUs can be configured in greater distances (up to 10 m).

This means that for a single-tier installation, the maximum configuration is 256 I/O, with up to 1024 I/O for multiple line installations. For a distributed system using PROFIBUS DP 65536 I/O connections can be used (up to 125 stations, for example ET 200M using IM 153).

The slots are freely addressable, i.e. no slot rules exist (except CPU 312 IFM, 312C, 313, 314, 314 IFM).

Communication	Technology
Point-to-point coupling with data transmission rates up to 115 Kbit/s and various protocols, e.g. for connecting printers, scanners and third-party devices	Counting in different operating modes up to 500 kHz, measuring up to 100 kHz and proportioning
Connection to the fieldbus AS-Interface for communicating with binary sensors and actuators	Cam controls with up to 13 cam tracks per module
Connection to PROFIBUS using either the DP or the FMS protocol or by using fiber-optic cable. Connection of PROFIBUS PA field devices using DP/PA link	All sorts of positioning tasks: - controlled positioning in rapid-traverse/creep-speed mode - Point-to-point positioning and profiles using stepper and servomotors - Point-to-point multi-axis interpolation using stepper and servomotors Connection of positioning drives with PROFIBUS DP
Connection to Industrial Ethernet using ISO/TCP or TCP/IP protocol for data communication	PID controller with backup capability and integrated, online self configuration for different types of controllers (continuous controllers, stepper controllers, pulse controllers)
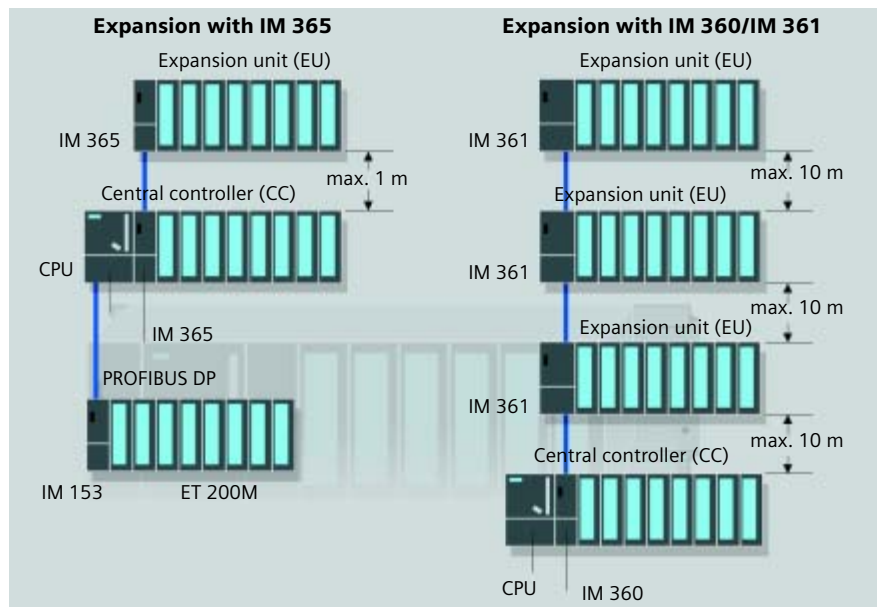
Expanding the S7-300

I/O modules - Special features

Signal modules are the interface of the SIMATIC S7-300 to the process. A number of various digital and analog modules make those I/Os available which are required for the respective task.

Easy installation

Sensors and actuators are connected using front connectors. The connector is simply plugged into the new module when the module is replaced, the wiring remains unchanged. Coding of the front connector prevents confusion. SIMATIC TOP connect (not for onboard I/Os of compact CPUs) simplify the wiring process in the case of prewired front connectors and terminal blocks even more.

High packaging density

The large number of channels on each module is the one reason for the space-saving design of the S7-300: Modules are available with 8 to 32 channels (digital) and 2 to 8 channels (analog).

Easy parameterization

Modules are configured and parameterized using STEP 7, there are no complicated switch settings. Data is stored centrally and, when modules have been replaced, automatically transferred to the the new module to prevent transmission errors. No software upgrading is necessary when using new modules. Configurations which have been carried out one can be repeated identically any number of times, e.g. for series machines.

Diagnostics, interrupts

Many modules monitor signal acquisition (diagnostics) and signals from the process as well (process alarm). In this way it is possible to react quickly to any irregularities or process events. Whether the controller should react and what the reaction should be can be parameterized in STEP 7.

Special modules

The simulation module can be inserted in the S7-300 for testing and simulation purposes. It enables encoder signals to be simulated with the switch and displays output signals using LEDs. The module can be plugged in anywhere without worrying about slot rules.
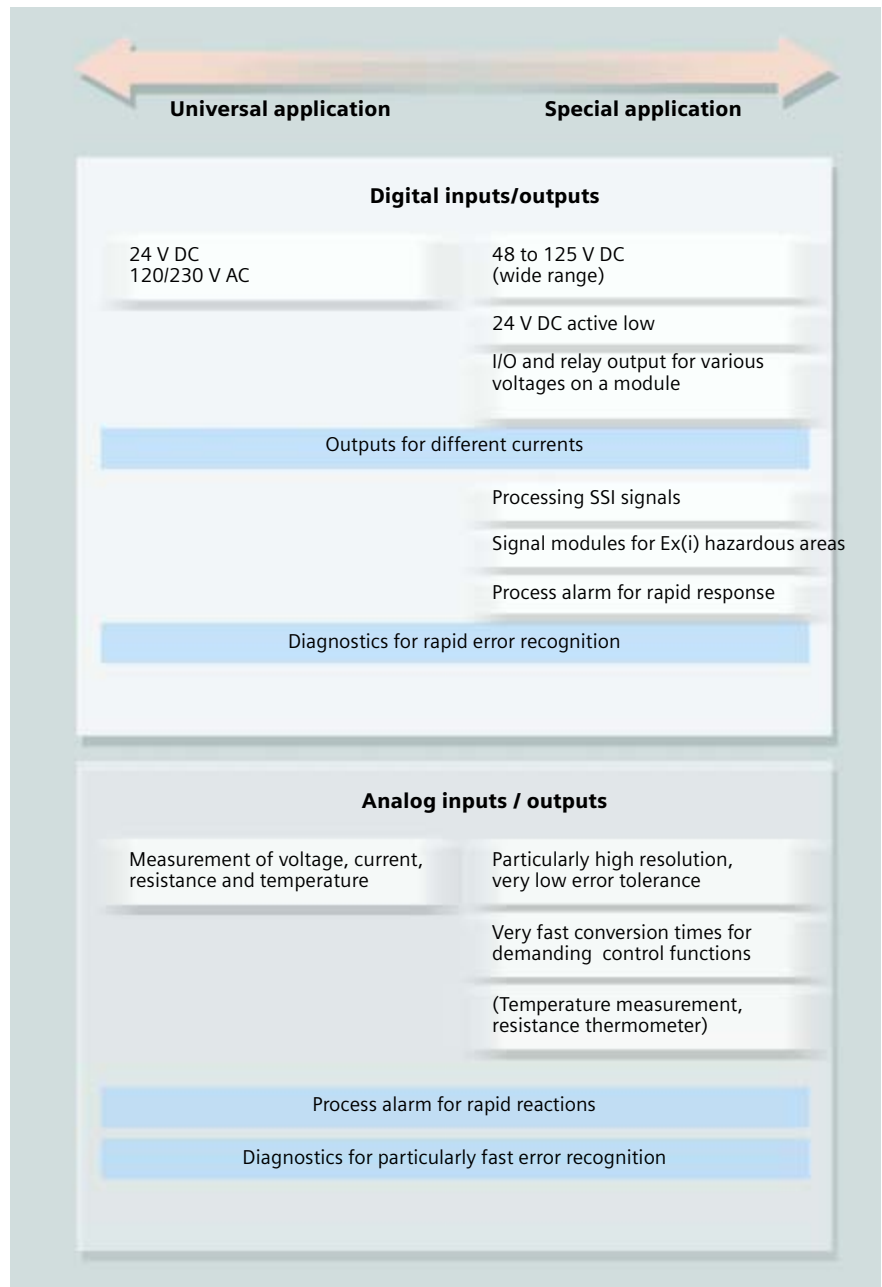
Signal modules for universal and special applications

The dummy module reserves a slot which has not yet been configured. The mechanical configuration and address allocation remain unchanged when the module is slotted at a later date.

On the following pages you will find criteria for selecting the right signal module for a given application.

Detailed technical specifications are available in the latest version of Catalog CA 01 (Internet: www.siemens.de/automation/ca01

I/O modules - Selection guide for digital inputs

Module type	Selection guide for digital inputs						
Voltage	DC						
Suitable for	Switches and 2-/3-/4 wire proximity switches (BEROs)						
Input voltage	24 V						48 to 125 V
Source/sink inputs	P					M	P
Diagnostics/interrupt capability	yes	no					
Input delay	0,1 - 20 ms	1,2 bis 4,8 ms					10 ms
Number of channels	16	16	32	8	16	16	16
Galvanic isolation: Number of groups	1	1	2	1	1	1	8
Extras	–	–	–	8 DO	16 DO	–	–
Order No. group	6ES7 321-7BH0.-...	6ES7 321-1BH0.-...	6ES7 321-1BL0.-...	6ES7 323-1BH0.-...	6ES7 323-1BL0.-...	6ES7 321-1BH5.-...	6ES7 321-1CH8.-...

Module type	Selection guide for digital inputs			
Voltage	AC			
Suitable for	Switches and 2-/3-/4 wire proximity switches (BEROs)			
Input voltage	120/230 V	120 V	120/230 V	120/230 V
Source/sink inputs	P	P	P	P
Diagnostics/interrupt capability	no	no	no	no
Input delay	25 ms	25 ms	25 ms	25 ms
Number of channels	16	32	8	8
Galvanic isolation: Number of groups	4	4	4	8
Extras	–	–	–	–
Order No. group	6ES7 321-1FH0.-...	6ES7 321-1EL0.-...	6ES7 321-1FF0.-...	6ES7 321-1FF1.-...

I/O modules - Selection guide for digital outputs

Module type	Selection guide for digital outputs						
Voltage	DC						
Suitable for	Solenoid valves, DC contactors and indicator lights						
Output voltage	24 V						48 to 125 V
Output current	0.5 A					2 A	1.5 A
Diagnostics/interrupt capability	no				yes	no	
Number of channels	16	32	8	16	8	8	8
Galvanic isolation: Number of groups	2	4	1	1	1	2	4
Extras	–	–	8 DI	16 DI	–	–	–
Order No. group	6ES7 322-1BH0.-...	6ES7 322-1BL0.-...	6ES7 323-1BH0.-...	6ES7 323-1BL0.-...	6ES7 322-8BF0.-...	6ES7 322-1BF0.-...	6ES7 322-1CF8.-...

Module type	Selection guide for digital outputs							
Voltage	AC				UC (relay)			
Suitable for	AC magnet coils, contactors, motor starters, small motors and indicator lights				AC magnet coils, contactors, motor starters, small motors and indicator lights			
Output voltage	120/230 V	120/230 V		120 V	24 - 120 V DC: 24 - 230 V AC:	24 to 120 V DC 48 to 230 V AC		
Output current	1 A	1 A	2 A	1 A	2 A	3 A	5 A	
Diagnostics/interrupt capability	no	no	yes/no	no	no			yes/no
Number of channels	16	8	8	32	16	8	8	8
Galvanic isolation: Number of groups	2	2	8	4	2	4	8	8
Extras	–	–	–	–	–	–	–	–
Order No. group	6ES7 322-1FH0.-...	6ES7 322-1FF0.-...	6ES7 322-5FF0.-...	6ES7 322-1EL0.-...	6ES7 322-1HH0.-...	6ES7 322-1HF0.-...	6ES7 322-1HF1.-...	6ES7 322-5HF0.-...

Module type	Selection guide for analog inputs						
Physical measured variable	Voltage						
Encoder measurement range	± 80 mV ± 250 mV ± 500 mV ± 1 V ± 2.5 V		± 5 V 1 to 5 V ± 10 V	0 to 10 V		± 1 V ± 2.5 V ± 10 V 0 to 2 V 0 to 10 V	± 10 V ± 50 mV ± 500 mV 1 to 5 V ± 1 V ± 5 V
Diagnostics/interrupt capability	yes			no		yes	no
Operating error	± 1 %		± 0.1 %	± 0.9 %	± 0.7 %	± 0.15 %	± 0.6 %
No. of channels No. of groups	8 4	2 1	8 4	4 1	2 1	4 4	8 1
Resolution	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	8 bit	12 bit + sign	13 bit + sign	12 bit + sign
Conversion time per channel	min. 3 ms	min. 3 ms	min. 10 ms	5 ms	min. 85 ms	min. 0,2 ms	< 70 ms
Additional functions	Measurement of current, resistance and temperature (TC + RTD)	–	Measurement of current	2 analog outputs	Measurement of resistance and temperature (RTD), 2 analog outputs	Measurement of current, 4 analog outputs	Measurement of current, resistance and temperature
Order No. group	6ES7 331-7KF0.-...	6ES7 331-7KB0.-...	6ES7 331-7NF0.-...	6ES7 334-0CE0.-...	6ES7 334-0KE0.-...	6ES7 335-7HG0.-...	6ES7 331-1KF00-...

Module type	Selection guide for analog inputs					
Physical measured variable	Current					
Encoder measurement range	± 3.2 mA, ± 10 mA, ± 20 mA, 0 to 20 mA, 4 to 40 mA		± 20 mA 0 to 20 mA 4 to 40 mA	0 to 20 mA	± 10 mA 0 to 20 mA 4 to 40 mA	0 to 20 mA
Type of connection	2 and 4 wire transducer			4 wire transducer		2 and 4 wire transducer
Diagnostics/interrupt capability	yes			no	yes	no
Operating error	± 1 %		± 0.3 %	± 0.8 %	± 0.25 %	± 0.5 %
No. of channels No. of groups	8 4	2 1	8 4 (8)	4 1	4 4	8 1
Resolution	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	8 bit	13 bit + sign	12 bit + sign
Conversion time per channel	min. 3 ms	min. 3 ms	min. 10 ms	5 ms	min. 0.2 ms	< 70 ms
Additional functions	Measurement of voltage, resistance and temperature (TC + RTD)	–	Measurement of voltage	2 analog outputs	Measurement of voltage, 4 analog outputs	Measurement of voltage, resistance and temperature
Order No. group	6ES7 331-7KF0.-...	6ES7 331-1BH0.-...	6ES7 331-7NF0.-... (6ES7 331-7NF1.-...)	6ES7 334-0CE0.-...	6ES7 335-7HG0.-...	6ES7 331-1KF00-...

I/O modules - Selection guide for analog inputs

Module type	Selection guide for analog inputs				
Physical measured variable	Resistance				
Encoder measurement range	150 Ω, 300 Ω, 600 Ω			10 kΩ	600 Ω, 6 kΩ
Anschlussart	2- /3- /4 wire connection				
Diagnostics/interrupt capability	yes			no	
Operating error	± 1 %		± 0.1 %	± 3.5 %	± 0.5 %
No. of channels / **No. of groups**	4 / 4	1 / 1	8 / 4	4 / 2	8 / 1
Resolution	max. 14 bit + sign	max. 14 bit + sign	max. 15 bit + sign	12 bit + sign	12 bit + sign
Conversion time per channel	min. 3 ms	min. 3 ms	min. 10 ms	min. 85 ms	< 140 ms
Additional functions	Measurement of voltage, current and temperature (TC + RTD)	–	Measurement of temperature (RTD)	Measurement of temperature (RTD), 2 analog outputs	Measurement of currrent, voltage and temperature
Order No. group	6ES7 331-7KF0.-...	6ES7 331-7KB0.-...	6ES7 331-7PF0.-...	6ES7 334-0KE0.-...	6ES7 331-1KF00-...

Module type	Selection guide for analog inputs							
Physical measured variable	Temperature							
Encoder measurement range	Pt 100 (-120 - +130 °C)	Pt 100 Ni 100 (-200 - +385 °C)		Pt:100; 200; 500; 1000; Ni:100; 120; 200; 500; 1000; Cu 10 (-200 - +850 °C and -120 - +130 °C)	Thermoelements Typ E, N, J, K, L		Thermoelements Typ B, E, N, J, K, L, R, S, T, U	Pt 100 (-120 - +130 °C)
Diagnostics/interrupt capability	no	yes						no
Operating error	± 1 %			± 0,1 %	± 1 %		± 0.1 %	± 1 %
No. of channels / **No. of groups**	4 / 2	4 / 4	1 / 1	8 / 4	8 / 4	2 / 1	8 / 4	8 / 1
Resolution	max. 14 bit + sign	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	12 bit + sign
Conversion time per channel	min. 85 ms	min. 3 ms	min. 3 ms	min. 10 ms	min. 3 ms	min. 3 ms	min. 10 ms	< 140 ms
Additional functions	Measurement of resistance, 2 analog outputs	Measurement of voltage, current and temperature (TC)	–	Measurement of resistance	Measurement of voltage, current and temperature (RTD)	–	–	Measurement of voltage, current and temperature
Order No. group	6ES7 334-0KE0.-...	6ES7 331-7KF0.-...	6ES7 331-7KB0.-...	6ES7 331-7PF0.-...	6ES7 331-7KF0.-...	6ES7 331-7KB0.-...	6ES7 331-7PF1.-...	6ES7 331-1KF00-...

I/O modules - Selection guide for analog outputs

Type of module	Selection guide for analog outputs					
Physical measured variable	Voltage					
Encoder measurement range	0 to 10 V, 1 to 5 V, ± 10 V			0 to 10 V		0 to 10 V 0 to 2 V
Diagnostics capability	yes			no		yes
Operating error	± 0.5 %		± 0.12 %	± 0.6 %	± 1 %	± 0.5 %
Number of channels **Number of groups**	4 4	2 2	4 4	2 1	2 1	4 4
Resolution	12 bit	12 bit	max. 15 bit + sign	8 bit	12 bit + sign	13 bit + sign
Conversion time per channel	0.8 ms	0.8 ms	1.5 ms	2.5 ms	min. 85 ms	0.8 ms
Additional functions	Current output	Current output	Current output	Current output 4 analog inputs	4 analog inputs	Current output 4 analog inputs
Order No. group	6ES7 332-5HD0.-...	6ES7 332-5BH0.-...	6ES7 332-7ND0.-...	6ES7 334-0CE0.-...	6ES7 334-0KE0.-...	6ES7 335-7HG0.-...

Type of module	Selection guide for analog outputs			
Physical measured variable	Current			
Encoder measurement range	± 20 mA, 0 to 20 mA, 4 to 20 mA			0 to 20 mA
Type of connection	2 wire connection			
Diagnostics capability	yes			no
Operating error	± 0.6 %		± 0.18 %	± 1.0 %
Number of channels **Number of groups**	4 4	2 2	4 4	2 1
Resolution	12 bit	12 bit	max. 15 bit + sign	12 bit
Conversion time per channel	0.8 ms	0.8 ms	1.5 ms	0.8 ms
Additional functions	Power output	Power output	Power output	Power output, 4 analog outputs
Order No. group	6ES7 332-5HD0.-...	6ES7 332-5HB0.-...	6ES7 332-7ND0.-...	6ES7 334-0CE0.-...

Further information regarding SIMATIC controllers can be found in the Internet:
www.siemens.com/simatic-controller

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