

For System Solutions with  
Emphasis on Production Engineering



Product Brief • November 2003

# simatic

# S7-300



**SIEMENS**

# Introduction, application, benefits

Machine and plant constructors are being increasingly requested to offer more flexible and productive machines at reduced prices. This places new demands on the automation systems with respect to e.g. scope of functions, processing speed and size, as well as engineering and networking. PLCs are required with a large scope of functions and high processing speeds in a compact design. The networking facilities should be improved at the same time, but the engineering requirements should be simultaneously reduced.

SIMATIC® S7-300® is the most widely sold PLC within the context of Totally Integrated Automation with many successful reference applications worldwide found in many different industrial sectors. S7-300 users profit from the experience and global servicing facilities of the market leader as well as the quality associated with SIMATIC. This is the basis for increasing profits and improving competitiveness using innovative automation solutions.

The S7-300 has been designed for system solutions with the emphasis on production engineering, and is a universal automation platform providing optimum solutions for applications with central or distributed designs. Permanent innovations upgrade this automation platform even further. Examples include regular further development of the powerful CPU modules whose range now also includes a CPU with integral Ethernet/PROFINET interface for Component based Automation.

## 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, OEM



Production line in the automobile industry – automated with the S7-300

- Processing of plastics
- Packaging industry
- Food and drink industry
- Process engineering

## Special applications

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

- **Failsafe applications:** failsafe S7-300F as well as corresponding I/O are now possible <sup>1)</sup>
- For applications requiring powerful **technological and motion control functions:** Technology CPU 317T-2 DP <sup>1)</sup>
- **Machine control in compact form:** SIMATIC C7 all-in-one control systems with integral HMI on basis of the S7-300 CPUs <sup>1)</sup>
- **Distributed, intelligent preprocessing:** CPU in ET 200S and ET 200X design <sup>1)</sup>

## Low engineering costs

The S7-300 is characterized by efficient configuring and programming which results in low engineering costs. The huge quantity frameworks of the CPUs make the S7-300 an ideal platform for the task-oriented STEP 7 Engineering Tools complying to IEC 61131-3, for example high-level languages such as SCL. In addition, technology-oriented runtime software, e.g. Easy Motion Control can be used for motion control tasks.

The Engineering Tools also facilitate modular programming and re-usability of existing software. Engineering Tools not only support development but also readability, ease of maintenance and documentation of programs.

Additionally, powerful integrated system diagnostics increase controller availability and thus productivity. Configurable process diagnostics for analyzing process faults, reducing downtimes and further enhancing productivity are also implemented.

## Low operating costs

The Micro Memory Card (MMC) can act as data and program memory so that no backup battery is required and maintenance costs can partly be saved. The MMC can also accommodate a complete project, including symbols and comments, which makes servicing easier since no project data are required on the respective device.

The MMC also facilitates program updating. It permits read and write access during RUN so that, for instance, archiving of measured values or processing of recipes becomes easy.

<sup>1)</sup> Please refer to page 20 for order numbers of more detailed documentation

# Design and networking

## 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.

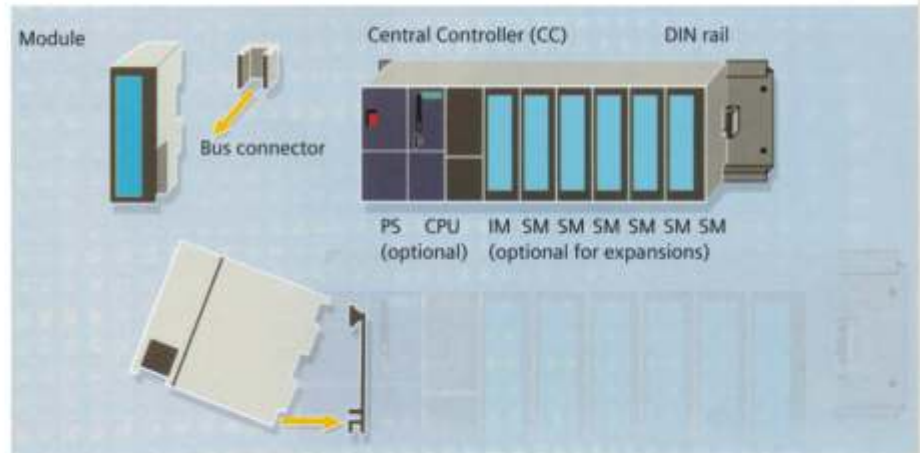
## Powerful, flexible networking

Interfaces that are directly integrated in the CPUs permit the configuration of a powerful communication landscape that employs standard bus technologies, e.g. for HMI and programming device functions. Sufficient connectivity is provided for numerous HMI devices. A routing function enables a programming device to be connected at any point in the network and to address all network nodes.

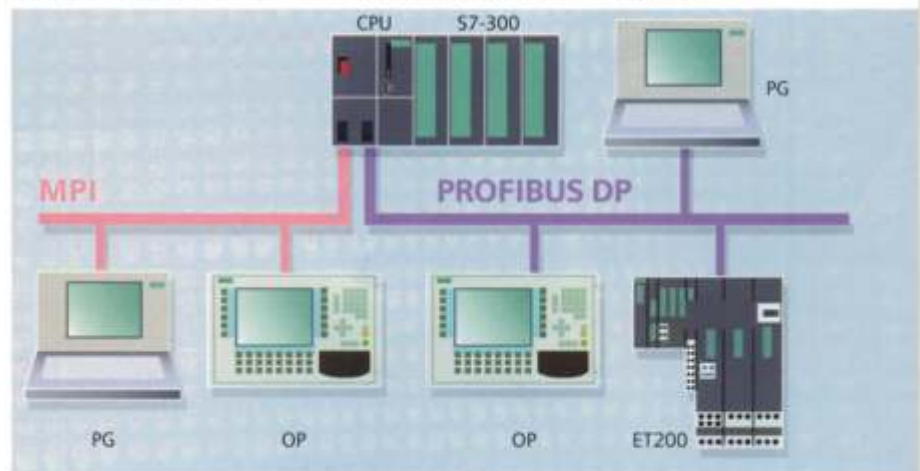
## Multi-point interface - MPI

MPI is the low-cost solution for communications with programming devices and PCs, HMI systems and other SIMATIC S7/C7/WinAC® controllers. A total of 125 MPI stations can be connected at transmission rates of 187.5 kbit/s, e.g. for exchanging process data among various controllers or for HMI functions without any programming overhead.

With the CPU 317 and 318-2 DP, the MPI can also be used as PROFIBUS DP interface and permits the configuration of two DP lines.



Configuration of the S7-300: space-saving, modular and extremely simple



Integrated interfaces of the S7-300 CPUs for direct connection to MPI and PROFIBUS DP

## PROFIBUS DP

For the economical configuration of large distributed networks, the SIMATIC S7-300 can also be connected to PROFIBUS DP (according to IEC 61158/EN 50170). This opens up communications options with a variety of communications partners - from the SIMATIC controller to third-party field devices.

Communications with existing SIMATIC S5 or SIMATIC 505 systems is also possible.

Distributed I/Os can be configured with STEP 7 like centralized I/Os which saves a lot of engineering overheads. The S7-300 can be used both as master and slave.

Support of the DP V1 functionality permits programming and optimization of field devices during operation, and therefore also shorter machine setup times. Detailed device diagnostics additionally reduces plant down times.

## Ethernet (PROFINet)

The new CPU with integral PROFINet interface is predestined for Component based Automation as well as programming and HMI via Ethernet. Omission of a communications processor which is otherwise required leads to lower purchasing costs and further space advantages.

# CPU spectrum

For setting up a programmable controller system, the user can choose from a graded spectrum of CPUs, from the starter model to the high-performance CPU. The CPUs enable short machine cycles thanks to their high processing speed. The narrow module width permits compact controller configurations and small control cabinet dimensions.

The so-called standard CPUs have a width of only 40 mm and are also available in two fail-safe designs.

A variety of compact CPUs with a width of 80 or 120 mm featuring additional integrated I/Os and technological functions are also available. This onboard I/O (digital/analog) and the technological functions, such as for counting, positioning and closed-loop control may save you from investing in additional modules.

The range is rounded off by a special technology CPU with powerful process functions.



CPU 314C-2 DP and CPU 315-2 DP (right)

Design	CPU	Integrated interfaces	Integrated I/O	Integrated technological functions	Technical specifications: see page
Standard CPUs	CPU 312	MPI			6
	CPU 314	MPI			6
	<b>NEW</b> CPU 315-2 DP	DP, MPI			6
	CPU 317-2 DP	DP, DP/MPI			6
	CPU 318-2 DP	DP, DP/MPI			7
Fail-safe CPUs	CPU 315F-2 DP	DP, MPI		Fail-safety	7
	CPU 317F-2 DP	DP, DP/MPI		Fail-safety	7
Compact CPUs	CPU 312C	MPI	Digital	Counting	8
	CPU 313C	MPI	Digital, analog	Counting	8
	CPU 313C-2 PtP	PtP, MPI	Digital	Counting	8
	CPU 313C-2 DP	DP, MPI	Digital	Counting	8
	CPU 314C-2 PtP	PtP, MPI	Digital, analog	• Counting • Positioning	9
	CPU 314C-2 DP	DP, MPI	Digital, analog	• Counting • Positioning	9
Technology CPU	CPU 317T-2 DP	DP, DP/MPI	Digital	• Synchronism • Travel to fixed stop • Print mark control • Cam switching • Controlled positioning	9

# CPU spectrum

All CPUs 317 have 512 KB of working memory and enable extensive use of STEP 7 Engineering Tools and technologically oriented runtime software. They also offer highly flexible networking since up to 32 active links with other nodes, e.g. programming devices and operator panels can be built up simultaneously.

As many as four versions of high-end CPUs are available for a variety of applications:

- The 317-2 DP standard CPU is suitable for the most common control tasks with a high share of communications functions. Both DP interfaces are available as combined DP/MPPI interfaces and can be configured either as PROFIBUS master or PROFIBUS slave.
- The PROFINET-CPU 317-2 PN/DP offers a combined PROFIBUS DP/MPPI interface and a PROFINET interface for 100 Mbit/s, based on Ethernet as the communications standard. It can therefore also be used as a router between Ethernet and PROFIBUS. The PROFINET communications functions (PN stands for PROFINET) are used for Component based Automation in modular plant and machine construction. Communication is carried out using Ethernet-TCP/IP with the PROFINET and S7 protocols. The CPU 317-2 PN/DP can also be programmed via the PROFINET interface using STEP 7.
- The fail-safe 317F-2 DP CPU offers failsafety system expansions in comparison to the standard CPU and the PROFIsafe profile for safe communications. It complies with major specifications/standards:
  - IEC 61508 (SIL 3),
  - EN 954 (Category 4) and
  - NFPA 79, NFPA 85

It has an approval from the German Technical Inspectorate (TÜV).

Safety-relevant programs can be programmed using the STEP 7 LAD and FBD languages and certified programming examples from the F library of Distributed Safety.



CPU 317-2 DP – the standard CPU with two DP interfaces

For expansion, the fail-safe ET 200S and ET 200M stations are available.

- The technology CPU 317T-2 DP integrates powerful technology and motion control functions in the CPU. It is designed for dynamic motion control of multiple axes. Pre-programmed, PLCopen-compliant motion control functions, integral discrete I/O, equidistance and isochrone mode of PROFIBUS DP permit flexible motion control of several (even coupled) axes, for example controlled positioning, synchronism and/or cam switching.

STEP 7 enables convenient configuration and parameterization of the axes.

#### The six compact CPUs

- CPU 312C
- CPU 313C
- CPU 313C-2 PtP
- CPU 313C-2 DP
- CPU 314C-2 PtP
- CPU 314C-2 DP

with integral I/O and technological functions have additional convincing features:

- Fast recording of actual values with direct access to hardware counters and inputs for the counting and frequency measurement functions permits an excellent dynamic response, e.g. for positioning tasks.



CPU 317T-2 DP – the technology CPU for motion control functions

- In cooperation with the integral analog output, the positioning functions permit direct control of MICROMASTER frequency converters.
- The high processing rate for floating-point commands permits extremely fast program execution where mathematical tasks are involved.
- By scanning the serial number of the MMC during operation, it is possible to implement copy protection for the user software.
- The large number of function calls and data blocks facilitate the portability of user programs which were developed for "standard" CPUs and are now also to be used on compact CPUs.

NEW

# Standard CPUs



	Standard CPUs				
	CPU 312	CPU 314	CPU 315-2 DP	CPU 317-2 DP	CPU 317-2 PN/DP
<b>Main memory/ instructions</b>	16 Kbyte/5 K	48 Kbyte/16 K	128 Kbyte/42 K	512 Kbyte/170 K	
<b>Load memory</b>	64 KB to 4 MB through MMC	64 Kbyte to 8 Mbyte through MMC			
<b>Backup</b>	all blocks through MMC			all blocks to max. 256 Kbyte	
<b>Processing times</b>					
• Bit operations	0.2 µs	0.1 µs		0.05 µs	
• Word operation	2 µs	1 µs		0.2 µs	
• Fixed-point arithmetic	5 µs	2 µs		0.2 µs	
• Floating-point arithmetic	6 µs	3 µs		1 µs	
<b>Bit memories/timers/ counters</b>					
• Bit memories	128 byte	256 byte	2048 byte	4096 byte	
• S7 timers / counters	128/128	256/256	256/256	512/512	
• IEC timers / counters	✓	✓	✓	✓	
<b>Number of blocks</b>					
• Number of loadable blocks (FCs+FBs+DBs)	1024		1024	2048	
• Range of numbers	512 FC, 512 FB, 511 DB		2048 FC, 2048 FB, 1023 DB	2048 FC, 2048 FB, 2047 DB	
<b>Organization blocks (OB)</b>	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), (OB 21 [not 315-2 DP]), time-triggered (OB 35), (OB32-34 [not 315-2 DP]), interrupt-triggered (OB 40), DPV1 restart (OB 55-57), restart (OB 100), asyn. error (OB 80, 82, 85-87), syn. error (OB 121,122)		
<b>Address ranges</b>					
• I/O address area	1024/1024 byte	1024/1024 byte	2048/2048 byte	8192/8192 byte	
• I/O process image	128/128 byte	128/128 byte	128/128 byte	256/256 byte	
• Digital channels (central)	256	1024	1024	1024	
• Analog channels (central)	64	256	256	256	
<b>Expansions</b>					
• Racks	1	max. 4			
• Modules per rack	8	8			
<b>DP interfaces</b>					
• Number of DP master systems int./CP 342-5	–	–	1/1	2/2	1/2
• Equidistant	–	–	✓	✓	✓
• Activat./deact. DP slaves	–	–	✓	✓	✓
• Transmission speed	–	–	12 Mbit/s	12 Mbit/s	12 Mbit/s
• No. of slaves per station	–	–	124	124	124
• Lateral communication	–	–	✓	✓	✓
<b>PROFINet interface</b>	–	–	–	–	✓
• Transmission rate					100 Mbit/s
• PROFINet/CBA					✓
• PROFINet I/O					Available soon
• S7 communication					✓
• PG/OP communication					✓
<b>Dimensions (mm)</b>	40 x 125 x 130	40 x 125 x 130	40 x 125 x 130	80 x 125 x 130	
<b>MLFB group</b>	6ES7312-1AD..	6ES7314-1AF..	6ES7315-2AG..	6ES7317-2AJ..	6ES7317-2EJ..

# Standard CPUs – Fail-safe CPUs

	Standard CPU	Fail-safe CPUs	
	CPU 318-2 DP	CPU 315F-2 DP	CPU 317F-2 DP
<b>Main memory/ instructions</b>	512 KByte, of which max. 256 KByte Code and max. 256 KByte instructions	192 Kbyte/36 K F-instructions	512 Kbyte/100 K F-instructions
<b>Load memory</b>	–	64 Kbyte to 8 Mbyte through MMC	
<b>Backup</b>	<ul style="list-style-type: none"> <li>8 Kbyte bit memories, timers, counters, data without battery</li> <li>all blocks with battery</li> </ul>	all blocks to max. 256 Kbyte	
<b>Processing times</b>			
• Bit operations	0.1 µs	0.1 µs	0.1 µs
• Word operation	0.1 µs	1 µs	0.2 µs
• Fixed-point arithmetic	0.1 µs	2 µs	0.2 µs
• Floating-point arithmetic	0.6 µs	3 µs	1 µs
<b>Bit memories/ timers/counters</b>			
• Bit memories	1024 byte	2048 byte	4096 byte
• S7 timers / counters	512/512	256/256	512/512
• IEC timers / counters	✓	✓	✓
<b>Number of blocks</b>			
• Number of loadable blocks (Sum of FCs + FBs + DBs)	1024 FC, 1024 FB, 2047 DB	1024	2048
• Range of numbers	1024 FC, 1024 FB, 2047 DB	2048 FC, 2048 FB, 1023 DB	2048 FC, 2048 FB, 2047 DB
<b>Organization blocks (OB)</b>	real-time interrupt (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, 84-87) 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) DPVI restart (OB 55-57) restart (OB 100) asyn. error (OB 80, 82, 85-87) syn. error (OB 121, 122)	as for 315F-2 DP Supplementary: Delay alarm (OB 21) Time-triggered (OB 32-34)
<b>Address ranges</b>			
• I/O address area	8192/8192 byte	2048/2048 byte	8192/8192 byte
• I/O process image	2048/2048 byte	384/384 byte	1024/1024 byte
• Digital channels (central)	1024	1024	1024
• Analog channels (central)	256	256	256
<b>Expansions</b>			
• Racks	max. 4	max. 4	
• Modules per rack	8	8	
<b>DP interfaces</b>			
• Number of DP master systems int./CP 342-5	2/2	1/1	2/2
• Equidistant	✓	✓	✓
• Activation/deactivation of slaves	–	✓	✓
• Transmission speed	12 Mbit/s	12 Mbit/s	12 Mbit/s
• No. of slaves per station	32 (MPI-SS), 125 (DP-SS)/ 64	124	124
• Lateral communication	✓; sender and receiver	✓	✓
<b>Dimensions (mm)</b>	160 x 125 x 130	40 x 125 x 130	80 x 125 x 130
<b>Order No. group</b>	6ES7318-2AJ..	6ES7315-6FF..	6ES7317-6FF..

# Compact CPUs

	Compact CPUs			
	CPU 312C	CPU 313C	CPU 313C-2 PtP	CPU 313C-2 DP
<b>Main memory/instruc.</b>	16 Kbyte/4 K	32 Kbyte/10 K	32 Kbyte/10 K	32 Kbyte/10 K
<b>Load memory</b>	64 Kbyte to 4 Mbyte through MMC	64 Kbyte to 8 Mbyte through MMC		
<b>Backup</b>	all blocks through MMC			
<b>Processing times</b>				
• Bit operations	0.2 µs	0.1 µs		
• Word/fixed point/floating-point arithmetic ops	2/5/6 µs	1/2/3 µs		
<b>Bit mem./tim./counters</b>				
• Bit memories	128 byte	256 byte		
• S7 timers / counters	128/128	256/256		
• IEC timers / counters	✓	✓		
<b>Number of blocks</b>				
• No. of loadable blocks	1024			
• Range of numbers	512 FC, 512 FB, 511 DB			
<b>Program processing</b>	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), asynchronous error (OB 80, 82, 85, 87), synchronous error (OB 121, 122), station failure/restoration (OB 86, only with CPU 313C-2 DP)			
<b>Address ranges</b>				
• I/O address range	1024/1024 byte	1024/1024 byte	1024/1024 byte	1024/1024 byte
• I/O process range	128/128 byte	128/128 byte	128/128 byte	128/128 byte
• Digital channels (cent.)	266	1016	1008	1008
• Analog channels (cent.)	64	253	248	248
<b>Expansions</b>				
• Racks	1	max. 4		
• Modules per rack	8	8		
<b>DP interfaces</b>				
• No. of DP master systems int./CP 342-5	–			1/1
• Equidistant	–			✓
• Act./deact. of slaves	–			✓
• Transmission speed	–			12 Mbit/s
• No. of DP slaves / station	–			32
• Lateral communication	–			✓
<b>Integrated functions</b>				
• Counters	2 incremental encoders 24 V/10 kHz	3 incremental encoders 24 V/30 kHz		
• Pulse outputs	2 channel pulse-width modulation max. 2.5 kHz	3 channel pulse-width modulation max. 2.5 kHz		
• Freq. measurement	2 channels max. 10 kHz	3 channels max. 30 kHz		
• Controlled positioning	–	–		
• Integ. FBs "loop control"	–	PID controller		
<b>Integrated I/O</b>				
• Digital inputs	10; 24 V DC; all channels can be used for process alarms	24; 24 V DC; all channels can be used for process alarms	16; 24 V DC; all channels can be used for process alarms	
• Digital outputs	6; 24 V DC, 0.5 A	16; 24 V DC, 0.5 A	16; 24 V DC, 0.5 A	
• Analog inputs	–	4: ± 10 V, 0 to 10 V, ± 20 mA, 0/4 to 20 mA; 1: 0 to 600 Ω, PT100	–	
• Analog outputs	–	2: ± 10 V, 0 to 10 V, ± 20 mA, 0/4 to 20 mA	–	
<b>PtP interface</b>				
• Physics	–		RS485/422	–
• Protocol driver	–		3964 (R), ASCII	–
<b>Dimensions (mm)</b>	80 x 125 x 130	120 x 125 x 130		
<b>Req. front connector</b>	1 x 40 pin	2 x 40 pin	1 x 40 pin	1 x 40 pin
<b>Order No. group</b>	6ES7312-5BD..	6ES7313-5BE..	6ES7313-6BE..	6ES7313-6CE..



# Compact CPUs – Technology CPU

	Compact CPUs		Technology CPU
	CPU 314C-2 PtP	CPU 314C-2 DP	CPU 317T-2DP
<b>Main memory / instructions</b>	48 Kbyte/16 K	48 Kbyte/16 K	512 Kbyte/170 K
<b>Load memory</b>	64 Kbyte to 8 Mbyte through MMC		64 Kbyte - 8 Mbyte through MMC
<b>Backup</b>	all blocks through MMC		all blocks up to 256 Kbyte through MMC
<b>Processing times</b>			
• Bit operations	0.1 µs	0.1 µs	0.05 µs
• Word operations/fixed point a./floating point arithmetic	1/2/3 µs	1/2/3 µs	0.2/0.2/1 µs
<b>Bit memories/timers/counters</b>			
• Bit memories	256 byte	256 byte	4096 byte
• S7 timers / counters	256/256	256/256	512/512
• IEC timers / counters	✓	✓	✓
<b>Number of blocks</b>			
• Number of loadable blocks	1024	1024	2048
• Range of numbers	512 FC, 512 FB, 511 DB	512 FC, 512 FB, 511 DB	2048 FC, 2048 FB, 2047 DB
<b>Program processing</b>	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), asynchronous error (OB 80, 82, 85, 87), synchronous error (OB 121, 122), station failure/restoration (OB 86, only with CPU 314C-2 DP)		as for CPU 317F-2 DP
<b>Address range</b>			
• I/O address range	1024/1024 byte	1024/1024 byte	8192/8192 byte
• I/O process range	128/128 byte	128/128 byte	256/256 byte
• Digital channels (central)	1016	1016	1024
• Analog channels (central)	253	253	256
<b>Expansions</b>			
• Racks	max. 4	max. 4	1
• Modules per rack	8	8	8
<b>DP interfaces</b>			
• No. of DP master systems int./ CP 342-5	–	1/1	2/2
• Equidistant	–	✓	✓
• Activation/deactivation of slaves	–	✓	✓
• Transmission speed	–	12 Mbit/s	12 Mbit/s
• No. of DP slaves / station	–	32	124
• Lateral communication	–	✓	✓
<b>Integrated functions</b>	<ul style="list-style-type: none"> <li>Counters: 4 incremental encoders 24 V/60 kHz</li> <li>Pulse outputs: 4 channel pulse-width modulation max. 2.5 kHz</li> <li>Frequency measurement: 4 channels max. 60 kHz</li> <li>Controlled positioning: SFB for positioning 1 axis using 2 DA, AA</li> <li>Integrated FBs "loop control": PID controller</li> </ul>		<ul style="list-style-type: none"> <li>Gear and curve synchronism</li> <li>Travel to fixed stop</li> <li>Print mark control via measuring probes</li> <li>Path or time-controlled cam switching</li> <li>Controlled positioning</li> </ul>
<b>Integrated I/Os</b>			
• Digital inputs	24; 24 V DC; all channels can be used for process alarms		4; 24 V DC; for BERO evaluation
• Digital outputs	16; 24 V DC, 0.5 A		8; 24 V DC; 0.6 A; for fast cam switching functions
• Analog inputs	4: ± 10 V, 0 to 10 V, ± 20 mA, 0/4 to 20 mA; 1: 0 to 600 Ω, PT100		–
• Analog outputs	2: ± 10 V, 0-10 V, ± 20 mA, 0/4-20 mA		–
<b>PtP interface</b>	RS485/422	–	–
• Protocol driver	3964 (R), RK512, ASCII	–	–
<b>Dimensions</b>	120 x 125 x 130	120 x 125 x 130	160 x 125 x 130
<b>Required front connector</b>	2 x 40 pin	2 x 40 pin	1 x 40 pin
<b>Order No. group</b>	6ES7314-6BF..	6ES7314-6CF..	6ES7317-6TJ..

# Fail-safe 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 applications in the production industry.

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 PROFIsafe-Profile) 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.



*Mixed configuration of standard and fail-safe modules, including motor starters*

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# Programming with STEP 7 and Engineering Tools

The S7-300 is programmed with the basic 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, such as Engineering Tools, cannot be used for simulation. 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 open additional possibilities to program automation solutions in a user-friendly, task oriented manner. The following tools are available for programming:

### S7-SCL

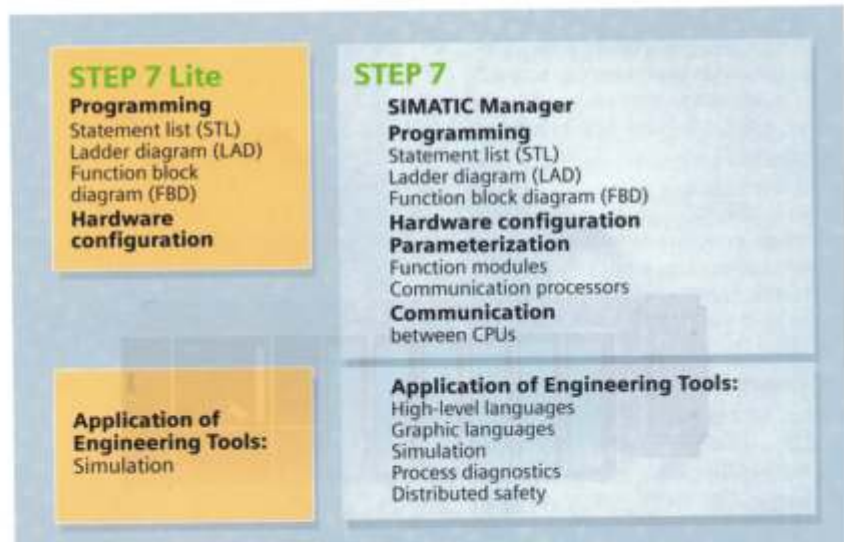
(Structured Control Language), the high-level language based on PASCAL for programming SIMATIC S7/C7 controllers

### S7-GRAPH

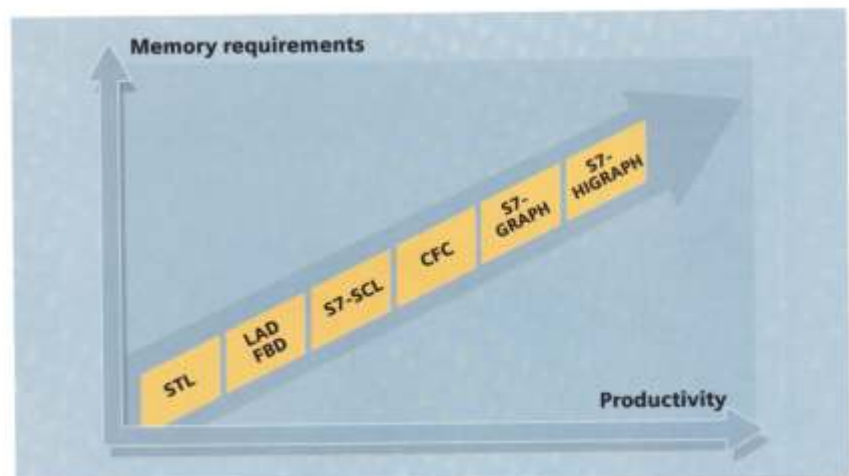
for graphic configuration of sequential controls for SIMATIC S7/C7

### 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 requirement of engineering tools

## CFC

(Continuous Function Chart), the technological plan for graphic interconnection of complex functions for SIMATIC S7

## Distributed Safety

Software package for generating safety-related programs in LAD and FBD, including F library with programming examples

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 and CFC) are used, CPUs 314 and higher are recommended.

# Communication - Ethernet, PROFIBUS and more

## Totally Integrated Automation

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 cell networking.

**PROFIBUS** (IEC 61158/EN 50170) – the international standard for the cell and field areas, as well as PROFIBUS PA for intrinsically-safe process automation applications. PROFINET, the Ethernet standard of PROFIBUS International (PNO), allows connection of PROFIBUS segments to Industrial Ethernet using a PROFINET device with proxy function.

**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.

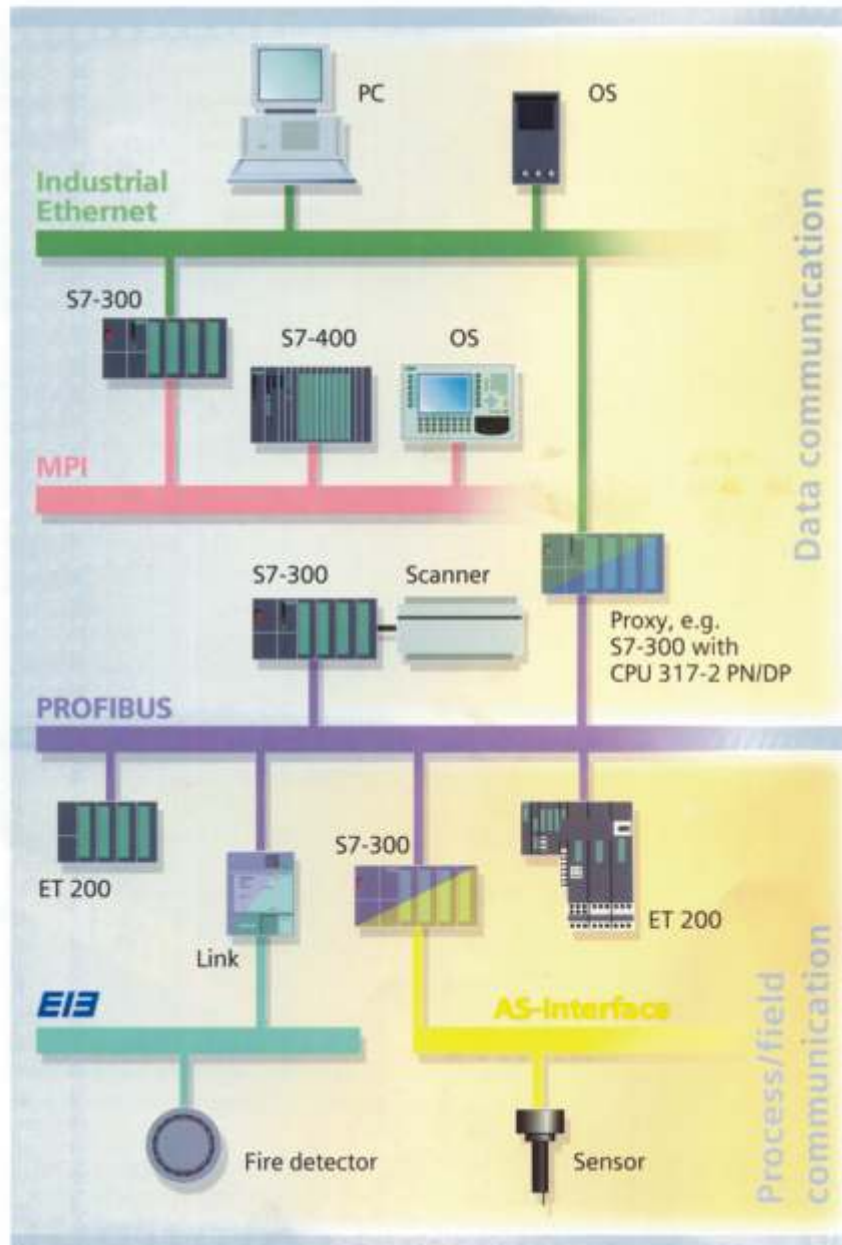
**Point-to-point coupling** – for communication between two nodes with special protocols. The point-to-point structure represents the simplest communication form. Different special protocols are used (e.g. RK 512, 3964(R) and ASCII).

## 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



The S7-300 can be connected to all kinds of networks

- S7-300 are simply assigned to the HTML objects.
- Monitoring the S7-300 using these Web pages with a standard browser.
- Sending e-mails from the user profile of the S7-300 through FC calls.
- Remote programming through the TCP/IP using telephone network as well (e.g. ISDN).

# 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 with 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)<sup>1</sup>. 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 6ES536 I/O connections can be used (up to 125 stations, for example ET 200M using IM 153).

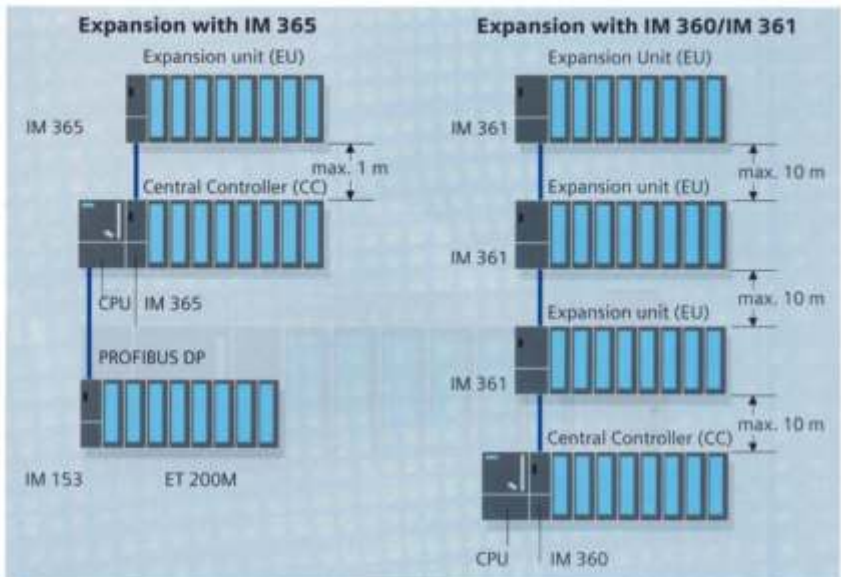
The slots are freely addressable, i.e. no slot rules exist<sup>2</sup>.

<sup>1</sup>) except for CPU 312 IFM, 312C, 313C and 317T-2 DP

<sup>2</sup>) except for CPU 312, 312 IFM, 312C, 313, 314, 314 IFM and 317T-2 DP

Communication
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
Connection to the fieldbus AS-Interface for communicating with binary sensors and actuators
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
Connection to Industrial Ethernet using ISO/TCP or TCP/IP protocol for data communication

Technology
Counting in different operating modes up to 500 kHz, measuring up to 100 kHz and proportioning
Cam controls with up to 13 cam tracks per module
All sorts of positioning tasks: <ul style="list-style-type: none"> <li>• Controlled positioning in rapid-traverse/creep-speed mode</li> <li>• Point-to-point positioning and profiles using stepper and servomotors</li> <li>• Point-to-point multi-axis interpolation using stepper and servomotors</li> </ul>
Connection of positioning drives with PROFIBUS DP
PID controller with backup capability and integrated, online self configuration for different types of controllers (continuous controllers, stepper controllers, pulse controllers)



Centralized expansion of the S7-300 to a maximum of 32 modules

# 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.

## Fast connection

Using SIMATIC TOP connect makes it even easier to connect (not for onboard I/Os of compact CPUs). You can choose between prewired front connectors with individual strands and a completely modular building block system, consisting of front connector module, cable and terminal block.

## High packaging density

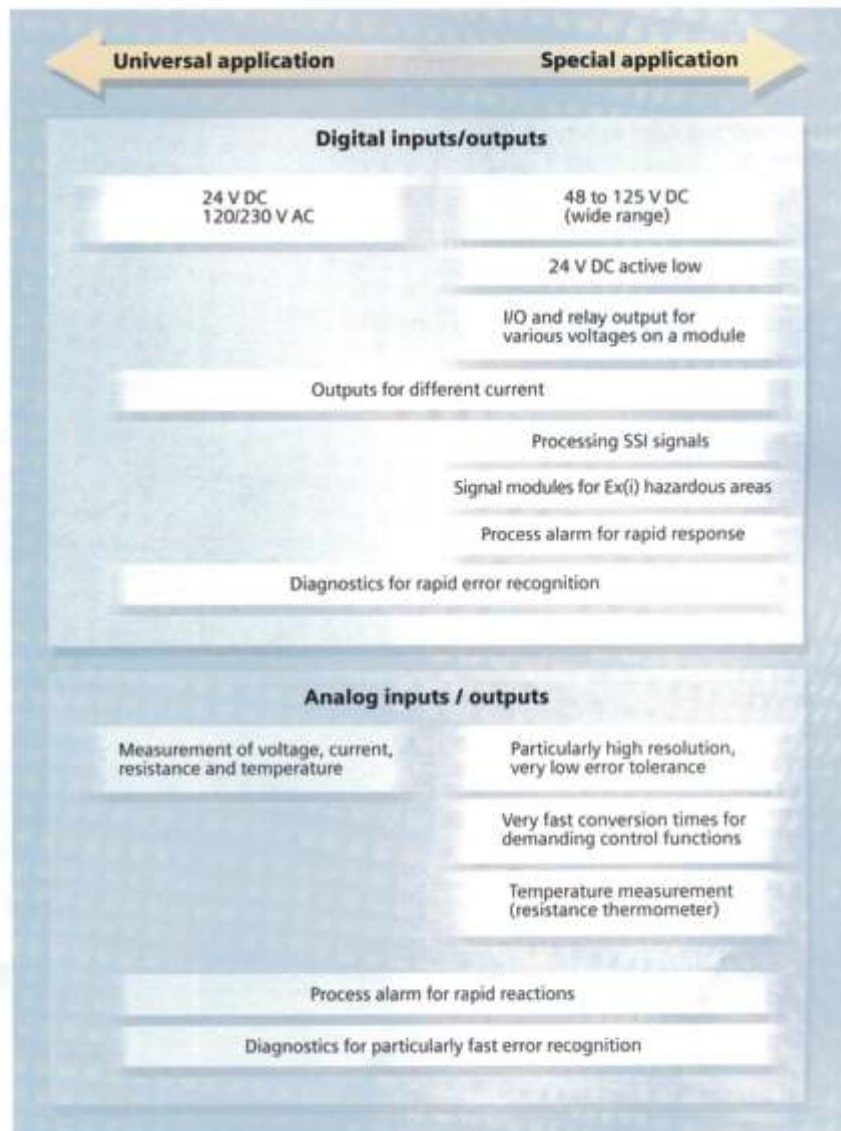
The large number of channels on each module is the one reason for the space-saving design of the S7-300: Modules are available with 8 to 32 channels (digital) and 2 to 8 channels (analog).

## 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 new module to prevent setup errors. No software upgrading is necessary when using new modules. Configurations which have been carried out once 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.



Signal modules for universal and special applications

## 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.

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.com/automation/ca01](http://www.siemens.com/automation/ca01)  
[www.siemens.com/automation/mall](http://www.siemens.com/automation/mall)

# I/O modules - Selection guide for digital inputs bom Ol

Module type	Selection guide for digital inputs				
Voltage	DC				
Suitable for	Switches and 2-/3-/4 wire proximity switches (BEROs)				
Input voltage	24 V				
Source/sink inputs	P				
Diagnostics/interrupt capability	✓	–	–	–	–
Input delay	0.1 - 20 ms (parameterizable)	typ. 3 ms (fixed)			
Number of channels	16	16	32	8	16
Galvanic isolation: Number of groups	1	1	2	1	1
Extras	suitable for isochronous mode	–	–	8 DO	16 DO
Order No. group	6ES7 321-7BH0-....	6ES7 321-1BH0-....	6ES7 321-1BL0-....	6ES7 323-1BH0-....	6ES7 323-1BL0-....

Module type	Selection guide for digital inputs				
Voltage	DC				UC Universal voltage
Suitable for	Switches and 2-/3-/4 wire proximity switches (BEROs)		NAMUR encoders	Switches and 2-/3-/4 wire proximity switches (BEROs)	
Input voltage	24 V			48 to 125 V	UC 24/48 V
Source/sink inputs	M	P		–	–
Diagnostics/interrupt capability	–	–	✓	–	–
Input delay	typ. 3 ms	0.05 ms	3 ms	10 ms	< 6 ms
Number of channels	16	16	16	16	16
Galvanic isolation: Number of groups	1	1	2	8	16
Extras	–	suitable for isochronous mode	includes many functions for control and instrumentation technology	–	–
Order No. group	6ES7 321-1BH5-....	6ES7 321-1BH10-....	6ES7 321-7TH00-....	6ES7 321-1CH20-....	6ES7 321-1CH00-....

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	120/230 V	120/230 V	120/230 V
Source/sink inputs	P	P	P	P
Diagnostics/interrupt capability	–	–	–	–
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 321-1FL0-....	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				
Output current	0.5 A				
Diagnostics/interrupt capability	-				
Number of channels	16	16	32	8	16
Galvanic isolation: Number of groups	2	2	4	1	1
Extras	-	suitable for isochronous mode	-	8 DI	16 DI
Order No. group	6ES7 322-1BH0-....	6ES7 322-1BH10-....	6ES7 322-1BL0-....	6ES7 323-1BH0-....	6ES7 323-1BL0-....

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	✓		-	
Number of channels	8	16	8	8
Galvanic isolation: Number of groups	1	4	2	4
Extras	-	includes many functions for control and instrumentation technology	-	-
Order No. group	6ES7 322-1BF0-....	6ES7 322-8BH00-....	6ES7 322-1BF0-....	6ES7 322-1CF00-....

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	DC: 24 - 120 V	24 to 120 V DC		48 to 230 V AC		24 V/ 48 V
Output current	1 A	1 A	2 A	1 A	1 A	2 A	3 A	5 A			0.5 A
Diagnostics/interrupt capability	-	-	✓/!	-	-	-			✓/!	✓	
Number of channels	16	8	8	32	16	8	8	8	8	16	
Galvanic isolation: Number of groups	2	2	8	4	2	4	8	8	8	16	
Extras	-	-	-	-	-	-	-	-	-	-	
Order No. group 6ES7 322-	1FH0-....	1FF0-....	5FF0-....	1EL0-....	1HH0-....	1HF0-....	1HF1-....	5HF0-....	5GH00-....		



# I/O modules - Selection guide for analog inputs

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	± 1 V ± 5 mV ± 10 mV 1 to 5 V
Diagnostics/interrupt capability	✓		-		✓		-	
Operating error	± 1 %		± 0.1 %	± 0.9 %	± 0.7 %	± 0.15 %	± 0.6 %	± 0.4 %
No. of channels	8	2	8	4	2	4	8	8
No. of groups	4	1	4	1	1	4	1	1
Resolution	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	8 bit	12 bit + sign	13 bit + sign	12 bit + sign	13 bit + sign
Conversion time / channel	min. 3 ms	min. 3 ms	min. 10 ms	5 ms	min. 85 ms	min. 0.2 ms	< 70 ms	52 µs
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	Suitable for isochrone mode
Order No. group	6ES7 331-7KF0-...	6ES7 331-7KB0-...	6ES7 331-7NF0-...	6ES7 334-0CE0-...	6ES7 334-0KE0-...	6ES7 335-7HG0-...	6ES7 331-1KF0-...	6ES7 331-7HF0-...

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	± 20 mA 0 to 20 mA 4 to 20 mA
Type of connection	2 and 4 wire transducer			4 wire transducer		2 and 4 wire transducer		
Diagnostics/interrupt capability	✓		-		✓		-	
Operating error	± 1 %		± 0.3 %	± 0.8 %	± 0.25 %	± 0.5 %	± 0.3 %	
No. of channels	8	2	8	4	4	8	8	8
No. of groups	4	1	4 (8)	1	4	1	1	1
Resolution	max. 14 bit + sign	max. 14 bit + sign	15 bit + sign	8 bit	13 bit + sign	12 bit + sign	12 bit + sign	13 bit + sign
Conversion time / channel	min. 3 ms	min. 3 ms	min. 10 ms	5 ms	min. 0.2 ms	< 70 ms	< 70 ms	52 µs
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	Measurement of voltage, resistance and temperature	Suitable for isochrone mode
Order No. group	6ES7 331-7KF0-...	6ES7 331-1BH0-...	6ES7 331-7NF0-... (6ES7 331-7NF1-...)	6ES7 334-0CE0-...	6ES7 335-7HG0-...	6ES7 331-1KF0-...	6ES7 331-1KF0-...	6ES7 331-7HF0-...

# 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	
Type of connection	2- / 3- / 4 wire connection				
Diagnostics/interrupt capability	✓		-		
Operating error	± 1 %		± 0.1 %	± 3.5 %	± 0.5 %
No. of channels	4	1	8	4	8
No. of groups	4	1	4	2	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 current, voltage and temperature
Order No. group	6ES7 331-7KF0.-...	6ES7 331-7KB0.-...	6ES7 331-7PF0.-...	6ES7 334-0KE0.-...	6ES7 331-1KF0.-...

Module type	Selection guide for analog inputs							
Physical measured variable	Temperature							
Encoder measurement range	Pt 100 (-120 to +130 °C)	Pt 100 Ni 100 (-200 to +385 °C)		Pt:100; 200; 500; 1000; Ni:100; 120; 200; 500; 1000; Cu 10 (-200 to +850 °C and -120 to +130 °C)	Thermocouples Type E, N, J, K, L		Thermocouples Type B, E, N, J, K, L, R, S, T, U	Pt 100 (-120 to +130 °C) Ni 100; Ni 1000; LG-Ni 1000; (both standard and climate)
Diagnostics/interrupt capability	-		✓		-			-
Operating error	± 1 %			± 0.1 %	± 1 %		± 0.1 %	± 1 %
No. of channels	4	4	1	8	8	2	8	8
No. of groups	2	4	1	4	4	1	4	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 331-1KF0.-...

# I/O modules - Selection guide for analog outputs

an Production engineering

Type of module	Selection guide for analog outputs					
Physical measured variable	Voltage					
Encoder measurement range	0 to 10 V, 1 to 5 V, $\pm 10$ V			0 to 10 V	0 to 10 V 0 to 2 V	
Diagnostics capability	✓			-	✓	
Operating error	$\pm 0.5$ %		$\pm 0.12$ %	$\pm 0.6$ %	$\pm 1$ %	$\pm 0.5$ %
No. of channels	4	2	4	2	2	4
No. of groups	4	2	4	1	1	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, suitable for isochronous operation	Current output 4 analog inputs	4 analog inputs	Current output, 4 analog inputs
Order No. group	6ES7 332-5HD0-....	6ES7 332-5B80-....	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	$\pm 20$ mA, 0 to 20 mA, 4 to 20 mA			0 to 20 mA
Type of connection	2 wire connection			
Diagnostics capability	✓			-
Operating error	$\pm 0.6$ %			$\pm 0.18$ % $\pm 1.0$ %
No. of channels	4	2	4	2
No. of groups	4	2	4	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	Voltage output	Voltage output	Voltage output	Voltage output, 4 analog inputs
Order No. group	6ES7 332-5HD0-....	6ES7 332-5B80-....	6ES7 332-7ND0-....	6ES7 334-0CE0-....

# Standards

## The SIMATIC S7-300 fulfills the following national and international standards:

- DIN, EN, IEC
- UL certificate
- cULus
- FM class 1 div. 2: groups A, B, C and D
- Temperature group T4 ( $\leq 135\text{ }^{\circ}\text{C}$ )
- Marine approvals from:
  - American Bureau of Shipping
  - Bureau Veritas
  - Des Norske Veritas
  - Germanischer Lloyd
  - Lloyds Register of Shipping
- Ambient temperature 0 to 60  $^{\circ}\text{C}$  for all components
- Earthquake-proof
- EU regulation 94/9/EC (ATEX 100a)

## The fail-safe CPUs additionally comply with the following standards:

- IEC 61508 (SIL 3)
- EN 954 (Cat. 4)
- NFPA 79, NFPA 85

An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract. Availability and technical specifications are subject to change without notice.

## Product briefs on further variants of the S7-300 for special applications

Product brief	MLFB group
Fail-safe with SIMATIC	6ZB5310-OKE02-0BA.
Technology CPU 317T-2 DP	6ZB5310-OLM02-0BA.
Control Systems C7	6ZB5310-OFM02-0BA.
Bit-modular distributed I/O system ET200S	6ZB5310-OKG02-0BA.
Cabinetless distributed I/O ET200 with protection IP65/67	6ZB5310-OKN02-0BA.
Basics of explosion protection	6ZB5310-OLE02-0BA.
Technological tasks with SIMATIC	E20001-A430-P210
Point-to-point coupler modules	6ZB5310-OKF02-0BA.
AS-Interface	E20001-A150-P302
PROFIBUS	6ZB5530-0AQ02-0BB.
Industrial Ethernet	6ZB5530-0AK02-0BA.

The information provided in this brochure contains descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products.

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

To get in touch with **your contact person** near you, look in the Internet under: [www.siemens.com/automation/partner](http://www.siemens.com/automation/partner)

With the **A&D Mail** you can order electronically using the Internet [www.siemens.com/automation/mail](http://www.siemens.com/automation/mail)

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[www.siemens.com/simatic-s7-300](http://www.siemens.com/simatic-s7-300)

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