

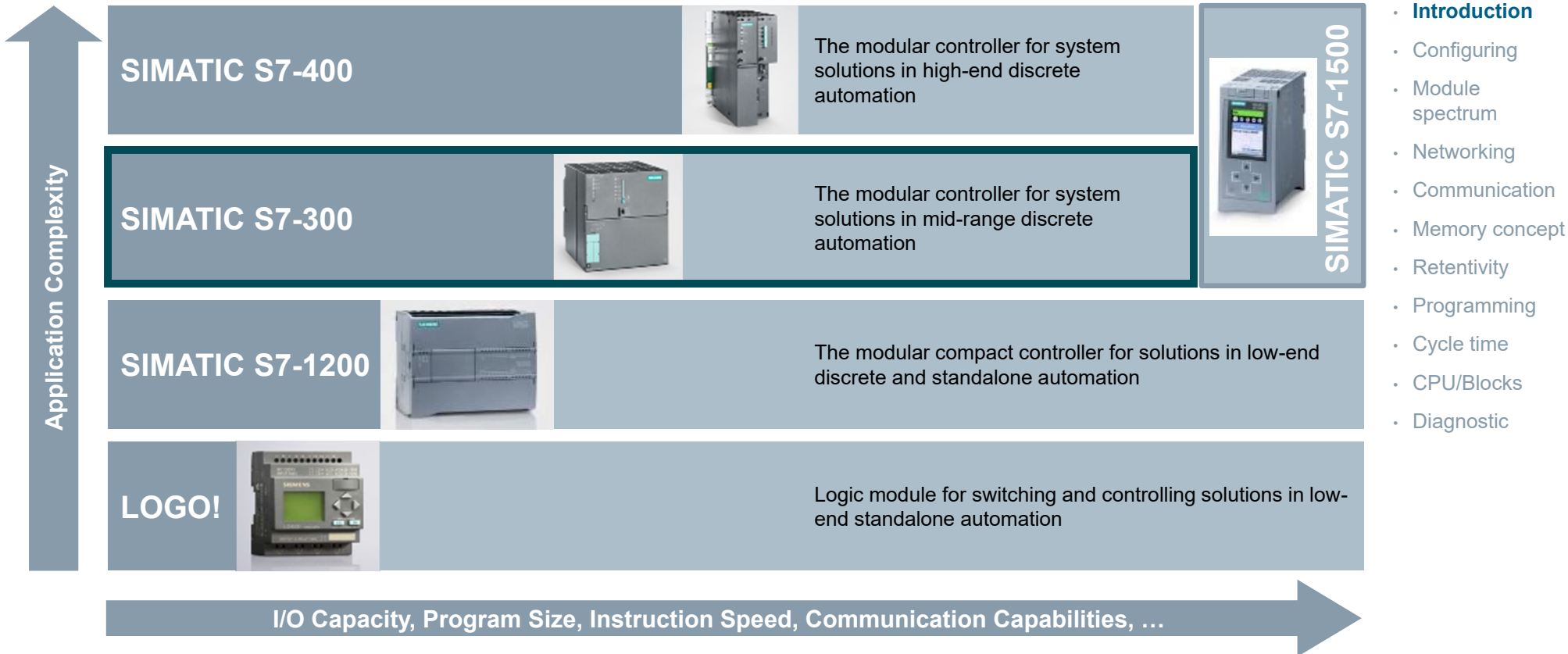


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SIMATIC S7-300

The universal controller for system solutions with factory automation as focal point

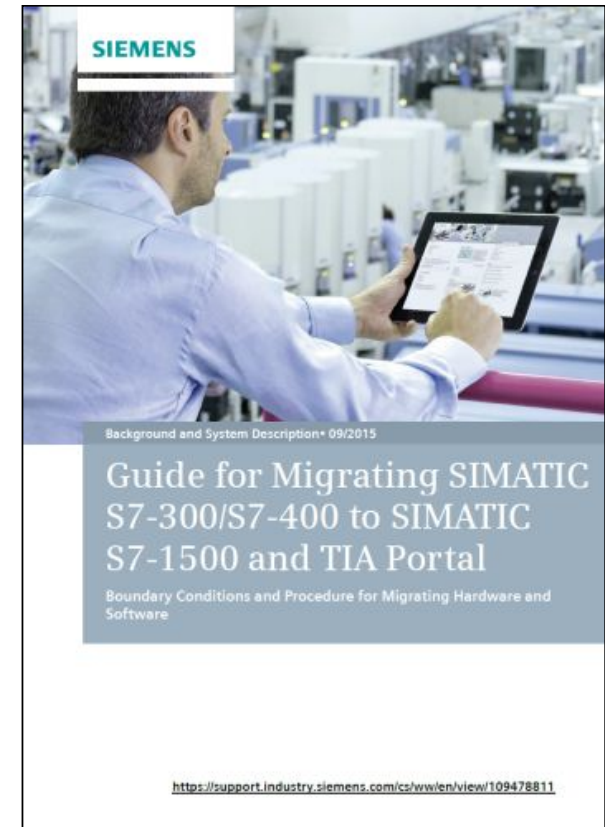
Positioning of Modular Controllers in the discrete automation



Information for Migration From SIMATIC S7-300/S7-400 to SIMATIC S7-1500

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- **General migration marketing site:** www.siemens.com/tia-migration
- **Migration tools topic site (SIOS):** 83557459
(e.g. TIA selection tool, migration tool TIA portal, programming guide line, S7 instruction comparison table, ... + internal documents in the intranet section: price list for adapters, direct access to IO conversion, ...)
- **Programming guide line S7-1200/1500 (every customer needs to know this before migration and to use the S7-1500 in TIA portal in an optimal way!):** programming-guideline
- **Migration guide line S7-300 to S7-1500:** 109478811
- **IO adapter document:** Periphery Adapter 2017 en.pdf



S7-300 properties

- **Compact** dimensions

- Comprehensive range of features and modules for optimum adaptation to the automation task

- **Flexible** application due to simple implementation of distributed structures with PROFIBUS and PROFINET

- Fanless and maintenance-free (no backup battery required)

- **Powerful** thanks to a host of integral functions



Compact
Flexible
Powerful

- **Introduction**
- Configuring
- Module spectrum
- Networking
- Communication
- Memory concept
- Retentivity
- Programming
- Cycle time
- CPU/Blocks
- Diagnostic

General technical specifications

Degree of protection	IP20 to IEC 60 529
Ambient temperature	
▪ For horizontal installation	0 to 60 °C
▪ For vertical installation	0 to 40 °C
Relative humidity	10 to 95%, without condensation, corresponds to relative humidity (RH), stress level 2 acc. to IEC 61131, Part 2)
Air pressure	From 1080 to 795 hPa (corresponds to an altitude of -1000 to +2000 m)
Insulation	
▪ < 50 V	500 V DC test voltage
▪ < 150 V	2500 V DC test voltage
▪ < 250 V	4000 V DC test voltage
Electromagnetic compatibility	Requirements of the EMC directive: interference immunity according to IEC 61000-6-2 Test according to: IEC 61000-4-2, 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6 Interference emission according to EN 50081-2, Test according to EN 55016, Limit value class A, Group 1
Vibrations	Frequency range $10 \text{ Hz} \leq f \leq 58 \text{ Hz}$: Continuous: 0,0375 mm amplitude, occasionally 0,75 mm amplitude Frequency range $58 \text{ Hz} \leq f \leq 150 \text{ Hz}$: Continuous: 0,5 g constant acceleration, occasionally 1 g constant acceleration Testing according to IEC 60068-2-6; Tested with: $5 \text{ Hz} \leq f \leq 9 \text{ Hz}$, constant amplitude 3,5 mm; $9 \text{ Hz} \leq f \leq 150 \text{ Hz}$, constant acceleration 1 g; Duration of oscillation: 10 frequency passes per axis in each direction of the 3 mutually perpendicular axes
Shock	Test according to IEC 60068-2-27. Tested with: Half-sine wave: strength of shock 15 g peak value, 11 ms duration; Shock direction: 3 shocks each in \pm direction in each of the 3 mutually vertical axes

Configuring Mounting/arrangement of modules

The modules are snapped onto the DIN rail in the following order starting from the left:

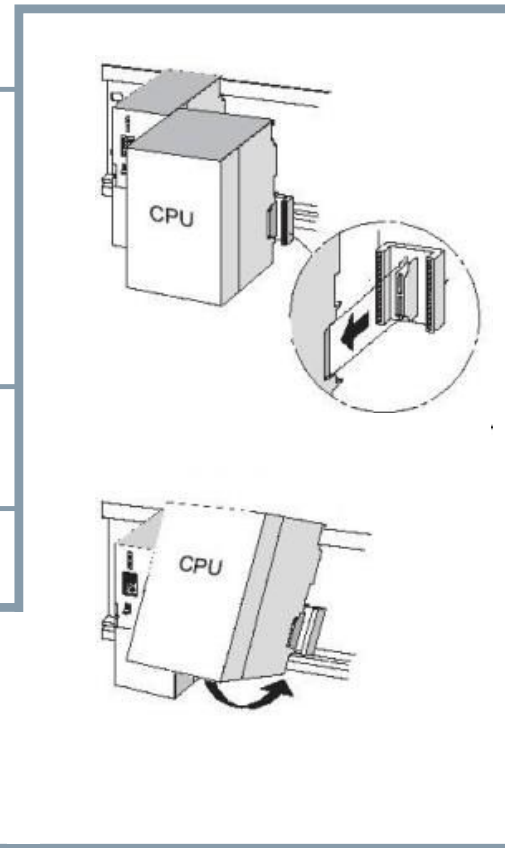
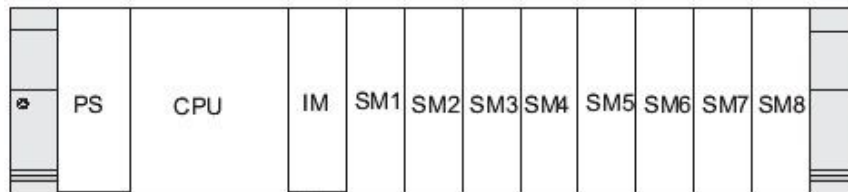


- Power supply module (PS)
- CPU
- Signal modules (SM), function modules (FM), communications processors (CP), interface modules (IM)

If an IM is used in the central rack, it must be plugged into slot 3

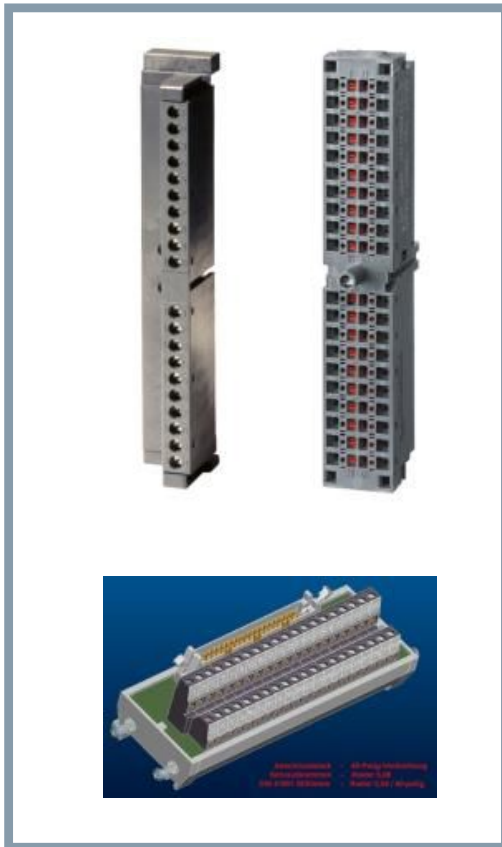


A maximum of 8 modules (SM, CP, FM) may be inserted into each rack



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Configuring Connection systems



Connection

- 20-pin front connector for 16-channel modules
- 40-pin front connector for 32-channel modules
- Cable and terminal block for 64-channel modules
- Slot for attachable coding element
- Cable strain relief



Connection systems

- Screw-type connection system
- Spring-loaded terminal system
- Cutting/clamping connection system (FastConnect)



Tools/accessories

- Specific labeling enclosed with SMs
- Front labeling available on Internet as print template
- S7-SmartLabel: software for machine labeling of modules directly from the STEP 7 project



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Configuring SIMATIC TOP connect – plug in, ready, go!

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For **fast** and **reliable** connection of actuators and sensors up to 30 m

For **clear** control cabinet wiring

Consisting of

- Front connector module
- Connecting cable
- Terminal block

All components are easy to connect and replace
→ **short commissioning and maintenance times**

Further information at www.siemens.com/simatic_tc

Innovative and efficient system cabling



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Configuring Maximum configuration

Modular CPUs

- Max. 32 modules (SM, CP, FM)



Compact CPUs

- Max. 31 modules (SM, CP, FM)



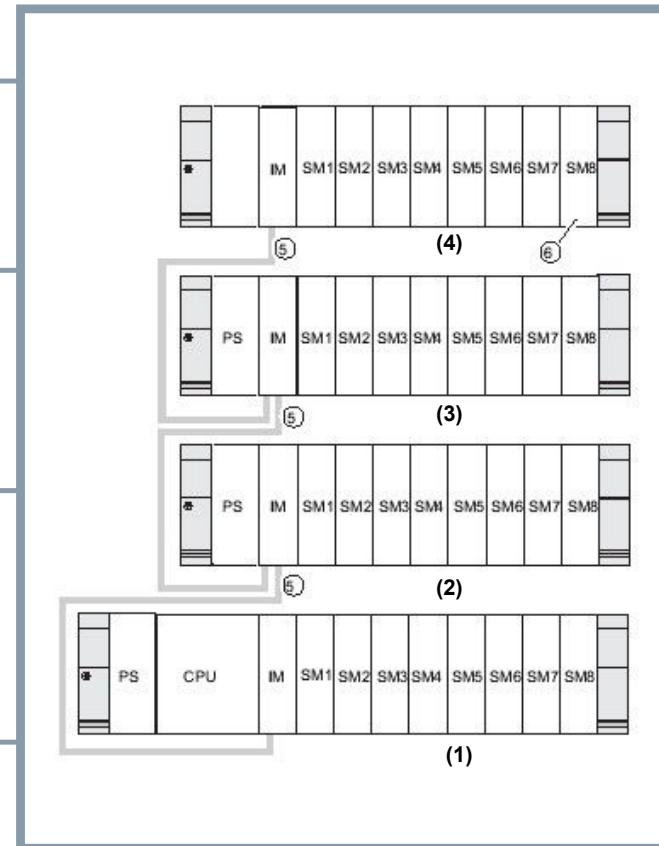
All

- 1 central rack (1)
- 3 expansion racks (2 to 4)



Note:

- With the 312 and 312C CPUs only a single structure is possible on one rack!



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Configuring Grounding, non-grounded operation

Grounded operation

- When setting up an S7-300 with grounded reference potential, any interference currents that occur are conducted to the protective earth/ground

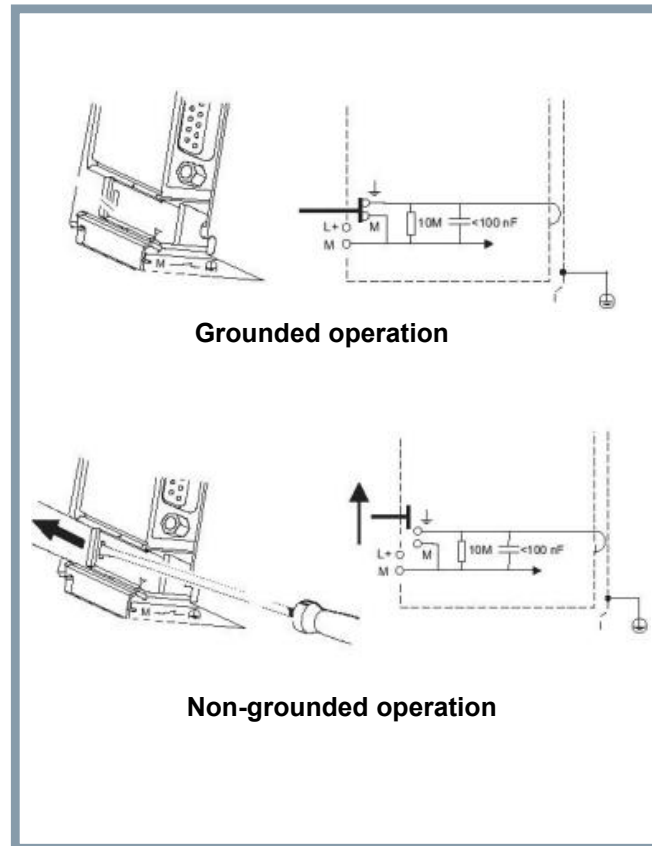
Non-grounded operation

- When setting up an S7-300 with non-grounded reference potential, any interference currents that occur are conducted to the protective earth/ground via an RC network integrated in the CPU
- To create the floating status, the grounding slide switch must be pulled out

Note:

- S7-300 with a compact CPU cannot be set up for non-grounded operation

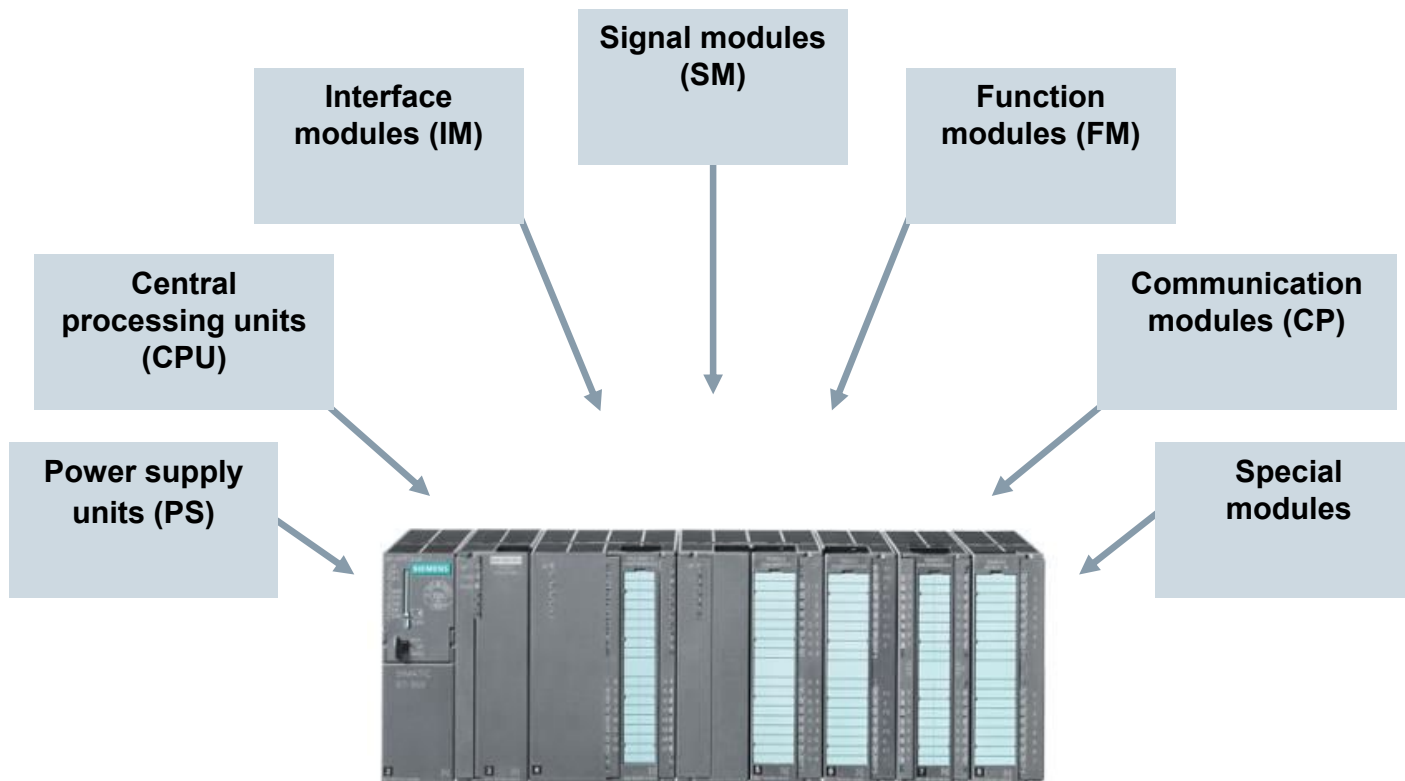
configuration of ground-fault monitoring with non-grounded reference potential



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Module spectrum

The following modules can be used in an S7-300 automation system:



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CPU overview

22 different CPUs

7 standard CPUs

(CPU 312, CPU 314, CPU 315-2 DP, CPU 315-2 PN/DP, CPU 317-2 DP, CPU 317-2 PN/DP, CPU 319-3 PN/DP)

7 compact CPUs with integrated technological functions and distributed I/O

(CPU 312C, CPU 313C, CPU313C-2PtP, CPU313C-2DP, CPU314C-2PtP, CPU314C-2DP, CPU314C-2 PN/DP)

3 technology CPUs

(CPU 315T-3PN/DP, CPU 317T-3 PN/DP, CPU 317TF-3 PN/DP)

5 failsafe CPUs

(CPU 315F-2 DP, CPU 317F-2 DP, CPU 315F-2 PN/DP, CPU 317F-2 PN/DP, CPU 319F-3 PN/DP)

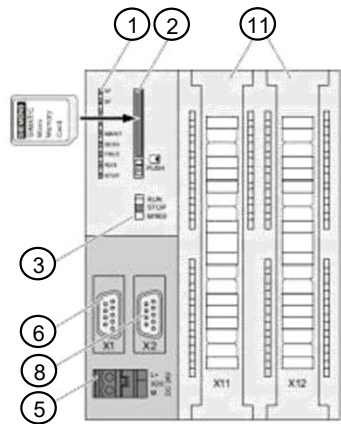


Scaled CPU portfolio: for each application suitable CPU

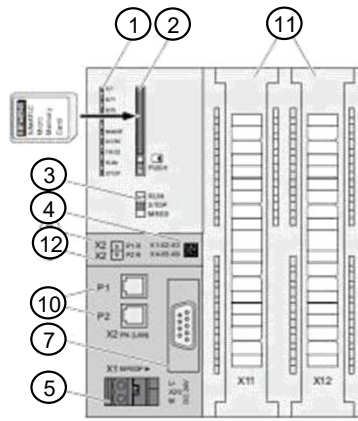
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CPU overview

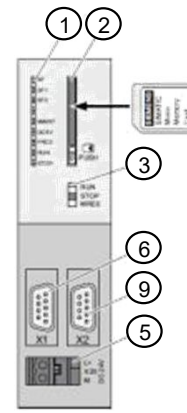
Operating and display elements



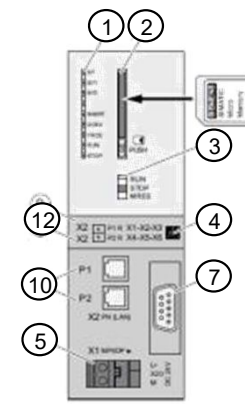
CPU 31xC



CPU 314C-2PN/DP



CPU 31x



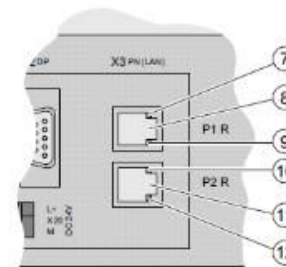
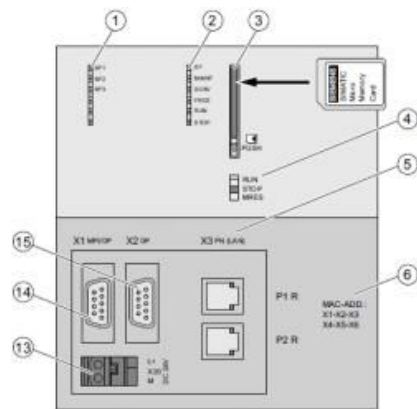
CPU 31x-2PN/DP

1	Status and error indicators	7	1. Interface X1 (MPI/DP)
2	Slot for SIMATIC Micro Memory Card (MMC) incl. ejector	8	2. Interface X2 (PtP or DP)
3	Operating mode switch	9	2. Interface X2 (DP) (at 31x CPUs only at 31x-2DP)
4	MAC-Address and 2D-Barcode	10	2. Interface X2 (PN), with 2-Port-Switch
5	Connection for voltage supply	11	Connections of the integrated inputs and outputs
6	1. Interface X1 (MPI) (at 317-2 DP CPU: MPI/DP)	12	Status indicator of second interface (X2) LED lit green: LINK to a partner is active LED changes to yellow: active data traffic (RX/TX)

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CPU overview

Operating and display elements

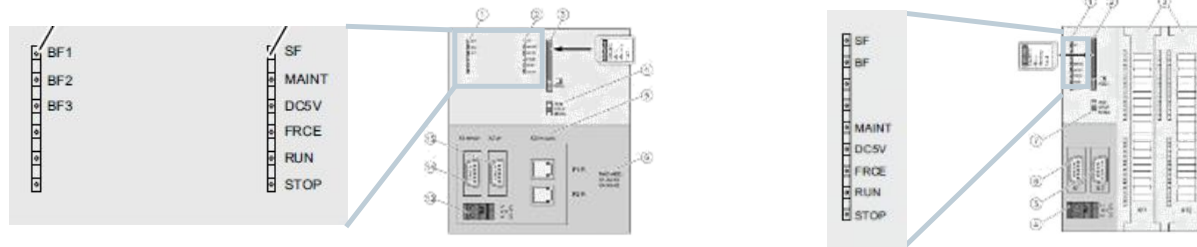


CPU 319-3PN/DP

1	Indicator for bus errors	9	Yellow LED – Port 1 (LED- designation: RX/TX)
2	Status and error indicators	10	Green LED – Port 2 (LED- designation: LINK)
3	Slot for SIMATIC Micro Memory Card (MMC) incl. ejector	11	PROFINET- Port 2
4	Operating mode switch	12	Yellow LED – Port 2 (LED-designation: RX/TX)
5	3. Interface X3 (PN), with 2-Port-Switch	13	Connection for voltage supply
6	MAC-Address	14	1. Interface X1 (MPI/DP)
7	Green LED – Port 1 (LED designation: LINK)	15	2. Interface X2 (DP)
8	PROFINET- Port 1		

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CPU overview LEDs



CPU	LED	Color	Meaning
all	SF	red	Hardware fault or software error
	DC5V	green	5V supply for CPU and S7-300 bus
	FRCE	yellow	LED lights: active force order. LED flashes at 2 Hz: function node flash test (CPUs with firmware V2.2.0 or higher only)
	RUN	green	CPU in RUN. The LED flashes at 2 Hz when starting, at 0.5 Hz when paused
	STOP	yellow	CPU in STOP or HALT or startup mode. The LED flashes on general reset request at 0.5 Hz, during general reset at 2 Hz
	MAINT	yellow	Maintenance-demanded
CPU 31xC-2DP / CPU 315-2DP	BF	red	Bus error at the DP-interface (X2)
CPU 314C-2 PN/DP / CPU 317-2 DP CPU 31x-2 PN/DP / CPU 319-3 PN/DP	BF1	red	Bus error at 1. Interface (X1)
	BF2	red	Bus error at 2. Interface (X2)
CPU 319-3 PN/DP	BF3	red	Bus error at 3. Interface (X3)

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CPU overview

SIMATIC Micro Memory Card (MMC) and Operating mode switch

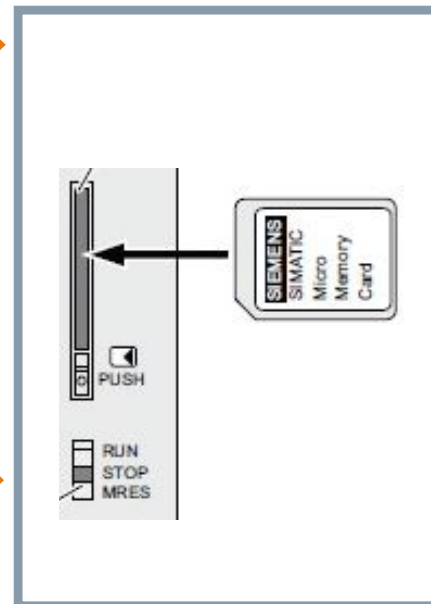
Slot for the SIMATIC Micro Memory Card (MMC)

- A SIMATIC Micro Memory Card (MMC) is used as a memory module
- You can use the MMCs as load memories and as transportable data media

Note

- As the CPUs do not have an integral load memory, an MMC is essential for the operation of the CPUs

Positions of the operating mode switch:

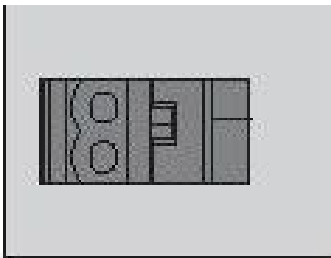


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Position	Meaning	Explanation
RUN	Operation mode RUN	The CPU is processing the user program
STOP	Operation mode STOP	The CPU is not processing a user program
MRES	Reset	Key position of the operating mode switch for resetting the CPU. The reset by means of the operating mode switch demands a special sequence of operations from you

CPU overview

Connection for the voltage supply



Connection for the voltage supply

- Each CPU has a 2-pin socket as a connection for the power supply (24V DC)
- External power supply possible
- Short commissioning and maintenance times
- An appropriate connector for the socket is included with the CPU

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Cost reduction by external current supply of the CPU with 24V DC

CPU overview

Standard CPUs

CPU 312	for small plants
CPU 314	for plants with additional demands regarding scope of program and the command processing speed
CPU 315-2 DP	for plants with medium/high requirements program scope and the networking as well as distributed structure via PROFIBUS DP
CPU 315-2 PN/DP	for plants with medium/high demands on the program scope and distributed structure via PROFIBUS DP and PROFINET IO; can be used as distributed intelligence in Component Based Automation (CBA) on PROFINET
CPU 317-2 DP	for plants with high demands on the program scope and distributed structure via PROFIBUS DP
CPU 317-2 PN/DP	for plants with high demands on the program scope and distributed structure via PROFIBUS DP and PROFINET IO; can be used as distributed intelligence in Component Based Automation (CBA) on PROFINET
CPU 319-3 PN/DP	for plants with very high demands on performance and program scope and the networking as well as distributed structure via PROFIBUS DP and PROFINET IO



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Standard CPUs

Memory, performance and quantity framework



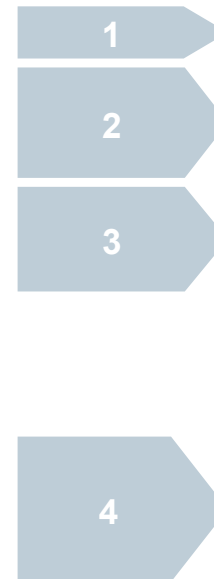
	CPU 312	CPU 314	CPU 315-2DP / CPU 315-2PN/DP	CPU 317-2DP / CPU 317-2PN/DP	CPU 319-3 PN/DP
Main memory	32 kByte	128 kByte	256 / 384 kByte	1 MByte	2 MByte
Instructions	10 k	42 k	85 k / 128 k	340 k	680 k
Lode memory	MMC (max. 8 MB)				
Command runtime (Bit)	0,1 µs	0,06 µs	0,05 µs	0,025 µs	0,004 µs
FB / FC	1024			2048	4096
Data blocks	1024			2048	4096
Bit memory / Clock memory	256 Byte / 8			4096 Byte / 8	8192 Byte / 8
Timer / Counter	256/256			512/512	2048/2048
Address space I/O (Byte)	1024 / 1024		2048 / 2048	8192 / 8192	
No. of digital channels I/O	256/256	1024/1024	16384/16384	65536/65536	
No. of analog channels I/O	64/64	256/256	1024/1024	4096/4096	
Operable FMs	8				
Operable CP (PtP)	8				
Operable CP (LAN)	4	10			
Communication interfaces	X1: MPI	X1: MPI	X1: MPI (315-2DP) X1: MPI/DP (315-2PN/DP) X2: DP (315-2DP) X2: PN (315-2PN/DP)	X1: MPI/DP X2: DP (317-2DP) X2: PN (317-2PN/DP)	X1: MPI/DP X2: DP X3: PN

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CPU 31X-Y PN/DP: Performance and Quantity Framework CBA



General Data		CPU 31X-2 PN/DP	CPU 319-3 PN/DP
Maximum data length for arrays and structures	acyclic CBA interconnections	1400 Byte	1400 Byte
	cyclic CBA interconnections	450 Byte	450 Byte
PROFINET communication			
Number of remote interconnection partner		32	32
Remote interconnections with acyclical transfer	Minimum interval of the sampling frequency	500ms	200ms
	Number of incoming interconnections*	100	100
	Number of outgoing interconnections*	100	100
Remote interconnections with cyclical transfer	Transmission frequency: Minimum transmission interval	10ms	1ms
	Number of incoming interconnections*	200	300
	Number of outgoing interconnections*	200	300
HMI interconnections via PROFINET (acyclical)	HMI variable update intervall	500ms	500ms
	Number of HMI variables	200	600
PROFIBUS proxy functionality			
Number of operable PROFIBUS devices		16	32
Number of interconnections master/slave		1000	3000
Number of internal PROFIBUS interconnections		500	1000
* with 8 byte average data length			

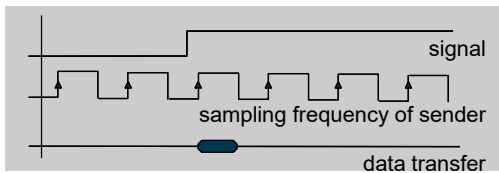


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CPU 31X-Y PN/DP: Performance and Quantity Framework CBA

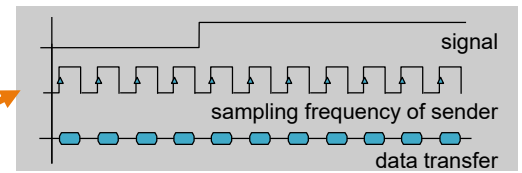


2 Acyclical Communication



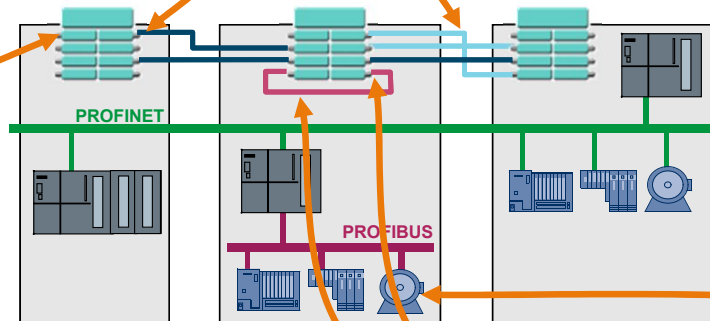
PROFINET Communication	
Remote interconnections with acyclical transfer	
Minimum interval of the sampling frequency	500ms
Number of incoming interconnections*	100
Number of outgoing interconnections*	100

3 Cyclical Communication



PROFINET Communication	
Remote interconnections with acyclical transfer	
Minimum interval of the sampling frequency	20ms
Number of incoming interconnections*	200
Number of outgoing interconnections*	200

1 PROFINET Communication	
Number of remote interconnection partner	32



4 PROFIBUS proxy functionality	
Number of operable PROFIBUS devices	16
Number of interconnections master/slave	1000
Number of internal PROFIBUS interconnections	500

CPU overview

Compact CPUs

CPU 312C	Compact CPU with integrated digital inputs/ outputs and integrated functions of counting and frequency measurement
CPU 313C	Compact CPU with integrated digital and analog inputs/outputs and integrated functions of counting, frequency measurement and PID control
CPU 313C-2 PtP	Compact CPU with integrated digital inputs/ outputs, second serial interface and integrated functions counting, frequency measurement and PID control
CPU 313C-2 DP	Compact CPU with integrated digital inputs/ outputs, PROFIBUS-DP-interface and integrated functions counting, frequency measurement and PID control
CPU 314C-2 PtP	Compact CPU with integrated digital and analog inputs/outputs, second serial interface and integrated functions of counting, frequency measurement, PID control and positioning
CPU 314C-2 DP	Compact CPU with integrated digital and analog inputs/outputs, PROFIBUS-DP-interface and integrated functions counting, frequency measurement and PID control and positioning
CPU 314C-2 PN/DP	Compact CPU with integrated digital and analog inputs/outputs, integrated functions counting, frequency measurement and PID control and positioning. Distributed structure via PROFIBUS DP and PROFINET IO; can be used as distributed intelligence in Component Based Automation (CBA) on PROFINET



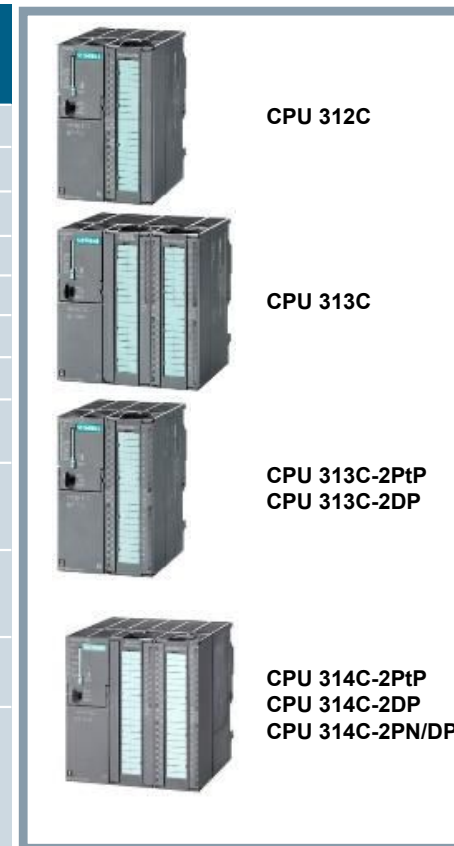
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Compact CPUs

Memory, performance and quantity framework



	CPU 312C	CPU 314C-2PtP CPU 314C-2DP CPU 314C-2PN/DP	CPU 314C-2PtP CPU 314C-2DP CPU 314C-2PN/DP
Main memory	64 kByte	128 kByte	192 kByte
Instructions	21 k	42 k	64 k
Lode memory	MMC (max. 8 MB)		
Command runtime (Bit)	0.1 µs	0.07 µs	0.06 µs
FB / FC / DB	1024		
Bit memory / Clock memory	256 Byte / 8		
Timer / Counter	256/256		
Address space I/O (Byte)	1024 / 1024	1024 / 1024 2048 / 2048 (bei DP)	1024 / 1024 2048 / 2048 (DP & PN/DP)
No. of digital channels I/O	266 / 262	1016 / 1008 (313C) 1008 / 1008 (313C-2PtP) 16256 / 16256 (313C-2DP)	1016 / 1008 (PtP) 16048 / 16096 (DP & PN/DP)
No. of analog channels I/O	64 / 64	253 / 250 248 / 248 (PtP) 1015 / 1015 (2DP)	253 / 250 (PtP) 1006 / 1007 (DP & PN/DP)
Front connector	1 x 40 Pol	1 x 40 Pol 2 x 40 Pol (313C)	2 x 40 Pol
Communication interfaces	X1: MPI	X1: MPI X2: PtP (313-2PtP) X2: DP (313-2DP)	X1: MPI X1: MPI/DP (314C-2PN/DP) X2: PtP (314C-2PtP) X2: DP (314C-2DP) X2: PN (314C-2 PN/DP)



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Compact CPUs Integral I/Os

- Low-cost, universal input/output channels onboard
- Each digital input can be used as alarm input
- Analog inputs can also be used as digital input

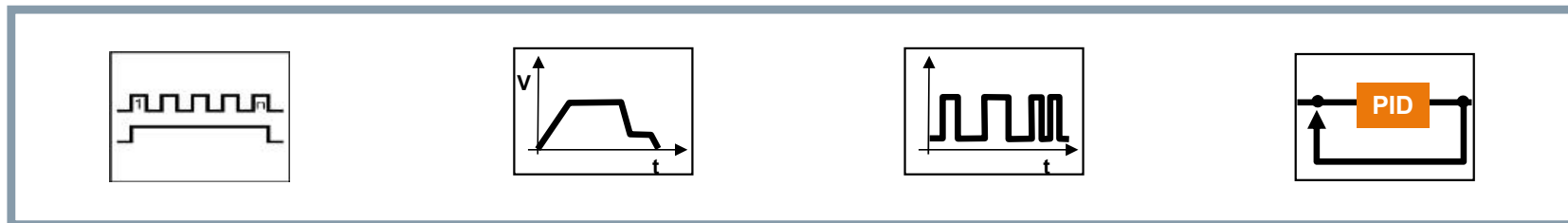


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	DE	DA	AE	AA
CPU 312C	10	6	---	---
CPU 313C	24	16	4+1	2
CPU 313C-2PtP / 313C-2DP	16	16	---	---
CPU 314C-2PtP / 314C-2DP / 314C-2PN/DP	24	16	4+1	2
Rated voltage	DC 24 V	DC 24 V	---	---
Rated voltage	DC 20.4 - 28.8 V	DC 20.4 - 28.8 V	---	---
Current range	---	0.5 A	---	---
Max. frequency	---	100 Hz	---	---
Voltage measuring range	---	---	± 10V; 0..10V	± 10V; 0..10V
Current measuring range	---	---	± 20mA; 0/4..20mA	± 20mA; 0/4..20mA
Resolution	---	---	11Bit + VZ	11Bit+VZ
Filter (50/60 Hz)	---	---	reversible	---
Input delay	0.1/0.5/3/15 ms	---	5 ms	---
Output delay	---	2 ms	---	1,2 ms
Electrical isolation to backplane bus	Ja	Ja	Ja	Ja

Compact CPUs

Integral technology functions



	CPU 312C	CPU 313C, CPU 313C-2PtP, CPU 313C-2DP	CPU 314C-2PtP, CPU 314C-2DP, CPU 314C-2PN/DP
Counting			
• Connectable encoders	Incremental encoder, pulse generator with directional signal	Incremental encoder, pulse generator with directional signal	Incremental encoder, pulse generator with directional signal
• No. of channels	2	3	4
• Limit frequency	10 kHz	30 kHz	60 kHz
Frequency measurement	ja	ja	ja
Period measurement	ja	ja	ja
• No. of channels	2	3	4
Pulse width modulation	ja	ja	ja
• No. of outputs	2	3	4
• Limit frequency	2.5 kHz	2.5 kHz	2.5 kHz
Positioning	no	no	1 axis
Controlling	-	PID	PID

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Compact CPUs Integral counters

Integral counters in all compact CPUs

- Recording of pulse and incremental encoder signals (DC 24V)
- Counting forward/backward with comparison values that can be modified during operation
- 10 - 60 kHz (depending on CPU)

Different operating modes can be set

- Single counting (e.g. filling, dosing)
- Periodic counting (e.g. determining angle of rotation)
- Counting with gate control (e.g. length measurement)

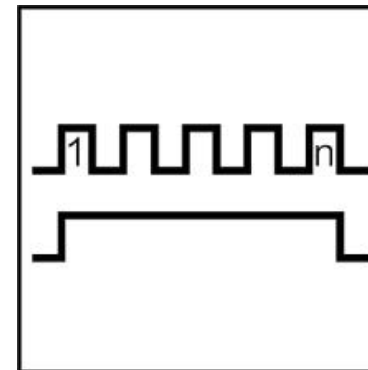
Frequency measurement

- Counting with fixed time basis

Period measurement

- Measure of the time between two consecutive counting edges

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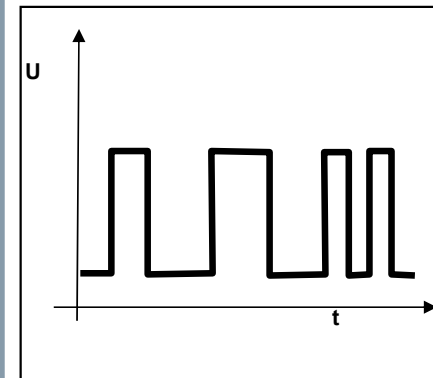
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Compact CPUs Pulse width modulated outputs

Pulse outputs on all compact CPUs

- Direct control of valves, actuators, control gear, heating equipment, etc. (DC 24V/ 0.5A)
- Periodic and pulse-pause ratio modifiable during operation
- 2.5 kHz switching frequency, up to 4 outputs (depending on CPU)

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Compact CPUs

Simple motion control without additional components

Economical

- As no additional modules are required

Optimum memory requirements and runtime

- No additional programming costs, as function is component of operating system

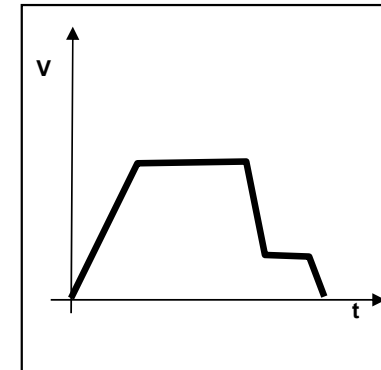
Flexible

- Parameters (delay, acceleration, etc.) can be changed from motion to motion
- Various operating modes can be selected: absolute or relative positioning, jog mode, etc.

Simple

- Preassembled functionality can be integrated into the user program by means of standard blocks

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CPU overview

Technology CPUs 315T-2 DP, 317T-2 DP und 317TF-2 DP

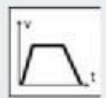


Properties

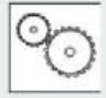
- Full functionality of the standard CPU 315/317-2 DP
- Integrated technology/motion control functionality
- Failsafe user program for realization of failsafe applications like emergency stop (317TF-3 PN/DP CPU)
- The typical application for MC tasks is for 3 - 8 axes – a maximum of 32 axes are possible
- Integrated inputs/outputs
4 digital inputs and 8 digital outputs, usable for technological functions, e.g. reference point recording (BERO) or fast cam switching signals
- PROFIBUS DP (DRIVE) interface for the isochronous connection of drive components
- A common S7 user program for control and MC tasks
- “S7-Technology” option package required




Controlled positioning



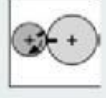
Gearbox synchronism




Electronic cam



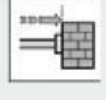
Color mark correction via sensor probe



Path or time-dependent cam switching



Travel to limit stop



PLCopen
motion control

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CPU overview

Failsafe CPUs

- The failsafe CPUs are used in plants with higher safety requirements
- The CPU checks the proper operation of the controller by means of regular self-tests, command tests and logical and chronological program run control. In addition, the distributed I/O is checked by requesting signs of life.
- If an error is detected in the system, the system is brought to a safe state
- Complies with safety requirements to SIL 3 acc. to IEC 61508 and PL e acc. to ISO 13849.1



CPU 315F-2DP CPU 315F-2 PN/DP

- Quantity framework same as corresponding standard CPU

CPU 317F-2 DP CPU 317F-2 PN/DP

- The failsafe CPU with large program memory and quantity framework for demanding applications
- Quantity framework same as corresponding standard CPU

CPU 319F-3 PN/DP

- The failsafe CPU with very high resources and quantity frameworks for high performance applications
- Quantity framework same as corresponding standard CPU

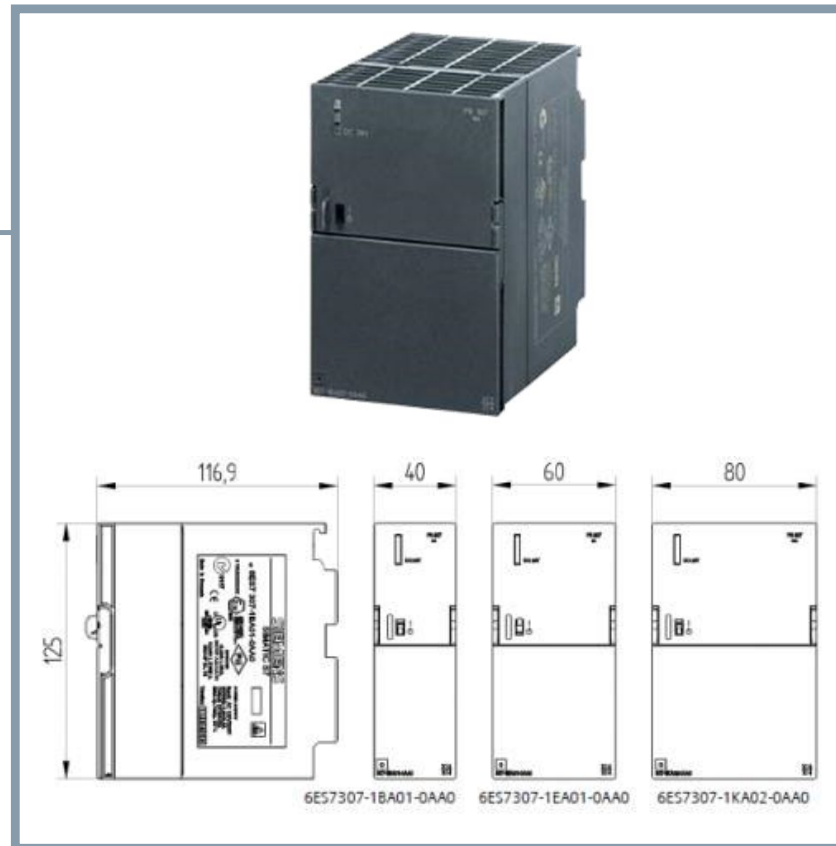
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Power supply modules (PS)

Properties



- Conversion of the supply voltage (AC 120/230V, DC 24 to 110 V) to the operating voltage DC 24 V
- Output current 2A, 5A and 10A
- High degree of efficiency
- Power failure bridging time: min. 20 ms
- Starting current limitation according to NAMUR recommendation
- Short circuit-proof outputs
- Noise emission and immunity compliant with EN 61000-6-3 / EN 61000-6-2, EN 61000-4-2/-3/-4/-5/-6/-11



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Signal modules (SM) Digital modules



Digital input modules SM 321

- For the connection of switches and 2-wire proximity switches (BERO)
- Input voltage DC: 24V, 24-48V, 48-125V; AC: 120V or 120/230V
- with 8, 16, 32 or 64 (24V) inputs



Digital output modules SM 322

- For the connection of magnetic valves, contactors, small motors, lamps and motor starters
- Load voltage: DC: 24V, 24/48V, 48-125V; AC: 120V, 230V, 120/230V
With BG relay: AC to 230V and DC 24V, AC to 230V and DC 120V or AC 24 - 230V and DC 24 – 120V
- with 8, 16, 32 or 64 (24V) outputs



Digital input/output modules SM 323

- Input voltage DC 24V / load voltage DC 24V
- With 8/8 or 16/16 inputs/outputs



Programmable digital input / output module SM 327

- Input voltage DC 24V / load voltage DC 24V
- With 8 fixed inputs and 8 channels programmable as inputs or outputs



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Signal modules (SM) Analog modules



Analog input modules SM 331 ✓

- For the connection of voltage and current sensors, thermocouples, resistors and resistance thermometers
- Voltage/current Inputs: 0-10V; 1-5V; 1-10V; -1-1V; $\pm 10V$; $\pm 2,5V$; $\pm 250mV$; $\pm 5V$; $\pm 50mV$; $\pm 500mV$; $\pm 80mV$; $\pm 10mA$; $\pm 20mA$; 0/4-20mA; $\pm 3,2mA$
Thermocouples: Type B/E/J/K/L/N/R/S/T/U & TXK/TXK(L) acc. to GOST
Thermal sensors: Pt 100/200/500/1000; Ni 100/120/200/500/1000; LG-Ni1000; Cu10 Resistance: 0-150 Ohm; 0-300 Ohm; 0-600 Ohm; 0-6000 Ohm;
- With 2, 6 or 8 analog inputs

Analog output modules SM 332 ✓

- For the connection of analog actuators
- Voltage/current outputs: 0 - 10V; 1 - 5V; $\pm 10V$ / 0 - 20mA; $\pm 20mA$; 4 - 20mA
- With 2, 4 or 8 analog outputs

Analog input / output modules SM 334 ✓

- Voltage /current inputs: 0 - 10V und 0 - 20mA
Thermal sensors: Pt 100; Resistance: 0-10000 Ohm
- Voltage /current outputs: 0 - 10V; 0 - 20mA
- With 4/2 analog inputs/outputs

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Interface modules (IM)

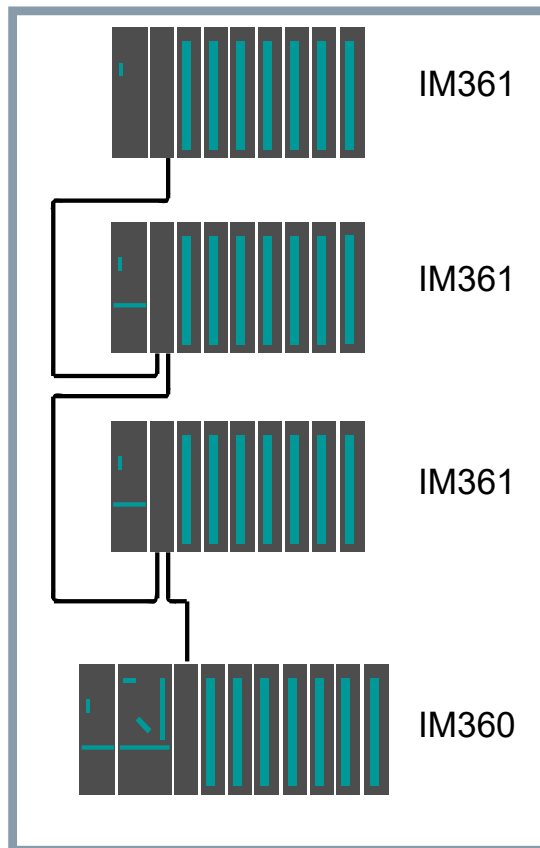
Properties

- The IM 360/IM 361 and IM 365 interface modules permit a multi-tier structure of the S7-300 automation system
- IM always occupies slot 3 and is located to the left of the first signal module
- Maximum of 8 modules per subrack
- The power consumption must not exceed 1.2 A per tier



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Interface modules (IM) IM 360/IM 361



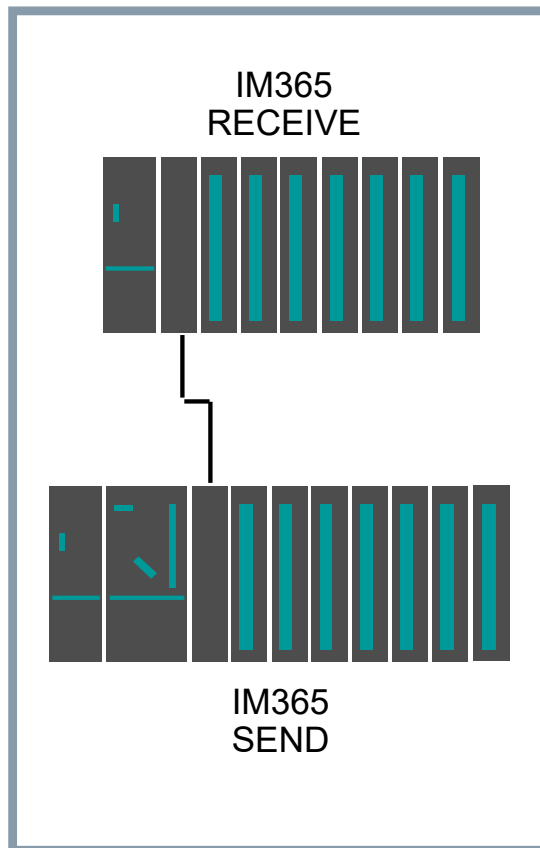
Properties

- Central rack + max. 3 expansion racks possible
- Spacing between two adjacent sub racks: up to 10 m
- Connecting cable
 - 1 m 6ES7368-3BB01-0AA0
 - 2,5 m 6ES7368-3BC51-0AA0
 - 5 m 6ES7368-3BF01-0AA0
 - 10 m 6ES7368-3CB01-0AA0
- IM 360 inserted in central rack
- IM 361 inserted in expansion rack
- No restrictions to the selection of modules

**Variable structure in the cabinet
Smaller wiring expenditure**

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Interface modules (IM) IM 365



Properties

- Central rack + 1 expansion rack possible
- Spacing between two adjacent racks: 1 m
- One IM 365 inserted in the central rack and one in the expansion rack
- No separate power supply. The modules in the ER are supplied via the CPU power supply
- IM 365 does not route the communication bus (K-Bus) to rack 1, i.e. you cannot install CPs or FMs with communication bus function in rack 1

cost-efficient IO extension

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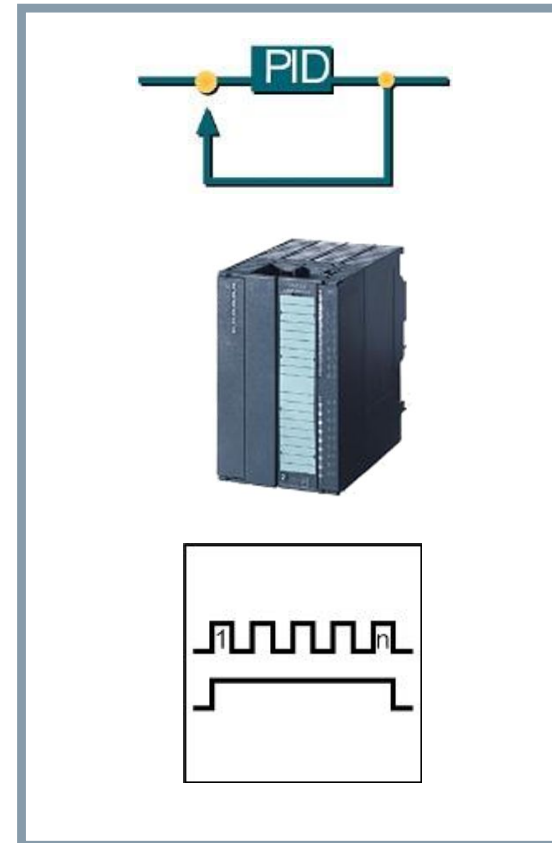
Function modules (FM)

Function modules relieve the CPU from labor-intensive tasks such as counting, positioning and controlling

Modules spectrum:

- Counter modules FM 350-1, FM 350-2
- Positioning modules for:
 - rapid/creep speed drives FM 351
 - step motors FM 353
 - servo motors FM 354
- Positioning and continuous path control modules FM 357-2
- SSI position detection modules SM 338
- Electronic cam controllers FM 352
- High Speed Boolean Processor FM 352-5
- Control
 - Controller modules FM 355
 - temperature control FM 355-2
- Weighing and proportioning electronics SIWAREX

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Communication processor (CP)

In the S7-300 communication modules are used for data exchange by means of point-to-point connection, AS Interface, PROFIBUS DP/FMS and Industrial Ethernet/PROFINET

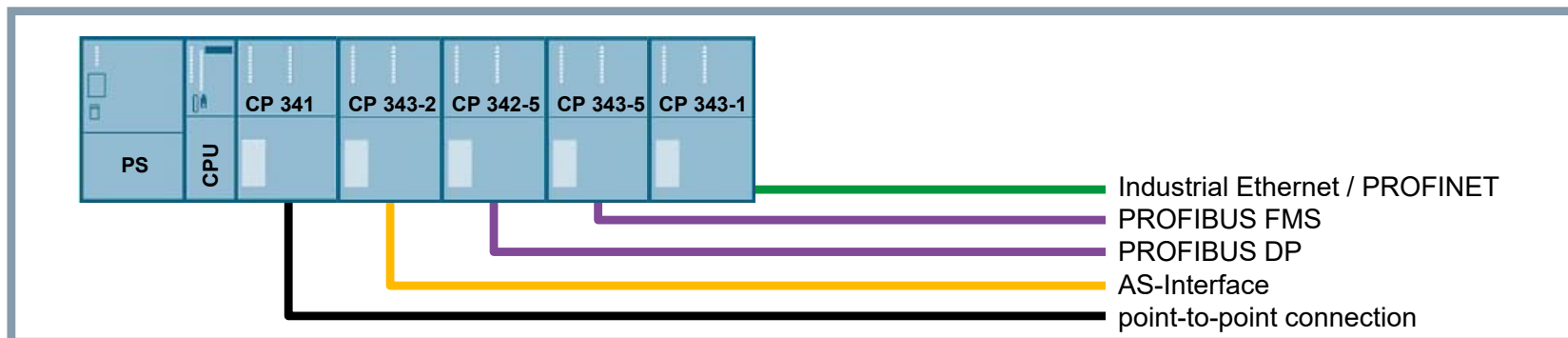


Module spectrum:

- CP 340, 341: CP for point-to-point connection
- CP 343-2, CP 343-2P: CP for connection to AS-Interface
- CP 342-5, 342-5 FO: CP for connection to PROFIBUS DP
- CP 343-5: CP for connection to PROFIBUS FMS
- CP 343-1, Lean, Advanced, ERPC, BACnet: CP for connection to Industrial Ethernet / PROFINET



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Communication processor (CP) CP 340, 341: Point-to-Point-Connection

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Properties CP 340

- The economical complete solution for serial communication via point-to-point coupling
- 3 versions with different transmission interfaces:
- RS 232C (V.24), 20 mA (TTY) and RS 422/RS 485 (X.27)
- Implemented protocols:
- ASCII, 3964 (R) (not for RS 485) and printer driver

Properties CP 341

- For quick, high-performance data exchange via point-to-point coupling
- 3 versions with different transmission interfaces:
- RS 232C (V.24), 20 mA (TTY) and RS 422/RS 485 (X.27)
- Implemented protocols:
- ASCII, 3964 (R) (not for RS 485), printer driver and RK 512
- The following protocols can also be loaded: Modbus RTU



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Communication processor (CP) CP 343-2, CP 343-2P: AS-Interface

Properties

- Supports all AS-Interface master functions according to the AS-Interface Specification V3.0
- Connection of up to 62 AS-Interface slaves
- Integrated analog value transmission (all analog profiles)
- The CP 343-2P / CP 343-2 occupies 16 bytes each in the I/O address area of the SIMATIC S7-300. The digital I/O data of the standard slaves and A slaves are saved in this area
- Suitable for AS-i Power24V (from product version 2 / Firmware-Version 3.1) for Standard AS-i with 30 V voltage

Configuration

- All connected AS-Interface slaves are configured at the press of a button
- No further configuration of the CP is required
- The CP 343-2P also supports configuring of the AS-Interface network with STEP 7 V5.2 and higher

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Communication processor (CP) CP 342-5, 342-5 FO: PROFIBUS DP

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Properties

- Communication processor of the SIMATIC S7-300 for the PROFIBUS DP bus system
- Communication services:
 - PROFIBUS DP master for 124 DP slaves
 - SYNC, FREEZE,
 - Shared Input/Output
 - activation/deactivation of DP slaves
 - PROFIBUS DP slave
 - PG/OP-communication
 - S7-communication (Client, Server)
 - open communication (SEND/RECEIVE)
- Number of S7 connections: 16
- Interface:
 - CP 342-5: 9-pin Sub-D socket (RS485)
 - CP 342-5 FO: 2 female duplex connectors for direct connection to the optical PROFIBUS over 2 x 2 male simplex connectors and 2 plug-in adapters



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Communication processor (CP) CP 343-5: PROFIBUS FMS

Properties

- Simple integration of the SIMATIC S7 into a multi-vendor automation group by means of PROFIBUS FMS
- Communication services:
 - PROFIBUS FMS, according to PROFIBUS IEC 61158/61784, permits the transmission of messages via various FMS services:
 - READ (max. 237 Byte), WRITE (max. 233 Byte)
 - INFORMATION REPORT (unconfirmed transmission of variables, max. 233 Byte)
 - IDENTIFY (identification features of the communication partner)
 - STATUS (partner status)
 - PG/OP-communication
 - S7-communication
 - Open communication (SEND/RECEIVE)
- Number of S7 connections: 16
- Interface: 9-pin Sub-D socket (RS485)

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Communication processor (CP) CP 343-1 Lean

Properties

- The CP 343-1 Lean offers the communication options of the S7-300 with PGs/PCs, Master computers, HMI devices, other SIMATIC S5/S7 systems and PROFINET IO-Controllers
- Communication services:
 - PROFINET IO-Device
 - Open communication (SEND/RECEIVE) over TCP/IP and UDP
 - PG/OP communication
 - S7 communication (server only)
 - Media redundancy (MRP)
- Number of connections
 - S7 communication: 4
 - Open communication (TCP/IP, UDP): 8
- Interface: 2 x RJ45 (2-Port-Switch)

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Communication processor (CP) CP 343-1

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Properties

- CP for connecting a SIMATIC S7-300 to Industrial Ethernet networks, also as PROFINET IO Controller or IO Device
- Communication services:
 - PROFINET IO-Controller for 32 IO-Devices
 - PROFINET IO-Device
 - Open communication (SEND/RECEIVE) over TCP/IP, UDP, ISO
 - PG/OP communication
 - S7-Kommunikation (Client, Server, Multiplexing)
 - Media redundancy (MRP)
- Security mechanisms:
 - Access protection by means of configurable IP access list
- Number of connections:
 - S7 communication: 16
 - Offene communication (TCP/IP, UDP, ISO): 16
- Interface: 2 x RJ45 (2-Port-Switch)



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Communication modules (CP)

CP 343-1 Advanced

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Properties

- CP for connecting a SIMATIC S7-300 to Industrial Ethernet / PROFINET with IT and security functionality
- Communication services:
 - PROFINET IO-Controller for 128 IO-Devices; PROFINET IO-Device; CBA
 - IP address assignment via DHCP
 - IP-Routing
 - Open communication (SEND/RECEIVE) over TCP/IP, UDP, ISO
 - PG/OP communication, S7 communication (Client, Server, Multiplexing)
 - Media redundancy (MRP)
 - IT communication: Web-Server, E-Mail, FTP
- Security mechanisms:
 - Access protection by means of configurable IP access list
 - Firewall for filtering connections on the basis of their IP/port addresses
 - Bandwidth limitation to avoid communication overload
 - VPN server and VPN client for tap-proof access to controllers
 - etc...
- Number of connections
 - S7 communication: 16; Open communication (TCP/IP, UDP, ISO): 16
- Two independent interfaces
 - 1. Gigabit interface: 1 x RJ45; 2. PROFINET: 2 x RJ45 (2-Port-Switch)



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Communication modules (CP)

CP 343-1 ERPC (Enterprise Connect): database connection

Properties

- Connecting of SIMATIC S7-300 to different ERP or MES systems over Industrial Ethernet / PROFINET
- Communication services:
 - ERPC communication: Connection to databases such as ORACLE, MySQL, MS-SQL, DB2 and Message Queue systems
 - Open communication (SEND/RECEIVE) over TCP/IP, UDP, ISO
 - PG/OP communication
 - S7 communication (Client, Server)
- Security mechanisms:
 - Access protection by means of configurable IP access list
- Number of connections
 - S7 communication: 8
 - Open communication (TCP/IP, UDP, ISO): 8
- Interface:
 - Gigabit-Interface 1 x RJ45



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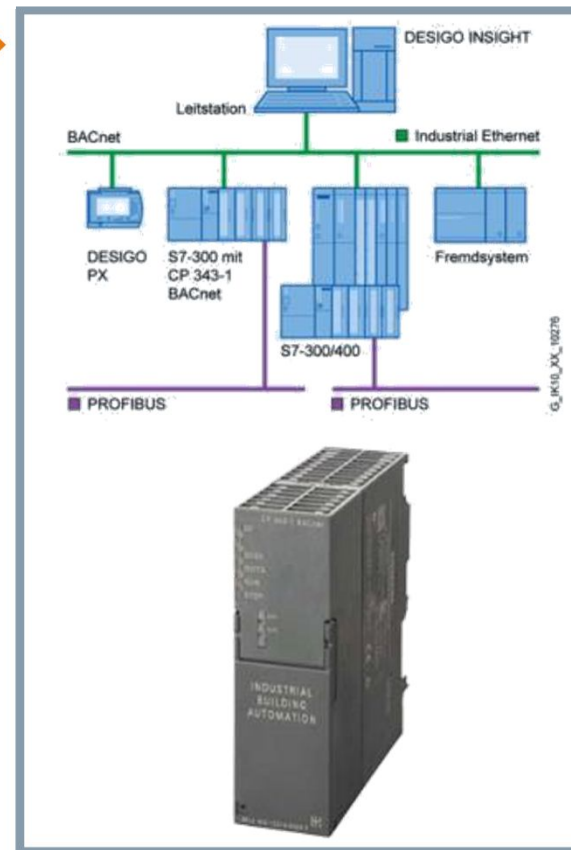
Communication modules (CP)

CP 343-1 BACnet (Building Automation and Control Networks)

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Properties

- BACnet is a communication protocol for data networks in building automation and control developed by ASHRAE
- The CP 343-1 BACnet connect a SIMATIC S7-300 to the Industrial Ethernet and via the BACnet protocol it also permits the integration in systems that support the BACnet protocol
- Communication services:
 - BACnet communication based on TCP/IP, BACnet server according EN 16484, Part 5
 - Open communication (SEND/RECEIVE) over TCP/IP, UDP
 - PG/OP communication
 - S7 communication (Server)
- Number of connections
 - S7 communication: 4
 - Open communication (TCP/IP, UDP): 8
- Interface: 1 x RJ45



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Special modules



Simulator SM 374

- Simulator module for program testing during commissioning and operation
- For simulation of encoder signals via switches
- For the display of signal states at outputs via LEDs
- Inputs: 16 switches
- Outputs: 16 LEDs

Dummy module DM 370

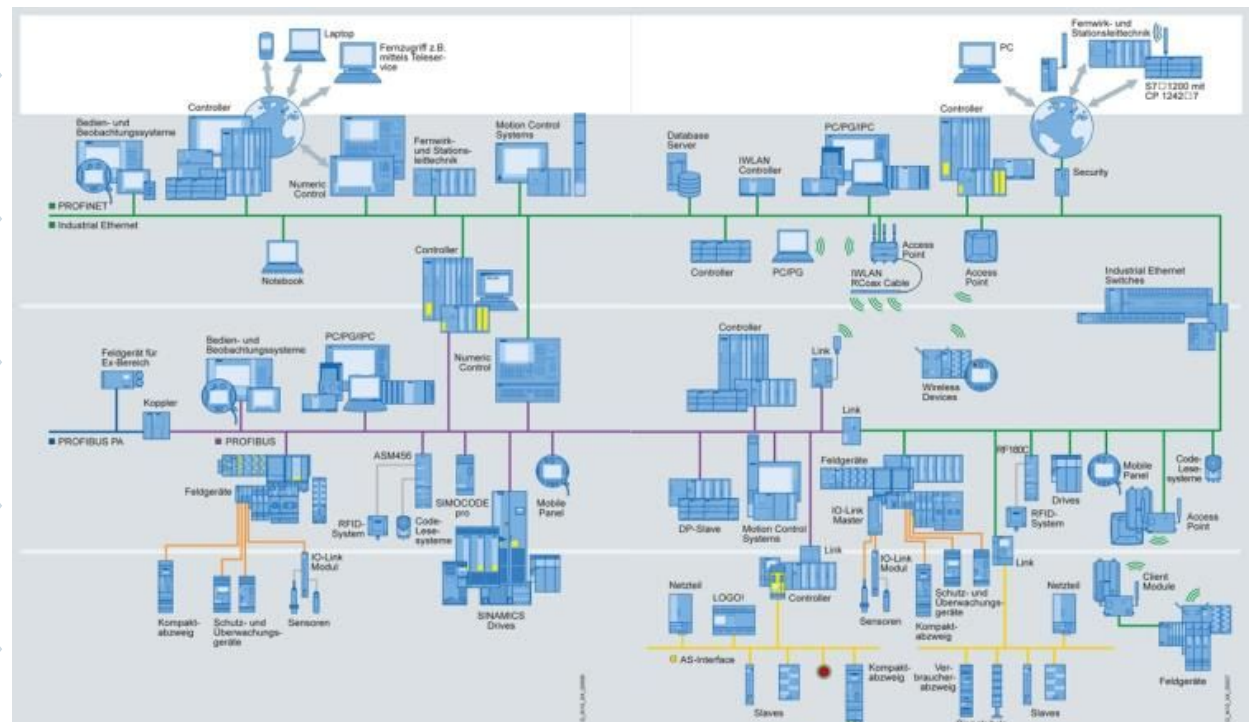
- Dummy module for reserving slots for non-parameterized signal modules
- Retention of structure and address assignment when replacing with signal module

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Networking Overview

Depending on the different requirements of the automation levels (plant control, cell, field and actuator/sensor level), SIMATIC offers the following sub networks:

- Multi Point Interface (MPI)
- PROFIBUS
- Industrial Ethernet / PROFINET
- Point-to-Point connection (PtP)
- Actor-/Sensor-Interface (ASI)



Networking

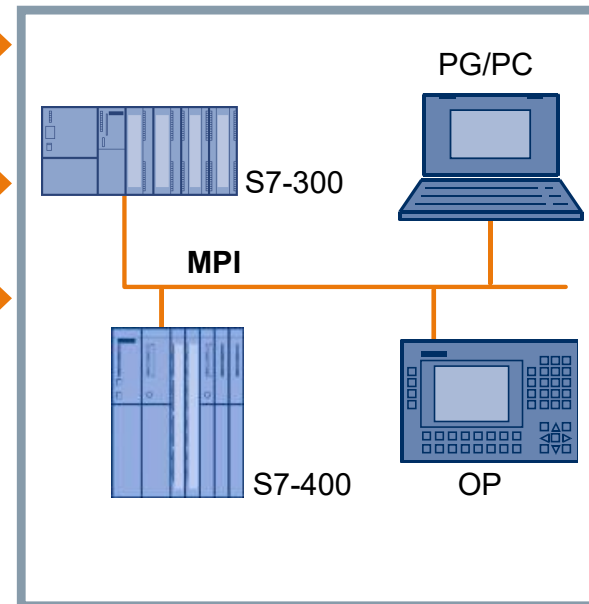
Multi Point Interface (MPI)

MPI is a sub network with a small extent and a small number of nodes for the field and cell levels

MPI interface is available in all S7-300 CPUs

Connectable devices:

- PG/PC
- OP/TP
- S7-300/S7-400 with MPI-Interface
- S7-200 (at 19,2 Kbaud only)



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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
187,5 kBaud 12 Mbaud for CPU 314C-2 PN/DP, 315-2 PN/DP, 317 and 319-3 PN/DP	32	50m/el otherwise same as PROFIBUS	RS 485, LWL	shielded TP, fiber optic

Networking

PROFIBUS: the network for the cell and field area

The PROFIBUS is offered in two versions:

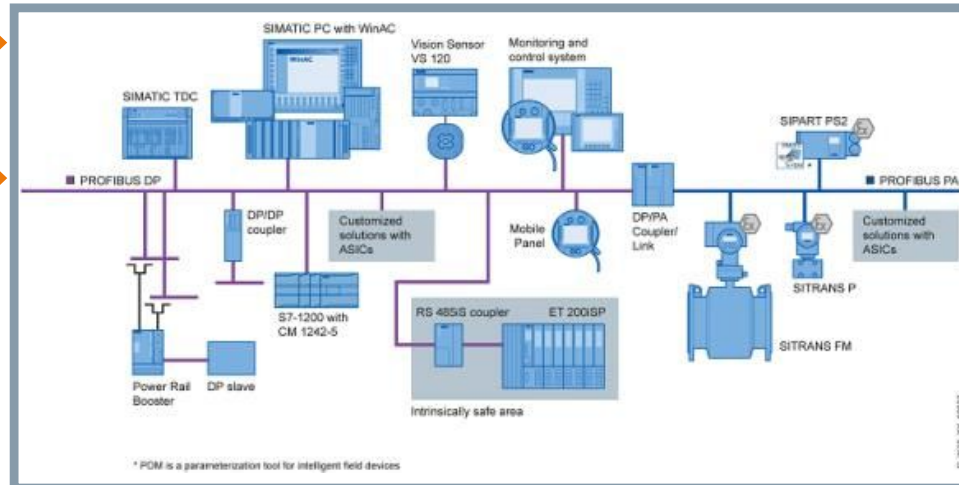
- As a PROFIBUS DP field bus for fast, cyclic data exchange and PROFIBUS PA for the intrinsically safe area (DP/PA coupler required)
- PROFIBUS FMS or PROFIBUS FDL for high speed data exchange between equal priority communication partners (can only be implemented via CP)



- One or two DP interfaces are available in all S7-300 CPUs with the identification "DP"

Connectable devices:

- PG/PC
- OP/TP
- DP- Master /Slaves
- Actuators/sensors
- S71200/S7-300/S7-400/S7-1500/ET200 with PROFIBUS DP-Interface



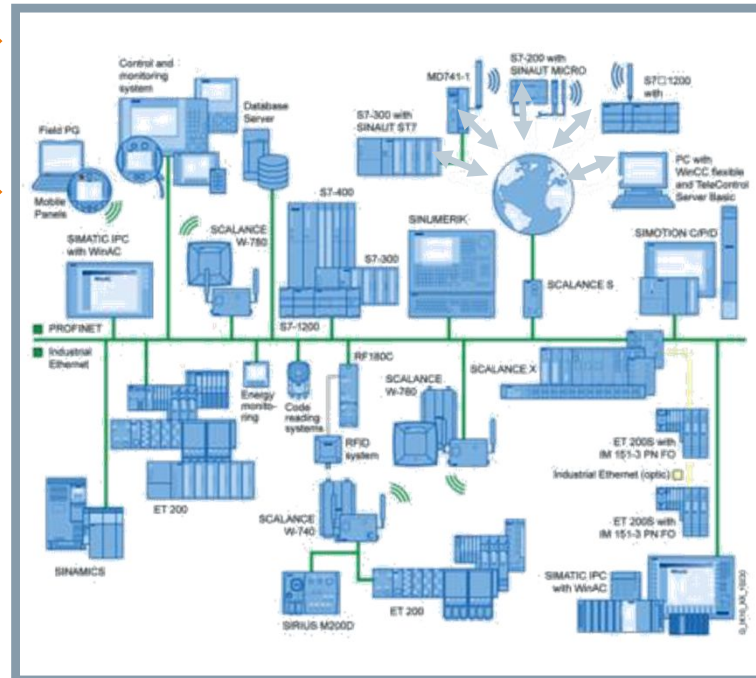
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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
9,6 kBaud – 12 MBaud	126	9,6 km/el. >90 km optical	RS 485, fiber optic	shielded TP, fiber optic

Networking Industrial Ethernet

Subnetwork for the control level and the cell level for communication between computers and automation systems

- Used for the exchange of large quantities of data
- Can be used for transmitting over long distances
- In physical terms, Ethernet is an electrical network based on
 - a shielded coaxial cable
 - a twisted pair cabling or
 - an optical network based on a fiber optic cable
- Connectable devices:
 - PG/PC with network card
 - Active network components (e.g. a switch)
 - S7-1200/S7-300/S7-400/S7-1500 with communications processors (e.g. CP 343-1, 343-1 Advanced)



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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
100 Mbit/s	> 1000	2,5 km elect. About 200 km optical	AUI, 9 pin SUB D, RJ45	Twisted Pair Cat5 (100BASE-TX)

Networking PROFINET (PN)

PROFINET (PN) is the open Industrial Ethernet Standard for automation

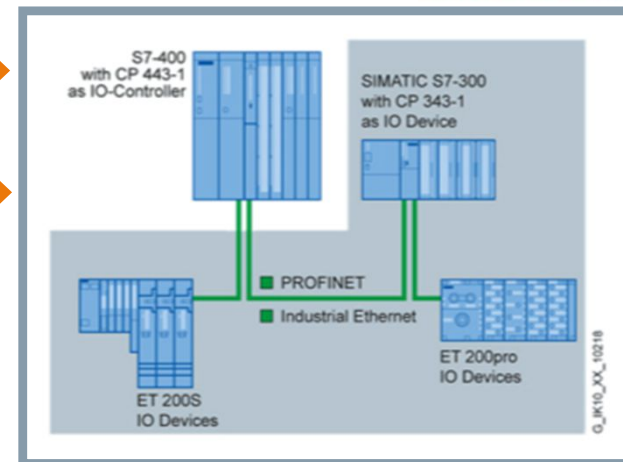
- PROFINET is the network for the management level, cell level and field level
- PROFINET is based on Industrial Ethernet and uses TCP/IP and IT standards
- PROFINET is available in two versions:
 - PROFINET IO: Communication at the field level
 - PROFINET CBA: Communication between intelligent modules



- A PN interface is available in all S7-300 CPUs with the identification "PN"

Connectable devices:

- PROFINET IO components (e.g. IM 151-3 PN in an ET 200S)
- S7-1200/S7-300/S7-400/S7-1500 with PROFINET-Interface (e.g. CPU 317-2 PN/DP or CP 343-1 PN)
- Active network components (e.g. a switch)
- PG/PC with network card



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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
100 Mbit/s	> 1000 PN IO: 256 (CPU319-3 PN/DP)	2,5 km elect. about 200 km optical	RJ45	Twisted Pair Cat5 (100BASE-TX)

Networking

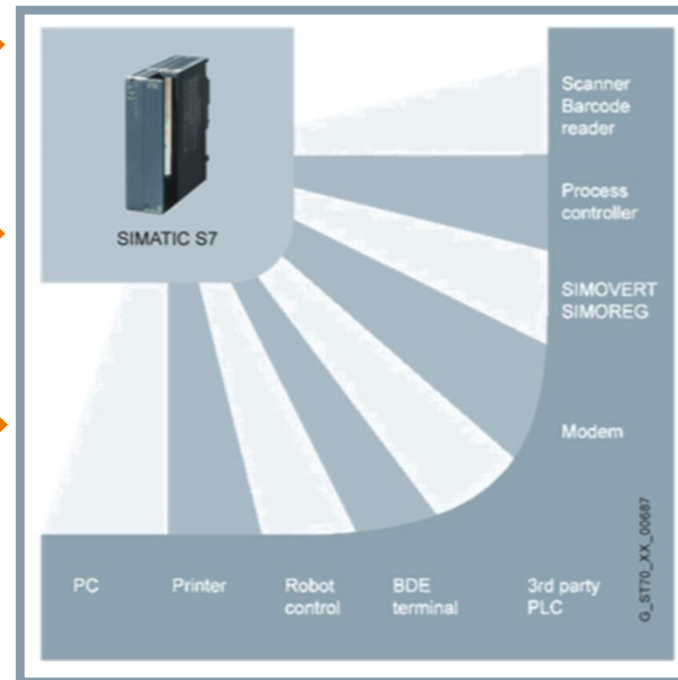
Point-to-point connection

- Data exchange via a serial interface between automation devices, computers or other systems with communication capability

- PtP connection can be implemented in the S7-300 via a CPU with integrated PtP interface or via a PtP-CP

Connectable devices:

- Devices with a serial interface e.g. Barcode readers, printers etc.
- S7-300/S7-400/S7-1500 with PtP-Interface (e. g. CPU 314C-2 PtP or CP 340/341)



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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
300 Bit/s – 115,2 kBit/s	2 ohne Sondertreiber	V24 → 10m, TTY → 1000m, X27 → 1200m	RS232 (V.24), 20mA (TTY), RS422/485 (X27)	V24 Kabel, shielded TP, TTY Kabel

Networking Actor-/Sensor-Interface

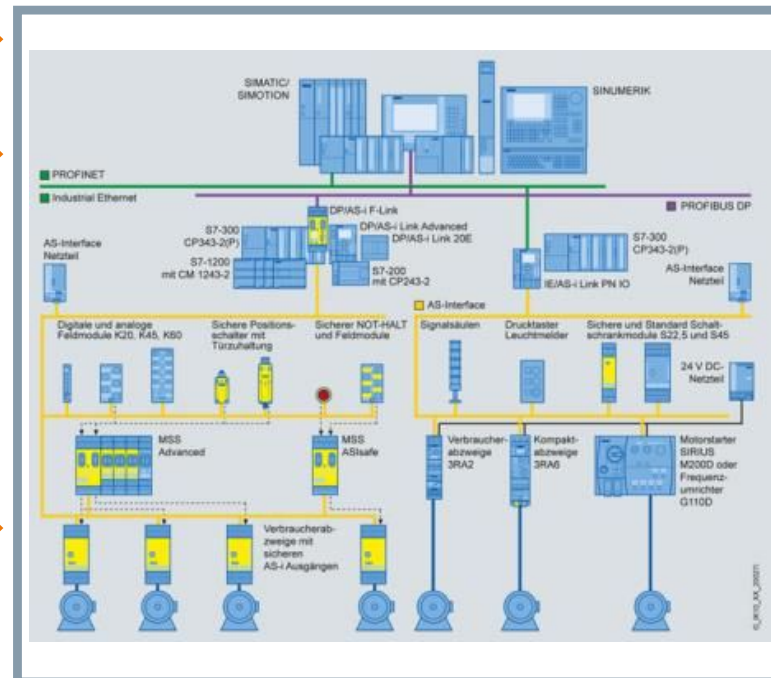


The AS-Interface is a subnetwork system for the lowest processing level

- It is used specifically for networking binary sensors and actuators
- The data volume is no more than 4 bits per slave station
- Data and auxiliary energy are transmitted via a shared cable
- In the S7-300, the connection to the actuator/sensor is implemented via CPs

Connectable devices:

- actuators, sensors, switches, LEDs etc.
- LOGO/S7-1200/S7-300 with AS-I-Interface (e. g. CP 343-2, CP 343-2P)



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Transmission rate	Nodes	Max. network size	Connection system	Bus medium
167 kBit/s	1 Master, 31/62 Slaves	500m with repeater and extender	AS-I cable with insulation displacement method	AS-I cable

Communication

Overview of communication services



Communication service	Functionality	Time at which S7 connection is set up	MPI	PB	PtP	PN/IE
PG communication	Commissioning, test, diagnosis	From the PG, starting when the service is being used	X	X	---	X
OP communication	Operator control and monitoring	From the OP at POWER ON	X	X	---	X
S7 basic communication	Data exchange	Programmed to take place via blocks (SFC parameters)	X	X	---	---
S7 communication	Data exchange as server and client	Via active peer at POWER ON	Only as server		---	X
S5 compatible communication	Send/Receive communication	Via active peer at POWER ON	---	X	---	X
Global Data communication	Cyclic exchange of data (e.g. flags)	Does not require an S7 connection	X	---	---	---
Routing of PG functions, CPUs with DP- or PN-Interface only	E.g. testing, diagnostics across network boundaries	From the PG, starting when the service is being used	X	X	---	X
PROFIBUS DP	Data exchange between master and slave	Does not require an S7 connection	---	X	---	---
PROFIBUS FMS	Data exchange as server and client	FMS connection is required	---	X	---	---
Point-to-Point connection	Data exchange via serial interface	Does not require an S7 connection	---	---	X	---
PROFINET CBA	Data exchange by means of component-based com.	Does not require an S7 connection	---	---	---	X
PROFINET IO	Data exchange between master and slave	Does not require an S7 connection	---	---	---	X
SNMP (Simple Network Management Protokoll)	network diagnostics and parameterization	Does not require an S7 connection	---	---	---	X
Open communication over TCP/IP, ISO-on-TCP, UDP	Data exchange via Industrial Ethernet with TCP/IP protocol (by means of loadable FBs)	Does not require an S7 connection, is programmed to take place via loadable FBs	---	---	---	X
Websserver	Diagnose	Does not require an S7 connection	---	---	---	X
Data set routing	e.g. parameterization and diagnostics of field devices on the PROFIBUS DP by an engineering system operated on an MPI or PN (e.g.PDM)	Takes place when the parameterization tool accesses the field device	X	X	---	X
Time synchronization	Broadcast frames	Does not require an S7 connection	X	X	---	---
	NTP protocol	Does not require an S7 connection	---	---	---	X

Communication

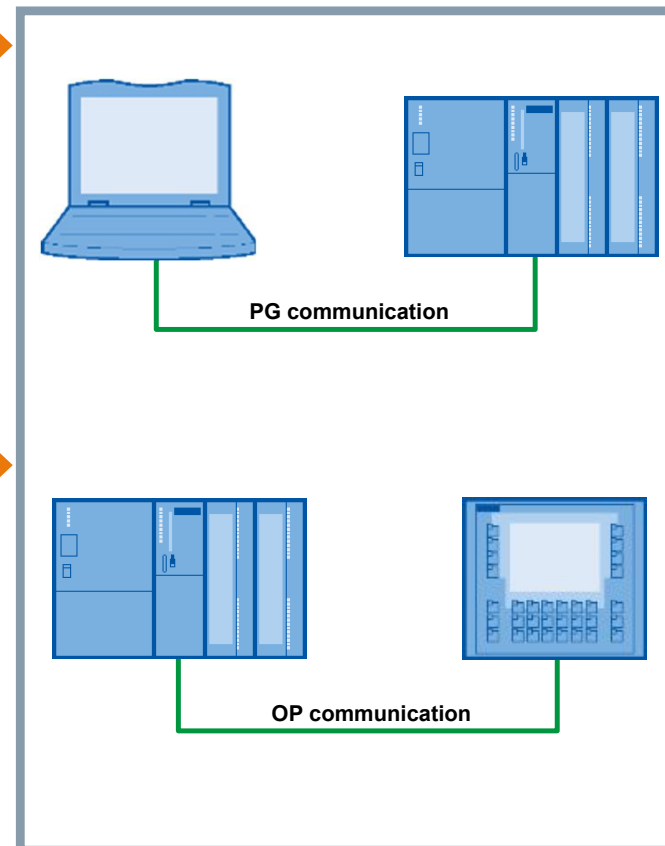
PG/OP communication

PG communication

- Complete functionality for the programming of SIMATIC automation devices with STEP 7
- Download of the hardware configuration
- Loading of STEP 7 programs
- Online operation of the SIMATIC terminals
- Test and diagnosis of the programs

OP communication

- Reading and writing of variables
- Automatic sending and receiving of data to the HMI terminals (OP, OS) without additional communication function in the user program of the communication partner



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Communication

Global data communication

The GD communication enables the cyclic data exchange of global data such as inputs, outputs, flags and areas in data blocks between CPUs by means of the MPI

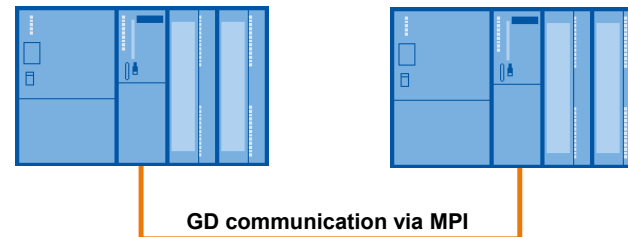


- for small volumes of data (22 Bytes for S7-300)
- broadcast call (data security is not guaranteed in this case)
- No user program required; the communication is configured in the GD table



	GD ID	SIMATIC 300 (1) \ CPU 314 (1)	SIMATIC 300 (2) \ CPU 314 (2)
1	GD 1.1.1	>MW10	MW22
2	GD 1.2.1	MW12	>MW20
3	GD		
4	GD		

Processing phase



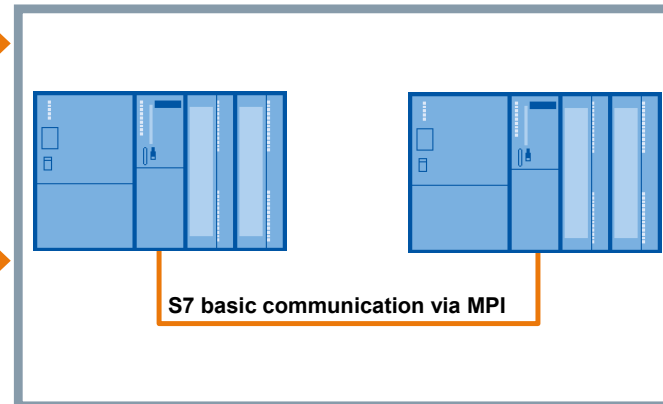
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Communication

S7 Basic Communication

The S7 basic communication makes simple functions available for all S7-300 CPUs, in order to transmit small volumes of data via the MPI subnetwork / S7 station

- No connection configuration necessary
- The maximum amount of transferable useful data is 76 bytes throughout the system
- Data transmission with the aid of SFCs
 - Communication via MPI subnetwork
 - SFC 65 X_SEND Send data to comm. partner
 - SFC 66 X_RCV Receive data from comm. partner
 - SFC 67 X_GET Read data from comm. partner
 - SFC 68 X_PUT Write data to comm. partner
 - SFC 69 X_ABORT Abort connection
 - Communication within an S7 terminal
 - SFC 72 I_GET Read data from comm. partner
 - SFC 73 I_PUT Write data to comm. partner
 - SFC 74 I_ABORT Abort connection
- The connections to the communication partners are set up dynamically on calling the SFC



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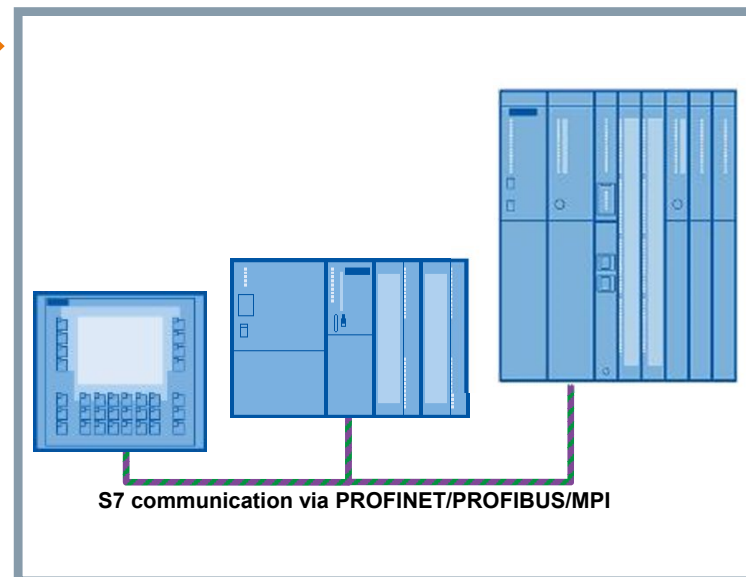
Communication

S7 communication

Properties

- Secure transmission of data between communication partners (BSEND/BRCV)
- Fast, unacknowledged transmission of data (USEND/URCV)
- Program-controlled writing and reading of variables without additional communication function in user program of the comm. partner (PUT/GET)

- Control functions
- Monitoring functions
- Connection configuration required
- The data volume is between 76 and 460 bytes (up to 64 Kbytes for BSEND/BRCV)
- The connections are set up at terminal RESTART and remain continuous, even if the terminal enters the STOP operating state



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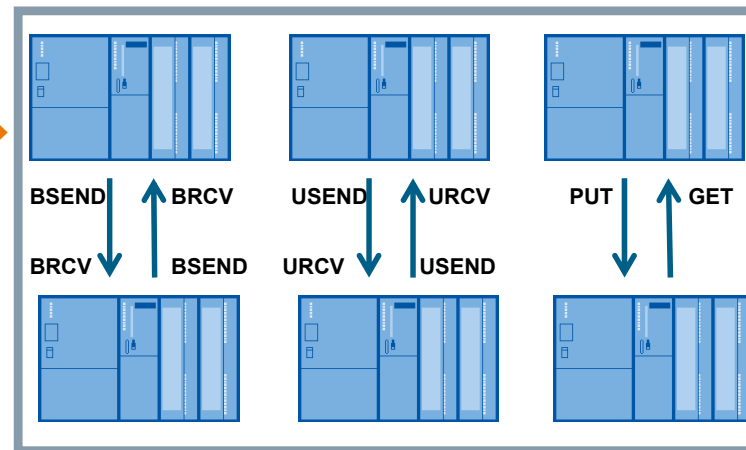
Communication

S7 communication

Data transmission with the aid of SFBs

- Transmit and receive functions
 - **FB 8 USEND (FB 28 USEND_E*)**: Send data to comm. partner (unack.)
 - **FB 9 URCV (FB 29 URCV_E*)**: Receive data from comm. partner (unack.)
 - **FB 12 BSEND**: Send data to comm. partner (safe)
 - **FB 13 BRCV**: Receive data from comm. partner (safe)
 - **FB 14 GET (FB 34 GET_E*)**: Read data from comm. Partner
 - **FB 15 PUT (FB 35 PUT_E*)**: Write data to comm. Partner
- Control functions
 - **SFB 19 START**: The RESTART of the comm. partner
 - **SFB 20 STOP**: STOP the comm. partner
 - **SFB 21 RESUME**: Resume the comm. partner

* 4 send/reception ranges, communication over PN interface of S7-300 CPU from V3.2 only



- Monitoring functions
 - **SFB 22 STATUS**: Supplies the op. status of the comm. partner
 - **SFB 23 USTATUS**: Receives the operating status
- Query function
 - **SFC 62 CONTROL**: Query the status of a connection

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Communication

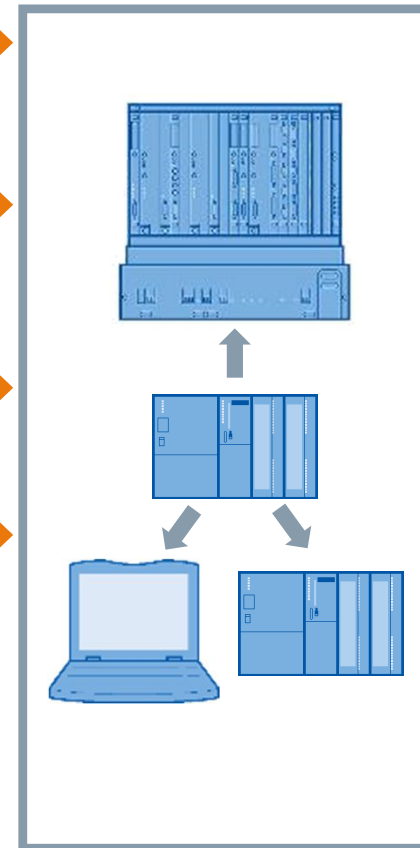
S5-compatible communication

The S5-compatible communication is implemented in S7-300 by means of the communications processors (e.g. CP 343-5, CP 343-1, 343-1 Advanced)

- The SEND/RECEIVE interface enables simple data exchange between two comm. partners such as: SIMATIC S7 to SIMATIC S5/S7 / PG/PC / other systems

- Communication between terminals in different STEP 7 projects
- Configuration of connection required

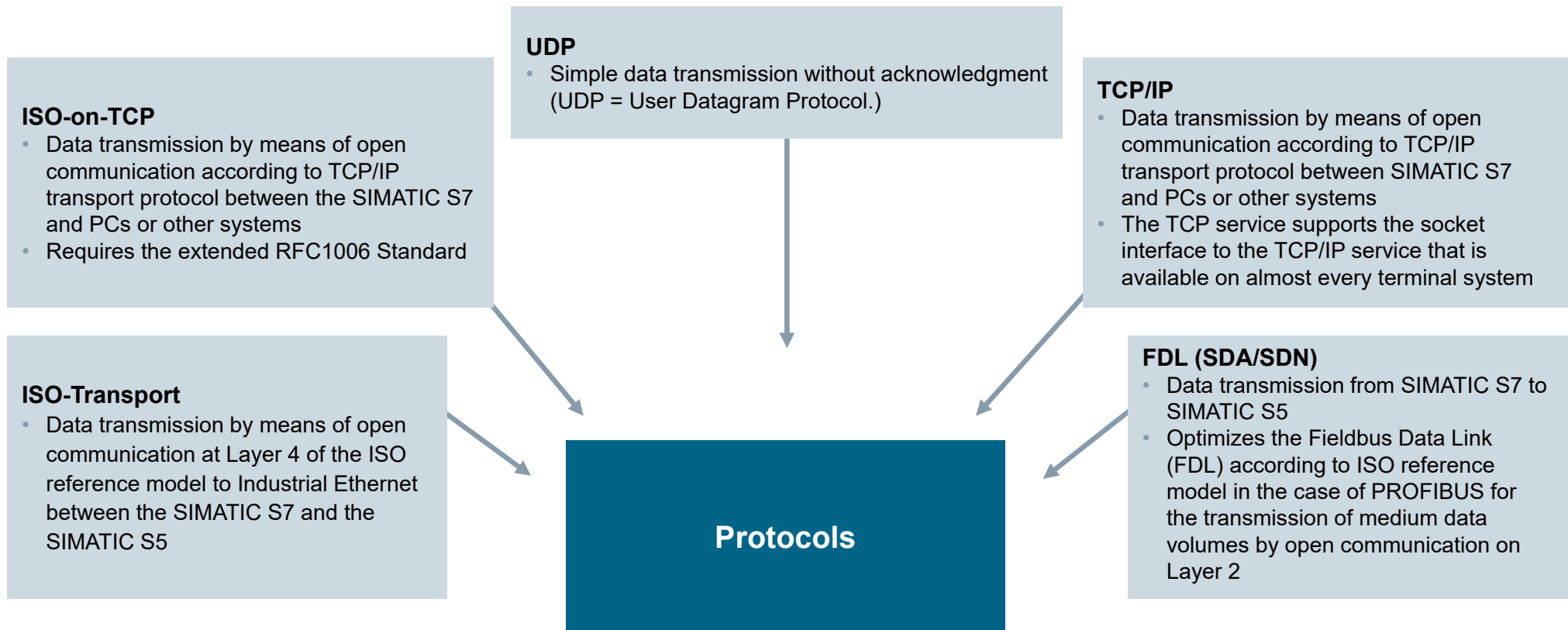
- Blocks:
 - **FC 5 AG_SEND** Transmits data blocks by means of a configured connection (up to 240 Bytes)
 - **FC 6 AG_RECV** Receives data blocks (up to 240 Bytes)
 - **FC 50 AG_LSEND** Transmits data blocks (up to 8 kBytes)
 - **FC 60 AG_LRECV** Receives data blocks (up to 8 kBytes)
 - **FC 7 AG_LOCK** Locks external data access by FETCH/WRITE
 - **FC 8 AG_UNLOCK** Unlocks external data access by FETCH/WRITE



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Communication

S5-compatible communication



Communication

Point-to-point communication

A point-to-point link permits the data exchange via a serial connection

- Transmission of data up to 1 kBytes
- Configuration of connection required

ASCII

- a procedure that can be placed in Layer 1 (bit transmission layer) of the ISO reference model

3964(R)

- based on Layer 2 (data link layer) of the ISO reference model.
- Has a high transmission security, hamming distance = 3

RK 512

- based on Layer 4 (transport layer) of the ISO reference model.
- Has a high transmission security, hamming distance = 4

Protocols

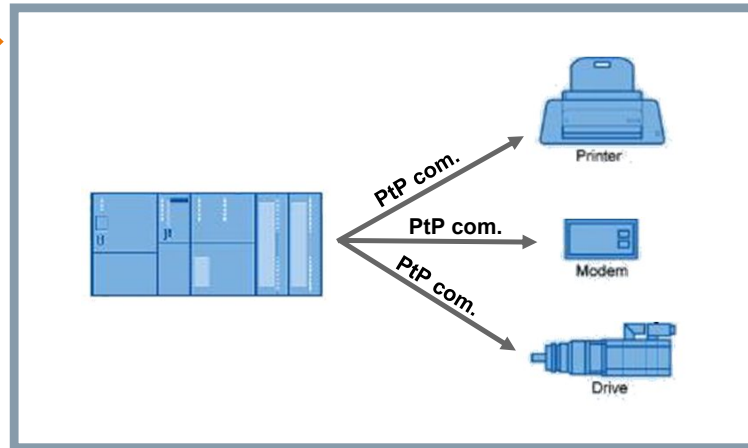
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Point-to-point communication

Blocks for S7-300 CPU 313C/314C-2PtP

- Blocks for ASCII/3964(R)
 - **SFB 60 SEND_PTP** Transmit data
 - **SFB 61RCV_PTP** Receive data
 - **SFB 62RES_RCVB** Reset receive buffer of the CPU
- Blocks for RK 512
 - **SFB 63SEND_RK** Transmit data
 - **SFB 64FETCH_RK** Fetch data
 - **SFB 65SERVE_RK** Receive data/serve data



Blocks for S7-300 CP 340

- **FB 2 P_RCV** Transmit data
- **FB 3 P_SEND** Receive data
- **FB 4 P_PRINT** Send data to a printer
- **FC 5 V24_STAT** Supplies signal states at the RS 232C interface
- **FC 6 V24_SET** Set/reset the outputs at the RS 232C interface

Blocks for S7-300 CP 341

- **FC 5 V24_STAT** Read the signal states at the RS 232C interface
- **FC 6 V24_SET** Set/reset the outputs at the RS 232C interface
- **FB 7 P_RCV_RK** Receive data
- **FB8 P_SND_RK** Transmit/fetch data

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Communication PROFIBUS DP

The “distributed I/O“ extends the centralized I/O with I/O modules which are connected by means of PROFIBUS-DP (interface to CPU or CP) to a central device

- PROFIBUS-DP services offer the possibility of communicating transparently with the distributed I/O.
- From the control program, the distributed I/O is addressed in exactly the same way as the centralized I/O
- The following distinction is made:
 - Cyclic data exchange: transmission of time-critical process data
 - Acyclic data exchange: transmission, for example, of parameter data (non time-critical)
 - Direct data exchange: exchange of data between DP-Master and DP-Slaves with preprocessing (I-Slaves) and between Slaves and I-Slaves
 - Equidistant data exchange: Provides an exactly reproducible bus cycle time. Reproducibility of the PROFIBUS DP cycle to 1 ms precisely
- The distributed I/O is configured with the hardware configuration in STEP 7
- High data security thanks to automatic repeating and additional test mechanisms (parity bit per sign and check-sum at Layer 2)

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Communication PROFIBUS FMS (Fieldbus Message Specification)

- PROFIBUS-FMS offers services for the transmission of structured data (FMS variables) to:
 - Reading of FMS variables
 - Writing of FMS variables
 - Reporting of FMS variables
- The data structures are transmitted in a neutral form and converted in the communication partner
- Data exchange between two communication partners such as:
 - SIMATIC S7 with PROFIBUS-CP
 - SIMATIC S5 with PROFIBUS-CP
 - PC/PG with PROFIBUS-CP
 - Other devices that support FMS services
- Correspond to the European Standard EN 50170 Vol.2 PROFIBUS • enables open communication with other devices
- Achieves high level of data security through automatic repetition and additional test mechanisms (parity bit per sign and check-sum on Layer 2)

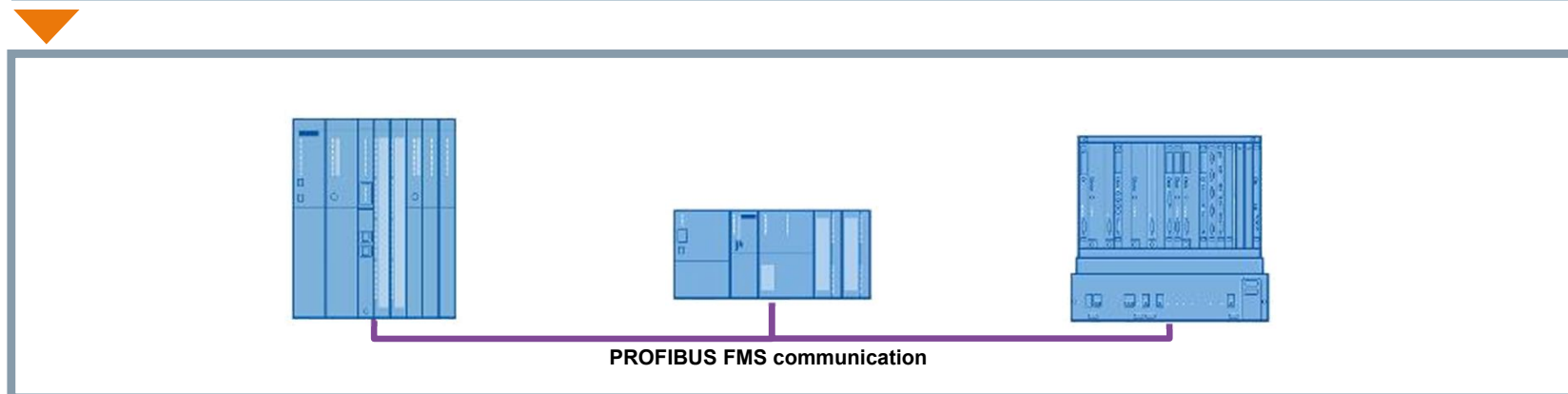
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Communication

PROFIBUS FMS (Fieldbus Message Specification)

- FMS connections are required for the data exchange
 - The connections are set up at RESTART of the terminals and remain continuously, even if the terminal enters the STOP operating state
-
- Blocks for the PROFIBUS-FMS communication
 - **FB 3 READ** Read data from a communication partner. Useful data size: 237 Byte
 - **FB 6 WRITE** Write data to a communication partner. Useful data size: 233 Byte
 - **FB 4 REPORT** Send a structured variable to the communication partner. Useful data size: 233 Byte
 - **FB 2 IDENTIFY** Read the identification of another device
 - **FB 5 STATUS** Read the status of a remote device upon user query

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Communication

Open communication via PROFINET

- The CPUs with integral PROFINET interface support the functionality “Open IE communication”
 - Precondition: STEP7 from V5.4 + SP4
- The open IE communication is performed via TCP/IP- (RFC 793) / ISO-on-TCP- (RFC 1006) / UDP- (RFC 768) –protocol
- The following blocks are required for the data exchange:
 - FB 63 "TSEND,, : to transmit data
 - FB 64 "TRCV,,: to receive data
 - FB 65 "TCON" : to connection structure
 - FB 66 "TDISCON,,: to connection setup
 - UDT 65 "TCON_PAR,,: contains the data structure for connection configuration
 - FB 67 "TUSEND" *: to transmit data
 - FB 68 "TURCV" *: to receive data
 - UDT 66 "TCON_ADR" *: contains the data structure for address parameters of communication partner
- The connection is configured via the user program (UDT 65)
- Data can only be transmitted and received after the connection structure (FB65)
- Useful data size
 - at TCP/IP and ISO-on-TCP max. 32 kByte
 - at UDP max. 1472 Byte

* For UDP-Protocol only

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Communication

SNMP protocol

SNMP (simple network management protocol) is the standardized protocol for diagnosing and also parameterizing the Ethernet network infrastructure

- Applications based on SNMP can be processed in parallel with applications with PROFINET on the same network
- SNMP can be used:
 - by the IT Administration of machine and plant operators, in order to monitor their Industrial Ethernet network by means of standard network management systems.
 - by users in order to integrate the network diagnosis in a central HMI/SCADA system.
 - by the IT Administration, in order primarily to monitor the office network, but also in many cases the automation network by means of standard network management systems (e.g. HP Openview).
 - by automators (plant operators), in order to integrate the network diagnosis by means of SNMP OPC Servers in a central HMI/SCADA system
- Die S7-300 PN CPUs supports communication service SNMP V1 and following standard MIBs (Management Information Base):
 - MIB II, standardized in the RFC 1213
 - LLDP-MIB, standardized in the international standard IEE 802.1AB
 - LLDP-PNIO-MIB, standardized in the international standard IEC 61158-6-10

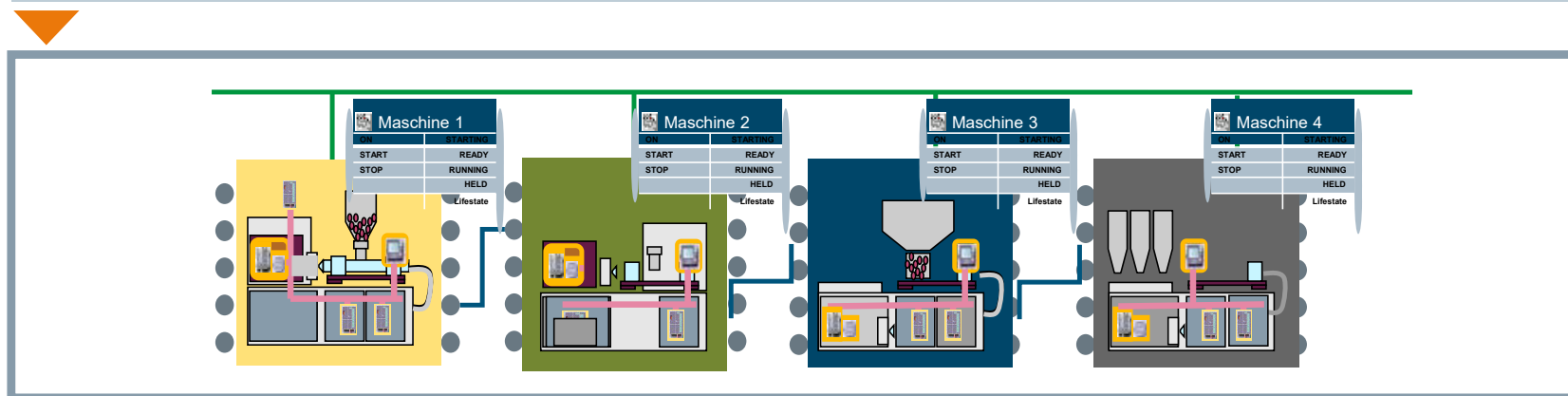
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Communication PROFINET CBA

Component Based Automation is an automation concept for the implementation of modular applications based on the PROFINET standard

- Simple modularization of plants and production lines by means of distributed intelligence
- Machine-machine communication along the production line
- Graphical configuration of the communication of intelligent modules

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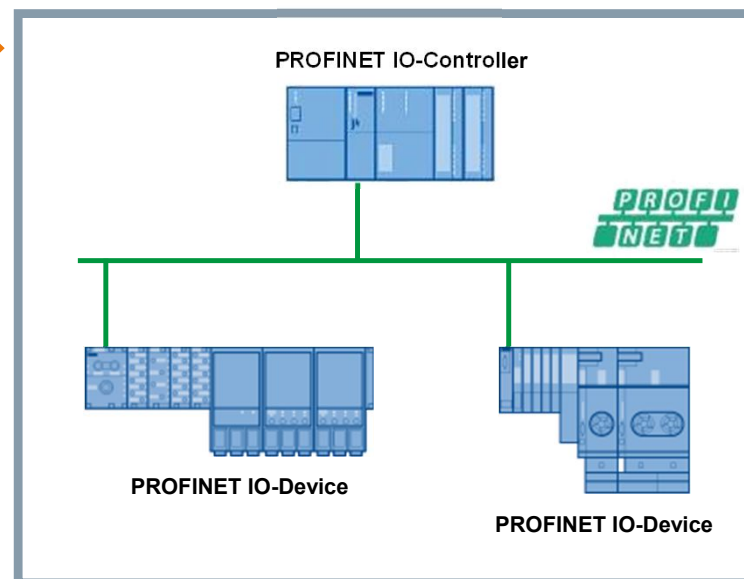


Communication PROFINET IO

- Data exchange with distributed I/O devices which are connected via PROFINET IO (interface to CPU or CP) to one central device
- From the control program, the distributed I/O is addressed in exactly the same way as the centralized I/O
- Same configuration and diagnostics view for PROFIBUS DP and PROFINET IO

PROFINET device classes

- PROFINET IO-Controller
 - Exchange of the distributed I/O signals with assigned field devices
 - Access to distributed I/O signals via process image
- PROFINET IO-Device
 - Field device assigned to the IO-Controller
- PROFINET IO-Supervisor:
 - Engineering and diagnostic terminal
- Currently, 256 IO-Devices can be operated on one IO-Controller



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Communication Webservice

Read access via Internet browser and integrated PROFINET interface

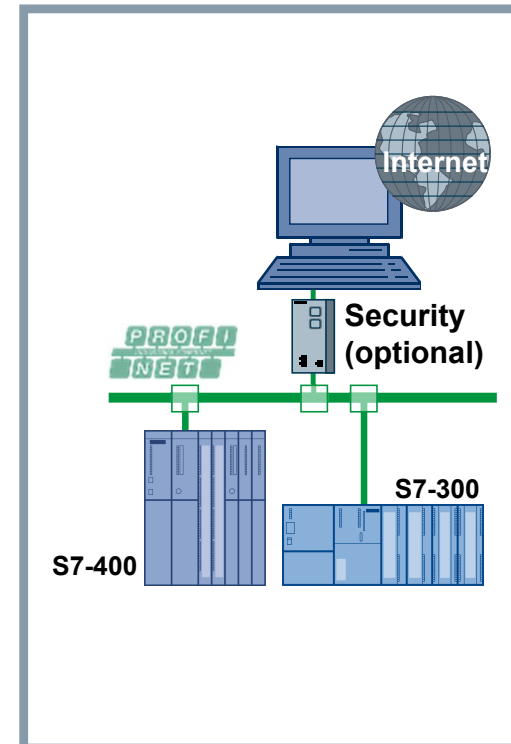
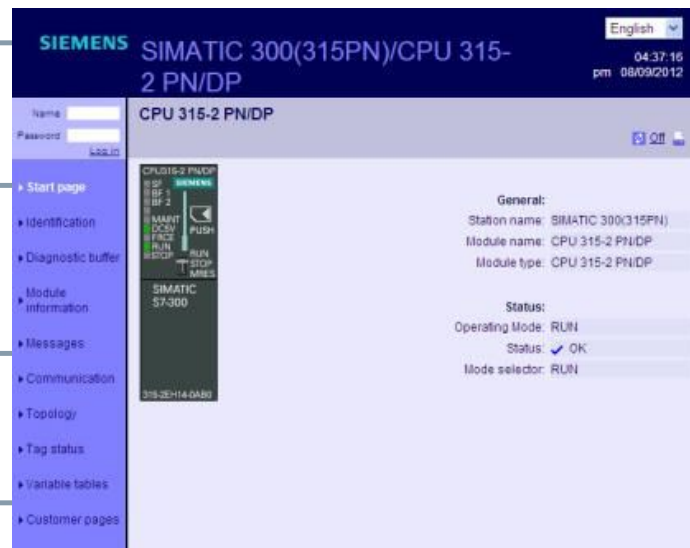
Display optimized for PCs, multi panels, mobile phones

7 standard languages (GE, EN, FR, IT, SP, CH, JP)

Automatically page update

Secure: User management with Log-In, HTTPS

Omnipresent diagnostics



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User-friendly access to diagnostics data anywhere; Enhanced plant availability

Communication Webserver



Standard pages

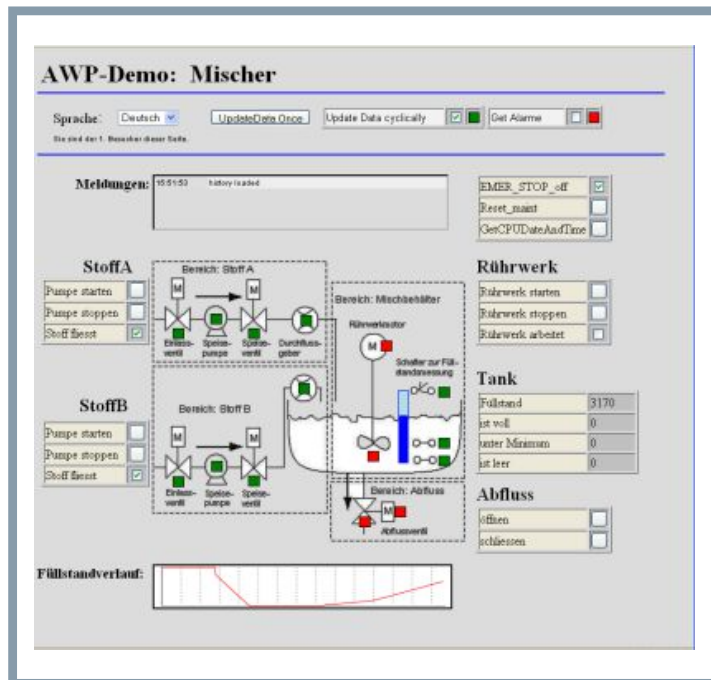
The standard pages are available at each PN CPU already after activating of Webserver

- **Start page:** CPU information and status
- **Identification:** Serial number & Firmware version
- **Diagnostic buffer:** with up to 500 CPU messages
- **Module information:** State of a station with detailed information
- **Messages:** displaying of CPU messages
- **Communication:** displaying of interface parameters, statistics, resources and open user communication diagnostics
- **Topology:** Topology view of projected PROFINET IO systems with target-/ actual-view
- **Status of the variables:** Monitoring of up to 50 variables
- **Variable tables:** Monitoring of up to 50 variable tables with max. 200 variables



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Communication Webserver



User-defined Web page

- Expansion of current CPU standard pages by application-specific pages
- On the Web page, values from the user program can be
 - displayed and
 - modified with password protection
- Application-specific Web pages are not a replacement for HMI systems, but can be particularly used for servicing purposes

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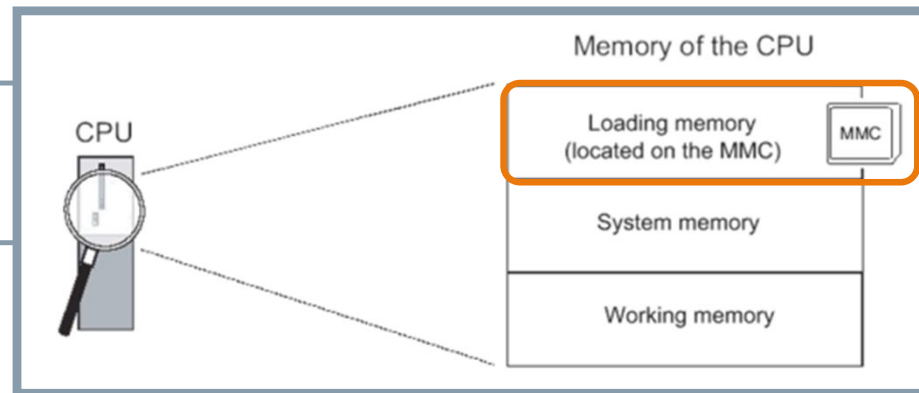
Application-specific diagnostics; Adaptation of machine parameters
HMI functions for servicing purposes

S7-300 memory concept

Loading memory

- Located on the micro memory card (MMC) ✓

- Used for recording code and data blocks and system data (configuration, connections, module parameters, etc.). ✓



- Blocks that are not identified as relevant to the process are recorded exclusively in the load memory. ✓

- In addition, the complete configuration data of a project can be stored on the MMC. ✓

- SIMATIC MMC spectrum: 64 KB, 128 KB, 512 KB, 2 MB, 4 MB and 8 MB ✓
- max. of delete/write operations: 100.000
- min. data retention on the MMC (after the last programming action): 10 years

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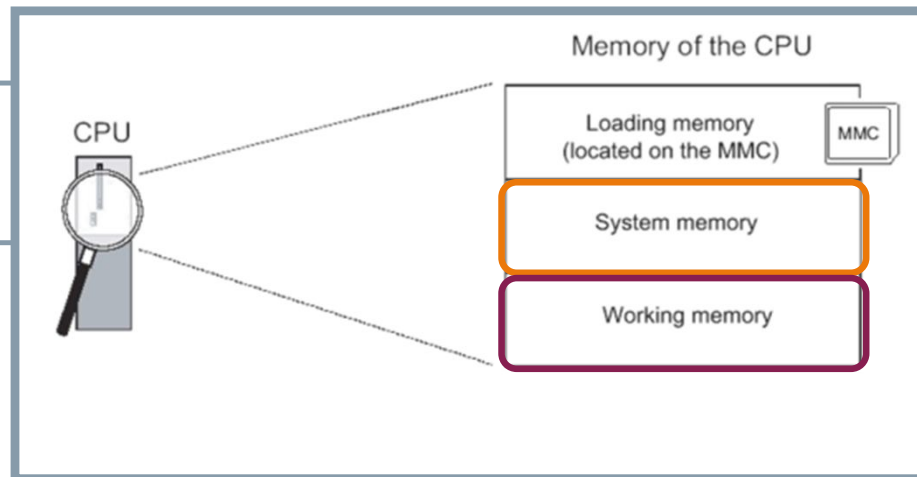
S7-300 memory concept

System memory

- The system memory is integrated in the CPU and is not expandable

It contains:

- the operand areas: flags, timers and counters
- the process images of the inputs and outputs
- the local data



Working memory

- The working memory is integrated in the CPU and is not expandable
- It is used for processing the code and for processing the data of the user program.
- The program is processed exclusively in the area of the main memory and the system memory.

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Retentivity concept of the S7-300

Thanks to retentivity, the contents of the main memory are retained even after power OFF/ON and restart (warm start).

All S7-300 CPUs with an MMC memory card have a maintenance-free retentive memory

- Load memory
 - is always retentive
- System memory
 - Retentivity of the flags, times and counters can be configured
 - Diagnostic buffer, MPI address and operating hour counters are always retentive
- Main memory
 - Contents of the retentive DBs are always retentive
 - From V2.0.12 non-retentive DBs are also supported (after restart the DBs with their initial values from the load memory are initialized)

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Retentivity concept of the S7-300

Retentivity behavior of the DBs for CPUs with firmware < V2.0.12

- For these CPUs the contents of the DBs in the event of power OFF-ON or STOP-RUN are always retentive

Retentivity behavior of a DB for CPUs with firmware >= V2.0.12

- With these CPUs, you can specify in STEP 7 (from Version 5.2 + SP 1) or via the SFC 82 "CREA_DBL" (parameter ATTRIB • Bit NON_RETAIN) whether in the event of Power OFF/ON or RUN-STOP a DB
 - retains the current values (retentive DB) or
 - adopts the initial values from the load memory (non-retentive DB)

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Resources-optimized and need-oriented employment of the retentive data

Retentivity concept of the S7-300



Retentive behavior of the memory objects

Memory object	Operating state transition		
	POWER OFF / ON	STOP → RUN	Memory reset
User program/data (load memory)	X	X	X
▪ Retentive behavior of DBs on CPUs with firmware < V2.0.12	X	X	--
▪ Retentive behavior of DBs on CPUs with firmware ≥ V2.0.12	Can be set in the properties of the DBs in STEP 7 V5.2 + SP1 or higher		--
Bit memories, timers, and counters configured as retentive objects	X	X	--
Diagnostic buffer, runtime meter	X ¹	X	X
MPI address, baud rate of an MPI interface DP address, baud rate of an MPI/DP interface, if set as DP note in the parameter. Note: After POWER OFF/ON and CPU memory reset, the parameters of a pure DP interface are not retained unless the parameter assignment (SDBs) was loaded	X	X	X
▪ IP suite/device name of the PROFINET interface	Depends on the type of assignment of the IP address parameters and of the device name	X	Depends on the type of assignment of the IP address parameters and of the device name
¹ Only the last 100 entries in the diagnostics buffer are retained after POWER OFF / POWER ON			
„X“ retentive; „--“ not retentive			

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Programming

The CPUs are programmed with STEP 7 in LAD, FBD or STL

STEP 7 Basis, STEP 7 Professional or STEP 7 Lite can be used (no PROFIBUS DP support)

The engineering tools (e.g. S7-GRAPH, S7-HiGraph, SCL, CFC or SFC) are executable on all CPUs. The CPU 314 or higher is recommended

The Standard CPUs are programmed with STEP 7 V5.2 Service Pack 1 or higher. Older STEP 7 versions require an upgrade.

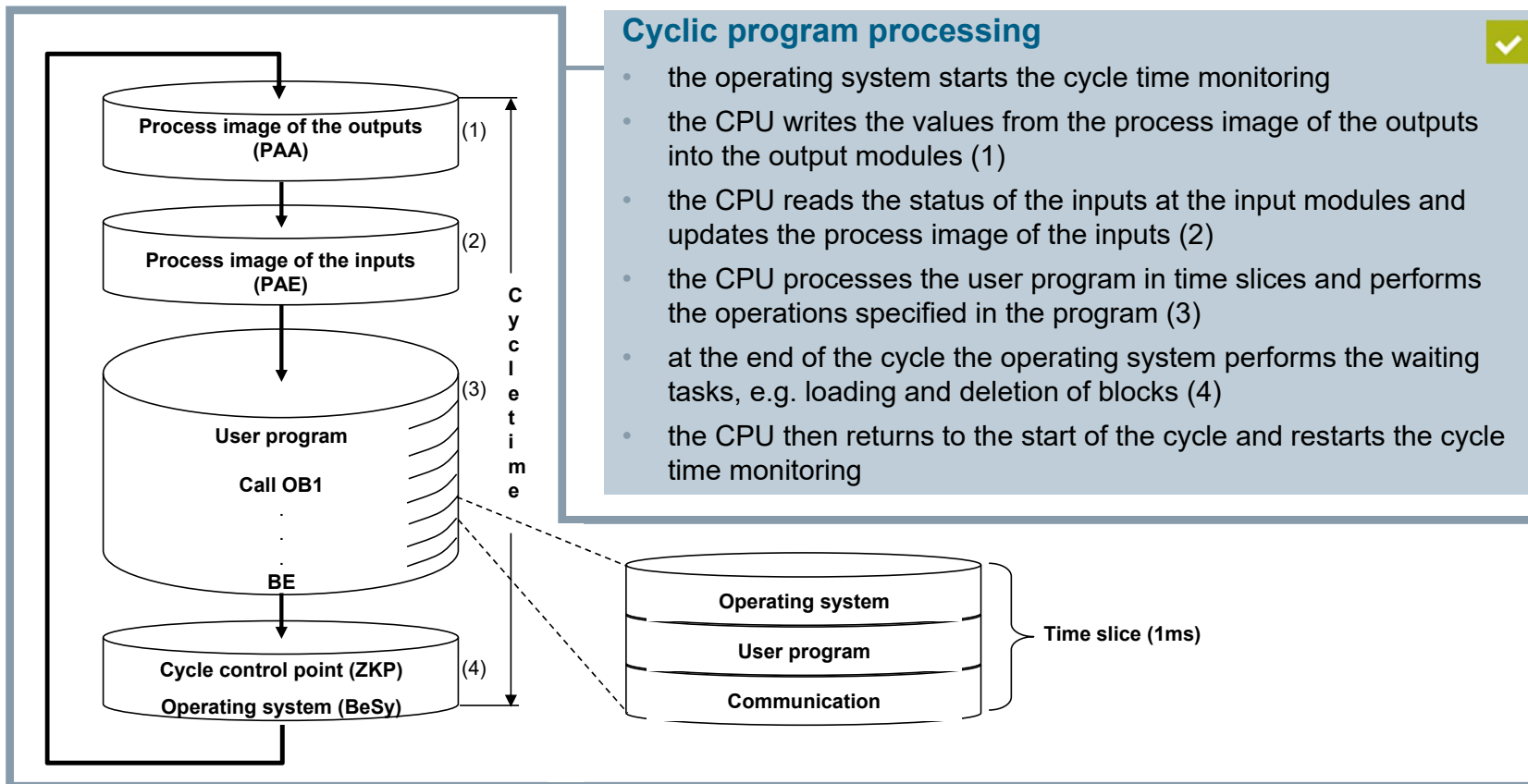
The Compact CPUs are programmed with STEP 7 V5.3 Service Pack 2 or higher. Older STEP 7 versions require an upgrade.

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Sequence of the cyclic program processing



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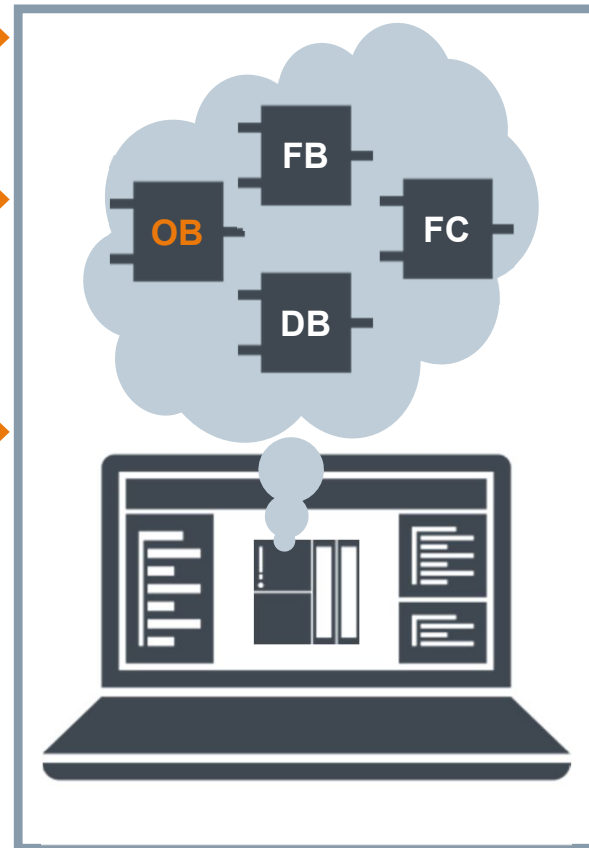
CPU/blocks

A user program for an S7-300 consists of blocks (OB, DB, FB, FC) that contain the instructions, parameters and data

The individual CPUs of the S7-300 differ in the quantity of blocks that you can set up for the respective CPU or that are provided by the operating system of the CPU

Organization blocks (OB)

- These form the interface between the operating system and the user program.
- They are called by the operating system and they control
 - the cyclic and alarm-controlled program processing
 - the startup behavior of the automation system
 - the handling of errors



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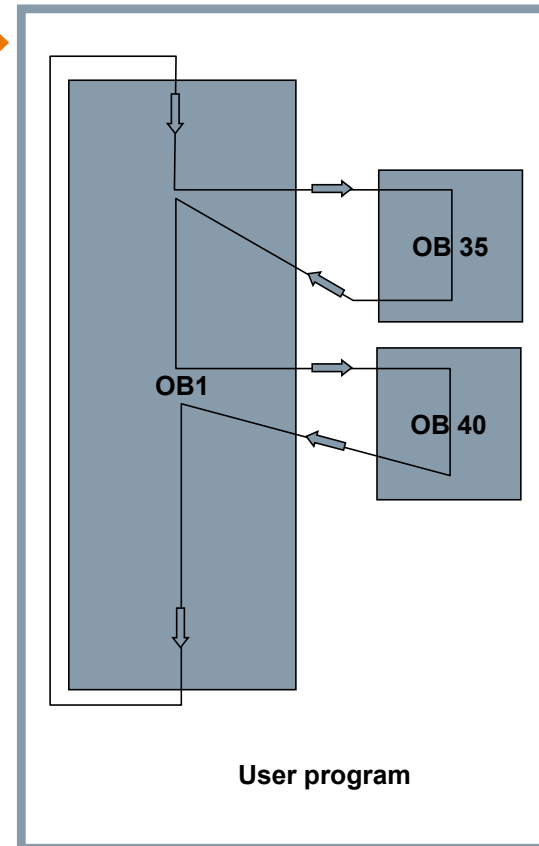
CPU/blocks

- | | |
|--|---|
| • OB 1 | Free cycle |
| • OB 10 | Real-time interrupts |
| • OB 20, 21 | Delay interrupts |
| • OB 32, 33, 34 35 | Cyclic interrupts |
| • OB40 | Process interrupts |
| • OB55, 56, 57 | DPV1 interrupts (only DP-CPU) |
| • OB 61 ³ | Synchronous cycle interrupt |
| • OB65 | Technology synchronous interrupt
(technology CPU only) |
| • OB80 | Asynchronous error interrupts |
| • OB82, 83 ¹ , 85, 86 ² , 87 | Diagnostic interrupts |
| • OB100 | Restart (warm start) |
| • OB121, 122 | Synchronous error interrupts |

¹ (for PROFINET IO only, at IM151 and IM154 also for central I/Os)

² (CPUs with DP or PN-IO only)

³ (IM151-8 PN/DP CPU and CPU 314C-2 PN/DP: Synchronous cycle interrupt only on PROFINET IO (not on PROFIBUS DP); CPU 315, IM154, 317 und 319: Synchronous cycle interrupt either on PROFINET IO or on PROFIBUS DP; CPU 313C-2 DP and CPU 314C-2 DP: no Synchronous cycle interrupt)

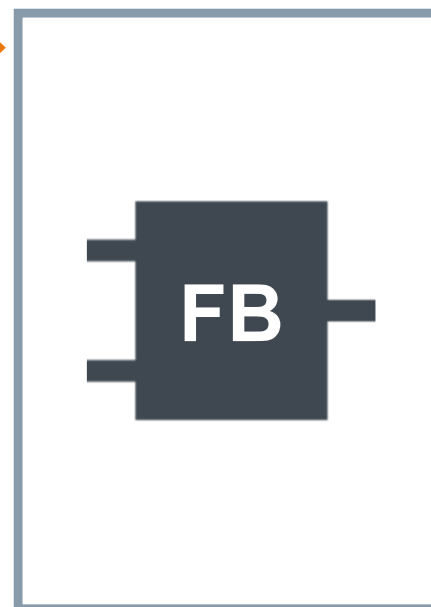


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CPU/blocks

Function blocks (FB)

- An FB contains a program that is performed whenever the FB is called by another code block
- It has an assigned data block as a memory (instance data block)
- The parameters that are transferred to the FB as well as the static variables are stored in the instance DB and are not lost after the FB is processed
- The temporary variables are stored in the local data stack and are lost after processing of the FB



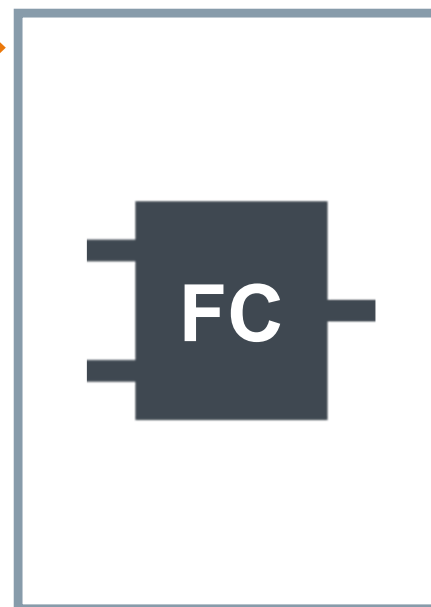
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	312	312C, 313, 314, 315, IM151/154	317	319
Number	1024	1024	2048	4096
Permissible number	0 to 7999			
Max. size of an FB (process-relevant code)	32 kByte	64 kByte	64 kByte	64 kByte

CPU/blocks

Functions (FC)

- An FC contains a program that is performed whenever the FC is called by another code block
- A function is a code block “without a memory”
- The temporary variables of the FC are stored in the local data stack and are lost after processing of the FC
- Functions can use global data blocks for storing data



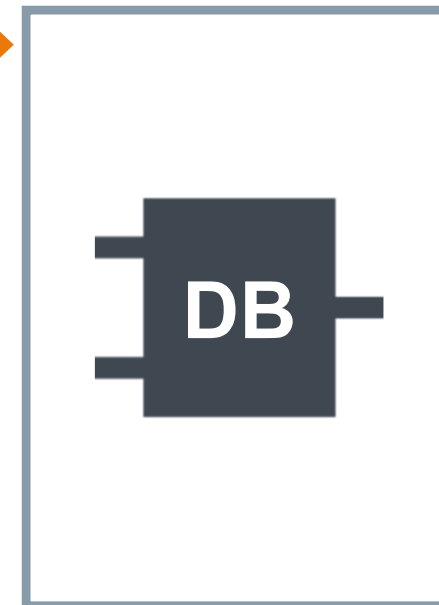
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	312	312C, 313, 314, 315, IM151/154	317	319
Number	1024	1024	2048	4096
Permissible number	0 to 7999			
Max. size of an FC (process-relevant code)	32 kByte	64 kByte	64 kByte	64 kByte

CPU/blocks

Data blocks (DB)

- Contain no STEP 7 instructions
- Contain variable data which the user program works with
- Global data blocks
 - Global data blocks contain user data that can be used from all other blocks
 - The structure of global data blocks can be freely defined
- Instance data blocks
 - An instance DB is assigned to each call of a function block that transfers parameters
 - The current parameters and the static data of the FB are stored in the instance DB
 - The variables declared in the FB determine the structure of the instance data block



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	312	312C, 313, 314, 315, IM151/154	317	319
Number	1024	1024	2048	4096
Permissible number	0 to 16000			
Max. size of an DB (process-relevant code)	32 kByte	64 kByte	64 kByte	64 kByte

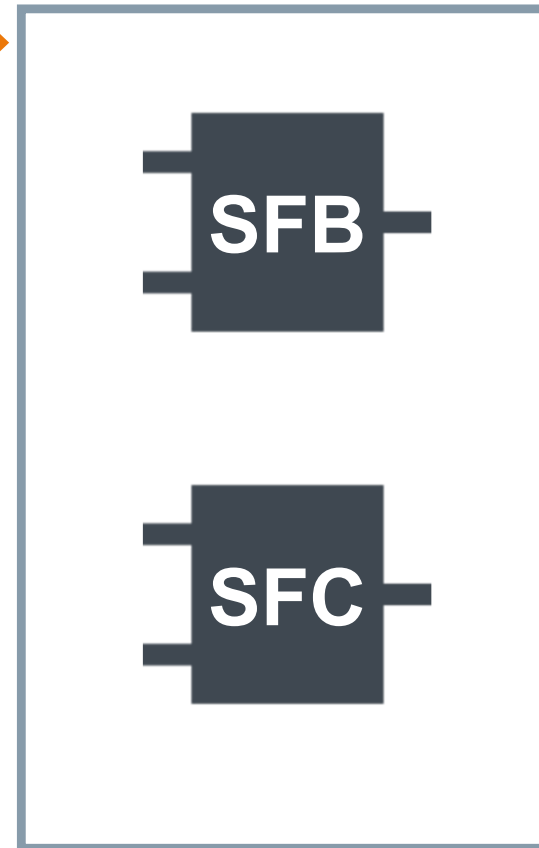
CPU/blocks

System function blocks (SFB)

- The SFBs are integrated in the S7-CPU and are thus part of the operating system • they are not loaded as part of the program
- Like FBs, SFBs are blocks “with a memory” and require instance DBs
- S7-CPU offer SFBs:
 - for communication via configured connections
 - for integrated special functions

System functions (SFC)

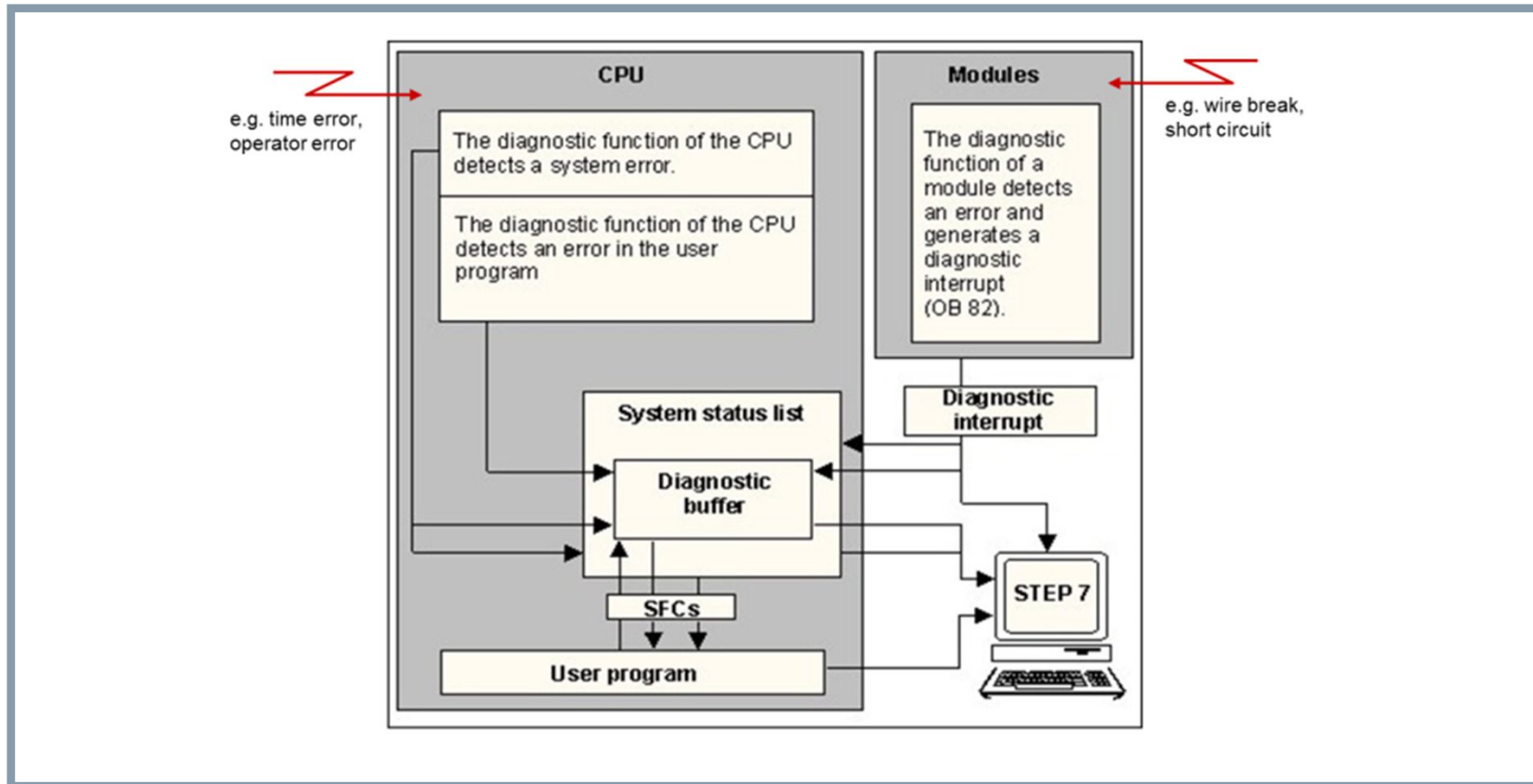
- A system function is a pre-programmed function that is integrated into the S7-CPU
- Like FCs, the SFCs are blocks “without a memory”



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Diagnosis

System diagnosis



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Diagnosis

Diagnostic functions

Calling the diagnostic function by means of a menu option

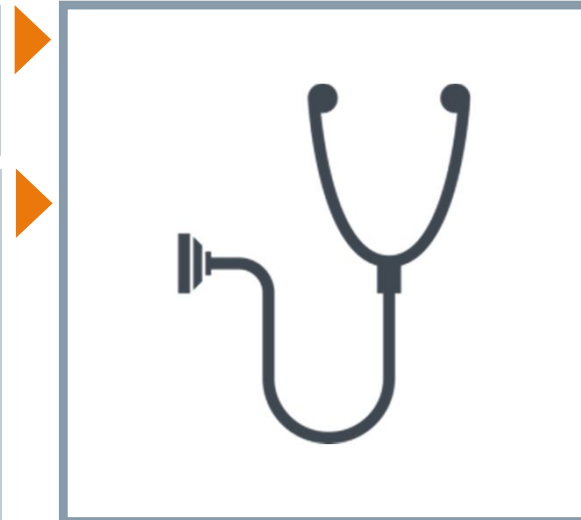
- System diagnosis
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Diagnostic events

- Internal and external errors on a module
- System errors in the CPU
- Operating status transitions (e.g. from RUN to STOP)
- Errors in the user program
- Withdrawing/inserting modules
- User messages entered with the system function SFC 52

System diagnosis – reactions

- System status list is updated
- Event is entered in a diagnostic buffer
- Event is given a time stamp
- If an error OB is available, it is started, otherwise the CPU enters the stop state

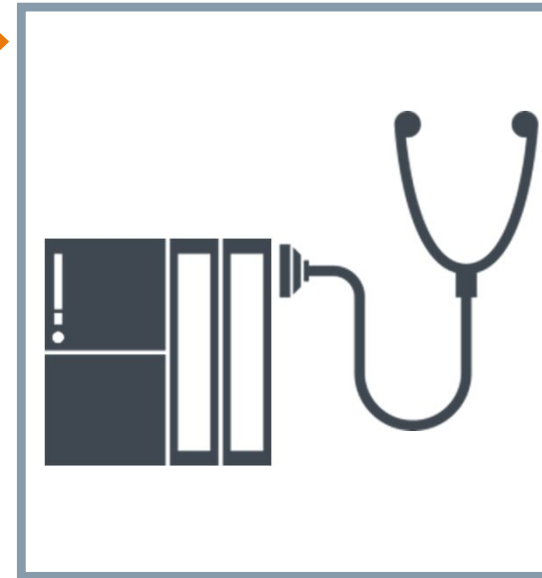


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Diagnosis Diagnostics possibilities

- Diagnostics with LED display
- Diagnostic buffer
- Diagnostics of field devices on PROFINET and PROFIBUS
- Diagnostics with system functions
 - evaluating of the diagnostics from centralized or distributed modules or DP slaves with SFB 54 RALRM (called in diagnostic OB82)
 - read an SSL partial list or an extract thereof with SFC 51 „RDSYSST“
 - Reading the diagnostic data (slave diagnostics) of a DP slave, using SFC 13 "DPNRM_DG"
 - Reading data records by calling SFC52 "RDREC"
 - Reading out the start information of the current OB, using the SFC 6 "RD_SINFO"
 - Triggering detection of the bus topology in a DP master system with the SFC103 "DP_TOPOL"

- Report System Error
- Diagnostics in STEP7 using the "Diagnosing Hardware" function
- Network infrastructure diagnostics (SNMP)
- Diagnostics with CPU Webserver



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Diagnostic buffer

- If an error occurs, the CPU writes the cause of error to the diagnostic buffer
- The diagnostic buffer is a buffered memory area of the CPU organized as a cyclic buffer
- Up to 500 events can be entered
- The contents are not deleted even at system restart
- The entries cannot be modified either by the programming device or by the user program itself

- All entries are given a time stamp
- The following entries are made:
 - Operating system events (diagnostic messages of the CPU, error events, ...)
 - Operator inputs via programming device or operating mode switch
 - Programmed user messages via system function (SFC)
 - Diagnostic events of other modules (diagnostic interrupts)
- The diagnostic buffer can be read by means of STEP7
- Messages can be sent to HMI devices/programming devices or CPU Webserver



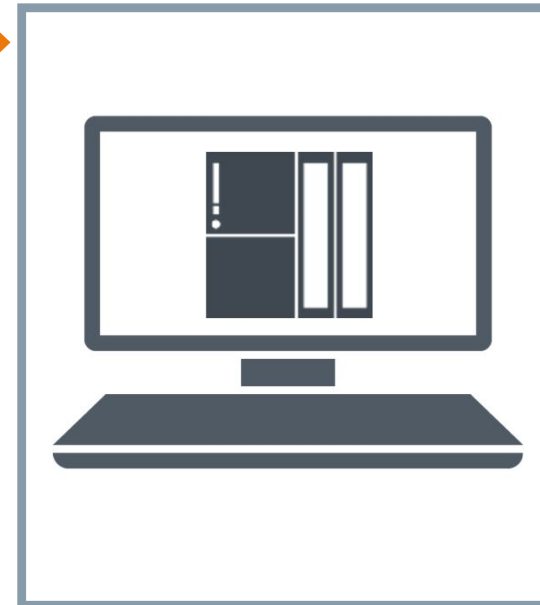
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Diagnosis

System status list

- The system status list (SZL) describes the current status of the automation system
- The SZL provides an overview of the structure, the current parameter settings, the current states and processes in the CPU and the assigned modules
- The data of the SZL is read-only and cannot be modified. It is a virtual list that is compiled only on request

- There are two possible ways of reading the SZL:
 - implicitly via STEP 7 menu commands from the programming device (e.g. memory configuration, static CPU data, diagnostic buffer, status indications)
 - explicitly via the system functions SFC 51 RDSYSST from the user program, specifying the required part list number
- The contents of the SZL are subdivided into:
 - System data: fixed or programmable characteristics of the CPU such as memory configuration, block types and number
 - Diagnostic status data: describe the momentary status of the components that are monitored by the system diagnosis, e.g. diagnostic events, module status data in the CPU ...
 - Diagnostic buffer
 - Diagnostic data on the modules



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Thank you for your attention!

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