General

S5-135U, S5-155U

Application
General

Fig. 4/1   S5-155U programmable controller

The SIMATIC S5-135U and S5-155U programmable controllers are multiprocessor controllers intended for automation tasks in the medium and upper performance levels. They provide a simple and economical solution for all automation tasks such as

- Open-loop control
- Closed-loop control and computation
- Communication
- Operator control and process monitoring
- Signalling and logging
- Data processing

The controllers are therefore suitable for:

- Machine control systems
- Process automation
- Process monitoring
- Coordinating functions

The standardized hardware technology, modular design of the PLCs and high performance capabilities of the programming device result in the following features:

- Easy use thanks to simple assembly of the modules and connection to I/O modules
- Simple adaptability of the various process signals because of different input/output voltages of the I/O modules
- Analog process signals can also be adapted via I/O modules
- Extra-discrete modular assembly using different I/O modules
- Simple programming by structuring the program and using standardized program sections (function blocks)
- Off-loading of the central processors and user program through the use of intelligent I/O modules (e.g. digital position decoder, valve control module)

- Simple communication with other programmable controllers and computers by means of internal communications processors and bus systems
- Easy system start-up by means of programming devices and service units with extensive programming and debugging aids

The programming language used is STEP 5 with the following methods of representation:

- Control system flowchart - CSF
- Ladder diagram - LAD
- Statement list - STL

and at a higher level

- GRAPH 5/II for sequential control.

S5-135U programmable controller

The S5-135U is a multi-processor programmable controller with special–purpose central processors (CPUs) which are available in various combinations, each with its own program memory:

- CPU 928B,
  optimized for fast bit and word processing as well as serial point-to-point communication
- CPU 928,
  optimized for open- and closed-loop control tasks

- CPU 922,
  optimized for arithmetic operations, closed-loop control, monitoring and reporting

Each CPU uses the same operations set and is optimized for its particular tasks.

By using a number of CPUs, the automation task can be broken down into manageable parts. Each processor executes its program indepen-

dently of the others. This increases the overall processing speed. Each processor can be started independently of the others.

S5-135U, S5-155U (continued)

Application (continued) S5-155U programmable controller	Apart from the CPUs mentioned, the following CPU can be used in the S5-155U programmable controller: • CPU 948, optimized for high-speed execution of bit and word operations, with large capacity program memory	The S5-155U programmable controller is therefore the most powerful PLC in the SIMATIC S5 system.	The S5-155U programmable controller • has a high processing speed and • offers the largest memory expansion.
S5-155H fault-tolerant programmable controller	The fault-tolerant variant SIMATIC S5-155H is for automation tasks that must not be interrupted under any circumstances. In order to ensure that the fault-tolerant S5-155H programmable controller is available in every case it is designed redundantly.	The S5-155H consists of 2 ZG 135U/155U central controllers (same hardware and software). Both central controllers work together in dynamic 1 out of 2 structure (hot-standby).	This enables high demands to be placed on failsafety and availability.
Design	It is essential to have a CPU in the central controller. The CPU handles central control of the entire programmable controller. Depending on requirements, a central controller can be equipped with the following modules: • CPU 948 (in the S5-155U only) for high-speed bit and word processing with large memory • CPU 928B, optimized for fast bit and word processing and serial point-to-point connection	• CPU 928, optimized for open-loop and closed-loop control tasks • CPU 922, primarily for calculation, closed-loop control, monitoring and reporting • Coordinator, required where more than one CPU is in use • External memory: CP 516 memory submodule • Communications processors for connecting human–machine interfaces and peripheral devices as well as for connection to local area networks	• Modules for the input and output of binary and analog signals • CP 581 integrated PC • Intelligent I/O modules • Interface modules for connecting expansion units and distributed I/Os and field devices
Expansion units	If there are not enough slots available in the central controller, or if certain modules are to be deliberately located elsewhere, expansion units can be connected to the central controller. Centralized expansion units are located direct at the central controller or in a cabinet next to it. Distributed expansion units can be located up to 3000 m (9840 ft) from the central controller. Additional centralized expansion units can be connected to the distributed expansion units.	An expansion unit can be equipped with the following modules depending on design and requirements: • Communications processors for connecting human-machine-interfaces, personal computers (PCs) and peripheral devices as well as for connection to local area networks	• Modules for the input and output of binary and analog signals • CP 581 integrated PC • Intelligent I/O modules • Interface modules for connection to the central controller or additional expansion units

4

General

S5-135U, S5-155U (continued)			
Design (continued) Multiprocessing	The performance capability of a programmable controller can be considerably enhanced by using several CPUs. Each CPU executes its program independently of the others.	A coordinator assigns access to the internal S5 bus to the CPUs. The necessary information exchange between the CPUs is also handled by the coordinator.	Each CPU can be started up independently of the others.
Internal S5 bus	The internal S5 bus connects the modules of the programmable controller with each other. All internal data traffic between the CPUs,	memory submodules, communications processors, interfaces and input/output modules is conducted over this bus.	If several CPUs are in use, a coordinator controls access to the internal S5 bus.
Interface modules	In centralized and distributed configurations, interface modules handle data traffic between the central controller and the expansion units as well as distributed I/Os completely autonomously. This means that modules in	the expansion units behave in exactly the same way for the user as modules in the central controller. The PROFIBUS-DP field bus can be designed with a special interface module.	A feature of this LAN is fast cyclical communication and enables simple connection of distributed I/O stations and field devices to the automation system.
Communications processors	Communications processors handle data traffic with the following completely autonomously: • Standard peripheral devices such as printers, keyboards, CRT units • Computers • Other programmable controllers	This offloads the CPU of time-intensive communications tasks. The necessary data for texts and images can be stored in each communications processor's own RAM or EPROM submodule.	In addition, communications processors can be used to configure the SINEC L1, PROFIBUS and Industrial Ethernet LANs and to connect programmable controllers to the LAN.
Input/output modules and intelligent I/O modules	The input/output modules and the intelligent I/O modules constitute the link between the programmable controller and the process. They can be plugged into the central controller and the expansion units.		

S5-135U, S5-155U (continued)

Design (continued)
Possible configurations

Central configuration

In a central configuration, the expansion units are either in the same cabinets as the central controllers or in a separate cabinet next to it. The maximum length for the cable connecting the central controller to the furthest expansion unit is 2 m (6.5 ft).
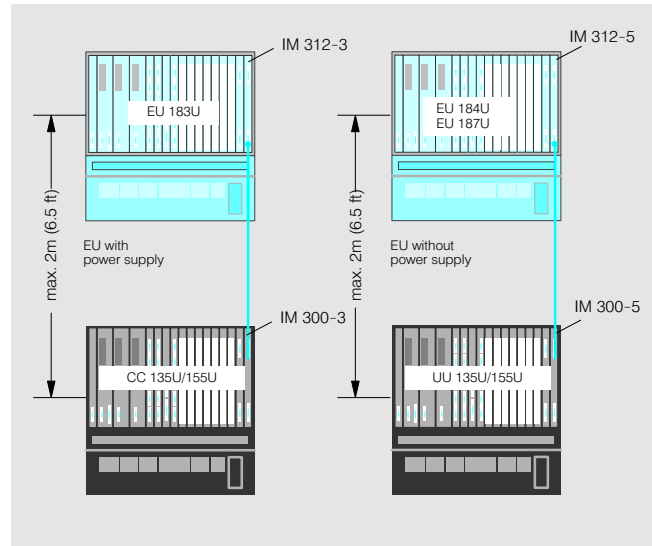
Fig. 4/2   Central configuration of expansion units

Distributed configuration

In a distributed configuration, the expansion units are installed at a distance of up to 3000 m (9840 ft) from the central controller. Four additional expansion units can be connected in a distributed configuration to each distributed expansion unit.

Expansion units of the S5-115U and the distributed I/O and field devices can also be connected.
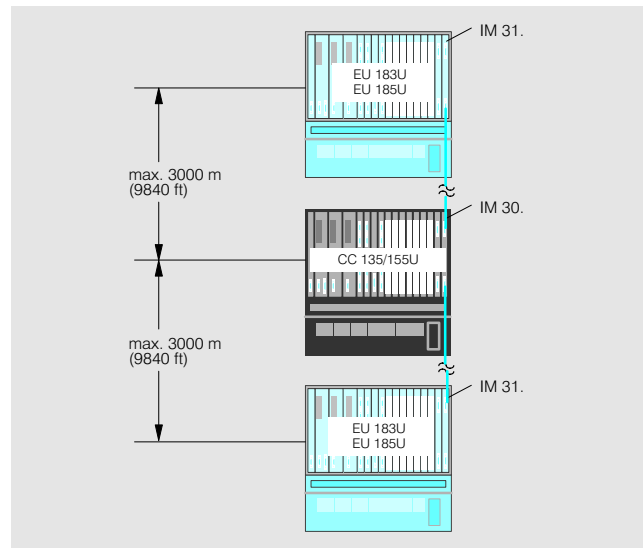
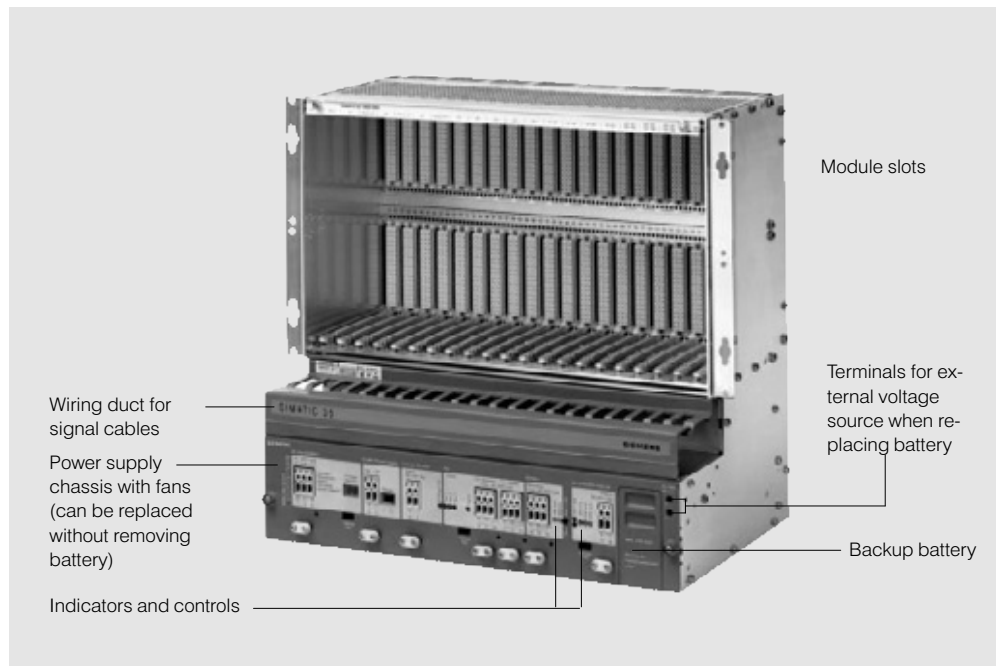Fig. 4/3   Distributed configuration of expansion units

S5-135U, S5-155U (continued)

Module slots

Terminals for external voltage source when replacing battery

Backup battery

Wiring duct for signal cables

Power supply chassis with fans (can be replaced without removing battery)

Indicators and controls

Fig. 4/4   Mechanical features of the ZG 135U/155U central controller for the S5–135U and S5–155U programmable controllers

The central controllers and expansion units consist of a compact housing with

- Power supply chassis with 3 fans and a lithium backup battery as well as a storage battery (for the RAM)
- 21 (or 20 or 11) module slots

The backup battery is not required in expansion units. Expansion units are also available without the power supply chassis or fans.

Housing
The housing consists of bolted sheet-steel sections with ventilation openings at the top and bottom. The slots have socket connectors and guides to accommodate the modules.

A wiring duct for signal cables runs along the front, beneath the modules and above the power supply chassis.

Power supply chassis
The power supply chassis with 3 fans is located in a tier in the bottom part of the housing.

The input voltage is either 24 V DC or 230/120 V AC. An internal switch is provided for selecting either 230 V or 120 V AC.

Output voltages for the internal power supply to the modules:

5 V DC (10 A, 18 A, 40 A; short-circuit protected), with jacks for measuring current, 24 V DC (0.4 A, 0.5 A, 1 A, 2 A; fused), with jacks for measuring voltage 15 V DC

Monitoring facilities (with LED indicators) are provided for:
- Input voltage (no indication)
- 5 V output voltage
- 15 V, 24 V output voltage
- 3.4 V backup battery voltage
- Airflow for the fans
- 24 V load voltage (external)

All screw terminals on the power supply chassis are intended for conductors of up to 4 mm^2 cross-section.

Backup battery
A lithium backup battery with storage battery as reserve is provided to supply power to all RAMs in the event of a power failure.

Two jacks are provided for external input of the backup voltage. This allows the backup battery to be replaced without interrupting the backup voltage, even when the input voltage is switched off. The power supply chassis can be replaced without interrupting the backup supply.

S5-135U, S5-155U (continued)

Design and connection of the I/O modules

The input and output modules have a plastic cover to protect the components and printed circuits from accidental contact. The module widths correspond to either 1 or 2 slots.

LEDs to the left of the terminal pins - corresponding to the labelling area of the front connectors - indicate the statuses of inputs and outputs.

A DIL coding switch is used to set the parameter range (address range) for addressing a module.

A swivelling handle facilitates module extraction.

Front connectors (of single and double width) are available for connecting signal leads to the module. The front connectors latch onto the module at the bottom and are screwed to the module at the top.

Attaching front connectors for AC to DC modules is prevented by mechanical keying as a safeguard against dangerous operating conditions.

The front connectors can be labelled on their sides.

Special self-adhesive labelling strips are provided with each module. These should be affixed to the front connector. This clearly identifies the individual inputs and outputs.
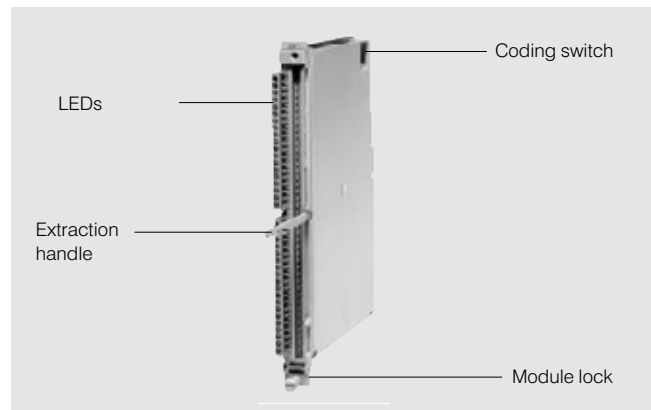

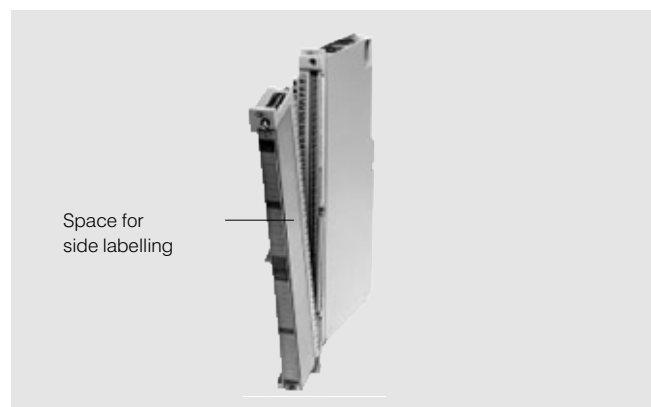Fig. 4/5 Design of the I/O modules
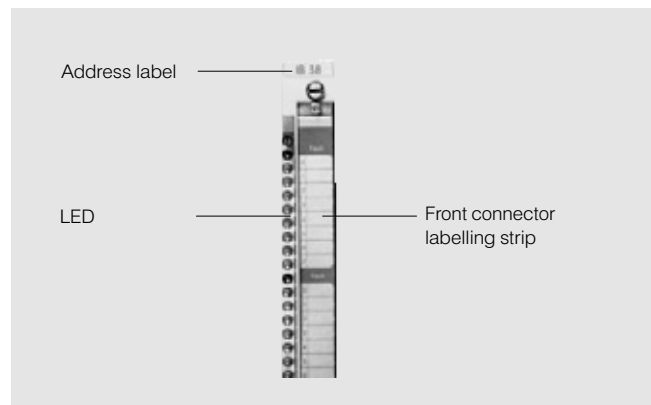

Fig. 4/6 Connection via front connectors

Fig. 4/7 I/O modules with labelling strips

SIMATIC S5-135U, S5-155U/H

General

Design (continued)
Mechanical features
(continued)

Desing and connection of the I/O modules
(continued)

Signal leads are connected to the modules using the front connectors.

There are two ways of connecting signal leads to the front connectors:

- Crimp snap-in terminals for single and double-width front connectors
- Screw terminals for single and double-width front connectors; end sleeves for the conductors are not required.
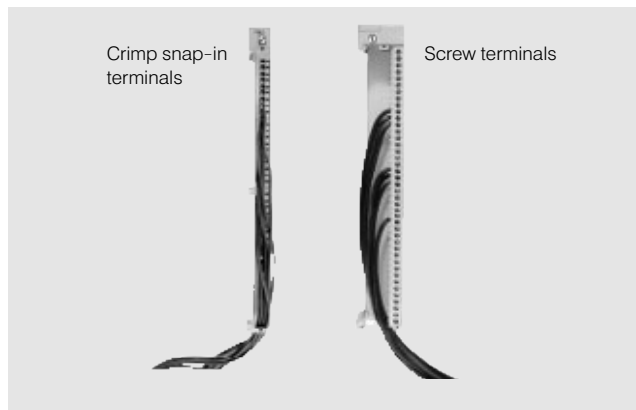
Fig. 4/8   Connection of the signal cable

Principle of operation

The principle of operation of the S5-135U and S5-155U programmable controllers is largely governed by the components "program memory" and "processor".

In the S5-155H fault-tolerant programmable controller, the redundancy functions are an additional factor (see page 4/18).

Program memory

The program contains the user program.

Processor

The processor operates cyclically:

At the beginning of the cycle, the processor reads the signal states of all inputs and stores them in a process input image (PII).

The program is then executed step by step.

The processor stores the calculated signal states in a process output image (POI).
At the end of the cycle, the processor writes the signal states into the outputs.

The cycle can be stopped by interrupts (process and time interrupts).
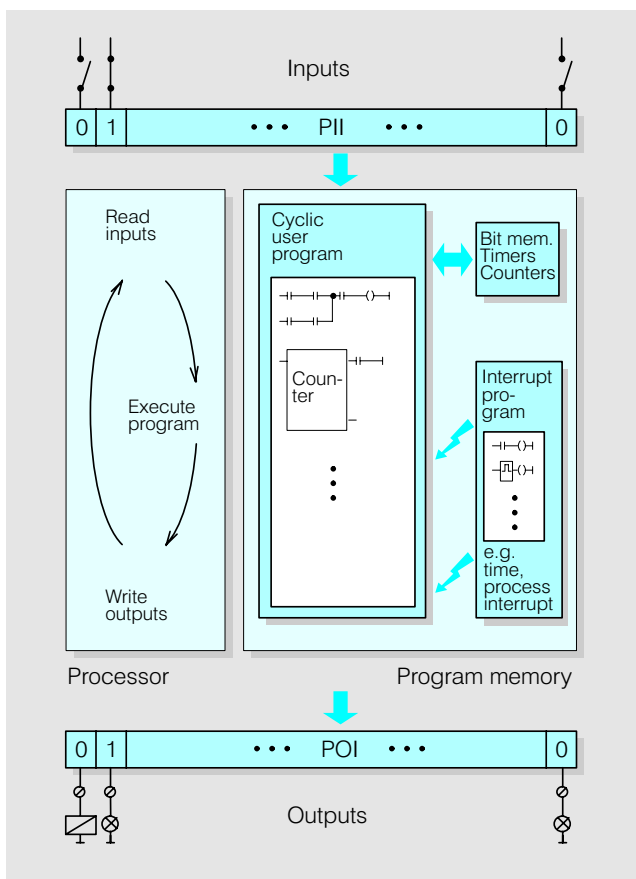
Fig. 4/9   Functional design of the S5-135U, S5-155U

S5-135U, S5-155U (continued)

Programming
Programming language

Fig. 4/10 Programming the S5-135U and S5-155U/H programmable controllers

The programming language for SIMATIC S5 programmable controllers is STEP 5 (see Section 7) in one of the following representations:

- CSF - Control System Flowchart
- LAD - Ladder Diagram
- STL - Statement List

Programs for sequence control systems can be entered clearly in the form of a flow diagram using GRAPH 5 (see Section 7).

Programming devices

The following programming devices can be used for programming the S5-135U and the S5-155U/H programmable controllers:
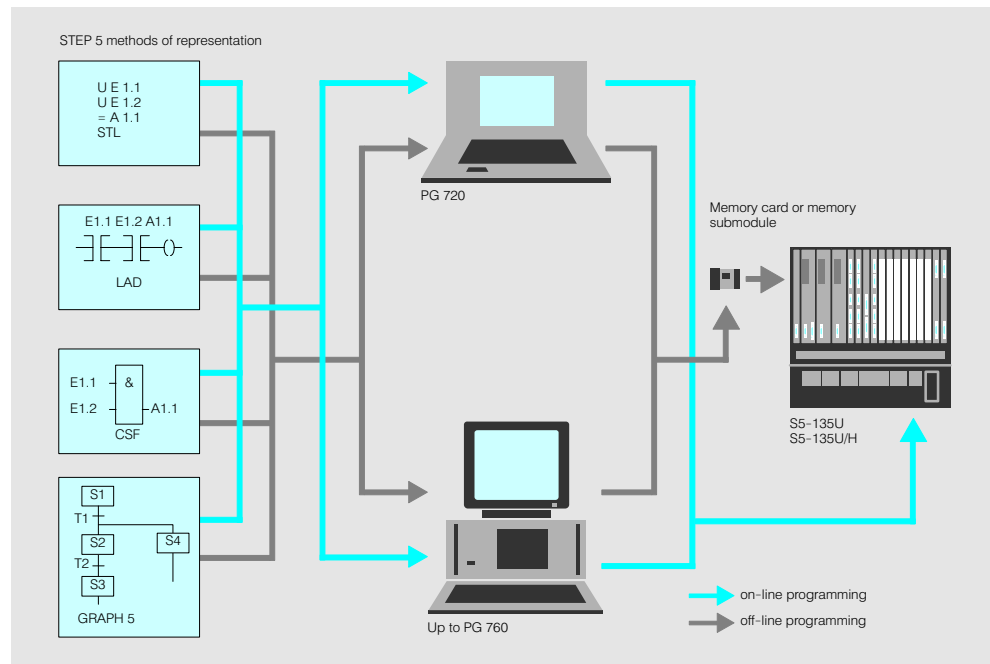- PG 720, PG 720P
- PG 740

- PG 760
- PG 710 Plus, PG 730, PG 750, PG 770

The programming devices have operator prompting to facilitate programming and aids for debugging and system start-up.

A printer can be connected to the programming device for program documenting.

Program input

There are two ways of entering the program:
- Direct program entry to the CPU in the central controller (on-line programming)

- Programming the memory cards or memory submodules (EPROM or EEPROM) in the programming device without connecting it to the PLC.

The memory card or memory submodule is then plugged into the central controller (off-line programming).

Program execution

Cyclic program execution

The blocks of the user program are executed in the sequence specified in the organization block.

Interrupt-driven program execution

When certain input signal changes occur, cyclic execution is interrupted at the next statement and an organization block assigned to this

event is started. The user can formulate his response program to this interrupt in this organization block. Cyclic program execution is then resumed at the point at which it was interrupted.

Time-controlled program execution

An organization block is called after a preset time (time interrupt). Organization

blocks are available. Times between 10 ms and 20 min can be set for each organization block. This makes it possible for certain parts of the program to be processed independently of the scan time.

SIMATIC S5-135U, S5-155U/H
General

S5-135U, S5-155U (continued)

Communication
Point-to-point connection

Communications processors enable the programmable controller to communicate with other programmable controllers, computers, human-machine-interfaces, and peripheral devices through point-to-point connections.

They have their own memory for data, texts and graphics. Data communication with the devices connected is handled by the communications processors absolutely independently, which relieves the central processing units from time-consuming communications tasks.

Communication with computers, other programmable controllers and peripheral devices, such as printers, is carried out by the CP 523, CP 524 and CP 544 communications processors.

The CP 526, CP 527 and CP 528 communications processors are responsible for communications with the units of the SIMATIC HMI human-machine-interface.
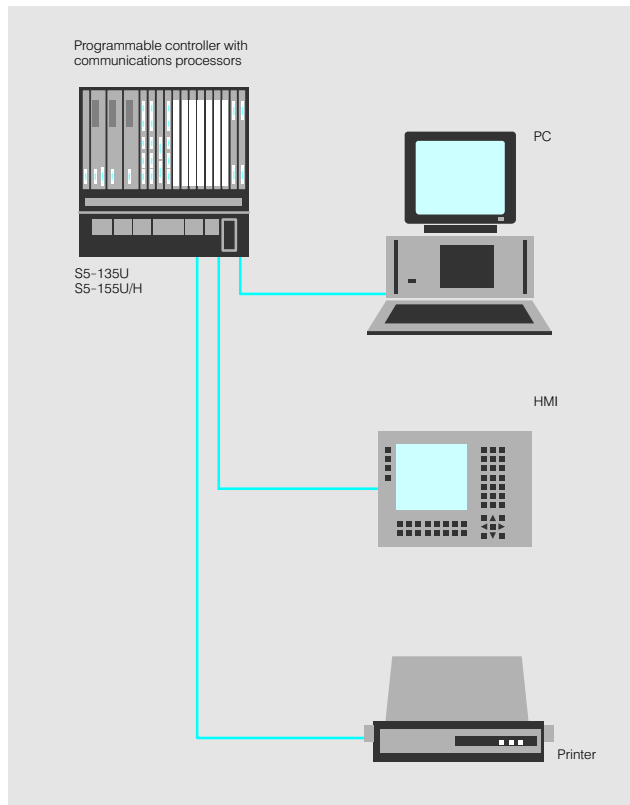
Fig. 4/11 Interfacing the programmable controller with PC, HMI devices and printer

Local area networks

SINEC L1 bus system
The SINEC L1 bus system (Siemens Network Communication Low Range) provides a simple solution to the configuring of small, distributed automation systems on the lower level of communications technology.

The following PLCs can be connected to this bus system: S5-90U, S5-95U/F, S5-100U, S5-115U/H/F, S5-135U and S5-155U/H.

Features
• Up to 31 nodes
• Baud rate 9.6 kbit/s
• Max. coverage 50 km (31 miles)
• Transmission medium: twisted pair cable

PROFIBUS bus system
See Section 10.

Industrial Ethernet bus system
See Section 10.

S5-135U, S5-155U (continued)

Quality assurance procedures

To ensure correct operation of all SIMATIC S5 products and to prevent failures, extensive, cost-effective quality assurance procedures are carried out at every stage of the life of a product:

- During product planning
- During product development
- During production
- In product operation

Product planning

The product planning phase covers all the activities from market research to type specification. Quality assurance in the product planning phase ensures that the SIMATIC S5 product conforms to the high standards of quality required on the market.

Product development and production

The following are some examples of routine quality assurance precautions taken during development and production:

- Use of high-quality components

- Worst-case design of all circuits
- Systematic and computer-controlled testing of all components supplied by subcontractors
- Burn-in of all LSI circuits, e.g. processors and memories. Burning in is an aging process which helps to reduce the number of failures early in a product's life. The components are subjected to a high temperature for several hours in a burn-in cubicle
- Measures to prevent static charge building up when handling MOS circuits
- Visual inspections at various stages of production
- In-circuit testing of all modules, i.e. computer-aided testing of all components and their interaction with other components in the complete circuit
- Continuous heat-run test at elevated ambient temperature over a period of several days

- Careful computer-controlled final testing
- Statistical evaluation of all failures to enable the immediate initiation of suitable corrective measures

Product operation

Even when the SIMATIC S5 products are in operation on the customer's premises, they are still under constant supervision. Extensive quality control precautions are taken in the following areas:

- Stockkeeping and dispatch
- Service
- Field observation

Established methods are used in all these areas, which operate precisely, punctually and conscientiously, whilst also remaining flexible for special customer requirements.

Sometimes an even higher level of fault-tolerance or safety is required than that normally offered by the SIMATIC S5 U range. Fault-tolerant or failsafe programmable controllers, such as the S5-115H or the S5-115F are available for this purpose.

Availability

Availability is the probability of finding a system in a functional state at a specified point in time.

Safety

Safety is defined by DIN 31000 as "A state of lower risk than the permitted limit". The "permitted limit is the maximum acceptable degree of risk for a specific plant". The plant-specific degree of risk may be stipulated by law, by the plant operator or by an independent body of experts, e.g. the German Technical Inspectorate (TÜV).

Installation guidelines

SIMATIC programmable controllers are designed for use in harsh industrial environments. To ensure correct operation of the equipment, it must be installed and connected in accordance with certain rules. Certain principles must also be observed as regards wiring, earthing and shielding.

Timely planning of the necessary measures for improving the electromagnetic compatibility (EMC) of the programmable controllers is advisable in order to avoid retrofitting. These rules are explained in the section entitled "Installation guidelines" in the relevant product manuals.

For the installation of failsafe controls, the relevant regulations must be observed.

4

SIMATIC S5-135U, S5-155U/H
General

Application
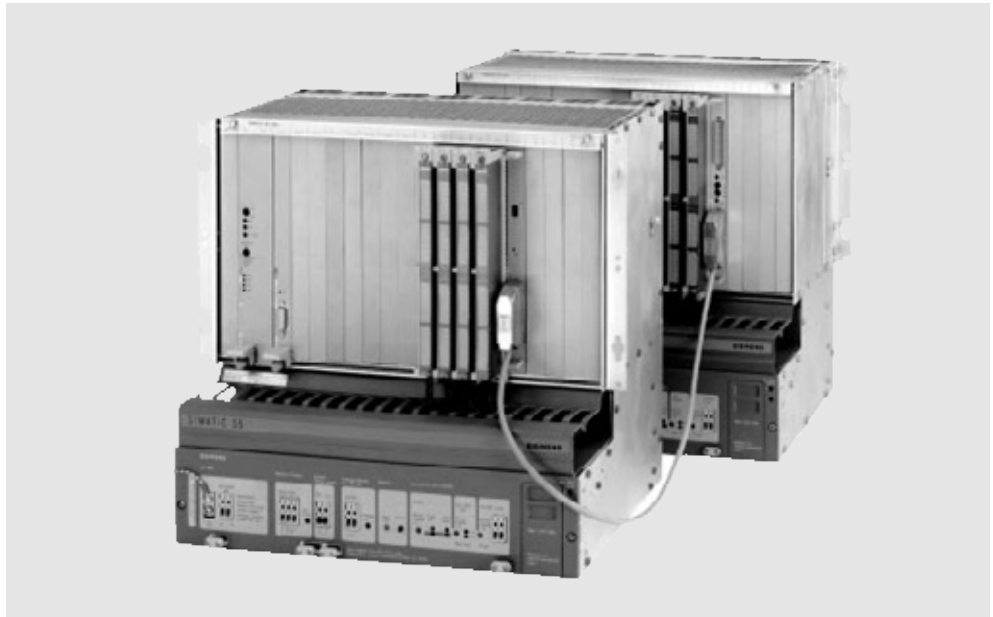
Fig. 4/12 S5–155H programmable controller

In many fields of automation, increasingly high demands are being placed on the availability and fault-tolerance of programmable controllers (PLCs). Particularly in fields where a plant shutdown would be extremely expensive. In such cases, only redundant systems can offer the standard of availability required.

Fault-tolerant systems continue to work in all likelihood when one or more parts of the control fail.

The S5-155H/S5-155H Lite programmable controller consists of two interlinked central controllers. It operates on the "master/slave" principle. One subunit, the master, controls the process. If a fault occurs, the other subunit, the slave, takes over control.

This ensures a high degree of fault-tolerance, which makes the S5-155H/S5-155H Lite programmable controller especially suitable for applications in the following fields:

Fields with predominantly continuous processes, e.g.:
- Refineries
- Chemicals
- Power stations
- Steelworks
- Environmental protection (e.g. water treatment)
- Pipelines
- Off-shore installations

Areas of production employing batch processes, e.g.:
- The automotive industry
- The pharmaceutical industry
- The food industry
- In plants with flexible manufacturing systems
- In high-bay warehouses

S5-155H, S5-155H Lite (continued)

Design
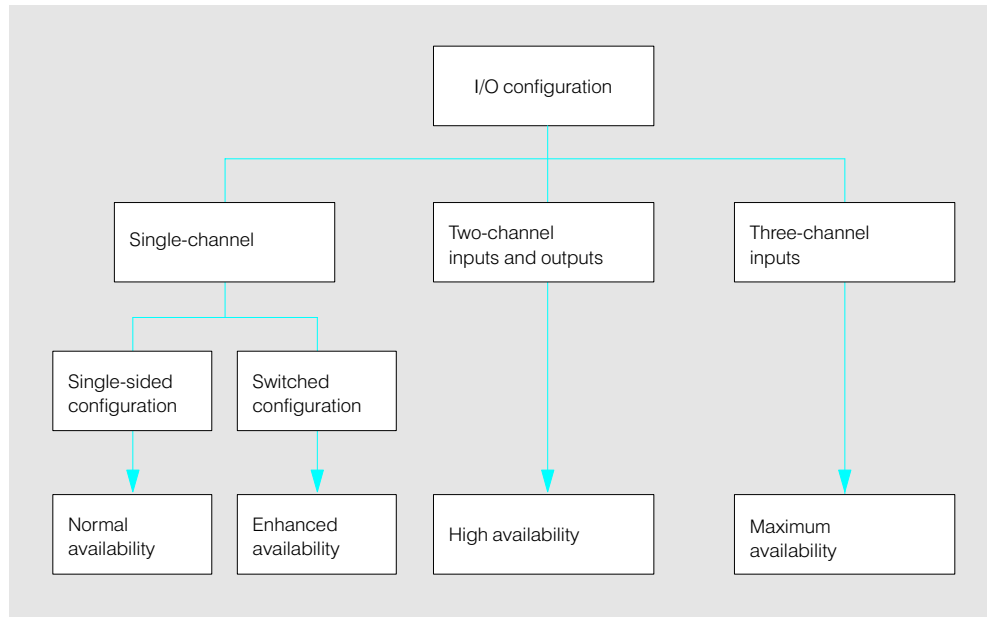
Fig. 4/13 Degrees of availability of the I/O area

In the S5-155H/S5-155H Lite programmable controller the central functions are always implemented in a redundant configuration.

S5-155H
Configured with CPU 948R

S5-155H Lite
Configured with CPU 948RL

The I/Os can, however, also be configured with redundancy.

The two subunits of the S5-155H/S5-155H Lite programmable controller are both equipped with the same hardware and software and interlinked via the IM 304 and IM 324R interface modules (for linking central controllers) and the 721 connecting cable.

Three different levels of availability are possible, depending on the arrangement of the I/O modules:
• Normal availability (single-sided configuration)
• Enhanced availability (switched configuration)
• Maximum availability (fully redundant configuration)

Full redundancy of the S5-155H/S5-155H Lite is implemented with
• Two-channel configuration of inputs and outputs
• Three-channel input configuration

Fig. 4/13 shows the configurations for the three levels of availability.

The different levels of availability can be combined as required.

The performance capability, user convenience and other technical features of the S5-115H/S5-155H Lite fault-tolerant programmable controller correspond to a large extent to the features of the S5-155U.

SIMATIC S5-135U, S5-155U/H
General

Design
Normal availability
(single-sided configuration)

In the single-sided configuration (see Fig. 4/14) the I/Os are connected in single-channel mode and only addressed by one of the two subunits. The I/Os in this configuration can be plugged into either

- a central controller or, if the number of slots is not sufficient,
- expansion units.

Information read into the one subunit (e.g. from digital input modules) is automatically transmitted to the second subunit.

It is immaterial whether one subunit is the master and the other the standby. What is important is whether or not the subunit which is connected to the I/Os is operational.
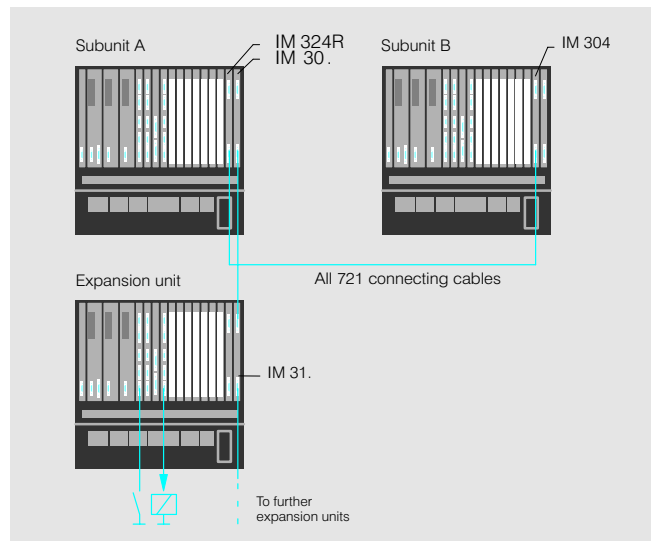
Fig. 4/14 Single-sided configuration (normal availability)

In the event of a failure, the I/Os connected to the subunit concerned are also out of action.

This configuration is used for sections of a plant which do not require enhanced availability.

Enhanced availability
(switched configuration)

In the switched configuration (see Fig. 4/15) the I/Os are connected in single-channel mode, but they can be addressed by both subunits. The I/Os in this configuration must always be plugged into an EG 185U expansion unit.

Up to 16 expansion units can be connected in switched configuration, distributed between up to 8 I/O bus lines.

Expansion units in switched configuration are connected via the IM 304 interface module in the central controller and the IM 314R interface module in the expansion unit. The expansion units can also be expanded in a centralized configuration via the IM 300 interface module.
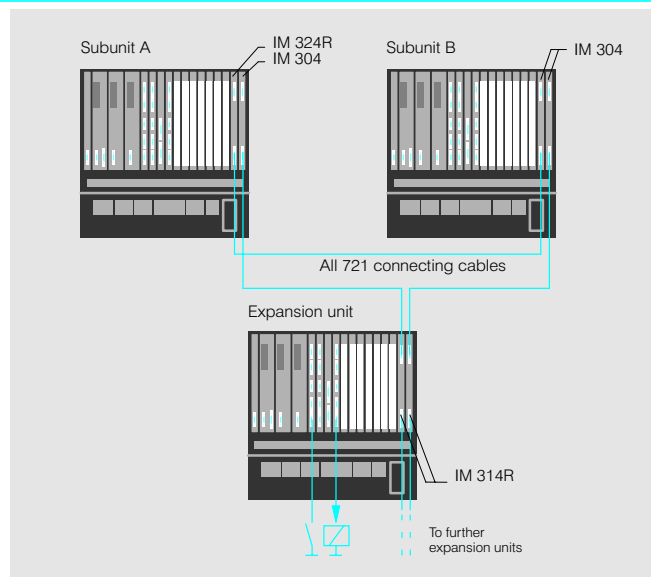
Fig. 4/15 Switched configuration (enhanced availability)

Expansion units in switched configuration are connected to both subunits and are addressed by the one currently acting as master.

This configuration is employed when failure of individual I/Os is not crucial.

S5-155H, S5-155H Lite (continued)

Design (continued)
High availability
(fully redundant configuraion)

Two-channel configuration

In the two-channel I/O config-
uration, identical I/Os are
installed with the same ad-
dresses in both subunits.
Both failure of one of the cen-
tral controllers and failure of
one of the two redundant I/Os
can be tolerated. The I/O
modules can be installed ei-
ther in the central controllers
themselves or in expansion
units.

Three-channel configuration

The maximum degree of avail-
ability is obtained with a
three-channel input configura-
tion. Two of the three input
channels are assigned to the
CPUs directly, whereas the
third channel is connected to
both CPUs via an expansion
unit in switched configuration.
If one of the CPUs fails, the
intact CPU continues to oper-
ate with two input channels.

The three-channel input con-
figuration has the following
advantages:
- A high degree of availability
  with a choice of two out of
  three
- Numerous faults can be rec-
  ognized and located without
  additional wiring such as:
  Module fault,
  Load voltage failure,
  Wirebreak,
  Short-circuit to frame and
  Sensor fault
- Low wiring overhead
- Both redundant and diverse
  sensor configurations pos-
  sible

The redundant I/O modules to
be used in the two- and three-
channel configurations must
be made known to the operat-
ing system using the COM
155H parameter assignment
software.

They can be addressed in the
same way as single-channel
l/Os in the user program. The
operating system does the
rest.

The communications proces-
sors can also be used with
two-channel mode in a redun-
dant configuration (see page
4/16). The user must program
the redundancy function.
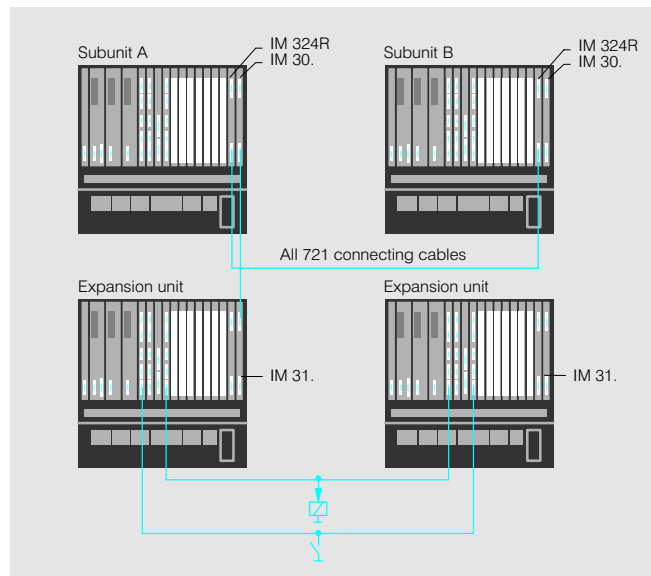
Fig. 4/16 Two-channel configuration (high availability)
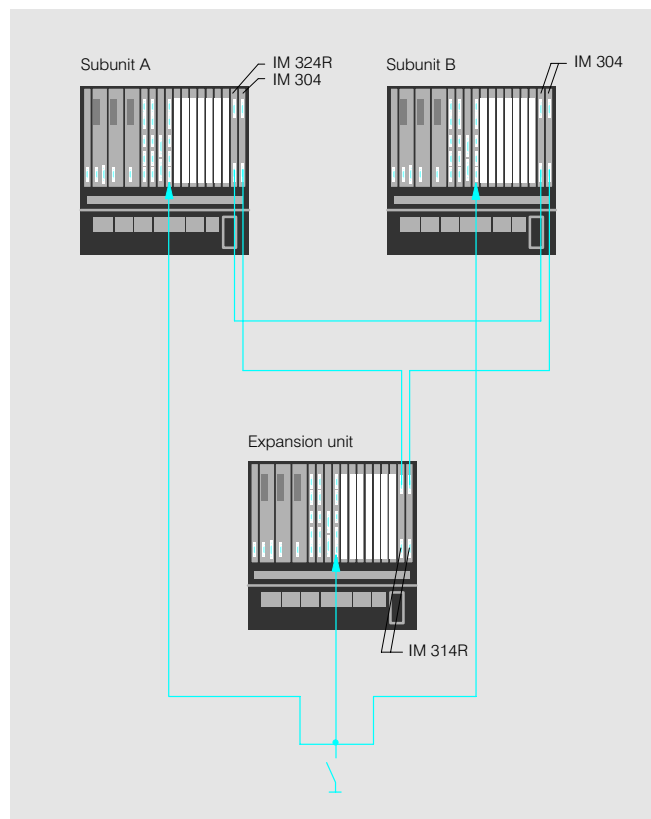
Fig. 4/17 Three-channel configuration (maximum availability)

The following can be con-
nected to the central control-
ler:
- EG 184U
- EG 185U
- EG 187U
- ET 100U
  electronic terminator
- ET 200 distributed
  I/O system

S5-155H, S5-155H Lite (continued)

Design (continued)
Mixed configuration

The different levels of availability can be combined as required. A mixed configuration, i.e. a combination of redundant, switched and single-sided configuration, is frequently the most economical solution.
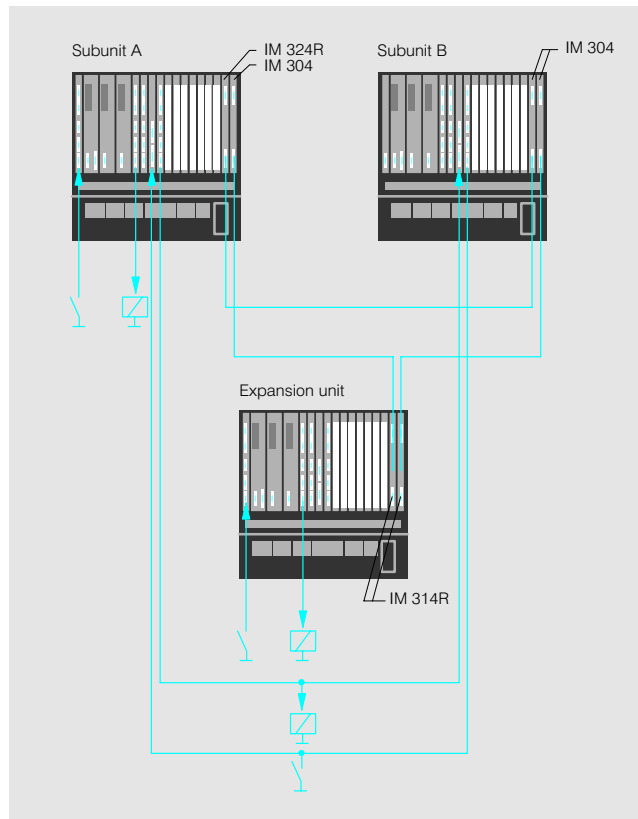
Fig. 4/18 Mixed configuration

Redundancy of the IPs and CPs

Intelligent I/O modules (IPs) and communications processors (CPs) can also have redundant configuration.

Switched redundant configuration
The IPs and CPs can be plugged into expansion units of switched configuration.

Two-channel redundant configuration
The CPs can additionally be plugged into the two subunits.

Selection criteria
The type of configuration which is most favorable depends on the type of application.

Advantages of the switched redundant configuration:
- In the case of a central controller failure, the IPs/CPs remain redundant
- In the case of an IP/CP failure, the central controllers remain highly fault tolerant
- Shorter scan time

Disadvantages of the switched redundant configuration:
- At least two switched expansion units required
- If the IPs/CPs are to be repaired, the corresponding expansion unit must be switched off. This means that all other I/O modules in this expansion unit are out of operation

Advantages of the two-channel redundant configuration:
- No switched expansion units required
- If the CPs are to be repaired, only redundant components have to be disconnected from the power supply

Disadvantages of the two-channel redundant configuration:
- Longer scan time

S5-155H, S5-155H Lite (continued)

Design (continued)
Redundancy of the
IPs and CPs

IPs and CPs in switched redundant configuration

If an intelligent I/O module (IP) or a communications processor (CP) is to be used in switched expansion units, a minimum of two expansion units is required. One CP/IP each must be plugged into the two expansion units. If data is received in an intelligent I/O module or a communications processor, it is automatically transmitted to the second subunit, regardless of which is the master and which is the reserve unit.

CPs and IPs in two-channel redundant configuration

If a communications processor (CP) or an intelligent I/O module (IP) is to be of two-channel redundant configuration, one CP/IP must be plugged into each of the two subunits. Both CPs/IPs are assigned different page frames and operate independent of each other. If a CP/IP receives data, it is automatically transmitted to the second subunit, regardless of which is the master and which is the reserve unit.

The redundancy function both in the case of the switched and the two-channel redundant configuration must be programmed by the user. The user program defines which CPs/IPs are active and it must detect whether one of the CPs/IPs is faulty, in order to be able to switch over to the other CP/IP if necessary.

The operating system ensures that the data in both subunits remains equal. Both CPs/IPs are regarded as independent modules.

In contrast to the I/O modules in redundant configuration, redundant CPs and IPs are assigned different addresses and page frames in the two subunits.
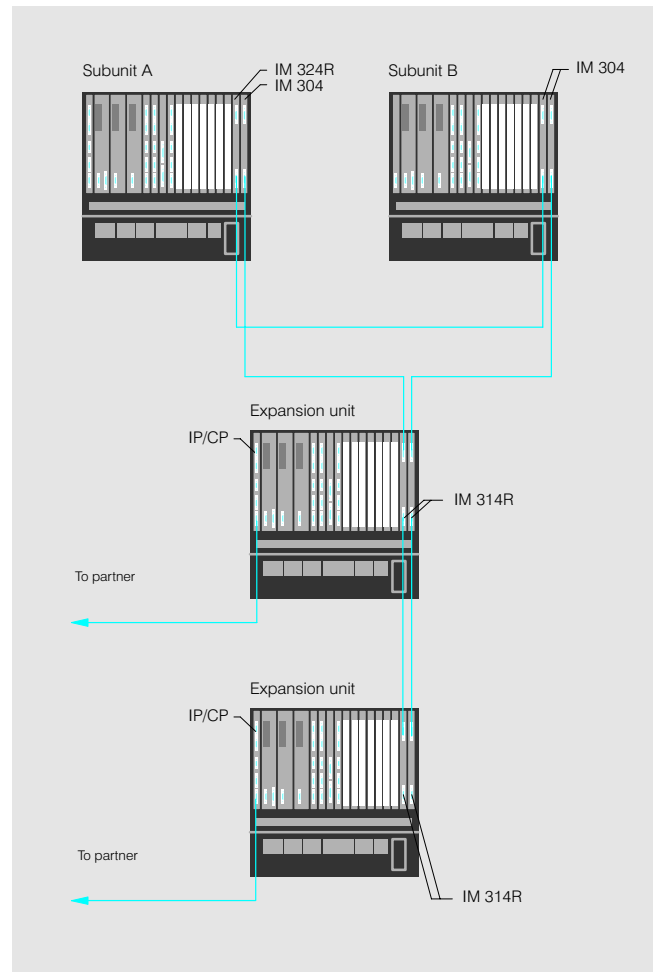
Fig. 4/19 CP/IP in switched redundant configuration
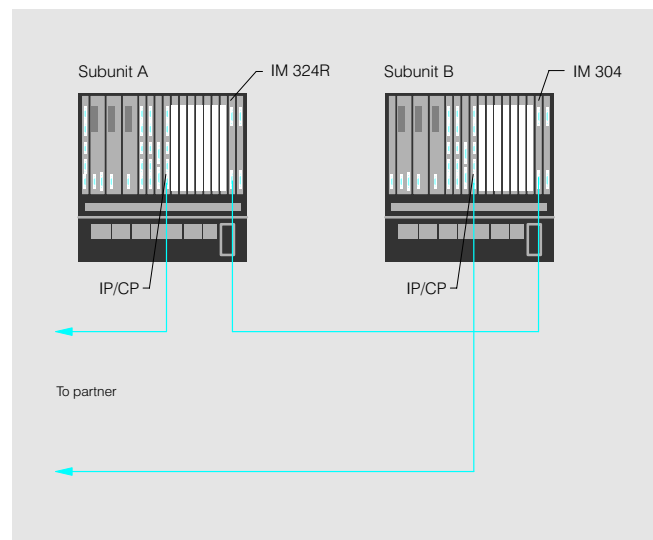
Fig. 4/20 CP/IP in two-channel redundant configuration

S5-155H, S5-155H Lite (continued)

Principle of operation

The principle of operation of the S5-155H/S5-155H Lite fault-tolerant programmable controller can be compared with an "OR" operation. The programmable controller is in an operational state when at least one of the two subunits is functioning correctly (see Fig. 4/21).

Both central controllers contain the CPU 948R/RL. The oper-ating system of the CPU 948R/RL performs all the additional functions of the S5-155H/S5-155H Lite independently e.g.:
- Data exchange
- Fault handling (switchover to standby unit)
- Synchronization of the two subunits
- Self-test
- Fault locating

The operating system of the S5-155H/S5-155H Lite supports redundant operation of:
- Digital I/O modules
- Analog I/O modules
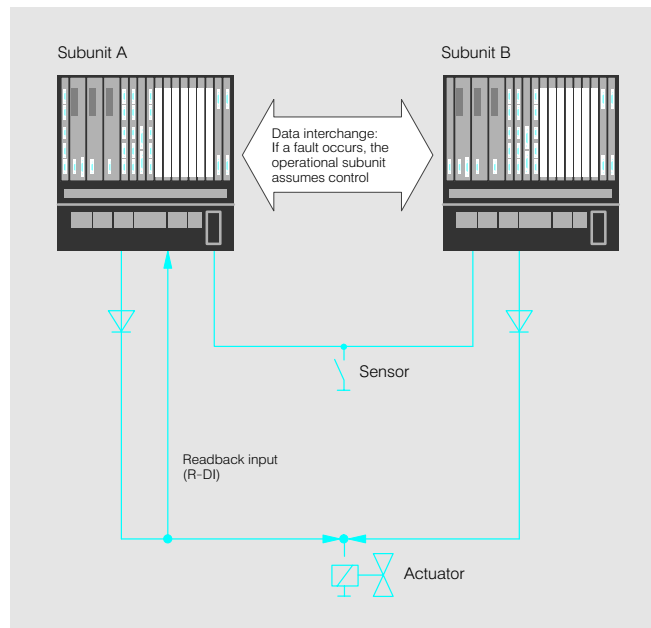
Fig. 4/21 Example of an S5-155H with redundant input and output

Data interchange and fault handling

Master-slave operation

The S5-155H/S5-155H Lite basically oper-ates on the master-slave principle in hot-standby mode (see right). One subunit, the master, controls the process. If a fault occurs, the other subunit, the standby or slave, takes over the control functions. The faulty subunit can then be repaired without interrupting the process.

The combined operation of the two subunits differs according to the I/O configuration:
- Switched configuration
  The master controls the process whilst the slave merely runs on standby. If a fault occurs, the standby immediately takes over control

- Two-chanel I/O configuration (fully redundant configuration)
  Both subunits control the process in parallel. The standby also issues output signals and reads in input signals. For further details, please refer to Section 11 (Configuring)
- Three-channel I/O configuration (fully redundant configuration).
  The combined operation of both subunits corresponds to the two-channel I/O configuration

Hot-standby

Hot-standby is the ability to switch over to a standby device in the event of a fault automatically and without detrimental effect.

For operation in this mode it is absolutely essential that both subunits should be able to exchange data quickly and reliably. In the S5-155H/S5-155H Lite the two subunits are normally linked by the central controller interface via which they are both supplied with:
- The same user program
- The same data blocks
- The same process I/O image contents
- The same receive buffer contents, e.g. when using communications processors

The standby unit is therefore always up to date and ready to take over control immediately if a fault occurs.

S5-155H, S5-155H Lite (continued)

Principle of operation
(continued)
Synchronization

To avoid delay in switching over from master to standby, synchronization of the subunits is essential. This includes interchange and comparison of data to ensure that both subunits have the same information at their disposal. The synchronization procedure used for the S5-155H/S5-155H Lite is "event-driven synchronization".

Event-driven synchronization is carried out every time an event occurs which could change the internal state of the subunits, e.g.:
• Commands with direct access to the I/Os
• Block call commands
• Time function commands

The user need not think about the synchronization when programming. The synchronization is completely taken over by the operating system.

Self-test

Extensive self-test functions are implemented in the S5-155H/S5-155H Lite. The following components and functions are tested:
• Internal S5 bus
• Central controller link
• Fault locating device
• CPUs
• Processing unit/ASIC
• Memories

Every fault recognized by self-test is reported.

Self-test on restart

Each subunit runs through all the self-test functions on restart.

Self-test in cyclic operation

For cyclic operation the operating system breaks down the self-test functions into short sections approxi-mately 5 ms long. One or more of these is processed in a cycle. The number of sections per cycle is configured by the user.

Operating modes

Fault detection

In the two-channel redundant I/O configuration faults are detected by:
• Comparison, in the case of digital inputs
• A readback input, in the case of digital outputs
• Comparison, in the case of analog inputs
• Comparison and readback, in the case of analog outputs

In the three-channel redundant input configuration fault detection takes place with a choice of two out of three.

Fault detection with fault locating

For uninterrupted operation, the operating system must be able not only to detect faults but also to locate them, in order to deactivate the faulty module (by switching off the load voltage, in the case of outputs).

This operating mode can be used for both digital input and output modules. Advantages of this operating mode:
• In the event of a fault, the programmable controller S5-155H/S5-155H Lite continues to operate with the module which is functioning correctly
• Faults can be corrected more quickly and easily

In the two-channel redundant I/O configuration, the operating system is responsible for the software side of fault locating. On the hardware side, locating inputs and outputs (L-DIs and L-DOs) are required.

In the three-channel redundant input configuration, fault detection takes place by fault locating with a choice of two out of three.

For further information regarding the principle of operation of the fault-tolerant S5-155H/S5-155H Lite programmable controller, see Section 11 (Configuring).

4

**Programming,
parameter assignment**
Programming

Programming of the S5-155H/ S5-155H Lite programmable controller is the same as for the S5-155U. All STEP 5 operations allowed in the S5-155U, apart from the multiprocessing operations, can be used.

Both on-line and off-line programming are possible.

On-line programming

For on-line programming the programming device is connected to the CPU of one of the subunits. The program is auto-matically relayed to the other subunit.

Off-line programming

Off-line programming is possible using an EPROM submodule in the programming device without connecting it to the programmable controller. The submodule is then duplicated and plugged into the CPUs of both subunits.
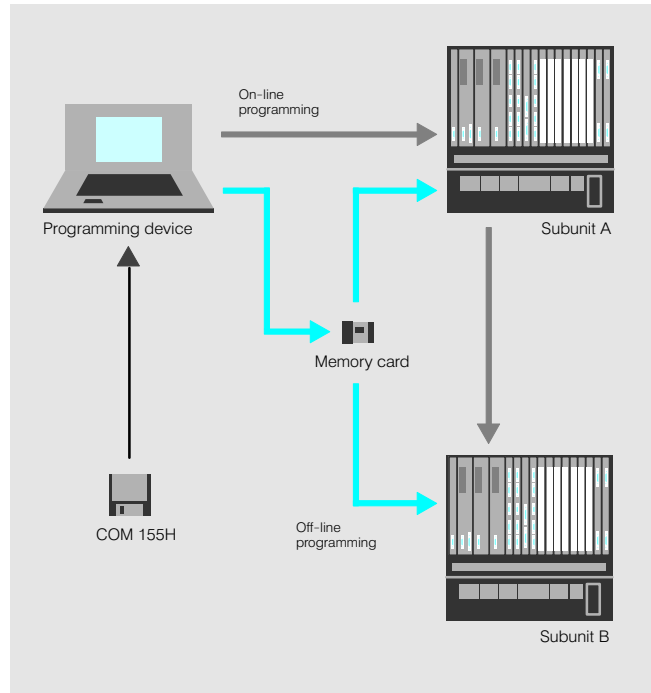
Fig. 4/22 On-line and off-line programming

parameter assignment

COM 155H parameter assignment software

The COM 155H parameterization software supports the user in parameter assignment and error diagnostics:
- Interactive parameter assignment of data specific to the H version

- Generation of the parameter assignment data block from the parameter assignment data
- System diagnostics using the error data blocks and the interrupt register
- Printout of data specific to the H version

- General system handling, e.g. starting the system

CPU 928A

Application

The CPU 928A is designed for mid-range applications. It is particularly suitable for high-speed word processing (arithmetic operations, closed-loop control) and for high-speed binary signal processing (logic control).
It can be used in S5-135U and S5-155U.

Design

The module contains the following:
- Microprocessor (ASIC) for processing binary statements and for high-speed processing of a number of selected word statements
- Microprocessor (16 bit) for processing word statements and the operating program of the module
- Microprocessor (8 bit) for processing the programming device port
- Memory (RAM) for bit memories, timers, counters, process image, etc.
- Internal memory:
  64 Kbyte for the user program and 46 Kbyte (RAM) for data of the user program (data blocks)
- Receptacle for SIMATIC memory card (FLASH EPROM) for max. 64 Kbyte user program.
  STEP 5 V6.6 and higher is required for programming and erasing the memory card.

- Programming device port (15-way Cannon socket)
- Shift register (246 x 8 bit) with high processing speed
- Operating program for cyclic, time- and process-controlled processing and error handling
- Software for multiprocessor communication
- Closed-loop controller algorithm (e.g. for pressure, temperature or flow control) with the following features: Output signal as manipulated variable or change in manipulated variable, parameterization via data block (fixed or variable values), limiting the output signal (high and low limits)

Depending on the job to be done, one to four CPUs 928 can be used in a central controller of the S5-135U or S5-155U programmable controllers, which are also suitable for multiprocessor operation with the following CPUs:

- CPU 948, CPU 928B, CPU 928 in the central controller of the S5-135U/155U.

Both time-controlled (clock: 10, 20, 100, 200, 500, 1000, 2000 and 5000 ms) and interrupt-driven program execution are possible.

CPU 928A (continued)

Restart modes	
Cold restart with reset, manual	All bit memories, timers and counters are reset and the process image erased. Scanning of the user program starts at the beginning.
Warm restart, manual	The bit memories, timers, counters and the process image are retained during the down-time. Scanning of the user program continues at the point of interuption.
Warm restart, automatic	Following power recovery, the PLC automatically enters the RUN mode. The other data is as listed under warm restart, manual.
Overall reset	All memory areas are erased. The programmable controller enters the basic state. If a RAM is used, the user program must be loaded. If an EPROM ist used, a cold restart with reset is possible. The overall reset function can be triggered by a switch on the processor or from the programming device.
The following start-up is possible if block DX 0 is programmed accordingly:	
Automatic restart	After voltage recovery the CPU returns automatically to the operating state. The other data is as listed under cold restart with reset, manual.

Technical specifications

Microprocessors		8031 (8 bit)	
		80186 (16 bit), ASIC	
Memory space			
• RAM internal (for data blocks only)		46 Kbyte	
• RAM internal or Memory card (flash EPROM); for program	max.	64 Kbyte	
Execution time for			
• 1 K binary statements (AND, OR)		1.1 ms	
• 1 K digital statements (load, transfer)		15 ms	
• 8 control loops		20 ms	
Number of control loops	max.	64 with standard function block "R64 controller structure" (see Section 7)	
Bit memories		2048	
Timers			
• Number		256	
• Range		0.01 ... 9990 s	
Counters			
• Number		256	
• Range		0 ... 999	
Inputs	digital max.	1024 with process image	
	additional max.	3072 without process image	
	additional max.	4096 for direct memory access [1]	
	additional max.	518,152 for page addressing [2]	

	analog max.	192	
	additional max.	256 for direct memory access [1]	
	additional max.	32,130 for page addressing [2]	
Outputs	digital max.	1024 with process image	
	additional max.	3072 without process image	
	additional max.	4096 for direct memory access [1]	
	additional max.	518,152 for page addressing [2]	
	analog max.	192	
	additional max.	256 for direct memory access [1]	
	additional max.	32,130 for page addressing [2]	
Program execution		• Cycle (OB1)	
		• Interrupt-driven	
		• Time-controlled in 9 clock pulses	
Current consumption (at 5 V)			
• CPU 928A	max.	0.6 A	
• Memory card	max.	0.2 A	
Power loss	max.	3 W	
Space requirement		1 slot	
Weight			
• CPU 928	approx.	0.5 kg (1.1 lb)	
• Memory submodule	approx.	0.04 kg (0.088 lb)	

1) Only with IM 304, IM307, IM 308 interface modules.
2) Only with IM 308 interface module (theoretical end value).

Ordering data	Order No.		Order No.
CPU 928 with receptacle for 1 memory submodule	**6ES5 928-3UA21**	**Memory card with flash** EPROMs 128 Kbyte (only 64 Kbyte usable)	**6ES5 374-2KG21**
System manual, programming guide, manual	see page 4/155		

CPU 928B

Application

The CPU 928B is designed for mid-range applications. It is particularly suitable for high-speed word processing (arithmetic operations and closed-loop control) and high-speed binary signal processing (logic control).

In addition the module also has a second interface and is thus suitable for high-speed serial point-to-point connections or for connecting to the SINEC L1 LAN (slave or master with point-to-point connections).
It can be used in S5-135U and S5-155U.

Design

The module contains the following:

- Arithmetic unit, microprogrammed, with bit and word processor (16 bit), for high-speed processing of binary and word statements

- Microprocessor (16 bit) for processing the operating program of the module

- Microprocessor (16 bit) for processing the built-in interface and the second optional serial interface

- Memory (RAM) for bit memories, S bit memories, timers, counters, process image, etc.

- Internal memory:
  64 Kbyte for the user program and 46 Kbyte (RAM) for data of the user program (data blocks)

- Receptacle for SIMATIC memory card (FLASH EPROM) for max. 64 Kbyte user program.
  STEP 5 V6.6 and higher is required for programming and erasing the memory card.

- Programming device port (15-way Cannon socket)

- Receptacle for interface module; the following can be installed:
  Second interface for programming device and operator panel;
  V.24 interface;
  TTY interface;
  RS 422 A interface for point-to-point connections;
  SINEC L1 interface

- Shift register (246 x 8 bit) with high processing speed

- Hardware clock

- Operating program for cyclic, time- and process-controlled processing and error handling

- Software for multiprocessor communication

- Closed-loop controller algorithm (e.g. for pressure, temperature or flow control) with the following features: Output signal as manipulated variable or change in manipulated variable, parameterization via data block (fixed or variable values), limiting the output signal (high and low limits)

- Driver for 3964, 3964R, RK512, "open driver"

- Special functions for cycle statistics

Depending on the job to be done, one to four CPUs 928B can be used in a S5-135U/155U central controller, which are also suitable for multiprocessor operation with the following CPUs:

- CPU 922, CPU 928, CPU 948 in the central controller of the S5-135U/155U

The CPU 928B functions on the same basis as, and is upwards-compatible with, the CPU 928. All STEP 5 commands for the CPU 928 can execute without modification on the CPU 928B.

Restart modes	
Cold restart with reset, manual	All bit memories, timers and counters are reset and the process image erased. Scanning of the user program starts at the beginning.
Warm restart, manual	The bit memories, timers, counters and the process image are retained during the down-time. Scanning of the user program continues at the point of interruption.
Warm restart, automatic	Following power recovery, the CPU automatically enters the RUN mode. The other data is as listed under warm restart, manual.
Overall reset	All memory areas are erased. The programmable controller enters the basic state. If a RAM is used, the user program must be loaded. If an EPROM is used, a cold restart with reset is possible. The overall reset function can be triggered by a switch on the processor or from the programming device.

CPU 928B (continued)

Design (continued)

Restart modes (continued)	
By parameterizing the DX 0 the following start-up is possible:	
Cold restart, automatic (without memory)	Following power recovery, the CPU goes to RUN mode automatically. Otherwise the same as cold restart with reset, manual.
Cold restart, automatic (with memory)	Following power recovery, scanning of the user program starts at the beginning. All bit memories, timers and counters are retained.

Technical specifications

Microprocessors		80186 (16 bit) 80188 (16 bit)	
Memory space			
• RAM internal (for data blocks only)		46 Kbyte	
• RAM internal or Memory card (flash EPROM); for program	max.	64 Kbyte	
Execution time for			
• 1 K binary statements		0.6 ms	
• 1 K word statements		1.5 ms	
• 8 control loops		20 ms	
Scan time monitoring		Programmable, default: 200 ms	
Number of control loops	max.	64 with standard function block "R 64 controller structure" (see Section 7)	
Bit memories		2048	
S bit memories		8192	
Timers			
• Number		256	
• Range		0.01 ... 9990 s	
Counters			
• Number		256	
• Range		0 ... 999	
Inputs digital	max.	1024 with process image	
additional	max.	3072 without process image	
additional	max.	4096 for direct memory access[1]	
additional	max.	518,152 for page addressing[2]	

analog	max.	192	
additional	max.	256 for direct memory access [1]	
additional	max.	32,130 for page addressing[2]	
Outputs digital	max.	1024 with process image	
additional	max.	3072 without process image	
additional	max.	4096 for direct memory access[1]	
additional	max.	518,152 for page addressing[2]	
analog	max.	192	
additional	max.	256 for direct memory access[1]	
additional	max.	32,130 for page addressing [2]	
Program execution		• Cycle (OB1) • Interrupt-driven • Time-controlled in 9 clock pulses • Clock-controlled	
Current consumption (at 5 V)			
• CPU 928B	typ.	0.6 A	
• Memory card	max.	0.2 A	
• 377 memory submodule (RAM)	max.	0.1 A	
• Interface modules		0.1 ... 0.2 A	
• Power loss	max.	3 W	
Space requirements		1 slot	
Weight			
• CPU 928B	approx.	0.5 kg (1.1 lb)	
• Memory submodule	approx.	0.04 kg (0.088 lb)	

1) Only with IM 304, IM 307, IM 308 interface modules.
2) Only with IM 308 interface module (theoretical end value).

Ordering data

	Order No.		Order No.
CPU 928 B with receptacle for 1 memory submodule and receptacle for 1 interface module	**6ES5 928-3UB21**	**Memory card with flash EPROMs** 128 Kbyte (only 64 Kbyte usable)	**6ES5 374-2KG21**
System manual, programming guide, communications manual, instruction manual	see page 4/155	**Interface module** for 20 mA current loop (TTY) for V.24 (RS 232C) for RS 422-A/RS 485 for SINEC L1	**6ES5 752-0AA12** **6ES5 752-0AA23** **6ES5 752-0AA43** **6ES5 752-0AA53**
		COM PP parameter assignment software	**6ES5 752-0AA62** see Section 7

CPU 948

Application

The CPU 948 is the high-speed memory giant for the S5-155U. It is the most powerful CPU and is designed for applications in the upper performance range. It has a large user memory and is suitable for both very high-speed word processing (arithmetic operations and closed-loop control) and very high-speed binary signal processing (logic control). The CPU 948 is fully compatible with its predecessors, the CPU 946/947.

Design

The module contains the following:
- STEP 5 processing unit (with 2 ASICs) for processing the user program
- Microprocessor (16 bit) for processing the operating system of the module
- Microprocessor (16 bit) for processing the built-in interface and the second optional serial interface
- Memory (RAM) for bit memories, S bit memories, timers, counters, process image, etc.
- Internal memory (RAM) with 640 or 1664 Kbyte for the user program
- Receptacle for SIMATIC memory card (flash EPROMs)
- Hardware clock

- Interfaces
  1. Built-in serial interface (TTY) for programming device
     or operator panel
  2. Slot for interface module for programming device;
     V.24 interface;
     TTY interface;
     RS 422 A interface for point-to-point connections;
     SINEC L1 interface

Depending on the job to be done, up to 4 CPUs 948 can be used in a central controller of the S5-155U programmable controller; they are also suitable for multi-processor operation with CPU 948B, CPU 928 and CPU 922.

The user programs can be stored in the integral RAM (640 or 1664 Kbyte). If necessary, the programming device can be used to store the user program on a flash EPROM to protect it from power failures.

The CPU 948 is fully compatible with the CPUs 946/947. It is not necessary to modify existing programs.

Functions

Program execution

- Cyclic program execution; Read-in of input statuses, execution of the control program and output of the output statuses
- Time-controlled program execution; 9 independent time-controlled program execution levels. The time of processing can be defined separately for each level. Times between 10 ms and 20 min can be set. A time-controlled timed interrupt is also available
- Interrupt-controlled program execution;
  via interrupts or process alarms;
  4 interrupts via signal lines of the internal S5 backplane bus;
  8 process alarms via input byte IB 0

- Time interrupt-controlled program processing;
  This execution level is activated after expiry of a programmed time (time resolution: 1 ms)

Execution levels of higher priority can interrupt execution levels of lower priority after each STEP 5 operation.

Monitoring

- Scan time
- Collision of two timed interrupts
- Addressing error
- Acknowledgement delay

Time

- Set, read, interrupt
- Operating hours counter

Integral function blocks

Including, for example
- Disable or delay interrupts
- Delete or generate blocks
- Transfer process images
- Copy data blocks

Hardware self-test functions

- Including, for example, RAM test, BASP (output disable) test and clock test

Further functions

- Easy access to the extended I/O area via function block FB 196 (contained in the "Basic functions" program package, (see Section 7)
- Programming device functions via the internal S5 backplane bus, thus providing fast program loading via the Industrial Ethernet bus system
- Password protection of the user program

CPU 948 (continued)

Design (continued)

Restart modes	
Cold restart with reset, manual	All bit memories, timers and counters are reset and the process image erased. Scanning of the user program starts at the beginning.
Warm restart, manual	The bit memories, timers, counters and the process image are retained during the down-time. Scanning of the user program continues at the piont of interruption.
Warm restart, automatic	Following power recovery, the PLC automatically enters the Run mode. The other data is as listed under warm restart, manual.
The following start-up is possible if block DX 0 is programmed accordingly:	
Cold restart, automatic	Following power recovery, the programmable controller automatically enters the RUN mode. The other data is as listed under cold restart with reset, manual.
Cold restart with memory, manual	The bit memories, timers, counters and the process image are retained during the down-time. Scanning of the user program continues at the point of interruption.
Cold restart with memory, automatic	Following power recovery, the programmable controller automatically enters the RUN mode. The other data is as listed under cold restart with memory, manual.

Technical specifications

Microprocessors			80186 (16 bit) 80188 (16 bit), 2 ASICs
Total memory space			
• Internal memory			640 Kbyte or 1664 Kbyte
• Memory submodule (flash EPROM)			640 Kbyte or 1164 Kbyte
Programming language			STEP 5, SCL
Block types			Organization blocks (OB), Programming blocks (PB), Function blocks (FB, FX), Data blocks (DB, DX)
Number of blocks	max.		256 per block type
Nesting depth of the blocks			60
Program execution			• Cyclic (OB1) • Interrupt-driven • Time-controlled • Operator-controlled stop
Execution times for			
• Bit operations			0.18 µs
• Word operations			0.5 µs
• Time/counter operations			0.18 µs
• Fixed-point addition			0.55 µs
• Floating-point addition			3.3 µs
Scan time monitoring			Programmable, default: 200 ms
Inputs	digital	max.	1024 with process image
	additional	max.	3072 without process image
	additional	max.	4096 for direct memory access [1]
	additional	max.	518,152 for page addressing [2]
	analog	max.	192
	additional	max.	256 for direct memory access [1]
	additional	max.	32,130 for page addressing [2]

Outputs	digital	max.	1024 with process image
	additional	max.	3072 without process image
	additional	max.	4096 for direct memory access[1]
	additional	max.	518152 for page addressing [2]
	analog	max.	192
	additional	max.	256 for direct memory access [1]
	additional	max.	32,130 for page addressing [2]
Bit memories			2048
S bit memories			32768
Nesting levels			8
Timers			
• Number			256
• Range			0.01 ... 9990 s
Counters			
• Number			256
• Range			0 ... 999
Interfaces			
1st interface (integral)			programming device/operator panel depending on interface module used
2nd interface (optional)			
Current consumption (at 5 V)			
• CPU 948		max.	3.6 A
• Memory card		max.	0.2 A
• Interface module		max.	0.1 ... 0.2 A
Power loss		max.	20 W
Space requirements			2 slots
Weight			
• CPU 928		approx.	1 kg (2.2 lb)
• Memory submodule		approx.	0.06 kg (0.13 lb)

1) Only with IM 304, IM 307, IM 308 interface modules.
2) Only with IM 308 interface module (theoretical end value).

CPU 948 (continued)

Ordering data	Order No.		Order No.
CPU 948 • With 640 Kbyte user memory • With 1664 Kbyte user memory	**6ES5 948-3UA11**	**Interface module** for 20 mA current loop (TTY) for V.24/V.28 (RS 232C) for RS 422-A/RS 485 for programming device for SINEC L1	**6ES5 752-0AA12** **6ES5 752-0AA22** **6ES5 752-0AA43** **6ES5 752-0AA53** **6ES5 752-0AA62**
System manual, programming instructions, manual	**6ES5 948-3UA21**	**COM PP parameter assignment software**	see Section 7
Memory card with flash EPROMs Memory capacity: 256 Kbyte 1 Mbyte 2 Mbyte	see page 4/155 **6ES5 374-2KH21** **6ES5 374-2KK21** **6ES5 374-2KL21**		
Programming adapter (for memory cards)	**6ES5 985-2MC11**		

On account of the higher CPU speed, it is necessary to make adjustments to the standard function blocks in the case of the intelligent I/O modules.

Please check that the version numbers of your standard function block comply with the required minimum version, by referring to the following table.

Module	FB numbers concerned	Standard FB can be used from
IP 240	167 to 173	V 2.2
IP 241	156 to 158	A 04
IP 242 A (...-1AA3.)	178 to 182	A 02
IP 242 B (...-1AA41)	183, 184	A 03
IP 243	160, 161	A 02
IP 244	162	A 03, B 03, C 04
IP 246	164, 165	A 02
IP 247	164, 165	A 02
IP 252	100, 101	V 3.0
IP 260	170	A 02
IP 261	171	Not implementable
IP 281	(no FB)	Implementable due to direct access

SIMATIC S5-135U, S5-155U/H

Central processing units

Application
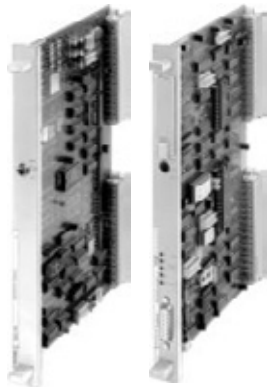
Several CPUs can be used in one central controller, depending on the task to be performed. The 923A/C coordinators allocate access rights to the internal S5 bus to the individual CPUs.

923A coordinator

The 923A coordinator is used for coordinating access of from two to four CPUs in the S5-135U and S5-155U programmable controllers.

923C coordinator

The 923C coordinator is used for coordinating access of from two to four CPUs in the S5-135U and S5-155U programmable controllers and for programming and start-up of up to eight CPUs and communications processors. The coordinator also enables the programmable controller to be programmed via the Industrial Ethernet, PROFIBUS and SINEC L1 LANs.

Design

923A coordinator

The module contains the following:

- Memory (RAM) for 2048 interprocessor communication bit memories
- Clock generator and scaler for producing the time base on which access to the S5 bus is allocated among the CPUs

923C coordinator

The module contains the following:

- RAM for 2048 interprocessor communication bit memories and for data blocks

- Clock generator and scaler for producing the time base on which the internal S5 backplane bus is allocated to the CPUs
- Central programming device port with multiplexer: With the programming device connected to a 923C coordinator, the user can program up to eight processors without changing the front connectors

For programming a programmable controller via the Industrial Ethernet, PROFIBUS and SINEC L1 local area network, the programming device ports of the 923C coordinator and the CP 143, CP 5430 or CP 530 communications processors need to be linked by means of the 725 connecting cable.

The central programming device interface can only be operated if the S5-DOS operating system is loaded in the programming device.

Principle of operation

Each CPU communicates with the input and output modules via the internal S5 backplane bus. The coordinator allocates access rights to the S5 back-

plane bus to each CPU in cycles (time-sharing). The allocation sequence is fixed (CPU 1 - CPU 2 - CPU 3 - CPU 4).

The CPUs can exchange information via interprocessor communication bit memories in the coordinator.

Technical specifications

Current consumption (at 5 V)			Space requirements	approx.	1 slot
• 923A coordinator	max.	0.5 A	Weight		0.3 kg (0.7 lb)
• 923C coordinator	max.	1.1 A			
Power loss					
• 923A coordinator	max.	2.5 W			
• 923C coordinator	max.	6 W			

Ordering data

	Order No.		Order No.
923A coordinator The operating instructions are included in the S5-135U/155U system manual (see page 4/155).	**6ES5 923-3UA11**	**725 connecting cable** for connecting 923C coordinator to the CP 143 or CP 530 communications processor	
923C coordinator The operating instructions are included in the S5-135U/155U system manual (see page 4/155).	**6ES5 923-3UC11**	0.9 m (3 ft) 2.5 m (8 ft)	**6ES5 725-0AK00** **6ES5 725-0BC50**

CPU 948R/RL for S5-155H/S5-155H Lite

Application

The CPU 948R is designed for the S5-155H fault-tolerant programmable controller, the CPU 948RL for the S5-155H Lite.

They have a large user memory and are suitable for both high-speed word processing (arithmetic operations and closed-loop control) and high-speed binary signal processing (logic control).

Design

The CPU 948R/RL differs only in its firmware from the CPU 948 for the S5-155U programmable controller. You must plug in a CPU 948R/RL into both subunits of the S5-155H/ –155H Lite fault-tolerant programmable controller.

The module contains the following:
- STEP 5 processing unit (with 2 ASICs) for processing the user program

- Microprocessor (16 bit) for processing the operating system of the module
- Microprocessor (16 bit) for processing the built-in serial interface
- Internal memory (RAM) with 128, 640 or 1664 Kbyte for the user program (355 memory submodule and RAM memory submodules are no longer required)

- Memory (high-speed RAM) for bit memories, S bit memories, timers, counters, process image, etc.
- Receptacle for memory card (flash EPROMs, non-volatile and electrically erasable)
- Hardware clock
- Built-in serial interface (TTY) for programming device or operator panel

The CPU 948R requires 2 slots. It can be plugged into the ZG 135U/155U central controller.

Principle of operation

Depending on the application, the central processing unit executes the user program either cyclically, time-controlled, interrupt-controlled or time interrupt-controlled. The firmware executes all additional functions of the fault tolerant programmable controller S5-155H/–155H Lite automatically.

These functions include the following:
- Data exchange
- Synchronization of the two subunits
- Self-test
- Fault handling (switchover to standby unit)
- Fault locating

Multi-processor operation as with the CPU 948 is not possible with the CPU 948RL. The additional functions (self-test, synchronization, fault locating) increase the execution time by 5 to 15 %.

Functions

- Event-driven synchronization
- Transparent programming
- Any combination of 1-, 2- and 3-channel I/O configuration (3-channel configuration only for inputs)
- Support of redundant analog inputs and outputs with fault detection and fault locating

- Comprehensive self-test functions
- Comprehensive system diagnostics functions
- Single-channel and redundant connection to the SINEC L1, PROFIBUS and Industrial Ethernet LANs
- Single-channel and redundant connection to the PROFIBUS-DP field bus

- Programming device functions via the Industrial Ethernet LAN

For further information on functions, program execution and restart modes, refer to the description of the CPU 948 on page 4/27.

Programming

In addition to programming in STEP 5, the CPU 948R/RL can also be programmed with the SCL compiler in the SCL programming language. The SCL high-level language is a programming language similar to PASCAL which has been optimized for PLC applications.

SCL can be used for programming complex tasks simply and easily in the SIMATIC S5. The SCL compiler is integrated in the STEP 5 basic package S5-DOS/MT, Version 6.

The user programs can be stored in the integral RAM (128, 640 or 1664 Kbyte). If necessary, the programming device can be used to store the user program on a flash EPROM to protect it from power failures. For this purpose, a programming adapter is required.

CPU 948R/RL for S5-155H/S5-155H Lite (continued)

Technical specifications

Microprocessors			80186 (16 bit) 80188 (8 bit), 2 ASICs	Inputs	analog	max.	CPU 948RL: 192 (1-, 2- or 3-channel) CPU 948RL: 64 (1- or 2-channel))
Total memory space					additional	max.	384 for direct memory access (1-channel)
• Internal memory (RAM)			128 Kbyte (CPU 948RL) 640 or 1664 Kbyte (CPU 948R)		additional	max.	32,130 for page addressing[1]
• Memory submodule (flash EPROM)			128 Kbyte (CPU 948RL) 640 or 1664 Kbyte (CPU 948R)	Outputs	digital	max.	1024 with process image (1- or 2-channel)
Programming language			STEP 5, SCL		additional	max.	3072 without process image (1-channel)
Program execution			• Cycle (OB1), • Interrupt-driven • Time-controlled • Operator-controlled stop		additional	max.	6144 for direct memory access
					additional	max.	518,152 for page addressing[1]
					analog	max.	CPÜ 948R: 192 (1- or 2-channel)
Execution times for					CPU 948RL	max.	CPÜ 948RL: 64 (1- or 2-channel)
• Bit operations			0.18 µs		additional	max.	384 for direct memory access
• Word operations			0.5 µs		additional	max.	32,130 for page addressing[1]
• Timer/counter operations			14/0.18 µs	Bit memories/S bit memories			2048/32768
• Fixed-point addition			0.55 µs				
• Floating-point addition			3.3 µs	Timers			
Basic cycle time		typ.	10 ms (CPU 948R) 20 ms (CPU 948RL)	• Number/Range			256/0.01 to 9990 s
				Counters			
				• Number/Range			256/0 to 999
Scan time monitoring			Programmable, default: 200 ms	Current consumption (at 5 V DC)			
				• CPU 948R		max.	3.6 A
Inputs	digital	max.	1024 with process image (1-, 2- or 3-channel)[2]	• Memory card			0.2 A
	additional	max.	3072 without process image (1-channel)	Power loss		max.	20 W
	additional	max.	6144 for direct memory access (1-channel)	Space requirements			2 slots
	additional	max.	518,152 for page addressing[1]	Weight		approx.	1 kg (2.2 lb)

1) Only with IM 308 interface module (theoretical end value).
2) 3-channel no possible with CPU 948RL.

Ordering data

	Order No.		Order No.
CPU 948R For S5-155H With 640 Kbyte user memory With 1664 Kbyte user memory	**6ES5 948-3UR12** **6ES5 948-3UR22**	To be ordered as a separate item: **S5-155H manual** consisting of the S5-155H operating instructions, the programming instructions and the CPU 948R/RL quick reference German English French	**6ES5 998-4SR11** **6ES5 998-4SR21** **6ES5 998-4SR31**
CPU 948RL For S5-155H Lite With 128 Kbyte user memory	**6ES5 948-3UR51**		
Memory card (flash EPROM) 256 Kbyte 1 Mbyte 2 Mbyte	**6ES5 374-2KH21** **6ES5 374-2KK21** **6ES5 374-2KL21**	**S5-135U/155U system manual** consisting of the descriptions of the central controllers (CC) and expansion units (EU), the interface modules (IM), the power supply and the I/Os German English French	**6ES5 998-0SH11** **6ES5 998-0SH21** **6ES5 998-0SH31**
ZG 135U/155U subrack 230 V/115 V AC; 5 V, 18 A 230 V/115 V AC; 5 V, 40 A 24 V DC; 5 V, 18 A 24 V DC; 5 V, 40 A	**6ES5 188-3UA12** **6ES5 188-3UA22** **6ES5 188-3UA32** **6ES5 188-3UA52**		
ZG 155H subrack 24 V DC; 5 V, 14 A	**6ES5 188-3UH31**		
COM 155H parameterization software for configuration and diagnostics of the S5-155H fault-tolerant PLC on 3 ¹/₂" diskettes, Single license Copy license	**6ES5 895-3SR ☐ 3** **6ES5 895-3SR ☐ 3-0KL1** ↑		
German English French	**1** **2** **3**		

Overview

Digital input/output modules

Input modules			Output modules		
Voltage values	Module ID	Page	Voltage values/ current values	Module ID	Page
5... 15 V DC	434-4	4/33	Transistor outputs 24 V DC; 0.5 A	441-4 451-4	4/38 4/38
24 V DC	420-4 430-4 432-4	4/33 4/33 4/33			
24/48/60 V DC	431-4	4/33	24 V DC; 2 A	453-4 454-4	4/38 4/38
24/48/60 V AC	435-4	4/33	24/48/60 V DC; 0.5 A	457-4	4/38
115 V AC	436-4UA 436-4UB	4/33	24/48/60 V AC, 2 A	455-4	4/38
230 V AC	436-4UA 436-4UB	4/33	115/230 V AC; 2 A	456-4UA 456-4UB	4/38 4/38
230 V AC	436-4UA 436-4UB	4/33	Relay outputs 60 V DC; 0.5 A 250 V AC; 5A	458-4UA 458-4UB	4/38 4/38
230 V AC	436-4UA 436-4UB	4/33	**Input/output modules**		
230 V AC	436-4UA 436-4UB	4/33	Voltage values/ current values	Module ID	Page
			24 V DC (inputs), 24 V DC; 0.5 A (outputs)	482-4	4/43

Digital input modules

Application
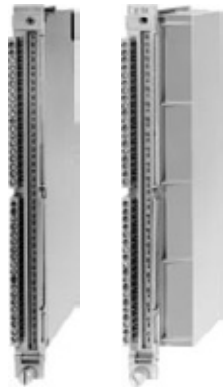
The digital input modules convert the external binary signals from the process to the internal signal level of the programmable controllers.

Design

Digital input modules with 32, 16 and 8 inputs for a range of input voltages are available. The modules require either one or two slots.

Front connectors are used for terminating the signal cables. Both modules and front connectors may be inserted and removed under power.

Green LEDs indicate the signal status of the inputs.

Adhesive labels are supplied to identify the modules and front connectors.

Principle of operation

Enable input
The input signals can be disabled by means of the enable input F. This enable input can be deactivated by removing a jumper on the module.

Interrupt processing
The 432-4 digital input module generates an interrupt when an input signal changes:

- In the central controller, an interrupt line is provided for each CPU. Modules must be plugged into the central controller

- The CPU 948 has a mode of operation available which recognizes an interrupt by scanning the input byte 0. All modules (max. 8) used for interrupt generation must be accommodated in the same unit.

Digital input modules (continued)

Technical specifications

Digital input module		6ES5 420-4UA14	6ES5 430-4UA14	6ES5 431-4UA12	6ES5 432-4UA12[1]
Number of inputs		**32**	**32**	**16**	**32** (with a group signal)
Galvanic isolation		No	Yes	Yes	Yes
• In groups of		—	32	1	8
Input voltage (rated value)		**24 V DC**	**24 V DC**	**24/48/60 V DC**	**24 V DC**
Input voltage					
• For "0" signal		– 33 ... + 5 V	– 3 ... + 7 V	– 33 ... + 8 V	– 33 .. +5 V
• For "1" signal		+ 13 ... + 33 V	+ 13 ... + 33 V	+ 13 ... + 72 V	+ 13 ... + 33 V
Input current					
• For "1" signal	typ.	8.5 mA	7 mA	4.5 mA (at 24 V) 6.5 mA (at 48 V) 7.5 mA (at 60 V)	8.5 mA
Delay		1.4 ... 5 ms	2.5 ... 6.5 ms	1.4 ... 5 ms	3 ms/1 ms/0.3 ms
Cable length					
• Unshielded (at delay)	max.	600 m (1968 ft)	600 m (1968 ft)	400 m (1312 ft)	600 m (1968 ft) (3 ms) 200 m (656 ft) (1 ms) 50 m (164 ft) (0.3 ms)
• Shielded	max.	1000 m (3280 ft)	1000 m (3280 ft)	1000 m (3280 ft)	1000 m (3280 ft)
Enable input F Input voltage					
• Rated value		24 V DC	24 V DC	24/48/60 V DC	24 V DC
• Enable		+ 13 ... + 33 V	+ 13 ... + 33 V	+ 13 ... + 72 V	+ 13 ... + 33 V
• Disable		– 33 ... + 5 V	– 33 ... + 5 V	– 33 ... + 8 V	– 33 ... + 5 V
Input current of enable input	typ.	5 mA	5 mA	5 mA (at 48 V)	5 mA
Cable length (unshielded)	max.	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)
Insulation voltage (external connections to housing)					
• In acc. with VDE 0160		—	75 V DC	75 V DC	75 V DC
• Tested with		—	1250 V AC	1250 V AC	1250 V AC
Supply voltage V_{pos}					
• Rated value		—	24 V DC	—	—
• Ripple V_{pp} (referred to rated voltage)	max.	—	+ 15 %	—	—
• Permissible range (including ripple)		—	20 ... 30 V	—	—
• Value at <0.1 s	max.	—	36 V	—	—
Current consumption					
• Internal (at 5 V)	typ.	80 mA	100 mA	90 mA	200 mA
• External (at 24 V)	typ.	—	100 mA	—	—
Power loss	max.	7.0 W	8.3 W	2.2 ... 7.7 W (at 24 ... 60 V)	7.5 W
Space requirements		1 slot	1 slot	1 slot	1 slot
Front connector		42-pin	42-pin	42-pin	42-pin
Weight	approx.	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)

1) A shielded signal lead is required for use of the module.
A filter (SIFI C, B84113-C-B30 or equivalent) is required in the 24 V DC load power supply for the module.

Digital input modules (continued)

Technical specifications (continued)

Digital input module		6ES5 434-4UA12	6ES5 435-4UA12	6ES5 436-4UA12[1]	6ES5 436-4UB12[1]
Number of inputs		**32**	**16**	**16**	**8**
Galvanic isolation		Yes	Yes	Yes	Yes
• In groups of		32	8	8	1
Input voltage (rated value)		**TTL signals** (+ 5 V) **CMOS signals** (+ 15 V) **signals from NAMUR sensors** (with current output in acc. with DIN 19234)	**24/48/60 V AC** (47 ... 63 Hz)	**115/230 V AC** (47 ... 63 Hz)	**115/230 V AC** (47 ... 63 Hz)
Input voltage					
• For "0" signal		0 ... + 0.8 V (TTL) 0 ... + 4.5 V (CMOS)	0 ... 15 V	0 ... 60 V	0 ... 60 V
• For "1" signal		+ 2.4 ... + 5 V (TTL) or open input + 10.5 ... + 15 V (CMOS) or open input	20 ... 72 V	90 ... 264 V	90 ... 264 V
Input current					
• For "0" signal	typ.	– 1 mA (TTL) – 3 mA (CMOS)) ≤1.2 mA (NAMUR)	—	—	—
• For "1" signal	typ.	0.1 mA (TTL) 0.3 mA (CMOS) ≥2.1 mA (NAMUR)	15 mA (at 48 V) 20 mA (at 60 V)	15 mA (at 115 V) 25 mA (at 230 V)	15 mA (at 115 V) 25 mA (at 230 V)
Delay					
• Positive edge		1.4 ... 5 ms	2 ... 15 ms	2 ... 15 ms	2 ... 15 ms
• Negative edge		1.4 ... 5 ms	10 ... 25 ms	10 ... 25 ms	10 ... 25 ms
Cable length					
• Unshielded	max.	200 m (656 ft) (TTL/CMOS) 600 m (1968 ft)/ (NAMUR)	600 m (1968 ft) 1000 m (3280 ft)	600 m (1968 ft) 1000 m (3280 ft)	600 m (1968 ft) 1000 m (3280 ft)
• Shielded	max.	1000 m (3280 ft)			
Enable input F			Jumper F+/F- in the front connector	Jumper F+/F- in the front connector	Jumper F+/F- in the front connector
Input voltage					
• Rated value		5/15/24 V DC			
• Enable		+ 4 ... + 33 V			
• Disable		– 15 ... + 2 V			
Input current of enable input	typ.	5 mA			
Cable length (unshielded)	max.	100 m (328 ft)			
Insulation voltage (External connections to housing)		75 V DC	250 V AC	250 V AC	250 V AC
• In acc. with VDE 0160 • Tested with		1250 V AC	1500 V AC	1500 V AC	1500 V AC
Supply voltage V_{pos} • Rated value		24 V DC (L+); 15 V DC (LH+)	—	—	—
• Ripple V_{pp} (referred to rated voltage)	max.	15 %	—	—	—
• Permissible range (including ripple)		20 ... 30 V; 5....15 V	—	—	—
• Value at t < 0.1 s	max.	36 V	—	—	—
Current consumption					
• Internal (at 5 V)	typ.	80 mA	100 mA	100 mA	80 mA
• External (at 24 V)	typ.	200 mA			
• External (at 15 V)	typ.	300 mA			
Power loss	max.	5.5 W	3.5 W (at 24 V) 18.0 W (at 60 V)	3.5 W (at 115 V) 17.0 W (at 230 V)	2.0 W (at 115 V) 8.5 W (at 230 V)
Space requirements		1 slot	2 slots	2 slots	2 slots
Front connector		42-pin	20-pin	20-pin	20-pin
Weight	approx.	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)	0.4 kg (0.88 lb)

1) A filter (SIFI C, B84113-C-B30 or equivalent) is required in the 230 V AC load power supply for the module.

Digital input modules (continued)

Ordering data	Order No.		Order No.
Non–floating		**436-4UB digital input module**	**6ES5 436-4UB12**
420-4 digital input module	**6ES5 420-4UA14**	8 inputs, 115/230 V AC	
32 inputs, 24 V DC			
		The operating instructions are included in the S5-135U/155U system manual (see page 4/155).	
Floating			
430-4 digital input module	**6ES5 430-4UA14**		
32 inputs, 24 V DC		**497 front connector**	
431-4 digital input module	**6ES5 431-4UA12**	Crimp terminals, single-width, 42-pin	**6ES5 497-4UA12**
16 inputs, 24/48/60 V DC			
432-4 digital input module	**6ES5 432-4UA12**	Crimp terminals, double-width, 42-pin	**6ES5 497-4UA22**
for interrupt processing, 32 inputs, 24 V DC		Crimp terminals, double-width, 20-pin	**6ES5 497-4UA42**
434-4 digital input module	**6ES5 434-4UA12**		
32 inputs, 5/15 V DC (TTL, CMOS, NAMUR)		Screw terminals, single-width, 42-pin	**6ES5 497-4UB31**
435-4 digital input module	**6ES5 435-4UA12**	Screw terminals, double-width, 42-pin	**6ES5 497-4UB12**
16 inputs, 24/48/60 V AC			
436-4UA digital input module	**6ES5 436-4UA12**	Screw terminals, double-width, 20-pin	**6ES5 497-4UB42**
16 inputs, 115/230 V AC			

Digital input modules (continued)

Fig. 4/23 Connection diagrams of the digital input modules

SIMATIC S5-135U, S5-155U/H
Digital input/output modules

Digital output modules

Application

The digital output modules convert the internal signal levels of the programmable controllers into the binary signal levels required externally by the process.

Design

Digital output modules with 32, 16 and 8 outputs are available with a range of output voltages and also with relay contact outputs. The modules require either one or two slots.

Front connectors are used for terminating the signal cables. Modules and front connectors may be inserted and removed under power.

Green LEDs indicate the signal status of the outputs. In DC output modules, red LEDs indicate short-circuits in the signal leads. The signal output H is set to "1" if an overcurrent or short-circuit is detected in an output. Up to 16 signal outputs can be connected in parallel. In AC output modules, red LEDs indicate when a fuse has blown.

Adhesive labels are supplied to identify modules and front connectors.

Principle of operation

Enable input
The output of signals can be suppressed by an enable input F. This function can be deactivated by removing a jumper on the module.

Digital output modules (continued)

Technical specifications

Digital output module	6ES5 441-4UA14	6ES5 451-4UA14	6ES5 453-4UA12[4)	6ES5 454-4UA14[5)	6ES5 455-4UA12
Number of outputs	**32**	**32**	**16**	**16**	**16**
Galvanic isolation	No	Yes	Yes	Yes	Yes
• In groups of	—	32	1	16	8
Supply voltage V_p, V_{pos}					
• Rated value	**24 V DC**	**24 V DC**	**24 V DC[1)**	**24 V DC**	**24/48/60 V AC**
• Frequency					47 to 63 Hz
• Ripple V_{pp} (referred to rated voltage) max.	15 %	15 %	15 %	15 %	—
• Permissible range (including ripple)	20 ... 30 V	20 ... 30 V	20 ... 30 V	20 ... 30 V	20 ... 72 V
• Value at <0.1 s max.	36 V	36 V	36 V	36 V	—
Output current at "1" signal					
• Rated value	**0.5 A**	**0.5 A**	**2 A**	**2 A**	**2 A**
• Permissible range	5 mA ... 0.5 A	5 mA ... 0.5 A	10 mA[2) ... 2 A	10 mA[2) ... 2 A	0.4 ... 2 A
• Making current per group for t <3/<20/<50 ms max.					25/15/13 A
Lamp load max.	5 W	5 W	10 W	10 W	25 W
Short-circuit protection	Electronic	Electronic	Electronic	Electronic	Fuse (4x6.3 A)
Limitation of the voltage induced on circuit interr. (int.) to	V_{pos} − 47 V	V_{pos} − 47 V	V_{pos} − 47 V	V_{pos} − 47 V	
Switching frequency for					
• Resistive loads max.	100 Hz	100 Hz	100 Hz	100 Hz	20 Hz
• Lamps max.	11 Hz	11 Hz	11 Hz	11 Hz	11 Hz
• Inductive loads max.	2 Hz (at 0.3 A)	2 Hz (at 0.3 A)	0.2 Hz (at 1 A)	0.2 Hz (at 1 A)	2 Hz
	0.5 Hz (at 0.5 A)	0.5 Hz (at 0.5 A)	0.5 Hz (at 2 A)	0.5 Hz (at 2 A)	
Total load rating [3)					
• With fan	100 %	100 %	100 %	50 %	75 %
• Without fan	50 %	50 %	25 %	50 %	50 %
Leakage current at "0" sign. max.	0.5 mA	0.5 mA	1 mA	1 mA	5 mA
Signal level of the outputs					
• At "0" signal max.	+ 3 V	+ 3 V	+ 3 V	+ 3 V	0.1 V_p
• At "1" signal min. max.	V_{pos} −1.5 V	V_{pos} −1.5 V	V_{pos} −2.5 V	V_{pos} − 2 V	V_{pos} − 1.5 V
Cable length (unshielded) max.	400 m (1312 ft)	400 m (1312 ft)	400 m (1312 ft)	400 m (1312 ft)	300 m (984 ft)
Enable input F					Junper F+/F− in the front connector
Input voltage					
• Rated value	24 V DC	24 V DC	24 V DC	24 V DC	
• Enable	+ 13 ... + 33 V	+ 13 ... + 33 V	+ 13 ... + 33 V	+ 13 ... + 33 V	
• Disable	− 33 ... + 5 V	− 33 ... + 5 V	− 33 ... + 5 V	− 33 ... + 5 V	
Input current of enable input typ.	5 mA	5 mA	5 mA	5 mA	
Cable length (unshielded) max.	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)	
Signalling output H					
Voltage if fault min.	V_{pos} − 5 V	V_{pos} −5 V	V_{pos} −5 V	V_{pos} − 5 V	
Current if fault (limited) max.	10 mA	10 mA	10 mA	10 mA	
Voltage if no fault max.	3 V	3 V	3 V	3 V	
Insulation voltage (external connections to housing)					
• In acc. with VDE 0160	—	75 V DC	75 V DC	75 V DC	250 V AC
• Tested with	—	1250 V AC	1250 V AC	1250 V AC	1500 V AC
Current consumption					
• Internal (at 5 V) typ.	80 mA	120 mA	120 mA	100 mA	100 mA
• External (at 24 V, no load) typ.	150 mA	150 mA	—	100 mA	—
Power loss max.	17.0 W	17.0 W	49.0 W	17.5 W	39.0 W
Space requirements	1 slot	1 slot	2 slots	1 slot [5)	2 slots
Front connector	42-pin	42-pin	42-pin	25-pin/42-pin	20-pin
Weight approx.	0.45 kg (1 lb)	0.45 kg (1 lb)	0.6 kg (1.3 lb)	0.55 kg (1.2 lb)	0.7 kg (1.5 lb)

1) Can also be used as L− switch.
2) 1 input of a digital input module is permissible as the minimum load.
3) Referred to the sum of the rated currents through an L+ input.

4) A shielded signal lead is required for use of the module.
   A filter (SIFI C, B84113-C-B-30 or equivalent) is required in the 24 V DC load power supply for the module.
5) Due to current load a double wide front connector is required.

Digital output modules (continued)

Technical data (continued)

Digital output module	6ES5 456-4UA12 [5]	6ES5 456-4UB12 [5]	6ES5 457-4UA12 [6]	6ES5 458-4UA12	6ES5 458-4UA12
Number of outputs	**16**	**8**	**16**	**16** (relay contacts)	**16** (relay contacts)
Galvanic isolation	yes	yes	yes	yes	yes
• In groups of	8	1	1	1	8
Supply voltage V_p, V_{pos}					
• Rated voltage	**115/230 V AC**	**115/230 V AC**	**24/48/60 V DC[1]**	**24 V DC**	**24 V DC**
• Frequency	47 to 63 Hz	47 to 63 Hz	—	—	—
• Ripple V_{pp} (referred to rated voltage) max.	—	—	15 %	15 %	15 %
• Permissible range (including ripple)	88 ... 264 V	88 ... 264 V	20 ... 72 V	20 ... 30 V	20 ... 30 V
• Value at t < 0.1 s max.	—	—	90 V[2]	35 V	35 V
Output current at "1" signal					
• Rated value	**2 A**	**2 A**	**0.5 A**	—	—
• Permissible range	0.04 ... 2 A	0.04 ... 2 A	5 mA ... 0.5 A	—	—
• Making current per group for t <3/<20/<50 ms max.	25/15/13 A	16/8/6,5 A	—	—	—
Lamp load max.	100 W	100 W	5 W	—	—
Short-circuit protection	Fuse (4x6.3 A)	Fuse (4x6.3 A)	Electronic	None	None
Switch. cap. of the contacts max.				60V DC/48 V AC	110V DC/250 V AC
• Resistive load					
With arc suppr. module max.	—	—	—	500 mA	5 A at 30 V DC , 5 A at 250 V DC
Without arc suppr. module max.	—	—	—	70 mA[4]	0.3 A at 115 V DC A
• Inductive load					
With arc suppr. module max.	—	—	—	50 mA[4]	1.0 A at 30 V DC 1.5 A at 250 V AC
Without arc suppr. module max.	—	—	—	—	0.08 A at 115 V DC
Switch. cycl. (VDE 0660, Part 200)	—	—	—	$1 \cdot 10^8$	$3 \cdot 10^7$
Limitation of the voltage induced on circuit interruption (internal) to			V_{pos} –75 V		
Switching frequency for					
• Resistive loads max.	20 Hz	20 Hz	100 Hz	100 Hz	10 Hz
• Lamps max.	11 Hz	11 Hz	11 Hz	11 Hz	5 Hz
• Inductive loads max.	2 Hz	2 Hz	2 Hz (at 0.5 A)	2 Hz	2 Hz
Total load rating [3]					
• With fan	75 %	100 %	100 %	100 %	100 %
• Without fan	70 %	50 %	50 % (100 % at 35 °C)	100 %	100 %
Leakage current at "0" sign. max.	5 mA	5 mA	1 mA	—	—
Signal level of the outputs					
• At "0" signal max.	0.1 V_p	0.1 V_p	+ 3 V	—	—
• At "1" signal min.	—	—	V_p –2.5 V		
max.	V_p – 1.5 V	V_p – 1.5 V	—	—	—
Cable length (unshielded) max.	300 m (984 ft)	300 m (984 ft)	400 m (1312 ft)	400 m (1312 ft)	400 m (1312 ft)
Enable input F	Jumper F+/F– in the front connector	Jumper F+/F– in the front connector			
Input voltage					
• Rated value			24/48/60 V DC	24/48/60 V DC	24 V DC
• Enable			+ 13 ... + 72 V	– 13 ... + 33 V	+ 13 ... + 33 V
• Disable			– 72 ... + 8 V	– 33 ... + 5 V	– 33 ... + 5 V
Input current of enable input typ.			2.5 ... 6.5 mA	5 mA	5 mA
Cable length (unshielded) max.			200 m (656 ft)	200 m (656 ft)	200 m (656 ft)

1) Can also be used as L–switch.
2) For supply voltages higher than 72 V, the output voltage may exceed 13 V ("1" signal) in the non-drive state.
3) Referred to the sum of the rated currents through an L+ input.
4) Up to 500 mA possible with protective circuitry for the load (see operating instructions).
5) A filter (SIFI C, B84113–C–B–30 or equivalent) is required in the 230 V AC load power supply for the module.
6) A shielded signal lead is required for use of the module.
   A filter (SIFI C, B84113–C–B–30 or equivalent) is required in the 24 V DC load power supply for the module.

Digital output modules (continued)

Technical specifications (continued)

Digital output module	6ES5 456-4UA12 [1]	6ES5 456-4UB12[1]	6ES5 457-4UA12[2]	6ES5 458-4UA12	6ES5 458-4UA12
Signal output H					
Voltage if fault min.			$V_{pos} - 5$ V		
Current if fault (limited) max.			10 mA		
Voltage if no fault max.			3 V		
Insulation voltage (external connections to housing)					
• In acc. with VDE 0160	250 V AC	250 V AC	75 V DC	75 V DC	250 V AC
• Tested with	1500 V AC	1500 V AC	1250 V AC	500 V AC	1500 V AC
Current consumption					
• Internal (at 5 V) typ.	100 mA	100 mA	120 mA	80 mA	120 mA
• External (at 24 V, no load) typ.	—	—	—	200 mA	250 mA
Power loss max.	39.0 W	18.0 W	13.0 W	5.2 W	6.6 W
Space requirements	2 slots	2 slots	2 slots	1 slot	1 slot
Front connector	20-pin	20-pin	42-pin	42-pin	42-pin
Weight approx.	0.7 kg (1.5 lb)	0.6 kg (1.3 lb)	0.6 kg (1.3 lb)	0.45 kg (1 lb)	0.7 kg (1.5 lb)

1) A filter (SIFI C, B84113‑C‑B30 or equivalent) is required in the 230 V AC load power supply for the module.
2) A shielded signal lead is required for use of the module.
    A filter (SIFI C, B84113‑C‑B30 or equivalent) is required in the 24 V DC load power supply for the module.

Ordering data

	Order No.		Order No.
Non-floating		**458-4UA digital output module** 16 relay-contact outputs, 60 V; 0.5 V	6ES5 458-4UA12
441-4 digital output module 32 outputs, 24 V DC; 0.5 A	6ES5 441-4UA14		
		458-4UC digital output module 16 relay-contact outputs, 110 V DC; 250 V AC; 5 A	6ES5 458-4UC11
Floating			
451-4 digital output module 32 outputs, 24 V DC; 0.5 A	6ES5 451-4UA14	**498 arc-suppression module** for the 458-4UA.. digital output module (RC elements for 4 outputs)	6ES5 498-1AB11
453-4 digital output module 16 outputs, 24 V DC; 2 A (can also be used as L‑switch)	6ES5 453-4UA12	The operating instructions are included in the S5-135U/155U system manual (see page 4/155).	
454-4 digital output module 16 outputs, 24 V DC; 2 A	6ES5 454-4UA14	**497 front connector** Crimp terminals, single-width, 42-pin	6ES5 497-4UA12
455-4 digital output module 16 outputs, 24/48/60 V AC; 2 A	6ES5 455-4UA12	Crimp terminals, double-width, 42-pin	6ES5 497-4UA22
456-4UA digital output module 16 outputs, 115/230 V AC; 2 A	6ES5 456-4UA12	Crimp terminals, double-width, 20-pin	6ES5 497-4UA42
		Screw terminals, single width, 42-pin	6ES5 497-4UB31
456-4UB digital output module 8 outputs, 115/230 V AC; 2 A	6ES5 456-4UB12	Screw terminals, double width, 42-pin	6ES5 497-4UB12
		Screw terminals, double width, 25-pin (454-4 only)	6ES5 497-4UB22
457-4 digital output module 16 outputs, 24/48/60 V DC; 0,5 A (can also be used as L‑ switch)	6ES5 457-4UA12	Screw terminals, double width, 20-pin	6ES5 497-4UB42

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Digital output modules (continued)

6ES5 441-4UA14

6ES5 451-4UA14

6ES5 453-4UA12
6ES5 457-4UA12

6ES5 454-4UA14

6ES5 455-4UA12
6ES5 456-4UA12

6ES5 456-4UB12

6ES5 453-4UA12
6ES5 457-4UA12

6ES5 458-4UC11
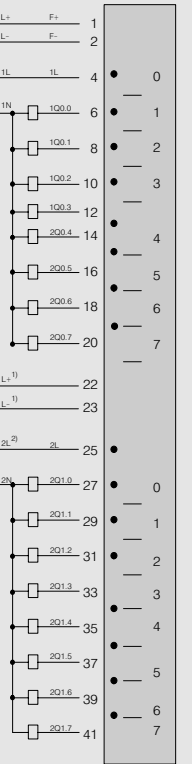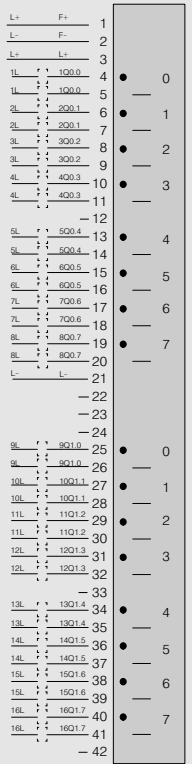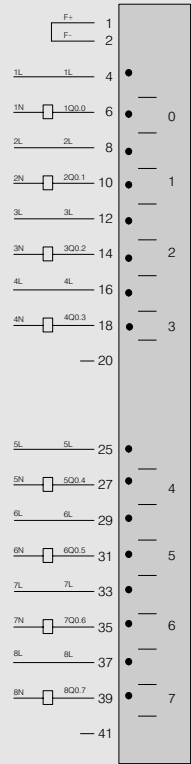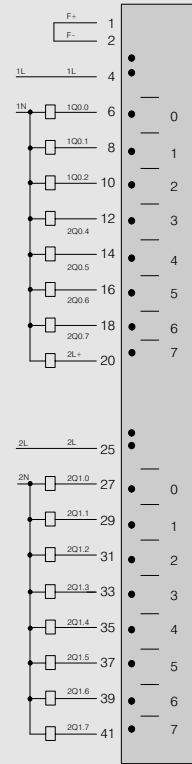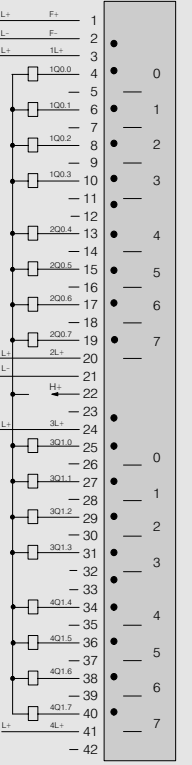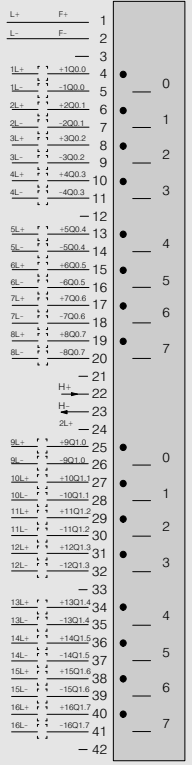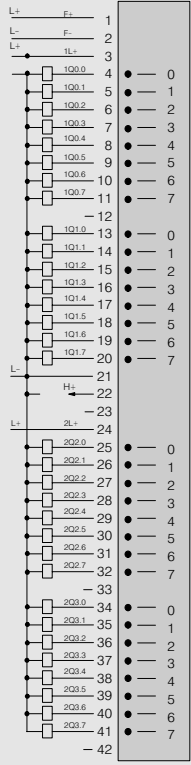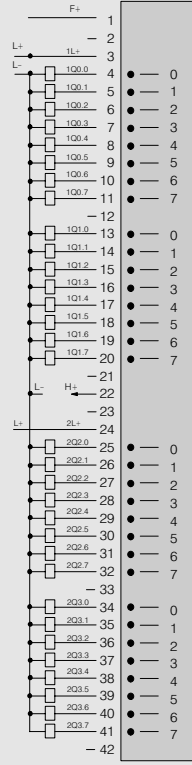
Fig. 4/24 Connection diagrams of digital output modules

1) 24 V DC supply voltage for the relays
2) Voltage for the relay contacts

Digital input/output module

Application

The digital input/output module converts the external signals from the process to the internal signal levels of the programmable controllers and converts the internal signal levels of the programmable controllers to the levels required externally by the process.

Design

The digital input/output module provides 16 binary inputs and eight binary outputs. Another eight terminals can be used either as inputs or outputs.

A shielded signal lead is required for use of the module.

Technical specifications

Number of inputs	**16** or **24**	Enable input	Jumper F+/F− in the front connector
Galvanic isolation	Yes		
• In groups of	16/24	Synchronization input	As for other binary inputs
Input voltage		Synchronization output and short-circuit signalling output	
• Rated value	**24 V DC**	• At "0" signal max.	+3 V
• For "0" signal	− 33 ... + 5 V	• At "1" signal	
• For "1" signal	+ 13 ... + 33 V	(short-circuit) min.	V_{pos} − 5 V
Input current		• Output current max.	10 mA (current-limited)
• At "1" signal typ.	8.5 mA		
Delay		**Supply voltage** $_{pos}$	
• At "0"→"1" typ.	0.3 ms	(for load)	
• At "1"→"0" typ.	0.3 ms	• Rated value	**24 V DC**
Cable length		• Ripple V_{pp} (referred	
• Unshielded max.	50 m (164 ft)	to rated voltage) max.	15 %
Number of outputs	**8** or **16**	• Permissible range	
Galvanic isolation	Yes	(including ripple)	20 ... 30 V
• In groups of	8/16	• Value at t < 0.1 s max.	36 V
Output current at "1" signal		Insulation voltage	
• Rated value	**0.5 A**	(external connections to housing, internal connections, other groups)	
• Permissible range	5 mA ... 0.5 A	• In acc. with VDE 0160	75 V DC
Lamp load max.	5 W	• Tested at	1250 V AC
Inductive load max.	12 W		
Short-circuit protection	Electronic	Current consumption	
Limitation of the voltage induced on circuit interruption		• Internal (at 5 V) typ.	90 mA
(internal) to	− 27 V	• External (at 24 V, without load) typ.	30 mA
Switching frequency for		Power loss max.	13 W
• Resistive loads max.	100 Hz	Space requirements	1 slot
• Lamps max.	11 Hz	Front connector	42-pin
• Inductive loads max.	2 Hz at 0.3 A, 0.5 Hz at 0.5 A	Weight approx.	0.4 kg (0.88 lb)
Total load rating			
• With fan	100 %		
• Without fan	50 % (100 % at 35 °C)		
Leakage current at "0" signal max.	0.5 mA		
Signal level of the outputs			
• At "0" signal max.	+ 3 V		
• At "1" signal min.	V_{pos} − 1.5 V		
Cable length			
• Unshielded max.	400 m (1312 ft)		

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Digital input/output modules

Digital input/output module (continued)

Ordering data	Order No.		Order No.
482-4 digital input/output module 16 or 24 inputs, 24 V DC and 8 or 16 outputs, 24 V DC; 0.5 A	**6ES5 482-4UA11**	**497 front connector** Crimp terminals, single-width, 42-pin Crimp terminals, double-width, 42-pin	**6ES5 497-4UA12** **6ES5 497-4UA22**
The operating instructions are included in the S5-135U/155U system manual (see page 4/155).		Screw terminals, single-width, 42-pin Screw terminals, double-width, 42-pin	**6ES5 497-4UB31** **6ES5 497-4UB12**

6ES5 482-4UA11
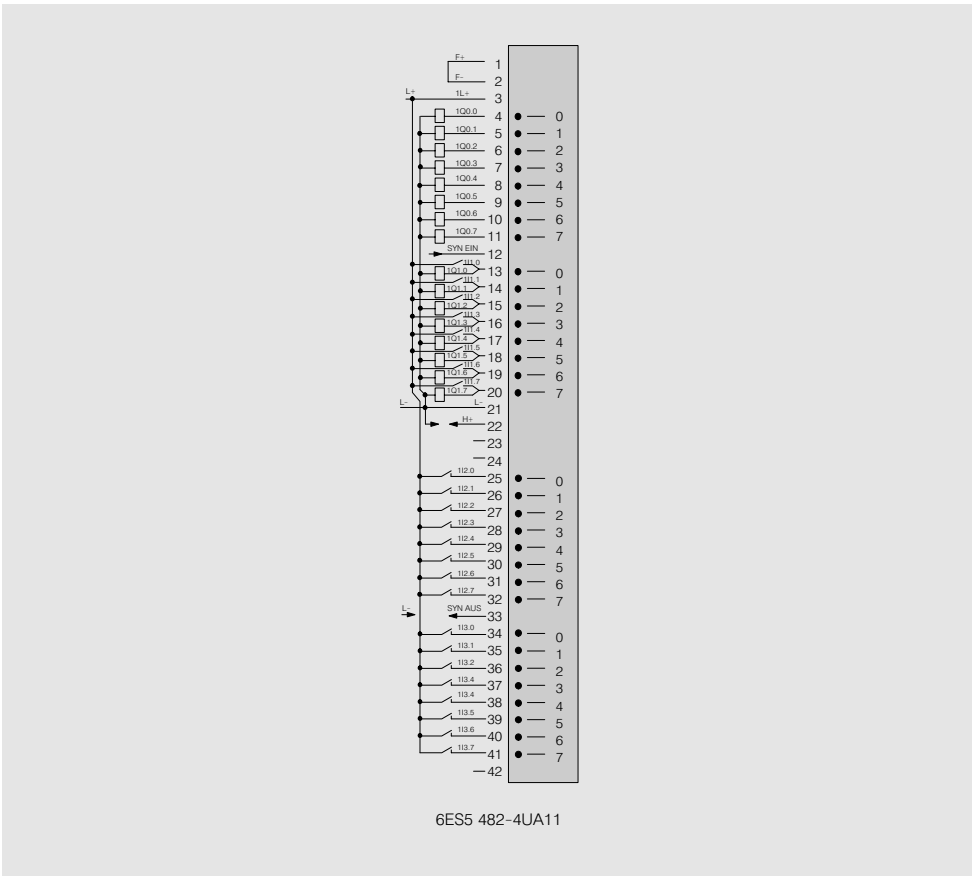
Fig. 4/25 Connection diagrams for the 482 digital input/output module

Overview

Analog input/output modules

Input modules			Output modules		
Voltage values/ current values	Module ID	Page	Voltage values/ current values	Module ID	Page
±12.5 mV... 10 V	460-4	4/45	±10 V... or 0... 20 mA	470-UA	4/50
±20 mA or +4.... 20 mA	465-4	4/45	±10 V	470-4UB	4/50
0... 1 V	463-4	4/45	±1... 5 V	470-4UC	4/50
0... 10 V			±4... 20 mA		
0... 20 mA or +4...20 mA					
±1.25 V to ±10 V	466-3	4/45			
0... 1.25 V to 0... 10 V					
+1... 5 V					
0... 20 mA or 4... 20 mA					
±20 mA					

Analog input modules

Application

The analog input modules convert the analog signals from the process into digital values, which can be processed by the programmable controller.

Application of analog input modules:
- Process monitoring
- Measuring physical quantities, e.g. in mechanical engineering, process engineering, building services automation
- Control engineering

Design

Analog input modules with 16, 8 and 4 inputs are available. The modules require one slot.

Front connectors are used for terminating the signal cables. Modules and front connectors may be inserted and removed under power (except for the 466 input module).

Adhesive labels are supplied to identify modules and front connectors.

460 input module:
- Eight floating channels
- Sequential measured value acquisition by means of optovoltaic multiplexer
- Measuring range selection by means of measuring range modules
- Direct acquisition of thermocouple voltages
- Direct four-wire connection of resistance-type sensors, e.g. Pt 100
- Power supply from L+, L-
- Use in large plants/machines with high common-mode voltages
- For closed-loop control applications with time constant ranging from seconds to infinity

463 input module:
- Four individually isolated channels
- Simultaneous scanning of all channels within $16^2/_3$ or 20 ms (50 or 60 Hz)
- Measuring range selection via jumpers in the front connector
- Acquisition of transducer signals
- For fast, noise-immune measured value acquisition even under unfavourable potential conditions
- For closed-loop control applications where speed is a critical factor (time constants >20 ms)

Analog input modules (continued)

Design (continued)

465 input module:
- 16 non-floating channels
- Sequential measured value acquisition with semiconductor multiplexers
- Measuring range selection by means of measuring range modules
- Direct acquisition of thermocouple voltages
- Direct four-wire connection of resistance-type sensors, e.g. Pt 100
- Use in small-scale plants/ machines where potential conditions are not a critical factor

Common features of the 460, 463 and 465 input modules:
- Integrating analog-digital conversion with a high degree of noise suppression at 50 (60) Hz and suppression of harmonics
- Enable input and input signals can be disabled
- The 460-4 input modules require two 498 measuring range modules
- The 465-4 input modules require two or four 498 measuring range modules, depending on whether up to 8 inputs or more than 8 inputs are used

466 input module:
- Eight differential or 16 individual channels (floating)
- Instantaneous value coding
- Measuring range selection through fixed wiring at the front connector
- For closed-loop control applications where speed is a critical factor (time constant >4 ms)

Technical specifications

Analog input module	6ES5 460-4UA13		6ES5 465-4UA13[2]	6ES5 463-4U.12
Number of inputs	**8** voltage/current inputs or **8** inputs for Pt 100 resistance thermometers		**16** voltage/current inputs or **8** inputs for Pt 100 resistance thermometers	**4** voltage/current inputs
Galvanic isolation	Yes		No	Yes
Input ranges (rated value)	± **12.5 mV** (for 460-4 only); ± **50 mV**; ± **500 mV**; **Pt 100**; ± **1 V**; ± **5 V**; ± **10 V**; ± **20 mA**; + **4 ... 20 mA** Input range can be selected for 4 channels at a time, using measuring range modules			**0 ... 1 V, 0 ... 10 V, 0 ... 20 mA** + **4 ... 20 mA** for two-wire transducers and four-wire transducers
Input resistance in the individual ranges	12.5 mV: ≧ 10 MΩ	Pt 100: ≧ 10 MΩ	10 V: 50 kΩ; 2 ‰	1V: ≧ ± 10 MΩ; 10 V: 90 kΩ;
	50 mV: ≧ 10 MΩ	1 V: 90 kΩ; 2 ‰	20 mA: 25 kΩ; 1 ‰	20 mA: 50 Ω
	500 mV: ≧ 10 MΩ	5 V: 50 kΩ 2 ‰	4 ... 20 mA: 31.25 Ω; 1 ‰	4 ... 20 ,A: 62.5 Ω;
Types of connection for signal sensors	Two-wire connection; four-wire connections for Pt 100			Two-wire connection
Digital representation of the input signal	12 bit plus sign or 13 bit two's complement (2048 units = rated value)			12 bit two's complement (1024 units = rated value)
Measuring principle	Integrating			Integrating
Conversion principle	Voltage-time conversion			Voltage-frequency conversion
Integration time (selectable for optimum noise suppression)	20 ms at 50 Hz 16 $^2/_3$ ms at 60 Hz			20 ms at 50 Hz 16 $^2/_3$ ms at 60 Hz
Encoding time max. per channel	60 ms at 50 Hz based on rated value 50 ms at 60 Hz based on rated value			20 ms at 50 Hz 16 $^2/_3$ ms at 60 Hz
Cycle time for 4 inputs	—		—	20 ms at 50 Hz 16 $^2/_3$ ms at 60 Hz
8 inputs	0.48 s at 50 Hz		0.48 s at 50 Hz	—
16 inputs	—		0.96 s at 50 Hz	—
Permissible voltage between inputs or between inputs and the central grounding point (destruction limit) max.	± 18 V or max. ± 75 V for 1 ms with a pulse repeat rate of 50 pulses/second			± 30 V or ± 75 V for 1 ms with a pulse repeat rate of 100 pulses/second
Permissible voltage between the reference potential of a non-floating sensor and the central grounding point max.	75 V DC/60 V AC		± 1 V	75 V DC/60 V AC

Analog input modules (continued)

Technical specifications (continued)

4

Analog input module	6ES5 460-4UA13		6ES5 465-4UA13[2]		6ES5 463-4U.12
Fault indication for					
• Overranging	At 200 % of rated value (4095 units)				At 150 % of rated value
• Wire breakage of sensor line	Can be designed for the range 50 mV, 500 mV and Pt 100				No
Noise suppression for f = n · (50/60 Hz ± 1 %) n = 1,2 ...					
• Common mode noise (V_p < 1 V) min.	100 dB		86 dB		80 dB
• Series mode noise max. (peak noise value < rated value of the range)	40 dB		40 dB		40 dB
Basic error limits[1] (at 20 °C)	12.5 mV: ± 2 ‰ 50 mV: ± 2 ‰ 500 mV: ± 1.5 ‰	Pt 100: ± 2 ‰ 1 V: ± 3,5 ‰ 5 V: ± 3.5 ‰	10 V: ± 3.5 ‰ 20 mA: ± 2.5 ‰ 4 ... 20 mA: ± 2.5 ‰		1.1 ‰
Operational error limits[1] (at 0 °C to 60 °C; for one year)	12.5 mV: ± 6 ‰ 50 mV: ± 5 ‰ 500 mV: ± 4.5 ‰	Pt 100: ± 5 ‰ 1 V: ± 7.7 ‰ 5 V: ± 7.7 ‰	10 V: ± 7.7 ‰ 20 mA: ± 6.7 ‰ 4 ... 20 mA: ± 6.7 ‰		3.7 ‰
Cable length (shielded) max.	200 m (656 ft); 50 m (164 ft) up to 50 mV		200 m (656 ft); 50 m (164 ft) up to 50 mV		200 m (656 ft)
Enable inputs (as with analog outputs)	+ 24 V		+ 24 V		+ 24 V
Supply voltage (as with analog outputs)	+ 24 V		+ 24 V		+ 24 V
Constant current source for Pt 100	2.5 mA		2.5 mA		—
Current consumption					
• Internal (at 5 V) typ.	0.13 A		0.15 A		0.2 A
• External (at 24 V) typ.	0.15 A		0.15 A		0.15 A
Power loss max.	3.5 W		1.5 W		5.0 W
Space requirements	1 slot				1 slot
Front connector	42-pin				42-pin
Weight approx.	0.4 kg (0.88 lb)				0.4 kg (0.88 lb)

Analog input module	6ES5 466-3LA11
Number of inputs	**8** differential inputs or **16** individual inputs (referred to ground) in 4 or 2 groups (selectable)
Galvanic isolation	Yes
Input ranges (rated values)	**0 ... 20 mA; 4 ... 20mA; ± 20 mA** **0 ... 1.25 V; 0 ... 2.5 V; 0 ... 5 V; 1 ... 5 V; 0 ... 10V** **± 1.25 V; ± 2.5 V; ± 5 V; ± 10 V;** } Selector switch lets you select these values for 4 channels separately
Input resistance in the individual ranges	Voltage measuring range: ≥ 10 MΩ Current measuring range: 125 Ω
Types of conn. for signal sensors	Two-wire connection
Digital repres. of the input signal	13 bit two's complement or 12 bit abs. value + sign or 12 bit binary
Measuring principle	Instantaneous value encoding
Conversion principle	Successive approximation
Encoding time max. per channel	250 µs
Cycle time for	
• 8 inputs max.	2 ms
• 16 inputs max.	4 ms
Permissible voltage between inputs or between inputs and central grounding point max.	± 30 V (static) or ± 75 V for 1 ms with a pulse repeat rate of 50 pulses/second
Permissible voltage between the reference potential of a non-floating sensor and the central grounding point max.	75 V DC/60 V AC

1) In accordance with DIN 43 745; referred to nominal measuring range (5 V supply from power supply chassis).
2) A filter (SIFI C, B84113-C-B30 or equivalent) is required in the 24 V DC load power supply for the module.

Analog input modules (continued)

Technical specifications (continued)

Analog input module	**6ES5 466-3LA11** (continued)
Fault indication for • Overranging • Wire breakage of sensor line	Yes (overflow bit) No
Noise suppression for f = n · (50/60 Hz ± 1 %); n = 1,2 ... • Common mode noise (V_p < 1 V) min. • Series mode noise min. (peak noise value < value of the range)	70 dB 40 dB
Basic error limits[1] (at 20 °C)	Voltage ranges (except 0 ... 1.25 V; ± 1.25 V): 0.1 % Current ranges and 0 ... 1.25 V; ± 1.25 V: 0.2 %
Operational error limits[1] (at 0 to 60 °C; for one year)	Voltage ranges (except 0 ... 1.25 V; ± 1.25 V): 0.2 % Current ranges and 0 ... 1.25 V; ± 1.25 V: 0.4 %
Cable length (shielded) max.	200 m (656 ft)
Enable inputs (as with analog outputs)	—
Supply voltage (as with analog outputs)	—
Constant current source for Pt 100	—
Current consumption • Internal (at 5 V) typ. • External (at 24 V) typ.	0.7 A —
Power loss max.	3.5 W
Space requirements	1 slot
Front connector	43-pin
Weight approx.	0.4 kg (0.88 lb)

1) In accordance with DIN 43 745; referred to nominal measuring range (5 V supply from power supply chassis).

Ordering data	Order No.		Order No.
460-4 analog input module 8 inputs, signal range set via measuring range module (two 498 measuring range modules are required); floating	**6ES5 460-4UA13**	**463-4 analog input module** 4 inputs, floating For 50 Hz power systems For 60 Hz power systems	**6ES5 463-4UA12** **6ES5 463-4UB12**
		466-3 analog input module 16 inputs, floating The operating instructions are in- cluded in the S5-135U/155U system manual (see page 4/155).	**6ES5 466-3LA11**
465-4 analog input module 16 inputs (8 with Pt 100), signal range set via measuring range module (two or four 498 measuring range modules are required); non-floating	**6ES5 465-4UA13**		
		497 front connector for 460, 463, 465 analog input modules Crimp terminals, single-width, 42-pin	**6ES5 497-4UA12**
498 measuring range module for 460-4 and 465-4 analog input modules; four channels each		Crimp terminals, double-width, 42-pin	**6ES5 497-4UA22**
±12.5 mV, ± 50 mV, ± 500 mV, Pt100	**6ES5 498-1AA11**	Screw terminals, single-width, 42-pin	**6ES5 497-4UB31**
± 1 V ± 5 V	**6ES5 498-1AA21** **6ES5 498-1AA61**	Screw terminals, double-width, 42-pin	**6ES5 497-4UB12**
± 10 V ± 20 V + 4 ... 20 mA;	**6ES5 498-1AA31** **6ES5 498-1AA41** **6ES5 498-1AA51**	**Front connector** for 466 analog input module Crimp terminals,	
for two-wire transducer + 4 ... 20 mA;	**6ES5 498-1AA71**	single-width, 43-pin	**6XX3 068**
for four-wire transducer		Screw terminals, single-width, 43-pin	**6XX3 081**

6ES5 460-4UA13
U/I connection

6ES5 460-4UA13
PT 100 connection

6ES5 465-4UA12
U/I connection

6ES5 465-4UA13
U/I connection

6ES5 463-4UA12
6ES5 463-4UB12
U/I connection

6ES5 466-3LA11
Individual inputs
U/I connection

6ES5 466-3LA11
Differential measurement
U/I connection
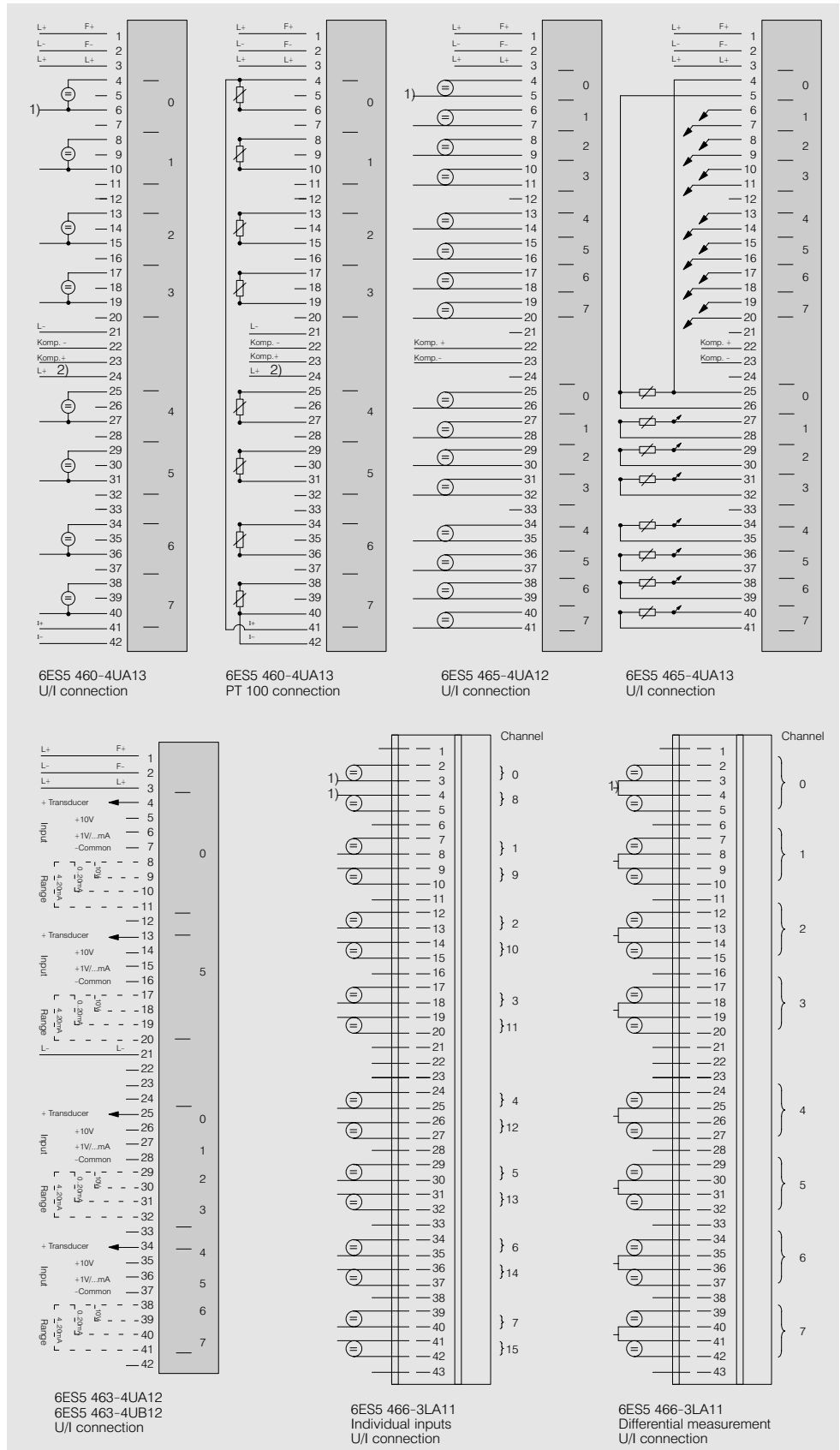
Fig. 4/26 Connection diagrams for analog input modules

1) Connection to the central grounding point of the system (see under technical specifications)
2) Only for disconnecting the test current if wire breakage monitoring is not activated

SIMATIC S5-135U, S5-155U/H

Analog input/output modules

Analog output modules

Application

The analog output modules convert the digital values from the programmable controller into analog signals required by the process.

Design

Three analog output modules are available with eight outputs each and a range of output voltages. The modules require one slot.

Front connectors are used for terminating the signal cables. Modules and front connectors may be inserted and removed under power.

Adhesive labels are supplied for identifying modules and front connectors.

Principle of operation

Enaple input

The enable input can be used to disable the output of new

values. The last output value is retained. The enable input can be deactivated by

removing the respective jumper on the module.

Technical specifications

Number of outputs	**8** voltage and current outputs	Enable input F	
Galvanic isolation	Yes (not between the outputs)	Input voltage	
Output ranges		• Rated value	24 V DC
(rated values)		• Enable	+ 13 ... 33 V
• 6ES5 470-4UA12	± **10 V; 0 ... 20 mA**	• Disable	– 33 ... + 5 V
• 6ES5 470-4UB12	± **10 V**		
• 6ES5 470-4UC12	**+ 1 ... 5 V; + 4 ... 20mA**	Input current	
Load resistance	Purely ohmic	(for enable) typ.	5 mA
• For voltage outputs min.	3.3 kΩ	Cable length	
• For current outputs max.	300 Ω	(unshielded) max.	200 m (656 ft)
Load connection	To the M$_{analog}$ terminal	**Supply voltage** V_{pos}	
Digital representation of the		• Rated value	24 V DC
output signal	12 bit two's complement	• Ripple V_{pp} (referred to	15 %
	(1024 units = rated value)	rated voltage)	
Permissible overload		• Permissible range	20 ... 30 V
capability approx.	25 % (up to 1280 units)	(including ripple)	
Conversion time	1 ms	• Value at t < 0.1 s max.	36 V
Short-circuit protection	Yes		
Short-circuit current approx.	25 mA (for a voltage output)	Current consumption	
Open-circuit voltage max.	18 V (for a current output)	• Internal (at 5 V) typ.	0.25 A
Voltage between the reference		• External (at 24 V) typ.	0.3 A
potential of the load (M$_{analog}$		Space requirements	1 slot
connection) and the casing max.	60 V AC/75 V DC		
Basic error limits[1]	± 2 ‰ ± 2 units	Power loss max.	9.0 W
(at 20 °C)		Front connector	42-pin
Operational error limits	± 6 ‰	Weight approx.	0.4 kg (0.88 lb)
(0 to 60 °C; for one year)			
Cable length (shielded) max.	200 m (656 ft)		

1) In accordance with DIN 43 745; referred to nominal measuring range (5 V supply from power supply chassis)
2) A filter (SIFI C, B84113-C-B30 or equivalent) is required in the 24 V DC load power supply for the module.

Analog output modules (continued)

Ordering data	Order No.		Order No.
470-4UA analog output module 8 outputs, ± 10 V, 0 ... 20 mA; floating	**6ES5 470-4UA13**	**497 front connector** Crimp terminals, single-width, 42-pin	**6ES5 497-4UA12**
470-4UB analog output module[2] 8 outputs, ± 10 V, floating	**6ES5 470-4UB13**	Crimp terminals, double-width, 42-pin	**6ES5 497-4UA22**
470-4UC analog output module 8 outputs, + 1 ... 5 V, + 4 ... 20 mA; floating	**6ES5 470-4UC13**	Screw terminals, single-width, 42-pin	**6ES5 497-4UB31**
		Screw terminals, double-width, 42-pin	**6ES5 497-4UB12**
The operating instructions are included in the S5-135U/155U system manual (see page 4/155).			

4

Fig. 4/27 Connection diagrams for analog output modules

SIMATIC S5-135U, S5-155U/H

Intelligent I/O modules

Application

Intelligent I/O modules are used for high-speed, high accuracy

- Closed-loop control
- Positioning
- Counting and proportioning

The advantage of the intelligent I/O modules lies in the fact that they execute these time-critical tasks completely autonomously. The CPU can then concentrate on its own control tasks more closely.

There is an entire range of intelligent I/O modules for the S5-135U and S5-155U/H programmable controllers, which can be used for various applications.

The following overview shows which modules can be used for which applications.

Signal preprocessing

Closed-loop control Page	Positioning Page Open-loop control	Positioning Page Closed-loop control	Counting/ Page proportioning	Signal processing Page

• IP 244   4/61
  temperature
	• IP 240 4/53
	  counter/position decod-
	  er/positioning module
		• IP 246I and 4/65
		  IP 246A positioning
		  module for servo drives
			• IP 240 4/53
			  counter/position decod-
			  er/positioning module
				• IP 243 analog 4/53
				  module

• IP 252   4/71
  closed-loop control
  module for drives
	• IP 241 4/55
	  digital position decoder
		• WF 721, 4/89
		  WF 723A, WF 723B and
		  WF 723C positioning
		  modules
			• IP 242A, IP 242B 4/57
			  counter modules	

• IP 260   4/74
  closed-loop control
  module for high-speed
  individual controllers
	• IP 247 4/69
	  positioning module for
	  stepper motors
			• IP 261 4/77
			  proportioning module	

	• WF 705 4/81
	  position encoder module
			• IP 281 4/79
			  counter module	

	• WF 706C 4/83 positioning module			
	• WF 707 4/86 cam controller			

- Page 4/84: Comparison of IP 240 and IP 288 with WF 706

- Page 4/87: Comparison of IP 241 and IP 288 with WF 707

- Page 4/90: Comparison of IP 246 with WF 721 and WF 723A

IP 240 counter, position decoder and positioning module

Application

The IP 240 counter, position decoder and positioning module is used for acquiring and preprocessing pulse trains for counting, position decoding, positioning and speed measurement with the IP 252 closed-loop control module (with incremental pulse generator).

The combination with IP 252 is only possible in the S5-115U.

Design

The module contains two channels that can be used independently of each other in four modes:

• Counting (signals from pulse encoders at frequencies of up to 70 kHz)
• Position decoding (in conjunction with incremental position encoders)
• Positioning via cut-off points
• Speed measurement for the IP 252 closed-loop control-module (in conjunction with incremental speed enco-ders)

Besides the inputs for pulse sensing (inputs for 5 V and 24 V available), each channel of the module is provided with:

• 1 enable input (5 V/24 V) for "counting" mode
• 1 reference input (preliminary contact, 5 V/24 V) for position decoding and positioning
• 2 outputs (5 V/24 V; 0.5 A) for control of actuators

The cables to the sensors can be connected

• either with 15-pin sub D connectors (upper sockets, shielded cables) or with
• screw-type connectors (lower sockets, cables up to 1.5 mm^2, up to approx. 10 kHz)

The module requires one slot.

Principle of operation

Counting

The positive-going edge of the enable input sets the counter to the initial value set in the user program (max. 9999). The counter counts the input pulses down to zero. When 0 is reached, the counter generates a process interrupt or sets its output (program-selectable). The pulses continue to be counted (down to max. -9999) if the enable input remains "1".

Position decoding

The counter counts up and down to ± 99,999. The counting pulse frequency can be doubled or quadrupled via user program. The channel is synchronized via the reference input.

Eight tracks (cams; travel sections or counting ranges; with allowance for a zero off-set) can be specified via software.

Positioning via cut-off points

In this mode, defined points within the traverse range (± 9,999,999) of the axis can be approached.
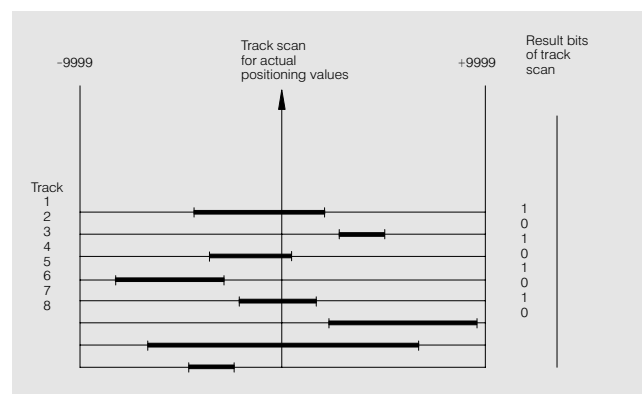
Fig. 4/29 Timing diagram for a positioning decoder
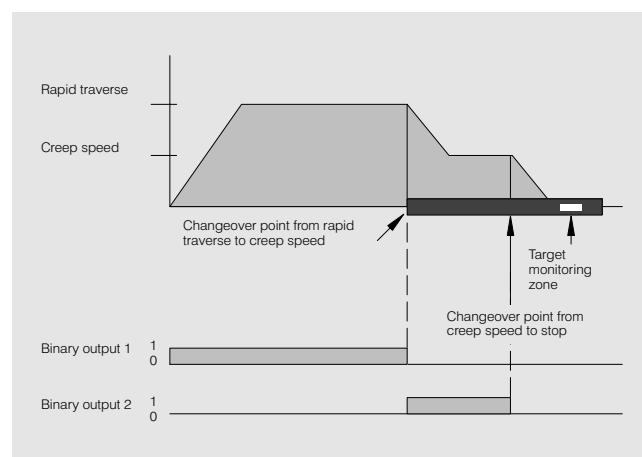
Fig. 4/30 Positioning of a pole-changing motor

IP 240 counter, position decoder and positioning module (continued)

Principle of operation (continued)

The drives used are driven direct. Up to 254 positions per channel can be stored in the module. The poisitons lie within three zones, which represent the cut-off points and the target range.

Synchronization is implemented via:
- Reference point approach
- Software synchronization

- Cyclic synchronization at the positive-going edge of the signal

A rotary or linear axis function can be programmed.

The actual value can be offset through relative and additive zero offset.

The positioning tolerance varies between

$\pm$ 0.002 mm at 0.06 m/min and $\pm$ 2 mm at 60 m/min.

The following errors are detected:
- Wire breakage with 5V symmetrical position encoders
- Short-circuit in signal cables
- Zero mark errors

The necessary program for the CPU is available in the form of standard function blocks (see Section 7).

Technical specifications

Pulse inputs

Galvanic isolation		No	
Position decoding, positioning			
• Differential inputs (5 V, symmetr.) for sensor interfaces to RS 422A or similar		2 pulses displaced by 90° and zero mark and inverse signals (e.g. Siemens 6FX2 001-2... positioning encoder)	
Input frequency	max.	500 kHz	
Cable length (shielded)	max.	30 m (98.4 ft) (w/ 5 V sensor sply)	
• 5V/24V inputs (asymmetrical)		2 pulses displaced by 90° and zero mark (e.g. Siemens 6FX2 001-4... posn. encoder)	
Input frequency	max.	50 kHz	25 kHz
Cable length (shielded)	max.	25 m (82 ft)	100 m (328 ft)
Counting			
5V/24V inputs		Pulses	
Input frequency	max.	70 kHz	25 kHz
Cable length (shielded)	max.	25 m (82 ft)	100 m (328 ft)
Input voltage			
• Rated value		5 V DC	24 V DC
• For "0" signal		0 ... 0.8 V	- 30 ... + 5 V
• For "1" signal		+ 2.4 ... 5 V	+ 13 ... 30 V
Input current at "1" signal	typ.	0.14 mA	6.5 mA

Binary inputs

Galvanic isolation		No	No
Input voltage			
• Rated value		5 V DC	24 V DC
• For "0" signal		0 ... 0.8 V	– 30 ... + 5 V
• For "1" signal		+ 2.4 ... 5 V	+ 13 ... 30 V
Input current at "1" signal	max.	0.14 mA	6.5 mA
Cable length (shielded)	max.	100 m (328 ft)	100 m (328 ft)

Binary outputs

Number per channel		2 with position decoding and positioning, 1 with counting
Galvanic isolation		Yes
Supply voltage V_{pos} (for load)		
• Rated value		24 V DC
• Ripple V_{pp}	max.	3 V
• Permissible range (including ripple)		20 ... 30 V
Output current at "1" signal		
• Rated value		500 mA
Switching frequency with		
• Resistive load (24 V, 50 mA)	max.	200 Hz
• Inductive load (8.5 W)	max.	2 Hz
• Lamp load (5 W)	max.	8 Hz
Residual load at "0" signal	max.	1 mA
Output voltage		
• At "1" signal	min.	V_{pos} – 3 V
Cable length		
• Shielded	max.	1000 m (3280 ft)
Current consumption		
• Internal (at 5 V)	typ.	0.8 A (excluding sensor supply)
Supply current for sensors		
• At 5 V	max.	0.8 A total
• At 24 V (external supply)	max.	0.6 A total
Addresses used		16 byte
Space requirements		1 slot
Weight	approx.	0.45 kg (0.99 lb)

Ordering data

	Order No.		Order No.
IP 240 counter, position decoder and positioning module	**6ES5 240-1AA21**	**705-3 connecting cables** for Siemens positioning encoder 6FX 2001-2 with V_{pos} = 5 V	
To be ordered as a separate item:		5 m (16.4 ft)	**6ES5 705-3 BF01**
Configuring package for IP 240 comprising manual and standard FB[1] for counting, position acquisition and positioning		10 m (32.8 ft)	**6ES5 705-3 CB01**
		20 m (65.6 ft)	**6ES5 705-3 CC01**
		32 m (104.9 ft)	**6ES5 705-3 CD21**
German	**6ES5 240-5AA11**		
English	**6ES5 240-5AA21**	**Sub D connector** 15-pin	**6ES5 750-2AA21**
French	**6ES5 240-5AA31**		
Italian	**6ES5 240-5AA51**		

1) For description see Page 7/109

IP 242A and IP 242B counter modules

Application

The IP 242A and IP 242B counter modules are used for acquiring and processing counting pulses up to a frequency of 500 kHz. They are suitable for pulse counting, frequency generation and division, and for measuring frequency, time and speed.

The IP 242B counter module is designed for applications

where the result needs to be processed extremely quickly. It has a large number of arithmetic functions and an integral measured value memory, which reduces the dependency on the access time of the CPU and it can therefore pass on the count values to the CPU ready processed.

Design

The IP 242A and IP 242B counter modules contain a total of seven independent 16-bit or 32-bit counter channels. Five of these channels can be used for counting up and down. The inputs and outputs are galvanically isolated. The IP 242A can be upgraded to an IP 242B with an EPROM and operated when the standard function blocks have been replaced.

The modules each require one slot.

Features

Counting frequency up to 500 kHz;

- Scaler chain (programmable and assigned randomly to counters 1 to 5), 4 x part factor 10 or 16 (BCD) and 1 x 4 bit
- Counters 1 to 5 cascadable
- Group interrupt output for user program

- 19 modes of operation for counters 1 to 5
- 1/3 modes of operation for counters 6 and 7
- Input signal level 5 V or 24 V, with 16-bit counters, adaption for each individual input by jumpers or resistors
- Output signal (24 V level) with up to 40 kHz pulse or varied pulse and pulse pause

Principle of operation

The counting and gate pulses of the individual counter channels can be derived from an external pulse encoder or from an internal quartz crystal. The counter outputs can be configured as either pulse outputs or level switch outputs.

An interrupt can be issued when a predefined interrupt value or the synchronization point is reached. The response times can be reduced considerably by instruction lists (short user programs) on the counter modules.

If the counting range of one counter is not sufficient, several counters can be cascaded together.

The necessary software for the CPU is available in the form of standard function blocks (see Section 7).

Technical specifications

Counter module	IP 242A	IP 242B
Number of counters		
• With 16 bit (cascadable) (counters 1 to 5)	5 (up/down programmable)	—
• With 24 bit (counters 6 and 7)	2 up and down for direct connection of incremental encoders with two pulse trains displaced by 90° (5 V, RS 422)	—
• With 32 bit (counters 6 and 7)	—	2 up and down for direct connection of incremental encoders with two pulse trains displaced by 90° (5 V, RS 422)
Number of modes (software-selectable)	19 (counters 1 to 5) 1 (counters 6 and 7)	19 (counters 1 to 5) 3 (counters 6 and 7)
Number of counters with comparison facility for random counts	7 (one interrupt value can be specified for each counter)	7 (one interrupt value can be specified for each counter)
Clock frequency (internal)		
• Counters 1 to 5	1 MHz with 16-bit scaler as well as programmable scaler chain	1 MHz with 16-bit scaler as well as programmable scaler chain
• Counters 6 and 7	—	10 MHz (direct, without scaler)
Counter frequency conditioning	Yes, for counters 1 to 5	Yes, for counters 1 to 5
Counting frequency		
• 24 V signals/ 5 V signals max.	480 kHz (counters 1 to 5)	480 kHz (counters 1 to 5)
• 5 V (RS 422) max.	500 kHz (counters 6 and 7)	500 kHz (counters 6 and 7)
Measured value preprocessing	No	Yes, by means of arithmetic functions
Measured value memory	No	Yes, freely assignable up to 100 measured values (100 x 2 data words)

IP 242A and IP 242B counter modules (continued)

Technical specifications (continued)

Counter module	IP 242A	IP 242B
Galvanic isolation (for inputs and outputs)	Yes, but not for incremental encoder inputs 6 and 7	
Power supply voltage V_{pos}		
• Rated value	24 V DC	
• Ripple V_{pp} max.	3.6 V	
• Permissible range (including ripple)	20 ... 30 V	
• Value at t < 0.5 s max.	35 V	
Input voltage (counters 1 to 5)	The counters can also be set to 24 V or 5 V signal levels by jumpers (one per input)	
• Rated value	24 V DC	
• For "0" signal	– 35 ... + 4.5 V	
• For "1" signal	+ 13 ... + 33 V	
• Rated value	5 V DC	
• For "0" signal	– 3 ... + 1.5 V	
• For "1" signal	+ 4 ... + 6.5 V	
Input voltage (counters 6 and 7)	5 V (RS 422)	
Input voltage at "1" signal typ.	13 mA (at 24 V), 12 mA (at 5 V)	
Output voltage		
• Rated value	24 V DC	
• At "0" signal max.	+ 3 V	
• At "1" signal min.	V_{pos} – 2.5 V	
Output current at "1" signal		
• Rated value	200 mA	
• Permissible range	0.2 ... 100 mA	
Output frequency max.	40 kHz	
Residual current at "0" signal max.	100 µA	
Short-circuit protection	Electronic	
Insulation voltage rating External connections to housing		
• In acc. with VDE 0160	75 V DC	
• Tested with	500 V AC	
Current consumption		
• Internal (at 5 V)	1.1 A	
• External (at 24 V, no load)	50 mA	
Assigned binary addresses	1 Kbyte with S5-155U, page addressing optional, 1 page frame	Page addressing, 1 page frame
Space requirements	1 slot	
Weight approx.	0.4 kg (0.9 lb)	

Ordering data	Order No.		Order No.
IP 242A counter module[2)	**6ES5 242-1AA32**	**Connector** (4 pcs.)	**6ES5 983-2AB11**
Upgrade kit from IP 242A and IP 242B	on request	**Converter** for 24 V asymmetrical incremental encoder up to 5 V (RS 422) - symmetrical incremental encoder	**6ES5 242-1AU11**
IP 242B counter module	**6ES5 242-1AA41**		
To be ordered as a separate item: **Configuring package for IP 242A/B** comprising manual and standard FB[1)		**705 connecting cable** for connection of Siemens position encoder 6FX2 001-2...	
German	**6ES5 242-5AB11**	Length 5 m (16.4 ft)	**6ES5 705-2BF00**
English	**6ES5 242-5AB21**	10 m (32.8 ft)	**6ES5 705-2CB00**
French	**6ES5 242-5AB31**	20 m (65.6 ft)	**6ES5 705-2CC00**
Italian	**6ES5 242-5AB51**		

1) For description see Page 7/121
2) Cannot be used with CPU 945

IP 243-3 analog module

Application

The analog module IP 243-3 allows the input, output, pre-processing and routing of analog signals with a short processing time.

Design

The module contains the following components:

- 1 analog/digital converter (–10 to + 10V, 12 bits, 35 s) with 8 inputs
- 2 digital/analog converters (–10 to +10V, 12 bit, 5 s)
- 1 digital/analog converter (0 to + 10V, 8 bit, 10 s)
- 4 analog value matching functions (zero offsets and amplifier settings)
- 2 difference amplifiers (P controllers) with settable gain

- 2 analog value comparators, the results are read in via a following logical circuit and then further processed as alarms (depending on the type of programmable controller used via alarm cables or via a digital input module with alarm generation)
- 1 digital output (8 outputs, 24 V; 0.4 A)
- 1 digital input (8 inputs, 24 V)

The gains and zero points can be set on the front panel via trimpots. 6 measuring sockets are available for checking the settings.
The module requires 1 slot.

Principle of operation

Depending on the given task, the components can be connected to each other or to the inputs and outputs (routing).

The analog values of an input selected via the multiplexer are converted to digital values via the A/D converter so that they can then be processed directly in the central controller.

At the same time they can be compared with other values in the IP 243-3. Individual analog values can be adapted for this. Set values for direct comparison can be sent from the central controller to the IP 243-3 through the D/A converter.

The program required for the central controller is available as standard function modules (see Catalog Section 7).

Technical specifications

A/D converter, 12 bit	1	D/A converter, 12 bit	2
Number of inputs	8	Output voltage	–10 to +10 V
Input voltage range (set with jumpers)	–5 to +5 V, –10 to +10 V, 0 to 10 V	Load impedance min.	2 kΩ
Input resistance approx.	1 MΩ	Digital representation of signal	11 bit + sign; output voltage range = 2047 units
Digital representation of signal	11 bit + sign; input voltage range = 2047 units	Short-circuit protection	yes
		Short-circuit current approx.	25 mA
Conversion method	successive approximation	Settling time to 99% of final value for 20 m line length	5 µs
Conversion time max. (without command processing times)	35 µs		
		Basic error limits	± 0.6 ‰
Basic error limits	± 0.6 ‰	Operational error limits	± 0.9 ‰ (0 to 55 °C)
Operational error limits	± 1.2 ‰ (0 to 55 °C)		

IP 243-3 analog module (continued)

Technical specifications (continued)

D/A converter, 8 bit	**1**	**Binary outputs**	**8**
(with amplilfier)		Output voltage range	
Output voltage range	0 to 10 V	• nominal value	24 V DC
Load impedance min.	2 kΩ	• for signal „0" max.	3 V
Digital representation of signal	8 bit;	• for signal „1" min.	U_p - 1.9 V
	output voltage range	Output current for signal "1"	
	= 255 units	• nominal value	200 mA
Short-circuit protection	yes	• permissible range	2 to 200 mA
Short-circuit current approx.	50 mA	Short-circuit protection	Fuse
Settling time to 99% of final value	10 µs	Limitation of inductive switch-off	
for 20 m line length		voltage to auf	-2 V
Basic error limits	± 2 ‰	Operating frequency with ohmic	
Operational error limits	± 4 ‰ (0 to 55 °C)	load max.	1 kHz
Analog value matching	**4**	Total load capability at 55 °C	37 %
Input voltage range	-4 to +10 V	(with ref. to the sum of the nomi-	
Input resistance approx.	200 kΩ	nal currents of all outputs)	
Input filter time constant approx.	0.1 ms	Residual current at signal "0"	250 µA
Gain range	0.5 to 5	**General data**	
Setting range for zero offset	-2 to +2 V	Supply voltage Vp	
Difference amplifier	**2**	• nominal value	24 V DC
Input voltage range	-10 to +10 V	• ripple Vpp	3.6 V
Input resistance approx.	1 MΩ	• permissible range (incl. ripple)	20 to 30 V
Input filter time constant approx.	0.5 ms	• value at t < 0.5 s	35 V
Gain range	1.1 to 20	Current consumption	
Output voltage range	-10 to 10 V	• internal (at 5 V)	600 mA
Load impedance min.	2 kΩ	• external (at 24 V, no load)	270 mA
Short-circuit protection	yes	Galvanic isolation	No
Short-circuit current approx.	50 mA	Cable length	
Comparator	**2**	• for analog signals, shielded	20 m
Number of inputs	2	• for binary signals	
Input voltage range	0 to +10 V	unshielded	400 m
Input resistance approx.	44 kΩ	shielded	1000 m
Input filter time constant approx.	0.25 ms	Reference potential for analog	0-V-connection (low resistance
Binary inputs	**8**	signals	connected to housing)
Input voltage range		Permissible voltage between	
• nominal value	24 V DC	analog input and	
• for signal "0"	-5 to +5 V (or input open)	0 V connection max.	35 V (destruction limit)
• for signal "1"	+13 to +30 V	Assigned binary addresses	8 bytes
Input current for signal "1" typ.	2.5 mA	Space requirement	1 slot
Delay time typ.	3 ms	Weight approx.	0.36 kg

Ordering data

	Order No.		Order No.
IP 243-3 analog module	**6ES5 243-1AA13**	**Front connector K**	
		• 43-pin, for crimp connection	**6XX3 068**
To be ordered as a separate		• 43-pin, for screw connection	**6XX3 081**
item:			
IP 243-3 manual		**Standard-function blocks**	**6ES5 848-7MA01**
German	**6ES5 998-0KF11**	for IP 243[1]	
English	**6ES5 998-0KF21**		
French	**6ES5 998-0KF31**		

1) For description see Page 7/119

IP 244 temperature control module

Application

The IP 244 temperature control module is used for controlling and monitoring temperatures and for measuring and monitoring analog values. This module processes temperature control loops, thus offloading the CPU.
The IP 244 can replace up to 13 individual controllers.

Design

The IP 244 contains a microprocessor which implements the control functions in multiplex mode. User setting is also possible.
The module requires one slot.

Inputs
- 1 binary input for switching the controller on and off (heating switch); operates only on controllers for which it was configured
- 13 analog inputs for connecting floating (grounding required) or non-floating thermocouples, two-wire connection, linearization by firmware, 0 ... 50 mV: Fe-CuNi, NiCr-Ni, Pt 10%-RhPt, Pt 13%-RhPt in accordance with DIN 43710 for temperatures up to 1600 °C

- 1 compensation input for connecting a Pt 100 resistance thermometer for reference junction temperature compensation (three-wire connection)
- 2 monitoring inputs (0 ... 20 V) for connecting transmitters. These signals are not processed by the controller but only monitored for limits

or

- 8 analog inputs for connecting Pt 100 resistance thermometers (0 ... 500 mV, four-wire connection)

or

- 16 analog inputs for connecting voltage sensors, such as pyrosensors (0 ... 500 mV; two-wire connection).

The analog inputs are designed, with respect to earthing and shielding, with enhanced resistance to interference which allows operation of the module in the proximity of electrical drives.

Outputs
- 17 outputs for two-position controller (HEAT-OFF) or three-position controller (HEAT-OFF-COOL); can be selected from 13 two-position to 8 three-position and 1 two-position controllers.
The "on" duration of an output (manipulated variable for cooling or heating) during one sampling interval corresponds to the value of the manipulated variable calculated by the controller. Manual operation is possible.

Principle of operation

Controller characteristics
- 13 controllers can be programmed with P, I and D components
- The treshold value can be selected to avoid pumping of an output
- The sampling time can be selected between 800 ms and 32 s

- Cascade controllers with one master controller and up to twelve secondary follow-up controllers optional
- Separate parameter sets for heating and cooling

IP 244 temperature control module (continued)

Controller self-optimization

The module has a self-optimizing facility (see Fig. 4/33) suitable for gradual processes (e.g. in the plastics industry). The module determines the optimum parameters in a heating-up phase.

Preconditions:

- The controlled process must have low-pass characteristics
- Two-position controlled systems must permit a temperature rise of 37 K; three-position controlled systems: 110 K
- The actual value may rise at a rate of 60 K/min, in max. at full heating capacity
- The heat-up phase must not exceed 12 hours

The self-optimization can be activated for each channel by means of a start/stop bit.
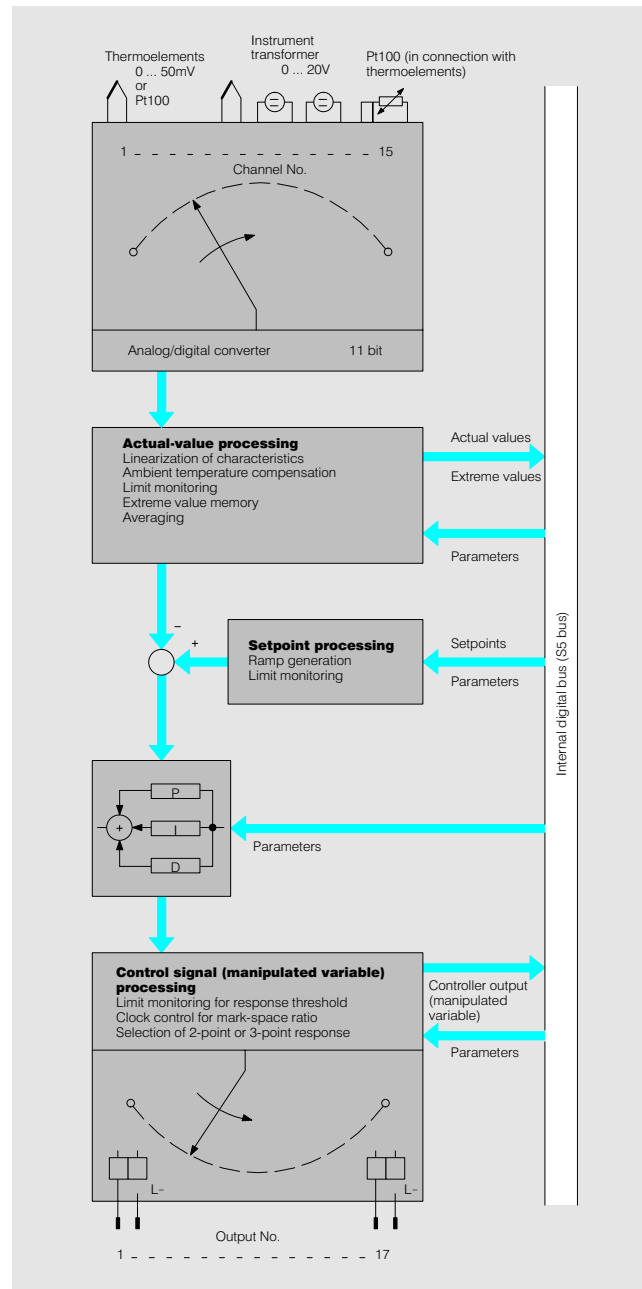
Fig. 4/33 Function diagram of temperature control module
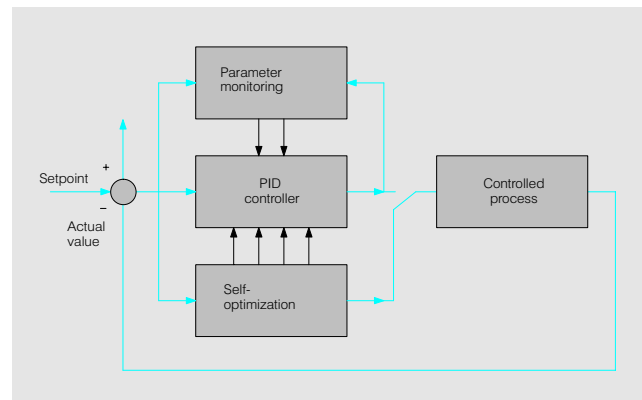
Fig. 4/34 Function diagram of controller self-optimization

IP 244 temperature control module (continued)

Principle of operation
(continued)

Actual-value processing
- Conversion of analog input values to 11-bit digital values
- Monitoring of actual values for two high and two low limits. A signal is given if a first limit is exceeded and the maximum or minimum value reached is stored (can be scanned at any time); if a second limit is exceeded, the controller in question is switched off
- Actual-value averaging is carried out if large deviations or disturbances are to be compensated
- Monitoring of the thermoelement cable for a break in the wire with the following reactions:
  Output of the value of the manipulated variable determined in the past or manual operation or changeover to another thermoelement

Setpoint processing
- Step changes in the setpoints can be converted into ramp functions with variable slope coefficients

- A second setpoint can be entered (e.g. for reduced temperature at night); either the first or the second setpoint can be selected with a control bit (set by the user program)
- Limit monitoring of the setpoints entered

Analog output
The CPU can read the manipulated variables of all controllers of the IP 244 in one scanning cycle and therefore transfer the manipulated variables to analog output modules.

Heating current monitoring
The module can also be programmed for the "closed-loop control with heating current monitoring" mode (thermoelements only).

Failure of the individual heating elements can be detected by monitoring the heating currents. The program evaluates any drop below the permissible heating current range.

Note
The IP 244 temperature control module must be inserted in the central controller when using the IM 307/IM 317 interface modules.

Operation of the IP 244 temperature control module is permissible only in slots with battery backup.

The necessary software for the CPU is available in the form of standard function blocks (including an example for easy start-up)
(see Section 7).

4

Technical specifications

Analog inputs		Integrating time (adjustable for optimum noise suppression)	
either		• At 50 Hz	20 ms
Inputs for thermoelements	13 (two-wire connection)	• At 60 Hz	16 2/3 ms
Input voltage range	0 ... 50 mV	Conversion time max. (1 measured value)	
Input resistance	10 MΩ	• At 50 Hz	60 ms
Permissible thermoelements (for max. temperature)	Fe-CuNi (700 °C), type L, type J NiCr-Ni (1200 °C); type K Pt10%-RhPt (1600 °C); type S Pt13%-RhPt (1600 °C); type R	• At 60 Hz	50 ms
		Permissible voltage between	
		• Inputs or between inputs and central grounding point max.	18 V (V–, V_p; destruction limit)
Inputs for instrument transformers	2	• Reference potential of a sensor and the central grounding point max.	25 V AC/60 V DC
Input ranges (rated values)	0 ... 20 V; can be changed to 0 ... 50 V	Test voltage	
Input resistance min.	50 kΩ (20 V); 10 kΩ (50 mV)	• Analog input to analog input	120 V AC
Themperature compensation inputs	1 for Pt 100 (three-wire connection)	• Analog input to S5 bus	500 V AC
		Fault message for	
or		• Range exceeded	Yes
Inputs for Pt 100 (resistance thermometers, max. temperature 830 °C)	8 (four-wire connection)	• Wire-breakage	Yes
		• Limit exceeded (programmable limit)	Yes
Input voltage range	0 ... 500 mV	• Short-circuit	Yes
or		Noise suppression for $f = n \cdot (50/60$ Hz ± 1 %); $n = 1, 2, 3 ...$	
Inputs for voltage sensors	16 (two-wire connection)		
Input voltage range	0 ... 500 mV		
Digital representation of input signals (internal)	11 bit + sign (2048 units = nominal value)	• Common mode noise min.	100 dB
Galvanic isolation	Yes	• Series mode noise (peak value of the noise voltage < rated value of the range) min.	40 dB
Measuring principle	Integrating		

IP 244 temperature control module (continued)

Technical specifications (continued)

Analog inputs (continued)

Basic error limits (for actual value acquisition)	50 mV: ± 1.0 ‰	± 1 unit
	20 V: ± 2.5 ‰	± 1 unit
Operational error limits (0 ... 55 °C)	50 mV: ± 3.0 ‰	± 1 unit
	20 V: ± 3.5 ‰	± 1 unit
Cable length max.	50 m (164 ft) shielded	

Binary input

Input voltage	
• Rated value	24 V DC
• For "0" signal	– 2 ... + 4.5 V
• For "1" signal	+ 13 ... + 35 V
Input current at "1" signal typ.	5 mA
Delay max.	5 ms
Cable length max.	600 m (1969 ft) unshielded

Controller

Sampling time T_A (cycle time of module)	0.8 ... 32 s
Function	$y = K \cdot (k \cdot x + \frac{1}{T_N} \int x\,dt + T_D \cdot \frac{dx}{dt})$
Parameters	
• k	0 or 1
• K	0.01 ... 256
• T_N	$(1 ... 512) \cdot T_A$ or $T_N = \infty$
• T_D	$(0.5 ... 512) \cdot T_A$ or $T_D = 0$
Setpoint	0 ... 1600 °C (11 bit)
Setpoint ramp	0 ... 65 536 K/h
Limit values	Setpoint ± 255 K
Threshold value	0 ... 50 % (of setpoint)
Hysteresis	0 ... 50 % (of setpoint)

Outputs

Outputs 1 ... 17	Controller outputs
Response	Depends on the programmed controller types: 13 x two-point to 8 x three-point and 1 x two-point
Galvanic isolation	No
Power supply voltage V_{pos}	
• Rated value	24 V DC
• Ripple V_{pp} max.	3.6 V
• Permissible range (including ripple)	20 ... 30 V
Output current at "1" signal	
• Rated value	120 mA
• Permissible range	0.2 ... 120 mA
Short-circuit protection	Yes
Limiting of the voltage induced on circuit interruption to	– 1 V
Lamp load max.	2.4 W
Load factor at 55 °C	100 %
Residual current at "0" signal max.	2 µA
Signal level of the outputs	
• At "0" signal max.	+ 3 V
• At "1" signal min.	V_{pos} – 2.5 V
Cable length	
• Unshielded max.	400 m (1312 ft)
• Shielded max.	1000 m (3300 ft)

General specifications

Current consumption	
• Internal (at 5 V) typ.	0.4 A
• External (at 24 V, without load) typ.	0.05 A
Assigned binary addresses	32 byte
Space requirements	1 slot
Weight approx.	0.3 kg (0.66 lb)

Ordering data

	Order No.		Order No.
IP 244 temperature control module	**6ES5 244-3AB31**	**721 connecting cables** shielded; For binary signals (max. 500 m (1640 ft))	
To be ordered as a separate item: **Configuring package for IP 244** comprising manual and standard FB[1]		2.5 m (8.2 ft)	**6ES5 721-4 BC50**
		3.2 m (10.5 ft)	**6ES5 721-4 BD20**
		5 m (16.4 ft)	**6ES5 721-4 BF00**
German	**6ES5 244-5AA11**	10 m (32.8 ft)	**6ES5 721-4 CB00**
English	**6ES5 244-5AA21**	32 m (104.9 ft)	**6ES5 721-4 CD20**
French	**6ES5 244-5AA31**		
Italian	**6ES5 244-5AA51**	For analog signals (max. 50 m (164 ft))	
		2.5 m (8.2 ft)	**6ES5 721-5 BC50**
		5 m (16.4 ft)	**6ES5 721-5 BF00**
		10 m (32.8 ft)	**6ES5 721-5 CB00**
		32 m (104.9 ft)	**6ES5 721-5 CD20**
		50 m (164 ft)	**6ES5 721-5 CF00**

1) For description see Page 7/121

IP 246I and IP 246A positioning modules

Application
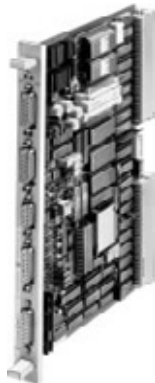
The IP 246 positioning module is used for positioning and position control of two independent axes with variable speed drives.

Design

Two versions of the IP 246 positioning module are available:

- IP 246I for incremental position encoders

- IP 246A for absolute (digital) position encoders

Principle of operation

Machine data and programs required for positioning are stored in the RAM of the IP 246 positioning module. For this, the COM 246 parameterization software (see Section 7) must be loaded into the programming device used.

The user can program target positions and traversing speeds:

- In the program memory of the CPU
- In the program memory of the IP 246 positioning module (with the COM 246 parameterization software)

The current position of the two axes is determined from the signals of the position encoder. From the difference to the current set position, a position controller (P-controller) calculates the current speed set-point, which is output as an analog signal ($\pm$ 10 V) and is available to the speed controller of the current converter of the appropriate axis.

The module can be serviced via two interfaces, either from the programmable controller or from a programming device.

Both axes can be used independent of each other either as a rotary or linear axis.

Operation with a programming device

In the diagnostics mode, both axes can be controlled from a programming device. Setpoints, actual values, following error and a number of other values are displayed on the screen. Error messages are displayed in detailed plain text.

For operation with a programmer (and for programming), the COM 246 parameterization software is required (see Section 7).

Operation with a programmable controller

For communication between the positioning module and the CPU, the appropriate standard function block (FB 164 and FB 165; see Section 7) must be loaded into the CPU. The possible calls are put together in a list (see page 4/66).

The PLC and programming device interfaces can be operated simultaneously. Using the PLC, simple point-to-point linkage of the two axes is possible.

Machine data

The machine record includes axis-specific parameters such as

- Various speeds
- Accelerations and decelerations in both directions
- Coordinates for reference point, software position switch
- Offsets, tool compensations
- Resolution
- Type of axis: Rotary or linear axis

IP 246I and IP 246A positioning modules (continued)

Principle of operation
(continued)

Traversing programs

The notation of the traversing programs conforms to a sub-set of DIN 66025. They are edited on the programming device using either this notation or in plain text.

Up to 255 programs can be stored on the positioning module. A program can be up to 1023 characters long, and the program memory can take a total of 10,000 characters.

Programs can be linked using subroutine calls. Other programmable functions are e.g.:

- Loops, including infinite loops
- On-the-fly changeovers
- Dwell times
- Offsets, tool compensations
- Metric and imperial measures

Each traversing program can be carried out by both axes (even simultaneously).
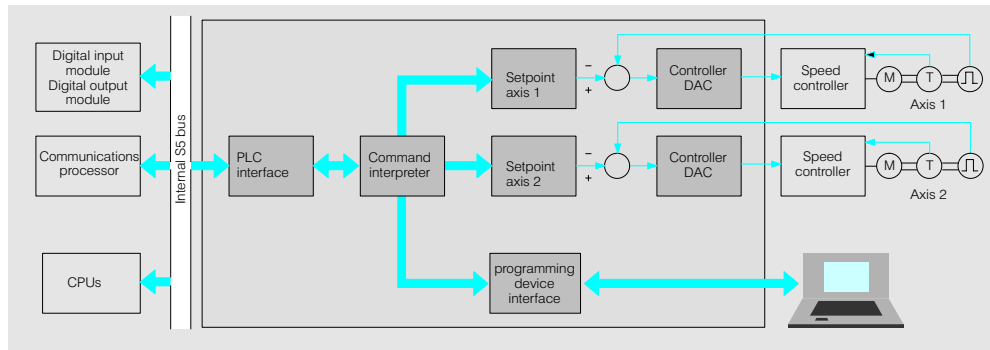
Fig. 4/35 Function diagram of the IP 246 positioning module

Functions

Module	IP 246I	IP 246A
Application	Positioning and position control of two independent axes with variable-speed drives	
Encoders used	Incremental • 5 V differential signal • 24 V signal	Absolute (digital) • 24 V signal • Switching to P potential • Switching to M potential
Type of axis	Linear axis Rotary axis	
Modes for • Operator communication	Jogging mode Follow-up mode Reference point approach and/or set reference point Incremental travel Automatic mode Teach-in mode Zero shift Tool offset Entry of machine data and traversing program Module identifier Drift compensation	
• Monitoring	Read machine data Read traversing program Read current actual values Read module identifier Path actual value Following error Distance to go	
Binary outputs signal the following: Selectable via binary inputs	"Axis ready for operation"; "Position reached" External start/stop	
User program referencing the IP 246 Can be stored in	RAM/EPROM CPU	
Machine data and traversing programs can be modified via CPU	Yes	
Module replacement possible without reloading program	Yes	

IP 246I and IP 246A positioning modules

Technical specifications

Position detection, incremental			
5 V inputs (to RS 422)			Two 90° displaced pulses, zero mark, and the inverse signals
24 V inputs			Two 90° displaced pulses and zero mark
Input voltage			24 V DC 5 V DC (RS 422)
• Rated value			
• For "0" signal			– 33 ... + 3 V
• For "1" signal			+ 10.5 ... 33 V
Input current (at "1" signal)	max.		7 mA
Galvanic isolation			No
Counting frequency			
• For 5 V inputs	max.		500 kHz
• For 24 V inputs	max.		50 kHz
Cable length (shielded)	max.		32 m (105 ft)

Position detection, absolute			
	max.		20 bit (parallel, Gray code)
Input voltage			
• Rated value			24 V DC
• For "0" signal			– 33 ... + 3 V
• For "1" signal			+ 10.5 ... 33 V
Input current (at "1" signal)	max.		7 mA
Galvanic isolation			No
Cable length (shielded)	max.		32 m (105 ft)

Binary inputs/outputs			
			4/2 per axis
Galvanic isolation			No
Input voltage			
• Rated value			24 V DC
• For "0" signal			– 33 ... + 3.6 V
• For "1" signal			+ 13 ... 33 V
Input current	typ.		9.5 mA (at 24 V)
Output voltage			
• Rated value			24 V DC
• For "0" signal	max.		+ 3 V
• For "1" signal	min.		V_{pos24} – 1.5 V
Output current			
• Output current at "1"	max.		120 mA (short-circuit proof)
Permissible range			5 ... 120 mA
• Residual current at "0"	max.		0.5 mA

Controller output			Analog rotational speed setpoint
Voltage range			–10 ... + 10 V
Load resistance	min.		5 kΩ
Short-circuit protection			Yes
Cable length (shielded)	max.		32 m (105 ft)

Machine data (general)			
Resolution			0.1 ... 99.9 μm
Traversing range	max.		± 40,000 mm or infinitely for rotary axis
Traversing speed			1 ... 65,000 mm/min.
Acceleration			10 ... 9999 mm/s^2
Following error	max.		99.999 mm
Speed gain K_V			0.1 ... 99.9/s $\dfrac{\text{Programmed speed V}}{\text{Following error } \Delta S}$
Backlash compensation	max.		64.999 mm
Tool length compensation	max.		± 40,000 mm

Supply voltages			
V_{pos24}			
• Rated value			24 V DC
• Ripple V_{pp}			3.6 V
• Permissible range (including ripple)			20 ... 30 V
Current consumption (at 5 V)	typ.		1.3 A (without position encoder)
Supply current for position encoder at 5 V and 24 V	max.		0.3 A per encoder
Supply voltage for 2-wire BERO			22 ... 33 V
Backup			From battery in PLC
Space requirements			
Weight	approx.		0.4 kg (0.9 lb)

4

SIMATIC S5-135U, S5-155U/H

Intelligent I/O modules

IP 246I and IP 246A positioning modules

Ordering data	Order No.		Order No.
IP 246I positioning module Incremental	**6ES5 246-4UA31**	**706 connecting cable** (cont.) • For 24 V sensor (open cable end)	
IP 246A positioning module Absolute (digital)	**6ES5 246-4UB11**	5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) 32 m (104.9 ft)	**6ES5 706-3BF00** **6ES5 706-3CB00** **6ES5 706-3CC00** **6ES5 706-3CD20**
To be ordered as a separate item:		• For absolute encoders	
Configuring package for IP 246I/A comprising manual, standard FB[1] and parameter assignment software COM 246[2] German English French	 **6ES5 246-5AA11** **6ES5 246-5AA21** **6ES5 246-5AA31**	5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) 32 m (104.9 ft) • For motor power section	**6ES5 706-6BF00** **6ES5 706-6CB00** **6ES5 706-6CC00** **6ES5 706-6CD20**
Sub D connector 15-pin (socket) 15-pin (plug) 9-pin (plug)	 **6ES5 750-2AB21** **6ES5 750-2AA21** **6ES5 750-2AA11**	5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) • For binary inputs/outputs	**6ES5 706-4BF00** **6ES5 706-4CB00** **6ES5 706-4CC00**

706 connecting cable
• For Heidenhain ROD 320
  (installed in 1HU and
  1FT motors)
		1 m (3.28 ft)
		5 m (16.4 ft)
		10 m (32.8 ft)
		20 m (65.5 ft)
			6ES5 706-5BB00
			6ES5 706-5BF00
			6ES5 706-5CB00
			6ES5 706-5CC00

5 m (16.4 ft)
10 m (32.8 ft)
20 m (65.6 ft)
32 m (104.9 ft)
	6ES5 706-1BF00
	6ES5 706-1CB00
	6ES5 706-1CC00
	6ES5 706-1CD20
		705-5 connecting cable
		• For Siemens position encoder
		  6FX2 001-2...
		  with V_{pos} = 5 V/24 V	

• For 5 V sensor
  (open cable end)
		standard 5 m (16.4 ft)
		lengths 10 m (32.8 ft)
		            20 m (65.6 ft)
		            32 m (104.9 ft)
			6ES5 705-5B F01
			6ES5 705-5CB01
			6ES5 705-5CC01
			6ES5 705-5CD21

5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) 32 m (104.9 ft)	**6ES5 706-2BF00** **6ES5 706-2CB00** **6ES5 706-2CC00** **6ES5 706-2CD20**		

1) For description see Page 7/123
2) For description see Page 7/21

IP 247 positioning module

Application
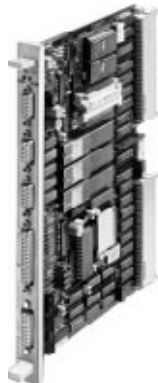
The IP 247 positioning module is used for positioning three independent axes with stepper motors.

Principle of operation

Machine data and traversing programs required for positioning are stored in the RAM of the IP 247 positioning module. For this, the COM 247 parameter assignment software (see Section 7) must be loaded into the programming device used.

The user can program target positions and traversing speeds

- In the program memory of the CPU or
- In the program memory of the IP 247 (with the COM 247 parameter assignment software).

The module calculates the angular increment to be carried out by the motor from the actual and target positions. The actual position of an axis is not fed back from outside but determined by the module itself.

From the mechanical characteristics of the drive unit (transmission ratio) and the machine data stored on the module (e.g. max. acceleration) the module determines the required pulse sequence (and direction) and transfers this to the power section of the stepper motor. Acceleration and deceleration are calculated using an exponential function: With exponential acceleration a greater path is covered over a given length of time than with linear acceleration.

Stepper motors with two, four or five phases can be controlled with step frequencies of 0.5 Hz to 100 kHz.

Operation with a programming device

All three axes can be controlled from a programming device. Actual values, residual path and a number of other values are displayed on the screen. Error messages are displayed in detailed plain text.

For operation with a programming device (and for programming) the COM 247 parameter assignment software is required.

Operation with a programmable controller

For communication between the positioning module and the CPU, the appropriate standard function blocks (FB 164 and FB 165; see Section 7) must be loaded into the CPU.

Machine data

The machine record includes axis-specific parameters such as:
- Various speeds
- Accelerations (frequency changes)
- Coordinates for reference point, software position switch

- Offsets, tool compensations
- The number of angular increments of the motor per revolution
- Transmission gear ratio of the drive
- Type of axis: rotary or linear axis

Traversing programs

The program memory takes 7000 characters. The rest same as for IP 246.

Operating modes

The following groups of modes are possible:
- Set reference point procedure and reference point by software
- Modes for manual traversing
- Automatic modes
- Input and deletion of compensations and shifts
- Teach-in mode

4

Intelligent I/O modules

IP 247 positioning module (continued)
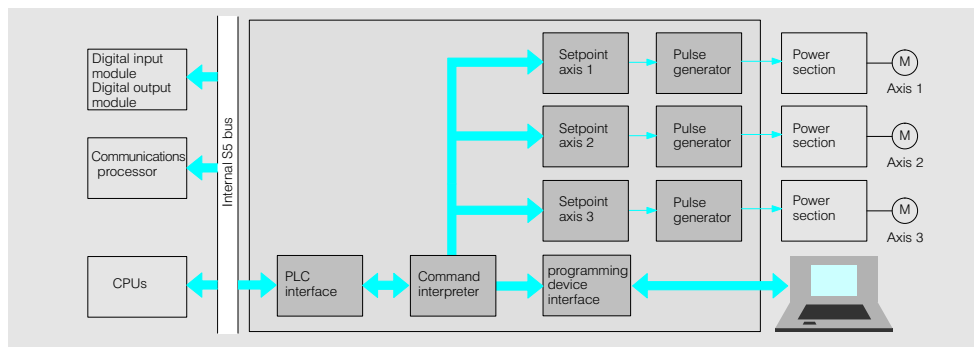
Fig. 4/36 Function diagram of the IP 247 positioning module

Technical specifications

Signal to the power section		**Machine data**	To be preselected with COM 247
Positioning outputs	Pulse, $\overline{\text{Pulse}}$ Direction, $\overline{\text{Direction}}$ Reset, $\overline{\text{Reset}}$	Traversing range	$\pm$ 100.000 mm
		Number of angular increments per revolution	12 ... 1000 $\frac{\text{pulses}}{\text{rev.}}$
Signal level for power section with		Transmission ratio of the drive	
• Optocouplers	5 V/20 mA, 24 V/20 mA jumper-selectable; 5 V to 24 V/20 mA with additional voltage		0,012 ... 64. 999 $\frac{\text{mm}}{\text{rev.}}$
		Pulse frequency	12 Hz ... 100 kHz
		Frequency gain	5 ... 2599.99 $\frac{\text{Hz}}{\text{ms}}$
• Differential inputs	5 V	Backlash compensation max.	64.999 mm
Ready signal input		Tool length compensation max.	$\pm$ 100,000 mm
• Rated value	24 V DC	**Supply voltages**	20 bit (parallel, Gray code)
• For "0" signal	– 33 ... + 3 V	V_{pos24}	
• For "1" signal	+ 10.5 ... 33 V	• Rated value	24 V DC
• Input current (at 24 V) typ.	7 mA	• Ripple max.	3.6 V
Binary inputs/outputs		• Permissible range (including ripple)	20 ... 30 V
Signal output "Position reached"		Current consumption	
• Rated value	24 V DC	• Internal (at 5 V) typ.	0.8 A
• For "0" signal max.	3 V	• External (at 24 V, without load) typ.	0.05 A
• For "1" signal min.	V_{pos24} – 1.5 V		
• Output current at "1" max. Permissible range	120 mA 5 ... 120 mA	Supply voltage for 2-wire BERO	22 ... 33 V
• Residual current at "0" max.	0.5 mA	Battery backup	PLC battery
Inputs for position switch (2), reference point switch, external Start/Stop		Cable length max.	100 m (328 ft)
• Rated value	24 V DC	Space requirements	1 slot
• For "0" signal	– 33 ... + 3.6 V	Weight approx.	0.4 kg (0.9 lb)
• For "1" signal	+ 13 ... V		
• Input current (at 24 V) typ.	9.5 mA		

Ordering data

	Order No.		Order No.
IP 247 positioning module without manual	**6ES5 247-4UA31**	**704 connecting cable** (open cable end)	
		• For power section	
To be ordered as a separate item:		1.6 m (5.2 ft)	**6ES5 704-4BB60**
Configuring package for IP 247		5 m (16.4 ft)	**6ES5 704-4B F00**
comprising manual, standard FB[1] and parameter assignment software COM 247[2]		10 m (32.8 ft)	**6ES5 704-4CB00**
		20 m (65.6 ft)	**6ES5 704-4CC00**
		50 m (164 ft)	**6ES5 704-4CF00**
German	**6ES5 247-5AA11**	• For binary inputs and outputs	
English	**6ES5 247-5AA21**	2 m (6.56 ft)	**6ES5 704-5BC00**
French	**6ES5 247-5AA31**	5 m (16.4 ft)	**6ES5 704-5BF00**
		10 m (32.8 ft)	**6ES5 704-5CB00**
Sub D connector		20 m (65.6 ft)	**6ES5 704-5CC00**
9-pin (plug)	**6ES5 750-2AA11**	50 m (164 ft)	**6ES5 704-5CF00**
25-pin (plug)	**6ES5 750-2AA31**		

1) For description see Page 7/123
2) For description see Page 7/21

IP 281 counter module

Application

The IP 281 counter module is used for acquiring and processing counting pulses up to a frequency of 250 kHz. This module is an economical alternative to the IP 242A and IP 242B counter modules. It is designed for applications where only one or two counter channels are required.

Design

The IP 281 basic board has one counter channel for direct connection of incremental encoders or pulse encoders. A second channel can be connected using an optional plug-in submodule. The two 16- or 32-bit counters can operate either independently or in conjunction with one another. The channel(s) can be used for counting both up and down.

The counter function and the bus interface of the IP 281 counter module are implemented in an ASIC. This ensures very fast data interchange with the CPU of the programmable controller. It is therefore particularly suitable for measured value acquisition, interrupt processing and high-speed closed-loop control.

The incremental encoders are connected via Sub D connectors; the digital inputs and outputs are connected via screw terminals (included in the scope of delivery).
The module requires one slot.

Features

- One channel for counting up and down (16 or 32 bit), upgradable to two channels (16 or 32 bit) with a plug-in submodule, for connection of incremental encoders
- Five operating modes for independent operation of the two counters
- Four operating modes for operation of the two counters in conjunction with one another
- Individual setting of counting width, counting range and counting mode for each counter
- Counting pulses are acquired from three different evaluations of the signal levels at the encoder inputs (single, double and quadruple evaluation)
- Transfer of values from counter 1 to counter 2 in the form of interrupt or load values
- Direct start of counter 2, when counter 1 has reached an interrupt value
- Enabling/disabling in the form of levels, pulses (at the digital input of the counter) or by software control
- Gate start, gate stop and setting via digital inputs
- Counters loaded with defined initial values
- Cormparison with one interrupt value for each counter
- Synchronous setting of start, stop and readout

Principle of operation

The IP 281 counter module captures the pulses from incremental encoders depending on direct connectable gate signals. The module evaluates the direction and compares the actual value per counter with a definable interrupt value. For fast response, the counter outputs can be used and/or an interrupt can be sent to the CPU. The counter outputs can be configured with a selectable minimum pulse or with level switching.

The user program does not require standard function blocks for data exchange with the CPU. High-speed access is achieved via load and transfer operations.

4

IP 281 counter module (continued)

Technical specifications

Number of counters with 16 or 32 bit alternatively	1 upgradable to 2 both up and down with 2 pulse trains displaced by 90° (5 V level, RS 422), also 24 V incremental encoders	Signal input voltage • Rated value • For "0" signal • For "1" signal	24 V DC -3 V ... + 4,5 V +13 V ... + 30 V
		• Rated value	5 V DC (to RS 422)
Number of modes (software-selectable)	5	Input current at "1" signal typ. typ.	13 mA (at 24 V) 12 mA (at 5 V)
Number of counters with comparison facility for random counts	1 or 2	Output voltage • At "0" signal max. • At "1" signal min.	+3 V V_{pos} - 2.5 V
Counting frequency when driven with		Output current at "1" signal • Rated value	500 mA
• 24 V signals max. • 5 V RS 422 signals max.	250 KHz 250 KHz	Short-circuit protection	Electronic
Galvanic isolation • For inputs and outputs • Between two inputs	Yes Yes (between encoder and digital inputs)	Insulation voltage External connections to housing • In acc. with VDE 0160 • Tested with	75 V DC 500 V AC
• Between input and S5 bus	Yes	Current consumption • Internal (at 5 V) max.	0.6 A
Power supply voltage V_{pos} • Rated value • Ripple V_{pp} max.	24 V DC 3.6 V	• External (at 24 V, without load) max.	2.5 A
• Permissible range (including ripple)	20 ... 30 V	Assigned binary addresses	8 byte with linear addressing
• Value at t > 5 s max.	35 V	Space requirements	1 slot
		Weight approx.	0.4 kg (0.88 lb)

Ordering data

	Order No.		Order No.
IP 281 counter module with 24 V encoder power supply 24 V and 5.2 V encoder power supply	**6ES5 281-4UA12** **6ES5 281-4UP12**	**703 connecting cable** Between IP 281 and • Incremental position encoder for 5 V signals, to RS 422, power supply voltage 24 V, with one end open	
Plug-in submodule for upgrading with 2nd channel	**6ES5 281-4UB12**	10 m (32.8 ft) 20 m (65.6 ft) 32 m (104.9 ft) 50 m (164.0 ft) 100 m (328.0 ft)	**6ES5 703-3CB0**▪ **6ES5 703-3CC0**▪ **6ES5 703-3CD2**▪ **6ES5 703-3CF0**▪ **6ES5 703-3DB0**▪
To be ordered as a separate item: **IP 281 manual** German English French Italian	 **6ES5 998-0KP11** **6ES5 998-0KP21** **6ES5 998-0KP31** **6ES5 998-0KP51**	• Incremental position encoder for 24 V signals, power supply voltage 24 V, with one end open	
703 connecting cable Between IP 281 and • Siemens incremental position encoder 6FX2 001-2 ...		10 m (32.8 ft) 20 m (65.6 ft) 32 m (104.9 ft) 50 m (164.0 ft) 100 m (328.0 ft)	**6ES5 703-4CB0**▪ **6ES5 703-4CC0**▪ **6ES5 703-4CD2**▪ **6ES5 703-4CF0**▪ **6ES5 703-4DB0**▪
5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) 25 m (82.0 ft) 32 m (104.9 ft)	**6ES5 703-1BF0**▪ **6ES5 703-1CB0**▪ **6ES5 703-1CC0**▪ **6ES5 703-1CC5**▪ **6ES5 703-1CD2**▪	Cable opening bottom top	**0** **1**
• Incremental position encoder for 5 V signals, to RS 422, power supply voltage 5 V, with one end open		**Sub D connector** 15-pin (plug)	**6ES5 750-2AA21**
5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) 25 m (82.0 ft) 32 m (104.9 ft)	**6ES5 703-2BF0**▪ **6ES5 703-2CB0**▪ **6ES5 703-2CC0**▪ **6ES5 703-2CC5**▪ **6ES5 703-2CD2**▪		
Cable opening bottom top	**0** **1**		

WegerfassungsbaugruppeWF 705

Anwendungsbereich
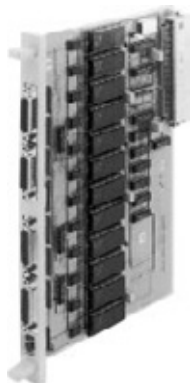
Die Wegerfassungs-
baugruppe WF 705 dient dem
Erfassen und Verarbeiten der
Signale von bis zu 12 syn-
chron-seriellen Absolutwert-
gebern (SSI).

Aufbau

An die Wegerfassungsbau-
gruppe WF 705 lassen sich
anschließen:
• 4 Absolutwertgeber, direkt
anschließbar

Erweiterung über Istwertver-
teiler, der die Werte von je 3
Achsen erfaßt;
bis zu 4 Istwertverteiler sind
an eine Wegerfassungsbau-
gruppe anschließbar. Der
Mischbetrieb (Direktanschluß
und Istwertverteiler) ist mög-
lich

Die Baugruppe benötigt 1 Ein-
bauplatz.

Arbeitsweise

Bild 4/41 zeigt den prinzipiel-
len Ablauf des Datenverkehrs
zwischen den Wegmeßgebern
und der Zentralbaugruppe
des Automatisierungsgerätes.

Für den Datenaustausch mit
der Zentralbaugruppe sind
Standard-Funktionsbausteine
für das Anwenderprogramm
lieferbar (siehe Katalogteil 7).
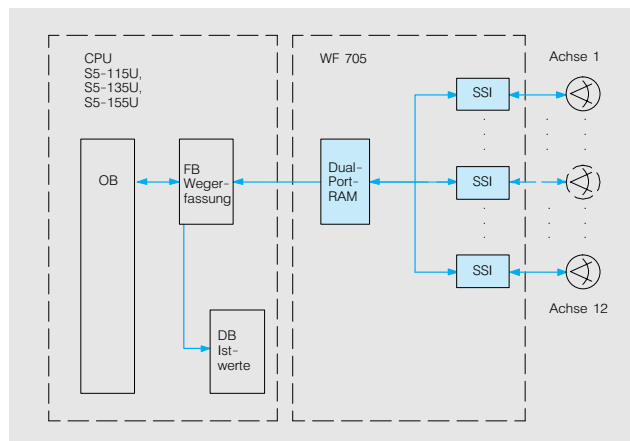
Bild 4/41 Funktionsbild des Datenverkehrs zwischen CPU und WF 705

Technische Daten

Anschließbare Geber		synchron-serielle Absolut-wertgeber (SSI)	
Wegerfassung absolut		25 Bit Datenlänge (SSI, Gray- oder Binär-Code)	
Verfahrbereich	max.	8192 Winkelschritte je Umdrehung, 4096 Umdrehungen	
Übertragungs-geschwindigkeit	max.	1 Mbit/s	
Stromaufnahme (bei 5 V)		0,5 A (ohne Geberversorgung)	
Versorgungsspannung für Wegmeßgeber		DC 24 V (extern)	
Versorgungsstrom für Wegmeßgeber bei 24 V	max.	0,3 A je Geber	
Leitungslänge (geschirmt) zum Geber			
• bei 125 kbit/s	max.	120 m	
• bei 1 Mbit/s	max.	25 m	
zum Istwertverteiler	max.	10 m	
Überwachungen		auf Kabelbruch und Kurzschluß	
Belegte Adressen		4 Byte	
Platzbedarf		1 Einbauplatz	
Gewicht	etwa	0,4 kg	

Weitere Angaben zu den Wegerfassungsbaugruppen finden Sie im Katalog AR 10.

Signalvorverarbeitende Baugruppen

Wegerfassungsbaugruppe WF 705 (Fortsetzung)

Bestelldaten	Bestell-Nr.	Preis		Bestell-Nr.	Preis
Wegerfassungsbaugruppe WF 705	**6FM1 705-3AA00**		**Steckleitung 790/590** mit offenem Leitungsende, zwischen WF 705 und		
Istwertverteiler	**6FM1 590-5AA00**		• SSI-Wegmeßgeber		
Standard-Software WF 705 zur Istwerterfassung auf Disketten 3$^1/_2$"			Standardlängen 2 m	**6FM1 790-1GA00**	
			5 m	**6FM1-790-1GB00**	
• MS-DOS Einfachlizenz	**6FM1 705-7UA30-1AA0**		10 m	**6FM1 790-1GC00**	
			18 m	**6FM1 790-1GD00**	
• 50er-Kopierlizenz	**6FM1 705-7UA30-1AA5**		Sonderlängen[1], max. 25 m bei 1 Mbit/s max. 120 m bei 125 Kbit/s	**6FM1 790-1GZ00**	
• weitere Kopierlizenzen	siehe Katalog AR 10				
zusätzlich zu bestellen ist die **Beschreibung WF 705**			• Istwertverteiler Standardlängen 2 m	**6FM1 790-1HA00**	
deutsch	**6ZB5 440-0AA01-0BA5**		5 m	**6FM1 790-1HB00**	
englisch	**6ZB5 440-0AA02-0BA5**		Sonderlängen[1], max. 10 m	**6FM1 790-1HZ00**	
			• zwischen Istwertverteiler und SSI-Wegmeßgeber		
			Standardlängen 2 m	**6FM1 590-2EA00**	
			5 m	**6FM1 590-2EB00**	
			10 m	**6FM1 590-2EC00**	
			18 m	**6FM1 590-2ED00**	
			25 m	**6FM1 590-2EE00**	
			35 m	**6FM1 590-2E F00**	
			50 m	**6FM1 590-2EG00**	
			60 m	**6FM1 590-2EH00**	
			Sonderlängen[1], max. 25 m bei 1 Mbit/s max. 120 m bei 125 Kbit/s	**6FM1 590-2EZ00**	
			1) Länge im Klartext angeben		

Wegerfassungsbaugruppe WF 706 C

Anwendungsbereich

Die Positionierungsbaugruppe WF 706 C dient dem Positionieren von Achsen über Abschaltpunkte mit polumschaltbaren Motoren oder (in Verbindung mit einem optionellen Analogmodul) zur Positionierung von Achsen mit Frequenzumrichtern, Servoantrieben oder Proportionalventil-Steuerungen. Außerdem eignet sich die WF 706 C ausgezeichnet zur Wegerfassung und zum Zählen.

Aufbau

Die WF 706 C ist in zwei Ausführungen lieferbar:
- Mit 3 Kanälen
- Mit 6 Kanälen

Zur Positionierung mit Frequenzumrichtern ist die WF 706 C modular mit 1 oder 2 Analogmodulen erweiterbar (3- bzw. 6-Kanal-version).

An die Baugruppe lassen sich folgende Geber anschließen:
- Inkrementalgeber
- Absolutwertgeber mit serieller Datenübertragung (SSI-Geber)
- Einfache 24-V-Signalgeber (BERO)

Durch die geringe Schnittstellenbreite von 8 Byte im Peripheriebereich können bis zu 16 Baugruppen in einem Automatisierungsgerät betrieben werden.

Die Baugruppe benötigt 1 Einbauplatz bei 3 Kanälen und 2 Einbauplätze bei 6 Kanälen.

Arbeitsweise

Je nach Variante können mit der WF 706 C drei oder sechs Achsen betrieben werden. Durch die einfache und offene Struktur stehen viele Funktionen zur Verfügung, z. B.
- Positionieren über Abschaltpunkte
- Wegerfassung mit schneller Schaltpunktausgabe
- Zähler mit schneller Vergleichswertausgabe
- Dosierzähler

In Verbindung mit Analogmodulen zusätzlich:
- Positionieren von Achsen mit Frequenzumrichtern oder Servoantrieben

- Positionieren von 3 Achsen mit Proportional-Ventilsteuerungen

Mit Hilfe der 4 Digitalausgänge mit einer Schaltleistung von 0,5 A bei 24 V lassen sich alle notwendigen Schütze direkt ansteuern.

Durch die ausschließliche Verwendung von Hardware-Logik und den Einsatz eines speziell für diese Aufgabe entwickelten integrierten Bausteins schalten die Ausgänge in weniger als 50 ms.

Dadurch ist die WF 706 auch als Universalzähler mit maximal 6 Kanälen einsetzbar.

Spezielle Funktionen unterstützen den Zählvorgang. So kann z. B. mit der Tor-Funktion ein Zählvorgang durch ein externes Signal auf einen schnellen Digitaleingang oder alternativ durch einen internen Zeittakt gesteuert werden.

Ein Analogmodul enthält 4 Analogausgänge, von denen drei direkt Kanälen zugeordnet sind. Sie können zur Positionierung von Antrieben (wahlweise ±10 V-Schnittstelle oder 0 ... 10 V-Schnittstelle mit Richtungsbit) werden.
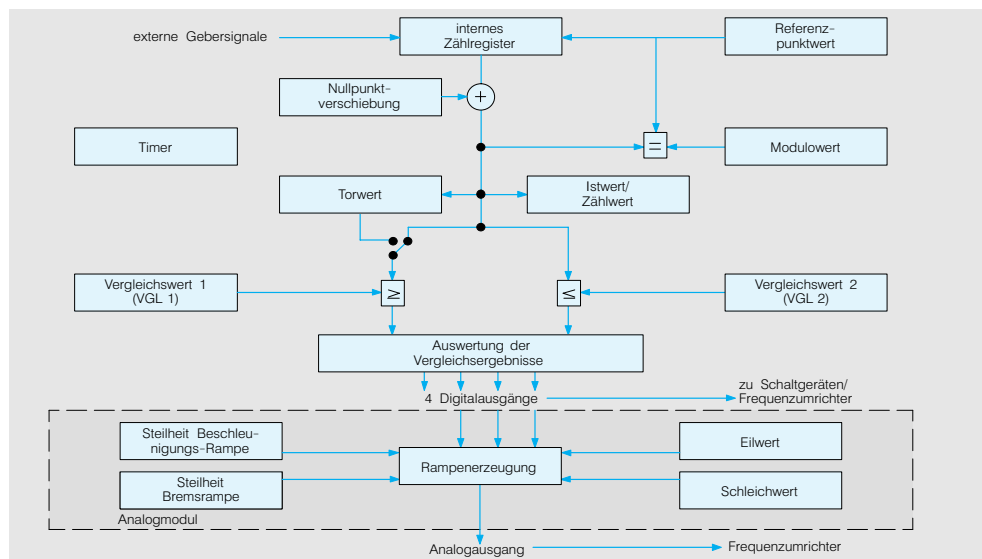
Bild 4/42 Struktur eines Kanals mit Analogmodul

Signalvorverarbeitende Baugruppen

Wegerfassungsbaugruppe WF 706 C (Fortsetzung)

Gesteuerte Positonierung mit IP 240 oder WF 706 C

		IP 240	WF 706
Anzahl der Achsen	max.	2	3/6
Anschließbare Wegmeßger		• inkremental 5 V • inkremental 24 V	• inkremental 5 V • SSI-Absolut- Wertgeber
Geberfrequenz bei 5 V inkremental bei 24 V inkremental Übertragungsrate (SSI)	max. max. max.	500 kHz 70 kHz —	500 kHz — 1 Mbit/s
Verfahrbereich		±9 999 999 Inkremente	16 777 215 Inkremente
Binäreingänge je Achse		Referenznocken (Vorkontakt)	Referenznocken (Vorkontakt)
Binärausgänge je Achse,		2 für • Eilgang • Schleichgang- oder • rechts • links	4 für • Eilgang • Schleichgang- oder • rechts • links
Speicherbare Positionen		254 je Achse	2 je Achse
Reaktionszeit		typ. 2 ms	< 50 µs
Belegte Adressen		16 Byte	8 Byte
Sonderfunktionen		• Längenmessung • externe Synchronisation • Zählfunktionen • Rundachse	• Längenmessung • externe Synchronisation • Zählfunktionen
Besondere Merkmale		• selbständige Berechnung der Schaltpunkte	• schneller Datenaus-tausch mit der CPU • kurze Reaktions- zeiten • Analogmodul für Frequenzumrichter (optional)

Technische Daten

Anschließbare Geber		inkrementale Geber synchr.-serielle Absolutwert- geber (SSI) 24-V-Signalgeber (BERO)	Verfahrbereich	max.	8192 Winkelschritte je Umdrehung 2048 Umdrehungen
			Potentialtrennung		nein
Wegerfassung inkremental 5-V-Eingänge (nach RS 422)		symmetrische Signale A, $\overline{A}$; B, $\overline{B}$; Z, $\overline{Z}$. Vierfachauswertung erfolgt immer	Übertragungsrate		62,5 kbit/s bis 1 Mbit/s
			Leitungslänge (geschirmt) bei 125 kbit/s bei 1 Mbit/s	max. max.	120 m 25 m
Verfahrbereich	max.	16 777 215 Inkremente	**Zählen**		
Potentialtrennung		nein	24-V-Eingänge		siehe Binäreingänge
Zählfrequenz	max.	500 kHz	Zählfrequenz	max.	200 kHz
Leitungslänge (geschirmt)	max.	35 m	Zählbereich	max.	16 777 215
Wegerfassung absolut		13 Bit, 21 Bit und 25 Bit Daten- länge (SSI, Gray- oder Binär-Code) 24 Bit werden ausgewertet	**Binäreingänge** Eingangsspannung Eingangsstrom		2 je Kanal 24 V 5 mA (bei 24 V)
			Binärausgänge Ausgangsspannung Ausgangsstrom	max.	4 je Kanal 24 V 0,5 A (kurzschlußfest)

Wegerfassungsbaugruppe WF 706 C (Fortsetzung)

Technische Daten (Fortsetzung)

Analogausgänge (optional)		Stromaufnahme (bei 5 V)	
• pro Modul		• 3-Kanal-Ausführung	0,75 A (ohne Geberversorgung)
angesteuert durch	4	• 6-Kanal-Ausführung	1,5 A (ohne Geberversorgung)
– WF 706 C	3	Versorgungsstrom für Weg-	
– SIMATIC S5	1	meßgeber bei	
• Ausgangsspannung	DC – 10 V ... +10 V	5 V und bei 24 V max.	0,3 A je Geber
Ausgangsstrom	– 5 mA ... + 5 mV	Belegte Adressen	8 Byte
Reaktionszeit	< 50 µs bei ohmscher Last	Platzbedarf	1 Einbauplatz
Überwachungen	auf Kabelbruch und Kurzschluß	• 3-Kanal-Ausführung	1 x 1$\frac{1}{3}$ SEP
Versorgungsspannungen		• 6-Kanal-Ausführung	2 x 1$\frac{1}{3}$ SEP
• Nennwert	DC 24 V	Gewicht	
• Welligkeit U_{ss}	3 V	• 3-Kanal-Ausführung etwa	0,4 kg
• zulässiger Bereich (Welligkeit eingeschlossen)	20 ... 30 V	• 6-Kanal-Ausführung etwa	0,45 kg

Bestelldaten	Bestell-Nr.	Preis		Bestell-Nr.	Preis
Positionierbaugruppe WF 706 C			**Steckleitung 790** zwischen WF 706 und		
mit 3 Kanälen	**6FM1 706-3AA20**		• Heidenhain-Wegmeßgeber ROD 320		
mit 6 Kanälen	**6FM1 706-3AB20**		Standardlängen 5 m	**6FM1 790-1BB00**	
Analogmodul	**6FM1 706-4AA00**		10 m	**6FM1 790-1BC00**	
			18 m	**6FM1 790-1BD00**	
zusätzlich zu bestellen ist			Sonderlängen[1]: max. 35 m	**6FM1 790-1BZ00**	
Beschreibung WF 706 mit Beispielprogramm-Diskette	**6ZB5 440-0KR01-0BA7**		• Siemens-Wegmeßgeber 6FC9 320 oder 6FX2 001-2		
			Standardlängen 2 m	**6FM1 790-1CA00**	
			5 m	**6FM1 790-1CB00**	
			10 m	**6FM1 790-1CC00**	
			18 m	**6FM1 790-1CD00**	
			Sonderlängen[1]: max. 35 m	**6FM1 790-1 CZ00**	
			• SSI-Wegmeßgeber mit offenem Leitungsende		
			Standardlängen 2 m	**6FM1 790-1FA00**	
			5 m	**6FM1 790-1FB00**	
			10 m	**6FM1 790-1FC00**	
			18 m	**6FM1 790-1FD00**	
			Sonderlängen[1]: max. 25 m bei 1 Mbit/s max. 120 m bei 125 Kbit/s	**6FM1 790-1 FZ00**	
			1) Länge im Klartext angeben.		

4

SIMATIC S5-135U, S5-155U/H

Signalvorverarbeitende Baugruppen

Anwendungsbereich

Das Nockensteuerwerk WF 707 dient der Ausgabe von wegabhängigen Schaltfunktionen bei Antrieben mit Linear- und Rundachsen. Das Einsatzgebiet liegt hauptsächlich bei kleinen und schnellaufenden Maschinen.

Aufbau

Die Baugruppe verfügt über 16 Nockenbahnen, auf denen insgesamt 32 Nocken verteilt werden können.

An die Baugruppe lassen sich folgende Geber anschließen:
- Inkrementalgeber
- Absolutwertgeber mit serieller Datenübertragung (SSI-Geber)
- Einfache 24-V-Signalgeber (BERO)

Durch die geringe Schnittstellenbreite von 8 Byte im Peripheriebereich können bis zu 16 Baugruppen in einem Automatisierungsgerät betrieben werden.

Die Baugruppe benötigt 1 Einbauplatz.

Arbeitsweise

32 Nocken, die beliebig auf 16 Nockenbahnen verteilt werden können, schalten genauer als 1 Grad bei 2400 Takten pro Minute. Das entspricht einer Reaktionszeit kleiner als 60 ms. Bei Verlängerung der Reaktionszeit auf ca. 120 ms stehen sogar 64 Nocken zur Verfügung.

Soll mit linearen Bewegungen gearbeitet werden, können jeweils 32 Nocken beliebig aufgeteilt werden für ein Nockenprogramm „Vorwärts" und ein Nockenprogramm „Rückwärts". Die Umschaltung zwischen den beiden Programmen erfolgt entweder mit Hilfe der automatischen Richtungserkennung oder gesteuert durch das Automatisierungsgerät.

Alle Nocken können wahlweise definiert werden als
- Weg-Weg-Nocken oder
- Weg-Zeit-Nocken.

Zusätzlich stehen zur Verfügung:
- Ein Zählnocken
- Ein Bremsnocken.

Durch die geschwindigkeitsabhängige, dynamische Verschiebung gleicht jeder Nocken automatisch die Totzeit des angeschlossenen Stellgliedes aus.

Jeder Nockendatensatz ist während des Betriebes über das Automatisierungsgerät veränderbar, so daß auch an der laufenden Maschine optimiert werden kann. Ein Rücklesen der Istwerte bzw. der aktuellen Nockendaten ist möglich.

Für jede Nockenbahn steht ein Digitalausgang 24 V/0,5 A auf der Baugruppe direkt zur Verfügung. Damit lassen sich die zu steuernden Aggregate direkt oder über Hilfsschütze ansteuern. Nicht benötigte Digitalausgänge können vom Automatisierungsgerät angesteuert werden.

Die Überwachung der
- Gebersignale,
- Synchronisation,
- Digitalausgänge

erhöht die Betriebssicherheit bzw. führt im Fehlerfall zu definierten Betriebszuständen und Meldungen.

Der Digitalausgang „OK-Meldung" signalisiert den fehlerfreien Betrieb.

Die Synchronisation des Istwertzählers mit dem inkrementalen Geber ist möglich durch
- Geber-Nullmarke,
- externes Synchronisationssignal,
- externes Synchronisationssignal und Geber-Nullmarke (UND-Verknüpfung) und
- Synchronisationsbit vom Automatisierungsgerät.

Nockensteuerwerk WF 707 (Fortsetzung)

Gesteuerte Positonierung mit IP 241 und WF 707

	IP 241	WF 707
Anzahl der Kanäle	2	1
Weggebereingänge	mit Geberan-paßmodul: Geber mit 3-Excess-Gray-Code, BCD-Code, Dual-Code; Analogwertgeber	5-V-Inkremental-geber (RS 422) 24-V-Inkremental-geber SSI-Absolutwertgeber
maximale Zählfrequenz	50 kHz für digitale Werte; 200 kHz für absolute, serielle Meß-werteingabe	200 kHz bei 5 V, 100 kHz bei 24 V, 1 Mbit/s bei SSI-Geber
Nockensteuerwerk	pro Kanal 16 Spuren mit je 1 Nocke	16 Spuren mit 32/64 Nocken
Digitalausgänge pro Kanal		16, DC 24 V
Geberversorgung von der Baugruppe	ja	ja

Technische Daten

Für rotatorische Achse

Nocken pro Nockenprogramm	32
Nocken wirksam	vorwärts/rückwärts
Zykluszeit pro Nockenprogramm	57,6 µs
Nocken pro Nockenprogramm	64
Nocken wirksam	vorwärts/rückwärts
Zykluszeit pro Nockenprogramm	115,2 ms

Für lineare Achse

Nocken pro	
• Vorwärtsprogramm	32
• Rückwärtsprogramm	32
Zykluszeit pro Nockenprogramm	57,6 µs

Nocken

Nockenarten	• Weg-Weg-Nocken • Weg-Zeit-Nocken • Zähl-Nocken • Brems-Nocken
Nockenbahnen max.	16
Taktzahl/min max.	2400

Programmierung

Weg-Weg-Nocken	Start-/Endposition in Inkrementen
Weg-Zeit-Nocken	Startposition in Inkrementen, Zeit als Faktor zur Zykluszeit

anschließbare Geber

	Inkrementalgeber Synchr.-serieller Absolutwert-geber (SSI-Absolutwertgeber) 24-V-Signalgeber (BERO)
erforderlicher Eingangsstrom der Gebersignale	10 mA
Nutzung des Gebersignals für weitere Baugruppen max.	5

Wegerfassung, inkrementell

5 V-Eingänge (nach RS 422)	symmetrische Signale A, $\overline{A}$; B, $\overline{B}$; z, $\overline{Zt}$. immer Vierfachauswertung
Verfahrbereich max.	65 536 Inkremente
Potentialtrennung	nein
Zählfrequenz max.	500 kHz

Signalvorverarbeitende Baugruppen

Nockensteuerwerk WF 707 (Fortsetzung)

Technische Daten (Fortsetzung)

Wegerfassung, absolut		SSI mit 13 oder 25 Bit Datenlänge (Gray- oder Dual-Code) 16 Bit werden ausgewertet	
Verfahrbereich	max.	65 536 Schritte	
Potentialtrennung		nein	
Übertragungsrate	max.	125 Kbit/s bis 1 Mbit/s	
Digitaleingänge		3	
Eingangsspannung		DC 24 V	
Eingangsstrom		5 mA (bei 24 V)	
Potentialtrennung		nein	
Eingangsfrequenz	max.	100 kHz	
Digitalausgänge		16	
Ausgangsspannung		DC 24 V	
Ausgangsstrom	max.	0,5 A kurzschlußfest	
Potentialtrennung		nein	

Überwachungen und Statusmeldungen	• Geber-Leitungsbruch • Geberfehler • Kurzschluß/Überlastung der Digitalausgänge • Synchronisation • Istwert • Nockenbahnstatus • Bewegungsrichtung
Versorgungsspannungen U_p	
• Nennwert	DC 24 V
• Welligkeit U_{ss}	3 V
• zulässiger Bereich (Welligkeit eingeschlossen)	20 bis 30 V
Versorgungsspannung	DC 5 V
Stromaufnahme bei DC 5 V ohne Geber	0,25 A
Versorgungsstrom für Weggeber bei DC 5 V und DC 24 V max.	0,3 A
Platzbedarf	1 Einbauplatz
Gewicht etwa	0,4 kg

Bestelldaten

	Bestell-Nr.	Preis		Bestell-Nr.	Preis
Nockensteuerwerk WF 707	**6FM1 707-3AA10**		**Wegmeßgeber**		
Steckleitung 790			• für Anbau		
zwischen WF 707 und			1000 Pulse/Umdrehung	**6FX2 001-2CB00**	
• WF 707 zum Durchschleifen der Wegistwerte			2000 Pulse/Umdrehung	**6FX2 001-2CC00**	
Längen 0,5 m	**6FM1 790-1JS00**		2500 Pulse/Umdrehung	**6FX2 001-2CC50**	
2,0 m	**6FM1 790-1JA00**		• für Einbau in Motoren der Baureihe 1 FT		
• Heidenhain-Wegmeßgeber ROD 320	siehe WF 706C (siehe Seite 4/85)		• weitere Wegmeßgeber	siehe Katalog SD 12 siehe Katalog ST 71	
• Siemens-Wegmeßgeber 6FC9 320 oder 6FX2 001-2	siehe WF 706C (siehe Seite 4/85)		zusätzlich zu bestellen ist die		
• SSI-Wegmeßgeber mit offenem Leitungsende	siehe WF 706C (siehe Seite 4/85)		**Beschreibung WF 707** mit Beispielprogramm-Diskette und EMV-Richtlinien	**6ZB5 440-0ST01-0BA3**	

Weitere Angaben zum Nockensteuerwerk finden Sie im Katalog AR 10.

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C

Anwendungsbereich
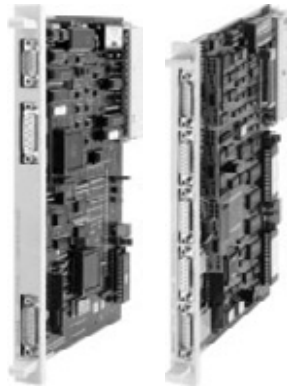
Die Baugruppen WF 721, WF 723 A, WF 723 B und WF 723 C bilden die Positionierfamilie WF 721/WF 723. Diese Baugruppen decken das Positionierspektrum ab bezüglich geregeltem Positionieren von drehzahlgeregelten Antrieben für sowohl Einachs- als auch Mehrachsanwendungen.

Durch sie lassen sich die elektrischen und hydraulischen Achsen von Maschinen und Anlagen einfach und wirtschaftlich automatisieren, z. B.:

- Transferstraßen
- Fördereinrichtungen
- Montagelinien
- Beschickungseinrichtungen
- Pressen
- Holzbearbeitungsmaschinen
- Verpackungsmaschinen
- Handhabungsgeräte, Portale
- Sondermaschinen
- Rundtaktmaschinen

WF 721/WF 723 A

Die Positionierbaugruppe WF 721 ist für typische Einachs-Anwendungen geeignet, während die WF 723 A auch für die Anwendung von mehreren unabhängigen Achsen ausgelegt ist. Die Positionierbaugruppen WF 721/WF 723 A sind bezüglich der Funktionalität und der Datenformate der WF-Parameter identisch. Das heißt, ein Maschinendatensatz einer WF 723 A-Achse kann auch von einer WF 721-Achse interpretiert werden und umgekehrt. Die WF 721 besitzt darüber hinaus im Vergleich zu einer WF 723 A einen doppelt so schnellen Meßkreistakt. Sie ist deshalb besonders für dynamische Einachs-Positionieraufgaben geeignet.

WF 723 B

Die Positionierbaugruppe WF 723 B setzt auf der Funktionalität der WF 721/WF 723 A auf und ergänzt das Positionierspektrum in der SIMATIC S5 hinsichtlich NC-Funktionalität. Die Positionierbaugruppe WF 723 B beinhaltet Bearbeitungsfunktionen wie Linear- und Zirkularinterpolation, Spindelfunktionen, Parameterrechnung und Standard-Bohrzyklen. Die Baugruppe WF 723 B läßt sich für drei Vorschubachsen, zwei Vorschubachsen und eine Spindel oder für drei Vorschubachsen und eine externe Spindel verwenden.

WF 723 C

Neben Einachs- und NC-Anwendungen gibt es weitere Positionieraufgaben, wobei mehrere Achsen in einem Verfahrprogramm koordiniert und damit verkettet zu verfahren sind. Die Positionierbaugruppe WF 723 C vervollständigt mit dieser Funktionalität die Positionierfamilie WF 721/WF 723. Weitere wichtige Anforderungen können mit der WF 723 C erfüllt werden, z. B. schnelles und exaktes Positionieren von Walzenvorschüben und Gleichlauf von maximal 3 Achsen.

Aufbau
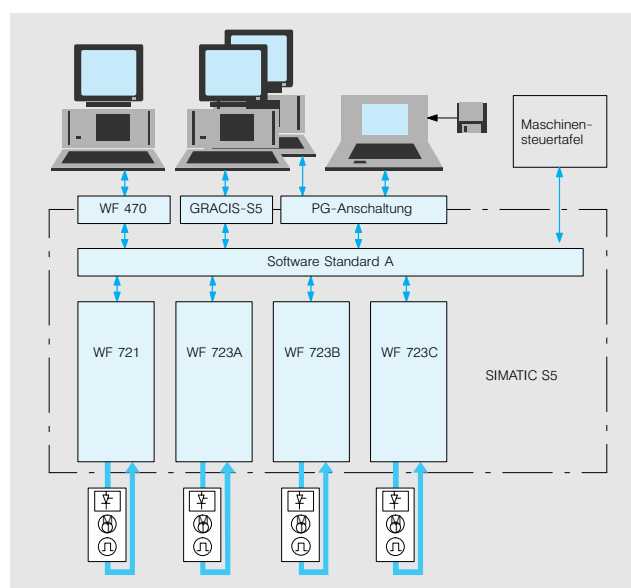
Bild 4/43 Struktur des Aufbaus zur Positionierung und Lageregelung

Durch die Standardisierung der Nahtstellen lassen sich Peripherie, Hardware- und Software-Module baugruppenübergreifend einsetzen. Dies spart Kosten bei der Projektierung, der Inbetriebnahme und dem Service.

An die Baugruppen lassen sich folgende Geber anschließen:

- Inkrementalgeber
- Absolutwertgeber mit serieller Datenübertragung (SSI)

Durch die geringe Schnittstellenbreite von 32 Byte im Peripheriebereich lassen sich bis zu 28 Baugruppen, d. h. 84 Achsen in einem Automatisierungsgerät betreiben.

Die Baugruppen benötigen jeweils 1 Einbauplatz. Ein Betrieb ohne Lüfter ist möglich.

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C (Fortsetzung)

Arbeitsweise

Die Baugruppen ermöglichen schnelles und genaues Positionieren beim Einrichten, Zustellen, Handhaben und Transportieren sowie eine hohe Oberflächengüte bei einfachen Bearbeitungsaufgaben. Folgende Betriebsarten sind möglich:

Betriebsarten	WF 721	WF 723 A	WF 723 B	WF 723 C
Einrichten	x	x	x	x
Referenzpunktfahren	x	x	x	x
Handbetrieb (MDI)	x	x	x	x
Steuern	x	x	x	x
Automatik	x	x	x	x
Automatik-Einzelschritt	x	x	x	x
Automatik-Einzelsatz	—	—	x	x
Nachführbetrieb	x	x	x	x
Slave	—	—	—	x

Weitere Merkmale
- Vorschubkorrektur (Override)
- Rundachse
- Beschleunigungsorverride
- Werkzeugkorrektur
- Schnelle Ein-/Ausgänge

Mit Maschinendaten wird die Positionierbaugruppe an die spezielle Bearbeitungstechnologie angepaßt.

Geregelte Positionierung mit IP 246, WF 721 oder WF 723 A

	IP 246	WF 721	WF 723 A
Anzahl der Achsen max.	2	1	3
Anschließbare Wegmeßgeber	• inkremental 5 V • inkremental 24 V • Absolutwertgeber parallel	• inkremental 5 V • SSI-Absolutwertgeber	• inkremental 5 V • SSI-Absolutwertgeber
Grundauflösung	0,1 ... 99,9 µm	1, 10, 100 µm	1, 10, 100 µm
Geberfrequenz • absolut • bei 5 V inkremental max. • bei 24 V inkremental max.	— 500 kHz 50 kHz	— 200 kHz —	1 Mbit/s 200 kHz —
Verfahrbereich Verfahrgeschw. max. Beschleunigung	± 40 m 65 000 mm/min 9999 mm/s^2	± 1000 m 500 000 mm/min 99999 mm/s^2	± 1000 m 500 000 mm/min 99999 mm/s^2
Programmspeicher	10000 Zeichen (etwa 500 Sätze) in bis zu 255 Programmen	bis zu 250 Sätze in bis zu 200 Programmen	bis zu 750 Sätze in bis zu 200 Programmen
Ausgabe M-Funktionen	während des gesamten Verfahrsatzes	zeit- oder quittungsgesteuert vor, während oder nach Verfahrsatz, istwertbezogen	
Verweilzeiten	100-ms-Schritte	4-ms-Zeit-raster	4-ms-Zeit-raster
Sonderfunktionen • Ruckbegrenzung • schnelle Eingänge für Prozeßsignal	— 4 Binäreingänge • Start/Stopp von extern	ja 6/6 Binäreingänge für • externen Satzwechsel • Start von extern • externen Satzwechsel mit fliegendem Istwert-Setzen • fliegendes Messen	
• Simulation • Satz-Vorlauf/-Rücklauf • Satz Ausblenden	— — —	ja ja ja	
PG-Anschluß	ja	für COM 723, PC-Steuern zentral über SIMATIC S5-PG-Schnittstelle	
Software für • Erstellen von Maschinendaten und Verfahrprogramm • Unterstützung bei Test und Inbetriebnahme	COM 246 COM 246 und Standard-Funktionsbausteine	COM 723 und Standard B-470, Standard-B-OP25 Standard B-GRACIS Standard A und Standard B-470, Standard-B-OP25 Standard B-GRACIS PC-Steuern	

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C (Fortsetzung)

Programmierung

Der modulare Aufbau der Standard-Software erleichtert das Erstellen maschinenspezifischer STEP 5-Programme. Der Speicher der

SIMATIC S5 wird dabei nicht belastet. Die Programme lassen sich auch im Simulationsbetrieb testen, ohne die Maschine in Betrieb zu nehmen.

Die Kommunikation zwischen der SIMATIC S5 und den Positionierbaugruppen übernimmt die Software Standard A.

Speicherkapazität	WF 721	WF 723 A	WF 723 B	WF 723 C
Anzahl Programme	200	200/Achse	200	200/Achse
Anzahl/ Sätze/Programme	100	100	200	200
max. Gesamt- anzahl Sätze	250	750	1000	1000

Bedienung über	WF 721	WF 723 A	WF 723 B	WF 723 C
COM 723	x	x	x	x
PC-Steuern	x	x	x	x
Standard B-470	x	x	—	—
Standard B-GRACIS	x	x	x	—
Standard B-OP25	x	x	in Vorbereitung	in Vorbereitung

COM 723

Komfortabel bei Programmierung und Projektierung und unterstützend bei Inbetriebnahme und Service. Das Software-Paket COM 723 in Verbindung mit SYSDOK 723 hilft. Einfach und schnell lassen sich mit COM 723 Datensätze erstellen und archivieren, die damit im Inbetriebnahme- und Servicefall schnell und unabhängig verfügbar sind.

COM 723 bietet:
• Einfache Handhabung durch bedienergeführte Window-Technik auf Basis Windows 3.1
• Einfache, kurze und flexible Projektierung und Inbetriebnahme durch Plausibilitätskontrollen und Offline-Projektierung im Büro
• Kurze Projektierungszeiten durch das Duplizieren von Anlagendateien und das gemeinsame Datenformat mit Standard B-GRACIS

• Einfacher und schneller Baugruppentausch durch Einstellung und Parametrierung der Baugruppe mittels Job-listen
• Servicefreundlichkeit durch das schnelle Vergleichen von Dateninhalten
• Gut lesbare Datensätze durch mögliche anwenderspezifische Erläuterungen
• Schneller Zugriff auf unterstützende Informationen durch die systemintegrierte, papierlose Dokumentation SYSDOK 723

SYSDOK 723

Die Systemintegrierte Dokumentation SYSDOK 723 beinhaltet die papierlose Form der jeweiligen Funktionsbeschreibung bzw. Programmieranleitung.

SYSDOK 723 basiert auf dem Standard-Hilfesystem von MS-Windows und läuft in einem eigenen Fenster neben COM 723. Es bietet neben der kontextbezogenen Hilfe folgende Funktionen:

• Einblendung und Sprünge zu verwandten Themen
• Blättern
• schrittweises Zurückverfolgen des Informationspfades
• elektronische Lesezeichen
• elektronische Notizzettel
• Suchen mit zweistufigem Index

PC-Steuern

Mit PC-Steuern steht zu Inbetriebnahme- und Testzwecken ein hilfreiches Werkzeug zur Verfügung. Erste Verfahrergebnisse der Achsen sind ohne die später hinzukommende Maschinensteuertafel möglich.

Im Servicefall kann der Anwender zum Lokalisieren eines Fehlers die Achsen direkt verfahren oder mit Statusanzeige einen Achsfehler im Klartext auslesen.

Vor unbefugten Eingriffen läßt sich das Software-Paket PC-Steuern durch die Funktion Schlüsselschalter schützen. Die Bedienung von PC-Steuern erfolgt unter Windows ab Version 3.1.

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C (Fortsetzung)

Programmierung
(Forsetzung)
Standard Bedienoberfläche

Zur Bedienung und Diagnose der Positionierbaugruppe WF 721/723A stehen Standard-Masken für das Bildschirmsystem WF 470 und das Operator Panel OP 25 zur Verfügung.

Die Kopplung zwischen SIMATIC S5 und dem Visualisierungsgerät erfolgt mit den Software-Paketen Standard B-470 bzw. Standard B-OP 25. Diese bieten standardisierte Masken und ermöglichen zusammen mit der Menütechnik eine komfortable Bedienung. Von der Eingabe der Maschinendaten bei der Inbetriebnahme

über die Programmierung der Verfahrbewegung bis zur Fehlerdiagnose wird der Anwender mit Masken geführt.

Außerdem besteht die Möglichkeit, die Maschine an den jeweiligen Prozeß durch frei projektierbare Masken anzupassen.

Standard B-GRACIS

Mit der Bedienoberfläche Standard B-GRACIS können die Bedienung und Diagnose sowie die Datenverwaltung und Datenversorgung der Positionierbaugruppen WF 721/723A und WF 723 B realisiert werden. Standard B-GRACIS ist sowohl unter GRACIS ULB (unterer Leistungsbereich) als auch unter GRACIS OLB (oberer Leistungsbereich) ablauffähig.
Neben Standard-Masken bietet das Visualisierungssystem GRACIS die Möglichkeit, die Maschine an den jeweiligen-Prozeß durch frei projektierbare Masken anzupassen.
Die einfache Bedienerführung erfolgt über Menütechnik und Softkey-Leiste.

Standard B-GRACIS bietet:
• Einfache Handhabung durch bedienergeführte Menütechnik und Hinweise in der Statuszeile
• Zeit- und Kostenersparnis in Verbindung mit der SIMATIC S5-CPU durch Standard B-GRACIS-Lösung auf Basis GRAPI (Gracis Applikations Interface)
• Schnelle, kurze Fehlerlokalisierung und Inbetriebnahme durch eindeutige Schnittstellen und Meldungen im Klartext
• Bedienerfreundliche Bedienung durch einmalige Zuordnung der Einheit in der Projektierungsphase
• Einfaches Ändern/Editieren von Datensätzen durch Plausibilitätskontrollen
• Standardbilder, die sich um spezielle Anlagenbilder erweitern lassen

Bei Standard B-GRACIS OLB stehen für die Verwaltung, Versorgung und Projektierung eigene Menüzweige zur Verfügung. Dadurch kann man komfortabel Datensätze kopieren und verliert bei komplexen Anlagen nie den Überblick.
Standard B-GRACIS OLB bietet zusätzlich:
• Hohe Verfügbarkeit im Falle eines Baugruppendefekts durch zentrale Datenarchivierung
• Kurze Projektierungszeiten durch das Duplizieren der Anlagendateien und das gemeinsame Datenformat mit COM 723
• Sowohl lokalen als auch vernetzten Einsatz (PROFIBUS oder Industrial Ethernet)
• Effektive Projektierung durch offene Struktur mit Import-Export-Funktionen
• Gut lesbare Datensätze durch mögliche anwenderspezifische Erläuterungen

Technische Daten

	WF 721	WF 723 A	WF 723 B	WF 723 C
Meßsysteme	inkrementelle Geber SSI-Absolutwertgeber	inkrementelle Geber SSI-Absolutwertgeber	inkrementelle Geber SSI-Absolutwertgeber	inkrementelle Geber SSI-Absolutwertgeber
Anzahl Kanäle	1	3 unabhängige Achsen	3 Vorschubachsen oder 2 Vorschubachsen/ 1 Spindel oder 3 Vorschubachsen/ 1 externe Spindel	bis zu 3 unabhängig kombinierbare Achsen 2 Walzenvorschub/ 1 Achse 1 Walzenvorschub 2 Achsen
Verfahrgeschwindigkeit				
• von mm/min	0,01	0,01	0,05	0,01
• bis mm/min	500 000	500 000	500 000	500 000
Beschleunigung				
• von mm/s^2			1	1
• bis mm/s^2	99 999	99 999	99 999	99 999
Ruckbegrenzung				
• von mm/s^2	1	1	—	1 (in Vorbereitung)
• bis mm/s^2	999 999	999 999	—	999 999 (in Vorbereitung)
Verfahrbereich in m	± 999.999 999	± 999.999 999	± 999.999 999	± 999.999 999
max. Spindeldrehzahl (1/min)	—	—	12 000	—

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C (Fortsetzung)

Technische Daten (Fortsetzung)

	WF 721	WF 723 A	WF 723 B	WF 723 C
Kenngrößen				
• 1 Referenzpunkt je Achse	x	x	x	x
• 2 Software-Endschalter	x	x	x	x
• Rundachse rangierbar	x	x	x	x
• Umkehrlose-Kompensation	x	x	x	x
• TEACH IN	x	x	x	x
• Istwertbewertungsfaktor zur Anpassung von Getriebeübersetzungen	x	x	x	x
• 6 Nullpunktverschiebungen	—	—	x	x
• Linear-/Zirkularinterpolation	—/—	—/—	3D/2D	2D/—
• Schraubenlinien-/F-Wort-Interpolation	—/—	—/—	x/x	—/—
• Standard-Bohrzyklen/Parameter	—/—	—/—	x/x	—/—
• orientierter Spindelhalt	—	—	x	—
• Gleichlauf von 3 Achsen	—	—	—	x
• Verfahrprogramme DIN 66025	x	x	x	x
Walzenvorschub	—	—	—	x[1]
Technologische Korrekturen				
• Vorschub/Beschleunigung (Override)	x/x	x/x	x/—	x/x
• Driftkompensation	x	x	x	x
• Werkzeugkorrektur	Länge, Verschleiß	Länge, Verschleiß	Länge, Radius, Verschleiß	Länge, Verschleiß
Eingänge für Prozeßsignale				
• fliegendes Messen/Istwertsetzen	x/x	x/x	x/—	x/x
• Start UND/ODER verknüpft	x	x	x	x
• externer Satzwechsel	x	x	—	x
• Referenzpunktverfahren ohne BERO/-setzen	x/x	x/x	x/—	x/x
• Istwert sperren/ Einlesefreigabe extern	—/—	—/—	—/—	x/x
Ausgänge für Prozeßsignale				
• Änderung von M-Funktionen	x	x	x	x
• Position erreicht und Halt	x	x	x	x
• Achse fährt vorwärts/rückwärts	x	x	x	x
• Startfreigabe	x	x	x	x
• Konstantfahrt/Beschleunigen, Verzögern	—/—	—/—	—/—	x/x
Schaltfunktionen (M-Funktionen, BCD-Ausgabe + 2 Dekaden)				
• quittungs-/zeitgesteuert	x/x	x/x	x/x	x/x
• wegabhängig	x	x	—	—
Überwachungen				
• Systemprogrammspeicher	x	x	x	x
• Busnahtstelle	x	x	x	x
• Ein-/Ausgabe der Daten	x	x	x	x
• Schleppabstand	x	x	x	x
• Spannungswerte 5 V, 15 V, 24 V	x	x	x	x
• Meßkreis	x	x	x	x
• Gleichlauftoleranz	—	—	—	—
Versorgungsspannungen				
• Baugruppe (von SIMATIC S5-Bus) Spannung/Stromaufnahme	DC 5 V/ 1,0 A	DC 5 V/ 1,3 A	DC 5 V/ 1,4 A	DC 5 V/ 1,4 A
• Geber Spannung intern/extern Stromaufnahme bei DC 5 V/ DC 24 V je Geber	DC 5 V/DC 24 V 0,3 A	DC 5 V/DC 24 V 0,3 A	DC 5 V/DC 24 V 0,3 A	DC 5 V/DC 24 V 0,3 A
• Eingänge (pro Kanal) Spannung/Stromaufnahme	DC 24 V/5 mA	DC 24 V/5 mA	DC 24 V/5 mA	DC 24 V/5 mA
• Ausgänge (pro Kanal) Spannung/Strom max.	DC 24 V/500 mA	DC 24 V/500 mA	DC 24 V/500 mA	DC 24 V/500 mA
Signalspannungs-Sollwert				
• Spannung/Strom bei ± 10 V	± 10 V/2 mA	± 10 V/2 mA	± 10 V/2 mA	± 10 V/2 mA

4

Positionierbaugruppen WF 721/WF 723 A/WF 723 B/WF 723 C (Fortsetzung)

Technische Daten (Fortsetzung)

	WF 721	WF 723 A	WF 723 B	WF 723 C
Ein- und Ausgänge				
• parametrierbare Aus-/Eingänge	6/6	6/6	6/6	6/6
• Reglerfreigabe/Reglerrückmeldung	1/1	3/3	3/3	3/3
SIMATIC S5-115U, -135U, -155U				
• Platzbedarf	1 x 1$^1/_3$ SEP	1 x 1$^1/_3$ SEP	1 x 1$^1/_3$ SEP	1 x 1$^1/_3$ SEP
• belegter Adreßraum	32 Byte	32 Byte	32 Byte	32 Byte
• Anzahl Baugruppen, max.	28	28	28	28
• Betrieb ohne Lüfter	möglich	möglich	möglich	möglich
Gewicht etwa	0,6 kg	0,7 kg	0,7 kg	0,7 kg

1) Funktionen Walzenvorschub: Konstantfahrt, Ruck am Beschleunigungsanfang, Beschleunigungsknickpunkte, Istwertnullen bei Start oder externer Einlesefreigabe, Überspeichern des Geschwindigkeitswertes, Druckmarkensteuerung

Bestelldaten	Bestell-Nr.	Preis		Bestell-Nr.	Preis
Positionierbaugruppe WF 721	6FM1 721-3AA20		**Dokumentation**		
Positionierbaugruppe WF 723 A	6FM1 723-3AA10		Kurzbeschreibung WF 721/		
Firmware-Hochrüstsatz WF 721	6FM1 721-4AA00		WF 723A deutsch	6ZB5 440-0PW01-0BA5	
Firmware-Hochrüstsatz			Handbuch WF 721/		
WF 723 A	6FM1 723-4AA00		723A komplett		
Positionierbaugruppe WF 723 B	6FM1 723-3BA00		• deutsch	6ZB5 440-0VK01-0BA2	
Firmware-Hochrüstsatz			• englisch	6ZB5 440-0VK02-0BA2	
WF 723 B	6FM1 723-4BA00		SYSDOK 723A		
Positionierbaugruppe WF 723 C	6FM1 723-3CA00		• deutsch	6ZB5 440-0RS01-2AA6	
Wegmeßgeber, inkrementell			• englisch	6ZB5 440-0RS02-2AA5	
• für Anbau			Kurzbeschreibung WF 723B	6ZB5 440-0SB01-0BA1	
1000 Pulse/Umdrehung	6FX2 001-2CB00		deutsch		
2000 Pulse/Umdrehung	6FX2 001-2CC00		Beschreibung WF 723B deutsch	6ZB5 440-0SC01-0BA1	
2500 Pulse/Umdrehung	6FX2 001-2CC50		Handbuch WF 723B komplett		
weitere	siehe Katalog ST 71		• deutsch	6ZB5 440-0VM01-0BA1	
• für Einbau in Motoren			• englisch	6ZB5 440-0VM02-0BA1	
der Baureihe 1FT	siehe Katalog SD 114		SYSDOK 723B		
Standard A	6FM1 700-7UA31-1AA0		• deutsch	6ZB5 440-0SJ01-2AA2	
Kopplung SIMATIC S5 mit			• englisch	6ZB5 440-0SJ02-2AA2	
WF-Technologiebaugruppen			Kurzbeschreibung WF 723C		
Standard B-470	6FM1 723-8AA31-1AA0		• deutsch	6ZB5 440-0VS01-0BA0	
STEP 5-Bausteine für SIMATIC S5			• englisch	6ZB5 440-0VS02-0BA0	
und Bildmasken für WF 470			Beschreibung WF 721/WF 723		
Kopplung Standard A mit WF 470			• deutsch	6ZB5 440-0VP01-0BA2	
Software für Datenverkehr			• englisch	6ZB5 440-0VP02-0BA2	
Standard-B-GRACIS ULB	6FM1 723-8UD31-1MA0		Handbuch WF 723C komplett		
Bildmasken und Textlisten			• deutsch	6ZB5 440-0VY01-0BA1	
für GRACIS ULB			• englisch	6ZB5 440-0VY02-0BA1	
Kopplung Standard A mit			SYSDOK 723C deutsch	6ZB5 440-0WA01-2AA2	
GRACIS Grund-Software					
Standard B-GRACIS OLB	6FM1 723-8UC31-1AA0		**Steckleitung 790**		
Applikationen und Bildmasken			zwischen		
für GRACIS OLB			• WF 721 und Stromrichter		
Kopplung Standard A mit			Standardlängen 2 m	6FM1 790-2BA00	
GRACIS Grund-Software			5 m	6FM1 790-2BB01	
Standard-B-OP 25	6FM1 025-8AA30-1MA0		10 m	6FM1 790-2BC00	
STEP 5-Bausteine für SIMATIC S5			Sonderlängen, max. 30 m1)	6FM1 790-2BZ00	
und Bildmasken für OP 25			• WF 723 und Stromrichter		
Kopplung Standard A			Standardlängen 2 m	6FM1 790-2CA00	
Software-Pakete			5 m	6FM1 790-2CB00	
für Programmiergeräte PG 710+/			10 m	6FM1 790-2CC00	
720/730/740/750/760/770 oder IBM-			Sonderlängen, max. 30 m1)	6FM1 790-2CD00	
kompatiblen Standard-PC (Dis-			zwischen WF-Baugruppe und		
kette 3,5" MS-DOS)			• Heidenhain ROD 320	siehe WF 706C	
Software COM 723	6FM1 723-6UA31-1AA0		• Siemens-Wegmeßgeber 6FC9 320	siehe WF 706C	
einschließlich SYSDOK 723 und			• SSI-Wegmeßgeber,		
Beschreibung COM 723			1 Leitungsende offen	siehe WF 706C	
PC-Steuern	6FM1 723-6UB30-1MA0		1) Länge in Klartext angeben.		

Overview

Overview

Special functions				
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Supplementary devices	
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Simulation modules	4/104
313 monitoring module	4/105

CP 516 memory submodule

Application

The CP 516 memory submodule is used for storing large amounts of data which are not constantly required in the user memory of the CPU, e.g. recipes and message texts. The module can also be used as a backup medium for production data acquisition.

Design

Two memory cards can be inserted in the CP 516 memory submodule. Memory cards with flash EPROM are useful for storing data for reading only. For greater data protection when using RAM memory cards, a lithium battery can be fitted in the CP 516 memory submodule, to ensure that the data is retained when the CP 516 is not plugged in. The module has a special connection for data interchange with a programming device.

Principle of operation

Data storage is controlled by the CPU using a standard function block. The data handling blocks for communications are already inserted in the operating system of the central controller (CPU).

Technical specifications

Number of memory locations		2	Power loss max.	5 W
Memory capacity	max.	8 Mbyte	Space requirements	1 slot
Current consumption (at 5 V)	max.	0.8 A	Weight	0.6 kg (1.32 lb)

Ordering data	Order No.		Order No.
CP 516 memory submodule	**6ES5 516-3UA11**	**Memory card**	
Standard function blocks including CP 516 manual	see Section 7	RAM, 256 Kbytes	**6ES5 374-2AH21**
		RAM, 512 Kbytes	**6ES5 374-2AJ21**
To be ordered as a separate item:		RAM, 1 Mbytes	**6ES5 374-2AK21**
CP 516 manual		Flash EPROM, 256 Kbytes	**6ES5 374-2FH21**
German	**6ES5 998-1EB11**	Flash EPROM, 1 Mbytes	**6ES5 374-2FK21**
English	**6ES5 998-1EB21**	Flash EPROM, 2 Mbytes	**6ES5 374-2FL21**
French	**6ES5 998-1EB31**	Flash EPROM, 4 Mbytes	**6ES5 374-2FM21**
		Lithium backup battery for CP 516	**6ES5 980-0AE11**

Special modules

CP 581; the integral PC in the SIMATIC

Application

The CP 581 is an AT-compatible PC for use in the S5-115U, S5-135U and S5-155U/H programmable controllers. When linked to the CPU of the programmable controller it offers additional computing power for solving complex automation tasks.

The CP 581 is used for acquisition, processing and storage

of large quantities of data. The CP 581 also allows you to incorporate especially simple PC applications under MS-DOS into automation applications.

Since there is no rotating memory on the basic board, the CP 581 can also be used reliably in applications where the shock level is high.

Design

The CP 581 has a modular design. It consists of a basic board and optionally a mass storage module and up to 2 slot modules.

CP 581 basis board

The basic board contains the following:

• 80486 DX4 microprocessor (100 MHz)
• VGA graphics interface (can be disabled)
• User memory, modular with 4 to 32 Mbyte
• Receptacle for a memory card with 1 Mbyte, 2 Mbyte, 4 Mbyte, 8 Mbyte or 16 Mbyte capacity
• Optional 4 Mbyte onboard silicon disk can be accessed as drive and implemented with flash EPROMS
• 1 V.24/TTY interface (COM 1) for printer
• 1 V.24/RS 485 interface (COM 2) for mouse
• 1 free V.24/RS 485 interface (COM 3)
• 1 VIDEO interface for multi-frequency monitor (3 Coax midi sockets) for distances up to 250 m (820 ft)
• 1 interface for standard keyboard, for distances up to 250 m (820 ft) with remote terminal interface (RTI)

Operator controls and indicators on the front panel:
• "RUN"-"STOP" switch: The tasks executed for the different switch settings can be specified in the user program (e.g. application start in the case of "RUN").
• "RESET" pushbutton
• LEDs: "RUN" (green) for operation "STOP" (red) for interrupts
• LEDs: "Fault" (red) for module faults, "SD" (green) for indicating memory card access

Mass storage module

Every basic board can be expanded by a mass storage-module.

A mass storage module consists of the following:
• Hard disk drive with at least 800 Mbyte capacity
• $3^1/_2$" diskette drive
• 1 Centronics interface for e.g. dongle, printer
• 1 free V.24/TTY interface (COM 4)

Operator controls and indicators on the front panel:
• "HD" LED (green) indicates access to the hard disk

Slot module

A basic board can be expanded by up to 2 slot modules.
A short AT module can be plugged into a slot module.

The short AT module for the CP 581 can be up to 10 mm wide, 120 mm high and 165 mm deep.

The CP 581 receives its power supply and battery backup from the programmable controller.

The CP 581 integral personal computer requires 1 to 4 slots depending on configuration.

CP 581 system software

The CP 581 system software contains communications software for data exchange with the CPU of the programmable controller (see Fig. 4/44) and the CP_Link software.

CP_Link enables start-up of the basic board without mass memory module using a programming device or PC via the interface (COM 1) of the CP 581. Using CP_Link, the operating system and the user program can be loaded into the basic board without mass storage module.

CP 581, the integral PC in the SIMATIC (continued)

Design (continued)

Operating system
Communication with the CPU of the programmable controller is supported by the sys-tem software of the CP 581 under the MS-DOS operating system.

The German version of the MS-DOS V 6.22 operating system is included in the scope of delivery of the basic board.

Language upgrades for English and French are to be ordered separately.

Principle of operation

While the CPU of the programmable controller concentrates on the pure control tasks, the CP 581 integral personal computer handles acquisition, processing and storage of large data quantities. MS-DOS standard user programs can be used for these tasks.

The CPU of the programmable controller communicates with the CP 581 via the S5 backplane bus. This ensures effective data exchange. Standard data handling blocks must be loaded into the program memory of the programmable controller's CPU for data exchange purposes. Addressing of the CP 581 is either linear or via pages (8 Kbyte dual-port RAM).

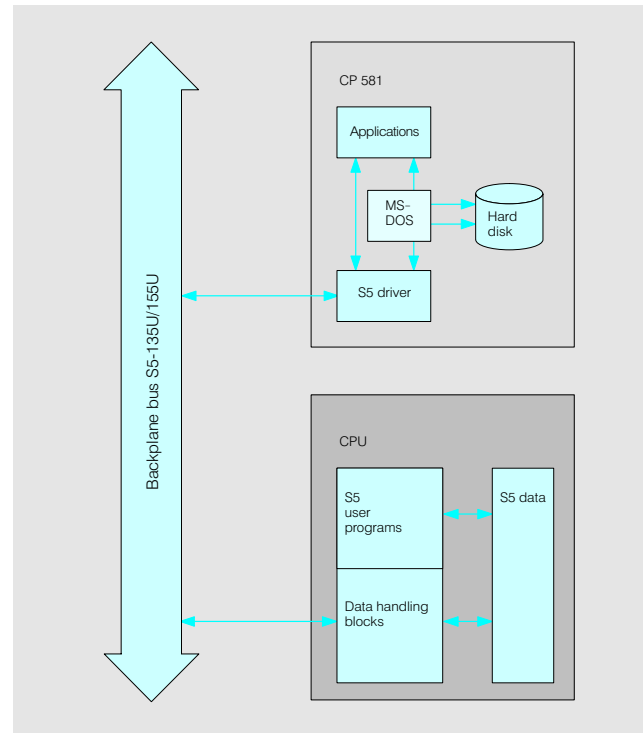The CP 581 can also be used as a standard PC.

Fig. 4/44 Data exchange between CP 581 and CPU

Functions

Process data acquisition
This function can be used to capture data from different S5 data areas, such as data blocks and bit memories, in the CP 581. This data can be read globally or selectively from the data area within a defined timebase and collected in one or more files in the CP 581. The CP 581 can record the collected and converted process data and then manage and process this data with a suitable MS-DOS user program (e.g. dBASE),

and all independently of the programmable controller.

S5 drive emulation
Thanks to the S5 drive emulation, S5 data can easily be incorporated into CP 581 programs.
• S5 data blocks can be converted automatically in order to incorporate them e.g. into standard programs such as Excel or Lotus 1-2-3 without any intermediate steps.
• S5 data blocks can be accessed via almost all MS-DOS commands.

After starting the drive emulation (S5 Remote), the CP 581 provides a new (virtual) drive. This is a logical and not a physical drive. There are 4 catalogs on this drive, one each for the CPUs 1 to 4. The CP 581 stores the data blocks of the CPUs in the catalogs in the form of MS-DOS files. It is operated on-line with data of the S5-CPU.

CP 581, the integral PC in the SIMATIC (continued)

Functions (continued)

Mass storage functions
If there is insufficient memory space available on the CPU of the programmable controller, it is possible to use these functions to store data in the CP 581 and to fetch it back to the CPU as required - selectively, if desired.

The mass storage functions also offer the facility of deleting an entire CP 581 catalog (without subcatalog) from the CPU.

Command interpreter
This function is used to execute any MS-DOS com-mands on the CP 581 from the CPU. If the CP 581 is oper-ated without keyboard and-monitor (e.g. mass memory functions), the command in-terpreter can be used, if nec-essary, to copy data on the CP 581 or to execute other necessary MS-DOS functions.

Programming
Programming is used to solve all those tasks resulting from communication between the CPU and the CP 581 which cannot be handled by the system programs supplied.

These include, e.g., data ex-change with higher-level com-puters or operator inputs for a CPU.

Additional functions
Interrupts are possible from the CP 581 integral PC to the CPU of the programmable controller and vice versa.

Direct network connection is possible via a slot module.

The booting sequence can be selected freely by the user.

Technical specifications

Basic board		
Microprocessor		80486DX4
Clock frequency		100 MHz
Coprocessor		Integrated
Onboard silicon disk (optional)		4 Mbyte
User memory		Without; can be equipped modularly up to 32 Mbyte
Ambient temperature		
• Operating		+ 5 °C to + 55 °C
• Transport/storage		- 20 °C to + 60 °C
• Relative humidity		8 to 80 % at 25 °C, no condensation
Supply voltage		5 V DC, ± 5 % / 24 V DC, + 25 %/– 15 %
Current consumption		
• At + 5 V	typ.	1.8 A
• At + 24 V	typ.	0.1 A
Power loss	approx.	12 W
Dual-port RAM		8 Kbyte
Space requirements		1 slot
Weight		0.5 kg (1.1 lb)

Mass storage module		
Diskette drive		$3\,^1/_2$"
Hard disk drive (memory capacity)	min.	800 Mbyte
Shock (measured on hard disk drive)		
• Form	max.	$^1/_2$ sine
• Duration	max.	11 ms
• Operating	max.	50 m/s^2
• Transport	max.	500 m/s^2

Vibration (measured on hard disk drive)		
• Operating	max.	5 m/s^2
• Transport	max.	20 m/s^2
Ambient temperature		
• Operating		+ 5 °C to + 55 °C
• Transport/storage		– 20 °C to + 60 °C
Relative humidity		8 to 80 % at 25 °C, no condensation
Supply voltage		5 V DC, ± 5 % / 24 V DC, + 25 %/– 15 %
Current consumption		
• At + 5 V	typ.	0.5 A
• At + 24 V	typ.	0.1 A
Space requirements		1 slot, beside the basic board
Weight		0.9 kg (2 lb)

Slot module		
Ambient temperature		
• Operating		+ 5 °C to + 55 °C
• Transport/storage		– 20 °C to + 60 °C
Relative humidity		8 to 80 % at 25 °C, no condensation
Supply voltage		5 V DC, ± 5 / 4 V DC, + 25 %/–15 %
Current consumption		
• At + 5 V	typ.	0.8 A (without AT module)
• At + 24 V	typ.	—
Space requirements		1 slot beside the basic board, mass storage module or slot module
Weight		0.3 kg (0.66 lb)

CP 581, the integral PC in the SIMATIC (continued)

Ordering data	Order No.		Order No.
CP 581 basic board for S5-115U/H, S5-135U and S5-155U/H 80 486 DX4 microprocessor 100 MHz, without user memory, incl. MS-DOS V 6.22 German	6ES5 581-0ED13	**RGB/VGA adapter** for connecting multi-frequency monitors with standard VGA connector (monitor must be able to filter the sync signals from the green channel)	6ES5 714-2AV01
Memory expansion • For internal RAM		**Connecting cables for monitors** (3 cables are required per monitor)	
4 Mbyte	6ES7 478-1AM00-0AA0	3.2 m (10.4 ft)	6ES5 736-2BD20
8 Mbyte	6ES7 478-1AN00-0AA0	5 m (16.4 ft)	6ES5 736-2BF00
16 Mbyte	6ES7 478-1AP00-0AA0	10 m (32.8 ft)	6ES5 736-2CB00
32 Mbyte	6ES7 478-1AQ00-0AA0	**Mass storage module**	6ES5 581-3LA11
• For Silicon disc (OSD) Flash EPROM 4 Mbyte	6ES7 478-1BM10-0AA0	**Slot module**	6ES5 581-0RA12
Y adapter • For converting COM 1/COM 3 to standard connectors	6ES5 714-2AS01	**CP 581 system software** ($3^1/_2$" diskette) German, English, French	
• For keyboard/COM 2	6ES5 714-2AT01	Single license	6ES5 835-8MD01
		Copy license	6ES5 835-8MD01-0KL1
Extension for keyboard/mouse RTI (remote terminal interface)	6ES5 751-3AA12	**Operating system MS-DOS V 6.22 - Upgrade**	
RTI connecting cable		English	6ES5 895-0BS22
10 m (32.8 ft)	6ES5 714-3CB00	French	6ES5 895-0BS32
20 m (65.6 ft)	6ES5 714-3CC00	To be ordered as a separate item:	
25 m (82 ft)	6ES5 714-3CC50	**CP 581 manual**	
32 m (104 ft)	6ES5 714-3CD20	German	6ES5 998-2AT11
40 m (131.2 ft)	6ES5 714-3CE00	English	6ES5 998-2AT21
50 m (164 ft)	6ES5 714-3CF00	French	6ES5 998-2AT31
63 m (206.6 ft)	6ES5 714-3CG30		
80 m (262.4 ft)	6ES5 714-3C J00	**CP 581 DDE server**	
100 m (328 ft)	6ES5 714-3DB00	German	
200 m (656 ft)	6ES5 714-3DC00	Single license	6ES5 835-6DD11
		Copy license	6ES5 835-6DD11-0KL1
		English	
PG keyboard	6ES9 501-3CA00–0AX0	Single license	6ES5 835-6DD21
		Copy license	6ES5 835-6DD21-0KL1

4

SIMATIC S5-135U, S5-155U/H
Special modules

Application

The simulation modules simulate input and output signals and thereby enable control of input and output modules.

Design

788-7LA simulation module

For 16 binary input signals and 16 binary output signals. The module is for use with the 482 digital input/output module.

The module contains the following:

- 16 switches for the input of binary signals; can be used as latching pushbutton (to the left) or as momentary-contact pushbutton (to the right)
- 16 LEDs for indicating binary output signals
- 2 sockets for feeding in the signal voltages
- 1 connection for the 768-7LA cable (0.3 m (1 ft); to be ordered separately) to the 482 digital input/output module

788-7LB simulation module

For 1 analog input signal and 1 analog output signal. The module is for use with the 460 analog input module and the 470-7LB analog output module. The module contains the following:

- 1 rotary switch for selecting the input range
- 1 ten-turn potentiometer for setting the input value (scale 0 to 100 %)
- 1 measuring instrument for indicating the input value (scale 0 to 100 %)
- 1 rotary switch for selecting the output range
- 1 measuring instrument for indicating the output value (scale 0 to 100 %)
- 1 connection for the 768-7LB cable (0.3 m (1 ft); to be ordered separately) to the 460 analog input module and to the 470-7LB analog output module

788-7LC simulation module

For input and indication of digital values (e.g. timer or counter values). The module is for use with the 482 digital input/output module. It contains the following:

- 1 4-digit key code switch for specifying digital values
- 1 4-digit numerical display for indicating digital values
- 1 connection for the 768-7LA cable (0.3 m (1 ft); to be ordered separately) to the 482 digital input/output module

The simulation modules can be used in the central controller ZG 135U/155U, ZG 135U and in the expansion unit EG 185U.

The modules each require 2 slots.

Ordering data	Order No.		Order No.
788-7LA simulation module for binary signals	**6ES5 788-7LA11**	To be ordered as a separate item: **Manual** German English	**6ES5 998-0EA11** **6ES5 998-0EA21**
788-7LB simulation module for analog signals	**6ES5 788-7LB11**	**Connecting cables** for simulation modules in S5-135U/155U	on request
788-7LC simulation module for digital values	**6ES5 788-7LC11**		

SIMATIC S5-135U, S5-155U/H

Picture evaluation systems

Introduction

The optical inspection and recognition of products in manufacturing is becoming an important topic as quality demands and production rates increase. The arguments in its favor are obvious:

• reduction of waste
• supply of tested products
These demands can be derived from the rules of DIN ISO 9000 or from the product liability laws.

Monotonous human visual inspection or identification is too expensive and inhumane. Moreover continuously increasing production rates are increasingly making use of personnel for inspection impossible.

Use of a picture evaluation system is an obvious choice:

• Automatic visual inspection in quality assurance; the machine tests objectively, fast and reliably dimensions, contours, forms and presence, correct assembly, positioning and completeness of parts, which can be microscopic (e.g. chip structures)
• Automatic part identification; parts can be assigned to predefined categories by shape, dimension, pattern, color, codes and symbols.

Picture evaluation systems can be used especially economically if certain conditions are fulfilled:

• Features of the product can be described uniquely by shape, dimension and pattern
• Delimitable number of these features
• Delimitable inspection location
• Sufficiently large image of the product to be tested
• High contrast between product and background

SIMATIC VIDEOMAT picture evaluation system

Application

SIMATIC VIDEOMAT is a complete picture evaluation system for implementation in the S5-115U, S5-135U/155U or S5-155H programmable controllers. With SIMATIC VIDEOMAT, pictures from both monochrome and color cameras can be evaluated. The automation of visual inspection using picture evaluation systems results in uniform product quality and is therefore both reliable and economical.

The main application for SIMATIC VIDEOMAT is in

• assembly technology in the automotive industry and automotive suppliers, the electrical industry, the plastics industry
and in
• packaging technology in the pharmaceutical, cosmetic, foodstuffs and beverage industries.

The module allows:

• Contactless visual inspection for quality assurance (dimensions, contours, shape, existence, assembly, location, quantity)
• Monitoring of high-speed processes
• Inspection of products with high throughput
• Identification of components on the basis of shape, dimensions, pattern, color, codes or characters
• Assignment of components to classes and categories

Features

SIMATIC VIDEOMAT has the following special features:

• Up to six cameras can be connected
• Fast moving objects can be captured from different viewpoints
• Picture preprocessing in real-time
• Recorded picture data is accessed while the picture is still being acquired
• Processing rates of up to 30 items per second
• Remote diagnostics and service is possible via modem and telephone lines
• Perfect optimization of the production process due to knowledge from online logging
• Wide range of applications by configuration of the most varied inspection tasks
• Low configuration effort due to easy operation and tried and tested function blocks
• Space saving integration into SIMATIC automation systems

SIMATIC VIDEOMAT picture evaluation system (continued)

Design

The module contains:
- 4 Mbyte picture memory, resolution 1024 x 1024 x 8 bit, freely configurable format
- 1024 x 1024 bit overlay and marking or mass storage
- 4 Mbyte program and data memory
- 360 Mbyte hard disk for archiving programs, data and pictures
- SVGA graphical resolution 1024 x 768, display of graphics and video is possible using windowing techniques

Interfaces:
- SVGA video output with simultaneous display of picture and graphic
- PCMCIA interface for connecting a modem for digital picture and data transmission via the telephone lines
- 1 serial (RS232 or TTY) interface and 1 centronics interface
- Keyboard interface, mouse interface
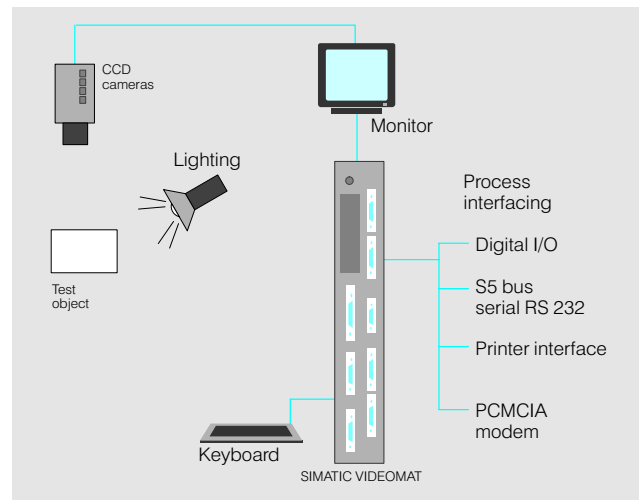- 8 x 24 V digital inputs
- 8 x 24 V digital outputs

Fig. 4/45 Videomat IV picture evaluation system

Software:
- MS-DOS 6.2 operating system
- System software for interactive generation of applications from monochrome pictures including parameterizable sequencing control and an interface to the process

- Driver for communication via standard data handling blocks

The module requires two slots.

Principle of operation

SIMATIC VIDEOMAT is a target system and programming system in one. The request for evaluation and output of the results takes place automatically via communication with the SIMATIC CPU.

Test programs, data and also camera pictures can be archived on-board.
In order to program the system, simply connect a monitor and keyboard. On the monitor, up to three pictures, data and graphics can be displayed in windows.

Due to user-friendly operator prompting, the picture evaluation system SIMATIC VIDEOMAT is easily adapted to the specific task, and no programming knowledge is necessary.

Technical specifications

Picture processor	80486 DX4, 133 MHz	Monitor connection	1 SVGA
Picture memory	8 Mbyte	Keyboard connection	1
Format	From 256 x 256 x 8 bit to 1024 x 1024 x 8 bit, freely configurable	Mouse connection	1
		24 V digital inputs	8
		24 V digital outputs	8
Operating system	MS-DOS 6.2	Current consumption	4 A at 5 V
Interfaces	RGB video output PCMCIA interface for connecting a modem 1 serial (RS232 or TTY) 1 centronics interface	Space requirements	2 slots

SIMATIC S5-135U, S5-155U/H

Picture evaluation systems

SIMATIC VIDEOMAT picture evaluation system (continued)

Ordering data	Order No.		Order No.
SIMATIC VIDEOMAT for mono-chrome picture evaluation for monochrome cameras, 50 Hz or 60 Hz picture frequency, simul-taneous storage of up to 3 camera pictures, system software, runtime license, several lan-guages • 6 camera ports • 6 camera ports, with hardware real-time picture processing	6GF2 005-0BC01 6GF2 005-0BE01	**CCD camera with C mount** 756 x 581 square pixels, 625 lines, 50 half-pictures / s, exposure time adjustable from 1/10,000 to 1/50 s, with restart and reset, voltage rating 12 V DC, 210 mA	6GF9 002-1AA
SIMATIC VIDEOMAT for color picture evaluation for RGB, FBAS, SVHS, Y-C color cameras, 50 Hz or 60 Hz picture frequency, HSI hardware or YUV color coding, system software, run-time license • 2 camera ports	6GF2 005-0CC01	**Single-chip-RGB color camera** 756 x 581 square pixels, 625 lines, 50 half-pictures / s, exposure time adjustable from 1/10,000 to 1/50 s, voltage rating 12 V DC, 500 mA	6GF9 002-1BA
		Lenses for above cameras depending on the application	on request
SIMATIC VIDEOMAT manual German English	6GF7 002-1CA01 6GF7 002-1CA02	**Lighting equipment** depending on the application	on request
		14" color monitor max. resolution 1024 x 768 pixels	6GF6 130-1MA
		Keyboard	C7951-Z727-K3
		Mouse	6ES7 790-0AA00-0XA0
		Connecting cables for VIDEOMAT • Adapter cable for connecting monochrome cameras	6GF9 002-1AG
		• Connecting cable for one RGB color camera, Length 10 m (32.8 ft) Length 20 m (approx. 66 ft)	6GF9 002-1BD 6GF9 002-1BE

Communications processors and bus systems

Overview

Communications processors are used for data interchange between the S5-135U and S5-155U/H programmable controllers and the I/O stations or other programmable controllers connected to them.

Programmable controllers can be linked in two ways:

Point-to-point connection

Point-to-point connection is used for connecting one I/O station or programmable controller to a single S5-135U or S5-155U/H programmable controller. The link can, for example, be made through the

second interface of the CPU. The CP 523, CP 524, CP 544 and CP 544B communications processors can also be used. These primarily relieve the CPU of the responsibility for communications thus en-abling a large number of I/Os to be connected.

Bus interfacing

Bus interfacing is used for interlinking a number of nodes. Possible nodes include:
• S5-135U and S5-155U/H programmable controllers
• Third-party programmable controllers

• Personal computers
• Minicomputers or workstations
• Field equipment
• Printers

There are four different busses to choose from, depending on the area to be covered, the number of nodes and the transmission rate:
• SINEC L1
• AS interface
• PROFIBUS
• Industrial Ethernet

A communications processor is available for each of these four bus systems.

4

Communication

Point-to-point connection via V.24, 20 mA, RS 422/485	Page	Bus interfacing		Page
• CP 523 communications processor Point-to-point connection with fixed protocols; One interface: V.24, 20 mA	4/110	• CP 530 communications processor	**SINEC L1** for small and medium-sized communications applications Transmission rate 9.6 kbit/s	4/118
• CP 524 communications processor Point-to-point connection with protocols loaded from diskette; Selection of protocols available for connection of third-party systems; One interface: V.24, 20 mA, RS 422/485	4/112	• CP 2430 FMS/DP communications processor	**AS interface** for digital sensors and actuators for the lowest field level	4/122
• CP 544 communications processor Point-to-point connection; Selection of protocols available for connecting third-party systems; two interfaces (interchangeable interface modules): V.24, 20 mA, RS 422/485	4/114	• CP 5431 FMS/DP communications processor	**PROFIBUS** to PROFIBUS standard DIN 19245, Part 1 Transmission rate 9.6 to 1500 kbit/s selectable	4/118
• CP 544B communications processor as CP 544, but with protocols loaded from diskette (special driver)	4/114	• CP 1430 TF/CP 1430 TCP/CP 1473 MAP communications processors	**Industrial Ethernet** CSMA/CD (IEEE 802.3) Transmission rate 10 Mbit/s	4/124
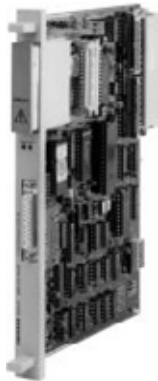
SIMATIC S5-135U, S5-155U/H
Communications modules

Application

The CP 523 communications processor is used for point-to-point connection to other programmable controllers and third-party equipment using standard protocols.

Design

The module contains the following:
- Microprocessor (8 bit) and interface chips (USART)
- RAM as user memory for temporary storage of messages
- Receptacle for 375 memory submodule (EPROM, EEPROM with max. 32 Kbyte) for a maximum of 4095 messages
- Hardware clock
- Interface for connection of devices with V.24 or 20 mA current-loop signals (sub D connector, 25-pin)

Operator controls and indicators on the front panel:
- 2 LEDs (green) for indicating the interface status

Devices with serial interfaces can be connected, e.g.:
- Printers
- Terminals
- Keyboards
- Barcode readers
- Programming devices and AT compatible PCs (e.g. in connection with the PRO-DAVE DOS 64R driver software)
- Programmable controllers via CPU 943, CPU 944, CPU 928B or the CP 521, CP 523, CP 544 communications processors (CP 524 and CP 525-2 only in conjunction with special drivers)

Interface
The interface is suitable for the transmission of
- 20 mA current-loop signals (TTY) and
- V.24 signals.

The transmission rate of the interface is 200 bit/s up to 9600 bit/s and is selectable in fixed steps.

The module requires one slot.

Principle of operation

The CP 523 communications processor can be used for the following functions:
- Interfacing programmable controllers and third-party devices and
- Message printout

The CP 523 handles data communication with the device connected to it completely autonomously, as well as preprocessing and temporary storage of data. The CP 523 occupies 8 byte in the analog I/O area.

All information between the communications processor and the CPU is exchanged via this area.

Interfacing
With the CP 523, interfacing to any desired unit with serial interface, e.g. interfacing with a personal computer for operator control and process monitoring, is possible.

Data transfer is possible either with a 10-bit or 11-bit character frame:
10-bit character frame either:
- 1 start bit, 7 data bit, 2 stop bit
- 1 start bit, 7 data bit, 1 parity bit, 1 stop bit
- 1 start bit, 8 data bit, 1 stop bit

CP 523 communications processor (continued)

Principle of operation
(continued)

11-bit character frame either:
- 1 start bit, 7 data bit, 1 parity bit, 2 stop bit
- 1 start bit, 8 data bit, 1 parity bit, 1 stop bit
- 1 start bit, 8 data bit, 2 stop bit

In the communications mode, two open listings and one standardized listing are available on the module:
- In the transparent communications mode, data transmission is without receive-side end identifier sequence (message frames with fixed lengths or evaluation of the character delay time determine the end of the message)

- In the interpretive mode, data transmission commences with receive-side end identifier sequence and-control character. The characters RUB OUT = 7Fh, Backspace = 08h, XON/XOFF (assign nothing or 01 h to 7Eh), 1 or 2 end characters (selectable from 01 h to FFh) are evaluated
- In the 3964(R)-K communications mode, data transmission is via the 3964 or 3964R protocol

Message printout
With the CP 523 communications processor it is possible to output up to 4095 messages on a peripheral device with serial interface (printer, visual display unit, etc.). The message texts are stored on the module's memory submodule. Each message can have a maximum of three variables.

Permissible variables include the following: Date, time of day, token characters for further message texts, printer control parameters.

Programming

Programming of the module is not necessary. Only the type of interface (V.24, TTY), the additional interface parameters (transmission rate, handshake, ...) and the operating mode (event recorder, interfacing) can be parameterized with the user submodule or via an initialization message from the programmable controller.

See page 4/115 for technical specifications.

Ordering data	Order No.		Order No.
CP 523 communications processor	**6ES5 523-3UA11**	**Manual**	
		German	**6ES5 998-0DD11**
375 memory submodule		English	**6ES5 998-0DD21**
EPROM 8 Kbyte	**6ES5 375-1LA15**	French	**6ES5 998-0DD31**
EPROM 16 Kbyte	**6ES5 375-1LA21**	Spanish	**6ES5 998-0DD41**
EPROM 32 Kbyte	**6ES5 375-1LA41**	Italian	**6ES5 998-0DD51**
EEPROM 8 Kbyt e	**6ES5 375-0LC31**		
EEPROM16Kbyte	**6ES5 375-0LC41**	**Connecting cables**	see Page 4/116
Program examples	**6ES5 897-2UE11**		
for data link			

SIMATIC S5-135U, S5-155U/H
Communications modules

Application

The CP 524 communications processor is used for point-to-point connection to other programmable controllers and third-party equipment using standard protocols. The CP 524 has one interface.

Design

The module contains the following:
- Microprocessor (8 bit) and interface chips
- RAM for variable data
- 2 dual-port RAM
- Receptacle for 373 memory submodule (EPROM) for up to 128 Kbyte of user program (interprocessor communication functions or message texts)
- Receptacle for interface module for connecting devices with V.24/V.28, 20 mA (TTY) or RS 422-A/RS 485 signals; software clock

Operator controls and indicators on the front panel:
- "RUN"-"STOP" switch "RUN" for normal operation, "STOP" for interrupting normal operation
- 2 LEDs (red) for indicating the interface status

Devices with a serial interface can be connected, e.g.:
- Printers, e.g. DR 210, DR 211, DR 230, DR 231, PT 88 and PT 89 (with ECMA character set)
- Programmable controllers, through CPU 928B or communications processors CP 524, CP 525-2, CP 544, CP 544B

- Programmable controllers via CPU 944 or communications processors CP 523, CP 521SI in conjunction with special drivers
- SICOMP M minicomputers
- AS 215, AS 235K, AS 235 and AS 235H automation systems of the TELEPERM M process control system (see Catalogs PLT 110 and PLT 111)
- Programming devices and AT compatible PCs (e.g. in connection with the PRO-DAVE DOS 64R driver software, see Section 7)
- Other automation systems
- Third-party computers

Each module requires one slot.

Interfaces

Three different interface modules are available for the interface of the CP 524 for transmitting:
- 20 mA current-loop signals (TTY)
- V24/V.28 signals
- RS 422-A/RS 485 signals

The transmission rate of the interface is
- 110 bit/s to 19,200 bit/s (9600 bit/s with TTY) and is
- selectable in fixed steps using the programming device.

The V.24/V.28 module provides a number of auxiliary-signals conforming to the RS 232C or CCITT V.24 standard when using the relevant special driver software (see Section 7).

RS 422-A or RS 485 signals (voltage difference) ensure a higher degree of immunity to noise from external sources than V.24 or TTY signals. The following links can be established in accordance with the EIA standard:
- Point-to-point connections with RS 422-A in full-duplex mode
- Multipoint connections with RS 485 in half-duplex mode (with special driver software)

See page 4/115 for technical specifications.

CP 524 communications processor (continued)

Principle of operation

The CP 524 communications processor is used for the following functions:
- Linking programmable controllers and third-party devices
- Message printout

The CP 524 handles data communication with the devices connected to it completely autonomously, as well as editing and buffering the data.

Interfacing

Communications are handled by the RK 512 standard driver program, which is supplied with the COM 525 parameter assignment software (S5-DOS version). For interfacing to third-party computers etc., special driver software may be re-quired (see Section 7).

The computer link permits the sending and fetching of all SIMATIC S5 data types, such as data words, peripheral byte, bit memories, input images, etc.

Linking orders for the connected programmable controller or the computer are stored in the memory submodule (EPROM) of the module. Thus, the data do not occupy any memory space in the central controllers (or memory submodules).

Data transmission between CP 524 and connected devices is initiated via standard function blocks (handling blocks) in the memory of the central controller.

Listing

Process status reports

Production and shopfloor data can be printed out for documentation purposes. Printout is initiated by the user program. Process status reports may be
- up to 99 lines long and
- include up to 40 variables per line.

The variables are transferred to the CP 524 in one single data block.

Message printouts

Up to 1000 different messages (e.g. fault messages, signals from limit monitors, changes in switch positions) can be printed out. Each message may have one variable.

Programming

The CP 524 can be programmed off-line using the 373 memory submodule. For this purpose, the COM 525 parameter assignment software

(S5-DOS version, see Section 7) must be loaded into the relevant programming device. The parameter assignment software

also supports start-up of the communications processors.

Ordering data	Order No.		Order No.
CP 524 **communications processor**	**6ES5 524-3UA15**	**Special drivers** (customized transmission protocols)	see Section 7
752 interface submodule for CP 524 only		To be ordered as a separate item:	
for 20 mA current loop (TTY)	**6ES5 752-0AA12**	**Manual**	
for V.24/V.28 (RS 232C)	**6ES5 752-0AA22**	for CP 524 (S5-DOS version)	
for RS 422-A/RS 485	**6ES5 752-0AA43**	German	**6ES5 998-1DB11**
373 memory submodule		English	**6ES5 998-1DB21**
EPROM 32 Kbyte	**6ES5 373-1AA41**	French	**6ES5 998-1DB31**
EPROM 64 Kbyte	**6ES5 373-1AA61**	**Connecting cables**	see page 4/116
EPROM 128 Kbyte	**6ES5 373-1AA81**		
COM 525 **parameter assignment software**	see Section 7		

SIMATIC S5-135U, S5-155U/H
Communications modules

CP 544, CP 544B communications processors

Application

The CP 544 and CP 544B communications processors are used for fast point-to-point connection to other programmable controllers and equipment of other manufacture with standard protocols. In the case of the CP 544B, customer-specific communications protocols can also be used. The CP 544 and the CP 544B have two replaceable interfaces.

Design

The modules contain the following:
- 80186 microprocessor (16 MHz)
- RAM for variable data
- Two dual-port RAM
- Receptacle for memory card (flash EEPROM) for up to 256 Kbyte (optional)
- 2 receptacles for interface submodules for the connection of devices with V.24/V.28, 20 mA TTY or RS 422-A/RS 485 signals
- Hardware clock

Operator controls and indicators on the front panel:
- "RUN"-"STOP" switch, RUN for normal operation, STOP for interrupting normal operation
- Four LEDs (red/green) for indicating the interface status
- Two LEDs for indicating the status of the module (RUN, STOP)

The following can be connected to the module:
- DR 210, DR 211, DR 230, DR 231, PT 88, PT 89 printers
- SIMATIC S5 programmable controllers via CP 524, CP 544, CPU 928B, CPU 944 and CPU 945; connection is also possible via CP 521 SI and CP 523 (see pages 2/67 and 4/110)
- SICOMP M minicomputers
- Automation systems AS 215, AS 235K, AS 235 and AS 235H from the TELEPERM M process control system (see Catalogs PLT 110 and PLT 111)
- Programming devices and AT compatible PCs (e.g. in connection with the PRO-DAVE DOS 64R driver software)
- Other automation systems
- Third-party computers

Interfaces

Three different interface submodules are available for the interfaces of the CP 544 and CP 544B for transmitting:
- 20 mA current-loop signals (TTY),
- V.24/V.28 signals (RS 232C)
- RS 422-A/RS 485 signals

The transmission rate of the interfaces is 300 bit/s to 76800 bit/s (9600 bit/s for TTY, 19200 bit/s V.24 and is selectable in fixed steps using the programming device.

The sum of the two transmission rates must not exceed 76800 bit/s when both interfaces are assigned.

RS 422-A or RS 485 signals (voltage difference) ensure a higher degree of immunity to noise from external sources than V.24 or TTY signals. Moreover, higher transmission rates can be reached. Point-to-point connection with RS 422-A in full-duplex mode can be established in accordance with the EIA standard.

CP 544, CP 544B communications processors (continued)

Principle of operation	The CP 544 and CP 544B communications processors enable point-to-point connection to other programmable controllers and computers. • Third-party devices can be connected via open drivers • Safe data transport over the transmission line is possible with the help of the 3964 (R) procedure	• A safe end-to-end link between the CPUs of both communications partners can be achieved with the RK 512 standard computer link The CP 544 and CP 544B communications processors handle data communications with the devices connected to it completely autonomously.	Communications jobs for the programmable controller or the computer can be stored in a data block in the CPU, the internal RAM of the CP 544 and CP 544B or on the additional memory card (flash EEPROM).
Programming	The CP 544 is programmed using the COM PP parameterization software. It can be programmed either on-line or off-line via the active TTY interface with the PG 720, PG 740, PG 760, PG 710 Plus,	PG 730, PG 750 and PG 770 programming device. For parameter assignment, the COM PP parameterization software must be loaded into the programming device.	COM PP permits simple, operator-prompted programming and supports both start-up and debugging.

4

Technical specifications for CP 523, CP 524, CP 544 and CP 544B

Communications processors		CP 523	CP 524	CP 544 and CP 544B
Interfaces		1, asynchronous, serial selectable: 20 mA (current loop) V.24 (RS 232 C)	1, asynchronous, serial plug-in submodule: 20 mA (current loop) V.24 (RS 232 C) RS 422-A/RS 485	2, asynchronous, serial plug-in submodule: 20 mA (current loop) V.24 (RS 232 C) RS 422-A/RS 485
Transmission rate				
• 20 mA (TTY; current loop)	max.	9600 bit/s	9600 bit/s	9600 bit/s
• V.24/V.28 (RS 232 C)	max.	9600 bit/s	19200 bit/s	19200 bit/s
• RS 422-A/RS 485	max.	—	19200 bit/s	76800 bit/s
• Sum of both interfaces	max.	—	—	76800 bit/s
Transmission protocols		3964 (R) ASCII, interpretive ASCII, transparent	RK 512, with special driver, e. g.: • 3964 (R) • ASCII, interpretive • ASCII, transparent • Customer-specific protocols, for other protocols see Section 7	RK 512, 3964 (R) ASCII, interpretive ASCII, transparent Additional functions for CP 544B: Use of customer-specific communications protocols (special drivers) is possible
Parity		Even, odd, mark, space, none	Even, odd, none	
Data format		7 or 8 bit	5-8 bit	6-8 bit
Character frame		10 or 11 bit	7-12 bit	8-12 bit
Listing				
• Message printouts	max.	4065 messages 3 variables per message Message text stored on memory submodule of CP	1000 messages 1 variable per message Message text stored on memory submodule of CP	
• Process status report	max.	—	Production and shopfloor data 99 lines long, 40 variables per line	
Parameterization		Off-line on EPROM/ EEPROM or in user program	with COM 525 off-line in EPROM	with COM PP on-line or off-line
Connector				
• 20 mA and V. 24		Screw connection Sub D socket, 25-pin	Sliding locking devices Sub D socket, 25-pin	Sliding locking device Sub D socket, 25-pin
• RS 422-A/RS 485			Sub D socket, 15-pin	Sub D socket, 15-pin

CP 523, CP 524, CP 544 and CP 544B communications processors (continued)

Technical specifications for CP 523, CP 524, CP 544 and CP 544B (continued)

Communications processors		CP 523	CP 524	CP 544 und CP 544B
Cable length				
• 20 mA current loop (TTY)	max.	Active: 10 m (32.8 ft) Passive	1000 m (3280 ft)	1000 m (3280 ft)
• V.24	max.	16 m (52.4 ft)	16 m (52.4 ft)	16 m (52.4 ft)
• RS 422-A/RS 485	max.	—	1200 m (3936 ft)	1200 m (3936 ft)
Current consumption				
• Module		(5 V) typ. 130 mA	(5 V) max. 1.5 A	(5 V/24 V) max. 0.9 A/0.12 A
• 373 memory submodule (5 V)	max.	—	0.3 A	
• 375 memory submodule(5 V)	max.	—	—	
• 377 memory submodule (5 V)	max.	—	—	
• Interface submodule for				
20 mA current loop (5 V/24 V)	max.	—	0.1 A/60 mA	0.1 A/60 mA
V.24/V.28 (5 V)	max.	—	0.2 A	0.2 A
RS 422-A/RS 485 (5 V)	max.	—	0.5 A	0.5 A
Power loss		1.2 W	7.5 W	4.5 W
Fan required		No	Yes	No
Space requirements		1 slot		
Weight				
• Module	approx.	0.3 kg (0.66 lb)	0.4 kg (0.88 lb)	0.5 kg (1.1 lb)
• Memory submodule	approx.	0.1 kg (0.22 lb)	0.1 kg (0.22 lb)	0.1 kg (0.22 lb)
• Interface submodule	approx.	—	0.1 kg (0.22 lb)	0.1 kg (0.22 lb)

Ordering data	Order No.		Order No.
CP 544 communications processor	**6ES5 544-3UA11**	**725, 726, 734 connecting cables**	
CP 544B communications processor	**6ES5 544-3UB11**	to other SIMATIC S5 devices via CP 524, CP 525-2, CP 544, CP 544B	
752 interface submodule		• 20 mA current loop (TTY)	
for 20 mA current loop (TTY)	**6ES5 752-0AA12**	3.2 m (10.4 ft)	**6ES5 726-1BD20**
for V.24/V.28 (RS 232C)	**6ES5 752-0AA22**	5 m (16.4 ft)	**6ES5 726-1B F00**
for RS 422-A/RS 485	**6ES5 752-0AA43**	10 m (32.8 ft)	**6ES5 726-1CB00**
		50 m (164 ft)	**6ES5 726-1CF00**
Memory card		200 m (656 ft)	**6ES5 726-1DC00**
with flash EPROM, 256 Kbyte	**6ES5 374-2KH21**	• V.24 (max. 16 m (52 ft))	
with RAM, 256 Kbyte	**6ES5 374-2AH21**	2 m (6.56 ft)	**6ES5 726-8BC00**
COM PP parameterization software	see Section 7	3.2 m (10.4 ft)	**6ES5 726-8BD20**
		5 m (16.4 ft)	**6ES5 726-8BF00**
The instruction manual for COM PP is contained in the CP 544 manual.		10 m (32.8 ft)	**6ES5 726-8CB00**
		16 m (52.4 ft)	**6ES5 726-8CB60**
		• RS 422-A/RS 485 (for CP 524 and CP 544)	
CP 544 adapter cable	**6ES5 734-4AG00**	5 m (16.4 ft)	**6ES5 725-7B F00**
to programming device connecting cable		10 m (32.8 ft)	**6ES5 725-7CB00**
	see Section 7	50 m (164 ft)	**6ES5 725-7CF00**
		200 m (656 ft)	**6ES5 725-7DC00**
Special driver for CP 544B		to SICOMP R minicomputers via PROMEA EA 01-G with DUST 3964R	
(customer-specific protocols)		• 20 mA current loop	
To be ordered as a separate item:		3.2 m (10.4 ft)	**6ES5 726-3BD20**
CP 544/CP 544B manual		5 m (16.4 ft)	**6ES5 726-3B F00**
German	**6ES5 998-2DB11**	10 m (32.8 ft)	**6ES5 726-3CB00**
English	**6ES5 998-2DB21**	50 m (164 ft)	**6ES5 726-3CF00**
French	**6ES5 998-2DB31**	200 m (656 ft)	**6ES5 726-3DC00**
		• V.24 (max. 16 m (52 ft))	
		2 m (6.56 ft)	**6ES5 726-4BC00**
		3.2 m (10.4 ft)	**6ES5 726-4BD20**
		5 m (16.4 ft)	**6ES5 726-4BF00**
		10 m (32.8 ft)	**6ES5 726-4CB00**
		20 m (65.6 ft)	**6ES5 726-4CC00**

CP 523, CP 524, CP 544 and CP 544B communications processors (continued)

Ordering data	Order No.		Order No.
725, 726 and 734 connecting cables		for printing with DR 210, DR 211, DR 230, DR 231 printer (with CP 524 and CP 525 only in connection with ECMA character set in the printer) (20 mA current loop up to 1000 m (3280 ft), V.24 up to 16 m (52.5 ft))	
to SICOMP minicomputers via PROMEA EA 01-E with DU 04			
• 20 mA current loop (max. 200 m (656 ft))			
3.2 m (10.4 ft)	**6ES5 725-8BD20**	3.2 m (10.4 ft)	**6ES5 726-5BD20**
5 m (16.4 ft)	**6ES5 725-8B F00**	5 m (16.4 ft)	**6ES5 726-5B F00**
10 m (32.8 ft)	**6ES5 725-8CB00**	10 m (32.8 ft)	**6ES5 726-5CB00**
50 m (164 ft)	**6ES5 725-8C F00**	50 m (164 ft)	**6ES5 726-5C F00**
200 m (656 ft)	**6ES5 725-8DC00**	200 m (656 ft)	**6ES5 726-5DC00**
to N10 modem (max. 16 m (52 ft))			
2 m (6.56 ft)	**6ES5 726-7BC00**		
3.2 m (10.4 ft)	**6ES5 726-7BD20**		
5 m (16.4 ft)	**6ES5 726-7B F00**		
10 m (32.8 ft)	**6ES5 726-7CB00**		
16 m (52.4 ft)	**6ES5 726-7CB60**		
assigns parameters to the CP 544 with PG 7. and CP 544 adapter cable			
5 m (16.4 ft)	**6ES5 734-2BF00**		
10 m (32.8 ft)	**6ES5 734-2CB00**		
25 m (82 ft)	**6ES5 734-2CC50**		

SIMATIC S5-135U, S5-155U/H
Communications modules

CP 2430 communications processor; AS-Interface

Application

The CP 2430 is an interface master module for connecting the
- SIMATIC S5-115U:
  The CP can be used in CP slots in the central controller and expansion unit via adapters
- SIMATIC S5-135/-155U:
  If used for I/O mode only, can be used in the I/O slots in the central unit and expansion unit; in paging mode the CP can be used in CP slots in the central controller and expansion unit

Depending on the configuration of the PLC up to four CP 2430 can be used in the PLC. Configuration of the CP is not necessary.
Control of up to 2 x 31 AS-Interface slaves in accordance with the ASi specification is implemented.
Up to 496 binary elements can be controlled if bi-directional slaves are used.
The supply voltage is monitored on the AS-Interface profile line.

Design
- Two AS-Interface masters on one module
- Occupies one slot in the SIMATIC S5
- In I/O mode, 32 bytes are used in the I/O address space

- Display of the connected and activated slaves and their ready-for-operation signals
- Connection of both AS-Interface lines via connectors with terminal blocks (solderless connection with screw locking)

- A pushbutton for each master part for switching the operating state and accepting the existing configuration
- Coding plug for setting addresses and variants

Principle of operation

Both AS-Interface masters control a separate AS-Interface segment with up to 31 AS-Interface slaves completely independently of one another

- Two operating variants:
  Standard mode:
  Data bits of the slaves can be addressed in the I/O address space of the PLC. Master calls are not possible.

Expanded mode:
Access to master calls in accordance with the ASI specification (e.g. writing parameters) is possible

User interface

Three variants are available:
- I/O mode:
  Only accesses to slave data in the I/O address space, no master calls

- I/O and paging operation:
  Accesses to slave data in the I/O address space and master calls via paging access

- Paging mode:
  Access to slave data and master calls via paging access

CP 2430 communications processor; AS-Interface (continued)

Technical specifications

Access method	Cyclical polling-master-slave-method, cyclical data transfer from host (PLC, PC)	**CP 2430** Supply voltage Current consumption	+5 V DC via backplane bus
Cycle time max.	5 ms with complete configuration	• via backplane bus typ.	700 mA with 5 V DC
Transmission medium	unshielded two-wire cable (2x1.5 mm^2) for data and auxiliary power	• from the AS-Interface max. shaped cable Interfaces	100 mA per AS-Interface segment
Connection method	Contact with the AS-Interface cables using the penetration method	• Assignment of I/O address area in PLC • AS-Interface connection	32 bytes with I/O operation 2 x 4-pin socket for connectors with terminal connections
Number of nodes max.	31		
Number of binary sensors/actuators	max. 124 (4 x 31) when using 4I, 4O, 2I/O- and 2 x 2I modules max. 248 when using 4I/4O modules	Permissible ambient conditions • Operating temperature • Transport/storage temperature Space required	0 to 60 °C −40 to +70 °C 1 slot
Error detection	Identification and repetition of faulty message frames	Weight	400 g

Ordering data

	Order No.		Order No.
CP 2430 Communications processor for connection of SIMATIC S5-115U, S5-135U, S5-155U to AS-Interface, including connector	**6GK1 243-0SA10**	**Manual for AS-Interface** contains CP 2413/CP 2430/ CP 2433 description, introduction and basics incl. software (FB60 + examples) • German • English • French • Italian	 **6GK1 971-2SA01-0AA0** **6GK1 971-2SA01-0AA1** **6GK1 971-2SA01-0AA2** **6GK1 971-2SA01-0AA4**

SIMATIC S5-135U, S5-155U/H

Communications modules

CP 5431 FMS/DP communications processor; PROFIBUS

Application
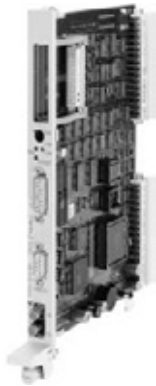
The CP 5431 FMS/DP communications processor is used for connecting the
- S5-115U/H,
- S5-135U and
- S5-155U/H
programmable controllers to the PROFIBUS network.

The programmable controller with the CP 5431 FMS/DP acts as a master on the PROFIBUS network.

Design

The module contains the following:
- One microprocessor with memory
- One receptacle for 376, 377 memory submodule
- One programming device interface
- One interface for PROFIBUS two-wire line
- One interface for plastic fiber optic cable (PROFIBUS)

Operator controls and indicators on the front panel:
- "RUN" - "STOP" switch
- LEDs for Stop, Run and CP fault

The module requires one slot.

Principle of operation

The CP 5431 FMS/DP communications processor handles data communications via the PROFIBUS network or via the PROFIBUS protocol (PROFIBUS FMS). The functions of a DP master (class 1) in accordance with EN 50 170 can also be used (combi-master functions).

The communications processor relieves the programmable controller of a considerable proportion of communications tasks.
It is programmed using the COM 5431 FMS/DP parameterization software with operator prompting (see Section 7).

The transmission rate can be set via the software (9.6, 19.2, 93.75, 187.5, 500 kbit/s or 1.5 Mbit/s). The preferred transmission rate of 187.5 kbit/s is preset.

Standard function blocks for the user program are available for data communications with the CPU (see Section 7).

Functions of the CP 5431 FMS/DP in accordance with EN 50 170:

- FDL interface:
  Direct access to layer 2 services (PROFIBUS layer 2); PLC-PLC connections

- Global I/O interface: Automatic transmission of I/O areas with global I/O
- Distributed I/O interface: Automatic transmission of I/O areas to PROFIBUS DP slaves
- Programming device interface for local and remote programming via the network
- Clock functions: Network-wide clock synchronization
- FMS user interface (PROFIBUS FMS)
- Cyclic I/O interface: Automatic transmission of I/O areas with cyclic interface

CP 5431 FMS/DP communications processor; PROFIBUS (continued)

Technical specifications

PROFIBUS overview

Access method	• Token passing between the active nodes • Master-slave between active and passive nodes in acc. with EN 50170
Transmission rate	9.6 to 1500 kbit/s, selectable
Transmission mode	Bit-serial
Number of nodes max.	127 (32 per segment)
Protocols	PROFIBUS-FMS PROFIBUS-DP

PROFIBUS electrical

Connection of nodes via	RS 485 bus terminal
Topology	Row/tree structure
Transmission medium	Twisted pair cable
Max. distance between 2 nodes	9.6 km at 9.6 kbit/s

PROFIBUS optical

Connection of nodes	Optical Link Modules	
Topology	Line, ring or star structure	
Transmission medium	Glass fiber optic 62.5/125 μm	Plastic fiber optic 980/1000 μm

	Glass fiber optic	Plastic fiber optic
Max. distance between 2 OLMs	2850 m (9348 ft)	53 m (173.8 ft)
Possible connections		
• No. of optical channels		
OLM P3/S3	1	
OLM P4/S4	2	
OLM P4/S4 electrical channels	3	

5431 FMS/DP comm. processor

Supply voltage	+ 5 V + 5 %; + 24 V + 25/–15 %
Current consumption	
• At 5 V	450 mA
• At 24 V	70 mA with RS 485, Average 100 mA, using both current sources of the programming device interface (terminating resistance irrelevant)
Connection to	
• PROFIBUS (RS 485)	9-pin sub D socket
• PROFIBUS (plastic)	Plastic fiber optic cable, HP-duplex
• Programming device/diagnostics interface	15-pin sub D socket
Permissible ambient conditions	
• Operating temperature	0 °C to + 55 °C
• Transport/storage temperature	– 40 °C to + 70 °C
Space requirements	1 slot
Weight	
• Module	0.4 kg (0.88 lb)
• Memory submodule	0.1 kg (0.22 lb)

Ordering data

	Order No.		Order No.
CP 5431 FMS/DP **communications processor** SINEC L2 interface module for S5-115U/H, S5-35U, S5-155U/H	**6GK1 543-1AA01**	**Bus cable for PROFIBUS (ctd.**) **Bus cable with PE coating**[2)3] 2-wire, shielded	**6XV1 830-0BH10**
		Bus cable (buried) [2)3] 2-wire, shielded	**6XV1 830-3AH10**
COM 5431 FMS/DP **parameter asgmt software**	see Section 7	**Trailing cable** [2)3] 2-wire, shielded	**6XV1 830-3BH10**
CP 5431 FMS/DP manual		**Bus cable for festoon** **mounting** [2)3] 2-wire, shielded	**6XV1 830-0AH10**
German English French	**6GK1 970-5AB01-0AA0** **6GK1 970-5AB01-0AA1** **6GK1 970-5AB01-0AA2**	**Bus cable for PROFIBUS-PA** • blue, for applications in hazardous areas	**6XV1 830-5AH10**
376 memory submodule (EPROM)		• black, for applications in non-harzardous areas	**6XV1 830-5BH10**
16 Kbyte 32 Kbyte 64 Kbyte	**6ES5 376-1AA11** **6ES5 376-1AA21** **6ES5 376-1AA31**	**FIBER OPTIC CABLE** [2] **standard cable, splittable** without connector, sold by the meter, max. 400 m (1312 ft)	see Section 10
377 memory submodule (RAM)		**FLEXIBLE FIBER** [2] **OPTIC CABLE** **trailing cable, splittable** without connector, sold by the meter, max. 200 m (656 ft)	see Section 10
16 Kbyte 32 Kbyte 64 Kbyte	**6ES5 377-1AA11** **6ES5 377-1AA21** **6ES5 377-1AA32**		
RS 485 bus terminal for **PROFIBUS** with connecting cable		**BFOC connector;** single for FIBER OPTIC CABLE, standard cable and trailing cable	**6GK1 901-0DA00-0AA0**
1.5 m (4.92 ft) 3.0 m (9.84 ft)	**6GK1 500-0AA00** **6GK1 500-0AB00**	Additional fiber optic cables, PROFIBUS fiber optic network components and PC modules	see Catalog IK 10
Bus cables for PROFIBUS			
Bus cable[2)3] **2-wire, shielded** **Bus cable, halogen–free** 2-wire, shielded	**6XV1 830-0AH10** **6XV1 830-0CH10**		

1) Up to 187.5 kbit/s

2) Sold by the meter, max. 1000 m (3280 ft), minimum order 20 m (65.6 ft)

SIMATIC S5-135U, S5-155U/H
Communications modules

CP 1430 TF/CP 1430 TCP/CP 1473 MAP communications processors; Industrial Ethernet

Application

CP 1430 TF/1430 TCP communications processor

The CP 1430 TF/1430 TCP communications processor is used for connecting the
- S5-115U/H,
- S5-135U and
- S5-155U/H

programmable controllers to the Industrial Ethernet cell network in accordance with IEEE 802.3.

Mit dem CP 1430 TF können Kommunikationen in Local Area Networks (LAN) aufgebaut werden.

Mit dem CP 1430 TCP können Kommunikationen über Wide Area Networks (WAN) realisiert werden.

CP 1473 MAP communications processor

The CP 1473 MAP communications processor is used for connecting the
- S5-115U/H,
- S5-135U and
- S5-155U/H

programmable controllers to the international standard MAP 3.0 Ethernet network.

Design

CP 1430 TF/1430 TCP communications processor

Two versions of the CP 1430 TF communications processor are available:
- CP 1430 TF Basic
  for using the SEND/RECEIVE interface or few TF connections; up to 64 ISO transport connections (for SEND/RECEIVE) or up to 16 TF connections.
- CP 1430 TF Extended
  for high-end applications, many TF connections and high real-time accuracy (1 ms), up to 100 TF connections or up to 100 ISO transport connections (for SEND/RECEIVE).

The CP 1430 TF and CP 1430 TCP communications processor have the following interfaces:
- 15-pin sub D socket (push-locking) for connection to Industrial Ethernet; switchable to AUI or Industrial Twisted Pair
- 15-pin sub D socket (screw-locking) for connection to programming devices.

Operator controls and indicators on the front panel:
- "RUN" – "STOP" switch
- LEDs for indicating the "STOP", "RUN", "FAULT" and "15 V" states

The module requires one slot.

CP 1473 MAP communications processor

The communications processor has two interfaces:
- 25-pin sub D socket for connection of the PG 720, PG 720 C, PG 740 and PG 760 programming devices
- 15-pin sub D socket for connection to Industrial Ethernet

Operator controls and indicators on the front panel:
- "RUN" – "STOP" switch
- "RESET" pushbutton
- LEDs for indicating the "STOP" and "RUN" states

The module requires two slots.

Principle of operation

The CP 1430 TF, the CP 1430 TCP and CP 1473 MAP handle data communications with the entire network completely autonomously. All layers of the ISO 7-layer reference model are implemented. The communications processors therefore relieve the programmable controller of a large proportion of communications tasks.

The CP 1473 MAP is programmed using the COM 1473 parameterization software with operator prompting. The CP 1430 TF and the CP 1430 TCP is programmed using the COM 1430 TF or COM 1430 TCP parameterization software. Standard function blocks for the user program are avail-able for data interchange with the CPU (see Section 7).

Programming

The PG 720, PG 720 C, PG 740 and PG 760 programming devices can be connected directly to the Industrial Ethernet. In this way, all programmable controllers

can be programmed remotely. Using the programming device multiplexer (see Section 8), several modules can be programmed via one interface.

See Section 10 as well as Catalog IK 10 for further details of the Industrial Ethernet LAN as well as of PC modules.

CP 1430 TF/CP 1430 TCP/CP 1473 MAP communications processors; Industrial Ethernet (continued)

Technical specifications

Industrial Ethernet electrical

Topology	Bus structure
Transmission medium	Triaxial cable 50 ohms
Transmission rate	10 Mbit/s
Transmission mode	Bit-serial
Max. distance between 2 random terminals	0.5 km (0.3 miles) without repeater 1.8 km (1.1 miles) with 2 repeaters 3 km (1.8 miles) with 4 repeaters and 2 x 500 m (1640 ft) fiber opitc cable
Max. number of nodes	100 nodes per segment 1024 nodes for the whole network
Allocation method	CSMA/CD in acc. with IEEE 802.3 (Ethernet)

Industrial Ethernet fiber optic

Topology	Star structure
Transmission medium	Fiber optic cable, fiber 62.5/125 µm
Transmission rate	10 Mbit/s
Transmission mode	Bit-serial
Max. distance between 2 random terminals	Max. 4.6 km (2.7 miles) with 1 active star coupler
Max. number of nodes	1024 nodes for the whole network
Allocation method	CSMA/CD in acc. with IEEE 802.3 (Ethernet)

CP 1430 TF/CP 1430 TCP/ CP 1473 MAP communications processors

Current consumption
- CP 1430 TF/CP 1430 TCP without transceiver

at 5 V	max.	1.7 A

- CP 1430 TF/CP 1430 TCP with transceiver

at 5 V	max.	3.2 A
at 24 V	max.	100 mA

- CP 1473 with 15 V module

at 5 V	max.	4.2 A (2.6 A without transceiver load)

Space requirements
• CP 1430 TF with transceiver	1 slot
• CP 1473 MAP	2 slots

Weight
• CP 1430 TF/ CP 1430 TCP	approx.	0.7 kg (1.54 lb)
• CP 1473 MAP	approx.	0.85 kg (1.87 lb)

Transceiver

Supply voltage	9 to 15 V DC
Current consumption	250 mA (with 1 interface) 490 mA (with 2 interfaces)

Connectors
• For connection to Industrial Ethernet	SINEC bus connector with coaxial socket
• For connection to terminal	15-pin sub D plug
Dimensions (W x H x D) in mm (in)	180 x 85 x 45 (6.92 x 3.26 x 1.73)
Weight approx.	0.64 kg (1.4 lb)

Repeater

Supply voltage	120/220 V AC
Current consumption ma max.	on request
Dimensions (W x H x D) in mm	on request
Weight approx.	on request

SSV 104 fan-out unit

Supply voltage	100 to 240 V AC
Power input	40 W
Dimensions (W x H x D) in mm	432 x 46 x 252
Weight (of desktop unit) approx.	2.1 kg (4.62 lb)

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SIMATIC S5-135U, S5-155U/H
Communications modules

CP 1430 TF/CP 1473 MAP communications processors; Industrial Ethernet (continued)

Ordering data	Order No.		Order No.
Communications processor		**Bus transceiver w/ 2 interfaces**	6GK1 901-0AA00-0AC0
• CP 1430 TF Basic	6GK1 143-0TA02	**for Industrial Ethernet**	
• CP 1430 TF Extended	6GK1 143-0TB01	lets you connect two terminals to	
COM 1430 TF parameter	see Section 7	Industrial Ethernet, incl. assembly	
assignment software		instructions in German, English,	
CP 1430 TF/COM 1430 TF manual		French	
German	6GK1 970-1TA43-0AA0	**SIBUKO transceiver package 2**	6GK1 100-0AB00
English	6GK1 970-1TA43-0AA1	**for Industrial Ethernet**	
French	6GK1 970-1TA43-0AA2	consisting of:	
Italian	6GK1 970-1TA43-0AA4	1 tapping mechanism,	
CP 1430 TCP		1 transceiver,	
communications processor	2XV9 450-1AU00	2 dust protectors for transceiver, 1	
COM 1430 TCP parameter	see Section 7	mounting plate for transceiver,	
assignment software		1 permanent mounting set for	
CP 1430 TCP/COM 1430 TCP		transceiver cable,	
manual		1 instruction (German, English,	
German	2XV9 450-1AU03	French)	
English	2XV9 450-1AU02	**Terminating resistors** (2)	6ES5 755-3AA11
CP 1473 MAP	6GK1 147-3MA00	for Industrial Ethernet	
communications processor		**Coaxial connector**	6ES5 755-4AA11
COM 1473 TCP parameter	see Section 7	(N connector; 2)	
assignment software		for 727-0 bus cable	
with CP 1473 MAP manual		**Repeater**	6ES5 755-1AA12
CP 1473 MAP manual		**SSV 104 fan-out unit**	6GK1 104-0AA00
German	6GK1 970-1MA73-0AA0	for connecting a maximum of	
English	6GK1 970-1MA73-0AA1	8 nodes to Industrial Ethernet	
Connecting cable PG 7xx/CP 1473	6XV1 800-6CH25	**727-1 connecting cable**	
2.5 m (8.2 ft)		for connecting transceiver to node	
CP-PLC cable		Length 3.2 m (11 ft)	6ES5 727-1BD20
for S5-115U/135U/155U		10 m (32 ft)	6ES5 727-1CB00
0.6 m (1.97 ft)	6XV1 800-6FE60	15 m (49 ft)	6ES5 727-1CB50
376 memory submodule (EPROM)		20 m (65 ft)	6ES5 727-1CC00
for CP 1473 MAP		32 m (105 ft)	6ES5 727-1CD20
16 Kbyte	6ES5 376-1AA11	50 m (164 ft)	6ES5 727-1CF00
32 Kbyte	6ES5 376-1AA21	**727-0 bus cable**	6ES5 727-0AA11
64 Kbyte	6ES5 376-1AA31	sold by the meter, without connec-	
Memory card		tor; length to be specified in m	
for CP 1430 TF, long format,		**725-0 connecting cable**	
flash EPROM, 256 Kbyte (16 bit)	6ES5 374-2KH21	for connecting the CP 1430 TF to	
RAM, 256 Kbyte (16 bit)	6ES5 374-2AH21	the module to be programmed	
Bus transceiver	6GK1 901-0AA00-0AA0	(for remote programming)	
for Industrial Ethernet		Length 0.9 m (2.9 ft)	6ES5 725-0AK00
lets you connect a terminal to Indu-		2.5 m (8.2 ft)	6ES5 725-0BC50
strial Ethernet, incl. assembly instruc-			
tions in German, English, French			

135U/155U central controller

Application

The 135U/155U central controller can be used optionally for the construction of a S5-135U, S5-155U or S5-155H programmable controller.

Two 135/155U central controllers are required for a S5-155H programmable controller.

4

Design

The 135U/155U central controller comprises:
- 21 free slots
- 1 power supply chassis with built-in fan

S5-135U, S5-155U

Depending on the extent of the automation task, the central controller can be equipped with the following CPUs:
- CPU 948 (max. 4)
- CPU 928B (max. 4)
- CPU 928 (max. 4)
- CPU 922 (max. 4)

All CPUs can also operate jointly in multiprocessor mode. When more than one of these central modules is used a 923A/923C coordinator is required (see page 4/30).

S5-155H

One CPU 948R can be used per central controller.

Power supply chassis
- Redundant two-out-of-three fan concept;
  Should one fan cease operating the speed of the other fans is increased thus enabling the programmable controller to continue operation. The defective fan can be replaced while the controller is in operation
- Redundant one-out-of-two battery concept;
  In the case of a failure of the main battery (Li battery) the accu battery switches on automatically for a period of three weeks
- Mains buffering to NAMUR: 20 ms
- Enhanced electromagnetic compatibility (EMC)

135U/155U central controller (continued)

Design
Possible configurations S5-135U/155U

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
923 A/C coordinator	■																				
CPU 922, CPU 928A, CPU 928B		■		■		■		■													
CPU 948		■	■	■	■	■	■	■													
IM 300-5, IM 301-5 interface modules[2]																			■	■	■
IM 300-3, IM 301-3, IM 304, IM 308, IM 308-B interface modules																	■	■	■	■	
IM 308-C, IM 307[1] interface modules														■	■	■	■				
Digital input modules, digital output modules	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Analog input modules, analog output modules	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Intelligent I/O modules	For slot assignment, see Section 11																				
Communications processors[3]	For slot assignment, see Section 11																				
Hardware interrupt processing			■		■		■														
PG MUX function via 923C coordinator		■		■		■															
Floating operation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				

1) Jumper selection on the IM 307 must be observed.
   Interrupt transfer is only possible on slots 107 to 131.
2) In the case of 135U with Order No. 6ES5 135-3UA42 only slot 163.
3) Note the functions given in the lower half of the table.

Possible configurations of the S5-155H

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
CPU 946R[4]		■	■																		
Communications processor[6]		For slot assignment, see Section 11																			
Intelligent I/O modules		For slot assignment, see Section 11																			
IM 301-3, IM 304-3, IM 308-3, IM 308-B interface modules																		■	■	■	■
IM 300-5, IM 301-5 interface modules	■																			■	
IM 304 or IM 342R interface module for linking the central controllers[7]																	■	■			
Digital input modules[5], digital output modules	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Analog input modules, analog output modules	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
IM 308-C, IM 307														■	■	■	■	■	■	■	■

4) Occupied slots.
5) Redundant operation of digital input modules is not possible with an input voltage of 115/230 V AC.
6) The space requirements for the separate modules must be taken into account.
7) Subunit A with IM 324R, subunit B with IM 304.

135U/155U central controller (continued)

Principle of operation

Multiprocessor operation
When using several CPUs, every single one processes the tasks assigned to it indepedently from the others. Every CPU features its own user program memory, own time and count cells and own bit memories.

In a time sharing process the coordinator assigns the access to the internal S5 bus cyclically to the individual CPUs. Thus, data collision on the bus is prevented.

Additionally, the coordinator is the intermediate memory for the communication of the

CPUs with each other. Two alternatives are available for that:
- The coupling bit memory exchange for small amounts of data suppored by the system program of the CPUs
- The multiprocessor communication for large amounts of data

4

Ordering data	Order No.		Order No.
135U/155U central controller		**Backup battery** (lithium battery)	**6EW1 000-7AA**
without CPU, without backup battery, with power supply		To be ordered as a separate item:	
• 230/120 V AC, 5 V/18 A, 15V/0.5 A, 24 V/1 A[1]	**6ES5 188-3UA12**	**S5-135U/155U system manual**	see page 4/155
• 230/120 V AC; 5 V/40 A, 15 V/2 A, 24 V/2.8 A	**6ES5 188-3UA22**	**Additional manuals**	see page 4/155
• 24 V DC; 5 V/18 A, 15 V/0.5 A, 24 V/1 A	**6ES5 188-3UA32**	**Replaceable fan**	**6ES5 988-3NB41**
• 24 V DC; 5 V/40 A, 15 V/2 A, 24 V/2.8 A[1]	**6ES5 188-3UA52**	**Accessories, spare parts**	see page 4/155
135U central controller	**6ES5 135-3UA42**		
without CPU, without backup battery			
• 24 V DC; 5 V/10 A			

1) Also for S5-155H

155H central controller

Application

The ZG155H central controller is suitable for building a complete S5–155H programmable controller in a module sub-rack.

Design

The central controller 155H is a module subrack divided into two halves. It has
- 10 slots (left half)
- 11 slots (right half)

Of these slots two each are used for the power supply, two for the CPU and one for the IM 324R/IM 304.

Five (left half) or six (right half) free slots are therefore available.

The 155H is supplied with two 24V DC; 5V,14A power supplies and a fan subassembly.

One or two backup batteries per power supply can also be ordered to back up the CPU (redundant backup).

Possible configurations of S5-155H (redundant configuration)

Pay attention to the number of slots required!

Slot	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Power supplies	■	■									■	■									
CPU 948R/RL			■	■									■	■							
Communications processor						■	■	■	■	■						■	■	■	■	■	■
Signal preprocessing modules						■	■	■	■	■						■	■	■	■	■	■
Interface modules IM 304, IM 324 R					■										■						
Interface module IM 304								■												■	■
Interface module IM 308						■	■									■	■				
Digital inputs/outputs						■	■	■	■	■						■	■	■	■	■	■
Analog inputs/outputs						■	■	■	■	■						■	■	■	■	■	■

Ordering data	Order No.		Order No.
155H central controller without CPU; without backup battery, with two power supplies 24 V DC; 5 V/14 A	**6ES5 188-3UH31**	To be ordered as a separate item: **S5-155H manual** (with description of the 155H)	see Page 4/155
Backup battery	**6ES7 971-0BA00**	**Other manuals**	see Page 4/155
		Accessories, parts	see Page 4/155

183U expansion unit

Application

The 183U expansion unit is designed for centralized and distributed connection to central controllers. It is also suitable for the centralized connection to distributed expansion units for S5-135U and S5-155U.

Design

The 183U expansion unit comprises:
- 21 free slots
- 1 built-in power supply chassis with fans

The 183U can be centrally connected to the central controller or to other expansion units with the IM 312 interface module. In addition the 183U can be connected distributed to central controllers with the IM 310, IM 314, IM 317 and IM 318 interface modules.

A hardware interrupt is not possible in the 183U expansion unit. No battery backup is provided for the RAM.

Possible configurations

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
IM 300 interface module																					■
IM 310, IM 314, IM 317 or IM 318 interface modules	■																				
IM 312-3 interface module																					■
Digital input modules, digital output modules	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Analog input modules, analog output modules	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Intelligent I/O modules	For slot assignment, see Section 11																				
313 monitoring module	■																				■

Ordering data	Order No.		Order No.
183U expansion unit with power supply		To be ordered as a separate item:	
• 230/120 V AC; 5 V/18 A, 15 V/0.5 A, 24 V/1 A	**6ES5 183-3UA13**	**S5-135U/155U system manual**	see page 4/155
		Additional manuals	see page 4/155
• 24 V DC; 5 V/18 A, 15 V/0.5 A, 24 V/1 A	**6ES5 183-3UA22**	**Accessories, spare parts**	see page 4/155

SIMATIC S5-135U, S5-155U/H
Central controllers/Expansion units

184U expansion unit

Application

The 184U expansion unit is designed for the centralized connection to central controllers and expansion units with power supply chassis for S5-135U and S5-155U.

Design

The 184U expansion unit comprises:
- 21 free slots
- 1 fan subassembly

The 184U can be centrally connected to the central controller or to other expansion units by using the IM 312 interface module.

A power supply chassis is not required because the expansion unit is supplied via the connecting cable for the IM 312-5 interface module.

A hardware interrupt is not possible in the expansion unit. Modules with RAM backup cannot be implemented because there is no battery backup for the supply voltage.

Possible configurations

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
IM 312-5 interface module																					■
Digital input modules, digital output modules	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Analog input modules, analog output modules	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Intelligent I/O modules	For slot assignment, see Section 11																				
313 monitoring module	■																				

Ordering data

	Order No.		Order No.
184U expansion unit without power supply		To be ordered as a separate item:	
• With 230/120 V AC fan	**6ES5 184-3UA11**	**S5-135U/155U system manual**	see page 4/155
• With 24 V DC fan	**6ES5 184-3UA21**	**Additional manuals**	see page 4/155
		Accessories, spare parts	see page 4/155

EG 185U expansion unit

Application

The EG 185U expansion unit is suitable for the distributed connection to central controllers and other expansion units S5-135U/155U. In addition, the EG 185U makes switched I/O design possible in the case of the fault-tolerant S5-155H programmable controller.

4

Design

The EG 185U expansion unit comprises:
- 21 free slots
- 1 built-in power supply chassis with fans

The EG 185U can be connected distributed to central controllers or other expansion units with the IM 314, IM 317 and IM 318 interface modules.

All intelligent I/O modules (IP) and communications processors (CP) can be connected in the EG 185U.

Up to 8 communications processors can be programmed via an interface if a 923C coordinator is used.

A hardware interrupt is not possible in the EG 185U expansion unit. A backup battery is provided for the RAM.

Possible configurations when connected to S5-135U, S5-155U

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
923 C coordinator		■																			
IM 300-5 interface module																					■
IM 314, IM 317 or IM 318 interface modules	■																				
IM 308-A interface module																			■	■	■
Digital input modules, digital output modules		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Analog input modules, analog output modules		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Intelligent I/O modules	For slot assignment, see Section 11																				
Communications processors	For slot assignment, see Section 11																				
IM 314R interface module (for the S5-155H)																			■	■	
313 monitoring module	■																				■

SIMATIC S5-135U, S5-155U/H
Central controllers/Expansion units

Design (continued)
Possible configurations when connected
to S5-155H

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
IM 300-5C, IM 308 interface modules; 313 monitoring module																					■
IM 314R interface module																			■	■	
Digital input modules, digital output modules		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■
Analog input modules, analog output modules		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■
Intelligent I/O modules	For slot assignment, see Section 11																				
Communications processors	For slot assignment, see Section 11																				
IM 308-C interface modules[1]			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			

1) Operation in EU only in combination with S5-155H

Ordering data	Order No.		Order No.
185U expansion unit with power supply, without backup battery		To be ordered as a separate item: **S5-135U/155U system manual**	see page 4/155
• 230/120V AC; 5V/18A, 15V/0.5A, 24V/1A	**6ES5 185-3UA13**	**Additional manuals**	see page 4/155
• 230/120V AC; 5V/40A, 15V/2A, 24V/2.8A	**6ES5 185-3UA33**	**Accessories, spare parts**	see page 4/155
• 24V DC; 5V/18A, 15V/0.5A, 24V/1A	**6ES5 185-3UA23**		
• 24V DC; 5V/40A, 15V/2A, 24V/2.8A	**6ES5 185-3UA43**		
Backup battery (lithium battery)	**6EW1 000-7AA**		

187U expansion unit

Application

The 187U expansion unit is designed for the centra-lized connection to central control-lers and expansion units with power supply chassis for S5-135U and S5-155U.

Design

The 187U expansion unit comprises:
• 11 free slots

A power supply chassis, fan and wiring duct are not avail-able.

The 187U expansion unit can be centrally connected to central controllers or other ex-pansion units with the IM 312 interface module.

The power supply is delivered by the connecting cable of the IM 312-5 interface module.

A hardware alarm is not pos-sible in the 187U expansion unit. No battery backup is provided for the RAM.

4

Possible configurations

Note the respective slot requirements of the modules!

Slot No.	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
IM 312-5 interface module																					■
Digital input modules, digital output modules	■		■		■		■		■		■		■		■		■		■		
Analog input modules, analog output modules	■		■		■		■		■		■		■		■		■		■		
313 monitoring module	■																				

Ordering data	Order No.		Order No.
187U expansion unit	**6ES5 187-5UA11**	**Additional manuals**	see page 4/155
To be ordered as a separate item: **S5-135U/155U system manual**	see page 4/155	**Accessories, spare parts**	see page 4/155

SIMATIC S5-135U, S5-155U/H

Power supply modules

Power supply chassis

Technical specifications

Power supply chassis	**6ES5 955**	-3LC41	-3LF41	-3LNC41	-3NF41	-3NA12	-7NC11
Installed in		ZG 135U/155U EG 183U EG185U	ZG 135U/155U EG 185U	ZG 135U/155U EG 183U EG 185U	ZG 135U/155U EG 185U	ZG 135U	ZG 155H
Input voltage							
• Rated value		**230 V/120 V AC**		**24 V DC**	**24 V DC**	**24 V DC**	**DC 24 V**
• Permissible range (including ripple)		187 to 264 V/93 to 132 V		18 to 33 V	18 to 33 V	20 to 30 V	18 to 33 V
Line frequency							
• Rated value		50 Hz					
• Permissible range		47 to 63 Hz					
Input current							
• Rated value		1.5 A (230 V)/ 2.5 A (120 V)	2.6 A (230 V)/ 4.5 A (120 V)	9.5 A	20 A	4.8 A	14 A
• Inrush current max.		26 A for 100 µs	25 A for 2 ms	100 A for 100 µs	200 A for 1 ms	100 A	100 A
$I^2 \cdot t$ value of inrush current		4 A^2s	5.2 A^2s	2,7 A^2s	18 A^2s	20 A^2s	2.7 A^2s
Stored energy time in the event of power failure		20 ms	20 ms	20 ms	20 ms	5 ms	5/20 ms (settable)
Message via separate floating contacts		Fan failure (1 fan), Fan failure (2 or 3 fans), Battery failure				Fan failure, Battery failure	Fan failure, Battery failure
Number of outputs		3 (outputs A1/A2/A3)				2	2
Output voltage (A1/A2/A3)							
• Rated value		5.1 V DC/24V DC/15 V DC				5.1 V DC/24 V DC	5.1V DC/24V DC
• Tolerance		± 0.5 %/(+ 25 %, –12.5 %)/ ± 5 %				± 0.5 % (+ 25 %, – 24 %)	– 0.5 %, + 2% (+ 25%, –12.5%)
Output current (A1/A2/A3)							
• Rated value		18 A/1 A/0,5 A	40 A/2.8 A/2 A	18 A/1 A/0.5 A	40 A/2.8 A/2 A	10 A/0.4 A	14 A/0,1 A
• Permissible range		0.5 to 18 A	1.6 to 40 A	0.5 to 18 A	1.6 to 40 A	0 to 10 A	0.2 to 14 A
Galvanic isolation		Yes				No	Yes
Main buffering		Li battery (3.6 V; 5 Ah)				Li battery (3.6 V; 5 Ah)	Li battery (3.6 V; 1.9 Ah)
Reserve buffering		Accumulator (3.6 V; 1.2 Ah)				–	Li battery (3.6 V; 1.9 Ah)
Input for monitoring the load voltage 24 V		Yes				No	No
Auxiliary voltage							
• 15 V ± 0.5 %		0.5 A	2 A	0.5 A	2 A	—	—
• 24 V + 25 %/– 12.5 %		1 A	2.8 A	1 A	2.8 A	0.4 A	1 A
Power loss max.		80 W	147 W	90 W	153 W	50 W	50 W
Number of integrated fans		3 (2-out-of-3 fan concept; fans can be exchanged during operation)				2	—
Weight approx.		5.8 kg (12.7 lb)				3.8 kg (8.4 lb)	1.3 kg (2.9 lb)

15 V submodule	**6ES5 956-0AA12 (for power supply only 6ES5 955-3NA12)**
Can be installed in	Power supply chassis
Input voltage	24 V auxiliary voltage of the power supply chassis
Input current approx.	Equal to output current
Output voltage	
• Rated value	+ 15 V
• Tolerance	± 0.5 %
Output current max.	0.5 A
Weight approx.	0.2 kg (0.4 lb)

Note:
The power supply units can be switched from 230 V to 120 V supply voltage. 5 V and 15 V ouput voltages are stabilized,
the 24 V output voltage is roughly stabilized.

SITOP load power supplies

Application

The SITOP power family of power supplies is designed for supplying electrical consumers such as actuators or transmitters. The SITOP power family offers a uniform range of regulated power supplies, from 2 A to 40 A, for every application.

The 24 V power supplies of the SITOP family have the following characteristics:
• High efficiency, up to 90%
• Easy mounting on standard rails or on a mounting plate
• Low space requirements
• Accurate output voltage

• Minimal residual ripple
• Integrated short-circuit protection
• Safe electrical isolation
• Compliance with national and international standards

SITOP power basic line

The SITOP power basic line (24 V/2 A to 40 A) has been specially developed and optimized for industrial use. The units are used as load power supplies and for supplying electronic modules with a narrow input voltage range. It has excellent control characteristics, without the need for optional extras at additional cost. With no more than the essential functions, these units represent the optimum solution for industrial customers in terms of price and technology.

SITOP power special line

The SITOP power special line (24 V/5 A to 10 A) is, like the basic line, specially designed for industrial use. The units are particularly suitable for use with distributed I/O (5A, 10 A) and for supplying the ASI bus (2.4 A). The special feature of these units is the extremely narrow and rigid metal case.

It allows installation in applications requiring a low mounting depth, i.e. in machines, tight spaces, U-profiles and switch-boxes at the machine.

SITOP power universal line

The units of the SITOP power universal line (24 V / 2.5 A to 4 A) have been developed for applications with demanding technical requirements. Interference suppression to class B guarantees minimal emitted interference. This means that in addition to industrial operation, the units are also suitable for domestic use, i.e. in building services automation.

For the basic technical specifications, see the following page.

Power supply modules

SITOP load power supplies (continued)

Technical specifications

Equipment series	basic line	special line	universal line
	SITOP power 24 V/2 to 40 A	SITOP power 24 V/5 to 10 A	SITOP power 24 V/2.5 to 4 A
Rated supply voltage	120/230 V AC to 3 400 V AC	120/230 V AC	120/230 V AC
Stored energy time in the event of power failure	> 20 ms; > 3 ms	> 20 ms	> 20 /30 ms (at 120/187 V)
Line frequency			
• Rated value	50/60 Hz	50/60 Hz	50/60 Hz
• Permissible range	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Output voltage			
• Rated value	24 V DC	24 V DC	24 V DC
• Tolerance	± 3%; ±1%	± 3%	± 1%
• Residual ripple	< 150 mV	< 150 mV	< 50 mV
Efficiency, approx.	83 % to 89 %	87 % to 89 %	> 85 %
Line frequency			
• Rated value	50 Hz		
• Permissible range	47 to 63 Hz		
Output current			
• Rated value	2 to 40 A	5 to 10 A	2.5 to 4 A
• Range	0 to 40 A	0 to 10 A	0 to 4 A (up to 50 °C)
Short-circuit protection	Electronic	Electronic	Electronic
Degree of protection (IEC 536)	Class I	Class I	Class I
Galvanic isolation (SELV in acc. with EN 60950)	Yes	Yes	Yes
Radio interference suppression	Class A	Class A (EN 55011)	Class B (VDE 0871)
Degree of protection (IEC 529)	IP 20 and IP 00	IP 20	IP 20
Ambient temperature	0 to + 60 °C	0 to + 60 °C	0 to + 60 °C
Weight	0.5 to 7 kg	0.7 to 1.2 kg	0.5 kg

Ordering data

	Order No.		Order No.
Power supply **SITOP power basic line**		**Power supply** **SITOP power universal line**	
Single-phase, 24 V/2 A	**6EP1 331-1SL11**	Single-phase, 24 V/2.5 A	**6EP1 332-1SH11**
Single-phase, 24 V/5 A	**6EP1 333-1SL11**	Single-phase, 24 V/4 A	**6EP1 332-1SH21**
Single-phase, 24 V/10 A	**6EP1 334-1SL11**	Single-phase, 24 V/20 A	**6EP1 336-1SH01**
3-phase, 24 V/20 A	**6EP1 436-1SL11**	3-phase (500 V), 24 V/20 A	**6EP1 436-1SH01**
3-phase, 24 V/40 A	**6EP1 437-1SL11**		
Power supply **SITOP power special line**			
Single-phase, 24 V/5 A	**6EP1 333-1AL11**		
Single-phase, 24 V/10 A	**6EP1 334-1AL11**		
DC/DC, 30 V/2.4 A	**6EP1 632-1AL01**		

Further information can be found in the catalog for systems engineering KT 10.

Overview

Overview The following overview shows the interface modules and connecting cables used to connect the various expansion units to the central controllers.

Configuration/ transmission mode	Central controller		Expansion unit			Connecting cable
	Programmable controller type	Interface module type	EU type for S5-135U, S5-155U/H	ER type for S5-115U/H/F	Interface module type	Type Length
Centralized up to 2 m (6.5 ft), asymmetrical	S5-135U S5-155U S5-155H[1],	**IM 300-3**	EU 183U	—	**IM 312-3**	0.5 m[2) 0.95 m[2)
		IM 300-5 (-5CA11[)]	EU 184U EU 187U	—	**IM 312-5**	0.5 m[2) 1.5 m[2)
		IM 300-5 (-5LB1[)]	—	ER 701-1	**IM 306**	705-0/ 0.5 ... 2.5 m
		IM 301-3	EU 183U	—	**IM 312-3**	0.5 m[2) 0.95 m[2)
		IM 301-5	EU 184U EU 187U	—	**IM 312-5**	0.5 m[2) 1.5 m[2)
Centralized and distributed up to 100 m (328 ft), symmetrical	S5-135U S5-155U S5-155H[1],	**IM 301-3**	EU 183U		**IM 312-3**	0.5 m[2) 0.5 m[2)
		IM 301-3	EU 183U	ER 701-2 ER 701-3	**IM 310**	705-0/ 1 ... 100 m
		IM 301-5	EU 184U EU 187U		**IM 312-5**	0.5 m[2) 1.5 m[2)
Distributed up to 500 m (1640 ft), symmetrical	S5-135U S5-155U S5-155H[1],	**IM 304**	EU 183U EU 185U	ER 701-2 ER 701-3	**IM 314**	721-0/ 1 ... 500 m
	S5-155H[3)		EU 185U	ER 701-3H	**IM 314R**	721-0/ 1 ... 500 m
Distributed up to 3000 m (9840 ft), serial electrical	S5-135U S5-155U S5-155H[1],	**IM 308**	EU 183U EU 185U	ER 701-2 ER 701-3	**IM 318-3**	Shielded, twisted 2-wire cable
			ET 100U		**IM 318-8**	
Distributed 50 ... 1500 m (164 ... 4920 ft) (each between 2 interface modules), serial optical	S5-135U S5-155U S5-155H[1],	**IM 307**	EU 183U EU 185U	ER 701-2 ER 701-3	**IM 317** **IM 307** (IM 307 not in ER 701-2)	722-2 (fiber optic cable)

1) S5-155H with two-channel I/O modules (fully redundant configuration) or single-channel/single-sided I/O configuration.
2) At its one end, the cable is permanently connected to IM 312, at the other end it is provided with a plug connector for connection to IM 300-, or IM 301-.
3) S5-155H with single-channel I/Os (switched).

4

SIMATIC S5-135U, S5-155U/H

Interface modules

IM 300 and IM 312 interface modules; centralized configuration

Application

The IM 300/IM 312 interface modules are used for centralized configuration of I/O modules and intelligent I/O modules (without page addressing) with a central controller via the following expansion units:

- EG 183U
- EG 184U
- EG 187U

These expansion units can also be connected in centralized configuration with the EG 183U and EG 185U expansion units.

Design

The IM 300 interface module must be plugged into the slot provided in the central controller. The IM 312 interface module is plugged into the expansion unit. Up to four IM 300 interface modules can be used in the central controller, however, not more than two IM 300-5 in the ZG 135U/155U.

One IM 300 interface module can be plugged into each EG 183U or EG 185U expansion unit.

The IM 300 interface module allows two areas of 256 byte to be configured (P and Q areas).

Connecting the EG 184U and EG 187U expansion units

(Expansion units without power supply chassis) The IM 300-5C interface module is to be used in the central controller and the IM 312-5 interface module in the expansion unit (see Fig. 4/49). Power (5 V, internal) is supplied to the EG 184U and EG 187U expansion units by way of the interface modules.

Connection of the EG 183U expansion unit

(Expansion unit with power supply chassis) The IM 300-3 interfacemodule is to be used

in the central controller and the IM 312-3 interface module in the expansion unit (see Fig. 4/47). The IM 312-3 and IM 312-5 interface modules cannot be used simultaneously in one chain.

Connecting additional expansion units

In addition to the aforementioned expansion units, an expansion unit in the ER 701-1 expansion rack of the S5-115U programmable controller can also be connected (see Fig. 4/48). The expansion unit is supplied with power (5 V) by way of the interface module.

Technical specifications

Current consumption (at 5 V)			Space requirements		1 slot
• IM 300	max.	0.6 A	Weight	approx.	0.35 kg (0.77 lb)
• IM 312	max.	0.2 A			
Power loss					
• IM 300	max.	3 W			
• IM 312	max.	1 W			

Ordering data

	Order No.		Order No.
IM 300 interface module		**IM 312 interface module**	
for the central controller		for the expansion units	
		EG 184U or EG 187U;	
• For connecting the EG 184U or EG 187U	6ES5 300-5CA11	• Expansion unit arranged above the central controller, 0.5 m (1.6 ft) cable	6ES5 312-5CA12
• For connecting the EG 183U	6ES5 300-3AB11		
• For connecting the ER 701-0 or ER 701-1	6ES5 300-5LB11	• Location of expansion unit arbitrary, 1.5 m (4.9 ft) cable	6ES5 312-5CA22
		EG 183U;	
IM 306 interface module	6ES5 306-7LA11	• Expansion unit arranged above the central controller, 0.5 m (1.6 ft) cable	6ES5 312-3AB12
for the expansion units ER 701-0, ER 701-1			
705 connecting cable		• Expansion unit arranged below the central controller, 0.95 m (3.1 ft) cable	6ES5 312-3AB32
for connecting the IM 300-5LB interface module to the IM 306			
Length 0.5 m (1.64 ft)	6ES5 705-0AF00	**Terminator for the IM 312-3 interface module**	6ES5 760-0AB11
1.2 m (3.93 ft)	6ES5 705-0BB20		
1.5 m (4.92 ft)	6ES5 705-0BB50	The operating instructions are included in the S5-135U/155U system manual (see page 4/155).	
2.5 m (8.2 ft)	6ES5 705-0BC50		

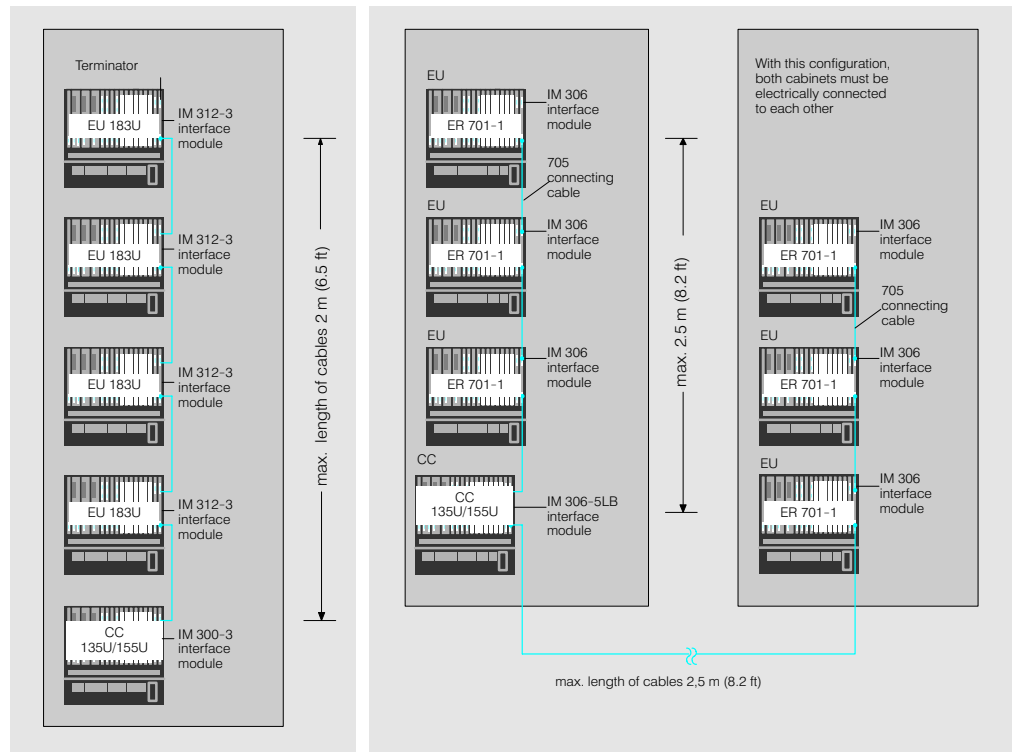**IM 300 and IM 312 interface modules; centralized configuration** (continued)

Fig. 4/47 Connection of expansion units with power supply chassis to the central controller in centralized configuration using the IM 312-3 and IM 300-3 interface modules

Fig. 4/48 Connection of expansion units without power supply chassis to the central controller in centralized configuration using the IM 306 and IM 300-5LB interface modules.
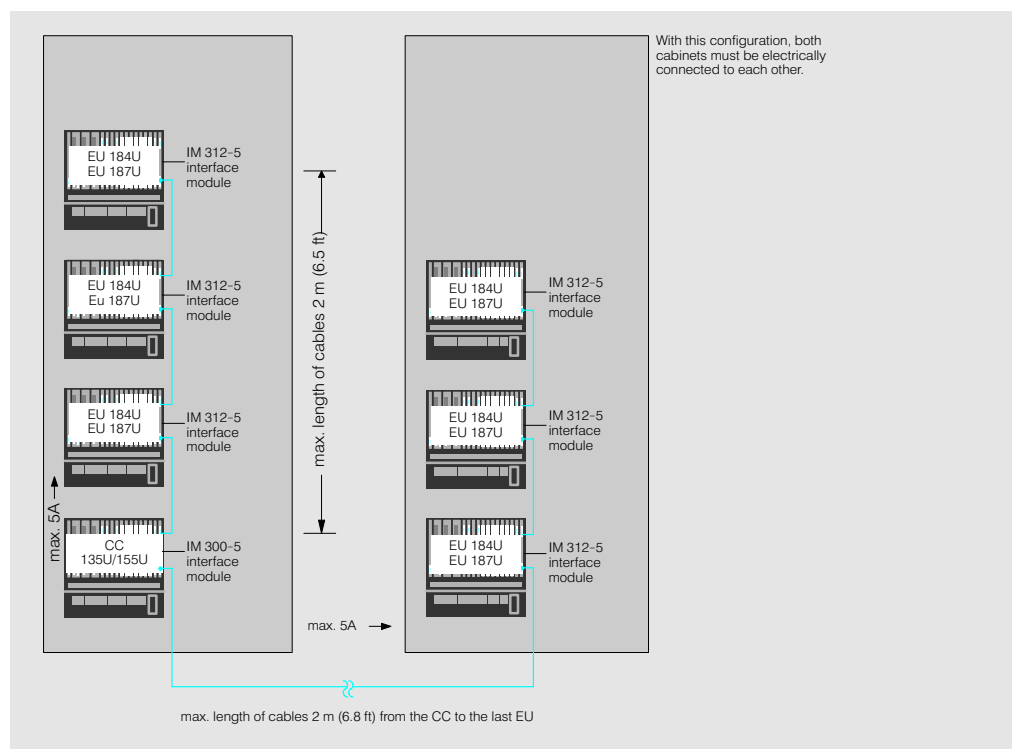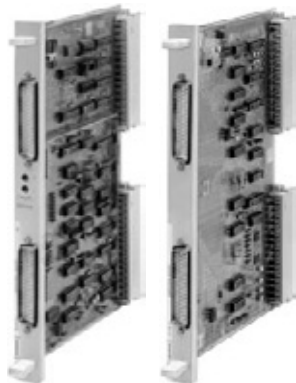

Fig. 4/49 Connection of expansion units without power supply chassis to the central controller in centralized configuration using the IM 312-5 and IM 300-5 interface modules.

SIMATIC S5-135U, S5-155U/H

Interface modules

IM 301 and IM 310 interface modules; distributed configuration up to 200 m (656 ft)

Application

The IM 301/IM 310 interface modules are used for distributed configuration of I/O modules and intelligent I/O modules (without page addressing) with a central controller via the EG 183U expansion unit. The expansion unit can be up to 200 m (656 ft) away from the central controller.

Design

The IM 301 interface module is plugged into the central controller and the IM 310 interface module into the expansion unit. Additional expansion units can be connected in centralized configuration to the distributed EG 183U expansion units. Up to four IM 301 interface modules can be plugged into the central controller.

The IM 301-5 interface module is used if additional EG 184U or EG 187U expansion units are to be connected in a centralized configuration to the central controller.

The IM 301-3 interface module is used if additional EG 183U expansion units are to be connected in a centralized configuration to the central controller.

Terminators must always be inserted into the last IM 310 and into the unused central connectors of the IM 301-3 and the unused distributed connectors of the IM 301-3 and IM 301-5.

The IM 301 interface module allows two areas of 256 byte to be configured (CP and Q areas).

Technical specifications

Current consumption (at 5 V)				Space requirements		1 slot
• IM 301	max.	0.8 A		Weight	approx.	0.3 kg (0.66 lb)
• IM 310	max.	0.7 A				
Power loss						
• IM 301	max.	4 W				
• IM 310	max.	3.5 W				

Ordering data

	Order No.			Order No.
IM 301 interface module		**721 connecting cable**		
for the central controller		1.00 m (3.28 ft)		**6ES5 721-0 BB00**
• For the connection of the	**6ES5 301-5CA12**	1.60 m (5.20 ft)		**6ES5 721-0 BB60**
EG 184U or EG 187U		2.00 m (6.56 ft)		**6ES5 721-0 BC00**
• For the connection of the	**6ES5 301-3AB13**			
EG 183U		2.50 m (8.20 ft)		**6ES5 721-0 BC50**
		3.20 m (10.4 ft)		**6ES5 721-0 BD20**
Terminator for the IM 301		5.00 m (16.4 ft)		**6ES5 721-0 BF00**
• For free distributed	**6ES5 760-0AA11**			
connection of IM 301-3 and		8.00 m (26.2 ft)		**6ES5 721-0 BJ00**
IM 301-5 (bottom)		10.00 m (32.8 ft)		**6ES5 721-0 CB00**
• For free centralized connection		12.00 m (39.3 ft)		**6ES5 721-0 CB20**
of IM 301-3 (top)	**6ES5 760-0AB11**			
		16.00 m (52.4 ft)		**6ES5 721-0 CB60**
IM 310 interface module		20.00 m (65.6 ft)		**6ES5 721-0 CC00**
for the expansion unit	**6ES5 310-3AB11**	25.00 m (82.0 ft)		**6ES5 721-0 CC50**
Terminator for the IM 310	**6ES5 760-0AA11**	32.00 m (104.9 ft)		**6ES5 721-0 CD20**
		40.00 m (131.2 ft)		**6ES5 721-0 CE00**
The operating instructions are		50.00 m (164.0 ft)		**6ES5 721-0 CF00**
included in the S5-135U/155U				
system manual (see page 4/155).		63.00 m (206.6 ft)		**6ES5 721-0CG30**
		80.00 m (262.4 ft)		**6ES5 721-0 CJ00**
		100.00 m (328.0 ft)		**6ES5 721-0 DB00**
		500.00 m (1640 ft)		**6ES5 721-0 DF00**

IM 301 and IM 310 interface modules; distributed configuration up to 200 m (656 ft) (continued)
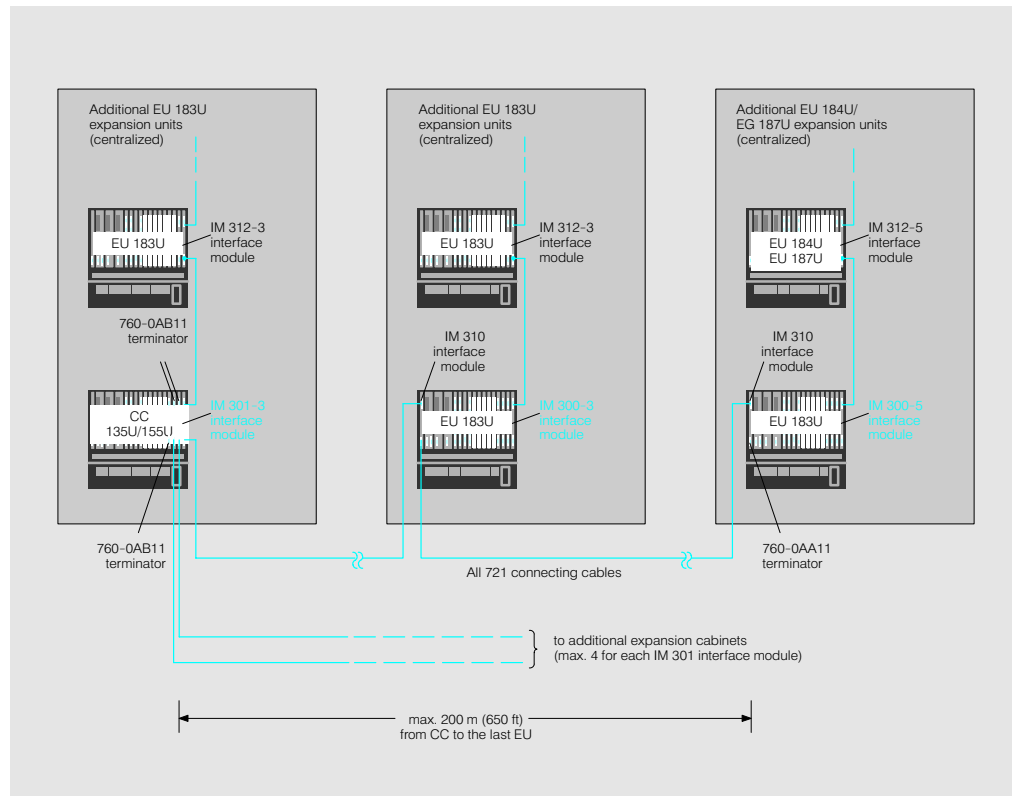

Fig. 4/50 Distributed connection of EG 183U expansion units to the central controller via the
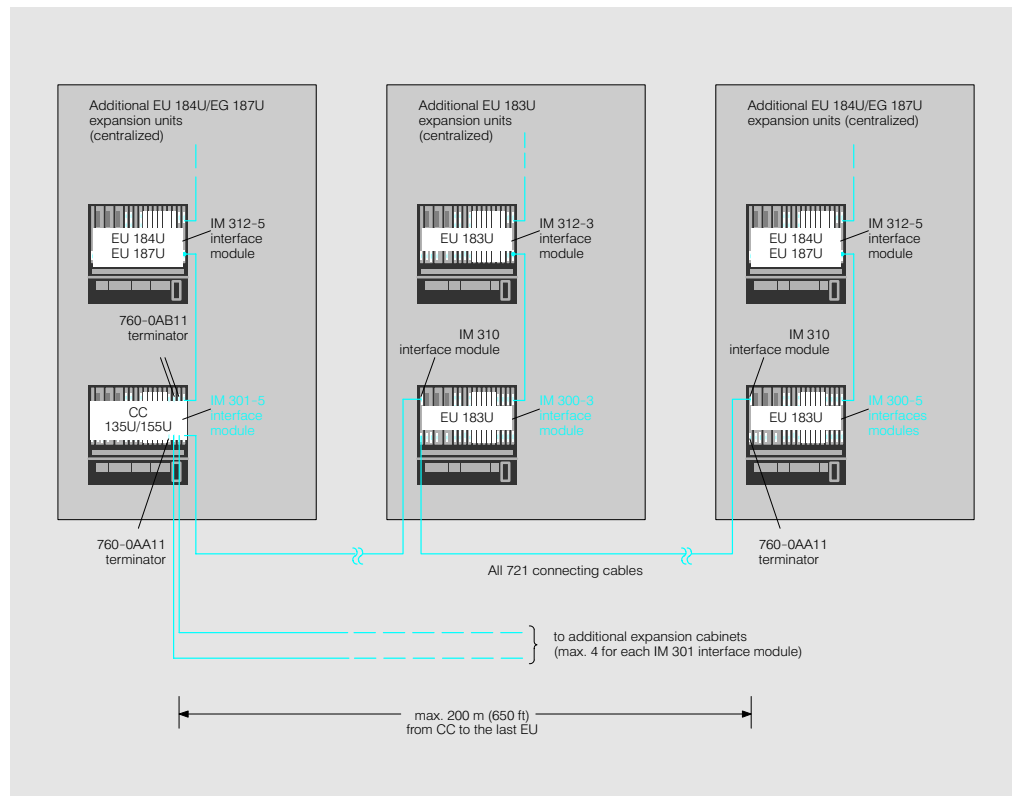IM 310 and IM 301-3 interface modules

Fig. 4/51 Distributed connection of EG 184U/187U expansion units to the central controller via the
IM 310 and IM 301-5 interface modules

SIMATIC S5-135U, S5-155U/H

Interface modules

IM 304 and IM 314 interface modules; distributed configuration up to 600 m (1969 ft)

Application

The IM 304/IM 314 interface modules are used for distributed configuration of I/O modules, intelligent I/O modules and communications processors with a central controller via the following expansion units:

• EG 183U
• EG 185U

The expansion unit can be up to 600 m (1969 ft) away from the central controller.

Design

The IM 304 interface module is plugged into the central controller and the IM 314 interface module into the expansion unit. Additional expansion units can be connected in a centralized configuration to the distributed expansion units. Up to four IM 304 interface modules can be plugged into the central controller.

Terminators must always be inserted into the last IM 314 interface module.

The IM 314 interface module allows four areas of 256 byte to be configured (P, Q, IM 3 and IM 4 areas). The IM 3 and IM 4 areas can only be accessed via absolute addresses.

Technical specifications

Current consumption (at 5 V)			Number of units connectable to one IM 304	4
• IM 304	max.	1.2 A		
• IM 314	max.	1.0 A	Space requirements	1 slot
Power loss			Weight approx.	0.3 kg (0.66 lb)
• IM 304	max.	6 W		
• IM 314	max.	5 W		

Ordering data

	Order No.		Order No.
IM 304 interface module for the central controller	**6ES5 304-3UB11**	**721 connecting cable**	see page 4/142
IM 314 interface module for the expansion unit	**6ES5 314-3UA11**		
Terminator for the IM 314	**6ES5 760-1AA11**		
The operating instructions are included in the S5-135U/155U system manual (see page 4/155).			

IM 304 and IM 314 interface modules; distributed configuration up to 600 m (1969 ft) (continued)
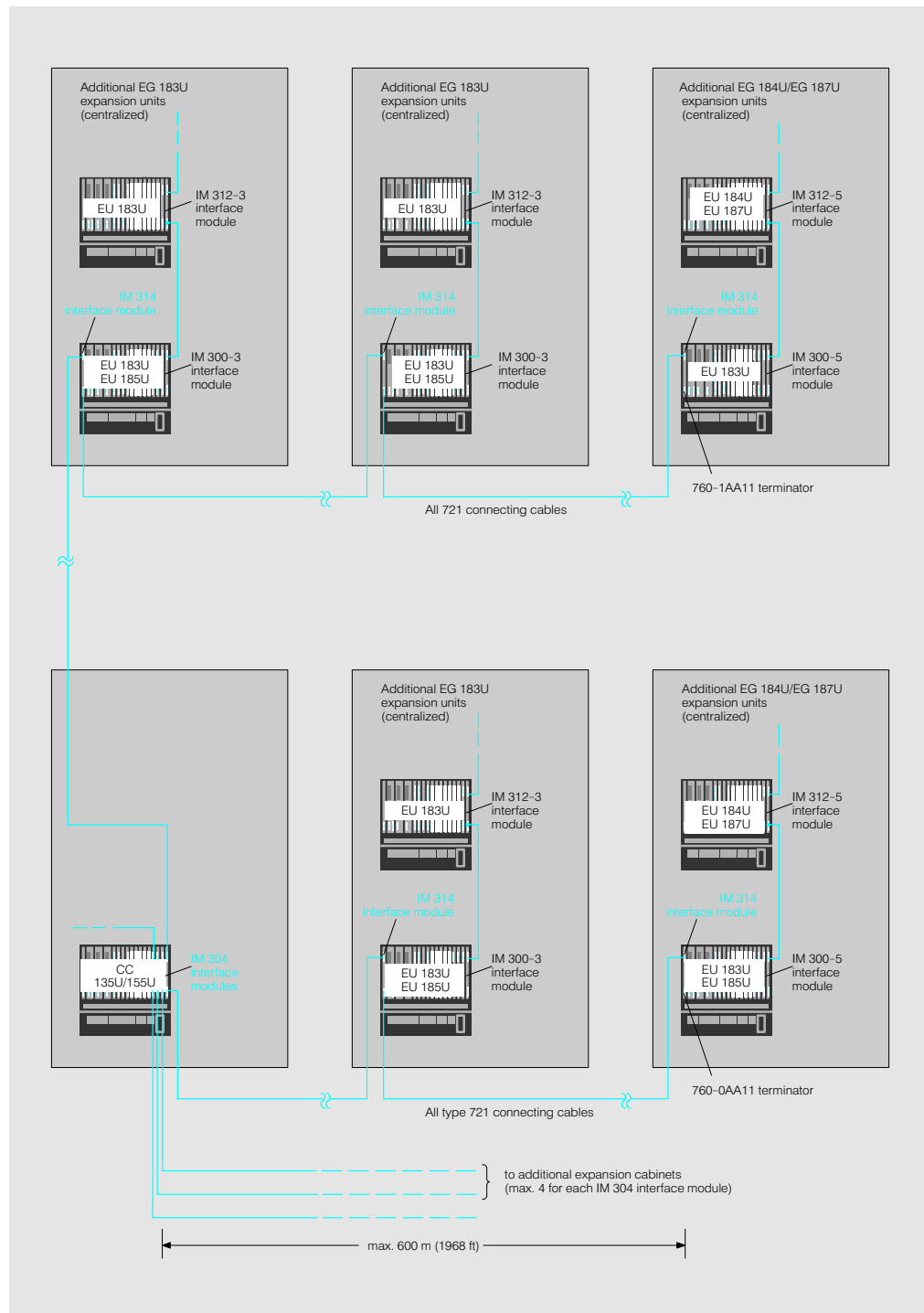
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Fig. 4/52 Connection of expansion units to the central controller in a distributed configuration using the IM 314 and IM 304 interface modules

SIMATIC S5-135U, S5-155U/H

Interface modules

IM 308 and IM 318 interface modules; distributed configuration up to 3000 m (9900 ft) and ET 100U connection

Application

The IM 308/IM 318 interface modules are used for distributed configuration of I/O modules with a central controller via the following expansion units:
• EG 183U
• EG 185U

The ET 100U intelligent electronic terminator can also be connected (see Section 6).

The expansion unit and the electronic terminator may be up to 3000 m (9900 ft) away from the central controller.

Design

The IM 308 interface module is plugged into the central controller and the IM 318-3 interface module into the expansion unit, or the IM 318-8 interface module into the ET 100U electronic terminator. Up to four IM 308 interface modules can be plugged into the central controller.

Two lines, each containing up to 32 expansion units or ET 100U electronic terminators in any order can be connected to an IM 308 interface module. A total of 63 expansion units and ET 100U electronic terminators can operate via one IM 308 interface module. Digital and analog I/Os can be used in the expansion units and electronic terminators, but not intelligent I/Os or communications processors.

A memory submodule containing the address list is only required for the IM 308 if ET 100U electronic terminators are connected to it.

The central controller and the expansion units or electronic terminators are floating with respect to each other.

The IM 308 interface module allows four areas of 256 byte to be configured (P, Q, IM 3 and IM 4 areas). The IM 3 and IM 4 areas can only be accessed via absolute addresses.

Cables

The interface modules are to be connected via two-core cables. The modules are supplied together with connectors for connecting the cables using screw terminals. The connectors are provided with

screw terminals for the incoming and the outgoing line. A terminating resistor (120 Ω; supplied with the IM 308) is to be mounted to the connector of the last IM 318. An expansion unit or an ET 100U electronic terminator can be switched off without affecting operation of the other units.

Selecting the cables: Shielded, twisted two-core cables are to be used. The resistance of a core must not exceed 50 Ω, irrespective of the cable length. The surge impedance should be around 120 Ω. The capacitance per unit length must be as low as possible (< 60 pF/m). The bottom table shows two types of cable that can be used.

Maximum transmission rates, depending on type of cable

and distance to the last unit of a line:

Type of cable	Transmission rate		
Distance	500 m (1640 ft)	1000 m (3280 ft)	3000 m (9840 ft)
Siemens control cable type A[1] 6ES5 707-5AA00	375 kbit/s	187 kbit/s	—
Siemens control cable type B V45551-F21-B5 (1.5 mm², paired)	187 kbit/s	62 kbit/s	31 kbit/s

1) Supplied by the meter

Technical specifications

Transmission rate (selectable)		31, 62, 187 or 375 kbit/s	Power loss			
			• IM 308	max.	2.5 W	
Number of units that can be connected			• IM 318	max.	1.5 W	
			Space requirements		1 slot	
• Per connection	max.	32				
• Total	max.	63	Weight	approx.	0.4 kg (0.88 lb)	
Current consumption (at 5 V)						
• IM 308	max.	0.5 A				
• IM 318	max.	0.3 A				

IM 308 and IM 318 interface modules; distributed configuration up to 3000 m (9900 ft) and connection of the ET 100U (cont.)

| Ordering data	Order No.		Order No.
IM 308 interface module Master interface module for central controller and EG 185U or for connecting up to 63 ET 100Us with S5-115U/H, S5-135U or S5-155U/H programmable controllers via plug-in connection and three terminating resistors	**6ES5 308-3UA12**	**IM 318-3 interface module** Slave interface module for EG 183U and EG 185U expansion units To be ordered as a separate item: **Manual** **Distributed I/Os,** **IM 308-3U/318-3U**	**6ES5 318-3UA11**
IM 318-8 interface module Slave interface module for ET 100U electronic terminator	**6ES5 318-8MA12**	German English French	**6ES5 998-2DP11** **6ES5 998-2DP21** **6ES5 998-2DP31**
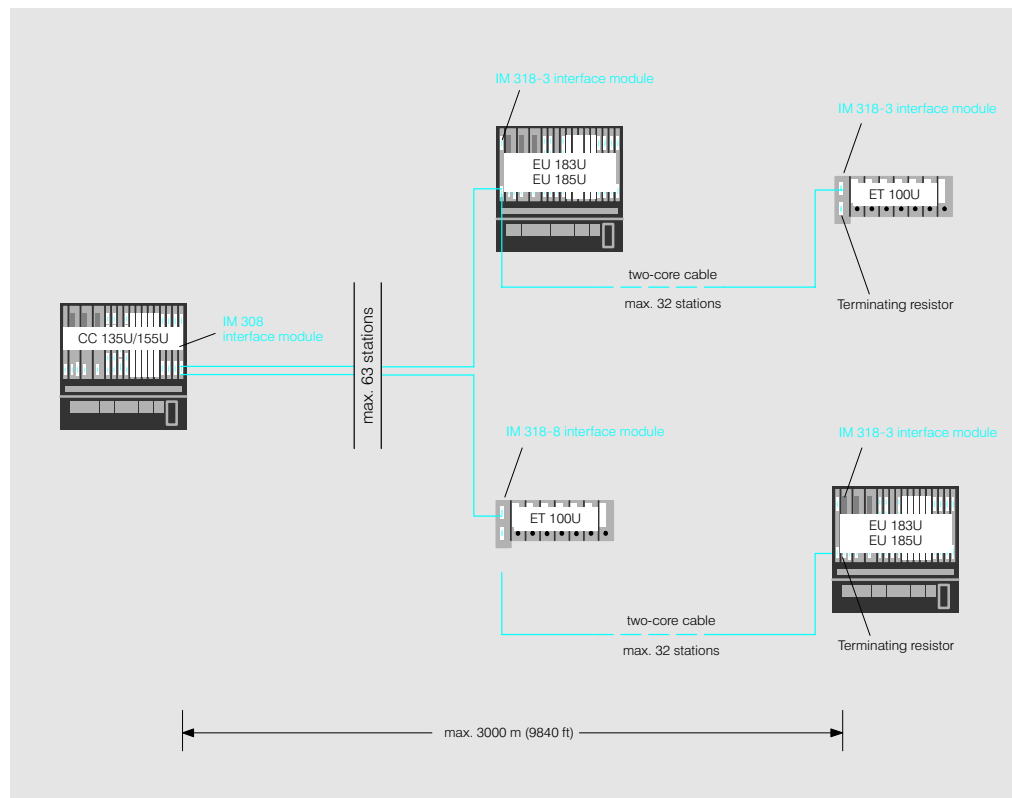
Fig. 4/55 Connection of expansion units and ET 100U to the central controller in a distributed configuration using the IM 318 and IM 308 interface modules

SIMATIC S5-135U, S5-155U/H

Interface modules

IM 308-C interface module; PROFIBUS-DP interface for S5-115U/H up to S5-155U/H

Application

The IM 308-C is a PROFIBUS-DP master and/or slave module for SIMATIC S5-115U/H up to S5-155U/H.

Up to 122 passive users like, for example, ET200 distributed I/O devices, the S5-95U/DP or field devices with PROFIBUS-DP interface can be connected to an IM 308-C interface module.

Design

The IM 308-C interface module must be plugged into the slot designed for it in the S5-115U/H up to S5-155U/H programmable controller.

The module requires a single-width slot.

The connection to the PROFIBUS LAN is made via

- a RS 485 bus interface plug or
- a RS 485 bus terminal.

Principle of operation

As master module, the IM 308-C interface module coordinates the bus access and the data transfer to the PROFIBUS-DP.

It can also operate as PROFIBUS-DP slave and thus makes data exchange with other PROFIBUS-DP masters possible.

The master and slave function can be used in combination, i.e. as a slave, an IM 308-C interface module receives data from another programmable controller and simultaneously works as master of e.g. ET 200 I/O components.

- Global Control: Sync, Freeze of I/O devices
- Address volume: 13 Kbyte data from the CPU can be addressed per IM 308-C
- Shared Inputs: the inputs of a slave can be read by several IM 308-C interface modules

Configuration

Configure this module with the configuration package COM PROFIBUS (see Section 7).


Technical specifications

Transfer rate	9.6 kbit/s up to 12 Mbit/s	Data volume	244 byte inputs and outputs per slave
Interfaces at PROFIBUS	9-pin sub D socket	Permissible environmental conditions	
Supply voltage (via backplane bus)	+5 V DC	• Operating temperature	0 °C to +60 °C
Current consumption at 5 V DC max.	0.6 A	• Transport/storage temperature	-40 °C to +70 °C
Address volume for inputs, outputs and diagnostics	13 Kbyte	• Relative humidity	5 to 95 %
		Mechanical design	
Number of I/O devices which can be connected	max. 122 ET 200 U/B/C, S5-95U/DP and/or other field devices	• Module format	Double eurocard
		• Dimensions (W × H) in mm	160 × 233.4
		• Weight approx.	0.5 kg
		• Space requirements	1 slot

Ordering data	Order No.		Order No.
IM 308-C interface module for connecting the SIMATIC S5-115U/H, S5-135U, S5-155U/H to PROFIBUS-DP, with memory card (256 kByte)	**6ES5 308-3UC11**	**Memory card** 256 Kbyte EPROM 1 Mbyte EPROM	**6ES5 374-1KH21** **6ES5 374-1KK21**

IM 304 and IM 324R interface modules for interfacing the S5-155H central controllers

Application
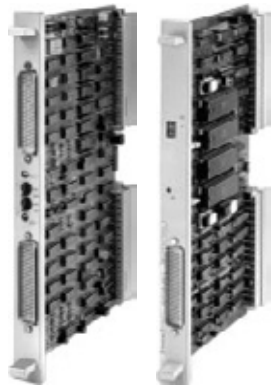
The IM 324R and IM 304 interface modules are used for linking the two ZG 135U/155U central controllers with a S5-155H failsafe programmable controller.

Design

The IM 324R interface module is plugged into the first central controller (subunit A) and the IM 304 interface module into the second central controller (subunit B). The two interface modules are connected via a 721 connecting cable (max. 100 m (328 ft)).
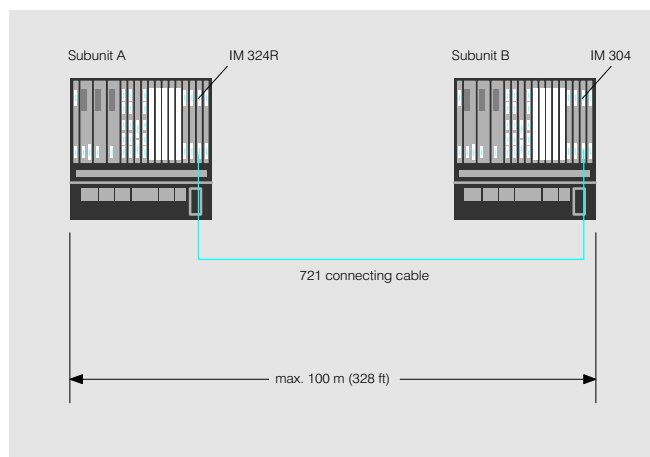

Fig. 4/56 Interfacing of the two central controllers

Principle of operation

The two IM 324R and IM 304 interface modules handle all data communications between the two central controllers of the failsafe programmable controller.

Technical specifications				
Current consumption (at 5 V)			Space requirements	1 slot
• IM 304	max.	1.5 A	Weight	0.3 kg (0.66 lb)
• IM 324R	max.	1.0 A		
Power loss				
• IM 304	max.	7.5 W		
• IM 324R	max.	5 W		

Ordering data	Order No.		Order No.
IM 304 interface module for linking the central controllers of the S5-155H	**6ES5 304-3UB11**	**721 connecting cable**	see page 4/142
IM 324R interface module for linking the central controllers of the S5-155H	**6ES5 324-3UR11**		

SIMATIC S5-135U, S5-155U/H
Interface modules

IM 304 and IM 314R interface modules for switched configuration at S5-155H

Application

The IM 304 and IM 314R interface modules are used for the single-channel configuration of the I/O modules of a S5-155H redundant programmable controller.

In addition, the interface modules are recommended for the three-channel input configuration when connecting the EG 185U expansion unit.

Design

An IM 304 interface module is plugged into each of the two central controllers. Two IM 314R interface modules are plugged into each expansion unit. The interface modules must be interconnected via 721 connecting cables (max. 600 m (1968 ft)). A terminating resistor must be plugged into the last interface module in each chain.

The expansion units (EG 185U) can be situated up to 600 m (1968 ft) away from the central controllers. A maximum of eight lines, each with up to four expansion units, can be connected to the central controllers. The maximum number of expansion units which can be connected is 16.

The following can also be connected to each EG 185U expansion unit:

- Expansion units EG 183U, EG 184U and EG 187U in a centralized configuration using IM 300 interface modules
- Expansion unit EG 183U and the ET 100U electronic terminator in distributed configuration using IM 308 interface modules
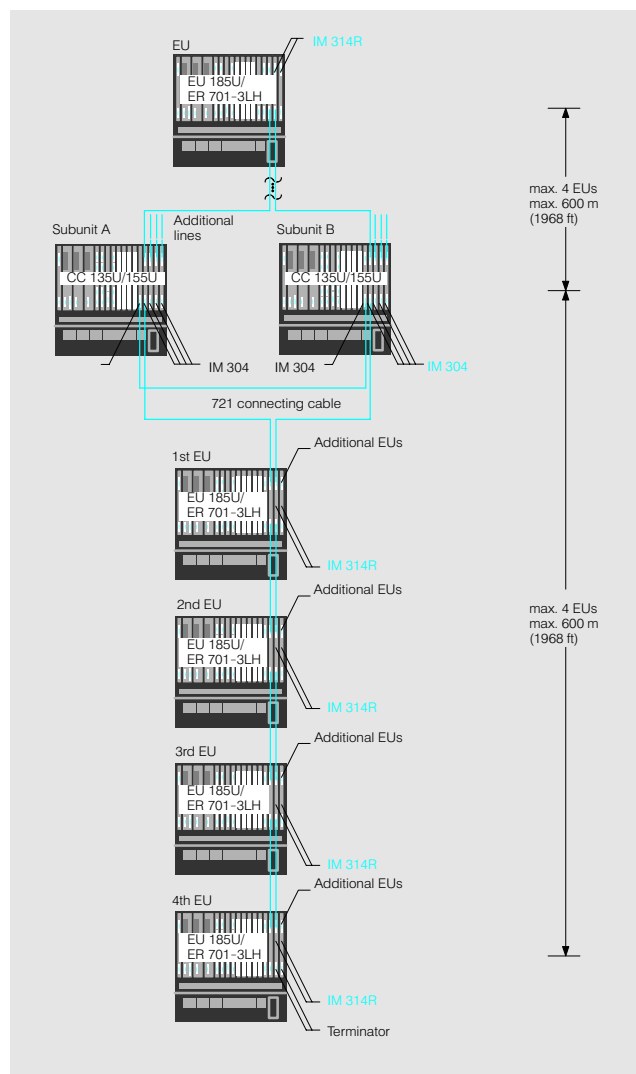- The ET 200 distributed I/O system using the IM 308-C interface module (see Section 6)

Fig. 4/57 Distributed switched I/O configuration

IM 304 and IM 314R interface modules for switched configuration at S5-155H (continued)

Principle of operation The IM 304 and IM 314R interface modules handle all data communications between the respective central controller and the expansion unit.

Technical specifications

Current consumption (at 5 V)			Space requirements		1 slot
• IM 304	max.	1.5 A	Weight	approx.	0.3 kg
• IM 314R	max.	1.0 A			
Power loss					
• IM 304	max.	7.5 W			
• IM 314R	max.	5 W			

Ordering data

	Order No.		Order No.
IM 304 interface module for the central controller	**6ES5 304-3UB11**	**721 connecting cable**	see page 4/142
IM 314R interface module for the EG 185U expansion unit	**6ES5 314-3UR11**		
Terminator for IM 314R	**6ES5 760-0HA11**		

SIMATIC S5-135U, S5-155U/H
Supplementary equipment

Front connectors

Application
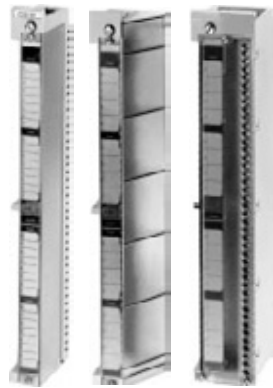
Front connectors must be used to terminate the signal cables for input and output modules. Either crimp terminals or screw terminals can be selected for all modules. Connector sleeves are not required.

Design

The front connectors are hooked into the module at the bottom, swung towards the module and bolted at the top.

The width of the front connectors corresponds to one of the following:
- 1 slot (single-width) or
- 2 slots (double-width).

Double-width front connectors should always be used for double-width modules or if the slot adjacent to the module at the right is unused (always in the EG 187U expansion unit; without fan).

Stranded conductors should be used for easy movement of the front connectors.

Further types of connection with modified front connectors, prepared cables and terminals for sensors and actuators can be found in the Catalog KT 10 (SITOP power).

Technical specifications

Front connector	6ES5 497-...	Space in the front connector	
Connection	Crimp terminals or screw terminals	• Cross-section approx.	470 mm^2
		• Number of cables	
Conductor cross-section		with 2.5 mm^2 max.	24
• Crimp terminals	0.5 ... 1.5 mm^2	with 1.5 mm^2 max.	36
• Screw terminals	0.5 ... 2.5 mm^2	with 0.5 mm^2 max.	48
		Weight approx.	0.2 kg (0.44 lb)

Ordering data

	Order No.		Order No.
497-4UA front connector for crimp terminals (without crimp contacts)		**497-4UB front connector** for screw terminals	
• Width = 1 slot, 42-pin for the following modules (with fan) 6ES5-420.., -430.., -431.., -432.., -434.., -441.., -451.., -458.., -460.., -463.., -465.., -470.., -482..	**6ES5 497-4UA12**	• Width = 1 slot, 42-pin for the following modules (with fan) 6ES5-420.., -430.., -431.., -432.., -434.., -441.., -451.., -458.., -460.., -463.., -465.., -470.., -482..	**6ES5 497-4UB31**
• Width = 2 slots, 42-pin for the modules 6ES5-453.., -454.., -457.., -482..; for the following modules (without fan) 6ES5-420.., -430.., -431.., -432.., -434.., -441.., -451, -458.., -460.., -463.., -465.., -470..	**6ES5 497-4UA22**	• Width = 2 slots, 42-pin for the modules 6ES5-453.., -454.., -457.., -482..; for the following modules (without fan) 6ES5-420.., -430.., -431.., -432.., -434.., -441.., -451.., -458.., -460.., -463.., -465.., -470..	**6ES5 497-4UB12**
• Width = 2 slots, 20-pin for the following modules 6ES5-435.., -436.., -455.., -456.., -951..	**6ES5 497-4UA42**	• Width = 2 slots, 25-pin for the module 6ES5-454..	**6ES5 497-4UB22**
		• Width = 2 slots, 20-pin for the following modules 6ES5-435.., -436.., -455.., -456.., -951..	**6ES5 497-4UB42**

4

Front connectors (continued)

Ordering data (continued)

	Order No.		Order No.
Front connector K for 6ES5-466..		**Crimp contacts**	**6XX3 070**
• For screw terminals Width = 1 slot, 43-pin;	**6XX3 081**	pack of 250	
• For crimp terminals Width = 1 slot, 43-pin;	**6XX3 068**	**Crimping tool** for crimping crimp contacts	**6XX3 071**
LED extension for front connector with		**Extraction tool** for crimp contacts	**6ES5 497-4UC11**
• screw terminals	**6ES5 497-4UL21**		
• crimp terminals	**6ES5 497-4UL11**		

Manuals, further accessories

Ordering data

	Order No.		Order No.
S5-135U/155U system manual with operating instructions for CC, EU, CPU, IM 300 to IM 314 interface modules, digital input and output modules and analog input and output modules		**Manuals** (continued) **S5-135U/155U pocket guide** for CPU 922, CPU 928, CPU 928B and CPU 948; G, GB, F, E, I	**6ES5 997-3UA■3**
German	**6ES5 998-0SH11**	German	
English	**6ES5 998-0SH21**	English	
French	**6ES5 998-0SH31**	French	
Spanish	**6ES5 998-0SH41**	Spanish	
Italian	**6ES5 998-0SH51**	Italian	
			1
Programming instructions			2
• for CPU 922 G, GB, F, E	**6ES5 998-0PR■1**		3
• for CPU 928 G, GB, F, E	**6ES5 998-1PR■1**		4
• for CPU 928B G, GB, F, E, I	**6ES5 998-2PR■1**		5
• for CPU 948 G, GB, F, E, I	**6ES5 998-3PR■1**	**S5-155H manual** with operating instructions for S5-155H, programming guide and CPU 948R/RL quick refer- ence	
Communications manual for CPU 928B G, GB, F, E, I	**6ES5 998-0CN■2**	German	**6ES5 998-4SR11**
		English	**6ES5 998-4SR21**
S5-135U/155U manual for		French	**6ES5 998-4SR31**

• **CPU 922** with S5-135U/155U
  system manual and program-
  ming instructions CPU 922;
   G, GB, F, E
	6ES5 998-0UL■3	**Power supply chassis**
		• 230V/120V AC; 5V, 18A;
		  24V, 1A; 15V, 0.5A
		  for ZG 135U/155U, EG 183U
		  and EG 185U
			6ES5 955-3LC41

• **CPU 928** with S5-135U/155U
  system manual and program-
  ming instructions CPU 928;
   G, GB, F, E
	6ES5 998-1UL■4	• 230V/120V AC; 5V, 40A;
		  24V, 2.8A; 15V, 2A
		  for ZG 135U/155U and
		  EG 185U
			6ES5 955-3LF41

• **CPU 928B** with S5-135U/155U
  system manual, communica-
  tions manual for CPU 928B/
  CPU 948 and CPU 928B pro-
  gramming instructions;
   G, GB, F, E, I
	6ES5 998-2UL■4	• 24V DC; 5V, 18A; 24V, 1A;
		  15V, 0.5A
		  for ZG 135U/155U,
		  EG 183U and EG 185U
			6ES5 955-3NC41

• **CPU 948** with S5-135U/155U
  system manual, communica-
  tions manual for CPU 928B/
  CPU 948 and CPU 922 pro-
  gramming instructions;
   G, GB, F, E, I
	6ES5 998-1UM■2	• 24V DC;5V, 40A; 24V, 2.8A;
		  15V,2A
		  for ZG 135U/155U and
		  EG 185U
			6ES5 955-3NF41

		• 24V DC; 5V, 10A; 24V, 0.8A for ZG 135U	**6ES5 955-3NA12**
German	1	**Fan chassis for EG 184U**	
English	2	• 230/120V AC	**6ES5 988-3LA11**
French	3	• 24V DC	**6ES5 988-3NA11**
Spanish	4	**Spare fan** for CC and EUs with power supply chassis 6ES5 955-3..41	**6ES5 988-3NB41**
Italian	5		

SIMATIC S5-135U, S5-155U/H

Supplementary equipment

Manuals, further accessories (continued)

Ordering data (continued)	Order No.		Order No.
Accessories for ZG 135U/155U, EG 183U to EG 187U (cont.)		**Accessories for ZG 135U/155U, EG 183U to EG 187U** (cont.)	
Spare fan (set of 2)		**Dust filter (set of 10)**	6ES5 981-0EA11
• 230V AC for 6ES5 955-3LC14/-3LF12 and 6ES5 988-3LA11	6ES5 988-3LB21	for dust filter holder 6ES5 981-0FA11	
• 24V DC for 6ES5 955-3NA12/ -3NC13/-3NF11 and 6ES5 988-3NA11	6ES5 988-3NB11	**Dummy front plates** for covering free slots	
		• Width 1 slot	6XF2 008-6KB00
Backup battery		• Width 2 slots	6XF2 016-6KB00
• For power supply chassis (3.4V, 5Ah)	6EW1 000-7AA	**15 V module**	6ES5 956-0AA12
• For memory submodules with RAM (3V, 0.2Ah)	6ES5 980-0DA11	for building into power supply chassis 6ES5 955-3NA12/ -3NF11/-3LF12 for supplying the	
Rechargeable battery for power supply chassis 6ES5 955-3xx41	6ES5 980-0NC11	bus connector for Industrial Ethernet. All other power supply chassis do not require a 15 V module.	
Baffle plate for improving the cooling of devices with fan; air entry from lower front side, air exit upper back side	6ES5 981-0DA11	**Accessories for ZG 155H**	
		Power supply 24 V DC; 5 V, 14 A	6ES5 955-7NC11
Dust filter holder for CC and EUs with power supply chassis 6ES5 955-0FA41	6ES5 981-0FA41	**Fan subassembly** 24 V DC	6ES7 408-1TA01-0XA0
Dust filter (set of 10) for dust filter holder 6ES5 981-0FA41	6ES5 981-0EA41	**Replacement fan**	6ES7 408-1TA00-6AA0
		Dust filter (10 items)	6ES7 408-1TA00-7AA0
Dust filter holder for CC and EUs with power supply chassis 6ES5 955-3LC14/ -3LF12/-3NA12/-3NC13/-3NF11, 6ES5 988-3xA11	6ES5 981-0FA11	**Backup battery** Lithium, type AA 3.6 V; 1.9 Ah	6ES7 971-0BA00