STEP 5 programming software

Application

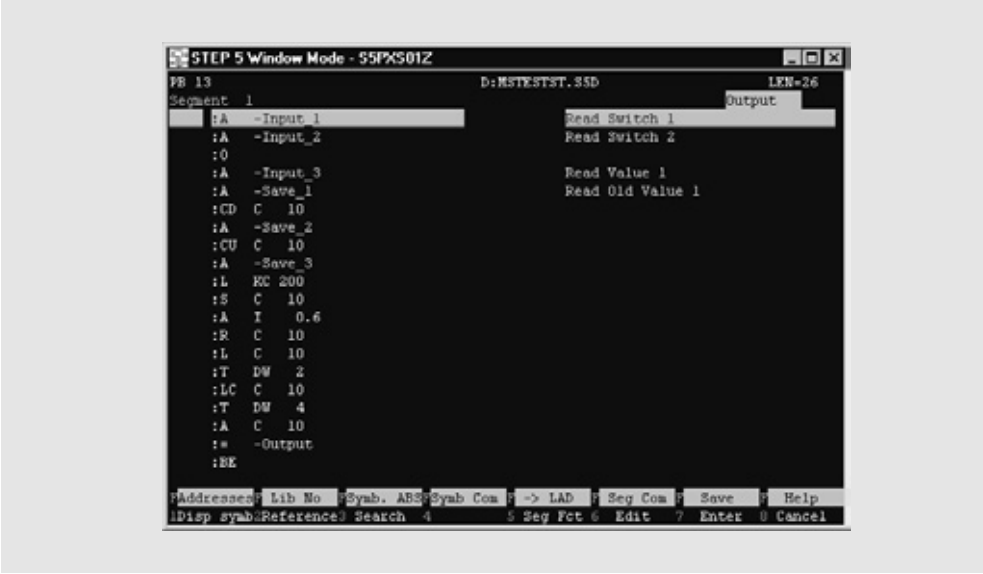

Fig. 7/2 STEP 5, STL representation

STEP 5 is the time-tested programming software for SIMATIC S5 programmable controllers. With STEP 5 it is possible to create, test and document user programs for all SIMATIC S5 programmable controllers.

STEP 5 is an attractive solution for all S5 users:

- Ergonomic user interface according to the SAA standard;
  makes STEP 5 user friendly and easy to operate
- Novell-based network capability; facilitates data maintenance and archiving considerably
- Large range of functions; manages even complex tasks without great effort

STEP 5 is available in two variants:

- STEP 5/ST basic package for programming devices and PCs;
  for programming, testing, documenting, installing and automatic documentation of S5 programs for the programmable controllers S5-90U, S5-95U/F, S5-100U, S5101-U, S5-115U/H/F,S5-135U, S5-150U and S5-155U/H.
- STEP 5/ST for mini PLCs for PC;
  STEP 5/ST for mini PLCs is specially for programming the mini controllers S5-90U, S5-95-U/F and S5-100U. Only the following software packages are executable: GRAPH Mini, COM IP 266, COM GRAPH, COM Text, COM 95F, COM DB1, COM 521 BASIC.
  All other COM packages and optional packages cannot be used.

STEP 5 runs under the operating systems

- MS-DOS 5.0 or higher
- Windows 3.x and
- Windows 95

on

- PG 730, PG 750, PG 770
- PG 720, PG 740, PG 760
  or
- AT-compatible PC.

At least 4 megabytes of RAM are required.

Design

STEP 5/ST basic package for programming devices and PCs

The scope of supply includes:

- STEP 5 programming software (including KOMDOK)
- STL editor/batch compiler
- COM DB 1 parameterization software

The basic package is installed on the programming devices PG 720, PG 740 and PG 760 as standard software. If it is required for a PC it is supplied on CD and diskettes.

STEP 5/ST for mini controllers

The scope of supply includes:

- STEP 5 programming software for mini controllers; based on the STEP 5 programming language.

STEP 5 for mini controllers is only supplied for PC on CD and diskettes.

STEP 5 programming software (continued)

Function
Structured programming

With STEP 5 it is possible to program clearly from simple AND/OR operations to complex functions, e.g. switch off delays or arithmetic calculations. A STEP 5 program can be several thousand statements long. To keep programs as clear as possible, STEP 5 features several control structures:

- Blocks
  A linear sequence of commands is subdivided into sections and each section packed into a block. There are different types of blocks for different technological subtasks of a program.
  The executable program consists of calls of blocks in other blocks. Nesting is possible to a depth of 32 levels.
- Segments
  For fine structuring inside blocks subtasks can be programmed in individual segments. Segments can be copied from one block to another.
- Comments
  A complete program, blocks, segments and individual statements can be commented directly. This ensures that the program remains understandable on every level of abstraction.

Methods of representation

STEP 5 can be programmed in three methods of representation:

- Statement list (STL):
  The program consists of a sequence of mnemonic abbreviations of the commands to be executed by the programmable controller.
- Ladder diagram (LAD):
  Graphic representation of the automation task with circuit diagram symbols (American representation)
- Control system flowchart (CSF):
  Graphical method of representing the automation task with symbols according to DIN 40700/DIN 40719

With all three methods of representation, absolute or symbolic designations for operands can be used.

In LAD and CSF, complex functions and function block calls can be entered using the function keys. They are displayed as graphic symbols on the screen.

Programs that were created in STL cannot necessarily be displayed in LAD or CSF because STL has several features of its own. However, programs in LAD or CSF can be translated to STL. LAD and SCF are largely mutually compatible.

Fig. 7/3 Compatibility of the STEP 5 methods of representation

STEP 5 programming software (continued)

Function (continued)
Blocks

There are 5 types of block:
- Organization blocks (OB); for organizing the control program
- Program blocks (PB); contain the control program, subdivided according to functional or technological criteria
- Sequence blocks (SB); for programming sequential control systems
- Function blocks (FB); contain frequently recurring or especially complex parts of the program (e.g. signaling and calculation functions). Function blocks can be parameterized and have an extended operation set
- Data blocks(DB) for storing data that is required to process the control program, e.g. actual values, limit values, texts

Types of operation

STEP 5 makes a distinction between three types of operation:
- Basic operations; e.g. logic operations, storage operations, loading and transferring, timer operations, counter operations, comparison operations, arithmetic operations, block operations. They can be executed in organization, program, sequence and function blocks.

Except for addition (+F), subtraction (-F) and organizational operations they can be executed in all three methods of representation
- Supplementary operations; complex functions, e.g. substitution statements, test functions, word logic, decrementing/incrementing and branching functions. This can only be executed in STL.
- System operations; These access the operating system directly and must therefore only be used by experienced programmers. They can only be executed in STL.

Additional functions

A whole range of easy-to-use additional functions make program handling easy:
- Storage of user-specific project settings
- Symbol editor; for creating and automatically updating assignment lists for the symbolic programming of blocks
- Automatic generation and updating of cross-reference lists
- Comparison of user programs between diskette, hard disk, PLC or EPROM
- Transfer of blocks to EPROM or EEPROM submodules for the programmable controllers
- Rewiring of inputs, outputs, flags, timers and counters (i.e. renaming operands in the entire user program or individual blocks)

Test- and service fuctions

For commissioning and maintenance, STEP 5 provides a number of test and service functions;
- Direct and program-dependent signal state display, i.e. status of variables or blocks (program status)
- Control of outputs, flags etc.
- Detection of double assignment of bit, byte and word addresses for I/Q/F/S

Program documentation

With the menu "documentation" it is possible to output the following documentation on a printer:
- Complete programs or program sections, if necessary with comments
- Cross-reference lists for operand symbols(I/Q/F/T/C/S) and/or individual operands (e.g. I 1.7)
- Program overview display, if necessary with call structure of all blocks of a complete program
- Assignment plan for inputs, outputs, flags, timers and counters
- Assignment lists with comments (up to 40 characters per assignment)

In addition to standard output, user-friendly output of documentation functions (previously called KOMDOK) can be used. It permits, for example, automation of printout using control statements or graphic preparation, sorting and evaluation of program data.

7

STEP 5 programming software (continued)

Function (continued)
STEP 5 Version 7.0

STEP 5 Version 7.0 includes a whole range of improvements and innovations over the previous version.

Real DOS application

Version 7.0 is the first "real" DOS variant of STEP 5 and makes consistent use of the functions of this operating system:

- Consistent implementation of the SAA standard
- Use of DOS directory paths; the previous restriction to one directory per drive has been abolished
- Use of all drive letters from A to Z

Improved performance

Version 7.0 includes further increases in performance:

- Use of the entire RAM including extended memory (XMS)
- Reduction of the memory requirements in the conventional memory area
- Lower package reloading times for improved strategy
- Integration of the EPROM driver into the STEP 5/ST basic package; it no longer needs to be resident in the RAM

Ergonomic user interface

Operator ergonomics has been improved once again:

- Shallower menu structures; by and large there are now only two menu levels
- Standardization of the dialog field structure
- New acceleration keys and hotkeys
- Project settings in "index cards"
- Access to interfaces from project settings
- Direct fast callup of editors from the project settings, the block directory and ISTACK
- Test functions quickly accessible through new menu items "test" and "PLC"
- Online/offline switchover now in dialog boxes

Fig. 7/4 Dialog field-structure

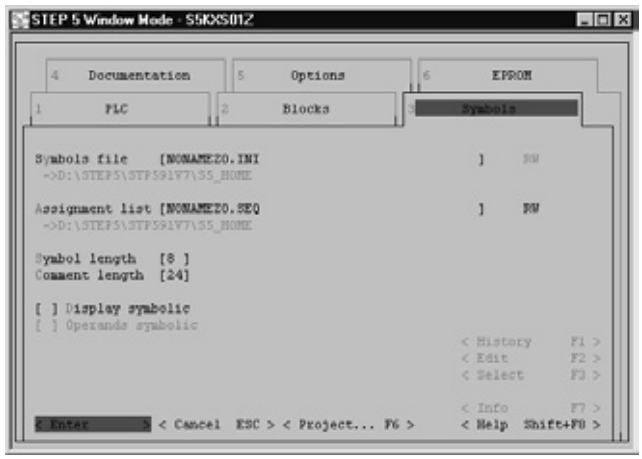

Fig. 7/5 Project settings (index cards)

- Extended and standardized syntax for the block list, valid for all functions (editor, printer etc.)

New functions

Numerous new functions have been integrated into the program:

- Switchover between various languages within STEP 5
- Call of a DOS shell from STEP 5
- Automatic loading of the last active optional package on restarting STEP 5 (if parameterized)
- Retention of the project files last used in the "file" menu
- History (repetition function) for input fields in dialog boxes or in program handling
- Extension of help and info functions in the menu and in the dialog boxes, fast access by menu keys
- Integration of COM packages into the "change" menu
- New options for general project settings, e.g. compatibility monitoring between older and new STEP 5 versions

Extensive downward compatibility

In the development of STEP 5/ST V7.0, the greatest possible compatibility with versions 3.x and 6.x has been retained.

If new options are used, e.g. DOS paths, incompatibility with older STEP 5 versions can arise because they do not know these functions. In this case a message appears indicating abandonment of compatibility.

STEP 5 basis packages (continued)

Technical specifications

	STEP 5/ST basic package for programmers and PCs	STEP 5/ST for mini-controllers
Current version	V 7.0	V 7.0
Operating system	MS-DOS V5.0 and higher Windows 3.x Windows 95	MS-DOS V5.0 and higher Windows 3.x Windows 95
RAM capacity min. in the programmer/PC	4 Mbytes	4 Mbytes
Disk requirements in the programmer/PC	13 Mbytes	13 Mbytes
Platform	PG, PC	PC
Target system	S5-90U S5-95U/F S5-100U S5-101U S5-115U/H/F S5-135U S5-150U S5-155U/H	S5-90U S5-95U S5-100U

Ordering data

	Order No.
STEP 5/ST-basic pacakge for PG and PC (V7.0) on the basis of MS-DOS with authorization diskette, for programming all PLCs with PCs, on $3^1/_2$" diskettes in German, English, French, Spanish, Italian. Single license Copy license	 **6ES5 894-0MA04** **6ES5 894-0MA04-0KL1**
STEP 5/ST for mini-controllers (V7.0) on the basis of MS-DOS with authorization diskette for programming mini PLCs, S5-90U, 95U and 100U, executable on PC, on $3^1/_2$" diskettes in German, English , French, Spanish, Italian Single license Copy license	 **6ES5 864-0MA04** **6ES5 864-0MA04-0KL1**

	Order No.
PC-AG cable (734-1) Connecting cable between SIMATIC S5 (15-pin) and PC (25-pin), 3.2m	**6ES5 734-1BD20**
PG-AG cable (734-2) (included in the scope of supply of the programmer, 3.2m) connecting cable between the programmer and SIMATIC S5,	
5 m	**6ES5 734-2BF00**
10 m	**6ES5 734-2CB00**
25 m	**6ES5 734-2CC50**
Documentation for STEP 5/ST for PG/PC (V7.0) (also for STEP 5/ST basic package and STEP 5/ST for mini controllers)	
German	**6ES5 998-0MA14**
English	**6ES5 998-0MA24**
French	**6ES5 998-0MA34**
Spanish	**6ES5 998-0MA44**
Italian	**6ES5 998-0MA54**

7

TISOFT

Application

TISOFT is a complete software package for programming and documenting all SIMATIC programmable controllers of the series 505.

TISOFT allows the rapid and simple implementation of all automation tasks, as well as straightforward maintenance of the plant placed in operation.

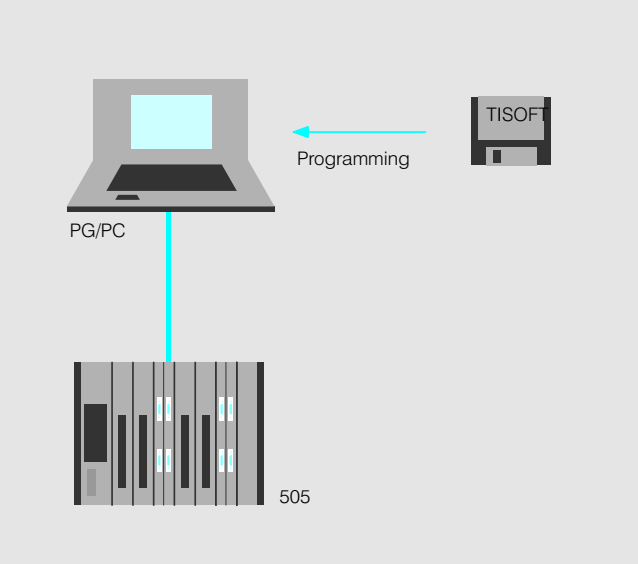

Fig. 7/6 Programming with TISOFT

Design

- Tools for programming, documenting, debugging, developing and maintaining programs
- Menu-driven operation
- Extensive on-line auxiliary functions
- Programmable updating displays
- Sophisticated debugging aids

TISOFT has the same user interface for all programmable controllers. Plant modifications and extensions can thus be implemented by the user with no additional training.

TISOFT runs on:

- SIMATIC PG 720, PG 720C, PG 730, PG 730C, PG 740, PG 750, PG 760 and PG 770 programming devices
- IBM PCs
- IBM-compatible PCs

Additional requirements:

- Floppy disk drive (at least 360 Kbyte) and hard disk drive
- Monochrome or color monitor
- MS-DOS
- Connecting cable for RS 232 C modem (for on-line mode only)

7

Ordering data	Order No.		Order No.
TISOFT for 505 Version 6.2	**PPX:PC505-6262**	**Manual** for 505 TISOFT	
TISOFT upgrading to Version 6.2	**PPX:PC505-UPG62**	English German French Italian	**PPX:TS505-8101-6** **PPX:TS505-8101D** **PPX:TS505-8101F** **PPX:TS505-8101I**
TISOFT license V6.2 for 505	**PPX:TSSL505-6251**		
TISOFT V6.2 additional copy for 505 PLC	**PPX:TSSL505-6362**		

APT (Application Productivity Tool)

Application

APT is an integrated control system design environment that uses computer-aided software engineering (CASE) technology to provide an object-oriented design environment for the SIMATIC-505 programmable controllers. APT also provides a link between the individual controllers and their logical representation in the data base of the SIMATIC PCS human-machine-interface. The package runs on PCs or on the state-of-the-art Siemens programming devices.

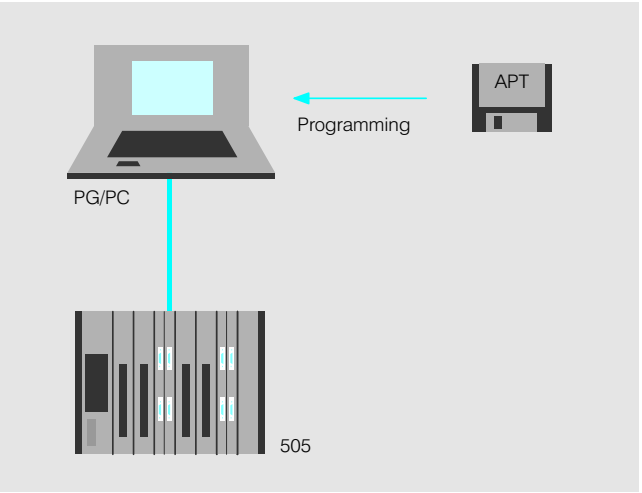

Fig. 7/7 Programming with APT

Functions

APT provides a natural means of mapping the physical process into the control system. It encourages the partition into a hierarchical structure which is easier to understand and implement.

APT uses a graphical approach to design. GRAFCET techniques are used for developing sequential logic. APT also has a graphical representation for continuous control processes based on the SAMA[1] standard. Development of lower-level control actions are simplified by using a library of devices and continuous function blocks that include internal interlocks and comprehensive auxiliary information.

Separate safe-state sequential function charts (SFC) provide alternate control actions for emergency situations. The safe-state SFCs have flexible return-to-normal paths to match the process operating procedures. Extensive validation functions are included to quickly trap invalid and missing configurations. MAITT, a test language interpreter, is included for writing tests and validating control logic.

The principal features of APT are:

- Supports sequential continuous, safe-state, parallel, batch control strategies and process partitioning
- Integrates application design development, testing, documentation, and maintenance
- Windowing, split-screens, pull-down help screens, embedded algorithms, and fill-in-the-blank forms
- Sequential function chart (SFC) and continuous function chart (CFC) graphics-based languages
- State control and math text-based languages
- Multiple main and subordinate safe-state SFCs with priority levels
- Libraries of standard control algorithms

Ordering data

	Order No.		Order No.
SIMATIC APT software Upgrade, with manual set (Version 1.7a)	**PPX:APT-6201-T**	**Manuals** System overview for APT software, English	**PPX:APT-8100**
SIMATIC APT software Upgrade to V1.7a, with manual set	**PPX:APT-6202-T**	User manual for APT software, German French	**PPX:APT-8101D** **PPX:APT-8101F**
SIMATIC APT software Version 1.7a , with APT manual set, single license and network card CP 1413, for linking with Industrial Ethernet, compatible with SIMATIC 505 and SIMATIC S5	**PPX:APT-6204-T**	Programming instructions for APT software, German French	**PPX:APT-8102D** **PPX:APT-8102F**
		Manual set for APT software (Version 1.7a)	**PPX:APT-8200-T**

1) Scientific Apparatus Manufacturers Association

GRAPH 5/II

Application

The S5 software package GRAPH 5/II is used for configuring, programming, testing and documenting sequence control systems with a standard method of representation. Graph 5/II contains all functions of the STEP 5 basic package (see page 7/3).
A program package with standard function blocks is required for runnlng the GRAPH 5/II functions in the programmable controllers (see page 7/55).

GRAPH 5/II can be used in the following programmable controllers:

- S5-95U
  (as of 6ES5 095-8M. .2);
  only with FB 72, FB 73, FB 74 and SB5
- S5-100U;
  only with CPU 103
- S5-115U;
  with CPU 941, CPU 942, CPU 943, CPU 944 and CPU 945
- S5-135U:
  with CPU 922, CPU 928 and CPU 928B
- S5-150U;
  no restrictions
- S5-155U;
  with CPU 946, CPU 947 and CPU 948

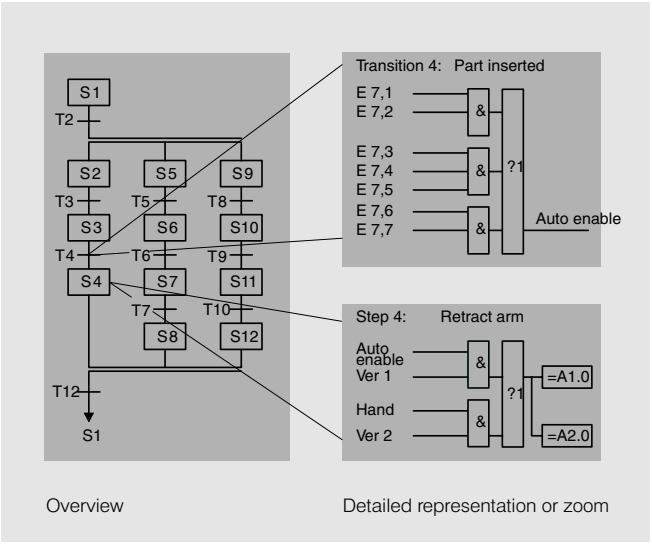

Fig. 7/8 GRAPH 5/II methods of representation

GRAPH 5/II is executable under S5-DOS/ST, S5-DOS/MT (V.6x) on the following programming devices:

PG 710 Plus, PG 720, PG 720C, PG 740, PG 730, PG 730C, PG 740, PG 750, PG 760 and PG 770.

Functions

- Generating the programs in accordance with the standard IEC DIS 1131-3
- Conversion of GRAPH 5 blocks to GRAPH 5/II and vice versa; change of GRAPH 5 blocks;
- Programming of the steps (S) and transitions (T) in STL, CSF or LAD
- Overview and detailed representation or zoom
- Synchronization of system, process and programmable controller. There are 2 methods of synchronization:

  Synchronization with the automatically generated synchronization SB (supports alternative branches);

  Synchronization with the standard function block (FB 70 – 73), which controls the chain (also supports simultaneous branches)
- Diagnostic functions with criteria analysis (via Industrial Ethernet for up to 4 programmable controllers), operating mask on the screen as "HW tableau/PG operating panel" or as "Simple operating panel", indication of fault signals
- User interface and plausibility check when generating step chains
- Step-overlapping magnifying glass: multiple control of the same outputs, similar links and locks are only configured and saved once, step-independent actions are realized (can also be included in chain diagnostic function)
- Search function:
  Operands can be found step- and transition-overlapping
- Preset timer values for easier programming
- Minimum monitoring time for monitoring unpermissible system states
- Optimization of the runtime by shorter operating times of the blocks and immediate activation of the following step at completed transition

Ordering data

	Order No.
GRAPH 5/II software package (S5-DOS/ST, S5-DOS/MT) for configuring and programming sequence control systems, for the S5-95U to S5-155U programmable controllers (for S5-95U only with restrictions) on $3^1/_2$" diskettes German, English, French Single license Copy license	 **6ES5 884-1FA03** **6ES5 884-1FA03-0KL1**
Documentation for GRAPH 5/II V6.6 German English French	 **6ES5 998-1FA13** **6ES5 998-1FA23** **6ES5 998-1FA33**
Software package GRAPH 5/II V7.0[2] **(MS-DOS, FlexOS))**	availble soon

1) Does not run under STEP 5/ST V7.0

2) Adapted to the new architecture and improved user interface of STEP 5/ST V7.0

PRODAVE

Application

PRODAVE is a toolbox which allows process data traffic between the programmable controller and the programming device/PC. PRODAVE builds up the process data traffic between the programmable controller and the programming device/PC via the AS511 protocol or via the 3964R (AK512).

PRODAVE runs under MS-DOS or Windows. All current compilers, such as MS-C, Turbo C and Turbo Pascal can be used as programming language.
Further details about the protocol processing are not required.
The PLC communication is processed by PRODAVE autonomously in the background.

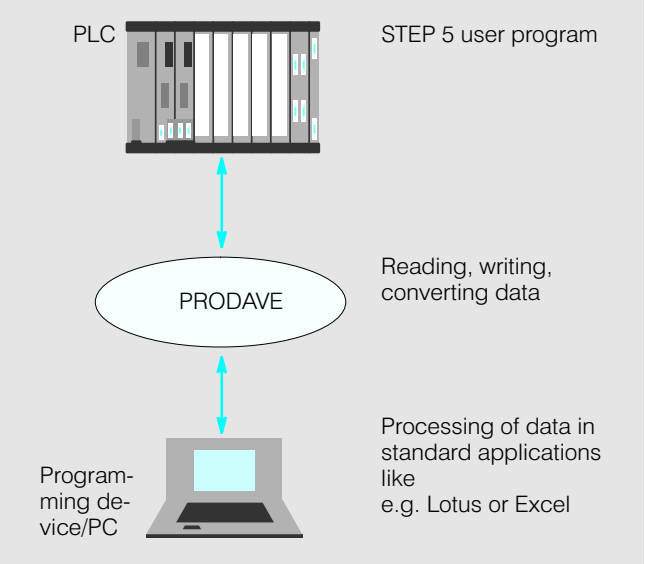

Fig. 7/11 Programming with PRODAVE

PRODAVE DOS/WIN
PRODAVE DOS/WIN communicates via the serial interface of the programming device/PC with the programming device interface at the CPU, i. e. no special communications processor is needed in the PLC for connection of the programming device/PC. Either the COM 1 or COM2 interface can be used in the programming device or PC. For connection via the COM2 interface of the programming device or COM1 and COM2 interface of the PC, an V.24/TTY converter must be used.

The programming device multplexer PG-MUX can be used as an interface multiplexer for the connection of max. 7 PLCs to a serial interface of the programming device/PC.

PRODAVE DOS 64R, PRODAVE WIN 64R
PRODAVE DOS 64R or WIN 64R communicate with the PLC via the serial interface of the programming device and via the CP 521/ CP 523/CP 524 and CP 525 communications processors. Thus, the interface of the CPU remains free.

PRODAVE NET
PRODAVE NET communicates with the programmable controller via SINEC H1/ PROFIBUS and runs on a programming device/PC under MS-DOS and Windows 3.11.

PRODAVE DDE (for SIMATIC S5)
PRODAVE DDE communicates via the serial interface of the programming device with the programming device interface on the CPU (protocol AS 511).

It also communicates via the serial interface of the programming device/PC with a point-to-point CP slotted into a programmable controller (e.g. CP 524, protocol RK 512).
PRODAVE DDE includes a DDE interface with which standard Windows applications (e.g. Excel) can communicate with the control.

PRODAVE for SIMATIC S7-300/-400
PRODAVE for SIMATIC S7-300/-400 runs under MS-DOS/Windows 3.11/WIndows 95 and communicates with the control via the MPI interface (no operation with TK 858 and modem).

Principle of operation

Once loaded, the PRODAVE toolbox remains resident in memory. It can therefore operate in quasi-background whilst other applications such as statistical evaluations of such process data run in the foreground. The individual tools can be called within the processing program. PRODAVE allows not only the evaluation and monitoring of a process, but also intervention in the process because a number of functions for writing data from the programming device to the programmable controller are available.

Functions

The toolbox contains the following functions:

- Read PLC info (PLC type, CP type, version)
- Read PLC status (RUN, STOP)
- Byte conversion from a byte to 8 logical values and vice versa
- Read data words from block (range from... to...)
- Write data words into block (address range)
- Read/write data words from/in blocks with simultaneous conversion of the data (e.g. KF, KG format)
- Read input bytes from the PLC
- Write output byte to the PLC
- Format conversion of data (e.g. KH to integer)
- Bit memory bit test as status check
- Read bit memory byte or word from the PLC

PRODAVE (continued)

Functions (continued)

- Write bit memory byte or word to the PLC
- Read counter statuses from the PLC
- Set counter statuses in the PLC
- Read timers from the PLC
- Time calls for the user program delay, reset, sync, (e.g. for delay loops for reading data cyclically)
- Output error messages in plaintext
- Load the toolbox in the user memory
- Remove the toolbox from the user memory

Further functions of PRODAVE DOS 511 and WIN 511:

- Common reading of data of different format (MIX-READ function)
- Detection of all data blocks (DB and DX) in the PLC with the book function
- Operation of PRODAVE with TK 858 and modem (not for PRODAVE for SIMATIC S7-300/-400)
- Additional use of the programming device interfaces COM 3 and COM 4 for the data traffic (also for PRODAVE WIN 511 Mini)
- Fast processing of the data traffic without considerable additional memory space requirements

Scope of supply

PRODAVE software on 31/2" diskettes, instructions in German and English. For that, the receipt of the old software package must be presented, its serial number must be stated and the original diskette must be sent in with the rest of the labels.

Ordering data

	Order No.
PRODAVE DOS 511	
For data link via programming device interface of the PLC under MS-DOS operating system, on $3^1/_2$" diskettes, operating instructions in German and English	
Single license	**6ES5 886-2MP01**
Copy license	**6ES5 886-2MP01-0KL1**
PRODAVE WIN 511	
For data link via programming device interface of the PLC under WINDOWS 3.11 operating system, on $3^1/_2$" diskettes, operating instructions in German and English	
Single license	**6ES5 886-2WQ01**
Copy license	**6ES5 886-2WQ01-0KL1**
PRODAVE WIN 511 Mini	
For data link via programming device interface of the PLC under Windows operating system, (only DB read/write and ask for PLC status), on $3^1/_2$" diskettes, operating instructions in German and English	
Single license	**6ES5 886-2WP01**
Copy license	**6ES5 886-2WP01-0KL1**
PRODAVE DOS 64R	
For data link via CP 524/CP 525 (RK 512) or CP 521-SI/CP 523 (3964R) under MS-DOS operating system, on $3^1/_2$" diskettes, with operating instructions	
Single license	**6ES5 897-2UD ■1**
Copy license	**6ES5 897-2UD ■1-0KL1**
German	**1**
English	**2**
French	**3**
Spanish	**4**

	Order No.
PRODAVE WIN 64R	
For data link via e.g. CP 524/CP 525 (RK 512) or CP 521 SI/CP 523 (3964R) under Windows 3.11 operating system, on $3^1/_2$" diskettes, operating instructions in German and English	
Single license	**6ES5 897-2VD01**
Copy license	**6ES5 897-2VD01-0KL1**
PRODAVE NET	
For data link with SIMATIC S5 via PROFIBUS/Industrial Ethernet under MS-DOS and MS-WINDOWS operating system, on $3^1/_2$" diskettes, manual in German and English	
Single license	**6ES5 886-2MS01**
Copy license	**6ES5 886-2MS01-0KL1**
PRODAVE WIN DDE for SIMATIC S5	
For data link via programming device interface of the PLC under Windows 3.11 (with DDE interface), on $3^1/_2$" diskettes, operating instructions in German and English	
Single license	**6ES5 886-2WS01**
Copy license	**6ES5 886-2WS01-0KL1**

COM 246, COM 247

Application

The COM 246 and COM 247 parameter assignment software enables parameter assignment, programming and control of the IP 246 and IP 247 positioning modules.

COM 246 is required for the following modules:
6ES5 246-4UA31,
6ES5 246-4UB11.

COM 247 is required for the following modules:
6ES5 247-4UA31.

Full functional capability can only be guaranteed with these combinations. See page 7/122 for standard function blocks for the relevant programmable controller.

COM 246 und COM 247 sind ablauffähig unter MS-DOS.

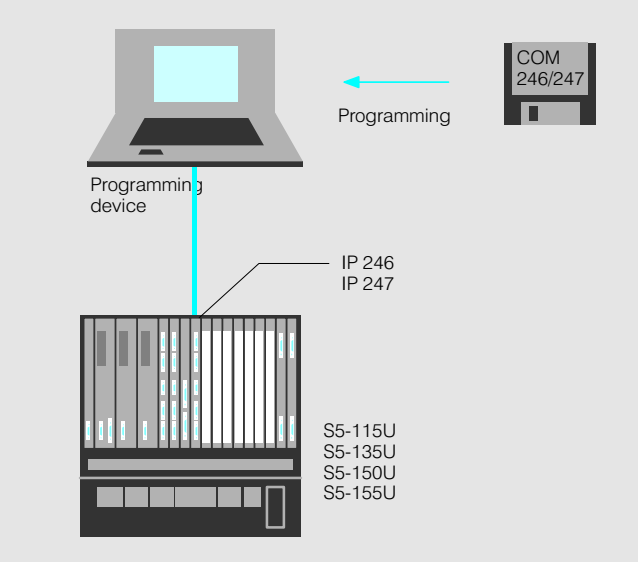

Fig. 7/14 Connection and programming of the IP 246 and IP 247 positioning modules

Functions

The COM 246 and COM 247 parameter assignment software enables operator-prompted interactive dialog with the positioning modules.

There are user-friendly functions available for this purpose:

- Input and output of machine data and traverse programs
- Representation of traverse programs in accordance with DIN 66 025 and in plaintext (you can switch at will between the two representation types)
- Help menus, extensive fault diagnostics

Ordering data

	Order No.
The parameter assignment software COM 246 is part of the: **Configuration package for IP 246I/A** consisting of: Manual, standard FBs and parameter assignment software COM 246 German English French	 **6ES5 246-5AA11** **6ES5 246-5AA21** **6ES5 246-5AA31**
The parameter assignment software COM 247 is part of the: **Configuring package for IP 247** consisting of: Manual, standard FBs and parameter assignment software COM 247 German English French	 **6ES5 247-5AA11** **6ES5 247-5AA21** **6ES5 247-5AA31**

7

COM PP

Application

The COM PP parameter assignment software is used for creating the parameter blocks which are required for driving the CP 544 and the second interface on the CPU 928B.
The COM PP software is user-friendly with interactive operator prompting.

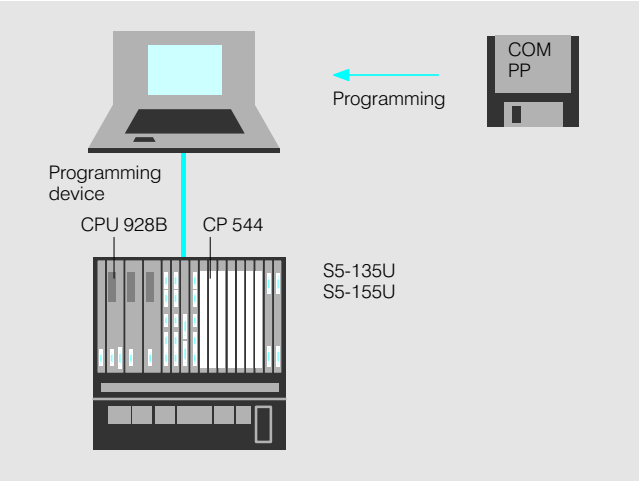

Fig. 7/19 Programming with COM PP

Ordering data	Order No.		Order No.
COM PP **parameter assignment software** for paramerizing the CP 544 and the second interface on the CPU 928 B, on $3^1/_2$" and $5^1/_4$" diskettes German/English/French Single license Copy license	 **6ES5 895-4SP01** **6ES5 895-4SP01-0KL1**	**Operating instructions**	see CP 544 manual or S5-135U/155U manual for CP 928B

7

Software
Engineering Tools

COM 115H, COM 155H, COM 95F, COM 115F

COM 115H and COM 155H parameter assignment software

The COM 115H and COM 155H software packages assign parameters to the fault-tolerant S5-115H and S5-155H programmable controllers.

They support the user in configuring and fault diagnostics:

- Configuring the H-related data
- Generating the configuration block from the configuration data
- System diagnostics via the error data block and interrupt register
- Documentation of the H-related data via printer
- General system data handling

COM 95F and COM 115F parameter assignment software

The COM 95F and COM 115F software packages assign parameters to the failsafe S5-95F and S5-115F programmable controllers.

They support the user at:

- Configuring the inputs and outputs
- assigning parameter to the operating system of the CPU in dialog with the programming device

The user need not take into account the redundancy of the PLC and the connection diagrams of the various input and output modules during program development.

Ordering data

	Order No.
COM 115H parameter assignment software for programming the S5-115H programmable controller; on $3^1/_2$" and $5^1/_4$" diskettes; German, English, French, Spanish, Italian	
Single license	**6ES5 895-3ST□1**
Copy license	**6ES5 895-3ST□1-0KL1**
COM 155H parameter assignment software for programming the S5-115H programmable controller; on $3^1/_2$" and $5^1/_4$" diskettes; German, English, French	
Single license	**6ES5 895-3SR□3**
Copy license	**6ES5 895-3SR□3-0KL1**
German	**1**
English	**2**
French	**3**
Spanish	**4**
Italian	**5**

	Order No.
COM 115F parameter assignment software for programming the S5-115F programmable controller; on $3^1/_2$" and $5^1/_4$" diskettes German, English, French, Italian	
Single license	**6ES5 895-3SF□5**
Copy license	**6ES5 895-3SF□5-0KL1**
COM 95F parameter assignment software assigns parameters to the S5-95F programmable controller with manual, on $3^1/_2$" and $5^1/_4$" diskettes; German, English, French, Italian	
Single license	**6ES5 895-6MF□2**
Copy license	**6ES5 895-6MF□2-0KL1**
German	**1**
English	**2**
French	**3**
Italian	**5**

7

COM PROFIBUS

Application

COM PROFIBUS allows the connection of

- distributed I/O devices ET 200U, ET 200M, ET 200B, ET200C, ET 200L, ET 200X,
- the DP/AS interface link, DP/PA link,
- the S5-95U/DP slave,
- S7-200/-300 as the slave and
- other field devices

to the master interface

- IM 308-C,
- S5-95U/DP master
- and other DP master modules.

Compared to COM ET 200 Windows (up to 12/96), COM PROFIBUS has been extended to include FMS configuring of the 5412 (A2) PC module (see page 3/89).

- IM 308-C;
  The set configuration of PROFIBUS DP is stored on a memory card. Burning of the memory card can be implemented directly with the programming device or a PC (with EPROM/EEPROM PG). The data are downloaded via the CP 5411, CP 5511, CP 5611 PC modules or the MPI.

Fig. 7/21 Parameter assignment with COM PROFIBUS

- S5-95U/DP master:
  The set configuration of PROFIBUS-DP is transferred to the programmable controller by downloading via the DP interface.
- FMS configuring
  CP 5412 (A2) PC module
- SOFTNET
  PC modules:
  CP 5411,
  CP 5511,
  CP 5611

COM PROFIBUS runs on the PG 720, PG 740 or PG 760 and AT-compatible PCs, under Windows 3.11 or Windows 95.

Principle of operation

The COM PROFIBUS parameter assignment software is installed on the programming device/PC. It enables simple, user-prompted generation of the address list and parameters for the slave devices. The following must be defined:

- DP address
- Address area in which the I/O modules are to be addressed
- Start addresses of the I/O modules
- Slave-specific parameter assignments, for example, measuring range of an analog input channel

The following must also be defined:

- Setting of the transmission rate
- Setting of the failure response

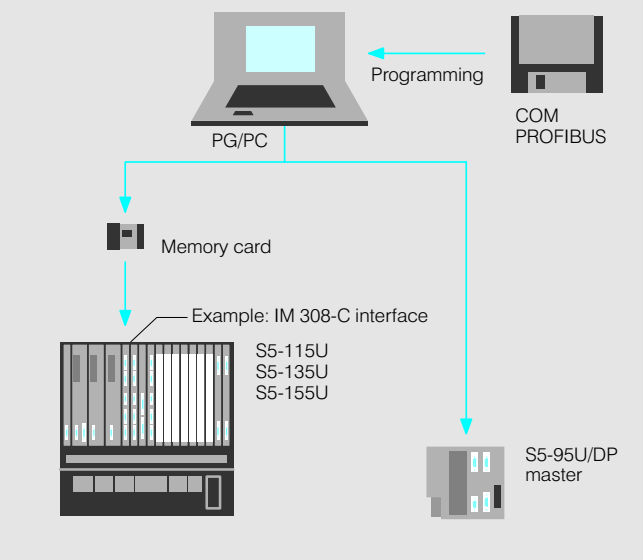

Fig. 7/22 Parameter assignment with COM PROFIBUS

With an online connection between the programming device/PC and PROFIBUS/DP, the COM PROFIBUS parameter assignment software can be used to locate faults in the startup phase or during operation.

COM PROFIBUS (continued)

Ordering data	Order No.		Order No.
COM PROFIBUS parameter assignment software for programming the IM 308-C and other DP master modules, runs on PG 720, 740 and 760 or AT-compatible PCs, with Windows 3.1 or Windows 95, on 3 1/2" diskettes with manual for the distributed ET 200 I/O system,		**Manual for the distributed ET 200 I/O system**	
single license	**6ES5 895-6SE□2**	German	**6ES5 998-3ES12**
copy license	**6ES5 895-6SE□2-0KL1**	English	**6ES5 998-3ES22**
German	**1**	French	**6ES5 998-3ES32**
English	**2**	Spanish	**6ES5 998-3ES42**
French	**3**	Italian	**6ES5 998-3ES52**
Spanish	**4**		
Italian	**5**		

7

COM 525, COM 530, COM 5431 FMS/DP, COM 1430 TF, COM 1473 MAP

Application

The COM 525, COM 530, COM 5431 FMS/DP, COM 1430 TF, COM 1430 TCP and COM 1473 MAP parameter assignment software is needed for programming and parameter input for the relevant communications processors with a programming device.

- COM 525 for CP 524, CP 525
- COM 530 for CP 530 (L1)
- COM 5431 FMS/DP for CP 5431 FMS/DP (PROFIBUS)
- COM 1430 TF for CP 1430 TF (Industrial Ethernet)
- COM 1430 TCP for CP 1430 TCP (Industrial Ethernet)
- COM 1473 MAP for CP 1473 MAP (MAP 3.0-Ethernet)

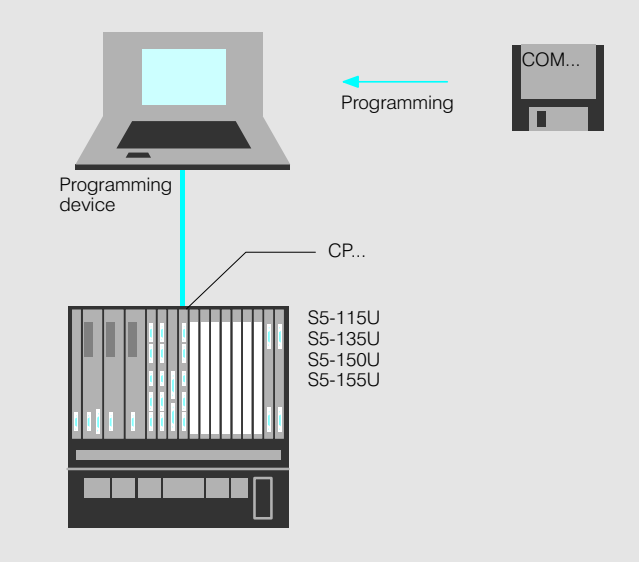

Fig. 7/26 Programming the communications processors

Functions

The programs offer operator prompting and interactive screen forms to facilitate the programming of specific functions of the communications processors. The programs also include extensive testing, diagnostics and documentation functions.

COM 525, COM 530, COM 5431 FMS/DP, COM 1430 TF, COM 1473 MAP (continued)

Ordering data	Order No.
COM 525 parameter assignment software	
assigns parameters to the CP 524 and CP 525; German, English, French; on $3^1/_2$" and $5^1/_4$" diskettes	
Single license	**6ES5 895-4SA□1**
Copy license	**6ES5 895-4SA□1-0KL1**
COM 530 parameter assignment software	
assigns parameters to the CP 530; Ger., English, French, Italian;	
on $3^1/_2$" diskettes	
Single license	**6ES5 835-6SC□1**
Copy license	**6ES5 835-6SC□1-0KL1**
on $5^1/_4$" diskettes	
Single license	**6ES5 895-6SC□1**
Copy license	**6ES5 895-6SC□1**
German	**1**
English	**2**
French	**3**
Spanish	**4**
Italian	**5**
COM 5431 FMS/DP parameter assignment software	
assigns parameters to the CP 5431 FMS/DP, with manual CP 5431 FMS/DP; on $3^1/_2$" diskettes,	
German	**6GK1 745-1AD00-0EA0**
English	**6GK1 745-1AD01-0EA0**
French	**6GK1 745-1AD02-0EA0**
Italian	**6GK1 745-1AD04-0EA0**

	Order No.
CP 5431 FMS/DP manual	
German	**6GK1 970-5AB01-0AA0**
English	**6GK1 970-5AB01-0AA1**
French	**6GK1 970-5AB01-0AA2**
Italian	**6GK1 970-5AB01-0AA4**
COM 1430 TF parameter assignment software	
assigns parameters to the CP 1430 TF, with CP 1430 TF manual, on $3^1/_2$" diskettes,	
German	**6GK1 743-0TA00-0EA0**
English	**6GK1 743-0TA01-0EA0**
French	**6GK1 743-0TA02-0EA0**
Italian	**6GK1 743-0TA04-0EA0**
CP 1430 TF/COM 1430 TF manual	
German	**6GK1 970-1TA43-0AA0**
English	**6GK1 970-1TA43-0AA1**
French	**6GK1 970-1TA43-0AA2**
Italian	**6GK1 970-1TA43-0AA4**
Parameter assignment software COM 1430 TCP	
Configuration software for CP 1430 TCP, on $3^1/_2$" diskettes	**2XV9 450-1AU01**
Manual CP 1430 TCP/COM 1430 TCP	
German	**2XV9 450-1AU03**
English	**2XV9 450-1AU02**
COM 1473 MAP parameter assignment software	
assigns parameters to the communications processor, CP 1473 MAP, with manual CP 1473 MAP, on $3^1/_2$" diskettes,	
German	**6GK1 773-0MA10-0EA0**
English	**6GK1 773-0MA11-0EA0**
CP 1430 TF manual	
German	**6GK1 970-1MA73-0AA0**
English	**6GK1 970-1MA73-0AA1**

7

Introduction standard function blocks

Application

Standard function blocks are ready-made software modules which can be linked into programs written by the user for the programmable controllers of the U range. They consist of self-contained complex functional procedures which are often required by the user when programming.

For instance, standard function blocks for mathematical and arithmetic functions, sequence control and closed-loop control are available. The blocks are stored in the user memory of the programmable controller and can be called up by the user as required in his program. They can be called many times during program execution and supplied with the required actual parameters.

Complex functions can be included very simply by the user in his programs through the use of standard function blocks. This makes programming, testing and debugging of user programs very efficient. The user can tap a vast amount of experience by using standard function blocks. The blocks are continuously updated and main-tained.

Design

User program structure

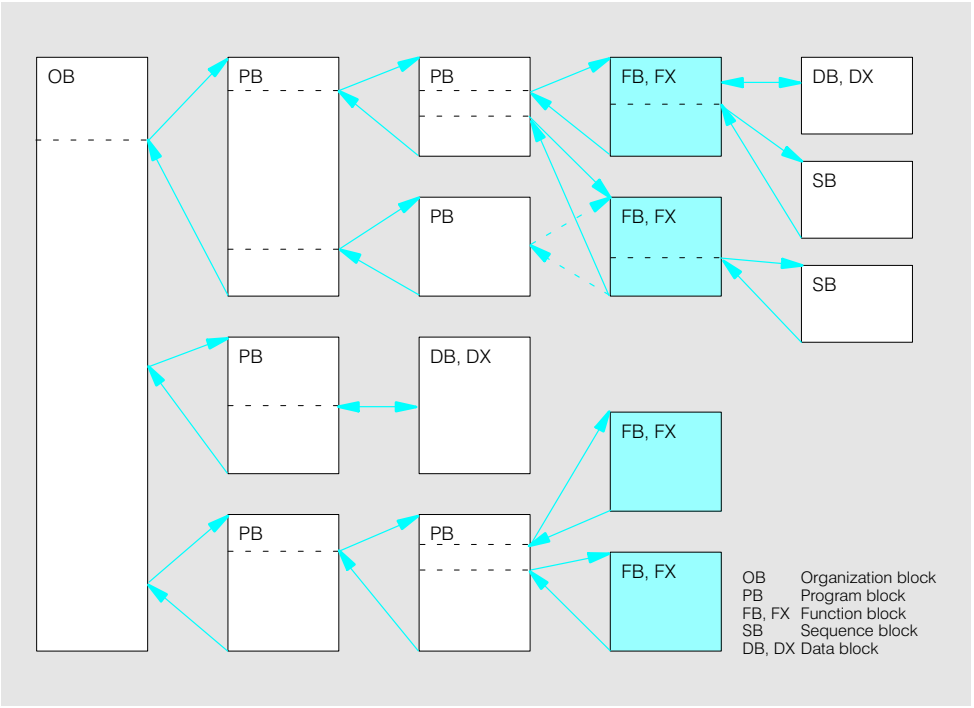

Fig. 7/28 Function blocks within a user program

The user writes his programs for the S5 programmable controllers of the U range in the STEP 5 programming language. The programs are structured, i.e. broken down into self-contained sections. The individual program sections are called "blocks".

The following types of blocks are used for different purposes:

- Organization blocks (OB), for supervising the user program
- Program blocks (PB), for structuring the program according to the technological control task
- Function blocks (FB, FX), for recurring complex functions
- Sequence blocks (SB), for individual technological sequence controls
- Data blocks (DB, DX), these are memory areas in which data for the user program can be stored

The blocks can be nested as required (Fig. 7/28), i.e. blocks from one level can call blocks in a lower level.

Introduction standard function blocks (continued)

Design (continued)
Notes on programming with standard function blocks

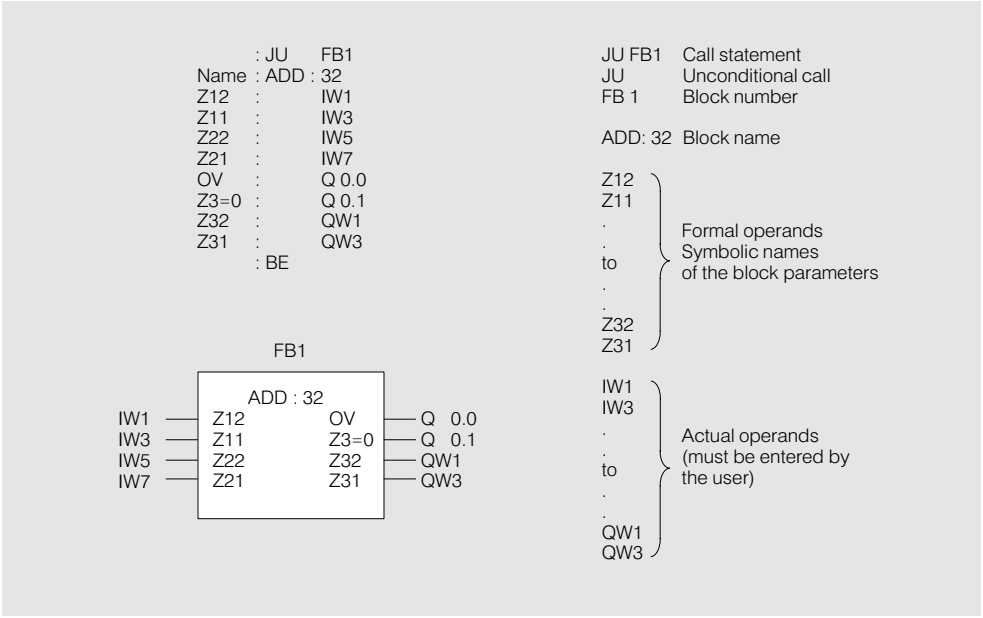

Fig. 7/29 Representation of standard function blocks by the programming device
above: in statement list form (STL)
below: in control system flowchart (CSF) form

A standard function block is designed in such a way that the programming device prompts the user when linking the block into his program. The internal programming of the function block is not important for this.

The function block is called with a call statement (see Fig. 7/29). It is then displayed with its block name and its formal operands (block parameters). Formal operands are mnemonics which represent the type of function of inputs and outputs as well as the data required by the function block.

An actual operand must be entered alongside each formal operand when the corresponding block is called up. The actual operand is chosen by the user according to the requirements of the control task at that particular point.

"A" type parameters (outputs or results) are shown on the right of the function symbol. Basic and supplementary operations in function blocks can only be shown in the statement list. Parameters with "E, D, B, T or Z" types of parameters (inputs or preset data) are shown in the graphic design on the left of the function symbol.

Documentation

A software handbook containing a comprehensive description of the function blocks is provided with each of the program packages (on diskettes).

Software

Runtime Software

Overview

Program packages Installable in **S5-**	90U	95U	100U CPU 103	**115U** CPU 941 to 944	CPU 945	135U/155U CPU 922	CPU 928	CPU 928B	155U CPU 946/ 947	CPU 948	Page
Basic functions		■	■	■	■	■	■	■	■	■	7/39
Floating-point arithmetic		■	■	■							7/51
Mathematical functions					■	■	■	■	■	■	7/52
GRAPH 5 / II		■	■	■		■	■	■	■		7/55
Closed-loop control											
S5-100U/-115U closed-loop control		■	■	■							7/63
R64 controller structure						■	■	■			7/72
Compact fuzzy control		■	■	■	■		■	■	■	■	7/75
Modular PID and fuzzy control					■	■	■	■	■	■	7/77
Standard software PMC											
PMC/LS-B				■			■	■	■	■	7/91
Message functions											
Message functions for standard CP				■	■	■	■	■	■	■	7/94
Compact message functions				■	■	■	■	■	■	■	7/96
Signalling functions		■	■	■	■	■	■	■	■	■	7/98
Data handling blocks				Internal	Internal	■	■	■	■		7/104
Intelligent I/O modules	■	■	■	■	■	■	■	■	■	■	7/109
CP 516 memory submodule					■	■	■				7/128
Failsafe standard function blocks	Can be used for S5-95F, S5-115F only (CPU 942F)										7/129

7

Basic functions

ADD:32
32-bit binary adder

FB 1 for 95U
FB 1 for 100U
FB 1 for 115U
FB 1 for 135U
FB 3 for 155U

The ADD:32 function block adds two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number (31 bit + sign).

The function block sets the following condition codes if appropriate:
Overflow (result is cancelled), result is 0.

Number range:
– 2 147 483 648 to
+ 2 147 483 647
(– 2^{31} to + 2^{31} –1).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	108	10	1.8
100U with CPU 103	108	10	2.1
115U with			
CPU 941[1)]	108	10	2.8
CPU 942[1)]	108	10	2.8
CPU 943[1)]	108	10	2.6
CPU 944[1)]	108	10	<0.2
135U/155U with			
CPU 922	100	10	1.6
CPU 928	100	10	0.8
CPU 928B	100	10	0.3
CPU 948	69	10	0.03
155U with CPU 946/947	69	10	0.13

1) As of Order No.: 6ES5 94.-7UB

SUB:32
32-bit binary subtractor

FB 2 for 95U
FB 2 for 100U
FB 2 for 115U
FB 2 for 135U
FB 7 for 155U

The SUB:32 function block subtracts two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number (31 bit + sign).

The function block sets the following condition codes, if appropriate:
Overflow (result is cancelled), result is 0.

Number range:
– 2 147 483 648 to
+ 2 147 483 647
(– 2^{31} to +2^{31} –1).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	108	10	1.8
100U with CPU 103	108	10	2.1
115U with			
CPU 941[1)]	108	10	2.5
CPU 942[1)]	108	10	2.5
CPU 943[1)]	108	10	2.3
CPU 944[1)]	108	10	<0.2
135U/155U with			
CPU 922	100	10	1.6
CPU 928	100	10	0.74
CPU 928B	100	10	0.4
CPU 948	69	10	0.03
155U with CPU 946/947	69	10	0.13

1) As of Order No.: 6ES5 94.-7UB

Basic functions (continued)

MUL:32
32-bit binary multiplier

FB 3 for 95U
FB 3 for 100U
FB 3 for 115U
FB 3 for 135U
FB 11 for 155U

The MUL:32 function block multiplies two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number (63 bit + sign).

The function block sets the following condition code, if appropriate:
Result is 0.

Number range:
Multiplicand -2^{31} to $+2^{31}-1$
Multiplier -2^{31} to $+2^{31}-1$
Product -2^{63} to $+2^{63}-1$.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	399	11	8.3 to 31.4
100U with CPU 103	399	11	3.2 to 5.4
115U with			
CPU 941[1)]	399	11	4.0 to 8.2
CPU 942[1)]	399	11	4.0 to 8.2
CPU 943[1)]	399	11	3.5 to 5.6
CPU 944[1)]	209	11	0.01 to 0.035
135U/155U with			
CPU 922	302	11	11.6
CPU 928	302	11	4.32
CPU 928B	302	11	0.5
CPU 948	197	11	0.11
155U with CPU 946/947	197	11	0.7

1) As of Order No.: 6ES5 94.-7UB

7

DIV: 32
32-bit binary multiplier

FB 4 for 95U
FB 4 for 100U
FB 4 for 115U
FB 4 for 135U
FB 15 for 155U

The DIV:32 function block divides two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number (31 bit + sign).

The function block sets the following condition codes, if appropriatie:
Overflow (result is candelled), quotient equals zero, remainder equals zero, error: division by zero.

Number range:
–2 147 483 648 to + 2 147 483 647 (-2^{31} to $+2^{31}-1$).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	395	14	2.1 to 25.8
100U with CPU 103	395	14	2.4 to 4.2
115U with			
CPU 941[1)]	395	14	5.9 to 6.8
CPU 942[1)]	395	14	5.9 to 6.8
CPU 943[1)]	395	14	4.2 to 4.7
CPU 944[1)]	395	14	1.7 to 2.2
CPU 945[1)]	203	14	0.015 to 0.12
135U/155U with			
CPU 922	242	14	1.2 to 37
CPU 928	242	14	0.9 to 13.3
CPU 928B	242	14	1.2
CPU 948	203	14	0.2
155U with CPU 946/947	203	14	0.2 to 2

1) As of Order No.: 6ES5 94.-7UB

Basic functions (continued)

RAD:16
16-bit binary root extractor

FB 5 for 95U
FB 5 for 100U
FB 5 for 115U
FB 5 for 135U
FB 18 for 155U

The RAD:16 function block extracts the sqare root of a fixed-point binary number (15 bit + sign). The result is two fixed-point binary numbers (8-bit root, 16-bit remainder).

The function block sets the following condition code, if appopriate:
Radicand negative.

Number range:
Radicand – 32 768 to + 32 767
Root 0 to + 181
Remainder 0 to + 361.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	126	6	5.3
100U with CPU 103	126	6	1.3
115U with			
CPU 941[1)]	126	6	1.6
CPU 942[1)]	126	6	1.6
CPU 943[1)]	126	6	1.4
CPU 944[1)]	126	6	0.3
CPU 945[1)]	126	6	0.045
135U/155U with			
CPU 922	126	6	0.6 to 9.7
CPU 928	126	6	0.42 to 6.5
CPU 928B	126	6	0.4
CPU 948	128	6	0.12
155U with CPU 946/947	128	6	0.7

1) As of Order No.: 6ES5 94.-7UB

RAD:GP
Floating point root extractor

FB 6 for 115U
FB 6 for 135U
FB 19 for 155U

The RAD: GP function block extracts the square root of a floating-point number (exponent: 7 bit + sign; mantissa: 23 bit + sign). The result is also a floating-point number (exponent: 7 bit + sign; mantisse: 23 bit + sign). The least significant bit of the mantissa is not rounded.

The function block sets the following condition code, if appropriate:
Radicand negative.

Number range:
Radicand
±0.1469368 exp. –39 to
±0.1701412 exp. +39
Root
+ 0.3833234 exp. –19 to
+ 0.1304382 exp. +20.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with CPU 945	127	5	0.04
135U/155U with			
CPU 922	133	8	3.8 to 10.8
CPU 928	133	8	2.2 to 7.1
CPU 928B	133	8	0.4
CPU 948	129	5	0.09
155U with CPU 946/947	129	5	0.3 to 0.4

7

Basic functions (continued)

REG:SCHB
Shift register (bit)

FB 10 for 95U
FB 10 for 100U
FB 10 for 115U
FB 10 for 135U
FB 24 for 155U

The REG:SCHB (bit) function block implements a right-left shift register of variable length. The shift register is located in the bit memory area; the first and last bit memory byte must be specified.

The shift register has inputs for right and left shifting and corresponding outputs for the carry.

The REG:SCHB function block requires a data block which must be called before REG:SCHB itself.

Max. register length: 32 bit

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	250	14	5.3[1] to 77.4[2]
100U with CPU 103	250	14	2.3[1] to 28.8[2]
115U with			
CPU 941[4]	250	14	6.7[1] to 33.4[2]
CPU 942[4]	250	14	6.7[1] to 33.4[2]
CPU 943[4]	250	14	6.4[1] to 31.8[2]
CPU 944[4]	250	14	0.5[1] to 2.5[2]
CPU 945	250	14	0.045[1] to 0.28[2]
135U/155U with			
CPU 922	250	14	1.5[3]
CPU 928	250	14	1.9[3]
CPU 928B	250	14	0.7
CPU 948	252	14	0.04 to 1.49
155U with			
CPU 946/947	252	14	0.2 to 12

1) With 8 bit
2) With 128 bit
3) With 32 bit
4) As of Order No.: 6ES5 94.-7UB..

REG:SCHW
Shift register (word)

FB 11 for 95U
FB 11 for 100U
FB 11 for 115U
FB 11 for 135U
FB 25 for 155U

The REG:SCHW (word) function block implements a right-left shift register of variable length. The shift register is located in the data area; this data area and the number of data words needed must be specified. The shift register has inputs for right and left shifting and corresponding outputs for the carry.

Several "shift register" function blocks can be chained if bit memory words, input words, output words or peripheral words are used for the inputs and outputs "ZER", "TEL", ZAR", and "ZAL".

The "ZER" and "ZEL" inputs of the following function block must then be connected to the "ZAR" and "ZAL" outputs of the preceding block.

Conditions

The data words DW0 and DW1 of the data block selected are not available to the user; this means that, with a single data block, the maximum possible length of the shift register is 254 words.

For K > 254 or K = 0, the function block is not processed.

The shift register can be extended by one data block with each subsequent call of the REG:SCHW function block.

Continued on the next page.

Basic functions (continued)

REG:SCHW (continued)
Shift register (word)

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	125	10	20.1[1] to 31.4[2] 81.0[4] to 122.8[5]
100U with CPU 103	125	10	27.0[1] to 37.0[2] 96.0[4] to 144.0[5]
115U with CPU 941[6]	125	10	31.0[1] to 44.0[2] 117.0[4] to 170.0[5]
CPU 942[6]	125	10	31.0[1] to 44.0[2] 117.0[4] to 170.0[5]
CPU 943[6]	125	10	30.0[1] to 43.0[2] 113.0[4] to 166.0[2]
CPU 944[6]	125	10	1.5[1] to 2.3[2] 5.2[4] to 8.7[5]
CPU 945	120	10	0.045[1] to 0.18[2] 0.525[4] to 0.675[5]
135U/155U with CPU 922	125	10	1.0 to 100[3]
CPU 928	125	10	0.8 to 67[3]
CPU 928B	125	10	0.4
CPU 948	117	10	0.36[1] to 0.43[2] 1.37[4] to 1.64[5]
155U with CPU 946/947	117	10	0.4

1) With 64 SR words (1 word = 2 byte)
2) With 64 SL words
3) With 254 words
4) With 254 SR words
5) With 254 SL words
6) As of Order No.: 6ES5 94.-7UB..

REG:FIFO
Buffer

FB 12 for 95U
FB 12 for 100U
FB 12 for 115U
FB 12 for 135U
FB 26 for 155U

The REG:FIFO function block contains a FIFO (first in/first out) register of variable depth.

The FIFO is located in a data area; this data area and the length of the buffer must be specified. 16-bit words can be read in and read out.

The function block has outputs for "Buffer full" and "Buffer empty".

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	160	11	1.4
100U with CPU 103	160	11	1.6
115U with CPU 941[4]	160	11	2.3
CPU 942[4]	160	11	2.3
CPU 943[4]	160	11	2.2
CPU 944[4]	160	11	0.3
CPU 945	148	11	0.015
135U/155U with CPU 922	160	11	1.2
CPU 928	160	11	0.6
CPU 928B	160	11	0.1
CPU 948	162	11	0.035
155U with CPU 946/947	162	11	0.2

1) As of Order No.: 6ES5 94.-7UB..

Basic functions (continued)

REG:LIFO
Stack

FB 13 for 95U
FB 13 for 100U
FB 13 for 115U
FB 13 for 135U
FB 27 for 155U

The REG:LIFO function block stores the information in a stack (LIFO = last in/first out).

The depth of the stack is variable. The stack is located in a data area; this data area and the depth of the stack must be specified. 16-bit words can be stored.

The function block has outputs for "Stack full" and "Stack empty".

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	117	11	1.4
100U with CPU 103	117	11	1.4
115U with			
CPU 941[1)]	117	11	max. 2.4
CPU 942[1)]	117	11	max. 2.4
CPU 943[1)]	117	11	max. 2.3
CPU 944[1)]	117	11	max. 0.3
CPU 945	110	11	max 0.012
135U/155U with			
CPU 922	117	11	0.9
CPU 928	117	11	0.52
CPU 928B	117	11	0.1
CPU 948	119	11	0.03
155U with CPU 946/947	119	11	0.2

1) As of Order No.: 6ES5 94.-7UB..

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COD:B8
Code converter BCD into binary

FB 21 for 115U

The function block "Code converter BCD into binary" converts a BCD number consisting of 8 decades plus sign into a fixed-point binary number (31 + 1 bit).

Permissible range of BCD numbers: -99999999 to +99999999.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	183	7	3.3
CPU 942[1)]	183	7	3.3
CPU 943[1)]	183	7	2.5
CPU 944[1)]	183	7	0.9

1) As of Order No.: 6ES5 94.-7UB..

COD:32
Code converter binary into BCD

FB 23 for 115U

The function block "Code converter binary into BCD" converts a fixed-point binary number (31 + 1 bit) into a BCD number consisting of 10 decades plus sign.

Permissible range of the fixed-point binary numbers: -2^{31} to $+ 2^{31} - 1$

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	302	8	3.5
CPU 942[1)]	320	8	3.5
CPU 943[1)]	302	8	2.5
CPU 944[1)]	302	8	1.2

1) As of Order No.: 6ES5 94.-7UB..

Basic functions (continued)

AE:464
Read in analog value from 6ES5 464 modules

FB 30 for 95U

FB 30 for 100U

FB 30 for CPU 941 to 944

FB 13 for 135U

FB 27 for 155U

The function block "AE:464" is used to read in analog values from the 6ES5 464-8M... analog input modules.

The function block takes into consideration the characteristics of the various analog input modules and produces at its output a standardized value between specified lower and upper limits for a given nominal input signal. The user sets the limits.

The function block for the S5-95U, S5-100U and S5-115U (CPU 941 to 944) produces the standardized value as a 16-bit fixed-point number, for the S5-115U (CPU 945), S5-135U and S5-155U as a 32-bit floating-point number.

Modules to be used:
6ES5 464-8MA11
6ES5 464-8MA21
6ES5 464-8MB11
6ES5 464-8MC11
6ES5 464-8MD11
6ES5 464-8ME11
6ES5 464-8MF11
6ES5 464-8MF21.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	395	9	5.8
100U with CPU 103[2)]	395	9	3.5
115U with			
CPU 941[1)]	418	9	4.5
CPU 942[1)]	418	9	4.5
CPU 943[1)]	418	9	3.9
CPU 944[1)]	418	9	2.7
135U/155U with			
CPU 922	384	11	3.6
CPU 928	384	11	1.9
CPU 928B	384	11	0.6
CPU 948	386	11	0.095
155U with			
CPU 946/947	386	11	0.4

1) As of Order No.: 6ES5 94.-7UB..

2) As of Order No.: 6ES5 103-8MA03

AE:460
Read in analog value from 6ES5 460/465 modules

FB 30 for CPU 941 to 944

FB 250*) for CPU 945

FB 31 for 135U/155U

*) is integrated in the operating system of the CPU 945

The function block "AE:460" is used to read in analog values from the 6ES5 460-4UA/7LA.. or 6ES5 465-4UA/7LA.. analog input modules.

The function block takes into consideration the characteristics of the various analog input modules and produces at its output a standardized value between specified lower and upper limits for a given nominal input signal. The user sets the limits.

The function block for the S5-115U (CPU 941 to 944) produces the standardized value as a 16-bit fixed-point number, for the S5-115U (CPU 945), S5-135U and S5-155U as a 32-bit floating-point number.

Both cyclic and selective sampling are possible.

Modules to be used:
6ES5 460-4UA1.
6ES5 460-4LA1.
6ES5 465-4UA1.
6ES5 465-7LA1.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	315	11	4.9
CPU 942[1)]	315	11	4.9
CPU 943[1)]	315	11	4.6
CPU 944[1)]	315	11	2.8
135U/155U with			
CPU 922	300	13	3.5
CPU 928	300	13	1.6
CPU 928B	300	13	0.6
CPU 948	305	13	0.095
155U with			
CPU 946/947	305	13	0.4

1) As of Order No.: 6ES5 94.-7UB..

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Basic functions (continued)

AE:463
Read in analog value from 6ES5 463-4U modules

FB 32 for CPU 941 to 944

FB 241*) for CPU 945

FB 32 for 135U/155U

*) is integrated in the operating system of the CPU 945

The function block "AE:463" is used to read in analog values from the 6ES5 463-4UA□□ or 6ES5 463-4UB□□ analog input modules.

The function block takes into consideration the characteristics of the various analog input modules and produces at its output a standardized value between specified lower and upper limits for a given nominal input signal. The user sets the limits.

The function block for the S5-115U (CPU 941 to 944) produces the standardized value as a 16-bit fixed-point number, for the S5-115U (CPU 945), S5-135U and S5-155U as a 32-bit floating-point number.

Modules to be used:
6ES5 463-4UA1.
6ES5 463-4UB1.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	235	9	4.2
CPU 942[1)]	235	9	4.2
CPU 943[1)]	235	9	4.0
CPU 944[1)]	235	9	2.7
135U/155U with			
CPU 922	219	11	3.0
CPU 928	219	11	1.6
CPU 928B	219	11	0.6
CPU 948	221	11	0.08
155U with			
CPU 946/947	221	11	0.5

1) As of Order No.: 6ES5 94.-7UB..

AE:466
Read in analog value from 6ES5 466-3LA modules

FB 33 for CPU 941 to 944

FB 243*) for CPU 945

FB 33 for 135U/155U

*) is integrated in the operating system of the CPU 945

The function block "AE:466" is used to read in analog values from the 6ES5 466-3LA1 □ analog input modules.

The function block takes into consideration the characteristics of the various analog input modules and produces at its output a standardized value between specified lower and upper limits for a given nominal input signal. The user sets the limits.

The function block for the S5-115U (CPU 941 to 944) produces the standardized value as a 16-bit fixed-point number, for the S5-115U (CPU 945), S5-135U and S5-155U as a 32-bit floating-point number.

Modules to be used:
6ES5 466-3LA1.

Technical specifications

For S5-	Block length in word	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	283	9	10.6
CPU 942[1)]	283	9	10.6
CPU 943[1)]	283	9	8.4
CPU 944[1)]	283	9	4.8
135U/155U with			
CPU 922	252	11	3.3
CPU 928	252	11	1.6
CPU 928B	252	11	0.5
CPU 948	254	11	0.09
155U with			
CPU 946/947	254	11	0.7

1) As of Order No.: 6ES5 94.-7UB..

Basic functions (continued)

RLG:AA
Output analog value

FB 251 for 95U*)

FB 251 for 100U*)

FB 251 for 115U*)

FB 41 for 135U/155U

*) is integrated in the operating system

The function block "Output analog value" is used to output analog signals to the process via analog output modules. The function block must be assigned values between a lower and an upper limit.

Modules to be used:
6ES5 470-4UA12
6ES5 470-4UB12
6ES5 470-4UC12
6ES5 470-7LA12
6ES5 470-7LB12
6ES5470-7LC12.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
100U with			
CPU 103	—	9	max. 6
115U with			
CPU 941[1)]	—	9	max. 6
CPU 942[1)]	—	9	max. 6
CPU 943[1)]	—	9	max. 6
CPU 944[1)]	—	9	max. 6
135U/155U with			
CPU 922	101	12	2.9
CPU 928	101	12	2.4
CPU 928B	101	12	0.2
CPU 948	105	12	0.053
155U with			
CPU 946/947	105	12	0.27

1) As of Order No.: 6ES5 94.-7UB..

Retten
Laden
Save, load scratch bit memories

FB 38 for 115U

FB 39 for 115U

FB 38 for 135U/155U

FB 38 for 135U/155U

When a cyclic user program is interrupted by a time-controlled or process interrupt-driven program, there is danger of the data stored in the "scratched bit memory area" (FW 200 to FW 254) being over-written by the interrupt-driven program.
The "RETTEN" function block is called at the beginning of the interrupt service routine to save the scratch bit memories in a data block.

The "LADEN" function block is called at the end of the interrupt service routine to reload FW 200 to FW 254 with the scratch bit memories for the cyclic program.

Technical specifications

For S5-	Block length in words		Call length in words		Processing time in ms	
	FB 38	FB 39	FB 38	FB 39	FB 38	FB 439
115U with CPU 945	93	86	3	3	0.133	0.133
135U/155U with CPU 948	105	96	3	3	0.11	0.105
155U with CPU 946/947	105	96	3	3	0.24	0.24

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Basic functions (continued)

SST:UHR
Clock

FB 129 for 155U

The "SST:UHR" function block sets and reads the system clock. The block is not programmable.

It reserves the data words DW 0 to DW 11 in DB 55; the user must initialize these data words.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
155U with CPU 946/947	53	2	0.1 to 0.4

DB-COPY
Copy data words between data blocks DB/DX

FB 44/45 for 115U

FB 44/45 for 135U

FB 44/45 for 155U

The function blocks copy a defined number of data words (0 to 255) between a source DB/DX and a destination DB/DX.

With the CPU 941 to CPU 944 only the normal data area (DB) is permitted.

The FB 44 and FB 45 function blocks have the same function. They differ only in their type of parameter assignment.

The parameters of the FB 44 are specified when they are called (direct parameter assignment) while the FB 45 receives its block parameters by the transfer of a pointer on a parameter field (indirect parameter assignment).

Technical specifications

For S5-	Block length in words		Call length in words		Processing time in ms	
	FB44	FB 45	FB 44	FB 45	FB 44	FB 45
115U with						
CPU 941[1)]	216	273	8	2	2.4 to 24.3	2.6 to 24.7
CPU 942[1)]	216	273	8	2	2.4 to 24.3	2.6 to 24.7
CPU 943[1)]	216	273	8	2	2.0 to 22.2	2.4 to 22.5
CPU 944[1)]	216	273	8	2	1.0 to 1.2	0.9 to 1.5
CPU 945	247	318	8	2	0.025 to 0.115	0.035 to 0.125
135U/155U with						
CPU 922	168	217	8	2	2.3 to 2.8	3.0 to 3.3
CPU 928	168	217	8	2	1.4 to 1.6	1.7 to 2.0
CPU 928B	168	217	8	2	0.3 to 0.6	0.4 to 0.7
CPU 948	233	303	8	2	0.04 to 0.315	0.09 to 0.34
155U with						
CPU 946/947	233	303	8	2	0.3 to 0.7	0.3 to 0.8

1) As of Order No.: 6ES5 94.-7UB..

2) The times are depending on the number of bytes to be transfered.

Basic functions (continued)

PER:ET
Read and write extended I/Os

The function block "Read and write extended I/Os" transfers (depending on the type of parameter assignment) an I/O area via one of the interface modules specified to a CPU-internal area or vice versa.

Input bytes can thus be read from the extended I/Os and output bytes written to the extended I/Os.

FB 196:
Direct parameter assignment
FB 197:
Indirect parameter assignment

The following table contains all source and destination areas which can be addressed.

Areas		S5-115U	S5-135U with CPU 922 928-.UA..	CPU 928 -.UB..	S5-155U
I/O area	P (byte no.)	128-255	128-255	128-255	128-255
	Q (byte no.)	0-255	0-255	0-255	0-255
	IM3 (byte no.)	0-255	0-255	0-255	0-255
	IM4 (byte no.)	0-255	0-255	0-255	0-255
Internal area	DB (DW no.)	10-2042	10-2042	10-2042	10-2042
	DX (DW no.)	-	10-2042	10-2042	10-2042
	Bit memories (byte no.)	0-235	0-235	0-235	0-235
	S-Bit memories (byte no.)	-	-	0-1023	0-4095

The "PER:ET" function block is used with one of the following interface modules:

IM 300-3, IM 300-5 (-5CA11), IM 300-5 (-5LB11), IM 301-3, IM 301-5, IM 304, IM 305, IM 306, IM 307 and IM 308

Note:
The I/O modules addressed with one block call must be addressed continuously. After each gap in the addresses, the PER:ET function block must be called again.

Technical specifications

For S5-	Block length in words		Call length in words		Processing time[2] in ms	
	FB 196	FB 197	FB 196	FB 197	FB 196	FB 197
115U with						
CPU 941[1]	213	272	7	2	2.3 to 10.9	2.1 to 10.7
CPU 942[1]	213	272	7	2	2.3 to 10.9	2.1 to 10.7
CPU 943[1]	213	272	7	2	2.1 to 10.7	1.9 to 10.5
CPU 944[1]	213	272	7	2	0.4 to 0.6	0.7 to 0.9
CPU 945	214	282	7	2	0.025 to 0.115	0.035 to 0.125
135U/155U with						
CPU 922	267	322	7	2	3.2 to 4.7	3.9 to 5.4
CPU 928	267	322	7	2	1.4 to 2.6	1.8 to 3.0
CPU 928B	267	322	7	2	0.9 to 2.1	1.0 to 2.2
CPU 948	301	369	7	2	0.07 to 1.2	0.09 to 1.4
155U with						
CPU 946/947	301	369	7	2	1.1 to 1.3	1.3 to 1.5

1) As of Order No.: 6ES5 94.-7UB..

2) The times are depending on the number of bytes to be transferred.

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Basic functions (continued)

Summary Program package "Basic functions"

Function block	For S5 programmable controllers					
	95U	100U with CPU 103	115U with CPU 941-944	115U with CPU 941-944	135U	155U
ADD : 32	FB 1	FB 1	FB 1	—	FB 1	FB 3
SUB : 32	FB 2	FB 2	FB 2	—	FB 2	FB 7
MUL : 32	FB 3	FB 3	FB 3	FB 3	FB 3	FB 11
DIV : 32	FB 4	FB 4	FB 4	FB 4	FB 4	FB 15
RAD : 16	FB 5	FB 5	FB 5	FB 5	FB 5	FB 18
RAD : GP	—	—	—	FB 6	FB 6	FB 19
REG : SCHB	FB 10	FB 10	FB 10	FB 10	FB 10	FB 24
REG : SCHW	FB 11	FB 11	FB 11	FB 11	FB 11	FB 25
REG : FIFO	FB 12	FB 12	FB 12	FB 12	FB 12	FB 26
REG : LIFO	FB 13	FB 13	FB 13	FB 13	FB 13	FB 27
COD : B8	—	—	FB 21	—	—	—
COD : 32	—	—	FB 23	—	—	—
AE : 464	FB 30	FB 30	FB 30	FB 242[1)]	FB 30	FB 30
AE : 460	—	—	FB 31	FB 250[1)]	FB 31	FB 31
AE : 463	—	—	FB 32	FB 241[1)]	FB 32	FB 32
AE : 466	—	—	FB 33	FB 243[1)]	FB 33	FB 33
RLG : AA	FB 251[1)]	FB 251[1)]	FB 251[1)]	FB 251[1)]	FB 41	FB 41
SON : WS	—	—	—	—	—	—
SST : UHR	—	—	—	—	—	FB 129
Retten	—	—	—	FB 38	—	FB 38
Laden	—	—	—	FB 39	—	FB 39
DB-COPY	—	—	FB 44/45	FB 44/45	FB 44/45	FB 44/45
PER : ET	—	—	FB 196/197	FB 196/197	FB 196/197	FB 196/197

[1)] These function blocks are integrated in the operating system of the CPU.

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Ordering data	Order No.
Program package "Basic functions" for S5-95U, S5-100U with CPU 103, S5-115U with CPU 941-944[2)], CPU 945, S5-135U /155U with CPU 922, 928, 928 B, CPU 948, S5-155U with CPU 946/947, with manual in German, English, French, for MS-DOS, S5-DOS/MT operating system, on $3^1/_2$" diskettes (720 Kbyte) and on $5^1/_4$" diskettes (360 Kbyte) Single license Copy license	**6ES5 848-7AA02** **6ES5 848-7AA02–0KL1**

[2)] As of Order No.: 6ES594.-7UB..

Floating-point arithmetic

Application

The standard function blocks for floating-point arithmetic enable the S5-115U, S5-100U (with CPU 103) and S5-95U to execute arithmetic operations with

- 32-bit fixed-point numbers (31 bit + sign bit) and
- 32-bit floating-point numbers (exponent: 7 bit + sign bit, mantissa: 23 bit + sign bit)

Functions

The following standard function blocks are available for floating-point arithmetic:

- FB 15: Fixed-point to floating-point conversion
- FB16: Floating-point to fixed-point conversion
- FB 17: Add two floating-point numbers
- FB 18: Subtract two floating-point numbers
- FB 19: Multiply two floating-point numbers
- FB 20: Divide two floating-point numbers
- FB 21: Compare two floating-point numbers

These function blocks set the following bit memories for futher processing:

- Overflow
- Result is 0
- Error

Number range for fixed-point numbers:
2 147 483 648 to + 2 147 483 647 (-2^{31} to $+2^{31} - 1$).

Number range for floating-point numbers:
± 1 469 368 exp.38 to 1 701 412 exp. + 39.

Technical specifications

Block number	Block name	Block length in words	Processing time in ms with						Nesting depth	Blocks called	Bit memories reserved
			S5-95U	S5-100U CPU 103	S5-115U CPU 941	CPU 942	CPU 943	CPU 944			
FB 15	GP:FPGP	72	0.41 - 4.67	0.9 - 1.3	0.85 - 2	0.85 - 2	0.78 - 1.4	0.04 - 0.23	0	—	FW 200 to FW 203
FB 16	GP:GPFP	95	0.54 - 5.63	1.1 - 1.8	1.6 - 2.3	1.6 - 2.3	1.2 - 1.9	0.14 - 0.5	0	—	FW 200 to FW 203
FB 17	GP:ADD	266	1.29 - 2.62	1.4 - 1.9	2.1 - 2.5	2.1 - 2.5	1.6 - 2.25	0.13 - 0.56	0	—	FW 200 to FW 212
FB 18	GP:SUB	267	1.14 - 1.38	1.77 - 2.3	2.1 - 2.5	2.1 - 2.5	1.8 - 2.3	0.13 - 0.56	0	—	FW 200 to FW 212
FB 19	GP:MUL	176	3.63 - 3.97	2.7 - 4.3	2.5 - 4.8	2.5 - 4.8	2.2 - 4.6	1.3 - 4.4	1	FB 242, MUL: 16	FW 200 to FW 220
FB 20	GP:DIV	223	0.56 - 9.3	1.8 - 4.0	1.6 - 4.2	1.6 - 4.2	1.1 - 3.5	0.5 - 2	0	—	FW 200 to FW 214
FB 21	GP:VGL	112	0.67 - 1.01	1.0 - 1.5	1.5 - 1.8	1.5 - 1.8	1.0 - 1.4	0.1 - 0.15	0	—	FW 200 to FW 207

Ordering data

	Order No.
Program package "Floating-point arithmetic" for S5-95U, S5-100U with CPU 103, S5-115U with CPU 941-944 with manual in German, English, French, for MS-DOS, S5-DOS/MT operating system, on 3 1/2" diskettes (720 Kbyte) and on 5 1/4" diskettes (360 Kbyte)	
Single license	**6ES5 845-7GP01**
Copy license	**6ES5 845-7GP01-0KL1**

Mathematical functions

Application

The following standard function blocks are available for executing often-used mathematical functions:

- Trigonometric functions; sine, cosine, tangent, cotangent
- Arc functions; arc sine, arc cosine, arc tangent, arc cotangent
- Logarithmic functions; natural logarithm, common logarithm, logarithm to any base
- Exponential functions; exponent to base e, exponent to base 10, exponent to any base.

The function blocks are available for S5-135U and S5-155U.

Principle of operation

Standard function blocks for mathematical functions are handled in the same way as equivalent STEP 5 statements. When the block is called,

- the contents of accumulator 1 are changed in accordance with the function executed (without altering the contents of the other accumulators or the base address register BR), or
- the contents of accumulators 1 and 2 are combined in accordance with the function executed, with the contents of accumulator 3 being pushed into accumulator 2 and the contents of accumulator 4 into accumulator 3 (like a STEP 5 arithmetical function). The contents of the BR register remain unchanged.

All standard function blocks for mathematical functions process 32-bit floating-point numbers.

SINUS
sin (x)

FB 101 for 115U/135U/155U

The "SINUS" function block calculates the sine of a 24/32-bit floating-point number.

The value must lie within the range
0 (KG = + 0000000 + 00) to
2π (KG = + 6283185 + 01).

COSINUS
cos(x)

FB 102 for 115U/135U/155U

The "COSINUS" function block calculates the cosine of a 24/32-bit floating-point number.

The value must lie within the range
9 (KG = + 0000000 + 00) to
2π (KG = + 6283185 + 01).

TANGENS
tan(x)

FB 103 for 115U/135U/155U

The "TANGENS" function block calculates the tangent of a 24/32-bit floating-point number. The value must lie within the range
0 (KG = + 0000000 + 00) to
2π (KG = + 6283185 + 01).

If the input value is π/2 (KG = + 1570796 + 01) or 3π/2 (KG + 4712389 + 01), the result is infinite and the function block reports an error.

COTANG
cotan (x)

FB 104 for 115U/135U/155U

The "COTANG" function block calculates the cotangent of a 24/32-bit floating-point number. The value must lie within the range
(KG = + 2938734 - 34 to
KG = + 6283184 + 01).

If the input value is 0π (KG = 3141593 + 01) or 2π (KG = 6283185 + 01), the result is infinite and the function block reports an error.

ARCSIN
arcsin (x)

FB 105 for 115U/135U/155U

The "ARCSIN" function block calculates the arcsine of a 24/32-bit floating-point number.

The value must lie within the range
- 1 (KG = - 1000000 + 01) to
+ 1 (KG = + 1000000 + 01).

Mathematical functions (continued)

ARCCOS arccos (x) **FB 106 for 115U/135U/155U**	The "ARCCOS" function block calculates the arccos of a 24/32-bit floating-point number.	The value must lie within the range – 1 (KG = – 1000000 + 01) to + 1 (KG = + 1000000 + 01).	
ARCTAN arctan (x) **FB 107 for 115U/135U/155U**	The "ARCTAN" function block calculates the arctan of a 24/32-bit floating-point number.	With a value of less than KG = – 5773456 + 07 the result output is – π/2, with a value greater than KG = + 1209486 + 07 the result is + π/2.	
ARCOT arcot (x) **FB 108 for 115U/135U/155U**	The "ARCCOT" function block calculates the arccot of a 24/32-bit floating-point number.	With a value of less than KG = – 5773456 + 07 the result output is π,	with a value greater than KG = + 1209486 + 07 the result is 0.
LN X ln (x) **FB 109 for 115U/135U/155U**	The "LN X" function block calculates the natural log of a 24/32-bit floating-point number.	With a value of less than or equal to 0, accumulator 1 remains unchanged and the function block reports an error.	
LG X lg (x) **FB 110 for 115U/135U/155U**	The "LG X" function block calculates the common log of a 24/32-bit floating-point number.	With a value of less than or equal to 0, accumulator 1 remains unchanged and the function block reports an error.	
B LOG X $\log_b$ (x) **FB 111 for 115U/135U/155U**	The "B LOG X" function block calculates the log to any base. Base b is expected in accumulator 1, the value x in	accumulator 2, both as 24/32-bit floating-point numbers. Both values must be greater than 0, and the base cannot have the value 1.	The result is represented in accumulator 1 as a 24/32-bit floating-point number.
E^X e^x **FB 112 for 115U/135U/155U**	The "E^X function block calculates the exponential value to the base e of a 24/32-bit floating-point number.	The value must lie within the range KG = – 8802962 + 02 to KG = + 8802966 + 02, otherwise an overflow condition is produced.	
ZEHN^X 10^x **FB 113 for 115U/135U/155U**	The "ZEHN^X" function block calculates the exponential value to the base 10 of a 24/32-bit floating-point number.	The value must lie within the range KG = – 3823079 + 02 to KG – 3823079 + 02, otherwise an overflow condition is produced.	
A2^A1 $a2^{a1}$ **FB 114 for 115U/135U/155U**	The "A2^A1" function block calculates the exponential value to any base. Base a2 is expected in accumulator 2,	the exponent a1 in accumulator 1, both as 24/32-bit floating-point numbers. The base value must be positive. The result is represented in accumulator 1 as a 24/32-bit floating-point number.	If the result produces an overflow, the contents of accumulators 1 and 2 remain unchanged and the function block reports an error.

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Mathematical functions (continued)

Technical specifications

Block number	Block name	Block length in words			Processing time in ms with					
		CPU 922, 928	CPU 945	CPU 946/ 947, 948	CPU 922	CPU 928	CPU 928B	CPU 945	CPU 946/947	CPU 948
101	SINUS	242	192	211	3.8	2.4	1.3	0.039	0.4	0.15
102	COSINUS	238	188	207	3.8	2.4	1.4	0.038	0.4	0.14
103	TANGENS	318	268	287	4.0	2.5	1.4	0.043	0.4	0.16
104	COTANG	321	271	290	4.0	2.5	1.3	0.041	0.4	0.15
105	ARCSIN	218	184	203	3.5	2.2	1.3	0.035	0.35	0.14
106	ARCCOS	253	219	238	3.7	2.3	1.3	0.040	0.35	0.15
107	ARCTAN	268	241	260	4.2	2.6	1.4	0.044	0.45	0.17
108	ARCCOT	269	246	265	4.3	2.7	1.4	0.046	0.45	0.17
109	LN X	222	187	206	4.3	2.9	1.5	0.042	0.5	0.17
110	LG X	222	191	210	4.3	2.9	1.5	0.044	0.5	0.17
111	B LOG X	274	227	254	7.6	5.1	1.9	0.079	0.95	0.31
112	E^X	253	217	236	4.5	3.0	1.5	0.046	0.5	0.18
113	ZEHN^X	260	224	243	4.6	3.1	1.5	0.048	0.5	0.19
114	A2^A1	418	364	391	7.4	4.9	1.9	0.077	0.5	0.31

Ordering data

Order No.

Program package "Mathematical functions"
for S5-115U with CPU 945,
S5-135U/155U with
CPU 922, 928, 928B, CPU 948,
S5-155U with CPU 946/947,
with manual
in German, English, French,
for MS-DOS, S5-DOS/MT
operating systems,
on 3 $^1/_2$" diskettes (720 Kbyte)
and
on 5 $^1/_4$" diskettes (360 Kbyte)

Single license — **6ES5 848-7MT01**
Copy license — **6ES5 848-7MT01-0KL1**

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GRAPH 5/II

Application

GRAPH 5/II is an easy-to-use software system for planning and design, programming, documenting and testing sequencers. It consists of the GRAPH 5/II system program for the programming device and the GRAPH 5/II package of standard function blocks (see page 7/10).

Compared with the GRAPH 5 package, the GRAPH 5/II package offers additional diagnostic functions, synchronization and optimized processing times.

The sequence blocks generated with an older version of GRAPH 5 can be matched to the new function blocks with the GRAPH 5/II option package.

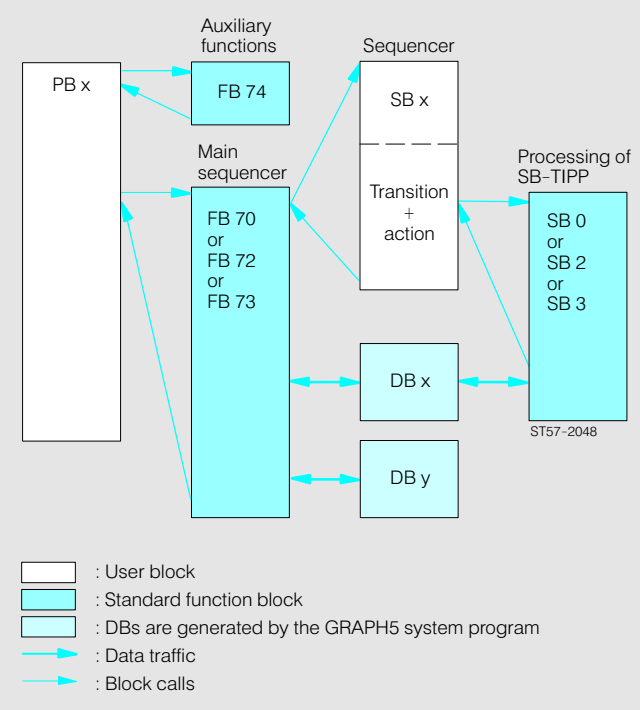

Fig. 7/31 Calling structure

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Processing times

For S5-	Structure linear sequencer FB 70	FB 73	FB 73/74	2 simultaneous sequencers FB 70	FB 72	FB 72/74	4 simultaneous sequencers FB 70	FB 72	FB 72/74	8 simultaneous sequencers FB 70	FB 72	FB 72/74
95U	—	5.9	8.5	—	11	14	—	19	22.5	—	38	41
100U with CPU 103	23	13	19	33	27	29	54	43	47	77	65	71
115U with												
CPU 941	13	7	10	17	12	15	29	19	22	41	29	36
CPU 942	11	6	9	15	11	13	25	17	19	39	30	33
CPU 943	10.1	4	5.5	14.4	10.5	11.8	22.6	18.2	19.6	38	33.6	35.1
CPU 944	1.2	1.0	1.15	1.45	1.3	1.45	3.56	2.0	2.1	3.8	3.2	3.3
CPU 945	0.49	0.43	0.47	0.51	0.48	0.51	0.58	0.51	0.59	0.72	0.58	0.74
135U/155U with												
CPU 922	16.0	10.4	13.9	22.0	18.0	21.6	33.8	29.0	32.6	57.1	51.1	54.6
CPU 928B	1.0	0.7	0.85	1.5	1.1	1.3	1.9	1.6	1.85	24	2.85	3.2
CPU 948	0.59	0.5	0.57	0.73	0.67	0.74	1.01	0.94	1.0	1.53	1.44	1.52
155U with CPU 946/947	1.65	1.2	1.5	2.15	1.85	2.2	3.2	2.8	3.1	5.3	4.75	5.1

1) Processing times for sequencers with 25 steps, 3 assignments per step, 3 scans per transition, switching per cycle (in ms).

GRAPH 5/II (continued)

GPH:HKET
Main sequencer

FB 70 for 100U to 155U

The "GPH:HKET" function block controls the main sequencer of a sequence control system. It controls the conveniently programmable operating modes (e.g. manual, automatic) and calls the secondary sequencers.
A maximum of 255 sequencers can be called; a single sequencer can contain 127 steps.

A maximum of eight columns (simultaneous or alternative branches) can be programmed for each sequencer; one initial step can be selected for each column.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time
100U with CPU 103	1100	24	
115U with CPU 941-944, CPU 945	1100 1097	24 24	Depending on the volume of the sequence control system, see table on page 7/55
135U /155U with CPU 922	1085	24	
CPU 928	1085	24	
CPU 928B	1085	24	
CPU 948	1095	24	
155U with CPU 946/947	1095	24	

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GPH:UKET
Secondary sequencer

FB 71 for 100U to 155U

The "GPH:UKET" function block controls the secondary sequencer of a sequence control system. Secondary sequencers are called in the main sequencer steps.

The operating modes of the main sequencer are forward-ed automatically to the secondary sequencer. All other functions are the same as in FB 70.

Technical specifications

STEP 5 blocks for S5-	Block length in words	Call length in words	Processing time
100U with CPU 103	1104	16	
115U with CPU 941-944	1104	16	Depending on the volume of the sequence control system, see table on page 7/55
CPU 945	1101	16	
135U/155U with CPU 922	1089	16	
CPU 928	1089	16	
CPU 928B	1089	16	
CPU 948	1099	16	
155U with CPU 946/947	1099	16	

GRAPH 5/II (continued)

GPH:SIM1
High-speed simultaneous sequencer

FB 72 for 95U to 155U

The "GPH:SIM1" function block enables somewhat less convenient but high-speed processing of alternative and simultaneous sequencers. Number of sequencers and steps as for FB 70.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time
95U	731	9	
100U with			
CPU 103	731	9	
115U with			
CPU 941-944	731	9	Depending on the volume of the sequence control system, see table on page 7/55
CPU 945	731	9	
135U/155U with			
CPU 922	731	9	
CPU 928	731	9	
CPU 928B	731	9	
CPU 948	731	9	
155U with			
CPU 946/947	731	9	

GPH:LIN1
High-speed linear sequencer

FB 73 for 95U to 155U

The "GPH:LIN1" function block enables somewhat less convenient but high-speed processing of linear sequencers. Number of sequencers and steps as for FB 70.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time
95U	333	9	
100U with			
CPU 103	333	9	
115U with			
CPU 941-944	333	9	Depending on the volume of the sequence control system, see table on page 7/55
CPU 945	333	9	
135U/155U with			
CPU 922	333	9	
CPU 928	333	9	
CPU 928B	333	9	
CPU 948	333	9	
155U with			
CPU 946/947	333	9	

GRAPH 5/II (continued)

GPH:ZFK1
Auxiliary functions

FB 74 for 95U to 155U

The "GPH:ZFK1" function block implements auxiliary functions for FB 72 and FB 73, e.g. step selection and synchronization.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time
95U	370	9	
100U with CPU 103	370	9	
115U with CPU 941-944	370	9	Depending on the volume of the sequence control system, see table on page 7/55
CPU 945	370	9	
135U/155U with CPU 922	369	9	
CPU 928	369	9	
CPU 928B	369	9	
CPU 948	369	9	
155U with CPU 946/947	369	9	

PG COPY
Read diagnostic message

FB 67 for 100U to 155U

The "PG COPY" function block provides the programming device with a diagnostic message from the diagnostic buffer for display purposes.

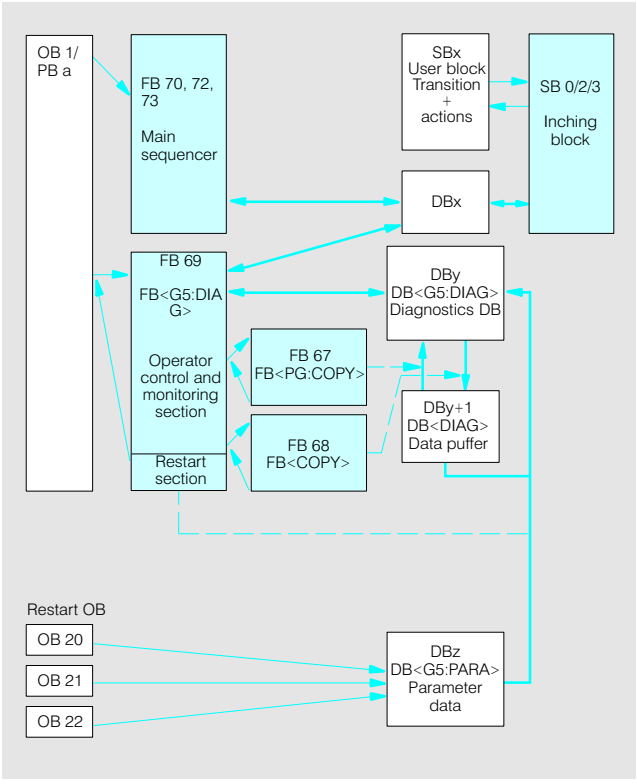

Fig. 7/32 Calling structure for diagnostics

GRAPH 5/II (continued)

COPY
Write diagnostic messages

FB 68 for 100U to 155U

The "COPY" function block enters the diagnostic messages in the diagnostic buffer.

G5 DIAG
Diagnostics

FB 69 for 100U to 155U

The "DIAG" function block organizes and monitors the GRAPH 5/II diagnostics. It calls function blocks FB 67 and FB 68.

Technical specifications

For S5-	Block length in words FB 67	FB 68	FB 69
95U	118	107	1800
100U with CPU 103			
115U with			
CPU 941-944	118	107	1800
CPU 945	120	109	1667
135U/155U with			
CPU 922	103	92	1520
CPU 928	103	92	1520
CPU 928B	103	92	1520
CPU 948	112	101	1530
155U with			
CPU 946/947	112	101	1530

Diagnostic functions

The diagnostic functions monitor all GRAPH 5/II sequencers and transfer the sequencer status information to a programming device or an operator control and monitoring device.

Services:

- Detection of errors in sequencers and preparation of first-up signals
- Updating of status data of the sequencers monitored
- Selection and display of sequencer operating modes
- Recording of diagnostic information in a data buffer

GPH:REAK
Reactivate times

FB 75 for 100U to 155U

The "GPH:REAK" function block saves and reactivates waiting times and monitoring timers in the case of changes of operationg mode and after faults.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time
100U with CPU 103	1144	12	
115U with			
CPU 941-944	1144	12	
CPU 945	1109	12	
135U/155U with			Depending on the volume of the sequence control system
CPU 922	1098	12	
CPU 928	1098	12	
CPU 928B	1098	12	
CPU 948	1098	12	
155U with CPU 946/947	1108	12	

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GRAPH 5/II (continued)

Sequence blocks
Execution blocks
SB-TIPP

These blocks are needed for executing GRAPH 5 sequencers in the programmable controller. A special SB-TIPP is allocated to each GRAPH 5/II function block:

FB	FB 70	FB 72	FB 73
SB-TIPP	SB0	SB2	SB3

The associated SB-TIPP is called in each transition of sequence block SBx, and executes the operating modes initialized in the corresponding function block.

When a sequencer is generated with the GRAPH 5/II system program, the SB-TIPP call is automatically entered in the user sequence block SBx.

(Ordering data for the GRAPH 5/II system program for programmers: see page 7/10)

Technical specifications

For S5-	Block length in words		
	SB0	SB2	SB3
95U	—	3333	75
100U with			
CPU 103	385	333	75
115U with			
CPU 941-944	385	333	75
CPU 945	385	333	75
135U/155U with			
CPU 922	385	333	75
CPU 928	385	333	75
CPU 928B	385	333	75
CPU 948	385	333	75
155U with			
CPU 946/947	385	333	75

For each sequencer of a sequence control system there is one sequence block SBx, which contains the structure, step enabling or transition conditions and actions.

The user generates sequence blocks SBx using the GRAPH 5/II system program.

GRAPH 5/II (continued)

Sequence blocks (cont.)
Synchronization block SB5

Linear sequencers with alternative branches can be synchronized with the system.

The GRAPH 5/II option package generates a block for the sequencer with the conditions of synchronization.

With the synchronization conditions, the synchronization block SB 5 sets the step which corresponds to the system status.

The SB 5 synchronization block can be run on the following programmable controllers:

- S5-95U
- S5-100U with CPU 103
- S5-115U with CPU 941-944, 945
- S5-135U/155U with CPU 922, 928, 928 B, 948
- S5-155U with CPU 946/947

It has a block length of 318 words.

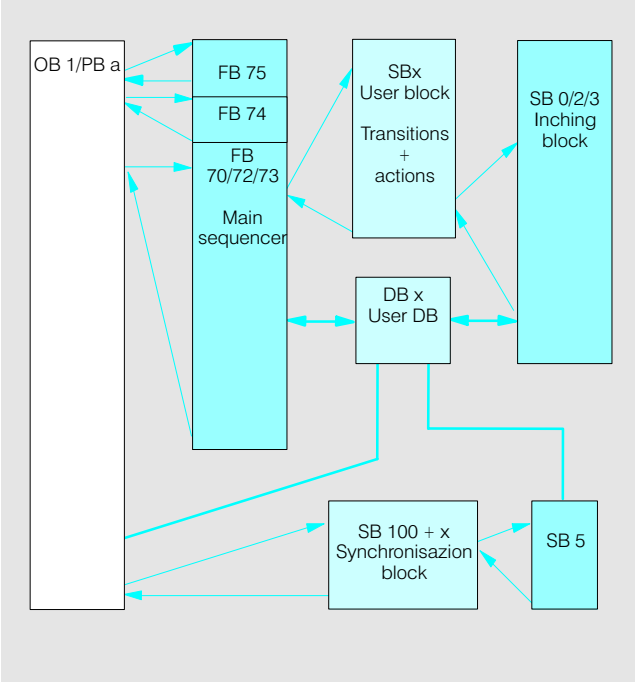

Fig. 7/33 Call structure for synchronization

Data blocks
Work and diagnostic data blocks DBx, DBy

One DBx work data block is available for each sequencer in sequence control system, and is allocated automatically to the associated SBx sequence block. The DBx work data block maintains the current status of the sequencer.

The error messages for all sequencers in a programmable controller are stored in the DBy diagnostic data block. The GRAPH 5 system program diagnostic function can thus be used to trace group errors over the inidvidual sequencers all the way to the detail level of the faulty sequencer.

The DBx and DBy blocks are generated with the GRAPH 5/II system program.

Summary

The GRAPH 5/II program package contains the following blocks:

- Function blocks FB 67 to FB 75
- Sequence blocks SB 0, SB 2, SB 3, SB 5

Ordering data

	Order No.
GRAPH 5/II program package for S5-95U, S5-100U with CPU 103, S5-115U with CPU 941-944, 945, S5-135U/155U with CPU 922, 928, 928B, CPU 948, S5-155U with CPU 946/947 MS-DOS, S5-DOS/MT operating systems, on $3^1/_2$″ diskettes (1.44 Mbyte) and on $5^1/_4$″ diskettes (1.2 Mbyte) with manual in German, English, French	
Single license	**6ES5 848-7DA03**
Copy license	**6ES5 848-7DA03-0KL1**

	Order No.
GRAPH 5/II programming software	See page 7/11
Documentation for GRAPH 5/II program package, V 6.6	
German	**6ES5 998-1FA13**
Englisch	**6ES5 998-1FA23**
French	**6ES5 998-1FA33**

Signalling functions

Application

The processes involved in process and power engineering can only be reliably controlled and monitored if a constant check is kept on operations at a central point. All important events, such as checkback, auxiliary and fault signals and messages, must be monitored and brought to the attention of the operators both visually and audibly.

A set of standard function blocks with the designation "Signalling functions" is available for this purpose.

A distinction is made between first-up and new-value messages (DIN 19 235). In the case of the former, the message (in a group of messages), whose status was the first in the group to change after the last acknowledgement was made, is highlighted. All messages occuring after this first-up message are referred to as new-value messages.

The signalling and acknowledgement states can be indicated by a steady light or flashing light with various frequencies.

A number of individual messages can be combined and displayed as a group message.

MLD:TG
Clock generator

FB 50 for 95U to 155U

The "Clock generator" function block produces flashing frequencies for the lamp outputs of the annunciator blocks.

The positive-going edges of the 0.63 Hz, 1.25 Hz, 2.5 Hz and 5 Hz frequencies are synchronized.

The FR parameter provides these frequencies in bits 4 to 7 of the specified byte (frequency byte).

Bit assignment of the FR frequency byte

Bit 0: Signal 0
Bit 1: Signal 0
Bit 2: Signal 0
Bit 3: Signal 0
Bit 4: F4 flicker frequency 5 Hz
Bit 5: F3 fast flashing light 2.5 Hz (1/2F4)
Bit 6: F2 flashing light 1.25 Hz (1/4F4)
Bit 7: F1 slow flashing light 0.63 Hz (1/8F4)

Conditions

- For the S5-95U, S5-100U (with CPU 103), S5-115U, S5-135U:
  The above frequencies result if called in OB 13, provided the cycle time is < 1 00 ms.
  For cycle times > 100 ms, FB 50 must be called from OB 13 only on each 2nd, 5th or 10th pass; the frequencies are then changed accordingly. FB 50 must not be called more than once in a single cycle.
- For the S5-155U:
  The above frequencies result if called in OB 13, provided the cycle time is < 100 ms.
  For cycle times > 100 ms, FB 50 must be called from OB 14, OB 15 or OB 16; the frequencies are then changed accordingly. FB 50 must not be called more than once in a single cycle.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
95U	23	3	0.4
100U with CPU 103	20	3	0.5
115U with			
CPU 941[1)]	44	3	0.8
CPU 942[1)]	20	3	0.8
CPU 943[1)]	20	3	0.7
CPU 944[1)]	20	3	<0.1
CPU 945	23	3	0.005
135U/155U with			
CPU 922	22	3	0.4
CPU 928	22	3	0.2
CPU 928B	22	3	0.05
CPU 948	19	3	0.01
155U with CPU 946/947	19	3	0.1

1) As of Order No.: 6ES5 94.-7UB.

Signalling functions (continued)

MLD:EZW
MLD:EZWK
First-up signal with single-frequency flashing light (word mode)

FB 51 for 95U to 155U

FB 57 for 95U to 155U

The MLD:EZW and MLD:EZWK function blocks indicate changes in signal status (either with a steady light or flashing light), depending on acknowledgement signals. The sensor signals are processed in word mode either on the open-circuit or closed-circuit principle.

The function block implements the indication of a first-up signal and the output of an audible signal, First-up signals. new-value signals and the audible signal are all acknowledged separately.

In the case of the MLD:EZW function block (FB 51), the signals are routed to outputs.
In the case of the MLD:EZWK function block (FB 57), the signals can be routed either to outputs or to bit memories.

Technical specifications

	Max. number of signal words	signals	Block length in words	Call length in words	Processing time in ms	Block-length in words	Call length in words	Processing time in ms
FB	**FB 51/FB 57**		**FB 51**			**FB 57**		
For S5-95U	16	256	368	18	4.4 to 137	378	19	4.4 to 137
100U with CPU 103	16	256	368	18	5.3 to 162	386	19	5.30 to 162
115U with CPU 941[1]	16	256	368	18	6.8 to 212	386	19	6.8 to 212
CPU 942[1]	16	256	368	18	6.8 to 212	386	19	6.8 to 212
CPU 943[1]	16	256	368	18	6.5 to 207	386	19	6.5 to 207
CPU 944[1]	16	256	368	18	0.30 to 1.8	386	19	0.3 to 11.8
CPU 945	16	256	326	18	0.40 to 0.925	339	19	0.04 to 0.9
135U/155U with CPU 922	16	256	368	18	4 to 60	392	19	4 to 60
CPU 928	16	256	368	18	4 to 55	392	19	4 to 55
CPU 928B	16	256	368	18	0.2 to 7.7	392	19	0.2 to 7.7
CPU 948	40	640	323	18	0.07 to 1.575	336	19	0.07 to 1.575
155U with CPU 946/947	40	640	323	18	0.2 to 10	336	19	0.2 to 10

1) As of Order No.: 6ES5 94.-7UB.

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Signalling functions (continued)

MLD:EDW
MLD:EDWK
First-up signal with double-frequency flashing light (word mode)

FB 52 for 95U to 155U

FB 58 for 95U to 155U

The MLD:EDW and MLD:EDWK function blocks indicate changes in signal status with a flashing light whose frequency depends on acknowledgement signals. The sensor signals are processed in word mode either on the open-circuit or closed-circuit principle.

The function block implements the indication of a first-up signal and the output of an audible signal. First-up signals, new-value signals and the audible signal are all acknowledged separately.

In the case of the MLD:EDW function block (FB 52), the signals are routed to outputs.
In the case of the MLD:EDWK function block (FB 58), the signals can be routed either to outputs or to flags.

Technical specifications

	Max. number of signal words	signals	Block length in words	Call length in words	Processing time in ms	Block length in words	Call length in words	Processing time in ms
FB	**FB 52/FB 58**		**FB 52**			**FB 58**		
For S5-95U	16	256	449	20	4.8 to 177	463	21	4.8 to 177
100U with CPU 103	16	256	454	20	8.1 to 223	469	21	8.1 to 223
115U with								
CPU 941[1]	16	256	454	20	1.2 to 266	469	21	10.2 to 266
CPU 942[1]	16	256	454	20	10.2 to 266	469	21	10.2 to 266
CPU 943[1]	16	256	454	20	9.8 to 261	469	21	9.8 to 261
CPU 944[1]	16	256	454	20	0.5 to 14.1	469	21	0.5 to 14.1
CPU 945	16	256	401	20	0.045 to 1.145	417	21	0.045 to 1.145
135U/155U					4 to 88			4 to 88
with CPU 922	16	256	457	20	4 to 63	477	21	4 to 63
CPU 928	16	256	457	20	0.2 to 9.4	477	21	0.2 to 9.4
CPU 928B	16	256	457	20	0.11 to 2.856	477	21	0.11 to 2.856
CPU 948	40	640	401	20		417	21	
155U with					0.2 to 15			0.2 to 15
CPU 946/947	40	640	401	20		417	21	

1) As of Order No.: 6ES5 94.-7UB.

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Signalling functions (continued)

MLD:EZ
MLD:EZK
First-up signal with single-frequency flashing light (bit mode)

FB 55 for 95U to 155U

FB 59 for 95U to 155U

The MLD:EZ and MLD:EZK function blocks indicate changes in signal status (either with a steady light or flashing light), depending on acknowledgement signals. The sensor signals are processed on the open-circuit or closed-circuit principle. Processing is carried out in bit mode.

The function block implements the indication of a first-up signal and the output of an audible signal. First-up signals, new-value signals and the audible signal are acknowledged separately.

In the case of the MLD:EZ function block (FB 55), the signals are routed to outputs.
In the case of the MLD:EZK function block (FB 59), the signals can be routed either to outputs or bit memories.

Technical specifications

Function block	Max. number of signal words **FB 55/ FB 59**	Block length in words **FB 55**	Call length in words	Processing time in ms	Block length in words **FB 59**	Call length in words	Processing time in ms
For S5-95U	30	301	21	3.9 to 100.0	314	22	3.9 to 100.0
100U with CPU 103	30	300	21	5.1 to 100.8	309	22	5.1 to 100.8
115U with							
CPU 941[1)]	30	300	21	5.8 to 120	309	22	5.8 to 120
CPU 942[1)]	30	300	21	5.8 to 120	309	22	5.8 to 120
CPU 943[1)]	30	300	21	5.7 to 115	309	22	5.7 to 115
CPU 944[1)]	30	300	21	0.2 to 7.5	309	22	0.2 to 7.5
CPU 945	30	282	21	0.035 to 0.955	296	22	0.035 to 0.955
135U/155U				6 to 175			6 to 158
with CPU 922	30	281	22	4 to 86	318	22	4 to 85
CPU 928	30	300	22	0.2 to 7	318	22	0.2 to 6.7
CPU 928B	30	300	22	0.09 to 2.585	318	22	0.08 to 2.38
CPU 948	64	282	21		293	22	
155U with				0.2 to 12			0.2 to 12
CPU 946/947	64	282	21		293	22	

1) As of Order No.: 6ES5 94.-7UB

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Signalling functions (continued)

MLD:ED
MLD:EDK
First-up signal with double-frequency flashing light (bit mode)

FB 56 for 95U to 155U

FB 60 for 95U to 155U

The MLD:ED and MLD:EDK function blocks indicate changes in signal status with a flashing light whose frequency depends on acknowledgement signals. The sensor signals are processed on the open-circuit or closed-circuit principle. Processing is carried out in bit mode.

The function block implements the indication of a first-up signal and the output of an audible signal. First-up signals, new-value signals and the audible signal are acknowledged separately.

In the case of the MLD:ED function block (FB 56), the signals are routed to outputs.

In the case of the MLD:EDK function block (FB 60), the signals can be routed either to outputs or bit memories.

Technical specifications

Function block	Max. number of signal words	Block length in words	Call length in words	Processing time in ms	Block length in words	Call length in words	Processing time in ms
	FB 56/ FB 60	**FB 56**			**FB 60**		
For S5-95U	30	334	23	4.3 to 102.0	347	24	4.3 to 102.0
100U with CPU 103	30	332	23	5.7 to 101.2	341	24	5.7 to 101.2
115U with CPU 941[1)]	30	332	23	6.9 to 122	341	24	6.9 to 122
CPU 942[1)]	30	332	23	6.9 to 122	341	24	6.9 to 122
CPU 943[1)]	30	332	23	6.5 to 116	341	24	6.5 to 116
CPU 944[1)]	30	332	23	0.3 to 8.3	341	24	0.3 to 8.3
CPU 945	30	312	23	0.04 to 1.06	326	24	0.04 to 1.06
135U/155U with CPU 922	30	311	22	6 to 175	349	24	6 to 175
CPU 928	30	311	22	4 to 86	349	24	4 to 86
CPU 928B	30	311	22	0.2 to 7	349	24	0.2 to 7.3
CPU 948	64	309	23	0.09 to 2.585	323	24	0.09 to 2.585
155U with CPU 946/947	64	309	23	0.2 to 16	323	24	0.2 to 16

1) As of in Order No.: 6ES5 94.-7UB

Signalling functions (continued)

MLD:SAMW
MLD:SAM
Group signal (word mode)
Group signal (bit mode)

FB 53 for 95U to 155U

FB 54 for 95U to 155U

The MLD:SAMW function block combines individual signals to form a group signal. The smallest group consists of one sensor word (16 signals or messages).

The "Group signal (word mode)" function block works together with the MLD:EZW (FB 51), MLD:EDW (FB 52), MLD:EZWK (FB 57) and MLD:EDWK (FB 58) function blocks. It uses the data block edited by the signalling function blocks.

The "Group signal (bit mode)" function block works together with the MLD:EZ (FB 55), MLD:ED (FB 56), MLD:EZK (FB 59) and MLD:EDK (FB 60) function blocks. It uses the data block edited by the signalling function blocks.

Each new signal is indicated by high-frequency flashing light and an audible signal. After acknowledgement of the signalling function blocks, the group signal and the audible singal can be acknowledged separately if the signal is still present, the flashing light changes to a steady light, otherwise it darkens.

Technical specifications

Function block	Max. number of signal words	Block length in words	Call length in words	Processing time in ms	Block length in words	Call length in words	Processing time in ms
	FB 53/ FB 54	**FB 53**			**FB 54**		
For S5-95U	16	114	12	2.2 to 22.0	107	11	2.0 to 15.0
100U with CPU 103	16	116	12	2.5 to 27.6	106	11	2.2 to 59.6
115U with							
CPU 941[1)]	16	116	12	2.9 to 31.2	106	11	2.9 to 31.2
CPU 942[1)]	16	116	12	2.9 to 31.2	106	11	2.9 to 31.2
CPU 943[1)]	16	116	12	2.8 to 30.5	106	11	2.8 to 30.5
CPU 944[1)]	16	116	12	0.1 to 1.9	106	11	0.1 to 1.90
CPU 945	16	109	12	0.02 to 0.19	103	11	0.015 to 0.465
							2 to 8
135U/155U with CPU 922	16	116	12	3 to 8	106	11	1 to16
CPU 928	16	116	12	1 to 8	106	11	0.1 to 3.6
CPU 928B	16	116	12	0.3 to 1.7	106	11	0.03 to 1.11
CPU 948	40	106	12	0.04 to 0.45	100	11	
155U with CPU 946/947	40	106	12	0.2 to 2	100	11	0.2 to 2

1) As of Order No.: 6ES5 94.-7UB

Ordering data

	Order No.
"Signalling functions" program package for S5-95U S5-100U with CPU 103, S5-115U with CPU 941-944, CPU 945 S5-135U/155U with CPU 922, 928, 928B, CPU 948, S5-155U with CPU 946/947, for S5-DOS/MT operating system on 3 1/2" diskettes (720 Kbyte) and on 5 1/4" diskettes (360 Kbyte)	
Single license	**6ES5 848-7EA01**
Copy license	**6ES5 848-7EA01-0KL1**

Data handling blocks

Application

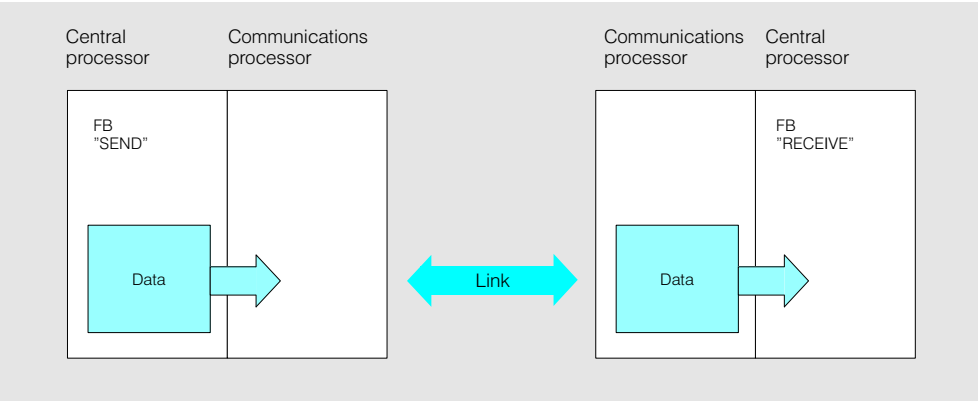

Fig. 7/88 Example of data transmission using data handling blocks

Data traffic between a central processor and

- Communications processors (CPs)
- Intelligent I/O modules IP 246, IP 247 and IP 252
- CP 516 submodule memory

is carried out with the aid of standard function blocks, called "data handling blocks". For example, see Fig. 7/76.

In the case of the S5-115U, the data handling blocks are fully integrated in the operating system.

The functions for the CPU 922, 928, 928B and CPU 948 of the S5-135U are stored in the operating system, the parameters, however, are passed via loadable standard function blocks.

The data handling blocks can handle the central processor data traffic with all communications processors interfaced to the programmable controller, e.g. with two CPs 525 or one CP 528. The structure of the data handling blocks depends on the type of the central processor used, but not on the communications processors.

Standard function blocks for "multiprocessor communication" are integrated in the operating systems of the CPU 922, 928, 928B and CPU 948 for data transfer between CPUs over the page frames of the C coordinator

Note:

The relevant standard function blocks are required for initialization and control of the intelligent I/Os. These standard function blocks call the data handling blocks as required.

SEND
Send

FB 244 for 115U*)

FB 120 for 135U

FB 120 for 155U

*) integrated in the operating system

The SEND standard function block controls data transmission from the central processor to an I/O module memory (dual-port RAM). The two possible operating modes are SEND-All and SEND-Direct.

SEND-Direct can be used, for example, to send a data area specified by the user program in the central processor to the module.

The SEND-All function, on the other hand, sends only data requested by the module, and determines which data are to be transmitted by the central processor.

Technical specifications

For S5-	Block length in words	Processing time
135U/-155U with		
CPU 922	36	See table on
CPU 928	36	page 7/105
CPU 928B	36	
CPU 948	36	

Data handling blocks (continued)

RECEIVE
Receive

FB 245 for 115U*)

FB 121 for 135U

FB 121 for 155U

*) integrated in the operating system

The RECEIVE standard function block transfers data from the I/O module memory (dual-port RAM) to the central processor.

Like the SEND function block, the RECEIVE function block has two operating modes: RECEIVE-Direct and RECEIVE-All.

Technical specifications

For S5-	Block length in words	Processing time
135U/-155U with		
CPU 922	36	See table
CPU 928	36	below
CPU 928B	36	
CPU 948	36	

Processing times for data transmission using the SEND and RECEIVE data handling blocks:

For S5-	Processing time in ms for transmission of			
	16 byte	128 byte	256 byte	512 byte
115U with CPU 941 to 944, CPU 945	1	7.5	15	30
135U/155U with				
CPU 921[1)]	60	65	70	93
CPU 922[1)]	6	7	8	10
M prozessor[2)3)]	6	7	8	10
CPU 928	6	7	7	9
CPU 928B	6	7	7	9
CPU 948	6	7	7	9

1) The S processor data handling blocks differ from the others because of queue processing (see ACTIVE and UP ACTIV function blocks). Four to five ACTIVE calls are necessary for data transfer, depending on the amount of data involved. When these calls are not implemented in one cycle, the user program cycle time must be taken into account when estimating the total data transfer time.

2) The specified times contain the processing times for the function blocks, including the data transfer time and a waiting period of 5 ms for the module response (a maximum of 2 waiting periods of up to 5 ms each may occur).

3) The times given are approximate values for one R processor transferring data with the data handling blocks. When four R processors are used in parallel, it can take up to 11 ms, for example, to transfer 256 bytes. In multiprocessor operation, the properties of the CPs/IPs must be taken into account.

Data handling blocks (continued)

FETCH

FB 246 for 115U*)
FB 122 for 135U
FB 122 for 155U

*) integrated in the operating system

The FETCH standard function block signals the module that it has to make certain specific data available in the memory (dual-port RAM).

The central processor then queries these data with the RECEIVE-All function.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 922	36	See table on
CPU 928	36	page 7/105
CPU 928B	36	
CPU 948	36	

CONTROL

FB 247 for 115U*)
FB 123 for 135U
FB 123 for 155U

*) integrated in the operating system

The CONTROL standard function block queries the module for status information at any point in the user program. The request might be for the number of the task which the module is currently processing,

or for the information whether a certain task is currently executing or whether that task is free of errors, or whether it has been finished due to a specific error.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 922	24	See table on
CPU 928	24	page 7/105
CPU 928B	24	
CPU 948	24	

RESET

FB 248 for 115U*)
FB 124 for 135U
FB 124 for 155U

*) integrated in the operating system

The RESET function block can be used to reset individual communications relationships to their initial status.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 921	76	See table on
CPU 922	21	page 7/105
CPU 928	21	
CPU 928B	21	
CPU 948	21	

Data handling blocks (continued)

SYNCHRON
Synchronize

FB 249 for 115U*)

FB 125 for 135U

FB 125 for 155U

*) integrated in the operating system

The SYNCHRON function block synchronizes the interface between the central processor and the modules (CP, IP, magnetic bubble memory) during system start-up.

The memory (dual-port RAM) is thereby cleared or preset.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 921	119	See table on
CPU 922	21	page 7/105
CPU 928	21	
CPU 928B	21	
CPU 948	21	

SEND-A
Send

FB 126 for 135U

FB 126 for 155U

The SEND-A is a special version of the SEND function block. The SEND-All function call is shorter, thus making parameter assignment more lucid.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 922	24	See table on
CPU 928	24	page 7/105
CPU 928B	24	
CPU 948	24	

REC-A
Receive

FB 127 for 135U

FB 127 for 155U

REC-A is a special version of the RECEIVE function block. The RECEIVE-All function call is shorter, thus making parameter assignment more lucid.

Technical specifications

For S5-	Block length in words	Processing time
135U/155U with		
CPU 922	24	see table on
CPU 928	24	page 7/105
CPU 928B	24	
CPU 948	24	

Data handling blocks (continued)

Summary

The "Data handling blocks" program package contains the following function blocks:

For S5-	S5-115U[1] with CPU 941-944, CPU 945	S5-135U/155U with CPU 922 CPU 928 CPU 928B CPU 948
SEND	FB 244	FB 120
RECEIVE	FB 245	FB 121
FETCH	FB 246	FB 122
CONTROL	FB 247	FB 123
RESET	FB 248	FB 124
SYNCHRON	FB 249	FB 125
ACTIVE	–	–
UP ACTIV	–	–
SEND-A	–	FB 126
REC-A	–	FB 127

*) With the S5-115U the function blocks are contained in the operating system of the central controller module.

Ordering data	Order No.
"Data handling blocks" program package for S5-135U/155U with CPU 922, 928, 928B, 948	
Single license	**6ES5 842-7CB01**
Copy license	**6ES5 842-7CB01-0KL1**

7

Function blocks for IP 240

Application

For the operation of the intelligent I/O modules (see Sections 2 and 4), programs are required in the programmable controller to control the functions of the intelligent I/O modules, to acquire and process the data and to evaluate the signals and interrupts coming from the modules.

These programs are available in the form of standard function blocks, which are briefly described below. A complete description of the function blocks is contained in the programming instructions which are supplied together with the modules.

The following standard function blocks are available for the IP 240:

Positioning
- FB 167 "STRU.POS" for initialization
- FB 168 "STEU.POS" for control

Position decoding
- FB 169 "STRU.WEG" for initialization
- FB 170 "STEU.WEG" for control

Counting
- FB 171 "STRU.DOS" for initialization
- FB 172 "STEU.DOS" for control

Speed measurement
for forewarding to the IP 252 closed-loop control module
- FB 173 "STRU.252" for initialization (for S5-115U only)

STRU.POS
Initialization of function block for positioning mode

FB 167
for 115U, 135U, 155U

The configuring FB first checks the input parameters and the length of the data block to be used for data interchange with the IP 240. It then transfers the general module data (machine readable product designation of the module, FW and HW versions) from the IP to the data block, verifying its own compatibility with the firmware version as it does so. It then enters any errors detected during the start-up test in the data block. Finally, the configuring data (parameters for FB 167) and the following data areas are transferred from the DB to the IP:

- Zero offset
- Final value for the rotary axis
- Distance values for the switching and signalling ranges
- Position numbers and position values for positions 1 to 254.

The function block is normally called in restart organization blocks.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1159	14	34 to 410
CPU 942[1)]	1159	14	34 to 410
CPU 943[1)]	1159	14	34 to 410
CPU 944[1)]	1159	14	14 to 170
CPU 945	1007	15	11.6 to 135
135U/155U with			
CPU 922	1152	15	23 to 320
CPU 928	1152	15	18 to 264
CPU 928B	1152	15	13 to 161
CPU 948	1059	16	11.6 to 135
155U with			
CPU 946/947	1059	16	10 to 130

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 240 (continued)

STEU.POS
Control function block for positioning mode

FB 168
for 115U, 135U, 155U

The control function block first checks to make sure that the channel has been configured for "positioning" mode. Then, depending on the parameters with which the FR was initialized, specific data areas are forwarded from the data block to the IP or read out from the IP and updated in the data block.

The following functions are possible:

- Read actual value, final value and status bits
- Write control bits and position number
- Write position data for position 0
- Read interrupt request bytes
- Write new position values for positions 1 to 254
- Write new zero offset
- Write new distance values for positions 1 to 254

Parameter assignment errors and data errors are flagged in the PAFE byte and described in detail in words DW 8 to 10 and DW 13. When an error is detected, the selected function is not executed.

The control FB is normally invoked in the cyclic program. Before it is called, IP 240 must be initialized with the configuring function block FB 167 (STRU.POS, initalize positioning mode).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	830	5	6.0 to 7.4
CPU 942[1)]	830	5	6.0 to 7.4
CPU 943[1)]	830	5	6.0 to 7.4
CPU 944[1)]	830	5	1.9 to 2.8
CPU 945	801	5	1.1 to 2.0
135U/155U with			
CPU 922	833	5	4.3 to 6.2
CPU 928	833	5	2.5 to 4
CPU 928B	833	5	2.1 to 3.0
CPU 948	795	5	0.8 to 2.4
155U with			
CPU 946/947	795	5	0.9 to 2.1

1) As of Order No.: 6ES5 94.-7UB..

STRU.WEG
Initialize position decoder

FB 169
for 115U, 135U, 155U

The "Initialize position decoder" function block supplies the IP 240 (position decoding mode) with the initial and final setpoint values of the tracks for both channels and the assignments of process interrupts and digital outputs to the tracks.

The data is forwarded in a data block. The user must initialize this DB before calling the function block.

The function block is normally called in restart organization blocks.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1098	12	76
CPU 942[1)]	1098	12	76
CPU 943[1)]	1098	12	76
CPU 944[1)]	1098	12	20
CPU 945	971	13	14.8
135U/155U with			
CPU 922	1654	13	83
CPU 928	1654	13	56
CPU 928B	1654	13	20
CPU 948	993	14	19.2
155U with			
CPU 946/947	992	14	23

1) As of Order No.: 6ES5 94.-7UB..

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Function blocks for IP 240 (continued)

STEU.WEG
Control position decoder

FB 170
for 115U, 135U, 155U

The following functions can be executed with the "Control position decoder" function block in "Position decoding" mode:

- Read actual values and status bits
- Read track identification bits
- Read, delete or modify start and end values of a track
- Write zero offset
- Read interrupt request bytes

The function block is normally called in the cyclic program. Before it is called, the IP 240 must be initialized with FB 169 (STRU.WEG, initialize position decoder).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	975	5	6 to 54
CPU 942[1)]	975	5	6 to 54
CPU 943[1)]	975	5	6 to 54
CPU 944[1)]	975	5	2 to 17
CPU 945	918	5	0.8 to 17
135U/155U with			
CPU 922	1539	5	6.6 to 68
CPU 928	1539	5	3.5 to 45
CPU 928B	1539	5	1.7 to 4.0
CPU 948	980	5	0.8 to 15.9
155U with			
CPU 946/947	980	5	2.1 to 17

1) As of Order No.: 6ES5 94.-7UB..

STRU.DOS
Initialize counter

FB 171
for 115U, 135U, 155U

The "Initialize counter" function block transfers parameter data from the CPU to the IP 240. These data include the setpoint count and information on the use of digital output, process interrupt and gate control. The function block reports any parameter errors from the IP 240 to the CPU.

The function block is normally called in restart organization blocks.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	814	9	27
CPU 942[1)]	814	9	27
CPU 943[1)]	814	9	27
CPU 944[1)]	814	9	11.5
CPU 945	739	10	9.3
135U/155U with			
CPU 922	1248	10	25
CPU 928	1248	10	18
CPU 928B	1248	10	11
CPU 948	740	11	9.4
155U with			
CPU 946/947	740	11	11

1) As of Order No.: 6ES5 94.-7UB..

7

Function blocks for IP 240 (continued)

STEU.DOS
Control counter

FB 172
for 115U, 135U, 155U

The "Control counter" function block can execute the following functions in "Counting" mode:

- Issue commands to the IP 240, such as start, stop, initialize
- Read actual values and status bits
- Process interrupts

The function block is normally called in the cyclic program.

Before it is called, the IP 240 must be initialized with FB 171 (STRU.DOC, initialize position decoder).

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	680	5	6 to 11
CPU 942[1)]	680	5	6 to 11
CPU 943[1)]	680	5	6 to 11
CPU 944[1)]	680	5	1.6 to 2.2
CPU 945	641	5	0.9 to 1.2
135U/155U with			
CPU 922	1110	5	6 to 10
CPU 928	1110	5	3.5 to 6.0
CPU 928B	1110	5	1.9 to 2.2
CPU 948	696	5	0.8 to 1.2
155U with			
CPU 946/947	696	5	1.6 to 2.2

1) As of Order No.: 6ES5 94.-7UB..

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STRU.252
Initialize speed measurement

FB 173
for 115U, 135U, 155U

The "Initialize speed measurement" function block reserves the IP 240 for "IP 252 expansion" mode only. This mode is possible only on the S5-115U.

The user must initialize a data block with the data to be forwarded before calling the function block.

The FB is normally called in organization block OB 20 on a cold restart and in organization block OB 22 on a warm restart.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	562	5	29
CPU 942[1)]	562	5	29
CPU 943[1)]	562	5	29
CPU 944[1)]	562	5	16
CPU 945	789	10	2.6

1) As of Order No.: 6ES5 94.-7UB..

Ordering data

	Order No.	Order No.
The standard function blocks for IP 240 are part of the:		
Configuring package for IP 240 consisting of: Manual and standard FBs for metering, position acquisition and positioning		
German	**6ES5 240-5AA11**	
English	**6ES5 240-5AA21**	
French	**6ES5 240-5AA31**	
Italian	**6ES5 240-5AA51**	

Function blocks for IP 242A

PER:ZSTK
Counter module controller (for page addressing)

FB 178 for 115U, 135U, 155U

The IP 242 A counter module normally uses page addressing. The FB 178 function block supports the following functions:

- Counter initialization
- Issue of commands to the counter module, e.g. start, stop, initialize
- Interrupt processing

The function block can be called both from a restart organization block (for cold restarts) and from a cyclic or interrupt-driven program. Different functions are enabled according to the calling point, e.g. initialization is enabled if it is called in the cold restart OB, interrupt acknowledgement is enabled if called in the interrupt OB and all other functions are enabled if called in the cyclic program.

Counter data (initialization values, counter settings, actual counter readings, etc.) are stored in a data block for processing by the CPU or for transfer to the counter module.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1359	11	4.8 to 60.2
CPU 942[1)]	1359	11	4.8 to 60.2
CPU 943[1)]	1359	11	4.7 to 59.6
CPU 944[1)]	1359	11	0.8 to 10.7
135U/155U with			
CPU 922[2)]	1281	11	3.6 to 48
CPU 928[3)]	1281	11	2 to 26
CPU 928B	1281	11	1.6 to 19.9
CPU 948	1203	12	0.23 to 2.65
155U with			
CPU 946/947	1203	12	12 to 6.4

1) As of Order No.: 6ES5 94.-7UB..

PER:ZSTL
Counter module controller (for linear addressing)

FB 179 for 115U, 155U

The IP 242A counter module can be used for linear addressing in the S5-115U and S5-155U programmable controllers. This addressing technique uses a special address space in the PLC. As with page addressing, data exchange between the CPU and the IP 242 A can only take place via the function block. Interrupt handling functionality is restricted if the IP 242 A is used with linear addressing.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1407	11	4.8 to 60.2
CPU 942[1)]	1407	11	4.8 to 60.2
CPU 943[1)]	1407	11	4.7 to 59.6
CPU 944[1)]	1407	11	0.8 to 10.7
155U with			
CPU 946/947	1225	12	1.2 to 6.4
CPU 948	1225	12	0.23 to 2.65

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 242A (continued)

PER:BS
Write to counter module (for page addressing)
PER:BL
Read from counter module (for page addressing)
PER:IN
Acknowledge counter module interrupt (for page addressing)

The IP 242 A counter module is capable of executing command lists as a result of interrupt events. This attribute helps to offload the CPU and enhances the response time of the total system. Certain function blocks have been developed to further accelerate data exchange between the CPU and the IP 242 A. These blocks are "read from module", "write to module" and "acknowledge interrupt".

The FBs are used in conjunction with FB 178.

Module to be used:
6ES5 242-1AA3.

FB 180
for 115U, 135U, 155U

Technical specifications PER:BS

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	466	5	3.9 to 14.3
CPU 942[1)]	466	5	3.9 to 14.3
CPU 943[1)]	466	5	3.7 to 13.8
CPU 944[1)]	466	5	0.7 to 1.7
135U/155U with			
CPU 922	364	5	3.6 to 10.1
CPU 928	364	5	2.1 to 5.4
CPU 928B	364	5	1.5 to 4.8
CPU 948	338	5	0.175 to 0.675
155U with			
CPU 946/947	338	5	0.7 to 1.4

1) As of Order No.: 6ES5 94.-7UB..

FB 181
for 115U, 135U, 155U

Technical specifications PER:BL

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	247	5	2.5 to 4
CPU 942[1)]	247	5	2.5 to 4
CPU 943[1)]	247	5	2.3 to 3.9
CPU 944[1)]	247	5	0.4 to 0.7
135U/155U with			
CPU 922	224	5	2.8 to 4.2
CPU 928	224	5	1.4 to 2.3
CPU 928B	224	5	1.0 to 1.4
CPU 948	194	5	0.115 to 0.175
155U with			
CPU 946/947	194	5	0.6 to 0.7

1) As of Order No.: 6ES5 94.-7UB..

FB 182
for 115U, 135U, 155U

Technical specifications PER:IN

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	203	6	3.3
CPU 942[1)]	203	6	3.3
CPU 943[1)]	203	6	3.1
CPU 944[1)]	203	6	0.6
135U/155U with			
CPU 922	154	6	2.7
CPU 928	154	6	1.3
CPU 928B	154	6	1.1
CPU 948	160	7	0.13
155U with			
CPU 946/947	160	7	0.7

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 242B

ZYK:242B
Counter module controller

FB 183
for 115U, 135U, 155U

The following functions can be executed with the "Counter module controller" function block:

- Counter initialization
- Loading, starting and reading of counter

To initialize the counter module, the function block FB 183 is normally called in the restart organization blocks OB 20, 21 and 22.

Control of the counter module (i.e. starting of counter or reading of actual values) is then carried out in the cyclic program (organization block OB 1).

Counter data (initialization values, counter settings, actual counter readings, etc.) are stored in a data block for processing by the CPU or for transfer to the counter module.

The IP 242 B counter module is capable of executing command lists as a result of interrupt events. This attribute helps to offload the CPU and enhances the response time of the total system.

In contrast to the IP 242 A, the IP 242 B also offers arithmetic functions in connection with load, transfer and comparison operations.

Certain control words tailored to the module functions have been developed to further accelerate data exchange between the CPU and the IP 242 B, besides the use of the command list.

Amongst others, these are the following:

- Process command list
- Write constant register
- Prepare loading
- Read sequence of measured values

The commands are used in conjunction with FB 183.

The module is capable of storing the calculation results (or the counter contents) in measured value sequences on the IP 242 B with a total of 100 x 2 DW.

A second data block is required to read these measured value sequences.

Module to be used:
6ES5 242-1AA4.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1111	10	9.9 to 41
CPU 942[1)]	1111	10	9.9 to 41
CPU 943[1)]	1111	10	8.5 to 37.78
CPU 944[1)]	1111	10	1.6 to 7.1
CPU 945	1002	10	0.42 to 3.36
135U/155U with			
CPU 922[2)]	1293	10	1.0 to 46.4
CPU 928[3)]	1293	10	4.6 to 25
CPU 928B	1293	10	3.6 to 20.1
CPU 948	1246	10	0.74 to 3.69
155U with			
CPU 946/947	1246	10	1.7 to 6.7

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 242B (continued)

INT:242B
Process interrupt

FB 184
for 115U, 135U, 155U

The FB 184 function block is used to process interrupts and process alarms.

The great advantage is that the access times for the special functions "Write register", "Read register" and "Acknowledge interrupt" are optimized.

To evaluate the process alarms or interrupts, the FB 184 is called in an organization block of the interrupt-driven program (OB 2 to OB 9, depending on the programmable controller).

The FB 184 may only be used in conjunction with FB 183.

The interrupt source can be acquired from parameter IIR.

Further functions are:

- Transfer new parameter assignment data to the module (write data). The counter registers and the global registers can thus be transferred from the data block to the module.
- Read data from the counter module. All counter content registers, the counter status registers and all result registers are read by the module.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	375	10	3.5 to 12.2
CPU 942[1)]	375	10	3.5 to 12.2
CPU 943[1)]	375	10	2.4 to 11.3
CPU 944[1)]	375	10	< 0.5 to 2.5
CPU 945	311	10	0.04 to 2.07
135U/155U with			
CPU 922	394	10	1.8 to 17
CPU 928	394	10	0.9 to 4.7
CPU 928B	394	10	< 0.5 to 3.4
CPU 948	370	11	0.05 to 2.00
155U with			
CPU 946/947	370	11	< 0.5 to 2.3

1) As of Order No.: 6ES5 94.-7UB..

INT:242B
Read counter module

FB 185
für 115U, 135U, 155U

Standard function block FB 185 (ZA:242B) quickly reads the counter module IP 242B (page addressing).

The function block FB 185 matches the functions of FB 183 when called with BEF = ZA in a cyclic, time-controlled program

You can additionally invoke the FB 185, which has shorter running times.

This function block can

- read the counter state register
- read the counter value register
- read the results register

Technical specifications

for S5-	Block length, in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	346	5	2.0 to 5.9
CPU 942[1)]	346	5	2.0 to 5.2
CPU 943[1)]	346	5	1.8 to 6.7
CPU 944[1)]	346	5	0.4 to 1.3
CPU 945	303	5	0.03 to 0.6
135U/155U with			
CPU 922	352	5	1.8 to 6.2
CPU 928	352	5	
CPU 928B	352	5	< 0.5 to 2.9
CPU 948	367	6	0.05 to 0.25
155U with			
CPU 946/947	367	6	< 0.4 to 1,2

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 242B (continued)

Ordering data	Order No.	Order No.
The standard function blocks for IP 242A and IP 242B are part of the:		
Configuration package for IP 242A/B		
consisting of		
Manual and standard FBs		
German	**6ES5 242-5AB11**	
English	**6ES5 242-5AB21**	
French	**6ES5 242-5AB31**	
Italian	**6ES5 242-5AB51**	

Function blocks for IP 243-3

PER:ANL
Read analog module

FB 160
für 115U, 135U, 155U

The function block "read analog module" accepts the selected analog value (if the analog module IP 243 is present) and passes on the value either as a bit pattern as it is received from the module or as a 16-bit fixed-point number scaled to the appropriate nominal values.

Moreover, the function block can be used to read the digital inputs and comparator outputs.

Technical specifications

for S5-	Block length, words	Call length, words	Execution time in ms
115U with			
CPU 941[1)]	165	13	4.4 to 5.9
CPU 942[1)]	165	13	4.9 to 5.9
CPU 943[1)]	165	13	4.1 to 5.5
CPU 944[1)]	165	13	0.3 to 1.7
CPU 945	222	14	0.175 to 0.185
135U/155U with			
CPU 922	180	14	1.8 to 2.1
CPU 928	180	14	1.1 to 1.2
CPU 928B	180	14	1.0 to 1.1
CPU 948	222	14	0.48 to 0.49
155U with			
CPU 946/947	222	14	0.69 to 0.74

1) As of Order No.: 6ES5 94.-7UB..

PER:ANS
Write analog module

FB 161
für 115U, 135U, 155U

The function block "write analog module" transfers the either specified bit pattern or a 16-bit fixed-point number scaled to the nominal value to the IP 243-3 analog module.

The function block can be used to control digital outputs (the module must be equipped with a memory for digital output).

Technical specifications

for S5-	Block length, words	Call length, words	Execution time in ms
115U with			
CPU 941[1)]	158	8	3.2 to 3.5
CPU 942[1)]	158	8	3.2 to 3.5
CPU 943[1)]	158	8	2.6 to 2.8
CPU 944[1)]	158	8	0.1 to 1.66
CPU 945	202	9	0.05 to 0.06
135U/155U with			
CPU 922	170	9	1.4 to 1.7
CPU 928	170	9	0.7 to 1
CPU 928B	170	9	0.2 to 0.3
CPU 948	195	9	0.06 to 0.07
155U with			
CPU 946/947	195	9	0.6 to 0.64

1) As of Order No.: 6ES5 94.-7UB..

Function blocks for IP 243-3 (continued)

Ordering data	Order No.		Order No.
The Standard function blocks for IP 243-3 for: S5-115 with CPU 941-944, CPU 945, S5-135U/155U with CPU 922, 928, 928B, 948, S5-155U with CPU 946/947 for operating system MS-DOS, S5-DOS/MT on $3^1/_2$" diskettes or $5^1/_4$" diskettes incl. example program German, English, French	**6ES5 848-7MA01**		

Function blocks for IP 244

PER:TREG
Control temperature controller

FB 162
for 115U, 135U, 155U

The "Control temperature controller" function block transfers the control parameters and setpoint values to the module and reads error messages, actual values and manipulated variables, extreme values or the self-optimizing parameters. The data is stored in three data blocks.

The function block can assign parameters to the entire module or one controller.

The diskette also contains a test program to facilitate installation, with comments in the appropriate language.

Module to be used:
6ES5 244-3AA22 and
6ES5 244-3AB31

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1]	1746	15	6.9 to 74.4
CPU 942[1]	1746	15	6.9 to 74.4
CPU 943[1]	1746	15	6.5 to 72.8
CPU 944[1]	1746	15	0.8 to 5.9
CPU 945	1788	15	0.185 to 3.72
135U/155U with			
CPU 922[2]	1504	15	5.7 to 8.8
CPU 928[3]	1504	15	4.4 to 6.2
CPU 928B	1504	15	1.6 to 12.6
CPU 948	1637	15	0.36 to 3.39
155U with			
CPU 946/947	1637	15	0.8 to 1.7

1) As of Order No.: 6ES5 94.-7UB..
2) As of Order No.: 6ES5 922-3UA11
3) As of Order No.: 6ES5 928-3UA12

Ordering data

	Order No.
The standard function blocks for IP 244 are part of the:	
Configuring package for IP 244 consisting of:	
Manual and standard FBs	
German	**6ES5 244-5AA11**
English	**6ES5 244-5AA21**
French	**6ES5 244-5AA31**
Italian	**6ES5 244-5AA51**

7

Function blocks for IP 246 and 247

Application

The "Control and monitor positioning module" and" Initialize positioning module" function blocks are compatible with both the IP 246 and the IP 247.

PER:POS
Control and monitor positioning module

FB 164 for 115U, 135U, 155U

The "Control and monitor positioning module" function block performs the following functions:

- Starts a job (modes BA 1 ... BA 19) on the IP 246 or IP 247 (modes BA 1 ... BA 17) from an application program. Cyclically reads an actual position value, following error or residual path from the IP 246 or IP 247. These values are output in binary or BCD code, according to the setting of the BCD parameter
- Continually reads the mode setting, current M function, feedback signals and module error from the initialized interface. These are provided as output parameters from the function block or in the axis-specific data block

FB 164 works in conjunction with DB 164. The data block must first be initialized by the user, up to and including data word DW 15. There are no special provisions to be made for the data words.

DB 164 is divided into two areas. Data words DW 1 to DW 7 are set aside for indirect initialization of the function block. Data words DW 8 to DW 15 comprise the fixed working area of FB 164. Work areas may not be changed.

Job-specific parameters are additionally required for some modes of operation. Before a mode is enabled, these must be stored in the appropriate data block as byte, word and double word parameters. The free area of DB 164 can be used for this purpose.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1)]	1012	20	5.6 to 11.8
CPU 942[1)]	1012	20	5.6 to 11.8
CPU 943[1)]	1012	20	4.3 to 10.4
CPU 944[1)]	1012	20	0.6 to 5.3
CPU 945	627	19	0.1 to 0.8
135U/155U with			
CPU 922[2)]	618	19	3.0 to 11.8
CPU 928[3)]	618	19	0.5 to 6.0
CPU 928B	618	19	1.2 to 3.9
CPU 948	682	19	0.6 to 1.2
155U with			
CPU 946/947	682	19	1.0 to 4.4

1) As of Order No.: 6ES5 94.-7UB..
2) As of Order No.: 6ES5 922-3UA11
3) As of Order No.: 6ES5 928-3UA12

PER:PDAT
Positioning module

FB 165 for 115U, 135U, 155U

The "Initialize positioning module" function block handles the transfer of data between the application program and the IP 246 or IP 247. Each valid job number leads to data transfer between the module and the PLC.

Data transfer PLC → IP 246/IP 247

Data awaiting transfer are stored in a data block (source DB) which you must first create. The data block is configured directly using the FB 165 block parameters or indirectly in the axis-specific data block.

Data transfer from IP 246/IP 247 → PLC

Data to be read from the IP 246 or IP 247 are stored in a data block (target DR) in the controllers memory (target DB). The user can configure this data block directly using the FB 165 block parameters or indirectly in the axis-specific data block.

Function blocks for IP 246 and 247 (continued)

Positioning module PER:PDAT FB 165 (continued)

With the aid of FB 165 and the PLC interface, the user can

- Read, delete and transfer machine data and traversing programs on the IP 246 or IP 247
- Read the SYS-ID from the IP 246 or IP 247 and transfer it to the IP 246 or IP 247
- Request an overview of machine data or traversing programs on the IP 246 or IP 247 and simultaneously read actual values (actual position value, residual path)

FB 165 works in conjunction with the DB 165 data block. It requires data words DW 3 to DW 47, inclusive, for its working area.

The user can specify an axis-specific data block through the DBNR parameter. This data block requires a "job block" of 15 data words in length for every axis.

Technical specifications

For S5-	Block length in words	Call length in words	Processing time in ms
115U with			
CPU 941[1]	706	13	5.4 to 11.8
CPU 942[1]	706	13	5.4 to 11.8
CPU 943[1]	706	13	5.1 to 9.3
CPU 944[1]	706	13	3.2 to 8.3
CPU 945	640		
135U/155U with			
CPU 922[2]	573	13	3.0 to 13
CPU 928[3]	573	13	1.0 to 6.6
CPU 928B	573	13	1.2 to 4.0
CPU 948	569		
155U with		13	1.8 to 6.1
CPU 946/947	569		

1) As of Order No.: 6ES5 94.-7UB..
2) As of Order No.: 6ES5 922-3UA11
3) As of Order No.: 6ES5 928-3UA12

The FB 164 and FR 165 function blocks can be initialized directly or indirectly. In the case of direct initialization, the job-specific data and parameters are provided as input parameters to the FB. With indirect initialization, the axis-specific data block is configured from the data block which was valid before the call. The function block supplies the remainder of the parameters from the axis-specific DB.

The "SEND", "RECEIVE", "FETCH" and "SYNCHRON" data handling blocks are required for communication between the positioning module and the CPU (see page 7/97) and are called by FB 164 or FB 165.

The "SYNCHRON" block must be called once (by the user) in the restart organization blocks.

The COM 246 or COM 247 system program (see page 7/21) for the appropriate programming device is required for comfortable installation and programming of the positioning module.

Ordering data

	Order No.		Order No.
The standard function blocks for IP 246/247 are part of the:		The standard function blocks for IP 246/247 are also part of the:	
Configuring package for IP 246I/A consisting of: Manual, standard FBs and parameter asgmt software COM 246		**Configuring package for IP 247** consisting of: Manual, standard FBs and parameter assignment software COM 247	
German	**6ES5 246-5AA11**	German	**6ES5 247-5AA11**
English	**6ES5 246-5AA21**	English	**6ES5 247-5AA21**
French	**6ES5 246-5AA31**	French	**6ES5 247-5AA31**

7

Function blocks for CP 516 memory submodule

Application

FB 199
for 115U, 135U, 155U

Data transfer between the CPU and the CP 516 is carried out with the function block FB 199. The handling blocks (see page 7/104) must also be provided in the CPU. DB 255 is permanently assigned as work area to FB 199.

Functions

- Transfer of a data block from the CPU to the CP 516 or vice versa
- Deletion of a sector or a data block within a sector on the CP 516[1)]
- Transfer of the list of data blocks of a sector to a data block[1)]
- Transfer of the memory card data (type, capacity) to the CPU[1)]
- Transfer contents of card A to card B or vice versa
- Formatting of a memory card

Technical specifications

For S5-	Name	Block length in words	Call length in words	Transfer time CP/CPU or CPU/CP in s
115U with				
CPU 941	EXT-115U	959	20	Approx. 1s
CPU 942	EXT-115U	959	20	for 1 kbyte at
CPU 943	EXT-115U	959	20	100 ms scan
CPU 944	EXT-115U	959	20	time
CPU 945	EXT-945U	988	20	
135U/155U with				
CPU 922	EXT-135R	1168	20	
CPU 928	EXT-135R	1168	20	
CPU 928B	EXT-135R	1168	20	
CPU 948	EXT-155U	1168	20	
155U with				
CPU 946/947	EXT-155U	1168	20	

Ordering data

	Order No.
Standard function blocks for the CP 516 memory submodule for	
S5-115U with CPU 941-944, 945, S5-135U/155U with CPU 922, 928, 928B, 948, S5-155U with CPU 946/947, with CP 516 manual,	
for MS-DOS, S5-DOS/MT operating system on 3 1/2" diskettes (720 Kbyte), on 5 1/4" diskettes (360 Kbyte),	
Single license	**6ES5 848-6GC■ 1**
Copy license	**6ES5 848-6GC■1-0KL1**
with manual in	↑
German	**1**
English	**2**
French	**3**

1) Not for S5-115U

Failsafe standard FBs

Application

S5-95F

Only the following function blocks can be used in the S5-95F:

- Prototype-tested standard function blocks
- User-created function blocks tested at the system acceptance test

Prototype-tested standard function blocks have been tested by various test institutes and, like the S5-95F, possess a certificate. They enable implementation of frequently required functions without extra overhead.

Non-prototype-tested standard function blocks are rejected by the S5-95F.

S5-115F

Only standard function blocks tested and approved by the German Technical Inspectorate (TÜV) can be used for the S5-115F programmable controller. A check is made at system start-up to ensure that only such standard FBs are used.

The software package with the standard FBs for the S5-115F contains blocks for the following tasks:

- Calculations with 32 bit fixed-point numbers
- Processing of messages
- Control of sequencers
- Safe point-to-point link between two S5-115Fs

Each standard FB for the S5-115F has been prototype-tested by the Bavarian Technical Inspectorate (TÜV). The result of this test is recorded in a certificate supplied together with the software.

The test divides the blocks into the following groups:

- Standard function blocks that can perform safety-related tasks (failsafe standard FBs)
- Standard FBs that cannot influence other blocks of the control program (reaction-free standard FBs)

At the individual acceptance test of your control program, the safety test of the standard FBs is restricted to the following:

- Library number check
- Usage to the intended purpose check
- Block parameter assignment check

Standard function block package "Fuel engineering"

for 95F, 115F

The standard function block "Fuel engineering" contains typical functions for fuel engineering.

The function blocks can be called as often as desired allowing several burners to be operated with one S5-95F or S5-115F.

The blocks are designed for continuous and intermittent operation. They have been TÜV prototype-tested.

Design

Function block	Explanations	Function block	Explanations
Initialization FB 10	• Call in OB 21/22 • Reset data in DB	Solenoid valve oil FB 15	• Control of the oil solenoid valves
Fuel preselection FB 11	• Switching of operating mode oil/gas • Generation of control enable • Indication of operating mode via LEDs	Solenoid valve gas FB16	• Control of the gas solenoid valves • Seal check • Indication of operating states
Safety sequence FB 12	• Scanning of safety sequence • Output of fault signals as first-up signal • Interface to text display	Networked controllers FB 17	• External controller check • Ignition position networked controller ON depending on fuel, closed-loop control enable, open-loop control enable, limit switch
Pre-ventilation FB 13	• Start of pre-ventilation time • Valve control and monitor • Display of operating mode		• Control of the actuating motor in the OPEN/CLOSED position
Ignition FB 14	• Control of ignition valve depending on fuel, networked controllers, pre-ventilation • Manual/automatic ignition • Indication of operating mode	First-up signal FB 18	• Output of the first fault signal of 16 possible signals • Acknowledgment of fault signals one after the other • Lamp test

Failsafe standard FBs (continued)

Standard function block package "Emergency off"

for 95F

Emergency off circuits of category 0 to 2 in accordance with DIN EN 60204 Part 1 can be safely controlled with the standard function block package "Emergency off". The blocks have been prototype-tested by the German Trade Association Institute for Safety at Work.

Handling emergency off with on-board I/O
Up to 16 emergency off sequences and 8 shutdown devices can be implemented.

Handling emergency off with external I/O
Up to 56 emergency off sequences and 28 shutdown devices can be implemented.

Design

Function block	Explanations	Function block	Explanations
• Startup initiation FB 21 FB 22 • Start block for OB 1 FB 40	Initialization of the data used at start-up • Management of a shutdown device • Monitoring of the start condition for the sequence • Restart disable after initiation • Actuator readback • Acknowledgment of an initiation • Can be called eight times	• Start block for OB 3 FB 41	• Simultaneous management of 16 emergency off sequences and 8 shutdown devices • Fast shutdown after initiation • Programmable assignment of different sequences to one shutdown device
• Start-up initiation FB 21 FB 22 • Start block for OB 1 (1 FB per DI and DQ module) FB 42, FB 44, FB 46, FB 48, FB 50, FB 52 FB 54, FB 56	Initialization of data used at start-up • Management of a shutdown device • Monitoring of the start condition for the sequence • Restart disable after initiation • Actuator readback • Acknowledgment of an initiation • Can be called four times	• Start block for OB 3 (1 FB per DI and DQ module) FB 43, FB 45, FB 47, FB 49, FB 51, FB 53, FB 55, FB 57	• Simultaneous management of 8 emergency off sequences and 4 shutdown devices • Fast shutdown after initiation • Programmable assignment of different sequences to one shutdown device

Standard function block package "Extended functions"

for 95F

The standard function block package "Extended functions" contains function blocks for processing special functions.

The diskette contains one file with functions for the S5-95F and one file with functions for the S5-115F. The following functions can be used for the S5-95F:

- Arithmetic functions
- Signalling functions
- Sequencer

Design

Function block	Explanations	Function block	Explanations
Arithmetic function • Addition FB 101 • Subtraction FB 102 • Multiplication FB 103 • Division FB 104	Addition of two fixed-point binary numbers (31 bit + sign) Subtraction of two fixed-point binary numbers (31 bit + sign) Multiplication of two fixed-point binary numbers (31 bit + sign) Division of two fixed-point binary numbers (31 bit + sign)	• First-up signal FB 152 • New value signal FB 153	The signals are differentiated between first-up signal and new value. The first signal is output. Every signal change is output as a new value.
Signalling functions • Clock generator FB 150 • Clock generator FB 151	OB 13 call for 8 edge-synchronous blink frequencies. The OB 13 call interval determines the blink frequency. Called in the cyclical program section. The blink frequencies are generated via a timer.	Sequencer FB 170	Sequential control • Linear processing • Branched processing • Alternative branchings The FB 170 function block operates in conjunction with up to 255 sequence blocks (SB 1 to SB 255) and one working data block (DB). One single step of a sequential control is programmed in a step block. The function block requires the working data block for storing the current statuses of the sequencer such as "operating mode" and "current step".

Failsafe standard FBs (continued)

Standard function block package "Extended functions" (continued)

The following functions can be used for the S5-115F:

- Arithmetic functions
- Signalling functions
- Sequencer

for 115F

Design

Function block	Explanations
Arithmetic functions[1])	
• ADD:32 32 bit binary adder FB 1	FB 1 (block name ADD:32) adds two fixed-point binary numbers (31 bit + sign). The result is a fixed-point binary number (31 bit + sign) and lies within the interval -2^{30} ... $+2^{30}$. The function block sets the following identifier for further processing: • Overflow of the number range • Result of the addition is zero
• SUB:32 32 bit binary subtractor FB 2	FB 2 (block name SUB:32) subtracts two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number (31 bit + sign) and lies within the interval -2^{30} to 2^{30}. The function block sets the following identifier for further processing: • Overflow of the number range • Result of the subtraction is zero
• MUL:32 32 bit binary multiplier FB 3	FB 3 (block name MUL:32) multiplies two fixed-point binary numbers (31 bit + sign). The result is a fixed-point binary number (63 bit + sign) and lies within the interval -2^{62} to $+2^{62}$. The function block sets the following identifier for further processing: • Overflow of the number range • Result of the multiplication is zero
• DIV:32 32 bit binary divider FB 4	FB 4 (block name DIV:32) divides two fixed-point binary numbers (31 bit + sign). The result is also a fixed-point binary number. (31 bit + sign) with remainder (31 bit + sign). The function block sets the following identifier for further processing: • Overflow • Error from division by zero • Quotient equals zero • Remainder equals zero
Signalling functions	Continuous monitoring of the process is frequently required for rationalized and safe control in process engineering and power engineering. All significant checkback signals, indicator signals and fault signals must be captured and indicated via LEDs or audible signals. The following blocks are available for this purpose:
• TAKT1 Clock generator via OB 13 call FB 50	FB 50 (block name TAKT1) generates eight edge-synchronous blink frequencies. The block is called in OB 13. The blink frequencies are defined by the OB 13 call interval.
• TAKT2 Clock generator via timer FB 51	FB 51 generates eight edge-synchronous blink frequencies. The block is called in the cyclic program section. The blink frequencies are generated via timer T in the cyclic control program. The basic frequency f1 is defined via the programmable time value.
• MLD:ERST First-up signal FB 52	FB 52 monitors an encoder word (16 signals) • for signal level "0" (quiescent current monitor) or • for signal level "1" (load current monitor). The signals are differentiated according to first-up signal and new value. Indications depends on the acknowledgment signals. The monitor responds with a signal if • one bit of the encoder word and • the bit of the specification parameter have the same signal state. The modified signal states of the encoder word are indicated. First-up indicator The first indication of a signal change is output as the first-up signal. The first-up signal is indicated by setting output bits.

1) As of Order No.: 6ES5 942-7UF12

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Failsafe standard FBs (continued)

Standard function block package "Extended functions" (continued)

for 115F

Design

Function block	Explanations
Signalling functions (continued)	
• MLD:NEUW First-up signal FB 53	FB 53 (block name MLD:NEUW) monitors an encoder word (16 signals) • for signal level "0" (quiescent current monitor) or • for signal level "1" (load current monitor). The monitor responds with a signal if • one bit of the encoder word and • the bit of the specification parameter have the same signal state. Modified signal states of the encoder word EINW are indicated with • Flashing light • Steady light • Horn Indication depends on acknowledgment signals. New value indication The first indication of a signal change is output as the first-up signal. The first-up signal is indicated by setting output bits.
Step sequence control[1)]	Many technical process sequences can be subdivided into individual steps that must be processed chronologically one after the other. Control tasks of this type can be implemented very easily and clearly using step sequence controls. The essential advantages of step sequence controls are: • Easy and time-saving programming • Control program easy to modify • Fast location of errors The smallest unit of a step sequence control is the sequence step or step. Each step is programmed in its own step block. Each step block consists of a statement section and a scan section. • In the statement section, you define actions to be executed in the step (for example, switching of actuators, starting of timers, etc.) • In the scan section, you program the step enabling condition for the next step (for example, by scanning limit switches or waiting times). Several steps executed one after the other constitute a step sequence. As well as linear (unbranched) step sequences, in which the order of the steps is constant, you can also program branched step sequences. Branched step sequences are divided into several parallel program paths. The paths to be followed depend on the status of the step enabling condition. In addition, there are various operating modes available for controlling the step sequence, for example, automatic mode, single-step mode, sequence STOP etc. as well as a fault monitor. Management of the step sequence with its various operating modes and management of the fault monitor independent of the process and can thus be organized by FB 70. Only the step blocks of the step sequence are process-dependent and must be programmed by you. Use of GRAPH 5 software is not possible. The step blocks must be programmed in STEP 5.
• ABL:MAST Step sequence control FB 7	Function block FB 70 ABL:MAST manages step sequence controls for machines or processes. Function block FB 70 operates in conjunction with up to 255 step blocks (SB 1 ... SB 255) and one working data block (DB). In the step blocks, you program the individual steps of the step sequence control. FB 70 requires the working data block for storing the current states of the step sequence, such as operating mode and current step.

1) As of Order No.: 6ES5 942-7UF12

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Failsafe standard FBs (continued)

Standard function block package "Extended functions" (continued)

Design

Function block	Explanations
Safety-related point-to-point connection between two S5-115Fs via CP 523[2)]	The point-to-point connection permits safety-related data exchange between two S5-115Fs via CP 523. Up to 124 net data words can be exchanged. One CP 523 is required in each programmable controller. Both CP 523s are linked via a connecting cable up to 10 m in length. The failsafe point-to-point connection has been prototype tested by the Bavarian Technical Inspectorate TÜV and is approved for plants with processes of • Requirement class 6 in accordance with DIN V 19250 • TÜV safety class 2. Both unidirectional and bi-directional data exchange are possible via point-to-point connection. Data blocks function as send and receive mailboxes for the safety-related data. Organization of data exchange is handled by three standard function blocks.
• ANLA-523 Start-up data to CP 523 FB 100	FB 100 is called in the startup OB. It transfers to the CP 523 all the data required to parameterize the CP 523 for safety-related data exchange.
Safety-related point-to-point connection between two S5-115Fs via CP 523[2)]	
• SEND-523 Send data to CP 523 FB 101	FB 101 is processed in the cyclic program (OB 1). It organizes sending of frame data to the connected CP 523. FB 101 starts data transfer by reading the net data from the send data block and calculating data for frame security. Send and security data are then transferred to the CP 523 in several data records. In the case of error-free transfer, the frame data are transferred automatically by the connected CP 523 to the second CP 523. If FB 101 detects a parameter assignment error or a send error, it signals this error in the "PAFE" byte. You must evaluate the "PAFE" byte and branch to an error routine in the event of a send error.
• EMPF-523 Receive CP 523 data FB 102	Function block FB 102 is processed in the cyclic program (OB 1). It handles receiving of the frame data from the connected CP 523. FB 102 reads the frame data in several data records from the CP 523 and checks the received frame for errors using the security information. Only when the frame has been received without errors does FB 102 transfer the net data to the receive data block. If FB 102 detects an error when checking the security information or if the programmed monitoring time runs out, FB 102 deletes the contents of the receive data block.

2) As of Order No.: 6ES5 942-7UF13

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Failsafe standard FBs (continued)

Ordering data	Order No.		Order No.
Standard function block package "Fuel engineering" for S5-95F, S5-115F, incl. German manual, on $3^1/_2$" and $5^1/_4$" diskettes, Single license Copy license	**6ES5 840-8NR11** **6ES5 840-8NR11-0KL1**	**Standard function block package "Extended functions"** for S5-95F, S5-115F, consisting of: Arithmetic functions, signalling functions, step sequence control and safety-related point-to-point connection, incl. German manual, on $3^1/_2$" and $5^1/_4$" diskettes, Single license Copy license	**6ES5 845-8DH12** **6ES5 845-8DH12-0KL1**
Standard function block package "Emergency off" for S5-95F, incl. German manual, on $3^1/_2$" and $5^1/_4$" diskettes, Single license Copy license	**6ES5 840-8NQ12** **6ES5 840-8NQ12-0KL1**		

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Special driver software

Application

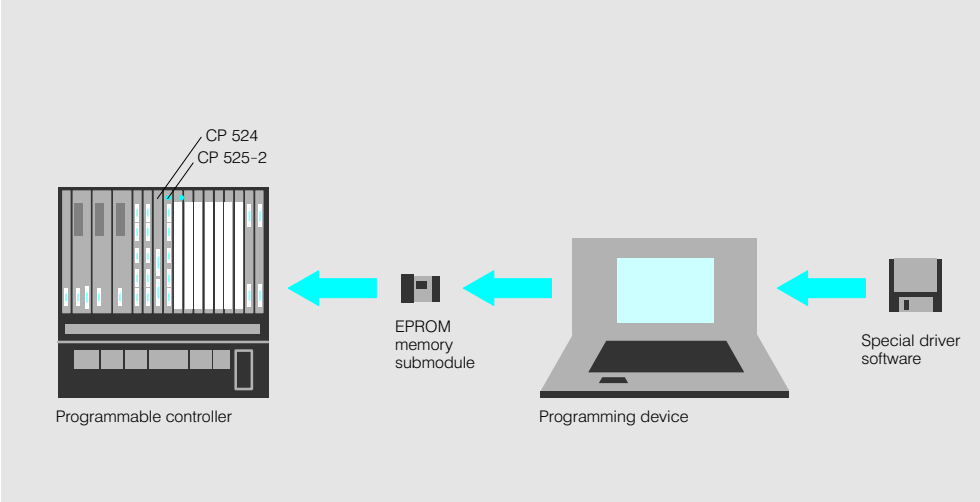

Fig. 7/89 Special driver software on the CP 524/CP 525-2 (driver software on minidiskette, routines are located into EPROM on the CP 524 and into RAM or EPROM on the CP 525) are required for interfacing host systems such as computers or subsystems such as scales or bar code readers.

The ever-increasing extent of the tasks performed by programmable controllers and the hierarchical structure of installations in the process industry often make it necessary to connect SIMATIC S5 systems to host computers and subsystems. These include scanners, barcode readers, automatic labelling machines and identification systems.

The CP 524 and CP 525-2 communications processors support connection to standard Siemens devices, e.g. computers, CRT units and printers. For this purpose the CP 524 communications processor has one interface and the CP 525-2 two interfaces.

Special drivers for CP 524 and CP 525-2 communications processors are available for connection to computers and subsystems of other manufacturers. The special drivers enable asynchronous transmission via:

- The 20 mA current-loop interface (TTY, over a distance of up to 1 km/1.6 miles)
- RS 232C interface (V24/V.28, up to 16 m/52.48 ft)
- RS 422/RS 485 interface (voltage differential transmission, only with CPU 524, up to 1200 m/3936 ft).

The user can choose from the following:

- Character frame;
  ASCII or full-transparent transmission, number of start bits, number of data bits, parity bit
- Procedure;
  Opening character, end character, acknowledgement character, block check character
- Message format;
  Specifications pertaining to the type and amount of data, etc.

These technical capabilities enable optimum adaptation to the interface of the host system.

The special drivers are delivered on diskette ($5^1/_4$" and $3^1/_2$") and are supplied with a manual.

Driver routines have been developed for many common process computers and subsystems such as the process computers and control systems manufactured by AEG, Allen Bradley, ASEA, Data General, FISHER CONTROL, Honeywell, IBM and MODICON as well as for the subsystems manufactured by Datalogic (scanners and barcode readers), SAAB SCANIA Automation (Premid microwave reader system), Philips (weighing equipment), Leuze (barcode readers) and Sick Opto electronic (barcode readers and other systems).

Thanks to their modularity, new special drivers can be easily created on demand.

If required, translations can be made of existing operating instructions for the special drivers.

An additional range of "open drivers" is also available which the user can tailor to his own requirements.

Many manufacturers of subsystems have integrated the Siemens RK 512 standard or 3964 (R) procedure in their systems. This enables these systems to be interfaced via the driver software contained in the COM 525 package. If only the 3964 (R) procedure has been implemented, a special driver (6ES5 897-2AB. 1) is required for the CPU 524/CP 525-2 communications processors.

Special driver software (continued)

Open drivers (continued)

"Open drivers"can be used to send and receive data of any structure (all printable ASCII characters and all other characters from 00H to FFH). The message structure is kept open so that the S5 user can send complete messages to the CP with all control characters intact (including start or end characters), and likewise receive complete messages. The structure of outgoing messages can vary from incoming ones.

Special driver software (continued)

Open drivers (continued)

Because of the wide variety of possible configurations, a thorough knowledge is required of the interface to be connected.

There is a choice of several "open drivers" with different technical specifications for a variety of configurations.

Sending:
All data types are allowed as source data. If the source type "DB" is used, messages can be sent from any data block. The maximum message length is 2048 byte.

Receiving:
A message can begin with any character. The CP recognizes the end of the data string being received from the end parameter. When the CP recognizes the end parameter, the complete message is passed to the CPU. The data are entered with the aid of FB RECEIVE-ALL. The data block for all received messages must have been created beforehand.

S5D004 open driver

The S5D004 "open driver" has the greatest choice of configurations.

The S5D004 "open driver" is configured through a direct SEND job from a STEP 5 program.

The following can be parameterized:

- Baud rate from 50 to 19,200 bauds (with full-duplex and TTY up to 9,600 bauds)
- Character frame
- Receiving data block, data word and CPU number
- Message end parameter: 1 or 2 end codes, timer, fixed length (combination of end codes or timer with fixed partblock length possible)
- Full-duplex mode
- Half-duplex mode optional XON/XOFF protocol for sending and receiving, optional STX hold-off interval, optional echo optional BREAK evaluation in ANZW
- Wordwise or bytewise transmission
- Character delay time: 4 to 65,535 ms in 1 ms raster

Technical specifications

No block check character;
No software handshake (acknowledgement), no hardware handshake (auxiliary signals);
CP 524: 20 mA (current loop), V.24, RS 422, RS 485
CP 525: 20 mA (current loop), V.24;
Maximum sending length from DB: 4096 byte,
unlimited receiving length through blocking,
maximum block length: 1024 byte
Buffering for heavy message traffic

S5D002 open driver

The S5D002 open driver supports the V.24 auxiliary signal (hardware handshake) of the CP 524 as required.

The S5D002 "open driver" is configured through a direct SEND job from a STEP 5 program.

The following can be parameterized:

- Baud rate from 50 to 19,200 baud (with full-duplex and 20 mA (current loop) up to 9,600 baud
- Character frame
- Receiving data block, data word and CPU number
- Message end parameter: 1 or 2 end codes, timer
- Full-duplex mode
- Half-duplex mode Optional XON/XOFF protocol for sending (monitoring time 6 s) and STX hold-off interval, optional echo
- Character delay time: 100 to 25,500 ms in 101 ms raster.

Note
The S5D002 driver is suitable only for use in the CP 524.

Technical specifications

No block check character;
no software handshake (acknowledgement),
programmable hardware handshake
(RTS-CTS handshake;
DTR, STEP 5-compatible PS3, DCD, DSR, RI and PM1 can be evaluated from STEP 5);
CP 524: 20 mA (current loop), V.24 with auxiliary signals, RS 422;
maximum sending length from DB: 4096 byte,
maximum receiving length: 508 byte

Ordering data	Order No.		Order No.
Program "Open driver" S5D004 for CP 524/CP 525-2 (programmed with PG)		**Program „Open driver" S5D002** for CP 524 (programmed with PG)	
Single license	**6ES5 897-2DC 1**	Single license	**6ES5 897-2NB 1**
Copy license	**6ES5 897-2DC 1-0KL1**	Copy license	**6ES5 897-2NB 1-0KL1**
with description in ↑		with description in ↑	
German	**1**	German	**1**
English	**2**	English	**2**
French	**3**		

1) To be used with CP 525 only

Special driver software (continued)

Technical specifications and ordering data for special driver programs

Device	Details	Master/slave relation-ship: S5 is	Protocol	Lan-gua ge	License	Order No.
AEG Logistat CP80 A200-A500	• Does not support control signals of the V.24 interface	Master	SEAB-1	G	Single license	**6ES5 897-2RB11**
					Copy license	**6ES5 897-2RB11-0KL1**
				G	Single license	**6ES5 897-2RD11**
AEG Logistat CP80 A200-A500	• Only for use with CP 524 • Processes the V.24 RTS control signals • Enables data transmission via modem module e.g. LABK03-frequency telegraphy unit (AEG)	Master	SEAB-1		Copy license	**6ES5 897-2RD11-0KL1**
				G	Single license	**6ES5 897-2RE11**
					Copy license	**6ES5 897-2RE11-0KL1**
AEG Logistat CP80 A200-A500	• Only for use with CP 524 • Processes the V.24 RTS and DCD control signals • Enables data transmission via modems (e.g. UEB4) or GDÜ from AEG	Slave	SEAB-1			
AEG Logistat CP80 A200-A500	• Does not support control signals of the V.24 interface	Slave	SEAB-1	G	Single license	**6ES5 897-2UB11**
					Copy license	**6ES5 897-2UB11-0KL1**
				G	Single license	**6ES5 897-2ND11**
AEG Geazent 8006 system	• Connection unit from the Geazent 8006 system with Partyline procedure to SIMATIC S5	Slave	AEG Partyline		Copy license	**6ES5 897-2ND11-0KL1**
				G	Single license	**6ES5 897-2XA11**
					Copy license	**6ES5 897-2XA11-0KL1**
AEG MARK IV Turbine control	• Does not support control signals of the V.24 interface	—		G	Single license	**6ES5 897-2KD11**
					Copy license	**6ES5 897-2KD11-0KL1**
ABB (ASEA) Robot control	• Does not support control signals of the V.24 interface • Max. transceiving length 128 byte	—	ADLP-10	G	Single license	**6ES5 897-2MA11**
					Copy license	**6ES5 897-2MA11-0KL1**
ABB (BBC) Procontrol P station automation system	• Does not support control signals of the V.24 interface • The DSCA 114 interface board is required on the ABB side	Slave	(In acc. with DIN 19 244 unbalanced mode)	G	Single license	**6ES5 897-2BB11**
					Copy license	**6ES5 897-2BB11-0KL1**
ABB (ASEA) Master Piece 200/1 Master Piece 800	• V.24 control signals not supported • Note: ABB offers further modules which can also be used for communication with SIMATIC: - e.g. via Modbus protocol with DSCA 180B interface - e.g. via Siemens RK 512 protocol with DSCA 180F interface For details, please contact ABB	Master	EXCOM protocol	G, E F	Single license	**6ES5 897-2WB ■ 1**
					Copy license	**6ES5 897-2WB ■ 1-0KL1**
	• For PLC 2, communication controller 1771 KGM is required			G	Single license	**6ES5 897-2XD11**
					Copy license	**6ES5 897-2XD11-0KL1**
Allen Bradley PLC 2	• Writing to the submodule, max. 252 byte • Reading from the submodule, max 255 byte	Slave				Please consult DEC
ATRON Memory submodule	• RK 512 drivers are available for SIMATIC S5 sister controllers	Master				
DEC Micro VAX, PDP 11				G E F		**1** **2** **3**

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Special driver software (continued)

Technical specifications and ordering data for special driver programs (continued)

Device	Details	Master/ slave relation-ship: S5 is	Protocol	Lan-gua ge	License	Order No.
Datalogic Scanners and barcode readers	• The Siemens RK 512 protocol is implemented in various Datalogic devices. A special driver is then not required. For details, please contact Datalogic			G	Single license Copy license	**6ES5 897-2GE11** **6ES5 897-2GE11-0KL1**
DIN 19 244 (balanced mode)	• Communications software in acc. with DIN 19244 and IEC TC 57, format class FT 1.2, with customer-specific adjustments		In acc with DIN 19 244 and IEC TC 57	G	Single license Copy license	**6ES5 897-2MD11** **6ES5 897-2MD11-0KL1**
DIN 19 244 (unbalanced mode)	• Communications software in acc. with DIN 19 244 and IEC TC 57, format class FT 1.2, with customer-specific adjustments		In acc. with DIN 19 244 and IEC TC 57	G	Single license Copy license	**6ES5 897-2TD11** **6ES5 897-2TD11-0KL1**
Printer	• This driver enables various printers to be interfaced for process status listing with CP 524/525 (as standard, only PT 88/89 and DR 210/21 1/ 230/231 printers with ECM module can be connected)		LAUF	G,E	Single license Copy license	**6ES5 897-2FB** ▯**1** **6ES5 897-2FB** ▯**1-0KL1**
ENRAF NONIUS Microlect System	• Not suitable for E&N CIU 858!	Master		G	Single license Copy license	**6ES5 897-2DB11** **6ES5 897-2DB11-0KL1**
Fisher Controls PROVOX Process control system **Hewlett Packard** HP 1000A, Type A600, A700, A900	• Communication is possible via Modbus protocol if function codes which are not supported by the Fisher PROVOX system are not used • RK 512 drivers are available for SIMATIC S5 sister controllers For details, please contact HP	Slave	Modbus protocol (RTU) message frame format	G,E, F	Single license Copy license	**6ES5 897-2QA** ▯**1** **6ES5 897-2QA** ▯**1-0KL1** Please consult HP
Hewlett Packard HP 9000, Process computer				G	Single license Copy license	**6ES5 897-2SD11** **6ES5 897-2SD11-0KL1**
Honeywell (Modbus)	• A Generik gateway TDC 200 or TDC 3000, for example, can be used as interface to the bus	Master	Modbus protocol, RTU message frame format	G,E, F	Single license Copy license	**6ES5 897-2KB** ▯**1** **6ES5 897-2KB** ▯**1-0KL1**
Honeywell (Modbus)	• A Generik gateway TDC 200 or TDC 3000, for example, can be used as interface to the bus	Slave	Modbus protocol, RTU message frame format	G,E, F	Single license Copy license	**6ES5 897-2QA** ▯**1** **6ES5 897-2QA** ▯**1-0KL1**
IBM AT Personal computer	• Toolbox, "PRODAVE DOS 64R" for PG/ PC (AT and AT-compatible) under MS-DOS operating system		RK 512 or procedure 3964 (R)	G,E, F,S	Single license Copy license	**6ES5 897-2UD** ▯**1** **6ES5 897-2UD** ▯**1-0KL1**
				G E F S		**1** **2** **3** **4**

Special driver programs (continued)

Technical specifications and ordering data for special driver programs (continued)

Device	Details	Master/ slave relation-ship: S5 is	Protocol	Lan-gua ge	License	Order No.
IEEE 488	• Interfacing to the bus is possible via "ICS 4835 Serial EE1E 488 Controller" • Controller can be obtained from: Meilhaus Electronic GmbH 82178 Puchheim Federal Republic of Germany Phone ++49-89-80 70 81			G	Single license Copy license	**6ES5 897-2LA11** **6ES5 897-2LA11-0KL1**
IBM S1 computer			Simliar to RK 512 and procedure 3964	G	Single license Copy license	**6ES5 897-2JE11** **6ES5 897-2JE11-0KL1**
Leuze Barcode reader	• e.g. BLC 10 • Siemens RK 512 is implemented in various devices from Leuze (a special driver is then not required) For details, please contact Leuze		Modbus protocol, RTU message frame format	G	Single license Copy license	**6ES5 897-2GE11** **6ES5 897-2GE11-0KL1**
Modicon (AEG)	• The J478 stand-alone modem, for example, can be used as interface module to the bus	Slave	Modbus protocol, RTU message frame format	G,E, F	Single license Copy license	**6ES5 897-2QA** ▯**1** **6ES5 897-2QA** ▯**1-0KL1**
Modicon (AEG)	• The J478 stand-alone modem, for example, can be used as interface module to the bus	Master		G,E, F	Single license Copy license	**6ES5 897-2KB** ▯**1** **6ES5 897-2KB** ▯**1-0KL1**
Modicon (AEG)	• Modbus for TELEPERM AS 215 process control system • AS 215 is master	Master	Modbus protocol, RTU message frame format	G	Single license Copy license	**6ES5 897-2PD11** **6ES5 897-2PD11-0KL1**
MTU MCS 4	• Nantos automation system			G	Single license Copy license	**6ES5 897-2LD11** **6ES5 897-2LD11-0KL1**
"Open driver"	• If the CP 524 is used, RS 485 operation is possible with the RS 422/485 module		No protocol	G,E, F,S	Single license Copy license	**6ES5 897-2DC** ▯**1** **6ES5 897-2DC** ▯**1-0KL1**
"Open driver"	• Suitable only for CP 524 with V.24 module Support the V24 accompanying signals		No protocol	G,E	Single license Copy license	**6ES5 897-2NB** ▯**1** **6ES5 897-2NB** ▯**1-0KL1**
"Open driver"	• This driver enables connection to "simple" RS 485 master/slave networks • The driver acts as master	Master	No protocol	G,E	Single license Copy license	**6ES5 897-2MB** ▯**1** **6ES5 897-2MB** ▯**1-0KL1**
"Open driver" (Operation procedure)	• Possible parameters: end/start character, BCC type, character delay time, XON/ XOFF protocol		LAUF	G	Single license Copy license	**6ES5 897-2EA11** **6ES5 897-2EA11-0KL1**
Philips Weighing systems	• PR 159X family PR 1600 family	Master	Philips EW protocol	G,E	Single license Copy license	**6ES5 897-2HD** ▯**1** **6ES5 897-2HD** ▯**1-0KL1**
Philips Closed-loop controllers	• KS 4580, KS 4770 via ICS 90	Master		G,E	Single license Copy license	**6ES5 897-2TA** ▯**1** **6ES5 897-2TA** ▯**1-0KL1**
				G E F S		**1** **2** **3** **4**

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Special driver programs (continued)

Technical specifications and ordering data for special driver programs (continued)

Device	Details	Master/ slave relation-ship: S5 is	Protocol	Lan-gua ge	License	Order No.
Rotork PAC-SCAN		Master	Rotork PA 14 protocol	G	Single license Copy license	**6ES5 897-2WA11** **6ES5 897-2WA11-0KL1**
SAAB Automation (Philips) Premid Identsystem	• Suitable for microwave ID systems with 20 decimal places, e.g. PC 301 /00;/02;/42 central processing units and PC 3001, PC 3002, PC 3003 data storage units or PC 3040/00/01 compact communications units			G	Single license Copy license	**6ES5 897-2GB11** **6ES5 897-2GB11-0KL1**
SAAB Automation (Philips) Premid Identsystem	• Suitable for microwave ID systems with 8 Kbyte data storage units, e.g. PC 3010/52 CPUs and 2K/8 Kbyte data storage units PC 3004, PC 3005			G G	Single license Copy license	**6ES5 897-2GC11** **6ES5 897-2GC11-0KL1**
Staefa WSE-1 Bus		Master			Single license Copy license	**6ES5 897-2SA11** **6ES5 897-2SA11-0KL1**
SICK Optoeletronic	• Suitable for barcode readers, decoders, terminals, etc.			G	Single license Copy license	**6ES5 897-2GE11** **6ES5 897-2GE11-0KL1**
Siemens Alarm systems	• Interfacing via SIDN interface unit	Master		G	Single license Copy license	**6ES5 897-2CC11** **6ES5 897-2CC11-0KL1**
Siemens 38 Terminals	• Terminals 3805, 3821, ES 005, ES 01 5, ES 021, ES 1 01 B		38xx	G,E	Single license Copy license	**6ES5 897-2DA ▯1** **6ES5 897-2DA ▯1-0KL1**
Siemens SIROTEC RCM			LSV 2	G	Single license Copy license	**6ES5 897-2VB11** **6ES5 897-2VB11-0KL1**
Siemens SICOMP M	• SEB-M			G	Single license Copy license	**6ES5 897-2HC11** **6ES5 897-2HC11-0KL1**
Siemens TELEPERM FM 100	• FM 100 field multiplexer			G	Single license Copy license	**6ES5 897-2LB11** **6ES5 897-2LB11-0KL1**
Siemens 3964 (R)	• 3964(R) procedure with programmable character frames, control characters and times. With/ without S5 header		3964 (R)	G,E	Single license Copy license	**6ES5 897-2AB ▯1** **6ES5 897-2AB ▯1-0KL1**
Siemens RK 512	• Computer link 512; non-standard feature: times, character frames and control charac-ters are programmable. RK 512 always has S5 header		RK 512	G,E	Single license Copy license	**6ES5 897-2CB ▯1** **6ES5 897-2CB ▯1-0KL1**
Siemens PG 7xx	• Toolbox "PRODAVE DOS 64R" for PG/PC (AT and AT-compatible) under MS-DOS operating system		RK 512 or 3964 (R) procedure	G,E F,S	Single license Copy license	**6ES5 897-2UD ▯1** **6ES5 897-2UD ▯1-0KL1**
Tandem Computer			Burroughs Print to Print Connection Protocol	G	Single license Copy license	**6ES5 897-2TB11** **6ES5 897-2TB11-0KL1**
				G E F S		**1** **2** **3** **4**

7

Special driver programs for CP 544B

Hard- and software requirements

The special drivers are executable on the CP 544B (6ES5 544-3UB11). A RAM or Flash EPROM memory submodule (..or ..) must be plugged into the CP 544B as the memory.

The two serial interfaces of the CP 544B can be operated independently of each other with different standard protocols and special drivers with the interface modules RS 232C (V.24)/TTY/RS 422/485.

For loading and parameterizing special drivers, the parameter assignment software COM PP Version 3.0 and higher is required.

Technical specifications

Allen Bradley Data Highway	
General notes	Data transmission is performed with the full duplex (DF 1) protocol for the data highway asynchronous link from Allan Bradley. All Allen Bradley modules on which the full duplex protocol can be parameterized on the "asynchronous link" interface can be used as the communication modules. Coupling with the 2nd CPU interface of Allen Bradley CPUs is also possible if the full duplex protocol can be set . The procedure is operated on an RS 232C, V.24 20 mA (TTY) or RS 422 (four-wire full duplex) interface.
Technical specifications	• Allen Bradley Data Highway full duplex (DF1) protocol • Interfaces: 20 mA (TTY), RS 232C (V.24), RS 422/485 (four-wire) • No "embedded responses"
Settable parameters	• Transmission rate of 300 baud to 76800 baud; TTY up to 9600 baud; RS 232 (V.24) up to 19200 baud • Character frame • Receive mailbox DB and data word • Timeout for acknowledgment character 30 ms to 10 s • Number of repetitions on NAK 0 to 5 • Number of ENQ requests 0 to 5 • Duplicate message transmission detection: ON or OFF • Acknowledgment of the CP immediately after receipt or only after transfer to the PLC

Extended open driver	
General notes	Transmission is performed asynchronously, half or full duplex and is run on an RS 232C (V.24), 20 mA (TTY) or RS 422/485 interface. The RS 485 interface of the CP 544B can use the RS 232C (V.24) interface with a modem for multipoint connections. Moreover, RS 232C (V.24) signaling and control lines can be used if the special driver is used.
Settable parameters	• Transmission rate 300 baud to 76800 baud; TTY up to 9600 baud, RS 232C (V.24) up to 19200 baud • Character frame • Mode, i.e. end criterion for receive • CP functions as master of a master-slave link • With/without RS 485 operation for two-wire connections • With/without RS 232C (V.24) accompanying signals • Handling of transmission errors at beginning of message frame • Break evaluation • Character timeout in millisecond timebase • Block assembly (continuous receiving) • BREAK output Data flow control with XON/XOFF or BUSY is not supported by this driver

Special driver programs for CP 544B (continued)

Technical specifications (continued)

MODBUS master

Technical specifications	• MODBUS protocol with RTU format • Master-slave link: SIMATIC S5 is master • Implemented function codes: 01, 02, 03, 04, 05, 06, 07, 08, 11, 12, 15, 16 • No RS 232C (V.24) control and signal lines • CRC polynomial $X^{16} + x^{15} + x^2 + 1$ • Interfaces: 20 mA (TTY), RS 232C (V.24), RS 422/485 (two-wire or four-wire) • Receive mailbox DB and data word are specified on transmission • Character timeout 3.5 characters (baudrate-dependent) • Broadcast message possible
Settable parameters	• Transmission rate of 300 baud to 76800 baud; TTY up to 9600 baud (RS 232C) V.24 up to 19200 baud • Character frame • With/without RS 485 operation for two-wire connections • With/without modem operation (ignore scratch character) • Response timeout 100 ms to 25.5 s in 100 ms timebase • Factor for character timeout 1-9

MODBUS slave

General notes	The communications software consists of a special driver and two function blocks. Data transmission is performed according to the master-slave principle. The master takes the initiative in transmission, the CP 544B functions as a slave and only transmits to the master on request. Message frame exchange from slave to slave is not possible.
Technical specifications	• MODBUS protocol with RTU format • Master-slave link: SIMATIC S5 is the slave • Implemented function codes: 01, 02, 03, 04, 05, 06, 08, 15, 16 • CRC polynomial $X^{16} + x^{15} + x^2 + 1$ • Interfaces: 20 mA (TTY), RS 232C (V.24), RS 422/485 (two-wire or four-wire) • Communications FBs (FB 180 for start-up, FB 181 for cyclic operation with data handling blocks) • MODBUS data address is converted to S5 data areas. Processable data areas: DB or DX, flags, outputs, timers, counters, (extended) I/Os, (extended) system addresses • Character timeout 3.5 characters (baudrate-dependent)
Settable parameters	• Transmission rate of 300 baud to 76800 baud; TTY up to 9600 baud RS 232C (V.24) up to 19200 baud • Character frame • Slave address of the CP • With/without RS 485 operation for two-wire connections • With/without modem operation (ignore scratch character) • Factor for character timeout 1-9 • Number of the working DB (for FB processing) • Release of the memory areas that can be written by the master and the readable (extended) I/Os

Ordering data

	Order No.
Allen Bradley Data Highway	
German	
Single license	**6ES5 897-3WB11**
Copy license	**6ES5 897-3WB11-0KL1**
Extended open driver with operation of the RS 232C (V.24) accompanying signals or two-wire operation for RS 485, German	
Single license	**6ES5 897-3DC** ■**1**
Copy license	**6ES5 897-3DC** ■**1-0KL1**
↑	**1**
	2

	Order No.
MODBUS master	
RTU message frame format	
German, English, French	
Single license	**6ES5 897-3KB** ■**1**
Copy license	**6ES5 897-3KB** ■**1-0KL1**
MODBUS slave	
RTU message frame format	
German, English, French	
Single license	**6ES5 897-3QA** ■**1**
Copy license	**6ES5 897-3QA** ■**1-0KL1**
↑	
German	**1**
English	**2**
French	**3**

1) To be used with CP 525 only