SIEMENS

Background and System Description • 04/2015

Guide for Migrating SIMATIC S5 Projects to SIMATIC S7-1500 and TIA Portal

Boundary Conditions and Procedure for Migrating Hardware and Software

https://support.industry.siemens.com/cs/ww/en/view/105106251

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1 Introduction

The new controller generation SIMATIC S7-1500 has an up-to-date system architecture and, together with TIA Portal, offers new and efficient programming and configuration options.

This document contains recommendations and notes for users who are currently using SIMATIC S5 automation systems and plan to migrate to the new SIMATIC controller generation S7-1500.

1.1 Purpose of this document

The objective of this document is to support plant migration to a modern controller generation and cover the most important questions that may arise in this context.

This document does not claim to cover all conceivable plant configurations and SIMATIC S5 components used.

Migration means changing software and hardware and transferring data from one environment to another largely using existing technological infrastructure. Migration goes beyond a simple update or upgrade and refers to a fundamental change of the system.

2 Planning Plant Migration

2.1 General procedure

In the run-up to plant migration, there is **considerable need for clarification**. Therefore, it is all the more important to develop a detailed comprehensive **concept for planning and implementing** the pending migration.

Each plant has **different requirements** for the migration process. Depending on the complexity of the plant control system, acceptable machine downtimes and production flexibility, the required preparation, procedure and depth of migration may differ.

It is always necessary to think out and plan migration of the **entire plant**, even if only a partial migration is considered. The question is not “How do I migrate a controller?” but "What should the plant look like at the end of migration and which migration steps are necessary?”.

Considerations and issues to be dealt with before migration:

- **Which plant parts should be migrated?**
  - Even a partial migration requires that the entire plant be considered.
- **Which components are affected?**
  - Stand-alone solutions or complex plant configuration
  - Communication with third-party systems
  - Existing special hardware and software components
- **Which considerations are important for planning the migration time?**
  - Schedule non-production times
  - 24/7 production
  - Produce in advance to buffer downtimes
  - Temporarily shift production
- **Fall-back strategies**
  - Allow quick migration back to previous hardware/software platform
  - Sufficient time buffers
  - Comprehensive tests up to the "point of no return"
  - New communication cabling even despite potential continued use of existing communication connections
- **Minimizing risk**
  - Accurately capture the actual plant
  - Detailed planning of each individual trade
  - Identify and consider dependencies
  - Gradual migration
  - Separate migration of centralized / distributed
  - Retain the cabling
  - Partial acceptances
  - Preliminary tests in the laboratory
  - Test connections to the control system

- **Plant operation after migration**
  - Timely training of operating and maintenance staff
  - Implement changed/improved processes
  - Different cycle times of the plant
  - Schedule spare parts planning for future plant expansion and improvements

2.2 Partial or complete migration

What is decisive for the migration scope?

- Complexity of the control solution
  - Single controller or multiple networked controllers
  - Connection to control system/third-party systems
  - Controllers, operator control and monitoring equipment used
  - Special functions such as positioning, PID, counter modules
  - Which bus systems, centralized / distributed I/Os
  - Communication modules / protocols
- Know-how of the existing plant
  - Core functions and communication
  - Processes
  - Connection of control systems
  - Original suppliers
  - Existing documentation and software
- Components that cannot be (directly) replaced / showstoppers
  - H systems
  - Special drives
  - Control systems, special SCADA systems
- Allowed production downtime
  - 24/7 production
  - Holiday shutdown
  - Produce in advance
  - Shift (parts of) production
- Available budget and time frame
- Applicable standards and regulations
- Production flexibility
- Modernization and improvement
  - Quicker cycle times, higher production quantities
  - Improved product quality
  - Lower energy and production costs
  - Higher availability, faster corrective maintenance times
- Upgrades and expansions planned for the future

In the end, all these influencing factors determine the decision on the type of migration that can be implemented:

- Complete migration
- Complete migration in phases
- Partial migration
- Rebuild

2.3 Planning the migration phases

The transition to new technology requires careful planning to avoid problems and ensure maximum use of new functions and capabilities. For these reasons, it is important to the take time to plan the objectives and required steps before the start of the migration process.

The following table provides a brief description of how to implement the required phases.

Phase	Designation	Name
1	Plant audit	**Identifying the status quo of the plant/machine** Identification and documentation of all control and plant components.
2	Analysis	**Analyzing the installed base** Analysis of all components, incl. third-party systems, communication types and their dependencies in the system. Definition of contributory trades.
3	Strategy	**Developing options** Consideration of all options, followed by the identification of potential obstacles.
4	Review	**Defining solutions, products, standards** Decision on the solutions, products and standards to be used.
5	Specification	**Checking the specifications** Detailed analysis of all specifications relating to the basic and additional functions.
6	Planning	**Defining the implementation plan** Technical and schedule planning of the individual migration phases.
7	Migration	**Implementing the migration project** Active project support with the aid of the entire Service and Support portfolio.
8	Service	**Integration and planning of maintenance and service** Early planning of the service concept, spare parts procurement, operating concepts and training.

2.4 Advantages of modernization

Since their launch, SIMATIC S5 controllers have performed well. With the phase-out of this product line, it will become increasingly complex and expensive to maintain these control systems.

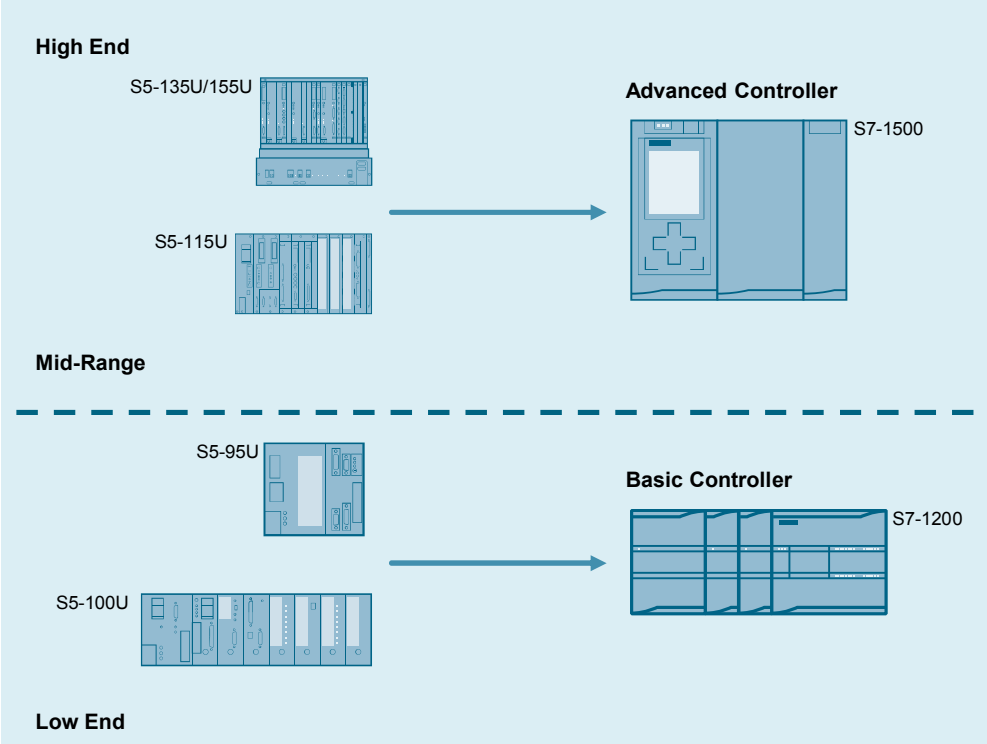
Meanwhile, mechanisms and technologies have changed. A modern SIMATIC automation system such as the S7-1500 can offer you the following technical and financial benefits:

- Increased productivity
- Reduced total production costs
- Increased utilization of machines
- Compliance with new regulations, for example: Security
- Improved product quality and process control
- Greater flexibility in production and production planning
- Support of future integration and expansion of your plants
- Support of state-of-the-art manufacturing technology
- Access to a pool of employees familiar with state-of-the-art automation technology and capable of maintaining modernized plants
- The risk for old plants increases continuously due to the difficult spare parts supply situation and the worsening availability of qualified service engineers

3 SIMATIC S5 and SIMATIC S7-1500 System Architecture

3.1 SIMATIC S5-115U, S5-135U, S5-155U

Figure 3-1 SIMATIC S5 and S7-1500 automation systems



NOTE Migration of SIMATIC S5-95U and S5-100U is not part of this document.

3.1.1 Information on the SIMATIC S5-115U automation system

The SIMATIC S5-115U automation system is a programmable logic controller for the mid performance range. The S5-115U system has a modular design. The individual components are:

- Power supply modules
- Central processing units
- Input and output modules
- Signal preprocessing modules
- Communications processors

These SIMATIC S5 components are mounted to an aluminum rack. This rack is used to mechanically fasten all modules. Racks feature one or two bus boards to electrically connect the modules to each other. The places of installation (slots) of the modules are numbered from left to right in ascending order.

Expansion options

If necessary, the connection capacity of the central controller (CC) can be increased by expansion racks (ER 701-2, ER 701-3). Appropriate interface modules connect the central controller to the expansion racks.

Memory concept

The S5-115U is programmed using the STEP 5 programming software from Siemens. The control program (S5 DOS file) can be transferred to the central processing unit (CPU) via a programmer or memory module.

Saving the programmed data to the CPU (CPU941 - CPU945) offers various options. The program can be stored in the internal program memory (RAM) of the CPU. This allows the user to modify the program at any time; however, it must be protected against data loss by a backup battery as the memory contents (program) would otherwise be lost in the event of a system voltage failure. The size of the internal program memory differs depending on the CPU type.

Another memory option is to burn an EPROM. In this case, the data is stored on a special memory module equipped with EPROMs or EEPROMs. This memory module is inserted into a slot of the CPU94x. When the controller is restarted, the data is transferred from the EPROM to the internal RAM.

Note

Which memory module type can be used depends on the CPU type used in your programmable controller.

The manual - SIMATIC S5, S5-115U Programmable Controller (EWA 4NEB 811 6130-01b) - provides information on the S5-115U programmable controller.
https://support.industry.siemens.com/cs/ww/en/view/1085937

3.1.2 Information on the SIMATIC S5-135U/155U automation system

The SIMATIC S5-135U/155U automation system is a programmable logic controller for the high-end performance range of the SIMATIC S5 devices. Its modular design allows you to variably equip a central controller (CC) with modules and adapt it to the respective automation task.
The possible configuration of the S5-135U/155U CC includes the following different module types:

- CPU
- Coordinators
- I/O modules
- Intelligent I/O module
- Interface modules
- CP card
- Visualization processor unit

The S5-135U/155U central controller consists of a housing with backplane bus to house the individual modules and a power supply unit with fans to power and cool the modules. The housing contains the bus PCB that electrically and logically connects the modules.

Expansion options

The SIMATIC S5-135U/155U programmable controllers consist of one central controller (CC) and depending on the configuration, one or more expansion units (EU 183U, EU 185U). You need an expansion unit if the number of slots in the central controller is not sufficient for the modules to be used.

To connect the central controller to the EUs and the EUs to each other, various IMs (**I**nterface **M**odules) are available.

Memory concept

To save your program, a user memory is integrated in the module (CPU) as a RAM. The memory capacity depends on the CPU type used.

As an external storage medium for user programs and user data, the following memory module types can be used:

- Flash EPROM memory card
- EPROM
- RAM

Note

Which memory module type can be used depends on the CPU type used in your programmable controller.

The SIMATIC S5-135U/155U system manual (6ES5 998-0SH11) provides information on the S5-135U/155U programmable controller.
https://support.industry.siemens.com/cs/ww/en/view/1085837

3.2 SIMATIC S7-1500

3.2.1 CPU

Compared to the SIMATIC S5 programmable controllers, the available CPU types of the new controller generation S7-1500 show considerable differences and functions.
Features and functions of the available CPU types of the S7-1500.

- Communication via Ethernet
- Communication via PROFIBUS/PROFINET
- HMI communication
- Integrated web server
- Integrated technology
- Integrated system diagnostics
- Integrated industrial security functions
- Safety mode (all S7-1500 CPUs are also available as an F-version)

Note F-modules will be described in a later version of this guide.

3.2.2 Information on the SIMATIC S7-1500 automation system

Together with the Totally Integrated Automation Portal (TIA Portal), SIMATIC S7-1500 offers you numerous new options to further increase the productivity of your machines and make the engineering process more efficient.

Thanks to the integration of numerous new performance features, the S7-1500 automation system provides the user with excellent operating capabilities and maximum performance.

The new performance features are:

- Increased system performance
- Integrated motion control functionality
- PROFINET IO IRT
- Integrated display for local operator control and diagnostics
- STEP 7 language innovations while retaining proven functions

Area of application

The S7-1500 automation system provides the flexibility and performance required for the broad range of control applications in machinery and plant engineering.

The S7-1500 complies with IP20 degree of protection and is intended for installation in a control cabinet.

Design and function

The S7-1500 automation system is mounted onto a DIN rail and can consist of up to 32 modules. U connectors are used to connect the modules to each other.

The scalable design allows you to tailor your controller to the local requirements.

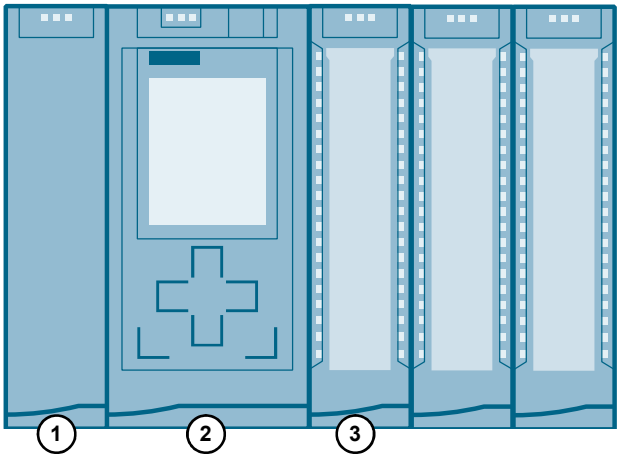
The system power supply is a power supply module with diagnostics capability that is connected to the backplane bus via a U connector.

The CPU executes the user program and the integrated system power supply supplies the electronics of the modules used via the backplane bus.

The I/O modules form the interface between the controller and the process.

Figure 3-2 shows a sample configuration of an S7-1500 automation system.

Figure 3-2 SIMATIC S7-1500



1. 25W DC system power supply module
2. CPU S7-1516
3. TM 1550 I/O modules

Memory concept

As the program memory, the S7-1500 automation system uses a SIMATIC Memory Card. The SIMATIC Memory Card is a preformatted memory card that is compatible with the Windows file system. The memory card is available in various sizes and can be used for the following purposes:

- Portable storage medium
- Program card (external load memory for the CPU)
- Firmware update card
- Service data card

For read/write operations on the SIMATIC Memory Card with the PG/PC, you need a standard SD card reader.
The SIMATIC Memory Card is mandatory for operating the CPU.

Note The SIMATIC S7-1500 system manual (A5E03461181-AB) provides information on the S7-1500 automation system.

https://support.industry.siemens.com/cs/ww/en/view/86140384

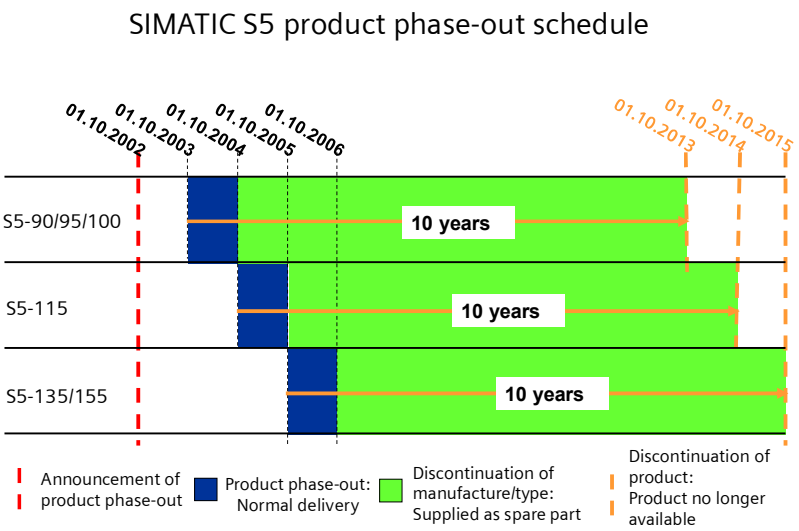
4 Hardware Migration

4.1 General information on migrating the hardware

The SIMATIC S5 components have been discontinued since 2003 and are no longer manufactured. They are largely still available as a spare part.

Spare parts are only provided in exchange for the component. The number of available components is continuously decreasing.

Figure 4-1 SIMATIC S5 product phase-out



For questions about the phase-out strategy of the SIMATIC S5 products and the availability of spare parts beyond the dates of discontinuation, please consult your regional Siemens contact.

Hardware that can be affected by migration:

- Controller with local and distributed I/Os
- Visualization, HMI, PC and SCADA
- Distributed I/Os
- Network type
- Drives, converters, motors and gears
- Motor control unit and control products
- Sensors and other field devices

4.1.1 Support, aids, adapters

Siemens and its certified partners facilitate migration by providing:

- Conversion tools
  - (integrated in the STEP 7 software)
- I/O adapters to avoid required rewiring
- Guides for step-by-step implementation, including the associated technical documentation

- Training for migrating from SIMATIC S5 to S7
  - From STEP 5 to STEP 7 (TIA Portal)
  - Guide for replacing the recommended hardware
- Web-based portal with:
  - Download of technical documentation
  - Software updates
  - Migration guides
  - FAQs
  - Sales and Technical Support addresses
- Third-party products
  - I/O adapter cables
  - RS232 > TTY converter

4.2 Selecting the CPU

Like SIMATIC S5, SIMATIC S7-1500 provides a selection of CPUs with different performance levels.

For reference, the Appendix provides an overview table that compares the S5 CPU to the recommended S7-1500 CPUs. (Chapter 7.1.1 CPU modules)

As - aside from criteria such as processing speed, internal memory, number of interfaces and communication connections, etc. - there are other plant-dependent selection criteria, the tables only provide a rough guide for selecting the CPU.

Examples of other plant-dependent selection criteria:

- Does the S5 CPU still have reserves or is it already operated in the limit range of the automation task (terminal-terminal response time, cycle time, memory requirements, …)?
- Should plant parts that belong together logically or logistically and that have previously been separated on the controller side be combined to one shared control area? Keyword: plant redesign
- Was the previous S5 CPU oversized?

4.3 Centralized and distributed I/O

4.3.1 Centralized I/O

The basic design of the centralized I/O of the SIMATIC S5 differs only insignificantly from the one of the S7-1500. Both systems share the same design where the CPU and the centralized I/O are connected via an appropriate backplane bus. Module connectors are used to connect the systems to the plant I/O.

However, the details of the two systems differ significantly so that it is not possible to directly connect the two systems. For this reason, Siemens offers appropriate I/O adapters that allow you, for example during migration of a plant, to quickly connect the plant cabling to the new SIMATIC S7-1500.

4.3.2 I/O adapters

I/O adapters were developed to allow fast and cost-effective connection to a cross-system I/O for a transitional period. Therefore, I/O adapters for the SIMATIC S7-300, S7-400 or S7-1500 connect the old to the new; i.e., they connect proven production systems and plants to state-of-the-art automation technology.

In practice, I/O adapters can be used without any problems. Remove the front connector from the input/output modules, replace the programmable controller, plug the adapter onto the new I/O units and fasten the existing front connectors. The individual components can be plugged in the easiest way. Once the software has been updated, the S7 is ready for service.

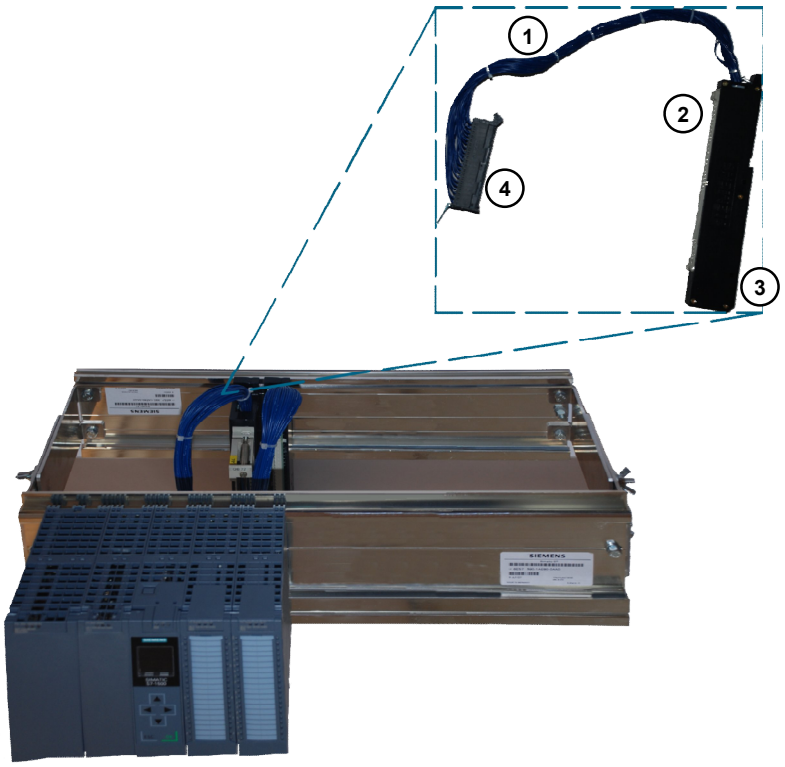
Advantages

- Updating the circuit diagrams is reduced to a minimum
- The signals are reconfigured by software via the assignment list
- The downtimes of machines and plants are reduced to a minimum

This procedure not only saves significant time and costs, it also helps considerably minimize errors.

For detailed information on the I/O adapter for the SIMATIC S7, please refer to the following document: “IO adapter SIMATIC S7-300, 400 and 1500”.
It can be downloaded at the following link:
https://support.industry.siemens.com/cs/ww/en/view/83557459

Figure 4-2 I/O adapter with S7-1500



1. Connecting cable
2. Connector for S5 front connector
3. Case with printed circuit board
4. S7-1500 front connector

4.3.3 Expansion units in S5 (EU)

SIMATIC S5 provided the option to expand the centralized I/O by more I/O modules with the aid of expansion units (EU). These expansion units were connected to the central controller (CC) using appropriate interface modules (IM 308/IM318).

With SIMATIC S7-1500, it is much easier to implement such I/O expansions via PROFINET or PROFIBUS connections. In addition, up to 32 modules can be plugged side by side in the central configuration of the S7-1500. Therefore, S7-1500 does not have such special interface modules.

You replace an S5 central controller with connected S5 expansion unit(s) by the use of a central S7-1500 station and the connection of SIMATIC ET 200MP stations via PROFINET. For these ET 200MP stations, you can use the same I/O adapters as for the central configuration of the S7-1500.

4.3.4 Distributed I/O

SIMATIC S5, too, provided the option to connect distributed I/O. In this context, primarily the ET 100 and ET 200U have to be mentioned.

4.3.5 SIMATIC ET 100

The ET100 is a distributed I/O device that was replaced by ET 200U or PROFIBUS already in the days of S5. Direct connection to ET100 is not possible. Migrating to PROFINET or PROFIBUS and ET 200SP or ET 200MP is recommended.

4.3.6 SIMATIC ET 200U and ET 200B

In S5, it was possible to connect the distributed I/O to the central controller using SINEC L2 / PROFIBUS. Migration to S7-1500 can be implemented as both a partial or complete migration. (Figure 4-3)

Partial migration of plants with ET 200U/B stations

For the partial migration, the ET 200U/B I/O system is retained and connected to an S7-1500 CPU. There are 3 variants for connecting it to the new S7-1500 CPU:

1. Use of a CPU with an integrated PROFIBUS interface. In this case, S7-1516, S7-1517 and S7-1518 CPUs can be used.
2. Use of a PROFIBUS CM or PROFIBUS CP in the central configuration of the S7-1500:
   - CM1542-5: 6GK7542-5DX00-0XE0 or
   - CP1542-5: 6GK7542-5FX00-0XE0
3. Via the IE/PB Link PN/IO: 6GK1411-5AB00 (Figure 4-3)

Configuration of ET 200U/B stations in STEP 7 TIA Portal

In STEP 7 TIA Portal, the existing ET 200U/B stations are configured using the appropriate GSD files:

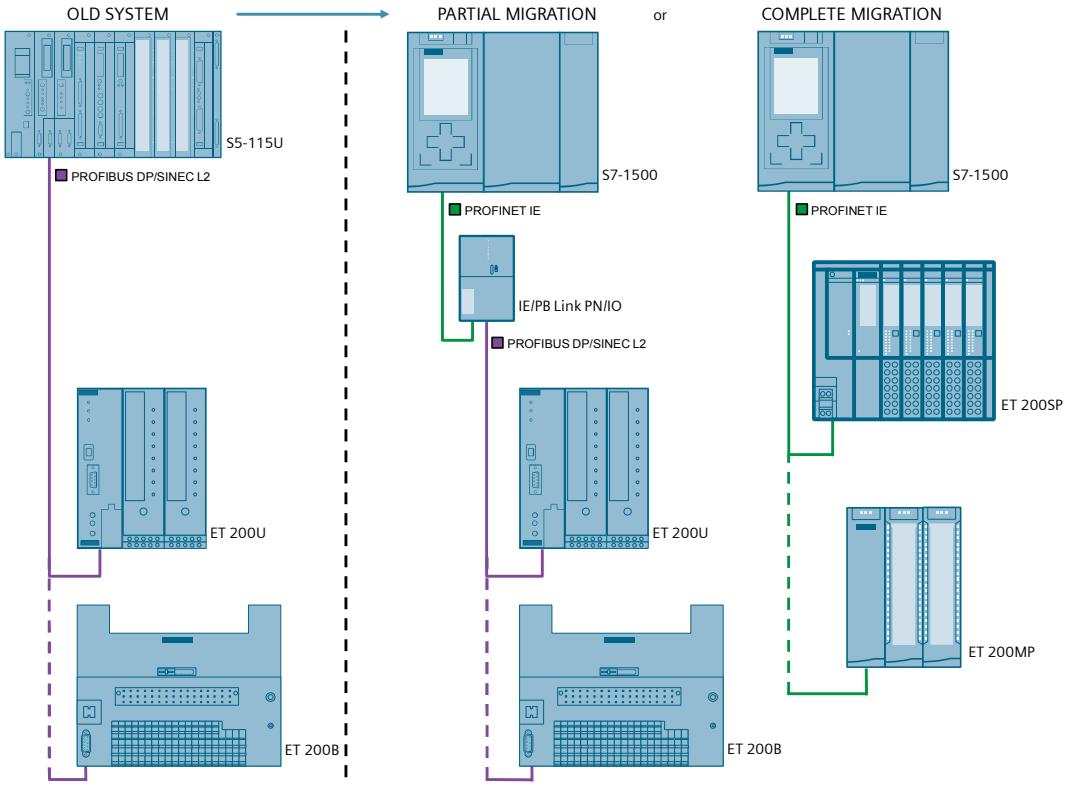
PROFIBUS GSD files: ET 200U

PROFIBUS GSD files: ET 200B

Complete migration of plants with ET 200U/B stations

Aside from the central controller, the complete migration to S7-1500 involves migrating the complete I/O to the new control components. For this purpose, the complete ET 200 I/O portfolio is available to you. For example, ET 200SP, ET 200MP, ET 200AL, etc.

Figure 4-3 Migration of distributed plants



Note

Even if the partial migration allows direct connection to the OLD I/O, it is recommended to implement the complete migration to ET 200MP/SP/AL/etc. and the connection via PROFINET. When the basic functionality of the plant has been migrated, this can also be done in a second migration step.
For example, advantages result from: Improved system diagnostics, faster bus, state-of-the-art technology and relatively easy migration and connection to the existing I/O.

4.4 Communication and networks

SIMATIC S5 provided numerous communication options:

- System-internal communication
- With external communication partners
- Numerous communications protocols

The "CPU-CPU Communication" compendium provides an overview, including appropriate S5 protocols:

https://support.industry.siemens.com/cs/ww/en/view/78028908

Note Communication will be discussed in greater detail in a later version of this guide.

4.4.1 SINEC H1

The SINEC H1 communications system allows open communication of distributed data terminal equipment in automation engineering in the mid and high-end performance range.

The SINEC H1 communications system consists of the SINEC H1 communications processors in various data terminal equipment and the SINEC H1 network components (Figure 4-4).

The SINEC H1 communications processors implement open communication between the data terminal equipment. The communications protocol of the SINEC H1 communications processors covers layers 2 to 7 of the ISO/OSI reference model.

Protocol layers 1 and 2a of the SINEC H1 communications system are implemented according to the IEEE 802.3 standard or ISO/IEC 8802-3.

Table 4-1 SINEC H1 transport protocol

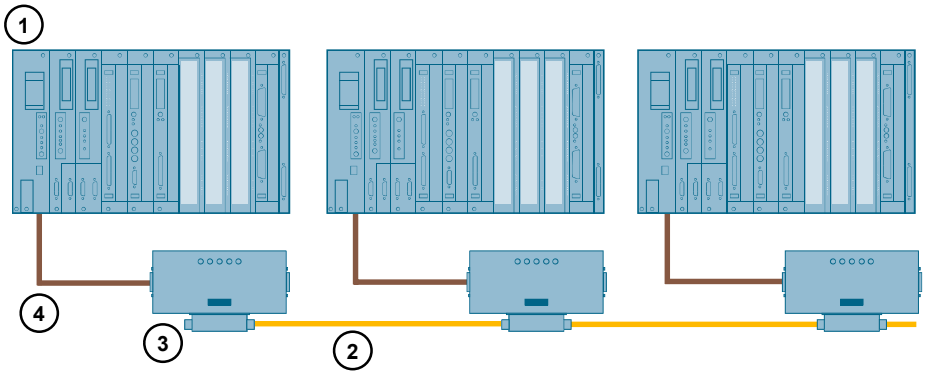
	Send/Receive	Fetch/Write active/passive	TF	PG/OP
CP535	X	X		X
CP143TF	X	X	X	X
CP1430TF Basic Extended	X	X	X	X

Table 4-2 SINEC H1 transport protocol TCP/IP, UDP

	Send/Receive	Fetch/Write active/passive	TF	PG/OP
CP1430TCP	X	X		X

Sample configuration - SINEC H1 with SIMATIC S5

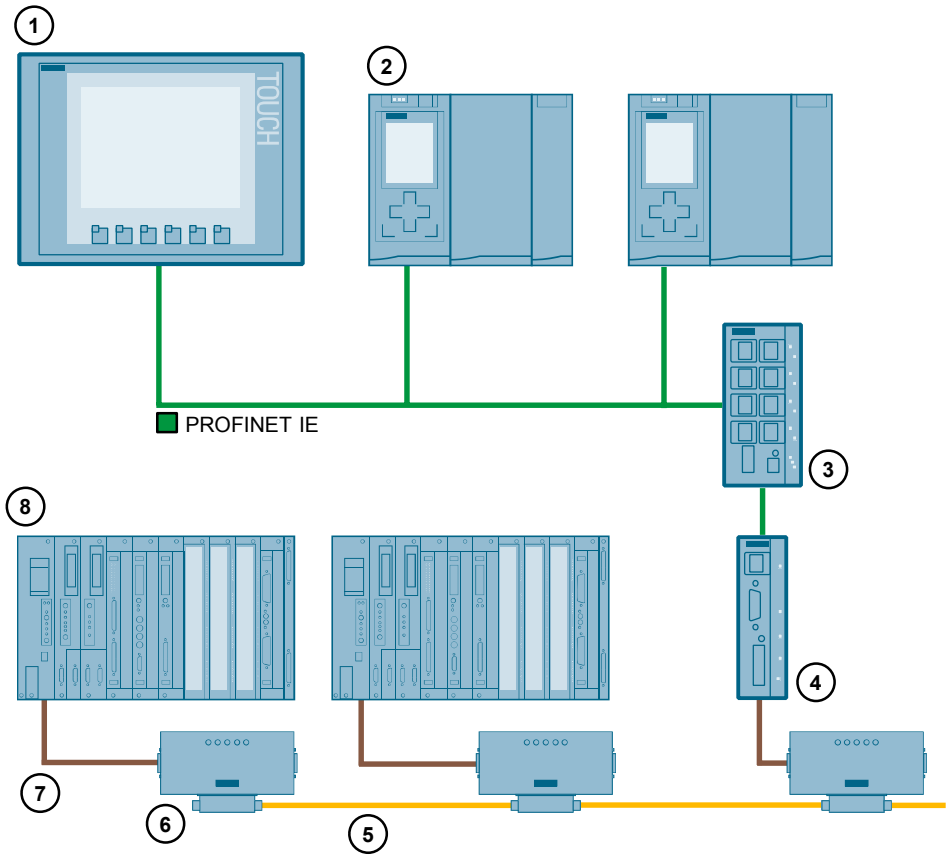
Figure 4-4 SINEC H1 communications system



1. SIMATIC S5 controller with CP535 SINEC H1 interface module (6ES5 535-3MA12)
2. Coaxial cable (6ES5 727-0AA11) for a SINEC H1 segment
3. Bus coupler (6GK1901-0AA00-0AA0)
4. Drop cable (6ES5 727-1BD20) as a medium to connect a terminal unit

Sample configuration of a partial migration with SIMATIC S5, SINEC H1 and S7-1500

Figure 4-5 Cross-network configuration



1. Comfort Panel in the Industrial Ethernet network
2. SIMATIC S7-1500 controller in the Industrial Ethernet network
3. SCALANCE X208 (6GK208-0AB10-2AA3)
4. SCALANCE X101-1AUI converter (6GK5 101-1BX00-2AA3)

Note In STEP 7 (TIA Portal) V1x, it is not required to configure this hardware.

5. Coaxial cable (6ES5 727-0AA11) for a SINEC H1 segment
6. Bus coupler (6GK1901-0AA00-0AA0)
7. Drop cable (6ES5 727-1BD20) as a medium to connect a terminal unit
8. SIMATIC S5 controller with CP535 SINEC H1 interface module (6ES5 535-3MA12)

Note For information on the SINEC H1 bus system, please refer to the SIMATIC NET Manual for Triaxial Networks (6GK1970-1AA20-0AA0).

https://support.industry.siemens.com/cs/ww/en/view/1415288

4.4.2 SINEC L1

The SINEC L1 bus can be seen as a predecessor to SINEC L2 and supports the low-end communication performance range. SINEC L1 consists of the following components:

- CP530 communications processor
- BT 777 bus terminal (for each node)
- Bus cable (4-wire, shielded)

The CP530 communications processor (6ES5530-3LA12) performs the core coordination function ("master") for the SINEC L1 bus that operates according to the "master-slave method". It controls the flow of information. In the higher-level controller - the so-called master PLC -, the CP530 is connected within the bus system. The lower-level programmable controllers - called slave PLCs or simply slaves – can connect to SINEC L1 in two ways:

- The programmable controllers S5-100U, S5-101U and S5-115U connect via the programming device interface that already exists on the controller.
  Note: The CPU 100 of the 100U programmable controller is not slave-capable.
- If, for certain reasons, the programming device interface should remain on a lower-level S5-115U controller, it is optionally possible, also in this case, to connect a CP530, which then performs the slave interface function. On the SINEC L1 bus, the programmable controllers S5-135U and S5-150U always communicate only via a CP530 communications processor.

Note For information on the SINEC L1 bus system, please refer to the SIMATIC S5 Bus System SINEC L1 manual (GWA 4 NEB 811 0545-01d).

https://support.industry.siemens.com/cs/ww/en/view/16895465

Note Using SINEC L1 (CP530 – 6ES5530-..) components, it is not possible to establish communication with the S7-1500 system. Complete migration to PROFINET is recommended.

4.4.3 SINEC L2

SINEC L2 is a bus system that networks SIMATIC S5 programmable controllers, programmers and other control systems. Furthermore, PROFIBUS-compatible devices from various manufacturers can be connected to this bus system. Components that comply with the PROFIBUS standard can communicate via the SINEC L2 bus.

Note For information on SINEC L2, please refer to the SINEC L2 Bus System manual (6GK1970-5AB01-0AA1).

https://support.industry.siemens.com/cs/ww/en/view/1804226

Table 4-3 SINEC L2 transport protocol

	FMS	FDL	DP master	DP slave	PG/OP
CP5431	X	X	X		X
CP541		X	X	X	X
IM308C			X	X	

4.4.4 Serial communication

Note Serial communication will be described in a later version of this guide.

4.5 Operator control and monitoring

Note Operator control and monitoring will be described in a later version of this guide.

5 Software Conversion

5.1 General information on software conversion

In general, you can migrate ALL your STEP 5 programs to STEP 7!

However, depending on the STEP 5 commands used or special blocks, it may be necessary to make adjustments after migration.

This chapter explains the most important differences between the two software platforms. In addition, we introduce you to a number of tools. They are intended to provide the best possible support for migration and any adjustments that may be required.

Nevertheless, there may be reasons which make it advisable to rebuild certain programs or programs parts: Examples of such reasons:

- Simpler code
- Additional functions
- Improved diagnostic capability
- Creation of standard functions and libraries capable of meeting future requirements
- Migration effort same as or higher than rebuilding
- Achievement of higher throughputs due to increase in performance
- And many more

Note For a general programming guide for SIMATIC S7-1500, refer to the following entry ID:

https://support.industry.siemens.com/cs/ww/en/view/81318674

5.1.1 Programming languages

LAD/FBD/STL

In SIMATIC STEP 5, the following standard programming languages were available:

- Ladder diagram (LAD)
- Function block diagram (FBD)
- Statement list (STL)

For the SIMATIC S7-1500 CPUs, these programming languages are available to you as well.

S7-SCL

Note In addition, TIA Portal from SIEMENS offers the S7-SCL programming language, which is similar to a high-level language. Using S7-SCL, particularly more comprehensive functions can be implemented easily and conveniently. Therefore, we recommend that functions such as data handling, search algorithms, copy functions, comparison functions, etc. be converted to S7-SCL when migrating from STEP 5 to STEP 7 (TIA Portal).

Note For an overview of the statements available to you for S7-1500, please use the following link:
https://support.industry.siemens.com/cs/ww/en/view/86630375

GRAPH 5 / GRAPH in TIA Portal

In SIMATIC S5, the graphic programming language GRAPH 5 was used for sequencer programming. For this purpose, GRAPH is now available. (This guide does not cover GRAPH.)

5.1.2 Requirements, programming environment

The following software is required for migration:

- STEP 5 version 7.2 (Industry Online Support product page)
- STEP 7 version 5.5 and STEP 7 V13.1 (Combo License)

As the hardware platform, we recommend:

- SIMATIC Field PG M4 Premium or Premium Plus

  (for example, article number: 6ES7716-1CB10-0CE4 or 6ES7716-2CB10-0EC4)

  Important features:
  - Intel Core I5 or I7
  - S5 online interface, S5 EProm mer, S5 PLC cable, S5 EPROM adapter dual-boot operating system: Windows XP Prof. and Windows 7 Ult. 64-bit
  - Preloaded software and licenses for STEP 5, STEP 7 Prof. 2010, STEP 7 Prof. V13, WinCC flex. 2008, WinCC Adv. V13, Startdrive V13
- Possibly replacement EPROM for S5
  - Advisable for a partial migration to be able to back up required program changes to the remaining S5 part.
    When doing so, you must first delete the S5 EEPROM with the programmer before you can write the new program to it.

Note The TIA Selection Tool allows you to easily configure your field PG to suit your needs.

However, always select at least one of the important features listed above.

Link to the TIA Selection Tool: www.siemens.com/tia-selection-tool

Note We explicitly advise against using a standard PC or notebook computer! The reasons for this include:

- Non-existing or wrong interfaces for S5 (RS232/TTY)
- Complex setup of a dual-boot partition
- Installation of the complete software packages (time and costs)
- S5 EPrommer or EPROM adapter may be necessary

5.1.3 Procedure and tool support

We recommend migrating your STEP 5 program to STEP 7 (TIA Portal) in 2 basic steps on a tool-supported basis.

- First migrate the STEP 5 program to STEP 7 V5.5. When performing this step, the S5/S7 converter supplied with STEP 7 V5.x supports you.
  After this automatic conversion, it may be necessary to manually adjust the STEP 7 program generated as described above to ensure error-free compilation in STEP 7 V5.x.
- In a second step, the generated STEP 7 project is migrated to TIA Portal. This migration is implemented directly in TIA Portal and requires no separate tool.

5.1.4 Conversion to STEP 7 V5.x and S5/S7 converter

The S5/S7 converter is supplied with STEP 7 V5.x and installed automatically.

STEP 5 files for conversion

Mandatory files for conversion:

- * ST.S5D file
  Contains your STEP 5 program.
- * XR.INI file

  This is the cross-reference list of your STEP 5 program and required for the program structure of the generated STEP 7 program.

Optionally, you can use the S5 assignment list. You need this file if you want to use the STEP 5 symbols also in the STEP 7 program.

- * Z0.SEQ file

For a detailed conversion guide using the S5/S7 converter, please refer to the "Conversion" chapter of this document:

https://support.industry.siemens.com/cs/ww/en/view/45531547

Changes to the converted STEP 7 program

In STEP 5, there are a number of special instructions, system and organization blocks, data types, etc. that do not conform to IEC and no longer exist in STEP 7 V5.x and in STEP 7 V1x (TIA Portal). (For example, LIR, TIR, MAB, etc.)

These program constructs are applied during automatic conversion and commented out. In addition, appropriate error and warning messages are displayed

after the conversion run. Therefore, you have to make changes to these program parts or blocks.

You have to rework your STEP 7 program until the STEP 7 program can be compiled in STEP 7 V5.x without errors or is consistent. This is the prerequisite for the next step: Migration to TIA Portal.

Note We recommend that STEP 5 blocks where indirect store commands such as LIR, TIR, MBA, MAB were frequently used be commented out in STEP 7 V5.x and the included function be rebuilt in TIA Portal after migration. Experience shows that it is relatively easy to rebuild these functions in S7-SCL.

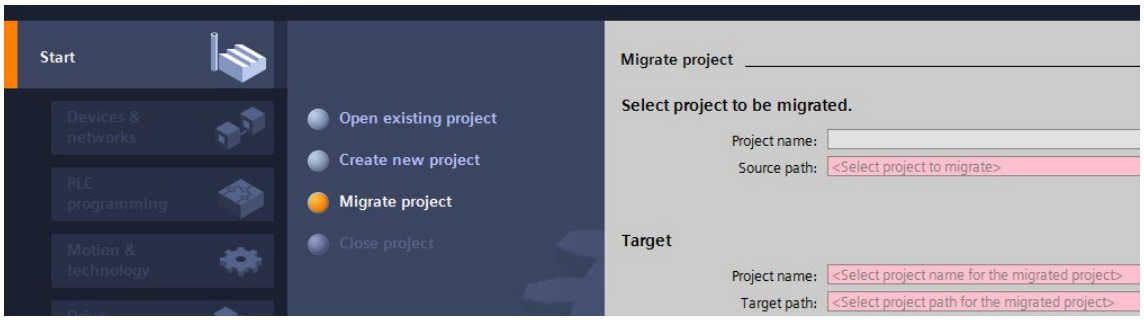
5.1.5 Migration to STEP 7 1x to TIA Portal

Migration to STEP 7 V1x to TIA Portal requires a consistent STEP 7 V5.x project. For information on how to check your project for consistency, refer to the following entry:

https://support.industry.siemens.com/cs/ww/en/view/5416540

For migration to TIA Portal, all you need to do is open TIA Portal and in the Portal view, select the "Migrate project" menu option.

Figure 5-1 STEP 7 (TIA Portal)



For more information on migration, please refer to the TIA Portal Online Help, topic: "Migrating Projects to a TIA Portal Project"

5.2 Program structure and standard functions

5.2.1 Organization blocks (OBs)

Organization blocks are located in the firmware of the SIMATIC CPU and called by the CPU's operating system when specific events occur. They are the interface between the system program and the user program and can be programmed by the user. Both S5 CPUs and S7-1500 CPUs have organization blocks. In some cases, the available OBs differ between the two SIMATIC platforms.

OBs are processed on a priority-controlled basis. When there are multiple simultaneous OB requests, the highest priority OB is processed first. When an event occurs whose priority is higher than the one of the currently active OB, this OB is interrupted.

The most important OBs are listed below.

Cyclic program processing

Table 5-1

S5 CPUs	S7-1500 CPUs	Description
OB 1	Main OB	Cyclic program processing For S7-1500, multiple cyclic OBs can be used.

Time-controlled program processing (cyclic interrupts)

Table 5-2

S5 CPUs	S7-1500 CPUs	Description
OB 10-OB18	Cyclic interrupt OB	Time-controlled program processing For program processing at periodic intervals.

SIMATIC S7-1500 provides 20 OBs you can use for time-controlled program processing. In contrast to S5, the S7-1500 allows you to individually set the cycle clock for each cyclic interrupt OB and additionally set a phase shift.

Program processing during startup (restart)

Startup OBs are processed once when the CPU mode changes from STOP to RUN. When the startup OB has been processed, cyclic program processing starts.

In S5, you could use 3 different startup OBs. Depending on the CPU startup, the respective OB was then called by the operating system and processed once.

- OB20: Manual/automatic restart
- OB21: Manual restart
- OB22: Automatic restart

In S7-1500, you can use up to 100 startup blocks. (Type class: OB_Startup). If multiple startup OBs are programmed, they are called in the order of the numbering.

The following variables are available in OB_Startup:

Note This requires that "Optimized block access" be unchecked in the settings of the OB block properties!

Table 5-3 - Temporary variables of a startup OB in S7-1500

Variable	Data type	Description
OB10x_EV_CLASS	BYTE	Event class and IDs: B#16#13: active
OB10x_STRTUP	BYTE	Startup request: • B#16#81: Request for manual warm restart • B#16#82: Request for automatic warm restart • B#16#83: Request for manual hot restart • B#16#84: Request for automatic hot restart • B#16#85: Request for manual cold restart • B#16#86: Request for automatic cold restart • B#16#87: Master: Request for manual cold restart • B#16#88: Master: Request for automatic cold restart • B#16#8A: Master: Request for manual warm restart

Variable	Data type	Description
		• B#16#8B: Master: Request for automatic warm restart
OB10x_PRIORITY	BYTE	Priority class: 27 or 1 (for S7-1500-CPUs)
OB10x_OB_NUMBR	BYTE	OB number (100, 101 or 102)
OB10x_RESERVED_1	BYTE	Reserved
OB10x_RESERVED_2	BYTE	Reserved
OB10x_STOP	WORD	Number of the event that set the CPU to STOP
OB10x_STRT_INFO	DWORD	Supplementary information on the current startup
OB10x_DATE_TIME	DATE_AND_TIME	Date and time when the OB was requested

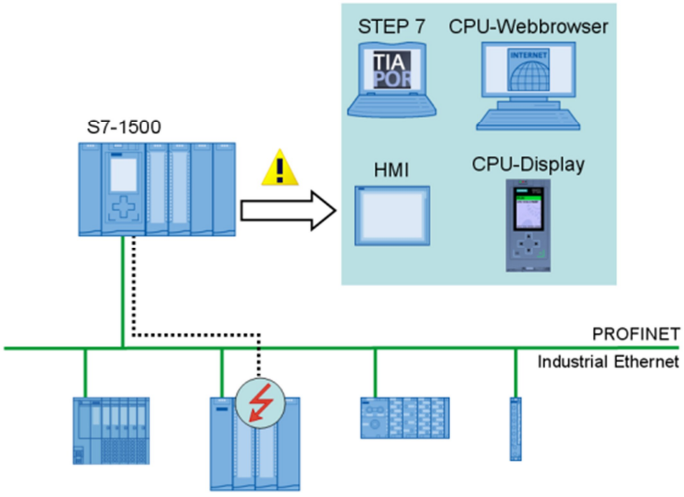
OBs for error diagnostics

As parts of the system architecture of S5 and S7-1500 differ, errors are displayed and handled differently. Particularly in the field of hardware errors, the new S7-1500 control system offers very convenient system diagnostics options.

For information on system diagnostics, please refer to the following two entries:

https://support.industry.siemens.com/cs/ww/en/view/68011497

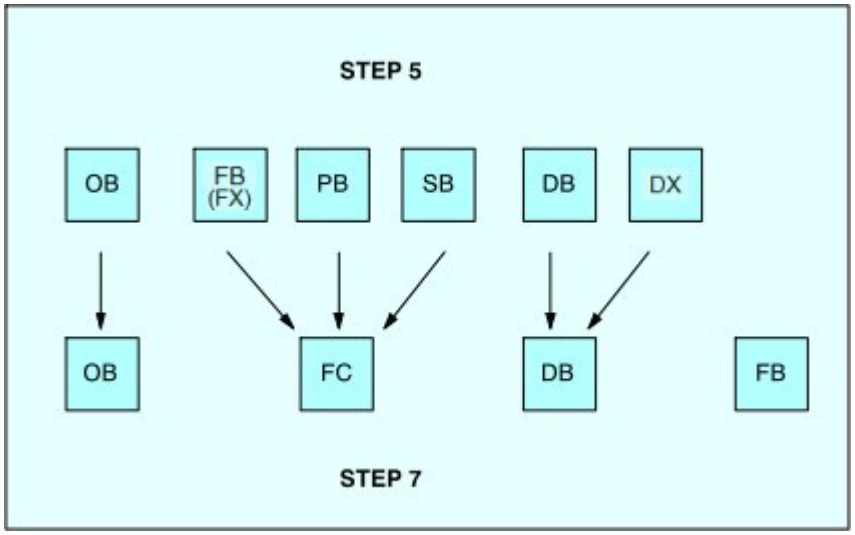
https://support.industry.siemens.com/cs/ww/en/view/98210758



Special OBs, see "OBs for special functions"

5.2.2 Program blocks, function blocks and functions

Figure 5-2 – Block migration from STEP 5 to STEP 7



Program blocks in STEP 5 (PBs)

In STEP 5, program blocks (PBs) were only used to structure the program. It was not possible to transfer parameters in the block interface. Similarly, the PB could not be assigned a data block as an instance. To edit data in data blocks, it was always necessary to open the respective DB before accessing it.

Function blocks in STEP 5 (FBs / FXs)

For function blocks (FBs/FXs) in STEP 5, it was possible to transfer input and output parameters in the block interface. Similarly to the PB, the FB could not be assigned a data block as an instance. To edit data in data blocks, it was always necessary to open the respective DB before accessing it.

Sequence blocks in STEP 5 (SBs)

Sequence blocks (SBs) in STEP 5 were used for sequential control, mainly in conjunction with GRAPH 5. The S5/S7 converter converts SBs to FCs.

Functions in STEP 7 (FCs)

For functions in STEP 7 (FCs), appropriate input and output signals can be declared and transferred to the FC when they are called.

In addition, the FC can provide a direct return value of the function.

Temporary variables can be declared in an FC.

Function blocks in STEP 7 (FBs)

For function blocks in STEP 7 (FBs), appropriate input and output signals can also be declared and transferred to the FB when they are called. In addition, each FB can be assigned an instance (DB) as a separate “memory”. (Static variables)

Static and temporary local variables can be declared in a STEP 7 FB.

5.3 Data structures and data blocks

5.3.1 Data handling in S5 and S7

In STEP 5, it was possible to store data in data blocks, DBs and DX, and in flags. It was not possible to structure data or define user-defined data types in STEP 5.

STEP 7 and S7-1500, however, provide various options to structure data and conveniently access these structures.

Note If your STEP 5 program contains functions for data handling (e.g., copy, fill, find, etc. ... data), it is useful to consider restructuring these data areas and using the convenient programming functions in STEP 7 TIA Portal. In this context, we also recommend using the S7-SCL programming language for creating these blocks.

Data blocks and data structures in STEP 5

STEP 5 had the DB and DX data blocks.

DB and DX can be considered to be equivalent. As significantly more than 255 blocks can be addressed per block type in STEP 7, DX blocks are no longer required and no longer exist in STEP 7.

DX data blocks are migrated to STEP 7 DBs (starting with DB number 256).

In STEP 5, the data in data blocks is organized word by word; in STEP 7, however, it is organized byte by byte. Word addresses in STEP 5 are converted to byte addresses in STEP 7. See the table below:

Table 5-4

STEP 5	STEP 7
DL 0, 1, 2, 3, …255	DBB 0, 2, 4, 6, …510
DR 0, 1, 2, 3, …255	DBB 1, 3, 5, 7, …511
DW 0, 1, 2, 3, …255	DBW 0, 2, 4, 6, …510
DD 0, 1, 2, 3, …254	DBD 0, 2, 4, 6, …508
D x.y	DBX 2x.y for 8<= y <= 15 DBX (2x+1).y for 0<= y <= 7

Flags in STEP 5

SIMATIC S5 CPUs featured a standard flag area from M0.0 to M255.0. Some of the more recent S5 CPUs additionally featured an extended flag area, the so-called S flags (S0.0 to S1023.7 / S4095.7)

In STEP 5, there was an unwritten rule: Flags from M200.0 to M255.7 were used as so-called scratch flags in programs. These scratch flags are equivalent to today's temporary local data in STEP 7 V5.x / STEP 7 V1x. Basically, you can continue to use these flags. However, for various reasons, we recommend that you adapt your program to modern, state-of-the-art programming. Instead, use instance data or temporary local data. More information can also be found in the Programming Guideline for S7-1200/S7-1500:

https://support.industry.siemens.com/cs/ww/en/view/81318674

5.3.2 The S5 system data blocks DB 0, DB1 and DX0

In SIMATIC S5, there were system data blocks (DB 0, DB 1, DX 0) that contained system information and system settings. Due to the modified and therefore modern system architecture of the SIMATIC S7-1500, these data blocks are no longer required and no longer exist in S7-1500. In the SIMATIC S7-1500, these settings are made in the hardware configuration.

DX0 – parameter assignments for program processing

In DX 0, it was possible to change the default settings for the various execution classes and their OBs. E.g., cycle clocks, priorities, ...

For the SIMATIC S7-1500, these settings can be made in TIA Portal in the settings of the appropriate OBs.

DB0 – address list

DB 0 contains the start addresses of the blocks. Users had only read access to this DB.

Symbolic programming in the S7-1500 renders this special DB unnecessary and there is no counterpart for it.

DB1 – communication flag definition

DB 1 of the S5 CPU was needed to parameterize the communication flags. In SIMATIC S5, communication flags were used for signal exchange with the communications processors.

The S7-1500 does not require communication flags for communication with its modules. Therefore, this data block is no longer required and no longer exists.

5.4 OBs for special functions

In the S5 world, there were a number of organization blocks with special functions (starting with OB110) the S7-1500 no longer requires or for which a better functionality has been implemented. This means these OBs no longer exist (e.g., OB110 access to the condition code byte, etc.)

If these special OBs were used in your program, you have to recreate these programs to the necessary extent with the appropriate function in STEP 7.

5.5 Assignment list – symbol table – symbols

The option to program symbolically has already been available in STEP 5. The symbols used were saved in a so-called assignment list. (*Z0.SEQ).

When migrating using the S5/S7 converter, these symbols are applied and stored in the symbol table of the SIMATIC Manager of STEP 7 V5.x.

In STEP 7 in TIA Portal, you can only program symbolically. Blocks, variables, constants, ... are created directly with the desired name without assigning numbers. (Exception: OBs). Therefore, a separate symbol table is not available in TIA Portal.

When migrating from STEP 7 V5.x to STEP 7 V1x in TIA Portal, the symbols from the symbol table are applied.

5.6 Programming sequential controls – GRAPH 5 and GRAPH in TIA Portal

Note Programming sequential controls – GRAPH 5 and TIA Portal GRAPH – will be described in a later version of this guide.

6 The most important Recommendations

6.1 Contacts in the region

Find a SIEMENS contact in your region:
www.siemens.com/YourContact

6.2 Services offered by Siemens

Migration of obsolete control systems is the prerequisite for high availability over the entire life cycle of your plant.
Siemens offers comprehensive migration support for typical fields of application. We support you from the idea stage to planning and implementation. The scope of services includes migration or temporary support of your migration projects.

Your benefits at a glance:

- Cost and time savings in the implementation phase
- Optimum preparation of your migration
- High degree of planning reliability

Your paths to Technical Support
https://support.industry.siemens.com/sc/en/en/sc/3082

Service packages and overview
https://support.industry.siemens.com/sc/en/en/sc/3083

6.3 Solution Partners

The Partner Finder allows you to find one of our qualified Solution Partners to solve your migration task.

Solution Partner Program
www.siemens.com/automation/solutionpartner

6.4 References and online documents

6.4.1 Important information

Table 6-1 – S5-115U manuals

S5-115U manuals	Link
S5-115U Programmable Controller	1085937
S5-115U Device Manual (CPU941A, CPU942A, CPU943A, CPU944A) – (only available in German language)	29773759
S5-115 Device Manual CPU 945-7UA1./-7UA2.	1086944
Supplement to the Device Manual of the S5-115U Programmable Controller CPU 945-7UA1./-7UA2. (6ES5 998-3UF11) (only available in German language)	17683238

S5-115U manuals	Link
S5-115U Programmable Controller CPU 941/942/943/944 Reference Guide	1085938
Pocket Guide CPU 945	1087145

Table 6-2 – S5-135U/S5-155U manuals

S5-135U/S5-155U manuals	Link
SIMATIC S5-135U/155U System Manual	1085837
S5-135U Programmable Controller CPU 921, CPU 922	19064874
S5-155U Programmable Controller (CPU 946/947)	19064665
PLC S5-135U CPU 928 Programming Guide	15342414
S5-135U CPU 928B Programming Guide	1085940
S5-155U CPU 948 Programming Guide	1087149
S5-135U/155U List of Operations	1086150
S5-135U/155U CPU 928/CPU 928B/CPU 948 List of Operations	14779967
S5-135U CPU 928B Communications	15350394

Table 6-3 – S7-1500 manuals and STEP 7 manuals in TIA Portal

S7-1500 manuals and STEP 7 manuals in TIA Portal	Link
SIMATIC Programming Device SIMATIC Field PG M4	67463270
SIMATIC S7-1500, ET 200MP Automation System	59191792
SIMATIC S7-1500 / ET 200MP Manual Collection	86140384
Programming Guideline for S7-1200/S7-1500	81318674
SIMATIC S7-1200 / S7-1500 Comparison List for Programming Languages Based on the International Mnemonics	86630375
SIMATIC S7-1500 Getting Started	71704272
SIMATIC S7-1500 Cycle and Response Times	59193558
TIA Selection Tool	Link
SIMATIC S7-1500 / ET 200MP Manual Collection	86140384

7 Appendix

7.1 Comparison of SIMATIC S5 and S7 components

The following tables show the respective S7-1500 equivalent to the listed SIMATIC S5 module in terms of content.

It is essential that you note the following:

Note

The contents of these tables are for reference only!

In addition to the technical features listed in the tables, the components have more technical properties which differ in some cases. Which technical features are important and relevant to the respective plant / plant part can only be identified through careful analysis of the installed base and must be determined in this migration phase. See also "Planning the migration phases".

This means: The respective listed SIMATIC S7-1500 hardware component must not automatically be regarded as an equivalent to the listed SIMATIC S5 component. It is the user's responsibility to consider the technical characteristics (e.g., limits) of the SIMATIC S5 and S7 module and to check whether these parameters are relevant to the customer application (plant) and complied with.

Examples of relevant technical parameters:

- Power supply
- Signal voltage
- Frequency
- Connection to common potential or channel separation
- Number of channels
- Load current
- Contact load
- Switching rate
- etc. ...

7.1.1 CPU modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-1

S5-115U	Description	S7-1500	Description
6ES5 941-7UA11	CPU 941	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 941-7UB11	CPU 941	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 942-7UA11	CPU 942	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 942-7UB11	CPU 942	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 943-7UA11	CPU 943	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 943-7UB11	CPU 943	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 943-7UA21	CPU 943	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 943-7UB21	CPU 943	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 944-7UA11	CPU 944	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 944-7UB11	CPU 944	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 944-7UA21	CPU 944	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 944-7UB21	CPU 944	6ES7 513-1AL00-0AB0 6ES7 515-2AM00-0AB0	CPU 1513-1 PN CPU 1515-2 PN
6ES5 945-7UA13 6ES5 945-7UA23	CPU 945 *)	6ES7 516-3AN00-0AB0 6ES7 517-3AP00-0AB0 6ES7 518-4AP00-0AB0	CPU 1516-3 PN/DP or CPU 1517-3 PN/DP or CPU 1518-4 PN/DP

Table 7-2

S5-135U	Description	S7-1500	Description
6ES5 921-3UA11	CPU 921	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 921-3UA12	CPU 921	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 922-3UA11	CPU 922	6ES7 513-1AL00-0AB0	CPU 1513-1 PN
6ES5 928-3UB12	CPU 928B	6ES7 516-3AN00-0AB0	CPU 1516-3 PN/DP
6ES5 928-3UB21	CPU 928B	6ES7 516-3AN00-0AB0	CPU 1516-3 PN/DP

Table 7-3

S5-155U	Description	S7-1500	Description
6ES5 946-3UA23	CPU 946	6ES7 516-3AN00-0AB0	CPU 1516-3 PN/DP
6ES5 947-3UA22	CPU 947	6ES7 516-3AN00-0AB0	CPU 1516-3 PN/DP
6ES5 948-3UA12 6ES5 948-3UA22 6ES5 948-3UA23	CPU 948 *)	6ES7 516-3AN00-0AB0 6ES7 517-3AP00-0AB0 6ES7 518-4AP00-0AB0	CPU 1516-3 PN/DP or CPU 1517-3 PN/DP or CPU 1518-4 PN/DP

*) Please note the information in the “Selecting the CPU” chapter

7.1.2 S5-115U digital modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-4

S5-115U	Description	S7-1500	Description
Digital input modules			
6ES5 420-7LA11	32 DI, 24V DC , NON-FLOATING	6ES7 521-1BL00-0AB0	32 DI, 24V DC, HF, 35mm
		6ES7 521-1BL10-0AA0	DI 32x24VDC, BA, 25mm * / **
6ES5 430-7LA12	32 DO, 24V DC, FLOATING	6ES7 521-1BH00-0AB0	16 DI, 24V DC, HF, 35mm
		6ES7 521-1BH10-0AA0	DI 16x24VDC, BA, 25mm * / **
6ES5 434-7LA12	8 DI, 24V DC, ALARM SIGNAL, FLOATING	6ES7 521-1BH00-0AB0	16 DI, 24V DC, HF, 35mm
		6ES7 521-1BH10-0AA0	DI 16x24VDC, BA, 25mm * / **
6ES5 435-7LA11	16 DI, 115V UC, FLOATING	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 435-7LB11	16 DI, 115V UC, FLOATING, 8X2DI	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 435-7LC11	8 DI, 115V UC, FLOATING, 8X1DI	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 436-7LA11	16 DI, 230V UC, FLOATING, 4X4DI	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 436-7LB11	16 DI, 230V AC, FLOATING	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 436-7LC11	8 DI, 230V UC, FLOATING, 8X1DI	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
Digital output modules			
6ES5 441-7LA13	32 DO, 24V DC/0.5[a], NON-FLOATING	6ES7 522-1BL00-0AB0	32 DQ, 24V DC/0.5[a], ST, 35mm
		6ES7 522-1BL10-0AA0	DQ 32x24VDC/0.5[a], BA, 25mm * / **

S5-115U	Description	S7-1500	Description
6ES5 451-7LA11	32 DO, 24V DC/0.5ª, FLOATING	6ES7 522-1BL00-0AB0	32 DQ, 24V DC/0.5ª, ST, 35mm
6ES5 454-7LA12	16 DO, 24V DC/2ª, FLOATING	6ES7 522-1BF00-0AB0	8 DQ, 24V DC/2ª, HF, 35mm
6ES5 454-7LB11	8 DO, 24V DC/2ª, FLOATING	6ES7 522-1BF00-0AB0	8 DQ, 24V DC/2ª, HF, 35mm
6ES5 456-7LA11	16 DO, 115/230V AC/1ª, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST (Triac), 35mm
6ES5 456-7LB11	16 DO, 115/230V AC/2ª, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST (Triac), 35mm
6ES5 458-7LC11	16 RO, 250V AC/1.5ª, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST (Triac), 35mm
Digital input/output modules			
6ES5 482-7LA11	16 DI/16 DO, 24V DC/0.5ª, FLOATING	6ES7 523-1BL00-0AA0	16 DI, 24V DC/16 DQ, 24V DC/0.5A, BA, 35mm
		6ES7 523-1BL00-0AA0	DI 16x24VDC / DQ 16x24VDC/0.5A BA, 25mm * / **
Labeling sheets for S5-115U and S7-1500			
6ES5 497-7LA11	Labeling sheets for S5-115U/F front cover	6ES7 592-2AX00-0AA0	Labeling sheets for 35mm wide S7-1500 modules
		6ES7 592-1AX00-0AA0	Labeling sheets for 25mm wide S7-1500 modules

* Unlike the 35mm wide modules whose delivery has already started, the 25mm wide modules feature no parameters and diagnostics.

**I/O adapters for the SIMATIC S7-1500 product range are currently not available for the 25mm wide I/O modules.

7.1.3 S5-135U/155U digital modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-5

S5-135U/155U	Description	S7-1500	Description
Digital input modules			
6ES5 420-4UA14	32 DI, 24V DC, NON-FLOATING	6ES7 521-1BL00-0AB0	32 DI, 24V DC, HF, 35mm
		6ES7 521-1BL10-0AA0	DI 32x24VDC, BA, 25mm * / **
6ES5 430-4UA14	32 DI, 24V DC, FLOATING	6ES7 521-1BH00-0AB0	16 DI, 24V DC, HF, 35mm
		6ES7 521-1BH10-0AA0	DI 16x24VDC BA, 25mm * / **
6ES5 432-4UA12	32 DI, 24V DC, FLOATING	6ES7 521-1BH00-0AB0	16 DI, 24V DC, HF, 35mm
		6ES7 521-1BH10-0AA0	DI 16x24VDC BA, 25mm * / **
6ES5 436-4UA12	16 DI, 115V/240V AC, FLOATING	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
6ES5 436-4UB12	8 DI, 115/240V AC, FLOATING	6ES7 521-1FH00-0AA0	16 DI, 230V AC, BA, 35mm
Digital output modules			
6ES5 441-4UA14	32 DO, 24V DC/0.5A, NON-FLOATING	6ES7 522-1BL00-0AB0	32 DQ, 24V DC/0.5A, ST, 35mm
		6ES7 522-1BL10-0AA0	DQ 32x24VDC/0.5A BA, 25mm * / **
6ES5 451-4UA14	32 DO, 24V DC/0.5A, FLOATING	6ES7 522-1BL00-0AB0	32 DQ, 24V DC/0.5A, ST
6ES5 453-4UA12	16 DO, 24V DC/2A, FLOATING	6ES7 522-1BF00-0AB0	8 DQ, 24V DC/2A, HF
6ES5 454-4UA14	16 DO, 24V DC/2A, FLOATING	6ES7 522-1BF00-0AB0	8 DQ, 24V DC/2A, HF
6ES5 456-4UA12	16 DO, 115/240V AC/2A, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST, (Triac)
6ES5 456-4UB12	8 DO, 115/240V AC/2A, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST, (Triac)
6ES5 458-4UC11	16 RO, 250V AC/1.5A, FLOATING	6ES7 522-5FF00-0AB0	8 DQ, 230V AC/2A, ST, (Triac)
Digital input/output modules			
6ES5 482-4UA20	16/24 DI, 8/16DO, 24V DC; 0.5A, FLOATING	6ES7 523-1BL00-0AA0	16 DI, 24V DC/16 DQ, 24V DC/0.5A, BA

S5-135U/155U	Description	S7-1500	Description
Labeling strips/sheets for S5-135U/155U and S7-1500			
C79451-A3229-C113	Labeling strips for S5-135U/155U	6ES7 592-2AX00-0AA0	Labeling sheets for 35mm wide S7-1500 modules
		6ES7 592-1AX00-0AA0	Labeling sheets for 25mm wide S7-1500 modules

* Unlike the 35mm wide modules whose delivery has already started, the 25mm wide modules feature no parameters and diagnostics.

**I/O adapters for the SIMATIC S7-1500 product range are currently not available for the 25mm wide I/O modules.

7.1.4 S5-115U/H/F analog modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-6

S5-115U	Description	S7-1500	Description
Analog input modules			
6ES5 460-7LA13	8 AI, FLOATING., for S5-115U/H/F	6ES7 531-7KF00-0AB	AI 8xU/I/R/RTD/TC ST
6ES5 465-7LA13	16 AI, NON-FLOATING	6ES7 531-7KF00-0AB	AI 8xU/I/R/RTD/TC ST
Analog output modules			
6ES5 470-7LA13	8 AO, +- 10V, 0-20MA, FLOATING, S5-115U/F	6ES7 532-5HF00-0AB0	AQ 8xU/I HS (125µs)
6ES5 470-7LB13	8 AO, +- 10V, FLOATING	6ES7 532-5HF00-0AB0	AQ 8xU/I HS (125µs)
6ES5 470-7LC13	8 AO, +1V to +5V, +4mA to +20mA, FLOATING, for S5-115U/F	6ES7 532-5HF00-0AB0	AQ 8xU/I HS (125µs)

7.1.5 S5-135U/155U analog modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-7

S5-135U/155U	Description	S7-1500	Description
Analog input modules			
6ES5 460-4UA13	8 AI, FLOATING	6ES7 531-7KF00-0AB0	AI 8xU/I/R/RTD/TC ST
6ES5 465-4UA13	16 AI, NON-FLOATING	6ES7 531-7KF00-0AB0	AI 8xU/I/R/RTD/TC ST
Analog output modules			
6ES5 470-4UA13	8 AO, +/-10V/0-20mA, FLOATING	6ES7 532-5HF00-0AB0	AQ 8xU/I HS (125µs)
6ES5 470-4UB13	8 AO, +/-10V, FLOATING	6ES7 532-5HD00-0AB0	AQ 4xU/I ST
6ES5 470-4UC13	8 AO, +1 – 5V, +4- 20mA, FLOATING	6ES7 532-5HD00-0AB0	AQ 4xU/I ST

7.1.6 Communication modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-8

Article number	Description	S7-1500	Article number
Communication modules			
6ES5 523-3UA11	CP523 communications processor. For S5 PLCs of the U series PLC115U or higher. Can, in some cases, also be used in H / F systems.	Communication module for serial connection CM PtP RS232 BA does not support the printer function	6ES7 540-1AD00-0AA0
6ES5 524-3UA15	CP524 communications processor with RS422/RS485 module. Can be used in PLC 115U/H, 135U (not S proc.) and PLC 155U.	CM PtP RS422/485 communication module for serial connection	6ES7 540-1AB00-0AA0
		Note: Other physical interfaces are also available. See the technical specifications of the module.	
6ES5 525-3UA21	CP525 communications processor. Can be used in PLC 115U, 135U (not S proc.) and 155U.	Note: Successor products: CP544 (6ES5 544-3UA11) CP544B (6ES5 544-3UB11)	
6ES5 544-3UA11	CP544 communications processor. Point-to-point connection (serial data transmission). Can be used in PLC 15U/H, PLC 135U and PLC 155U/H.	CM PtP RS232 BA communication module	6ES7 540-1AD00-0AA0
		CM PtP RS422/485 BA communication module	6ES7 540-1AB00-0AA0
		CM PtP RS232 HF communication module	6ES7 541-1AD00-0AB0
		CM PtP RS422/485 HF communication module	6ES7 541-1AB00-0AB0
6ES5 544-3UB11	CP544B communications processor. Point-to-point connection (for the use of special drivers). Can be used in PLC 15U/H, AG 135U (not S proc.), PLC 155U/H.	CM PtP RS232 BA communication module	6ES7 540-1AD00-0AA0
		CM PtP RS422/485 BA communication module	6ES7 540-1AB00-0AA0
		CM PtP RS232 HF communication module	6ES7 541-1AD00-0AB0
		CM PtP RS422/485 HF communication module	6ES7 541-1AB00-0AB0
6ES5 530-7LA12	CP530/SINEC L1 communications processor. Can be used in PLC 115U.	SINEC L1 cannot be migrated directly. Communication with S7-1500 cannot be established with SINEC L1 components. Complete migration to PROFINET is recommended.	
6ES5 535-3MA12	CP535, SINEC H1 communications processor. Can be used in PLC 15U and PLC 135U. Successor type: CP143 A1 module (6GK1143-0AB01). For information, see article number 6GK1143-0AB01.		

Article number	Description	S7-1500	Article number
6GK1143-0AB01	SINEC CP143 A1 with 15V module.	CP1543-1 communications processor for connecting the SIMATIC S7-1500 system to Industrial Ethernet networks	6GK7 543-1AX00-0XE0

7.1.7 Special modules

Note The content of this table is for reference only!

Please note the general information in this chapter:
"Comparison of SIMATIC S5 and S7 components"

Table 7-9

Article number	Description	S7-1500	Description
Intelligent I/O modules			
6ES5 240-1AA11	IP240, counter module consider the mode	6ES7 550-1AA00-0AB0	TM Count 2x24V consider the mode
6ES5 240-1AA11	IP240, counter module consider the mode	6ES7 550-1AA00-0AB0	TM Count 2x24V consider the mode
6ES5 240-1AA21	IP240, counter module consider the mode	6ES7 550-1AA00-0AB0	TM Count 2x24V consider the mode
6ES5 242-1AA13	IP242, counter module	6ES7 550-1AA00-0AB0	TM Count 2x24V
6ES5 242-1AA32	IP242A, counter module	6ES7 550-1AA00-0AB0	TM Count 2x24V
6ES5 242-1AA41	IP242B, counter module	6ES7 550-1AA00-0AB0	TM Count 2x24V
6ES5 241-1AA12	IP 241, digital position decoder, basic module	Currently no statement can be made	
6ES5 243-1AA11	IP 243, fully configured analog module	Currently no statement can be made	
6ES5 244-244-3AB31	IP 244, temperature control module	Currently no statement can be made	
6ES5 245-1AB12	IP 245, valve control, servo	Currently no statement can be made	
6ES5 246-4UA21	IP 246 (forced ventilated)	Currently no statement can be made	
6ES5 247- 4UA41	IP 247, positioning module for step motors	Currently no statement can be made	
6ES5 252-3AA13	IP 252, closed-loop control module	Currently no statement can be made	
6ES5 308-3UA12	IM308, interface module for distributed connection	Currently no statement can be made	
6ES5 318-3UA11	IM318, CC interface module for distributed connection	Currently no statement can be made	

8 History

Table 8-1

Version	Date	Modifications
V1.0	04/2015	First version