SIEMENS

Background and System Description • 05/2017

Guide for Migrating SIMATIC S7-300/S7-400 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/109478811

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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, regarding the new generation, who have so far been using SIMATIC S7-300/S7-400 automation systems and are planning to change to the new SIMATIC controller generation S7-1500.

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 S7-300/S7-400 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.

Note This document is not valid for SIMATIC S7-400 in connection with PCS 7.

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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 accordingly.

It is always necessary to think through 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 to 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 communication networks

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- **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 project software
- Components that cannot be (directly) replaced
  - 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

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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

Table 2-1

Type	Cause	Advantages	Disadvantages
Partial migration	- Replacement of devices due to end of product lifecycle - Increased productivity with new devices	Protection of investment, low expense	Where appropriate two systems
System expansion	Extension of an existing plant	Protection of investment	Two systems
Complete migration	Replacement of hardware, software migration	Innovative products, advantages of the new systems are fully used	Great effort

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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	Description
1	Plant audit	**Identifying the status quo of the plant/machine** All control and plant components are identified and documented.
2	Analysis	**Analyzing the installed basis** All components, incl. third-party systems, communication types and their dependencies in the system are analyzed. Definition of contributory trades.
3	Strategy	**Preparing options for action** All options are considered, followed by the identification of potential obstacles.
4	Review	**Specifying solutions, products, standards** Decision on the solutions, products and standards to be used.
5	Specification	**Checking specifications** Precise 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	**Realization of 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

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2.4 Advantages of modernization

The S7-1500 system supplements the previous S7-300/S7-400 systems. Over the next few years, the systems S7-300, S7-400 and S7-1500 will be marketed in parallel. A phasing out of S7-300/S7-400 is not planned before the end of 2020. After this time the components of both systems will still be available for another 10 years as spare parts.

Note More information can be found in the delivery release of the S7-1500 controllers:

https://support.industry.siemens.com/cs/ww/en/view/67856446

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, for example, due to integrated system diagnostics and thus related higher plant availability
- Increased utilization of machines
- Compliance with new regulations, for example: Security, protection against modern dangers
- 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

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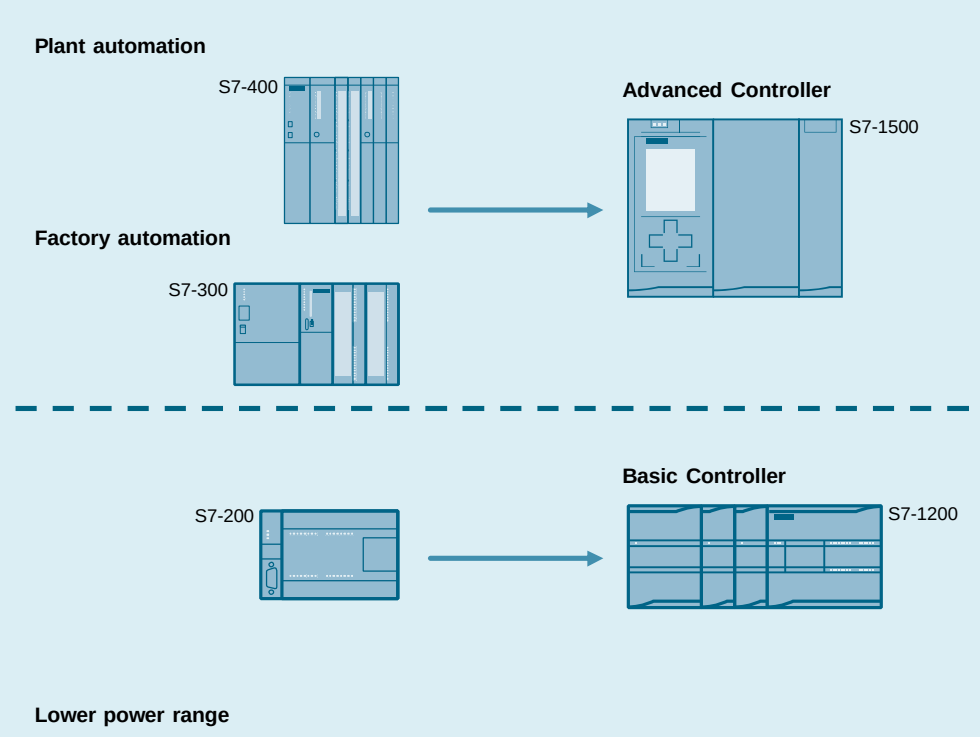
3 SIMATIC S7-300/S7-400 and SIMATIC S7-1500 System Architecture

3.1 SIMATIC S7-300/S7-400

Figure 3-1 SIMATIC S7-300/S7-400 and S7-1500 automation systems



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3.1.1 Information on the SIMATIC S7-300 automation system

The SIMATIC S7-300 automation system is a programmable controller for factory automation/engineering in the OEM sector. The S7-300 system has a modular design and consists of the following components:

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

These SIMATIC S7 components are mounted to an aluminum rack. This rack is used to mechanically fasten all modules. In order to enable communication with the following modules, bus connectors are used on the back.

Expansion options

If necessary, the connection capacity of the central rack can be increased by expansion devices (IM 360 S, IM 361 R, 365 S-R). Appropriate interface modules connect the central controller to the expansion racks.

Memory concept

The S7-300 is programmed using the STEP 7 programming software from Siemens. The control program can be transferred to the central processing unit (CPU) via a programmer.

The user program is saved in the load memory of the CPU. Since the CPU does not have an internal load memory, a memory card (MMC) is used for this purpose. Since the program cannot be stored in a volatile manner on the MMC, work can be carried out without a buffer battery. The Micro Memory Card is mandatory for operating the CPU. The size of the internal program memory differs depending on the CPU type.

Note The first generation of S7-300 CPUs still worked with a memory card. Here it was necessary to provide a buffer battery for the CPU to still preserve the program in the event of a power failure.

Note Information on the S7-300 automation system can be found in the device manual:
https://support.industry.siemens.com/cs/ww/en/view/8859629

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3.1.2 Information on the SIMATIC S7-400 automation system

Note This document is not valid for SIMATIC S7-400 in connection with PCS 7.

The SIMATIC S7-400 automation system is a programmable controller for factory automation. Redundancy concepts for increased plant availability are often pursued in the field of process automation. This is where CPUs S7-400H and lately S7-410H are used. This special new controller type will still be developed further in future.

Its modular design allows you to variably equip a central controller with modules and adapt it to the respective automation task.

The possible configuration of the S7-400 includes the following different module types:

- Power supply modules
- Central processing units
- Input and output modules
- Interface modules
- Communications processors
- Function modules

These SIMATIC S7 components are mounted to a rack. It also serves for the mechanical fastening all modules and includes the bus board that provides electrical and logical connection for the modules.

Expansion options

If necessary, the connection capacity of the central rack can be increased by expansion devices (IM 460 S, IM 461 R). Appropriate interface modules connect the central controller to the expansion racks.

Memory concept

The S7-400 is programmed with STEP 7. The user program can be transferred to the central processing unit (CPU) via a programmer and is stored in the load memory of the CPU. The integrated work memory is used for processing. The memory capacity depends on the CPU type used. Memory cards (RAM type) can be used to expand the load memory. In this case the data is only saved volatile, i.e. if no buffer battery is used in the power supply, the data gets lost after switching off. As soon as the memory card (RAM type) is unplugged from the CPU, the data is also lost. However, if a memory card (flash type) is used, data can be (the entire user program or service data) saved non-volatile.

Note Information on the S7-400 automation device is described in the manual of the SIMATIC S7-400.
https://support.industry.siemens.com/cs/ww/en/view/44444467

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3.2 SIMATIC S7-1500

3.2.1 CPU

Compared to the SIMATIC S7-300/S7-400 programmable controllers, the available CPU types of the new S7-1500 controller generation 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)

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

Fields 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.

Configuration und function

The S7-1500 automation system is mounted onto a DIN rail and can consist of up to 32 modules centrally. The modules are connected via multi-pin and shielded U connectors.

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.

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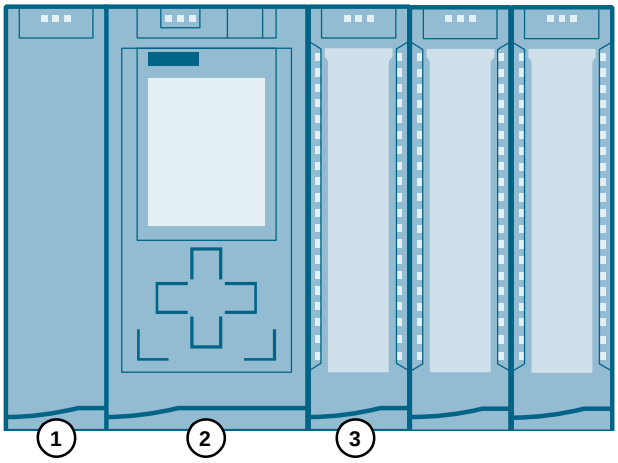
The CPU executes the user program and the integrated system power supply supplies the electronics of the modules used via the backplane bus.

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. System power supply module, e.g., PM1507
2. CPU S7-1500, e.g., CPU 1516
3. I/O modules, function modules, communication module

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 writing on/reading from the SIMATIC memory card, a standard SD card reader installed in the SIMATIC field PG and most PCs is sufficient.
The SIMATIC Memory Card is mandatory for operating the CPU.

Note The SIMATIC S7-1500 system manual provides information on the S7-1500 automation system.

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

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4 Hardware Migration

4.1 General information on migrating the hardware

4.1.1 Reasons for a migration

- Modernization
- Protection of investment
- Change to current engineering (more efficient working, increased flexibility)
- Basis for future modifications
- Shorter product introduction times
- Reduced operational costs

4.1.2 Support, tools

Siemens and its certified partners facilitate migration by providing:

- Check tool
  - Readiness Check Tool (https://support.industry.siemens.com/cs/ww/en/view/60162195)
- Conversion tools
  - Already integrated in STEP 7 (TIA Portal)
  - Migration Tool (enables migration without installed TIA Portal)
- Guides for step-by-step implementation, including the associated technical documentation
- Training for migrating from SIMATIC S7-300/S7-400 to S7-1500
  - from STEP 7 V5.x to STEP 7 TIA Portal
  - Guide for replacing the recommended hardware
- Documents on the internet (www.siemens.en/tia-migration) and in the Service Portal (https://support.industry.siemens.com)

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4.1.3 Types of hardware migration – fallback strategies

For a hardware migration the implementation strategy has to be selected first. Resources, time and financial aspects as well as risks have to be evaluated very carefully.

Table 4-1

Type	Description	Advantages	Disadvantages
Hot Migration	• Parallel installation of the old and new system • Sensors provide signals for both systems • Actuators are controlled by the legacy system • Outputs of the new system are compared with those of the legacy system • The controller remains in the legacy system until the new system has been tested	• Minimized risk • Shortest downtime	• Highest costs
Warm migration	• Parallel installation of the old and new system • Sensors provide signals for both systems • During downtimes sensors and actuator signals are applied to the new system • Dismantling the old system is carried out after successful restart	• Average costs • Average risk • Average downtime	
Cold migration	• Dismantling the old system is carried out during standstill • Installation of the new system • Restart of the new system	• Minimized costs	• Highest risk • Longest downtime

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4.2 Selecting the CPU

Like SIMATIC S7-300/S7-400, SIMATIC S7-1500 provides a selection of CPUs with different performance levels.

For reference, the appendix provides an overview table that compares the S7-300/S7-400 CPUs 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:

- Are there still reserves in the S7-300/S7-400 CPU 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

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4.3 Centralized and distributed I/O

4.3.1 Centralized I/O

The basic design of the centralized I/O of the SIMATIC S7-300/S7-400 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.

4.3.2 Expansion racks in S7-300/S7-400

In SIMATIC S7-300/S7-400 the centralized I/O can be expanded by other I/O modules with the help of expansion units (module racks 1-3). The expansion racks are connected to the central unit (module rack 0) by means of the respective interface modules IM 36x or IM 46x.

Table 4-2

Central unit interface	Expansion unit interface	Maximum number of expansion units
IM 360 S	IM 361 R	3
IM 365 S-R	IM 365 S-R	1

Table 4-3

Central unit interface	Expansion unit interface	Maximum number of expansion units	Power supply
IM 460-0 S	IM 461-0	4	Feed in EU
IM 460-1 S	IM 461-1	4	Feed in EU
IM 460-3 S	IM 461-3	1	Transferred during connection
IM 460-4 S	IM 461-4	4	Feed in EU

For S7 1500, these particular interface modules are not necessary, since up to 32 modules can be plugged side by side in the central configuration.

In comparison, the following 2 maximum configurations are listed:

Table 4-4

Smallest maximum configuration	Largest maximum configuration
PS+CPU1511/1513+modules with 25mm 870mm	PS+CPU1517/1518+modules with 35mm 1370mm

If the control cabinet does not provide the necessary width for a central configuration, there is also the option of connecting a distributed station in the control cabinet via PROFINET.

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Note Further information on the S7-400 automation system is available in the manual S7-400, M7-400 Automation System Module Data.
https://support.industry.siemens.com/cs/ww/en/view/1117740

4.3.3 Distributed I/O

For S7-300/S7-400 as well as S7-1500, distributed I/Os can be connected via PROFIBUS or PROFINET, for example, ET200SP, ET200MP, ET200AL, ET200pro, ET200eco or ET200iSP. How and which I/O is used depends on some factors (e.g., quantity framework/number of inputs and outputs, environmental conditions). This is how the I/O may be maintained during migration.

Table 4-5 Interface modules for ET 200 I/Os

ET 200 Type	Interface module PB	Interface module PN	Integrated in TIA Portal
ET 200SP	Yes	yes	yes
ET 200MP	Yes	yes	yes
ET 200S	Yes	yes	yes
ET 200M	Yes	yes	yes
ET 200pro	Yes	yes	yes
ET 200iSP	Yes	no	yes
ET 200eco	Yes	yes	yes
ET 200AL	Yes	yes	yes
ET 200R	Yes	no	yes
ET 200L	Yes	no	yes

Table 4-6 Properties of ET 200 I/Os

ET 200 Type	Properties
ET 200SP	Control cabinet, IP20, compact size, fine modular
ET 200MP	Control cabinet, IP20, multi-channel
ET 200S	Control cabinet, IP20, small size, fine modular
ET 200M	Control cabinet, IP20, modular, for hazardous zone 2/21
ET 200pro	Without control cabinet, IP6x, M12 connection, modular
ET 200iSP	Hazardous area zone 1, 2, 21, 22
ET 200eco	Without control cabinet, IP6x, M12, block I/O
ET 200AL	Without control cabinet, IP6x, M8 M12 connection, flexible mounting through front or cross-type screwing, typical for handling and mounting applications
ET 200R	Digital input/output module for robots
ET 200L	IP20, block I/O

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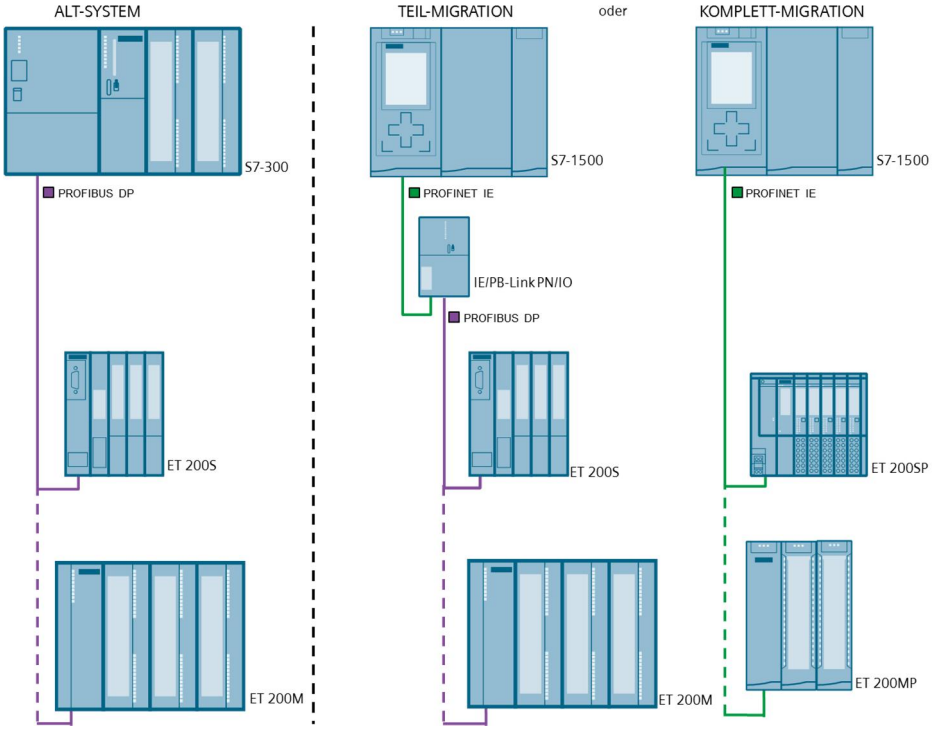
Complete migration of plants with ET 200 stations

It is possible to fully retain the I/O during migration (provided it is compatible with the CPU).

If the existing system is based on PROFIBUS, the interface connections could be exchanged for all stations to change to PROFINET. Alternatively, an S7-1500 with PROFIBUS can be employed, or a gateway (IE/PB link) which forwards signals centrally from PROFIBUS to PROFINET.

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 200 MP, ET 200AL, etc.

Figure 4-1 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.

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4.4 Communication and networks

In SIMATIC S7-300/S7-400 there are a number of options for communication. These were expanded even further with S7-1500. The innovations comprise the following areas:

- System-internal communication
- Communication with external partners (numerous communications protocols)

Below, some technical details between S7-300 and S7-1500 are compared with each other.

The multitude of communication depends on the type of CPU and/or of the communication processor/communication module used.

4.4.1 Modules in the central rack

The backplane bus was changed for the S7-1500. More modules can now be plugged in the central rack. There are no other expansion racks in the system of the S7-1500.

Table 4-7 Number of modules per module rack/in the central rack

	S7-300	S7-1500
Number of modules in the central rack	8	32
Number of racks	4	1
Number of modules per racks	8	32

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4.4.2 Available interfaces

The communication modules are an innovation in the system of the S7-1500 that provide the option to connect the internal interfaces of the CPU as well as the communication processors to the I/O.

Table 4-8: Overview of available interfaces

Interface	S7-300	S7-1500
Internal interface of the CPU	available	available
CP *) (Communication processor)	available	available
CM *) (Communication module)	Differentiation between CM and CP not available for S7-300	available

*)
CM->Expansion of integrated PROFINET interface

CM->Expansion of integrated ETHERNET interface with further functionality

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4.4.3 Available components

Table 4-9 Available devices

Device	S7-300	S7-1500
PROFINET/ Ethernet	CP 343-1	CM 1542-1 CP 1543-1
PROFIBUS	CP 342-5 CP 343-5	CM 1542-5 CP 1542-5
PtP	CP 340 CP 340 CP 341 CP 341	CM PtP RS422/RS485 BA CM PtP RS232 BA CM PtP RS422/RS485 HF CM PtP RS232 HF

4.4.4 Number of internal interfaces

Similar to the S7-300, the number of interfaces for the S7-1500 depends on the type of CPU.

Table 4-10 Overview of number of interfaces S7-1500

CPU	Number Interfaces	Type	Number Ports
1510SP(F)	1	1 x Profinet (3 x with BUS adapter)	3 1st interface-> 1 + bus adapter -> 2
1512SP(F)	1	1 x Profinet (3 x with BUS adapter)	3 1st interface -> 1 + bus adapter -> 2
1511(F/T/C) 1512C 1513(F)	1	1 x Profinet	1st interface -> 2
1515(F/T)	2	2 x Profinet	1st interface -> 2 2nd interface -> 1
1516(F)	3	2 x Profinet, 1 x Profibus	1st interface -> 2 2nd interface -> 1 3rd interface -> 1xPB
1517(F/T/TF)	3	2 x Profinet, 1 x Profibus	1st interface -> 2 2nd interface -> 1 3rd interface -> 1xPB
1518(F)	4	3 x Profinet, 1 x Profibus	1st interface -> 2 2nd interface -> 1 3rd interface -> 1 4th interface -> 1xPB

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4.4.5 Functions of the PROFINET/Ethernet interfaces

Some CPUs (depending on type) of the S7-1500 were provided with more than one interface, this makes it possible to distribute several functions in the CPU to the different interfaces.

Table 4-11 Excerpt of the functions available of the PROFINET/Ethernet interfaces

Function	S7-300 with PN interface	S7-1500 1st interface	S7-1500 2nd interface (if available)	S7-1500 3rd interface (if available)
Controller	yes	yes	yes, (as of FW V2.0)	no
IO device	yes	yes	yes, (as of FW V2.0)	no
Shared IO device	yes	yes	yes, (as of FW V2.0)	no
Isochronous mode	yes	yes	no	no
Web server	yes	yes	yes	yes
SIMATIC communication	yes	yes	yes	yes
S7 Routing	yes	yes	yes	no
IRT	yes	yes	no	no
MRP manager	yes	yes	no	no
MRP client	yes	yes	no	no
Open IE communication	yes	yes	yes	yes
OPC UA	no	yes	yes	yes

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4.4.6 Functions of the PROBUS interface

Table 4-12 Available functions of the PROFIBUS interface

Function	S7-300 (for CPUs with internal DP interface)	S7-1500
DP master	yes	yes
DP slave	yes	no (only via CM/CP)
SIMATIC communication	yes	yes
S7 Routing	yes	yes
Data record routing	yes	yes
Isochronous mode	yes	yes
Constant bus cycle time	yes	yes
Data transmission rate	up to 12 Mbit/s	up to 12 Mbit/s
MPI	yes	no

4.4.7 Interfaces for point-to-point connections

Table 4-13 Communication modules for point-to-point connections

Interface	S7-300/S7-400	S7-1500
RS 232	CP 340, CP 341, CP 441	CM PtP RS 232 BA/HF
RS 422	CP 340/341, CP 440/441	CM PtP RS 422/485 BA/HF
RS 485	CP340/341, CP 440/441	CM PtP RS 422/485 BA/HF
TTY	CP 340/341, CP 441	---

4.4.8 Number of connections

The quantity framework of the S7-1500 was expanded in comparison to S7-300. It is now possible to establish several connections via the internal interfaces of the CPU.

Table 4-14 Number of connections

Device	Number of connection internal interfaces (total)
S7-300 (selection)	
315-2PN/DP	16
317-2PN/DP	16
319-3PN/DP	32
S7-400 (selection)	
412-2PN	48
414-3PN/DP	64
416-3PN/DP	96
S7-1500	
1511(C/F/T)	64
1512C	88
1513(F)	88
1515(F/T)	108
1516(F)	128
1517(F/T)	160
1518(F)	192

The “CPU-CPU Communication” compendium gives you an overview.
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.

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4.5 Operator control and monitoring

Various devices for visualization tasks are available in different versions. However, the panels formerly used in combination with S7-300/S7-400 are discontinued. It is therefore recommended to migrate Operator Panels (OP), Touch Panels (TP), Multi or Mobile Panels (MP) to Basic Panels or Comfort Panels.

4.5.1 HMI hardware

When replacing the hardware, please note the requirements for the visualization unit:

- Display size/orientation (format change from 4:3 to 16:9, 4“, 7“, 9“, 12“, 15“, 19“, 22“ and horizontal/vertical)
- Installation dimensions/cut
- Housing material (possibly special environmental conditions)
- Type/number of interfaces (MPI, PROFIBUS, PROFINET, USB)
- Data storage/storage options/memory size

Note A detailed guideline for migrating older panels to Comfort Panels is available at: https://support.industry.siemens.com/cs/ww/en/view/49752044

4.5.2 HMI software

Migrating the project which is part of the panel is possible. To do this, the project has to be available for WinCC flexible 2008 SP2/SP3, otherwise migration is not possible. If an older version of the project is available, you must first upgrade it to reach this version. It is also possible to migrate a ProTool project in WinCC TIA Portal. To do this, an intermediate step is required. The ProTool project has to be migrated to WinCC flexible 2008 first. Then an upgrade to WinCC (TIA Portal) can be performed.

Note Further information on the topic of migrating WinCC flexible to WinCC (TIA Portal) is available in the respective guideline:

https://support.industry.siemens.com/cs/en/en/view/77430539

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4.6 Technological function

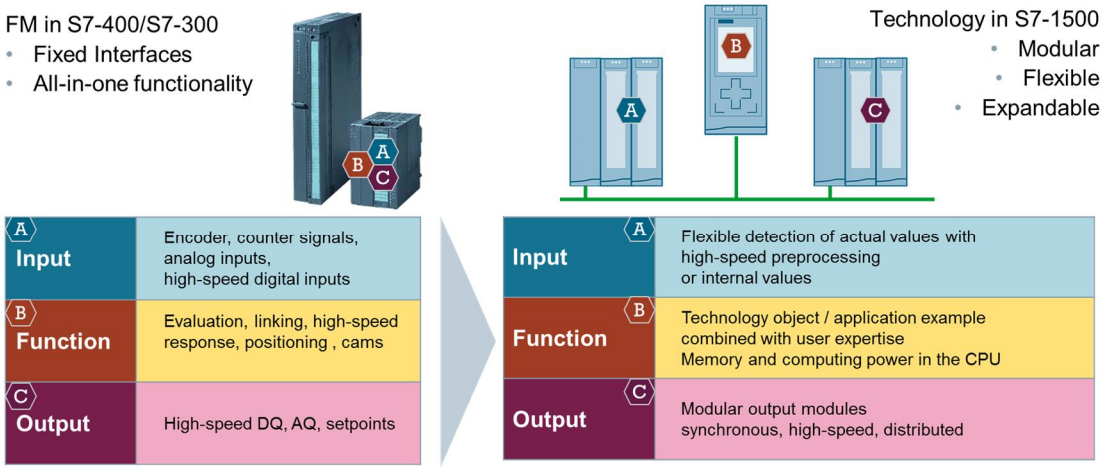
Note

When migrating the technological functions of S7-300/S7-400 to S7-1500, in most cases it will not be possible to migrate the components one-to-one, instead a solution-based approach is used, i.e. hardware and software reproduce the function together.
In the overviews below one possible solution is shown.

4.6.1 Function modules

For the S7-300/S7-400 the acquisition and the processing of process data as well as the output of the results is summarized in one module. In comparison, for the S7-1500 the tasks/functions are distributed to several devices in order to enable a flexible approach. For example, for cam and positioning tasks the same module can be used or an acquired position value is used for different functions.

Figure 4-2



Note

This is why the parts for input data, technological functions and output data are listed separately in the following tables and a suitable solution is suggested, depending on the individual case. Optimizations regarding price, function or space are sometimes not possible, but due to the multitude of combination options, not all variants can be listed. In the comment column, it may be referred to features that go beyond the previous performance of FMs.

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Counter modules (FM 350-1/FM450-1)

Table 4-15

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Input (Counter signal)	Pulse encoder 24V	TM Count 2x24V	200kHz input frequency
	Incremental encoder 24V	TM Count 2x24V	200kHz input frequency
	Incremental encoder 5V	TM PosInput2	1MHz input frequency
Function	Internal 1 MHz reference	TM TimerDIDQ 16x24V	For measuring time
	Counting, measuring	TM Count 2x24V or TM PosInput2	
	Comparator	TM Count 2x24V or TM PosInput2	Fast responds to DQ
	Hardware gate	TM Count 2x24V or TM PosInput2	Fast responds to DI
	Time measurement	TM Timer DIDQ 16x24V	
Output	2DQ	TM Count 2x24V, TM PosInput2	

Note

TM Count 2x24V and TM PosInput2 have the same counter functionality. They only differ in the type of input signals. TM Count 2x24V is suitable for 24V counter signals and TM PosInput2 for the difference signals to RS422 or 5V level. Configuration and user interface are compatible.

The function of reading an SSI absolute value encoder is of no relevance for the replacement of FM x50.

Instead of the blocks FM_CNT_CTRL the High_Speed_Counter technology object is used.

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Counter module (FM350-2)

Table 4-16

	Function in S7-300	Solution in S7-1500	Comment
Input Counter signal	Pulse encoder 24V + direction	TM Count 2x24V	200kHz counter signal
	Pulse encoder 24V without direction	TM Count 2x24V, TM Timer DIDQ 16x24V	200kHz counter signal/ 50kHz counter signal
	Incremental encoder 24V	TM Count 2x24V, TM Timer DIDQ 16x24V	200kHz counter signal/ 50kHz counter signal
Function	Counting	TM Count 2x24V, TM Timer DIDQ 16x24V	
	Measuring	TM Count 2x24V	Counting and measuring at the same time
	Comparator	TM Count 2x24V	2 outputs
	Hardware gate	TM Count 2x24V	Gate start and gate stop separately
Output	DQ	TM Count 2x24V	2DQ per counter channel

Note TM Timer DIDQ 16x24V does not have the full function scope of the FM 350-2. In many cases a solution can be offered for the same price or less, and provide a higher update rate of the counter values. To do this, use the “count” mode in the configuration of 8DI/8DQ.

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Rapid traverse/crawl mode positioning (FM351 / FM451)

Table 4-17

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Input Position	Incremental encoder 24V	TM Count 2x24V	200kHz input frequency
	Incremental encoder 5V	TM PosInput2	1MHz input frequency
	Absolute SSI	TM PosInput2	Flexible encoder parameter (up to 40Bit)
Function	Rapid traverse/crawl mode	Example program (on request)	
	Loop traverse	User-specific amendments	
Output	4DQ	2DQ on TM Count TM PosInput +2DQ on DQ 16x24VDC for direction	

Note The rapid traverse/crawl method for positioning operations has lost considerable significance on the market. Check the whether a solution with the “PositioningAxis” technology object is more suitable for correct positioning.

Cam control unit (FM352/FM452)

Table 4-18

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Input Position	Incremental 24V	TM Count 2x24V	200kHz input frequency
	Incremental 5V	TM PosInput2	1MHz input frequency
	Absolute SSI	TM PosInput2	
		Internal position value of TO Axis	Saves costs and space
Function	Position-based cams, time-based cams	“TO cam“ “TO cam track”	Available as of TIA Portal V14
	Brake cams, counter cams	User-specific amendments	More flexibility
	Length measurement	TO MeasuringInput	Available as of TIA Portal V14
Output	DQ for cam outputs	TM Timer DIDQ 16x24V	Scalable for several outputs, Resolution 1µs

Note By using the TM Timer DIDQ 16x24V as output, more than 16 outputs can be operated on one axis. If the positioning value is already available as parameter of a technology object, new acquisition is not necessary, this saves space and costs.
The “TO Cam” is suitable for few cams on one output.
The “TO Cam track” is suitable for outputting several cams in succession on the same output.

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Positioning for stepper drives (FM353)

Table 4-19

	Function in S7-300	Solution in S7-1500	Comment
Input	DI for reference point	TM PTO4	
		CPU 151xC	
Function	Speed axes	TO Speed_Axis	
	Positioning	TO Positioning_Axis	
	Traversing programs	Technology Template “S7-1500 MotionList”	On request
	G code programming		Non-standard CPU
	BOOST: Controlling the motor current	User-specific amendments	
Output	DQ for pulse and direction	TM PTO4	
		CPU 151xC	24V signal level

Note Use the technology objects that output the setpoint via the TM PTO4 for controlling. The pulses output are used as position feedback.

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Positioning for servo drives (FM354)

Table 4-20

	Function in S7-300	Solution in S7-1500	Comment
Input	Incremental 5V	TM PosInput2	
	Absolute SSI	TM PosInput2	
		Measuring the actual value via PROFIdrive	Saves space and costs
Function	Speed axes	TO Speed_Axis	
	Positioning	TO Positioning_Axis	
	Traversing programs	Technology template “S7-1500 MotionList”	On request
	G code programming		Non-standard CPU
Output	AQ for speed setpoint	AQ 8xU/I HS	
		Setpoint output via PROFIdrive	Saves space and costs

Note The “PositioningAxis” technology object is suitable for positioning with servo drives. If you connect the servo drive directly via PROFINET, you can save the position acquisition via TM PosInput2 and also the setpoint output via an analog output. Through the modularization it is also possible to connect a 24V incremental encoder to a TM Count 2x24V and to read the position this way.

Positioning for stepper and servo drives (FM453)

Table 4-21

	Function in S7-400	Solution in S7-1500	Comment
Input	Incremental 5V	TM PosInput2	
	Absolute SSI	TM PosInput2	
		Measuring the actual value via PROFIdrive	
Function	Speed axes	TO Speed_Axis	
	Positioning	TO Positioning_Axis	
	Traversing programs	Technology template “S7-1500 MotionList”	On request
	G code programming		Non-standard CPU
Output	AQ for speed setpoint	AQ 8xU/I HS	
	DQ for pulse/direction	TM PTO4 or CPU 151xC	
		Setpoint output via PROFIdrive	Saves space and costs

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Easy positioning with SW (Easy Motion Control)

Table 4-22

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Input Position	Incremental 24V	TM Count 2x24V	
	Incremental 5V	TM PosInput2	
	Absolute SSI	TM PosInput2	
	PROFIdrive input driver	TO with PROFIdrive interface	Saves space and costs
Function	Speed axes	TO Speed_Axis	
	Positioning	TO Positioning_Axis	
	Easy gear synchronization	TO Synchronous_Axis	
Output	AQ for speed setpoint	AQ 4xU/I HS	Saves space and costs
	PROFIdrive output driver	TO with PROFIdrive interface	

Highly functional, programmable modules FM 352-5, FM 357-2, FM 458-1DP

Table 4-23

High-speed Boolean processor FM 352-5	4-axis interpolation FM 357-2	Configurable application module FM 458-1DP
Solution of the application based on:		
TM Count for incremental encoder	TM Count for incremental encoder	CPU 1518 for short cycle times
TM PosInput for SSI encoder	TM PosInput for SSI encoder	TM Count for incremental encoder
TM pulse for precise pulses or short response time	TO Positioning_Axis for single-axis positioning	TM PosInput for SSI encoder
TM timer for precise edges	CPU 151xT for complex motion tasks	TM timer for precise edges

Note

A migration of freely-programmable modules requires an analysis of the application.

The modules mentioned here are largely freely programmable and are used for very different tasks. This is why it is necessary to find a suitable solution for the respective application. Please contact Customer Support if you need help.

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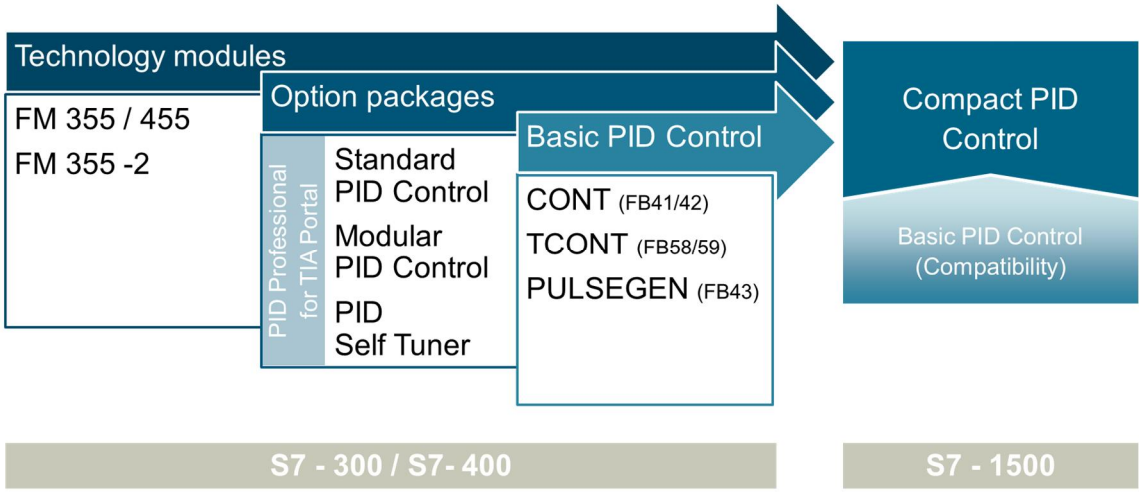
4.6.2 Control

Figure 4-3



The following 3 control types are integrated and available for the S7-1500 in the TIA Portal.

General description of the PID blocks

Table 4-24

Name	Function	Advantages
PID_Temp *)	Temperature control for active heating and cooling with control and two actuators	• Included in firmware • Self-tuning (automatic detection of control parameter) 2-stage: Pretuning and fine tuning on the operating point • Clear configuration screens • Commissioning screens with integrated graphic plotter
PID_3Step	Stepper controller for integrated actuators (e.g., servomotors).	
PID_Compact	Continuous PID control or pulse control (PMW)	

*) as of STEP7 V13 SP1, S7-1500 FW V1.7

Controller module (FM355C / 455C)

Table 4-25

	Function in S7-300/S7-400 (per channel)	Solution in S7-1500	Comment
Input	AI	AI 4xU/IRTD/TC	More types TC/TRD
	2DI	DI 16x24VDC	
Function	Continuous controller	TO PID Compact, TO PID_Temp	
	Fuzzy control (with selftuning)	---	
	Self-tuning via ES or PID self-tuner	2-stage self-tuning integrated in TO	Improved algorithm, no additional software

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	Function in S7-300/S7-400 (per channel)	Solution in S7-1500	Comment
			required; no wiring effort
	Dead band	TO PID_Temp	
	Split range	TO_PID_temp	Two parameter records
	Ramp/linearization	Blocks in preparation	
	Cascade control	TO PID_Temp	Application example (SIOS: 103526819)
	Other controller structures	User-specific expansion	
	Backup operation (CPU stop)	Separate CPU to increase availability	
Output	AQ	AQ 4xU/I ST	

Controller module (FM355S/455S)

Table 4-26

	Function in S7-300/S7-400 (per channel)	Solution in S7-1500	Comment
Input	AI	AI 4xU/I/RTD/TC	More types TC/RTD
	2DI	DI 16x24VDC	
Function	Pulse control (PWM)	TO PID_Compact, TO PID_Temp	
	Stepper controller (e.g., servomotor)	TO PID_3Step	
	Fuzzy control (with self-tuning)		
	Self-tuning via ES or PID self-tuner	2-stage self-tuning integrated in TO	Improved algorithm, no additional software required; no wiring effort
	Dead band	TO PID_Temp, TO PID_3Step	
	Split range	TO PID_Temp	Two parameter records
	Ramp/linearization	In preparation	
	Cascade control	TO PID_Temp	Application example (SIOS: 103526819)
	Other controller structures	User-specific expansion	
	Backup operation (CPU stop)	Separate CPU to increase availability	
Output	2DQ	DQ 8x24VDC	

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Temperature/controller module (FM355-2 C/S)

Table 4-27

	Function in S7-300	Solution in S7-1500	Comment
Input	As FM355 C/S		
Function	Heating controller	TO PID_Compact, TO PID_Temp/TO PID_3Step	Alternative: Basic PID_Controller: TCONT_CP/TCONT_S
	Cooling controller	TO PID_Compact/TO PID 3Step	
	Heating/cooling controller	TO PID_Temp	Two parameter records
	Self-tuning integrated	2-stage self-tuning integrated in TO	Improved algorithm
	Control zone	TO PID_Temp	
	Multi-zone control: Parallel optimization	TO PID_Compact, TO PID_Temp/TO PID_3Step	Synchronized optimization of several controller possible
Output	As FM355 C/S		

Additional blocks for controlling several heating or cooling zones for FM455 C/S

Table 4-28

	Function in S7-400	Solution in S7-1500	Comment
Function blocks	Heating/cooling controller	TO PID_Temp	Two parameter records
	Self-tuning	2-stage self-tuning integrated in TO	Improved algorithm
	Control zone	TO PID_Temp	
	Multi-zone control: Parallel optimization	TO PID_Compact/TO PID_Temp/TO PID_3Step	Synchronized optimization of several controller possible
	Controller-call scheduler	Distribution to different cyclic OBs	

Standard PID Control (PID_CP/PID_ES)

Table 4-29

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Function	Continuous controller, Pulse control (PID_ES)	TO PID_Compact/TO PID_Temp	
	Stepper controller (PID_ES)	TO PID_3Step	
	Self-tuning via ES or PID self-tuner	2-stage self-tuning integrated in TO	Improved algorithm
	Dead band	TO PID_Temp, TO PID3Step	
	Cascade control	TO PID_Temp	Application example (SIOS: 103526819)
	Timer, ramp-function generator smoothing, square root	Blocks in preparation	

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Modular PID Control

Table 4-30

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Function	Actual value preparation Error monitoring PID control Control value processing Pulse generator, split range	TO PID_Compact, TO PID_Temp, TP PID_3Step	
	Standardization, scaling, switching	User-specific expansion	STEP 7 Standard functions (scale, standard, …)
	Controller-call scheduler	Distribution to different cyclic OBs	
	Integrator, PT1, PT2 Limitation, limit monitors Polygone Change-over control Ramp-function generator, timer, setpoint generator	Blocks for simulation and command and actual value sensing in preparation	Application example with simulation (SIOS: 79047707)
	Self-tuning	2-stage self-tuning integrated in TO	

Basic (PID Control)

Table 4-31

	Function in S7-300/S7-400	Solution in S7-1500	Comment
Function	CONT_C (FB41)	TO CONT_C better: TO PID_Compact	Same interface, no self-tuning Self-tuning integrated
	CONT_C (FB41) +PULSEGEN (FB43)	TO CONT_C+PULSEGEN better: TO PID_Compact	Same interface, no self-tuning Self-tuning integrated
	CONST_S (FB42)	TO CONT_S better: TO PID_3Step	Same interface, no self-tuning Self-tuning integrated
	TCONT_CP (FB58)	TO TCONT_CP better TO PID_Temp	Same interface, Self-tuning integrated
	TCONT_S (FB59)	TO TCONT_S better TO PID_3Step	Same interface, no self-tuning Self-tuning integrated
	PID Selftuner TUN_EC/TUN_ES	Integrated in TO PID_Compact, TO PID_Temp, TO PID_3Step	Wiring no longer required since integrated in TO

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5 Software Conversion

5.1 General information on software conversion

In general, you can migrate ALL your STEP 7 V5.x programs to STEP 7 (TIA Portal)!

However, depending on the STEP 7 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

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5.1.1 Programming languages

STEP 7 V5.x

In SIMATIC STEP 7 V5.x, the following standard programming languages were available:

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

The following languages can additionally be used as option package:

- Structured Control Language (SCL)
- Continuous Function Chart (CFC)
- S7-GRAPH
- Hi-GRAPH

Note Please note that there can be a difference between a pure STEP 7 V5.x and a PCS7 installation since PCS7 already includes options.

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STEP 7 (TIA Portal)

In SIMATIC STEP 7 (TIA Portal), the following standard programming languages are available to you:

- Ladder diagram (LAD)
- Function block diagram (FBD)
- Statement list (STL) (not for S7-1200)
- Structured Control Language (SCL)
- S7-GRAPH (not for S7-1200)

Note S7-SCL is a 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 7 V5.x 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

5.1.2 Option packages and expansions

There are various expansions or option packages for STEP 7 V5.x, some of which are listed below.

The TIA Portal provides a broad basis for the engineering, since many expansions that had to be installed separately as options in STEP 7 V5.x are now available integrated.

Table 5-1

STEP 7 V5.x	TIA Portal
WinCC Flexible WinCC	WinCC in TIA Portal (various variants)
Distributed Safety	STEP 7 Safety
SINAMICS MICROMASTER STARTER	Startdrive
Teleservice	Integrated
Easy Motion Control	For S7-300/S7-400/WinAC available in the TIA Portal, for S7-1500 the functionality is illustrated via integrated TO (technology objects)
Modular PID Standard PID PID Selftuner	For S7-300/S7-400/WinAC available as PID professional, for S7-1500 the basic functionality can be illustrated via integrated TO (technology objects) integrated
S7 Technology	
Different SIRIUS engineering software	sometimes available, for example, SIMOCODE ES

Note If options or expansions are used in the installation packages of TIA Portal, they have to be same version as STEP 7.

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5.1.3 Variants of the TIA Portal

When installing the TIA Portal please note the following variants:

Table 5-2

STEP 7	Devices used
STEP 7 Basic	S7-1200
STEP 7 Professional	S7-300, S7-400, S7-1200, S7-1500, WinAC RTX, Open Controller

Table 5-3

WinCC	Devices used
WinCC Basic	Basic Panels
WinCC Comfort	Comfort Panels, Mobile Panels
WinCC Advanced	PC single station
WinCC Professional	SCADA

Table 5-4

STEP 7 Safety	Devices used
STEP 7 Safety Basic	S7-1200
STEP 7 Safety Advanced	S7-300, S7-400, S7-1500, WinAC RTX

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5.1.4 Prerequisites licensing

For the migration of the STEP 7 V5.x project (only the STEP 7 part) it is necessary that the software is installed and also licensed:

- STEP 7 V5.4 SP5 or higher + STEP 7 V13SP1 (possible as combo license)

If the project is also to be included in a WinCC flexible part, licenses are also necessary:

- WinCC flexible 2008 SP2 or higher + WinCC V13 SP1 (possible as combo license)

Each other option that is subject to license, which is part of the STEP 7 V5.x project, also has be licensed.

Note The TIA selection tool supports you with the migration of licenses and suggests the most economical variants:
http://www.siemens.en/tia-selection-tool

5.1.5 Programming environment

In order to be able to install TIA Portal STEP 7 V13SP1, you require the following operating system versions:

- Windows 7 Prof./Enterprise/Ultimate in 32/64Bit
- Windows 8 Professional/Enterprise
- Windows Server 2008 R2 Std SP1
- Windows Server 2012

In addition, it is possible to use TIA Portal in the following virtualization environments:

- VMware Player 6
- VMware Workstation 10
- VMware vSphere Hypervisor ESX(i) 5.5 (as of UPD2)
- Microsoft Windows Server 2012 R2 Hyper-V

Note Statements regarding compatibilities of the individual SIMATIC packages can be found at https://support.industry.siemens.com/cs/ww/en/view/64847781

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
  - Internal PG interface for S7 memory cards
    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. V13SP1, WinCC flex. 2008, WinCC Adv. V13SP1, Startdrive V13SP1

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.en/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
- Complex setup of a dual-boot partition
- Installation of the complete software packages (time and costs)

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Note An action package for field PGs is available that is specifically designed for migrations, which can be performed with the migration tool: The package does not include STEP 7 V5.x or WinCC flexible licenses. The article number is: 6ES7716-2CA10-0CD4

5.2 Migration of the project

5.2.1 Preparatory steps

Before the actual migration of the project can be carried out, some points have to be checked and, if required, changed.

Note A migration of the project is only possible as of STEP 7 V5.4 SP5. However, you can convert projects that have been created with an older version. To do this, open the project with STEP 7 V5.4 SP5 or higher and perform a consistency check of the blocks incl. compilation.

Table 5-5

Step	Instruction
1.	Check whether the required software packages have been installed and licensed for STEP 7 V5.x or TIA Portal. See chapter 5.1.2
2.	Check the project structure of your STEP 7 V5.x project. Multi-projects cannot be migrated as a whole. To do this, each individual project has to be used.
3.	Check whether the project includes WinCC flexible or WinCC stations. If only the STEP 7 part is to be migrated, you have to remove the other stations from the project.
4.	Check whether the components included in the STEP 7 V5.x project can be migrated. To do this, use the Readiness Check Tool. Note: Modules/stations that are connected via GSD file can be migrated in any case, since GSD files are automatically installed in the TIA Portal

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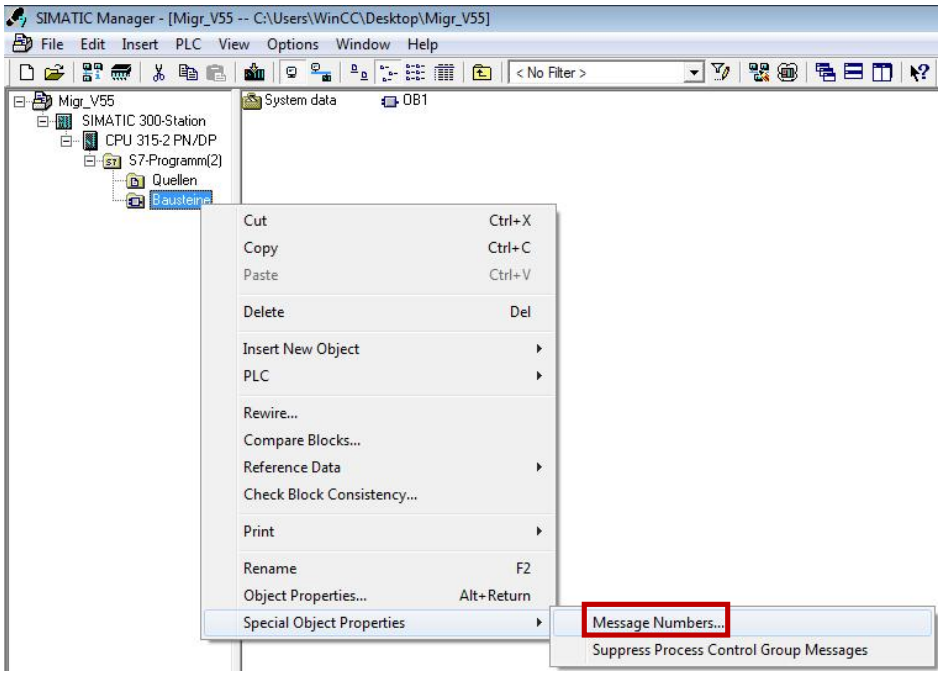
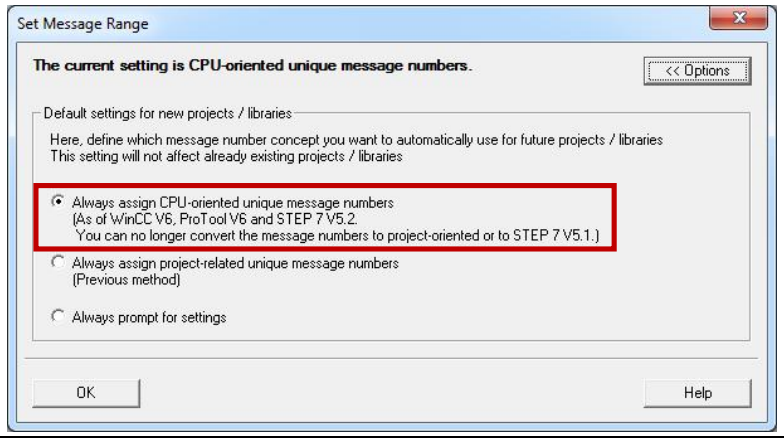
Step	Instruction
5.	Check which alarm numbering procedure is used in the project. If project-wide is set, the migration is cancelled.





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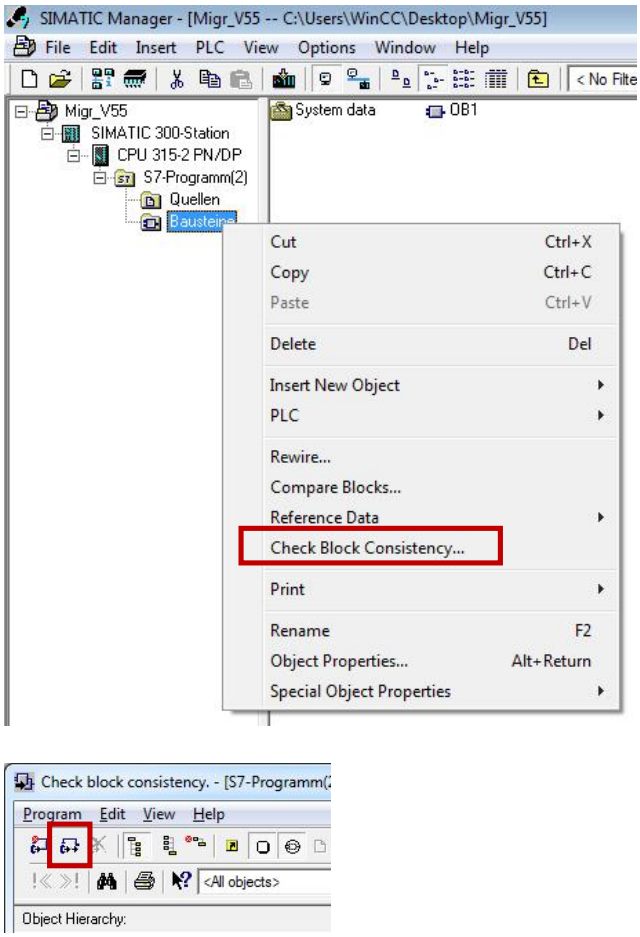
Step	Instruction
6.	Check whether the initial project is consistent. 

Note 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

Note The components in the TIA Portal are subject to the target date 01.10.2007. All products no longer released at this date, are not included.
In order to check the hardware in the STEP 7 V5.x project, the Readiness Check Tool can be used.
https://support.industry.siemens.com/cs/ww/en/view/60162195
If the Readiness Check Tool finds modules that cannot be migrated directly, in most cases there is still the option in STEP 7 V5.x to change to a successor module that is included in TIA Portal.
This behavior does not apply to devices that have been integrated via GSD file.

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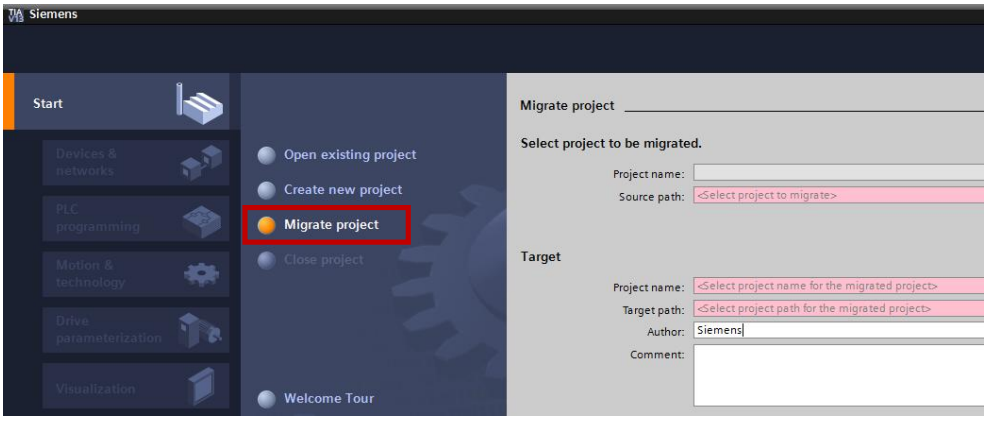
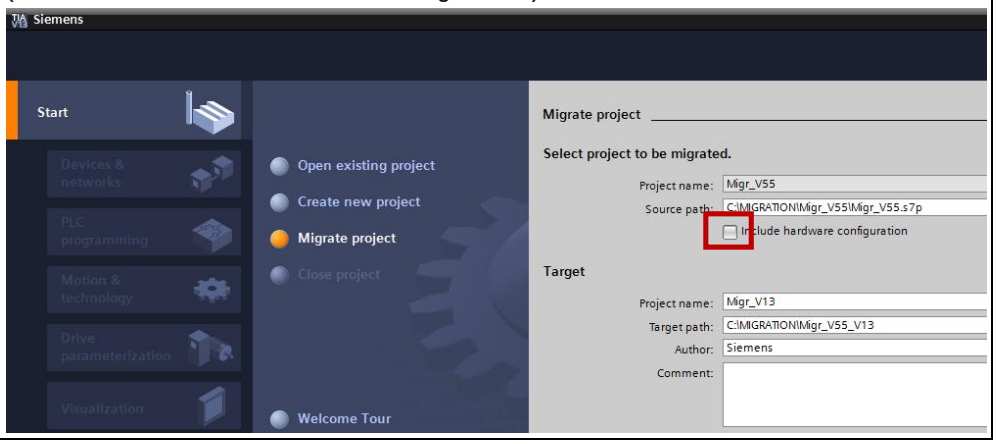
5.2.2 Migration from STEP 7 V5.X to STEP 7 (TIA Portal)

Option 1: Migration with TIA Portal

In order to migrate a project from STEP 7 V5.x to STEP 7 (TIA Portal) V13 SP1 (both software packages are located on a computer), perform the following steps:

Table 5-6

Step	Instruction
1.	Open the TIA Portal.
2.	Open the “Migrate project” menu item in the portal view. 
3.	Select the appropriate initial project. (Note the tick on “Include hardware configuration”) 

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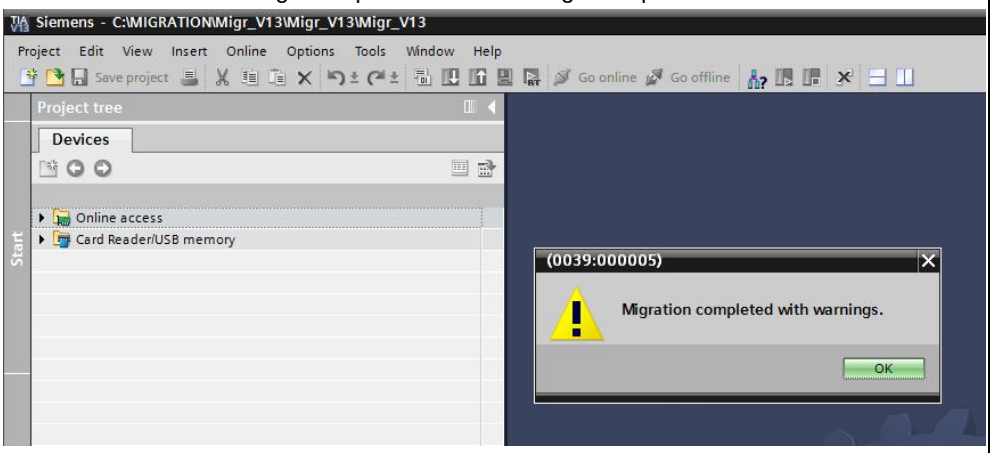
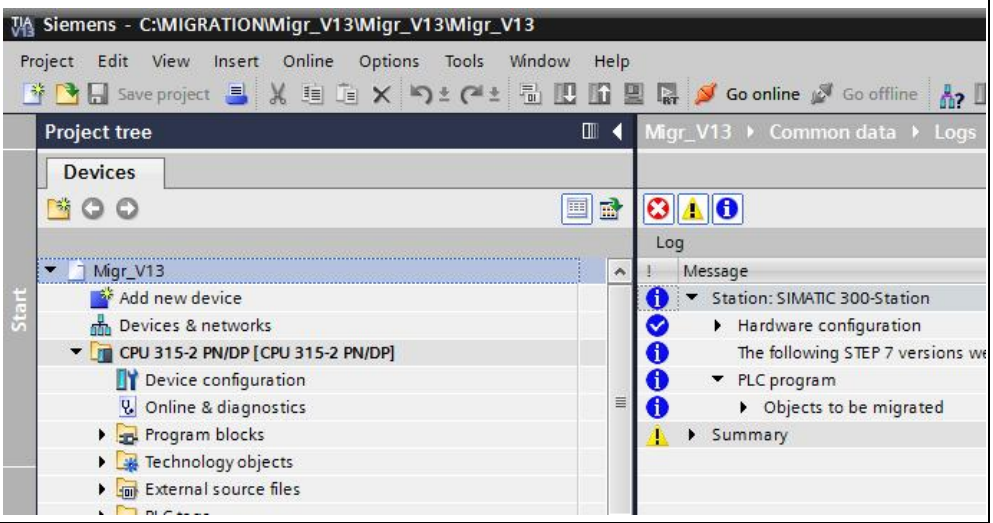
Step	Instruction
4.	Check the result of the migration process with the migration protocol.  
5.	If necessary, adapt the project.
6.	Compile the migrated project.
7.	If required, rectify the fault.
8.	If required, carry out further steps.

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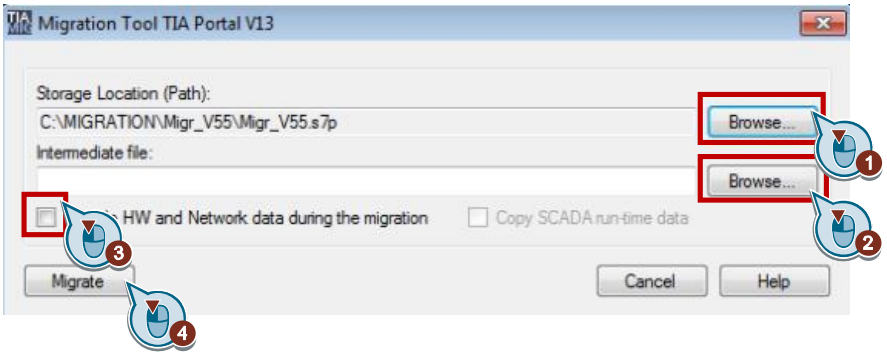
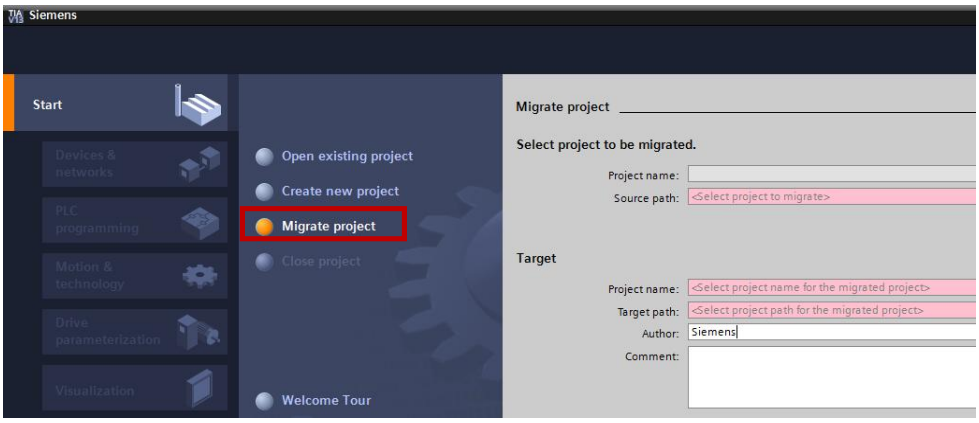
Option 2: Migration with the migration tool

If STEP 7 V5.x and STEP 7 (TIA Portal) are installed on 2 different systems there is also an alternative way to still carry out the migration. To do this, proceed as follows:

Note The migration tool can be found on any installation DVD of STEP 7 (TIA Portal) or in the following entry (for the current version of the TIA Portal): https://support.industry.siemens.com/cs/ww/en/view/58638200

Table 5-7

Step	Instruction
1.	Open the Migration Tool TIA V13.
2.	Select the source project in “Storage Location” with “Browse”. Enter the target path in “Intermediate file” via “Browse”  Tick “Include HW and Network data during the migration” if you not only want to migrate the software but also the hardware.
3.	Click “Migrate” to start migration. Once completed “intermediate.am13” is created in the selected target directory.
4.	Copy the file to the target system on which the TIA Portal is installed.
5.	Open the TIA Portal.
6.	Open the “Migrate project” menu item in the portal view. 

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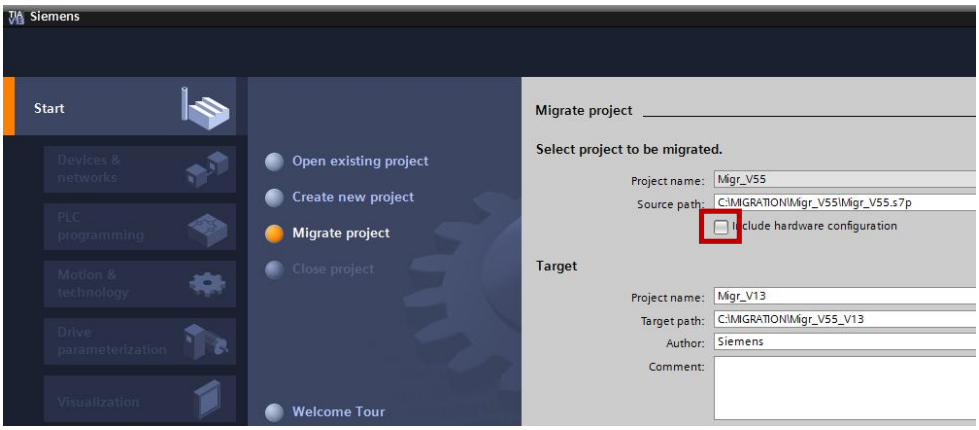
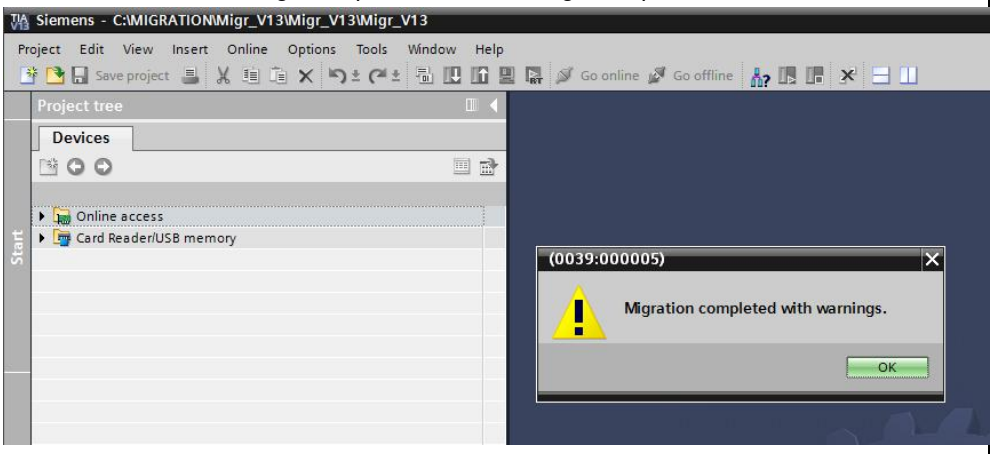
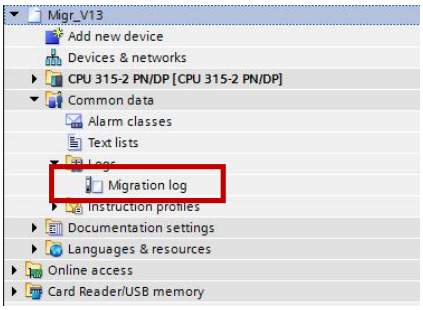
Step	Instruction
7.	Select the appropriate initial project. (Note the tick on “Include hardware configuration”) 
8.	Check the result of the migration process with the migration protocol.  
9.	If necessary, adapt the project.
10.	Compile the migrated project.
11.	If required, rectify the fault.

5.2.3 Migrating projects with safety program

Without compilation

When you are converting a project that contains a failsafe CPU, you can carry out the migration just as for a standard program. You will get a complete STEP 7

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Safety project where the program structure of Distributed Safety and the overall signature has been preserved.

Note The acceptance printout created with S7 Distributed Safety V5.4 SP5 remains valid!

With compilation

Only when the migrated project is recompiled with STEP 7 Safety Advanced V13 will it receive the new program structures and a new overall signature.

Note The safety program is only compiled when the password for the F program is entered! Without entering a password, only the standard user program is compiled!

Checking or reworking required

When you want to migrate a project that includes a safety program that has been created with Distributed Safety, the following points should be checked or observed.

During the 1st step of the migration of the STEP 7 V5.x project to the TIA Portal there will be no messages yet. Only when the CPU is migrated to S7-1500 the process is aborted with the respective error message(s) if there are certain instructions.

Table 5-8

Problem	Remedy/note
At present no runtime group communication is supported by STEP 7 Safety	Restructure the F runtime groups already in the STEP 7 V5.x project
For the migration onto S7-1500 the name of the I/O DB is changed	STEP 7 Safety changes the name as well as the number of the I/O DB. Adapt the places of use manually in the program
Replacement of F_GLOBDB.VKE0/1 by FALSE/TRUE for S7-1500	Adapt the places of use manually in the program
Replacement of QBAD_I_xx or QBAD_O_xx by the value status	This change is valid for the I/Os ET 200SP/ET 200MP and others that support the “RIOforFA-Safety” profile. Adapt the places of use manually in the program

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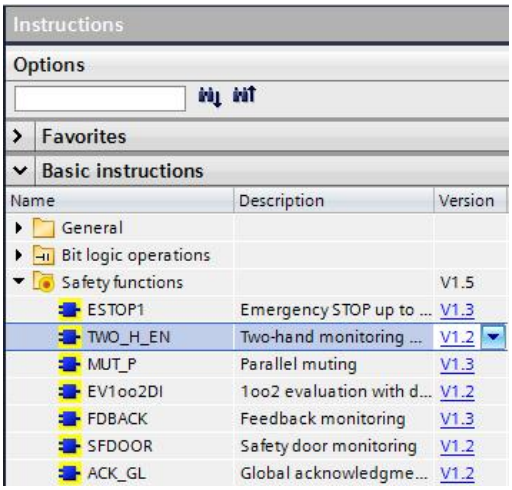
Problem	Remedy/note
The following instructions are not supported by S7-1500: – OV – MUTING – TWO_HAND – WR_FDB – RD_FDB – OPN – SENDS7 – RCVS7	Delete the instructions in the STEP 7 V5.x project and add them again in the TIA Portal project. To do this, drag the blocks from the “Instructions” > “Basic instructions”.  Note the block version when inserting them.

Note More information on STEP 7 Safety can be found in the manual: https://support.industry.siemens.com/cs/en/en/view/54110126

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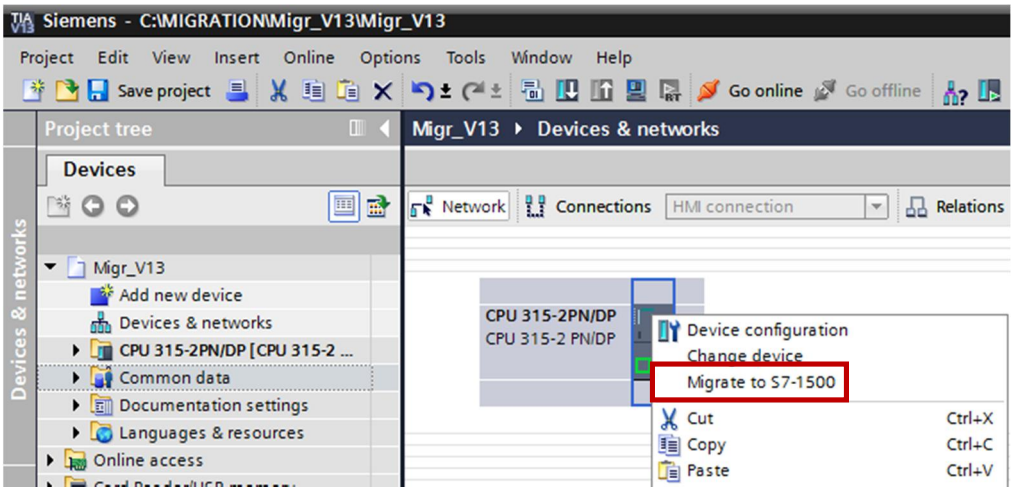
5.2.4 Further steps - migrating the CPU S7-300/S7-400 to S7-1500

Once the project is available in the TIA Portal, other adaptations have to be carried out as well. The CPU is not automatically changed to the S7-1500 during the migration process.

Table 5-9

Step	Instruction
1.	Migrate the S7-300/S7-400 to a S7-1500 by selecting the “Migrate to S7-1500” menu item. 

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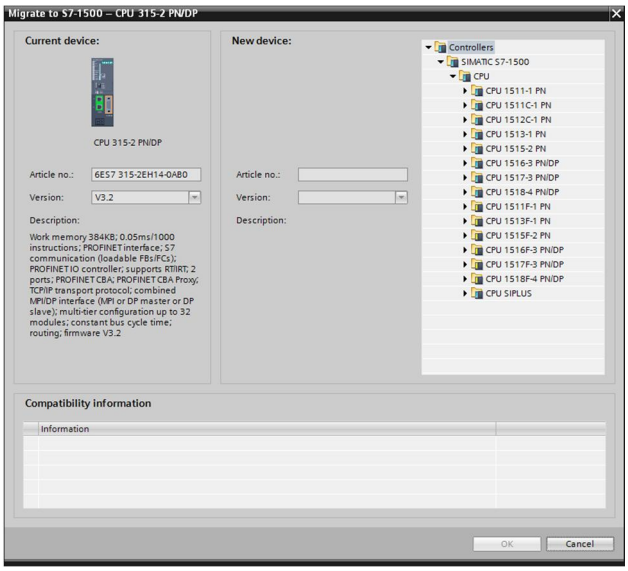
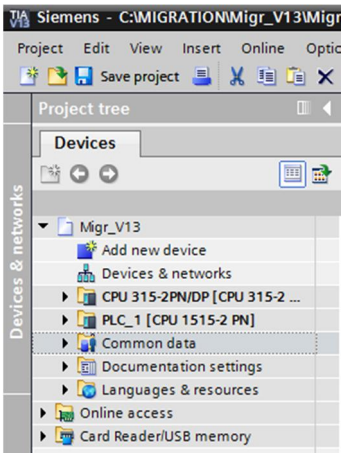
Step	Instruction
2.	Select the suitable CPU.  <u>Important:</u> When changing to the CPU S7-1500 only the CPU is adjusted. If other modules are inserted in the central configuration of the S7-300, they have to added manually when changing to S7-1500. Note: You can import the HW configuration from your STEP 7 V5.x project into the TIA Selection Tool. When you now migrate a S7-1500 to the station, the central modules are converted, as far as possible.
3.	After completion the two CPUs are in the project. 
4.	The program should now still be optimized.

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5.2.5 Optimization of the TIA portal project

The full migration is not yet completed with the created TIA Portal project. If there are no other messages in the migration protocol itself and if there are also no errors after compilation, in most cases it will still be necessary to carry out an optimization. The command records and command structures between S7-300/S7-400 and S7-1500 differ. This is why commands in a S7-300 may possibly be handled or processed differently. This may possibly lead to a migrated program in a S7-1500 to run slower than in a S7-300/S7-400 although the technical data clearly speaks for the S7-1500.

Among others, the following points should be observed for optimization:

- Optimized blocks
- Block sizes
- New data types
- New instructions
- Symbolic
- Library concept
- Integrated blocks (library)

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Optimized blocks

In the TIA Portal optimized blocks are used, for compatibility reason there are non-optimized blocks. For optimized blocks, the declared data elements in the available memory section of the block are automatically arranged in a way so that its capacity is optimally used and access can be carried out with optimal performance. Large data types are stored at the beginning, smaller ones at the end. Bits are stored as byte, the controller does not have to execute masking or conversions.

The data is structured and stored in a way that is optimum for accessing this data in the CPU used. The data elements only obtain a symbolic name in the declaration, via which the tag within the block can be addressed. This increases the performance of the CPU. Access errors, for example, from a HMI are not possible like this.
For S7-300 and S7-400 the maximum size of a data block is limited to 64KByte. A S7-1500 can process data blocks up to 10Mbyte - when block access is optimized. Non-optimized blocks can also be accessed conventionally (direct addressing), however this restricts the performance. This is why the two variants should not be mixed in the user program.

In addition, optimized blocks have a storage reserve with which make it possible to reload in running operation.

Quantity framework

For the S7-1500 the overall quantity framework has become larger – inter alia, the number of useable blocks, the size of all blocks and the new SIMATIC Memory Card with up to 32GByte usable memory has increased. All this supports the usability for the user but also has an effect on the size of the user program.

Table 5-10

Block type	S7-300/S7-400	S7-1500
DB	64 Kbyte	Optimized up to 10Mbyte (depending on the CPU type), non-optimized 64kbyte
OB	64 Kbyte	Optimized up to 512kbyte, depending on the CPU type
FB	64 Kbytes	Optimized up to 512kbyte, depending on the CPU type
FC	64 Kbytes	Optimized up to 512kbyte, depending on the CPU type
Memory card	Up to 8 Mbyte/up to 64 Mbyte	Up to 32 Gbyte

Symbolic

The TIA Portal works fully on symbolic level. The user does not have care about the numbering of their blocks.

Through the continuous framework of the TIA Portal, the tags that have been created in STEP 7 can be used in the visualization part. Symbolic programming facilitates the handling and readability but also the maintenance of the program. Elements/tags, e.g., from the devices & networks view can be directly dragged into the program via drag-and-drop.

A symbol table as in STEP 7 V5.x no longer exists in the TIA Portal. Symbols only mean PLC tags here and are summarized in the tag table. The user can divide them in partial groups for logical grouping.

Note In the TIA Portal what was previously known as tag tables are now watch tables.

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New data types

For the programming in TIA Portal some new data types have been introduced, among others also 64 bit data types. This makes it possible to process considerably larger and more precise values.

Table 5-11

Data type	Size	Range of values
USInt	8 bit	0 .. 255
SInt	8 bit	-128 .. 127
UInt	16 bit	0 .. 6535
UDInt	32 bit	0 .. 4.3 m
ULInt	64 bit	0 .. 18.4 (10^{18})
Lint	64 bit	-9.2 .. 9.2 (10^{18})
LWord	64 bit	16#0000 0000 0000 0000 to 16# FFFF FFFF FFFF FFFF
LReal	64 bit	-1.79e+308 .. 1.79e+308
Time data types		
DTL	Reads the current system time (setting in: YEAR, MONTH, DAY, WEEKDAY, HOUR, MINUTE, SECOND, NANSECOND)	
LTime	64 bit	LT#-106751d23h47m16s854ms775us808ns up to LT#+106751d23h47m16s854ms775us807ns
LTIME_OF_DAY	64 bit	LTOD#00:00:00.000000000 up to LTOD#23:59:59.999999999
Unicode data types		
WCHAR	2 byte	Popular unicode characters
WSTRING	(4+2*n)Byte	Preset value: 254 characters Max. value: 16382 characters
Pointer data type		
VARIANT	A parameter of the VARIANT type is a pointer that can point to tags of different data types. In contrast to the ANY pointer the VARIANT is a pointer with type test. I.e. the target structure and source structure are checked at runtime and have to be identical.	

PLC data type

The PLC data types are a new feature. Just as with the UDTs an independent data type can be designed in STEP 7 V5.x that can be reused in the entire program, typically in data blocks but also in interfaces of function blocks. A change can therefore be carried out centrally and is updated in all the places used.

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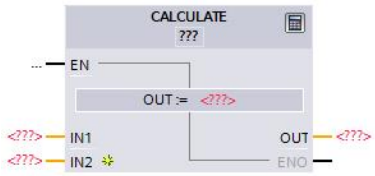
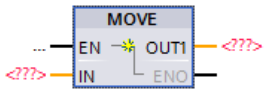
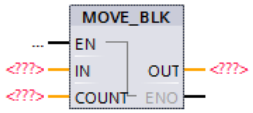
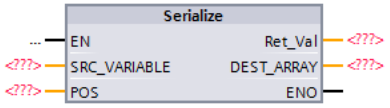
New instructions

New instructions make it very conveniently possible to configure the programming. Below, you can find a small selection of new instructions:

Table 5-12

Name	Usage	Appearance
CALCULATE	Carry out calculations independent from data type	
MOVE	Copy value Copy array	
MOVE_BLK	Copy array (when parts of the arrays are to be copied with known data type)	
UMOVE_BLK	Copy array without interruption	
MOVE_BLK_ VARIANT	Copy array (when parts of the arrays are to be copied whose data type is only known at program runtime)	
Serialize	Converts structured data into a byte array	
Deserialize	Converts bytes from a byte array into one or several structures	

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Libraries

With the TIA Portal you can create independent libraries from different project elements that can be easily reused.

Using libraries offers the following advantages:

- Simple storage for the data configured in the TIA Portal:
- Cross-project exchange
- Central update function of library elements
- Versioning of library elements
- Fewer error sources when using control blocks through system-supported consideration of dependencies

Note Other recommendations of how the user program can be optimized can be found in programming guideline S7-1200/S7-1500.
https://support.industry.siemens.com/cs/ww/en/view/90885040

Note Once hardware and software have been fully migrated, optimized and loaded, a test of all functions should be carried out!

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5.3 Program structure and standard functions

5.3.1 Organization blocks (OB)

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. S7-300/S7-400 CPUs as well as 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 (1 stands for lowest, 26 for highest priority). 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 5-13

S7-300 CPUs/ S7-400 CPUs	S7-1500 CPUs	Description
OB 1	Main OB	Cyclic program processing For S7-1500, multiple cyclic OBs can be used that are performed in one cycle after the other.

Time-controlled program processing (cyclic interrupts)

Table 5-14

S7-300 CPUs/ S7-400 CPUs	S7-1500 CPUs	Description
OB 32-35/ OB 30-38	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 S7-300/S7-400, the S7-1500 allows you to individually set the cycle clock for each cyclic interrupt OB and to individually set the phase shift. For S7-300/S7-400 it depends on the respective CPU which OBs are available. For S7-400 CPUs priorities can be set, for S7-300 CPUs this is not possible.

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 and cycle time monitoring starts.

In S7-300/S7-400, you could use 3 different startup OBs. Depending on the CPU startup, the respective OB is then called by the operating system and processed once. The S7-1500 always runs in warm restart.

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Table 5-15

S7-300 CPUs/ S7-400 CPUs	S7-1500 CPUs
OB100: Restart OB101: Restart OB102: Cold start (only for S7-400)	Up to 100, OB_Startup that are performed one after the other in a call phase

OBs for error diagnostics

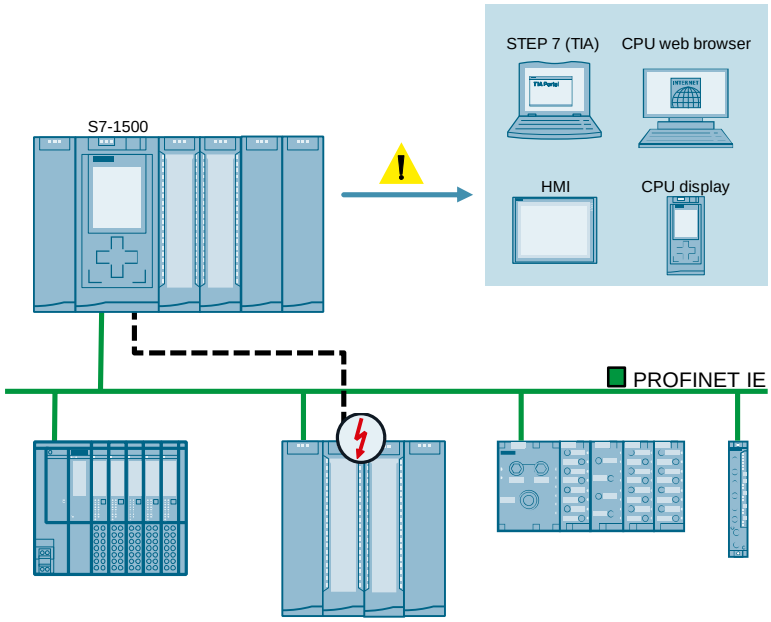
As parts of the system architecture of S7-300/S7-400 and S7-1500 differ, errors are also displayed and handled differently. Particularly in the field of hardware errors, the new S7-1500 control system offers very convenient system diagnostics options. Whilst the diagnostic blocks (report system error in short SFM) offered by the system for S7-300/S7-400 still had to be selected by the users themselves, it is automatically integrated in S7-1500. Through the integration into the firmware of the CPU, information can also be displayed in STOP mode. The system provides a uniform display concept for the user, no matter whether in engineering, in the web server, on the panel or on the display.

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

Figure 5-1



If other plant-specific programming is necessary in the error OBs, naturally this is possible.

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Overview of organization blocks and their priorities

There are other organization blocks for other tasks. The OBs and their appropriate priorities are listed in the following table:

Table 5-16

Name of the OB	Possible priorities (preset priorities)	Possible OB numbers
Startup	1	100 or ≥123
Cyclic program	1	1 or ≥ 123
Time-of-day interrupt	2 -24 (2)	10-17 or ≥ 123
Time-delay interrupt	2-24 (3)	20-23 or ≥ 123
Cyclic interrupt	2-24 (8-17, depending on frequency)	30-38 or ≥ 123
Hardware interrupt	2-26 (18)	40-47 or ≥ 123
Status interrupt	2-24(4)	55
Update interrupt	2-24(4)	56
Manufacturer or profile-specific interrupt	2-24(4)	57
Isochronous interrupt	16-26 (21)	61-64 or ≥ 123
Time error	22	80
Cycle monitoring time	22	80
Diagnostic interrupt	2-26 (5)	82
Removing/inserting modules	2-26 (6)	83
Module rack error	2-26(6)	86
MC servo interrupt	17-26 (25)	91
MC interpolator interrupt	16-26 (24)	92
Programming error	2-26 (7)	121
I/O access fault	2-26 (7)	122

Note The communication always has priority 15. This makes it possible to provide OBs with a priority larger than 15 so that these OBs are not interrupted by the communication.

5.3.2 Function blocks and functions, data blocks, PLC data types

For reasons of compatibility STEP 7 V5.x and STEP 7 TIA Portal does not differ in the basic functions but in some details. They are explained in detail in the programming guideline.

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

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Functions (FC)

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 tags and constants can be declared in an FC.

Function blocks (FB)

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. For each call of an FB, an instance (in required, multiinstance) is assigned as memory, in which the values of its tags are saved for the processing in the next program cycle. Static and temporary local tags as well as constants can be declared in a STEP 7 FB.

Data blocks (DB)

Data blocks are used to save relevant data. In STEP 7 V5.x as well as in STEP 7 TIA Portal there are global data blocks and also instance data blocks. However, there is a big difference in the use and the handling of the data blocks. Whilst in STEP7 V5.x only DBs with up to 64kbyte can be used, in TIA Portal blocks up to a size of 16Mbyte can be created and used. This depends on the properties of the blocks (optimized/non-optimized), the CPU and the available memory. In addition, optimized data blocks can be reloaded in running operation and their interface can be changed (“Loading without reinitialization”). This is made possible by the memory reserve in the data blocks. Another function that improves and facilitates working with data blocks, is the creation of snapshots. This is where the user can accept the values that have existed at a certain time, as start values or as actual value.

PLC data types

PLC data types in STEP 7 TIA Portal are similar to the UDTs in STEP7 5.x.
To facilitate a reusability of structures in the program, PLC data types can be created. In contrast to “Structs”, PLC data types are globally valid and not only in the block in which they have been defined. They are used within data blocks (for example, the interface definition) and also in other locations in the program. If a detail has to be changed in a PLC data type, all places used in the program will be corrected automatically.

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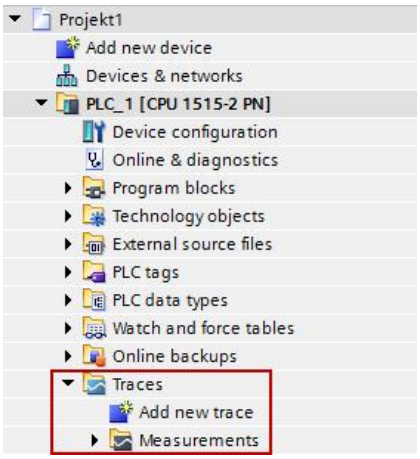
5.3.3 Advantages of STEP 7 TIA Portal compared to STEP 7 V5.x

The basic function in STEP 7 V5.x and STEP 7 TIA Portal are the same. However, there are some detailed improvements regarding handling and programming. Below, you find an excerpt of some functions that have been realized in STEP 7 TIA Portal.

General functions

Table 5-17

STEP 7 TIA Portal	Description/advantage
Traces can be performed within/with the CPU	Before, traces were only possible with effort - with additional modules/additional wiring. Now the function is integrated in software and CPU-FW. 

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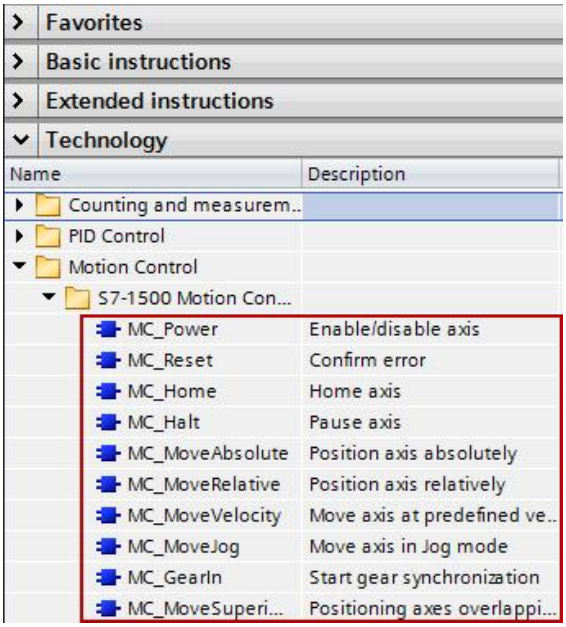
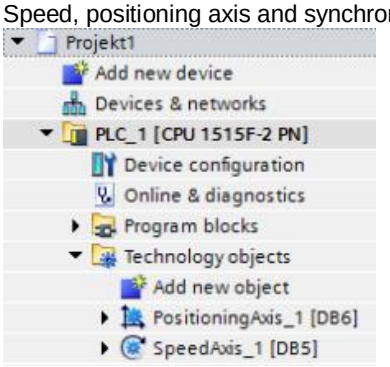
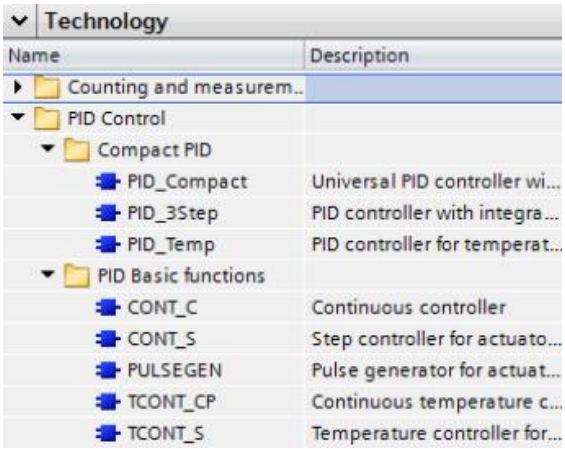
STEP 7 TIA Portal	Description/advantage
Motion functions are already integrated in the standard CPU -> PLCopen Blocks	Before, motion functions were not integrated in standard CPUs  Speed, positioning axis and synchronous axes are available 
PID integrated compact controller (PID_Compact, PID_3Step, PID_Temp) PID basic controllers are included for reasons of compatibility	

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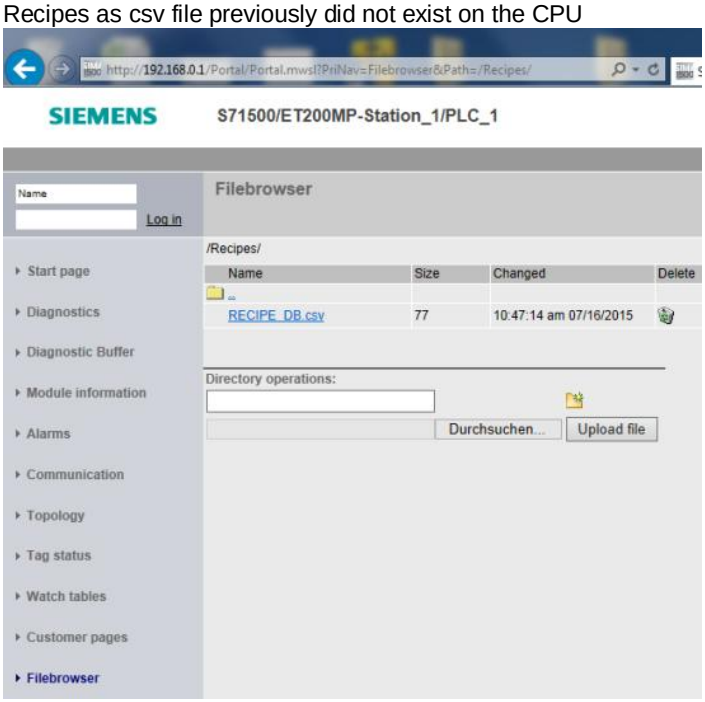
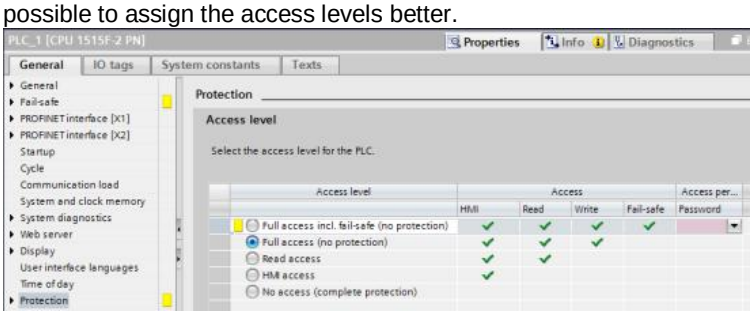
STEP 7 TIA Portal	Description/advantage
Recipes/archives as CSV file, via the web server of the CPU	Recipes as csv file previously did not exist on the CPU 
Security Integrated – more protection levels available	There are only 2 protection levels for S7-300/S7-400. Now it is possible to assign the access levels better. 
Download in run (memory reserve available), all modifications enabled at the same time	Download in run was previously also possible, but the user had to observe the sequence so that the CPU did not go to STOP

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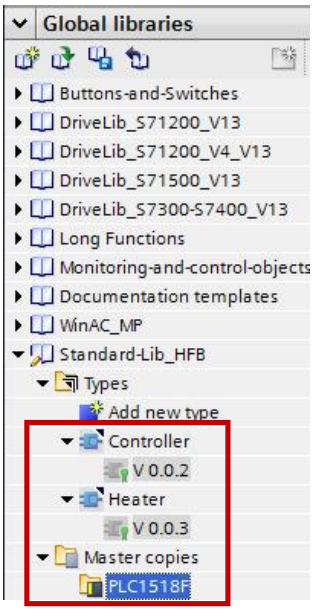
STEP 7 TIA Portal	Description/advantage
Library concept	Libraries have already been possible for STEP 7 V5.x but without versioning. Blocks, data types, screens and entire stations can be stored. 
System status list (SSL) has been replaced by a new system diagnostic	The diagnostic options for the S7-1500 and TIA Portal have been fully revised. A system diagnostic has already been implemented. The user no longer has to concern themselves with blocks such as “report system error”.
Projects can always be saved	It is always possible to save the project, even when there are incomplete or faulty networks.
Automatic data consistency	There is a central data management in the TIA Portal. Changed application data is automatically instantly updated within the entire project (also across several devices).
Project-wide cross-references	Cross-references are automatically permanently available. The places of use are displayed across all devices. Via the cross-reference list you can directly go the location of use, the editor is opened, and the location is automatically selected.
Drag-and-drop	Drag-and-drop can be used in many places in the TIA Portal, also cross-devices.

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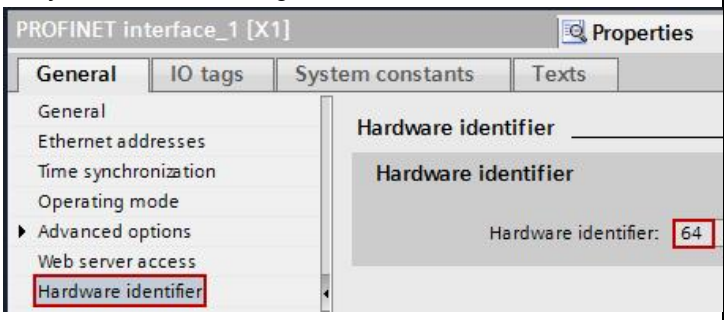
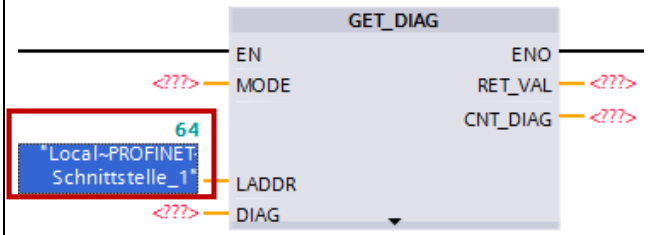
Programming

Table 5-18

STEP 7 TIA Portal	Description/advantage
All instructions are available in all programming languages	In STEP 7 V5.x not all instructions were available in LAD/FBD
Same performance for all programming languages	In TIA Portal all programming languages are directly compiled into machine code and therefore offer all the same performance.
Symbols and comments are saved in CPU -> full upload possible	Now it is possible to carry out a full system upload.
Hardware identifier and hardware constant – simplified handling of system functions	The newly introduced “Hardware Identifier” and hardware constants enable a symbolic programming without (logic) I/O addresses. Entry in the module settings  Entry of the hard constants in the tag table  Exemplary wiring on a block 
Several branches in a network	In order to be able to use networks as logic units, it is possible to add several branches in a network

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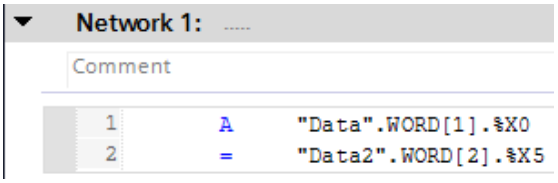
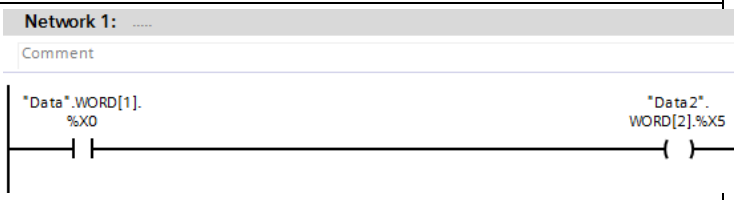
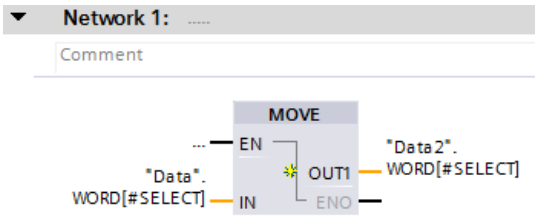
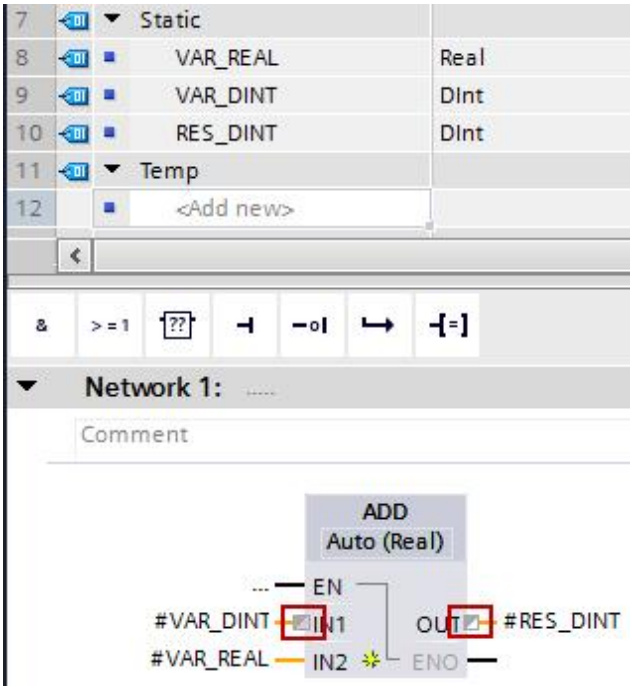
STEP 7 TIA Portal	Description/advantage
Slicing possible – access to elements of a larger data type	Slicing access can look as follows, e.g.,: .%X0 for Bool, .%B0 for byte, .%W0 for word, .%D0 for double word 
Slicing also possible in LAD/FBD SCL – no programming required in STL	 The output tag is a WORD. Each time a bit of the appropriate word is accessed.
Indirect addressing also possible in LAD/FBD SCL	
implicit type conversion	

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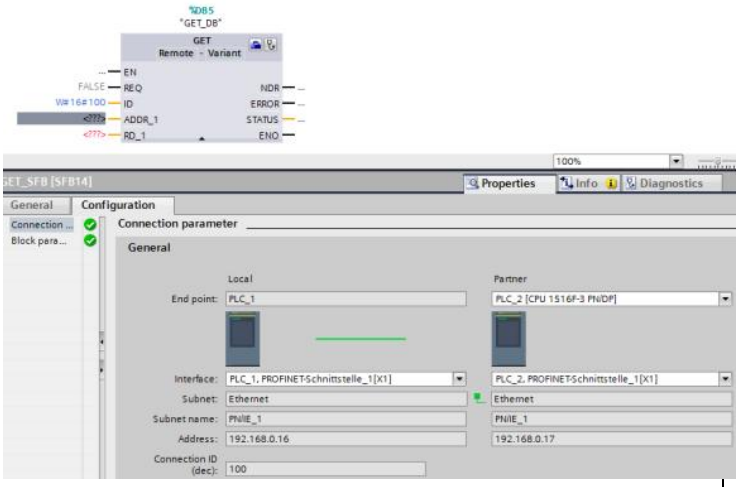
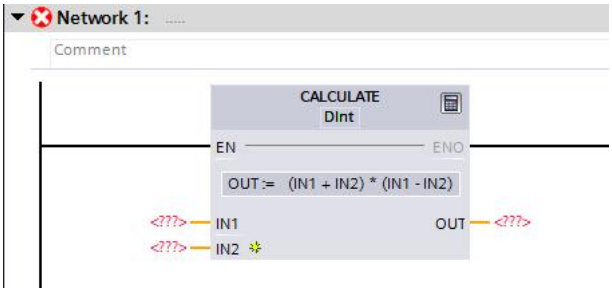
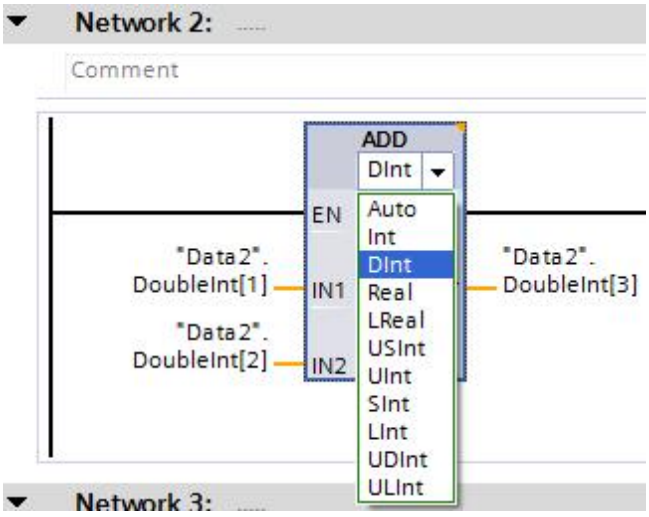
STEP 7 TIA Portal	Description/advantage
Simplified handling of send/receive communication through wizard	
Simplified “Calculate” block	
Simplified mathematic functions (selectable data type)	

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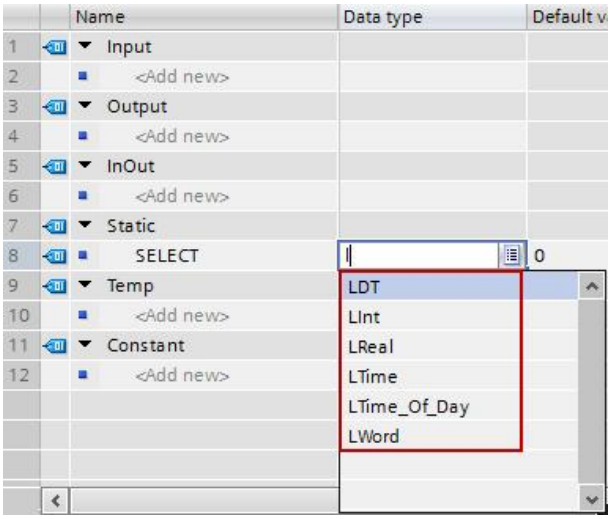
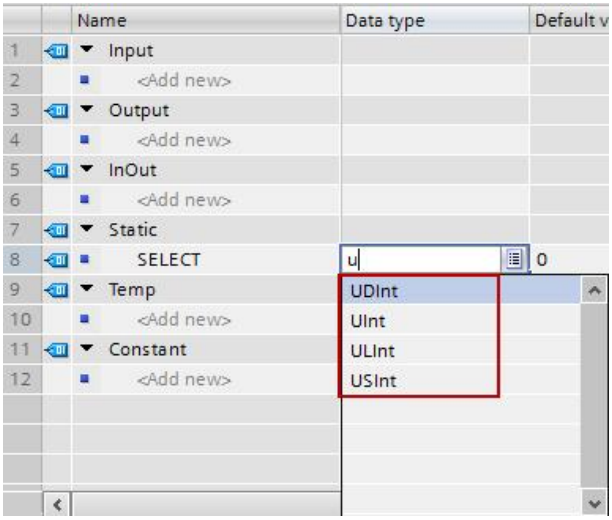
STEP 7 TIA Portal	Description/advantage
64 bit data types available	
Short and unsigned data types available	
Variant instead of any pointer	For more information and examples, refer to the TIA Portal Online Help.

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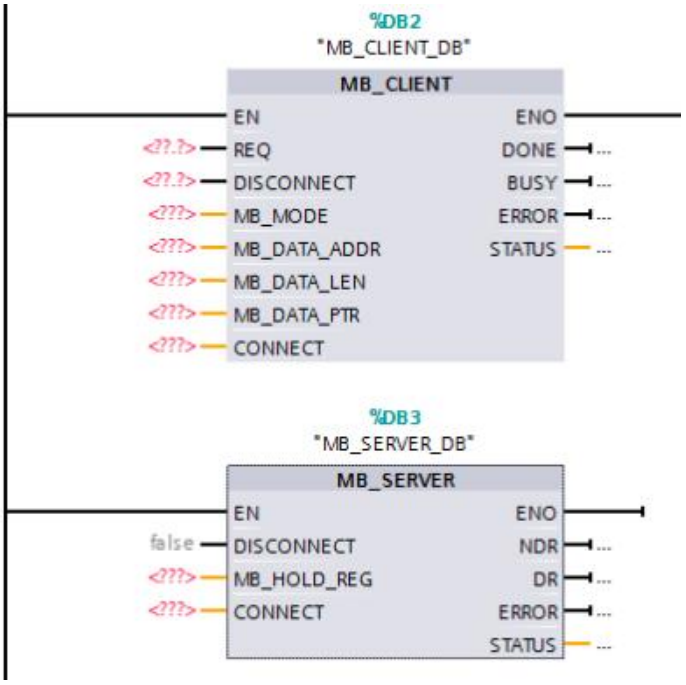
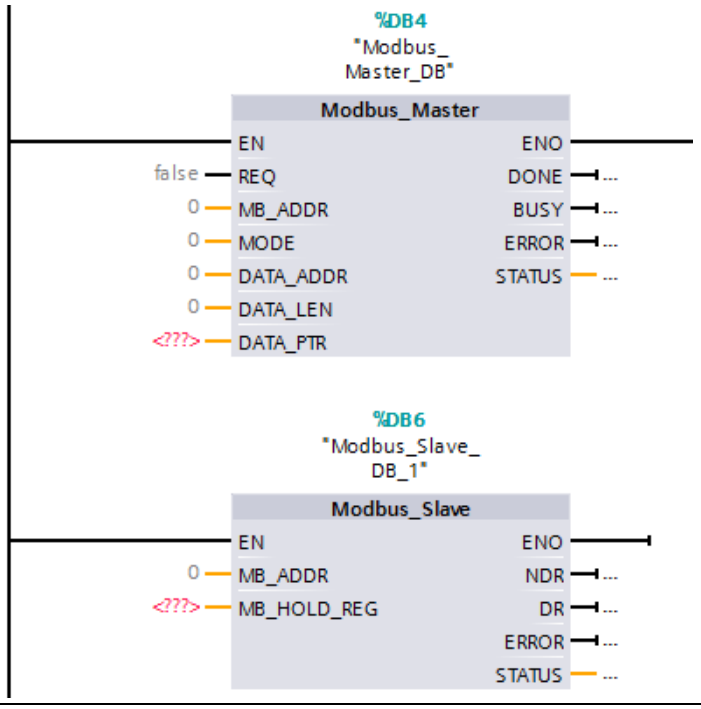
STEP 7 TIA Portal	Description/advantage
Integrated modbus blocks	Modbus TCP blocks:  Modbus RTU blocks: 

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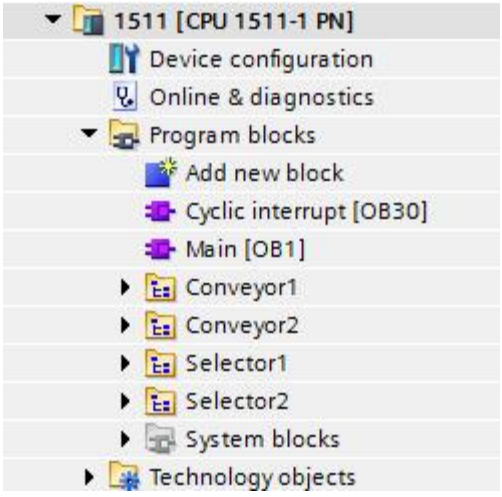
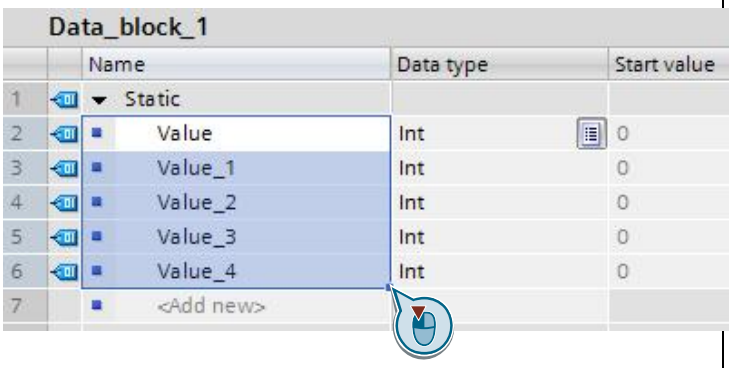
STEP 7 TIA Portal	Description/advantage
Program structuring	For a good overview of the program design subgroups can be created in the “Program blocks” folder which enables a logic division of the program 
Benefits of known office features	When creating tags, the autofill function, which is known from Office, can be used. With this feature it is possible to create a large number of tags very quickly. 
Saving of projects	It is always possible to save the project, even when there are incomplete or faulty networks.
Team engineering	Automation tasks can be processed in parallel in teamwork

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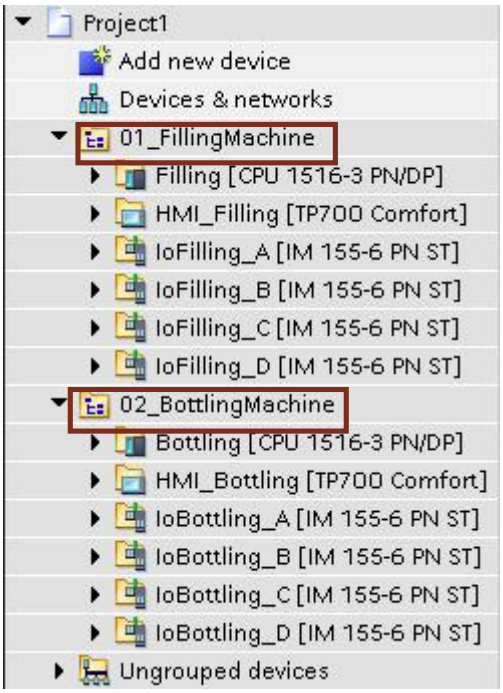
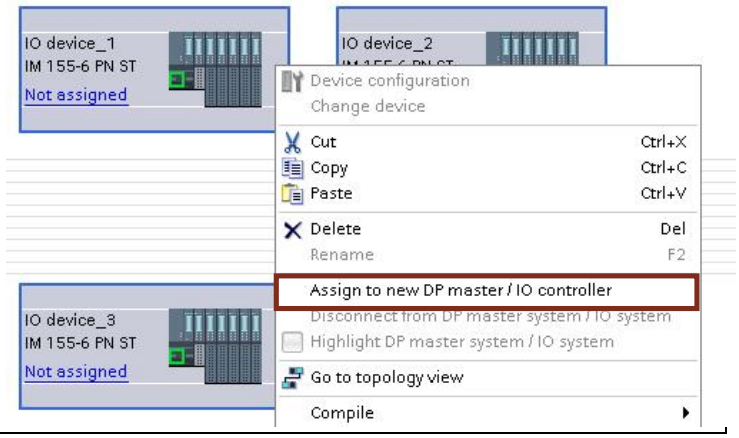
STEP 7 TIA Portal	Description/advantage
Grouping of devices in project navigation	Groups can be created in the project tree, to sort plant parts 
Assigning several PROFINET devices to a controller in one step	Mass functions allow certain functions to be carried out for several devices, here, for example, assigning several IO devices to one controller 

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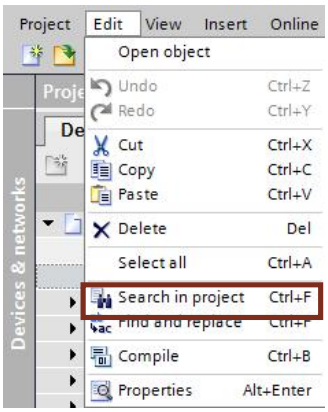
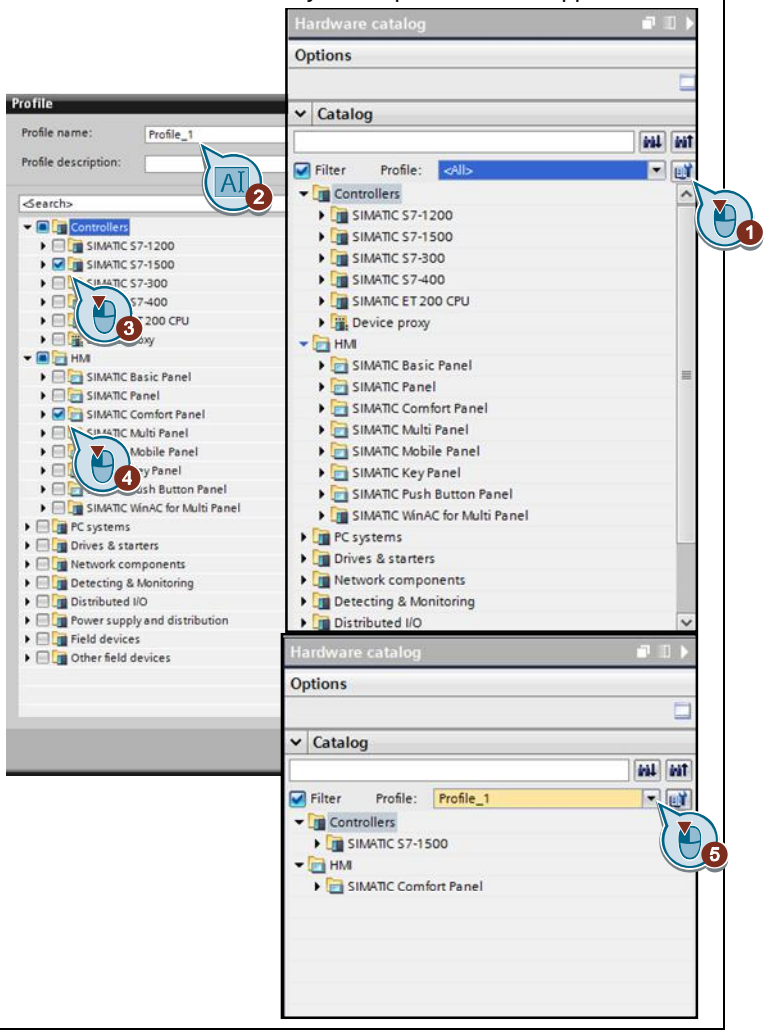
STEP 7 TIA Portal	Description/advantage
Global search	The search is not only restricted to the currently open block but can also be carried out globally. This is how it is possible to find all places in the project. 
Creating/saving profiles	When machines always have the same structure, they often also require the same components. For this purpose, profiles can be created in the hardware catalog, which apply a self-defined filter on all devices. Therefore only the required devices appear. 

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STEP 7 TIA Portal	Description/advantage
Creating or restoring backups of the CPU via display (without additional software)	A backup can be created directly on the CPU (via display). 

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5.3.4 Differences in the hardware of the S7-300/S7-400 and S7-1500

Apart from many innovations in the internal processing (firmware) and also the improved backplane bus, two hardware properties of the S7-1500 have to be pointed out. There is a display on the front of the CPU that can be taken off. Thus, there are not only LEDs available as rough status information on the CPU, but a detailed display, for example, for firmware versions, diagnostics, interface settings. The display size depends on the CPU – for the CPUs 1511, 1512C and 1513 there is a narrow, for the CPUs 1515, 1516, 1517, 1518 a wide display. Since the CPUs 1510SP, 1512SP and the open controller of that type belong to ET 200SP, they do not have a display.

Figure 5-2 Displays of the CPUs 1511/1512C/1513 or 1515/1516/1517/1518

Another alteration between the two S7-CPU generations is the SIMATIC Memory Card (SMC). Whilst the Micro Memory Card (MMC) for the S7-300 could only be written onto (internally or externally) with a special prommer by the SIMATIC file system, an ordinary card reader can now be used for the SMC. In addition, the memory available has grown considerably – now cards up to 32 GB can be used and thus much more complex programs can be created.

Note

You can delete and create folders on the SMC. However, do not format the card with the Windows card reader, or the storage medium becomes useless for the CPU.

For more information regarding the SMC, please refer to the system manual for the S7-1500 in chapter “SIMATIC Memory Card” at:
https://support.industry.siemens.com/cs/ww/en/view/59191792

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5.4 Programming of sequential controls – S7-GRAPH in STEP 7 V5.x and TIA Portal

Note Programming sequential controls – S7-GRAPH will be described in a later version of this guide.

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6 The Most Important Recommendations

6.1 Contact person in the region

Find a SIEMENS contact person 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 path 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

Moreover, if required, we also offer you personal individual support – customized to your specific needs:

- Clarification and assessment of the core functionalities via your Siemens contact person: www.siemens.en/industry/contact
- Complete service from consultation through to implementation, right up to full project completion within the framework of our SIMATIC Migration Services: http://www.siemens.en/fa-services

6.3 Solution partner

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

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

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6.4 References and online documents

6.4.1 Important information

Table 6-1

Topic pages	Link
Migration topic page	83558085

Table 6-2

S7-300 manuals	Link
SIMATIC S7-300 CPU 31xC and CPU 31x: Technical data	12996906
SIMATIC S7-300 CPU 31xC and CPU 31x: Installation	13008499
SIMATIC S7-300 Instruction list S7-300 CPUs and ET 200 CPUs	31977679
SIMATIC S7-300 S7-300 Module Data	8859629

Table 6-3

S7-400 manuals	Link
SIMATIC S7-400 Automation System Module Data	1117740
SIMATIC S7-400 Automation System, CPU Specifications	53385241
Automation System S7-400 Installation	1117849
Automation System S7-400 Configuration and Use	22586851

Table 6-4 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
Migration Guide S7-31xT to S7-1500(T)	109743136
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
SIMATIC S7-1500 Structure and Use of the CPU Memory	59193101

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7 Appendix

7.1 SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

The following tables show the respective S7-1500 equivalent to the listed SIMATIC S7-300/S7-400 module in terms of content.

It is essential that you note the following:

Note

The content of this table is 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 S7-300/S7-400 component. It is the user's responsibility to consider the technical characteristics (e.g., limits) of the SIMATIC 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. ...

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7.1.1 CPU modules

Note

The content of the following table is for reference only!

Please note the general information in this chapter:
SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison.

The TIA Selection Tool provides support for the implementation of S7-300/S7-400 to S7-1500: http://www.siemens.en/tia-selection-tool

Table 7-1

S7-300	Description	S7-1500	Description
6ES7 312-1AE13-0AB0	CPU 312-1	6ES7 511-1AK01-0AB0	CPU 1511
6ES7 312-1AE14-0AB0	CPU 312-1	6ES7 511-1AK01-0AB0	CPU 1511
6ES7 312-5BE03-0AB0	CPU 312C	6ES7 215-1AG40-0XB0	CPU 1215C
6ES7 312-5BF04-0AB0	CPU 312C	6ES7 215-1AG40-0XB0	CPU 1215C
6ES7 313-5BF03-0AB0	CPU 313C	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 313-5BG04-0AB0	CPU 313C	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 313-6CF03-0AB0	CPU 313C-2DP	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 313-6CG04-0AB0	CPU 313C-2DP	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 313-6BF03-0AB0	CPU 313C-2PtP	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 313-6BG04-0AB0	CPU 313C-2PtP	6ES7 511-1CK00-0AB0	CPU 1511C
6ES7 314-1AG13-0AB0	CPU 314	6ES7 511-1AK01-0AB0	CPU 1511
6ES7 314-1AG14-0AB0	CPU 314	6ES7 511-1AK01-0AB0	CPU 1511
6ES7 314-6CG03-0AB0	CPU 314C-2DP	6ES7 512-1CK00-0AB0	CPU 1512C
6ES7 314-6CH04-0AB0	CPU 314C-2DP	6ES7 512-1CK00-0AB0	CPU 1512C
6ES7 314-6EH04-0AB0	CPU 314C-2PN/DP	6ES7 512-1CK00-0AB0	CPU 1512C
6ES7 314-6BG03-0AB0	CPU 314C-2PtP	6ES7 512-1CK00-0AB0	CPU 1512C
6ES7 314-6BH04-0AB0	CPU 314C-2PtP	6ES7 512-1CK00-0AB0	CPU 1512C
6ES7 315-2AG10-0AB0	CPU 315-2DP	6ES7 513-1AL01-0AB0	CPU 1513-1PN
6ES7 315-2AH10-0AB0	CPU 315-2DP	6ES7 513-1AL01-0AB0	CPU 1513-1PN
6ES7 315-2EH13-0AB0	CPU 315-2PNDP	6ES7 515-2AM01-0AB0	CPU 1515-2PN
6ES7 315-2EH14-0AB0	CPU 315-2PN/DP	6ES7 515-2AM01-0AB0	CPU 1515-2PN
6ES7 315-6FF01-0AB0	CPU 315F-2DP	6ES7 513-1FL01-0AB0	CPU 1513F-1PN
6ES7 315-6FF04-0AB0	CPU 315 F-2DP	6ES7 513-1FL01-0AB0	CPU 1513F-1PN
6ES7 315-2FH13-0AB0	CPU 315F-2PN/DP	6ES7 515-2FM01-0AB0	CPU 1515F-2PN
6ES7 315-2FJ14-0AB0	CPU 315F-2PN/DP	6ES7 515-2FM01-0AB0	CPU 1515F-2PN
6ES7 317-2AJ10-0AB0	CPU 317-2	6ES7 516-3AN01-0AB0	CPU 1516-3PN/DP
6ES7 317-2AK14-0AB0	CPU 317-2	6ES7 516-3AN01-0AB0	CPU 1516-3PN/DP
6ES7 317-2EK13-0AB0	CPU 317-2PN/DP	6ES7 516-3AN01-0AB0	CPU 1516-3PN/DP
6ES7 317-2EK14-0AB0	CPU 317-2PN/DP	6ES7 516-3AN01-0AB0	CPU 1516-3PN/DP
6ES7 317-6FF03-0AB0	CPU 317F-2	6ES7 516-3FN01-0AB0	CPU 1516F-3PN/DP
6ES7 317-6FF04-0AB0	CPU 317F-2	6ES7 516-3FN01-0AB0	CPU 1516F-3PN/DP
6ES7 317-2FK13-0AB0	CPU 317F-2PN/DP	6ES7 516-3FN01-0AB0	CPU 1516F-3PN/DP
6ES7 317-2FK14-0AB0	CPU 317F-2PN/DP	6ES7 516-3FN01-0AB0	CPU 1516F-3PN/DP

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S7-300	Description	S7-1500	Description
6ES7 318-3EL00-0AB0	CPU 319-3PN/DP	6ES7 517-3AP00-0AB0	CPU 1517-3PN/DP
6ES7 318-3EL01-0AB0	CPU 319-3PN/DP	6ES7 517-3AP00-0AB0	CPU 1517-3PN/DP
6ES7 318-3FL00-0AB0	CPU 319F-3PN/DP	6ES7 517-3FP00-0AB0	CPU 1517F-3PN/DP
6ES7 318-3FL01-0AB0	CPU 319F-3PN/DP	6ES7 517-3FP00-0AB0	CPU 1517F-3PN/DP
6ES7 151-7AA20-0AB0	IM 151-7 CPU	6ES7 510-1DJ01-0AB0	CPU 1510SP-1PN
6ES7 151-7AA21-0AB0	IM 151-7 CPU	6ES7 510-1DJ01-0AB0	CPU 1510SP-1PN
6ES7 151-7AB00-0AB0	IM 151-7 CPU FO	6ES7 512-1DK01-0AB0[1]	CPU 1510SP-1PN
6ES7 151-7FA20-0AB0	IM 151-7F-CPU	6ES7 510-1SJ01-0AB0	CPU 1510SP F-1PN
6ES7 151-7FA21-0AB0	IM 151-7F-CPU	6ES7 510-1SJ01-0AB0	CPU 1510SP F-1PN
6ES7 151-8AB00-0AB0	IM 151-8 PN/DP CPU	6ES7 512-1DK01-0AB0	CPU 1512SP-1PN
6ES7 151-8AB01-0AB0	IM 151-8 PN/DP CPU	6ES7 512-1DK01-0AB0	CPU 1512SP-1PN
6ES7 151-8FB00-0AB0	IM 151-8F PN/DP CPU	6ES7 512-1SK01-0AB0	CPU 1512SP F-1PN
6ES7 151-8FB01-0AB0	IM 151-8F PN/DP CPU	6ES7 512-1SK01-0AB0	CPU 1512SP F-1PN
6ES7 154-8AB01-0AB0	IM 154-8 PN/DP CPU	6ES7 516-2PN00-0AB0	CPU 1516pro-2PN
6ES7 154-8FB01-0AB0	IM 154-8 PN/DP F-CPU	6ES7 516-2GN00-0AB0	CPU 1516pro F-2PN
6ES7 154-8FX00-0AB0	IM 154-8 PN/DP F-CPU	6ES7 516-2GN00-0AB0	CPU 1516pro F-2PN

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Table 7-2

S7-400	Description	S7-1500	Description
6ES7 412-1XJ05-0AB0	CPU 412-1MPI/DP	6ES7 513-1AL01-0AB0	CPU 1513-1PN
6ES7 412-2XJ05-0AB0	CPU 412-2	6ES7 515-2AM01-0AB0	CPU 1515-2PN
6ES7 412-2EK06-0AB0	CPU 414-2PN/DP	6ES7 516-3AN01-0AB0	CPU 1516-3PN/DP
6ES7 414-2XK05-0AB0	CPU 414-2	6ES7 517-3AP00-0AB0	CPU 1517-3PN/DP
6ES7 414-3XM05-0AB0	CPU 414-3	6ES7 517-3AP00-0AB0	CPU 1517-3PN/DP
6ES7 414-3EM05-0AB0	CPU 414-3PN/DP	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 414-3EM06-0AB0	CPU 414-3PN/DP	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 414-3FM06-0AB0	CPU 414F-3PN/DP	6ES7 518-4FP00-0AB0	CPU 1518F-4PN/DP
6ES7 416-2XN05-0AB0	CPU 416-2 *)	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 416-3XR05-0AB0	CPU 416-3 *)	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 416-3ER05-0AB0	CPU 416-3PN/DP *)	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 416-3ES06-0AB0	CPU 416-3PN/DP *)	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP
6ES7 416-2FN05-0AB0	CPU 416F-2DP *)	6ES7 518-4FP00-0AB0	CPU 1518F-4PN/DP
6ES7 416-3FR05-0AB0	CPU 416F-3PN/DP *)	6ES7 518-4FP00-0AB0	CPU 1518F-4PN/DP
6ES7 416-3FS06-0AB0	CPU 416F-3PN/DP *)	6ES7 518-4FP00-0AB0	CPU 1518F-4PN/DP
6ES7 417-4XT05-0AB0	CPU 417-4 *)	6ES7 518-4AP00-0AB0	CPU 1518-4PN/DP

*) Please note the information in the "Selecting the CPU" chapter, especially the various memory sizes!

[1] CPU 1512 can only be used in combination with suitable bus adapter

7.1.2 Comparison of the software/hardware properties

The following tables below give an overview of the properties that are available in the individual CPU types.

CPU hardware properties

Table 7-3

Property	S7-300/S7-400	S7-1500
Display	no	Yes, for 1511, 1513-1518
Display for failsafe CPU shows - Safety mode enabled/disabled - Signature - Time stamp last change Safety program - Diagnostics	no	yes
Memory card with standard file system	no	yes
PPI interface	no	no
MPI interface	yes	no
DP interface	yes	yes
DP interface with PROFIsafe	yes	yes
1st PN interface with basic functions	yes	yes
1st PN interface with IRT	yes	yes
1st PN interface with PROFIsafe	yes	yes
2nd PN interface with basic functions	no	yes
3rd PN interface with basic functions	no	yes

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CPU properties

Table 7-4

Property	S7-300/S7-400	S7-1500
Process image	yes	yes
Multiple process image	yes, S7-400	yes
Flexible number assignment for OBs	no	yes
Flexible number assignment for F-OB	no	yes
OB1	yes	yes
OB1x	yes	yes
Up to 50 hardware interrupt OBs	up to 40	yes
up to 20 cyclic interrupts with different priorities	no	yes
Isochronous OBs	yes	yes
Several cyclic, startup, process OBs	no	yes
Several F-OBs for better program structuring	no	yes

CPU programming languages general

Table 7-5

Properties	S7-300/S7-400	S7-1500
Symbolic programming	yes	yes
STL	yes	yes
FBD/ F-FBD	yes	yes
LAD/F-LAB	yes	yes
SCL	yes	yes
S7-GRAPH	yes	yes
HiGraph	yes	no
CFC	yes	no, planned
Same functions in all programming languages	no	yes
SFBs	yes	yes
SFCs	yes	yes
S7 timer	yes	yes
S7 F timer	yes	yes
ICE counter	yes	yes
S7 counter	yes	yes
Edge evaluation	yes	yes
Global DBs	yes	yes
Instance DB	yes	yes
FBs	yes	yes
FCs	yes	yes
System status list (SSL)	yes	Totally new solution
64 bit data types	no	yes
Short/U short data types	no	yes
Implicit type conversion	no	yes
Slice access	no	yes
Calculate box	no	yes
Indirect addressing LAD/FBD	no	yes

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CPU programming languages LAD/FBD

Table 7-6

Property	S7-300/S7-400	S7-1500
Several branches in a network	no	yes
Expandable mathematics block – more than 2 inputs	no	yes
Expandable MOVE block – more than 2 outputs	no	yes
CALCULATE block for complex mathematical expressions	no	yes
Implicit data type conversion	no	yes
Automatic switchover for mathematics block	no	yes
Deactivating ENO	no	yes

Property	S7-300/S7-400	S7-1500
JMP_LIST	no	yes
Concept for libraries with versioning	no	yes
Concept for F libraries with versioning	no	yes
Data type D-WORD for safety program	no	yes, with UDT
D-INT data type for safety program	no	yes

CPU online functions

Table 7-7

Property	S7-300/S7-400	S7-1500
Consistent download of all modifications	no	yes
Download in run mode	yes	yes, simultaneous enabling of modifications, Actual values of DBs are not overwritten
Upload of hardware	yes - restricted	yes
Upload of the entire program	yes - restricted	yes
Trace	no	yes
Symbolic information is saved in the CPU	no	yes

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CPU security functions

Table 7-8

Property	S7-300/S7-400	S7-1500
Knowhow protection/block privacy STD blocks	yes	yes
Knowhow protection/block privacy F blocks	yes	yes
Copy protection	yes	yes
Access protection	no	yes
Additional F access protection	no	yes
Expanded access protection (protection levels) also for HMI	no	yes
Integrity check	no	yes

CPU communication

Table 7-9

Property	S7-300/S7-400	S7-1500
MODBUS TCP	No - separate library required	yes
MODBUS RTU	yes	yes

CPU diagnostics functions

Table 7-10

Property	S7-300/S7-400	S7-1500
Integrated system diagnostics	no	yes
Identical diagnostics on web server , HMI, display and engineering	no	yes

CPU web server

Table 7-11

Property	S7-300/S7-400	S7-1500
File explorer	no	yes
Archive and recipe handling via web server	no	yes

CPU technology functions

Table 7-12

Property	S7-300/S7-400	S7-1500
PID compact controller integrated	no	yes
Motion control integrated according to PLCopen	no	yes
Trace	no	yes

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7.1.3 Digital modules S7-300

Note The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-13

S7-300	Description	S7-1500	Description
Digital input modules			
6ES7 321-1BH02-0AA0	16DE, DC24V	6ES7 521-1BH00-0AB0 or 6ES7 521-1BH10-0AA0	16DE, 24VDC, HF 16DE, 24VDC, BA
6ES7 321-1BH10-0AA0	16DE, DC24V	6ES7 521-1BH00-0AB0	16DE, 24VDC, HF
6ES7 321-7BH01-0AB0	16DE, DC24V, DA, PA	6ES7 521-1BH00-0AB0	16DE, 24VDC, BA
6ES7 321-1BH50-0AA0	16DE, DC24V	6ES7 521-1BH50-0AB0	16DE, 24VDC, SRC BA
6ES7 321-1BL00-0AA0	32DE, DC24V	6ES7 521-1BL00-0AB0 or 6ES7 521-1BL10-0AA0	16DE, 24VDC, HF or 32DE, 24VDC, BA
6ES7 321-1FH00-0AA0	16DE, AC120/230V	6ES7 521-1FH00-0AA0	16DE, 230VAC, BA
6ES7 321-1FF01-0AA0	8DE, AC120/230V	6ES7 521-1FH00-0AA0	16DE, 230VAC, BA
6ES7 321-1FF10-0AA0	8DE, UC120/230V	6ES7 521-1FH00-0AA0	16DE, 230VAC, BA
6ES7 321-1CH00-0AA0	16DE, 24-48V UC	6ES7 521-7CH00-0AB0 or 6ES7 521-7EH00-0AB0	16DE, 24-48V UC HF or 16DE, 24..125V UC HF
6ES7 321-1CH20-0AA0	16DE, DC 48-125V	6ES7 521-7EH00-0AB0	16DE, 24..125V UC HF
6ES7 321-7EH00-0AA0	16DE, DC 424-125V	6ES7 521-7EH00-0AB0	16DE, 24..125V UC HF
Digital output modules			
6ES7 322-1BH01-0AA0	16DA, DC24V/0.5A	6ES7 522-1BH01-0AA0 or 6ES7 522-1BH00-0AB0	16DA, 24VDC/0.5A, BA or 16DA, 24VDC/0.5A, ST
6ES7 322-8BF00-0AB0	8DA, DC24V/0.5A	6ES7 522-1BH00-0AB0	16DA, 24VDC/0.5A, ST
6ES7 322-1BH10-0AA0	16DA, DC24V/0.5A High Speed	6ES7 522-1BH00-0AB0	16DA.24VDC/0.5A, ST
6ES7 322-1BL00-0AA0	32DA, DC24V/0.5A	6ES7 522-1BL00-0AB0 or 6ES7 522-1BL10-0AA0	32DA, 24VDC/0.5A, ST
6ES7 322-7BH01-0AB0	8DA, DC24V, 0.5A	6ES7 522-1BF00-0AB0	8DA, 24VDC/2A HF
6ES7 322-1FH00-0AA0	16DA, AC120/230V	6ES7 522-5FF00-0AB0	8DA, 230VAC/2A, ST
6ES7 322-1FF01-0AA0	8DA, AC120/230V	6ES7 522-5FF00-0AB0	8DA, 230VAC/2A, ST
6ES7 322-5FF00-0AA0	8DA, AC120/230V	6ES7 522-5FF00-0AB0	8DA, 230VAC/2A, ST
6ES7 322-1HH01-0AA0	16DA, AC120/230V,	6ES7 522-5FF00-0AB0	8DA, 230VAC/2A, ST

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S7-300	Description	S7-1500	Description
	relais		
6ES7 322-5GH00-0AA0	16DA, UC 24-48V/0.5A	6ES7 522-5EH00-0AB0	16DA, 24...125V UC/2A HF
6ES7 322-1CF00-0AA0	8DA, DC 48-125V/1.5A	6ES7 522-5EH00-0AB0	16DA, 24...125V UC/2A HF
Digital input/output modules			
6ES7 323-1BL00-0AA0	16DE/16DA	6ES7 523-1BL00-0AA0	16DI, 24VDC/16DA, 24VDC/0.5A BA
6ES7 323-1BH01-0AA0	8DE/8DO	6ES7 523-1BL00-0AA0	16DI, 24VDC/16DA, 24VDC/0.5A BA
Labeling strips for S7-300 and S7-1500			
6ES7 392-2AX10-0AA0 6ES7 392-2BX10-0AA0 6ES7 392-2CX10-0AA0 6ES7 392-2DX10-0AA0	petrol light beige yellow red Labeling strips for 40-pin front connector	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.

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7.1.4 Digital modules S7-400

Note The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-14

S7-400	Description	S7-1500	Description
Digital input modules			
6ES7 421-7BH01-0AB0	16DE, DC24V, DA, PA	6ES7 521-1BH00-0AB0	16DE, 24VDC, HF
6ES7 421-1BL01-0AA0	32DE, DC24V	6ES7 521-1BL10-0AA0	32DE, 24VDC, BA
6ES7 421 1FH20-0AA0	16DE, UC120/230V	6ES7 521-1FH00-0AB0	16DE, 230VAC, BA
6ES7 421-7DH00-0AB0	16DE, 24-48V UC	6ES7 521-7CH00-0AB0	16DE, 24-48V UC HF
6ES7 421-1EL00-0AA0	32DE, AC 120 V	6ES7 521-7EH00-0AB0	16DE, 24…125V UC HF
6ES7 421-1FH20-0AA0	16DE, UC 120/230V	6ES7 521-7EH00-0AB0	16DE, 24…125V UC HF
Digital output modules			
6ES7 422-7BL00-0AB0	32DA, DC24V/0.5A	6ES7 522-1BH00-0AB0 or 6ES7 522-5EH00-0AB0	16DA, 24VDC/0.5A, ST 16DA, 24...125V UC/2A HF
6ES7 422-1BL00-0AA0	32DA, DC24V/0.5A	6ES7 522-1BL00-0AB0 or 6ES7 522-1BL10-0AA0	32DQ, 24VDC/0.5A, ST or 32DQ, 24VDC/0.5A, BA
6ES7 422-1BH11-0AA0	16DA, DC24V/AA	6ES7 522-1BF00-0AB0	8DA, 24VDC/2A, HF
6ES7 422-1FH00-0AA0	16DA, AC120/230V/2A	6ES7 522 5FF00-0AB0	8DA, 230VAC/2A (Triac)
6ES7 422-1HH00-0AA0	16RA, DC60V/230V	6ES7 522-5FF00-0AB0	8DA, 230VAC/2A (Triac)

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

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7.1.5 Analog modules S7-300

Note The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-15

S7-300	Description	S7-1500	Description
Analog input modules			
6ES7 331-7KF02-0AB0	8AE, 12 bit	6ES7 531-7KF00-0AB0	8AE, U/I/R/RTD/TC ST
6ES7 331-1KF01-0AB0	8AE, 13 bit	6ES7 531-7KF00-0AB0	8AE, U/I/R/RTD/TC ST
6ES7 331-7HF01-0AB0	8AE, 14 bit, isosynchronous	6ES7 531-7KF00-0BA0 or 6ES7 531-7NF10-0AB0	8AE, U/I/R/RTD/TC ST 8AE, U/I HS 125µs
6ES7 331-7KB02-0AB0	2AI, 12 bit	6ES7 531-7QD00-0AB0	4AE, U/I/R/RTD/TC ST
6ES7 331-7NF00-0AB0	8AE, 16 bit	6ES7 531-7NF10-0AB0 or 6ES7 531-7NF00-0AB0	8AE, U/I HS 125µs 8AE U/I HF
6ES7 331-7NF10-0AB0	8AE, 16 bit	6ES7 531-7NF10-0AB0 or 6ES7 531-7NF00-0AB0	8AE, U/I HS 125µs or 8AE U/I HF
6ES7 331-7PF01-0AB0	8AE, RTD	6ES7 531-7PF00-0AB0	8AE, R/RTD/TC HF
6ES7 331-7PF11-0AB0	8AE, TC	6ES7 531-7PF00-0AB0	8AE, R/RTD/TC HF
Analog output modules			
6ES7 332-5HD01-0AB0	4AA, 12 bit	6ES7 532-5HD00-0AB0	4AA, U/I ST
6ES7 332-5HB01-0AB0	2 AA, 12 bit	6ES7 532-5NB00-0AB0	2AA, U/I ST
6ES7 332-5HF00-0AB0	4AA, 16 bit, isosynchronous	6ES7 532-5HF00-0AB0	8AA, U/I HS 125µs
6ES7 334-0CE01-0AA0	4AE/2AA, 12 bit	6ES7 534-7QE00-0AB0	4AE, U/I/R/RTD/TC 2AA, U/I ST
6ES7 334-0KE00-0AB0	4AE/2AA, 12 bit	6ES7 534-7QE00-0AB0	4AE, U/I/R/RTD/TC 2AA, U/I ST

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7.1.6 Analog modules S7-400

Note The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-16

S7-400	Description	S7-1500	Description
Analog input modules			
6ES7 431-1KF00-0AB0	8AE, 13 bit, 240ms, U/I/R	6ES7 531-7KF00-0AB0 or 6ES7 531-7NF10-0AB0 or 6ES7 531-7PF00-0AB0	8AE, U/I/R/RTD/TC ST 8AE, U/I, HS 125 µs 8AE, R/RTD/TC HF
6ES7 431-1KF10-0AB0	8AE, 13 bit, 240ms, U/I/R/RTD/TC	6ES7 531-7KF00-0AB0 or 6ES7 531-7NF10-0AB0 or 6ES7 531-7PF00-0AB0	8AE, U/I/R/RTD/TC ST 8AE, R/RTD/TC HF
6ES7 431-0HH00-0AB0	16AE, 13 bit, 65ms, U/I	6ES7 531-7KF00-0AB0	8AE, U/I/R/RTD/TC ST
6ES7 431-7QH00-0AB0	16AE, 16 bit, 25ms, DA, PA, U/I/R/RTD/TC	6ES7 531-7NF10-0AB0 or 6ES7 531-7NF00-0AB0	8AE, U/I, HS 125 µs 8AE U/I HF
6ES7 431-7KF00-0AB0	8AE, 16 bit, DA, 10..100ms, U/I/TC	6ES7 531-7NF10-0AB0 or 6ES7 531-7PF00-0AB0 or 6ES7 531-7NF00-0AB0	8AE, U/I, HS 125 µs 8AE, R/RTD/TC HF 8AE U/I HF
6ES7 431-7KF10-0AB0	8AE, 13 bit, 240ms, U, I, R RTD, TC	6ES7 531-7PF00-0AB0	8AE, R/RTD/TC HF
6ES7 431-1KF20-0AB0	8AE, 14 bit, 640µs, U/I/R	6ES7 531-7NF10-0AB0	8AE, U/I, HS 125 µs
Analog output modules			
6ES7 432-1HF00-0AB0	8AA, 13 bit, 0 -10V/0-20mA, 2ms, U/I	6ES7 532-5HF00-0AB0 or 6ES7532-5ND00-0AB0	8AA, U/I, HS 125 µs 4AA, U/I HF

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7.1.7 Communication modules S7-300

Note

The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-17

Article number	Description	S7-1500	Article number
6ES7 340-1AH02-0AE0	CP 340 RS232	6ES7 540-1AD00-0AA0	CM PtP RS232 BA
6ES7 340-1CH02-0AE0	CP 340 RS422/485	6ES7 540-1AB00-0AA0	CM PtP RS422/485 BA
6ES7 341-1AH02-0AE0	CP 341 RS232	6ES7 541-1AD00-0AB0	CM PtP RS232 HF
6ES7 341-1CH02-0AE0	CP 341 RS422/485	6ES7 541-1AB00-0AB0	CM PtP RS422/485 HF
6ES7 870-1AA01-0YA.	Modbus RTU Master	6ES7 541-1AD00-0AB0 or 6ES7 541-1AB00-0AB0	CM PtP RS232 HF or CM PtP RS422/485 HF
6ES7 870-1AB01-0YA.	Modbus RTU Slave	6ES7 541-1AD00-0AB0 or 6ES7 541-1AB00-0AB0	CM PtP RS232 HF or CM PtP RS422/485 HF

7.1.8 Communication modules S7-400

Note

The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-18

Article number	Description	S7-1500	Article number
6ES7 440-1CS00-0YE0	CP 440 RS 422/485 (ASCII, 3964R)	6ES7 541-1AB00-0AB0	CM PtP RS422/485 HF
6ES7 441-1AA0.-0AE0	CP 441-1 RS232.422.485	6ES7 541-1AB00-0AB0 or 6ES7 541-1AD00-0AB0	CM PtP RS422/485 HF or CM PtP RS232 HF
6ES7 441-2AA0.-0AE0	CP 441-2 RS232, 422, 485	6ES7 541-1AB00-0AB0 or 6ES7 541-1AD00-0AB0	CM PtP RS422/485 HF or CM PtP RS232 HF

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7.1.9 Technology modules S7-300

Note

The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-19

Article number	Description	S7-1500	Description
6ES7 338-4BC01-0AB0	Signal module for reading position values for 3 SSI encoder	6ES7 551-1AB00-0AB0	TM PosInput 2 channels for incr. or SSI encoder for RS422 signals
6ES7 350-1AH03-0AE0	FM 350-1 counter module, up 500KHz	6ES7 550-1AA00-0AB0	TM Count 2x24V channels for 24 V incr. or pulse encoder
6ES7 350-2AH01-0AE0	FM 350-2, 8 channels, counter module, up 20KHz,	6ES7 552-1AA00-0AB0	TM TimerDIDQ 16x24V, 16DE/16DA, time controlled, PWM, oversampling or TM Count 2x24V
6ES7 351-1AH01-0AE0	FM 351, positioning module	6ES7 550-1AA00-0AB0 or 6ES7 551-1AB00-0AB0 + SW functions in the CPU	TM Count 2x24V or TM PosInput2
6ES7 352-1AH02-0AE0	FM352, cam control unit	6ES7 552-1AA00-0AB0 + SW functions in the CPU	TM TimerDIDQ 16x24V, 16 DE/DA, time controlled, PWM, oversampling
6ES7 354-1AH01-0AE0	FM 354, positioning control	Functions integrated in the CPU, I/O interface connection if required	
6ES7 355-1VH10-0AE0	FM 355 S 4 channels, step and pulse	Integrated compact controller + input/output modules	No fuzzy control, Controller structures application possible
6ES7 355-0VH10-0AE0	FM 355 C 4 channels, continuous	Integrated compact controller + input/output modules	No fuzzy control, Controller structures application possible
6ES7 355-2CH00-0AE0	FM 355-2 C 4 channels, continuous	Integrated compact controller + input/output modules	Controller structures application possible
6ES7 355-2SH00-0AE0	FM355-2 S 4 channels, step and pulse	Integrated compact controller + input/output modules	Controller structures application possible

This overview of the function modules is only displayed in a simplified way. To fully implement the hardware, the entire application has to be considered.

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7.1.10 Technology modules S7-400

Note The content of this table is for reference only!

Please note the general information in this chapter:

SIMATIC S7-300/S7-400, S7-1500 components and HMI in comparison

Table 7-20

Article number	Description	S7-1500	Description
6ES7 450-1AP00-0AE0	FM 450-1 counter module, 2 channels	6ES7 550-1AA00-0AB0	TM Count 2 channels for 24 V incr. Or pulse encoder
6ES7 451-3AL00-0AE0	FM 451, positioning module	6ES7 550-1AA00-0AB0 or 6ES7 551-1AB00-0AB0	TM Count 2x24V or TM PosInput 2 and SW functions in the CPU
6ES7 452-1AH00-0AE0	FM 452, cam control unit	6ES7 552-1AA00-0AB0	TM TimerDIDQ 16x24V, 16 DE/DA, time controlled, PWM, oversampling and SW functions in the CPU
6ES7 453-3AH00-0AE0	FM 453, positioning module	Functions integrated in the CPU, I/O interface connection if required	
6ES7 455-0VS00-0AE0	FM 455C, PID control modules, 16 channels, continuous	Integrated compact controller + input/output modules	no fuzzy control, controller structures application possible
6ES7 455-1VS00-0AE0	FM 455S, PID control modules, 16 channels, step and pulse	Integrated compact controller + input/output modules	no fuzzy control, controller structures application possible

This overview of the function modules is only displayed in a simplified way. To fully implement the hardware, the entire application has to be considered.

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7.1.11 Operator panels

Note The content of this table is for reference only!

Extensive information can be found in the panels migration guide:

https://support.industry.siemens.com/cs/ww/en/view/49752044

Table 7-21

Predecessor device	MLFB/article number	Replaced by	MLFB/article number
OP 77B	6AV6641-0CA01-0AX1	KP400 Comfort	6AV2124-1DC01-0AX0
TP 177B 4" Color	6AV6642-0BD01-3AX0	KTP400 Comfort	6AV2124-2DC01-0AX0
TP 177B Mono	6AV6642-0BC01-1AX1	TP700 Comfort	6AV2124-0GC01-0AX0
TP 177B Color	6AV6642-0BA01-1AX1		
TP 277	6AV6643-0AA01-1AX0		
MP 177	6AV6642-0EA01-3AX0		
OP 177B Mono	6AV6642-0DC01-1AX1	KP700 Comfort	6AV2124-1GC01-0AX0
OP 177B Color	6AV6642-0DA01-1AX1		
OP 277	6AV6643-0BA01-1AX0		
MP 277 8" Touch	6AV6643-0CB01-1AX1	TP900 Comfort	6AV2124-0JC01-0AX0
MP 277 8" Key	6AV6643-0DB01-1AX1	KP900 Comfort	6AV2124-1JC01-0AX0
MP 277 10" Touch	6AV6643-0CD01-1AX1	TP1200 Comfort	6AV2124-0MC01-0AX0
MP 277 10" Key	6AV6643-0DD01-1AX1	KP1200 Comfort	6AV2124-1MC01-0AX0
MP 377 12" Touch	6AV6644-0AA01-2AX0	TP1500 Comfort	6AV2124-0QC02-0AX0
MP 377 12" Key	6AV6644-0BA01-2AX1	KP1500 Comfort	6AV2124-1QC02-0AX0
MP 377 15" Touch	6AV6644-0AB01-2AX0	TP1900 Comfort	6AV2124-0UC02-0AX0
MP 377 19" Touch	6AV6644-0AC01-2AX1	TP2200 Comfort	6AV2124-0XC02-0AX0

Note Since comfort panels use widescreen as screen format, old and new operator panels can only be compared to a limited extent.

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8 History

Table 8-1

Version	Date	Modifications
V1.0	09/2015	First version
V1.01	09/2015	Additional note in chapters 1.1, 3.1.2 and 7.1.1
V1.1	05/2017	Expansion of migration of technological functions + general revision

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