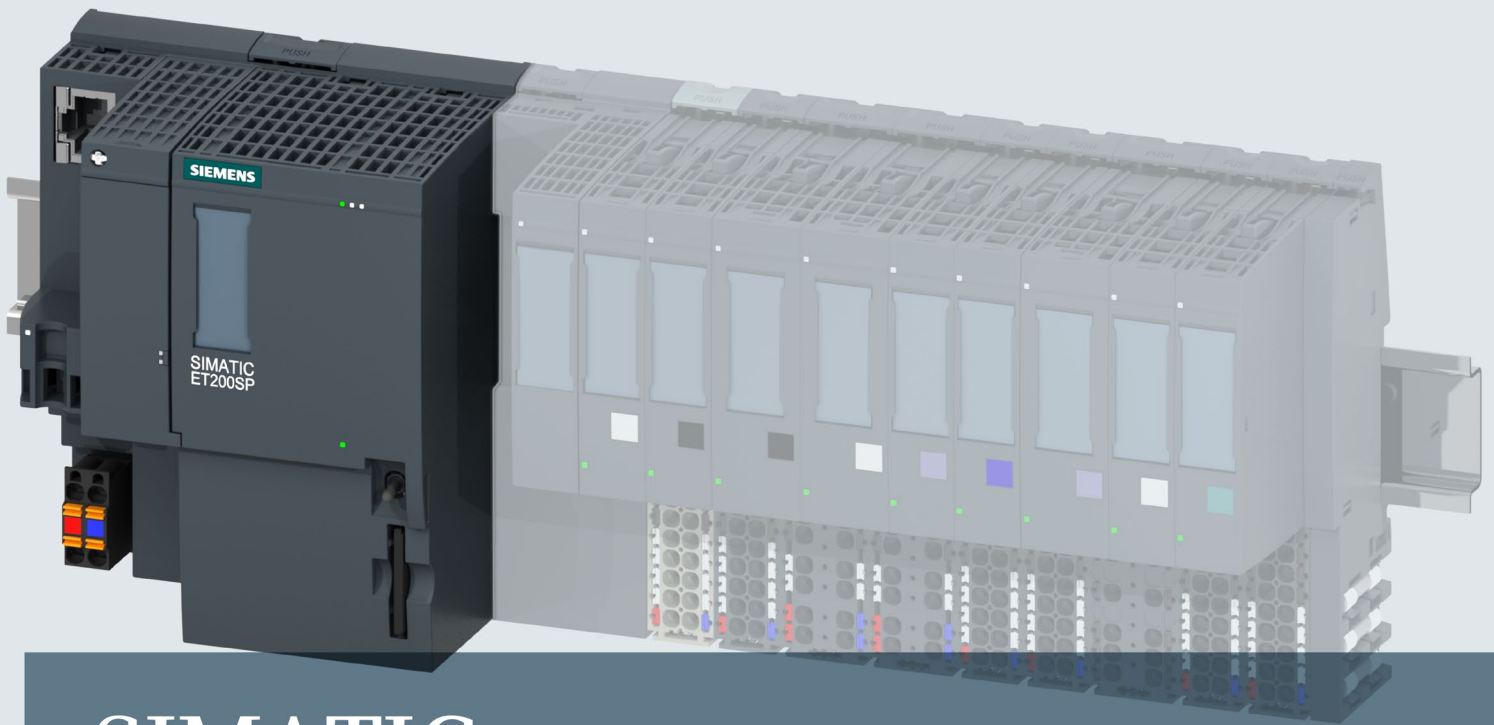# SIEMENS

SIMATIC

ET 200SP

CPU 1510SP-1 PN (6ES7510-1DJ01-0AB0)

Manual

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SIMATIC

ET 200SP
CPU 1510SP-1 PN
(6ES7510-1DJ01-0AB0)

Manual

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

> ### ⚠ DANGER
> indicates that death or severe personal injury **will** result if proper precautions are not taken.

> ### ⚠ WARNING
> indicates that death or severe personal injury **may** result if proper precautions are not taken.

> ### ⚠ CAUTION
> indicates that minor personal injury can result if proper precautions are not taken.

> ### NOTICE
> indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

> ### ⚠ WARNING
> Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Preface

Purpose of the documentation

This manual supplements the ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) system manual as well as the function manuals. This manual contains a description of the module-specific information. The system-related functions are described in the system manual. All system-spanning functions are described in the function manuals.

The information provided in this manual and the system manual allows you to commission the CPU 1510SP-1 PN.

Conventions

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe the notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept.

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Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (http://www.siemens.com/industrialsecurity).

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- **Product support**

  All the information and extensive know-how on your product, technical specifications, FAQs, certificates, downloads, and manuals.

- **Application examples**

  Tools and examples to solve your automation tasks – as well as function blocks, performance information and videos.

- **Services**

  Information about Industry Services, Field Services, Technical Support, spare parts and training offers.

- **Forums**

  For answers and solutions concerning automation technology.

- **mySupport**

  Your personal working area in Industry Online Support for messages, support queries, and configurable documents.

This information is provided by the Siemens Industry Online Support in the Internet (http://www.siemens.com/automation/service&support).

Industry Mall

The Industry Mall is the catalog and order system of Siemens AG for automation and drive solutions on the basis of Totally Integrated Automation (TIA) and Totally Integrated Power (TIP).

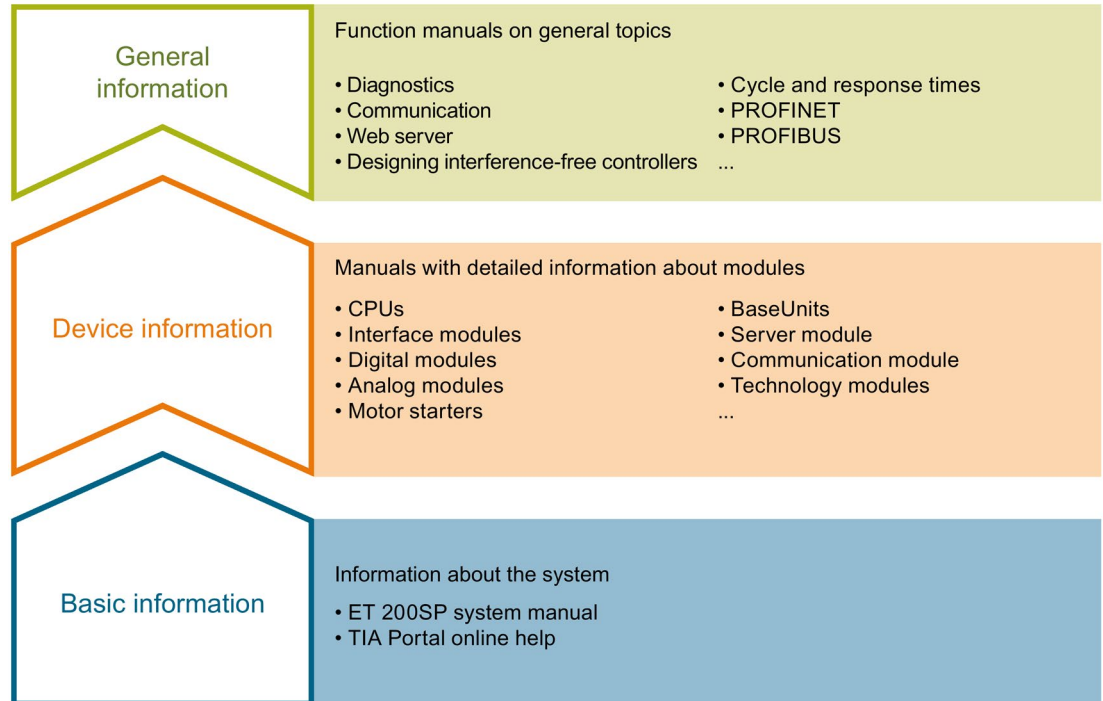Catalogs for all the products in automation and drives are available on the Internet (https://mall.industry.siemens.com).

Table of contents

Documentation guide

The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.
This arrangement enables you to access the specific content you require.

General information

Function manuals on general topics

- Diagnostics
- Communication
- Web server
- Designing interference-free controllers
- Cycle and response times
- PROFINET
- PROFIBUS
- ...

Device information

Manuals with detailed information about modules

- CPUs
- Interface modules
- Digital modules
- Analog modules
- Motor starters
- BaseUnits
- Server module
- Communication module
- Technology modules
- ...

Basic information

Information about the system

- ET 200SP system manual
- TIA Portal online help

Basic information

The system manual describes in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP. distributed I/O system. The STEP 7 online help supports you in the configuration and programming.

Device information

Product manuals contain a compact description of the module-specific information, such as properties, wiring diagrams, characteristics and technical specifications.

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC ET 200SP distributed I/O system, e.g. diagnostics, communication, Web server, motion control and OPC UA.

You can download the documentation free of charge from the Internet (http://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/tech-doc-et200/Pages/Default.aspx).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (https://support.industry.siemens.com/cs/us/en/view/73021864).

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (http://support.automation.siemens.com/WW/view/en/84133942).

"mySupport"

With "mySupport", your personal workspace, you make the most of your Industry Online Support.

In "mySupport" you can store filters, favorites and tags, request CAx data and put together your personal library in the Documentation area. Furthermore, your data is automatically filled into support requests and you always have an overview of your current requests.

You need to register once to use the full functionality of "mySupport".

You can find "mySupport" in the Internet (https://support.industry.siemens.com/My/ww/en).

"mySupport" - Documentation

In the Documentation area of "mySupport", you have the possibility to combine complete manuals or parts of them to make your own manual.
You can export the manual in PDF format or in an editable format.

You can find "mySupport" - Documentation in the Internet (http://support.industry.siemens.com/My/ww/en/documentation).

"mySupport" - CAx Data

In the CAx Data area of "mySupport", you can have access the latest product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find "mySupport" - CAx Data in the Internet (http://support.industry.siemens.com/my/ww/en/CAxOnline).

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus in individual products.

You can find the application examples on the Internet (https://support.industry.siemens.com/sc/ww/en/sc/2054).

TIA Selection Tool

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).
This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.
With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet (http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool).

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to run commissioning and maintenance activities simultaneously on various SIMATIC S7 stations as a bulk operation independently of the TIA Portal.

The SIMATIC Automation Tool provides a multitude of functions:

- Scanning of a PROFINET/Ethernet network and identification of all connected CPUs

- Address assignment (IP, subnet, gateway) and station name (PROFINET device) to a CPU

- Transfer of the data and the programming device/PC time converted to UTC time to the module

- Program download to CPU

- Operating mode switchover RUN/STOP

- Localization of the CPU by means of LED flashing

- Reading out CPU error information

- Reading the CPU diagnostic buffer

- Reset to factory settings

- Updating the firmware of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet (https://support.industry.siemens.com/cs/ww/en/view/98161300).

PRONETA

With SIEMENS PRONETA (PROFINET network analysis), you analyze the plant network during commissioning. PRONETA features two core functions:

- The topology overview independently scans PROFINET and all connected components.

- The IO check is a fast test of the wiring and the module configuration of a system.

You can find SIEMENS PRONETA on the Internet (https://support.industry.siemens.com/cs/ww/en/view/67460624).

Product overview $\quad$ 2

2.1 $\qquad$ New functions in firmware version V2.0

New functions of the CPU in firmware version V2.0

This section lists the new features of the CPU with firmware version V2.0.

You can find additional information in the sections of this manual.

Table 2- 1 $\quad$ New functions of the CPU with firmware version 2.0 compared with firmware version V1.8

New functions	Applications	Customer benefits
OPC UA server	You realize the data communication between different systems, both within the process level and on the control and enterprise levels: • To embedded systems with controllers • To controllers with MES systems and systems of the enterprise level (ERP, asset systems) • To Siemens controllers with controllers from other manufacturers • To intelligent sensors with controllers Supported standard: OPC Data Access, DA.	OPC UA is a unified standard for data communication and is independent of any particular operating system platforms. You have integrated security mechanisms on different automation systems, for example, for data exchange, on the application level, for authentication of the user. OPC UA servers provide a large amount of data: • Values of PLC tags that clients can access • Data types of these PLC tags • Information about the OPC UA server itself and the CPU In this way, clients can gain an overview and can read and write values.
PROFINET IO		
MRPD: Media Redundancy for Planned Duplication for IRT	PROFINET IO IRT enables you to realize applications that place particularly high demands on failure safety and accuracy (isochronous).	By sending the cyclic IO data in both directions in the ring, the communication to the IO devices is maintained even when the ring is interrupted and does not result in device failure even with fast update times. You achieve higher failure safety than with MRP.
PROFINET performance upgrade	You can develop applications with high demands on speed and clock cycles. This is interesting for applications with high demands on performance.	Better utilization of the bandwidth results in short reaction times.
Limitation of the data infeed into the network	You limit the network load for standard Ethernet communication to a maximum value.	You smooth peaks in the data infeed. You share the remaining bandwidth based on requirements.

New functions	Applications	Customer benefits
Web server		
Backing up and restoring via the Web server	You can, for example, backup and restore the configuration of the CPU to the PG/PC on which the Web server is running.	You can make a backup copy of an operational project without STEP 7. In an "emergency", you can simply use an existing configuration without STEP 7, for example, during commissioning or after a program download.
Web server provides up to three project languages for comments and alarm texts	When you export your plants worldwide, for example, comments or alarm texts can be stored on the card in up to 3 languages. For example, German - author's language, English - internationally usable, Portuguese - end user's language.	You provide customers with better service.
Trace via Web server	When you enable trace functions via the Web server, you have better service support. You can send your trace recordings via Web service, for example, to your service partner.	You get plant/project information for diagnostics and maintenance requirements without STEP 7. You can provide trace recordings for each Web server.
Monitoring of configured technology objects via a Web server	You can monitor statuses, errors, technology alarms and the current values of technology objects (TOs) with the Web server.	You save time in troubleshooting.
Motion control		
Greater number of axes for Motion Control applications and new technology objects: Output cam, cam track and measuring input	Speed specification, e.g. for: • Pumps, fans, mixers • Conveyor belts • Auxiliary drives Positioning tasks, e.g.: • Lifting and vertical conveyors • Feeding and gate control • Palletizing equipment Output cams and cam tracks make other applications possible, e.g.: • Applying glue tracks • Triggering switching operations with precise positioning • Very precise processing of products on a conveyor belt Measuring inputs are used, for example: • For measuring products • For detecting the position of the product on a conveyor belt	You can implement additional Motion Control applications with a CPU. The scalable configuration limits allow you to handle all types of application. High machine speeds result in greater productivity with better accuracy.

New functions	Applications	Customer benefits
ET 200SP		
Support for ET 200AL in a central configuration	You can set up a simple connection of IP 65/67 I/O to the CPU. You can connect up to 16 ET 200AL I/O modules via a BA send module on the central bus of the ET 200SP CPU. The distance between two ET 200AL modules can be up to 15 m. You can realize the use of ET 200AL in assembly and handling engineering directly at moving parts, for example in linear axes or drag chains.	You do not have to individually run sensors or actuators at the central control cabinet to the different sections of a machine or assembly line. You save time and costs: • Through lightweight construction • Reduction of wear and exposure to vibration • Increased productivity
Increasing the address space in the station	For example, you can use up to 49 ET 200SP energy meter modules behind an ET 200SP CPU.	A larger address space of 2560 bytes (2048 bytes for ET 200SP module + 512 bytes for ET 200AL modules) is available in the station. The address space has been increased to 288 bytes per module.
Support for communications processors		
CP 1542SP-1	Flexible expansion of the ET 200SP system with an additional Ethernet interface; network separation.	
CP 1542SP-1 IRC	Seamless data recording with time stamping, support for standardized telecontrol protocols DNP3 and IEC.	
CP 1543SP-1 ISEC	With the integrated security functions firewall (Stateful Inspection) and VPN protocol (IPSec), the communications processor protects ET200SP stations and subordinate networks against unauthorized access, and employs encryption to protect data transmission against manipulation and espionage.	

2.2 Operating principle

The CPU contains the operating system and executes the user program. The user program is located on the SIMATIC memory card and is processed in the work memory of the CPU.

The PROFINET interfaces on the CPU allow simultaneous communication with PROFINET devices, PROFINET controllers, HMI devices, programming devices, other controllers and other systems. The CPU 1510SP-1 PN supports operation as an IO controller, I-device or standalone CPU.

With its optional PROFIBUS interface, CM DP, CPU 1510SP-1 PN supports the configuration of PROFIBUS networks in addition to PROFINET IO. When you use the interface as a PROFIBUS DP interface, you can configure the CPU 1510SP-1 PN as a DP master or as an intelligent DP slave (I-slave).

IO controller

CPU 1510SP-1 PN sends and receives data from the connected IO devices within a PROFINET IO system. You can operate the CPU with a maximum of 64 connected IO devices, a maximum of 64 of which use IRT (Isochronous Real Time).

I-device

The "I-device" (intelligent IO device) functionality allows you to exchange data with an IOcontroller. CPU 1510SP-1 PN thus fulfills the role of an intelligent distributed pre-processing unit for sub-processes. The I-device is connected as an IO device to a higher-level IO controller for this purpose.

Advantages:

● Interference-resistant configuration due to short signal and encoder wiring

● Reduced wiring requirements for transmission of the data via PROFINET

Standalone CPU

You can also use the CPU 1510SP-1 PN in the ET 200SP distributed I/O system as a "central system" without a higher-level controller.

DP master

To use the ET 200SP as a DP master, you need the CPU and the optional communication module, CM DP. When used as a DP master, ET 200SP exchanges data with the connected DP slaves via PROFIBUS DP.

Intelligent DP slave (I-slave)

To use the ET 200SP as an intelligent DP slave (I-slave), you need the CPU and the optional communication module, CM DP. As an I-slave, the ET 200SP CPU is connected via PROFIBUS DP to a higher-level DP master and exchanges data with it.

2.3   Properties

Article number

6ES7510-1DJ01-0AB0

View of the module

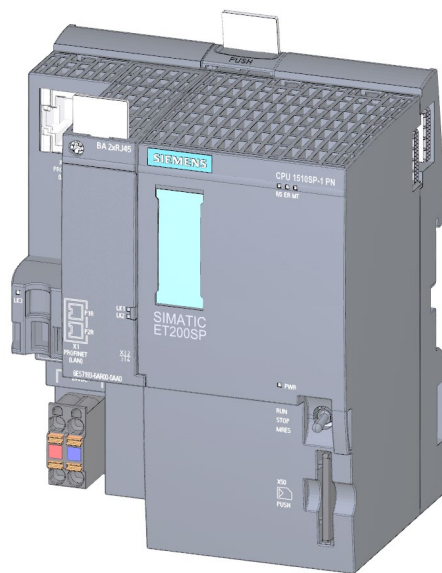The following figure shows the CPU 1510SP-1 PN.

Figure 2-1   CPU 1510SP-1 PN

Properties

The CPU 1510SP-1 PN has the following technical properties:

- Communication:

  – Interfaces

    The CPU 1510SP-1 PN has a PROFINET interface (X1 P3) with an integrated 3-port switch. Port 1 and port 2 are located on the optionally pluggable BusAdapter. Port 3 is integrated in the housing of the CPU. The CPU supports the BusAdapters BA 2xRJ45 and BA 2xFC. You connect the PROFINET IO to the CPU via the BusAdapter.

    In addition to PROFINET basic functionality, the interface also supports PROFINET IO RT (real-time) and IRT (isochronous real-time). PROFINET IO communication or real-time settings can be configured. The basic functionality of PROFINET supports HMI communication, communication with the configuration system, communication with a higher-level network (backbone, router, Internet) and communication with another machine or automation cell.

    Port 1 and port 2 can also be used as ring ports for the configuration of redundant ring structures in Ethernet.

    ### Note

    The CPU is delivered without a BusAdapter. You can find the article numbers of the supported BusAdapters in the "Accessories/spare parts" section of the ET 200SP distributed automation system (http://support.automation.siemens.com/WW/view/en/58649293) system manual.

    The CM DP is optionally available with a PROFIBUS interface (X2). You can find additional information about this expansion module in the manual Communication module CM DP (http://support.automation.siemens.com/WW/view/en/90156526).

    You can find information about connecting the PROFINET IO BusAdapter to the CPU as well as connecting the optional PROFIBUS interface to the interface module in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293).

  – OPC UA
    With OPC UA, data is exchanged via an open and vendor-neutral communication protocol. The CPU, as OPC UA server, can communicate with OPC UA clients such as HMI panels, SCADA systems, etc.

- Integrated Web server:

  A Web server is integrated in the CPU. You can read out the following information with the Web server:

  – Start page with general CPU information

  – Identification information

  – Contents of the diagnostics buffer

  – Query of module states

  – Firmware update

  – Alarms (without acknowledgment option)

  – Information about communication

  – PROFINET topology

  – Tag status, writing tags

  – Watch tables

  – Memory usage

  – User pages

  – Data logs (if used)

  – Online backup and restoration of the configuration.

  – Diagnostic information for the motion control technology objects

  – Display of trace recordings stored on the SIMATIC memory card

  – Readout service data

  – Basic Web pages

  – Display of the Web server in 3 project languages, for example, comments and message texts

  – Recipes

  – User-defined Web pages

- Integrated technology:

  – Motion Control

    The Motion Control functionality uses technology objects to support speed-controlled axes, positioning axes, synchronous axes, external encoders, cams, cam tracks and measuring inputs, as well as PLCopen blocks for programming the motion control functionality.
    You can find a detailed description of the use of Motion Control and its configuration in the S7-1500 Motion Control (http://support.automation.siemens.com/WW/view/en/109739589) function manual.
    You can also use the TIA Selection Tool (http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool) or the SIZER (http://w3.siemens.com/mcms/mc-solutions/en/engineering-software/drive-design-tool-sizer/Pages/drive-design-tool-sizer.aspx) to create or configure axes.

  – Integrated closed-loop control functionality

    - PID Compact (continuous PID controller)

    - PID 3Step (step controller for integrating actuators)

    - PID Temp (temperature controller for heating and cooling with two separate actuators)

- Trace functionality:

  – Trace functionality supports you in troubleshooting and optimizing the user program, especially for motion control or closed-loop control applications. Trace only supports saves measurements on a SIMATIC memory card. You will find additional information on "Trace" in the Using the trace and logic analyzer function (http://support.automation.siemens.com/WW/view/en/64897128) function manual.

- Integrated system diagnostics:

  – The alarms for the system diagnostics are automatically created by the system and displayed on a PG/PC, HMI device or the Web server. System diagnostics information is also available when the CPU is in STOP mode.

- Integrated security:

  – Know-how protection

    The assignment of passwords protects user blocks against unauthorized access and modifications.

  – Copy protection

    Copy protection links user blocks to the serial number of the SIMATIC memory card or to the serial number of the CPU. User programs cannot run without the corresponding SIMATIC memory card or CPU.

  – Access protection

    Extended access protection provides high-quality protection against unauthorized configuration changes. You can use authorization levels to assign separate rights to different user groups.

  – Integrity protection

    The system protects the data transferred to the CPU against manipulation. The CPU detects erroneous or manipulated engineering data.

    You can find additional information on the topic of "Protection" in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293).

- Support for ET 200AL

  – Simple connection of IP 65/67 I/O modules to the CPU.

- Communication CPs

  – CP 1542SP-1: Flexible expansion of the ET 200SP system with an additional Ethernet interface; network separation.

  – CP 1542SP-1 IRC: Seamless data recording with time stamping, support for standardized telecontrol protocols DNP3 and IEC.

  – CP 1543SP-1 ISEC: With the integrated security functions firewall (Stateful Inspection) and VPN protocol (IPSec), the communications processor protects ET200SP stations and subordinate networks against unauthorized access, and employs encryption to protect data transmission against manipulation and espionage.

- Address space

  – A larger address space of 2560 bytes (2048 bytes for ET 200SP module + 512 bytes for ET 200AL modules) is available within the station.

- CPU 1510SP-1 PN supports the following additional functions:

  – PROFIenergy
  You can find information on the topic of "PROFIenergy" in the PROFINET function manual (https://support.industry.siemens.com/cs/ww/en/view/49948856) and in the PROFINET specification on the Internet (http://www.profibus.com).

  – Shared device
  You can find information on the topic of "Shared device" in the PROFINET function manual (https://support.industry.siemens.com/cs/ww/en/view/49948856).

  – Configuration control
  You can find information on the topic of "Configuration control" in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293).

  – Isochronous mode
  You can find information about the "Isochronous mode" topic in the PROFINET (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.

2.4 Operating and display elements

2.4.1 Front view of the module with BusAdapter

The figure on the left shows the CPU 1510SP-1 PN including a plugged BA 2xRJ45 BusAdapter. The figure on the right shows a separate view of the BA 2xRJ45 BusAdapter.
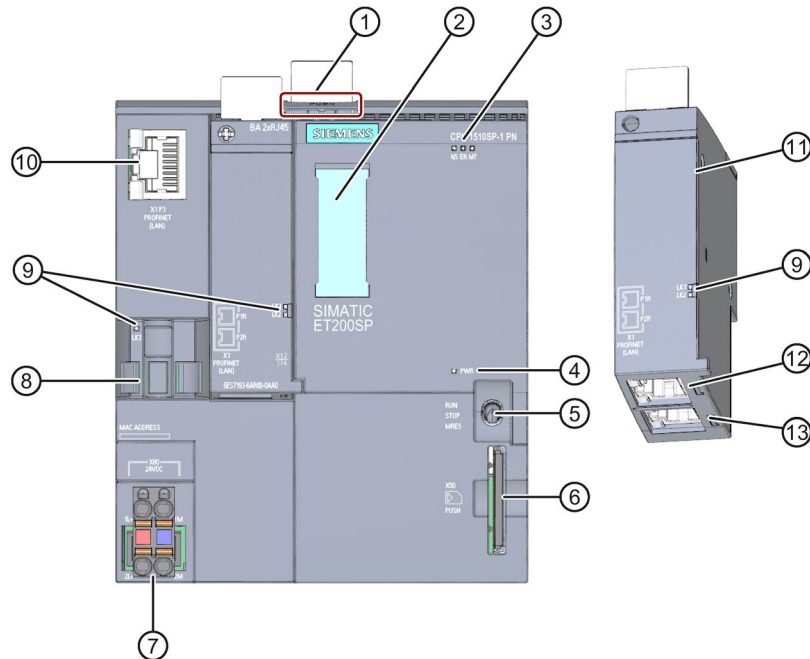
①	Mounting rail release
②	Labeling strips
③	LEDs for status and error displays
④	LED for display of the supply voltage
⑤	Mode switch
⑥	Slot for the SIMATIC memory card
⑦	Connection for supply voltage (included in product package)
⑧	Cable support and attachment for port P3 of the PROFINET interface
⑨	LEDs for status displays of the PROFINET interface: LK1 and LK2 on BusAdapter, LK3 on CPU
⑩	Port P3 of the PROFINET interface: RJ45 socket
⑪	Separate view of the BusAdapter
⑫	Port P1 R of the PROFINET interface: RJ45 socket on BusAdapter BA 2×RJ45
	R: Ring port for configuring a ring topology with media redundancy
⑬	Port P2 R of the PROFINET interface: RJ45 socket on BusAdapter BA 2×RJ45
	R: Ring port for configuring a ring topology with media redundancy

Figure 2-2   Front view of the CPU 1510SP-1 PN with BusAdapter

2.5 Mode switch

Use the mode switch to set the CPU operating mode.

The following table shows the position of the switch and the corresponding meaning.

Table 2- 2   Mode switch settings

| Position	Meaning	Explanation
RUN	RUN mode	The CPU is executing the user program.
STOP	STOP mode	The user program is not being executed.
MRES	Memory reset	Position for CPU memory reset.

Wiring 3

3.1 Pin assignment

This section provides information on the pin assignment of the individual interfaces and the block diagram of the CPU 1510SP-1 PN.

24 V DC supply voltage (X80)

The connector for the supply voltage is plugged in when the CPU ships from the factory.

The figure below shows the pin assignment for 24 V DC supply voltage.
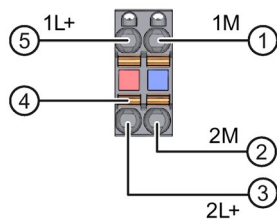
①   Ground of the supply voltage
②   Ground of the supply voltage for loop-through (maximum of 10 A permitted)
③   +24 V DC of the supply voltage for loop-through (maximum of 10 A permitted)
④   Spring NC contacts
⑤   + 24 V DC of the supply voltage

Internally jumpered:
① and ②
③ and ⑤

Figure 3-1   Supply voltage connection

PROFINET IO interface on the CPU (X1 P3)

The assignment corresponds to the Ethernet standard for an RJ45 connector.

- When autonegotiation is deactivated, the RJ45 socket is allocated as a switch (MDI-X).

- If autonegotiation is activated, then autocrossing is active and the RJ45 socket has either a device assignment (MDI) or switch assignment (MDI-X).
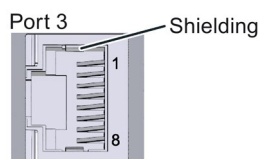
PROFINET IO interface on the BusAdapter BA 2xRJ45 (X1 P1 R and X1 P2 R)

The assignment at the BA 2xRJ45 BusAdapter corresponds to the Ethernet standard for an RJ45 connector.

Table 3- 1   Pin assignment PROFINET IO interface on the BusAdapter BA 2xRJ45
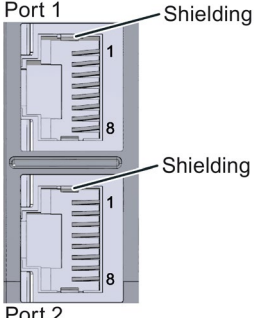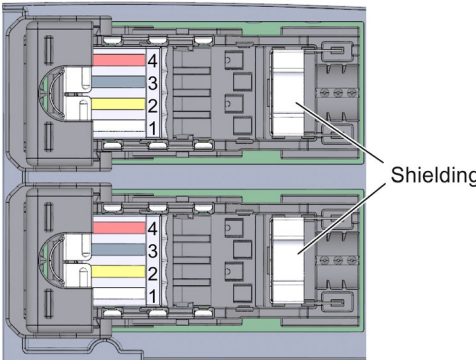
View	Designation
	• When autonegotiation is deactivated, the RJ45 socket is allocated as a switch (MDI-X). • If autonegotiation is activated, then autocrossing is active and the RJ45 socket has either a device assignment (MDI) or switch assignment (MDI-X).

PROFINET IO interface on the BusAdapter BA 2xFC (X1 P1 R and X1 P2 R)

The following table shows the pin assignment for the PROFINET IO interface on the BusAdapter BA 2xFC.

Table 3- 2   Pin assignment PROFINET IO interface on the BusAdapter BA 2xFC

View	Signal name		Designation
	1	TD	Transmit data +
	2	TD_N	Transmit data -
	3	RD	Receive data +
	4	RD_N	Receive data -

Reference

You can find additional information on the topics of "Connecting the CPU" and "Accessories/spare parts" in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293).

Assignment of the MAC addresses

The MAC address is a globally unique device identifier that is assigned to each PROFINET device in the factory. Its 6 bytes are divided into 3 bytes for the manufacturer ID and 3 bytes for the device ID (serial number). The front of the CPU 1510SP-1 PN is lasered with the MAC address of the PROFINET interface.

The PROFINET interface (X1) of the CPU 1510SP-1 PN has three ports. Port 3 is located on the CPU. Ports 1 and 2 are located on the optional BusAdapter. In addition to the PROFINET interface, each PROFINET port also has a separate MAC address. There is therefore a total of four MAC addresses for the CPU 1510SP-1 PN.

The MAC addresses of the PROFINET ports are needed for the LLDP protocol, for example for the neighborhood discovery function.

The table below shows how the MAC addresses are assigned.

Table 3- 3　　Assignment of the MAC addresses

	Assignment
MAC address 1	PROFINET interface X1 • Visible in STEP 7 for accessible devices • Lasered on the front of the CPU (start of the number range)
MAC address 2	Port X1 P1 R (required for LLDP, for example)
MAC address 3	Port X1 P2 R (required for LLDP, for example)
MAC address 4	Port X1 P3 (required for LLDP, for example)

Block diagram

The following figure shows the block diagram of the CPU 1510SP-1 PN.
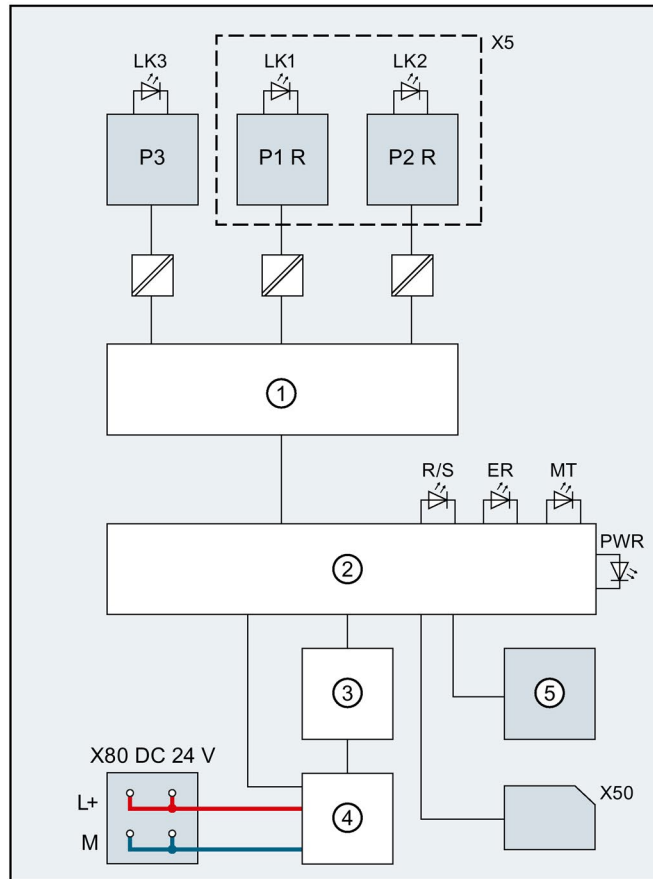
①	PROFINET switch	P1 R	PROFINET interface X1 Port 1
②	Electronics	P2 R	PROFINET interface X1 Port 2
③	Backplane bus interface	P3	PROFINET interface X1 Port 3
④	Internal supply voltage	L+	24 V DC supply voltage
⑤	RUN/STOP/MRES mode selector	M	Ground
X5	BusAdapter	LK1, 2, 3	LED Link TX/RX
X50	SIMATIC memory card	R/S	RUN/STOP LED (yellow/green)
X80 24 V DC	Infeed of supply voltage	ER	ERROR LED (red)
		MT	MAINT LED (yellow)
		PWR	POWER LED (green)

Figure 3-2   Block diagram of the CPU 1510SP-1 PN

Interrupts, error messages, diagnostics and system alarms

<div style="text-align: right; font-size: 3em;">4</div>

The status and error displays of the CPU 1510SP-1 PN are described below.

You will find additional information on "Interrupts" in the STEP 7 online help.

You can find additional information on the topics of "Diagnostics" and "System alarms" in the Diagnostics (http://support.automation.siemens.com/WW/view/en/59192926) function manual.

4.1 Status and error display of the CPU

LED displays

The figure below shows the LED displays of the CPU 1510SP-1 PN and the BA 2xRJ45 BusAdapter.

① RUN/STOP LED (yellow/green LED)
② ERROR LED (red LED)
③ MAINT LED (yellow LED)
④ LINK RX/TX LED for ports X1 P1 and X1 P2 (green LEDs on BusAdapter)
⑤ POWER LED (green LED)
⑥ LINK RX/TX LED for port X1 P3 (green LED on CPU)
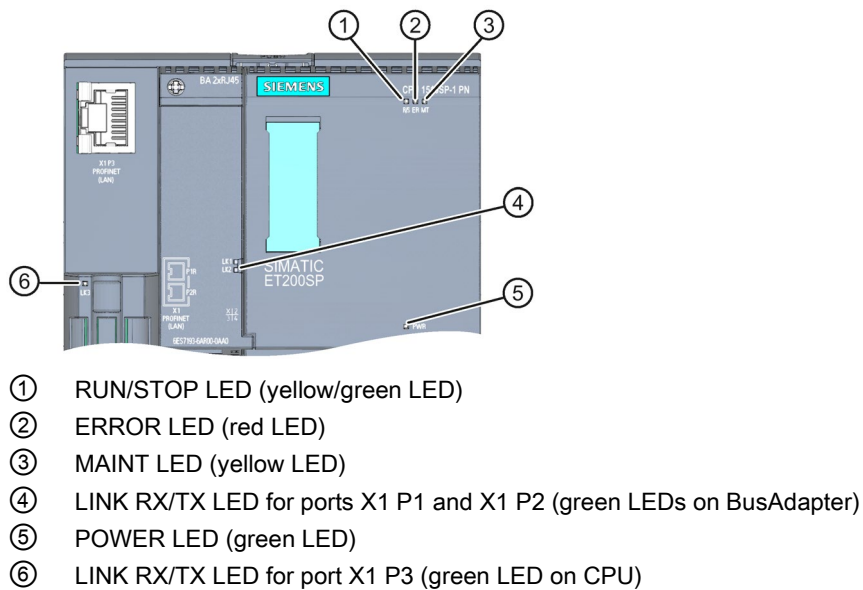
Figure 4-1   LED displays on the CPU and BusAdapter

Meaning of the POWER, RUN/STOP, ERROR and MAINT LEDs

CPU 1510SP-1 PN features an LED for monitoring the supply voltage of the electronics (PWR) and three LEDs for displaying the current operating and diagnostics status. The following table shows the meaning of the various combinations of colors for the POWER, RUN/STOP, ERROR and MAINT LEDs.

Table 4- 1   Meaning of the LEDs

POWER LED	RUN/STOP LED	ERROR LED	MAINT LED	Meaning
□ LED off	▤ LED off	□ LED off	□ LED off	Missing or insufficient power supply on the CPU.
■ LED lit green	▤ LED off	☀ LED flashes red	□ LED off	An error has occurred.
■ LED lit green	■ LED lit green	□ LED off	□ LED off	CPU is in RUN mode.
■ LED lit green	■ LED lit green	☀ LED flashes red	□ LED off	A diagnostics event is pending.
■ LED lit green	■ LED lit green	□ LED off	■ LED lit yellow	Maintenance demanded for the plant. The affected hardware must be checked/replaced within a short period of time.
				Active Force job
				PROFIenergy pause
■ LED lit green	■ LED lit green	□ LED off	☀ LED flashes yellow	Maintenance required for the plant. The affected hardware must be checked/replaced within a foreseeable period of time.
				Bad configuration
■ LED lit green	■ LED lit yellow	□ LED off	☀ LED flashes yellow	Firmware update successfully completed.
■ LED lit green	■ LED lit yellow	□ LED off	□ LED off	CPU is in STOP mode.
■ LED lit green	■ LED lit yellow	☀ LED flashes red	☀ LED flashes yellow	The program on the SIMATIC memory card is causing an error.
				CPU defective
■ LED lit green	☀ LED flashes yellow	□ LED off	□ LED off	CPU is performing internal activities during STOP, e.g. startup after STOP.
				Download of the user program from the SIMATIC memory card
■ LED lit green	☀ LED flashes yellow/green	□ LED off	□ LED off	Startup (transition from RUN → STOP)
■ LED lit green	☀ LED flashes yellow/green	☀ LED flashes red	☀ LED flashes yellow	Startup (CPU booting)
				Test of LEDs during startup, inserting a module.
				LED flashing test

Meaning of the LINK LED

Each port has a LINK LED (LK1, LK2, LK3). The table below shows the various "LED scenarios" of the ports of the CPU 1510SP-1 PN.

Table 4- 2   Meaning of the LEDs

LINK LED	Meaning
□ LED off	There is no Ethernet connection between the PROFINET interface of the PROFINET device and the communication partner. No data is currently being sent/received via the PROFINET interface. There is no LINK connection.
☀ LED flashes green	The "LED flashing test" is being performed.
■ LED lit green	There is an Ethernet connection between the PROFINET interface of your PROFINET device and a communication partner.

Technical specifications

<div style="text-align: right; font-size: 3em;">5</div>

	6ES7510-1DJ01-0AB0
General information	
Product type designation	CPU 1510SP-1 PN
Hardware function version	FS03
Firmware version	V2.0
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of version	V14
Configuration control	
Via data record	Yes
Operator controls	
Mode selector	1
Supply voltage	
Type of supply voltage	24 V DC
Low limit of permitted range (DC)	19.2 V
High limit of permitted range (DC)	28.8 V
Reverse polarity protection	Yes
Power and voltage failure buffering	
Power/voltage failure buffer time	5 ms
Input current	
Current consumption (rated value)	0.6 A
Inrush current, max.	4.7 A; rated value
I²t	0.14 A²s
Power	
Incoming power to the backplane bus	8.75 W
Power loss	
Power loss, typ.	5.6 W
Memory	
Number of slots for SIMATIC memory card	1
SIMATIC memory card required	Yes
Work memory	
Integrated (for program)	100 KB
Integrated (for data)	750 KB
Load memory	
Plug-in (SIMATIC memory card), max.	32 GB
Buffering	
Maintenance-free	Yes

	6ES7510-1DJ01-0AB0
CPU processing times	
For bit operations, typ.	72 ns
For word operations, typ.	86 ns
For fixed-point arithmetic, typ.	115 ns
For floating-point arithmetic, typ.	461 ns
CPU blocks	
Number of elements (total)	2000; blocks (OB/FB/FC/DB) and UDTs
DB	
Number range	1 ... 60 999; divided into: Number range that can be used by user: 1 ... 59 999 and number range for DBs generated by SFC 86: 60 000 ... 60 999
Size, max.	750 KB; for absolutely addressed DBs, the max. size is 64 KB
FB	
Number range	0 ... 65 535
Size, max.	100 KB
FC	
Number range	0 ... 65 535
Size, max.	100 KB
OB	
Size, max.	100 KB
Number of free-cycle OBs	100
Number of time-of-day interrupt OBs	20
Number of time-delay interrupt OBs	20
Number of cyclic interrupt OBs	20
Number of hardware interrupt OBs	50
Number of DPV1 interrupt OBs	3
Number of isochronous mode OBs	1
Number of technology synchronous interrupt OBs	2
Number of startup OBs	100
Number of asynchronous error OBs	4
Number of synchronous error OBs	2
Number of diagnostic interrupt OBs	1
Nesting depth	
Per priority class	24
Counters, timers and their retentivity	
S7 counters	
Quantity	2048
Retentivity	
• can be set	Yes

	6ES7510-1DJ01-0AB0
IEC counters	
Quantity	Any (only limited by the work memory)
Retentivity	
• can be set	Yes
S7 timers	
Quantity	2048
Retentivity	
• can be set	Yes
IEC timers	
Quantity	Any (only limited by the work memory)
Retentivity	
• can be set	Yes
Data areas and their retentivity	
Total retentive data area (including timers, counters, bit memories), max.	128 KB; for bit memories, timers, counters, DBs and technological data (axes), usable retentive memory: 88 KB
Bit memory	
Number, max.	16 KB
Number of clock memories	8; there are 8 clock memory bits, grouped in one clock memory byte
Data blocks	
Retentivity can be set	Yes
Retentivity preset	No
Local data	
Per priority class, max.	64 KB; max. 16 KB per block
Address area	
Number of IO modules	1024; max. number of modules/submodules
I/O address area	
Inputs	32 KB; all inputs are in the process image
Outputs	32 KB; all outputs are in the process image
Of which per integrated IO subsystem	
• Inputs (volume)	8 KB
• Outputs (volume)	8 KB
Of which per CM/CP	
• Inputs (volume)	8 KB
• Outputs (volume)	8 KB
Process image partitions	
Number of process image partitions, max.	32
Address space per module	
Address space per module, max.	288 bytes; for both input and output data

	6ES7510-1DJ01-0AB0
Address space per station	
Address space per station, max.	2560 bytes; for central inputs and outputs; depending on configuration; 2048 bytes for ET 200SP modules + 512 bytes for ET 200AL modules
Hardware configuration	
Number of distributed IO systems	32; a distributed IO system is understood to mean the integration of distributed I/O via PROFINET or PROFIBUS communication modules as well as the connection of I/O via AS-i master modules or links (e.g. IE/PB link)
Number of DP masters	
Via CM	1
Number of IO controllers	
Integrated	1
Via CM	0
Rack	
Modules per rack, max.	80; CPU + 64 modules + server module (configuration width max. 1 m) + 16 ET 200AL modules
Number of rows, max.	1
PtP CM	
Number of PtP CMs	The number of PtP CMs that can be connected is only limited by the available slots
Time	
Clock	
Type	Hardware clock
Backup duration	6 wk; at 40 °C ambient temperature, typ.
Deviation per day, max.	10 s; typ.: 2 s
Operating hours counter	
Quantity	16
Time-of-day synchronization	
Supported	Yes
On DP, master	Yes; via CM DP module
On DP, slave	Yes; via CM DP module
In AS, master	Yes
In AS, slave	Yes
On Ethernet via NTP	Yes
Interfaces	
Number of PROFINET interfaces	1
Number of PROFIBUS interfaces	1; via CM DP module
With optical interface	No

	6ES7510-1DJ01-0AB0
1st interface	
Interface hardware	
Number of ports	3; 1st integrated + 2nd via BusAdapter
Integrated switch	Yes
RJ45 (Ethernet)	Yes; X1 P3; opt. X1 P1 and X1 P2 via BusAdapter BA 2xRJ45
BusAdapter (PROFINET)	Yes; usable BusAdapters: BA 2x RJ45, BA 2x FC
Protocols	
PROFINET IO controller	Yes
PROFINET IO device	Yes
SIMATIC communication	Yes
Open IE communication	Yes
Web server	Yes
Media redundancy	Yes
PROFINET IO controller	
Services	
• PG/OP communication	Yes
• S7 routing	Yes
• Isochronous mode	Yes
• Open IE communication	Yes
• IRT	Yes
• MRP	Yes; as MRP redundancy manager and/or MRP client; max. number of devices in the ring: 50
• MRPD	Yes; requirement: IRT
• PROFIenergy	Yes
• Prioritized startup	Yes; max. 32 PROFINET devices
• Number of connectable IO devices, max.	64; a total of up to 256 distributed I/O devices can be connected via AS-i, PROFIBUS or PROFINET
• of these, IO devices with IRT, max.	64
• Number of connectable IO devices for RT, max.	64
• of these, in a line topology, max.	64
• Number of IO devices that can be activated/deactivated simultaneously, max.	8; in total over all interfaces
• Number of IO devices per tool, max.	8
• Update times	The minimum value of the update time also depends on the communication allocation setting for PROFINET IO, the number of IO devices and the amount of configured user data

	6ES7510-1DJ01-0AB0
Update time with IRT	
• With send clock of 250 µs	250 µs to 4 ms; note: with IRT with isochronous mode, the minimum update time of 625 µs of the isochronous OB is crucial
• With send clock of 500 µs	500 µs to 8 ms; note: with IRT with isochronous mode, the minimum update time of 625 µs of the isochronous OB is crucial
• With send clock of 1 ms	1 ms to 16 ms
• with send clock of 2 ms	2 ms to 32 ms
• with send clock of 4 ms	4 ms to 64 ms
• with IRT and "odd" send clock parameter assignment	Update time = set "odd" send clock (any multiple of 125 µs: 375 µs, 625 µs to 3 875 µs)
Update time with RT	
• With send clock of 250 µs	250 µs to 128 ms
• With send clock of 500 µs	500 µs to 256 ms
• With send clock of 1 ms	1 ms to 512 ms
• with send clock of 2 ms	2 ms to 512 ms
• with send clock of 4 ms	4 ms to 512 ms
PROFINET IO device	
Services	
• PG/OP communication	Yes
• S7 routing	Yes
• Isochronous mode	No
• Open IE communication	Yes
• IRT	Yes
• MRP	Yes
• MRPD	Yes; requirement: IRT
• PROFIenergy	Yes
• Shared device	Yes
• Number of IO controllers with shared device, max.	4
2nd interface	
Interface hardware	
Number of ports	1
RS 485	Yes; via CM DP module
Protocols	
PROFIBUS DP master	Yes
PROFIBUS DP slave	Yes
SIMATIC communication	Yes

	6ES7510-1DJ01-0AB0
Interface hardware	
RJ45 (Ethernet)	
100 Mbps	Yes
Autonegotiation	Yes
Autocrossing	Yes
Industrial Ethernet status LED	Yes
RS 485	
Transmission rate, max.	12 Mbps
Protocols	
Number of connections	
Number of connections, max.	96
Number of connections reserved for ES/HMI/Web	10
Number of connections via integrated interfaces	64
Number of connections per CP/CM	32
Number of S7 routing connections	16
SIMATIC communication	
S7 communication, as server	Yes
S7 communication, as client	Yes
User data per job, max.	See online help (S7 communication, user data size)
Open IE communication	
TCP/IP	Yes
• Data length, max.	64 KB
• Multiple passive connections per port, supported	Yes
ISO-on-TCP (RFC1006)	Yes
• Data length, max.	64 KB
UDP	Yes
• Data length, max.	1472 bytes
DHCP	No
SNMP	Yes
DCP	Yes
LLDP	Yes
Web server	
HTTP	Yes; standard and user-defined pages
HTTPS	Yes; standard and user-defined pages

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	6ES7510-1DJ01-0AB0
PROFIBUS DP master	
Number of connections, max.	48
Services	
• PG/OP communication	Yes
• S7 routing	Yes
• Data record routing	Yes
• Isochronous mode	No
• Constant bus cycle time	No
• Number of DP slaves	125; a total of up to 256 distributed I/O devices can be connected via AS-i, PROFIBUS or PROFINET
• Activation/deactivation of DP slaves	Yes
OPC UA	
OPC UA server	Yes; Data Access (Read, Write, Subscribe), Runtime license required
• Application authentication	Yes
• Security Policies	Available Security Policies: None, Basic128Rsa15, Basic256Rsa15, Basic256Sha256
• User authentication	"Anonymous" or with user name and password
Additional protocols	
MODBUS	Yes; MODBUS TCP
Media redundancy	
Switchover time in the case of cable break, typ.	200 ms; with MRP; bumpless with MRPD
Number of devices in the ring, max.	50
Isochronous mode	
Isochronous mode (application synchronized up to terminal)	Yes; only with PROFINET; with a minimum OB 6x cycle of 625 µs
S7 signaling functions	
Number of stations that can be logged in for signaling functions, max.	32
Block-related alarms	Yes
Number of configurable interrupts, max.	5000
Number of simultaneously active interrupts in interrupt pool	
• Number of reserved user interrupts	300
• Number of reserved interrupts for system diagnostics	100
• Number of reserved interrupts for motion control technology objects	80

	6ES7510-1DJ01-0AB0
Test/commissioning functions	
Shared commissioning (Team Engineering)	Yes; parallel online access possible for up to 3 engineering systems
Status block	Yes; up to 8 simultaneously (in total over all ES clients)
Single-step	No
Status/modify	
Status/modify tag	Yes
Tags	Inputs/outputs, bit memory, DB, peripheral inputs/outputs, timers, counters
Number of tags, max.	
• Of which are status tags, max.	200; per job
• Of which are modify tags, max.	200; per job
Forcing	
Forcing	Yes
Forcing, tags	Peripheral inputs/outputs
Number of tags, max.	200
Diagnostics buffer	
Available	Yes
Number of entries, max.	1000
• Of which are power failure-proof	500
Traces	
Number of configurable traces	4; up to 512 KB data possible per trace
Interrupts/diagnostics/status information	
Diagnostics display LED	
RUN/STOP LED	Yes
ERROR LED	Yes
MAINT LED	Yes
Monitoring of the supply voltage (PWR LED)	Yes
Connection display LINK TX/RX	Yes
Supported technology objects	
Motion control	Yes; note: the number of axes affects the cycle time of the PLC program; selection guide via the TIA Selection Tool or SIZER
• Number of available motion control resources for technology objects (except cams)	800
• Required Motion Control resources	
– per speed-controlled axis	40
– per positioning axis	80
– per synchronous axis	160
– per external encoder	80
– per output cam	20
– per cam track	160
– per measuring input	40

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	6ES7510-1DJ01-0AB0
Controller	
• PID_Compact	Yes; universal PID controller with integrated optimization
• PID_3Step	Yes; PID controller with integrated optimization for valves
• PID temp	Yes; PID controller with integrated optimization for temperature
Counting and measuring	
• High-speed counter	Yes
Standards, approvals, certificates	
Suitable for safety functions	No
Highest safety class achievable in safety mode	
Performance level according to EN ISO 13849-1:2008	None
SIL according to IEC 61508	No
Ambient conditions	
Ambient temperature during operation	
Horizontal mounting position, min.	0 °C
Horizontal mounting position, max.	60 °C
Vertical mounting position, min.	0 °C
Vertical mounting position, max.	50 °C
Ambient temperature during storage/transport	
Min.	-40 °C
Max.	70 °C
Configuring	
Programming	
Programming language	
• LAD	Yes
• FBD	Yes
• STL	Yes
• SCL	Yes
• GRAPH	Yes
Know-how protection	
User program protection	Yes
Copy protection	Yes
Block protection	Yes
Access protection	
Protection level: Write protection	Yes
Protection level: Read/write protection	Yes
Protection level: Complete protection	Yes

	6ES7510-1DJ01-0AB0
Cycle time monitoring	
Low limit	Configurable minimum cycle time
High limit	Configurable maximum cycle time
Dimensions	
Width	100 mm
Height	117 mm
Depth	75 mm
Weights	
Weight, approx.	310 g

Technical specifications of the BusAdapter BA 2×RJ45

Table 5- 1   Technical specifications of the BusAdapter BA 2×RJ45

	6ES7193-6AR00-0AA0
Interfaces	
PROFINET IO	
Number of PROFINET interfaces	1
RJ45	Yes; 2 x
Cable length	
• Copper cables	100 m
Dimensions	
Width	20 mm
Height	69.5 mm
Depth	59 mm
Weights	
Weight, approx.	46 g

Technical specifications of the BusAdapter BA 2×FC

Table 5- 2   Technical specifications of the BusAdapter BA 2×FC

	6ES7193-6AF00-0AA0
Interfaces	
PROFINET IO	
Number of PROFINET interfaces	1
FC (FastConnect)	Yes; 2 x
Cable length	
• Copper cables	100 m
Dimensions	
Width	20 mm
Height	69.5 mm
Depth	59 mm
Weights	
Weight, approx.	53 g

General technical specifications

You can find information on the general technical specifications, such as standards and approvals, electromagnetic compatibility, protection class, etc., in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293).

Dimension drawing

A

This section contains a dimension drawing of the module mounted on a mounting rail. Always observe the specified dimensions for installation in cabinets, control rooms, etc.
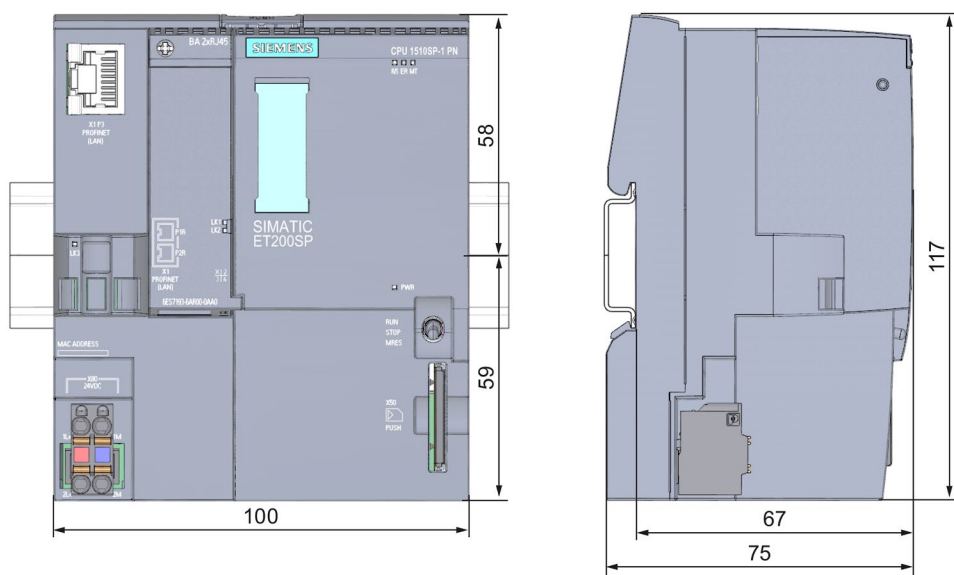
Dimension drawing of the CPU 1510SP-1 PN

Figure A-1   Dimensional drawing CPU 1510SP-1 PN