

SIEMENS



Manual

SIMATIC

S7-1500R/H

CPU 1515R-2 PN
(6ES7515-2RM00-0AB0)

Edition

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support.industry.siemens.com

SIMATIC

S7-1500R/H CPU 1515R-2 PN (6ES7515-2RM00-0AB0)

Equipment Manual

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Legal information

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Preface

Purpose of the documentation

This manual supplements the system manual of the S7-1500R/H redundant system and 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 enables you to commission the CPU 1515R-2 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)".

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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.

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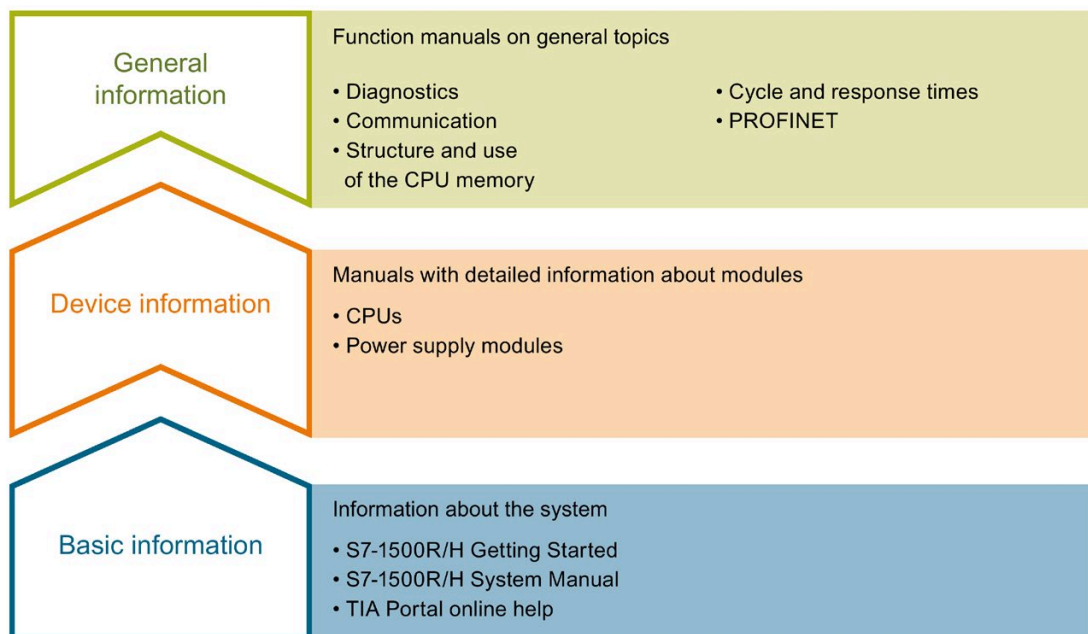
You can find catalogs for all automation and drive products on the Internet (<https://mall.industry.siemens.com>).

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S7-1500R/H Documentation Guide

The documentation for the redundant S7-1500R/H system is divided into three areas. This division enables you to access the specific content you require.



Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the redundant S7-1500R/H 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 redundant S7-1500R/H system, e.g. diagnostics, communication.

You can download the documentation free of charge from the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109742691>).

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/ww/en/view/109742691>).

S7-1500/ET 200MP Manual Collection

The S7-1500/ET 200MP Manual Collection contains the complete documentation on the redundant S7-1500R/H system gathered together in one file.

You can find the Manual Collection on the Internet
(<https://support.industry.siemens.com/cs/ww/en/view/86140384>).

SIMATIC S7-1500 comparison list for programming languages

The comparison list contains an overview of which instructions and functions you can use for which controller families.

You can find the comparison list on the Internet
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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 on individual products.

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

Product overview

2.1 New functions in firmware version V2.9

This section contains an overview of the most important new firmware functions of the CPU since the last edition of the manual.

New functions of the CPU in firmware version V2.9

New functions	Customer benefits	Where can I find information?
Influence switchover time of switched S1 devices	As of FW version V2.9, you can influence the switchover time between disconnection and return of switched S1 devices after a failure/STOP of the primary CPU. This function offers the following advantages: • Optimization of the switchover time between disconnection and return of switched S1 devices	PROFINET function manual (http://support.automation.siemens.com/WW/view/en/49948856)
MRP interconnection	The MRP interconnection procedure is an extension of MRP. MRP interconnection enables the redundant coupling of 2 or more rings with MRP in PROFINET networks. MRP interconnection offers the following advantages: • When setting up redundant network topologies, there is no limitation to the maximum number of devices of 50 devices in a ring. • Monitoring of larger topologies with ring redundancy.	
Simulation of R/H-CPU's	PLCSIM Advanced V4.0 supports simulation of R/H-CPU's • Virtual commissioning of machines with R/H-CPU's in a system • Automatic testing of the STEP 7 user program The simulation offers the following advantages: • Early error detection and risk minimization • Reduced response times • No hardware costs	S7-PLCSIM Advanced Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109773484)

2.1 New functions in firmware version V2.9

New functions	Customer benefits	Where can I find information?
OB 72 (CPU redundancy error)	As of FW version V2.9, the operating system calls OB 72 on further events: - The R/H-system has entered RUN-Redundant system state and the synchronization of the two R/H-CPU is possible redundantly. - The R/H-system has entered RUN-Redundant system state, but the synchronization of the two R/H-CPU is not possible redundantly. - The R/H-system is still in RUN-Redundant system state and the synchronization of the two R/H-CPU is possible redundantly now or again. - The R/H-system is still in RUN-Redundant system state, but the synchronization of the two R/H-CPU is no longer possible redundantly.	S7-1500R/H System Manual (https://support.industry.siemens.com/cs/ww/en/view/109754833)
"RH_CTRL" instruction	As of FW version V2.9, the "RH_CTRL" instruction supports additional functions: - Request SYNCUP - Switch primary CPU to STOP mode (only in RUN-Redundant system state) - Switch backup CPU to STOP mode	
Instructions for recipe phases	As of FW version V2.9, the instructions for recipe phases supports: - RecipeExport (export recipe) - RecipeImport (import recipe)	Online help for STEP 7
Technology objects TO_BasicPos and SSI_Absolute_Encoder	Technology object "TO_BasicPos" You use the "TO_BasicPos" instruction to cyclically control a SINAMICS drive with the technology for SINAMICS S/G/V basic positioners. Technology object SSI_Absolute_Encoder You use the "SSI_Absolute_Encoder" instruction to control position detection and measuring functions of the TM PosInput technology module via the user program.	

New functions of the CPU in firmware version V2.8

New functions	Customer benefits	Where can I find information?
Download modified user program in RUN-Redundant system state	You can download a modified user program into the R/H CPUs in the RUN-Redundant system state. Advantage: The redundant system will remain consistently in the RUN-Redundant system state during the change to the user program. The system state will not switch to RUN-Rolo or SYNCUP.	S7-1500R/H System Manual (https://support.industry.siemens.com/cs/ww/en/view/109754833)
Backing up the configuration of the S7-1500R/H redundant system in runtime	You do not have to interrupt the process during a backup while the plant is running. Uninterrupted plant operation avoids high restart and material costs.	
Switched S1 device	The "Switched S1 device" function of the CPU enables operation of standard IO devices in the S7-1500R/H redundant system.	
Testing with breakpoints	When testing with breakpoints, you run a program from breakpoint to breakpoint in the STARTUP (startup OB) or RUN-Solo system state. Testing with breakpoints provides you with the following advantages: • Testing SCL and STL program code with the help of breakpoints • Localization of logic errors step by step • Simple and quick analysis of complex programs prior to actual commissioning • Recording of current values within individual executed loops • Using breakpoints for program validation is also possible in SCL or STL networks within LAD/FBD blocks.	
PID controller	PID controllers are built into all R/H-CPU as standard. PID controllers measure the actual value of a physical variable, for example, temperature or pressure, and compare the actual value with the setpoint. Based on the resulting error signal, the controller calculates a manipulated variable that causes the process value to reach the setpoint as quickly and stably as possible. The PID controllers offer you the following advantages: • Simple configuration and programming through integrated editors and blocks • Simple simulation, visualization, commissioning and operation via PG and HMI • Automatic calculation of the control parameters and tuning during operation • No additional hardware and software required	• S7-1500R/H System Manual (https://support.industry.siemens.com/cs/ww/en/view/109754833) • PID Control Function Manual (https://support.industry.siemens.com/cs/ww/en/view/108210036)
Alarms in the user program	Alarms enable you to display events from process execution in the S7-1500R/H redundant system and to quickly identify, accurately locate, and correct errors.	Diagnostics function manual (https://support.industry.siemens.com/cs/ww/en/view/59192926)

Additional information

You can find an overview of all new functions, improvements and revisions in the respective firmware versions on the Internet

(<https://support.industry.siemens.com/cs/ww/en/view/109478459>).

2.2 Configuration and operating principle

Structure

The S7-1500R redundant system consists of the following components:

- Two CPUs of the type CPU 1515R-2 PN
- Two SIMATIC memory cards
- PROFINET cable (redundancy connections, PROFINET ring)
- IO devices
- Load power supply (optional)

You mount the CPUs on a common mounting rail or spatially separated on two separate mounting rails. You connect the two CPUs and the IO devices in a PROFINET ring via the PROFINET cable.

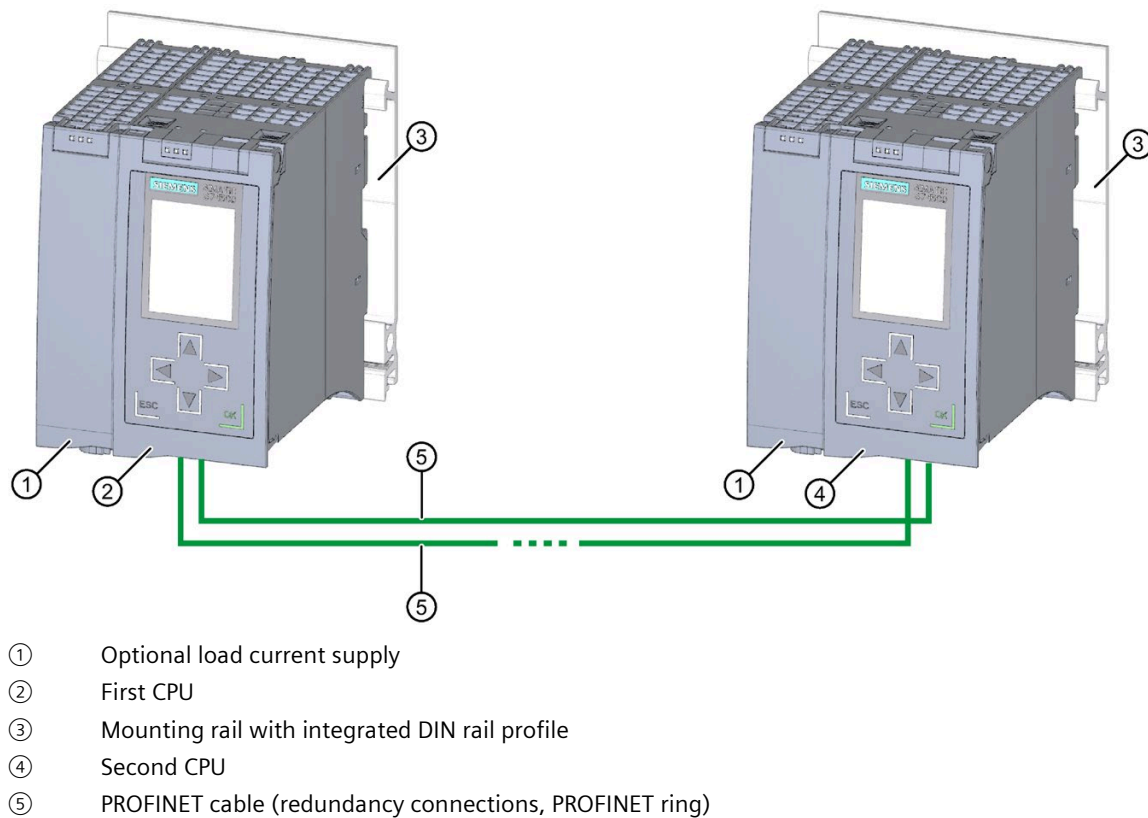


Figure 2-1 Configuration example for S7-1500R

Note**Standard rail adapter**

You mount the CPUs on a standardized 35 mm rail using the standard rail adapter.

You will find information on mounting the standard rail adapter in the S7-1500R/H redundant system (<https://support.industry.siemens.com/cs/ww/en/view/109754833>) System Manual.

Principle of operation

One of the two CPUs in the redundant system takes on the role of CPU for process control (primary CPU). The other CPU takes on the role of the following CPU (backup CPU). The assigned role of the CPUs can change during operation. Synchronization of all relevant data between primary CPU and backup CPU ensures fast switching between CPUs in the event of a primary CPU failure. If the primary CPU fails, the backup CPU retains control of the process as the new primary CPU at the point of interruption.

The redundancy connections are the PROFINET ring with MRP. The CPUs are synchronized via a PROFINET ring.

Additional information

You can find a detailed description of the operation and design of the CPUs in the system manual Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

2.3 Hardware properties

Article number

6ES7515-2RM00-0AB0

View of the module

The figure below shows the CPU 1515R-2 PN.



Figure 2-2 CPU 1515R-2 PN

Note

Protective film

Note that there is a removable protective foil on the display when the CPUs are delivered.

Properties

CPU 1515R-2 PN has the following technical properties:

Property	Description	Additional information
CPU display	All CPUs of the redundant system S7 1500R/H have a display with plain text information. The display provides you with diagnostic messages as well as information about the article number, the firmware version and the serial number of the CPU. You can also view and assign the IP addresses, the PROFINET device name and the redundancy ID of the CPU. The system IP address can be viewed via STEP 7 but not in the display. In addition to the functions listed here, a large number of other functions are available on the display. These additional functions are described in the SIMATIC S7 1500 Display Simulator.	- Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual - SIMATIC S7-1500 Display Simulator (https://support.industry.siemens.com/cs/ww/en/view/109761758)
Supply voltage	The 24 V DC supply voltage is fed via a 4-pin plug located on the front of the CPU.	- Section Connecting (Page 24) - Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual
PROFINET IO		
PROFINET IO interface (X1 P1 R and X1 P2 R)	The CPU has an X1 interface with two ports (X1 P1 R and X1 P2 R). - The PROFINET IO interface X1 (default P1 R) is used to set up the PROFINET ring with the two CPUs and the IO devices. - The PROFINET IO interface X1 (default P2 R) is used to make the connection between the two R-CPU's in the PROFINET ring. In the PROFINET ring, the synchronization frames between the CPUs are transmitted via the following connections: - The direct connection (X1 P2 R) - The indirect connection (X1 P1 R) via the IO devices - The interface supports PROFINET IO RT (Real-Time) and PROFINET basic functionality. Basic PROFINET functionality comprises: - HMI communication - Communication with the configuration system - Communication with a higher-level network (backbone, router, Internet) - Communication with another machine or automation cell	- Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual - Function manual PROFINET (https://support.industry.siemens.com/cs/ww/en/view/49948856)

Property	Description	Additional information
PROFINET interface (X2 P1)	The CPU has an X2 interface with one port (X2 P1). The interface supports PROFINET basic functionality.	
Operation of the CPUs as IO controllers	IO controller: As IO controllers the CPUs address the following configured IO devices: • IO devices with S2 system redundancy within the PROFINET ring • IO devices with S2 system redundancy that are decoupled from the PROFINET ring via a switch • Standard IO devices (switched S1 devices) Standard IO devices usually do not support H-Sync Forwarding. To avoid a cycle time increase when the PROFINET ring is interrupted, integrate the standard IO devices behind a switch and not in the PROFINET ring.	

H-Sync Forwarding

H-Sync Forwarding enables a PROFINET device with MRP to forward synchronization data (synchronization frames) of an S7-1500R redundant system only within the PROFINET ring.

In addition, H-Sync Forwarding forwards the synchronization data even during reconfiguration of the PROFINET ring. H-Sync Forwarding avoids a cycle time increase if the PROFINET ring is interrupted.

Note

Support of H-Sync Forwarding

The technical specifications typically state whether a PROFINET device supports H-Sync Forwarding.

The GSD file will also indicate whether the device supports H-Sync Forwarding. The device supports H-Sync Forwarding when the "ApplicationClass" attribute contains the "HighAvailability" token.

You will find more information on H-Sync Forwarding in the system manual S7-1500R/H redundant system (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

Accessories

You can find information on the topic of "Accessories/spare parts" in the system manual for Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

2.4 Firmware functions

Functions

CPU 1515R-2 PN supports the following firmware functions:

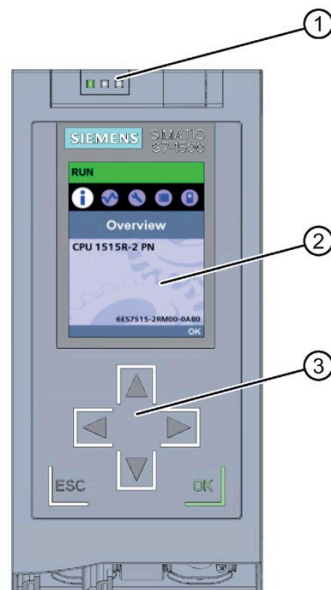
Function	Description	Additional information
CPU redundancy	There are two duplicate CPUs that synchronize their data via redundancy connections within a PROFINET ring. If one of the CPUs fails, the other CPU retains control of the process.	Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual
Integrated system diagnostics	The system automatically generates the messages for the system diagnostics and outputs these messages via a programming device/PC, HMI device or the integrated display. System diagnostics information is also available when the CPUs are in operating state STOP.	Function manual Diagnostics (https://support.industry.siemens.com/cs/ww/en/view/59192926)
Integrated trace functionality	Trace functionality supports you in troubleshooting and/or optimizing the user program. You record device tags and evaluate the recordings with the trace and logic analyzer function. Tags are, for example, drive parameters or system and user tags of a CPU. Trace and logic analyzer functions are suitable for monitoring highly dynamic processes. Note: Note that the S7-1500R/H redundant system supports recording of measurements. However, saving the measurements to the SIMATIC memory card is not supported.	Function manual Using the trace and logic analyzer function (https://support.industry.siemens.com/cs/ww/en/view/64897128)
PROFINET IO		
System redundancy S2	IO-Devices with S2 system redundancy enable uninterrupted operation during a primary backup switchover. If the role of the CPUs changes, the new primary CPU takes over the PROFINET IO communication.	- Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual - Function manual PROFINET (http://support.automation.siemens.com/WW/view/en/49948856)
Switched S1 device	The switched S1 device function of the CPU enables operation of standard IO devices in the S7-1500R/H redundant system.	Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual
RT (real time)	RT prioritizes PROFINET IO frames over standard frames. This ensures the required determinism in the automation technology. In this process the data is transferred via prioritized Ethernet frames.	Function manual PROFINET (http://support.automation.siemens.com/WW/view/en/49948856)
MRP (Media Redundancy Protocol)	The Media Redundancy Protocol enables the configuration of redundant networks. Redundant transmission links (ring topology) ensure that an alternative communication path is made available if a transmission link fails. Within the PROFINET ring, the R-CPU's assume the role of the MRP Manager following appropriate project configuration and all other devices in the ring assume the role of the MRP clients.	

Function	Description	Additional information
MRP interconnection	The process MRP interconnection is an enhancement of MRP and allows redundant coupling of two or more rings with MRP in PROFINET networks. MRP interconnection is - like MRP - specified in the standard IEC 62439-2 (Edition 3).	
PROFenergy	PROFenergy is a PROFINET-based data interface for switching off consumers centrally and with full coordination during pause times regardless of the manufacturer or device type. Through this, the process should only be provided with the energy that is absolutely required. Most of the energy is saved by the process. The PROFINET device itself only contributes a few watts to the savings potential.	
Integrated technology		
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)	Function manual PID Control (https://support.industry.siemens.com/cs/ww/en/view/108210036)
Controlling, measuring and position detection	• TO_BasicPos (control of a SINAMICS drive) • SSI_Absolute_Encoder (control of position detection and measuring function of the TM PosInput technology module)	STEP 7 online help
Security Integrated		
Know-how protection	The know-how protection protects user blocks against unauthorized access and modifications.	Redundant System S7-1500R/H (https://support.industry.siemens.com/cs/ww/en/view/109754833) System Manual
Access protection	You can use authorization levels to assign separate rights to different user groups.	
Integrity protection	The CPUs dispose of integrity protection by default. Integrity protection identifies possible manipulations of engineering data on the SIMATIC memory card or during data transfer between STEP 7 and the CPUs. Integrity protection also checks the communication from a SIMATIC HMI system to the CPUs for possible manipulations of engineering data. If integrity protection identifies the manipulation of engineering data, the user receives a corresponding message.	
Password provider	As an alternative to manual password entry, you can link a password provider to STEP 7. A password provider offers the following advantages: • Convenient handling of passwords. STEP 7 automatically imports the password for the blocks. This saves you time. • Optimum block protection because the users do not know the password itself.	

2.5 Operator controls and display elements

2.5.1 Front view of the CPU with closed front panel

The figure below shows the front view of the CPU 1515R-2 PN.



- ① LEDs for the current operating state and diagnostic status of the CPU
- ② Display
- ③ Control keys

Figure 2-3 View of the CPU 1515R-2 PN (with front panel) - front

Note

Temperature range for display

To increase its service life, the display switches off at a temperature below the permitted operating temperature of the device. When the display cools down, it automatically switches itself on again. When the display is switched off, the LEDs continue to show the status of the CPUs.

You can find additional information on the temperatures at which the display switches itself on and off in the Technical specifications (Page 33).

Pulling and plugging the front panel with display

You can pull and plug the front panel with display during operation.

WARNING

Personal injury and damage to property may occur

If you remove or attach the front panel of a redundant system S7-1500R/H during operation, personal injury or damage to property can occur in hazardous area zone 2.

Before you remove or fit the front panel, always switch off the power supply to the S7-1500R/H redundant system in hazardous area zone 2.

Locking the front panel

You can lock the front panel to protect the SIMATIC memory card and the mode selector of the CPU against unauthorized access.

You can attach a security seal or a padlock with a hoop diameter of 3 mm to the front panel.

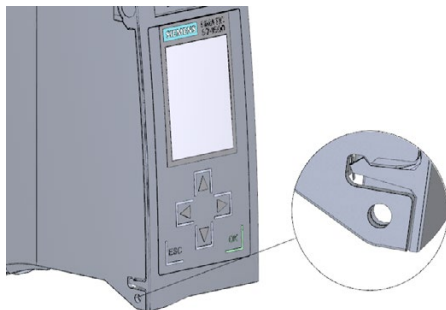


Figure 2-4 Locking latch on the CPU

In addition to the mechanical lock, you can also block access to a password-protected CPU on the display (local lock) and assign a password for the display. You can find additional information on the display, the configurable protection levels and the local lock in the system manual for Redundant System S7-1500R/H

(<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

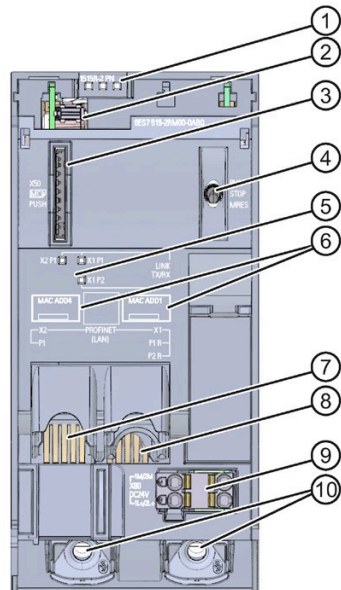
Reference

You can find detailed information on the individual display options, a training course and a simulation of the available menu commands in the SIMATIC S7-1500 Display Simulator

(<https://support.industry.siemens.com/cs/ww/en/view/109761758>).

2.5.2 Front view of the CPU without front panel

The figure below shows the operator controls and connection elements of the CPU 1515R-2 PN.

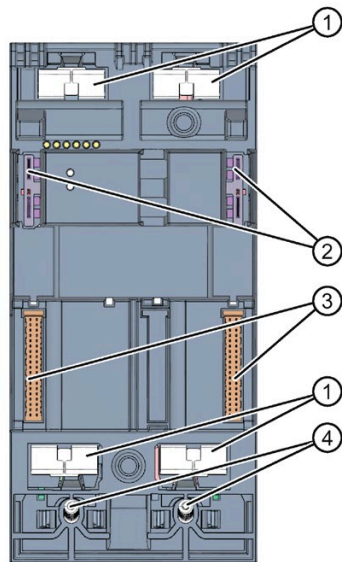


- ① LEDs for the current operating state and diagnostic status of the CPUs
- ② Display connector
- ③ Slot for the SIMATIC memory card
- ④ Mode selector
- ⑤ LED displays for the 3 ports of the PROFINET interfaces X1 and X2
- ⑥ MAC addresses of the interfaces
- ⑦ PROFINET IO interface X2 with 1 port
- ⑧ PROFINET IO interface X1 with 2 ports
- ⑨ Connector for power supply
- ⑩ Fixing screws

Figure 2-5 View of the CPU 1515R-2 PN (without front panel) - front

2.5.3 Rear view of the CPU

The figure below shows the connection elements on the rear of the CPU 1515R-2 PN.



- ① Shield contact surfaces
- ② Plug-in connection for power supply
- ③ Plug-in connection for backplane bus
- ④ Fixing screws

Figure 2-6 View of the CPU 1515R-2 PN - rear

2.6 Mode selector

You use the mode selector to:

- Request a change to a specific operating state
- Disable or enable the change of a specific operating state
(if, for example, the mode selector is set to STOP, you cannot switch the CPU to RUN via a communication task configured in the TIA Portal or via the display)

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

Table 2- 1 Mode switch settings

Position	Meaning	Explanation
RUN	RUN mode	The CPU has permission to go to RUN.
STOP	STOP mode	The CPU does not have permission to go to RUN.
MRES	Memory reset	Position for CPU memory reset.

Reference

You can find a brief overview of the various operating states and system states in the section Status and error display of the CPU (Page 28).

You can find a detailed description of the operating states and system states in the system manual for S7-1500R/H Redundant System (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

Connecting

3.1 Terminal assignment

This section provides information on the terminal assignment of the individual interfaces and the block diagram of the CPU 1515R-2 PN.

24 V DC supply voltage (X80)

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

The following table shows the signal names and the descriptions of the pin assignment of the 24 V DC supply voltage.

Table 3- 1 Pin assignment 24 V DC supply voltage

View	Signal name ¹⁾		Description
Connector			
	1	1L+	+ 24 V DC of the supply voltage
	2	1M	Ground of the supply voltage
	3	2M	Ground of the supply voltage for loop-through ²⁾
	4	2L+	+ 24 V DC of the supply voltage for loop-through ²⁾

¹⁾ 1L+ and 2L+ as well as 1M and 2M are bridged internally.

²⁾ Maximum 10 A permitted

You can find information on the various supply options in the system manual for Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

PROFINET interface X1 with 2-port switch (X1 P1 R and X1 P2 R)

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

- When autonegotiation is deactivated, the RJ45 socket is allocated as a switch (MDI-X).
- When autonegotiation is activated, autocrossing is in effect and the RJ45 socket is allocated either as data terminal equipment (MDI) or a switch (MDI-X).

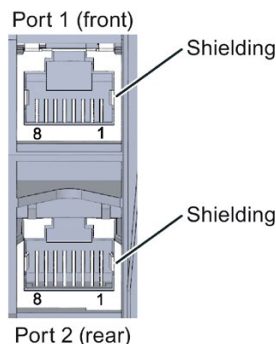


Figure 3-1 Interface assignments

PROFINET interface X2 with 1 port (X2 P1)

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

Autocrossing is always active on X2. This means the RJ45 socket is allocated either as data terminal equipment (MDI) or a switch (MDI-X).

Additional information

You can find additional information on the topic of "Connecting the CPU" and on the topic "Accessories/spare parts" in the system manual for Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

Assignment of the MAC addresses

For each CPU, CPU 1515R-2 PN has:

- One PROFINET interface with two ports
- One PROFINET interface with one port

Each of the PROFINET interfaces has a MAC address and each of the PROFINET ports has its own MAC address. There are a total of ten MAC addresses for the two CPUs of the CPU 1515R-2 PN.

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

The number range of the MAC addresses is sequential. The first and last MAC addresses are printed on the rating plate on the right side of each CPU 1515R-2 PN.

3.1 Terminal assignment

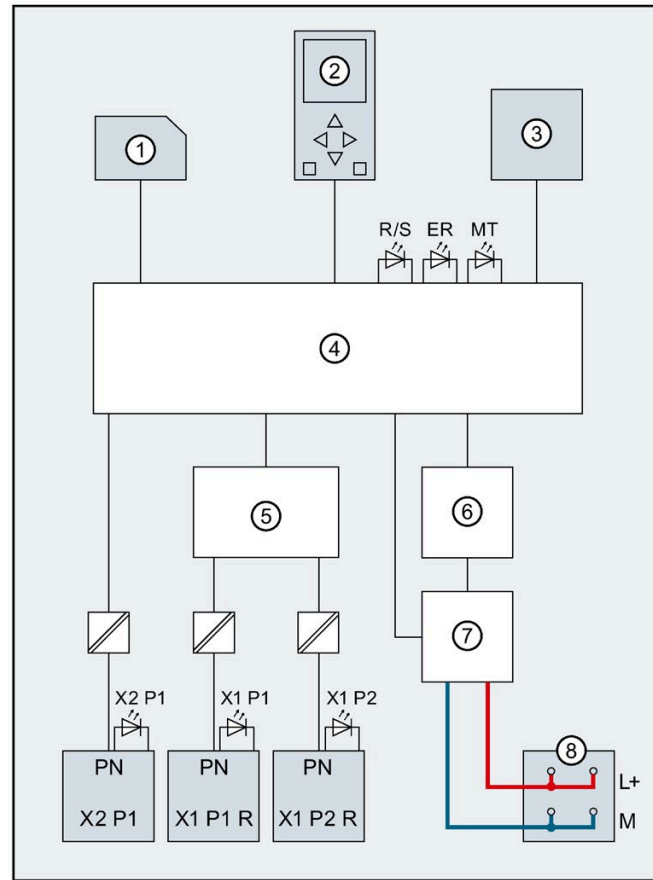
The table below shows how the MAC addresses are assigned.

Table 3- 2 Assignment of MAC addresses using the example of a single CPU

	Assignment	Labeling
MAC address 1	PROFINET interface X1 (visible in STEP 7 for accessible devices)	• Front printed • Right-side printed (start of 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	PROFINET interface X2 (visible in STEP 7 for accessible devices)	• Front printed
MAC address 5	Port X2 P1 (required for LLDP, for example)	• Right-side printed (end of number range)

Block diagram

The following figure shows the block diagram of the CPU 1515R-2 PN.



- | | | | |
|---|---|------------------------|------------------------------|
| ① | SIMATIC memory card (X50) | PN X1 P2 R | PROFINET interface X1 port 2 |
| ② | Display | PN X2 P1 | PROFINET interface X2 port 1 |
| ③ | Mode selector RUN/STOP/MRES | L+ | 24 V DC supply voltage |
| ④ | Electronics | M | Ground |
| ⑤ | PROFINET 2-port switch | R/S | RUN/STOP LED (yellow/green) |
| ⑥ | Backplane bus connection
(connection to backplane bus not
configurable) | ER | ERROR LED (red) |
| ⑦ | Internal supply voltage | MT | MAINT LED (yellow) |
| ⑧ | Supply of the 24 V DC supply voltage
(X80) | X1 P1, X1 P2,
X2 P1 | LED Link TX/RX |

PN X1 P1 R PROFINET interface X1 port 1

Figure 3-2 Block diagram of the CPU 1515R-2 PN

Interrupts, diagnostics, error messages and system events

4

4.1 Status and error display of the CPU

The LED displays of the CPU are described below.

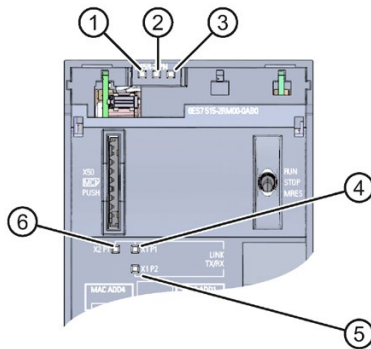
You can find more detailed information on "Interrupts" in the STEP 7 online help.

You can find additional information on the topic of "Diagnostics" and "System events" in the Diagnostics (<https://support.industry.siemens.com/cs/ww/en/view/59192926>) function manual and in the system manual Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

You can find additional information on the topic of "Operating states and system states" as well as various failure scenarios in the system manual for S7-1500R/H Redundant System (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

LED display

The figure below shows the LED displays of the CPU 1515R-2 PN.



- ① RUN/STOP LED (yellow/green LED)
- ② ERROR LED (red LED)
- ③ MAINT LED (yellow LED)
- ④ LINK RX/TX LED for port X1 P1 (yellow/green LED)
- ⑤ LINK RX/TX LED for port X1 P2 (yellow/green LED)
- ⑥ LINK RX/TX LED for port X2 P1 (yellow/green LED)

Figure 4-1 LED display of the CPU 1515R-2 PN (without front panel)

LED displays depending on operating states and system states

CPU 1515R-2 PN has the following LEDs for displaying the current operating state and diagnostics status.

- RUN/STOP LED
- ERROR LED
- MAINT LED

The LEDs indicate the operating state of the respective CPU within the redundant system. Operating states describe the behavior of a single CPU at a specific time. The combination of the operating states of the CPUs forms the system state.

The following figure shows the possible operating states of the CPUs and the resulting system states.

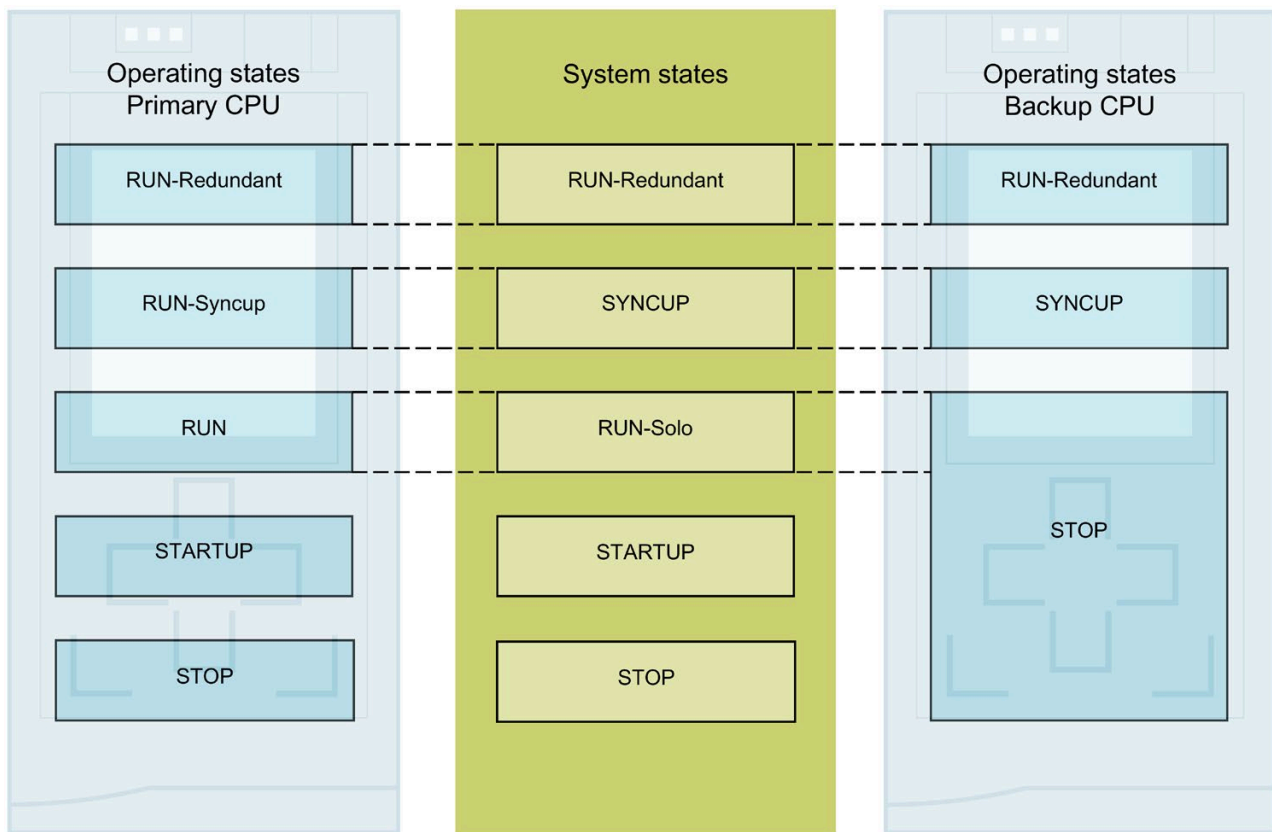


Figure 4-2 Operating states and system states

Meaning of the RUN/STOP, ERROR and MAINT LEDs

CPU 1515R-2 PN has the following LEDs for displaying the current operating state and diagnostics status.

Note

LED patterns of the redundant system S7 1500R

Note that it is not always possible to:

- Determine the state of the CPU from the signal pattern
- Determine the state of the other CPU from the signal pattern

The "Meaning" column only shows a possible typical cause.

To investigate the cause of the signal pattern, use the diagnostic buffer and its display via:

- STEP 7
 - HMI devices
 - Displays of the CPUs
-

The following table shows the meaning of the various color combinations for the RUN/STOP, ERROR and MAINT LEDs.

Table 4- 1 Meaning of the LEDs

RUN/STOP LED	ERROR LED	MAINT LED	Meaning
 LED off	 LED off	 LED off	Missing or insufficient supply voltage on the CPU.
 LED flashes yellow/green	 LED flashes red	 LED flashes yellow	Startup (CPU booting)
			Test of LEDs during startup, inserting a module.
			LED flashing test
 LED lit yellow	 LED off	 LED lit yellow	CPU is in operating state STOP.
			Completion of system initialization
 LED flashes yellow	 LED off	 LED lit yellow	CPU executes internal activities in an operating state $\neq$ RUN-Redundant.
 LED lit yellow	 LED flashes red	 LED flashes yellow	CPU defective
			Firmware update using SIMATIC Memory Card has failed.
 LED lit yellow	 LED off	 LED flashes yellow	Firmware update successfully completed.
 LED flashes yellow/green	 LED off	 LED lit yellow	The primary CPU is in operating state STARTUP. The backup CPU is in operating state SYNCUP. The backup CPU has not yet been restarted for SYNCUP during this phase.
 LED flashes yellow	 LED off	 LED off	The CPU performs a warm restart.
 LED lit green	 LED off	 LED lit yellow	Maintenance demanded for the plant. You need to check/replace the affected hardware within a short period of time.
			The primary CPU is in the RUN or RUN-Syncup operating state.
			Active Force job
 LED lit green	 LED off	 LED off	The CPU is in operating state RUN-Redundant. There are no events, requirements, errors, etc.
 LED lit green	 LED flashes red	 LED off	A diagnostic event is pending in operating state RUN-Redundant.
 LED lit green	 LED flashes red	 LED lit yellow	A diagnostic event (e.g. failure of an IO device within the PROFINET ring or no access to SIMATIC memory card possible ¹⁾) and maintenance is demanded (e.g. interruption of the PROFINET ring).

¹⁾ If there is not enough storage space on a SIMATIC Memory Card or on both SIMATIC Memory Cards in RUN-Redundant, the write function is aborted, and the redundant system continues operation with the original configuration. The redundant system will remain in the RUN-Redundant system state.

4.1 Status and error display of the CPU

Note**MAINT LED of the two CPUs**

The MAINT LEDs of both CPUs only go out when the following conditions are fulfilled:

- The CPUs are in the RUN-Redundant system state.
- No maintenance is demanded.

Note**LED displays in redundant mode**

In the RUN-Redundant system state, the LED displays on both CPUs are identical (exception: you are performing an LED flash test on one CPU).

Meaning of LINK RX/TX LED

Each port has a LINK RX/TX LED. The table below shows the various LED patterns of the ports of the CPU 1515R-2 PN.

Table 4- 2 Meaning of LINK RX/TX LED

LINK TX/RX LED	Meaning
 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. The redundancy connections were interrupted.
 Flashes green	The CPU performs an LED flash test.
 Illuminated green	There is an Ethernet connection between the PROFINET interface of your PROFINET device and a communication partner. The redundancy connections are OK.
 LED flashes yellow/green	Data is currently being received/sent by a communication partner via the PROFINET interface of the PROFINET device. Note that the human eye perceives this LED image as an LED that is lit yellow or flickering yellow.

Note**"LED" instruction**

You can read the status (e.g. "On" or "Off") of LEDs of a CPU or a module using the "LED" instruction. Note, however, that it is not possible to read the LED status of the LINK RX/TX LEDs on all S7-1500 R/H CPUs.

You can find additional information on the "LED" instruction in the STEP 7 online help.

Technical specifications

The following table shows the technical specifications as of 05/2021. You can find a data sheet including daily updated technical specifications on the Internet (<https://support.industry.siemens.com/cs/ww/en/pv/6ES7515-2RM00-0AB0/td?dl=en>).

Article number	6ES7515-2RM00-0AB0
General information	
Product type designation	CPU 1515R-2 PN
HW functional status	FS01
Firmware version	V2.9
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	V17 (FW V2.9) / V16 (FW V2.8) / V15.1 (FW V2.6)
Display	
Screen diagonal [cm]	6.1 cm
Control elements	
Number of keys	6
Mode selector switch	1
Supply voltage	
Type of supply voltage	24 V DC
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	5 ms
Input current	
Current consumption (rated value)	0.8 A
Inrush current, max.	2.4 A
I^2t	0.02 A ² ·s
Power loss	
Power loss, typ.	6.3 W
Memory	
Number of slots for SIMATIC memory card	1
SIMATIC memory card required	Yes
Work memory	
• integrated (for program)	500 kbyte
• integrated (for data)	3 Mbyte

Article number	6ES7515-2RM00-0AB0
Load memory	
Plug-in (SIMATIC Memory Card), max.	32 Gbyte
Backup	
maintenance-free	Yes
CPU processing times	
for bit operations, typ.	60 ns
for word operations, typ.	72 ns
for fixed point arithmetic, typ.	96 ns
for floating point arithmetic, typ.	384 ns
CPU-blocks	
Number of elements (total)	8 000; Blocks (OB, FB, FC, DB) and UDTs
DB	
Number range	Number range: 1 to 59 999
Size, max.	3 Mbyte; For non-optimized block accesses, the max. size of the DB is 64 KB
FB	
Number range	0 ... 65 535
Size, max.	500 kbyte
FC	
Number range	0 ... 65 535
Size, max.	500 kbyte
OB	
Size, max.	500 kbyte
Number of free cycle OBs	100
Number of time alarm OBs	20
Number of delay alarm OBs	20
Number of cyclic interrupt OBs	20
Number of process alarm OBs	50
Number of startup OBs	100
Number of asynchronous error OBs	4
Number of synchronous error OBs	2
Number of diagnostic alarm OBs	1
Nesting depth	
per priority class	24
Counters, timers and their retentivity	
S7 counter	
Number	2 048
Retentivity	
adjustable	Yes

Article number	6ES7515-2RM00-0AB0
IEC counter	
• Number	Any (only limited by the main memory)
Retentivity	
– adjustable	Yes
S7 times	
• Number	2 048
Retentivity	
– adjustable	Yes
IEC timer	
• Number	Any (only limited by the main memory)
Retentivity	
– adjustable	Yes
Data areas and their retentivity	
Retentive data area (incl. timers, counters, flags), max.	512 kbyte
Flag	
• Size, max.	16 kbyte
• Number of clock memories	8; 8 clock memory bit, grouped into one clock memory byte
Data blocks	
• Retentivity adjustable	Yes
• Retentivity preset	No
Local data	
• per priority class, max.	64 kbyte; max. 16 KB per block
Address area	
Number of IO modules	4 096; max. number of modules / submodules
I/O address area	
• Inputs	32 kbyte; All inputs are in the process image
• Outputs	32 kbyte; All outputs are in the process image
per integrated IO subsystem	
– Inputs (volume)	8 kbyte
– Outputs (volume)	8 kbyte
Subprocess images	
• Number of subprocess images, max.	32
Hardware configuration	
Number of distributed IO systems	1
Number of IO Controllers	
• integrated	1

Article number	6ES7515-2RM00-0AB0
Time of day	
Clock	
Type	Hardware clock
Backup time	6 wk; At 40 °C ambient temperature, typically
Deviation per day, max.	10 s; Typ.: 2 s
Operating hours counter	
Number	16
Clock synchronization	
supported	Yes
on Ethernet via NTP	Yes
Interfaces	
Number of PROFINET interfaces	2
1. Interface	
Interface types	
RJ 45 (Ethernet)	Yes; X1
Number of ports	2
integrated switch	Yes
Protocols	
IP protocol	Yes; IPv4
PROFINET IO Controller	Yes
PROFINET IO Device	No
SIMATIC communication	Yes; Only Server
Open IE communication	Yes
Web server	No
Media redundancy	Yes
PROFINET IO Controller	
Services	
PG/OP communication	Yes
Isochronous mode	No
IRT	No
PROFInergy	Yes
Number of connectable IO Devices, max.	64
Updating times	The minimum value of the update time also depends on communication share set for PROFINET IO, on the number of IO devices, and on the quantity of configured user data
Update time for RT	
for send cycle of 1 ms	1 ms to 512 ms

Article number	6ES7515-2RM00-0AB0
2. Interface	
Interface types	
• RJ 45 (Ethernet)	Yes; X2
• Number of ports	1
• integrated switch	No
Protocols	
• IP protocol	Yes; IPv4
• PROFINET IO Controller	No
• PROFINET IO Device	No
• SIMATIC communication	Yes; Only Server
• Open IE communication	Yes
• Web server	No
• Media redundancy	No
Interface types	
RJ 45 (Ethernet)	
• 100 Mbps	Yes
• Autonegotiation	Yes
• Autocrossing	Yes
• Industrial Ethernet status LED	Yes
Protocols	
Number of connections	
• Number of connections, max.	108
• Number of connections reserved for ES/HMI/web	10
• Number of S7 routing paths	16
Redundancy mode	
Media redundancy	
– MRP	Yes; MRP Automanager according to IEC 62439-2 Edition 2.0
– MRP interconnection, supported	Yes; as MRP ring node according to IEC 62439-2 Edition 3.0
– MRPD	No
– Switchover time on line break, typ.	200 ms; PROFINET MRP
– Number of stations in the ring, max.	50; Only 16 are recommended, however

Article number	6ES7515-2RM00-0AB0
SIMATIC communication	
• PG/OP communication	Yes; encryption with TLS V1.3 pre-selected
• S7 routing	Yes
• S7 communication, as server	Yes
• S7 communication, as client	No
Open IE communication	
• TCP/IP	Yes
– Data length, max.	64 kbyte
– several passive connections per port, supported	Yes
• ISO-on-TCP (RFC1006)	Yes
– Data length, max.	64 kbyte
• UDP	Yes
– Data length, max.	2 kbyte; 1 472 bytes for UDP broadcast
– UDP multicast	Yes; Max. 5 multicast circuits
• DHCP	No
• DNS	Yes
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
Web server	
• HTTP	No
• HTTPS	No
OPC UA	
• OPC UA Client	No
• OPC UA Server	No
Further protocols	
• MODBUS	Yes; MODBUS TCP
Isochronous mode	
Equidistance	No

Article number	6ES7515-2RM00-0AB0
S7 message functions	
Number of login stations for message functions, max.	64
Program alarms	Yes
Number of configurable program messages, max.	10 000; Program messages are generated by the "Program_Alarm" block, ProDiag or GRAPH
Number of loadable program messages in RUN, max.	5 000
Number of simultaneously active program alarms	
• Number of program alarms	800
• Number of alarms for system diagnostics	200
Test commissioning functions	
Joint commission (Team Engineering)	No
Status block	Yes; up to 8 simultaneously
Single step	No
Number of breakpoints	8; Breakpoints are only supported in RUN-Solo status
Status/control	
• Status/control variable	Yes
• Variables	Inputs/outputs, memory bits, DBs, distributed I/Os, timers, counters
• Number of variables, max.	
– of which status variables, max.	200; per job
– of which control variables, max.	200; per job
Forcing	
• Forcing	Yes
• Forcing, variables	Peripheral inputs/outputs
• Number of variables, max.	200
Diagnostic buffer	
• present	Yes
• Number of entries, max.	3 200
– of which powerfail-proof	500
Traces	
• Number of configurable Traces	4
• Memory size per trace, max.	512 kbyte
Interrupts/diagnostics/status information	
Diagnostics indication LED	
• RUN/STOP LED	Yes
• ERROR LED	Yes
• MAINT LED	Yes
• Connection display LINK TX/RX	Yes

Article number	6ES7515-2RM00-0AB0
Supported technology objects	
Motion Control	No
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	Yes
• High-speed counter	No
Standards, approvals, certificates	
Suitable for safety functions	No
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C; Display: 50 °C, at an operating temperature of typically 50 °C, the display is switched off
• vertical installation, min.	0 °C
• vertical installation, max.	40 °C; Display: 40 °C, at an operating temperature of typically 40 °C, the display is switched off
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	5 000 m; Restrictions for installation altitudes > 2 000 m, see manual
Configuration	
Programming	
Programming language	
– LAD	Yes
– FBD	Yes
– STL	Yes
– SCL	Yes
– CFC	No
– GRAPH	Yes
Know-how protection	
• User program protection/password protection	Yes
• Copy protection	No
• Block protection	Yes

Article number	6ES7515-2RM00-0AB0
Access protection	
• protection of confidential configuration data	Yes
• Password for display	Yes
• Protection level: Write protection	Yes
• Protection level: Read/write protection	Yes
• Protection level: Complete protection	Yes
Cycle time monitoring	
• lower limit	adjustable minimum cycle time
• upper limit	adjustable maximum cycle time
Dimensions	
Width	70 mm
Height	147 mm
Depth	129 mm
Weights	
Weight, approx.	830 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 for Redundant System S7-1500R/H (<https://support.industry.siemens.com/cs/ww/en/view/109754833>).

Dimension drawing

A.1 Dimension drawing

This section contains the dimensional drawing of the module on the mounting rail, as well as a dimensional drawing with the front panel open. Keep to the dimensions when installing in cabinets, control rooms, etc.

Dimension drawings of the CPU 1515R-2 PN

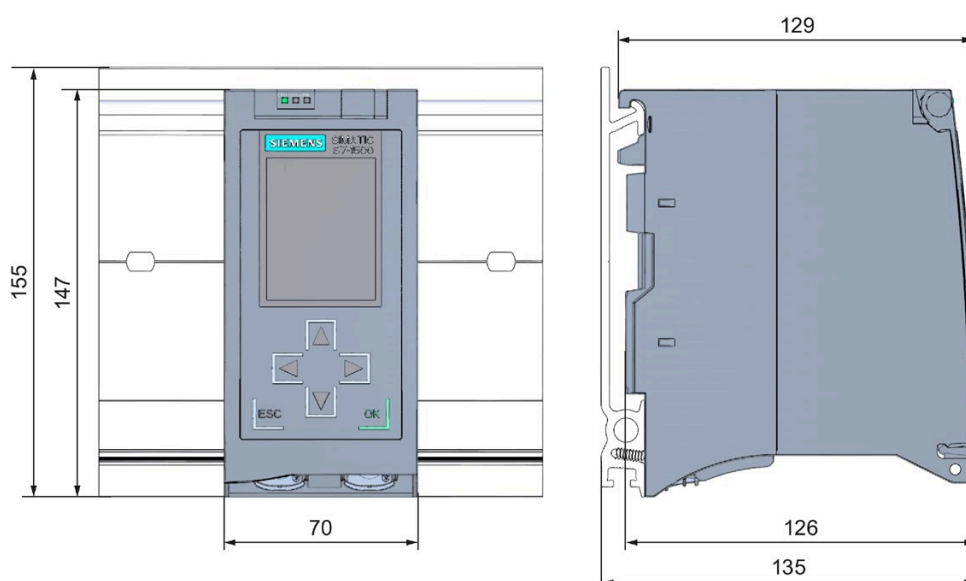


Figure A-1 Dimension drawing of the CPU 1515R-2 PN, front and side view

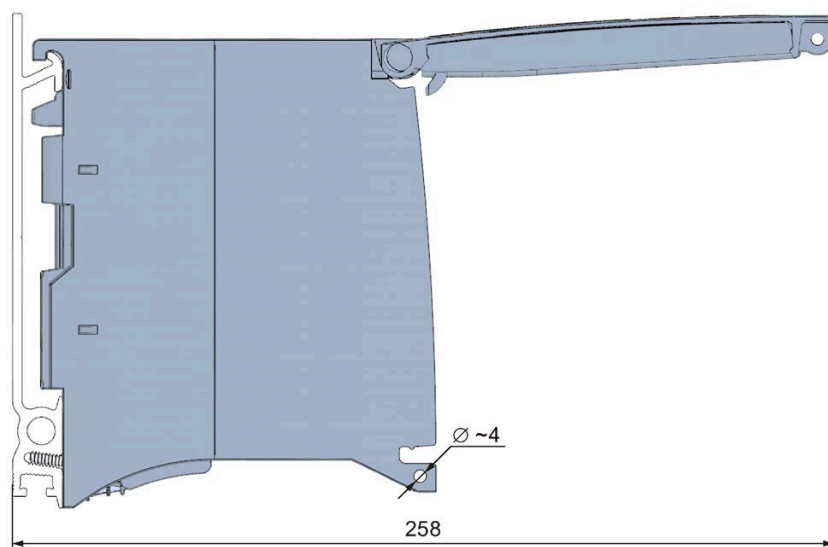


Figure A-2 Dimension drawing CPU 1515R-2 PN, side view with open front panel