

SIMATIC

S7-1500 Software Controller CPU1505SP (F), CPU 1507S (F) and CPU 1508S (F) SIMATIC Industrial OS Version 30.0

Operating Instructions

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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.

Trademarks

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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.

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Documentation guide

1.1 Guide for these operating instructions

Purpose of the documentation

These operating instructions supplement the system manual of the S7-1500 automation system as well as the function manuals. Cross-system functions are described in the system manual.

The information provided in these operating instructions and the system manual enables you to commission the Software Controller.

Basic knowledge required

The following knowledge is required to understand the documentation:

- General knowledge of automation technology
- Knowledge of the SIMATIC industrial automation system
- Knowledge of working with STEP 7
- Knowledge of working with Linux

Validity of the documentation

This documentation is valid for the following Software Controller:

Software Controller	Article number
CPU1505SP CPU1505SP F	cannot be ordered, since only available preinstalled on a CPU 1515SP PC2 (F)
CPU 1507S CPU 1507S F	6ES7 672-7AD02-0YGO 6ES7 672-7FD02-0YGO
CPU 1508S CPU 1508S F	6ES7 672-8AD02-0YGO 6ES7 672-8FD02-0YGO

Notes

Also observe notes marked as follows:

Note

A note contains important information on:

- The product described in the documentation
 - The handling of the product
 - The part of the documentation to which you should pay particular attention
-

Definitions and naming conventions

The following terms are used in this documentation:

- **CPU or Software Controller:** These terms refer to the CPU1505SP (F), CPU 1507S (F) and the CPU 1508S (F).
- **STEP 7:** We refer to the configuration and programming software as "STEP 7" in this documentation as a synonym for the version "STEP 7 V18 (TIA Portal)".
- **PC:** This term designates a SIMATIC IPC and includes the following Open Controllers.
 - CPU 1515SP PC2
 - CPU 1515SP PC2 F

1.2 S7-1500/ET 200MP Documentation Guide

1.2.1 S7-1500 / ET 200MP Documentation Guide



The documentation for the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system is arranged into three areas.

This arrangement enables you to access the specific content you require. Changes and supplements to the manuals are documented in a Product Information.

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

Basic information



The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems.

The STEP 7 online help supports you in the configuration and programming.

Examples:

- Getting Started S7-1500
- S7-1500/ET 200MP System Manual
- Online help TIA Portal

Device information



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

Examples:

- Equipment Manuals CPUs
- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules

- Equipment Manuals Analog Modules
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules
- Equipment Manuals Power Supply Modules

General information



The function manuals contain detailed descriptions on general topics relating to the SIMATIC S7-1500 and ET 200MP systems.

Examples:

- Function Manual Diagnostics
- Function Manual Communication
- Function Manual Motion Control
- Function Manual Web Server
- Function Manual Cycle and Response Times
- PROFINET Function Manual
- PROFIBUS Function Manual

Product Information

Changes and supplements to the manuals are documented in a Product Information. The Product Information takes precedence over the device and system manuals.

You can find the latest Product Information on the S7-1500 and ET 200MP systems on the Internet (<https://support.industry.siemens.com/cs/de/en/view/68052815>).

Manual Collection S7-1500/ET 200MP

The Manual Collection contains the complete documentation on the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O 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 (<https://support.industry.siemens.com/cs/ww/en/view/86630375>).

1.2.2 SIMATIC Technical Documentation

Additional SIMATIC documents will complete your information. You can find these documents and their use at the following links and QR codes.

The Industry Online Support gives you the option to get information on all topics. Application examples support you in solving your automation tasks.

Overview of the SIMATIC Technical Documentation

Here you will find an overview of the SIMATIC documentation available in SIOS:



Industry Online Support International (<https://support.industry.siemens.com/cs/ww/en/view/109742705>)

Watch this short video to find out where you can find the overview directly in SIOS and how to use SIOS on your mobile device:



Quick introduction to the technical documentation of automation products per video (<https://support.industry.siemens.com/cs/us/en/view/109780491>)



YouTube video: Siemens Automation Products - Technical Documentation at a Glance (<https://youtu.be/TwLSxxRQsA>)

mySupport

With "mySupport" you can get the most out of your Industry Online Support.

Registration	You must register once to use the full functionality of "mySupport". After registration, you can create filters, favorites and tabs in your personal workspace.
Support requests	Your data is already filled out in support requests, and you can get an overview of your current requests at any time.
Documentation	In the Documentation area you can build your personal library.
Favorites	You can use the "Add to mySupport favorites" to flag especially interesting or frequently needed content. Under "Favorites", you will find a list of your flagged entries.
Recently viewed articles	The most recently viewed pages in mySupport are available under "Recently viewed articles".
CAX data	The CAX data area gives you access to the latest product data for your CAX or CAE system. You configure your own download package with a few clicks: • 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" on the Internet. (<https://support.industry.siemens.com/My/ww/en>)

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 on individual products.

You can find the application examples on the Internet. (<https://support.industry.siemens.com/cs/ww/en/ps/ae>)

1.2.3 Tool support

The tools described below support you in all steps: from planning, over commissioning, all the way to analysis of your system.

TIA Selection Tool

The TIA Selection Tool tool supports you in the selection, configuration, and ordering of devices for Totally Integrated Automation (TIA).

As successor of the SIMATIC Selection Tools, the TIA Selection Tool assembles the already known configurators for automation technology into a single 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. (<https://support.industry.siemens.com/cs/ww/en/view/109767888>)

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and the optimal use of resources

You can find SINETPLAN on the Internet (<https://new.siemens.com/global/en/products/automation/industrial-communication/profinet/sinetplan.html>).

See also

PRONETA Professional (<https://support.industry.siemens.com/cs/ww/en/view/109781283>)

Safety information

2.1 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 constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit (<https://www.siemens.com/industrialsecurity>).

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

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (<https://www.siemens.com/cert>).

2.2 Notes on data protection

Siemens observes the principles of data protection, in particular the principle of data minimization (privacy by design).

For this Software Controller product this means:

The product does not process/store any personal data, only technical functional data (e.g. time stamp). If the user links this data with other data (e.g. shift plans) or stores personal data on the same medium (e.g. hard disk) and thus establishes a personal reference, the user must ensure compliance with data protection regulations.

2.3 Change of the operating mode with critical actions

Switch the CPU to "STOP" mode before actions that result in very high utilization of the hardware ("critical actions").

2.4 Information about third-party software updates

This product contains third-party software. Siemens accepts liability with respect to updates/patches for the third-party software only when these are distributed by Siemens in the context of a Software Update Service contract or officially approved by Siemens. Otherwise, updates/patches are installed at the user's own risk. You can find more information in our Software Update Service (<https://www.siemens.com/sus>).

2.5 Notes on protecting root rights

A user with root rights has extensive access and manipulation possibilities on the system. A root user has, for example, the right to change the operating state of the CPU, even if the root user is not a member of the "software_controller_operators" group.

Therefore, make sure that the root rights are adequately protected to prevent unauthorized changes. Use secure passwords and use a standard user account for regular operation. Other measures, such as the use of security policies, should be applied as required.

2.6 Additional security information

SIMATIC Industrial OS (IndOS) is a Linux-based (Debian) operating system. The following security information additionally applies to users of SIMATIC Industrial OS.

Access to the PC

A user has extensive access and manipulation possibilities on the system.

Therefore, make sure that the PC is adequately protected in physical terms to prevent unauthorized changes.

Rights for operating the Software Controller

Do not change the access rights for files provided by Siemens, such as the Linux tools for the Software Controller. The Linux tools are executable with standard user rights in the "software_controller_operators" group.

Linux security issues

The security issues of the Linux operating system are the responsibility of the user.

Product overview

3.1 Introduction to PC-based control

Overview

The SIMATIC S7-1500 Software Controller is a PC-based controller. The PC-based controller offers the same functionality as all CPUs of the SIMATIC S7-1500 automation system in a PC-based real-time environment.

As part of the SIMATIC series of products, the Software Controller can communicate with STEP 7 and other SIMATIC products, such as WinCC Unified and Industrial Ethernet networks. Communication with the distributed I/O occurs in the same way via PROFINET. The Software Controller uses distributed I/O in order to control the automation process. To network the Software Controller with the distributed I/O, you use the interfaces of your PC. In addition, the CPU 1505SP can use the centralized I/O of the ET 200SP Open Controller.

The Software Controller uses communication via programming devices and operator panels (Industrial Ethernet) for connection with STEP 7 or other programming packages on a different PC.

You use the same programming languages, program structure, and programming interface (STEP 7) with the PC-based controller as for hardware controllers. For the SIMATIC S7-1500 Software Controller, you can use the same user program as for a hardware controller.

Note

Available operating systems

The present manual describes Software Controllers using the Industrial OS operating system. A description of Software Controllers using Windows is available on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109817941>)

3.2 Overview of functions

The S7-1500 Software Controller realizes the function of an S7-1500 hardware controller as software on a PC.

The Software Controller has the following technical properties.

Configuration and programming with Resource Configurator and STEP 7

All programming languages defined in IEC 61131-3 are supported.

Innovative real-time system based on virtualization technology

The real-time system of the S7-1500 Software Controller enables you to operate the Software Controller in parallel with, but independent of, IndOS.

- Real-time and deterministic behavior
- Fast power-up at Power On of the PC

Fast program execution with multiple, priority-controlled execution levels

- Cyclically, time-controlled, isochronously with PROFINET
- Event-driven via hardware and diagnostic interrupts

Storing of retentive data

The Software Controller ensures protection of system data even after a power failure:

- Storing of retentive data on the hard drive of the PC (UPS required)
- Backup of retentive data on the NVRAM (on SIMATIC IPCs and Open Controller with this option) possible in case of a power failure

Communication

The S7-1500 Software Controller uses interfaces of the PC for PROFINET.

- IndOS-independent use of PC interfaces for PROFINET for operating distributed I/O. Depending on the interface hardware used, the following functions are possible:
 - PROFINET IO RT
 - PROFINET IO IRT
 - PROFINET energy
 - Media redundancy
 - I-Device
 - Isochronous mode
 - MRP/MRPD
- Communication (SIMATIC Communication, Open User Communication, OPC UA) with IndOS applications or external devices

Integrated Web server

All CPUs of the SIMATIC S7-1500 automation system support querying of the CPU via the Web server. The Web server provides the following diagnostics possibilities:

- CPU mapping with LEDs and current operating mode
- Reading out entries from the diagnostics buffer
- Querying module states
- Querying current alarms

- Information on communication
- Information on the status of the topology and PROFINET devices
- Firmware updates
- Transferring user data to the load memory of the CPU and managing this data
- User-programmable web pages for support of service- and commissioning-specific machine functions
- API (Application Programming Interface) as an interface for:
 - Reading and writing CPU data
 - Executing functions (for example backing up and restoring the CPU configuration, changing the operating state)

Trace functionality

All CPUs of the SIMATIC S7-1500 automation system support the trace functionality. The trace functionality supports the recording of analog and digital tags for each cycle and their representation as a trend with STEP 7. It is particularly useful for motion control and closed-loop control applications.

Integrated technology

- S7-1500 Motion Control
 - PLC Open blocks for programming motion functionality by means of PROFINET IO and PROFIdrive interface.
 - The functionality supports speed-controlled axes, positioning axes, synchronous axes, and external encoders.
- Integrated closed-loop control functionality: The CPU has three PID controllers with integrated optimization for a wide range of closed-loop control tasks:
 - PID_Compact for universal closed-loop control tasks
 - PID_3Step for valves
 - PID_Temp for closed-loop temperature control tasks

Motion control functions of the technology CPUs

Supported technology objects:

- Speed-controlled axes
- Positioning axes
- Synchronous axes
- External encoders
- Output cams
- Cam tracks
- Measuring inputs

Advanced synchronization functions:

- Synchronization with specification of the synchronous position
- Actual value coupling
- Shifting of the master value at following axis
- Camming

Other functions:

- Cyclic specification of motion vector from the application (MotionIn interface)
- Technology object for control of kinematics with up to 4 interpolating axes, e.g. Cartesian gantry, delta picker, roll picker, articulated arm, cylindrical robot, tripod, SCARA
- Support of user-defined kinematics
- Trace functions for all CPU tags, both for diagnostics in real-time as well as for sporadic error detection, can also be called via the Web server of the CPU
- Extensive closed-loop control functionalities, e.g. easy-to-configure blocks for automatic optimization of the controller parameters for optimized control quality

Integrated system diagnostics

System diagnostics is generated automatically and displayed by:

- Programming device
- PC
- HMI
- Web server

System diagnostics is also available when the CPU is in STOP mode.

Integrated security

- Protection of confidential configuration data
You have the option of assigning a password for protecting confidential configuration data of the respective CPU. This refers to data such as private keys that are required for the proper functioning of certificate-based protocols.
- Know-how protection
Allows you to securely protect algorithms against unauthorized access and modification
- Copy protection
Copy protection links user blocks with the serial number of one or more SIMATIC Memory Cards or the serial number of one or more CPUs. User programs cannot run without the corresponding SIMATIC Memory Card or CPU.
- Access protection
Extended access protection provides comprehensive protection against unauthorized configuration changes. To assign separate rights to different user groups, you use authorization levels.

- Integrity protection
The system protects the data transferred to the CPU from unauthorized manipulation. The CPU reliably detects altered or external transmission of engineering data.
- Password provider
As an alternative to manual password input, you can connect a password provider to STEP 7. A password provider offers the following advantages:
 - Convenient handling of passwords. STEP 7 reads in the password automatically for the blocks
 - Optimum block protection because the users themselves do not know the password

3.3 Functions

3.3.1 Memory concept of the CPU

3.3.1.1 CPU memory areas

Introduction

This section describes the structure of the CPU memory.

Memory areas

The CPU uses the mass storage of the PC on which it is installed.

The following figure shows the partitions (sda) on the PC:

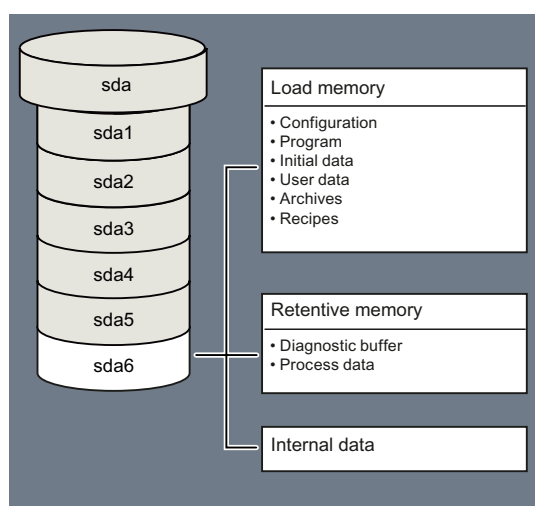


Figure 3-1 Partitions on the PC

Note**Disk naming**

Note that for the IPC227G, IPC277G, BX-39A and PX-39A the disk name is "nvme0n1". The naming for the individual partitions is nvme0n1p1 to nvme0n1p6.

For more information on the different partitions, see chapter [Installing the Software Controller](#) (Page 29).

Work memory

The RAM of the PC is used for the work memory. When the CPU starts, the SIMATIC hypervisor exclusively allocates a portion of the RAM memory. As a result, this RAM memory is available exclusively to the CPU. The work memory is volatile memory that contains the code and data blocks. The work memory is permanently allocated to the CPU and cannot be extended.

Load memory

The load memory is located in the mass storage of the PC. The CPU volume contains not only the load memory but also internal configuration data and even retentive data, depending on the configuration.

NOTICE**Fill level of load memory**

Make sure that there is still enough free memory space available in the CPU's load memory. Insufficient load memory space may have the following consequences:

- A project cannot be downloaded to the CPU successfully
- A CPU does not change into RUN operating state after project download
- Retentive data might be lost

Retentive memory

Retentive memory is non-volatile memory for saving a limited quantity of data in the event of power failure. You can store retentive data in two ways, depending on the resources of the PC:

- In the NVRAM of a PC (if the PC used has this option)
- On the CPU volume

The system stores data defined as retentive in retentive memory. The system retains this data beyond a power-off or power failure.

If you are using PC mass storage, use a UPS to ensure a complete backup of the retentive data in case of a power failure.

NVRAM

When NVRAM is used (on SIMATIC IPCs with this option), the storing of retentive data in the event of a power failure is also possible. The volume of data that can be stored retentively is limited and can depend on properties of the PC used.

Note

Note that NVRAM is necessary for using the fail-safe feature "Fast Compile & Fast Commissioning".

For more information on fail-safe feature "Fast Compile & Fast Commissioning", refer to the SIMATIC Safety - Configuring and Programming (<https://support.automation.siemens.com/WW/view/en/54110126>) manual.

CPU memory area

The CPU volume is a partition on the mass storage of the PC used. The CPU volume is already available and has the following contents:

- Load memory
- Configuration data
- Retentive data
Retentive data is saved to the mass storage of the PC, if:
 - you select "PC mass storage" in the configuration of category "Retentive memory" in TIA Portal
 - you set "nvram_usage" to "false" in the Resource Configuration file
For more information on the Resource Configuration file, refer to section Resource Config JSON file (Page 42).

The selection "Saving retentive data: PC mass storage" can make the entire data memory retentive. To ensure complete backup of the retentive data in case of a power failure, refer to the description in section Shutdown and startup (Page 61).

Reference

For additional information about the memory structure and the basic meaning of these memory areas, refer the function manual Structure and Use of the CPU Memory (<https://support.industry.siemens.com/cs/ww/en/view/59193101>). This documentation also describes how you obtain information about the memory utilization using STEP 7.

3.3.1.2 Storage of retentive data

Introduction

When you stop the Software Controller or a power failure occurs, you can store data retentively:

- In the PC mass storage or
- In the onboard NVRAM

The following data is saved:

- The current data from data blocks, bit memory, timers, counters and technology objects that is marked as retentive in TIA Portal
- Contents of the diagnostics buffer
- Contents of the message buffer
- Current operating mode (RUN/STOP)

The retentive data is stored automatically in the following situations:

- Shutdown of the Software Controller using command line commands
- Shutdown of the operating system (standard or triggered by a UPS signal)
- Power failure (by using a UPS or NVRAM)

Note**Options for storage of retentive data**

For information on the memory type and memory size of your hardware platform, check your PC system's technical specifications.

Saving in mass storage

The Software Controller has its own CPU volume in the mass storage of your PC. The storage operation is thus independent of the operating system status.

Note**Preservation of retentive data when saving in mass storage**

To retain the retentive data of the original configuration, proceed as follows:

1. Copy the mass storage.
 2. Start the CPU with the copied data.
-

When you save the retentive data on the PC's mass storage, the quantity of the retentive data on the mass storage differs from the quantity of memory in NVRAM.

NOTICE
Uninterruptible power supply (UPS)
A power failure without shutting down the operating system can cause damage to the file structure of the operating system. To protect the file system, use a UPS (Page 61) or activate the usage of NVRAM.

Deleting the data

To delete the data from the CPU, use the "--MemoryReset" command of the CPU Control Tool.

Storage in NVRAM

The storage of retentive data in NVRAM protects you from losing important program data after a power failure. The storage in NVRAM has the advantage that the storage process is also possible in case of a sudden power failure. But the storage process with this method depends on the buffer capacity of the power supply of your PC. This reduces the amount of retentive data that can be saved compared to when saving in the mass storage.

Note

Availability of NVRAM

You must order NVRAM with the SIMATIC IPCs. With the latest BX-39A, PX-39A, IPC227G and IPC277G devices, the NVRAM modules can be ordered separately and mounted afterwards. If you mount an NVRAM device after installation of the Software Controller, you must reinstall the Software Controller.

The reference information of the product information includes information on which IPCs support NVRAM.

In TIA Portal, the memory location "PC mass storage" is set by default in the delivery state of the SIMATIC IPC. To utilize NVRAM, you must change the storage location.

3.3.2 Interface types

Below you find an overview of the interfaces used by the IndOS PC:

- CPU 1505SP:
 - A PROFINET onboard interface of CPU 1515SP PC2.
Isochronous data exchange via Isochronous Real Time (IRT) is possible
- CPU 1507S:
 - Two PROFINET interfaces, onboard or plug-in. One interface is IO-compatible.
If the IPC used has a CP 1625 communications processor, isochronous data exchange over Isochronous Real Time (IRT) is possible.
- CPU 1508S:
 - Two PROFINET interfaces, onboard or plug-in. Both interfaces are IO-compatible.
If the IPC used has a CP 1625 communications processor, isochronous data exchange over Isochronous Real Time (IRT) is possible.

Additional information on the interfaces of the PC used is available in the technical specifications for your device.

Note

Interfaces used for IRT communication

If you are using an interface for IRT communication, do not use the same interface for going online in TIA Portal. Using the same interface can lead to buffer overflows and a negative influence on the real-time performance.

Choose one of the following three possibilities:

- use a different Software Controller interface for the connection to TIA Portal
 - use a Linux interface that is bridged with the SIMATIC RT-VMM interface
 - use IP forwarding set between the Linux interface and the SIMATIC RT-VMM virtual network interface
-

3.3.3 PROFINET IO

Properties of PROFINET IO

PROFINET is a fieldbus standard of the PROFIBUS user organization that defines a cross-vendor communication and engineering model.

As part of PROFINET, PROFINET IO is a communication concept that is used to implement modular, distributed applications.

A PROFINET IO system consists of the following PROFINET devices:

- IO controller
Device used to address the connected IO devices.
- IO device
A distributed field device that is assigned to an IO controller.

The PROFINET IO controller operating mode enables direct access to IO devices via Industrial Ethernet.

The PROFINET IO device operating mode enables you to operate S7 stations as "intelligent" PROFINET IO devices on Industrial Ethernet.

For this purpose, the CPU uses the PC interfaces that you must assign during configuration.

Note

Using the "Prioritized startup" functionality

If you want to use the "Prioritized startup" functionality in STEP 7 for the PROFINET interface of the CPU 1507S or CPU 1508S, separate the CPU and the device with the help of a PROFINET switch.

Reference

You can find additional information on the "PROFINET IO" topic in the STEP 7 online help and in the PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>) function manual.

3.3.4 PROFlenergy

PROFlenergy

PROFlenergy (for PROFINET) reduces the energy consumption by using PROFlenergy commands during the production-free time.

Additional information

- Function manual: PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>)
- Additional information on PROFlenergy is available on the Internet (<https://www.profibus.com>) under Common Application Profile PROFlenergy; Technical Specification for PROFINET; Version 1.0; January 2010; Order no: 3.802.

3.3.5 Web server of the CPU

3.3.5.1 Overview

The CPU has an integrated Web server that enables, among other things, the display of system diagnostics information via PROFINET.

You use an Internet browser on any web client, such as a PC, multi panel, or smartphone, to access:

- Module data
- User program data
- Diagnostics data of the CPU

This means access to the CPU is possible without STEP 7 installed. The Web server can only be configured using STEP 7.

The following options are available for accessing the Web server of the CPU:

- Web browser under IndOS on the same PC
- Web browser on an external device using (virtual) Ethernet interfaces
- Web browser on an external device using the assigned PROFINET interfaces

Benefits of the Web server

The Web server enables monitoring and administering of the CPU by authorized users over a network. This enables long-distance evaluations and diagnostics. Monitoring and evaluation is possible without STEP 7. All you need is a web browser.

Note

Protection of the CPU

Make sure that you protect the CPU from being compromised by, for example, limiting network access, using firewalls (Page 88)).

Web browsers

To access the HTML pages of the CPU, you need a web browser. The following web browsers have been tested for communication with the CPU:

- Internet Explorer (Version 11.0)
- Microsoft Edge (Version 100.0)
- Mozilla Firefox (Version 90.0)
- Google Chrome (Version 100.0)
- Opera (Version 85.0)
- Mobile Safari und Chrome for iOS (12.5.1)
- Android Browser (7.x, 8.x and 10.x)
- Chrome für Android (7.x, 8.x and 10.x)

Specific websites for the Software Controller

The functionalities of the Web server apply to all CPUs of the S7-1500 automation system. The Software Controller has the following special features:

- "Start page" web page
The start page before the login provides general information about the CPU.
The "Start page" web page also reflects the position of the mode selector. When the Software Controller is on a hardware platform without a physical mode selector, the switch position of the mode selector always shows RUN mode in the Web server. When the Software Controller is working on a hardware platform that has a physical mode selector, the position of the mode selector always shows the current operating state of the hardware platform in the Web server.
- "Identification" web page
The "Identification" web page gives you an overview of important CPU specifications.
- "View of Things" web page
The "View of Things" web page allows you to operate objects that you have created in WinCC.

Reference

You can find additional information about the "Web server" topic in the Web server (<https://support.industry.siemens.com/cs/ww/en/view/59193560>) function manual.

3.3.6 Fail-safe

You can operate the F-CPU in safety mode or in standard mode.

Information on using the F-CPU in safety mode is available in the programming and operating manual "SIMATIC Safety - Configuring and Programming (<https://support.automation.siemens.com/WW/view/en/54110126>)".

You can find additional information on the F-CPU in the Product Information for F-CPU (<https://support.industry.siemens.com/cs/document/109478599/simatic-s7-1200-s7-1500-f-cpus?dti=0&lc=en-WW>).

Installing

4.1 System requirements

To use the Software Controller, your system must meet the following requirements:

Category	Requirement
Operating system	SIMATIC Industrial OS (IndOS)
Operator interface	Color monitor, keyboard and mouse or other pointing devices (optional)
Communication interface	One or more communication interfaces for communication with STEP 7 or other S7 applications or for communication with distributed I/O
Supported Software Controllers	CPU 1507S (F) and CPU 1508S (F)
Open Controller	The ET 200SP Open Controller (CPU 1515SP PC2) will also be supported by CPU1505SP (F)
Supported SIMATIC IPCs	See section Reference information for use with SIMATIC IPC (Page 99)
Supported TIA Portal versions	as of V18
BIOS settings	Deactivating energy-saving modes The following BIOS settings are recommended on IPCs with installed CPU: • C-states deactivated • P-states deactivated Disabling booting from external media The Hypervisor does not automatically prevent booting from external media. Overclocking We recommend not to install the CPU in systems in which one of the following technologies is activated: • Intel Turbo Boost • Intel Speed Shift • Intel SpeedStep These technologies can have an effect on the real-time behavior of the CPU. We recommend that you disable these technologies. CPU Power Level Set the CPU Power Level to "Standard". For more information on where to find these settings in the BIOS, see section Reference information for use with SIMATIC IPC (Page 99).

4.2 Installing the Software Controller

The CPU is delivered in different variants with different article numbers.

CPU 1505SP is pre-installed on CPU 1515SP PC2 (the CPU 1505SP Software Controller cannot be ordered separately but only together with the hardware).

The following table shows which CPUs can be installed on which IPCs:

	CPU 1507S	CPU 1507S F	CPU 1508S	CPU 1508S F
IPC227G	✓	✓	--	--
IPC277G	✓	✓	--	--
IPC427E	✓	✓	✓	✓
IPC477E (PRO)	✓	✓	✓	✓
BX-39A	✓	✓	✓	✓
PX-39A (PRO)	✓	✓	✓	✓

Requirements

Observe the following requirements for the installation:

- PC must meet the System requirements (Page 29)
- The latest BIOS version installed on PC
- The BIOS must be in UEFI mode (except for CPU1515SP PC2 where legacy mode is used)
- IndOS must have already been installed
- User has root privileges
- The system time and date is set to the current time and date
Use the "date" command before installing the Software Controller to check whether the date is correct. If the date is not correct, use the "date +%Y%m%d -s "currentdate"" command to set the correct date (e.g. date +%Y%m%d -s "20211004")

Observe the following requirements during installation:

- The installation is not interrupted by manual operations or power failure.
In case of an interruption during installation, uninstall the Software Controller and then reinstall it.

Note

Installation location

It is only possible to install the Software Controller to the disk where IndOS is installed, even if there are other disks available in the system.

Note

Reinstallation of IndOS

If you reinstall IndOS with an already installed Software Controller on it, uninstall the Software Controller manually before reinstalling IndOS.

If you are unable to uninstall the Software Controller, clear the data on the RAW partition (Partition 6). You can clear the data from Partition 6 by using, for example, the following command:

```
dd if=/dev/zero of=/dev/sda6 or dd if=/dev/zero of=/dev/nvme0n1p6
```

Additional requirement for users of GNOME desktop environment

If PCs using GNOME desktop environment are kept idle for a configured period of time, IndOS goes into an unrecoverable suspension state.

To avoid this scenario, disable auto-suspension. For disabling auto-suspension, proceed as follows:

Open the command terminal and run the following commands with root privileges:

- `$ gsettings set org.gnome.settings-daemon.plugins.power sleep-inactive-ac-timeout 0`
- `$ gsettings set org.gnome.settings-daemon.plugins.power sleep-inactive-battery-timeout 0`

Edit the default of "/etc/gdm3/greeter.dconf" as root and uncomment the following configurations from the end of configuration.

```
# Automatic suspend
# =====

[org/gnome/settings-daemon/plugins/power]
# - Time inactive in seconds before suspending with AC power
# 1200=20 minutes, 0=never
sleep-inactive-ac-timeout=0
# - What to do after sleep-inactive-ac-timeout
# 'blank', 'suspend', 'shutdown', 'hibernate', 'interactive' or 'nothing'
sleep-inactive-ac-type='nothing'
# - As above but when on battery
sleep-inactive-battery-timeout=0
sleep-inactive-battery-type='nothing'
```

To apply this configuration run as root:

```
dpkg-reconfigure gdm3
```

This command causes GNOME Display Manager (GDM) to reload its configuration upon the next logout or reboot.

Industrial OS service stick

The Software Controller installer script (install.sh) depends on components stored on the Industrial OS service stick. Therefore, before you start installing the Software Controller, carry out the following steps first:

- Insert the Industrial OS service stick into your target device
- Open the Linux terminal on your target device
- Enter the following command to update your system:
`sudo apt update`

Note**Remote repository**

If you have set up a remote repository, the installation also considers the packages from the remote repository.

Software Controller setup

All necessary installation packages for installing the Software Controller are included in the compressed install script "install.sh". The install script contains the following Debian packages:

- vmm-installer.deb
- swcpu-installer.deb
- simatic-vmm-vnic.deb
- s7vmm-dev.deb
- swcpu-hooks.deb
- man-pages.deb

Apart from the install script "install.sh", there is also the following "uninstall.sh" script for uninstalling the Software Controller.

For information on how to uninstall the Software Controller, refer to section Uninstalling the Software Controller (Page 36).

Installation start

To extract the setup, enter the following command in the command prompt (the example uses the CPU 1507S and the IndOS installation default settings):

```
root@localhost:/home/pt# tar xvf CPU1507S-30.00.00.00-  
XXX_setup.tar.gz
```

To start the Software Controller setup, go into the extracted folder. Run the "install.sh" script by entering the following command (the example uses the CPU 1505SP):

```
root@localhost:~/CPU1505SP-30.00.00.00-XXX_setup# ./install.sh
```

Note**Location of installation script "install.sh"**

For the installation to be successful, run the "install.sh" installation script from the setup directory where the script is located.

The following figure gives you a summary of the installation process.

```

root@localhost:/home/pt/CPU1507S-30.00.00.00-46.01.00.14_setup#
root@localhost:/home/pt/CPU1507S-30.00.00.00-46.01.00.14_setup# ./install.sh
SWCPU Installation started...
W: Failed to fetch http://security.debian.org/debian-security/dists/bullseye-security/InRelease
debian.org'
W: Some index files failed to download. They have been ignored, or old ones used instead.
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Selecting previously unselected package vmm-installer.
Preparing to unpack .../vmm-installer_04.07.00.00.05.02.00.01_amd64.deb ...
Unpacking vmm-installer (04.07.00.00.05.02.00.01) ...
vmm-installer (Version: 04.07.00.00.05.02.00.01) Installation Successful
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Selecting previously unselected package siemens-swcpcu-hooks.
Preparing to unpack .../siemens-swcpcu-hooks_30.0.0.0_amd64.deb ...
Unpacking siemens-swcpcu-hooks (30.0.0.0) ...
siemens-swcpcu-hooks (Version: 30.0.0.0) Installation Successful
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Selecting previously unselected package siemens-swcpcu-man-pages.
Preparing to unpack .../siemens-swcpcu-man-pages_30.0.0.0_amd64.deb ...
Unpacking siemens-swcpcu-man-pages (30.0.0.0) ...
siemens-swcpcu-man-pages (Version: 30.0.0.0) Installation Successful
SWCPU Installation is finished successfully!
A reboot is required for installation to be completed!
Would you like to reboot the system? (y/n)

```

Figure 4-1 Installation

Note**License Agreement and Security Information**

Before you can proceed with the installation, confirm the following:

- License Agreement of Siemens AG
- Security Information
- Open Source and Third Party License

After the confirmations, the Debian package for the SIMATIC Hypervisor is installed to the system. This package prepares the environment by shrinking the disk and creating new partitions for the SIMATIC Hypervisor and the Software Controller to be installed. Afterwards the Software Controller Debian package and associated drivers are installed to the system.

After the installation

After the packages are installed, a reboot is required to ensure that all system related changes are applied.

Select "y" for automatically reboot the system and to complete the installation.

After the installation is completed, the disk partitions for IPC427E / IPC477E have the following structure:

pt@localhost:~\$ lsblk	
Partition	Description
sda	
- sda1	EFI system partition
- sda2	

pt@localhost:~\$ lsblk	
Partition	Description
- sda3	
- sda4	IndOS root file system
-- sokol	- "sokol" encrypted partition
- sda5	CPU data partition; mount point: /mnt/swcpu_mount
- sda6	CPU volume

For IPC227G, IPC277G, BX-39A and PX-39A, the partition naming is as follows:

root@localhost:/home/pt# lsblk	
Partition	Description
nvme0n1	
- nvme0n1p1	EFI system partition
- nvme0n1p2	
- nvme0n1p3	
- nvme0n1p4	IndOS root file system
-- sokol	- "sokol" encrypted partition
- nvme0n1p5	CPU data partition; mount point: /mnt/swcpu_mount
- nvme0n1p6	CPU volume

For more information on the CPU memory area, see chapter CPU memory areas (Page 19).

After the installation finishes, the system is configured with the basic hardware configuration and the Software Controller is in STOP mode. If your hardware requirements differ from the basic configuration, update the configuration accordingly in Resource Configurator. To be able to switch the Software Controller to RUN, carry out a CPU-only download in TIA Portal.

For information on how to use Resource Configurator, see chapter Resource Configurator (Page 39).

Generating hash values for installed files

You can check files that are installed by Software Controller for manipulation. To do so, compare the hash values of the installed files with the original hash values stored in the hash file. The hash file is part of the setup as provided from the Siemens Customer Support web site.

To generate the hash value for an installed file, use the following command under IndOS:

```
"sha256sum <file name>"
```

Note

Make sure that you keep the hash file in a secure place.

4.3 Updating/upgrading the Software Controller

To update or upgrade an already installed Software Controller, extract the new installer. Run `install.sh` with root privileges or by using the `sudo` command.

Note

Before you can start the update or upgrade, confirm the License Agreement and Security Information.

To proceed with the update or upgrade, the CPU must be powered off.

```
root@localhost:/home/pt/CPU1507S-30.00.00.00-46.01.00.14_setup# sudo ./install.sh
SWCPU Installation started...
VMM and CPU RAW Partitions already exist!
The system will be updated soon!
CPU needs to be powered off. Would you like to continue? (y/n)y
```

After successful update or upgrade, a reboot is required for the installation to be completed.

```
root@localhost:/home/pt/CPU1507S-30.00.00.00-46.01.00.14_setup# sudo ./install.sh
SWCPU Installation started...
VMM and CPU RAW Partitions already exist!
The system will be updated soon!
CPU needs to be powered off. Would you like to continue? (y/n)y
CPU is being powered off...
Command sent SUCCESSFULLY to SWCPU
 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
simatic-vmm-call-ipc (Version: 286001-00.19) Installation Successful
 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
simatic-vmm-vnic-ipc (Version: 2.1.4-1) Installation Successful
 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
vmm-installer (Version: 04.06.00.00.01.13.00.03) Installation Successful
 1 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
Preparing to unpack .../CPU1507S-installer_21.09.00.00-54.01.00.07_amd64.deb ...
Unpacking swcpu-installer (21.09.00.00.54.01.00.07) over (21.09.00.00.54.01.00.06) ...
swcpu-installer (Version: 21.09.00.00.54.01.00.07) Installation Successful
 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
siemens-swcpu-hooks (Version: 21.9.0.0) Installation Successful
 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
siemens-swcpu-man-pages (Version: 21.9.0.0) Installation Successful
SWCPU Installation is finished successfully!
A reboot is required for installation to be completed!
Would you like to reboot the system? (y/n)y
You selected 'yes', the system is going down for reboot NOW!
root@localhost:/home/pt/CPU1507S-21.09.00.00-54.01.00.07_setup_bundle#
```

After finishing the update or upgrade, the user project, retentive data and configuration data are still available.

4.4 Uninstalling the Software Controller

Requirements

To uninstall the Software Controller, root privileges are required.

Uninstallation start

The Software Controller installer provides a script called "uninstall.sh". Use this script to start the uninstallation process.

Note

Mount point of Software Controller

Before you uninstall the Software Controller, make sure that the mount point of the Software Controller (usually "/dev/sda5") is not in use by other processes.

For starting the uninstallation, enter the following command (the example uses the CPU 1505SP):

```
~/CPU1505SP-30.00.00.00-46.01.00.14_setup# ./uninstall.sh
```

The following figure gives you a summary of the uninstallation process.

```
root@localhost:~/CPU1505SP-30.00.00.00-46.01.00.14_setup# ./uninstall.sh
SWCPU Uninstallation Started ...
Starting uninstallation of siemens-swcpcu-man-pages ...
  Removing siemens-swcpcu-man-pages (30.0.0.0) ...
Uninstall operation of siemens-swcpcu-man-pages is successful
Starting uninstallation of siemens-swcpcu-hooks ...
  Removing siemens-swcpcu-hooks (30.0.0.0) ...
  Purging configuration files for siemens-swcpcu-hooks (30.0.0.0) ...
Uninstall operation of siemens-swcpcu-hooks is successful
Starting uninstallation of swcpu-installer ...
  Removing swcpu-installer (30.00.00.00-46.01.00.14) ...
  Purging configuration files for swcpu-installer (30.00.00.00-46.01.00.14) ...
Uninstall operation of swcpu-installer is successful
Starting uninstallation of vmm-installer ...
  Removing vmm-installer (04.06.00.00.01.13.00.03) ...
  Purging configuration files for vmm-installer (04.06.00.00.01.13.00.03) ...
Uninstall operation of vmm-installer is successful
Starting uninstallation of simatic-vmm-vnic-ipc ...
  Removing simatic-vmm-vnic-ipc (2.1.4-1) ...
  Purging configuration files for simatic-vmm-vnic-ipc (2.1.4-1) ...
Uninstall operation of simatic-vmm-vnic-ipc is successful
Starting uninstallation of simatic-vmm-call-ipc ...
  Removing simatic-vmm-call-ipc (286001-00.19) ...
  Purging configuration files for simatic-vmm-call-ipc (286001-00.19) ...
Uninstall operation of simatic-vmm-call-ipc is successful
SWCPU Uninstallation is finished successfully!
A reboot is required for the uninstallation to complete!
Would you like to reboot the system? (y/n)y
You selected 'yes', the system is going down for reboot NOW!
root@localhost:~/CPU1505SP-30.00.00.00-46.01.00.14_setup# Connection to 192.168.8.158 closed by remote host.
Connection to 192.168.8.158 closed.
```

Figure 4-2 Overview of the uninstallation process

After successful uninstallation, reboot the system. After the reboot, all Software Controller related components are removed from the system.

Disk partitions after uninstallation and reboot

After uninstallation and reboot, the disk partitions should have the following structure:

Partition	Description
sda1 / nvme0n1p1	EFI system partition
sda2 / nvme0n1p2	
sda3 / nvme0n1p3	
sda4 / nvme0n1p4	IndOS root file system

Verification of remaining disk partitions

You can verify the remaining disk partitions by running the following command:

fdisk -l

After running this command, only the following disk partitions remain:

- sda1 / nvme0n1p1
- sda2 / nvme0n1p2
- sda3 / nvme0n1p3
- sda4 / nvme0n1p4

Note

Disk partition sda6

If partition sda6 still remains after uninstallation, it has no effect on IndOS other than sda6 not being utilizable by IndOS.

The existence of the sda6 partition has no effect on the reinstallation of the Software Controller. The same partition will be occupied by the next installation.

If you do not intend to install the Software Controller again, proceed as follows:

- Delete sda6
 - Extend the root partition to be able to utilize this area
-

Commissioning

5.1 First commissioning

Commissioning

The following checklist guides you through the steps necessary for first commissioning.

Step	Procedure	Further information
1.	Install Software Controller V30.0 IndOS via setup installer	Section Installing the Software Controller (Page 29)
2.	Create a TIA Portal project	STEP 7 online help
3.	Create a Configuration file compatible to your TIA Portal project	Section Resource Configuration file (Page 42)
4.	Assign an IP address to the VMM Network Adapter	Paragraph "Network interface card" in section Resource Configurator (Page 39)
5.	Execute s7_resource_configurator via command line interface	Section Resource Configurator (Page 39)
6.	Reboot the device for the configuration changes to take effect (Software Controller is accessible via a physical interface or over VMM Network Adapter interface)	Section Resource Configurator (Page 39)
7.	Download user program onto device via TIA Portal connection	STEP 7 online help
8.	Switch Software Controller to RUN either via TIA Portal connection or s7_cpu_control tool	Section Operation using command line commands (Page 67)

Note

Bridging the physical and vNIC interfaces

If you want to bridge the physical interface and the vNIC interface, the bridge must have an IP address which is in the same subnet as vNIC.

5.2 Resource Configurator

Resource Configurator configures all system resources which are necessary for operating the Software Controller. Resource Configurator is part of the installer setup of the Software Controller. The tool is automatically installed on the target device. Resource Configurator does not have a graphical user interface but is a command line tool executable on the IndOS terminal.

You can use the IndOS terminal to carry out the following actions:

- Install
- Update

- Backup
- and configure the Software Controller

Configuration

Resource Configurator allows you to configure the following system resources:

- Assign/remove Software Controller interfaces, for example external network interface cards (Intel i210 or CP 1625)
- Configure NVRAM or Mass Storage as storage medium for saving retentive data
- Activate/deactivate LED usage
- Enable/disable automatic start of Software Controller during startup of PC

Storage location

Resource Configurator and its dependent files are located under the Software Controller data partition.

```
pt@localhost:/mnt/swcpu_mount/SWCPU/bin$ lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINTS
sda          8:0    0   28G  0 disk
├─sda1       8:1    0   256M  0 part  /efi
├─sda2       8:2    0    1M   0 part
├─sda3       8:3    0    1G   0 part
├─sda4       8:4    0   24G  0 part
├─└─sokol1 252:0    0   24G  0 crypt /
├─sda5       8:5    0    1G   0 part  /mnt/swcpu_mount
└─sda6       8:6    0   1.7G  0 part
pt@localhost:/mnt/swcpu_mount/SWCPU/bin$
```

Figure 5-1 Data partitions

During the setup, the Software Controller creates a partition containing the Software Controller data and mounts it under `/mnt/swcpu_mount`.

The command line tool is located under the following mount point:

- `/<mount_point>/SWCPU/bin/`

The Resource Configurator dependent Configuration file ("Resource Configuration file") is located under:

- `/<mount_point>/SWCPU/etc/resource_configurator/`

The last successfully applied resource assignment Configuration file is located under:

- `/etc/successful_config/`

Note**File transfer to other target devices**

If the target IPC has the same article number as the source IPC, you can also transfer "successful_config" files stored under this location to other devices and use these files as input to execute Resource Configurator.

Executing Resource Configurator

After completing the Software Controller installation, the Software Controller is configured with the basic hardware configuration and in STOP mode. If the hardware requirements differ from the basic configuration, update the configuration in Resource Configurator. To be able to switch the Software Controller to RUN, carry out a CPU-only download in TIA Portal.

During operation, execute Resource Configurator manually via command line to apply your configuration changes as desired. The following figure shows the help screen, which is visible via the "--help" command.

```

root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_resource_configurator --help
Copyright © Siemens AG, 2023
Command Line Configuration utility of S7-1500 Software Controller

Usage:
./s7_resource_configurator --resource-config <json-file> [--force-reboot] [--verbose]
./s7_resource_configurator --set-initial [--force-reboot] [--verbose]

Parameters:
-r, --resource-config=FILE      resource assignment JSON file
-s, --set-initial               remove hardware assignment and program of SWCPU
-f, --force-reboot              force to reboot after a successful operation with root privilege
-h, --help                     display help menu and exit
-v, --verbose                   set verbose logging
-V, --version                   display version info and exit

Examples:
./s7_resource_configurator -r /<path>/Resource_Assignment.json
./s7_resource_configurator --resource-config /<path>/Resource_Assignment.json --force-reboot --verbose
./s7_resource_configurator -s -f -v

```

Figure 5-2 Help screen

Resource configurator will take the following two parameters as input.

- "-r < Resource Configuration file >" (mandatory)

Other parameters:

- "-s, --set-initial"
This parameter resets the device configuration to a state where there is no interface assigned to CPU (initial state).
- "-f, --force-reboot"
This parameter forces IndOS to reboot automatically after successful execution of Resource Configurator to make the changes effective. Alternatively, you can manually reboot the system later.

The following figure shows the result after successful operation.

```

root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_resource_configurator -r /home/p
t/IPC_basic_configuration.json -v
Executing -> Resource Configurator...
Article number from JSON : AUTO
Article number from SMBIOS: 6AG4141-XXXXX-XXXX
Corresponding PCI_MAP file: PCI_MAP_6AG4141-XXXXX-XXXX.json
Executing -> Update VMM configuration...
Executing -> Update config area...
Executing -> Save Successful Configuration...
SUCCESSFUL!
REBOOT THE SYSTEM FOR CHANGES TO BE APPLIED!
root@localhost:/mnt/swcpu_mount/SWCPU/bin#

```

Figure 5-3 Successful operation

Resource Configurator shows the corresponding information message and informs the user to reboot the system. Reboot operation enables configuration changes to become effective on the device. Applying a new configuration leads to the erasure of the Software Controller's load memory.

Note

Multiple calls of Resource Configurator

Resource Configurator can also be called multiple times in a row. Provided configuration changes are applied according to the provided Resource Configuration file.

Changing the "nvram_usage" and "interfaces" entries erases the Software Controller's load memory while changing the "led_usage" and "start_cpu_on_pc_boot" entries does not erase the Software Controller's load memory.

5.2.1 Resource Configuration file

The Resource Configuration file consists of Software Controller parameters which are also available in TIA Portal. Use this file to modify these parameters so that they match the actual values of your TIA Portal project. Then apply these values to your project via the command line of Resource Configurator.

Resource Configuration file

The following figure shows a configuration file with an example basic configuration. Use this file to change the values to your actual parameters.

```

{
  "content_id": "resource_assignment",
  "article_number": "auto",
  "led_usage": true,
  "nvram_usage": false,
  "start_cpu_on_pc_boot": true,
  "interfaces": [
    {
      "name": "X2",

```

```

        "hw_identifier": 64,
        "type": "Intel standard Ethernet controller"
    }
]
}

```

The following figure shows a Configuration file with an example of an IE General external card configuration.

```

{
  "content_id": "resource_assignment",
  "article_number": "6AG4141-7BJ50-5AA0",
  "led_usage": true,
  "nvram_usage": false,
  "start_cpu_on_pc_boot": false,
  "interfaces": [
    {
      "name": "X2",
      "hw_identifier": 64,
      "type": "Intel standard Ethernet controller"
    },
    {
      "name": "X102",
      "hw_identifier": 72,
      "type": "Intel i210 or Compatible"
    }
  ]
}

```

The following figure shows a Configuration file with an example of an CP1625 external card configuration.

```

{
  "content_id": "resource_assignment",
  "article_number": "6AG4141-7BJ50-5AA0",
  "led_usage": true,
  "nvram_usage": false,
  "start_cpu_on_pc_boot": false,
  "interfaces": [
    {
      "name": "X2",
      "hw_identifier": 64,
      "type": "Intel standard Ethernet controller"
    },
    {
      "name": "X102",
      "hw_identifier": 72,
      "type": "CP 1625"
    }
  ]
}

```

```
    }  
  ]  
}
```

Note**Structure of Configuration file**

Resource Configurator configures the target device according to the information provided in the Configuration file. Resource Configurator does not check whether the Configuration file content and the configuration in TIA Portal are matching each other. It is the responsibility of the user to make sure that the Configuration file content matches the project configuration in TIA Portal.

Apart from changing the parameters to your actual values, do not change the file structure by removing/deleting or adding properties, which do not actually exist in your project.

"content_id"

"content_id" is an internal JSON key to distinguish between individual Configuration files. Do not modify this key and its corresponding value.

"article_number"

Change "article_number" to the article number of your device. The article number must match the article number of the IPC selected in TIA Portal.

If you set the value to "auto", Resource Configurator uses the correct device article number automatically.

Note**Automated setting of article numbers**

If you are using a customized article number, an automated setting of article numbers is not possible.

"led_usage"

If you want to use the hardware LEDs, set "led_usage" to "true". If you want to keep the hardware LEDs deactivated, set "led_usage" to "false".

Note

Note that in the basic configuration of the Configuration file, "true" already is the default value.

The parameter "led_usage" corresponds to the "Hardware LED" section of TIA Portal:

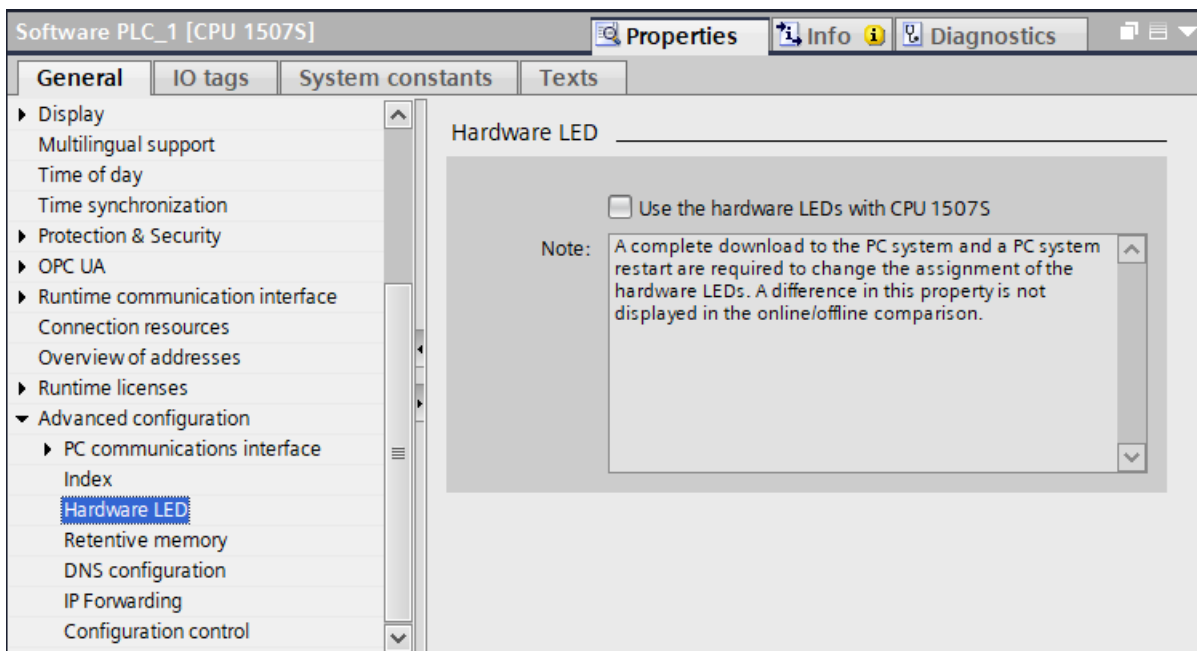


Figure 5-4 Hardware LEDs

"nvram_usage"

The parameter "nvram_usage" determines if the IPC's NVRAM is to be used to store retentive data

When using NVRAM as storage location or for using the "Fast Compile & Fast Commissioning" function, you do not need to set the "nvram_usage" flag to true. If NVRAM is available on the device, then this feature will be active automatically, independent of the "nvram_usage" setting in Resource Configurator.

The parameter "nvram_usage" corresponds to the "Retentive data memory" section of TIA Portal:

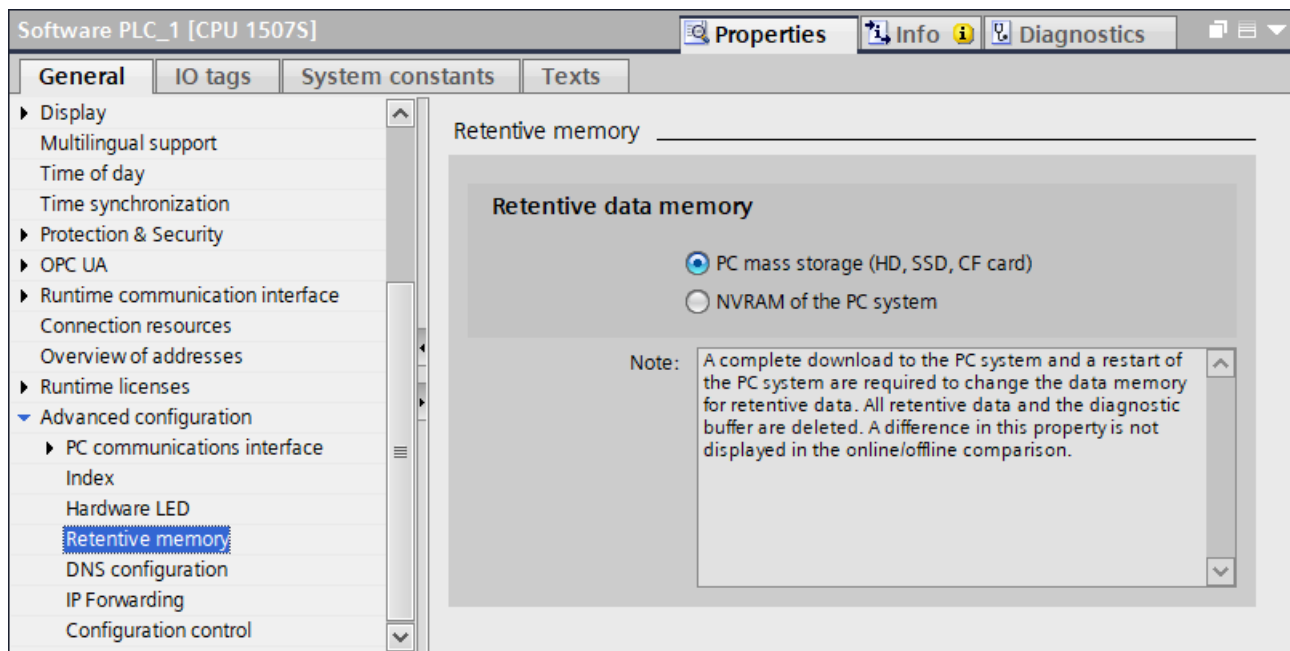


Figure 5-5 Retentive memory

"start_cpu_on_pc_boot"

If you want to start the Software Controller automatically after booting the PC, set "start_cpu_on_pc_boot" to "true".

Note

If you set "start_cpu_on_pc_boot" to "false", power on the CPU manually via the CPU Control Tool. Otherwise, the CPU download fails.

"interfaces"

In the "interfaces" section, you assign the interface parameters for the Software Controller.

"name" and "type"

Set "name" to the name of the interface assigned to the Software Controller (for example X2). Set "type" to the interface type assigned to the Software Controller (for example "Intel standard Ethernet controller" or "Intel Advanced Ethernet Controller").

The parameters "name" and "type" correspond to the "Interface assignment" section of TIA Portal:

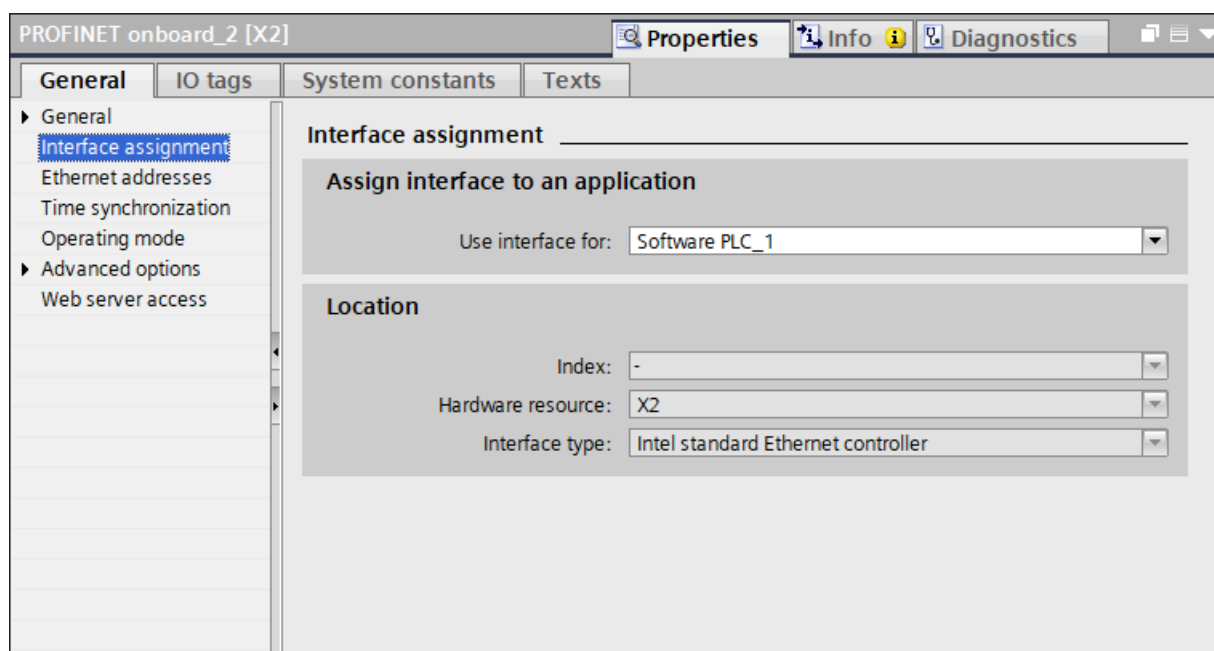


Figure 5-6 Interface assignment

Note

Also note that changing this parameter will delete the current project in the CPU.

The following table shows which CPU interfaces and types you can use on which device.

Device	CPU interface	Interface type
Open Controller CPU 1515SP PC2	X1	
IPC227G / IPC277G	X1, X2	Intel Advanced Ethernet Controller
IPC427E / IPC477E (PRO)	X2, X3	Intel Standard Ethernet Controller
BX-39A / PX-39A (PRO)	X2,	Intel Standard Ethernet Controller
	X3, X4	Intel Advanced Ethernet Controller
IE General card	X101, X102 ...	Intel i210 or compatible
CP 1625 card	X101, X102 ...	CP 1625

"hw_identifier"

Set "hw_identifier" to the hardware ID of the interface assigned to the Software Controller (for example "64").

The parameter "hw_identifier" corresponds to the "System constants" section of TIA Portal:

PROFINET onboard_2 [X2]					
Properties Info Diagnostics					
General IO tags System constants Texts					
Show hardware system constant ▾					
	Name	Type	Hardware identi.	Used by	Comment
	Local~PROFINET_onboard_2~Port_1	Hw_Interface	65	Software PLC_1	
	Local~PROFINET_onboard_2	Hw_Interface	64	Software PLC_1	

Figure 5-7 Hardware identifier

If there is more than one interface configured in TIA Portal, define additional interfaces in the Configuration file. For the definition of additional interfaces, the following applies:

- The interfaces defined in the Configuration file and in TIA Portal must be identical.
- The number of interfaces must not exceed the maximum number of interfaces that can be assigned to the Software Controller.

Note

PROFINET IO configuration on BX-39A and PX-39A (PRO)

Note that on the BX-39A / PX-39A (PRO) devices, configuring PROFINET IO is only supported in the following combinations:

- X2 + X3
 - X2 + X4
 - X2 + CP 1625 (plugged in PCIe)
 - X3 + CP 1625 (plugged in PCIe)
 - X4 + CP 1625 (plugged in PCIe)
-

Note

PROFIBUS interfaces

The Software Controller V30.0 does not support PROFIBUS with SIMATIC IPCs.

Note

Hardware ID 59

HW ID 59 belongs to the PC communication interface. Since IndOS does not have a PC Station interface, you cannot use HW ID 59 for a Software Controllers running on IndOS.

Network interface card

Note

If you assign a new network interface card, the name of the VMM Network Adapter changes, e.g. `emp0sf1`. The VMM Network Adapter IP address is no longer available. The `s7_cpu_control` tool can no longer communicate over the VMM Network Adapter interface.

To avoid this scenario, after the installation of the Software Controller setup is completed, you have the following possibilities:

- Assign a new IP address (for more information on how to assign IP addresses, see chapter Operation using command line commands)
or
- Write a udev rule to give a permanent name to the VMM Network Adapter interface according to its MAC address

To write a udev rule, proceed as follows:

1. Add a file with the file extension `.rules` (e.g. `"10-network.rules"`) to folder `"/etc/udev/rules.d"`
2. Write the following rule into the file:
`SUBSYSTEM=="net", ACTION=="add",`
`ATTR{address}=="MAC_ADDR_OF_VMM_NETWORK_ADAPTER",`
`NAME="VMM_NETWORK_ADAPTER_NAME"`
 The following example shows the rule with an example MAC address and VMM Network Adapter interface name added to it:
`SUBSYSTEM=="net", ACTION=="add", ATTR{address}=="28:63:36:78:b4:2d",`
`NAME="enp0s3f1"`
3. Save the file and reboot the system.
4. Use the `"ip a"` command to check, if the new VMM Network Adapter interface name has been added.
5. Copy `"21.09.00.00-XXX_setup.tar.gz"` to the `home/<user name>` directory.

Basic configuration of IPCs

The following basic Configuration file (for example `IPC_basic_configuration.json`) is included in the setup and stored in the following default path:

`/<mount_point>/SWCPU/etc/resource_configurator/.`

```
{
  "content_id": "resource_assignment",
  "article_number": "auto",
  "led_usage": true,
  "nvram_usage": false,
  "start_cpu_on_pc_boot": true,
  "interfaces": [
    {
      "name": "X2",
      "hw_identifier": 64,
      "type": "Intel standard Ethernet controller"
    }
  ]
}
```

```
    }
  ]
}
```

Basic configuration of the Open Controller

The CPU 1505SP on Open Controller (CPU 1515SP PC2) already preconfigured with factory settings:

- The interfaces have already been completely assigned.
- The NVRAM has already been activated as storage location for retentive data.
- The CPU 1505SP is configured for automatic start when the PC boots up.
- The LEDs are activated.

The following basic Configuration file is delivered via setup and stored in the following default path:

/<mount_point>/SWCPU/etc/resource_configurator/.

```
{
  "content_id": "resource_assignment",
  "article_number": "auto",
  "led_usage": true,
  "nvram_usage": true,
  "start_cpu_on_pc_boot": true,
  "interfaces": [
    {
      "name": "X1",
      "hw_identifier": 64
    }
  ]
}
```

Configuration update

A basic configuration is applied during installation by default. If you require a different configuration, reconfigure the system. As an example, we consider this following scenario. You want to use the additional external card CP 1625. You create your custom resource assignment file by modifying the existing one or by copying it with a different name.

Before executing the tool, the system administrator must create the necessary operator groups according to the Software Controller type and add users to these groups.

- For a standard Software Controller, the root and the users belonging to the "software_controller_operators" group can execute the tool.
- For a fail-safe Software Controller, only users belonging to the "failsafe_operators" group can execute the tool.

The following shows an example of a customized configuration:

```
{
  "content_id": "resource_assignment",
  "article_number": "auto",
  "led_usage": true,
  "nvram_usage": true,
  "start_cpu_on_pc_boot": true,
  "interfaces": [
    {
      "name": "X2",
      "hw_identifier": 64,
      "type": "Intel Standard Ethernet controller"
    }
    {
      "name": "X101",
      "hw_identifier": 72,
      "type": "CP 1625"
    }
  ]
}
```

Then execute Resource Configurator by providing this file as an input. Finally, reboot the system for the changes to take effect.

```
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_resource_configurator -r /home/p
t/IPC_basic_configuration.json -v
Executing -> Resource Configurator...
Article number from JSON : AUTO
Article number from SMBIOS: 6AG4141-XXXXX-XXXX
Corresponding PCI_MAP file: PCI_MAP_6AG4141-XXXXX-XXXX.json
Executing -> Update VMM configuration...
Executing -> Update config area...
Executing -> Save Successful Configuration...
SUCCESSFUL!
REBOOT THE SYSTEM FOR CHANGES TO BE APPLIED!
root@localhost:/mnt/swcpu_mount/SWCPU/bin#
```

Figure 5-8 Apply changes

If you apply the same configuration more than once, the following message appears:

"Hardware configuration is up to date. No changes will be applied!"

```
pt@localhost:~$ s7_resource_configurator -r /home/pt/my_project.json -v
Executing -> Resource Configurator...
HARDWARE CONFIGURATION IS UP TO DATE!
NO CHANGES WILL BE APPLIED!
pt@localhost:~$
```

Figure 5-9 Configuration is up to date

Note**Automated commissioning through scripting**

If you have automated the commissioning phase through scripting, we recommend that you use integer return values of the tool instead of strings for correct representation of the operation result.

Resource Configurator configures all IPC system resources which are necessary for operating the Software Controller. Resource Configurator is part of the installer setup of the Software Controller. The tool is automatically installed on the target device. Resource Configurator does not have a graphical user interface but is a command line tool that you execute by using the command prompt.

Delete configuration

For deleting the configuration, use the "set-initial" command. This command deletes the previously loaded project. You can use either of the two following commands:

- `s7_resource_configurator -s -v`
- `s7_resource_configurator --set-initial -verbose`

The following images shows the application of the "set-initial" command.

```
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_resource_configurator -s -v
Executing -> Resource Configurator...
Article number from JSON : AUTO
Article number from SMBIOS: 6AG4141-XXXXX-XXXX
Corresponding PCI_MAP file: PCI_MAP_6AG4141-XXXXX-XXXX.json
Executing -> Update VMM configuration...
Executing -> Update config area...
Executing -> Save Successful Configuration...
SUCCESSFUL!
REBOOT THE SYSTEM FOR CHANGES TO BE APPLIED!
root@localhost:/mnt/swcpu_mount/SWCPU/bin#
```

Figure 5-10 Delete configuration

5.2.2 Error handling**Configuration errors**

If an error occurs during the initial configuration, Resource Configurator sets the target to the last successfully applied configuration file.

The following figure shows the occurrence of an error during execution and the rollback to its previous configuration.

```

root@localhost:/mnt/swcpu_mount/SWCPU/bin#
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_resource_configurator -r
uration.json -v
Verbose logging switched to on
Executing -> Resource Configurator...
Executing -> Parse JSON file(s)...
MLFB from JSON : AUTO
MLFB from SMBIOS: 6AG4141-5BC50-3JA0
Corresponding IPC_PCI_MAP file: IPC_PCI_MAP_6AG4141-XXX5X-XXXX.json
Executing -> Update VMM configuration...
PCI device too large!
Adding a PCI device to VMM configuration is failed!
FAILED!
Executing -> Rollback to previous configuration...
Executing -> Resource Configurator...
Executing -> Parse JSON file(s)...
Executing -> Update VMM configuration...
Executing -> Update config area...
Executing -> Save Successful Configuration JSON files...
ROLLBACK SUCCESS!
SUCCESSFUL!
REBOOT THE SYSTEM FOR CHANGES TO BE APPLIED!

```

Figure 5-11 Configuration error while parsing Configuration file

Resource Configurator shows a status message about the operation result. If an error occurs, use the --verbose parameter (-v) to collect detailed information about the error reason.

Error messages

Resource Configurator displays status messages about the operation results. Possible results are "Success" or "Failure". When the status is "Failure", you can use the --verbose parameter (-v) to collect detailed information about the error reason. A return value of "0" means that no error appeared, and the operation was successful.

The following list gives an overview of possible error reasons:

Return value	Error message	Meaning
1	HWCONFIG_SAME_AS_BEFORE	Hardware configuration is up to date
2	ERR_NO_PARALLEL_EXEC	Parallel execution is not supported
3	ERR_NO_FILE	Input file(s) cannot be found or read
4	ERR_NOT_JSON	Given file(s) extension is not a JSON type
5	ERR_LOAD_CFG_FILE_FAILED	VMM config file could not be read properly
6	ERR_RM_PCI_DEVICE_FAILED	Removing PCI device(s) from VMM configuration failed
7	ERR_ADD_PCI_FAILED	Adding PCI device to VMM configuration failed
8	ERR_WRITE_CFG_FILE_FAILED	VMM configuration file could not be written properly
9	ERR_RES_CFG_PARSE_FAILED	Parsing resource configuration file failed
10	ERR_RES_CFG_DUPLICATE_VALUES	Please check for duplicate values in resource assignment Configuration file
11	ERR_RES_CFG_FILE_NAME_EMPTY	Name of resource configuration file is empty
12	ERR_IPC_PCI_PARSE_FAILED	Parsing PCI map file failed
13	ERR_WRITE_CONFIG_AREA_FAILED	Writing attributes to config area failed

5.3 Exporting and importing configuration files

Return value	Error message	Meaning
14	ERR_PREPARE_CONFIG_AREA_FAILED	Preparing config area failed
15	ERR_CREATE_CPU_PARTITIONS_FAILED	Creating CPU partition failed
16	ERR_CPU_PARTITIONS_ALREADY_EXIST	CPU partitions already exist
17	ERR_FETCH_SWCPU_DISK_NUMBER_FAILED	Fetching the Software Controller disk number failed
18	ERR_DECODE_PCI_PATH_FAILED	Decoding PCI path location failed
19	ERR_SET_BOOT_DELAY_FAILED	Setting boot delay parameter failed
20	ERR_NO_PCI_MAP_FILE_FOUND	No suitable PCI map file found in directory
22	ERR_INVALID_CONTENT	Invalid content in Configuration file
23	ERR_INVALID_MLFB	Article number is invalid
24	ERR_SMBIOS_MLFB_EMPTY	Article number from SMBIOS is empty (could not be retrieved)
25	ERR_SAVE_SUCCESS_FILE_FAILED	Saving resource assignment file failed
26	ERR_WRONG_ATTRIBUTE	Wrong attribute in Configuration file
27	ERR_ADD_AHCI_FAILED	Adding an AHCI to VMM configuration failed
28	ERR_RM_FLAG_FAILED	Removing MSI_MSIX flag failed
31	ERR_RM_ALL_AHCI_FAILED	Removing an AHCI from VMM configuration failed!
32	ERR_ADD_VIRT_NVME_FAILED	Adding virtual NVME device failed
33	ERR_ADD_SET_ACPI_VIRT_FAILED	Setting ACPI virtualization failed
34	ERR_ADD_MEM_REG_FAILED	Adding memory region failed
35	ERR_ADD_VM_MEM_FAILED	Adding VM memory failed
36	ERR_ADD_REBOOT_VIRT_FAILED	Adding Reboot Virtualization flag to VMM config file failed
37	ERR_REMOVE_REBOOT_VIRT_FAILED	Removing Reboot Virtualization flag from VMM config file failed

5.3 Exporting and importing configuration files

5.3.1 Command prompt

The tool for importing and exporting configuration files is called S7 CPU Configuration Tool. This command line executable tool is located under:

/<mount_point>/SWCPU/bin/

You can automate the usage of the tool via scripting.

Command prompt

The following image shows the command prompt and the available commands.

```
pt@localhost:~$ s7_cpu_configuration --help
Copyright © Siemens AG, 2023
Command line tool for File Import/Export operations of S7 - 1500 Software Controller

Usage:
s7_cpu_configuration --import <psc-file> [ --export <file-path> ]
Parameters:
-h [ --help ]          Print Help
-v [ --verbose ]       Set Verbose Logging
-V [ --version ]       Print Version
-p [ --print ]         Print Configuration
-e [ --export ]        File Name will be exported
-i [ --import ]        File Name will be imported
pt@localhost:~$
```

Figure 5-12 Command prompt

The meaning of the commands is as follows:

- --help or -h
The command displays a help screen.
- --verbose or -v
This command can be combined with other commands to switch verbose logging on. This command is useful for error cases to print logs containing detailed error information.
- --version or -V
The command shows the product version number.
- --print or -p <path>\filename.psc
The command prints metadata information of the specified .psc file.
- --export or -e <path>\filename.psc
The command exports the software configuration from the CPU to the specified .psc file.
- --import or -i <path>\filename.psc
The command imports the configuration from the specified .psc file into the CPU.

5.3.2 Exporting configuration files

Export operation

The following list gives you an overview of the steps necessary to carry out an export operation.

1. A Software Controller V30.0 or higher is installed via the setup installer.
2. You have created and applied a TIA Portal project to the CPU.
3. You have executed s7_cpu_configuration with the --export parameter via the command line interface.
4. The .psc file is created in this step.

Exporting CPU configuration

Before carrying out a CPU configuration export, the Software Controller must be in POWER ON operating state.

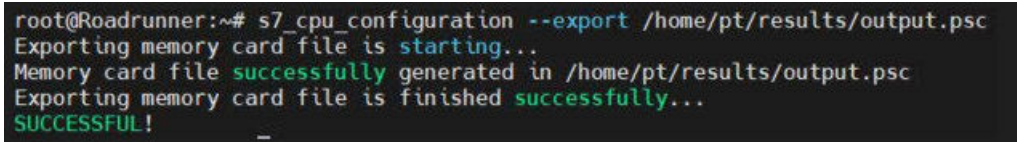
Note**Configuration export in RUN**

If you want to export a CPU configuration while the Software Controller is in RUN, make sure that the running CPU user program does not modify the load memory area

To carry out the CPU configuration export, proceed as follows:

1. Run the ".s7_cpu_configuration --export <path>" command in the command prompt.
2. Wait for execution.
3. After the confirmation that the operation was successful, the .psc file can be found at the given path.

The following image shows the export of an example file (.s7_cpu_configuration --export /path/to/project.psc).



```
root@Roadrunner:~# s7_cpu_configuration --export /home/pt/results/output.psc
Exporting memory card file is starting...
Memory card file successfully generated in /home/pt/results/output.psc
Exporting memory card file is finished successfully...
SUCCESSFUL!
```

Figure 5-13 Successful configuration export

Note**Usage of paths**

The export function does not work with relative paths. Do not use relative paths but use absolute paths instead.

5.3.3 Importing configuration file

Import operation

The following list gives you an overview of the steps necessary to carry out an import operation.

1. A Software Controller V30.0 or higher is installed via the setup installer.
2. You have a .psc file, either created in TIA Portal or by CPU configuration export.
3. The Software Controller is in POWER OFF operating state.
4. You have executed s7_cpu_configuration with the --import parameter via the command line interface.

5. You have switched the Software Controller to POWER ON.
6. The Software Controller can be operated using the imported configuration.

Importing CPU configuration

Before carrying out a CPU configuration import, the Software Controller must be in POWER OFF operating state.

You use the S7 CPU Control tool to change the operating state to POWER OFF, before executing the import command.

To carry out the CPU configuration import for a standard Software Controller, proceed as follows:

1. Power off the Software Controller using the command `./s7_cpu_control --PowerOff`.
2. Run the `./s7_cpu_configuration --import /path/to/project.psc` command in the command prompt.
3. Wait for execution.
4. After the confirmation that the operation was successful use the command `./s7_cpu_control --PowerOn`.
5. Use the command `./s7_cpu_control --Run` to put the Software Controller into RUN.

The following shows an example configuration import for a standard Software Controller.

```
pt@localhost:~$ s7_cpu_control --GetStatus
Current State: STOP
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --PowerOff
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_configuration --import /home/pt/psc_files/FileImport_IPC_427E_Addition.psc
Importing memory card file is starting...
Importing memory card file is finished successfully...
SUCCESSFUL!
pt@localhost:~$ s7_cpu_control --PowerOn
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --Run
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --GetStatus
Current State: RUN
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$
```

Figure 5-14 Example configuration import for standard Software Controller

To carry out the CPU configuration import for a fail-safe Software Controller, proceed as follows:

1. Power off the Software Controller using the command `./s7_cpu_control --PowerOff`.
2. Run the `./s7_cpu_configuration --import /path/to/project.psc` command in the command prompt.
3. Wait for execution.
4. After the confirmation that the operation was successful, power on the Software Controller again.

5. Confirm the collective fail-safe signature by using the S7 CPU Control Tool and running the command `./s7_cpu_control --ConfirmCollectiveFSignature -Signature <signature>`
6. Use the command `./s7_cpu_control --Run` to put the Software Controller into RUN.

```
pt@localhost:~$ s7_cpu_control --GetStatus
Current State: STOP
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --PowerOff
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_configuration --import /home/pt/psc_files/F_NonPMS_NonPro_Add.psc
Importing memory card file is starting...
Collective F-Signature: 9A0773BD
Importing memory card file is finished successfully...
SUCCESSFUL!
pt@localhost:~$ s7_cpu_control --PowerOn
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --ConfirmCollectiveFSignature -Signature 9A0773BD
Current Collective F-Signature: 9A0773BD
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --Run
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$ s7_cpu_control --GetStatus
Current State: RUN
Command sent SUCCESSFULLY to SWCPU
pt@localhost:~$
```

Figure 5-15 Example configuration import for fail-safe Software Controller

Note**Usage of paths**

The import function does not work with relative paths. Do not use relative paths but use absolute paths instead.

5.3.4 Printing configuration information

You have the possibility to print the metadata information of a .psc file. The information comes from the "Metadata.xml" file.

To print file metadata, proceed as follows:

1. Run the `./s7_cpu_configuration --print /path/to/project.psc` command in the command prompt.
2. Wait for execution.
3. After successful operation, you will find the metadata information printed on the command prompt.

The following image shows an example command line output.

```

root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_cpu_configuration --print /home/pt/fatih/Failsafe.psc
Metafile
<xmlattr>
  xmlns:xsd='http://www.w3.org/2001/XMLSchema'
  xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'
  xmlns='http://www.siemens.com/2016/10/PCStation/FileImport Component_10.xsd'
Component
  Index="2"
  Name="Software PLC 1"
  Id="add5af3c-4340-49f4-9b2c-5dfcc55c2d2f"
  TypeId="17687303"
  Author="z003y16h"
  Comment
  TextList="FA 70 E8 75 1D 5A 8E 29"
  Software="74 B0 49 C5 CA B6 B3 16"
  IuM
    Manufacturer="Siemens"
    OrderId='6ES7 672-7FC02-0YA0'
    SoftwareRevision="V30.0"
    FunctionDesignation
    LocationDesignation
    InstallationDate="2022-06-22T10:24:46.4434602Z"
    AdditionalInfoText
    CollectiveFailsafeSignature="0x9A0773BD"
root@localhost:/mnt/swcpu_mount/SWCPU/bin#

```

Figure 5-16 Example of printed configuration metadata

5.3.5 Error handling

Error messages

S7 CPU Configuration Tool displays status messages about the operation results. Possible results are "Success" or "Failure". When the status is "Failure", you can use the --verbose parameter (-v) to collect detailed information about the error reason. A return value of "0" means that no error appeared, and the operation was successful.

The following list gives an overview of possible error reasons:

Return value	Error message	Meaning
1	ERR_NO_FILE	Input file cannot be found or read
2	ERR_OMS_INIT_FAILED	Initialization of OMS DLL API failed
3	ERR_OMS_CONNECT_FAILED	Cannot connect to OMS
4	ERR_GENERATE_SESSION_ID_FAILED	Random session ID for an OMS session cannot be generated properly
5	ERR_GET_VALUE_FAILED	Requested value cannot be retrieved from value source
6	ERR_SET_VALUE_FAILED	Value cannot be updated on target object
7	ERR_COLLECT_INFO_FAILED	Required information cannot be collected properly
8	ERR_INVALID_EXTENSION_FAILED	Input file extension is not in a correct format
9	ERR_CREATE_TEMP_PATH_FAILED	Temporary working directory cannot be created
10	ERR_OPEN_PSC_FILE_FAILED	Input .psc file cannot be opened
11	ERR_EMPTY_PSC_FILE_FAILED	Input .psc file is empty
12	ERR_READING_ZIP_FILE_FAILED	Reading operation of internal zip files in .psc file cannot be executed
13	ERR_REMOVE_TEMP_PATH_FAILED	Temporary working directory cannot be removed from the system

5.3 Exporting and importing configuration files

Return value	Error message	Meaning
14	ERR_EXTRACT_FILE_FAILED	Compressed file cannot be extracted properly
15	ERR_CLOSED_ZIP_FILE_FAILED	Zip file cannot be closed properly
16	ERR_GENERATE_METAFILE_FAILED	XML metafile cannot be generated properly
17	ERR_GENERATE_PCSYSTEM_ARCHIVE_FAILED	PC system archive cannot be generated
18	ERR_GENERATE_PSC_ARCHIVE_FAILED	Output .psc file cannot be generated for the export operation
19	ERR_ADD_TO_EXISTING_ARCHIVE_FAILED	Some required file(s) cannot be added to archive to build up a complete .psc file
20	ERR_COMPRESS_FAILED	Compression operation failed
21	ERR_MOUNT_OMS_PARTITION_FAILED	Load storage area cannot be mounted to file system
22	ERR_UNMOUNT_OMS_PARTITION_FAILED	Load storage area cannot be unmounted from file system
23	ERR_IMPORT_UNCOMPRESS_PSC_FILE_FAILED	.psc file cannot be uncompressed during import operations
24	ERR_IMPORT_REPLACE_OMS_STORE_FAILED	Cannot replace the OMSSTORE in the extracted .psc file and the OMSSTORE currently on the device during import operations
25	ERR_EXPORT_COPYING_OMS_STORE_FAILED	Copying OMS Store to Linux file system failed
26	ERR_INVALID_FILE_PATH	Given file path is incorrect or missing
27	ERR_DECOMPRESS_FAILED	Compressed file cannot be decompressed properly
28	ERR_LOAD_STORAGE_OPERATION_FAILED	Cannot use load storage area properly
29	ERR_NOT_ENOUGH_MEMORY	Not enough memory for operations
30	ERR_DIRECTORY_OPERATION_FAILED	Performing directory operations failed
31	ERR_FILE_OPERATION_FAILED	Performing file operations failed
32	ERR_READ_CONSISTENCY_FILE	Reading consistency file failed
33	ERR_COMPARE_CONSISTENCY_FILE	Compare consistency file failed
34	ERR_OPEN_XML_FILE_FAILED	Opening XML file failed
Fail-safe specific error messages		
0x51A3	FAILSAFE_SUCCESS	Successful operation for fail-safe devices
0x80040331	ERR_NOT_IN_FAILSAFE_OPERATORS_GROUP	User is not a member of Failsafe Operators Group
0x80040332	ERR_IMPORT_FAILED	.psc file import operation failed
0x80040333	ERR_EXPORT_FAILED	.psc file export operation failed
0x80040334	ERR_PRINT_FAILED	.psc file print operation failed
0x80040335	ERR_GET_OMSSTORE_FOLDER_FAILED	Retrieving OMS Store folder failed
0x80040336	ERR_LOAD_DLL_FAILED	DLL library cannot be loaded to the program
0x80040337	ERR_UNLOAD_DLL_FAILED	DLL library cannot be unloaded from the program
0x80040338	ERR_CPU_TYPE_NOT_MATCH	CPU type does not match to installed CPU type
0x8004033F	ERR_GENERIC_FAIL	Not specified error occurred

5.4 Shutdown and startup

Software Controller start after booting PC

For IndOS, you do not determine the starting behavior of the Software Controller in TIA Portal but in the Resource Configuration file of Resource Configurator.

For information on how to start the Software Controller after booting the PC, refer to section Resource Configuration file (Page 42).

Software Controller mode after booting PC

The mode the Software Controller is in, after powering on the Software Controller, is set in the "Startup" section of TIA Portal.

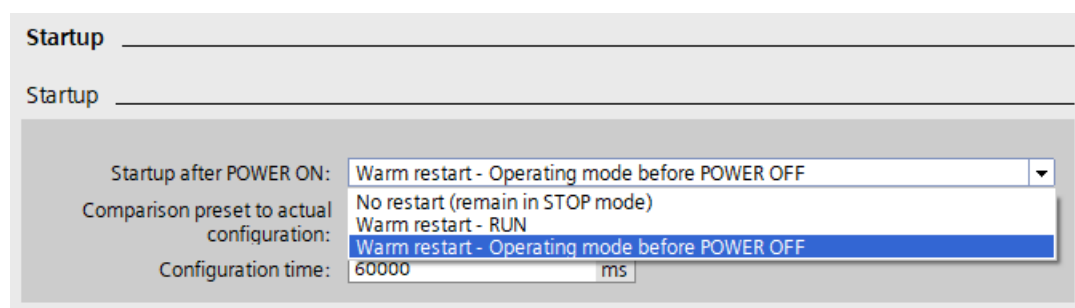


Figure 5-17 Startup

Option "No restart (remain in STOP mode)"

If you use this option and initiate a restart for IndOS, the Software Controller powers off and IndOS restarts the PC. Retentive data stored in PC mass storage or NVRAM is kept.

After restart, use the "Bootling of the PC" option "IndOS and S7-1500 Software Controller" in the GRUB screen menu. After system start, the Software Controller is powered on but is in STOP mode. All retentive data is available again.

Options "Warm restart - RUN" and "Warm restart - Operating mode before POWER OFF"

If you use one of these options and initiate a restart for IndOS, the Software Controller powers off and IndOS restarts the PC. Retentive data stored in PC mass storage or NVRAM is kept.

After restart, use the "Bootling of the PC" option "IndOS and S7-1500 Software Controller" in the GRUB screen menu. After system start, the Software Controller is in RUN or assumes its previous state before POWER OFF. All retentive data are available again.

Note

Software Controller operating mode

You can check the operating mode of the Software Controller using the `s7_cpu_control` tool.

Reference

You can find additional information on setting the startup type in the STEP 7 online help.

Rebooting PC

IndOS does not support IndOS-only restarts. When restarting IndOS, the complete PC including the Software Controller is stopped and shut down and the system is restarted.

To restart the Software Controller, use the "Bootting of the PC" option "IndOS and S7-1500 Software Controller" in the GRUB screen menu.

Note

IndOS shutdown behavior

If the Software Controller shuts down ungracefully, retentive data is lost. An ungraceful shutdown of the Software Controller can have the following reasons:

- A restart or shutdown of the Software Controller takes too long due to an interruption
 - The Software Controller is not reachable from IndOS due to a connectivity problem
 - The PCI configuration has changed, for example by plugging or unplugging a network interface card, leading to a name change of the virtual Ethernet interface
-

Note

Rebooting or shutting down IndOS and the Software Controller

When rebooting or shutting down IndOS and the installed Software Controller, the following log message might sporadically appear:

"Failed unmounting /mnt/swcpu_mount".

Note that this occurrence has no negative functional impact on the system.

Note

Software Controller cycle time after reboot of IndOS and Software Controller

Note that the cycle time of the Software Controller may increase during the boot of the system when IndOS and the Software Controller are starting.

For more information on the cycle time of CPUs, refer to the Cycle and Response Times (<https://support.industry.siemens.com/cs/ww/en/view/59193558>) function manual.

SFC 97 SHUT_DOWN instruction

You can shut down the PC from the Software Controller's user program by means of the "SHUT_DOWN: Shutdown target system" instruction. The instruction is available in TIA Portal in the "Instructions" task card under Basic instructions > Program control > Runtime control.

Note

Supported SHUT_DOWN modes

For IndOS, only the instruction "SHUT_DOWN: Shutdown target system"; MODE = 2 is supported.

When you use this instruction, the Software Controller restarts. IndOS is not shut down. All retentive data is saved.

Using an optional uninterruptible power supply (UPS)

IndOS supports the use of a UPS (for example SITOP or other devices). To be able to use a UPS, proceed as follows:

1. Connect the UPS to the PC via USB.
The UPS notifies IndOS. The PC detects a power failure and sends a power failure signal to the CPU. The CPU can then trigger a quick shutdown and back up the retentive data.
2. Enter the command "CPU_Control/PowerOffCPU" in the shutdown script of the UPS.

5.4.1 Behavior of Software Controller when shutting down IndOS

Shutting down IndOS

You can shut down IndOS using the following actions:

- In case of graphical user interface, switch off the PC by clicking the corresponding button
- Shut down the PC via the command-line command "shutdown"

When you restart the PC, the Software Controller starts as previously configured.

Note

IndOS fatal system error

If a fatal system error (kernel panic) occurs and the system is unable to recover, proceed as follows to keep retentive data:

- Unplug and then replug the power cable to simulate a power failure
To prevent the system from rebooting automatically and losing retentive data, make sure to unplug and then replug within ≤ 1 minute.

All retentive data stored in NVRAM will be retained.

Loss of retentive data when shutting down and restarting IndOS

If the following three conditions are met, retentive data might be lost after shutting down and restarting IndOS:

- You have configured retentive data
- You have set a password for the "No access" protection level
- You have downloaded project data to the CPU

To avoid a loss of retentive data, use one of the following two workarounds.

Workaround 1

Use the CPU Control Tool and the password to shut down the Software Controller, before shutting down and restarting IndOS.

Workaround 2

Save the password hash which belongs to the specified protection level in the TIA Portal project. Write a shell script to save the password hash to the internal graceful shutdown script of the Software Controller.

Note

Security

We strongly recommend that you use the password hash of protection level "HMI access" for better security.

Also make sure that only root users can execute the shell script that you wrote.

After finishing the operation, the user should change to a standard user account for higher security.

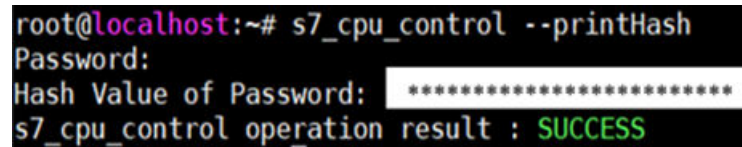
To keep the retentive data of your configured project with protection level "No access", carry out the following steps:

1. Execute the `s7_cpu_control` tool with the `printHash` option and obtain the password.

Note

Make sure that you keep the "hashes" file in a secure place.

The following example screenshot uses the protection level "HMI access":



```

root@localhost:~# s7_cpu_control --printHash
Password:
Hash Value of Password: *****
s7_cpu_control operation result : SUCCESS

```

2. Write a shell script which saves the obtained hash to the internal graceful shutdown script of the Software Controller.

Your script should be similar to the example script below:

```

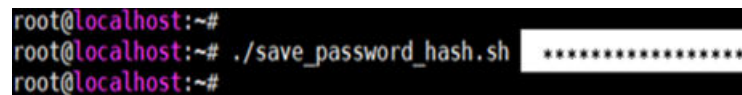
#!/bin/bash

GRACEFUL_SHUTDOWN_SCRIPT_PATH=/usr/local/bin/swcpugracefulshutdown.sh
sed -i -r "s/^(HASH_OF_USER_PASSWORD=).*$/\1/" $GRACEFUL_SHUTDOWN_SCRIPT_PATH

```

3. Execute the script you wrote with the obtained hash as shown in the following example screenshot.

In the example, the above shown script is saved as "save_password_hash.sh":



```

root@localhost:~#
root@localhost:~# ./save_password_hash.sh *****
root@localhost:~#

```

After these steps, the password hash is saved to the internal graceful shutdown script of the Software Controller. The script is part of the installer package. The script is installed automatically.

Note

Password changes

Note that when changing the password in the TIA Portal project, you must run the same script using the hash of the new password.

If the password has not been changed, it is sufficient to only run the script once.

Operation

6.1 Operation using command line commands

If the internal communication via the virtual Ethernet interface is established, you can control the CPU with the CPU Control Tool via command-line commands.

Note

Remote access from another device

The CPU Control Tool can run remotely on another device. To prevent external influence on the CPU, protect the TCP port with the port number "2024" in the firewall settings.

Requirement

The fifth partition is mounted in the file system.

Procedure

To use the CPU Control Tool, proceed as follows:

Execute the command `./s7_cpu_control`:

```
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_cpu_control
```

Note

Call infotext in the command line

If you do not specify a parameter after the `./s7_cpu_control` command, a list with permitted commands and a description opens.

To change the operating state of the CPU, enter the required command:

```
./s7_cpu_control <Command>
```

Check the operating state of the CPU after each command input with the command `--GetStatus`. This operation checks the actual execution result.

The following image shows a command sent to the CPU.

```
root@localhost:/mnt/swcpu_mount/SWCPU/bin#
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_cpu_control --STOP
Command sent SUCCESSFULLY to SWCPU
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_cpu_control --Getstatus
Current State: STOP
Command sent SUCCESSFULLY to SWCPU
root@localhost:/mnt/swcpu_mount/SWCPU/bin#
root@localhost:/mnt/swcpu_mount/SWCPU/bin#
```

Note**"--GetStatus" command with CPU switched off**

The "--GetStatus" command returns an error when the CPU is switched off.

Commands to control the CPU

The following table provides an overview of the command line commands supported by the CPU:

Command	Explanation
--PowerOnCPU	Starts the CPU in "STOP" mode. For more information on the transitions between the different operating modes, see section Operating mode transitions (Page 69).
--PowerOffCPU	Shuts down the CPU. Note that when powering off the CPU while the retentive memory is filled to capacity (100MB), an error message appears prompting you to restart Linux. Make sure that there is free retentive memory space available, before powering off the CPU. For more information on IndOS shutdown behavior, see section Shutdown and startup (Page 61).
--Run	Sets the CPU to "RUN" operating mode.
--Stop	Sets the CPU to "STOP" operating mode.
--GetStatus	Shows the operating mode of the CPU.
--MemoryReset	Resets the CPU memory.
--FactoryReset	Resets the CPU to factory settings.
--IP:	Identifies and stores the IP address of the runtime communication interface. Execute this command if the IP address already assigned has changed due to a download via STEP 7. Note: If you change the IP address, use the CPU Control Tool once with the new IP address. This approach allows you to make sure that the new IP address is saved successfully. Otherwise, retentive data is lost after IndOS reboot. If the new IP address is saved successfully, the following example message appears: Successfully saved IP address as 192.168.73.84

Note**Changing the operating mode of a CPU**

The user group "software_controller_operators" in the computer administration allows you to change the operating state of a CPU. The user who executes this command must be part of this user group.

This user group is not available by default. The user group needs to be created.

The command can also be executed when a protection level is configured for the CPU.

Parameters of the CPU Control Tool

The following table provides an overview of the CPU Control Tool parameters:

Parameter	Explanation
--force	Skips the warning and sets the CPU to the "STOP" operating mode.
--DumpServiceData	Saves service data to a etc/swcpu folder. Returns a success message.
--DumpServiceData=/etc/myFolder	Save service data to a etc/my folder. Returns a success message.
--DumpServiceData=SomeInvalidPath	The CPU Control Tool returns the following error message "Failed to save service-data".

6.2 Operating modes

6.2.1 Basic principles

Introduction

Operating modes describe the states of the CPU. You can set the following operating modes via the Web server, the CPU Control Tool or STEP 7.

- RUN
- STOP

In these operating modes, the CPU can communicate, for example, via the PN/IE interface. Status LEDs indicate the current operating mode.

Reference

You can find additional information in the STEP 7 online help.

6.2.2 Operating mode transitions

Operating modes and operating mode transitions

The following figure shows the operating modes and the operating mode transitions:

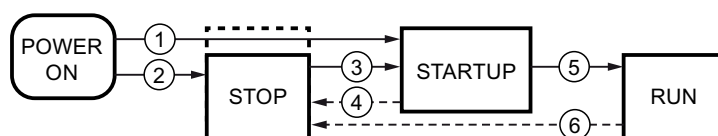


Figure 6-1 Operating modes and operating mode transitions

No.	Operating mode transitions	Conditions
①	POWER ON → STARTUP	After switching on, the CPU goes to "STARTUP" mode if: • The hardware configuration and program blocks are consistent. • The start-up type "Warm restart - RUN" is set or the start-up type "Warm restart - mode before POWER OFF" is set and RUN mode was active before POWER OFF. Non-retentive memory is cleared. The content of non-retentive DBs is reset to the start values of the load memory. Retentive memory and retentive DB contents are retained.
②	POWER ON → STOP	After switching on, the CPU goes to "STOP" mode if: • The hardware configuration and program blocks are not consistent or • The "No restart" startup type is set Non-retentive memory is cleared. The content of non-retentive DBs is reset to the start values of the load memory. Retentive memory and retentive DB contents are retained.
③	STOP → STARTUP	The CPU goes to "STARTUP" mode if: • The hardware configuration and program blocks are consistent. • The CPU is set to "RUN" by the programming device. Non-retentive memory is cleared. The content of non-retentive DBs is reset to the start values of the load memory. Retentive memory and retentive DB contents are retained.
④	STARTUP → STOP	The CPU returns from "STARTUP" mode to "STOP" mode in the following cases: • An error is detected during start-up. • The CPU is set to "STOP" from the programming device. • A STOP command is executed in the Startup OB.
⑤	STARTUP → RUN	The CPU goes to the "RUN" mode in the following cases of "START-UP": • The CPU has initialized the PLC tags. • The CPU has executed the startup blocks successfully.
⑥	RUN → STOP	The CPU returns from "RUN" mode to "STOP" mode in the following cases: • An error is detected that prevents continued processing. • A STOP command is executed in the user program. • The CPU is set to "STOP" mode via the programming device.

Maintenance

7.1 Firmware updates of I/O modules

Introduction

During operation it may be necessary to update the firmware (for example due to functional enhancements).

Note

Firmware update of I/O modules

You can update the firmware of an I/O module centrally or distributed.

Requirement

- You have downloaded the file(s) for the firmware update from the Customer Support (<https://support.industry.siemens.com/cs/ww/en/ps>) web site.
On this web site, select: Automation technology > Automation systems > SIMATIC industrial automation system > Controllers > SIMATIC S7 modular controllers > SIMATIC S7-1500.
From there, navigate to the specific type of module that you want to update. To continue, click on the link for "Software downloads" under "Support". Save the desired firmware update files.
- Before installing the firmware update, ensure that the modules are not being used.

Options for the firmware update

A can carry out the firmware update in STEP 7 (online) or via the Web server

Installation of the firmware update



WARNING

Impermissible plant states possible

Due to the installation of the firmware update, the CPU enters the STOP mode. The STOP mode can impact the operation of an online process or a machine.

Unexpected operation of a process or a machine can lead to fatal or severe injuries and/or to material damages.

Before installing the firmware update, make sure that the CPU is not executing any active process.

Procedure using STEP 7

To carry out an online firmware update in STEP 7, proceed as follows:

1. Select the module in the device view.
2. Select the "Online & diagnostics" command from the shortcut menu.
3. Select the "Firmware update" group in the "Functions" folder.
4. To select the path to the firmware update files, click the "Browse" button in the "Firmware update" area
5. Select the matching firmware file.
The table in the firmware update area lists all modules for which an update is possible with the selected firmware file.
6. Click the "Start update" button.
If the selected file can be interpreted by the module, the file is downloaded to the module. If the operating mode of the CPU needs to be changed for this purpose, you will be prompted to do this by means of dialogs.

Note

Updating the firmware

The "Run firmware after update" check box is always activated.

Procedure using the Web server

The procedure using the Web server is described in the function manual for the Web server. You can find the function manual on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/59193560>).

Reference

For further information on the procedure, refer to the STEP 7 online help.

7.2 Resetting the CPU

During a reset, the CPU is set to the "delivery state". This means that information stored on the CPU, such as retentive data, is deleted.

The following reasons may require a data reset:

- A restart with the original data (cold restart)
- Reset all internally persistent settings (e.g., IP address) for a defined status
- Use a cleaned state of the CPU for new projects

Reset options

To reset the CPU, you have the following options:

- **Memory reset:** The CPU is reset to the project settings configured by default. You can execute this functionality via the "--MemoryReset" command of the CPU Control Tool.
A general reset only clears the work memory of the CPU.
- **Factory settings:** CPU is reset to the default factory settings. You can execute this functionality in STEP 7 or via the "-- FactoryReset" command of the CPU Control Tool.

Note

STOP mode required

The CPU must be in STOP mode to be reset.

7.2.1 Reset using STEP 7

The following procedures are available to reset the CPU to factory settings using STEP 7.

Procedure using STEP 7

To reset the CPU using STEP 7, follow these steps:

1. Make sure there is an online connection to the CPU that is to be reset to the factory settings.
2. Open the online and diagnostics view of the CPU.
3. Select the "Reset to factory settings" group in the "Functions" folder.
4. Select the "Keep IP address" option button if you want to keep the IP address or the "Reset IP address" option button if you want to delete the IP address.
5. Click the "Reset" button.
6. Acknowledge the confirmation prompt with "OK".

Result

The CPU is set to STOP mode and is reset to factory settings.

The project is retained since the load memory is not erased.

7.3 Special features

7.3.1 Special situations when downloading in STEP 7

No connection possible

To download the project to the target system, establish an online connection.

If an online connection to the target system is not possible, check the interface settings, such as the IP address.

7.3.2 Timeouts

The PCI Express bus of the PC is shared by all applications on the PC. A high PCI Express bus load can therefore lead to runtime influences between applications. To keep the number of timeouts as low as possible, use a high send clock for isochronous mode in particular and avoid large loads (for example: 3D graphics).

7.3.3 Assignment of addresses with absolute addressing

To ensure optimum runtime during access to tags, the tags must be located at addresses that match their length. In the figure below, this means either in the light blue or in the dark blue area.



- ≤ 1 -byte tags (for example Bool, BYTE, Char) can be created at any addresses.
- 2-byte tags (for example WORD) must always be created at even addresses.
- 4-byte tags (for example DWORD, Int, REAL) must always be created at addresses that can be divided by four.
- 8-byte tags (for example LInt, UInt, LWord, LReal, LTime, LDT, LTOD) must always be created at addresses that can be divided by eight.

7.3.4 "Autonegotiation" port setting

Optimizing port settings on the IO device and IO controller

The transfer medium and the duplex option are checked during startup of the IO device for control unit wiring. These checks take time. You can shorten the time the check requires with specific presets of these options. Make sure that the settings made correspond to the actual conditions (using the correct cables).

To synchronize the settings for the local port and partner port, clear the "Start autonegotiation" check box for the CPU under "Port options" for both ports.

If you have disabled the autonegotiation setting including autocrossing, the time for negotiating the transmission rate during startup is saved.

Reference

You can find more information on the topic "Cabling rules with disabled autonegotiation" in the STEP 7 online help.

7.4 Backup and restore

Once you have configured the computer for your application, you can create an image of your system. You can use this image to restore your user-specific application to your system at a later time, if necessary.

You should back up an image of your configuration for the following reasons:

- To save a fixed intermediate status of the configuration.
- Create a backup of the current configuration in case of hardware problems and when the PC must be replaced.
- Create a master image to download the configuration to other PCs.

7.4.1 SIMATIC IPC Image & Partition Creator

"SIMATIC IPC Image & Partition Creator" is used to back up and restore files, directories, partitions and entire hard drives. "SIMATIC IPC Image & Partition Creator" prevents data loss caused by:

- Hardware failure
- Installation problems
- Operating errors
- External influences (viruses)

Note**Restoration of images on a larger CFast card**

If you want to restore an image from a smaller CFast card on a larger CFast card, do not change the size of the partitions proportionally.

Restoring images with Image & Partition Creator V3.6

If you are using Image & Partition Creator V3.6, the default restore option is to restore from volume to volume. To avoid booting problems after the restore, do not use this default restore type. Change from "Select volumes" to "Select disks" instead and restore as complete disks.

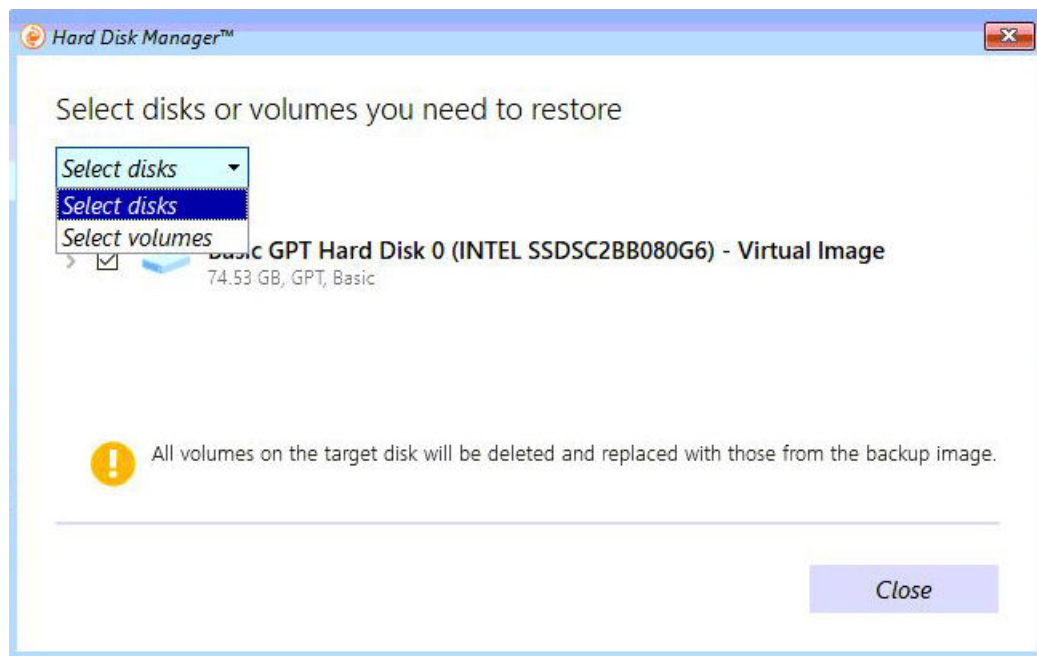


Figure 7-1 Changing the default restore type

After changing the restore type and clicking "Close", the following window appears. On this window, click on "Restore now".

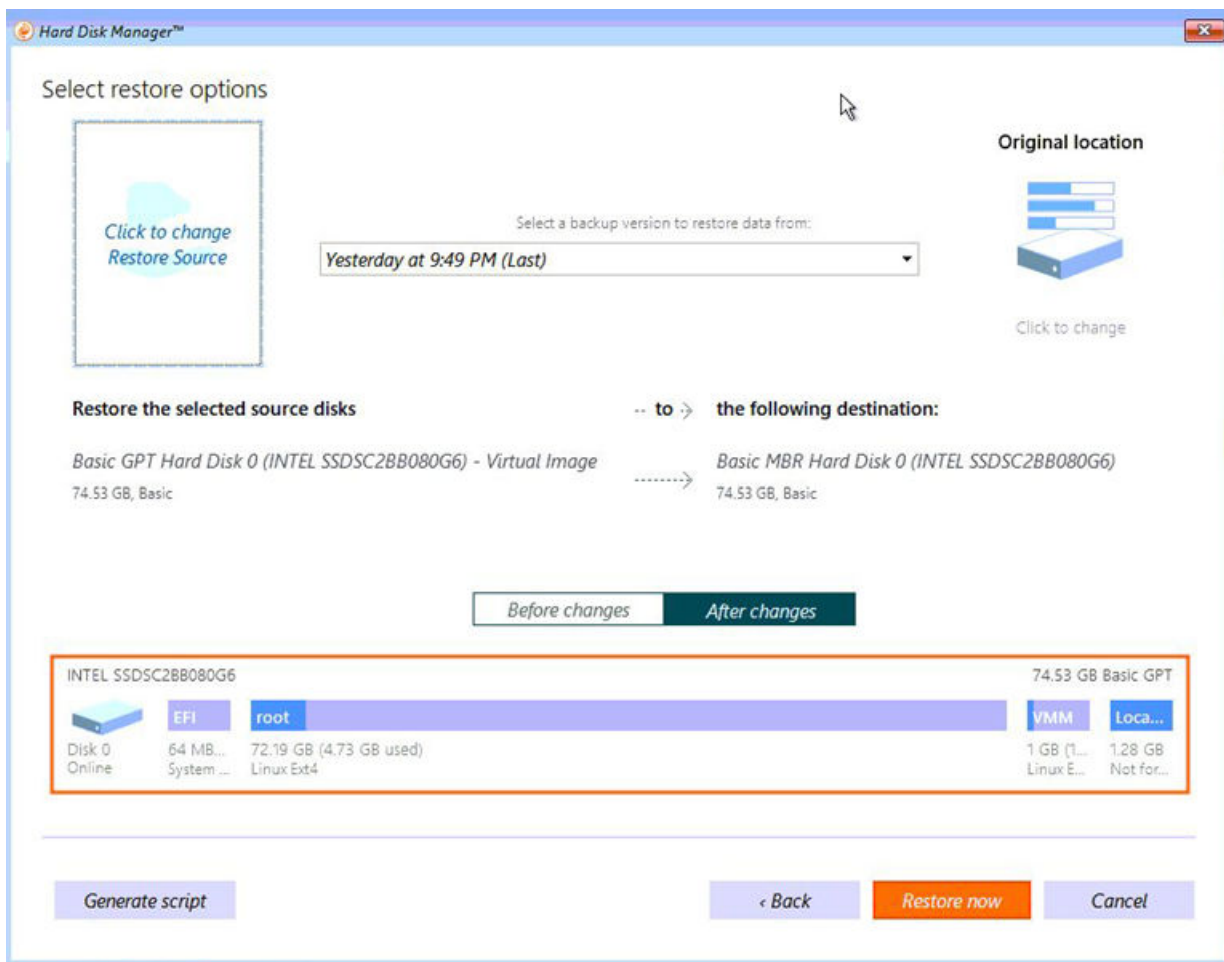


Figure 7-2 Disk to disk restore dialog

After finishing the restore, the following message appears.

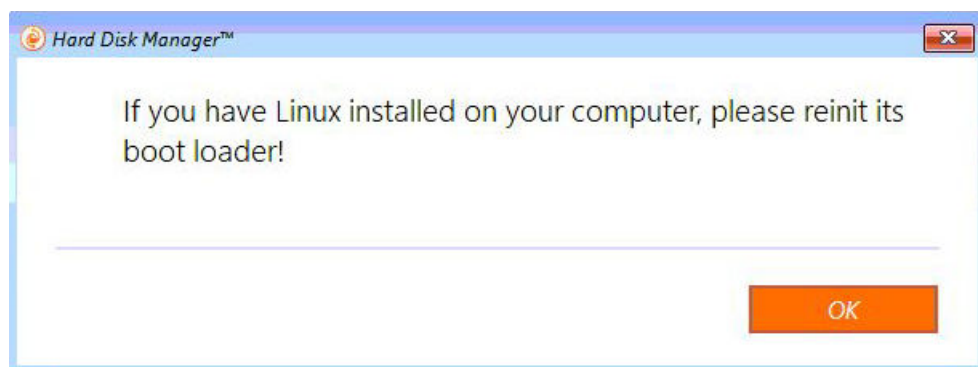


Figure 7-3 Reinit Linux boot loader

To confirm and reinitialize the Linux boot loader, click OK.

Restoring images with Image & Partition Creator V3.5 and V3.6

Image & Partition Creator V3.5 and V3.6 do not preserve symbolic links.

For this reason, there is a separate script (after_disk_restore.sh) provided in the Software Controller setup bundle. After a disk restore or clone operation in Image & Partition Creator, run this script to fix symbolic links.

Automatic default option

If you use the script without providing any arguments, the automatic option is selected by default. You should use the automatic option, if you did not create any separate partition independently from IndOS and the Software Controller.

The following image is an example for running the script without providing any argument:

```
root@localhost:~# ./after_disk_restore.sh
SUCCESS!
```

Figure 7-4 Script without providing any argument

Using the '-a' option

The behavior of the '-a' option is the same as the automatic default option. If you use '-a-', you set the auto mode and the Software Controller is installed on the third partition of the boot disk.

```
root@localhost:~# ./after_disk_restore.sh -a
SUCCESS!
```

Figure 7-5 Automatic option

Using the '-m' option

Use the '-m' option together with the full path of the Software Controller disk partition, if you want to provide the Software Controller partition manually.

The following image is an example for running the script using the '-m' argument:

```
root@localhost:~# ./after_disk_restore.sh -m /dev/sdb5
SUCCESS!
```

Figure 7-6 Manual option

Using the '-f' option

If you use the '-f' option, the system reboots automatically after the execution to apply the changes. Alternatively, you can use the '-a' option together with the '-f' option to enable the automatic option and an automatic reboot. If you want to use the '-m' option following by an automatic reboot, use '-m' and '-f'.

The following image is an example for running the script using the '-f' argument:

```
root@localhost:~# ./after_disk_restore.sh -f
SUCCESS!
```

Figure 7-7 Force option

The following image is an example for running the script using the '-m' and '-f' arguments:

```
root@localhost:~# ./after_disk_restore.sh -m /dev/sdb5 -f
SUCCESS!
```

Figure 7-8 Manual and force options

Using the '-h' option

The '-h' option displays the help screen:

```
root@localhost:~# ./after_disk_restore.sh -h

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'after_disk_restore.sh' is a Bash script that must be executed after
disk restore or clone operations by automatically or manually.

If no argument is given to the script, it will run in automatic mode.
Alternatively, '-a' argument could be given as another option to enable
automatic mode. In this case, the fifth partition of the disk is selected
where SWCPU is installed. If any partition is not created manually and
the existing partitions are created during IndOS and SWCPU installation
processes, the automatic option would be preferred. Otherwise, the manual
option is recommended. If the manual option is selected, '-m' argument
must be given and the disk partition where SWCPU is installed must be
given as a next argument. A reboot is required to apply these changes.
Therefore, only at the end of the successful operation, the reboot will
be triggered according to the result of user input. On the other hand,
if '-f' argument is given, a reboot will be done immediately without
asking user.

Please check the following examples:

Usage of automatic option : after_disk_restore.sh
Alternative usage of automatic option : after_disk_restore.sh -a
Usage of automatic option with a force option : after_disk_restore.sh -a -f
Usage of manual option : after_disk_restore.sh -m /dev/sdXY
Usage of manual option with a force option : after_disk_restore.sh -m /dev/sdXY -f
```

Figure 7-9 Help screen

After running the script, reboot the system to apply the changes.

Protection

8.1 Overview of the protective functions of the CPU

Introduction

This section describes the functions for protecting the S7-1500 automation system against unauthorized access. The following functions are available:

- Configuring access protection
- Using complex passwords
- Using virus scanners and firewall
- Protection against unauthorized operation (deactivating or restricting remote access)
- Copy protection
- Know-how protection
- Using allowlist tools

Further measures for protecting the CPU

The following measures additionally increase the protection against unauthorized access to functions and data of the CPU from outside and via the network:

- Deactivation of the Web server
- Deactivation of the time synchronization via an NTP Server
- Deactivation of the PUT/GET communication

Note

Functionalities disabled by default

These functionalities are deactivated by default. To use the functionalities, you enable them in STEP 7.

Reference

For additional information on the protection functions of the S7-1500 automation system, see the section on protection in the S7-1500 automation system manual (<https://support.industry.siemens.com/cs/ww/en/view/59191792>).

8.2 General information on protection

Configuration for the Web server

A user with the name "Any" is created by default in the user list of the Web server. This user has minimal access rights such as read-only access to the introduction and home page. Because the user "Any" does not have a password assigned in STEP 7, pay close attention to the access rights you assign to this user. Individual authorizations, such as the option to change the operating mode, may represent a security risk.

To assign safety-related authorizations, configure a new user and always assign a password in STEP 7. Assign secure passwords to users during configuration. A secure password has the following characteristics:

- Is only used for a single application
- Is more than 8 characters long
- Consists of lower-case and upper-case letters
- Includes special characters and numbers (?!+%\$1234...)

Whenever possible, select the option "Permit access only with HTTPS" as soon as you have assigned a password to at least one user.

Data blocks for PUT/GET instructions

The PUT/GET instructions are suitable for connections configured at one end or both ends.

When using the PUT/GET instructions, you can only use data blocks with absolute addressing. Symbolic addressing of data blocks is not possible.

Reference

You will find more information on the configuration of the Web server in the Web Server (<https://support.automation.siemens.com/WW/view/en/59193560>) function manual.

You will find more information on the PUT/GET and NTP instructions in the Communication (<https://support.automation.siemens.com/WW/view/en/59192925>) function manual.

8.3 Protection of confidential configuration data

As of STEP 7 V17, you have the option of assigning a password for protecting confidential configuration data of the respective CPU. This refers to data such as private keys that are required for the proper functioning of certificate-based protocols.

You can find detailed information on protecting confidential configuration data in the Communication function manual (<https://support.automation.siemens.com/WW/view/en/59192925>).

8.4 Access protection

8.4.1 Configuring access protection for the CPU in STEP 7

Introduction

To limit access to specific functions, the CPU offers different access levels.

Access levels and CPU passwords limit the functions and memory areas that are accessible without password. The individual access levels as well as the entry of their associated passwords are specified in the object properties of the CPU.

Access levels of the CPU

The following table provides you with an overview of the access levels of the CPU:

Access levels	Access restrictions
Full access including fail-safe (no protection)	Every user can change fail-safe blocks.
Complete access (no protection)	Every user can read and change the hardware configuration and the blocks. The writing of fail-safe modules is excluded.
Read access	With this access level, read-only access to the hardware configuration and the blocks is possible without entering a password. This means you can upload the hardware configuration and blocks to the programming device. In addition, the following is possible: • HMI access • Access to diagnostics data • Display of offline/online comparison results • Changing the operating state (RUN/ STOP) • Setting time-of-day However, you cannot download blocks or hardware configuration into the CPU without password. In addition, the following is not possible without a password: Writing test functions and firmware updates (online).

Access levels	Access restrictions
HMI access	With this access level only HMI access and access to diagnostics data is possible without the password. Without password, the following is not possible: • Load blocks and hardware configuration into the CPU • Load blocks and hardware configuration from the CPU into the programming device • Test functions • Changing the operating mode (RUN/STOP) • Firmware update • Display of online/offline comparison status
No access (complete protection)	When the CPU has complete protection, the following is not possible: • Read or write access to the hardware configuration and the blocks • HMI access • Server function for PUT/GET communication (is disabled in this access level and cannot be changed) Authentication with the password will again provide you full access to the CPU.

An enumeration of which functions are available in the different access levels is available in the "Setting options for the protection" entry in the STEP 7 online help.

Note

Forced shutdown of the CPU

If you use the command `.ls7_cpu_control --poweroffcpu --force` in the CPU Control Tool to force a shutdown of the CPU, a password for the access level "No access (complete protection)" must have been specified before (if configured in TIA Portal).

Note that using the `--force` command to shut down the system might lead to a loss of retentive data, even if a password has been specified.

Properties of the access levels

Each access level allows unrestricted access to certain functions without entering a password, for example identification using the "Accessible devices" function.

The default of the CPUs is "No access (complete protection)". In the default access level, it is not allowed to read or change the hardware configuration and the blocks. To obtain access to the CPUs, use an alternative parameter assignment in the properties of the CPU:

- A password for the protection level "No access (complete protection)"
- A different protection level, for example "Full access (no protection)"

Communication between the CPUs (via the communication functions in the blocks) is not restricted by the access level of the CPU, unless PUT/GET communication is deactivated in the "No access" (complete protection) access level.

Entry of the right password allows access to all the functions that are allowed in the corresponding level.

Note

Configuring an access level does not replace know-how protection

Configuring access levels offers a high degree of protection against unauthorized changes on the CPU via network access. Access levels are used to restrict the rights to download the hardware and software configuration to the CPU. However, blocks are not write- or read-protected. To protect the code of blocks, use know-how protection.

Behavior of functions with different access levels

The STEP 7 online help includes a table listing the online functions available in the various access levels.

Assigning access protection parameters in STEP 7

Note

Parameter assignment for access protection for the entire PC system

Unlike for a hardware CPU, parameter assignment for access protection is not done directly in the CPU's properties. This ensures that consistent protection level passwords are configured for all of a PC system's components.

To assign the access levels for the CPU, follow these steps:

1. Select the PC system that is assigned to the CPU.
2. Open the properties of the PC system in the Inspector window.
3. Open the "Protection" entry in the area navigation.

A table with the possible access levels appears in the Inspector window.

Access level	Access				Access permission
	HMI	Read	Write	Fail-safe	Password
☐ Full access incl. fail-safe (no protection)	✓	✓	✓	✓	
☐ Full access (no protection)	✓	✓	✓		
☒ Read access	✓	✓			
☐ HMI access	✓				
☐ No access (complete protection)					

Read access:
TIA Portal users will have read access to standard functions.
HMI applications can access all functions (fail-safe and standard).

Mandatory password:
For additional write access and access to the fail-safe functions, TIA Portal users need to enter the "full access incl. fail-safe" password.

Optional password:
For additional write access to standard functions without access to fail-safe functions, a "read/write access" password can be defined.

Enter password:

Confirm password:

Figure 8-1 Possible access levels

4. Activate the desired protection level in the first column of the table. The green checkmarks in the columns to the right of the respective access level show you which operations are still available without entering the password.
5. In the "Password" column, specify a password for the selected access level. In the "Confirmation" column, enter the selected password again to protect against incorrect entries.
Ensure that the password is sufficiently secure, in other words, that it does not follow a pattern that can be recognized by a machine!
You must enter a password in the first row ("Full access" access level). This enables unrestricted access to the CPU for those who know the password, regardless of the selected protection level.
6. Assign additional passwords as needed to other access levels if the selected access level allows you to do so.
7. Download the hardware configuration to the CPU, so that the access level will take effect. The configured protection level and the password become effective as soon as the data is downloaded to the CPU.

Access level for F-CPU

For the fail-safe CPUs, there is the additional access level "Full access incl. fail-safe (no protection)". For additional information on this access level, refer to the description in SIMATIC Industrial Software SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>).

Forgotten or lost access level passwords

If you have forgotten or lost an access level password in case of an activated access protection, proceed as follows.

Options standard CPUs

For standard CPUs, choose one of the following possibilities:

- In the Resource Configurator, use the "-s, --set-initial" command to reset the hardware configuration and reconfigure your configuration. Then download a project without access level passwords.
- Import a suitable project (.psc file) without access level passwords.
- Reinstall the Software Controller.

Options for fail-safe CPUs

- Import a suitable project (.psc file) without access level passwords.
- Reinstall the Software Controller.

8.4.2 Locking protection levels with the PLC program

Introduction

To specify if passwords are legitimized for the CPU, you use the instruction "Limit and enable password legitimization" (ENDIS_PW). In this way, you can prevent legitimized connections, even if the correct password is known.

Inadvertent locking

If passwords are set up (all protection levels) and the output parameters of the password of the block "Limit and enable password legitimization" are set to "Disallow in RUN", you will be completely blocked.

The output parameters of the block are retentive. This means that the parameter assignment is retained after "POWER OFF – POWER ON".

To disable the protection, enter the command-line command (Page 67) "/MemoryReset".

8.5 Protecting blocks

Know-how protection protects the following blocks from unauthorized access:

- Blocks of the OB, FB, FC type
- Global data blocks

Know-how protection protects the code of these blocks from unauthorized reading and modification.

Note

Transferring protected block or library

If you transfer a protected block from a hardware controller to a project of a SIMATIC S7-1500 Software Controller or vice versa, the block must be compiled again. To do so, you need the password for the block that is to be compiled.

If you transfer a system library from a hardware controller to a project of a SIMATIC S7-1500 Software Controller, the library must be recompiled.

Possible actions

You can perform the following actions with a know-how-protected block:

- Copying and deleting
- Calling in a program
- Online/offline comparison
- Downloading

Readable data

If a block is know-how protected, only the following data is readable without the correct password:

- In/out parameters Input, Output, InOut, Return, Static, Temp
- Block title
- Block comment
- Block properties
- Global tags without information on the point of use

Reference

For additional information on protected blocks or copying protected blocks and libraries, refer to the STEP 7 Online Help.

8.6 Virus scanners and firewall

Operation on systems with firewall

You can operate the CPU and all associated components on systems with activated firewall. Configure the firewall rules manually.

For Open User Communication, you can use application-specific IP ports. These ports are not enabled by default by the setup program. Due to the default settings, the firewall can thus prevent the connection. Therefore, configure the firewall rules for the Open User Communication yourself.

Configuring the firewall for Web server use

If you use a PC with an enabled firewall, you must configure the firewall for the use of the Web server. To open the application-specific ports in the firewall, create a new firewall rule for this purpose in the firewall settings.

8.7 Setting up copy protection

Application

The CPU has the same copy protection mechanisms as the S7-1500 Advanced Controller. You can link the copy protection to the serial number of the device and the mass storage.

Unlike the S7-1500 Advanced Controllers, the CPU only uses values for the serial number. The values are derived partly from the serial number of the PC motherboard and the PC mass storage. The serial numbers can therefore only be read at the corresponding points in the Web server or in the online diagnostics in STEP 7. Besides the serial number, the function for automatic insertion of the serial number during downloading is available.

Adding the serial number during download to a device

We recommend that you use the following option for setting up copy protection during in the configuration: "Serial number is inserted when downloading to a device or a memory card"

Reading out the serial number

You can read the serial numbers in the Web server on the "Diagnostics" web page under "Identification".

Reference

You can find additional information on setting up the copy protection in the STEP 7 online help.

Interrupts, diagnostics, error and system message

9.1 Status and error display of the CPU

Introduction

The status and error displays of the CPU are described below.

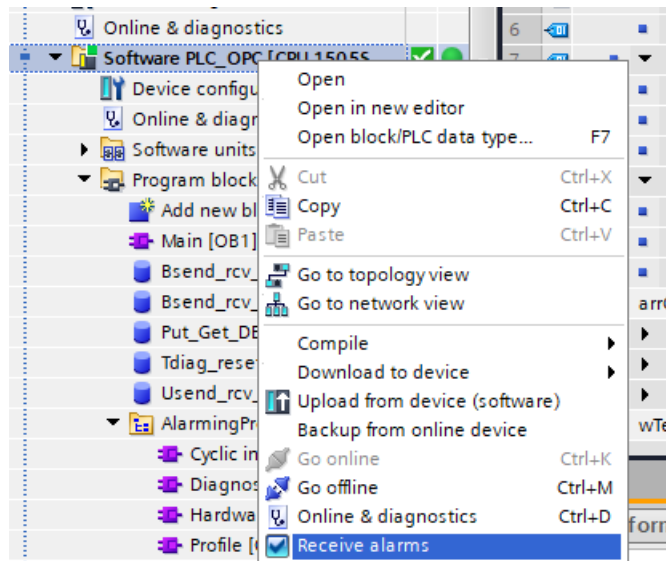
You will find additional information on "Alarms" in the STEP 7 online help.

You will find additional information on "Diagnostics" and "System messages" in the Diagnostics manual (<https://support.automation.siemens.com/WW/view/en/59192926>) function manual.

Acknowledge alarms

To be able to acknowledge alarms from TIA Portal for individual devices, proceed as follows:

In TIA Portal, activate the check box "Receive alarms" for the device, the alarms should be acknowledged for:



Status display

The status of the CPU is displayed at the following places:

- In STEP 7
- On the LEDs of the PC
- On the start page of the CPU Web server



- ① RUN/STOP LED (yellow/green LED)
- ② ERROR LED (red LED)
- ③ MAINT LED (yellow LED)
- ④ Status display in words

Meaning of the LED displays

To indicate the current operating mode and diagnostic status, the CPU has three LEDs. The following table shows the meaning of the various color combinations of the RUN/STOP, ERROR and MAINT LEDs.

Table 9-1 Meaning of the LEDs

RUN/STOP LED	ERROR LED	MAINT LED	Meaning
 LED off	 LED off	 LED off	POWER OFF, the DIAG LED display is not enabled.
 LED off	 LED flashes red	 LED off	An error has occurred.

RUN/STOP LED	ERROR LED	MAINT LED	Meaning
 LED green	 LED off	 LED off	CPU is in RUN mode.
 LED green	 LED flashes red	 LED off	A diagnostics event is pending.
 LED green	 LED off	 LED yellow	Maintenance demanded for the plant. The affected hardware must be replaced within a short period of time.
 LED green	 LED off	 LED flashes yellow	Maintenance required for the plant. The affected hardware must be replaced within a reasonable time period.
 LED green	 LED flashes red	 LED off	An error has occurred.
 LED yellow	 LED flashes red	 LED off	
 LED yellow	 LED off	 LED off	CPU is in STOP mode.
 LED yellow	 LED flashes red	 LED flashes yellow	The user program causes an error.
			CPU is defective
 LED flashes yellow	 LED off	 LED off	CPU is performing internal activities during STOP, e.g. ramp-up after STOP.
			Loading the user program.
 LED flashes yellow	 LED off	 LED off	CPU is in HOLD state.
			A programmed breakpoint in the user program has been reached.
 LED flashes yellow/green	 LED off	 LED off	Startup (transition from STOP → RUN).
 LED flashes yellow/green	 LED flashes red	 LED flashes yellow	Startup (CPU booting).
			Test of LEDs during startup, inserting a module.
			LED flashing test.

9.2 Export of diagnostic information

Customer Support offers help in critical cases. For a thorough analysis of your situation, Customer Support needs detailed diagnostic information. You can export these service data with the "SIMATIC Diagnostics Tool". The "SIMATIC Diagnostics Tool" gives you the option to collect diagnostic and system information. The "SIMATIC Diagnostics Tool" collects the information from a local computer or by remote access even from several computers connected by a network.

9.3 Diagnostics

The "SIMATIC Diagnostics Tool" is available as a Download (<https://support.automation.siemens.com/WW/view/en/65976201>) on the Internet.

Required service data

The exported service data must include the following information:

- Product-specific data
- Internal error logging as binary code
- Diagnostics buffer entries
- Latest call list
- Memory dump (optional)
- Time stamp of the TIA Portal project

Additional information and download

For the download and additional information on handling the "SIMATIC Diagnostics Tool", see the corresponding FAQ (<https://support.automation.siemens.com/WW/view/en/65976201>).

9.3 Diagnostics

9.3.1 Diagnostic information using STEP 7

Options for identifying diagnostic information

When the online connection to the CPU is established in STEP 7, the diagnostics status of the CPU and its lower-level components and the operating mode are also determined.

You have various options in STEP 7 for identifying diagnostic information:

- Accessible devices
- Devices and networks
- Online & Diagnostics
- "Diagnostics" tab in the Inspector window
- CPU diagnostics buffer
- "Online tools" task card

Reference

You can find further information about diagnostics in the Diagnostics (<https://support.automation.siemens.com/WW/view/en/59192926>) function manual and in the STEP 7 online help.

9.3.2 Diagnostics information using the Web server

System diagnostics using the CPU Web server

The CPU has an integrated Web server that enables, among other things, the display of system diagnostics information via PROFINET.

You use an Internet browser on any web client, such as a PC, multi panel, or smartphone, to access:

- Module data
- User program data
- Diagnostics data of the CPU

This means access to the CPU is possible without STEP 7 installed.

The Web server offers web pages with reduced complexity which have been optimized for devices with small screens and low computing power.

The following diagnostics options are available with the integrated Web server:

- Start page with general CPU information
- Identification information
- Contents of the diagnostics buffer
- Module information
- Messages (without acknowledgment option)
- Information about communication
- Topology

Reference

You can find additional information about the "Web server" topic in the Web server (<https://support.automation.siemens.com/WW/view/en/59193560>) function manual.

Technical Data

Technical specifications

You can find the latest technical data under the following link on the Siemens Industry Online Support.

CPU	Article number	Technical specifications
CPU1505SP	cannot be ordered, since only available preinstalled on a CPU 1515SP PC2 (F)	CPU 1515SP PC2 (https://support.industry.siemens.com/cs/ww/en/pv/6ES7677-2DB43-0GB0/td?dl=en)
CPU1505SP F		CPU 1515SP PC2 F (https://support.industry.siemens.com/cs/ww/en/pv/6ES7677-2SB43-0GB0/td?dl=en)
CPU 1507S	6ES7 672-7AD02-0YG0	CPU 1507S (https://support.industry.siemens.com/cs/ww/en/pv/6ES7672-7AD01-0YG0/td?dl=en)
CPU 1507S F	6ES7 672-7FD02-0YG0	CPU 1507S F (https://support.industry.siemens.com/cs/ww/en/pv/6ES7672-7FD01-0YG0/td?dl=en)
CPU 1508S	6ES7 672-8AD02-0YG0	CPU 1508S (https://support.industry.siemens.com/cs/ww/en/pv/6ES7672-8AD01-0YG0/td?dl=en)
CPU 1508S F	6ES7 672-8FD02-0YG0	CPU 1508S F (https://support.industry.siemens.com/cs/ww/en/pv/6ES7672-8FD01-0YG0/td?dl=en)

Reference information for use with SIMATIC IPC

B.1 Permitted commands and parameters

To configure and operate the CPU, different commands and parameters are available for the respective tools. This section lists the commands and parameters of the individual tools.

Commands and parameters in the CPU Control Tool

To be able to use the commands, start the CPU Control Tool with `./s7_cpu_control`, e.g.:

```
root@localhost:/mnt/swcpu_mount/SWCPU/bin# ./s7_cpu_control --MemoryReset
```

Command	Explanation
--PowerOnCPU	Starts the CPU in "STOP" mode.
--PowerOffCPU	Shuts down the CPU. For more information on IndOS shutdown behavior, see section Shutdown and startup (Page 61).
--Run	Sets the CPU to "RUN" operating mode.
--Stop	Sets the CPU to "STOP" operating mode.
--GetStatus	Shows the operating mode of the CPU.
--MemoryReset	Resets the CPU memory.
--FactoryReset	Resets the CPU to factory settings.
--IP:	Identifies and stores the IP address of the runtime communication interface. Execute this command if the IP address already assigned has changed due to a download via STEP 7.

To be able to use the parameters, start the CPU Control tool with `./s7_cpu_control`.

Parameter	Explanation
--Force	Skips the warning and sets the CPU to the "STOP" operating mode
--DumpServiceData	Saves service data to a etc/swcpu folder. Returns a success message.
--DumpServiceData=/etc/myFolder	Save service data to a etc/my folder. Returns a success message.
---DumpServiceData=SomeInvalidPath	The CPU Control Tool returns the following error message "Failed to save servicedata".

The following table shows additionally command line commands that are available for F-CPU's:

Command	Explanation
CPU_Control /GetCollectiveF-Signature	Outputs the collective F-signature
CPU_Control /ConfirmCollectiveFSignature	Confirms the collective F signature after entry of the collective F-signature

Parameters in the Management Tool for MAC Addresses

To be able to use the parameters, start the Management Tool with `./s7_vnic_macconfig`.

Parameter		Explanation
-m	-mount-path	Parent directory of "SWCPU"
-t	--target	Specifies the interface whose MAC address has changed - LINUX: Siemens RT-VMM network adapter - SWCPU: Runtime communication interface
-a	--mac-addr	Assigns new MAC address
-d	--default-mac	Assigns default value for MAC address

Parameters in the IPConfig Tool

To be able to use the parameters, start the IPConfig Tool with `./s7_vnic_ipconfig`. The parameters are case-sensitive.

Parameter		Explanation
-n	--nic	Name of the IndOS runtime communication interface via which the request is sent. To display the name, list all interfaces using the command "ip addr". <code>root@debian:/mnt/SWCPU/bin# ip addr</code> The interface with a MAC address between "28-63-36-78-B0-00" and "28-63-36-78-BF-FF" is the runtime communication interface.
-m	--mac	MAC address of the runtime communication interface from the CPU. Use the Management Tool for MAC Addresses with the parameter "-m" to display the MAC addresses of the interfaces. <code>root@debian:/mnt/media/SWCPU/bin# ./s7_vnic_macconfig -m</code>
-s	--setip	IP address assigned by the CPU for the runtime communication interface.
-t	--setmask	Network mask assigned by the CPU for the runtime communication interface.
-g	--setgw	Gateway that is assigned by the CPU for the runtime communication interface.

Note

Assigning IP addresses

IP address assignment to RT VMM network adapter can be done by generic Linux commands such as "nmcli" or by editing the network file located under /etc/NetworkManager. `s7_vnic_ipconfig` can also be used.

For the Software Controller side of vNIC, `s7_vnic_ipconfig` must be used.

After running the `s7_vnic_ipconfig` tool to assign an IP address to the runtime communication interface of the CPU, check the operation result.

To make sure that assigning the IP address was successful, check if the assigned IP address is reachable by using the ping command.

Note**Assigning IP address in RUN operating state**

If you use the `s7_vnic_ipconfig` tool to assign a new IP address while the CPU is in RUN, make sure that the option "IP address is set directly at the device" is set in TIA Portal.

If this option is not set, the `GetStatus` command will be "Failed" in the IPC Config Tool. When pinging the new IP address, the error message "Destination Host Unreachable" appears.

Command line parameters valid for all tools

The following table shows commands which can be used for all tools.

Parameter	Explanation
--Help	Displays the infotext in the command line editor
--Version	Displays the versions of the tool

Note**Version numbers**

The version numbers of individual tools might be different from the firmware version of the Software Controller. You can find the Software Controller firmware version under `/mnt/swcpu_mount/SWCPU/version_info`.

The version number stored in the `version_info` file (for example 21.09.00.00_54 .01.00.07) is an internal version number which corresponds to the official Software Controller version (for example 21.9).

B.2 SIMATIC IPC227G / IPC277G

If you are using these PCs supported by the CPU, note the following reference information for your device:

	Property	Notes
Hardware version	IPC227G: FS ≥ AA IPC277G: FS ≥ AA	The hardware version can be found on the rating plate of your SIMATIC IPC.
BIOS version	V28.01.05	
	Recommended BIOS Settings:	
	- Power → Advanced CPU Control → CPU Power Level = Stable Performance - Security → Current TPM device = Hidden (Not Detected, if no TPM available)	
	Hiding TPM module	
	Hiding the TPM module will decrease jitter on IndOS restart. For this reason, we recommend hiding the TPM module to avoid timeouts.	

B.3 SIMATIC IPC427E / IPC477E (PRO)

	Property	Notes
Operating systems	SIMATIC Industrial OS V3.2 (V3.2.4 or higher version based on V3.2)	
Boot method	UEFI boot	
Graphics driver		
LED use	IPC227G: Supported, configurable IPC277G: Not supported	
Mass storage		
Using onboard interfaces for PROFINET:		
PN / IE (LAN) X1	Yes (either X1 or X2 at a time)	To be configured in Resource Configuration file
PN / IE (LAN) X2	Yes (either X1 or X2 at a time)	
PN / IE (LAN) X3	not supported	

B.3 SIMATIC IPC427E / IPC477E (PRO)

If you are using these PCs supported by the CPU, note the following reference information for your device:

	Property	Notes
Hardware version	IPC427E: FS ≥ AA IPC477E: FS ≥ AA	The hardware version can be found on the rating plate of your SIMATIC IPC.
BIOS version	V21.01.18	
	Recommended BIOS Settings:	
	- Power→Power and Performance→CPU-Power Management Control→CPU Power Level = Standard - Security→Current TPM device = Hidden (Not Detected, if no TPM available)	
	Hiding TPM module Hiding the TPM module will decrease jitter on IndOS restart. For this reason, we recommend hiding the TPM module to avoid timeouts.	
Operating systems	SIMATIC Industrial OS V3.2 (V3.2.4 or higher version based on V3.2)	
Boot method	UEFI boot	
LED use	IPC427E: Supported, configurable IPC477E (PRO): Not supported	
NVRAM use	Supported, 135 KB can be used for user data	
Mass storage		Operating system installation on CFast (internal or external) < 16 GB
Using onboard interfaces for PROFINET:		
PN / IE (LAN) X1	Not supported	To be configured in Resource Configuration file
PN / IE (LAN) X2	Yes	
PN / IE (LAN) X3	Yes	

B.4 SIMATIC BX-39A / PX-39A (PRO)

If you are using these PCs supported by the CPU, note the following reference information for your device:

	Property	Notes
Hardware version	BX39A: FS ≥ AA PX39A: FS ≥ AA	The hardware version can be found on the rating plate of your SIMATIC IPC.
BIOS version	V29.01.03	
	Mandatory BIOS settings: - Advanced → System Agent (SA) Configuration → VMD Setup Menu → Enable VMD Controller = Disabled - Advanced → System Agent (SA) Configuration → Above 4GB MMIO BIOS Assignment = Disabled - Setup Utility → Security → Trusted Platform Module (TPM) = Hidden Note: If no TPM is available in the system, then this setting is not relevant. Recommended BIOS settings: - Advanced → Power and Performance → CPU-Power Management Control → Power & Performance Scenario = Max Performance - Advanced → Power and Performance → CPU-Power Management Control → Intel Speedstep = Disabled - Advanced → Power and Performance → CPU-Power Management Control → Intel Speed Shift Technology = Disabled - Advanced → Power and Performance → CPU-Power Management Control → HDC Control = Disabled - Advanced → Power and Performance → CPU-Power Management Control → C States = Disabled	
Operating systems	SIMATIC Industrial OS V3.2 (V3.2.4 or higher version based on V3.2)	
Boot method	UEFI boot	
LED use	Supported	
NVRAM use		
Mass storage		
Using onboard interfaces for PROFINET:		
PN / IE (LAN) X1	Not supported	
PN / IE (LAN) X2	Yes	To be configured in Resource Configuration file
PN / IE (LAN) X3	Yes	To be configured in Resource Configuration file
PN / IE (LAN) X4	Yes	To be configured in Resource Configuration file

Additional information

C.1 Siemens Industry Online Support

You can find current information on the following topics quickly and easily here:

- **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 (<https://support.industry.siemens.com>).

C.2 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).

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

Glossary

Cold restart

The controller executes OB 102 before the start of the free scan cycle (OB 1). Like a warm restart, a cold restart resets the peripheral inputs (PI) and changes the peripheral outputs (PQ) to a pre-defined safe state (default is 0). However, a cold restart does not save the retentive memory (M, T, C, or DB), but sets these areas to their default settings.

Data block

Data blocks (DBs) are data areas in the user program that contain user data. There are global data blocks, which can be accessed from all code blocks, and instance data blocks, which are assigned to a specific FB call.

Diagnostics buffer

The diagnostic buffer is a battery-backed memory area in the CPU where diagnostic events are stored in their order of occurrence.

Function block

A function block (FB) is a code block with static data. An FB allows you to pass parameters in the user program. Function blocks are thus suited for programming frequently recurring complex functions, such as closed-loop controls or operating mode selection.

I/O modules

All modules that can be operated with a CPU or an interface module.

Industrial Ethernet

Physical communication layer that supports communication with STEP 7, S7 CPUs, programming devices (PGs), operator panels (OPs), S7 applications, and PROFINET IO.

Load memory

Memory area (RAM) allocated for all of the blocks downloaded from STEP 7 excluding the symbol table and comments.

NTP

The Network Time Protocol (NTP) is a standard for synchronizing clocks in automation systems via Industrial Ethernet. NTP uses the UDP connectionless network protocol.

NVRAM

Non-Volatile Random Access Memory: Non-volatile memory area

Operating modes

Operating states describe the behavior of a single CPU at a specific time.

Organization block

Organization blocks (OBs) form the interface between the operating system of the CPU and the user program. The organization blocks determine the order in which the user program is executed.

PC system

Representation of a software-based virtual rack in STEP that defines a PC-based automation system.

PG

Programming device

PG/OP communication

Communication between the CPU and other S7 applications, such as programming devices (PGs), operator panels (OPs), and S7 controllers. The CPU supports Industrial Ethernet for PG/OP communication.

PLC

Programmable logic controller - electronic control system. The PLC functions are stored in a program on the control device. The device configuration and wiring are therefore independent of the controller functions. The PLC is configured similar to a computer. It consists of a CPU with memory, input and output devices, and an internal bus system. The I/O and the programming language are oriented to control engineering requirements

Priority

The priority of an application determines the order in which the operating system executes or interrupts an application in relation to the other applications that are running on the computer. An application with a higher priority interrupts the execution of an application with a lower priority. After the application with the higher priority finishes, the application with the lower priority resumes. A higher number indicates a higher priority.

TCP

Transmission Control Protocol: Enables transmission of data packets ("messages") if both nodes support RFC 1006.

Technology object

A technology object supports you in the configuration and commissioning of a technological function.

The properties of real objects are represented by technology objects in the controller. Real objects can be, for example, controlled systems or drives.

The technology object contains all data of the real object required for its open-loop or closed loop control, and it signals back status information.

Timer

Timers are components of the system memory of the CPU. The operating system automatically updates the content of the "timer cells" asynchronously to the user program. STEP 7 instructions define the precise function of the timer cell (for example on-delay) and trigger its execution.

UDP

User Datagram Protocol: Enables transmission of data units.

UPS

Uninterruptible power supply: A UPS ensures the power supply in case of brief disturbances in the power network.

User program

SIMATIC differentiates between the operating system of the CPU and user programs. The user program contains all instructions, declarations and data for the signal processing, which control a system or process. The user program is assigned to a programmable module, a CPU, for example. Structuring into smaller unit is supported.

Warm restart

During a warm restart, all non-retentive bit memory is deleted and non-retentive DB contents are reset to the initial values from load memory. Retentive bit memory and retentive DB contents are retained. Program execution begins at the call of the first startup OB.

Web server

The Web server is used to monitor the CPU via the Internet or via your company Intranet. This approach lets you carry out evaluations and diagnostics even at great distances. Messages and status information are visualized on HTML pages

Work memory

Memory area (RAM) allocated for the blocks used at runtime

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