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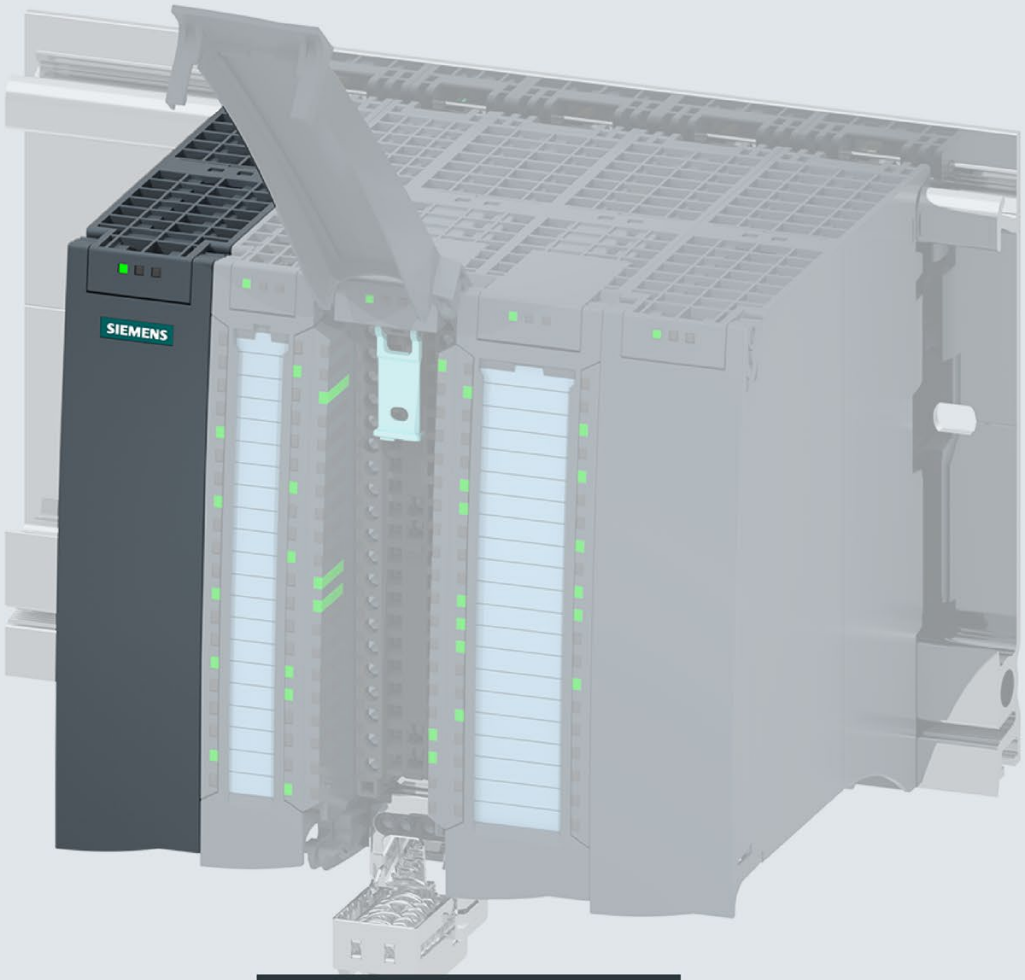

Manual

SIMATIC

S7-1500/ET 200MP

Interface module
IM 155-5 PN ST (6ES7155-5AA01-0AB0)

Edition 11/2017

support.industry.siemens.com

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SIMATIC

ET 200MP
Interface module IM 155-5 PN ST (6ES7155-5AA01-0AB0)

Manual

11/2017

A5E03612323-AC

Legal information

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⚠ 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.

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A5E03612323-AC
℗ 09/2017 Subject to change

Preface

Purpose of the documentation

This manual supplements the system manual S7-1500, ET 200MP automation system (https://support.industry.siemens.com/cs/ww/en/view/59191792). Functions that generally relate to the system are described in this manual.

The information provided in this manual and in the system/function manuals support you in commissioning the system.

Conventions

Please also observe notes marked as follows:

Note

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

Security information

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

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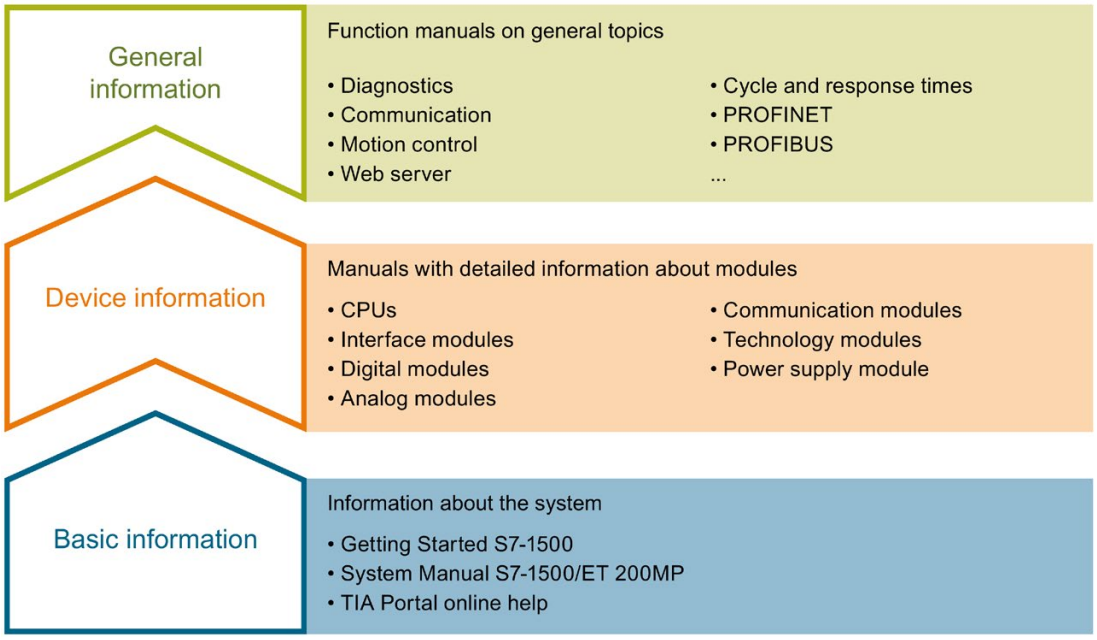
Table of contents

Documentation guide

1

The documentation for the SIMATIC S7-1500 automation system and the SIMATIC ET 200MP distributed I/O system is arranged into three areas.
This arrangement enables you to access the specific content you require.



Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems. The STEP 7 online help supports you in the configuration and programming.

Device information

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

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC S7-1500 and ET 200MP systems, e.g. diagnostics, communication, motion control, Web server, OPC UA.

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

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

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

"mySupport"

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

In "mySupport", you can save filters, favorites and tags, request CAx data and compile your personal library in the Documentation area. In addition, your data is already filled out in support requests and you can get an overview of your current requests at any time.

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

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

"mySupport" - Documentation

In the Documentation area in "mySupport" you can combine entire manuals or only parts of these to your own manual.
You can export the manual as PDF file or in a format that can be edited later.

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

"mySupport" - CAx data

In the CAx data area in "mySupport", you can access the current product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

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

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

Application examples

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

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

TIA Selection Tool

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

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

SIMATIC Automation Tool

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

General function overview:

- Network browsing and creation of a table showing the accessible devices in the network.
- Flashing of device LEDs or HMI display to locate a device
- Downloading of addresses (IP, subnet, gateway) to a device
- Downloading the PROFINET name (station name) to a device
- Placing a CPU in RUN or STOP mode
- Setting the time in a CPU to the current time of your PG/PC
- Downloading a new program to a CPU or an HMI device
- Downloading from CPU, downloading to CPU or deleting recipe data from a CPU
- Downloading from CPU or deleting data log data from a CPU
- Backup/restore of data from/to a backup file for CPUs and HMI devices
- Downloading service data from a CPU
- Reading the diagnostics buffer of a CPU
- Performing a CPU memory reset
- Resetting devices to factory settings
- Downloading a firmware update to a device

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

PRONETA

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

- The topology overview independently scans PROFINET network and all connected components.
- The IO check is a fast test of the wiring and the module configuration of a system.

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

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 optimal exploitation of resources

You can find SINETPLAN on the Internet (https://www.siemens.com/sinetplan).

Product overview

2

2.1 Properties

Article number

6ES7155-5AA01-0AB0

View of the module

Figure 2-1 View of the IM 155-5 PN ST interface module

Properties

- Technical properties
  - Connects the ET 200MP distributed I/O system with PROFINET IO
  - 24V DC power supply (SELV/PELV)
  - PROFINET IO connection using RJ45 bus connector
- Supported functions (Page 13)

Maximum configuration

- 512 bytes I/O data per station
- The integrated power supply of the interface module feeds 14 W into the backplane bus. Up to 12 I/O modules can be supplied this way. The exact number of operable modules is determined by the power budget (see relevant section in the ET 200MP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/59191792) system manual).
- A maximum of one power supply module (PS) upstream from the interface module and two downstream from the interface module is possible.
- If you use a power supply module (PS) upstream from the interface module, the maximum possible configuration is a total of 32 modules (up to 30 modules downstream from the interface module).

2.2 Functions

2.2.1 PROFINET IO

Introduction

The interface module supports the following PROFINET IO functions:

- Integrated switch with 2 ports
- Supported Ethernet services: ping, arp, SNMP, LLDP
- Port diagnostics
- Disabling ports
- Isochronous real-time communication
- Minimum update time 250 µs
- Prioritized startup
- Device replacement without PG (LLDP)
- Media redundancy (MRP)
- Shared device with up to two IO controllers
- Module-internal Shared Input/Shared Output (MSI/MSO)
- Isochronous mode of process data
- Identification data I&M 0 to 3
- Firmware update via PROFINET IO
- Reset to factory settings via PROFINET IO
- Configuration control (option handling)
- Module division into submodules

Note

Docking system

You cannot use the IM155-5 PN ST interface module as docking station. The use as a docking unit (function: IO devices changing during operation) in a docking system is supported.

Requirements

The following requirements apply to a configuration with the IM 155-5 PN ST interface module:

Table 2- 1 Requirements

PROFINET IO function	Configuration software		
	with GSD file[1]		STEP 7 (TIA Portal) as of V12
	STEP 7 as of V5.5 SP3	STEP 7 (TIA Portal) as of V12	
Real-time communication	X	X	X
Isochronous real-time communication	X	X	X
Prioritized startup	X	X	X
Device replacement without PG	X	X	X
Media redundancy	X	X	X
Shared device	X	X	X[2]
MSI/MSO	X	X	X[2]
Isochronous mode	-	-	X
Interface module; order number 6ES7155-5AA01-0AB0	X	X	X (STEP 7 V14 or higher with HSP 223)

[1] The usability of the PROFINET IO functions depends on the configuration software (Siemens and/or third party). Below, the usability of the PROFINET IO functions is described for STEP 7 only.

[2] Firmware version V2.0 or higher

Isochronous real-time communication

Synchronized communication protocol for cyclic exchange of IRT data between PROFINET devices. A reserved bandwidth is available in the send cycle for IRT data. The reserved bandwidth ensures that IRT data can be transferred at reserved synchronized intervals, without being influenced by other network loads (e.g., TCP/IP communication, or additional real-time communication).

A topological configuration is required for IRT.

Note

IO controller as sync master with IRT communication

We recommend operating the IO controller as sync master when configuring IRT communication.

Otherwise, IO devices with IRT and RT configuration could fail as a result of sync master failure.

You can find additional information on configuration of synchronized PROFINET devices in sync domains in the STEP 7 online help and

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.
- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Prioritized startup

Prioritized startup denotes the PROFINET functionality for accelerating the startup of IO devices operated in a PROFINET IO system with RT communication.

The function reduces the time that the correspondingly configured IO devices require to return to the cyclic user data exchange in the following cases:

- After the supply voltage has returned
- After a station has returned
- After activation of IO devices

Note

Dependency on the startup time

The startup time depends on the number and type of modules. You can optimize the startup time by

- inserting no more than 12 I/O modules
- inserting no power supply module.

The prioritized startup function with the requirements listed in the note above is not available for IRT communication and media redundancy.

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

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.
- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Cabling with fixed connection setting

If you set a fixed connection setting of the port in STEP 7, you should also deactivate "Autonegotiation/Autocrossover".

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

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.
- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Device replacement without PG

It is easy to replace IO devices that support this function:

- The device name does not have to be assigned with the PG.

The replaced IO device is assigned the device name by the IO controller. The IO controller uses the configured topology and the neighboring relationships determined by the IO devices for this purpose. All involved devices must support the LLDP protocol (Link Layer Discovery Protocol). The configured target topology must match the actual topology.

IO devices that have been used in another configuration must be reset to the factory settings before they can be used again (see S7-1500, ET 200MP (http://support.automation.siemens.com/WW/view/en/59191792) system manual).

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

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.
- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Media redundancy

Function for safeguarding communication and system availability. A ring topology ensures that an alternative communication path is made available if a transmission link fails.

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

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.
- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Shared device

IO device that makes its data available to up to two IO controllers.

As of firmware version V2.0, the interface module supports shared device functionality at the submodule level. A prerequisite for using this function is that the I/O modules also support this.

If **the engineering system performs no plausibility check of the shared device projects**, note the following:
If you reconfigure shared device configurations without the above mentioned plausibility check, you must recommission the ET 200MP. This means that you have to reload the projects of all involved IO controllers in the specific CPU after reconfiguration and, if necessary, switch the interface module POWER OFF/POWER ON.

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

- as of STEP 7 V5.5 in the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Module-internal Shared Input/Shared Output (MSI/MSO)

The Module-internal Shared Input function allows an input module to make its input data available to up to two additional IO controllers. Each controller has read access to the same channels.

The Module-internal Shared Output function allows an output module to make its output data available to up to two IO controllers. One IO controller has write access. A second IO controller can have read access to the same channels.

You can find more information on this topic in the STEP 7 online help and

- As of STEP 7 V14, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.

Isochronous mode of process data

The process data, transmission cycles via PROFINET IO, and the user program are synchronized to achieve ultimate deterministic. The input data and output data of distributed I/O devices in the system are detected and output simultaneously. The isochronous PROFINET IO cycle forms the corresponding clock generator.

To ensure problem-free isochronous mode, we recommend that you do not use acyclical services and that you limit diagnostic interrupts to the most crucial ones.

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

- as of STEP 7 V12, in the PROFINET with STEP 7 V14 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.

Submodules

The IM 155-5 PN ST interface module supports the module division of I/O modules in up to 4 submodules. This allows parts of an I/O module to be separately configured and parameterized.

It is possible to assign each of these submodules to different IO controllers.

The functions:

- Firmware update
- Write I&M data
- Calibration

can only be executed if you have configured submodule 1 during configuration.

2.2.2 Configuration control (option handling)

Properties

Configuration control allows you to prepare your distributed I/O system for future extensions or changes. Configuration control means that you can configure the planned maximum configuration of your distributed I/O system in advance and vary it later in a flexible manner by means of the user program.

Reference

You can find more information

- in the S7-1500, ET 200MP system manual (http://support.automation.siemens.com/WW/view/en/59191792)
- on the Internet (http://support.automation.siemens.com/WW/view/en/29430270)
- in the STEP 7 online help.

Wiring

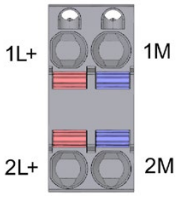
3

3.1 Terminal assignment

24V DC power supply

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

Table 3- 1 Pin assignment 24 V DC supply voltage

View	Signal name[1]	Designation
	1L+	24 V DC
	2L+	24 V DC (for looping through)[2]
	1M	Ground
	2M	Ground (for looping through)[2]

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

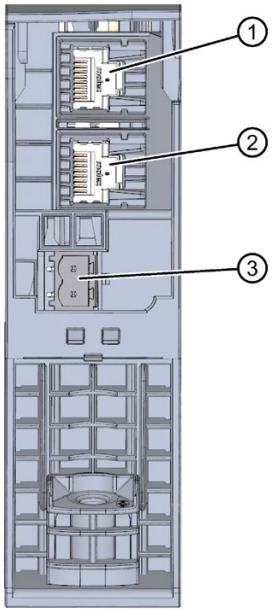
[2] Maximum 10 A permitted.

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

The pin assignment of the ports depends on the setting of the port option "Activate autonegotiation".

- Port P1 X1 R: When autonegotiation is deactivated, the RJ45 socket is allocated as data terminal equipment MDI (normal pin assignment).
- Port P2 X1 R: When autonegotiation is deactivated, the RJ45 socket is allocated as a switch MDI-X (crossed pin assignment).
- The following applies to both ports: When autonegotiation is activated, autocrossing is in effect and the RJ45 socket is allocated either as data terminal equipment MDI or a switch MDI-X.

The figure below shows the location of the PROFINET interface X1 and the connection socket for the 24 V DC supply voltage.



① Port P1 X1 R (front)
② Port P2 X1 R (rear)
③ Connection socket 24 V DC supply voltage

Figure 3-1 Location of the PROFINET ports and the 24 V DC connection socket (view from below)

Note

You need a screwdriver (max. blade width 2.5 mm) to remove the PROFINET plug.

Note

IM 155-5 PN ST interface module (6ES7155-5AA00-0AB0)

For the IM 155-5 PN ST with order number 6ES7155-5AA00-0AB0, note that the ports of the PROFINET interface X1 are offset by 90°.

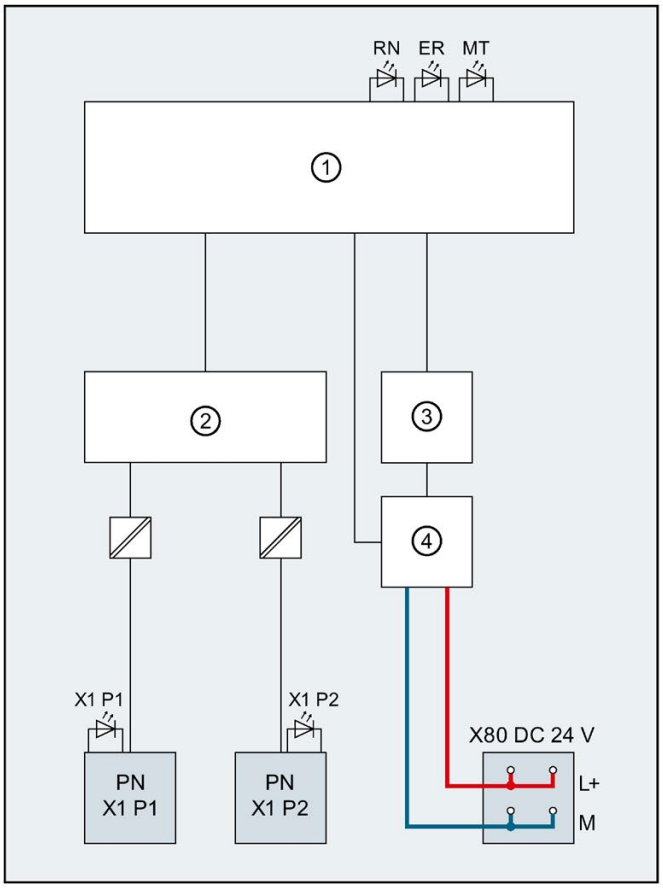
Additional information

You can find additional information on connecting the interface module and on accessories (RJ45 bus connector) in the ET 200MP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/59191792) system manual.

3.2 Block diagram

Block diagram

The following figure shows a block diagram of the IM 155-5 PN ST interface module.



①	Electronics	L+	24 V DC supply voltage
②	PROFINET 2-port switch	M	Ground
③	Backplane bus interface	RN	RUN/STOP LED (yellow/green)
④	Internal supply voltage	ER	ERROR LED (red)
X80 24 V DC	Infeed of supply voltage	MT	MAINT LED (yellow)
PN X1 P1	PROFINET interface X1 Port 1	X1 P1, X1 P2	LED Link TX/RX
PN X1 P2	PROFINET interface X1 Port 2		

Figure 3-2 Block diagram of the IM 155-5 PN ST interface module

Parameter

4

4.1 Parameters

Table 4- 1 Parameters for IM 155-5 PN ST interface module

Parameters	Value range	Default setting	Efficiency range
Connection to supply voltage L+	Connection/No connection	Connection	ET 200MP
Configuration control	Disable/enable	Disable	ET 200MP

4.2 Description of parameters

4.2.1 Connection to supply voltage L+

Parameter "Connection to supply voltage L+"

This parameter is used

- for diagnostics of the ET 200MP:

  If the actual configuration is different from the required configuration of the interface module supply voltage set with this parameter, the ET 200MP generates a diagnostic alarm.

- to check the power budget for the configuration with STEP 7 V12:

  Depending on how the parameter is set, either the infeed power for the interface module into the backplane bus or the power consumption from the backplane bus is entered into the calculation of the power budget.

The default setting "Connection to supply voltage L+ " means that the front of the interface module is supplied with 24 V DC and feeds power into the backplane bus.

Note

We recommend that you always supply the front of the interface module with 24V DC because if you then insert a power supply module (PS) **upstream** of the interface module, both the power of the power supply module (PS) and the power of the integrated power supply of the interface module are available for the I/O modules (power addition of PS infeed power + IM infeed power in power segment 1).

In this case, you do not have to change the default of the parameter in STEP 7.

The setting "No connection to supply voltage L+ means that the interface module is not supplied with 24 V DC on the front. This can only be the case when a power supply module (PS) is inserted upstream from the interface module and the power supply modules (PS) supply the interface module and the downstream modules. In the case of an interface module without power supply, its power consumption from the backplane bus must be considered as consumer in the power budget and the power segments must be formed accordingly.

Reference

See the section on the power budget and the forming of power segments in the ET 200MP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/59191792) System Manual.

Requirement

In order to generate a diagnostics, the IM 155-5 PN ST interface module must have been configured once.

See also

Diagnostic alarms (Page 30)

4.2.2 Configuration control

"Configuration control" parameter

You can use this parameter to enable the configuration control function in the ET 200MP distributed I/O system.

Note

If you configure the enable, the ET 200MP distributed I/O system requires a control data record 196 from the user program in order for the ET 200MP distributed I/O system to operate the I/O modules.

Reference

For more information on configuration control, refer to the S7-1500, ET 200MP system manual (https://support.industry.siemens.com/cs/ww/en/view/59191792) and to the STEP 7 online help.

Interrupts and diagnostic, error, and system alarms 5

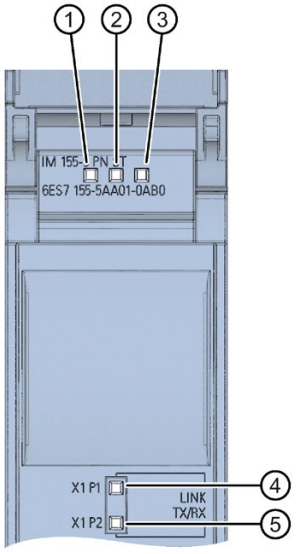
5.1 Status and error displays

Introduction

Diagnostics by means of LED display is an initial tool for error localization. To further limit the error, you usually evaluate the display of the CPU, the display of the module status in STEP 7 or the diagnostics buffer of the CPU. The buffer contains plain text information on the error that has occurred. For example, you will find the number of the appropriate error OB there.

LED display

The figure below shows the LED display on the IM 155-5 PN ST interface module.



① RUN (green)
② ERROR (red)
③ MAINT (yellow)
④ P1 LINK/TX/RX (green/yellow)
⑤ P2 LINK/TX/RX (green/yellow)

Figure 5-1 LED display on the interface module

Meaning of the LEDs RUN/ ERROR/ MAINT

Table 5- 1 Meaning of the LEDs RUN/ ERROR/ MAINT

LEDs			Meaning	Remedy
RUN	ERROR	MAINT		
Off	Off	Off	Supply voltage not present at interface module or too small	Check the supply voltage or turn it on at the interface module.
On	On	On	Test of LEDs during startup: The three LEDs light up simultaneously for approximately 0.25 s.	---
Flashes	Off	Off	Interface module is deactivated.	Activate the interface module with the configuration software or the user program.
			Interface module is not configured.	Configure the interface module with the configuration software.
			ET 200MP starts up.	---
			ET 200MP is reset to factory settings.	
On	Not relevant	Not relevant	ET 200MP is currently exchanging data with the IO controller.	
Not relevant	Flashes	Not relevant	Group error and group error channels	Evaluate the diagnostics data and correct the error.
			The set configuration does not correspond to the actual configuration of the ET 200MP.	Check the design of the ET 200MP to see whether a module is missing or defective, or whether a non-configured module is inserted.
			Invalid configuration states	See chapter Invalid configuration states of the ET 200MP on PROFINET IO (Page 38)
			Parameter assignment error in the I/O module	Evaluate the display of the module status in STEP 7 and correct the error in the corresponding I/O module.
Not relevant	Not relevant	On	Maintenance	See chapter Maintenance events (Page 32)
Flashes	Flashes	Flashes	"Node flash test" is performed. (The LEDs P1 and P2 of the PROFINET interface are also flashing.)	---
			Hardware or firmware defective. (The LEDs P1 and P2 of the PROFINET interface are not flashing.)	Replace the interface module.

Meaning of the LEDs P1 LINK/TX/RX, P2 LINK/TX/RX

Table 5- 2 Meaning of the LEDs P1 LINK/TX/RX, P2 LINK/TX/RX

LEDs P1 LINK/TX/RX, P2 LINK/TX/RX	Meaning	Remedy
Off	There is no Ethernet connection between the PROFINET interface of your PROFINET device and a communication partner (e.g. IO controller).	Check whether the bus cable to the switch/IO controller is interrupted.
On	There is an Ethernet connection between the PROFINET interface of your PROFINET device and a communication partner (e.g., IO controller).	---
flickers	There is active data traffic (sending/receiving) via the Ethernet connection.	---
Flashes	"Node flash test" is performed. (The LEDs RUN/ERROR/MAINT are also flashing.)	---

5.2 Interrupts

Introduction

The I/O device generates interrupts as a reaction to specific error events. Interrupts are evaluated based on the I/O controller used.

Evaluating interrupts with I/O controllers

The ET 200MP distributed I/O system supports the following interrupts:

- Diagnostic interrupts
- Hardware interrupts

In the event of an interrupt, interrupt OBs are automatically called in the CPU of the IO controller.

Information on the cause and class of the error is already available, based on the OB number and start information.

Detailed information on the error event can be obtained in the error OB using the instruction "RALRM" (read additional interrupt information).

System diagnostics

In STEP 7 (TIA Portal) as of V12, innovative system diagnostics is available for devices of the S7-1500 automation system and ET 200MP. Independently of the cyclical user program, alarms are made available on the display of the S7-1500 CPU, to the S7-1500 CPU web server, to the HMI device and in STEP 7.

For additional information on the system diagnostics, refer to the System Diagnostics function manual. (https://support.industry.siemens.com/cs/ww/en/view/59192926).

5.2.1 Triggering of a diagnostic interrupt

Triggering of a diagnostic interrupt

For an incoming or outgoing event (e.g., wire break on a channel of an I/O module), the module triggers a diagnostic interrupt if this is configured accordingly in STEP 7 (TIA Portal).

The CPU interrupts user program execution and executes the diagnostic interrupt OB. The event that triggered the interrupt is entered in the start information of the diagnostic interrupt OB.

5.2.2 Triggering of a hardware interrupt

Triggering of a hardware interrupt

When a hardware interrupt occurs, the CPU interrupts execution of the user program and processes the hardware interrupt OB. The event that triggered the interrupt is entered in the start information of the hardware interrupt OB.

Note

Diagnostics "Hardware interrupt lost" (from I/O module)

Avoid creating hardware interrupts cyclically.

If the hardware interrupt load is too high, hardware interrupts can get lost depending on the number of I/O modules and the communication load.

5.3 Alarms

5.3.1 Diagnostic alarms

Actions after a diagnostic alarm

There can be more than one diagnostic alarm at the same time. Actions initiated by diagnostic alarms:

- The ERROR LED of the interface module flashes.
- Diagnostic data is reported as diagnostic interrupts to the CPU of the IO controller and can be read via data records.
- Incoming diagnostic alarms are saved to the diagnostic buffer of the IO controller.
- The diagnostic interrupt OB is called. If the diagnostic interrupt OB is not available, the IO controller goes into STOP mode.

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

Reading out the diagnostic data

Table 5- 3 Reading out the diagnostic data with STEP 7

Automation system with IO controller	Application	See...
SIMATIC S7	Diagnostic data as plain text in STEP 7 using online view and diagnostic view	Online help of STEP 7 and • as of STEP 7 V12 PROFINET with STEP 7 V12 function manual (http://support.automation.siemens.com/WW/view/en/49948856) • as of STEP 7 V5.5 PROFINET System Description (https://support.industry.siemens.com/cs/ww/en/view/19292127) manual.
	Instruction "RDREC" Read data records from the IO device	
	Instruction "RALRM" Receive interrupts from the IO device	

Additional information on the data records for PROFINET IO

You can find the structure of the diagnostic data records and programming examples in the programming manual From PROFIBUS DP to PROFINET IO (https://support.industry.siemens.com/cs/ww/en/view/19289930) and in the application example on the Internet (https://support.industry.siemens.com/cs/ww/en/view/24000238).

Causes of error and troubleshooting

The causes of error and troubleshooting of the diagnostic alarms are described in the device manuals of the I/O modules in the section Interrupts/Diagnostic alarms.

See also

Channel diagnostics (Page 33)

5.3.2 Maintenance events

Triggering of a maintenance event

The PROFINET interface of the interface module supports the diagnostic concept and maintenance concept in PROFINET according to the IEC 61158-6-10 standard. The goal is to detect and remove potential problems as soon as possible.

For the interface module, maintenance events signal to the user when a network component must be checked or replaced.

The CPU interrupts user program execution and executes the diagnostic interrupt OB. The event that triggered the maintenance event is entered in the start information of the diagnostic interrupt OB.

The interface module signals a maintenance event to the higher-level diagnostic system in case of the following events:

Table 5- 4 Triggering of a maintenance event

Maintenance alarm	Event	Meaning
Maintenance demanded MAINT LED is lit	Synchronization loss	• No synchronization frame received No synchronization frame was received by the sync master within the timeout period after parameter assignment or during operation. • Successive synchronization frames are located outside permitted limits (jitter)
	Maintenance event of an I/O module	The maintenance event of a power supply module is passed through.

System alarms in STEP 7

The maintenance information is generated in STEP 7 with the following system alarms:

- Maintenance demanded - indicated for each port by a yellow wrench icon in the device view or in the hardware configuration.

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

5.3.3 Channel diagnostics

Function

Channel diagnostics provides information about channel faults in modules.

Channel faults are mapped as channel diagnostic data in IO diagnostic data records.

The "RDREC" instruction is used to read the data record.

Structure of the diagnostic data records

- Firmware version V4.0 or higher: The IM 155-5 PN ST interface module maps channel faults by means of extended channel diagnostics.

  The data records supported by the ET 200MP are based on the standard PROFINET IO - Application Layer Service Definition V2.3.

- Firmware version lower than V4.0: The IM 155-5 PN ST interface module maps channel faults by means of manufacturer-specific diagnostic data records.

  The data records are based on the PROFINET IO standard - Application Layer Service Definition V2.2.

You can purchase the standards from the PROFIBUS User Organization on the Internet (http://www.profibus.com).

Coding of the extended channel diagnostics (as of firmware version V4.0)

With the IM 155-5 PN ST interface module, the following extended channel diagnostics are reported by the Interface module in slot 1:

Table 5- 5 Manufacturer-specific diagnostics in the USI

ChannelError-Type	ExtendedChan-nel ErrorType	Associated value (AddValue)	Diagnostics
0x0601	0x0682	Slot	Communication with slot <No.> has failed
0x0602	0x0692	Slot	Permitted number of I/O modules exceeded
0x0602	0x069B	Slot	Permitted number of power supply modules exceeded
0x0602	0x0696	0	No U connector detected on an IM port
0x0602	0x0697	0	More than one bus master module (IM/CPU) detected
0x0610	0x06B1	Slot	Power budget error (overload has been detected in at least one power segment)
0x0610	0x06B2	0	Error IM power supply: Power supply not active or power supply active

Structure of the manufacturer-specific diagnostic data records (firmware version lower than V4.0)

The structure of the diagnostic data records is differentiated by the BlockVersion. The following BlockVersion applies to the IM 155-5 PN ST interface modules:

Table 5- 6 Structure of the manufacturer-specific diagnostic data records

IM 155-5 PN ST interface module	BlockVersion
6ES7155-5AA00-0AB0	W#16#0101

Manufacturer-specific diagnostics in the User Structure Identifier (USI)

The following manufacturer-specific diagnostic data is signaled in the USI with the IM 155-5 PN ST interface module:

Table 5- 7 Manufacturer-specific diagnostics in the USI

USI no. W#16#...	Diagnostics
0001	Power budget error (overload has been detected in at least one power segment)
0002	Permitted number of power supply modules exceeded
0003	Permitted number of I/O modules exceeded
0004	No U connector detected on an IM port
0005	More than one bus master module (IM/CPU) detected
0006	Communication with slot <No.> has failed
0007	Error IM power supply: Power supply not active or power supply active

Structure USI = W#16#0001

Table 5- 8 Structure of USI = W#16#0001

Data block name		Contents	Note	Bytes
USI		W#16#0001	Manufacturer-specific diagnostic data in case of overload in an ET 200MP power segment	2
The first power segment with overload starts at slot: <No.>				
	Slot	B#16#00 to B#16#1F		1
Followed by 3 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1

Structure USI = W#16#0002

Table 5- 9 Structure of the USI = W#16#0002

Data block name		Contents	Note	Bytes
USI		W#16#0002	Manufacturer-specific diagnostic data if the permitted number of power supply modules is exceeded	2
The first surplus module is located in slot: <No.>				
	Slot	B#16#00 to B#16#1F		1
Followed by 3 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1

USI structure = W#16#0003

Table 5- 10 USI structure = W#16#0003

Data block name		Contents	Note	Bytes
USI		W#16#0003	Manufacturer-specific diagnostic data if the permitted number of I/O modules is exceeded	2
The first surplus module is located in slot: <No.>				
	Slot	B#16#20 to B#16#FF		1
Followed by 3 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1

USI structure = W#16#0004

Table 5- 11 USI structure = W#16#0004

Data block name		Contents	Note	Bytes
USI		W#16#0004	Manufacturer-specific diagnostic data if no U connector is detected on an IM port	2
Followed by 4 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1
	Reserved			1

USI structure = W#16#0005

Table 5- 12 USI structure = W#16#0005

Data block name		Contents	Note	Bytes
USI		W#16#0005	Manufacturer-specific diagnostic data if there is more than one bus master module (IM/CPU)	2
Followed by 4 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1
	Reserved			1

USI structure = W#16#0006

Table 5- 13 USI structure = W#16#0006

Data block name		Contents	Note	Bytes
USI		W#16#0006	Manufacturer-specific diagnostic data if the communication with a slot has failed	2
Communication has failed with slot: <No.>				
	Slot	B#16#00 to B#16#1F		1
Followed by 3 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1

USI structure = W#16#0007

Table 5- 14 USI structure = W#16#0007

Data block name		Contents	Note	Bytes
USI		W#16#0007	Manufacturer-specific diagnostic data if the configuration of the interface module power supply is different from the parameterized configuration	2
Error IM power supply: Power supply <bit 0 in the least significant byte can be 0 or 1>				
	Power supply of the interface module	B#16#00	Power supply of the interface module is not active.	1
		B#16#01	Power supply of the interface module is active.	
Followed by 3 reserved bytes				
	Reserved			1
	Reserved			1
	Reserved			1

Additional information

You can find additional information on maximum configuration, power budget and power segments in the ET 200MP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/59191792) system manual.

5.3.4 Invalid configuration states of the ET 200MP on PROFINET IO

Invalid configuration states

The following invalid configuration states of the ET 200MP lead to a short failure of the ET 200MP IO device or prevent the exchange of user data with the I/O modules.

- More than two power supply modules (PS) inserted to the right of the interface module
- Number of modules exceeds maximum configuration
- Faulty backplane bus (e.g., additional IM present).
- I/O modules of a power segment consume more power than can be provided (overload). In the case of an overload, the interface module provides diagnostic information, cyclically checks the connection to the backplane bus and re-establishes it as soon as possible.

Additional information

You can find additional information on maximum configuration, power budget and power segments in the ET 200MP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/59191792) System Manual.

See also:

Status and error displays (Page 26)

5.3.5 STOP of the IO controller and recovery of the IO device

STOP of the SIMATIC IO controller

Diagnostic data received from the IO device while the IO controller is in STOP state does not initiate a call of the corresponding OBs when the IO controller goes into RUN. You have to read the data record $E00C_H$ using the "RDREC" in the startup OB. This record contains all diagnostic data for the slots assigned to an IO controller in an IO device.

Recovery of the SIMATIC IO device

If you want to read the diagnostic data in the STOP state of the IO controller, you have to read the $E00C_H$ data record using the "RDREC" instruction. This record contains all diagnostic data for the slots assigned to an IO controller in an IO device.

Technical specifications

6

Technical specifications of the IM 155-5 PN ST

Article number	6ES7155-5AA01-0AB0
General information	
Product type designation	IM 155-5 PN ST
HW functional status	FS01
Firmware version	V4.1.0
Vendor identification (VendorID)	0x002A
Device identifier (DeviceID)	0X0312
Product function	
• I&M data	Yes; I&M0 to I&M3
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V14 or higher with HSP 0223 / integrated with V15 or higher
• STEP 7 configurable/integrated as of version	GSDML V2.32
• PROFINET as of GSD version/GSD revision	V2.3 / -
Configuration control	
via user data	No
via dataset	Yes
Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Short-circuit protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	10 ms
Input current	
Current consumption (rated value)	0.2 A
Current consumption, max.	1.2 A
Inrush current, max.	9 A
I^2t	0.09 $A^2 \cdot s$

Article number	6ES7155-5AA01-0AB0
Power	
Infeed power to the backplane bus	14 W
Power available from the backplane bus	2.3 W
Power loss	
Power loss, typ.	4.5 W
Address area	
Address space per module	
• Address space per module, max.	256 byte; per input / output
Address space per station	
• Address space per station, max.	512 byte; per input / output
Hardware configuration	
Integrated power supply	Yes
System power supply can be plugged in to left of IM	Yes
Number of permissible power segments	3
Rack	
• Modules per rack, max.	30; I/O modules
Interfaces	
Number of PROFINET interfaces	1
1. Interface	
Interface types	
• Number of ports	2
• integrated switch	Yes
• RJ 45 (Ethernet)	Yes
Functionality	
• PROFINET IO Device	Yes
• Media redundancy	Yes; PROFINET MRP
Interface types	
RJ 45 (Ethernet)	
• Transmission procedure	PROFINET with 100 Mbit/s full duplex (100BASE-TX)
• 100 Mbps	Yes
• Autonegotiation	Yes
• Autocrossing	Yes

Article number	6ES7155-5AA01-0AB0
PROFINET IO Device	
Services	
– Isochronous mode	Yes
– IRT	Yes
– MRP	Yes
– MRPD	No
– PROFINET system redundancy	No
– PROFIenergy	No
– Prioritized startup	Yes
– Shared device	Yes
– Number of IO Controllers with shared device, max.	2
Open IE communication	
• TCP/IP	Yes
• SNMP	Yes
• LLDP	Yes
Isochronous mode	
Isochronous operation (application synchronized up to terminal)	Yes
Equidistance	Yes
shortest clock pulse	250 µs
max. cycle	4 ms
Interrupts/diagnostics/status information	
Status indicator	Yes
Alarms	Yes
Diagnostic functions	Yes
Diagnostics indication LED	
• RUN LED	Yes; Green LED
• ERROR LED	Yes; Red LED
• MAINT LED	Yes; yellow LED
• Connection display LINK TX/RX	Yes; 2x green-yellow LEDs
Potential separation	
between backplane bus and electronics	No
between PROFINET and all other circuits	Yes
between supply and all other circuits	No
Isolation	
Isolation tested with	707 V DC (type test)

Article number	6ES7155-5AA01-0AB0
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C
• vertical installation, max.	40 °C
Connection method	
ET-Connection	
• via BU/BA Send	No
Dimensions	
Width	35 mm
Height	147 mm
Depth	129 mm

Dimension drawing

A

The dimensional drawing of the module on the mounting rail, as well as a dimensional drawing with open front panel, are provided in the appendix. Always observe the specified dimensions for installation in cabinets, control rooms, etc.

Dimensional drawings of the IM 155-5 PN ST interface module

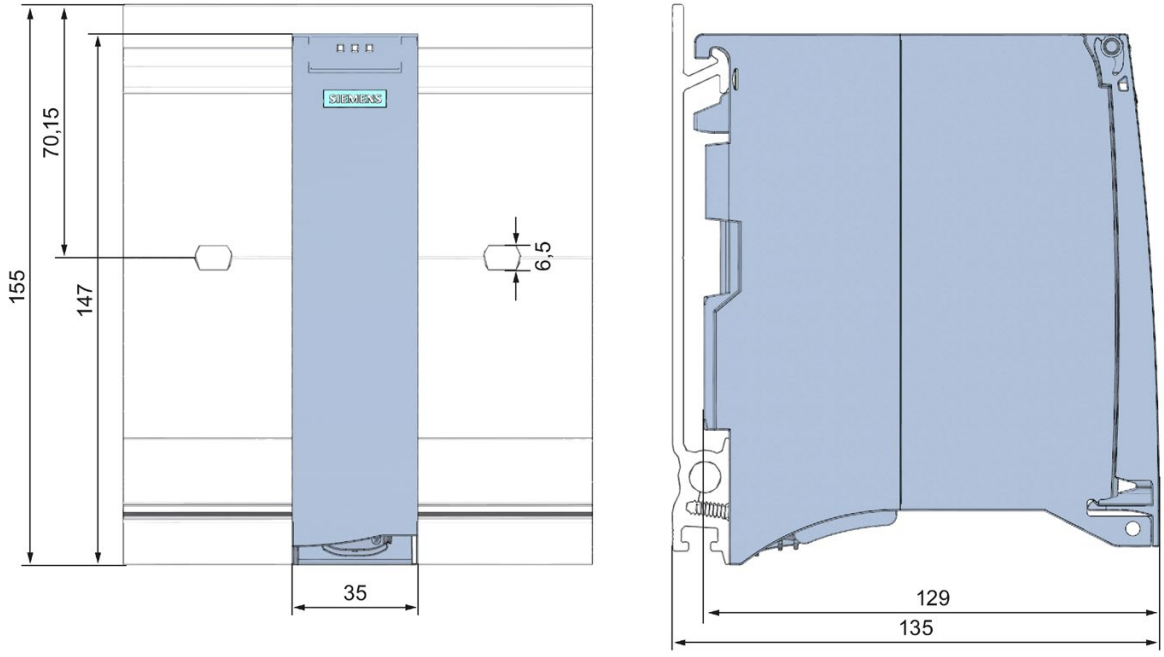


Figure A-1 Dimensional drawing of the IM 155-5 PN ST interface module, front and side views

Dimensional drawing of the IM 155-5 PN ST interface module, side view with open front cover

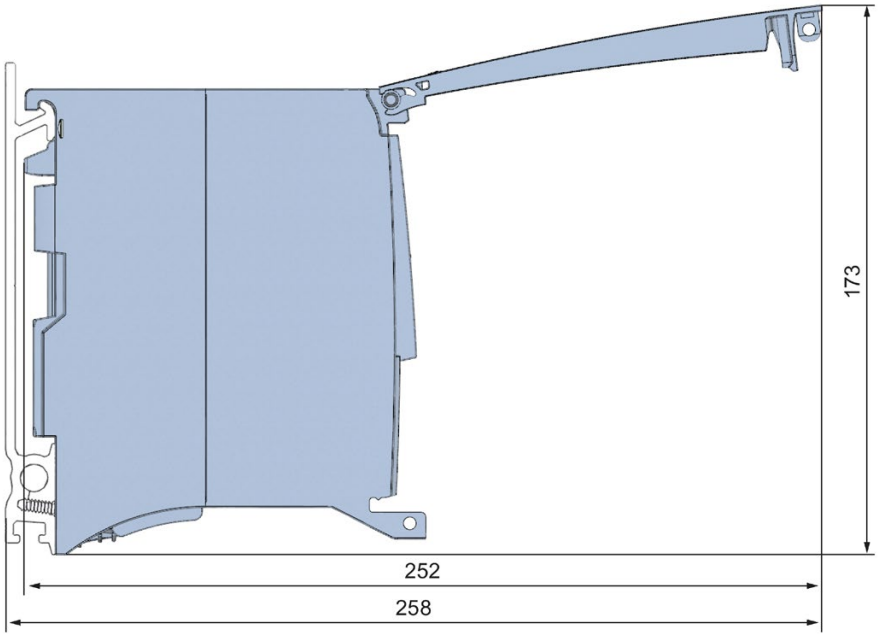


Figure A-2 Dimensional drawing of the IM 155-5 PN ST interface module, side view with open front cover

Response times

B

B.1 Response times of the ET 200MP

Introduction

The response time of the IM 155-5 PN ST is made up of:

- the update time configured for the IM as IO device.

plus

- the backplane bus cycle time.

Note

Validity of the formula

The following formula does not apply to shared device mode.

Backplane bus cycle time

The backplane bus cycle time is the time the interface module requires to output new output data, read new input data and then copy it to the PROFINET send buffer.

The backplane bus cycle time in µs is made up as follows:

- (number of output data in bytes + number of output addresses) x 0.0668 + 1.6131 (rounded)

plus

- (number of input data in bytes + number of input addresses) x 0.0959 + 2.5901 (rounded)

plus

- Operating system processing time (500 µs).

Example configuration for the calculation of the backplane bus cycle time

The following are used in the example:

Table B- 1 Example configuration for the calculation of the backplane bus cycle time

I/O module	Output data in bytes	Input data in bytes	Number of output addresses	Number of input addresses
Analog output module AQ 4xU/I ST	8	-	1	-
Analog output module AQ 4xU/I ST with value status	8	1	1	1
Digital output module DQ 32x24VDC/0.5A ST with value status	4	4	1	1
Digital input module DI 32x24VDC HF	-	4	-	1
Analog input module AI 8xU/I/RTD/TC ST	-	16	-	1
Sum	20	25	3	4

Example calculation of the backplane bus cycle time

Backplane bus cycle time in µs:

- (20 + 3) x 0.0668 + 1.6131 = 3.1495 ≈ 4 µs (rounded)

plus

- (25 + 4) x 0.0959 + 2.5901 = 5.3712 ≈ 6 µs (rounded)

plus

- Operating system processing time 500 µs

Result of backplane bus cycle time

Backplane bus cycle time = 510 µs

Calculating the response time

It is necessary to differentiate between two cases when calculating the response time of the IM 155-5 PN ST:

- Case 1: The configured update time is greater than/equal to the backplane bus cycle time.

  Then:

  Response time in µs = backplane bus cycle time + configured update time

- Case 2: The configured update time is less than the backplane bus cycle time.

  Then:

  Response time in µs = backplane bus cycle time + (configured update time x (backplane bus cycle time / configured update time)).

  If the division backplane cycle time / configured update time does not return an integer without remainder, an additional configured update time must be added next to the integer in the bracket.

Example calculation Case 1: The configured update time is greater than/equal to the backplane bus cycle time.

- Configured update time is, for example, 750 µs
- Backplane bus cycle time = 510 µs

Result of case 1

Response time of the IM 155-5 PN ST = 750 µs + 510 µs = **1260 µs**

Example calculation Case 2: The configured update time is less than the backplane bus cycle time.

- Configured update time is, for example, 500 µs
- Backplane bus cycle time = 510 µs

Result of case 2

Response time of the IM 155-5 PN ST = 510 µs + (500 µs x (510 µs / 500 µs) + 500 µs)) = 510 µs + (500 µs x 1 + 500 µs) = 510 µs + 1000 µs = **1510 µs**

Establishing the PROFINET response time for typical configurations on the PROFINET IO.

A typical PROFINET IO configuration consists of an IO controller with multiple IO devices that are connected by cable or IWLAN to the IO controller. Additional loads, such as programming devices (PGs), HMI devices (Panels) or additional S7 stations, can be present as data receiving stations on the PROFINET line.

You can find the measured values of the PROFINET response time for a typical configuration in this application example (https://support.industry.siemens.com/cs/ww/en/view/21869080).