Installation and operation of the left-alignable AXC F XT SPLC 1000 safety-related controller

User manual

UM EN AXC F XT SPLC 1000

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Installation and operation of the left-alignable AXC F XT SPLC 1000 safety-related controller

UM EN AXC F XT SPLC 1000, Revision 03 2024-05-15

This user manual is valid for:

Designation	Revision		Item No.
AXC F XT SPLC 1000	HW/FW:	≥ 01/01.00.0000	1159811

Prior to commissioning the device, observe the following:

- Ensure that you operate the device with the latest firmware version.
  If a firmware update is necessary, please contact your nearest Phoenix Contact representative. The firmware may only be updated by trained personnel.
- Ensure that the left-alignable safety-related controller is only aligned next to a PLCnext Control device which has a firmware version that is permissible for this.

PLCnext Control devices of the type Typs AXC F ... with the following firmware versions are permitted:

– AXC F 2152 with firmware version ≥2021.9
– AXC F 3152 with firmware version ≥2021.9

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1 For your safety

Read this manual carefully and keep it for future reference.

1.1 Labeling of warning notes

This symbol indicates hazards that could lead to personal injury.

There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word warns the reader of actions that might cause property damage or a malfunction.

Here you will find additional information or detailed sources of information.

1.2 Qualification of users

The use of products described in this user manual is oriented exclusively to:

– Electrically skilled persons or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.
– Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

This user manual is addressed to persons, who are familiar with the relevant safety concepts for handling electrical machines. The persons must be able to recognize dangers.

1.3 Information about this user manual

1.3.1 Purpose of this user manual

The information in this document describes how the AXC F XT SPLC 1000 works, its control elements, and its connection elements. The AXC F XT SPLC 1000 is a safety-related controller that, as the “PLCnext Control Extension” extension module, can be aligned to the left of an AXC F 2152 or AXC F 3152.

It also describes how the AXC F XT SPLC 1000 is integrated into the software tools listed in Section “System requirements (hardware and software)” on page 23.

This information will enable you to use the device in accordance with your requirements.

1.3.2 Validity of the user manual

This user manual is only valid for the left-alignable AXC F XT SPLC 1000 safety-related controller in the versions listed on the inner cover page.

The AXC F XT SPLC 1000 will also be referred to in the following by its short form, “SPLC 1000”.

This user manual is only valid in association with the user manuals listed in Sections 1.13 on page 22 and 13.1.6 on page 177.

1.4 Information on Open source software licenses and requesting source code

You can view the Open source software license information in the Web-based management system of the PLCnext Control device used.

Information on the following subjects is available in the UM EN AXL F X152 user manual:

- Licensing information on Open source software
- Requesting the source code
- Web-based management system of the PLCnext Control device used

1.5 General safety notes

WARNING: Depending on the application, incorrect handling of the SPLC 1000 can pose serious danger for the user

When working with the SPLC 1000, observe all the safety notes included in this section.

Requirements

Knowledge of the following is required:

- The non-safety-related target system PROFINET
- The PROFIsafe system
- The components used in your application (e.g., from the Axioline F product group)
- Operation of the software tools specified under the software requirements (see Section "System requirements (hardware and software)" on page 23)
- Safety regulations in the field of application

Qualified personnel

In the context of the use of the PROFIsafe system, the following operations may only be carried out by qualified personnel:

- Planning
- Configuration, parameterization, programming
- Installation, commissioning, servicing
- Maintenance, decommissioning

This user manual is therefore aimed at:

- Qualified personnel who plan and design safety equipment for machines and systems and are familiar with regulations governing occupational safety and accident prevention.
- Qualified personnel who install and operate safety equipment in machines and systems.

In terms of the safety notes in this user manual, qualified personnel are persons who, because of their education, experience and instruction, and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized to carry out any required operations, and who are able to recognize and avoid any possible dangers.

Documentation

You must observe all information and especially all safety notes in this user manual as well as in the documents listed in Section "Documentation" on page 22.

Safety of personnel and equipment

The safety of personnel and equipment can only be assured if the SPLC 1000 is used correctly (see Section "Intended use" on page 13).

Error detection

Depending on the wiring and the parameterization of the safe input/output devices, the PROFIsafe system can detect various errors within the safety equipment.

Observe startup behavior

The PROFIsafe system and the SPLC 1000 as the central component automatically initiate startup/restart of the safety function, 3.g., after power-up.

- To prevent automatic startup/restart, the user must program a startup/restart protection function in the safety program using the programming software for PROFIsafe PLCnext Engineer.

After power up of the supply voltage or a software reset, the SPLC 1000 starts immediately if the PLCnext Control mode selector switch is set to RUN and

– An SD card with a valid project is inserted in the PLCnext Control or

– A valid project exists on the internal flash memory of the PLCnext Control.

Information on the PLCnext Control mode selector switch is available in the UM EN AXL F X152 user manual.

By selecting one of the options “Write and Start Project...” or “Write and Start Project Changes...”, the safety function becomes active immediately after downloading the PLCnext Engineer project and following the startup phase of the SPLC 1000 and the PLCnext Control device. The outputs of the F-Devices and the non-safety-relevant PROFINET devices can be set in accordance with the programming.

Note for starting applications

- Observe the “Safety notes for starting applications” on page 64
- Also observe these notes to prevent unexpected machine startup after confirming an “Operator Acknowledgement”.

Measures to prevent mismatching and polarity reversal

- Take measures to prevent mismatching, polarity reversal, and manipulation of connections.
- Observe the country-specific installation, safety, and accident prevention regulations.

1.6 Field of application of the product

1.6.1 Intended use

This information will enable you to use the AXC F XT SPLC 1000 (SPLC 1000 for short) in accordance with your requirements in a PROFIsafe system.

– The device is a safety-related controller which supports the PROFIsafe protocol.
– The device enables the implementation of functional safety applications.
  The safety function of the SPLC 1000 is only available when used in a PROFIsafe system.
– The device can be used as an F-Host and/or as an F-Device in a PROFIsafe system.
  With the integrated F-Device instance, the device can be operated subordinately at a higher-level F-Host and, simultaneously, can be operated as an F-Host for lower-level F-Devices.
– In an Axioline F station, the device is aligned to the left of a PLCnext Control AXC F 2152 or AXC F 3152.
– In addition to the SPLC 1000, a complete PROFIsafe system also includes F-Devices and the PLCnext Engineer software, as well as a higher-level F-host if you are operating the SPLC 1000 itself as an F-Device.
– The SPLC 1000 can only perform its safety-related tasks in a PROFIsafe system if the device has been integrated into the execution process correctly and in such a way as to avoid errors.
– In a PROFIsafe system, the SPLC 1000 can be used to realize safety functions with the following requirements depending on the operating conditions:
  – Up to SIL 3 in accordance with standard IEC 61508
  – Up to SIL CL 3 in accordance with standard EN 62061
  – Up to PL e/Cat. 4 in accordance with standard EN ISO 13849-1

• Use the PLCnext Engineer software to implement safety-related programming in your application.
• Observe all information in this user manual as well as in the documents listed in “Documentation” on page 22.
• Only use the device in compliance with the technical data and ambient conditions stated in Section 13, “Technical data and ordering data” starting on page 175.

Degree of protection

Degree of protection of the device: IP20.

NOTE: Property damage due to incorrect use
The IP20 degree of protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment.

• Do not subject the device to mechanical and/or thermal stress that exceeds the specified limits.
• To ensure correct operation, the SPLC 1000 must be installed in a lockable housing or a lockable control cabinet with a minimum degree of protection of IP54.

Assembly guidelines

During installation of the device, observe the sections 4 “Mounting hardware” and 5 “Connecting and wiring the hardware”.

1.6.2 Foreseeable misuse

WARNING: Serious risks due to improper use
There is a serious risk to the user and/or equipment if the SPLC 1000 is used inappropriately or not in accordance with the intended use, or if the E-STOP box is subject to tampering.

1.6.3 Product changes

Modifications to the device hardware are not permitted.

Incorrect operation or modifications to the device can endanger your safety or damage the device. Do not repair the device yourself. If the device is defective, please contact Phoenix Contact.

1.6.4 Note on security

NOTE: Unauthorized deletion/replacement of the safety-related project possible

- Only provide the roles for user authentication – “Admin”, “Commissioner”, and “Engineer” – to those users who are authorized to program the safety-related controller. Otherwise, the unauthorized replacement or deletion of the safety-related project by the user cannot be ruled out.
  You can set the user roles in the Web-based management system of the PLCnext Control device used. A general description of the Web-based management system can be found in the PLCnext Info Center.
- It is imperative that you install the AXC F XT SPLC 1000 in a lockable housing or a lockable control cabinet.
  The device housing is not protected against tampering, and access to the device cannot be proven.

– It is possible to access the SD card, meaning that data can be read off and tampered with.
  We recommend securing the slot for the configuration memory (SD card) on the PLCnext Control device used against tampering using a seal.

NOTE:
For notes and restrictions on the use of the AXC F XT SPLC 1000 in combination with the security profile, please refer to the PLCnext Security Info Center.

- To display the corresponding informationen in the Contents area on the left, select the corresponding PLCnext Control device (here: SPLC 1000) by clicking on it.

1.7 Safety notes

Observe the country-specific installation, safety, and accident prevention regulations.

NOTE: Property damage due to incorrect use

The IP20 degree of protection (IEC 60529/EN 60529) requires that the device be used in a clean and dry environment. If you use the device in an environment that is outside of the specified limits, this may cause damage to the device.

- Do not subject the device to mechanical and/or thermal stress that exceeds the specified limits.

NOTE: Electrostatic discharge

The device contains components that can be damaged or destroyed by electrostatic discharge. When working with or on the device, observe the necessary safety precautions against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1

NOTE: Device failure due to foreign objects in device

Foreign objects in the device can lead to malfunctions or even device failure.

- Ensure that no foreign objects find their way into the device (e.g., into the vents).

NOTE: Device failure if operated outside the permitted ambient temperature range

Operating the device in ambient temperatures that are not within the permitted range may lead to malfunctions or even device failure.

- Ensure that the device is operated within the permitted ambient temperature range, see Section 13.2.

NOTE: Device failure due to vibrations and shock levels above the permitted specifications during operation

If the device is subjected to vibrations and shock levels above the permitted specifications during operation, this may lead to malfunctions or even device failure.

- Ensure that the permitted specifications for vibrations and shocks are adhered to when operating the device, see Section 13.2.

NOTE: Device defect due to polarity reversal

Polarity reversal puts a strain on the electronics and can damage the device.

- To protect the device, avoid reversing the poles of the 24 V supply.

1.8 UL notes

Use copper wire that is approved up to 80 °C.

1.8.1 UL Ordinary Location

- If the device is not used in the specified manner, the protection provided by the device may be impaired.
- Mount and install the device in such a way that the disconnecting device can be operated without restrictions.
- The supply source and the external circuits that are to be connected to this device must be electrically isolated from the mains voltage or hazardous voltage by means of reinforced or double insulation, and must satisfy the requirements of PELV circuits in accordance with UL/IEC 61010-2-201 and Section 9.4 Limited power supply in accordance with UL/IEC 61010-1 or NEC Class 2.

1.8.2 UL Hazardous Location

- Ambient temperature: -25 °C < T_{amb} < 60 °C
- This device must be installed in a housing that is at least certified for use in Class I, Zone 2, and IP54 degree of protection in accordance with UL/CSA 60079-0 and that can only be accessed using a tool when used in a Class I, Zone 2 environment.
- This device must be installed in an area that is classified as no higher than pollution degree 2 in accordance with IEC 60664-1.
- Electrical nominal values:
  UL = 24 V DC (19.2 V DC ... 30 V DC) / I_{max} = 100 mA

1.9 Notes on using the SPLC 1000 devices in potentially explosive areas

Please note:
With hardware revision (HW) 05 and higher, the SPLC 1000 is available with approval for potentially explosive areas. In this case, the approval is printed on the device.

Approval in accordance with directive 2014/34/EU (ATEX) and IECEx scheme

WARNING: Explosion hazard

- Before using the device in potentially explosive areas, make sure that your device has the required approval.

The marks and certificate numbers of the available approvals are printed on the device:

- **II 3 G Ex ec IIC T4 Gc**
- **UL 21 ATEX 2651X**
- **IECEx ULD 21.0029X**

WARNING: Explosion hazard

- Please make sure that the following notes and instructions are observed.

- T_{amb} = -25 °C ... +60 °C
- The device can be operated at an installation altitude of up to 2000 m without any restrictions.
- The category 3 device is designed for installation in zone 2 potentially explosive areas.
- The device meets the requirements of EN/IEC 60079-0 and EN/IEC 60079-7.
- Installation, operation, and maintenance must only be carried out by qualified electricians.
- Only devices designed for operation in Ex zone 2 and suitable for the conditions at the installation location may be connected to the circuits in zone 2.
- IP20 degree of protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. Do not subject the device to mechanical and/or thermal stress that exceeds the specified limits.
- The device must be stopped and immediately removed from the Ex area if it is damaged, was subjected to an impermissible load, stored incorrectly, or if it malfunctions.
- The device is not designed for use in potentially explosive dust atmospheres.
- This device must be installed in an area that is classified as no higher than pollution degree 2 in accordance with IEC 60664-1.
- If this device is used in a zone 2 environment, it must be installed in a housing that at least meets the requirements of degree of protection IP54 in accordance with EN/IEC 60079-7 or another approved degree of protection in accordance with IEC 60079-0, section 1.

- Follow the installation instructions as described.
- When installing and operating the device, observe the applicable regulations and safety directives (including national safety directives), as well as the generally recognized engineering rules. The safety-relevant data is included on the packing slip, the user manual and on the certificates (manufacturer‘s declaration, additional approvals where applicable). All documents can be downloaded at phoenixcontact.net/product/1159811.
- Observe the specified conditions for use in potentially explosive areas. Also observe the requirements of EN 60079-14.
- Opening or modifying the device is not permitted. Do not repair the device yourself but replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from non-compliance.
- The following work is only permitted in potentially explosive areas when the power is disconnected:
  - Snapping the device onto the DIN rail
  - Removing the device from the DIN rail
  - Connecting and disconnecting cables
- Connect the DIN rail to protective ground.
- For safe operation, lockable connectors must have a functional locking mechanism (e.g., locking clip, screw connection, etc.). Insert the locking mechanism. Repair any damaged connectors immediately.
- Only connect one cable to each terminal point.
- Only operate the device when all connectors are fully plugged in.

1.10 Electrical safety

WARNING: Hazardous shock currents and the loss of functional safety

Disregarding instructions for electrical safety may result in hazardous shock currents and the loss of functional safety.

- In order to ensure electrical safety, please observe the following points.

Direct/indirect contact

- Protection against direct and indirect contact according to VDE 0100 Part 410 (IEC 60364-4-41) must be ensured for all components connected to the system.

  In the event of an error, parasitic voltages must not occur (single-fault tolerance). This also applies to devices and components with dangerous contact voltages that are permanently connected to the network and/or diagnostic interfaces of the devices used.

This requirement can be met by:

– Using power supplies with safe isolation (PELV)
– Decoupling circuits that are not PELV systems using optocouplers, relays, and other components that meet the requirements of safe isolation.

Safe isolation

- Only use devices with safe isolation if dangerous contact voltages can occur at their connections during normal operation or as a result of an insulation error.

Power supply

WARNING: Loss of electrical safety and the safety function when using unsuitable power supplies

The SPLC 1000 is designed exclusively for protective extra-low voltage (PELV) operation in accordance with EN 60204-1.

- Only protective extra-low voltage in accordance with the defined standard may be used for the supply purposes.

The following applies to the network (PROFINET and Axioline F) and the I/O devices used in it:

- Only use power supplies that satisfy the requirements of EN 61204 and feature safe isolation with PELV in accordance with IEC 61010-2-201 (PELV). They prevent short circuits between the primary and secondary side.

Insulation rating

- When selecting the equipment, please take into consideration the dirt and surge voltages that may occur during operation.

The SPLC 1000 is designed for overvoltage category III (in accordance with DIN EN 60664-1). If you expect surge voltages in the system, which exceed the values defined in overvoltage category III, take into consideration additional measures for voltage limitation.

DC distribution network

DC distribution network according to IEC 61326-3-1:
A DC distribution network is a DC power supply network that supplies a complete industrial hall with DC voltage and to which any device can be connected. A typical system or machine distribution is not a DC distribution network. For devices that are provided for a typical system or machine distribution, the DC connections are viewed and tested as I/O signals according to IEC 61326-3-1.

- When using a SPLC 1000 in a DC distribution network, install appropriate surge protection (e.g., PT 2+1-S-48DC/FM, item no. 2817958) directly upstream of the device.

Installation and configuration

- Please observe the instructions for installing and configuring the PROFIsafe system (see Section “Documentation” on page 22).

WARNING: Incorrect installation and upgrades can pose serious risks
As the user you are obliged to design the devices used and their installation in the system in accordance with these requirements.

- Also check existing plants and systems retrofitted with PROFIsafe again in this respect.

1.11 Safety of the machine or system

The manufacturers and operators of machines and systems, in which the AXC F XT SPLC 1000 device is used, are responsible for adhering to all applicable standards, directives, and legislation.

Draw up and implement a safety concept

In order to use the device described in this document, you must have drawn up an appropriate safety concept for your machine or system. This includes a hazard and risk analysis, among others, in accordance with the directives and standards specified in Section “Standards and directives” on page 21, as well as a test report (checklist) for validating the safety function (see Section “Appendix: Checklists” on page 187).

The target safety integrity level (SIL in accordance with IEC 61508, SIL CL in accordance with EN 62061 or performance level (and category) in accordance with EN ISO 13849-1) is ascertained on the basis of the risk analysis. The required safety integrity level ascertained in this way determines how to use and parameterize the safety-related SPLC 1000 controller within the overall safety function.

Checking hardware and parameterization

- Carry out a **validation** every time you make a safety-related modification to your overall system.
- Use your test report to ensure that:
  - The safe PROFIsafe devices (F-Devices) are connected to the correct safe sensors and actuators.
  - The safe input and output devices have been parameterized correctly.
  - The variables have been linked to the safe sensors and actuators correctly (single-channel or two-channel).

1.12 Standards and directives

- Machinery Directive 2006/42/EC
- EMC Directive 2014/30/EU
- Directive 2011/65/EU, Restriction of the use of certain hazardous substances
- PROFINET Assembling Guideline
- PROFIsafe Policy, Guideline for PROFIBUS and PROFINET
- PROFIsafe System Description Technology and Application
- PROFIsafe Environment
  Guideline for PROFINET and PROFIBUS
- PROFIsafe – Profile for Safety Technology on PROFIBUS and PROFINET
- PROFIsafe Test Specification,
  Test Specification for PROFIBUS and PROFINET
- Functional Bonding and Shielding of PROFIBUS and PROFINET, Guideline for PROFIBUS and PROFINET

Use current versions of the PROFINET- und PROFIsafe documents

- For information on the latest versions of the PROFINET and PROFIsafe documents, refer to Section “Documentation” on page 177.

The standards to which the device conforms are listed in the certificate issued by the approval body or in the EC declaration of conformity (see phoenixcontact.net/products).

1.13 Documentation

The symbol informs you that you have to observe the instructions.
Only install and operate the device once you have familiarized yourself with its properties by means of the user documentation.

Use the latest documentation
Make sure you always use the latest documentation. You can find changes or supplements to this documentation on the Internet at phoenixcontact.net/products.

- When working on the PROFIsafe system and/or PROFINET and its components, you must always keep this user manual and other items of product documentation to hand and observe the information therein.
- Observe all documents consistently.

	Document	Description
PROFIsafe	– PROFIsafe System Description – PROFIsafe Policy, Guideline for PROFIBUS and PROFINET – PROFIsafe Environment, Guideline for PROFINET and PROFIBUS	For more detailed information on these documents, please refer to Section “Documentation” on page 177. Please also observe the relevant information on PROFINET and PROFIsafe, which is available on the Internet at www.profibus.com.
	– User manuals for the PROFIsafe I/O modules used in your application	For example, Axioline F, Axioline Smart Elements.
PROFINET	– PROFINET Assembling Guideline – Guideline for PROFIBUS and PROFINET “Functional Bonding and Shielding of PROFIBUS and PROFINET”	For more detailed information on these documents, please refer to Section “Documentation” on page 177.
	– UM EN PROFINET SYS	PROFINET basic principles
	– UM EN PROFINET CTRL DEV	PROFINET controller/device functions
Software	– Online help for the PLCnext Engineer software	
PLCnext Technology	– PLCnext Info Center	Comprehensive documentation for PLCnext Technology
	– plcnext-community.net	Information on troubleshooting and answers to frequently asked questions (FAQs) in the PLCnext Community
Security	– PLCnext Security Info Center	Comprehensive documentation for security in the context of PLCnext Technology
Axioline F	– UM EN AXL F SYS INST	User manual Axioline F: System and installation
	– UM EN AXL F X152	User manual Installing, commissioning, and operating the AXC F 1152, AXC F 2152, and AXC F 3152 controllers
	– UM EN AXL SE SYS INST	User manual Axioline Smart Elements

1.14 System requirements (hardware and software)

To commission the SPLC 1000 in accordance with the examples in this user manual, you need an active connection from the PLCnext Control device that the SPLC 1000 is left-aligned to a lower-level PROFINET system (see Section 6.4).

In order to follow the examples illustrated in this user manual, corresponding PROFINET devices, Axioline F I/O modules, and Axioline Smart Elements are required.

The following table provides an overview of the required hardware and software.

- Install the PLCnext Engineer software listed in the table on your PC.
  For trouble-free operation, follow the instructions in the software documentation.

Please note:
The PLCnext Engineer engineering software platform for Phoenix Contact automation controllers is compliant with IEC 61131-3. Its functionality can be extended with add-ins.

- Use PLCnext Engineer as an editor for programming safety-related user applications.
- Use PLCnext Engineer to configure and commission F-Devices used with the AXC F XT SPLC 1000.

PLCnext Engineer is certified by TÜV-Rheinland.

<table>
<tr><th>Hardware/software</th><th>Description</th><th>Ordering data</th></tr>
<tr><td>Left-alignable safety-related controller</td><td>AXC F XT SPLC 1000</td><td rowspan="6">For ordering data, see Section 13.1 on page 175.</td></tr>
<tr><td>PLCnext Control</td><td>AXC F 2152 or AXC F 3152</td></tr>
<tr><td>SD card</td><td>External optional flash memory</td></tr>
<tr><td colspan="2">Please note:
– The SD card is not supplied as standard with the SPLC 1000.
– We recommend the use of the SD card for operating the SPLC 1000 on an AXC F 2152 or AXC F 3152.</td></tr>
<tr><td>Power supply</td><td>Power supply for the SPLC 1000</td></tr>
<tr><td>PLCnext Engineer including add-in for functional safety applications
(Add-in Functional Safety Editor)</td><td>≥2021.9</td></tr>
</table>

1.15 Abbreviations used

Abbreviation	Meaning	Standard	Example
SIL	Safety Integrity Level	EN 61508, IEC 61508	SIL 2, SIL 3
SIL CL	SIL Claim Limit	EN 62061	SIL CL 3
Cat.	Category	EN ISO 13849	Cat. 2, Cat. 4
PL	Performance Level	EN ISO 13849	PL e, PL d

Abbreviation	Meaning
SPLC 1000	Left-alignable safety-related controller of performance class 1000 In this document, the AXC F XT SPLC 1000 is also referred to as a safety-related controller.
PLCnext Control	Controller with PLCnext Technology with which, thanks to the open control platform, automation projects can be realized without the restrictions of proprietary systems. Programming languages and development tools are freely selectable here. The SPLC 1000 can only be operated with a controller of the product family PLCnext Control AXC F 2152 or AXC F 3152. Therefore, these devices are meant when the term “PLCnext Control” is used in this manual.
PELV	Protective Extra-Low Voltage Circuit in which, under normal conditions or under the conditions of an individual error, the voltage of 30 V AC, 42.4 V peak value, or 60 V DC is not exceeded, except by grounding errors in other circuits. A PELV circuit is like a SELV circuit, but is connected to protective ground. (In accordance with to EN 61131-2)
F_Source_Add	F-Source Address (F-Parameter) PROFIsafe source address: – Address of the SPLC 1000 in its function as the F-Host. – Address of one of the SPLC 1000 (F-Device) superordinate F-Hosts.
F_Dest_Add	F-Destination Address (F-Parameter) PROFIsafe destination address: – Address of the SPLC 1000 in its function as the F-Device. – Address of F-Devices in the application.

For terms and abbreviations used for PROFIsafe, please refer to “Appendix: Terms for PROFIsafe” on page 185.

1.16 Safety hotline

If you have any technical questions, please contact the Safety Hotline:

- Phone: +49 5281 946 2777
- E-mail: safety-service@phoenixcontact.com

2 Transport, storage, and unpacking

2.1 Transport

The device is delivered in cardboard packaging.

- Only transport the device to its destination in its original packaging.
- Observe the instructions on how to handle the package, as well as the moisture, shock, tilt, and temperature indicators on the packaging.
- Observe the humidity specifications and the temperature range specified for transport (see Section “Technical data” on page 179).
- Protect the surfaces as necessary to prevent damage.
- When transporting the equipment or storing it temporarily, make sure that the surfaces are protected from the elements and any external influences, and that they are kept clean and dry.

2.2 Storage

The storage location must meet the following requirements:

– Dry
– Protected from unauthorized access
– Protected from harmful environmental influences such as UV light
– Temperature range: -40°C ... +85°C
– Air pressure: 58 kPa ... 106 kPa (up to 4500 m above sea level)
– Permissible air humidity: 5% to 95% (in accordance with DIN EN 61131-2)

2.3 Unpacking

The device is delivered in packaging together with a packing slip that provides installation instructions.

- Read the complete packing slip carefully before unpacking the device.

NOTE: Electrostatic discharge
The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1.

NOTE: Property damage due to noncompliance with ESD notes
If the ESD notes are not observed during unpacking and packaging, the device may become damaged.

- Observe the ESD notes during unpacking and packaging.

Checking the delivery

- Check the delivery for transport damage.
  Damaged packaging is an indicator of potential damage to the device that may have occurred during transport. This could result in a malfunction.
- Check to ensure that the security seals are undamaged (see Section 3.5.2).
  Any damage to the security seals is an indication of the device being opened without authorization, e.g., for unacceptable tampering purposes. In this case, correct operation of the device can no longer be ensured.
- Submit any claims for any transport damage and/or damaged security seals immediately and inform Phoenix Contact or your supplier as well as the shipping company without delay.
- Enclose photos that clearly document the damage to the packaging and/or delivery together with your claim.
- Immediately upon delivery, refer to the delivery note to ensure that the delivery is complete.

Scope of supply

– Safety-related AXC F XT SPLC 1000 controller
– AXL F BS BK XT bus base module (item no.: 1141222)
– AXL CN S/UL supply connector (item no.: 2701421)

3 Description of the AXC F XT SPLC 1000

3.1 General description of the SPLC 1000

The SPLC 1000 is a safety-relevant controller. It is a “PLCnext Control Extension” extension module which can be aligned to the left on an AXC F 2152 or AXC F 3152.

The SPLC 1000 supports the PROFIsafe protocol. The SPLC 1000 can be used as an F-Host and and F-Device at the same time in a PROFIsafe system. As an F-Host, the SPLC 1000 communicates directly with F-Devices within the Axioline F station modules that are connected on the right-hand side of the PLCnext Control device.

The safety-related I/O level in an Ethernet network is connected via PROFIsafe/PROFINET to the SPLC 1000 via the PLCnext Control device used.

Programming

You can configure and program the SPLC 1000 using the PLCnext Engineer automation software. PLCnext Engineer is connected to the SPLC 1000 via the PLCnext Control device used.

Password and user name for user authentication

You must authenticate yourself as a user in PLCnext Engineer using a user name and password in order to transfer the safety-related project online from the software over to the SPLC 1000.

- In this respect, observe the information in Section “Note on security” on page 14.

Information on user authentication for the PLCnext Control device used is available in the UM EN AXC F X152 user manual.

Web-based management WBM system

The SPLC 1000 itself does not have an integrated Web-based management interface.

Information on the WBM system of the PLCnext Control used is available in the UM EN AXC F X152 user manual (see Section “Documentation” on page 177)

Internal flash memory or SD card

Operating the SPLC 1000 on the PLCnext Control AXC F 2152/AXC F 3152 is permitted with and without an SD card.

The safety-related programs and configurations are saved as part of the PLCnext Engineer project in the internal flash memory of the PLCnext Control device or on the optional SD card plugged into the PLCnext Control device.

Using the SD card is recommended

We recommend using the SD card for operating the SPLC 1000 on an AXC F 2152 or AXC F 3152 instead of using the internal flash memory of the PLCnext Control device.

Operation with an SD card

Please note in this case that, when replacing the PLCnext Control device used with an identical device with suitable firmware, you can reuse the previously used SD card in the replacement device. This means that the application of the previously used safety-related and non-safety-related project is available again after plugging the SD card into the PLCnext Control.

NOTE: Failure state when removing the SD card

- Please note that the SD card may not be removed during operation.
  If the SD card is removed during operation, the SPLC 1000 will switch to the safe state (failure state).
- Always disconnect the power supply to the SPLC 1000 and to the PLCnext Control device before removing the SD card.

Operation without an SD card

Please note in this case that, when replacing the PLCnext Control device used with an identical device with suitable firmware, you must use the PLCnext Engineer software to

1. Download the non-safety-related project to the PLCnext Control (standard controller) used and
2. Download the safety-related project to the SPLC 1000.

NOTE: Project deletion possible when inserting the SD card

- It is imperative that you take organizational measures to prevent the deletion of the safety-related and non-safety-related project.
  - If you insert an SD card in the PLCnext Control device during ongoing operation of the PLCnext Control device and the SPLC 1000, the safety-related and non-safety-related project present on the internal flash memory will be deleted after a voltage reset or after the system is restarted.
    In addition, any safety-related project with a different CRC checksum present on the SD card could be loaded into the SPLC 1000.

Further information on the internal flash memory of the PLCnext Control device and on the optional pluggable SD card is available in the user manual of the PLCnext Control UM EN AXC F X152 used (see Section “Documentation” on page 177).

Diagnostics and status indicators (LEDs)

Diagnostics and status information is displayed directly on the SPLC 1000 via LEDs (see also Table 3-3 on page 58):

- FS: Failure State: Safe state of the SPLC 1000.
- RUN: Operating state of the SPLC 1000.
- P: The state of the safety-related communication relationship between the SPLC 1000 (F-Device) and a superordinate safety-related controller (F-Host).
- C: State of the safety-related communication relationship between the SPLC 1000 (F-Host) and configured subordinate F-Devices.

The presence of the supply voltage (communications voltage U_L) is displayed via the respective LED on the supply connector.

3.2 Description of the safety-related functioning of the SPLC 1000

The SPLC 1000 is a powerful two-channel safety-related controller for PROFIsafe. The PROFIsafe security protocol is transmitted via the PLCnext Control device used and via the PROFINET network. The safety function is programmed in the PLCnext Engineer software.

As an F-Host, the SPLC 1000 monitors and controls the safety function in a PROFIsafe-System. Its function is to decide whether or not a safe output may be set, for example.

For further information on the behavior of the SPLC 1000 as the F-Host, refer to Section “Behavior of the SPLC 1000 as the F-Host in PROFIsafe” on page 32.

The SPLC 1000 can also be operated as a lower-level F-Device on a safety-related controller (F-Host).

For further information on the behavior of the SPLC 1000 as an F-Device, refer to Section “Behavior of the SPLC 1000 as the F-Device in PROFIsafe” on page 34.

Request for a programmed safety function

Following the request for a programmed safety function (e.g., safety door open), the SPLC 1000 executes the programmed safety function. The relevant safe outputs of the F-Devices are set to the programmed value of the safety function.

Behavior in the event of an error / safe state (Failure State)

The integrated diagnostics function detects errors that have occurred. All serious errors detected in the SPLC 1000 that can lead to the loss of or adversely affect the programmed safety function switch the device to the safe state (Failure State). In this state, the safe outputs of the F-Devices are set to zero (FALSE).

The safe state will be displayed via the FS (Failure State) LED lighting up red.

In the event of an error, if you are connected online to the PLCnext Engineer, information about the error is also displayed in the software.

For descriptions of error states, associated effects, and appropriate measures for error removal, please refer to Section “Errors: Diagnostics, messages, and removal” on page 129.

PROFIsafe: communication diagnostics

The SPLC 1000 supports the user in monitoring and checking the communication relationships of the device-internal F-Host or F-Device.

For this, you can create management/diagnostic variables for the F-Host and the F-Device of the SPLC 1000 in the PLCnext Engineer software.

For further information on communication diagnostics of the SPLC 1000 refer to Section “Behavior of the SPLC 1000 as the F-Host in PROFIsafe” on page 32 and “Behavior of the SPLC 1000 as the F-Device in PROFIsafe” on page 34.

Exchange area

The following total maximum address area is available for exchange variables:

– The sum of the standard input data (NSI, inputs exchange area) may not exceed 128 bytes (data direction “I”: SPLC 1000 ⇐ standard controller).
– The sum of the standard output data (NSQ, outputs exchange area) may not exceed 128 bytes (data direction “Q”: SPLC 1000 ⇒ standard controller).

The data direction “I” and “Q” is specified from the point of view of the safety-related controller.

Also observe the information in section “Characteristic data of the SPLC 1000 safety-related controller” on page 182 regarding this.

Notes on the SPLC 1000 F-Addresses

One F_Source_Address and one F_Destination_Address can be defined for the SPLC 1000, because:

– The SPLC 1000 itself can be used as an F-Host.
– The SPLC 1000 can be used subordinately by a compact controller, such as an RFC 4072S, as an F-Device

In addition to the rules listed above, note that both F-Addresses must each be assigned in a separate number range.
Assign the F_Source_Address to the SPLC 1000 as the F-Host.
Assign the F_Destination_Address as necessary depending on the settings in the higher-level network.

A maximum of 32 F-Devices can be connected to one SPLC 1000.

This results in the following maximum values:

– The sum of the safe input data (SI) may not exceed 512 bytes (input user data and PROFIsafe backup data).
– The sum of the safe output data (SQ) may not exceed 512 bytes (output user data and PROFIsafe backup data).

Also observe the information in section “Characteristic data of the SPLC 1000 safety-related controller” on page 182 regarding this.

3.2.1 Behavior of the SPLC 1000 as the F-Host in PROFIsafe

As an F-Host the SPLC 1000 monitors and controls the safety function in a PROFIsafe-System. Its function is to decide whether or not a safe output may be set, for example.

Passivation and reintegration

If the communication relationship between the SPLC 1000 and an F-Device is aborted, for example due to a communication error, the F-Device will be passivated. Passivation prevents the F-Device from starting up immediately as soon as the communication relationship is reactivated. Passivation and reintegration are displayed via Boolean variables, which the PLCnext Engineer automatically generates for each F-Device. F-Devices can also be passivated or reintegrated from the application program via these variables.

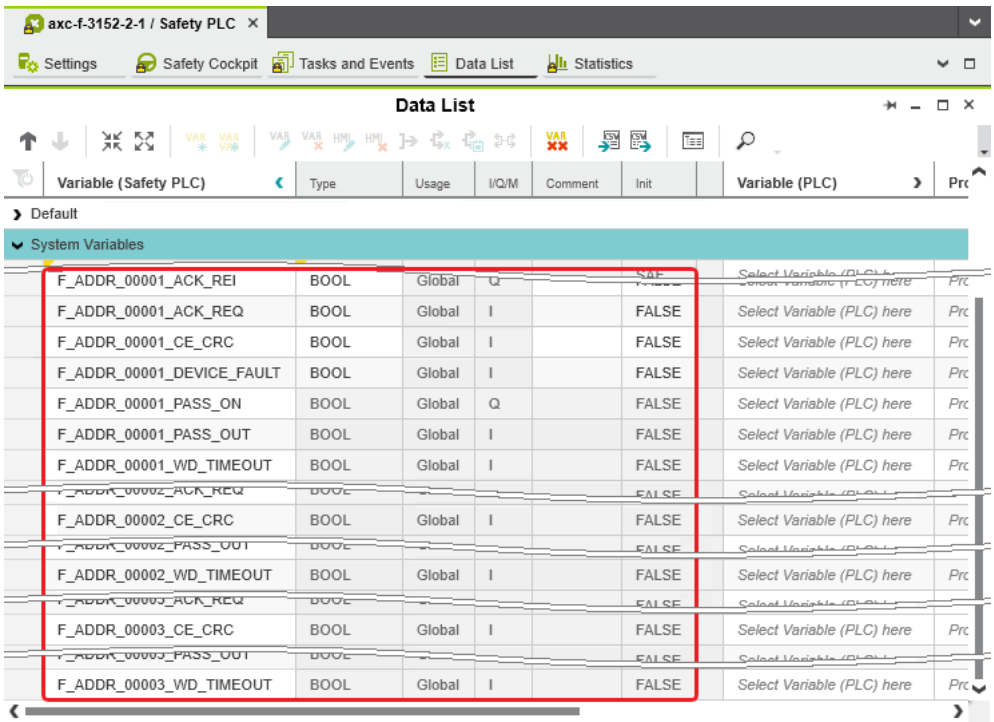
If an operator acknowledge request of the passivated F-Device is present, PROFIsafe-specific acknowledgment can be performed with a subsequent operator acknowledge reintegration. A non-safety-related signal can be used, for example. This overrides the passivation. As a result, the F-Device is reintegrated.

For more information about passivation and reintegration, please refer to Section 6, “Commissioning and validation” and Sections “Management/diagnostic variables for F-Devices” on page 107, “Management/diagnostic variables for each configured, lower-level F-Device” on page 151 and “Global management/diagnostic variables for lower-level F-Devices” on page 155.

PROFIsafe: F-Host communication diagnostics

The SPLC 1000 supports the user in monitoring and checking the communication relationships of the device-internal F-Host. The PLCnext Engineer software indicates why the communication relationship was disabled. A distinction is made between the F_WD_Time being exceeded (F_WD_Time OUT) and an F_CRC error (see Figure 3-1).

Figure 3-1 PROFIsafe: Management/diagnostic variables for communication diagnostics of the SPLC 1000 F-Host



To support the user, seven non-safety-related management/diagnostic variables are created by default in PLCnext Engineer for each F-Device in the data list of the safety-related controller.

If required by the application, PLCnext Engineer allows the user to specify whether more or fewer management/diagnostic variables are created.

Alternatively, other management/diagnostic variables can be created. The user can link these variables to non-safety-related exchange variables of the standard controller in PLCnext Engineer. To do this, the user must define non-safety-related exchange variables in the software, where they can be linked to the management/diagnostic variables.

You can read more about management/diagnostic variables in Section “Management/diagnostic variables for F-Devices” on page 107.

Various functions can be implemented using the management/diagnostic variables:

– Global acknowledgment of individual or multiple communication errors
– Reintegration of F-Devices
– System diagnostics using global management/diagnostic variables
– Diagnostics/control of intelligent F-Devices

Device identification/number of safe devices

In PROFIsafe, safe devices (F-Devices) are identified by means of F-Addresses, which must be assigned uniquely for each safe device. PROFIsafe destination address F_Dest_Add (F_Destination_Address) is used to uniquely identify safe devices. This address is defined on the F-Device via DIP switch (see Section 6.9.1) and in the PLCnext Engineer software and checked immediately after it is entered in PLCnext Engineer. PLCnext Engineer checks the entered addresses for uniqueness in the configured network and for correct value range.

The value of the F_Destination_Address can be set from 0_{dec} to 65534_{dec}.

For safety modules from Phoenix Contact, you can set PROFIsafe destination addresses from 1 to 999_{dec}, maximum. For safety modules from other manufacturers, you can set PROFIsafe destination addresses from 1_{dec} to 65534_{dec}.

Source address F_Source_Address (F_Source_Add for short) uniquely identifies the F-Host of a communication relationship. The F_Source_Address is assigned to the safety-related controller and is used for all communication relationships that are assigned to this safety-related controller. In this way, the SPLC 1000 obtains a source address (F_Source_Add).

The value of the F_Source_Address must be between 1_{dec} and 65534_{dec}.

NOTE: Use unique F-Adresses

- Please note that the combination of F_Source_Address and F_Destination_Address must be unique within the network.

3.2.2 Behavior of the SPLC 1000 as the F-Device in PROFIsafe

The SPLC 1000 can be operated as an F-Device at a lower level, for example on a safety-related compact controller such as the RFC 4072S. It will then be treated by this higher-level F-Host as an F-Device.

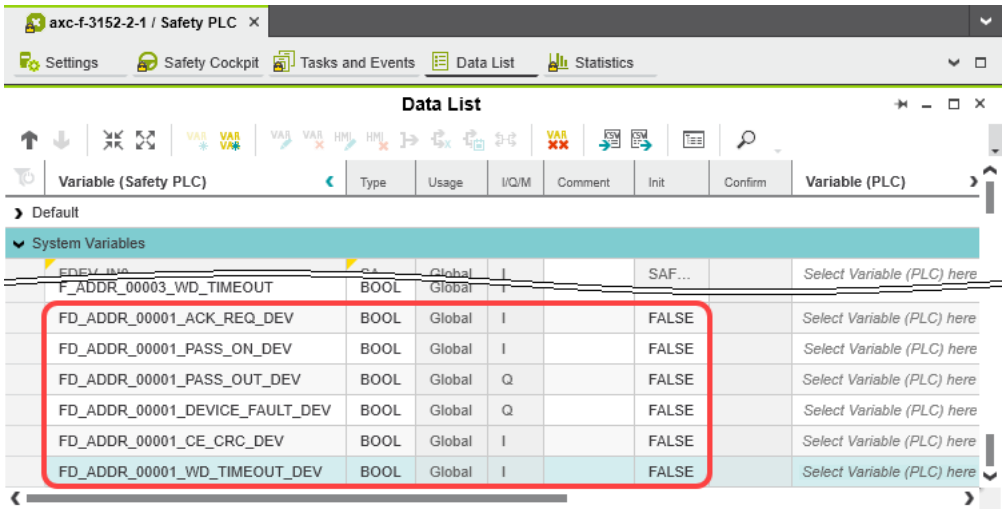
The SPLC 1000 can be used simultaneously as an F-Host and as an F-Device in two different PROFIsafe networks.

PROFIsafe: F-Device communication diagnostics

The SPLC 1000 supports the user in monitoring and checking the communication relationships of the device-internal F-Device. For this purpose, analogous to the above described management / diagnostic variables of the F-Host, management / diagnostic variables can also be created in the PLCnext Engineer for the F-Device of the SPLC 1000. The default setting for these variables is “Do not create”.

For additional information, please refer to Section “Management/diagnostic variables of the SPLC 1000 F-Device” on page 157.

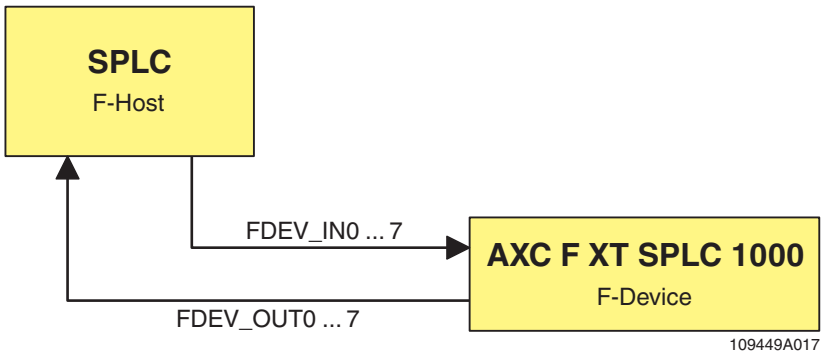
Figure 3-2 PROFIsafe: Management/diagnostic variables for communication diagnostics of the SPLC 1000 F-Device



System variables for the data exchange of the F-Device of the SPLC 1000

These system variables are used for the data exchange between the F-Device of the SPLC 1000 and the higher-level safety-related controller (F-Host).

Figure 3-3 Data exchange between the F-Device of the SPLC 1000 and the higher-level F-Host



– The eight system variables FDEV_IN0 to FDEV_IN7 contain the input process data (8 * 1 SAFEBYTE) of the F-Device instance of the SPLC 1000.
– The eight system variables FDEV_OUT0 to FDEV_OUT7 contain the output process data (8 * 1 SAFEBYTE) of the F-Device instance of the SPLC 1000.

The data direction is described from the view of the engineering:

– FDEV_INx = I
– FDEV_OUTx = Q

Please observe the informationen in Section “FDEV_INx and FDEV_OUTx (x = 0 ... 7) system variables” on page 151.

F_Destination_Address (F_Dest_Add)

For the SPLC 1000, an F_Destination_Address (F_Dest_Add) must be defined if the SPLC 1000 is to be used as an F-Device subordinate to a compact controller such as an RFC 4072S.

Notes on the F_Dest_Add of the SPLC 1000 F-Device

- Assign the F_Dest_Add in a separate number range.
- Assign the F_Dest_Add as necessary depending on the settings in the higher-level network.
  - The F-Device of the SPLC 1000 supports “FSCP 3/1 address type 1 (**F**unctional **S**afety **C**ommunication **P**rofile FSCP 3/1 (PROFIsafe™))” corresponding to the document:
    PROFIsafe – Profile for Safety Technology on PROFIBUS and PROFINET
    Profile part, related to IEC 61784-3-3
    Technical Specification, Version 2.6MU1, August 2018

Setting F-Dest_Add

When the SPLC 1000 is used as an F-Device, its F_Dest_Add can be set in the PLCnext Engineer software (see Figure 3-4).

- Set the F_Dest_Add of the SPLC 1000 in the “Safety Parameters” editor in the editor group of the controller.
- Set the F_Dest_Add of the SPLC 1000 in a range from 1 to a maximum of 65534_{dec}.
- Only assign F_Dest_Add values once.

Figure 3-4 F-Address of the SPLC 1000 F-Device in PLCnext Engineer: F_Dest_Add (F_Destination_Address)

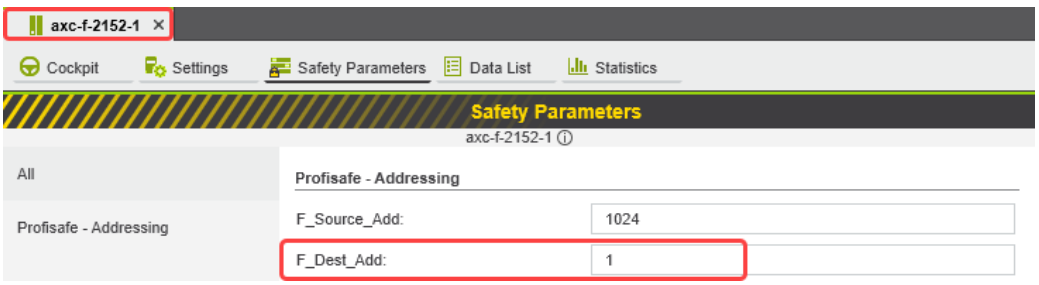
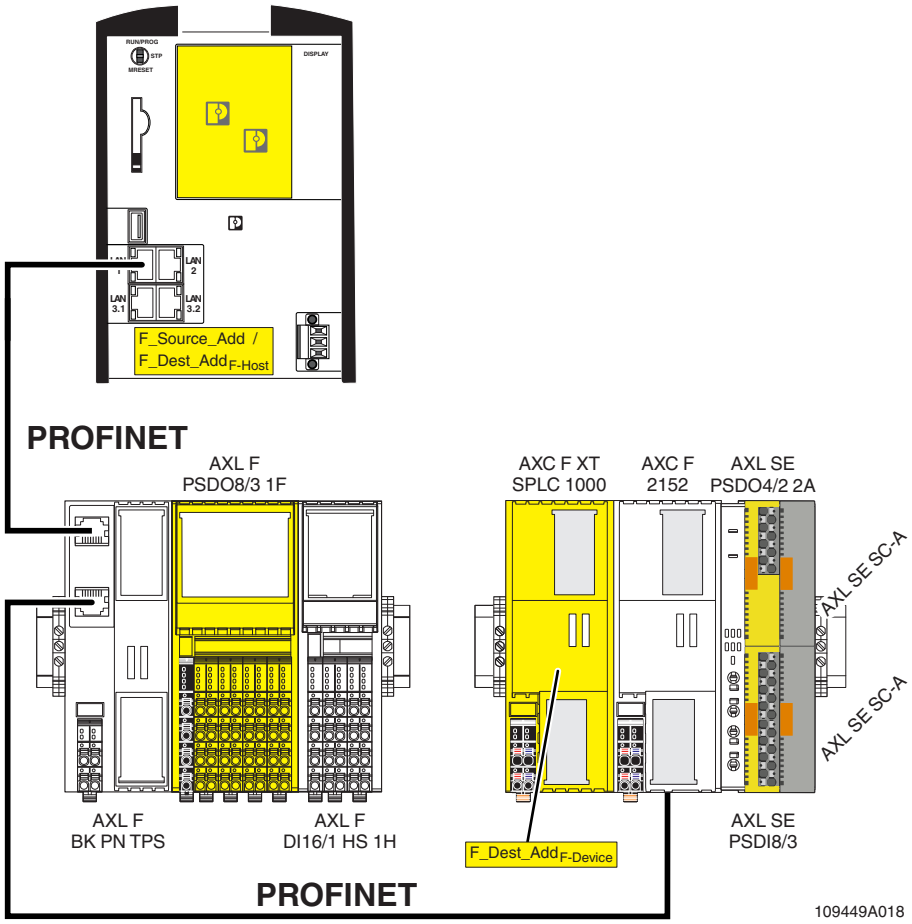


Bild 3-5 F-Adresses of the F-Host (RFC 4072S) and F-Device (SPLC 1000)



F-Adresses in PLCnext Engineer

For the above example application, the following F-Addresses are to be set in the PLCnext Engineer software for the RFC 4072S (F-Host) and the SPLC 1000 (F-Device):

RFC 4072S:

– F_Source_Add
– $F\_Dest\_Add_{F\text{-}Host}$

SPLC 1000:

– $F\_Dest\_Add_{F\text{-}Device}$

Additional information

Observe the following notes on the F-Device of the SPLC 1000 .

– For the F-Device of the SPLC 1000, the following applies: DAT = HAT.
  • Refer to the information on DAT (cycle time of the F-Device) and HAT (cycle time of the SPLC 1000) in Section “Determining $F\_WD\_Time\ IN_{min}$/$F\_WD\_Time\ OUT_{min}$” on page 42.
– PROFIenergy is not supported.
– iParameter are not supported.

3.3 Calculating/determining the response time (Safety Function Response Time, SFRT)

The procedure for determining the necessary times, which is explained in more detail below, is recommended.

1. Determining the maximum permissible safety function response time ($SFRT_{max}$) depending on the relevant safety function to be implemented and determining the resulting maximum monitoring/watchdog times (F_WD_Time IN_{max}/F_WD_Time OUT_{max}) as an upper limit for each individual safety function (see Section 3.3.1 on page 39).

2. Determining the minimum monitoring/watchdog times (F_WD_Time IN_{min}/F_WD_Time OUT_{min}) required for optimum system availability as a lower limit (see Section 3.3.2 on page 42).

3. Defining the monitoring/watchdog times (F_WD_Time IN/F_WD_Time OUT) to be parameterized within the determined upper and lower limits and checking/validating that each of the safety functions to be implemented may be implemented with the defined monitoring/watchdog times (see Section 3.3.3 on page 51).

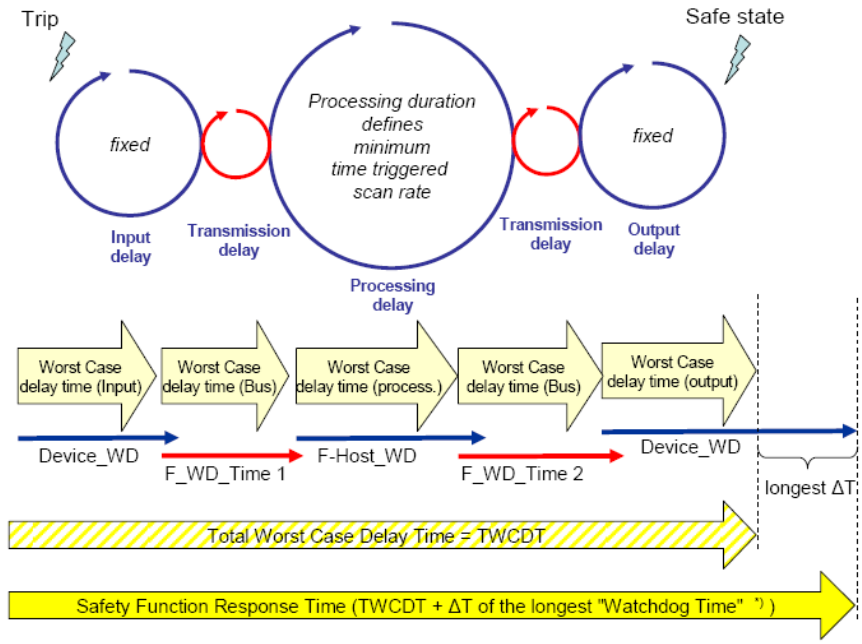
3.3.1 Determining $SFRT_{max}$ and F_WD_Time IN_{max}/ F_WD_Time OUT_{max}

In the application, the maximum permissible SFRT must be determined for each safety function implemented in the application. This maximum permissible SFRT also includes the part of the SFRT that applies to the PROFIsafe system if PROFIsafe and the SPLC 1000 are involved in the safety function.

A method of calculation for determining the part of the SFRT that applies to PROFIsafe is specified in the PROFIsafe system description (see Figure 3-6). The method of calculation specified is subject to certain general conditions.

For detailed information regarding the PROFIsafe system description, please refer to Section “Documentation” on page 177.

Figure 3-6 Calculation of the SFRT response time
(*) = Not necessarily the output device



The TWCDT (total worst case delay time) is therefore the sum of all maximum signal runtimes that may occur in the individual elements during normal operation.

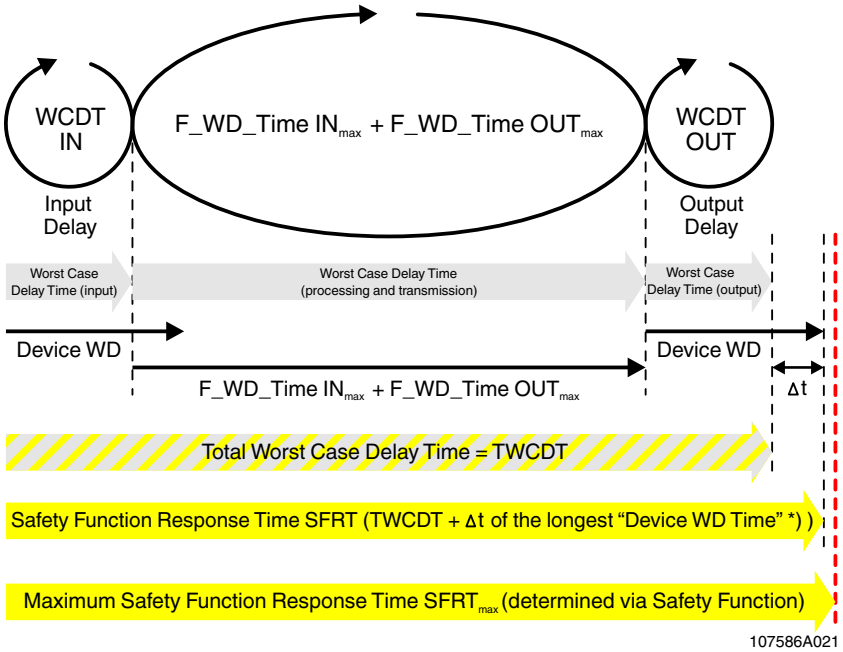
The individual elements are:

– (PROFIsafe) F-Devices
– Transmission (PROFIsafe via PROFINET including all network infrastructure components and lower-level subsystems, for example of the Axioline F local bus) and
– SPLC 1000.

Due to a closely synchronized sequence of F-Host / SPLC 1000 processing, this model is simplified when using the SPLC 1000. The runtimes, cycle times, and watchdog times of the SPLC 1000 (processing delay and F-Host_WD) are not actually relevant when determining the SFRT.

The following figure illustrates the relationship:

Figure 3-7 Simplified calculation of the SFRT response time
(*) = Not necessarily the output device



Key:

SFRT$_{max}$	Maximum permissible safety function response time of the PROFIsafe system involved in the safety function that is **determined for each safety function to be implemented**.
SFRT	The actual implemented safety function response time of the PROFIsafe system involved in the safety function and the SPLC 1000.
WCDT IN	Worst case delay time of the F-Device with input function. For this time, please refer to the device-specific user documentation for the F-Device used.
F_WD_Time IN$_{max}$	Value of the monitoring time F_WD_Time (watchdog time) which may be set as the maximum value for each individual F-Device with an input function that is involved in the safety function in order that SFRT$_{max}$ is not exceeded (see equation [2] on page 41).
F_WD_Time OUT$_{max}$	Value of the monitoring time F_WD_Time (watchdog time) which may be set as the maximum value for each individual F-Device with an output function that is involved in the safety function in order that SFRT$_{max}$ is not exceeded (see equation [2] on page 41).
WCDT OUT	Worst case delay time of the F-Device with output function. For this time, please refer to the device-specific user documentation for the F-Device used.
Device WD	Internal watchdog time of the F-Device involved in the safety function.

The central component in Figure 3-7 on page 40 is deemed to be the sum of F_WD_Time IN_{max} and F_WD_Time OUT_{max}.

The sum of these times specifies the maximum internal processing time that is required for point-to-point communication via PROFIsafe between the PROFIsafe input device and the PROFIsafe output device using the SPLC 1000, even in the event of an error, such as a telegram delay.

The actual SFRT to be implemented for the PROFIsafe system can be determined according to the following equation:

$$\mathbf{SFRT = WCDT\ IN + (F\_WD\_Time\ IN_{max} + F\_WD\_Time\ OUT_{max}) + WCDT\ OUT} \quad [1]$$

SFRT must therefore be ≤ $\mathbf{SFRT_{max}}$

Always take into consideration all the links that are involved in the safety function and programmed in the safety-related application program.

Maximum permissible watchdog times

To incorporate the maximum permissible watchdog times F_WD_Time IN_{max}/F_WD_Time OUT_{max} in the PROFIsafe system, the following equation should be used:

$$\mathbf{F\_WD\_Time\ IN_{max} + F\_WD\_Time\ OUT_{max} \leq SFRT_{max} - WCDT\ IN - WCDT\ OUT} \quad [2]$$

Please refer to the F-Device-specific user documentation to check whether further information is available regarding watchdog times within the internal device function.

If F-Devices are used where there is a difference (Δ t) between their worst case delay time (WCDT) and the implemented device watchdog time (Device WD), this difference must be taken into consideration in accordance with the PROFIsafe model for determining the SFRT.

Timer functions that are used within the safety function in the safety-related application program must be taken into consideration.

3.3.2 Determining F_WD_Time IN_{min}/F_WD_Time OUT_{min}

The F_WD_Time, which you as the user must determine according to your application, is set in the PLCnext Engineer software (“Safety Parameters” editor, see Figure 6-27 on page 105). If the safety-related communication relationship has been established between the partners, monitoring is performed independently by both F-Host (SPLC 1000) and F-Device to ensure that the set F_WD_Time is observed during safety-related communication.

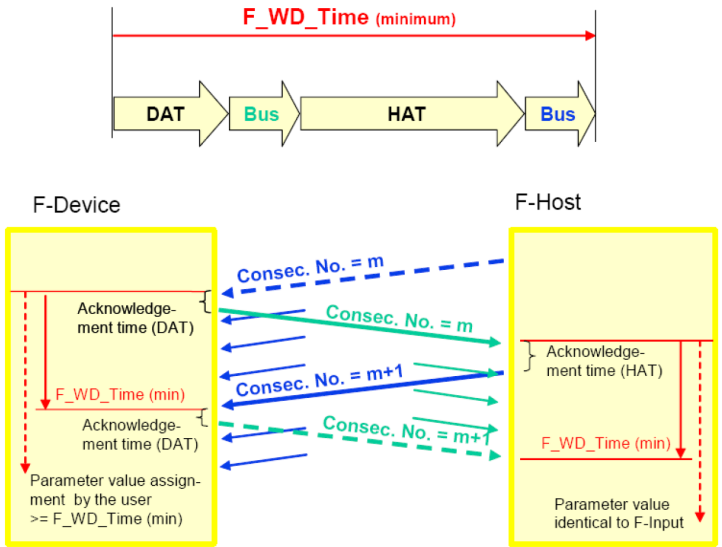
NOTE: Please note that if the F_WD_Time is too short for a safety-related communication relationship, systems and applications will not be available.
This is because the value for F_WD_Time must be greater than or equal to the total maximum telegram runtime from F-Host to F-Device and back again to at least be able to establish safety-related communication via PROFIsafe during error-free network operation.

- In addition to the transmission times on the network (PROFINET cycle), also consider internal stack and firmware runtimes in devices, delays caused by subsystem buses (e.g., device bus for modular I/O systems), etc.

The following figure from the PROFIsafe specification illustrates the relationship:

For detailed information on the PROFIsafe specification (PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO, Item No. 3.192), please refer to Section “Documentation” on page 177.

Figure 3-8 F_WD_Time (minimum)



Key:

DAT	Cycle time of the F-Device (F-Device acknowledge time)
Bus	Bus runtime including all relevant runtime components in the devices, backplane buses, bus heads (bus couplers or controllers) etc. of modular systems
HAT	Cycle time of the SPLC 1000 (F-Host Acknowledge Time: T_{ZSPLC})

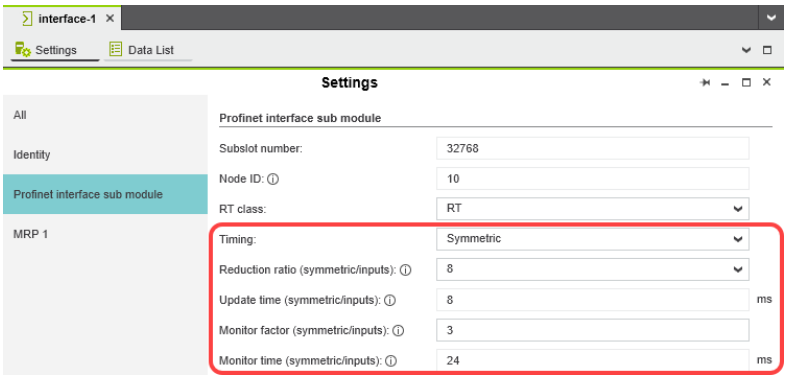
Determining the necessary times

DAT For the cycle time of the F-Devices, please refer to the device-specific user documentation for the F-Devices used.

Bus The “Bus” value is the sum of all the following times in the network/bus system used:

1. External bus runtime in the network:
   - Update time of the I/O data between PROFINET controller and device set via the “Reduction ratio” multiplied by the “Monitor factor” (multiplier of the update time).
     The result (monitor time) determines the time at which the communication relationship is disconnected if no cyclic data has been transmitted in the specified time (see Figure 3-9).
     In the following example, the setting “Symmetric” has been selected for the “Timing”. An adjustment of the values may be necessary if the setting “Asymmetric” is selected.

Figure 3-9 “Settings” editor of the interface editor group of the PROFINET device (settings of the AXL F BK PN TPS PROFINET bus coupler)



   - Relevant runtime components in bus heads (bus coupler) and backplane buses of modular systems.
     For these values, please refer to the manufacturer’s information.
   - Any runtimes within infrastructure components.
     For these values, please refer to the manufacturer’s information.

2. Internal bus runtime within the Axioline F station comprised of left-aligned SPLC 1000, PLCnext Control, and right-aligned safety-related Axioline Smart Elements and Axioline F modules (see example in Section “Structure of an Axioline F station” on page 62):

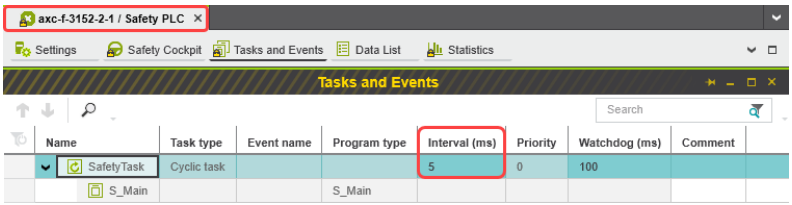
   – Internal SPLC 1000 runtime:

     The internal runtime of the SPLC 1000, which is to be taken into consideration in the “Bus” value, is equivalent to one SPLC 1000 cycle (T_{ZSPLC}).

     The cycle time of the SPLC 1000 can be set in PLCnext Engineer between 5 ms and 15 ms.

     Default setting (see Figure 3-10): T_{ZSPLC} = 5 ms

Figure 3-10 “Tasks and Events” editor in the editor group“ / Safety PLC”: Cycle time setting T_{ZSPLC} in ms

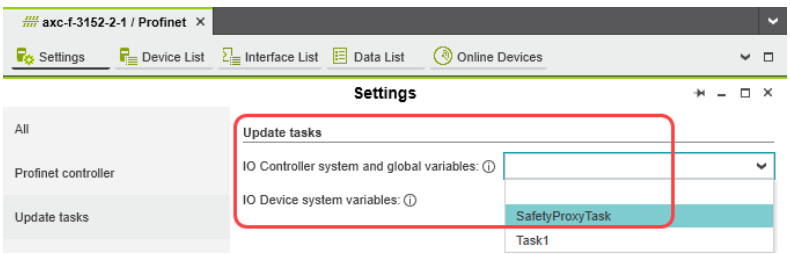


   – Internal update time $T_{UPD\ AXIO\ PLCnext}$:

     The update time ($T_{UPD\ AXIO\ PLCnext}$) between the Axioline F local bus cycle and the PLCnext firmware, which is to be taken into consideration in the “Bus” value, depends on the setting for “Update tasks, IO controller system and global variables” (see Figure 3-11). For the selected “SafetyProxyTask” setting, the following applies:

     $T_{UPD\ AXIO\ PLCnext} = T_{ZSPLC}$

Figure 3-11 “Settings” editor of the PROFINET editor group of the AXC F 3152; Update tasks for IO controller system variables and global variables: SafetyProxyTask



HAT The cycle time of the SPLC 1000 (T_{ZSPLC}) can be estimated during the system/machine planning phase.

Procedure for estimating the cycle time T_{ZSPLC}

Proceed as described in the following steps to estimate the cycle time T_{ZSPLC}:

- First, estimate the Program runtime.

When using the SPLC 1000, the program runtime depends on an idle component as well as the number of F-Devices used in the application and the number of safety-related function-block instances used.

Program runtime $_{Idle}$

First, the program runtime for an “empty” safety-related program (number of safety-related function-block instances = 0) is considered.

The relationship for this is:

$$\text{Program runtime}_{Idle} = 1\ \text{ms} + \frac{70}{1000}\ \text{ms} * n$$

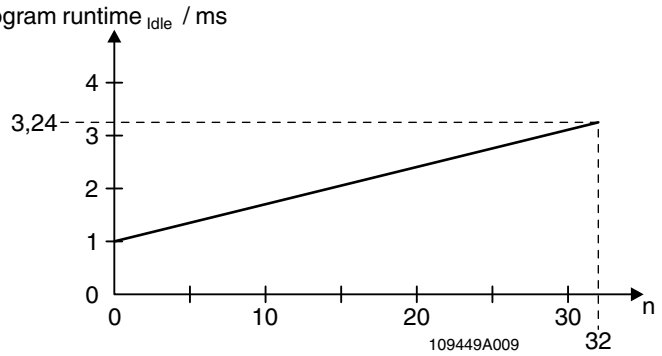
With n = 0 F-Devices, this results in:

Program runtime $_{Idle}$ = 1 ms

With each F-Device used, the Program runtime$_{Idle}$ is extended by 70 µs.

The following Figure 3-12 shows the dependency of the Program runtime$_{Idle}$ on the number n of F-Devices used in the application:

Figure 3-12 Program runtime$_{Idle}$ in relation to the number of F-Devices used



Key:

n: Number of F-Devices used in the application

Program runtime

In addition to the dependency of the program runtime on the number of F-Devices used in the application described above, there is an additional dependency. The program runtime also depends on the number of safety-related function-block instances (parameter a) used in the safety-related program.

With each safety-related function-block instance used in the safety-related program, the program runtime is extended on average by 20 µs.

As a result, the following applies:

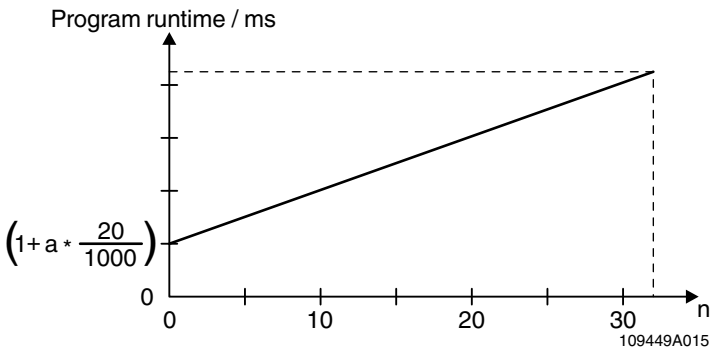
$$\text{Program runtime} = \text{Program runtime}_{\text{Idle}} + a * \frac{20}{1000}\ \text{ms}$$

$$= 1\ \text{ms} + \frac{70}{1000}\ \text{ms} * n + a * \frac{20}{1000}\ \text{ms}$$

$$= \left(1 + a * \frac{20}{1000}\right)\text{ms} + \frac{70}{1000}\ \text{ms} * n$$

This results in the following progression of the program runtime:

Figure 3-13 SPLC 1000 program runtime



Key:

a: Number of safety-related function-block instances used in the safety-related program

n: Number of F-Devices used in the application

The value of the SPLC 1000 program runtime determined approximately in the planning phase must comply with the following ratio to the cycle time of the SPLC 1000 T_{ZSPLC} because the CPU utilization of the SPLC 1000 must not exceed 70%. Otherwise, the SPLC 1000 issues a warning message.

$$\Rightarrow \quad \frac{\text{Program runtime}}{\text{Cycle time}} \leq 0.7$$

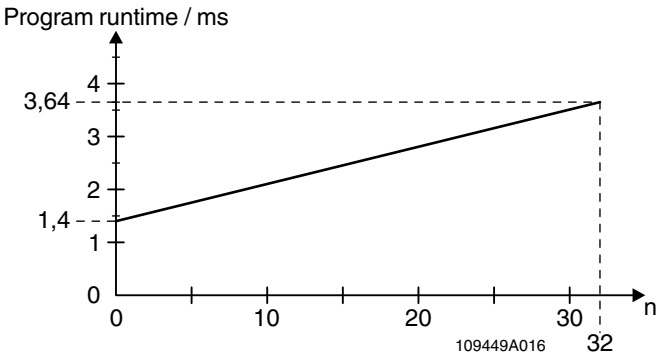
This results in the SPLC 1000 cycle time T_{ZSPLC} to be set by the user in accordance with the formula determined in the planning phase:

$$\Rightarrow \quad \text{Cycle time } T_{ZSPLC} \geq \frac{\text{Program runtime}}{0.7}$$

Example calculation

This example results in the following progression of the program runtime for a number of 0 to a maximum of 32 F-Devices and a number of 20 safety-related function blocks (a = 20):

Figure 3-14 SPLC 1000 program runtime in the example



Continuing with a = 20 and the maximum 32 F-Devices, the program runtime is:

$$\text{Program runtime} = \left(1 + 20 * \frac{20}{1000}\right) \text{ms} + \frac{70}{1000} \text{ms} * 32$$

$$= 3.64 \text{ ms}$$

With the above equation for the cycle time, the following results:

$$\Rightarrow \quad \text{Cycle time } T_{ZSPLC} \geq \frac{3.64 \text{ ms}}{0.7}$$

$$\Rightarrow \quad \text{Cycle time } T_{ZSPLC} \geq 5.2 \text{ ms}$$

In this example, the user is to set a cycle time of 6 ms.

Verification necessary!

Verify the times determined above during the commissioning phase as follows online.

NOTE: Online verification during the commissioning phase necessary
During the commissioning phase, the values determined offline during the planning phase are to be verified online by the user.

- During the commissioning phase, verify the values determined offline in the planning phase for the program runtime and the cycle time online in PLCnext Engineer.

For verification, use two system variables shown in the PLCnext Engineer software.

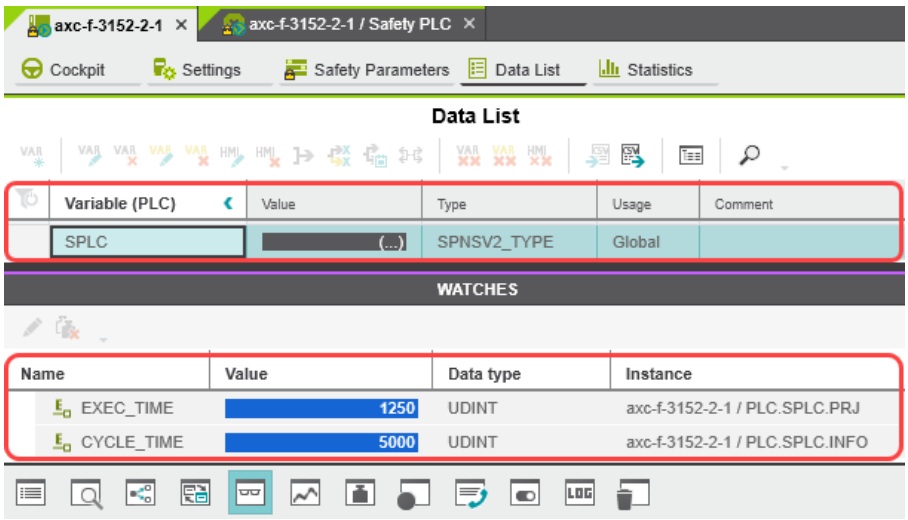
If the PLCnext Engineer software is connected online with the SPLC 1000 and the PLCnext Control device, you can display the cycle time and the program runtime of the SPLC 1000 in the software (see Figure 3-15) with the following two system variables (see Section “SPLC system variable” on page 143):

– Cycle time: CYCLE_TIME
– Program runtime: EXEC_TIME

$$\Rightarrow \quad \frac{\text{Program runtime (EXEC\_TIME)}}{\text{Cycle time (CYCLE\_TIME)}} \leq 0.7$$

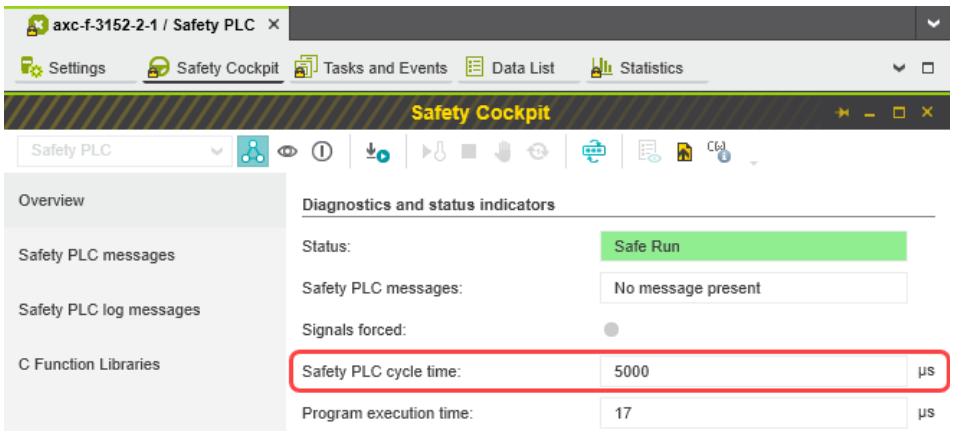
To learn how you can access the SPLC 1000 online with the PLCnext Engineer software, refer to sections “Transferring projects to PLCnext Control and SPLC 1000” on page 119 and Section “SPLC system variable” on page 143 as well as to the software online help function.

Figure 3-15 Online values of the SPLC 1000 cycle time and program runtime



The SPLC 1000 cycle time is also displayed in the “Safety Cockpit” editor:

Figure 3-16 PLCnext Engineer: “Safety PLC cycle time”



Based on the actual determined value of the SPLC 1000 cycle time, it may be necessary to adjust the F_WD_Time in order to increase system availability, for example.

WARNING: Avoid possible danger that may be caused by the safety function being triggered too late

Make sure that the maximum permissible values for F_WD_TIME IN_{max} and F_WD_TIME OUT_{max} are not exceeded (see Section “Determining $SFRT_{max}$ and F_WD_Time IN_{max}/ F_WD_Time OUT_{max}” on page 39).

The minimum F_WD_Time that can be set can be determined for each communication relationship using the following equation:

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times Bus + HAT} \quad \textbf{[3]}$$

For further calculation, a distinction will be made between the following two cases.

Communication between F-Host and F-Device via PROFINET

1. The F-Host of the SPLC 1000 communicates with an F-Device via PROFINET.
   In this case, the F-Device is connected, for example, via a PROFINET bus coupler with the PLCnext Control device used (here, AXC F 3152) to which the SPLC 1000 is left-aligned.
   Since the SPLC 1000 cycle and the PROFINET cycle run asynchronously with one another, the SPLC 1000 cycle must be included twice in the total when determining the minimum F_WD_Time, once as the “HAT” and again as the “internal bus runtime”. The external bus runtime is based on the relevant times of the PROFINET configuration.

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times (external\ bus\ runtime + internal\ bus\ runtime) + HAT}$$

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times (external\ bus\ runtime + T_{ZSPLC}) + T_{ZSPLC}}$$

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times external\ bus\ runtime + 3 \times T_{ZSPLC}} \quad \textbf{[4]}$$

Communication between F-Host and F-Device via the Axioline F local bus

2. The F-Host of the SPLC 1000 communicates with an F-Device via the Axioline F local bus.
   In this case, the F-Device is aligned to the right of the PLCnext Control device used (here, AXC F 3152). Via the Axioline F local bus, the F-Device is connected directly to the PLCnext Control device to which the SPLC 1000 is left-aligned.
   In this case, the internal bus runtime is the sum of the internal update time $T_{UPD\ AXIO\ PLCnext}$ (see point “Internal update time $T_{UPD\ AXIO\ PLCnext}$:” on page 44) and T_{ZSPLC}. As in the first case, HAT equals T_{ZSPLC}.

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times (internal\ bus\ runtime) + HAT}$$

$$\mathbf{F\_WD\_Time_{min} > DAT + 2 \times (T_{UPD\ AXIO\ PLCnext} + T_{ZSPLC}) + T_{ZSPLC}}$$

With $T_{UPD\ AXIO\ PLCnext} = T_{ZSPLC}$, the following applies (see point “Internal update time $T_{UPD\ AXIO\ PLCnext}$:” on page 44):

$$\mathbf{F\_WD\_Time_{min} > DAT + 5 \times T_{ZSPLC}} \quad \textbf{[5]}$$

Calculation for the example configuration

For the example configuration in Section “The SPLC 1000 as the F-Host with safety-related communication via PROFINET/PROFIsafe” on page 82 considered here, the following calculated minimum F_WD_Time OUT for communication with the F-Device AXL F PSDO8/3 1F results from the equation [4] from the above case 1 and taking the following values into account:

T_{ZSPLC}	=	5 ms	Cycle time of the safety-related controller (here: SPLC 1000, see Figure 3-15)
T_{ZPNIO}	=	8 ms x 3	Monitor time: PROFINET update time x monitor factor (see Figure 3-9 on page 43).
$T_{D\ AXL\ F\ BK\ PN\ TPS}$	=	1 ms	Update rate of the AXL F BK PN TPS PROFINET bus coupler.

$T_{Z\ AXL\ LB}$	=	10 µs	Update rate of the Axioline F local bus with one device
			Due to the low value this time is negligibly small in the following calculation for the given example. For larger local bus configurations, consider corresponding times in the calculation.
DAT_{PSDO}	=	1.5 ms	Processing time of the AXL F PSDO8/3 1F

$T_{Bus} = T_{ZPNIO} + 1 \times T_{D\ AXL\ F\ BK\ PN\ TPS} + 2 \times T_{Z\ AXL\ LB}$

$T_{Bus} = 24 + 1 \times 1\ ms + 2 \times 0\ ms$

$T_{Bus} = 25\ ms$

The F_WD_Time OUT for available and robust system behavior with the specified PROFINET settings results as follows for the example configuration from the bus head (bus coupler AXL F BK PN TPS) and the Axioline F output module (AXL F PSDO8/3 1F). The values listed and calculated above must be used in the following equation based on [4].

$F\_WD\_Time\ OUT_{min} = DAT + 2 \times external\ bus\ runtime + 3 \times T_{ZSPLC}$

$F\_WD\_Time\ OUT_{min} = 1.5\ ms + 2 \times 25\ ms + 3 \times 5\ ms$

$F\_WD\_Time\ OUT_{min} = 66.5\ ms$

From this example it is clear that the bus cycle and transfer times, and in particular here the PROFINET update time as well as the monitor time, are the values that determine the minimum achievable F_WD_Time. In particular, the monitor factor (multiplier of the update time for aborting the connection if no data is exchanged) acts as the cut-off between availability/robustness and the minimum achievable SFRT in the overall system.

If the PROFINET update time is maintained at 1 ms via “Reduction ratio (= 1)” and the monitor factor is maintained at 3, the minimum achievable F_WD_Time OUT in the example is calculated as follows:

$T_{Bus} = T_{ZPNIO} + 1 \times T_{D\ AXL\ F\ BK\ PN\ TPS} + 2 \times T_{Z\ AXL\ LB}$

$T_{Bus} = 3\ ms + 1 \times 1\ ms + 2 \times 0\ ms$

$T_{Bus} = 4\ ms$

The minimum F_WD_Time OUT is calculated as follows for the example configuration:

$F\_WD\_Time\ OUT_{min} = 1.5\ ms + 2 \times 4\ ms + 3 \times 5\ ms$

$F\_WD\_Time\ OUT_{min} = 24.5\ ms$

3.3.3 Determining F_WD_Time IN/F_WD_Time OUT to be parameterized and checking/validating that the safety function can be implemented

Having calculated the upper and lower limits of the F_WD_Time IN/F_WD_Time OUT as described in the two previous sections, you now need to determine the F_WD_Time IN/F_WD_Time OUT watchdog times that are to be parameterized within these limits for the safety function that is to be implemented. You then need to check/validate that the required safety function can be implemented using the determined values.

The values are essentially determined as follows:

$$(\text{F\_WD\_Time IN}_{min} + \text{F\_WD\_Time OUT}_{min}) < (\text{F\_WD\_Time IN} + \text{F\_WD\_Time OUT}) < (\text{F\_WD\_Time IN}_{max} + \text{F\_WD\_Time OUT}_{max})$$

The relationship between the values for F_WD_Time IN and F_WD_Time OUT is based on the relationship for the minimum F_WD_Time and the system availability determined in Section 3.3.2 on page 42.

Example

Based on the maximum possible safety function response time, the following requirement must be met:

$\text{F\_WD\_Time IN}_{max} + \text{F\_WD\_Time OUT}_{max} = 200$ ms	(Upper limit from the safety function)
$\text{F\_WD\_Time OUT}_{min} = 24.5$ ms	(From the example in Section 3.3.2)
$\text{F\_WD\_Time IN}_{min} = 50$ ms	(Assumed for the example calculation)

The watchdog times to be parameterized are chosen as follows in the example:

F_WD_Time OUT ≈ 2 x 24.5 ms ⇒ F_WD_Time OUT = 50 ms

F_WD_Time IN = 2 x 50 ms = 100 ms

Factor 2 has been chosen here so that it is still possible to later increase the PROFINET repeat cycles by the monitor factor or the PROFINET update time without endangering system availability by exceeding the F_WD_Time monitoring time.

As a result, the values selected in the example project (see Figure 6-27 on page 105) described in Section 6.4.2.1 are within the permissible range:

Minimum F_WD_Time (IN+OUT) < F_WD_Time (IN+OUT) to be parameterized < Maximum F_WD_Time (IN+OUT)

(50 + 24.5) ms < (100 + 50) ms < 200 ms

⇒ Sum of the watchdog times is less than 200 ms.

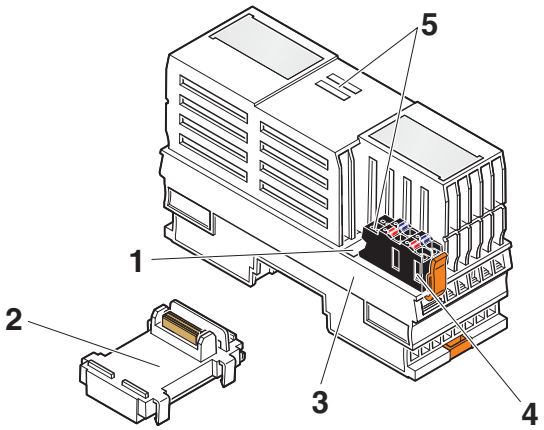
3.4 Possible fields of application of the SPLC 1000

Information on the possible fields of application for the SPLC 1000 is available in Sections “Example: The SPLC 1000 as the F-Host for Axioline F and Axioline Smart Elements F-Devices” on page 80 and “Further example configurations” on page 82.

3.5 SPLC 1000 components

3.5.1 Connection and operating elements

Figure 3-17 SPLC 1000 connection and operating elements



Key:

1 Function identification

2 AXL F BS BK XT bus base module (item no.: 1141222)

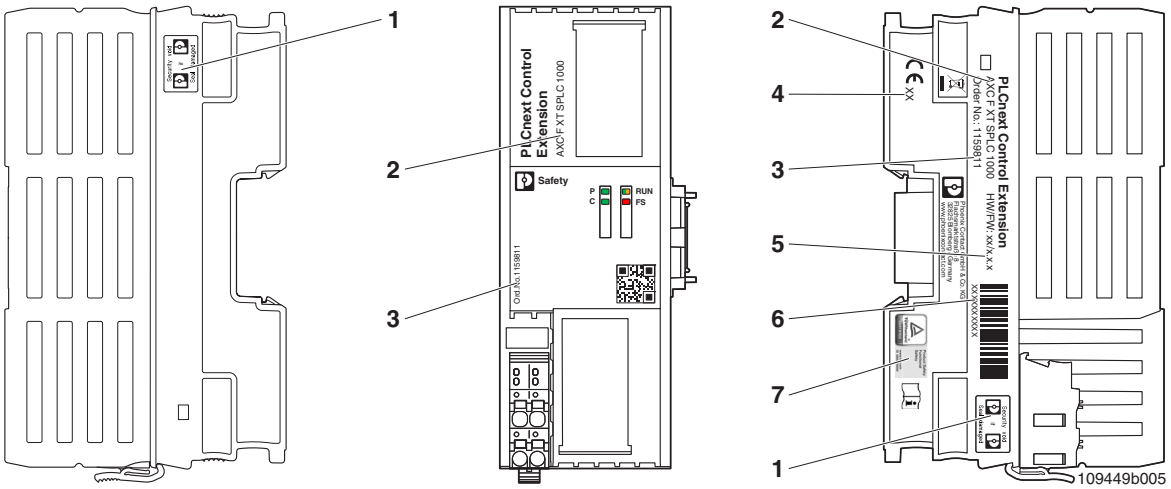
3 Electronics module

4 Supply connector (connector for connecting the supply voltage (communications voltage U_L, 24 V DC))

5 Diagnostic and status indicators

3.5.2 SPLC 1000 printing and test mark, and security seal

Figure 3-18 SPLC 1000 printing, security seal and test mark



Key:

1 Security-Siegel
2 Item designation
3 Item number
4 Year of manufacture
5 Revision versions (HW/FW)
6 Serial number
7 Test mark

Security seal

NOTE: Tampering with the device by unauthorized opening of the housing
To detect unauthorized opening of the housing and to prevent tampering with the device, two security seals are attached to the housing of the device.

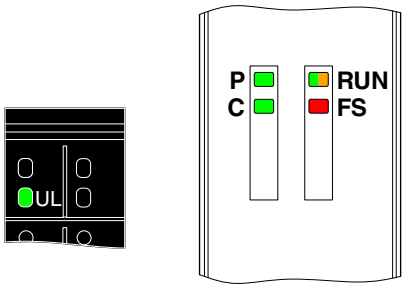
- Check if both security seals are in place and undamaged.
- Do not continue to use devices with damaged security seals.

3.6 Diagnostic and status indicators

The diagnostic and status indicators are used for quick local error diagnostics.

3.7 Arrangement of the LEDs

Figure 3-19 Diagnostic and status indicators



3.8 States of the safety-related communication

Table 3-1 Diagnostic and status indicators

Designation	Color	Meaning	Status	Description
P	–	The state of the safety-related communication relationship between the SPLC 1000 (F-Device) and a higher-level safety-related controller (F-Host).	Off	The safety-related communication relationship to the higher-level safety-related controller has not been initialized.
	Green		Flashing (1 Hz)	The safety-related communication relationship between the F-Device of the SPLC 1000 and the higher-level safety-related controller (F-Host) was interrupted due to a previous communication error. Safety-related communication between the F-Host and F-Device has been restored. However, safety-related process data is not exchanged because the F-Device of the SPLC 1000 was passivated. In order to continue the exchange of safety-related process data, an operator acknowledge request generated by the F-Device must be acknowledged. The F_ADDR_[nnnnn]_ACK_REQ management/ diagnostic variable set to TRUE displays the operator acknowledge request. The user acknowledges the operator acknowledge request by means of a deliberate operator acknowledge reintegration of the SPLC 1000 F-Device in the safety-related application program of the higher-level safety-related controller (F-Host). For this, the user sets the F_ADDR_[nnnnn]_ ACK_REl management/diagnostic variable to TRUE.
			On	The safety-related communication relationship to the higher-level safety-related controller has been initialized and established without errors.
C	–	State of the safety-related communication relationship between the SPLC 1000 (F-Host) and configured lower-level F-Devices.	Off	At least one configured safety-related communication relationship to a lower-level F-Device has not yet started or has been interrupted.
	Green		Flashing (1 Hz)	A communication error that must be acknowledged is still present for at least one safety-related communication relationship to a lower-level F-Device.
			On	All safety-related communication relationships to configured lower-level F-Devices have been initialized and established without errors. Safety-related process data will be transmitted.

3.9 Diagnostic states of the SPLC 1000

Table 3-2 Diagnostic and status indicators

Designation	Color	Meaning	Status	Description
RUN	–	SPLC 1000 operating state	Off	The SPLC 1000 is not ready for operation (power off) or has not been initialized.
	Green		Flashing (1 Hz)	The SPLC 1000 is in the SAFE STOP state. The SPLC 1000 initialization phase is running.
	Green/ orange		Flashing (1 Hz)	The SPLC 1000 is currently loading the project data from the SD card inserted in the PLCnext Control device to its internal memory.
	Green/ orange		Flashing (2 Hz)	The SPLC 1000 is in the DOWNLOAD state. The PLCnext Engineer software is transferring a project to the SPLC 1000.
	Orange		Flashing (1 Hz)	The SPLC 1000 is in the DEBUG STOP state.
	Orange		Flashing (2 Hz)	The SPLC 1000 is in the DEBUG HALT state
	Orange		On	The SPLC 1000 is in the DEBUG RUN state.
	Green		On	The SPLC 1000 is in the SAFE RUN state. The safety-related application program is being executed.

Table 3-2 Diagnostic and status indicators

Designation	Color	Meaning	Status	Description
FS	–	Failure State: Safe state of the SPLC 1000	Off	Error-free operating state of the SPLC 1000 with supply voltage present. A Failure State is not present.
	Red		Flashing (1 Hz)	The SPLC 1000 is in the Failure State due to a configuration error in the PLCnext Engineer software. The SPLC 1000 has switched to the safe state (Failure State). The SPLC 1000 can be accessed from PLCnext Engineer online. Remedy the error and perform a project download: • Remedy the configuration error in PLCnext Engineer. • Download the non-safety-related project to the PLCnext Control device used. • Download the safety-related project to the SPLC 1000.
			On	A critical error in the SPLC 1000 hardware has occurred and been detected. The SPLC 1000 has switched to the safe state (Failure State). Perform a voltage reset: • Switch off the supply voltage of the SPLC 1000 and the PLCnext Control device for at least 30 seconds and then switch it back on again (Power UP). Or restart the standard controller (PLCnext Control) in the PLCnext Engineer software: • Click on the “Reboot the controller” button in the PLCnext Control “Cockpit” editor.

3.10 State of the supply voltage

Table 3-3 Diagnostic and status indicators

Designation	Color	Meaning	Status	Description
UL	–	Supply voltage U_{Logic} (communications voltage U_L)	Off	24 V communications voltage feed-in not present or too low.
	Green		On	24 V communications voltage feed-in present.

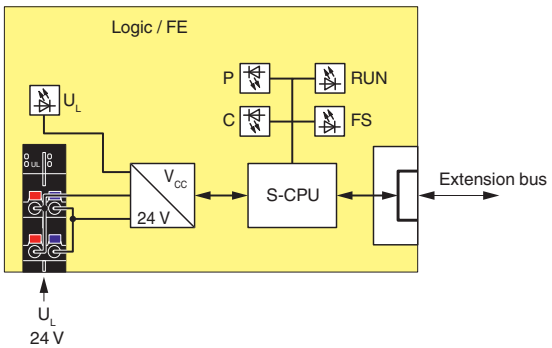
WARNING: Avoid possible danger – outputs can be set

- Take appropriate measures to ensure that your system/machine does not present any danger.

Variables can be overwritten in the DEBUG RUN state. These are then also transmitted to the PROFIsafe output devices and output.

3.11 Internal basic circuit diagram

Figure 3-20 Internal basic circuit diagram SPLC 1000



Key:

	LED	V_{CC} 24 V	Power supply unit
S-CPU	Safety-related processor	Extension bus	Left-aligned “PLCnext Control Extension” extension modules

4 Mounting hardware

For basic information on the Axioline F system and its installation, particularly mounting/removing Axioline F modules, please refer to the UM EN AXL F SYS INST user manual (“Axioline F: System and installation”).

4.1 Safety notes

NOTE: Electrostatic discharge

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1.

NOTE: Damage to electronics due to inadequate external protection – no safe fuse tripping in the event of a fault

The electronics in the device will be damaged if external fuse protection is inadequate.

- Protect the supply voltage externally in accordance with the connected load (number of Axioline F devices/amount of logic current consumption for each device).
- Ensure that the external fuse trips reliably in the event of a fault.

NOTE: Electronics may be damaged when overloaded

- Provide external fuses for the 24 V U_L area. If you are using an external fuse, the power supply unit must be able to supply four times the nominal current of the fuse. This ensures that it trips in the event of an error.

Please note:

During any work on the Axioline F station, the SPLC 1000, the PLCnext Control device, or a module, switch off the power supply to the Axioline F station and make sure the supply voltage is protected against unauthorized reactivation.

The SPLC 1000 is automatically grounded (FE) when it is snapped onto a grounded DIN rail.

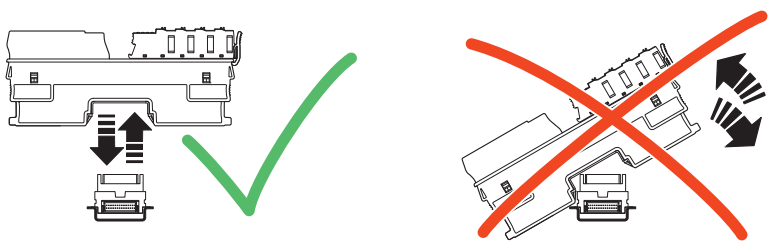
On the rear of the SPLC 1000, there are two FE springs that make contact with the DIN rail when the SPLC 1000 is placed on the DIN rail.

NOTE: Damage to the contacts when tilting

Tilting the modules can damage the contacts.

- Place the modules onto the DIN rail **vertically**.

Figure 4-1 Placing the module **vertically**



4.2 Basic information

Mounting location

The SPLC 1000 meets the IP20 degree of protection.

- It is imperative that you mount the SPLC 1000 in a lockable housing or in a lockable control cabinet with at least IP54 degree of protection.

NOTE: Unauthorized physical access
There is a danger of the device being tampered with through unauthorized physical access.

- Protect the SPLC 1000 and the modules connected to it against unauthorized physical access. Use a lockable control cabinet, for example.

Mounting/DIN rail

The SPLC 1000 is mounted on a 35 mm standard DIN rail without any tools using the bus base module. It is mounted perpendicular to the DIN rail.
The local bus is created automatically when the bus base modules of the PLCnext Control device and the Axioline F device are aligned next to one another.
The extension bus is created automatically when the bus base modules of the SPLC 1000 and PLCnext Control device are aligned next to one another.

The minimum distance to other devices is 100 mm above/below.

Observe the notes on securing the DIN rail and fastening elements as well as the notes on mounting distances in the UM EN AXL F SYS INST user manual.

Supply connector

The SPLC 1000 has a supply connector for connecting the power supply. The connector is fitted with spring-cage terminal blocks. When using suitable conductors, the conductors can be connected by means of direct connection technology (Push-in technology).

For additional information, please refer to Section 5.2.

FE connection

There are two FE springs (metal contacts) on the bottom of the SPLC 1000 which establish the connection to functional ground when the device is snapped onto a grounded DIN rail.

End brackets

Mount end brackets on both sides of the Axioline F station. The end brackets ensure that the Axioline F station is correctly mounted. End brackets secure the station on both sides and keep it from moving from side to side on the DIN rail. Phoenix Contact recommends the following end brackets:

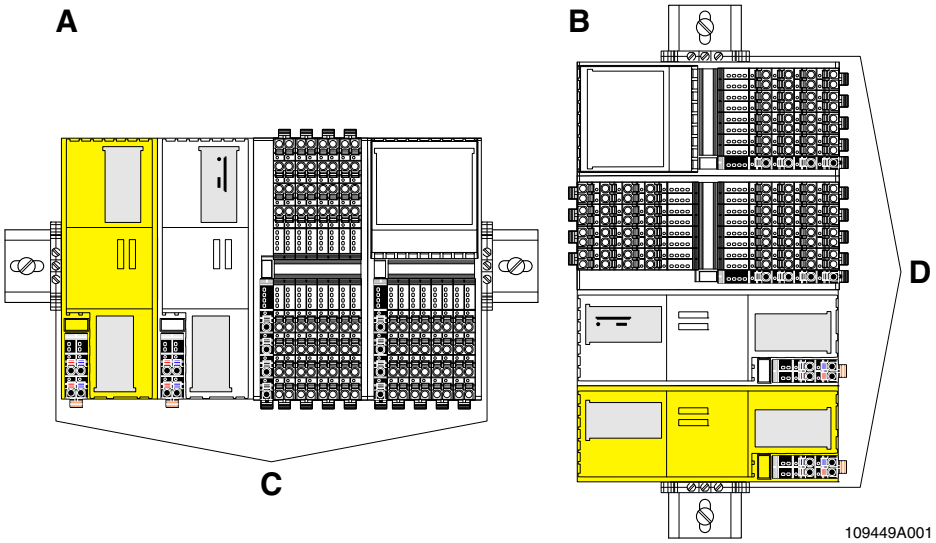
Table 4-1 Recommended end brackets

Mounting position	Ambient conditions	End brackets
Horizontal; A in Figure 4-2 on page 61:	Normal	CLIPFIX 35, CLIPFIX 35-5
	High shock and vibration load	E/AL-NS 35
Other; B in Figure 4-2 on page 61	Normal	E/AL-NS 35
	High shock and vibration load	

Mounting position

As standard, mount the SPLC 1000 in a horizontal position (A in Figure 4-2) on the DIN rail provided for that purpose.

Figure 4-2 Mounting positions for the AXC F XT SPLC 1000 in an Axioline F station



Key:

A Horizontal mounting position

B Vertical mounting position

C End brackets: CLIPFIX 35, CLIPFIX 35-5, E/AL-NS 35

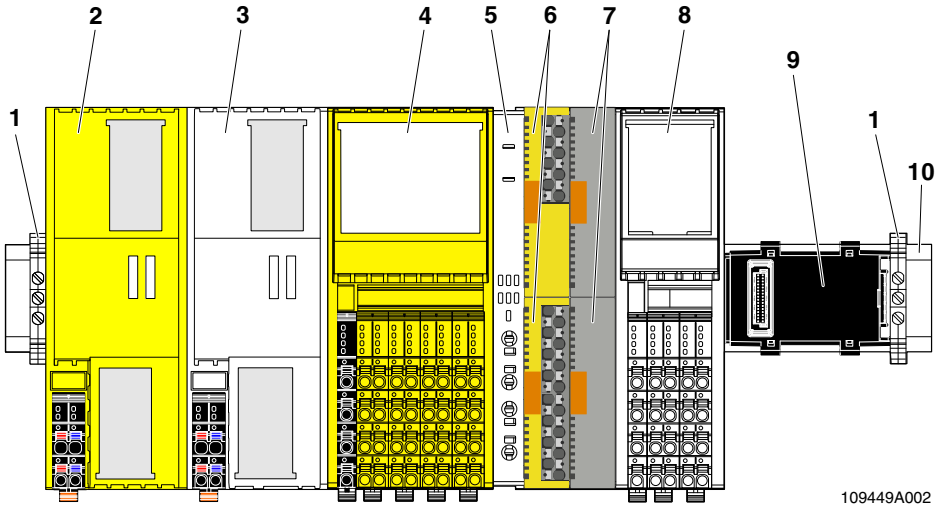
D End brackets: E/AL-NS 35

Other mounting positions are possible. In this case, temperature derating may be required. Note the ambient temperatures and any other special features (e.g., derating) specified in the device/module-specific documentation for the Axioline F devices.

4.3 Structure of an Axioline F station

Figure 4-3 shows an example structure of an Axioline F station with the SPLC 1000:

Figure 4-3 Example: Structure of an Axioline F station with left-aligned safety-related AXC F XT SPLC 1000 controller



Key:

1 End brackets (for securing the station; see Section “Accessories” on page 176)

2 Left-alignable safety-related AXC F XT SPLC 1000 controller

3 PLCnext Control

4 Safety-related Axioline F I/O module

5 Axioline F backplane (AXL F BP SE4) for Axioline Smart Elements

6 Safety-related Axioline Smart Elements I/O modules

7 Slot covers for unused Axioline Smart Elements slots

8 Axioline F I/O module

9 Bus base module

10 DIN rail

An Axioline F station is set up by mounting the individual components side by side. No tools are required. Mounting the components side by side automatically creates potential and bus signal connections between the individual components of the Axioline F station.

Left alignment of the AXC F XT SPLC 1000

You can align the AXC F XT SPLC 1000 as a “PLCnext Control Extension” extension module to the left of the PLCnext Control AXC F 2152 and AXC F 3152.

Observe the information on the left alignment of extension modules in the UM EN AXC F X152 user manual, in particular also on the useable bus base modules.

4.4 Mounting the SPLC 1000

- Disconnect the Axioline F station from the power supply.

Before mounting the SPLC 1000, note the following:

- Remove the PLCnext Control AXC F 2152 or AXC F 3152 used.
- If necessary, remove the supply connector of the PLCnext Control.
- Remove any further electronics modules, if necessary, and remount them later.
- Remove any bus base modules, if necessary, and remount them later.
- Follow the descriptions listed in this section.

Please note:

- Mount all necessary modules **before** supplying power to the Axioline F station.

  Modules to which power is only supplied following the PLCnext Control boot process are not detected or may result in a malfunction.
- To ensure that the left-alignable SPLC 1000 is detected correctly, follow the specifications of the voltage supply for the SPLC 1000 (see Section 5.2.2).

WARNING: Unintentional machine startup
If you mount the controller while the power is connected, this could result in unintentional machine startup and possibly cause personal injuries..

- Do not assemble or remove the device while the power is connected.
- Before mounting or removing, disconnect the power to the device and the entire Axioline F station and ensure that it cannot be switched on again.
- Make sure the entire system is fully remounted before switching the power back on. Observe the diagnostics indicators and any diagnostic messages.
- Make sure that the machine/system is only started when neither the Axioline F station nor the machine/system pose a hazard.

Safety notes for starting applications

- Take the following into consideration when determining and programming the start conditions for your machine or system:
  - The machine or system may only be started if it can be ensured that nobody is present in the danger zone.
  - Meet the requirements of EN ISO 13849-1 with regard to the manual reset function. The machine must not be set in motion and/or a hazardous situation must not be triggered by the following actions, for example:
    - Switching on safe devices
    - Acknowledging device error messages
    - Acknowledging communication errors
    - Acknowledging block error messages in the application
    - Removing startup inhibits for safety functions
- Observe the following when programming/configuring the safety logic:
  - Switching from the safe state (substitute value = 0) to the operating state can generate an edge change (zero/one edge).
  - In the safety logic, take measures to prevent this edge change resulting in unexpected machine/system startup or restart.

Note for starting applications

- Also observe these notes to prevent unexpected machine startup after confirming an “Operator Acknowledgement”.

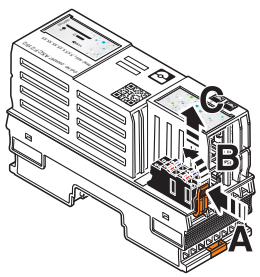
4.4.1 Removing the PLCnext Control supply connector

Please note:

- Before mounting the SPLC 1000, first remove the PLCnext Control device.

- Release the locking latch (A), tilt the supply connector upwards slightly (B), and remove it from the PLCnext Control (C).

Figure 4-4 Removing the supply plug



4.4.2 Removing other connectors from the PLCnext Control

- Remove all other connectors from the PLCnext Control (e.g., Ethernet cable).

4.4.3 Unlatching electronics modules

Before the SPLC 1000 can be aligned to the PLCnext Control device, you must remove the PLCnext Control electronics module.

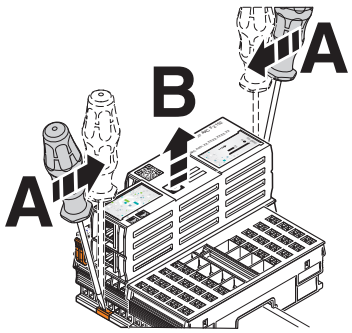
To unlatch the PLCnext Control device, proceed as follows:

- Remove the left end bracket on the Axioline F station, if applicable.
- Insert a suitable tool (e.g., a flat-bladed screwdriver) in the upper and lower snap-in mechanism (base latches) of the PLCnext Control/module one after the other and unlatch it (A).

The base latches are locked in place in the open position.

- Pull the electronics module straight back from the DIN rail (B).

Figure 4-5 Remove electronics module



4.4.4 Mounting the bus base modules

Please note:
To operate the SPLC 1000 on a PLCnext Control AXC F 2152, this requires a special bus base module (1 in Figure 4-8 on page 67).

The bus base module is not supplied with the AXC F 2152. For the ordering data, please refer to the UM EN AXC F X152 user manual.

- Before snapping on or off a bus base module, make sure that there is no electronics module on the adjacent bus base module on the left or right.
- For the left alignment of a further module (AXC F XT ...), first remove the cover cap of the adjacent bus base module on the right (A in Figure 4-8 on page 67).
- Read further information on mounting the bus base and electronics modules and in particular on the left alignment of the controller of the PLCnext Control product group in the UM EN AXL F SYS INST user manual.

AXC F 2152

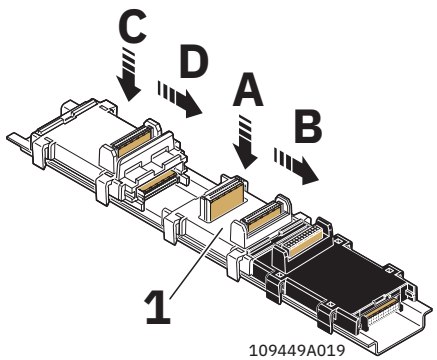
When using the AXC F 2152, replace the existing bus base module with the special bus base module (1 in Figure 4-6) for operating the SPLC 1000 on a PLCnext Control AXC F 2152 (scope of supply of the AXC F 2152: see UM EN AXC F X152 user manual).

To do so, proceed as follows:

- Remove the bus base module of the AXC F 2152 from the bus base module of the first adjacent module on the right.
- Remove the AXC F 2152 bus base module from the DIN rail.

When mounting the bus base modules, proceed as illustrated in Figure 4-6:

Figure 4-6 Mounting bus base module(s): AXC F 2152



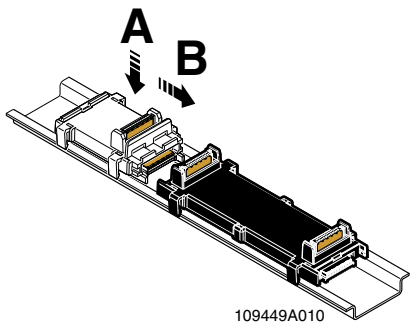
- Place the special bus base module for the AXC F 2152 on the DIN rail (A in Figure 4-6).
- Push the special bus base module of the AXC F 2152 into the connection for the bus base module of the adjacent module on the right (B in Figure 4-6).
- Place the bus base module for the SPLC 1000 on the DIN rail (C in Figure 4-6).
- Push the bus base module for the SPLC 1000 into the connection of the special bus base module for the AXC F 2152 (D in Figure 4-6).

AXC F 3152

When using the AXC F 3152, you do not need to replace the bus base module.

For mounting the bus base module for the SPLC 1000, proceed as illustrated in Figure 4-7:

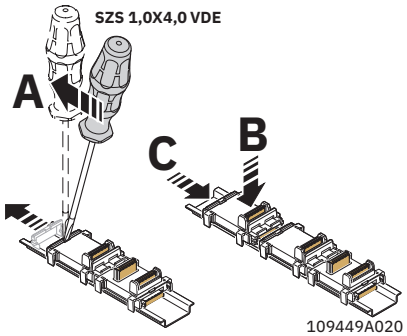
Figure 4-7 Mounting bus base module(s): AXC F 3152



- Remove the cover cap of the bus base module for the AXC F 3152 (A in Figure 4-8).
- Place the bus base module for the SPLC 1000 on the DIN rail (A in Figure 4-7).
- Push the bus base module for the SPLC 1000 into the connection of the bus base module for the AXC F 3152 (B in Figure 4-7).

Aligning additional AXC F XT ... modules on the left (in preparation):

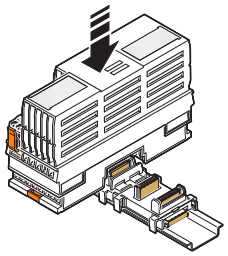
Figure 4-8 Mounting the bus base modules of further AXC F XT ... modules



- Remove the cover cap of the preceding bus base module (A in Figure 4-8).
- Place the bus base modules of the additional AXC F XT ... modules to be aligned on the left on the DIN rail (B in Figure 4-8).
- Push each subsequent bus base module into the connection of the previous bus base module (C in Figure 4-8).

4.4.5 Snapping on electronics modules

Figure 4-9 Snapping on electronics modules



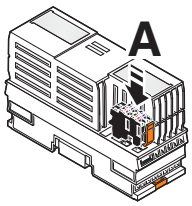
- Working from left to right, place each electronics module vertically on the corresponding bus base module and on the DIN rail until it snaps into place with a click. Make sure that the device plug for the bus base connection is situated above the corresponding socket on the bus base module.

4.4.6 Connecting connectors to the PLCnext Control device

- If you previously removed any connectors, for example an Ethernet cable, from the PLCnext Control device, reconnect these.

4.4.7 Connecting the supply connector

Figure 4-10 Connecting the supply connector



- Place all supply connectors in position and press them down firmly. Make sure that the respective locking latch snaps into place.
- Mount the left end bracket on the Axioline F station.

5 Connecting and wiring the hardware

5.1 Sizing of the power supply

Supply the SPLC 1000 using external 24 V DC voltage sources. The permissible voltage range is 19.2 V DC to 30 V DC (ripple included).

Only use power supplies that are suitable for operation with capacitive loads (increased inrush current).

- Select a power supply that is suitable for the currents in your application. The selection depends on the bus configuration and the resulting maximum currents.

WARNING: Loss of electrical safety and the safety function when using unsuitable power supplies

The SPLC 1000 is designed exclusively for protective extra-low voltage (PELV) operation in accordance with EN 60204-1.

- Only protective extra-low voltage in accordance with the defined standard may be used for the supply purposes.

The following applies to the network (PROFINET and Axioline F) and the I/O devices used in it:

- Only use power supplies that satisfy the requirements of EN 61204 and feature safe isolation with PELV in accordance with IEC 61010-2-201 (PELV). They prevent short circuits between the primary and secondary side.
- Observe the information in Section “Electrical safety” on page 19.

Please note:

When the SPLC 1000 is switched on, an increased inrush current is temporarily triggered. The SPLC 1000 behaves like a capacitive load when it is switched on.

- A **power supply without fall-back characteristic curve** must be used for correct operation of the SPLC 1000 (see Figure 5-2).
- Make sure the power supply and the externally required fuse are compatible. The power supply must be able to temporarily provide the tripping current. For specifications on the “Power supply”, please refer to Section “Technical data” as of page 180.

Some electronically controlled power supplies have a fall-back characteristic curve (see Figure 5-1). These are not suitable for operation with capacitive loads.

Figure 5-1 Overload range **with** fall-back characteristic curve

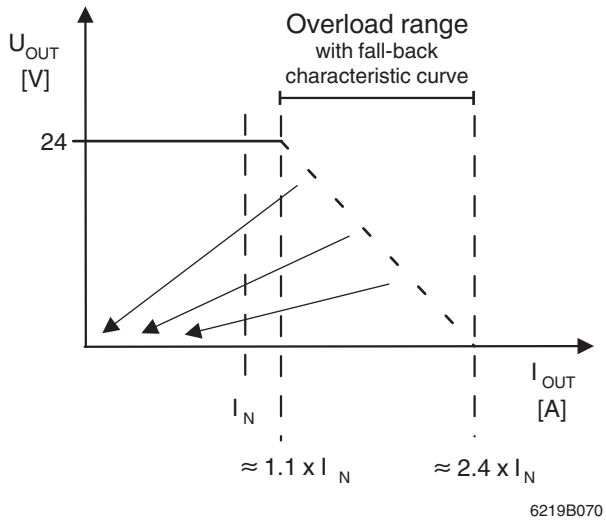
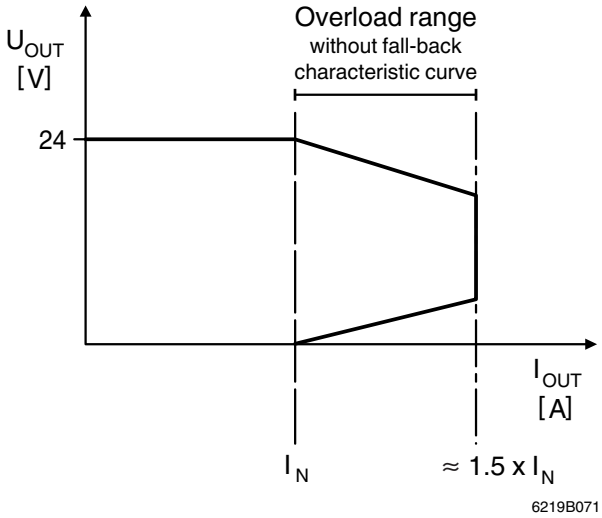


Figure 5-2 Overload range **without** fall-back characteristic curve



5.2 Supply voltage

5.2.1 DC distribution network according to IEC 61326-3-1

A DC distribution network is a DC power supply network which supplies a complete industrial hall with DC voltage and to which any device can be connected. A typical system or machine distribution is not a DC distribution network. For devices that are provided for a typical system or machine distribution, the DC connections are viewed and tested as I/O signals according to IEC 61326-3-1.

When using a AXC F XT SPLC 1000 in a DC distribution network, install appropriate surge protection (e.g., PT 2+1-S-48DC/FM, item no. 2817958) directly upstream of the device.

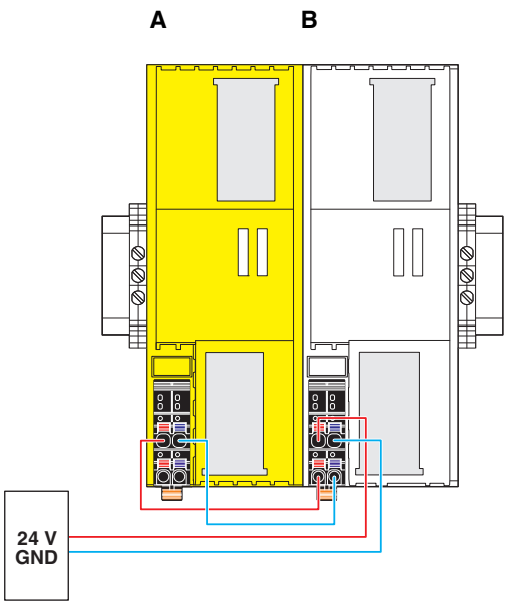
5.2.2 Connecting the supply voltage

Please note:
The supply voltage of the left-alignable SPLC 1000 and the PLCnext Control device used must be fed in via **a shared** power supply unit.

For further information on this, also read the information in the controller-specific UM EN AXC F X152 user manual.

- Connect the supply voltage via the Axioline F connector.

Figure 5-3 Connection of the supply voltage



Key:

A: AXC F XT SPLC 1000

B: AXC F 2152

5.2.3 Supply connector: terminal point assignment

Figure 5-4 Terminal points for the supply voltage (communications voltage U_L)

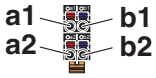


Table 5-1 Feed-in of the supply voltage

Terminal point	Color	Assignment
a1, a2	Red	24 V DC (U_L)
b1, b2	Blue	GND

Key:

U_L: Supply voltage feed-in (bridged internally)

GND: Supply voltage reference potential (bridged internally)

5.2.4 Supply connector: Assembling and connecting cables

Observe the notes in Section 5.2.3 when assembling the connector for the supply voltage.

- Strip 8 mm off the cable. If necessary, fit a ferrule to the cable.

When using ferrules:

- Use ferrules in accordance with the specifications in the UM EN AXL F SYS INST user manual.
- Make sure that the ferrules are crimped correctly.

Rigid conductor/ferrule

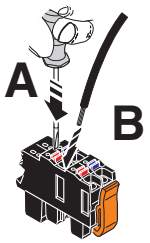
- Insert the conductor into the terminal point. It is clamped into place automatically.

Figure 5-5 Connecting a rigid conductor

Flexible conductor

- Open the spring by pressing on the spring lever with a screwdriver (A in Figure 5-6).
- Insert the conductor into the terminal point (B in Figure 5-6).
- Remove the screwdriver to secure the conductor (recommended: bladed screwdriver, blade width: 2.5 mm (e.g., SZS 0,4x2,5 VDE, item no. 1205037)).

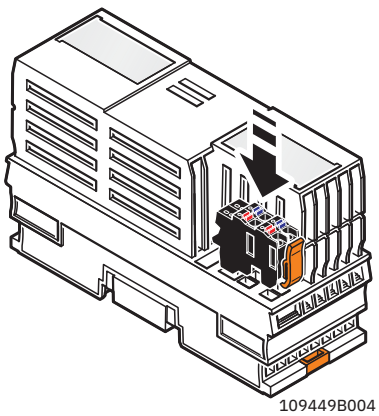
Figure 5-6 Connecting a flexible conductor



5.2.5 Connecting the supply connector

- Place the supply connector vertically into its position and press down firmly. Make sure that the locking latch snaps into place.

Figure 5-7 Connecting the supply connector



Supply the SPLC 1000 (together with the PLCnext Control used) with an external 24 V DC voltage supply. The permissible voltage range is 19.2 V DC to 30 V DC (ripple included).

Only use power supplies that are suitable for operation with capacitive loads (increased inrush current) (see Section 5.1).

- Connect the power supply to the supply connector as shown in Figure 5-5 and in Figure 5-6. Note the information in Section 5.2.3.

6 Commissioning and validation

WARNING: Avoid danger during commissioning

- Take appropriate measures to ensure that your system/machine does not present any danger during commissioning and validation.

WARNING: Safety function only available following validation

The planned system/machine safety function is only available following validation.

WARNING: Organizational or technical measures for checking the CRC checksum after a voltage reset or restart necessary

- Introduce organizational or technical measures for checking the CRC checksum expected for the respective system/machine after a voltage reset or system restart.

  The CRC checksum is displayed by the CRC element of the SPLC system variable (see Table 8-1 “SPLC system variable and elements of the SPNSV2_TYPE data structure”).
- Implement a technical measure for checking the CRC checksum in such a way that the check is carried out by a third technical entity beyond the SPLC 1000 and PLCnext Control.

The PLCnext Engineer software is required for commissioning the SPLC 1000.

The following topics are also available in the PLCnext Info Center:

- Configuring Axioline F modules
- Adding left-alignable “PLCnext Control Extension extension modules” to the bus configuration
- Configuring PROFINET devices
- Programming in accordance with IEC 61131-3
- Instantiating programs
- Assigning process data
- Specifying the refresh interval for Axioline F I/O data
- Transmitting projects to the PLCnext Control
- Creating a PLCnext Engineer HMI application

6.1 Initial commissioning

The following information for commissioning the SPLC 1000 must be observed.

– Familiarization with the previous sections of this user manual and with the UM EN AXC F X152 user manual is essential in order to carry out the steps listed in the following table correctly. The UM EN AXC F X152 user manual describes, among other actions, how to install, commission and operate the PLCnext Control AXC F 2152 and AXC F 3152.
  Therefore, if you have not done so already, read the previous sections and the UM EN AXC F X152 carefully. The section in the appendix of this user manual which corresponds to the previous sections must also be observed.
– The SPLC 1000 is commissioned immediately:
  – After switching on the supply voltage and subsequent successful startup, if an appropriate safety-related application program is available

  Or
  – Once an appropriate safety-related application program has been downloaded from PLCnext Engineer.

  With appropriate safety-related programming, the safety function is active immediately after the startup phase of the SPLC 1000 and the outputs of the F-Devices and the outputs of the non-safety-related PROFINET devices and I/O participants (e.g., Axioline F modules) can be set depending on the programming.

For initial commissioning, proceed as described in Table 6-1.

The following table describes all the steps from unpacking the SPLC 1000 through mounting/installation, right through to commissioning.

Table 6-1 Steps for initial commissioning of the SPLC 1000

Step		Relevant section and literature
1	Remove the device from the packaging while observing the ESD regulations.	Section “Safety notes” on page 59
2	Mount the device in accordance with your application.	Section “Mounting hardware” on page 59
3	If you want to use the SD card for operating the SPLC 1000 on an AXC F 2152 or AXC F 3152, insert the SD card into the PLCnext Control device.	Observe the information on the SD card in Section 3.1, “General description of the SPLC 1000” and in the controller-specific UM EN AXC F X152 user manual. **WARNING:** Follow the instructions in the note “WARNING: Organizational or technical measures for checking the CRC checksum after a voltage reset or restart necessary” on page 75.
4	Connect the power supply to the device.	– Notes on using PELV power supplies in Section “Electrical safety” on page 19 – Section “Supply voltage” on page 71

Make sure that the PLCnext Control device as well as the PROFINET and F-Devices used in your application have been mounted and installed correctly before switching on the supply voltage.

Table 6-1 Steps for initial commissioning of the SPLC 1000

Step		Relevant section and literature
5	Switch on the power supply for the SPLC 1000 and the PLCnext Control device used.	**WARNING: No safety function** The planned system/machine safety function is only available following validation. • Refer to step 16 in this table. **WARNING: Eliminate hazards** • Take appropriate measures to ensure that your system/machine does not present any danger during commissioning and validation.

Please note:
The SPLC 1000 and the PLCnext Control device used take approximately 1 minute to start up. This is due to the comprehensive self-tests the devices must perform. The LEDs on the two devices indicate the status.

The following steps must be performed in the PLCnext Engineer software.
When carrying out the following steps, please refer to the online help of the software. The online help function supports you during programming and configuration in PLCnext Engineer.

6	Carry out all the steps in order to be able to integrate the device as a PROFIsafe F-Host into a PLCnext Engineer project.	– Online help for PLCnext Engineer – Section “Integration of the SPLC 1000 as the F-Host in PLCnext Engineer” on page 85
7	Specify a new project password.	Section “Defining a project password” on page 90
8	Create the safety-related bus configuration in PLCnext Engineer.	– Section “Adding PROFINET devices” on page 94 – Section “Adding I/O modules (F-Devices)” on page 95
9	In PLCnext Engineer, set the F_Source_Address (F_Source_Add) and the F_Destination_Addresses (F_Dest_Add) that are set on the safe F-Devices.	Section “Assigning/checking the PROFIsafe address (F-Address) of PROFIsafe devices” on page 102
10	Check the settings for management/diagnostic variables and adapt the settings, if necessary.	– Section “Description of the safety-related functioning of the SPLC 1000” on page 31 – Section “Management/diagnostic variables for F-Devices” on page 107 – Section “Management/diagnostic variables for each configured, lower-level F-Device” on page 151 – Section “Global management/diagnostic variables for lower-level F-Devices” on page 155
11	Create the variables for the safety-related devices for process data exchange.	Section “Creating safety-related variables” on page 113
12	Link the created variables to the process data in accordance with your application.	Section “Assigning safety-related process data” on page 117

WARNING: Safety-related steps
The following steps include safety-related operations in the PLCnext Engineer software and the safety validation of the PROFIsafe system.
- For the following steps, please also observe the checklists in Section B , “Appendix: Checklists”.
- In addition, refer to the online help for the PLCnext Engineer software.

Table 6-1 Steps for initial commissioning of the SPLC 1000

Step		Relevant section and literature
13	Carry out the necessary device parameterization in the PLCnext Engineer software.	Section “Programming in accordance with IEC 61131-3 – Safety-related example program” on page 102
14	Check the bus configuration and variable assignment (exchange variables).	
15	Specify a new SafePLC password.	Section “Specifying the SPLC 1000 controller password” on page 119
16	Carry out the validation using the checklist ““Initial commissioning” and “recommissioning/device replacement” validation” on page 197.	Section “Appendix: Checklists” on page 187

NOTE: Unauthorized access to the SD card possible

It is possible to access the SD card, meaning that data can be read off and tampered with.

- Observe Section “Note on security” on page 14, in particular in terms of access protection for the SD card.

WARNING: Carry out verification in accordance with safety standards

- Carry out verification for all the steps involved in creating the safety program for your application in accordance with the applicable safety standards for your application.

6.2 Recommissioning after replacing the SPLC 1000

The device does not have to be configured again during recommissioning after replacing the SPLC 1000 (see steps 6 to 15 in Table 6-1 “Steps for initial commissioning of the SPLC 1000”).
Depending on the operating mode (see page 30: “Operation with an SD card” or “Operation without an SD card”), the safety-related project is either in the internal flash memory of the PLCnext Control device used or on the SD card inserted in the PLCnext Control device.

- For recommissioning after the device has been replaced, proceed as described in steps 1 to 5 and 16 in Table 6-1 on page 76.

  The prerequisite for this is that the device to be replaced has been removed from the application in accordance with the instructions in Section “Removing hardware” on page 163.

6.3 Recommissioning after replacing the PLCnext Control

6.3.1 Recommissioning after replacing the PLCnext Control without the use of an SD card

Once you have taken the steps necessary for replacing the PLCnext Control device, proceed in accordance with the instructions in Section 6.1, “Initial commissioning” and in particular in accordance with Table 6-1 “Steps for initial commissioning of the SPLC 1000” listed there.

6.3.2 Recommissioning after replacing the PLCnext Control with the use of a new, empty SD card

Once you have taken the steps necessary for replacing the PLCnext Control device, proceed in accordance with the instructions in Section 6.1, “Initial commissioning” and in particular in accordance with Table 6-1 “Steps for initial commissioning of the SPLC 1000” listed there.

6.3.3 Recommissioning after replacing the PLCnext Control with the use of a new SD card that contains a safety-related and a non-safety-related project

The device does not have to be configured again during recommissioning after replacing the PLCnext Control device (see steps 6 to 15 in Table 6-1 “Steps for initial commissioning of the SPLC 1000”) if an SD card that contains a safety-related project is inserted into the PLCnext Control device.

- For recommissioning after the device has been replaced, proceed as described in steps 1 to 5 and 16 in Table 6-1 on page 76.

  The prerequisite for this is that the device to be replaced has been replaced with a new device in the application in accordance with the instructions in UM EN AXC F X152.

WARNING:
Follow the instructions in the note “WARNING: Organizational or technical measures for checking the CRC checksum after a voltage reset or restart necessary” on page 75.

6.4 Example SPLC 1000 commissioning

6.4.1 Example: The SPLC 1000 as the F-Host for Axioline F and Axioline Smart Elements F-Devices

To make your introduction to working with the SPLC 1000 as straightforward as possible, the descriptions in later sections are based on the following configuration.

The SPLC 1000 communicates as the F-Host via PROFINET/PROFIsafe with the safety-related Axioline F I/O modules and via the Axioline F local bus with the safety-related Axioline Smart Elements I/O modules.

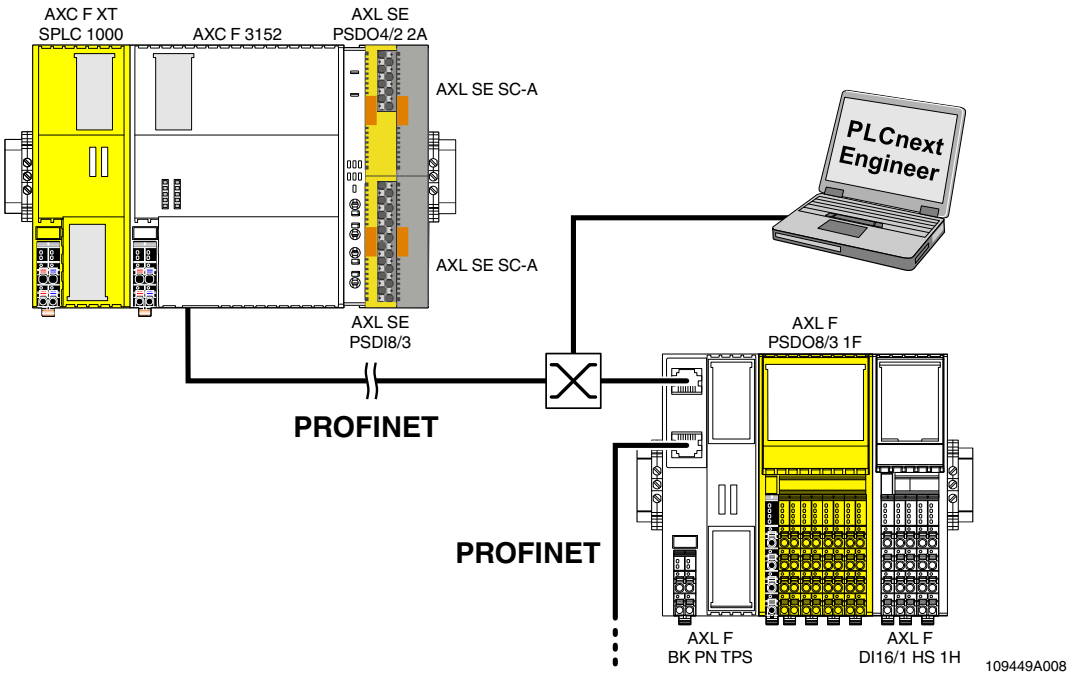
Lower-level PROFINET devices and PROFIsafe F-Devices
Please note that, in principle, you can use Axioline F bus couplers as well as the corresponding I/O devices and devices from other manufacturers as lower-level PROFINET devices and/or PROFIsafe F-Devices.

In the following example configuration in Figure 6-1, an Axioline F bus coupler is coupled at a lower level to an Axioline F station. The Axioline F station consists of the modular AXC F 3152 controller and an SPLC 1000 left-aligned to this.

Communication between the SPLC 1000 and the safety-related Axioline F I/O modules is done via PROFINET/PROFIsafe through the Axioline F PROFINET bus coupler.

Furthermore, the SPLC 1000 communicates via the PLCnext Control AXC F 3152 directly via the Axioline F local bus with the safety-related Axioline Smart Elements I/O modules.

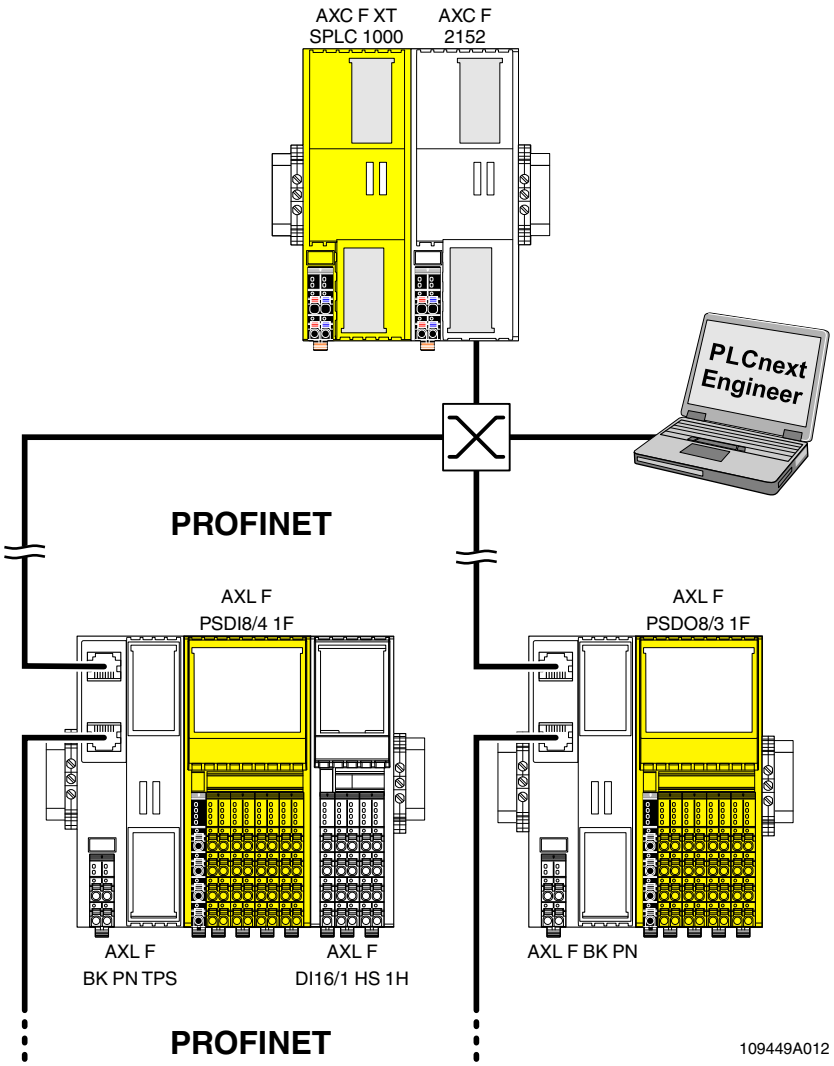
Figure 6-1 Example configuration: The SPLC 1000 as the F-Host with safety-related communication via the Axioline F local bus and via PROFINET/PROFIsafe



6.4.2 Further example configurations

6.4.2.1 The SPLC 1000 as the F-Host with safety-related communication via PROFINET/PROFIsafe

Figure 6-2 Example configuration: The SPLC 1000 as the F-Host with safety-related communication via PROFINET/PROFIsafe

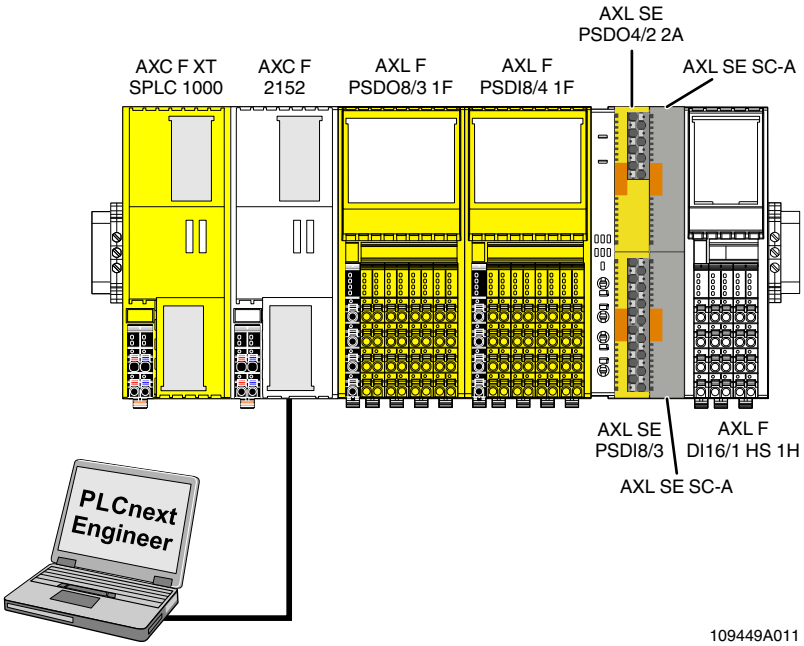


In this example configuration, two Axioline F bus couplers are coupled at a lower level to an Axioline F station. The Axioline F station consists of the modular AXC F 2152 small-scale controller and an SPLC 1000 left-aligned to this.

Communication between the SPLC 1000 as the F-Host and the safety-related Axioline F I/O modules is via PROFINET/PROFIsafe via the Axioline F PROFINET bus coupler.

6.4.2.2 The SPLC 1000 as the F-Host with safety-related communication via the Axioline F local bus

Figure 6-3 Example configuration: The SPLC 1000 as the F-Host with safety-related communication via the Axioline F local bus



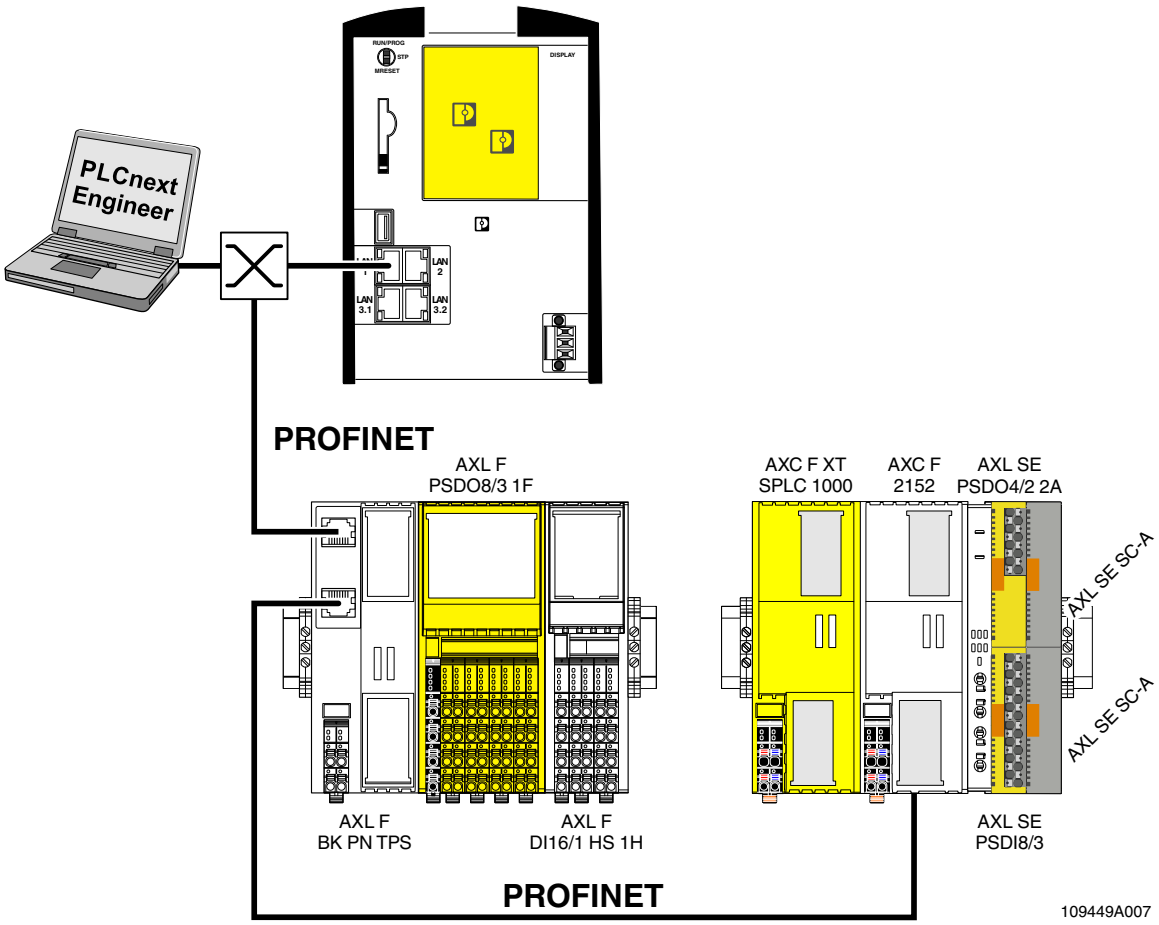
In this example configuration, the SPLC 1000 is aligned to the left of the modular AXC F 2152 small-scale controller in an Axioline F station.

In the Axioline F station, various F-Devices are aligned to the right of the PLCnext Control AXC F 2152. These are safety-related Axioline F and Axioline Smart Elements I/O modules.

The SPLC 1000 as the F-Host communicates via the PLCnext Control AXC F 2152 with the safety-related Axioline Smart Elements and Axioline F I/O modules directly via the Axioline F local bus.

6.4.2.3 The SPLC 1000 as the lower-level F-Device with safety-related communication via PROFINET/PROFIsafe and as the F-Host with safety-related communication via the Axioline F local bus

Figure 6-4 Example configuration: The SPLC 1000 as the lower-level F-Device with safety-related communication via PROFINET/PROFIsafe and as the F-Host with safety-related communication via the Axioline F local bus



In this example configuration, the SPLC 1000 communicates as the lower-level F-Device with the safety-related RFC 4072S compact controller (F-Host) via PROFINET/PROFIsafe.

Furthermore, the SPLC 1000 communicates as the F-Host via the PLCnext Control AXC F 2152 with the safety-related Axioline Smart Elements and Axioline F I/O modules directly via the Axioline F local bus.

6.4.3 Integration of the SPLC 1000 as the F-Host in PLCnext Engineer

The following sections describe how to:

– Create a new project in PLCnext Engineer (see Section 6.5.5).
– Add F-Devices connected to the SPLC 1000 (see Section 6.7.2).
– Program a safety-related program in PLCnext Engineer, including creating and linking variables (see Section 6.9).
– Configure F-Devices in PLCnext Engineer (see Section 6.9.1 and Section 6.9.2).
– Download the non-safety-related project to the PLCnext Control device and initiate the execution (see Section 6.10).
– Download the safety-related project to the SPLC 1000 and initiate the execution (see Section 6.10).
– Display safety-related online values in PLCnext Engineer (see Section 6.11).

For the chronological sequence of the listed steps, please refer to the example application.

This section assumes the following:

– You have installed the PLCnext Engineer software on your PC in accordance with the online help.
– You have installed the connected F-Devices in accordance with the device-specific user documentation.

When carrying out the following steps, please refer to the online help of the PLCnext Engineer software. The online help assists you in programming and parameterizing the software.

WARNING: Network error/network conflict
If you use more than one F-Host with the same F_Source_Address in different networks connected via routers, use routers with the following property:
In the event of a network error/network conflict, the router does not switch to “switch operation”. Use a router with “secure network separation”.

6.5 Software requirements

6.5.1 PLCnext Engineer software

Detailed information on PLCnext Engineer and on PLCnext technology can be found in the PLCnext community at plcnext-community.net and in particular in the PLCnext Info Center.

The PLCnext Engineer software is required for commissioning the SPLC 1000.

6.5.2 Installing PLCnext Engineer

The software can be downloaded at phoenixcontact.net/product/1046008.

- Download the software onto your PC.
- Double-click the *.exe file to start installation.
- Follow the instructions in the installation wizard.

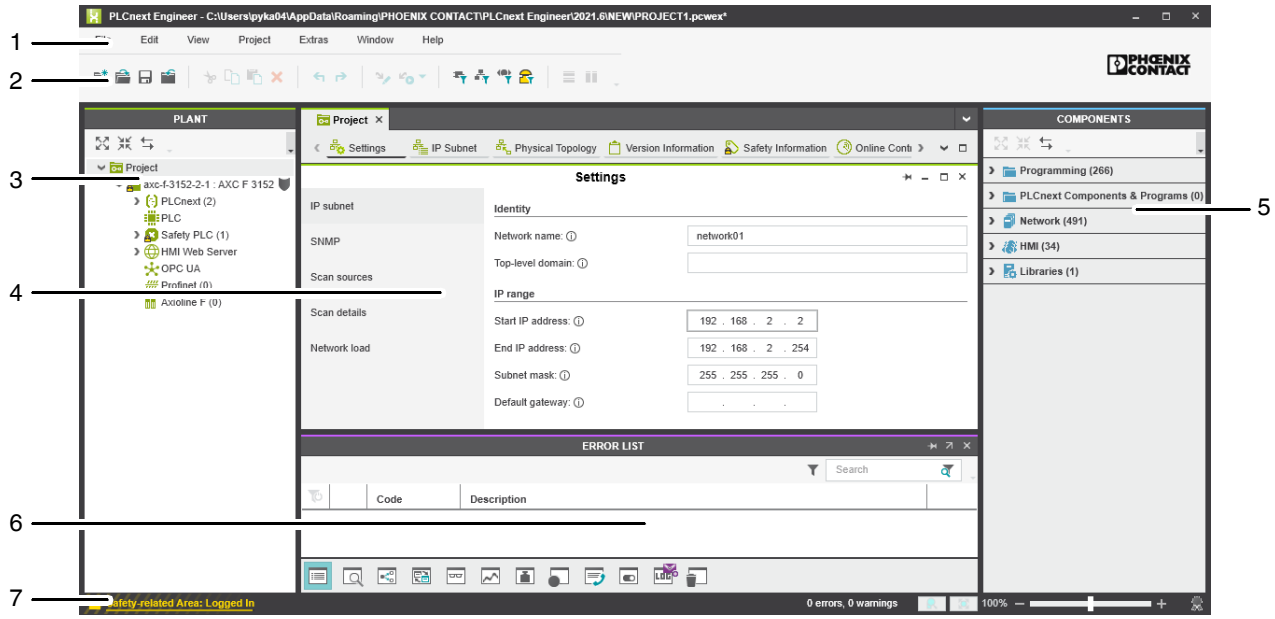
6.5.3 PLCnext Engineer license

Ensure that you install a version of the PLCnext Engineer software (≥2021.9) suitable for the SPLC 1000 you will be using.

PLCnext Engineer add-in for functional safety applications
Note that the “Add-in Functional Safety Editor” is necessary for creating functional safety applications in PLCnext Engineer.

6.5.4 User interface

Figure 6-5 PLCnext Engineer user interface



1. Menu bar
2. Toolbar
3. “PLANT” area
4. Editors area
5. “COMPONENTS” area
6. Cross-functional area
7. Status bar

“PLANT” area

All of the physical and logical components of your application are mapped in the form of a hierarchical tree structure in the “PLANT” area.

Editors area

Double-clicking on a node in the “PLANT” area or an element in the “COMPONENTS” area opens the associated editor group in the Editors area. Editor groups are always displayed in the center of the user interface. The color of the editor group indicates whether it is an instance editor (green; opened from the “PLANT” area) or a type editor (blue; opened from the “COMPONENTS” area). Each editor group contains several editors that can be opened and closed via buttons in the editor group.

“COMPONENTS” area

The “COMPONENTS” area contains all of the components available for the project.

The components can be divided into the following types based on their function:

– Developing program code (“Data Types”, “Programs”, and “Functions and Function Blocks”)
– Showing all devices available for the “PLANT” area and adding them via GSDML or FDCML (“Devices”)
– Editing HMI pages (“HMI”)
– Adding libraries such as firmware libraries, IEC user libraries or libraries provided by Phoenix Contact (“References”)

Cross-functional area

The cross-functional area contains functions that extend across the entire project.

– MESSAGES:

  Displays system messages, including an error list with all errors, warnings, and messages of the current project, as well as logs.
– GLOBAL FIND AND REPLACE:

  Finds and replaces strings in the project.
– CROSS REFERENCES:

  Displays all cross-references within the project, for example, the use and declaration of all variable types or HMI tags.
– NOTIFICATION LOGGER:

  Messages send from the firmware of the PLCnext Control device.
– WATCHES:

  Debug tool; shows the current values of the added variables in online mode.
– BREAKPOINTS:

  Debug tool for setting and resetting breakpoints when debugging within the application.
– CALL STACKS:

  Debug tool that shows the order for calling up when executing the code and that contains commands for debugging with breakpoints.
– LOGIC ANALYZER:

  Records and visualizes variable values at runtime.
– ONLINE STATE:

  While there is an online connection established to the controller and to the safety-related controller, a higher-level symbol of their operating state is displayed in the ONLINE STATE window.
– LOGGING:

  Shows all errors, warnings, and messages. A distinction is made between “online” (messages regarding the runtime environment, as well as errors and warnings that concern online communication) and “engineering” (messages regarding software events, e.g., GSDML and FDCML files; not project-related).
– RECYCLE BIN:

  Elements that have recently been deleted from the “PLANT” or “COMPONENTS” areas are moved to the recycle bin. Deleted elements can be restored from here, if needed.

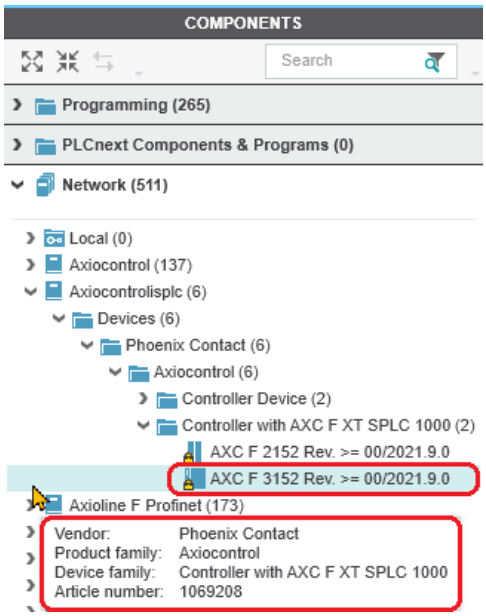
6.5.5 Creating a new project

- Open PLCnext Engineer.
- Create a new project.

Two PLCnext Control devices are available for selection in the PLCnext Engineer software for operating the left-alignable SPLC 1000.

- In the COMPONENTS area under “Network, Axiocontrol, Devices, Controller with AXC F XT SPLC 1000 (x)” click on the PLCnext Control device “AXC F 3152 Rev. >= 00/2021.9.0”.

Figure 6-6 Selecting the PLCnext Control AXC F 3152



- Drag the selected PLCnext Control into the “PLANT” area while pressing the mouse button.
- Paste the PLCnext Control to the project node.
- Open the “File, save project as…” menu.
- Enter a unique and meaningful name for the project (in the example: “UM_SPLC_1000”).
- Click the “Save” button.

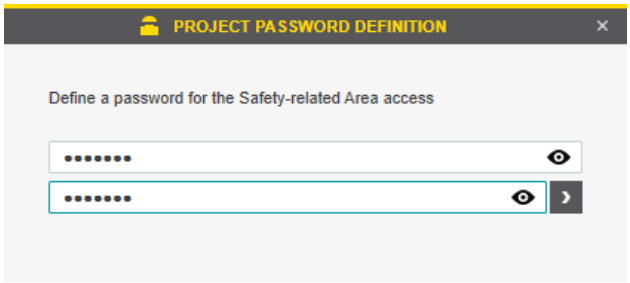
Further information on creating a new project is available in the UM EN AXC F X152 user manual and in the PLCnext Engineer software online help function.

6.5.6 Defining a project password

If prompted by PLCnext Engineer, enter a project password in the “PROJECT PASSWORD DEFINITION” dialog.

The project password in PLCnext Engineer allows you to edit safety-related parts of the PLANT, the COMPONENT area, the code, and the variables. Safety-related parts of the project can only be edited if you are logged into the safety-related area. This area is only accessible to authorized users.

Figure 6-7 Defining a project password



The project password must contain between 6 and 64 characters.

- Save the project using an appropriate project name (in the example: “UM_SPLC_1000”).

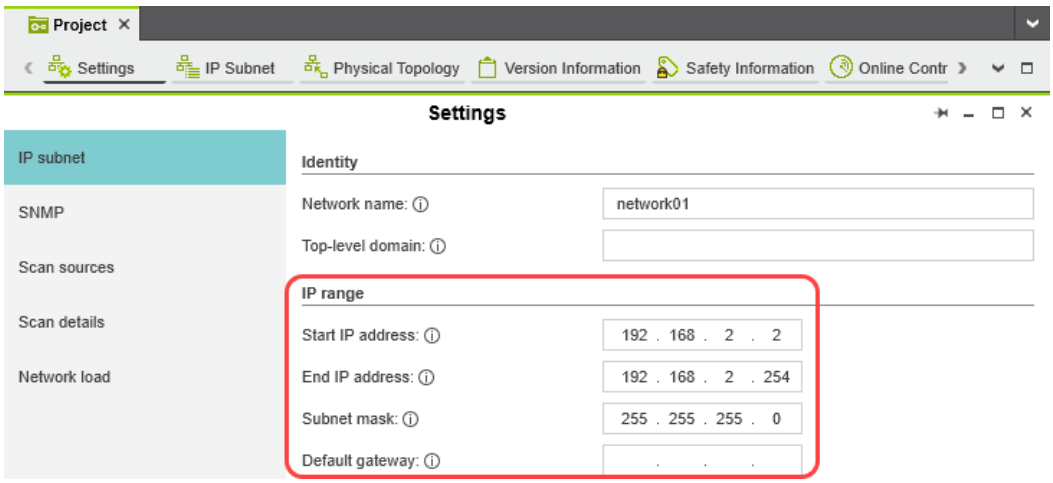
6.6 Further actions/steps in the PLCnext Engineer software

6.6.1 Creating the IP address range in the project

Please note:
For the following steps/settings in the project, proceed in accordance with the descriptions in the UM EN AXC F X152 user manual.

- Specify an IP address range for the project to be able to operate it in your network.

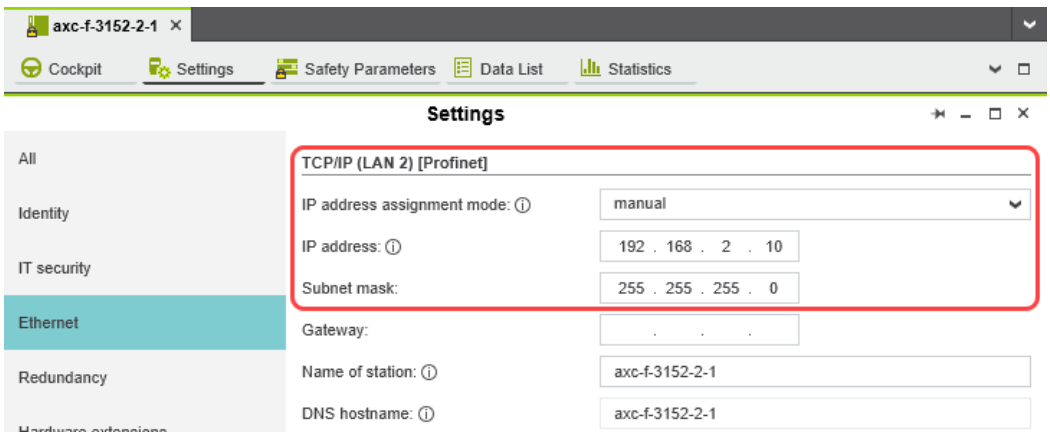
Figure 6-8 IP address range set in the project



6.6.2 Setting the IP address of the controller in the project

- Specify an IP address for the controller that lies within the previously set IP address range.

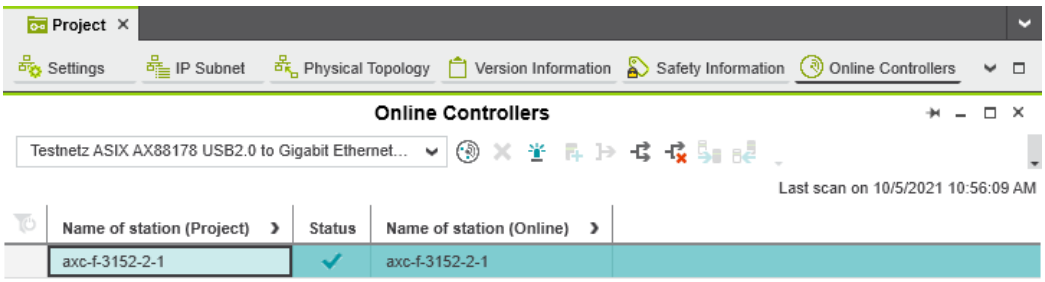
Figure 6-9 Controller IP address set



6.6.3 Connecting PLCnext Engineer to the controller

- Connect PLCnext Engineer to the controller to be able to transfer a project to the controller. To do so, select the controller available online in PLCnext Engineer.

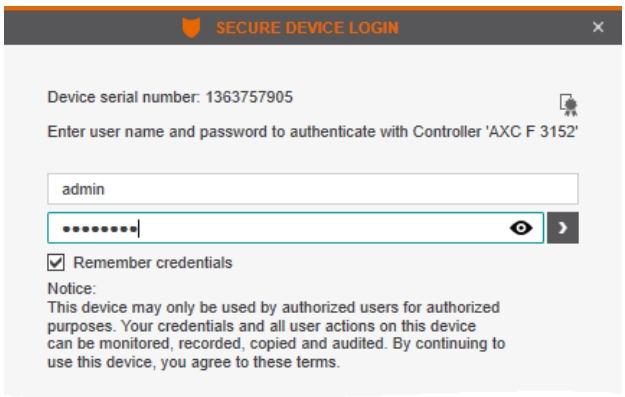
Figure 6-10 Configured controller assigned to an online device



6.6.4 User authentication

- Upon the request of PLCnext Engineer, enter a user name and a password if user authentication is enabled (default setting).

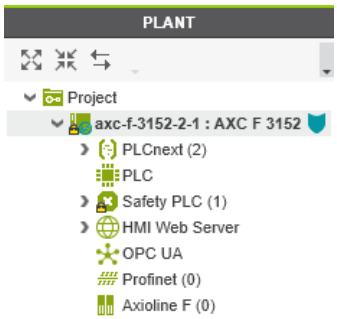
Figure 6-11 “SECURE DEVICE LOGIN” dialog



The user name, the password, and further information on user authentication preset in the delivery state can be found in the UM EN AXC F X152 user manual.

A successful connection will be displayed in the “PLANT” area on the node of the controller.

Figure 6-12 Controller successfully connected



Further information is available in the PLCnext Info Center and in the PLCnext Engineer online help function.

6.7 Configuring PROFINET devices

A description of the procedure for configuring PROFINET devices is available in the PLCnext Community at plcnext-community.net and in particular in the PLCnext Info Center as well as in the PLCnext Engineer online help function.

6.7.1 Adding PROFINET devices

- Double-click the “Profinet (x)” node in the “PLANT” area.

The “/ Profinet” controller editor group opens.

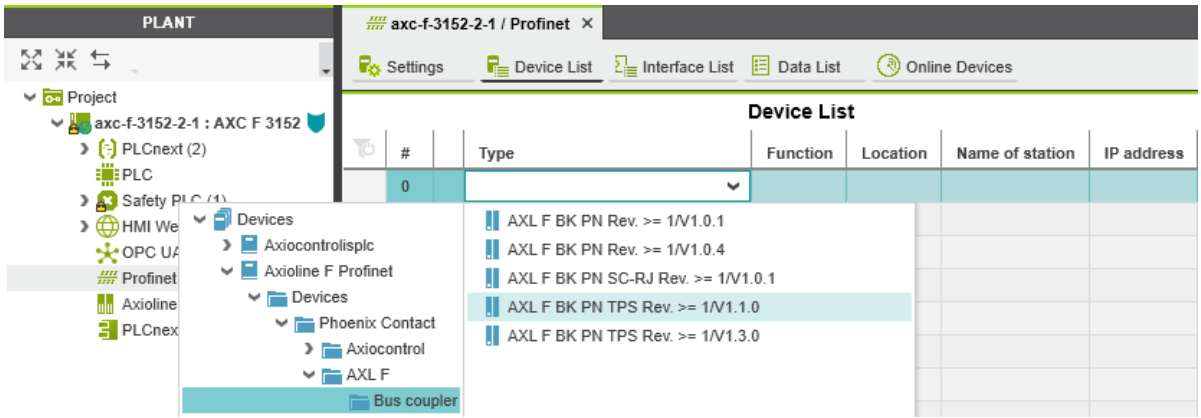
- Select the “Device List” editor.

Add the PROFINET devices in the “Device List” editor. To do so, proceed as follows:

- Select “Select type here” in the first row of the “Device List” editor.

The role picker opens. Only those elements from the “COMPONENTS” area that you can actually use are displayed in the role picker.

Figure 6-13 Role picker for selecting PROFINET devices

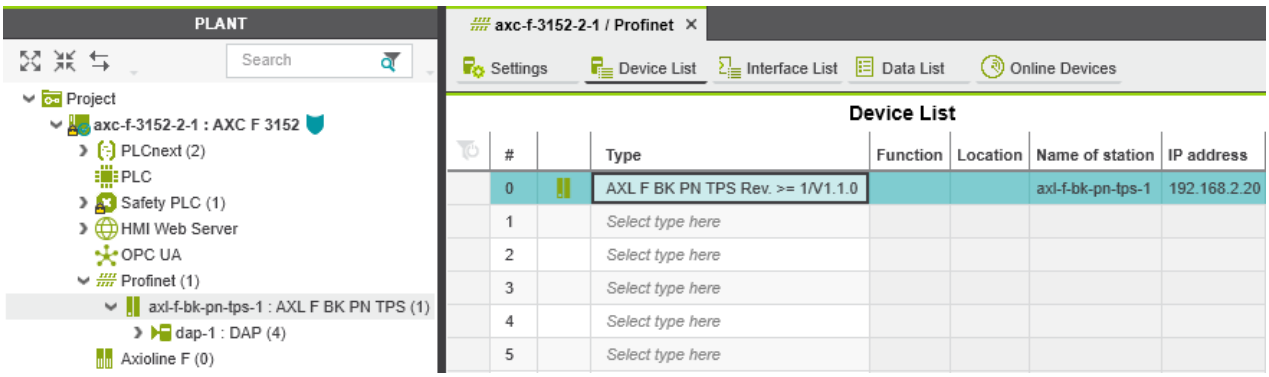


- Select the relevant PROFINET device in the role picker.

The PROFINET device is automatically added and mapped under the “Profinet (x)” node in the “PLANT” area.

- Proceed as described above to add more PROFINET devices.

Figure 6-14 PROFINET devices in the “PLANT” area and in the Device List



6.7.2 Adding I/O modules (F-Devices)

This section describes how to **manually** add I/O modules (here, F-Devices) to PROFINET devices and to the “Axioline F (x)” node.

Adding I/O modules to PROFINET devices

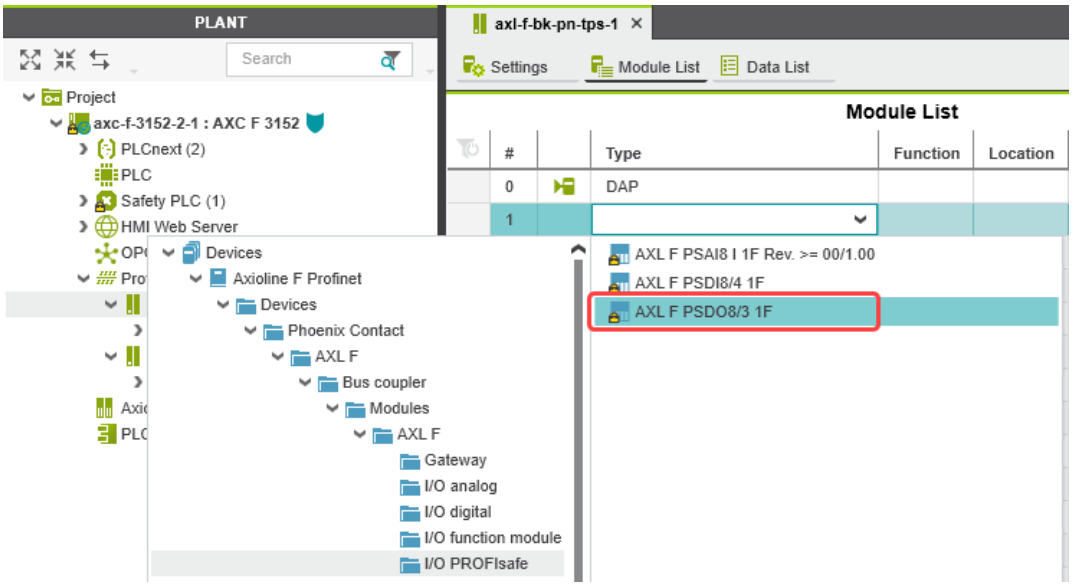
Double-click in the “PLANT” area on the PROFINET device whose I/O modules you wish to add.

The editor group of the selected PROFINET device opens; “axf-f-bk-pn-tps-1” in the example.

- Select the “Module List” editor.
- Select “Select type here” in the first row of the “Module List” editor.

The role picker opens.

Figure 6-15 Role picker for selecting the I/O modules



- Select the relevant I/O module in the role picker.

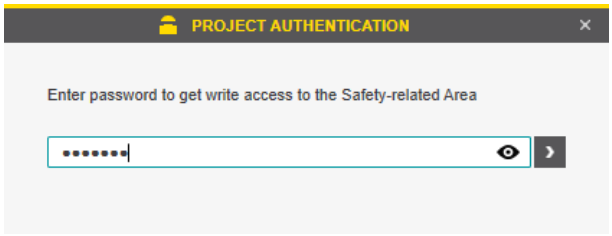
Project password: Logging into the Safety-related Area

In this area, you will be changing the safety-related project by adding F-Devices. If you are not logged into the “Safety-related Area”, PLCnext Engineer will prompt you to enter a password.

Through the targeted distribution of the password, you can specify the circle of users who may make changes to the safety-related project.

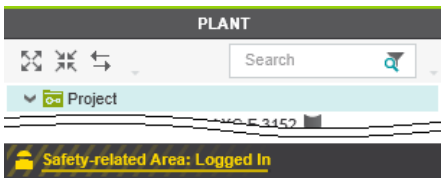
- Enter the password in the following dialog and confirm your entry by clicking on the arrow.

Figure 6-16 Entering the project password



A successful login is indicated by text highlighted in yellow:

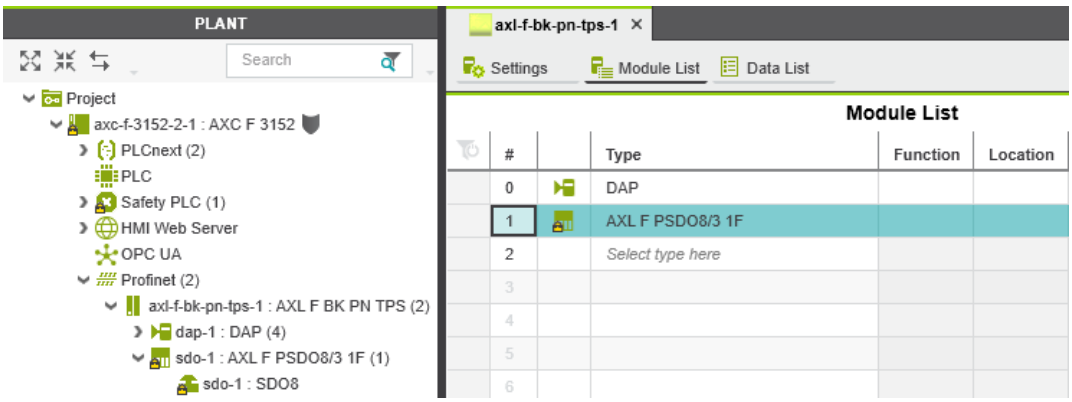
Figure 6-17 Successful login to the safety-related area



The I/O module is added and shown in the “PLANT” area under the “Profinet (x)” node for the respective PROFINET device (see Figure 6-18).

- Proceed as described above to add more I/O modules.

Figure 6-18 I/O modules connected to the PROFINET device



Adding I/O modules to the “Axioline F (x)” node

- Double-click the “Axioline F (x)” node in the “PLANT” area.

The “/ Axioline F” controller editor group opens.

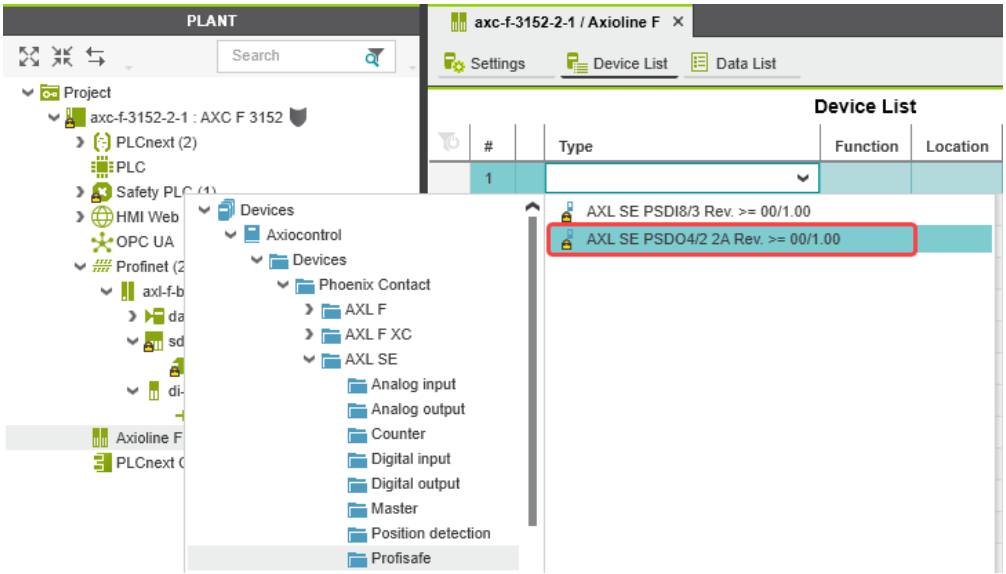
- Select the “Device List” editor.

Add the I/O modules in the “Device List” editor. To do so, proceed as follows:

- Select “Select type here” in the first row of the “Device List” editor.

The role picker opens.

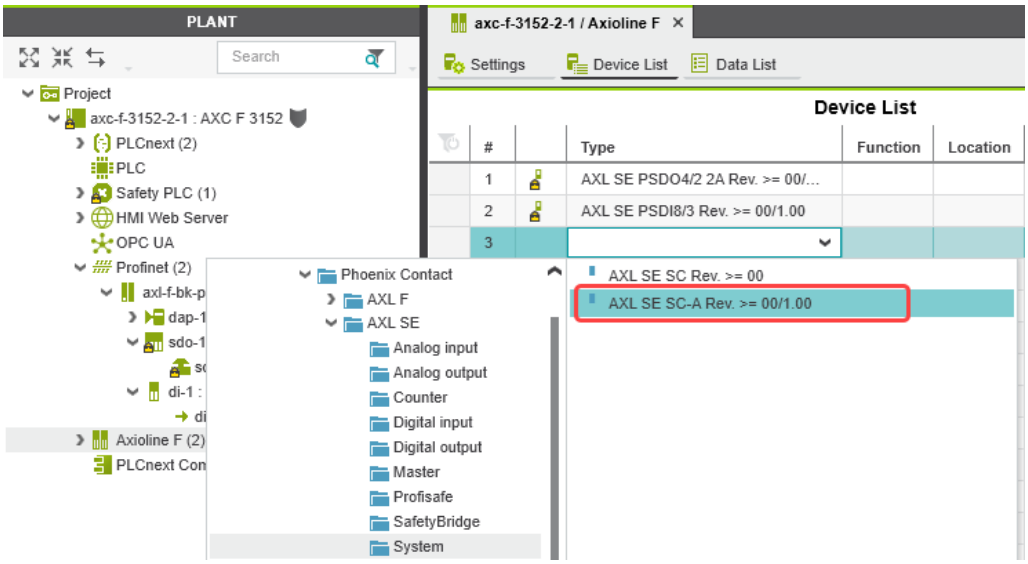
Figure 6-19 Role picker for selecting the I/O modules



- In the role picker, select the respective I/O modules.

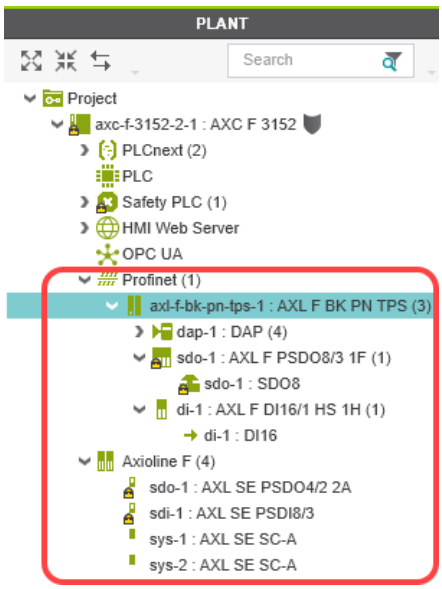
If, as in this example, you are using Axioline Smart Elements slot covers of the type AXL SE SC-A, configure these accordingly.

Figure 6-20 Role picker for selecting the I/O modules



The figure below shows all I/O modules contained in the example project.

Figure 6-21 Example project



6.8 Programming in accordance with IEC 61131-3 – Non-safety-related example program

Information on programming a non-safety-related program is not a part of this user manual.

Information on programming in accordance with IEC 61131-3 can be found in the PLCnext community at plcnext-community.net and in particular in the PLCnext Info Center as well as in the PLCnext Engineer online help function.

In the above listed sources, read how to:

– Open and create a program organization unit (POU) (see Section 6.8.1).
– Create non-safety-related variables.
– Create non-safety-related programs.
– Assign non-safety-related process data.
– Instantiate programs (see Section 6.8.2).
– Create PLCnext Engineer HMI applications.

Please note:
Due to the creation of a new project for the SPLC 1000 described in Section 6.5.5, you have to carry out the steps in sections 6.8.1 “Creating a POU” and 6.8.2 “Instantiating programs” for the SPLC 1000 yourself.

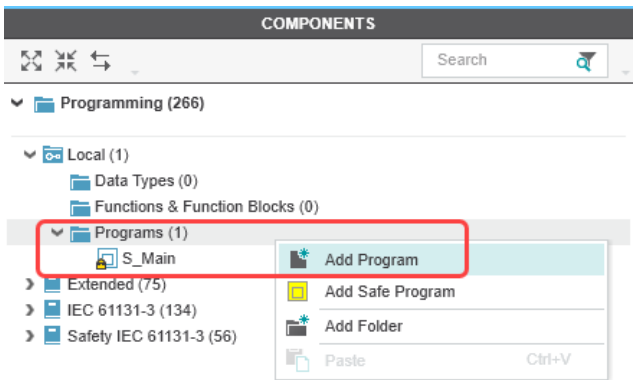
6.8.1 Creating a POU

If you have created a new project for the SPLC 1000, you must create the program organization unit (POU) with the name “Main” in the “COMPONENTS” area under “Programs” for the non-safety-related part of the project (see Figure 6-23).
The POU with the name “S_Main” has been created automatically.

To create a new POU, proceed as follows:

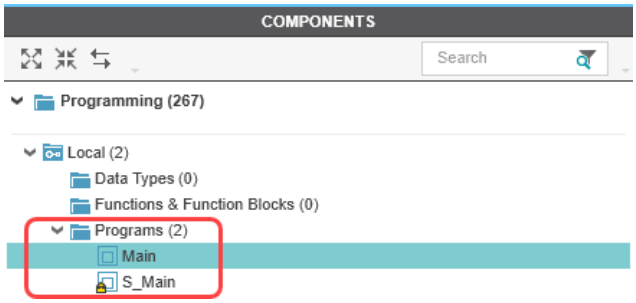
- Click on “Programming (x)” in the “COMPONENTS” area.
- Click on the arrow next to “Local (x)”.
- Right-click “Programs (x)”.
- In the context menu, select “Add Program”.

Figure 6-22 “Add Program” program POU context menu



- Enter the name “Main” for the new POU.

Figure 6-23 Program POUs: Main and S_Main



6.8.2 Instantiating programs

Programs are instantiated in the “Tasks and Events” editor. To instantiate a program, create the required task and assign it to the desired program instance.
Individual tasks are coordinated and processed in the Execution and Synchronization Manager (ESM). The PLCnext Control device used (AXC F 3152 in the example) operates with a dual-core processor and has one ESM (“ESM1” and “ESM2” in the “Tasks and Events” editor) per processor core.

Opening the “Tasks and Events” editor

To open the “Tasks and Events” editor, proceed as follows:

- Double-click on the “PLCnext (x)” node in the “PLANT” area.

The “/ PLCnext” editor group opens.

- Select the “Tasks and Events” editor.

Creating tasks

To create a new task, proceed as follows:

- In the “Name” column, enter a name for the new task in the “Enter task name here” input field (“Task1” in the example in Figure 6-24).
  The name may not contain any spaces.
- In the “Task type” column, click in the input field.
- Select the “Task type” from the drop-down list.
- Make all of the required settings for the task in the remaining columns.

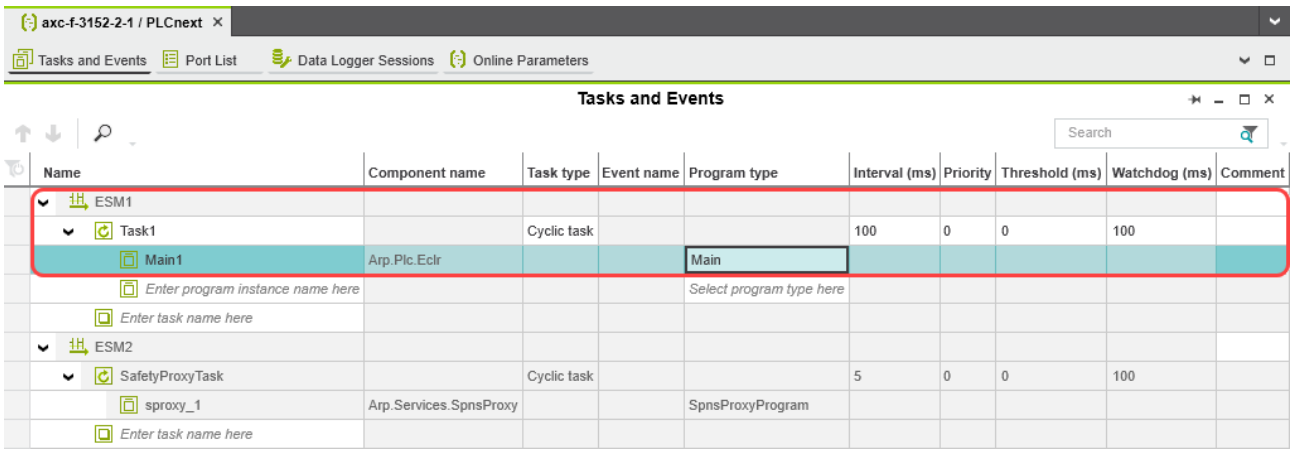
Instantiating a program

To instantiate a program, proceed as follows:

- In the “Name” column, enter a name for the program instance under a task in the “Enter program instance name here” input field (“Main1” in the example in Figure 6-24).
  The name may not contain any spaces.
- Click on “Select program type here” in the “Program type” column.
- Select the program to be instantiated from the drop-down list (“Main” in the example in Figure 6-24).

The selected program is instantiated and assigned to a task.

Figure 6-24 Tasks and program instances in the “Tasks and Events” editor



6.9 Programming in accordance with IEC 61131-3 – Safety-related example program

Once you have created the non-safety-related part of the example project, you can start creating the safety-related part.

6.9.1 Assigning/checking the PROFIsafe address (F-Address) of PROFIsafe devices

The PROFIsafe address (F-Address) is a unique ID for each F-Device in the network. The F-Host is assigned an F_Source_Address (F_Source_Add), while each F-Device is assigned its own F_Destination_Address (F_Dest_Add).

You must set the PROFIsafe address via the DIP switches directly on the F-Device prior to installation. Check the set F-Address in the project in PLCnext Engineer and adapt the settings there, if necessary.

Unique F-Address assignment – Avoid addresses overlapping

- Assign a unique F-Address to each F-Device that is used.
  Each F-Address assigned within a network must be unique.
- Avoid overlapping F-Addresses. They are not permitted.

In the example, the F-Devices are assigned the F-Destination addresses:
- AXL F PSDO8/3 1F: 1
- AXL SE PSDO4/2 2A: 2
- AXL SE PSDI8/3: 3

For more detailed information on setting the PROFIsafe F-Addresses, please refer to “Device identification/number of safe devices” on page 34 and the device-specific user documentation.

F_Source_Address (F_Source_Add)

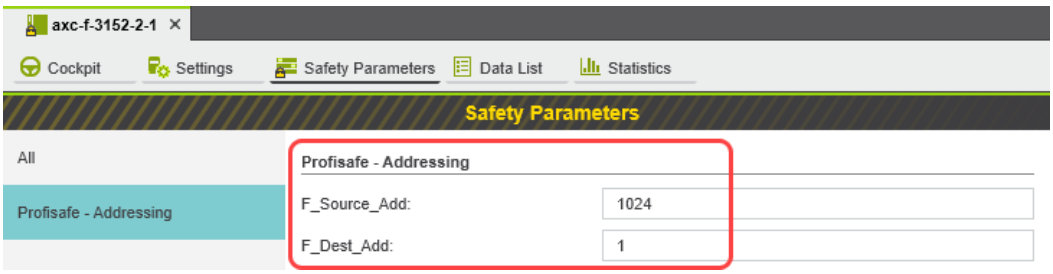
- Double-click the controller node in the “PLANT” area.

The controller editor group opens.

- Select the “Safety Parameters” editor.

If you are not currently logged into the safety-related area, you will now be prompted to enter the password in the “PROJECT AUTHENTICATION” dialog that opens (see “Project password: Logging into the Safety-related Area” on page 95).

Figure 6-25 F-Address of the F-Host: F_Source_Add (F_Source_Address)



- In the “PROFIsafe Addressing” view, check the setting for the F_Source_Add F-Address. In the example, set F_Source_Add to “1024”. If necessary, adapt the value of F_Source_Add to your application.

An adjustable range of “1 ... 65534_{dec}”, maximum, is permitted.

F_Destination_Address (F_Dest_Add)

Using the SPLC 1000 as F-Device: Setting F-Dest_Add

If you are using the SPLC 1000 in your application as an F-Device, you can also set its F_Dest_Add in the “Safety Parameters” editor (see Figure 6-25).

- Only assign F_Dest_Add values once.
- For the SPLC 1000 set PROFIsafe destination addresses in a range from 1 to a maximum of 65534_{dec}.

Using the SPLC 1000 as F-Host

An adjustable range of “1 ... 65534_{dec}”, maximum, is permitted for the F-Addresses of the safety modules used (F_Dest_Add / F_Destination_Address).

Please note the following points:

- Only assign F_Dest_Add values once.
- For safety modules from Phoenix Contact, set PROFIsafe destination addresses in a range from 1 to a maximum of 999_{dec}.
- For safety modules from other manufacturers, set PROFIsafe destination addresses in a range from 1 to 65534_{dec}.

- Under the “Profinet (x)” and “Axioline F (x)” nodes in the “PLANT” area, double-click on the lower-level node of the safety module whose F-Address you want to set.

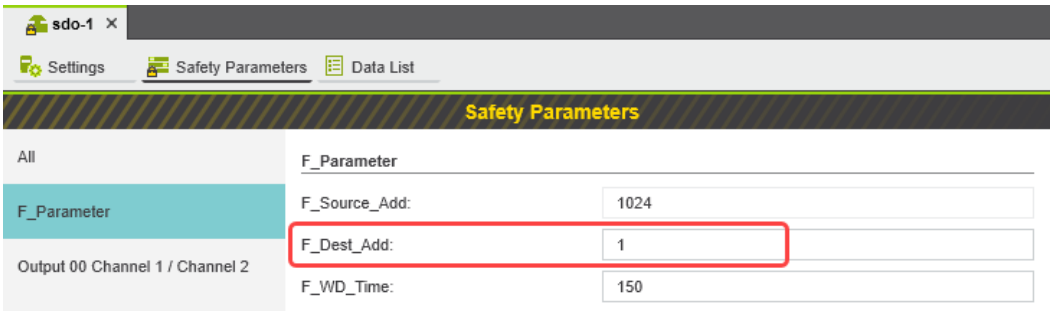
The safety module editor group opens.

DIP switches for setting the F-Address of F-Devices used

You must set the PROFIsafe address via the DIP switch directly in the F-Device prior to mounting. Check the set F-Address in the project in PLCnext Engineer and adapt the settings there.

- Select the “Safety Parameters” editor.

Figure 6-26 F-Address of the PROFIsafe F-Device: F_Dest_Add (F_Destination_Address)



- In the “F_Parameter” view, check the setting for the F_Dest_Add F-Address.
- Set F_Dest_Add to the value that corresponds to the DIP switch setting of the safety module.
- In the example, set F_Dest_Add for the safety modules used to the following values:
  - “1” for the AXL F PSDO8/3 1F (see Figure 6-26)
  - “2” for the AXL SE PSDO4/2 2A
  - “3” for the AXL SE PSDI8/3
- If necessary, adapt the F_Dest_Add values to your application.

An adjustable range of “1 ... 65534_{dec}”, maximum, is permitted.

- Proceed as described above for other safety modules in your application.

6.9.2 Checking/setting safety parameters for configured F-Devices

For configured F-Devices, you must check and possibly set various safety parameters, depending on the safety function and safety integrity. Specifically, these are F-Address F_Dest_Add, watchdog time F_WD_Time, and the input/output parameters.

WARNING: Safety and availability of the system/machine
Select a suitable watchdog time F_WD_Time to ensure the safety and availability of your system/machine.

- Select a watchdog time that is long enough to ensure the safety of your system/machine with maximum possible availability.

For further information on selecting the watchdog time, refer to Section 3.3 on page 38.

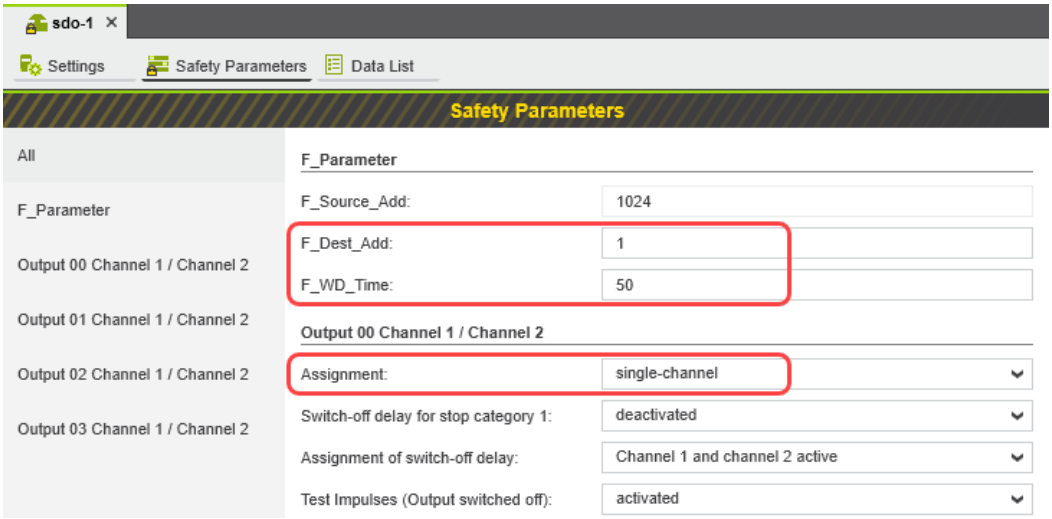
1. Call up the safety parameters for the AXL F PSDO8/3 1F:

- Under the “Profinet (x)” node in the “PLANT” area, double-click on the lower-level node of the safety module whose safety parameters you want to set (in the example in Figure 6-27: AXL F PSDO8/3 1F).

The safety module editor group opens.

- Select the “Safety Parameters” editor.

Figure 6-27 “Safety Parameters” editor: AXL F PSDO8/3 1F



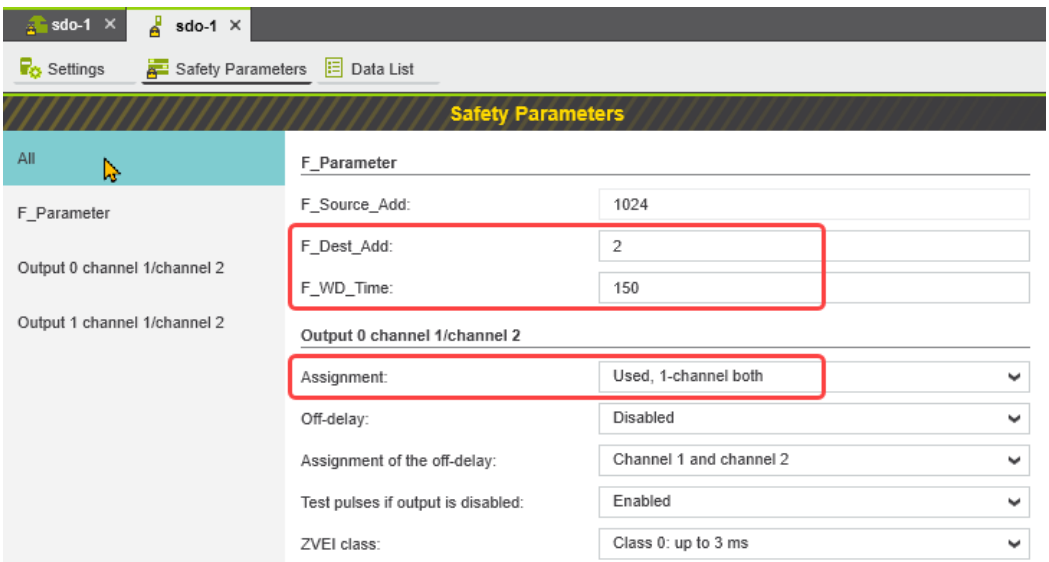
2. Call up the safety parameters for the AXL SE PSDO4/2 2A:

- Under the “Profinet (x)” node in the “PLANT” area, double-click on the lower-level node of the safety module whose safety parameters you want to set (in the example in Figure 6-28: AXL SE PSDO4/2 2A).

The safety module editor group opens.

- Select the “Safety Parameters” editor.

Figure 6-28 “Safety Parameters” editor: AXL SE PSDO4/2 2A



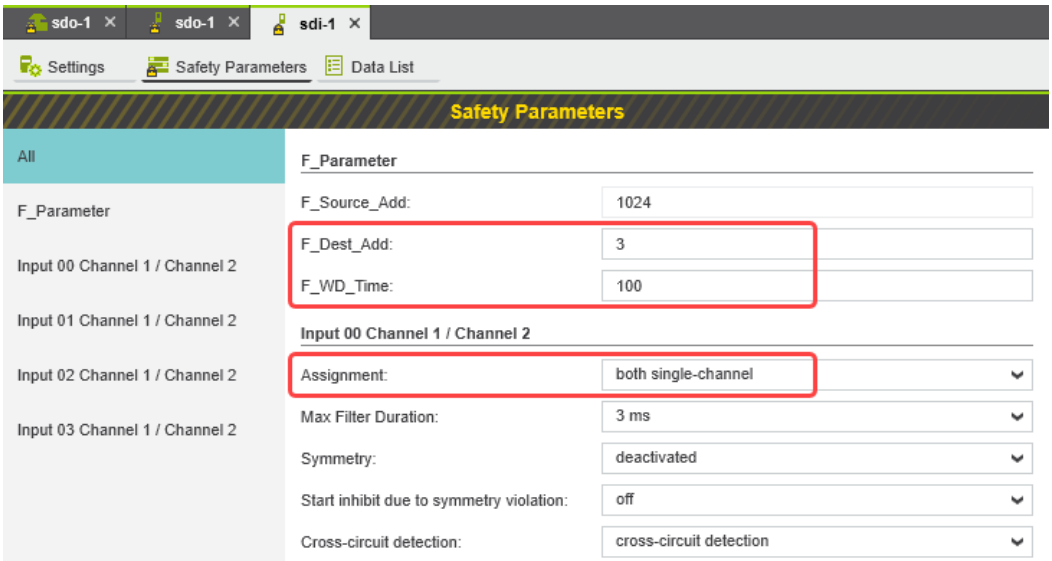
3. Call up the safety parameters for the AXL SE PSDI8/3:

- Under the “Profinet (x)” node in the “PLANT” area, double-click on the lower-level node of the safety module whose safety parameters you want to set (in the example in Figure 6-29: AXL SE PSDI8/3).

The safety module editor group opens.

- Select the “Safety Parameters” editor.

Figure 6-29 “Safety Parameters” editor: AXL SE PSDI8/3



4. Set the safety parameters:

- Set the required safety parameters.
  In the example in the figures 6-27, 6-28, and 6-29, these values are as follows:

Table 6-2 Safety-related parameters in the example

Value	AXL F PSDO8/3 1F	AXL SE PSDO4/2 2A	AXL SE PSDI8/3
Figure	Figure 6-27 on page 105	Figure 6-28 on page 105	Figure 6-29 on page 106
F-Address F_Dest_Add	1	2	3
Watchdog time F_WD_Time	50 ms	150 ms	100 ms
Assignment of channels 1 and 2 for the inputs or outputs	Output 00: single-channel	Output 0: assigned, both single-channel	Input 00: both single-channel

  If necessary, adapt the settings to your application.

- Repeat the above safety parameter settings for each safety module used in your application.

6.9.3 Management/diagnostic variables for F-Devices

In PLCnext Engineer, you can specify whether management/diagnostic variables are to be created for F-Devices in the project.

One part of these management/diagnostic variables is created by default.

These non-safety-related variables support you in the reintegration of passivated F-Devices, for example.

For this purpose, you can define non-safety-related exchange variables in PLCnext Engineer. You then connect these exchange variables to corresponding management/diagnostic variables in the safety-related “S_Main” POU (see Section “Creating a safety-related program” on page 115).

For further information on management/diagnostic variables, please refer to “Management/diagnostic variables for each configured, lower-level F-Device” on page 151 and “Global management/diagnostic variables for lower-level F-Devices” on page 155.

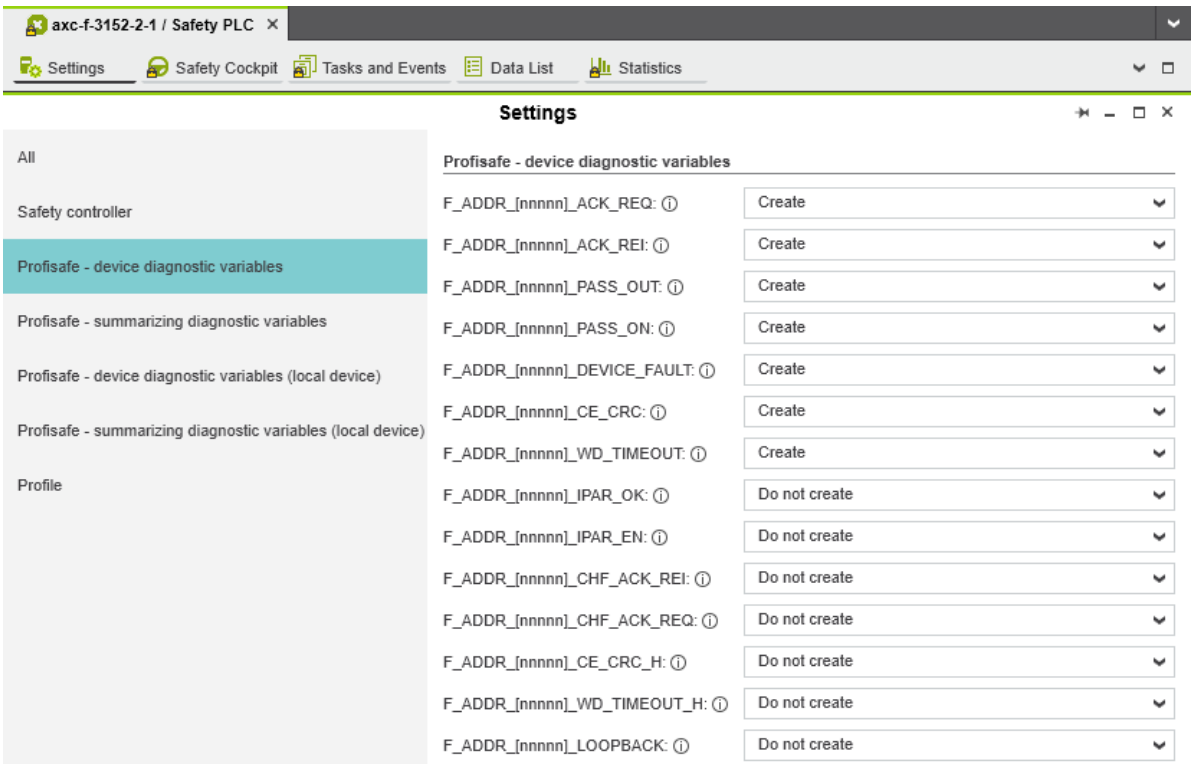
- Double-click on the “Safety PLC (x)” node in the “PLANT” area.

The “/ Safety PLC” editor group opens.

- Select the “Settings” editor.

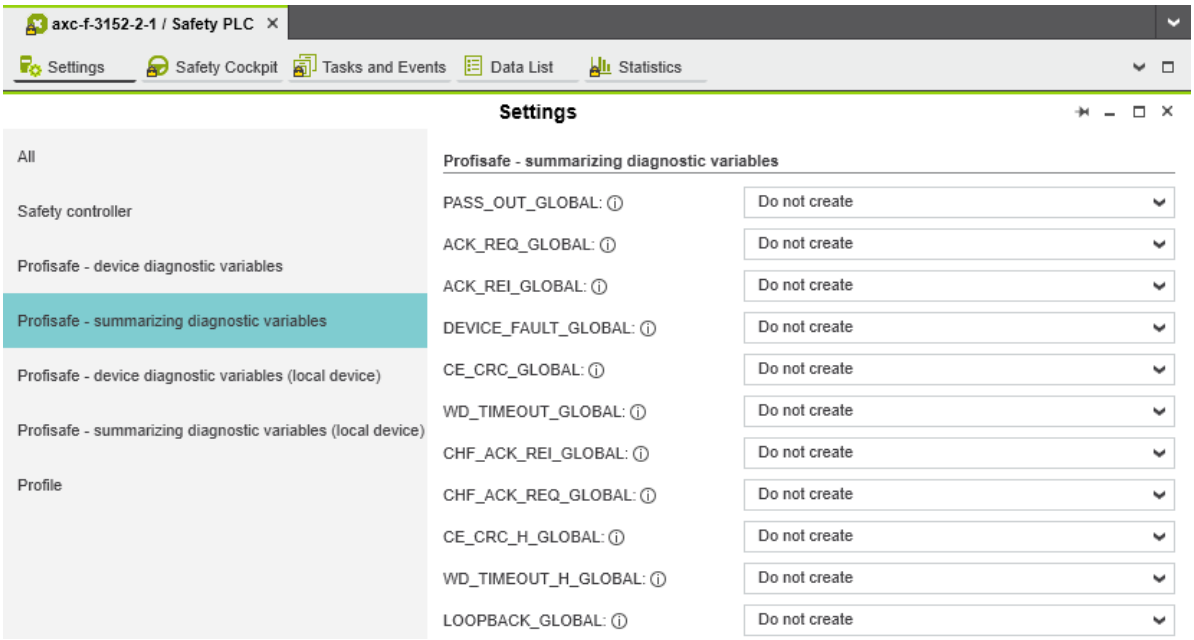
In the “Profisafe – device diagnostic variables” view, you can specify which management/diagnostic variables are to be generated for each F-Device configured in the project (see Figure 6-30).

Figure 6-30 Management/diagnostic variables for each configured F-Device



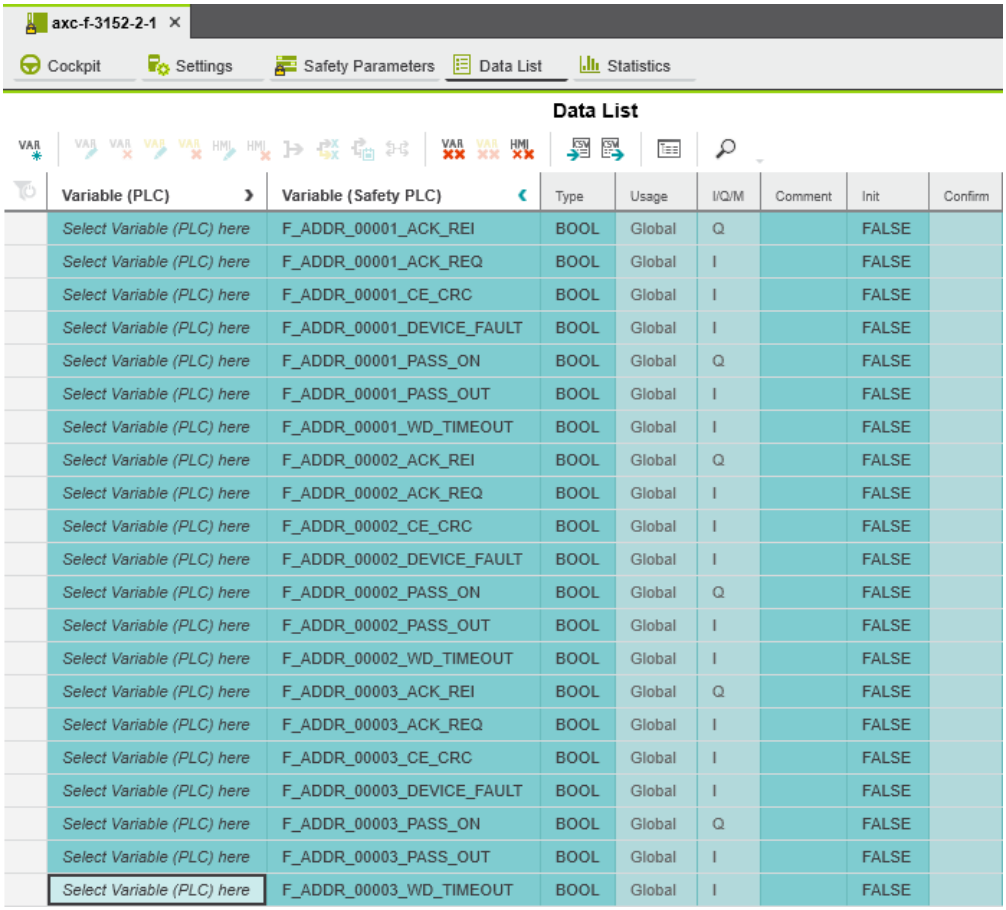
In the “Profisafe – summarizing diagnostic variables” view, you can specify which management/diagnostic variables are to be globally generated once for all PROFIsafe F-Devices configured in the project (see Figure 6-31).

Figure 6-31 Management/diagnostic variables for all configured F-Devices



Created variables are displayed in the “Data List” editor of the controller node:

Figure 6-32 Management/diagnostic variables of F-Devices (default)



Variable (PLC)	Variable (Safety PLC)	Type	Usage	I/Q/M	Comment	Init	Confirm
Select Variable (PLC) here	F_ADDR_00001_ACK_REI	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00001_ACK_REQ	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00001_CE_CRC	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00001_DEVICE_FAULT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00001_PASS_ON	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00001_PASS_OUT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00001_WD_TIMEOUT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00002_ACK_REI	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00002_ACK_REQ	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00002_CE_CRC	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00002_DEVICE_FAULT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00002_PASS_ON	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00002_PASS_OUT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00002_WD_TIMEOUT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00003_ACK_REI	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00003_ACK_REQ	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00003_CE_CRC	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00003_DEVICE_FAULT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00003_PASS_ON	BOOL	Global	Q		FALSE	
Select Variable (PLC) here	F_ADDR_00003_PASS_OUT	BOOL	Global	I		FALSE	
Select Variable (PLC) here	F_ADDR_00003_WD_TIMEOUT	BOOL	Global	I		FALSE	

For the three F-Devices used in the example, PLCnext Engineer creates 21 management/diagnostic variables by default.

6.9.4 Creating variables (exchange variables)

To exchange data between a standard controller and safety-related PLC, you can define “exchange variables” in PLCnext Engineer. These exchange variables are of a non-safety-related data type.

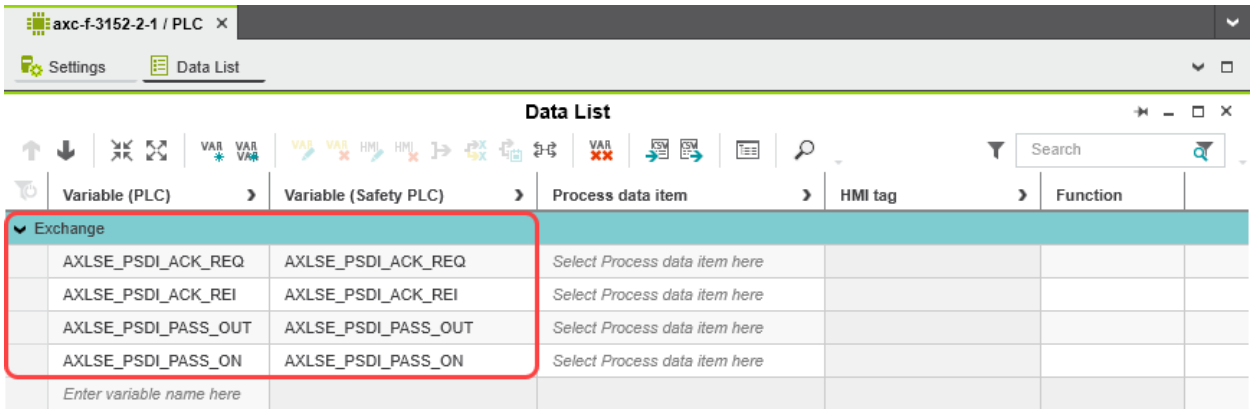
The aim is to link the created exchange variables with specific management/diagnostic variables described in Section 6.9.3.

Data direction for exchange variables
A data direction must be specified for exchange variables. The data direction determines whether the variable can be read (“I” data direction) or written (“Q” data direction) by the safety-related application. Depending on the set data direction, the standard application has write or read access to the respective variable.

1. In PLCnext Engineer, first create the “Exchange” variable group as shown in Figure 6-33 once you have opened the “PLC” node in the “PLANT” area.
2. Next, create 4 variables for each F-Device used in the “Variable (PLC)” column in this group.
3. Then, in the “Variable (Safety PLC)” column, create the corresponding non-safety-related exchange variables.
   These exchange variables are assigned to the safety-related PLC.
4. Finally, set the data direction of the exchange variables.

In the example in Figure 6-33, the 4 variables/exchange variables will be created for the AXL SE PSDI8/3 F-Device.

Figure 6-33 Exchange variables in the example



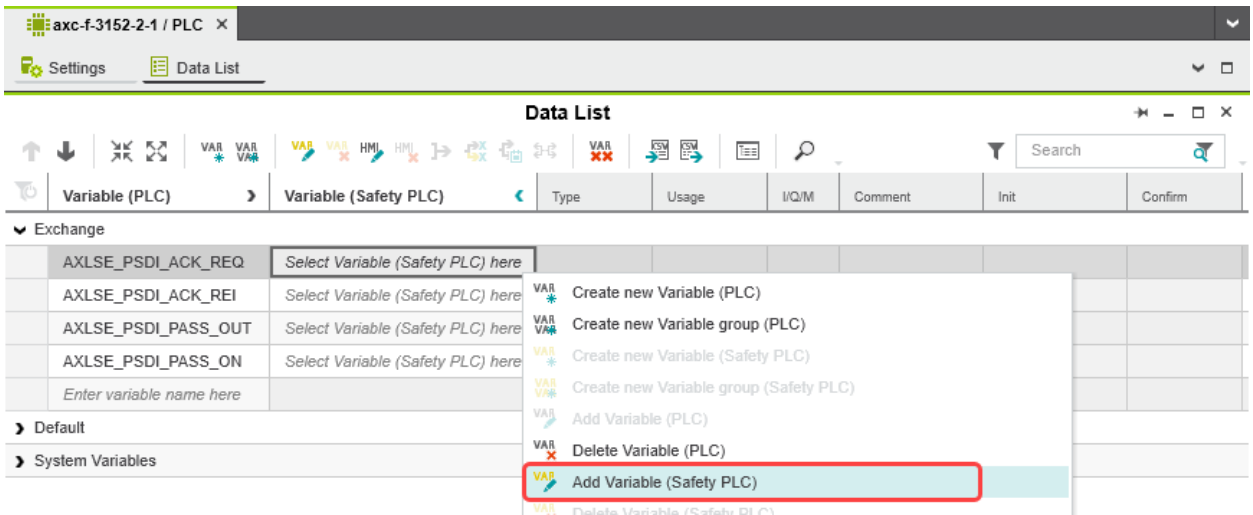
- Double-click on the “PLC” node in the “PLANT” area.

The “/ PLC” controller editor group opens.

- Select the “Data List” editor.
- Click on the button to generate a new variable group.
- Rename the new variable group to “Exchange”, for example.
- Enter the names of the variables in the “Variable (PLC)” column in turn as shown in Figure 6-33.

- In the “Variable (Safety PLC)” column, select “Add Variable (Safety PLC)” in the context menu for each variable you created earlier in turn (see Figure 6-34).

Figure 6-34 “Add Variable (Safety PLC)” context menu



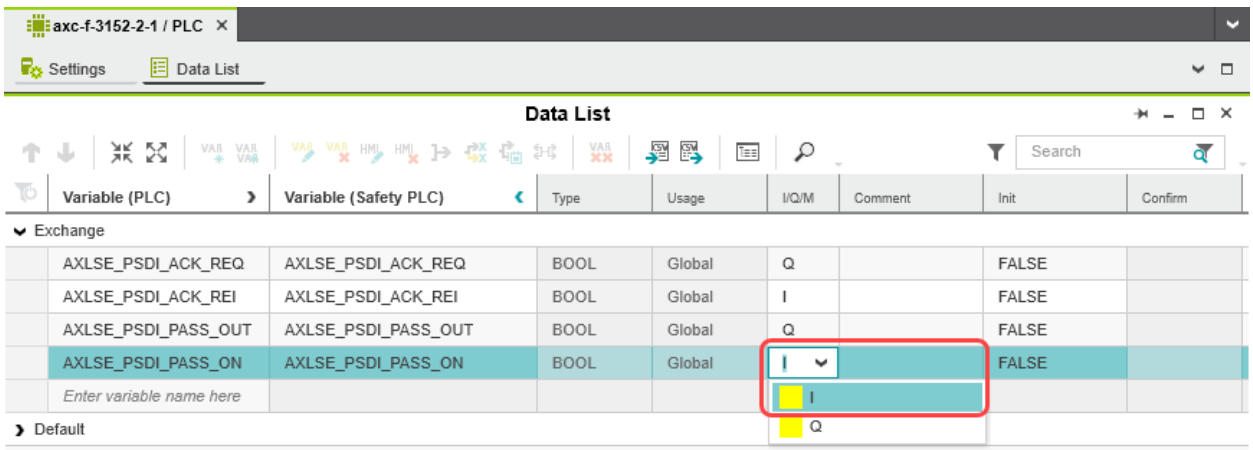
After you have created the exchange variables, you need to specify the data direction (I/Q).

Data direction

Set the data direction for the exchange variables. Refer to the information provided at the start of this section on page 110.

- Set the data direction in turn for each variable created earlier as shown in Figure 6-35.

Figure 6-35 Setting the data direction



6.9.5 Opening a safety-related POU

For further information on opening and creating POUs, please refer to Section “Creating a POU” on page 99.
For detailed notes on operating the PLCnext Engineer software, please refer to the online help for the software.

When you create a project, a POU with the name “S_Main” is created automatically for safety-related controllers in the “COMPONENTS” area under “Programs” (see Figure 6-23 on page 100).

- Click on “Programming (x)” in the “COMPONENTS” area.
- Then click on the arrow next to “Local (x)”, then on “Programs (x)”.
- Double-click on the desired safety-related POU (in the example: “S_Main” program).

The editor group for the selected POU opens.

6.9.6 Creating safety-related variables

Variables in the example project

The following table lists the safety-related variables used in the safety-related example program.

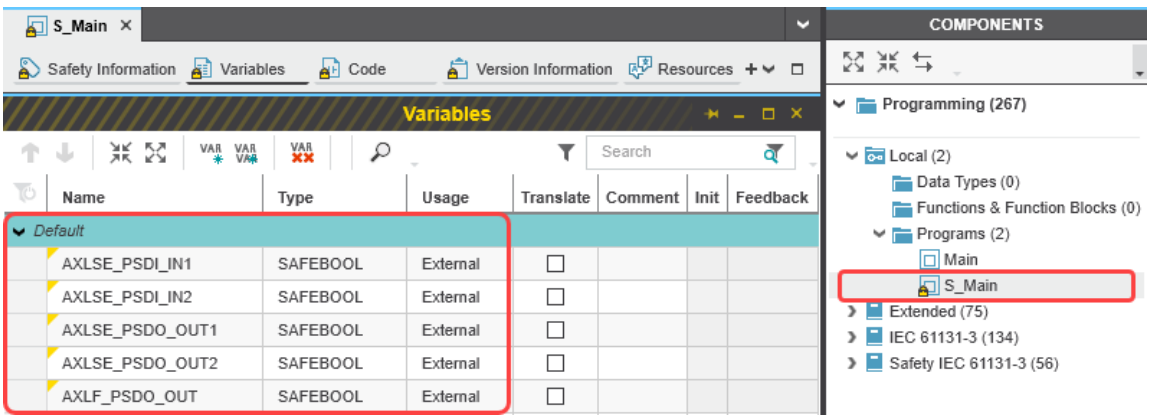
Table 6-3 Input/output variables in the example

Parameter	Variable name	Data type	Use	Description
IN1	AXLSE_PSDI_IN1	SAFEBOOL	External	AXL SE PSDI8/3: Input 0 channel 1 (IN0_CH1) PD: sdi-1 / IN0 CH1/2
IN2	AXLSE_PSDI_IN2	SAFEBOOL	External	AXL SE PSDI8/3: Input 0 channel 2 (IN0_CH2) PD: sdi-1 / IN0 CH2
OUT1	AXLSE_PSDO_OUT1	SAFEBOOL	External	AXL SE PSDO4/2 2A: Output 0 channel 1 (OUT0_CH1) PD: sdo-1 / OUT00 CH1/2
OUT2	AXLSE_PSDO_OUT2	SAFEBOOL	External	AXL SE PSDO4/2 2A: Output 0 channel 1 (OUT0_CH2) PD: sdo-1 / OUT00 CH2
OUT3	AXLF_PSDO_OUT	SAFEBOOL	External	AXL F PSDO8/3 1F: Output 0 channel 1 (OUT0_CH1) PD: axl-f-bk-pn-tps-1 / sdo-1 / sdo-1 / OUT00 CH1/2

Key: PD = Process Data element in PLCnext Engineer

- Select the “Variables” editor.
- Create the variables that you need for the selected POU (in the example in Figure 6-36: S_Main).
- Set the type and use for all created variables.

Figure 6-36 Creating variables for a POU (in the example: for the “S_Main” POU)

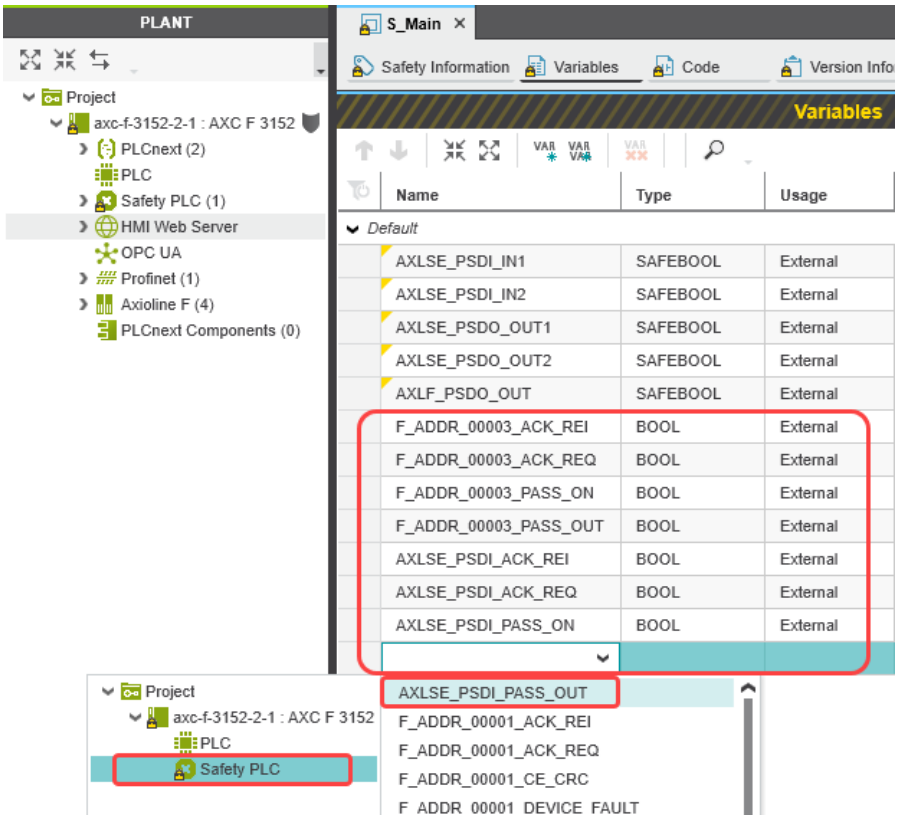


Selecting management/ diagnostic variables and exchange variables

Before the management/diagnostic variables and exchange variables that were created by default can be used in the code worksheet, you must select these variables in the variables worksheet.

- Select the “Variables” editor.
- Open the selection list by clicking on the arrow in the “Name” field (see Figure 6-37).
- Select the “Safety PLC”.
- Select the corresponding variable on the right-hand side of the window.
- Repeat this step for all the management/diagnostic variables and exchange variables shown in Figure 6-37.

Figure 6-37 Selecting management/diagnostic variables



Once you have created all of the necessary variables, create the program for the selected POU, see Section 6.9.7.

6.9.7 Creating a safety-related program

Safety-related example program

The safety-related example program in Figure 6-38 on page 116 includes the following functions:

– In the first part of the example, two inputs of the safety-related AXL SE PSDI8/3 input module are linked to two outputs of the safety-related AXL SE PSDO4/2 2A.
– In the second part of the example, two inputs of the safety-related AXL SE PSDI8/3 input module are linked with AND logic via the safety-related AND_S function block. The result will be linked to an output of the safety-related AXL F PSDO8/3 1F output module.
– In the third part of the example, exchange variables for the safety-related AXL SE PSDI8/3 input module from the “Exchange” variable group will be linked with the management/diagnostic variables. In the example, the passivation of an F-Device will be canceled via the variables with an operator acknowledge request and subsequent operator acknowledge reintegration (see Section “Operator acknowledge” on page 127).

The input/output variables are connected to process data in due course.

Creating a program

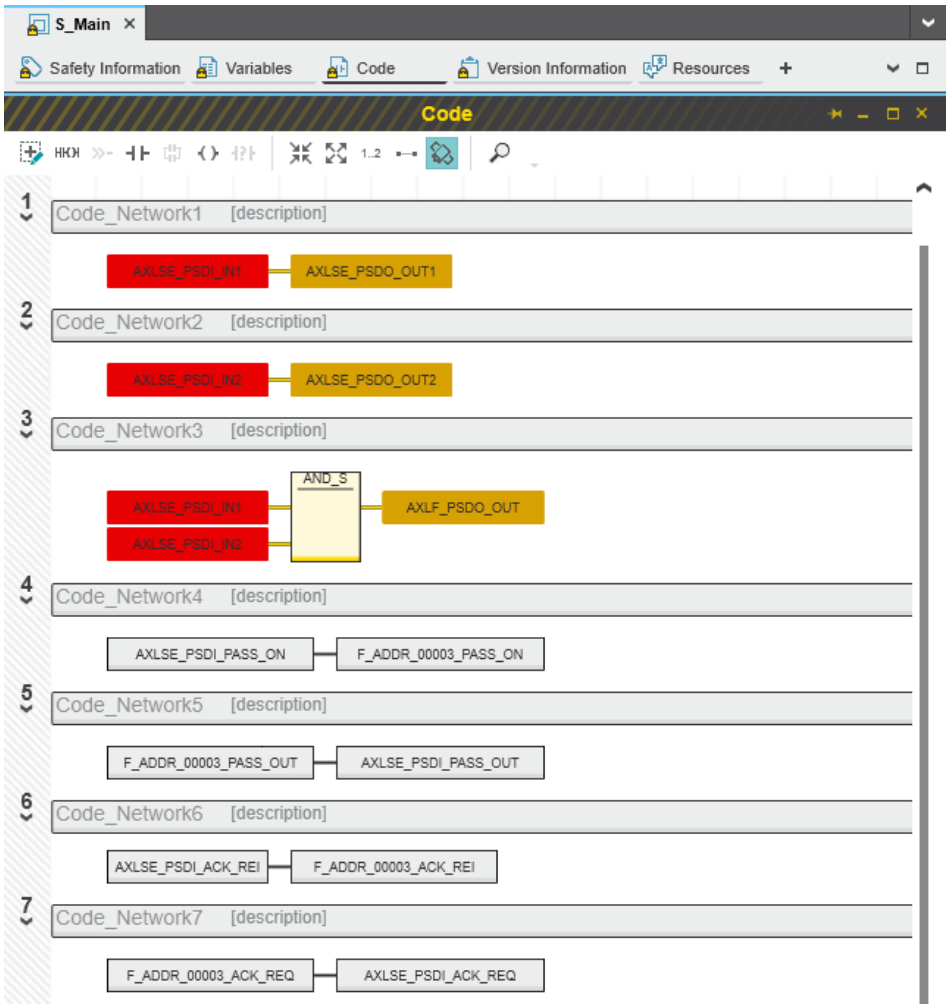
To create a program, proceed as follows:

• Select the code editor.

By default, the code editor is labeled with “Code”. You can change the designation of the code editor as desired.

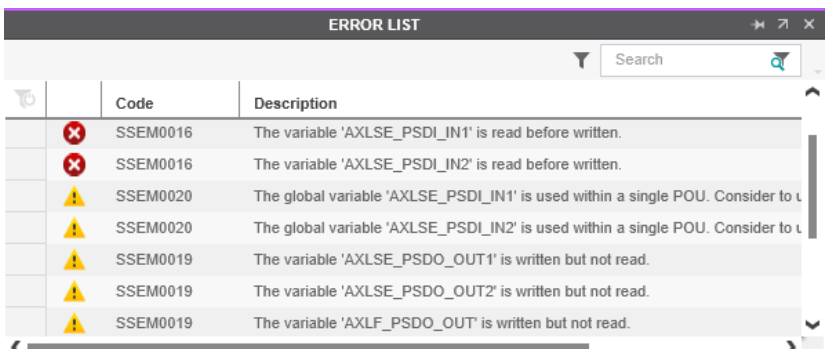
• Create the program as shown in Figure 6-38 on page 116.

Figure 6-38 Safety-related example program with errors displayed



The errors and warnings shown in Figure 6-38 (color-coded input and output variables in networks 1 to 3) are due to the fact that no process data has yet been assigned to these variables. You will execute this step in the following section.

Figure 6-39 Error list



6.9.8 Assigning safety-related process data

To assign a process data item to a variable, proceed as follows:

- Double-click on the “Safety PLC (x)” node in the “PLANT” area.

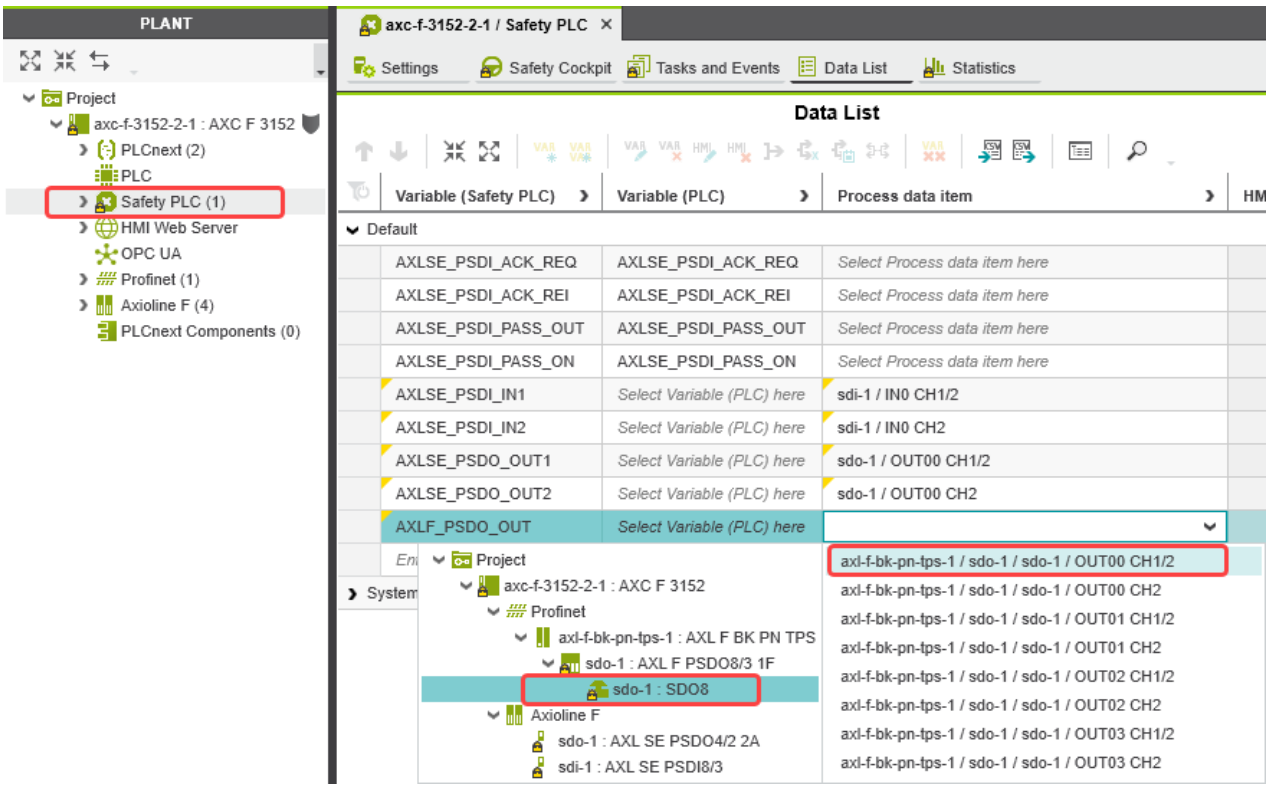
The “Safety PLC (x)” controller editor group opens.

- Select the “Data List” editor.

You can see an overview of all available variables in the “Data List” editor.

- In the “Process data item” column, use the role picker to assign the corresponding process data to all variables (see marking in section Figure 6-41).

Figure 6-40 Assigning safety-related process data



The following figure shows all safety-related variables created and the assigned process data:

Figure 6-41 Safety-related variables: Process data assigned

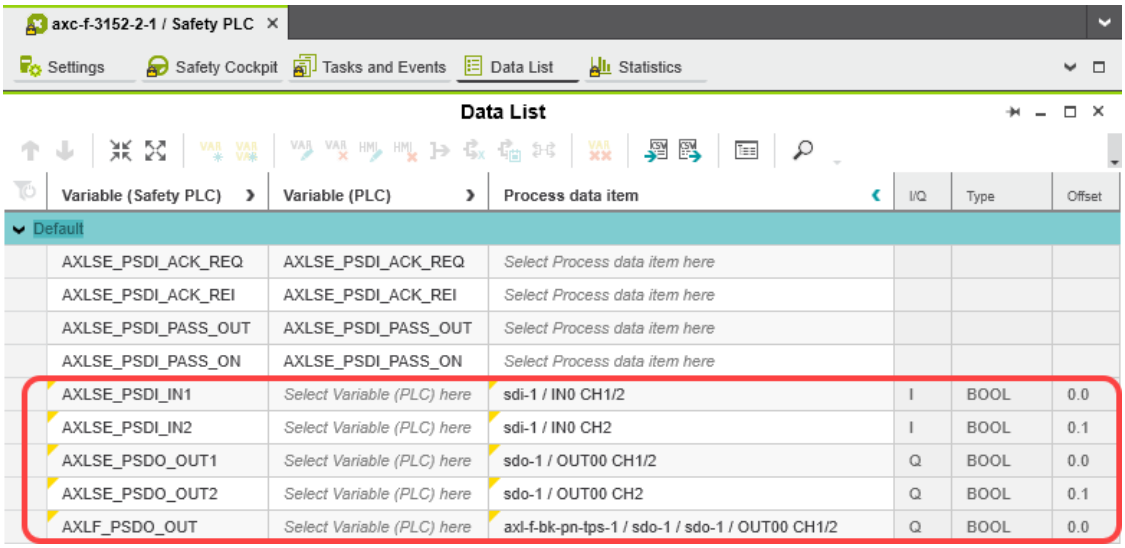
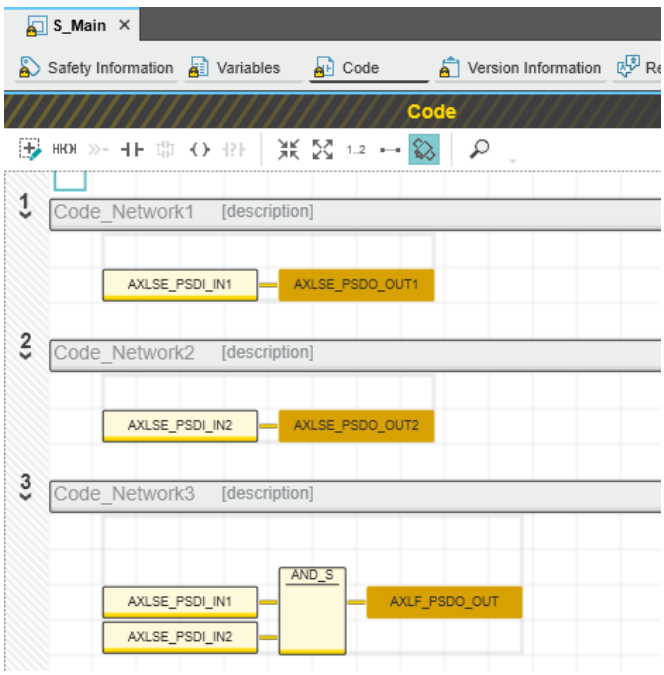


Figure 6-42 Safety-related program without errors



6.10 Transferring projects to PLCnext Control and SPLC 1000

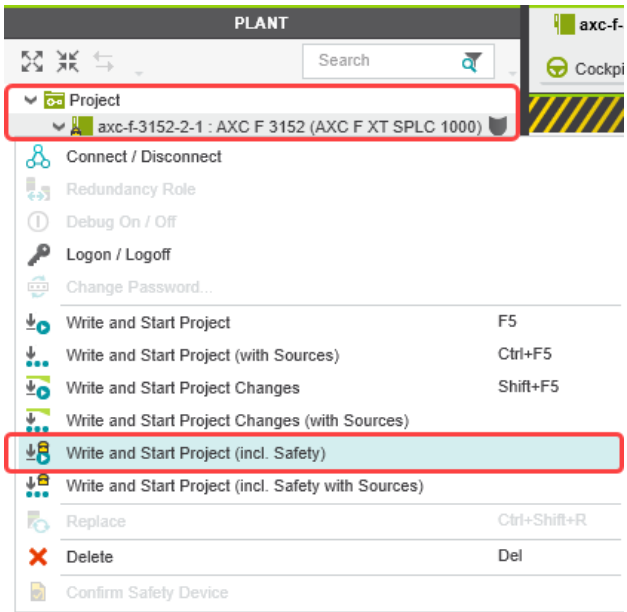
The PLCnext Engineer software enables simultaneous transmission of the non-safety-related project to the PLCnext Control device (in the example: AXC F 3152 controller) and of the safety-related project to the SPLC 1000.

Depending on the option selected in the top part of the context menu of the controller node in the PLANT area, two commands are available for transferring projects.

Proceed as follows:

- Right-click on the controller node in the PLANT area to open the context menu.
- In the context menu, click on “Write and Start Project (incl. Safety)”.

Bild 6-43 Controller node in the PLANT area:
“Write and Start Project (incl. Safety)” context menu



Signing in to the PLCnext Control device

PLCnext Control user authentication

If necessary, refer to the note on user authentication in Section 6.6.4.

- If necessary, enter the user name and password of the controller used in the dialog that opens.

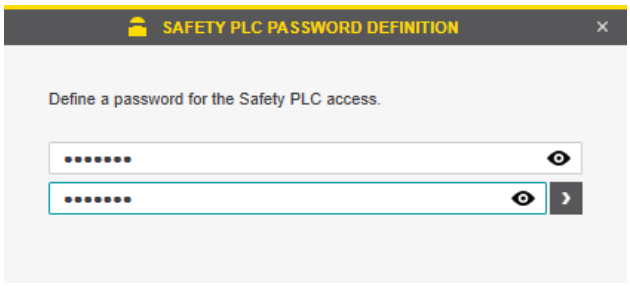
Specifying the SPLC 1000 controller password

The SPLC 1000 is protected by a controller password. Writing data to the SPLC 1000 or changing its operating mode is only possible after entering the controller password in PLCnext Engineer.

If this is the first time you are establishing a connection to the SPLC 1000, PLCnext Engineer will prompt you to specify a controller password.

- Specify a controller password, if you have not already done so, and the following dialog will be displayed.

Figure 6-44 Controller password: entering the SPLC 1000 password



Please note: Read information dialogs carefully and follow the instructions provided

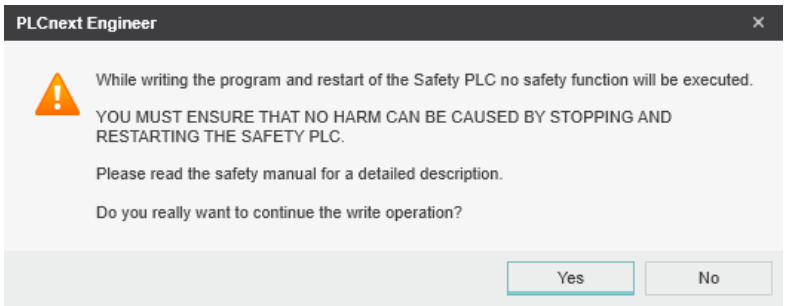
If information dialogs appear, please refer to the online help for the PLCnext Engineer software for further information.

- Acknowledge the messages in accordance with your application.

In the example:

- Make sure no hazard is posed when the SPLC 1000 is started and/or stopped, e.g., after downloading a project.
- Ensure the safety function is in order.

Figure 6-45 Info dialog: Avoid any hazard posed when starting and stopping the SPLC 1000



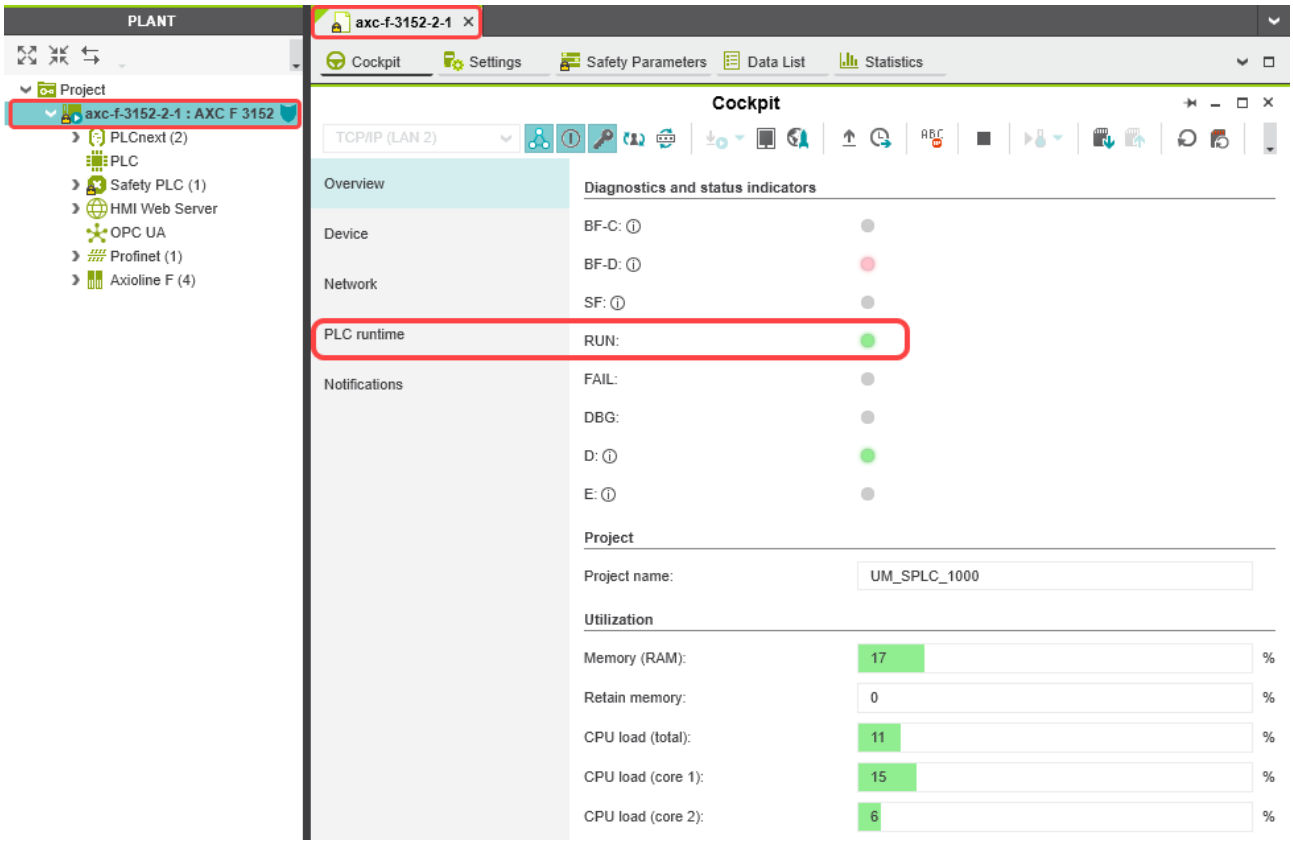
Transferring the non-safety-related program

The non-safety-related **p**roject is transferred to the controller.
Execution of the non-safety-related **p**roject is startet.

Once the safety-related startup has been completed seccesfully, the controller changes to RUN state. The permanently green RUN und D LEDs indicate this state.

The following information is displayed in the “Cockpit” editor:

Figure 6-46 Controller in the “RUN” state



If the system cannot be commissioned, for example due to an installation error, a corresponding error message appears in PLCnext Engineer.

The LEDs on the controller indicate this status. Read further information on the controller diagnostics and status indicators in the UM EN AXC F X152 user manual.

The SPLC 1000 is in the safe state (Failure State) because so far, no safety-related project has been transferred to the SPLC 1000.

Transferring the safety-related program

Immediately afterwards, the safety-related project is transferred to the SPLC 1000. Following sucessful transmission, the SPLC 1000 is restarted.

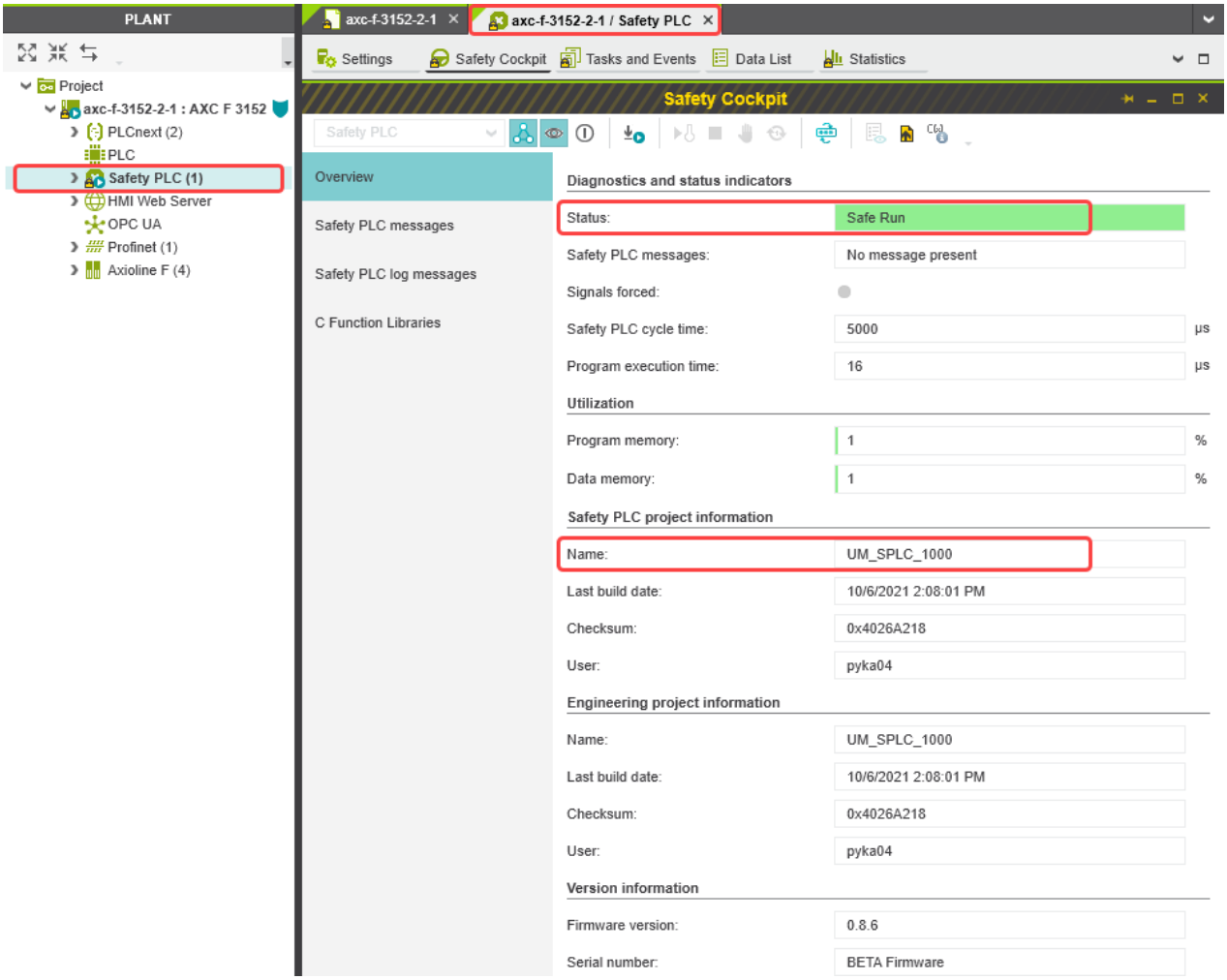
Figure 6-47 Sucessful transmission of the safety-related project and restart of the SPLC 1000

Execution of the safety-related project is started.

Once safety-related startup has been completed successfully, the SPLC 1000 changes to the RUN state. The permanently green RUN and C LEDs indicate this state.

The following information is displayed in the “Safety Cockpit” editor:

Figure 6-48 Safety Cockpit: SPLC 1000 in the “RUN” state – Safe Run



If the system cannot be commissioned, for example due to an installation error, a corresponding error message appears in PLCnext Engineer.

The LEDs on the SPLC 1000 indicate this status (see Section “Diagnostic and status indicators” on page 54).

6.11 Displaying safety-related online values

To view online variable values, you must have:

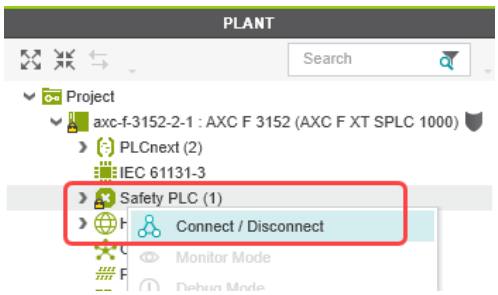
– Successfully compiled both projects (non-safety-related and safety-related)
– Transferred the non-safety-related project to the standard controller
– Transferred the safety-related project to the SPLC 1000
– Started both projects (non-safety-related and safety-related) without errors
– Connected the PLCnext Engineer online to the SPLC 1000 and the standard controller.

Proceed as follows:

- Right-click on the “Safety PLC (x)” node in the “PLANT” area to open the context menu.
- In the context menu, click on “Connect / Disconnect”.

PLCnext Engineer connects online to the SPLC 1000 to establish communication with online services.

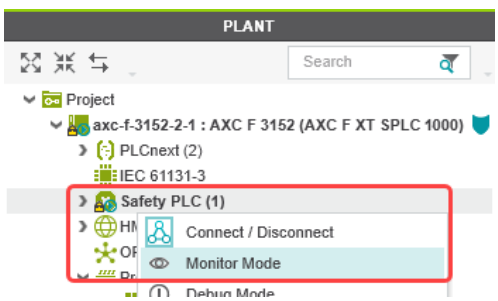
Figure 6-49 Connecting PLCnext Engineer online to the SPLC 1000



- In the context menu, click on “Monitor Mode”

PLCnext Engineer activates the monitoring mode for safety-related editors to display online values.

Figure 6-50 PLCnext Engineer: Activating the monitoring mode



- Open the instance editor of the “S_Main” POU by double-clicking on the “S_Main : S_-Main” node in the PLANT area.

If you are not currently logged into the safety-related area, you will now be prompted to enter the password in the “PROJECT AUTHENTICATION” dialog that opens (see “Project password: Logging into the Safety-related Area” on page 95).

The online values of the variables used in the “S_Main” POU are displayed in the “Variables” and “Code” editors.

Figure 6-51 “Variables” editor (S_Main): Online values of the variables used

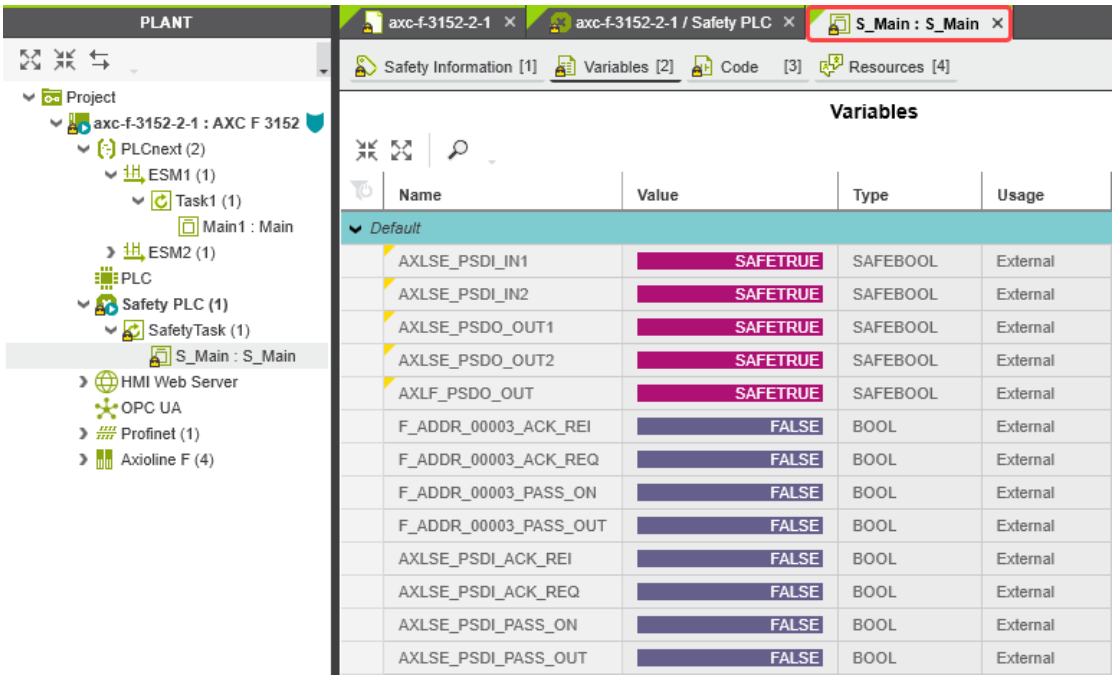
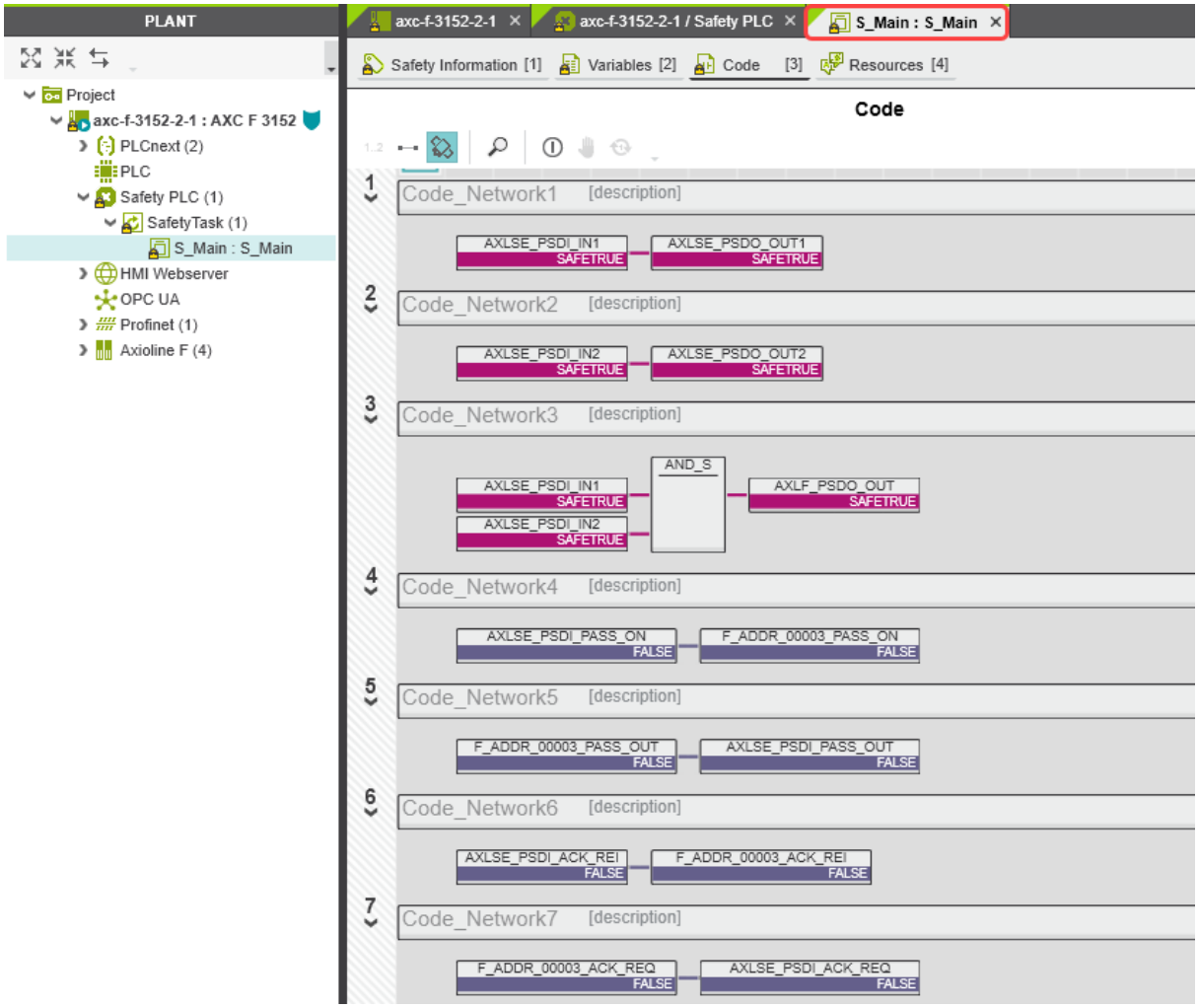


Figure 6-52 “Code” editor (S_Main): Online values of the variables used



6.12 PLCnext Engineer – Debug mode

- Double-click on the “Safety PLC (x)” node in the “PLANT” area.

The “Safety PLC” editor group opens.

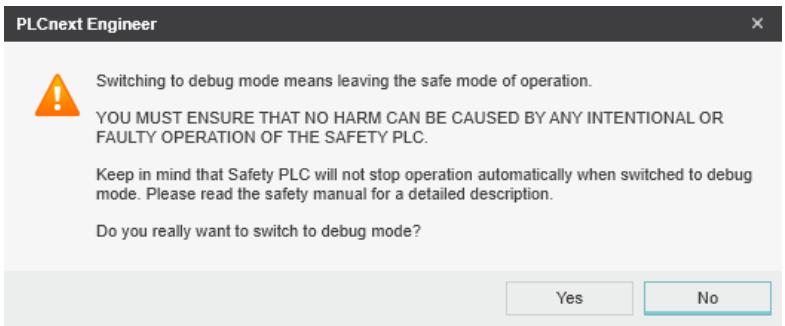
- Select the “Safety Cockpit” editor.
- Click on the button (“Connect to the controller to establish communication with online services.”).
- To enable debug mode, click on the button (“Enables or disables the debug mode at the safety-related PLC.”).

WARNING:
Switching to debug mode means that you will exit normal mode.

- Make sure that your system/machine cannot pose a hazard to people or equipment.

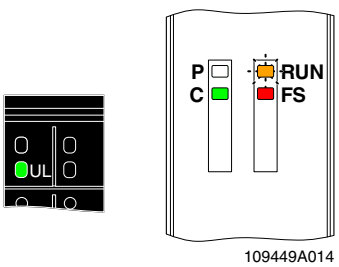
- Acknowledge the following message to switch to debug mode.

Figure 6-53 Exiting safe mode – switching to debug mode



The device LEDs indicate debug mode in the following way:

Figure 6-54 LEDs in debug mode



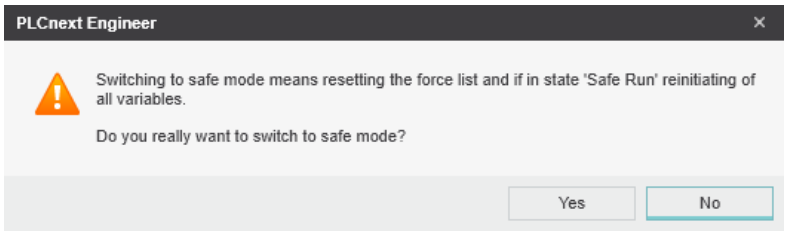
Refer to Section “Diagnostic and status indicators” on page 54 for additional information on the LEDs.

- To disable debug mode and switch to safe mode, click on the button.

WARNING:

- Make sure that your system/machine cannot pose a hazard to people or equipment.

Figure 6-55 Exiting debug mode – switching to safe mode



6.13 Operator acknowledge

F-Devices whose communication relationship with the F-Host of the SPLC 1000 is aborted, for example due to a communication error, are passivated. Passivated F-Devices indicate this with the F_ADDR_XXXXX_PASS_OUT management/diagnostic variable.
To request reintegration immediately upon re-establishment of the communication relationship between the F-Device and F-Host, the F-Devices generate an operator acknowledge request. This is displayed with the F_ADDR_XXXXX_ACK_REQ management/diagnostic variable. This operator acknowledge request is acknowledged via an operator acknowledge reintegration (F_ADDR_XXXXX_ACK_REI).

WARNING: Outputs can be set

- Do not acknowledge an operator acknowledge request automatically from the application program. Acknowledgment must be triggered by an intentional user action.

When reintegrating passivated PROFIsafe devices, safety-related outputs can be set.

- Take appropriate measures to ensure that your system/machine does not present any danger when passivated PROFIsafe devices are reintegrated.

In the following example, the communication relationship between the AXL SE PSDI8/3 F-Device and the F-Host of the SPLC 1000 is aborted. The subsequent passivation of the F-Device prevents it from starting up again immediately once the communication relationship is re-established. This passivation is indicated by the Boolean management/diagnostic variable F_ADDR_00003_PASS_OUT.

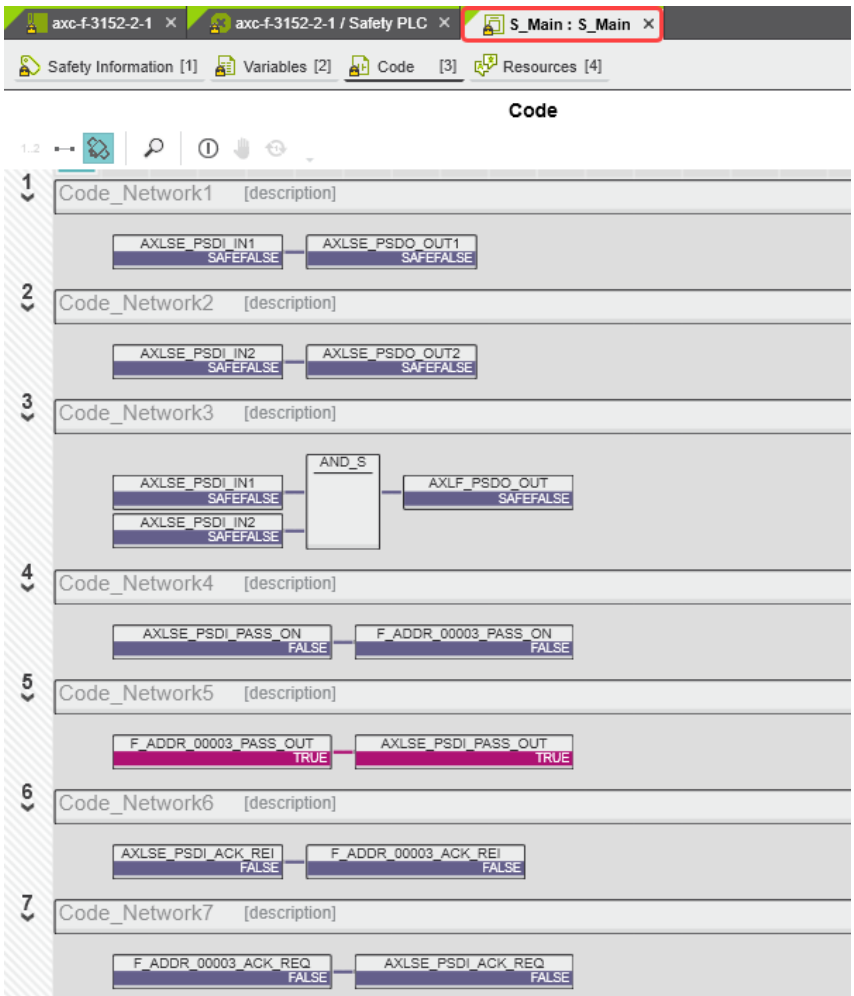
Once the communication relationship has been re-established successfully, the passivated F-Device signals an operator acknowledge request via the Boolean management/diagnostic variable F_ADDR_00003_ACK_REQ. The F-Device thus waits for a reintegration acknowledgement.

Setting the Boolean exchange variable AXLSE_PSDI_ACK_REI in the non-safety-related part of the example program cancels the passivation of the F-Device. As a result, the F-Device can be reintegrated into the network and can re-establish the communication relationship.

From now on safety-related process data is exchanged again between the F-Device and the F-Host of the SPLC 1000.

The following Figure 6-56 shows the passivated AXL SE PSDI8/3 F-Device.

Figure 6-56 PLCnext Engineer – Passivated PROFIsafe F-Devices



In the example in Figure 6-56, the safe inputs and outputs have entered the SAFEFALSE state. This behavior is due to the passivation of the F-Device.

7 Errors: Diagnostics, messages, and removal

The SPLC 1000 diagnostics and troubleshooting mechanisms are described in the following sections.

You will find further information on diagnostics for, among others, PLCnext Technology, Axioline F and PROFINET online at the listed addresses, in the listed user manuals, and in the PLCnext Engineer online help function:

- PLCnext Community at plcnext-community.net and in particular in the PLCnext Info Center
- "Installing, commissioning, and operating the AXC F 1152, AXC F 2152, and AXC F 3152 controllers" (UM EN AXC F X152)
- "Axioline F: Diagnostic registers and error messages" (UM EN AXL F SYS DIAG).

7.1 Diagnostics for F-Devices

PROFIsafe provides comprehensive diagnostic mechanisms that are defined in the PROFIsafe specification. For information on the PROFIsafe specification, please refer to Section "Documentation" on page 177.

Diagnostic messages for F-Devices are available as follows:

- Entries in the Notification Logger (Notification Manager)
- PROFIsafe-specific system variables in PLCnext Engineer (can be accessed in the application program, see Section 8.3 on page 143)

Refer to the device-specific user documentation for the F-Devices being used.

7.2 Diagnostics for SPLC 1000

The diagnostic and monitoring function integrated in the SPLC 1000 detects errors that have occurred. All serious errors detected in the SPLC 1000, which can lead to the loss of or adversely affect the programmed safety function, switch the device to the failure state. In this state, the outputs of the F-Devices are set to zero after the parameterized F_WD_TIME for the relevant output has elapsed at the latest. The PROFIsafe system switches to the safe state.

Exiting the Failure State of the SPLC 1000
Note that you can only leave the Failure State by doing the following:

- Download the safety-related project in the PLCnext Engineer software again, or
- Switch off the supply voltage of the SPLC 1000 and the PLCnext Control device for at least 30 seconds and then switch it back on again (Power UP) or
- Restart the SPLC 1000 and the PLCnext Control device in the PLCnext Engineer software in the following editors:
  - "Cockpit" of the PLCnext Control (in the example: AXC F 3152)
  - "Safety Cockpit" of the SPLC 1000

Diagnostic messages for the SPLC 1000 are available as follows:

– Entries are stored in the diagnostic memory of the SPLC 1000 (can be read with PLCnext Engineer). The “Safety PLC log messages” are displayed in the “Safety Cockpit” editor.
– As a hexadecimal value in the diagnostic parameter registers of the SPLC 1000. The registers are elements of the SPNSV2_TYPE structure, see Table 8-1 on page 143.
  Diagnostic parameter register 1: DIAG.PARAM_REG and
  Diagnostic parameter register 2: DIAG.PARAM_2_REG

For detailed information on diagnostics in the PLCnext Engineer software, please refer to the online help for the software.

Please contact your nearest Phoenix Contact representative if:

– One of the errors described in Section “Errors and error codes of the SPLC 1000 as the F-Host” on page 132 occurs again.
– Errors occur that are not listed in Section “Possible errors” on page 130.

7.3 Possible errors

This section describes possible errors, their causes, effects, and remedy. Section “Errors and error codes of the SPLC 1000 as the F-Host” on page 132 lists errors according to their error code.

Important notes:

FS LED/FS bit/failure state
Please note that for all error codes listed in the following Table 7-1 on page 132, the FS LED of the SPLC 1000 is always on and the FS bit is set in the SPNS_DIAG_STATUS_REG register.
The SPLC 1000 enters the failure state.

Observe error codes
If errors occur, always provide the service/support personnel from Phoenix Contact with the complete error code. These details provide important information for error analysis and repair.
The error codes are displayed in the SPNS_DIAG_PARAM_REG and SPNS_DIAG_PARAM_2_REG diagnostic parameter registers.
In debug mode, the error codes can be read in the PLCnext Engineer via the system variables.
For the safety hotline number, please refer to Section “Safety hotline” on page 25.

Error codes – Channel-dependent representation
Identical errors may occur on both independent processing channels of the SPLC 1000. Depending on the channel they are marked as follows:

0x8xxx	Channel 1
(0x9xxx)	Channel 2

for example:

0x8001	Channel 1
(0x9001)	Channel 2

In the following tables, both channel-dependent codes are listed for each error.

Order of project downloads

If further project downloads are required to ensure the consistency of projects, for example, please proceed as follows:

1. Download the non-safety-related project to the PLCnext Control (standard controller) used.
2. Download the safety-related project to the SPLC 1000.

Alternatively PLCnext Engineer provides two commands for downloading the projects in the context menu of the controller node in the PLANT area (see Section “Transferring projects to PLCnext Control and SPLC 1000” on page 119). Selecting one of these commands ensures the order of the project downloads.

Manual, user-initiated compilation of projects is not required. The PLCnext Engineer software compiles the projects prior to each project download.

Configuration memory

The terms “SD card” and “(pluggable) configuration memory” used in this user manual are synonyms.

Phoenix Contact

If the measures/remedies listed in the following tables do not help to remove the error, please contact your nearest Phoenix Contact representative.

NOTE: Startup of the SPLC 1000 and PLCnext Control device not ensured

In the following tables 7-1 and 7-2, observe this note with regard to remedies and responses to ensure proper startup of the SPLC 1000 and PLCnext Control device.

- For correct startup of the SPLC 1000 and the PLCnext Control device, switch on the supply voltage at the earliest 30 seconds after the device LEDs go out.

7.3.1 Errors and error codes of the SPLC 1000 as the F-Host

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

Error code (hex)	Error cause	Remedy or response
0x8001 (0x9001) to 0x8007 (0x9007)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8008 (0x9008)	The boot project is missing or incomplete.	• Check whether the non-safety-related project is loaded on the PLCnext Control device used. – If the non-safety-related project is loaded on the PLCnext Control device, download the safety-related project to the SPLC 1000 again. – If the non-safety-related project is not loaded on the PLCnext Control device, follow the instructions in the note on “Order of project downloads” above this table.
0x8009 (0x9009) to 0x8012 (0x9012)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8013 (0x9013)	The CPU load is higher than 90%.	• Reduce the processor load. • Analyze the safety-related project. Optimize the program code for better performance. • Avoid redundancies in the safety-related project so that the CPU load is not increased unnecessarily. • Check if the maximum number of F-Devices to be configured was exceeded. Reduce the number according to the information in Section “Technical data” on page 179, if necessary.

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

Error code (hex)	Error cause	Remedy or response
0x8014 (0x9014) to 0x8031 (0x9031)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8041 (0x9041) to 0x804A (0x904A)		
0x8061 (0x9061) to 0x806A (0x906A)		
0x8081 (0x9081) to 0x8085 (0x9085)		
0x80A1 (0x90A1) to 0x80A8 (0x90A8)		
0x80AA (0x90AA) to 0x80B0 (0x90B0)		
0x80C1 (0x90C1) to 0x80CE (0x90CE)		
0x80D1 (0x90D1) to 0x80D5 (0x90D5)		
0x80E1 (0x90E1) to 0x80E8 (0x90E8)		
0x80E9 (0x90E9)	The SD card is being used as an optional external memory. It was removed during operation.	Follow the instructions in note Section “NOTE: Startup of the SPLC 1000 and PLCnext Control device not ensured” on page 131 • Switch off the supply voltage of the SPLC 1000 and of the PLCnext Control device used. • Insert a properly working SD card containing the project in the PLCnext Control device or carry out the project downloads described in the note on “Order of project downloads” above this table if you are using an SD card not containing a project. • Boot the SPLC 1000 and the used PLCnext Control device by means of a power-off/power-on for both devices.

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

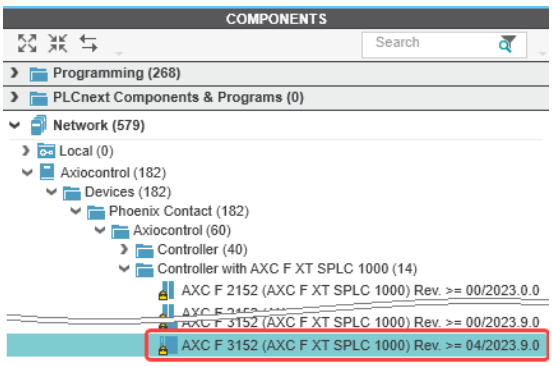
Error code (hex)	Error cause	Remedy or response
0x80EA (0x90EA), 0x80EB (0x90EB)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8101 (0x9101) to 0x8107 (0x9107)		
0x8110 (0x9110), 0x8111 (0x9111)		
0x8121 (0x9121) to 0x8125 (0x9125)		
0x8126 (0x9126)	Unknown version of the “pniodev.bin” file.	• Check whether the PLCnext Engineer version is suitable for the device versions used. • In the COMPONENTS area, under “Network, Axiocontrol, Devices, ..., Controller with AXC F XT SPLC 1000 (x)”, check if the “AXC F x152 (AXC F XT SPLC 1000) Rev. >= ...” template selected in the project matches the hardware and firmware versions of the SPLC 1000 and AXC F 2152 or AXC F 3152.  • Refer to the version information on the inner cover page of this user manual. • Download the non-safety-related project to the PLCnext Control device used. Download the safety-related project to the SPLC 1000. Follow the instructions provided in the note on “Order of project downloads” above this table. • If the error cannot be removed, please contact your nearest Phoenix Contact representative.
0x8127 (0x9127)	Unknown version of the “sdevpara.saf” file.	
0x8128 (0x9128)	Unknown version of the “swap.list” file.	

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

Error code (hex)	Error cause	Remedy or response
0x8129 (0x9129)	Inconsistent device parameters.	Follow the instructions in note Section "NOTE: Startup of the SPLC 1000 and PLCnext Control device not ensured" on page 131 • Check the device parameterization in your safety-related program. • Boot the SPLC 1000 and the used PLCnext Control device by means of a power-off/power-on for both devices. • Download the non-safety-related project to the PLCnext Control device used. Download the safety-related project to the SPLC 1000. Follow the instructions provided in the note on "Order of project downloads" above this table. If none of the steps described above remove the error: • Carry out the project downloads described in the note on "Order of project downloads" above this table if you are using an SD card not containing a project. • Boot the SPLC 1000 and the used PLCnext Control device by means of a power-off/power-on for both devices. • Replace the SPLC 1000. If the procedure described above does not rectify the error, please contact your nearest Phoenix Contact representative.
0x812A (0x912A)	Inconsistent process data description.	• Check process data assignment in your safety-related project. • Download the non-safety-related project to the PLCnext Control device used. Download the safety-related project to the SPLC 1000. Follow the instructions provided in the note on "Order of project downloads" above this table. • If the error cannot be removed, please contact your nearest Phoenix Contact representative.
0x812B (0x912B)	Internal error	Please contact your nearest Phoenix Contact representative.
0x812C (0x912C)	Maximum number of supported F-Devices exceeded.	Reduce the number of F-Devices connected to the SPLC 1000.
0x812D (0x912D)	Internal error	Please contact your nearest Phoenix Contact representative.
0x812E (0x912E)		

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

Error code (hex)	Error cause	Remedy or response
0x812F (0x912F)	The F-Destination address is invalid or outside the permissible range.	• Check the F-Destination addresses used in the project. • If necessary, correct the corresponding addresses.
0x8130 (0x9130)	Maximum number of supported process data descriptions exceeded.	Reduce the number of the process data descriptions.
0x8131 (0x9131) to 0x8136 (0x9136)	Inconsistent process data description.	• Check the process data and process data assignment. • Download the non-safety-related project to the PLCnext Control device used. Download the safety-related project to the SPLC 1000. Follow the instructions provided in the note on “Order of project downloads” above this table. • If the error cannot be removed, please contact your nearest Phoenix Contact representative.
0x8137 (0x9137) to 0x813C (0x913C)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8141 (0x9141) to 0x8150 (0x9150)		
0x8161 (0x9161) to 0x8165 (0x9165)		
0x8181 (0x9181) to 0x8186 (0x9186)		
0x8241 (0x9241) to 0x8247 (0x9247)		
0x824A (0x924A) to 0x824C (0x924C)	Internal error	Please contact your nearest Phoenix Contact representative.
0x824D (0x924D)	Ambient temperature is not in the specified range.	Check the ambient conditions (e.g., sufficient ventilation in the control cabinet) and operate the SPLC 1000 within the range specified.

Table 7-1 Errors codes of the SPLC 1000 as the F-Host

Error code (hex)	Error cause	Remedy or response
0x824E (0x924E) to 0x825C (0x925C)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8F00 (0x9F00) to 0x8F02 (0x9F02)		
0x8F03 (0x9F03) to 0x8F07 (0x9F07)	Hardware fault.	
0x8F08 (0x9F08) to 0x8F0B (0x9F0B)	An error occurred during the firmware upgrade.	Observe further instructions from a person instructed in performing the update.

7.3.2 Errors and error codes of the SPLC 1000 as an F-Device

Table 7-2 Errors codes of the SPLC 1000 as an F-Device

Error code (hex)	Error cause	Remedy or response
0x8141 (0x9141) to 0x8147 (0x9147)	Internal error	Please contact your nearest Phoenix Contact representative.
0x8148 (0x9148)	F-Parameter length invalid	Follow the instructions in note Section “NOTE: Startup of the SPLC 1000 and PLCnext Control device not ensured” on page 131 • Check the F-Device parameterization in your superordinate safety-related controller (F-Host). • If necessary, download the safety-related project to the superordinate safety-related controller. • Boot the SPLC 1000 and the used PLCnext Control device by means of a power-off/power-on for both devices.
0x8149 (0x9149)	F-Device not initialized	

7.4 Evaluation and acknowledgment of module-specific diagnostic messages

Depending on the error type, errors that are diagnosed in the Axioline F and Axioline Smart Elements PROFIsafe modules from Phoenix Contact used are transmitted to the SPLC 1000 as diagnostic messages via PROFINET.

The product documentation for the modules used contains an overview of the diagnosed errors, their causes, effects, and possible measures for error removal. It also includes information regarding module behavior following acknowledgment of diagnostic messages.

- For every error that occurs, the cause of the error must first be removed.
- If necessary, the error is then acknowledged.

Phoenix Contact provides special function blocks for device-specific diagnostics for the Axioline F backplane bus system. These function blocks enable global or local device-specific diagnostics.

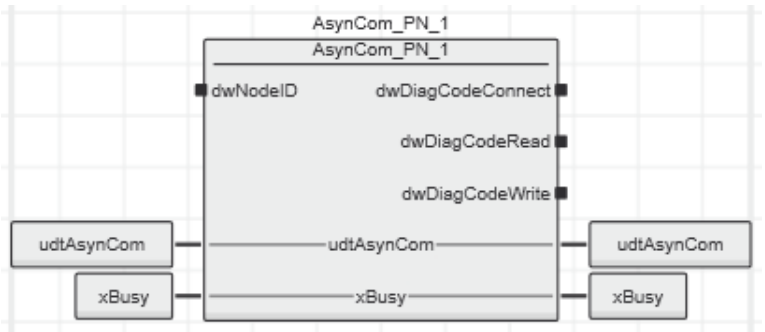
For this purpose, the AsynCom_PN_1 function block from the AsynCom_9 library for PLCnext Engineer must be used. This function block is used for reading information of the connected PROFINET devices. The function block receives this information from the configuration of the SPLC 1000 (device IDs, PROFINET names, etc.).

In addition, function blocks from the PN_Dev_Diag_5 library for PLCnext Engineer must also be used. An example of device-specific PROFIsafe diagnostics is the PNFD_AXL_Diag_2 function block. This function block is used to perform diagnostics on a safety-related device of the Axioline F product group via the PROFIsafe address. Displayed diagnostic messages can be confirmed (acknowledged) with the help of the function block.

7.4.1 AsynCom_PN_1 function block

Function block for reading information of the connected PROFINET devices.

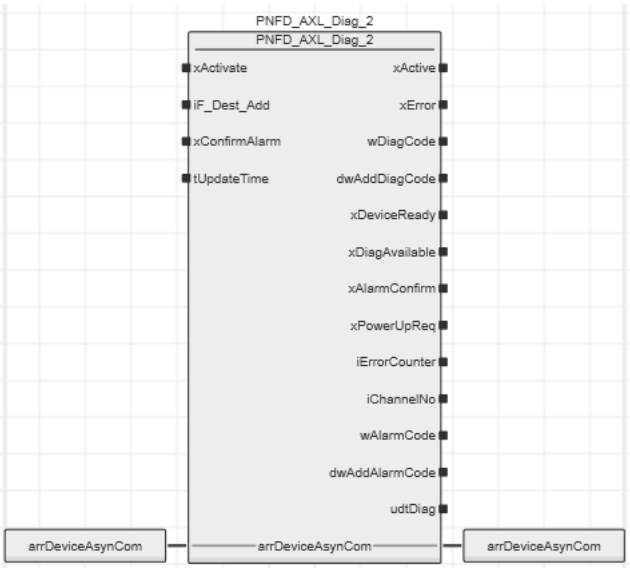
Figure 7-1 AsynCom_PN_1 function block (instance: AsynCom_PN_1)



7.4.2 PNFD_AXL_Diag_2 function block

Function block for diagnostics of a secure device of the Axioline F product group via the PROFIsafe address. Diagnostic messages that need to be confirmed can be confirmed with the help of the block.

Figure 7-2 PNFD_AXL_Diag_2 function block (instance: PNFD_AXL_Diag_2)



Safety notes for starting applications

- Take the following into consideration when determining and programming the start conditions for your machine or system:
  - The machine or system may only be started if it can be ensured that nobody is present in the danger zone.
  - Meet the requirements of EN ISO 13849-1 with regard to the manual reset function. The machine must not be set in motion and/or a hazardous situation must not be triggered by the following actions, for example:
    - Switching on safe devices
    - Acknowledging device error messages
    - Acknowledging communication errors
    - Acknowledging block error messages in the application
    - Removing startup inhibits for safety functions
- Observe the following when programming/configuring the safety logic:
  - Switching from the safe state (substitute value = 0) to the operating state can generate an edge change (zero/one edge).
  - In the safety logic, take measures to prevent this edge change resulting in unexpected machine/system startup or restart.

Note for starting applications

- Also observe these notes to prevent unexpected machine startup after confirming an “Operator Acknowledgement”.

8 System variables and status information

8.1 General information

This section describes the system variables that are available for the SPLC 1000.

The SPLC 1000 has a register set that is used for diagnostics and simple control of the SPLC 1000.

The diagnostic data is stored in the diagnostic status register and the diagnostic parameter register. These registers are available to the application program as system variables (system flags, global variables).

8.2 Data structures

Some system variables of the SPLC 1000 are organized as data structures. The data structure for this type of system variable contains further system variables.
In the Init Value Configuration of PLCnext Engineer, you can see which specific system variables belong to a system variable that is organized as a data structure.

To open the Init Value Configuration for a system variable organized as a data structure, proceed as follows:

- Double-click on the “PLC” node in the “PLANT” area.

The “/ PLC” controller editor group opens.

- Select the “Data List” editor.

Alternatively, you can open the “Data List” editor via the controller node in the “PLANT” area.

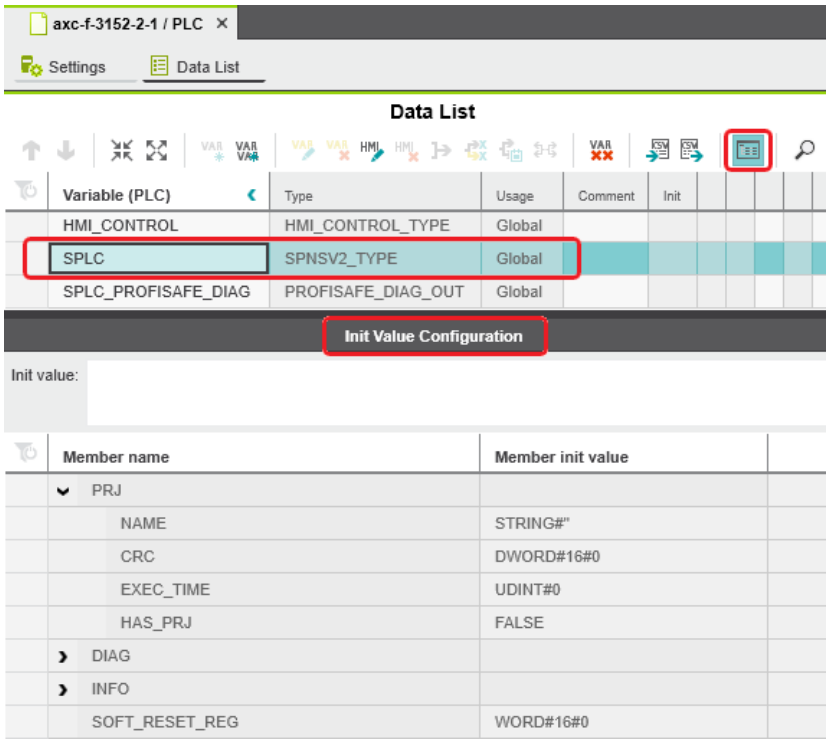
- Open the “System Variables” section.
- In the “Variable (PLC)” column, click on the arrow to display additional information.

The data type of the system variable is displayed in the “Type” column of the additional information.

- Select the row for the system variable organized as a data structure whose associated system variables you would like to view.
  To do this, click on the first column in the row for the system variable organized as a data structure.
- Click on the button to open the Init Value Configuration for the system variable organized as a data structure.

The Init Value Configuration for the selected system variable organized as a data structure opens below the “Data List” editor.

Figure 8-1 Example AXC F 3152: Init Value Configuration for the SPLC system variable organized as a data structure (SPNSV2_TYPE data type)



The “Member name” column in the Init Value Configuration displays all the system variables contained in the system variable which is organized as a data structure.

8.3 System variables of the SPLC 1000

8.3.1 SPLC system variable

The SPLC system variable uses the SPNSV2_TYPE data structure to provide the following information on the SPLC 1000.

Table 8-1 SPLC system variable and elements of the SPNSV2_TYPE data structure

System variable/elements	Type	Meaning
SPLC	SPNSV2_TYPE	The SPLC system variable provides the information in the SPNSV2_TYPE data structure.
PRJ		
NAME	STRING	PLCnext Engineer project name.
CRC	DWORD	Project CRC (32 bits) of the SPLC 1000 boot project.
EXEC_TIME	UDINT	Runtime of the SPLC 1000 program cycle in µs.
HAS_PRJ	BOOL	The safety-related application program and the program sources are contained in the memory of the SPLC 1000.
DIAG		
STATUS_REG	WORD	Diagnostic status register of the SPLC 1000 The diagnostic status register of the SPLC 1000 contains the status information of the SPLC 1000. It mirrors the state of the SPLC 1000 at all times including any error states that have occurred on the SPLC 1000. Additional information and error parameters, in particular in the failure state (FS), are included in the relevant diagnostic parameter registers of the SPLC 1000 (elements SPNS.DIAG.PARAM_REG and SPNS.DIAG.PARAM_2). The information in the diagnostic status register is detailed in Table 8-2 on page 145.
PARAM_REG	WORD	Diagnostic parameter register 1 of the SPLC 1000 (error code).
PARAM_2_REG	WORD	Diagnostic parameter register 2 of the SPLC 1000 (additional error messages for service/support).
EXT_PARAM_REG	DWORD	Extended diagnostic parameter register of the SPLC 1000 (additional error messages for service/support).
CH2_PARAM_REG	WORD	Diagnostic parameter register 1 of the SPLC 1000 channel 2 (CH2) (error code).
CH2_PARAM_2_REG	WORD	Diagnostic parameter register 2 of the SPLC 1000 channel 2 (CH2) (additional error messages for service/support).
CH2_EXT_PARAM_REG	DWORD	Extended diagnostic parameter register of the SPLC 1000 channel 2 (CH2) (additional error messages for service/support).
INFO		
CYCLE_TIME	UDINT	SPLC 1000 cycle in µs
TEMP		
TEMP_CURRENT	INT	Currently measured internal device temperature of the SPLC 1000

Table 8-1 SPLC system variable and elements of the SPNSV2_TYPE data structure

System variable/elements	Type	Meaning
TEMP_MIN	INT	Minimum measured SPLC 1000 temperature since the last power-on of the device.
TEMP_MAX	INT	Maximum measured SPLC 1000 temperature since the last power-on of the device.
STATUS_REG	WORD	SPLC 1000 temperature status register 0x0000: The internal device temperature of the SPLC 1000 is in the non-critical range. 0x0080: The internal device temperature of the SPLC 1000 is in the critical range, close to the tolerance threshold. The SPLC 1000 remains in RUN state and, in parallel, issues a warning with error code 0xFA41. 0x8000: The internal device temperature of the SPLC 1000 is beyond the permitted range. The SPLC 1000 goes into safe state and issues an error message with error code 0x924D.
CPU		
LOAD_CURRENT	INT	Current SPLC 1000 CPU load
LOAD_MIN	INT	Minimum measured SPLC 1000 CPU load since the last power-on of the device.
LOAD_MAX	INT	Maximum measured SPLC 1000 CPU load since the last power-on of the device.
STATUS_REG	WORD	SPLC 1000 CPU status register
FW_VERSION		
VERSION_MAJOR	BYTE	Major version of the SPLC 1000 firmware
VERSION_MINOR	BYTE	Minor version of the SPLC 1000 firmware
VERSION_BUILD	WORD	Build number of the SPLC 1000 firmware
FPGA_VERSION		
VERSION_MAJOR	BYTE	Major version of the SPLC 1000 hardware FPGA
VERSION_MINOR	BYTE	Minor version of the SPLC 1000 hardware FPGA
VERSION_BUILD	WORD	Build number of the SPLC 1000 hardware FPGA
NUM_OF_ACTIVE_ARS	UINT	Number of active PROFINET application relations (AR)
FW_UPDATE_STATUS	UINT	Status of safety-related firmware update
SOFT_RESET_REG	WORD	Software reset register of the SPLC 1000

8.3.2 SPLC.DIAG.STATUS_REG.xxx diagnostic status register

The following table describes the information of the individual bits (0 ... 15) in the diagnostic status register (SPLC.DIAG.STATUS_REG.xxx)

Table 8-2 Elements in the diagnostic status register (SPLC.DIAG.STATUS_REG.xxx)

System variable/elements	Type	Meaning
SPLC	See above	See above
DIAG	See above	See above
STATUS_REG	See above	See above
DBG [3]	BOOL	Non-safe debug mode of the SPLC 1000 The SPLC 1000 is in one of the two DEBUG states (DEBUG RUN or DEBUG STOP/DEBUG HALT).
EST	BOOL	There is an entry in the error memory of the safe operating system (error stack) of the SPLC 1000. Diagnostic and error messages from the safe SPLC 1000 operating system are present. These messages can be read and evaluated via PLCnext Engineer. This variable is always set to TRUE if there is at least one entry in the error memory of the safe operating system. As soon as the error memory has been read and emptied via PLCnext Engineer, the value of the variable changes to FALSE.
FS	BOOL	Failure State of the SPLC 1000 An error has been detected which sets the SPLC 1000 to the safe state (failure state). The corresponding additional error code is included in this state in the diagnostic parameter registers of the SPLC 1000 (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG).
INIT [2]	BOOL	Initialization of the SPLC 1000 Initialization of the SPLC 1000 firmware (safe operating system) has been performed and completed without errors.
IO [2]	BOOL	Initialization of the SPLC 1000 F-Host for I/O channel communication Initialization of the F-Host for PROFIsafe communication with the PROFIsafe I/O devices has been completed without any errors.
PON [2]	BOOL	Power-on process The SPLC 1000 is supplied with power. The firmware was downloaded to the main memory of the SPLC 1000 and started. The comprehensive self-test routines of the device have been completed successfully.
POST	BOOL	Power-on self-test of the SPLC 1000 (**P**OWER **O**N **S**ELFTEST) Power-on self-test of the SPLC 1000 is active.

Table 8-2 Elements in the diagnostic status register (SPLC.DIAG.STATUS_REG.xxx)

System variable/elements	Type	Meaning
PRO [2]	BOOL	Loading and starting of the safety-related application program The safety-related application program, which was created using PLCnext Engineer, has been loaded without any errors to the safe SPLC 1000 operating system and started.
RUN [3]	BOOL	Execution of the safety-related application program (RUN) The SPLC 1000 executes the safety-related application program and is in one of the two RUN states (SAFE RUN or DEBUG RUN).
SYN [2]	BOOL	Synchronization of SPLC 1000 and the standard controller (PLCnext Control) Synchronization between the SPLC 1000 and the standard controller (PLCnext Control) was completed successfully.
WARN	BOOL	Warning of the SPLC 1000 A group warning message of the SPLC 1000 is present.

[2] The variables indicate the startup status of the SPLC 1000. The startup sequence of the SPLC 1000 is divided into the following five consecutive sections:

1. Power-on process
2. Initialization of the SPLC 1000
3. Loading and starting of the safety-related application program
4. Synchronization of the SPLC 1000 and the standard controller (PLCnext Control device)
5. Initialization of the SPLC 1000 F-Host for I/O channel communication

[3] The variables indicate the RUN and DEBUG operating states of the SPLC 1000.

SPLC.DIAG.STATUS_REG diagnostics status register: Meaning of the individual bits

The SPLC.DIAG.STATUS_REG diagnostic status register contains the status information of the SPLC 1000. It mirrors the state of the SPLC 1000 at all times including any error states that have occurred on the SPLC 1000. Additional information and error parameters, in particular in the failure state (FS), are contained in the associated diagnostic parameter registers of the SPLC 1000 (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG) and in the extended diagnostic parameter register (SPLC.DIAG.EXT.PARAM_REG).

Table 8-3 Diagnostic status register of the SPLC 1000: SPLC.DIAG.STATUS_REG

Bit 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FS	POST	Res.	EST	Res.	Res.	Res.	Res.	WARN	DBG	RUN	I/O	SYN	PRO	INIT	PON

Bits 0 to 4

Bits 0 to 4 indicate the startup status of the SPLC 1000. The startup sequence of the SPLC 1000 is divided into the following five steps:

PON Power-on process complete

This bit is set as soon as the SPLC 1000 is supplied with power. The firmware was downloaded to the main memory of the SPLC 1000 and started. The comprehensive self-test routines of the device have been completed successfully.

INIT Initialization of the SPLC 1000 complete

This bit is set as soon as initialization of the SPLC 1000 firmware (safe operating system) has been completed without errors.

PRO Safety-related application program loaded and started

This bit is set as soon as the safety-related application program, which was created using PLCnext Engineer, has been loaded to the safe SPLC 1000 operating system without any errors and started.

SYN Synchronization of the SPLC 1000 and the standard controller (PLCnext Control)

The bit is set when the SPLC 1000 and the standard controller are synchronized.

I/O I/O channel communication initialized

This bit is set as soon as initialization of the F-Host for PROFIsafe communication with the PROFIsafe I/O devices has been completed without any errors.

Bits 5 and 6

The RUN and DBG bits indicate the operating status of the SPLC 1000.

RUN RUN mode of the SPLC 1000

This bit is set when the SPLC 1000 executes the safety-related application program and is in one of the two RUN states (SAFE RUN or DEBUG RUN).

DBG	Non-safe debug mode of the SPLC 1000 This bit is set when the SPLC 1000 is in one of the two DEBUG states (DEBUG RUN or DEBUG STOP/DEBUG HALT). This bit is not set in the SAFE STOP and SAFE RUN states. **Bits 7 and 10**
WARN	The set WARN (WARNING) bit indicates a group warning message of the SPLC 1000. **Bit 12**
EST	The EST (error stack) bit indicates that diagnostic and error messages for the safe SPLC 1000 operating system are present. These messages can be read and evaluated via PLCnext Engineer. This bit is always set if there is at least one entry in the error memory of the safe operating system. As soon as the error memory has been read and emptied via PLCnext Engineer, this bit is automatically reset to zero. **Bit 14**
POST	POWER ON SELF TEST This bit is set for the duration of the comprehensive power-on self-test of the SPLC 1000. It is reset once the power-on self-test is complete. **Bit 15**
FS	Failure State This bit is set as soon as an error has been detected, which sets the SPLC 1000 to the failure state. The corresponding additional error code is included in this state in the diagnostic parameter registers of the SPLC 1000 (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG).
Res.	Reserved

8.3.3 SPLC_PROFISAFE_DIAG system variable

The SPLC_PROFISAFE_DIAG system variable uses the PROFISAFE_DIAG_OUT data structure to provide further information on the SPLC 1000.

Table 8-4 SPLC_PROFISAFE_DIAG system variable and elements of the PROFISAFE_DIAG_OUT structure

System variable/elements	Type	Meaning
SPLC_PROFISAFE_DIAG	PROFISAFE_DIAG_OUT	The data structure provides PROFIsafe diagnostic information of the individual configured F-Devices.
MAX_PS_RECORDS	UINT	Maximum number of F-Devices to be configured
USED_PS_RECORDS	UINT	Configured number of F-Devices
PS_RECORDS		
[1] ... [300]		PROFIsafe records 1 ... 300
CODE_NAME	DWORD	–
DIAG_BIT_FIELD	DWORD	–
SRT_MIN	UINT	Minimum roundtrip time between F-Host and F-Device
SRT_MAX	UINT	Maximum roundtrip time between F-Host and F-Device
SRT_CUR	UINT	Current roundtrip time between F-Host and F-Device
FWD_TIME	UINT	Watchdog time
VALID_REG	UINT	–
NODE_ID	UDINT	Node ID
Reserved	UINT	Reserved
PS_GLOBAL_RECORD	DWORD	–

8.3.4 SPLC_CONTROL_COMMAND and SPLC_CONTROL_CONFIRM system variables

The SPLC_CONTROL_COMMAND system variable is used to request the resetting of diagnostic values from the non-safety-related project. Via the system variable SPLC_CONTROL_CONFIRM, the SPLC 1000 confirms that the diagnostic values have been reset in the non-safety-related project.

SPLC_CONTROL_COMMAND

This system variable requests the resetting of diagnostic values from the non-safety-related project.

Table 8-5 SPLC_CONTROL_COMMAND system variable and elements of the SPNS_CONTROL_TYPE data structure

System variable/elements	Type	Meaning
SPLC_CONTROL_COMMAND	SPLC_CONTROL_TYPE	Data structure with 32 bits for enabling SPLC 1000 functions.
CODE	DWORD	Bit 0: Resets the minimum and maximum safety roundtrip times (SRT_MIN, SRT_MAX). Data direction: Standard controller → SPLC 1000 (F-Host)
PARAM	DWORD	Bits 1 ... 31: Reserved.

SPLC_CONTROL_CONFIRM

This system variable shows in the non-safety-related project the acknowledgement from the SPLC 1000 that diagnostic values have been reset.

Table 8-6 SPLC_CONTROL_CONFIRM system variable and elements of the SPNS_CONTROL_TYPE data structure

System variable/elements	Type	Meaning
SPLC_CONTROL_CONFIRM	SPLC_CONTROL_TYPE	Data structure with 32 bits for confirming functions of the SPLC 1000 that have been requested via the SPLC_CONTROL_COMMAND variable.
CODE	DWORD	Bit 0: Confirms the resetting of the minimum and maximum safety roundtrip times (SRT_MIN, SRT_MAX). Data direction: SPLC 1000 (F-Host) → standard controller
PARAM	DWORD	Bits 1 ... 31: Reserved.

8.3.5 FDEV_INx and FDEV_OUTx (x = 0 ... 7) system variables

These system variables are used for the data exchange between the F-Device of the SPLC 1000 and the higher-level safety-related controller (F-Host).

Table 8-7 FDEV_INx and FDEV_OUTx (x = 0 ... 7) system variables

System variable	Type	Meaning
FDEV_IN0 ... FDEV_IN7	SAFEBYTE	Input process data of the F-Device instance of the SPLC 1000
FDEV_OUT0 ... FDEV_OUT7	SAFEBYTE	Output process data of the F-Device instance of the SPLC 1000

Please observe the informationen in Section “System variables for the data exchange of the F-Device of the SPLC 1000” on page 35.

8.3.6 Management/diagnostic variables for each configured, lower-level F-Device

The table below lists management/diagnostic variables. These variables can be created in PLCnext Engineer for each configured, lower-level F-Device. The table shows which variables are created by default. This setting can be modified by changing the value (Create/Do not create) (see Figure 6-30 on page 107).

Management/diagnostic variable	Default setting
F_ADDR_[nnnnn]_ACK_REQ	Create
F_ADDR_[nnnnn]_ACK_REI	Create
F_ADDR_[nnnnn]_PASS_OUT	Create
F_ADDR_[nnnnn]_PASS_ON	Create
F_ADDR_[nnnnn]_DEVICE_FAULT	Create
F_ADDR_[nnnnn]_CE_CRC	Create
F_ADDR_[nnnnn]_WD_TIMEOUT	Create
F_ADDR_[nnnnn]_IPAR_OK	Do not create
F_ADDR_[nnnnn]_IPAR_EN	Do not create
F_ADDR_[nnnnn]_CHF_ACK_REI	Do not create
F_ADDR_[nnnnn]_CHF_ACK_REQ	Do not create
F_ADDR_[nnnnn]_CE_CRC_H	Do not create
F_ADDR_[nnnnn]_WD_TIMEOUT_H	Do not create
F_ADDR_[nnnnn]_LOOPBACK	Do not create

WARNING: Variables can be toggled
The variables specified in Table 8-8 can be toggled.

- Program an evaluation function in the PLCnext Engineer software (e.g., using edge detection).

Table 8-8 Management/diagnostic variables for each configured, lower-level F-Device

System variable	Type	Meaning
F_ADDR_[nnnnn]_PASS_ON *)	BOOL	F-Device [nnnnn] is passivated when this variable is set to TRUE from the application program. **WARNING:** Resetting this variable to FALSE means that the safe input and output data is transmitted immediately. • Take appropriate measures to ensure that your system/ machine does not present any danger when passivation of the F-Device is reset.
F_ADDR_[nnnnn]_PASS_OUT *)	BOOL	F-Device [nnnnn] is passivated. Possible reasons for passivation: – Programmed passivation via the F_ADDR_[nnnnn]_PASS_ON system variable – Communication, device, and parameterization errors (see F_ADDR_[nnnnn]_ACK_REQ system variable)
F_ADDR_[nnnnn]_ACK_REQ *)	BOOL	F-Device [nnnnn] requires an operator acknowledge request after removing an error. Possible reasons for activating the operator acknowledge request: – Communication error (CRC, F_WD_TIME_OUT) – Error in an F-Device. Please refer to the user documentation for the F-Devices used.
F_ADDR_[nnnnn]_ACK_REI *)	BOOL	If F-Device [nnnnn] requires an operator acknowledge request, it can be acknowledged by an operator acknowledge reintegration (F_ADDR_[nnnnn]_ACK_REI).
F_ADDR_[nnnnn]_DEVICE_FAULT *)	BOOL	Error in an F-Device. If this variable was set to TRUE during operation, remove the cause. If the cause has been removed, the F_ADDR_[nnnnn]_DEVICE_FAULT variable is set to FALSE again. **WARNING:** The status change of this variable from TRUE to FALSE means that the safe input and output data is transmitted immediately by the F-Device. • Take appropriate measures to ensure that your system/machine does not present any danger when the error state of the F-Device is removed. For information on which errors cause the used F-Device to control this variable, please refer to the device-specific user documentation.

Table 8-8 Management/diagnostic variables for each configured, lower-level F-Device

System variable	Type	Meaning
F_ADDR_[nnnnn]_CE_CRC *)	BOOL	Communication error (F_CE_CRC) This parameter is set if at least one of the following reasons applies: – Inconsistent parameterization between F-Host and F-Device. – A communication error between F-Host and F-Device is present; for example, the F-Device has detected a communication error during operation that was caused by an incorrect CRC checksum. If this variable was set to TRUE during operation, the cause of the error must be removed first so that acknowledgment can be carried out using the F_ADDR_[nnnnn]_ACK_REI or ACK_REI_GLOBAL variable. If the cause has been removed, the F_ADDR_[nnnnn]_CE_CRC variable is set to FALSE again. In terms of system availability, this type of CRC error should only occur once every 10 hours at the most (see PROFIsafe specification regarding “SIL Monitor” and “Operator Acknowledge”). During PROFIsafe system startup, e.g., following a program download in PLCnext Engineer, this variable is briefly set as a result of the PROFIsafe system startup behavior. This is not relevant for the 10-hour monitoring period described above following a CRC error that occurred during operation.
F_ADDR_[nnnnn]_WD_TIME_OUT *)	BOOL	Communication error (F_WD_TIME_OUT) Set if the F-Device has detected a communication error caused by the parameterized F_WD_Time being exceeded. If this variable was set to TRUE during operation, the cause of the error must be removed first so that acknowledgment can be carried out using the F_ADDR_[nnnnn]_ACK_REI or ACK_REI_GLOBAL variable. If the cause has been removed, the F_ADDR_[nnnnn]_WD_TIME_OUT variable is set to FALSE again.
F_ADDR_[nnnnn]_IPAR_OK *)	BOOL	F-Device indicates that the iParameters have been applied This variable is set when the F-Device indicates that it has applied the iParameters.

Table 8-8 Management/diagnostic variables for each configured, lower-level F-Device

System variable	Type	Meaning
F_ADDR_[nnnnn]_IPAR_EN *)	BOOL	Initiate application of the iParameters This variable is set in the application in order to initiate the application of the iParameters. Intentionally setting of the F_ADDR_[nnnnn]_IPAR_EN variable starts the process for applying the iParameters. The process depends on the F-Device used. For more detailed information, please refer to the device-specific user documentation. **WARNING:** Depending on the application, applying the iParameters can result in hazardous states. • Take appropriate measures to ensure that your system/ machine does not present any danger when the application of the iParameters is initiated and/or iParameters are applied.
F_ADDR_[nnnnn]_CHF_ACK_REQ *)	BOOL	A channel error in the F-Device can be acknowledged (CHF_ACK_REQ_S). (Only for F-Devices in accordance with PROFIsafe profile version **2.6MU1**)
F_ADDR_[nnnnn]_CHF_ACK_REI *)	BOO	Channel error acknowledgement (CHF_ACK_C) (Only for F-Devices in accordance with PROFIsafe profile version **2.6MU1**)
F_ADDR_[nnnnn]_CE_CRC_H *)	BOOL	Communication error (F_CE_CRC_H) Local F-Host driver reports communication error.
F_ADDR_[nnnnn]_WD_TIMEOUT_H *)	BOOL	Communication error (F_WD_TIMEOUT_H) Local F-Host driver reports communication error.
F_ADDR_[nnnnn]_LOOPBACK *)	BOOL	Communication error (loopback check) Local F-Host driver reports communication error.
*) [nnnnn] = Number of the F-Device (e.g., F_ADDR_00001_PASS_ON, see Figure 6-32 on page 109)		

8.3.7 Global management/diagnostic variables for lower-level F-Devices

The table below describes management/diagnostic variables, which are globally created in PLCnext Engineer for all lower-level F-Devices. These variables indicate that the condition for setting these variables applies to at least one configured, lower-level F-Device. The variables are not created by default. To create them, the relevant parameters must be set to “Create” in PLCnext Engineer (see Figure 6-31 on page 108).

WARNING: Outputs can be set

- Do not acknowledge an operator acknowledge request automatically from the application program.
- Trigger acknowledgment only by an intentional user action.

When reintegrating passivated PROFIsafe devices, safety-related outputs can be set.

- Take appropriate measures to ensure that your system/machine does not present any danger when passivated PROFIsafe devices are reintegrated.

WARNING: Variables can be toggled

The variables specified in Table 8-9 can be toggled.

- Program an evaluation function in the PLCnext Engineer software (e.g., using edge detection).

Table 8-9 Management/diagnostic variables for lower-level F-Devices

System variable	Type	Meaning
PASS_OUT_GLOBAL	BOOL	At least one F-Device is passivated. Possible reasons for passivation: – Programmed passivation via the F_ADDR_[nnnnn]_PASS_ON system variable – Communication, device, and parameterization errors (see F_ADDR_[nnnnn]_ACK_REQ system variable)
ACK_REQ_GLOBAL	BOOL	At least one F-Device requires an operator acknowledge request after removing an error. Possible reasons for activating the operator acknowledge request: – Communication error (CRC, F_WD_TIME_OUT) – Error in an F-Device. Please refer to the user documentation for the F-Devices used.
ACK_REI_GLOBAL	BOOL	If at least one F-Device requires an operator acknowledge request, this can be acknowledged by means of an operator acknowledge reintegration (ACK_REI_GLOBAL).

Table 8-9 Management/diagnostic variables for lower-level F-Devices [...]

System variable	Type	Meaning
DEVICE_FAULT_GLOBAL	BOOL	Error in at least one F-Device. • If this variable was set to TRUE during operation, remove the cause for the error. • Then perform acknowledgement via the F_ADDR_[nnnnn]_ACK_REI or ACK_REI_GLOBAL variables. If the cause has been removed, the F_ADDR_[nnnnn]_DEVICE FAULT variable is set to FALSE again. **WARNING:** The status change of this variable from TRUE to FALSE leads to the immediate transmission of the safe input and output data by the F-Device. • Take appropriate measures to ensure that your system/machine does not present any danger if the error state of the F-Device has been removed. For information on which errors cause the used F-Device to control this variable, please refer to the device-specific user documentation.
CE_CRC_GLOBAL	BOOL	Communication error (F_CE_CRC) This parameter is set if at least one of the following reasons applies: – Inconsistent parameterization between F-Host and F-Device. – A communication error between F-Host and F-Device(s) is present; for example, at least one F-Device has detected a communication error during operation that was caused by an incorrect CRC checksum. If this variable was set to TRUE during operation, the cause of the error must be removed first so that acknowledgment can be carried out via the F_ADDR_[nnnnn]_ACK_REI or ACK_REI_GLOBAL variables. If the cause has been removed, the F_ADDR_[nnnnn]_CE_CRC variable is set to FALSE again. In terms of system availability, this type of CRC error should only occur once every 10 hours at the most (see PROFIsafe specification regarding “SIL Monitor” and “Operator Acknowledge”).
WD_TIME_OUT_GLOBAL	BOOL	Communication error (F_WD_TIME_OUT) Set if at least one F-Device has detected a communication error caused by the parameterized F_WD_Time being exceeded. If this variable was set to TRUE during operation, the cause of the error must be removed first so that acknowledgment can be carried out via the F_ADDR_[nnnnn]_ACK_REI or ACK_REI_GLOBAL variables. If the cause has been removed, the F_ADDR_[nnnnn]_WD_TIME_OUT variable is set to FALSE again.
CHF_ACK_REI_GLOBAL	BOOL	At least one F-Device reports a channel error in the F-Device and can be acknowledged (CHF_ACK_C). (Only for F-Devices in accordance with PROFIsafe profile version **2.6MU1**)

Table 8-9 Management/diagnostic variables for lower-level F-Devices [...]

System variable	Type	Meaning
CHF_ACK_REQ_GLOBAL	BOOL	At least one F-Device reports a channel error in the F-Devices and can be acknowledged (CHF_ACK_REQ_S). (Only for F-Devices in accordance with PROFIsafe profile version **2.6MU1**)
CE_CRC_H_GLOBAL	BOOL	At least one local F-Host driver reports a communication error (F_CE_CRC_H).
WD_TIMEOUT_H_GLOBAL	BOOL	At least one local F-Host driver reports a communication error (F_WD_TIMEOUT_H).
LOOPBACK_GLOBAL	BOOL	At least one local F-Host driver reports a communication error (loopback check).

8.3.8 Management/diagnostic variables of the SPLC 1000 F-Device

8.3.8.1 PROFIsafe: Device diagnostics variables (local device)

The table below lists management/diagnostic variables. These variables can be created in PLCnext Engineer for the SPLC 1000 configured as an F-Device. The table shows which variables are created by default. This setting can be modified by changing the value (Create/Do not create).

The F_Destination_Address of the SPLC 1000 (F_Dest_Add) is specified by the “[nnnn]” in the variable name.

Management/diagnostic variable	Default setting
FD_ADDR_[nnnn]_ACK_REQ_DEV	Do not create
FD_ADDR_[nnnn]_PASS_ON_DEV	Do not create
FD_ADDR_[nnnn]_PASS_OUT_DEV	Do not create
FD_ADDR_[nnnn]_IPAR_EN_DEV	Do not create
FD_ADDR_[nnnn]_IPAR_OK_DEV	Do not create
FD_ADDR_[nnnn]_DEVICE_FAULT_DEV	Do not create
FD_ADDR_[nnnn]_CHF_ACK_REI_DEV	Do not create
FD_ADDR_[nnnn]_CHF_ACK_REQ_DEV	Do not create
FD_ADDR_[nnnn]_CE_CRC_DEV	Do not create
FD_ADDR_[nnnn]_WD_TIMEOUT_DEV	Do not create

WARNING: Variables can be toggled
The variables specified in Table 8-10 can be toggled.

- Program an evaluation function in the PLCnext Engineer software (e.g., using edge detection).

Table 8-10 PROFIsafe: Device diagnostics variables (local device)

System variable	Type	Meaning
FD_ADDR_[nnnn]_ACK_REQ_DEV *)	BOOL	The SPLC 1000 F-Device requests an operator-acknowledge request from the higher-level safety-related controller (F-Host) after removing an error. Possible reasons for activating the operator acknowledge request: – Communication error (CRC, F_WD_TIME_OUT)
FD_ADDR_[nnnn]_PASS_ON_DEV *)	BOOL	The SPLC 1000 F-Device will be passivated by the higher-level safety-related controller (F-Host) when this variable is set to TRUE from the application program. **WARNING:** Resetting this variable to FALSE means that the safe input and output data is transmitted immediately. • Take appropriate measures to ensure that your system/machine does not present any danger when passivation of the SPLC 1000 F-Device is reset.
FD_ADDR_[nnnn]_PASS_OUT_DEV *)	BOOL	The SPLC 1000 F-Device is passivated. Possible reasons for passivation: – Programmed passivation via the FD_ADDR_[nnnn]_PASS_ON_DEV system variable – Communication, device, and parameterization errors (see FD_ADDR_[nnnn]_ACK_REQ_DEV system variable)
FD_ADDR_[nnnn]_IPAR_EN_DEV *)	BOOL	Initiate application of the iParameters This variable is set in the application in order to initiate the application of the iParameters. Intentionally setting the FD_ADDR_[nnnn]_IPAR_EN_DEV from the higher-level safety-related controller (F-Host) starts the process for applying the iParameters to the SPLC 1000 F-Device. The process depends on the higher-level safety-related controller used. For more detailed information, please refer to the device-specific user documentation. **WARNING:** Depending on the application, applying the iParameters can result in hazardous states. • Take appropriate measures to ensure that your system/machine does not present any danger when the application of the iParameters is initiated and/or iParameters are applied.

Table 8-10 PROFIsafe: Device diagnostics variables (local device)

System variable	Type	Meaning
FD_ADDR_[nnnn]_IPAR_OK_DEV *)	BOOL	The SPLC 1000 F-Device indicates that “the iParameters have been applied”. This variable is set when the SPLC 1000 F-Device reports that it has applied the iParameters.
FD_ADDR_[nnnn]_DEVICE_FAULT_DEV *)	BOOL	Error in the SPLC 1000 F-Device. This variable can be set to TRUE or FALSE in the application program during operation. **WARNING:** The status change of this variable from TRUE to FALSE leads to the immediate transmission of the safe input and output data by the SPLC 1000 F-Device. • Take appropriate measures to ensure that your system/machine does not present any danger if the error state of the SPLC 1000 F-Device has been removed.
FD_ADDR_[nnnn]_CE_CRC_DEV *)	BOOL	Communication error (F_CE_CRC) This parameter is set if at least one of the following reasons applies: – The SPLC 1000 F-Device has detected a communication error during operation that was caused by an incorrect CRC checksum. – Inconsistent parameterization between the higher-level safety-related controller (F-Host) and the SPLC 1000 F-Device. – There is a communication error between the higher-level safety-related controller (F-Host) and the SPLC 1000 F-Device. If this variable was set to TRUE during operation, the cause of the error must be removed first to enable the higher-level safety-related controller (F-Host) to carry out acknowledgment and reintegration. If the cause has been removed, the FD_ADDR_[nnnn]_CE_CRC_DEV variable is set to FALSE again. In terms of system availability, this type of CRC error should only occur once every 10 hours at the most (see PROFIsafe specification regarding “SIL Monitor” and “Operator Acknowledge”). During PROFIsafe system startup this variable is briefly set as a result of the PROFIsafe system startup behavior. This is not relevant for the 10-hour monitoring period described above following a CRC error that occurred during operation.
FD_ADDR_[nnnn]_CHF_ACK_REQ_DEV *)	BOOL	A channel error in the SPLC 1000 F-Device can be acknowledged.
FD_ADDR_[nnnn]_CHF_ACK_REI_DEV *)	BOOL	Channel error acknowledgement

Table 8-10 PROFIsafe: Device diagnostics variables (local device)

System variable	Type	Meaning
FD_ADDR_[nnnn]_WD_TIME_OUT_DEV *)	BOOL	Communication error (F_WD_TIME_OUT) Set if the SPLC 1000 F-Device has detected a communication error caused by the parameterized F_WD_Time being exceeded. If this variable was set to TRUE during operation, the cause of the error must be removed first to enable the higher-level safety-related controller (F-Host) to carry out acknowledgment and reintegration. If the cause has been removed, the FD_ADDR_[nnnn]_WD_TIME_OUT_DEV variable is set to FALSE again.

*) [nnnn] = F_Destination-Adresse (F_Dest_Add) of the SPLC 1000 used in the application as an F-Device is in the range: 1 ... 65534.

8.3.8.2 PROFIsafe: Collective diagnostics variables (local device)

The table below describes management/diagnostic variables, which are globally created in PLCnext Engineer for the SPLC 1000 as an F-Device. These variables indicate that the condition for setting these variables applies to at least one SPLC 1000 configured as an F-Device. The variables are not created by default. To create them, the relevant parameters must be set to “Create” in PLCnext Engineer (see Figure 6-31 on page 108).

WARNING: Outputs can be set

- Do **not** acknowledge an operator acknowledge request automatically from the application program.
- Trigger acknowledgment only by an intentional user action.

When reintegrating passivated PROFIsafe devices, safety-related outputs can be set.

- Take appropriate measures to ensure that your system/machine does not present any danger when passivated PROFIsafe devices are reintegrated.

WARNING: Variables can be toggled

The variables specified in Table 8-11 can be toggled.

- Program an evaluation function in the PLCnext Engineer software (e.g., using edge detection).

Table 8-11 PROFIsafe: Collective diagnostics variables (local device)

System variable	Type	Meaning
ACK_REQ_DEV_GLOBAL	BOOL	At least one SPLC 1000 configured as an F-Device requires an operator-acknowledge request after removing an error. Possible reasons for activating the operator acknowledge request: – Communication error (CRC, F_WD_TIME_OUT)
CE_CRC_DEV_GLOBAL	BOOL	Communication error (F_CE_CRC) The SPLC 1000 currently only supports one F-Device instance: see FD_ADDR_[nnnn]_CE_CRC_DEV system variable.
WD_TIMEOUT_DEV_GLOBAL	BOOL	Communication error (F_WD_TIME_OUT) The SPLC 1000 currently only supports one F-Device instance: see FD_ADDR_[nnnn]_WD_TIMEOUT_DEV system variable.

8.4 PLC_CRC_PRJ system variable

The PLC_CRC_PRJ system variable provides information on the CRC of the non-safety-related project.

Table 8-12 PLC_CRC_PRJ system variable

System variable	Type	Meaning
PLC_CRC_PRJ	UINT	Information on the CRC of the non-safety-related project

9 Removing hardware

For basic information on the Axioline F system and its installation, particularly mounting/removing Axioline F modules, please refer to the UM EN AXL F SYS INST user manual (“Axioline F: System and installation”).

9.1 Safety notes

NOTE: Electrostatic discharge

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD), in accordance with EN 61340-5-1 and IEC 61340-5-1.

NOTE: Damage to electronics due to inadequate external protection – no safe fuse tripping in the event of a fault

The electronics in the device will be damaged if external fuse protection is inadequate.

- Protect the supply voltage externally in accordance with the connected load (number of Axioline F devices/amount of logic current consumption for each device).
- Ensure that the external fuse trips reliably in the event of a fault.

Please note:

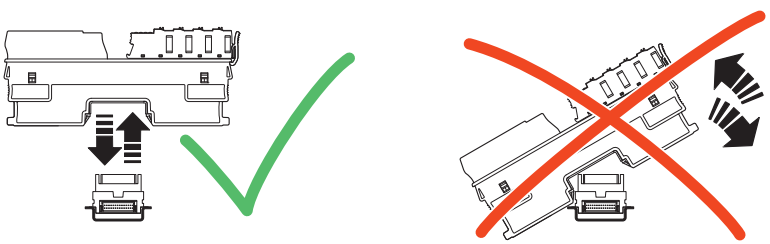
During any work on the Axioline F station, the SPLC 1000, the PLCnext Control device, or a module, switch off the power supply to the Axioline F station and make sure the supply voltage is protected against unauthorized reactivation.

NOTE: Damage to the contacts when tilting

Tilting the modules can damage the contacts.

- Remove the modules **vertically** from the DIN rail.

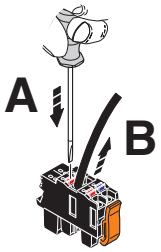
Figure 9-1 Removing the module **vertically**



9.2 Removing cables

- Disconnect the Axioline F station from the power supply.
- Open the spring by pressing the screwdriver onto the spring lever (A).
- Remove the cable (B).

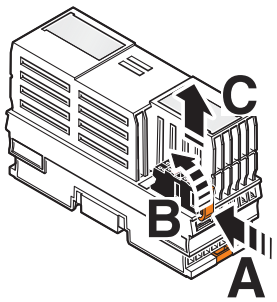
Figure 9-2 SPLC 1000: Removing cables



9.3 Removing the connector

- Release the locking latch (A), tip the connector slightly upwards (B), and remove it from the module (C).

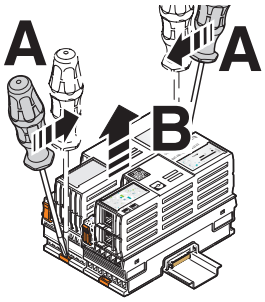
Figure 9-3 SPLC 1000: Removing the connector



9.4 Unlatching the SPLC 1000

- Insert a suitable tool (e.g., a flat-bladed screwdriver) in the upper and lower snap-in mechanism (base latches) of the module one after the other and unlock it (A). The base latches are locked in place in the open position.
- Pull the electronics module straight back from the DIN rail (B).

Figure 9-4 Unlatching the SPLC 1000



9.5 Removing the bus base module

Please note:
The bus base module of the SPLC 1000 has snap-in latches that are held in place by the electronics module on the right.

- First remove the electronics module on the right before you pull off and remove the SPLC 1000 bus base module.

- Remove the bus base module in accordance with the description in the UM EN AXL F SYS INST user manual.

Read the information on removing bus base modules of the Axioline F modules in the UM EN AXL F SYS INST user manual (Axioline F: System and installation).

10 Device replacement, device defects, and repairs

10.1 Device replacement

The device can be replaced, if necessary.

Observe the device type and version

The replacement device must satisfy the following conditions:

– Same device type (pos. 1 in Figure 3-18 on page 53)
– Same or later version (pos. 4 in Figure 3-18 on page 53)

Procedure

If you want to replace the device, proceed in accordance with the following section:

– “Removing hardware” on page 163
– “Mounting hardware” on page 59
– “Connecting and wiring the hardware” on page 69
– “Commissioning and validation” on page 75

- Disconnect the Axioline F station from the power supply.
- Replace the SPLC 1000 in your application with an identical device (same item number).
- Once the controller is replaced, restore all the necessary connections.

10.2 Device defect and repair

Do not open the housing

Do not open the housing of the SPLC 1000. If the housing is opened, the function of the device can no longer be ensured.

Device defects/repairs

Please contact Phoenix Contact. Repairs may only be carried out by Phoenix Contact.

- Send defective devices back to Phoenix Contact for repair or to receive a replacement device.
- We strongly recommend using the original packaging to return the product.
- Include a note in the packaging indicating that the contents are returned goods.
- Where possible, provide a detailed description of the errors that have occurred.
- If the original packaging is no longer available, observe the following points:
  – Observe the humidity specifications and the temperature range specified for transport (see Section “Technical data” on page 179).
  – If necessary, use dehumidifying agents.
  – Use suitable ESD packaging to protect components that are sensitive to electrostatic discharge.
  – Secure any loose parts.
  – Make sure that the packaging you select is large enough and the material is sufficiently thick.
  – Only use plastic bubble wrap sheets as wadding.
  – Attach warnings to the transport packaging so that they are clearly visible.
  – Please be aware that the delivery note is to be placed inside the package if the package is sent within the same country. If the package is being sent abroad, the delivery note must be placed inside a delivery note pocket and attached to the outside so that it is clearly visible.

11 Maintenance, decommissioning, and disposal

11.1 Maintenance

The device is maintenance-free.

11.2 Decommissioning and disposal

Carry out decommissioning in accordance with the requirements of the machine or system manufacturer.

When decommissioning the system or parts of the system, ensure the following for the devices used.

The device continues to be used as intended:

- Observe the storage and transport requirements (see Section “Transport, storage, and unpacking” on page 27).

Device disposal

The symbol with the crossed-out trash can indicates that this item must be collected and disposed of separately from other waste. Phoenix Contact or public collection sites will take the item back for free disposal. For information on the available disposal options, visit phoenixcontact.com. Delete personal data before returning the item.

Packaging disposal

- Dispose of packaging materials that are no longer needed (cardboard packaging, paper, bubble wrap sheets, etc.) with household waste in accordance with the currently applicable national regulations.

12 Extended SPLC 1000 settings and further useful information

12.1 Startup parameterization of PROFINET devices

In a PROFINET network used in systems manufacturing, devices must be coupled and decoupled. This function is managed by the program, depending on the application. In the off state, the device should be viewed as a missing device, with the difference being that the PROFINET controller does not search for it cyclically. Switching on and switching off correspond to application-driven connection establishment and release of the PROFINET device.

Please note:

The basic specifications of a PROFINET controller (e.g., maximum number of PROFINET devices that can be connected) cannot be exceeded by deactivating devices in the configuration.

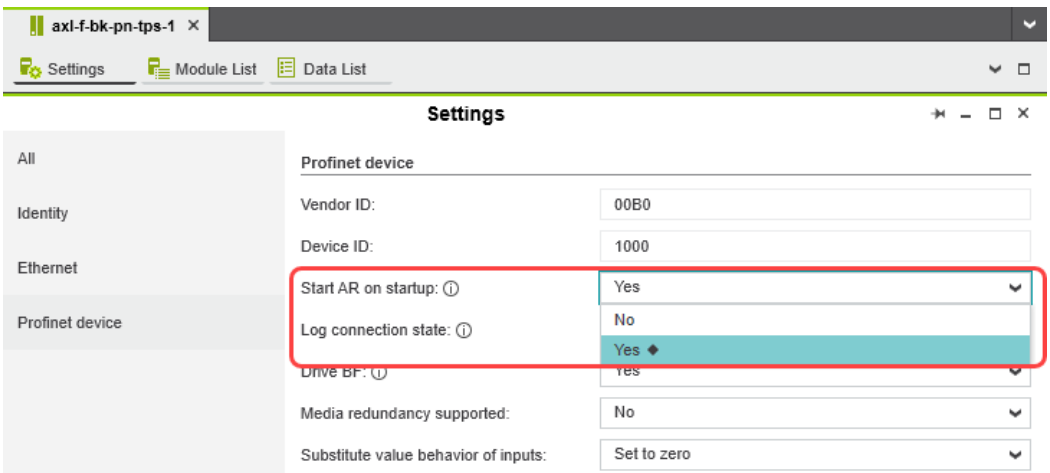
In the “Settings” editor of the PROFINET device, you must specify whether the controller establishes an application relationship when the PROFINET device is started.

When set to “No”, an application relationship is created for each PROFINET device but is not started; it remains inactive. In this case, an application relationship to the PROFINET device can be established using the AR_MGT function block (see Section “Function block for managing PROFINET application relationships (AR)” on page 173).

When set to “Yes”, the PROFINET device is started up directly. If an application relationship is not started, the PROFINET device is not started up.

This option is set to “Yes” by default.

Figure 12-1 PROFINET device – “Start AR on startup”



Safety notes for starting applications

- Take the following into consideration when determining and programming the start conditions for your machine or system:
  - The machine or system may only be started if it can be ensured that nobody is present in the danger zone.
  - Meet the requirements of EN ISO 13849-1 with regard to the manual reset function. The machine must not be set in motion and/or a hazardous situation must not be triggered by the following actions, for example:
    - Switching on safe devices
    - Acknowledging device error messages
    - Acknowledging communication errors
    - Acknowledging block error messages in the application
    - Removing startup inhibits for safety functions
- Observe the following when programming/configuring the safety logic:
  - Switching from the safe state (substitute value = 0) to the operating state can generate an edge change (zero/one edge).
  - In the safety logic, take measures to prevent this edge change resulting in unexpected machine/system startup or restart.

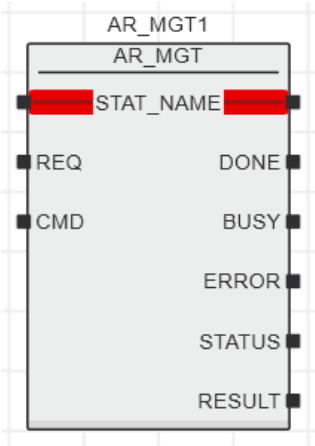
Note for starting applications

- Also observe these notes to prevent unexpected machine startup after confirming an “Operator Acknowledgement”.

12.2 Function block for managing PROFINET application relationships (AR)

You can use the AR_MGT function block to activate or deactivate PROFINET application relationships (AR) from a project. For example, process data and process data states (IOPS) are transmitted via the application relationships between the PROFINET controller and PROFINET device.

Figure 12-2 AR_MGT function block



The function block supports multiple instantiation. The maximum possible number of function block instances that can be activated simultaneously is limited by the maximum number of application relationships permitted by the PROFINET controller.

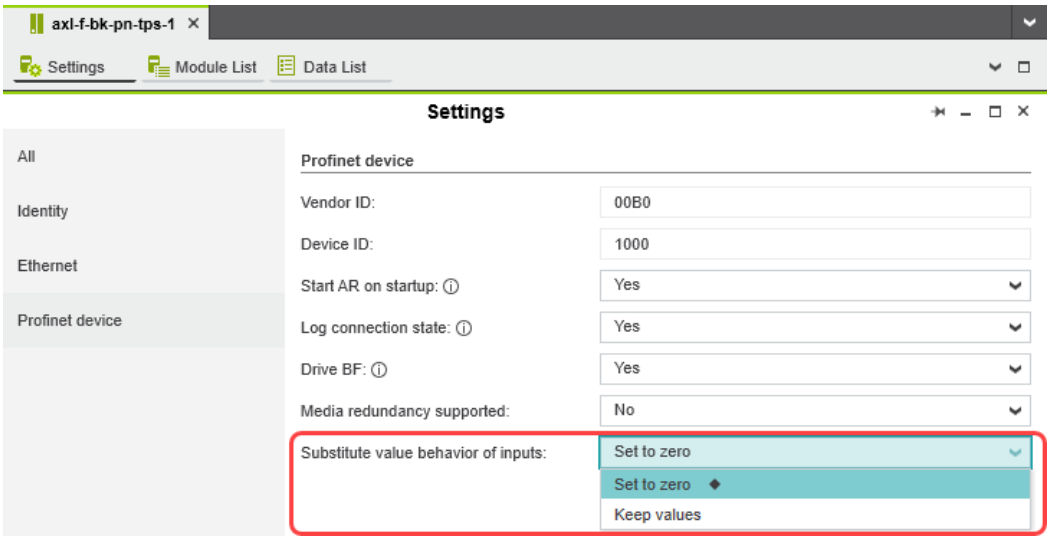
The function block for managing communication blocks is documented in the PLCnext Engineer online help.

12.3 Substitute value behavior for PROFINET devices and PROFIsafe F-Devices

The substitute value behavior for the input data of the PROFINET controller must be specified in your PLCnext Engineer project. By default, the input data of the PLCnext Control is set to zero if the connection to a PROFINET device is interrupted.

Set the substitute value behavior for each PROFINET device individually in PLCnext Engineer (see Figure 12-3).

Figure 12-3 PROFINET device – “Substitute value behavior of inputs”



If the connection to a PROFINET device is interrupted, the “Set to zero” option means that the corresponding input data of the PLCnext Control is set to zero. The “Keep values” option means that if the connection to a PROFINET device is interrupted, the input values that were valid immediately before the interruption are present as the input data in the application program.

When the connection to the PROFINET device is restored, the substitute values remain valid as input data until the PROFINET device has been started up completely. Once the connection has been established again, the latest input data is used.

Note on the substitute value behavior for F-Devices

When programming and configuring your safety logic, observe that the change from the safe state (substitute value = 0) to the operating state can cause an edge change (zero-one edge).

- In the safety logic, take measures to prevent this edge change resulting in unexpected machine/system startup or restart.

13 Technical data and ordering data

13.1 Ordering data

13.1.1 Extension module

Description	Type	Item No.	Pcs./Pkt.
The AXC F XT SPLC 1000 (SPLC 1000) is a left-alignable, safety-oriented control for operating PROFIsafe devices. The SPLC 1000 is connected to the AXC F 2152 or AXC F 3152 modular controllers from the PLCnext Control series.	AXC F XT SPLC 1000	1159811	1

13.1.2 Controller

Description	Type	Item No.	Pcs./Pkt.
PLCnext Control for the direct control of Axioline F I/Os. With two Ethernet interfaces. Complete with connector and bus base module.	AXC F 2152	2404267	1
PLCnext Control for the direct control of Axioline F I/Os. With three independent Ethernet interfaces. Complete with connector and bus base module.	AXC F 3152	1069208	1

13.1.3 Modules

Description	Type	Item No.	Pcs./Pkt.
Axioline F, Bus coupler, PROFINET, RJ45 jack, transmission speed in the local bus: 100 Mbps, degree of protection: IP20, including bus base module and Axioline F connector	AXL F BK PN TPS	2403869	1
Axioline Smart Elements, Digital input module, Functional safety, PROFIsafe, only for connection to Phoenix Contact or Siemens controller, safe digital inputs: 8 (1-channel assignment), 4 (2-channel assignment), 24 V DC, connection technology: 3-conductor, degree of protection: IP20	AXL SE PSDI8/3	1079241	1
Axioline Smart Elements, Digital output module, Functional safety, PROFIsafe, only for connection to Phoenix Contact or Siemens controller, safe digital outputs: 4 (1-channel assignment), 2 (2-channel assignment), 24 V DC, 2 A, connection technology: 2-conductor, degree of protection: IP20	AXL SE PSDO4/2 2A	1079231	1
Axioline Smart Elements, Slot cover, Diagnostic function, degree of protection: IP20	AXL SE SC-A	1088134	11
Axioline F, backplane, 4 slots for Axioline Smart Elements, transmission speed in the local bus: 100 Mbps, degree of protection: IP20	AXL F BP SE4	1088135	1

Description	Type	Item No.	Pcs./Pkt.
Axioline F, Digital output module, Functional safety, PROFIsafe, only for connection to Phoenix Contact or Siemens controller, digital outputs: 4 (2-channel assignment), 8 (1-channel assignment), 2 A, connection technology: 2-conductor, 3-conductor, degree of protection IP20.	AXL F PSDO8/3 1F	2701560	1
Axioline F, Digital input module, Digital inputs: 16, 24 V DC, connection technology: 1-conductor, Input filter time < 5 µs, transmission speed in the local bus: 100 Mbps, degree of protection: IP20, including bus base module and Axioline F connectors	AXL F DI16/1 HS 1H	2701722	1

13.1.4 Accessories

Description	Type	Item No.	Pcs./Pkt.
QUINT POWER and TRIO POWER power supplies from Phoenix Contact	See the latest Phoenix Contact INTERFACE catalog		
Bus base module for left-aligning the AXC F 2xxx controllers	AXC BS L 2	1064312	1
Program and configuration memory for storing the application programs and other files in the file system of the PLC, pluggable, 2 GB	SD FLASH 2GB PLCNEXT MEMORY	1043501	1
Program and configuration memory for storing the application programs and other files in the file system of the PLC, pluggable, 8 GB	SD FLASH 8GB PLCNEXT MEMORY	1061701	1
End bracket, width: 9.5 mm, color: gray (mounting)	E/NS 35 N	0800886	50
End bracket, for the end support bearing for the UKH 50 to UKH 240, for pushing onto DIN rail NS 35 and clamping in place using 2 screws, width: 10 mm, color: aluminum (mounting)	E/AL-NS 35	1201662	10
Quick mounting end bracket for NS 35/7.5 DIN rail or NS 35/15 DIN rail, with marking option, width: 9.5 mm, color: gray (mounting)	CLIPFIX 35	3022218	50
Quick mounting end bracket for NS 35/7.5 DIN rail or NS 35/15 DIN rail, with marking option, with parking option for FBS...5, FBS...6, KSS 5, KSS 6, width: 5.15 mm, color: gray (mounting)	CLIPFIX 35-5	3022276	50
End clamp, material: PA, color: gray, Mounting on a DIN rail NS 32 or NS 35 (Mounting)	E/UK	1201442	50

13.1.5 Software

Description	Type	Item No.	
Engineering software platform for Phoenix Contact automation controllers. PLCnext Engineer is IEC 61131-3-compliant and is available free of charge under Downloads. Its functionality can be extended using paid add-ins. To do this, open the license configurator via the “Configure” button. (Software)	See latest Phoenix Contact catalog		

13.1.6 Documentation

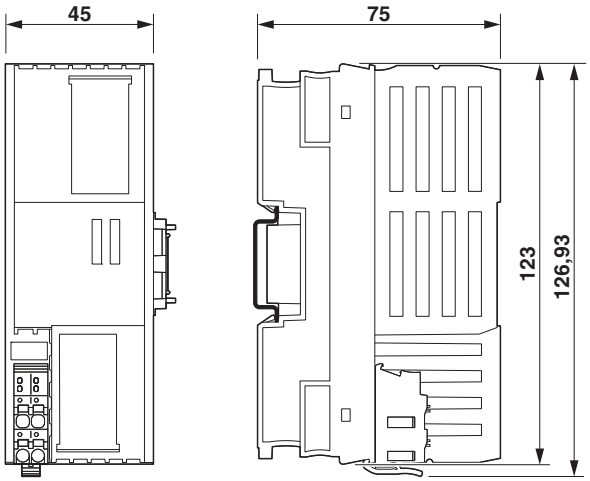
Make sure you always use the latest documentation.

It is available for download at phoenixcontact.net/products.

Description	Type	Item No.	Pcs./Pkt.
PROFINET			
User manual, English, PROFINET basic principles	UM EN PROFINET SYS	–	1
User manual, English, PROFINET controller/device functions	UM EN PROFINET CTRL DEV	–	1
PROFINET Assembling Guideline, Version 2.8, September 2019, Item No.: 8.072 “PROFINET_Assembling_8072_V28_Sep19.pdf”	For the latest versions of the documents visit www.profibus.com or contact your nearest Phoenix Contact representative regarding the document		
Functional Bonding and Shielding of PROFIBUS and PROFINET, Guideline for PROFIBUS and PROFINET, Version 2.6, February 2021, Order No. 8.102 „Earthing-Shielding_8102_V26_Feb21.pdf“			

Description	Type	Item No.	Pcs./Pkt.
PROFIsafe			
PROFIsafe System Description, Technology and Application, Version April 2016, Item No. 4.342 “PROFIsafe_SystemDescription_ENG__2016_web.pdf”			
PROFIsafe Policy, Guideline for PROFIBUS and PROFINET, Version 1.5, July 2011, Item No. 2.282 “PROFIsafe-Policy_2282_V15_Jul11.pdf”			
PROFIsafe Environment related to PROFIsafe V2.6.1 Guideline for PROFINET and PROFIBUS, Version 2.6, December 2015, Item No. 2.232 “PROFIsafe-Environment_2232_V26_Dec15.pdf”	For the latest versions of the documents visit www.profibus.com or contact your nearest Phoenix Contact representative regarding the documents.		
PROFIsafe – Profile for Safety Technology on PROFIBUS and PROFINET, Item No.: 3.192 Profile part, related to IEC 61784-3-3 Technical Specification, Version 2.6MU1, August 2018 “PROFIsafe_3192_V26MU1_Aug18.pdf”			
PROFIsafe Test Specification, related to PROFIsafe V2.6, Test Specification for PROFIBUS and PROFINET Version 2.3, March 2018, Item No.: 2.242 “Psafe-Testspec_2242_V23_Mar18.pdf”			
PLCnext Technology			
Information on troubleshooting and answers to frequently asked questions (FAQs) can be found in the PLCnext Community at plcnext-community.net.			
Comprehensive documentation on PLCnext Technology is available in the PLCnext Info Center.			
Axioline F documentation			
User manual, English, Axioline F: System and installation	UM EN AXL F SYS INST	–	–
User manual, English, Axioline F: Diagnostic registers and error messages	UM EN AXL F SYS DIAG	–	–
User manual, English, Axioline Smart Elements	UM EN AXL SE SYS INST	–	–
User manual, English, Installing, commissioning, and operating the AXC F 1152, AXC F 2152, and AXC F 3152 controllers	UM EN AXL F X152	–	–
Documentation for software			
Online help PLCnext Engineer			
Security			
Comprehensive documentation on security for PLCnext Technology is available in the PLCnext Security Info Center.			

13.2 Technical data

Dimensions (nominal sizes in mm)	
	
Outer dimensions (width x height x depth)	45 mm x 126.93 mm x 75 mm (the depth applies when a TH 35-7.5 DIN rail is used (in accordance with EN 60715)).

General data	
Color	Zinc yellow (RAL 1018)
Weight	142 g
Design	modular
Mounting type	DIN rail mount

Connection data	
Designation	Axioline F connector
Connection method	Push-in connection
Conductor cross-section, rigid/flexible	0.2 mm^2 ... 1.5 mm^2
Conductor cross-section [AWG]	24 ... 16
Stripping length	8 mm

Power supply

WARNING: Loss of electrical safety and the safety function when using unsuitable power supplies
The AXC F XT SPLC 1000 is designed exclusively for protective extra-low voltage (PELV) operation according to EN 60204-1.

- Only protective extra-low voltages in accordance with the listed standard may be used for the supply.

The following applies to the network (PROFINET and Axioline F) and the I/O devices used in it:

- Only use power supplies that satisfy the requirements of EN 61204 and feature safe isolation with PELV in accordance with IEC 61010-2-201 (PELV). They prevent short circuits between the primary and secondary side.

Please also observe the information in Section “Electrical safety” on page 19.

Select power supplies correctly!
Refer to the information on selecting the power supply in Section “Electrical safety” on page 19.

- Use only power supplies with safe isolation with 24 V DC.

Use a **power supply without fall-back characteristic curve** (see Section “Sizing of the power supply” on page 69).

Feed-in of the communications voltage U_L	
Supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, ripple included)
Current consumption	80 mA, typical Max. 100 mA

NOTE: Damage to the electronics

- Provide external protection for the module.

Protective circuit	
Polarity reversal protection for supply voltage	Polarity protection diode
Transient protection	Suppressor diode

Ambient conditions	
Ambient temperature (operation)	-25°C ... 60°C up to 2,000 m above mean sea level -25°C ... 55°C up to 3,000 m above mean sea level -25°C ... 50°C up to 4,000 m above mean sea level
Ambient temperature (storage/transport)	-40°C ... 85°C
Permissible humidity (operation)	5% ... 95% (in accordance with DIN EN 61131-2)
Permissible humidity (storage/transport)	5% ... 95% (in accordance with DIN EN 61131-2)
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above mean sea level)
Air pressure (storage/transport)	58 kPa ... 106 kPa (up to 4500 m above mean sea level)
Degree of protection	IP20
To ensure correct operation, the AXC F XT SPLC 1000 must be installed in a lockable housing or a lockable control cabinet with a minimum degree of protection of IP54.	
Protection class	III (IEC 61140, EN 61140, VDE 0140-1)
Resistance to gases that may endanger the functions, in acc. with DIN 40046-36, DIN 40046-37	Use of the device in these ambient conditions is prohibited.

Ambient conditions	
Vibration resistance (operation/storage/transport)	5g (in accordance with EN 60068-2-6/IEC 60068-2-6)
Shock (operation/storage/transport)	30g (in accordance with EN 60068-2-27/IEC 60068-2-27)
Continuous shock (operation/storage/transport)	10g (in accordance with EN 60068-2-27/IEC 60068-2-27)

Diagnostic and status indicators	
FS	LED: Red
RUN	LED: Green/orange
P	LED: Green
C	LED: Green

Safety characteristic data in accordance with EN ISO 13849-1	
Performance Level (PL)	Max. e
Category	Max. 4
Probability of a dangerous failure per hour (PFH_D)	$1 * 10^{-9}$
Diagnostic coverage (DC_{avg})	99%
Mean time to dangerous failure ($MTTF_D$)	> 80 years

Safety characteristic data for EN 62061	
Safety Integrity Level Claim Limit (SIL CL)	Max. 3
Probability of a dangerous failure per hour (PFH_D)	$1 * 10^{-9}$
Hardware Fault Tolerance (HFT)	1
Duration of use (mission time)	300 months, therefore no restrictions, no maintenance intervals
Safe Failure Fraction (SFF) in accordance with DIN EN 62061	99%

Safety characteristic data in accordance with IEC 61508 – high demand	
Safety Integrity Level (SIL)	Max. 3
Probability of dangerous failure per hour (PFH)	$1 * 10^{-9}$
Hardware Fault Tolerance (HFT)	1
Duration of use (mission time)	300 months, therefore no restrictions, no maintenance intervals

Characteristic data of the SPLC 1000 safety-related controller	
Programming tool	PLCnext Engineer
Programming languages supported	Programming in acc. with IEC 61131-3
Processor	ARM® Cortex®-M4, 180 MHz (CPU1) ARM® Cortex®-M4, 100 MHz (CPU2)
Cycle time	5 ms ($T_{ZSPLCmin}$)
Program memory	64 kB (safe program)
Data storage	8 kB (addressable area)
Safety-related input data (SI)	512 bytes
Safety-related output data (SQ)	512 bytes
Non-safety input data (NSI)	128 bytes (inputs exchange area)
Non-safety output data (NSQ)	128 bytes (outputs exchange area)
Device diagnostics input data (DI)	128 bytes
Device diagnostics output data (DQ)	128 bytes
Function block diagnostics output data (FBQ)	512 bytes
Number of function-block instances	Max. 256

PROFIsafe IO	
Device function	PROFIsafe F-Host, PROFIsafe F-Device
Number of supported devices	32
Profile version	V2.6MU1 (also includes support for V2.4)

Conformance with EMC directive 2014/30/EU	
Immunity test in accordance with EN 61000-6-2/IEC 61000-6-2	
Electrostatic discharge (ESD), EN 61000-4-2/IEC 61000-4-2	Criterion A, 8 kV air discharge
Electromagnetic fields EN 61000-4-3/IEC 61000-4-3	Criterion A, field strength: 10 V/m
Fast transients (burst) EN 61000-4-4/IEC 61000-4-4	Criterion A, 2 kV
Transient overvoltage (surge) EN 61000-4-5/IEC 61000-4-5	Criterion A; DC supply lines: ±0.5 kV/±1.0 kV (symmetrical/ asymmetrical)
Conducted disturbance variables EN 61000-4-6/IEC 61000-4-6	Criterion A, test voltage 10 V
Noise emission test according to E N 61000-6-3/IEC 61000-6-3	Class B

Approvals		
For the current approvals, go to		phoenixcontact.net/product/1159811.
ATEX	UL 21 ATEX 2651X	Ⓔx II 3 G Ex ec IIC T4 Gc EN IEC 60079-0, EN IEC 60079-7
IECEx	IECEx ULD 21.0029X	Ex ec IIC T4 Gc IEC 60079-0 Ed. 7, IEC 60079-7 Ed. 5.1
UL Ex, USA / Kanada	E366272	Class I, Zone 2, AEx ec IIC T4, Ex ec IIC T4 Gc X Class I, Div. 2, Groups A, B, C, D T4 UL 60079-0 Ed. 7 / CSA C22.2 NO. 60079-0 Ed. 4 UL 60079-7 Ed. 5 / CSA C22.2 NO. 60079-7 Ed. 2
UL, USA / Canada	E238705	cULus
Industrial Cyber Security	IITS2 029429 0027	Industrial IT Security, IACS Component IEC 62443-4-1:2018 IEC 62443-4-2:2019 PPP 15003B:2021 (IEC 62443-4-1: Full ML3 Process Profile) Configuration: Security Profile active

Manufacturer‘s declarations	
For the current Manufacturer‘s declarations, go to	phoenixcontact.net/product/1159811.

A Appendix: Terms for PROFIsafe

Terms that are used in connection with PROFIsafe in this user manual are described below.

A definition of PROFIsafe terms is also provided in the PROFIsafe profile.

CRC

Cyclic Redundancy Check

A cyclic redundancy check is used to verify the validity of the process data contained in the safety telegram, check whether the assigned address relationships are correct, and verify the safety-related parameters. This value is part of the safety telegram.

Consecutive number

Consecutive number

Method for ensuring that the safe data is transmitted completely and in the correct order.

Reintegration

Removal of passivation for the reintegration of previously passivated F-Devices (see also “Passivation”).

F-Parameters

(In accordance with PROFIsafe System Description, version April 2016)

F-Parameters contain information for adapting the PROFIsafe layer to specific customer specifications and for checking the parameterization by means of a separate method (diverse). The main F-Parameters are:

F_Source_Address / F_Destination_Address / F_Source_Add / F_Dest_Add (F-Address for short)	Unique address for F-Devices within a PROFIsafe island. The technology part of the F-Device compares the value with the local address switch or with an assigned F-Address in order to check authenticity of the connection. As of PROFIsafe profile V2.6.1, a distinction is made between two address types, which must be specified by the manufacturer in the F-Device-specific user documentation: Address type 1: The F-Device only checks the F_Destination_Address. Address type 2: The F-Device checks the F_Destination_Address and the F_Source_Address.
F_WD_Time	Specifies the time for the watchdog timer in milliseconds. The timer monitors the time that elapses until the next valid PROFIsafe message is received.
F_SIL	Indicates the SIL that the user can expect from the relevant F-Device. It is compared with the manufacturer‘s specification that is stored locally.
F_iPar_CRC	Checksum that is calculated from all iParameters of the technology-specific part of the F-Device.
F_Par_CRC	CRC signature that is created across all F-Parameters and ensures error-free transmission of the F-Parameters.

F_Source_Address

F-Parameter (F_Source_Add for short);
PROFIsafe source address, address of the safety-related SPNS PROFINET controller (F-Host)

F_Destination_Address
F-Parameter (F_Dest_Add for short);
PROFIsafe destination address; address of the PROFIsafe device (F-Device)

iParameters
Individual safety parameters of a device

Consecutive number
See “Consecutive number”

Passivation
If the safety module detects an error, it switches the affected channel or all channels of the module to the safe state; the channels are then passivated. The detected errors are reported to the safety-related controller.

For a safe input module, when passivation is enabled, substitute values (0) are provided for the safety program instead of the process values present at the safe inputs.

For a safe output module, when passivation is enabled, substitute values (0) are transferred to the safe outputs instead of the output values provided by the safety program.

PROFIsafe
Safety-related bus profile based on PROFIBUS DP or PROFINET. It defines the communication between a safety program and the safe I/O devices in a safe system.

PROFIsafe address
Each safe module has a PROFIsafe address. This address must be set on the safety module via DIP switches, for example, and then configured in the configuration tool for the safety-related controller used.

PROFIsafe monitoring time
Monitoring time for safety-related communication between the SPLC 1000 and the safe I/O devices.

This time is parameterized in the F_WD_Time F-Parameter.

B Appendix: Checklists

NOTE: Observe supporting checklists
The checklists listed in this section provide support during planning, assembly, and electrical installation, commissioning, parameterization, and validation of the SPLC 1000 and the PROFIsafe system.

These checklists may be used as additional planning documentation and/or as additional verification to ensure the steps in the specified phase are carried out carefully.

The checklists do not claim to be complete.

- Observe the applicable standards for your application and, based on these, create individual specific checklists for your system/machine.

Archive the completed checklists to use as reference for recurring tests.

The checklists do not replace validation, initial startup, as well as regular testing performed by qualified personnel.

The following section of a checklist shows an example of a filled in checklist.

Checklist . . .			
Device type/equipment identification		AXC F XT SPLC 1000 / BK15NA11	
Version: **HW/FW**	≥ 01/01.00.0000	**Date**	2021-02-18
Editor	John Smith	**Test engineer**	Jane Brown
Comment	System XXX has been checked for engine hood production		

No.	**Requirement**	**Yes**	**Comment**
X	. . .	☐	

Key:

Device type/equipment identification	Enter the device type and/or the equipment identification for the relevant device.
Version: HW/FW	Enter the hardware and firmware version of the device (see revision specification on the label, item 4 in Figure 3-18 on page 53).
Date	Enter the date on which you began to fill in this checklist.
Editor	Enter the name of the editor.
Test engineer	Enter the name of the test engineer.
Comment	Where necessary, enter a comment.
Requirement (mandatory)	These requirements must be met for a safety application, in order to complete the relevant phase using the checklist.
Requirement (optional)	These requirements are optional. For points that are not met (No), please enter an appropriate remark in the relevant field.

B 1 System-specific checklists

This section contains checklists that relate to the phases of life of the PROFIsafe system.

B 1.1 Planning

Checklist for planning the use of the PROFIsafe system			
Equipment identification			
		Date	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Have the applicable standards for the system/machine been selected and are the resulting requirements known for each safety function and phase of life of the system/machine?	☐	
2	Has risk assessment for the system/machine been carried out?	☐	
3	Has the corresponding safety category/safety integrity level been derived from risk assessment?	☐	
4	Have the individual safety functions been fully defined/specified?	☐	
5	Does the planned PROFIsafe system meet the required safety integrity for all defined safety functions?	☐	
6	Has the power supply been planned in accordance with the specifications on protective extra-low voltage (PELV) in accordance with EN 60204-1 (including safe isolation with PELV in accordance with IEC 61010-2-201)?	☐	
7	Has the maximum permissible response time (SFRT) for each individual safety function within the PROFIsafe system in your system/machine been determined and documented?	☐	
8	Can the planned system/machine be implemented when the determined SFRT is observed with the specified PROFINET infrastructure?	☐	
9	Can the planned application be realized with the programming capacities (for example by using function blocks) and has a specification of the safety-related application program been created?	☐	
10	Have the user rights for the safety-related application program been specified in the PLCnext Engineer software?	☐	
11	Has a project password been provided?	☐	
12	Who is authorized to “develop” the safety-related application program?	☐	Names:
13	Has a SafePLC password been provided?	☐	
14	Were the settings for user authentication defined in the web-based management system of the PLCnext Control used?	☐	Names:
15	Has the location where the software is to be installed (e.g., on the system PC) been specified?	☐	

No.	Requirement	Yes	Comment
16	Are measures planned which prevent unintentional, automatic restart with hazardous states?	☐	
17	Are measures planned to ensure unique F-Addresses throughout the network (F-Source Addresses of PROFIsafe devices and F-Destination Addresses of safety-related PROFINET controllers (SPLC 1000))?	☐	
18	Does the planned use correspond to the intended use of the system?	☐	
19	Has the technical data of the PROFIsafe system been observed?	☐	
20	Have the requirements of the PROFINET Assembling Guideline been observed and met during planning?	☐	
21	Have the accessories to be used been planned (e.g., cables, connectors)?	☐	
22	Are the period of use / proof test intervals and maintenance intervals of the PROFIsafe devices used known and documented?	☐	
23	Is the assignment of responsibility for subsequent phases of life specified (e.g., for assembly/installation/programming/startup/validation, etc.)?	☐	Name/company:
24	Are measures planned against unauthorized network access?	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 1.2 Programming

Checklist for programming the PROFIsafe system			
Equipment identification			
		Date	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	
1	Have the requirements from the applicable standards for the system/machine been observed and met in the programming phase?	☐	
2	Have the user rights for the safety-related application program been created in the PLCnext Engineer software?	☐	
3	Has the safety-related application program been created entirely in PLCnext Engineer?	☐	
4	Have additional application-specific programming guidelines been created and observed within the program specification for the planning phase?	☐	
5	Are standard input signals exclusively used to program standard operations (e.g., for the enable principle using the EN_OUT block or for acknowledgment)?	☐	
6	Are the parameterized F-Addresses (F-Source Addresses of PROFIsafe controllers and F-Destination Addresses of PROFIsafe devices) unique throughout the network?	☐	
7	Is the F_WD_Time calculated for each F-Device parameterized in the “Safety Parameters” editor in PLCnext Engineer?	☐	
8	Has a project password been defined?	☐	
9	Who is authorized to “develop” the safety-related application program?	☐	Names:
10	Has a SafePLC password been defined?	☐	
11	Has project information been entered in the “Description” field in the “Properties” editor in the “Project” editor group?	☐	Type: Location:
12	Are possible reciprocal effects due to exchange variables between the programming of the standard controller (PLCnext Control) and the SPLC 1000 taken into consideration and clear?	☐	
13	Has the following been observed when programming/configuring your safety logic? – Switching from the safe state (substitute value = 0) to the operating state can generate an edge change (zero/one edge). – In the safety logic, take measures to prevent this edge change resulting in unexpected machine/system startup or restart.	☐ ☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 1.3 Commissioning

Checklist for commissioning the PROFIsafe system			
Equipment identification			
		Date	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Have the requirements from the applicable standards for the system/machine been observed and met in the commissioning phase?	☐	
2	Is safety ensured during the commissioning phase by means of additional measures and if so what are these measures (see also No. 1)?		
	1 _____	☐	
	2 _____	☐	
	3 _____	☐	
	4 _____	☐	
	5 _____	☐	
	6 _____	☐	
	7 _____	☐	
	8 _____	☐	
	9 _____	☐	
	10 _____	☐	
	Additional requirements in: _____	☐	
3	Are adjustments to the F_WD_Time $_{min}$ required in order to ensure ruggedness of the system and system availability, since the actual SPLC 1000 cycle time may deviate from the SPLC 1000 cycle time estimated during the planning phase? **NOTE: Do not exceed F_WD_Time $_{max}$** The set F_WD_Time must not exceed the F_WD_Time $_{max}$ from the defined SFRT. (See also “Validation” checklist)	☐	
4	Are measures implemented against unauthorized network access?	☐	
5	Are specifications for the commissioning phase applicable and have they been met?	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 1.4 Validation

Checklist for validating the PROFIsafe system			
Equipment identification			
		Date	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Have the requirements from the applicable standards for the system/machine been observed and met for validation?	☐	
2	Have the requirements from the previous planning, programming, and commissioning phases been met?	☐	
3	Has validation of the F-Devices used been carried out and are the results available?	☐	
4	Have safety distances to be observed been calculated and checked according to the implemented response and delay times (response times, SFRT, $F\_WD\_Time_{max}$)?	☐	
5	Have all the safety functions been checked successfully?	☐	
6	Do the two CRC checksums displayed in the “Safety PLC” editor group in the “Safety Cockpit” editor in the “Overview” view (“Safety PLC project information” and “Engineering project information”) match? If you are connected online to the safety-related controller, the checksums are displayed in PLCnext Engineer.	☐	
7	Have measures against unauthorized network access been implemented and checked?	☐	

8	Are the directives and standards used listed in the declaration of conformity?	☐	
9	Have the programs created in PLCnext Engineer been archived as zip files? Enter the archiving location (e.g., drive or cabinet) in the “Comment” section.	☐	
10	Has a complete printout of the safety-related application program programmed in PLCnext Engineer been stored in the system?	☐	
11	Have all fully filled in checklists been stored in the system?	☐	
12	**Completion of validation** Has the latest program version (including the “Project information”) been downloaded to the safety-related SPLC 1000 controller on automatic startup? Have organizational or technical measures been introduced for checking the CRC checksum expected for the respective system/machine after a voltage reset or system restart? The CRC checksum is displayed by the CRC element of the SPLC system variable (see Table 8-1 “SPLC system variable and elements of the SPNSV2_TYPE data structure”). A technical measure for checking the CRC checksum must be implemented in such a way that the check is carried out by a third technical entity beyond the SPLC 1000 and PLCnext Control.	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 2 Device-specific checklists

This section contains checklists that relate to the phases of life of the SPLC 1000.

B 2.1 Planning

Checklist for planning the use of the AXC F XT SPLC 1000			
Device type/equipment identification			
Version: HW/FW		**Date**	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Has the systematic “Planning” checklist been observed?	☐	
2	Are all measures that are based on applicable standards and the PROFINET Assembling Guideline planned?	☐	
3	Has the current AXC F XT SPLC 1000 user manual been used as the basis for planning?	☐	
4	Have the power supply for the device and direct I/Os been planned as per the specifications for protective extra-low voltage (PELV) in accordance with EN 60204-1 (including safe isolation with PELV in accordance with IEC 61010-2-201)?	☐	
5	Are measures planned to prevent simple tampering? If so, what are they? 1 _____ 2 _____ 3 _____ 4 _____ 5 _____	 ☐ ☐ ☐ ☐ ☐	
6	Does the planned use correspond to the intended use?	☐	
7	Have the ambient conditions according to the technical data been observed?	☐	
8	Has the degree of protection been observed?	☐	
9	Have the accessories to be used been planned in accordance with the ordering data in this user manual (cables, plugs)?	☐	
10	Have specifications for assembly and electrical installation been defined (e.g., EPLAN) and communicated to the relevant personnel?	☐	
11	Have specifications for parameterization been defined and communicated to the relevant personnel?	☐	
12	Have specifications for startup been defined and communicated to the relevant personnel?	☐	
13	Has the technical data of the interfaces been observed?	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 2.2 Assembly and electrical installation

Checklist for assembly and electrical installation of the AXC F XT SPLC 1000			
Device type/equipment identification			
Version: HW/FW		**Date**	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Has assembly and electrical installation been carried out according to the specifications of the planning phase?	☐	
2	Has assembly and electrical installation been carried out according to the specifications in the user manual for the AXC F XT SPLC 1000?	☐	
3	Has assembly and electrical installation been carried out according to the specifications of the applicable standards and the PROFINET Assembling Guideline?	☐	
4	Have the power supply for the device and direct I/Os been installed as per the specifications for protective extra-low voltage (PELV) in accordance with EN 60204-1 (including safe isolation with PELV in accordance with IEC 61010-2-201)?	☐	
5	Have measures been taken to prevent simple tampering (e.g., control cabinet can be locked, PLCnext Engineer access rights (user authorization), etc.)? If so, what are they?		
	1 _____	☐	
	2 _____	☐	
	3 _____	☐	
	4 _____	☐	
	5 _____	☐	
	6 _____	☐	
	7 _____	☐	
	8 _____	☐	
	9 _____	☐	
	10 _____	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 2.3 Commissioning and parameterization

Refer to the online help for the PLCnext Engineer software.

Checklist for commissioning and parameterization of the AXC F XT SPLC 1000			
Device type/equipment identification			
Version: **HW/FW**		**Date**	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Have the systematic “Programming” and “Startup” checklists been observed?	☐	
2	Was commissioning completed in accordance with the specifications (specifications from the planning phase and/or in accordance with the AXC F XT SPLC 1000 user manual, see Table 6-1 “Steps for initial commissioning of the SPLC 1000”)?	☐	
3	Is it ensured that when the supply voltage of the AXC F XT SPLC 1000 is switched on, automatic startup does not cause a hazardous movement on the machine/system? **WARNING: Preventing automatic startup** • Take appropriate measures to ensure that automatic startup of your system/machine is prevented.	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

B 2.4 “Initial commissioning” and “recommissioning/device replacement” validation

Carry out a validation every time you make a safety-related modification to the PROFIsafe system.

In addition, refer to the online help for the PLCnext Engineer software.

Checklist for validation on initial commissioning or recommissioning/device replacement of the AXC F XT SPLC 1000			
Device type/equipment identification			
Version: HW/FW		**Date**	
Editor		**Test engineer**	
Comment			

No.	Requirement	Yes	Comment
1	Has the systematic “Validation” checklist been observed?	☐	
2	Have all the requirements of the “Planning” checklist been met?	☐	
3	Have all the requirements of the “Assembly and electrical installation” checklist been met?	☐	
4	Have all the requirements of the “Commissioning and parameterization” checklist been met?	☐	
5			
5a	Initial commissioning: Has a function test been performed to check all the safety functions in which the AXC F XT SPLC 1000 is involved?	☐	
5b	Recommissioning after replacing the AXC F XT SPLC 1000: The CRC checksum of the PLCnext Engineer project corresponds to the version validated and documented for the machine/system under 5a (see also checklist item No. 12 in Section B 1.4 “Validation”).	☐	
6	Does the power supply for the device and direct I/Os comply with the specifications on protective extra-low voltage (PELV) in accordance with EN 60204-1 (including safe isolation with PELV in accordance with IEC 61010-2-201)?	☐	
7	Do all cables correspond to the specifications?	☐	
8	Wiring check: Have all the inputs and outputs of all F-Devices physically present in the network and configured in PLCnext Engineer been wired correctly?	☐	
9	Have measures been taken to prevent simple tampering?	☐	
		Date	Signature (editor)
		Date	Signature (test engineer)

C Appendixes

C 1 List of figures

Section 3

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D Appendix: Revision history

Revision	Date	Content	
01	2021-11-11	First publication of the user manual for the AXC F XT SPLC 1000.	
02	2022-11-02	Revision with the following changes:	
		Kap. 1	New Section 1.8 “UL notes” added.
		Kap. 1.9, 5.1, 13.2	Warning box “Loss of electrical safety ...”: Standard “EN 61204” corrected.
		Kap. 1.11	Section on standards and directives revised.
		Kap. 1.12	– Designations of PROFIsafe documents updated. – PROFIsafe documentation: Link to www.profibus.com updated.
		Kap. 4.1	Safety notes: Note box: “Electronics may be damaged if overloaded” added.
		Kap. 4.2	– Note box: “Unauthorized physical access” added. – Text added: “The minimum clearance to other devices is ...”.
		Kap. 8.3.2	Diagnostic status register (SPLC.DIAG.STATUS_REG.xxx): Element DD deleted as it is not supported.
		Kap. 13	Revised: – Ordering data: – Description texts updated. – Link to www.profibus.com updated. – Technical data (designations updated, information added): – General data, design: modular – Resistance to gases that may endanger functions ... – Shock (...) – Continuous shock (...) – Parameters of the SPLC 1000 safety-related controller: information updated – PROFIsafe IO – Conformance with EMC Directive: Standard specifications added – UL approval added
03	2024-05-15	Revision with the following changes:	
		Entire document:	– Current user manual layout assigned, including: – All information boxes updated (without borders and with smaller icons now). – Texts adapted and “Procedure” paragraph format assigned to instructions, if required. – Captions converted. – “Management/diagnostic variables” term standardized.
		Section 1.5	– “Observe startup behavior”: section updated. – “Safety notes for starting applications”: section shortened and inserted reference to the same text in Section 4.4.

Revision	Date	Content	
		Section 1.6.4	Notes on security added.
		Section 1.8	UL information added: – “UL Ordinary Location” updated – “UL Hazardous Location” newly added.
		Section 1.9	“... for use ... in potentially explosive areas” newly added.
		Section 1.12	Note on current documentation changed.
		Section 1.13	Note on PLCnext Security Info Center added.
		Section 2.3	“Checking the delivery” section supplemented by the security seal check.
		Section 3.2	Entire Section 3.2 restructured and supplemented, including subsections (distinction in behavior of the SPLC 1000 as F-Host and F-Device).
		Section 3.2.1	New section: Behavior of the SPLC 1000 as the F-Host in PROFIsafe
		Section 3.2.2	New section: Behavior of the SPLC 1000 as the F-Device in PROFIsafe
		Section 3.3.2	“Program runtime” section: reference to 70 percent utilization of the SPLC 1000 CPU added.
		Section 3.5.2	Security seal added in the figure and associated safety note inserted.
		Section 3.7 ... 3.10	New section headings added.
		Section 3.8	P LED, flashing: description added.
		Section 4.4.4	– “AXC F 2152” section: text and figure (new: item 1) changed. – “AXC F 3152” section: text changed. – “Aligning additional ... modules ... on the left ...” section: figure changed (item 1 deleted).
		Section 4.4.5	Text under figure changed.
		Section 5.2.5	Figure changed: item A deleted.
		Section 6.1	Table 6-1: “Defining a project password” step moved (10 => 7)
		Section 6.4.3	Note added: WARNING: Network error/network conflict
		Section 6.5.4	“Cross-functional area” section: description updated (deleted: ERROR LIST; new: MESSAGES, NOTIFICATION LOGGER)
		Section 6.8.2	First paragraph changed.
		Section 6.9.1	“F_Destination_Address (...)” section: note on the DIP switches added.
		Section 6.9.6	“Selecting management/diagnostic variables and exchange variables” section: first paragraph “Before the management/diagnostic variables...” corrected.
		Section 6.10	Entire section updated, Sections 6.10.1 and 6.10.2 deleted. Section 6.10.3 becomes Section 6.11.
		Section 6.11 (6.10.3)	Procedure in section updated.
		Section 6.13 (6.12)	Operator acknowledge: description updated.
		Section 7.3	NOTE on startup of SPLC 1000 and PLCnext Control added to the end of the section.

Revision	Date	Content	
		Section 7.3.1	Table 7-1: – NOTE on startup of SPLC 1000 and PLCnext Control removed from the table. – Reference to the NOTE added to the table. – 0x8126 (0x9126)/0x8128 (0x9128): description of “Remedy or response” added. – Error code 0x8248 (0x9248)/0x8249 (0x9249) deleted (does not exist). – Individual wording changed (Please contact.../Check...).
		Section 7.3.2	Table 7-2: – NOTE on startup of SPLC 1000 and PLCnext Control removed from the table. – Reference to the NOTE added to the table. – “Remedy or response” of 0x8148 (0x9148) and 0x8149 (0x9149) combined.
		Section 8.3.1	Table 8-1: SPLC system variable: TEMP_CURRENT and STATUS_REG elements: “device-internal” added.
		Section 8.3.2	– Table 8-2 Diagnostic status register: – FS element: “... to the safe state...”: “safe” added. – SYN element: “PROFINET controller” replaced with “standard controller (PLCnext Control)”. – Following Table 8-3, Diagnostic status register: text for SYN bit added (PLCnext Control).
		Section 8.3.5 (Section 3.2.2)	– Contents in the “System variables for data exchange of the F-Device...” section moved. – Reference to this section added in Section 3.2.2.
		Section 8.3.6	– “Lower-level” term added for F-Devices. – Names of the individual management/diagnostic variables corrected. – WARNING positioned in front of Table 8-8. – Table 8-8: F_ADDR_[nnnnn]_DEVICE_FAULT system variable: meaning updated.
		Section 8.3.7	– “Lower-level” term added for F-Devices. – Names of the individual management/diagnostic variables corrected. – WARNING positioned in front of Table 8-9. – Table 8-9: DEVICE_FAULT_GLOBAL system variable: meaning updated.
		Section 8.3.8.1	– Names of the individual management/diagnostic variables corrected. – WARNING positioned in front of Table 8-10. – Table 8-10: – FD_ADDR_[nnnn]_DEVICE_FAULT_DEV system variable: meaning updated. – “SPLC 1000 as F-Device” and “SPLC 1000 (F-Device)” changed to “The SPLC 1000 F-Device”.
		Section 8.3.8.2	– Names of the individual management/diagnostic variables corrected. – WARNING positioned in front of Table 8-11.

Revision	Date	Content	
		Section 11.2	Note on disposal updated.
		Section 13.1	– Ordering data updated
		Section 13.1.6	– Note on security documentation updated.
		Section 13.2	– General data: color specification updated. – Characteristic data of the safety-related controller SPLC 1000: – Non-safety input data (NSI): “inputs exchange area” added. – Non-safety output data (NSQ): “outputs exchange area” added. – Conformance with EMC directive...: Transient overvoltage (surge)...: correction: Criterion ... /±1.0 kV ... – Approvals: various approvals added. – Note on manufacturer's declarations added.

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