

Axioline Smart Elements

User manual

User manual

Axioline Smart Elements

UM EN AXL SE SYS INST, Revision 03

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This user manual is valid for all Axioline Smart Elements (AXL SE ...)

108706_en_03

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1 For your safety

Read this user manual carefully and keep it for future reference.

1.1 Identification 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.

1.3 Field of application of the product

1.3.1 Intended use

You can integrate Axioline Smart Elements into systems with the Smart Element interface.

The Axioline Smart Elements have IP20 degree of protection and can be used in closed control cabinets or control boxes (junction boxes) with IP54 protection or higher.



Axioline Smart Elements are designed for use in industrial environments.

In the following, the terms “Axioline Smart Elements” and “Smart Elements” are used interchangeably.

1.3.2 Product changes

Modifications to hardware and firmware of the device 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.

2 Documentation landscape of Axioline Smart Elements

2.1 Available documents

The documentation for the Axioline Smart Elements product group is modular, providing you with the optimum information to meet your requirements.

Table 2-1 Axioline Smart Elements documentation

Document	Contents
Comprehensive information on Smart Elements	
User manual "Axioline Smart Elements" UM EN AXL SE SYS INST (this user manual)	This user manual is the generic user manual for Axioline Smart Elements. It describes the Axioline Smart Elements product group and everything about mounting, removal and wiring of Smart Elements.
Comprehensive information on the Axioline F system (including Axioline F backplane)	
User manual "Axioline F: System and installation" UM EN AXL F SYS INST	This manual is the generic system manual for Axioline F. It describes the Axioline F product group and everything about mounting, removal and wiring of Axioline F modules regardless of a higher-level network.
Basic information on a Smart Element	
Packing slip	Smart Elements with a safety function are supplied with a packing slip. It contains key information on the electrical installation. This includes, for example: <ul style="list-style-type: none"> - EU declaration of conformity - Safety notes - Brief description/Intended use - Mounting, removal, and installation - Additional applicable documentation Smart Elements without a safety function are not supplied with a packing slip. For use within an Axioline F system, the packing slips for the Axioline F backplanes also contain information on Smart Elements.
Tubular bag printing	The tubular bag printing contains key information on the electrical installation.
Printing on the Smart Element	Terminal point assignment is printed on the side of the Smart Element.
User manuals for safe Smart Elements	The user manual for each safe Smart Element contains the complete information required for use.
Data sheets	The data sheet for each Smart Element contains the complete information required for use. This includes at the very least: <ul style="list-style-type: none"> - Function description - Technical data - Connection assignment or terminal point assignment - Local diagnostic and status indicators - Connection examples

Table 2-1 Axioline Smart Elements documentation [...]

Document	Contents
Additional information on a Smart Element	
Quick start guides	Quick-start guides are available for various topics. A quick-start guide describes the startup of a Smart Element step by step using an example.
Application notes	Application notes provide additional information on special topics.

2.2 Documentation on the Internet

The documentation can be downloaded at phoenixcontact.net/<Item number of your Smart Element>. Here, you will find information on your product. During your search, take into account the difference between “Generate product PDF” and “Downloads”.

Generate product PDF

Click the “Generate product PDF” link to see the selected up-to-date information. It provides a **short overview** of the Smart Element. The generated PDF file contains the essential product information. If you require further information, you can use the “Downloads” tab.

Downloads

You can access the **complete** documentation and all other downloads related to a product via the “Downloads” item in the “Product Details” section.

2.3 Purpose of this user manual

This user manual provides information on the Axioline Smart Elements product group. It describes the product group and everything about mounting, removal, and wiring of Smart Elements. This description is independent of the system in which you use Smart Elements and independent of a higher-level network.

3 The Axioline Smart Elements product group

3.1 Axioline Smart Elements

Axioline Smart Elements are compact, pluggable I/O elements. They are particularly easy to handle during configuration, installation, and startup.

Compact

Eight or 16 terminal points on a base area of 15 mm x 62 mm provide an extremely compact housing design.

The large conductor cross-section of 1.5 mm² with ferrule including a plastic collar on a 3.5 mm pitch for I/O signals ensures low voltage drops, even over longer conductor lengths.

Easy handling

Push-in connection technology reduces signal line installation times, thanks to conductor connection without tools.

Minimize your startup time with Axioline Smart Elements, as they require little to no parameterization effort during startup or when replaced.

The release mechanism enables quick and easy mounting and removal.

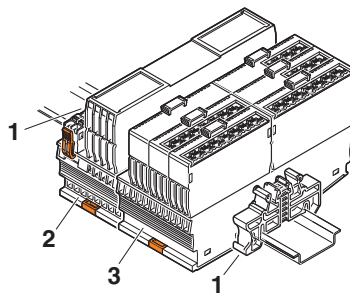
3.2 Use in an Axioline F station

Axioline F backplanes are available for integrating Axioline Smart Elements into an Axioline F station. Depending on the version, the backplanes feature four or six slots for Axioline Smart Elements. You can insert the Axioline Smart Elements at any position in the backplane.

Within an Axioline F station, the backplanes provide the I/O voltage and communications power supply for the Smart Elements.

You can combine Axioline F modules and Axioline Smart Elements in any way in an I/O station.

Figure 3-1 Example: Smart Elements in an Axioline F station



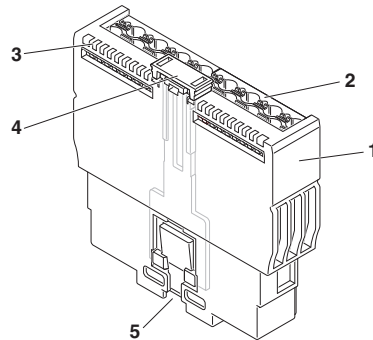
- 1 End bracket
- 2 Axioline F bus coupler
- 3 Axioline F backplane with Axioline Smart Elements plugged in

4 Product description

4.1 General description

Structure

Figure 4-1 Components of a Smart Element



- 1 Housing
- 2 Terminal points for I/O connection, depending on the housing version
- 3 Diagnostic and status indicators, depending on the Smart Element type
- 4 Release mechanism
- 5 Smart Element interface

Housing versions

Smart Elements for extra-low voltage are available in three housing versions, see [Figure 4-2](#):

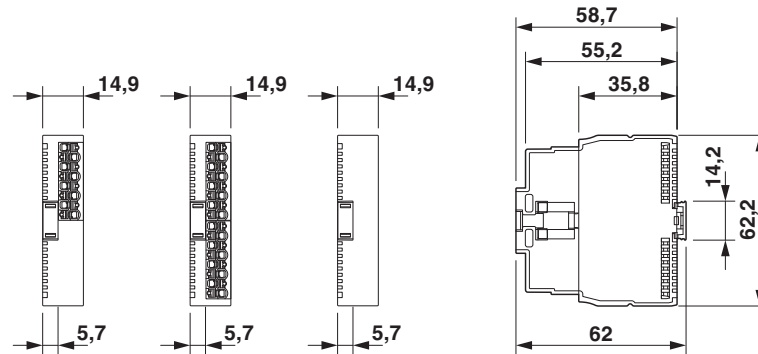
- Smart Elements with 16 terminal points
- Smart Elements with 8 terminal points
- Smart Elements without terminal points

The relay module is accommodated in a separate housing version, see [Figure 4-3](#).

Dimensions of extra-low voltage versions

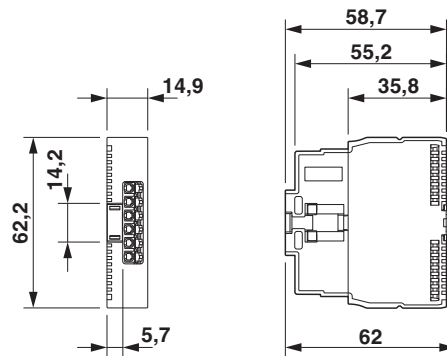
In addition to the housing versions for extra-low voltage, [Figure 4-2](#) also shows the dimensions of the Smart Elements. The dimensions are identical, independent of the number of terminal points.

Figure 4-2 Housing versions and dimensions of Smart Elements for extra-low voltage



Dimensions of the relay module

Figure 4-3 Housing version and dimensions of the relay module



Functions

Smart Elements with various functions are available within the Axioline Smart Elements product group.


- Smart Elements for the input or output of digital or analog signals
- Smart Elements for temperature measurement
- Smart Elements for communication
- Smart Elements for open and closed-loop control, and position detection
- ...

Voltage ranges

Smart Elements are available for the protective extra-low voltage (PELV) and the low voltage range. Smart Elements for both ranges can be installed right next to each other.

Table 4-1 Voltage ranges of the Smart Elements

Voltage range	Nominal voltage used	Permissible voltage range	Examples
Protective extra-low voltage (extra-low voltage)	24 V DC	19.2 V DC ... 30 V DC	AXL SE DI16/1
Low voltage	220 V DC 230 V AC	19.2 V DC ... 253 V DC 19.2 V AC ... 265 V AC (50 Hz ... 60 Hz)	AXL SE DOR2 W 230

 The instructions given in this user manual and in the product-specific documentation must be followed during installation and startup. Particularly observe: [“Mounting and removal of Smart Elements” on page 18.](#)

Mounting location

Smart Elements have IP20 degree of protection. They can be used in closed control cabinets or control boxes (junction boxes) with IP54 degree of protection in accordance with EN 60529 or higher.

Mounting

A Smart Element is snapped onto its slot without using any tools. See [Section “Mounting and removal of Smart Elements” on page 18.](#)

Removal

To remove a Smart Element from its slot, pull the release mechanism upwards. See [Section “Mounting and removal of Smart Elements” on page 18.](#)

Communications supply voltage (U_{SE})

The communications supply voltage of the Smart Element is provided via the Smart Element interface.

I/O supply voltage (U_p)

The I/O supply voltage of the Smart Element is provided via the Smart Element interface.

I/O connection

The I/O devices are connected directly via the terminal points of the Smart Element.

Grounding and shielding

The system providing the slot for the Smart Element has to provide a grounding and shielding concept.

Diagnostics

The Smart Elements feature diagnostic and status indicators. For the diagnostic options of a Smart Elements, please refer to the associated data sheet.

4.2 Approvals

For the latest information about approvals of Smart Elements, please visit phoenixcontact.net/product/<Item number of your Smart Element>.

4.3 Item designations

The item designation helps you to identify the function of a Smart Element.

	Product group	Function and number of inputs or outputs	Conductor connection	Function extension
Examples:	AXL SE	AI4		I 4-20
	AXL SE	AO4		U 0-10
	AXL SE	DI16	/1	
	AXL SE	RS485		
	AXL SE	INC1		SYM

Table 4-2 Structure of the item designations

Product group	AXL SE	Axioline Smart Elements
Function	DI	Digital input
	DO	Digital output
	DOR	Relay output
	SDI	Safe digital input
	SDO	Safe digital output
	PSDI	Safe digital input in a PROFIsafe system
	PSDO	Safe digital output in a PROFIsafe system
	AI	Analog input
	AO	Analog output
	RTD	Analog input for the connection of resistance temperature detectors
	CNT	Counter
	INC	Incremental encoder input
	RS485	Communication, serial data transmission via RS-485
	RS232	Communication, serial data transmission via RS-232
	IOL	IO-Link
PD	Potential distribution	
Function	SC	Slot cover for an unused Smart Element slot
	SC-A	Slot cover for an unused Smart Element slot, with diagnostic function
Number of inputs or outputs	1 ... 16	1 channel ... 16 channels

Table 4-2 Structure of the item designations [...]

Conductor connection	/1	1-conductor
	/2	2-conductor
Function extension	I 4-20	Current 4 mA ... 20 mA
	U 0-10	Voltage 0 V ... 10 V
	PT100	Measurement resistor Pt 100
	PT1000	Measurement resistor Pt 1000
	SYM	Symmetrical incremental encoders
	ASYM	Asymmetrical incremental encoder
	NPN	NPN-wired
	W 230	Changeover contact, 230 V AC
	2A	2 A output
	EF	Extended function
	24V	24 V
GND	Ground (GND)	

4.4 Color and marking

Color

The following housing colors are used for Smart Elements.

Table 4-3 Housing colors

Color	Similar RAL color	Use
Traffic gray A	RAL 7042	Standard
Zinc yellow	RAL 1018	Safety

Function

The function can be read even if the Smart Elements are plugged in.

Terminal points

Starting from the top, the terminal points are marked with 0, 1 to 15, maximum. In addition, each terminal point used is marked on the side depending on its function.

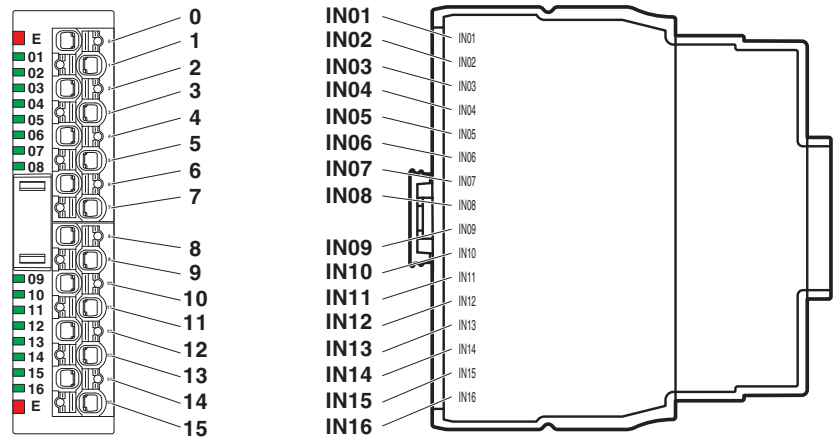


Figure 4-4 Terminal point marking (example: AXL SE DI16/1)

Indication elements

Diagnostics and status indicators are marked in accordance with their function. For the meaning, please refer to the data sheet specific to the Smart Element.

Equipment identification by the user

You can provide the Smart Element with an equipment identification. Two options are available:

- Stick a label to the release mechanism (1 in [Figure 4-5](#)).

Or

- Snap a marker onto the release mechanism.

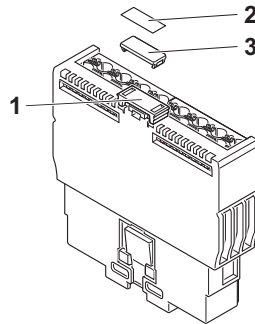


Figure 4-5 Equipment identification

- 1 Position for equipment ID on the release mechanism
- 2 Label for self-adhesion (see [Table 4-4](#))
- 3 Marker for snapping on (see [Table 4-4](#))

The dimensions of the marking area are 12 mm x 5.4 mm.

You can use the following marking material provided by Phoenix Contact:

Table 4-4 Marking material

No. in Figure 4-5	Description	Type	Item No.	Pcs./Pkt.
2	Label, continuous, cassette, transparent with black imprint, mounting type: adhesive, can be marked with THERMOFOX	MM-TML (EX4,2)R C1 TR/BK	0803979	1
2	Marker strip, roll, white, unmarked, can be marked with: THERMOMARK ROLL 2.0, THERMOMARK ROLL, THERMOMARK ROLL X1, THERMOMARK ROLLMASTER 300/600, THERMOMARK X1.2, mounting type: adhesive, for terminal block width: 5 mm, lettering field size: continuous x 5 mm	SK 5,0 WH:REEL	0805221	1
3	Markers, 24-section, unmarked, can be marked with THERMOMARK CARD and BLUEMARK, color: white	UM6M-TM (5X12)	0830928	10
3	Markers, sheet, white, unmarked, can be marked with: THERMOMARK CARD, THERMOMARK CARD 2.0, THERMOMARK PRIME, BLUEMARK ID, BLUEMARK ID COLOR, TOPMARK LASER, TOPMARK NEO, mounting type: snap into a high marker groove, for terminal block width: 5.2 mm, lettering field size: 4.17 mm x 11.3 mm	UCT6M-TM 5	0830756	10

5 Transport, storage, and unpacking

**NOTE: Electrostatic discharge**

Electrostatic discharge can damage or destroy components. 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.

5.1 Transport

Smart Elements are delivered in a tubular bag.

- Please observe the notes on the packaging.

Suitable transport packaging

- Only transport the device in its original packaging or in packaging suitable for transport.

Technical data and environmental conditions

- For transport, observe the humidity and air pressure specifications, and the temperature range.
See [Section “Technical data” on page 37](#).

5.2 Storage

Suitable storage location

The storage location must meet the following requirements:

- Dry
- Protected from unauthorized access
- Protected from harmful environmental influences such as UV light

Technical data and environmental conditions

- For storage, observe the humidity and air pressure specifications, and the temperature range.
See [Section “Technical data” on page 37](#).

5.3 Unpacking

Checking the delivery

- Check the delivery for damage and completeness.
- Submit claims for any transport damage immediately.


6 Mounting and removal of Smart Elements

6.1 Safety notes for mounting and removal


6.1.1 Qualification of users

The use of products described in this data sheet 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.

6.1.2 General safety notes

 **NOTE: Electrostatic discharge**
Electrostatic discharge can damage or destroy components. 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.

Removing or inserting a Smart Element

 **NOTE: Damage to contacts or malfunction**

- Before performing work on a Smart Element, disconnect the Smart Element from power.
This means:
 - Disconnect the connected I/O devices from power.
 - Switch off I/O supply voltage U_p .
 - Switch off communications voltage U_{SE} .For the system in which the Smart Element is used, this means the following:
Switch off the voltage that generates U_{SE} .

6.1.3 Additional safety notes for the low voltage range

Installing the system

Install the system in accordance with the requirements of EN 50178.



WARNING: Dangerous contact voltage

Please note that there are dangerous contact voltages when working on circuits that do not meet protective extra-low voltage requirements.

- The Axioline Smart Elements for the low voltage range may only be mounted and removed when the power supply is disconnected.
- When working on Smart Elements and wiring, always switch off the supply voltage and ensure it cannot be switched on again.
- The Smart Elements for the low voltage range must only be operated in a closed control cabinet.

Failure to observe these instructions can lead to damage to health or even life-threatening injury.



WARNING: Dangerous contact voltage in the event of ground faults

Please note that there are dangerous contact voltages when working on circuits that do not meet protective extra-low voltage requirements.

- Only operate the Smart Elements for the low voltage range in grounded grids.



Additionally observe the information in the product-specific data sheets.

6.2 Mounting position

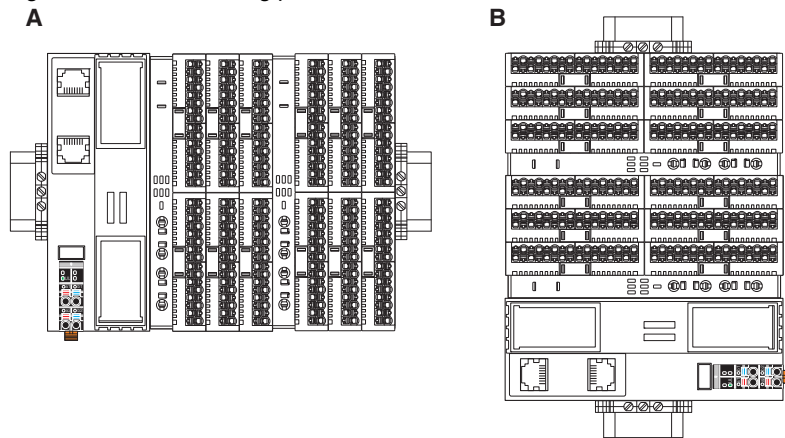
The mounting position depends on the system in which the Smart Element is used.

Mounting position in an Axioline F station

For Axioline F backplanes, only wall mounting on a horizontal or vertical DIN rail is permitted (6.3).

Wall mounting on a horizontal DIN rail on the wall is the **preferred** mounting position (6.3, A). This mounting position provides optimum air flow for the Smart Elements.

Figure 6-1 Mounting positions

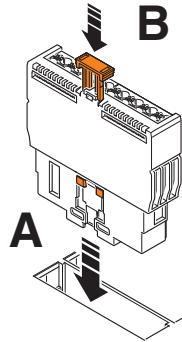


6.3 Mounting Smart Elements

A Smart Element and its slot are mechanically designed in such a way that you can only insert the Smart Element in one direction.

- Insert the Smart Element vertically into its slot (Figure 6-2, A).
- Push the release mechanism into the guide as far as it will go (Figure 6-2, B). This latches the Smart Element.

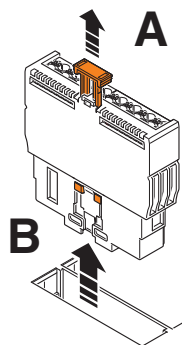
Figure 6-2 Inserting and latching the Smart Element in its slot



6.4 Removing Smart Elements

- Before removing a Smart Element, you might have to remove the inserted cables. See [Section “Connecting or removing cables” on page 22](#).
- To remove the Smart Element from its slot, pull the release mechanism vertically upwards (Figure 6-3, A).
- Pull the Smart Element out of its slot (Figure 6-3, B).

Figure 6-3 Removing the Smart Element from its slot



7 Connecting or removing cables

7.1 Cables connected to Smart Elements

The cables for I/O devices are directly connected to the Smart Elements.



For use in applications in which UL approval is required:

Observe any specifications in the documentation specific to the Smart Element used, and the rating on the Smart Element.

When using Smart Elements, you can use rigid and flexible cables, with or without ferrules.

Please observe the following when wiring:


- Ensure strain relief in accordance with DIN EN 62444, IEC 62444 for all cables.
- Make sure to install the conductor in the middle of the wiring space, especially with small cross-sections.



If using ferrules, use those which correspond to the specifications in

[Section “Conductor cross-sections, stripping and insertion lengths” on page 23.](#)

7.2 Conductor cross-sections, stripping and insertion lengths

 For electrical and/or thermal reasons, it may not be possible to use the minimum conductor cross-sections specified here for certain Smart Elements. Therefore, always observe the information in the documentation specific to the Smart Element.

Conductor cross-sections

Table 7-1 Permissible conductor cross-sections for Push-in connection technology **(without using the spring lever** for inserting the conductor)

Conductor	Cross-section
Rigid	0.5 mm ² 1.5 mm ² (AWG 20 ... 16)
Flexible with ferrule without insulating collar (A ...) or with insulating collar (AI ...)	
Flexible with TWIN ferrule with insulating collar (AI-TWIN ...)	0.5 mm ² (AWG 20)


 Flexible cables without ferrules are only suitable for Push-in connection technology **when using the spring lever**.


Table 7-2 Permissible conductor cross-sections **when using the spring lever** for inserting the conductor

Conductor	Cross-section
Rigid	0.25 mm ² 1.5 mm ² (AWG 24 ... 16)
Flexible with ferrule without insulating collar (A ...) or with insulating collar (AI ...)	
Flexible without ferrule	
Flexible with TWIN ferrule with insulating collar (AI-TWIN ...)	0.5 mm ² (AWG 20)

Table 7-3 Stripping lengths and ferrule lengths

Cross-section	Length
0.25 mm ² 1.5 mm ² (AWG 24 ... 16)	8 mm
TWIN ferrules: 0.5 mm ² (AWG 20)	10 mm

Stripping and insertion lengths

 **NOTE: Malfunction when the conductor is not securely fixed**
To ensure secure fixing and correct functioning:
Make sure that the stripping length of a conductor without ferrule or the insertion length of a conductor with ferrule corresponds to the specifications.
For crimping, we recommend the CRIMPFOX 6, CRIMPFOX DUO 10, or CRIMPFOX 10T-F crimping pliers for trapezoidal crimp, see [Section "Ordering data for accessories" on page 40](#).
According to the current state, they meet the general conditions with regard to the wiring space for Axioline Smart Elements (in accordance with DIN EN 60947-1 (DIN VDE 0660-100)-A1 internal cylindrical gauge).

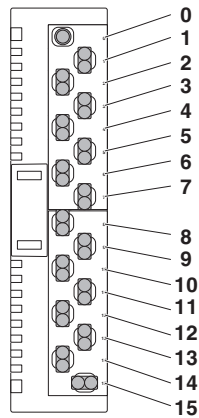
TWIN ferrules


When using TWIN ferrules, please observe the following:




Table 7-4 Use and alignment of TWIN ferrules

Terminal point	Use/alignment
0	TWIN ferrule is not permitted .
1 ... 14	Align the TWIN ferrules vertically .
15	Align the TWIN ferrules horizontally .

Figure 7-1 Use and alignment of TWIN ferrules



 Observe any information in the data sheets for the Smart Elements.


-  Single ferrule
-  TWIN ferrule (vertical insertion)
-  TWIN ferrule (horizontal insertion)

Ferrules

See [Section "Ordering data" on page 40](#).

CABLE-FLK14/AX-IO/OE/0,14/...

Deviating from the above specified conductor cross-sections, the use of assembled CABLE-FLK14/AXIO/OE/0,14/... round cables is permitted for digital modules with 1-conductor connection technology. The conductors of these cables are fitted with ferrules and have a conductor cross-section of 0.14 mm², AWG 26. If round cables are approved for a module, these are listed in the module ordering data.

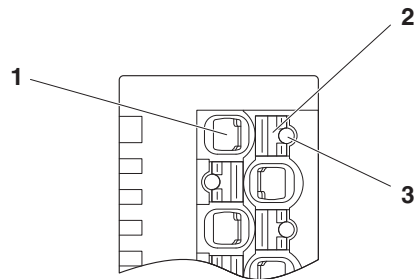
 **UL approval not required**
 For applications with UL approvals, the AWG 24-16 conductor cross-section has been certified.
 Due to the smaller conductor cross-section of AWG 26, **UL approval is not required** when using the Smart Element in combination with a round cable.

7.3 Terminal point with spring lever and touch connection

When using the screwdriver, pay attention to the position of the spring lever to the assigned terminal point.

When testing the signal with a measuring probe, pay attention to the position of the touch connection to the assigned terminal point.


Figure 7-2 Terminal point with associated spring lever and associated touch connection



- 1 Terminal point
- 2 Associated spring lever
- 3 Touch connection (for test probes, see [Section "Ordering data" on page 40](#))

7.4 Connecting unshielded cables

Wire the Smart Element in accordance with your application.

 For the terminal point assignment, please refer to the data sheet for the Smart Element.

When wiring, proceed as follows:

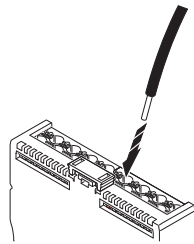
- Strip 8 mm off the cable.

Without tools

Suitable for:

- Conductor cross-sections from 0.5 mm²
- Rigid cables
- Flexible cables with ferrules
- Insert the cable into the terminal point. It is clamped into place automatically.

Figure 7-3 Connecting a cable without using tools

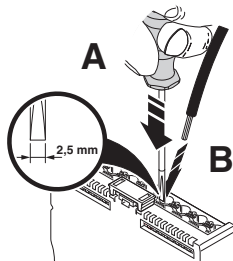


With tools

Suitable for:

- Rigid cables
- Flexible cables
- Flexible cables with ferrules
- Open the spring by pressing the spring lever using the screwdriver (Figure 7-4, A). Use a bladed screwdriver with a blade width of 2.5 mm, for example. Phoenix Contact recommends using the SZS 0,4x2,5 screwdriver (see Section "Ordering data" on page 40).
- Insert the cable into the terminal point (Figure 7-4, B).
- Remove the screwdriver to secure the cable.

Figure 7-4 Connecting a cable using tools



7.5 Connecting shielded cables



Smart Elements do not feature an option to connect shielding. For shielding, use the shielding concept of the system in which you use the Smart Element.

Please note in general:

- Observe the connection notes of the manufacturer of the sensors, actuators, encoders, etc.
- Do not use the shield contact as a strain relief. Carry out shielding and strain relief separately.
- For installation in a control cabinet: Connect the cable shield to functional ground at a suitable point immediately after the cables enter the control cabinet. Further route the cable in the control cabinet in a shielded manner.
- If a closed control cabinet is not available, connect the shield to a shield bus.
- Connect the shielding in accordance with the specifications for the system in which you are using the Smart Element.

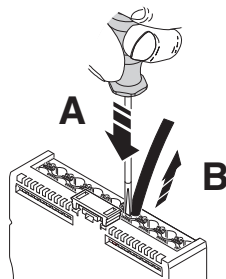
Within an Axioline F station, the AXL SHIELD SET Axioline shield connection set is available for optimum connection directly in front of the module, see UM EN AXL F SYS INST user manual.

In general, you can use Phoenix Contact products for shielding, see [phoenixcontact.net/webcode/#0845](https://www.phoenixcontact.net/webcode/#0845).

7.6 Removing cables from the terminal point

- To remove a cable from the terminal point, press on the spring lever using a suitable tool. This opens the terminal point (Figure 7-5, A).
A suitable tool is, for example, a bladed screwdriver with a blade width of 2.5 mm. Phoenix Contact recommends using the SZS 0,4x2,5 screwdriver (see Section “Ordering data” on page 40).
- Remove the conductor (Figure 7-5, B).

Figure 7-5 Removing the cable



8 Supply voltages

8.1 Required supply voltages

A Smart Element requires the following supply voltages:

- Communications power supply for the Smart Element U_{SE}
- I/O supply voltage U_P

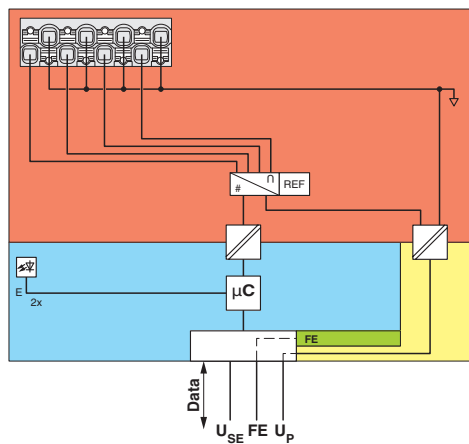
The Smart Element receives both supply voltages via the Smart Element interface. Technical data: see [Section "Technical data" on page 37](#).

If a Smart Element additionally needs to be supplied with voltage, it is fed in directly at the Smart Element, e.g., AXL SE DO4/2 2A EF. See product-specific data sheet.

Example of an internal basic circuit diagram

[Figure 8-1](#) shows that the Smart Element receives supply voltages U_{SE} and U_P from the system, in which the Smart Element is used.

Figure 8-1 Internal wiring of the terminal points (AXL SE AI4 I 4-20)



Key:

Data Data transmission

U_{SE} Communications power supply of the Smart Element

FE Functional ground

U_P I/O supply of the Smart Element



Microcontroller



Analog-to-digital converter



Electrical isolation for data or power supply



Reference voltage source



LED



Electrically isolated areas

Use in an Axioline F station

When integrating Smart Elements in an Axioline F station using an Axioline F backplane:

- Supply the bus head with communications voltage U_L .
From here, the U_{BUS} communications power for the local bus and the U_{SE} communications power for the Smart Elements are generated.
- Supply the Axioline F backplane with voltage U_P .
The backplane provides the Smart Elements with this I/O supply voltage.

For more detailed information, please refer to the “Axioline F: System and installation” user manual, UM EN AXL F SYS INST.

8.2 Power supply requirements

Choose a power supply unit that is suitable for the currents in your application. The selection depends on the devices used and the resulting maximum currents.



WARNING: Loss of electrical safety when using unsuitable power supplies. Dangerous shock currents.

The Smart Elements for extra-low voltage are designed exclusively for operation with protective extra-low voltage (PELV) in accordance with EN 60204-1.

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

- Only use power supply units that ensure safe isolation in accordance with EN 50178 and EN 61010-2-201. They prevent short circuits between the primary and secondary circuits.



WARNING: Dangerous contact voltage in the event of ground faults

- Only operate the Smart Elements for the low voltage range in grounded grids.

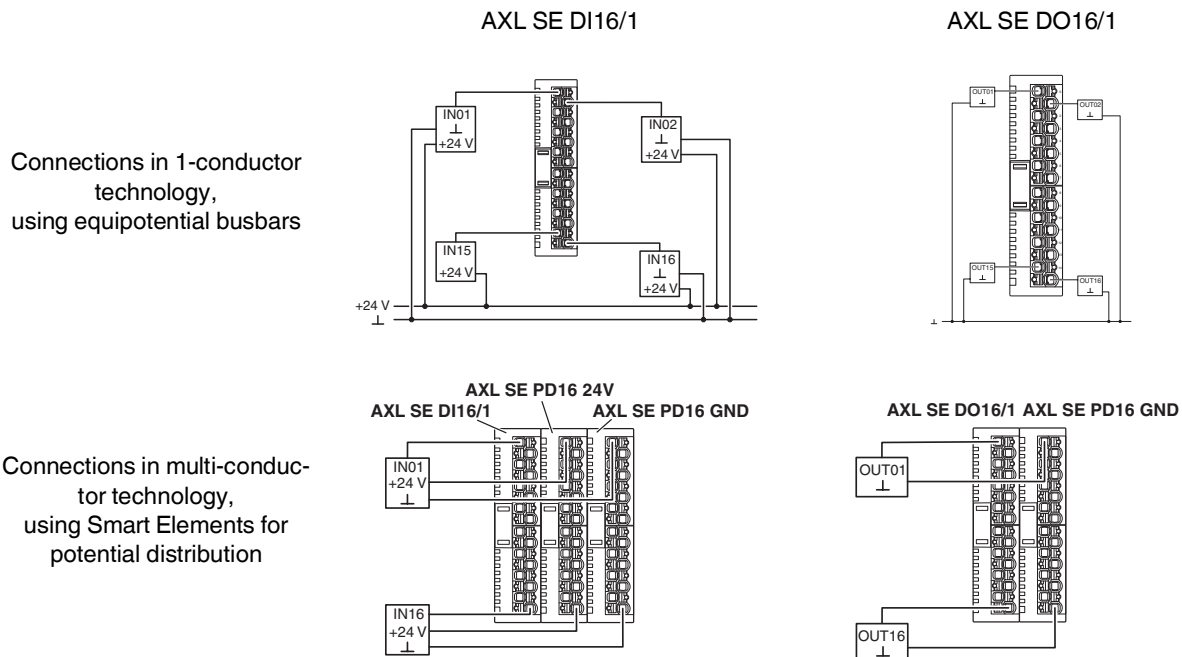
8.3 Smart Elements with 1-conductor technology

The AXL SE DI16/1 (NPN) and AXL SE DO16/1 (NPN) Smart Elements are designed for connecting sensors or actuators in 1-conductor technology.

There are two options to wire all the connections of the connected sensors or actuators:

1. Using equipotential busbars
2. Using AXL SE PD ... Smart Elements for potential distribution
Use these Smart Elements to implement all the connections of a sensor or actuator in multi-conductor technology on Smart Elements.

Figure 8-2 Examples of connections in 1-conductor and multi-conductor technology



You can use the following Smart Elements for potential distribution:

Table 8-1 Smart Elements for potential distribution

Item no.	Type	Features
1337223	AXL SE PD16 24V	16 x 24 V (U _P) 2 fuses, 2 A each
1337224	AXL SE PD16 GND	16 x GND (U _P)
1337225	AXL SE PD8/8 24V/GND	8 x 24 V (U _P), 8 x GND (U _P) 1 fuse, 4 A

Detailed information on the Smart Elements for potential distribution can be found in the associated data sheets. There you will also find instructions for use and examples.

9 Diagnostic and status indicators

For quick local error diagnostics, the Smart Elements are provided with diagnostic and status indicators. They enable the localization of errors.

Figure 9-1 Diagnostic and status indicators

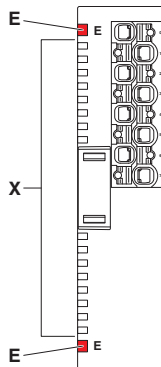


Table 9-1 Diagnostic and status indicators

Identification in Figure 9-1	Meaning	Color
E	Error: diagnostics, both LEDs redundantly indicate diagnostics.	Red
X	Status indicator, depends on the Smart Element	Green, yellow or red

Diagnostics

The diagnostic indicators (E, red) provide information on the state of the Smart Element. If the red LEDs are off, the Smart Element is working correctly.

As LED E is provided twice, one LED E is always visible, no matter what the cable installation is.

Table 9-2 Diagnostic LED E

Designation	Color	Description	Remedy	
E	Red	Error		
		Off	No error	
		Flashing (0.5 Hz)	Smart Element error	Replace the Smart Element.
		Flashing (4 Hz)	Communication error	Check whether the Smart Element has been inserted correctly.
		On	I/O error Possible causes: – I/O supply voltage not present – Short circuit or overload of an output – Wire break at an analog output – ...	Check the connected components and wiring. Remove the error.

Status

The status indicators indicate the status of the relevant input or output and of the connected I/O device or of a supply voltage.



For information about the diagnostic and status indicators on a Smart Element and their meaning, please refer to the specific documentation.

Reporting diagnostics via PDI

The malfunctions indicated by the local diagnostic and status indicators are also mapped in PDI object 0018_{hex} (DiagState).

Detailed information can be found in the data sheet for the Smart Element.

10 Process, parameter and diagnostic data

The Smart Element interface is used for the transmission of process data and parameter data.

10.1 Process data

Smart Elements have at least one byte of process data.

The AXL SE SC and AXL SE SC-A slot covers are an exception.

They have no process data (0 bytes) in all systems except for PROFIBUS. Due to the system, they have 1 byte of input process data with PROFIBUS.

The significance of the data corresponds to the Motorola format (Big Endian).

The significance of the data bytes declines as the number goes up.



For the process data assignment and the assignment of the process data to the terminal points of a Smart Element, please refer to the specific data sheet.

10.2 Parameter and diagnostic data (PDI channel)

Parameter and diagnostic data as well as other information is transmitted via the PDI channel (PDI = Parameters, Diagnostics, and Information).

The PDI channel is used in addition to the process data channel for demand-oriented, acyclic transmission of parameter and diagnostic data as well as other information. Each Axioline Smart Element has this acyclic channel to be able to exchange acyclic data.

Via the PDI channel, you use read and write services to access the communication objects created in the Smart Element. These objects can be used, for example, to set measuring ranges, to specify the substitute value behavior of outputs in the event of a bus error, or to read I/O diagnostic details.



For detailed information on PDI objects, please refer to the UM EN AXL F SYS INST user manual.

10.3 Saving of parameters

Every Axioline Smart Element has parameters. They can be read or written or can be read and written. The parameters that can be written are saved every time a change is made.

In the device description file of each Smart Element, some of the parameters are defined as startup parameters.

Startup parameters (flash)

Startup parameters are stored retentively (in a non-volatile way, permanently) in the flash memory.

Startup parameters include the application object parameters, e.g., substitute value, filter time, etc. As soon as valid parameters are specified for these objects, they are stored retentively on the Smart Element.

Due to the storage technology used, parameters that are stored retentively can only be written for a specific number of times (100,000 up to 1,000,000 times, typically). They are not suitable for being changed cyclically.

A Smart Element only accesses the flash memory if retentively stored parameters are changed. This way, the flash is not “strained” in case of repeated writing operations of identical startup parameters.

However, if retentively stored data is changed from the application constantly, for example, the flash ages accordingly fast.



NOTE: Damage to the flash memory during cyclic write access

The flash memory is only designed for a limited number of write access operations.

- Therefore make sure that write access operations are not performed too often and, in particular, are not performed cyclically.
- Observe this behavior when programming function blocks.

Other parameters (RAM)

Other parameters are stored temporarily (in a volatile way) in the RAM.

11 Device replacement, device defects, and repairs

11.1 Device replacement

To replace a Smart Element, proceed as follows:

- Observe the safety notes for mounting and removal.
See [Section 6.1, “Safety notes for mounting and removal”](#).
- If necessary, disconnect the wiring.
See [Section 7.6, “Removing cables from the terminal point”](#).
- Replace the Smart Element in your application with a new Smart Element. See
 - [Section 6.4, “Removing Smart Elements”](#)
 - [Section 6.3, “Mounting Smart Elements”](#).
- Connect the I/O devices, if necessary.
See
 - [Section 7.4, “Connecting unshielded cables”](#)
 - [Section 7.5, “Connecting shielded cables”](#).

Observe the device type and version

The new Smart Element must meet the following requirements:

- Same device type
- Same or later version of the hardware and firmware

11.2 Device defects and repairs

Do not open the housing

Repairs may only be carried out by Phoenix Contact. Do not open the housing. If the housing is opened, the function of the device can no longer be ensured.

Defective devices

Please contact Phoenix Contact.

12 Maintenance, decommissioning, and disposal

12.1 Maintenance

Smart Elements are maintenance-free.

12.2 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 17](#).

The device is not used anymore:

Device disposal

- Do not dispose of the device with household waste; it should instead be disposed of in accordance with the currently applicable national regulations.

Packaging disposal

- Dispose of packaging materials that are no longer needed (cardboard packaging, paper, bubble wrap sheets, tubular bags, etc.) with household waste in accordance with the currently applicable national regulations.

13 Technical data and ordering data



Observe additional documentation

- When using Smart Elements, also observe the technical data of the system in which you use the Smart Elements.
- For safety applications, refer to the documentation for the Smart Elements used with safety function.



The following values are default values.

- For deviating values, please refer to the documentation for the Smart Element used.

13.1 Technical data


General data (default values; for deviations see documentation for the Smart Element used)	
Ambient temperature (operation)	-25°C ... +60°C
Ambient temperature (storage/transport)	-40°C ... +85°C
Permissible humidity (operation/storage/transport)	5% ... 95% (non-condensing)
Permissible air pressure (operation/storage/transport)	5% ... 95% (non-condensing)
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above mean sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above mean sea level)
Degree of protection	IP20
Protection class	Extra-low voltage: III (IEC 61140, EN 61140, VDE 0140-1) Low voltage: II (IEC 61140, EN 61140, VDE 0140-1, mounted in an adequate housing with at least IP54 protection)
Overvoltage category	Extra-low voltage: II (IEC 60664-1, EN 60664-1) Low voltage: III (IEC 61010-2-201, EN 61010-2-201)
Pollution degree	Extra-low voltage: 2 (IEC 60664-1, EN 60664-1) Low voltage: 2 (IEC 61010-2-201, EN 61010-2-201)
Air clearances and creepage distances	Extra-low voltage: in accordance with IEC 60664-1, EN 60664-1 Low voltage: in accordance with IEC 61010-2-201, EN 61010-2-201
Housing material	Plastic



Do not use Smart Elements in an atmosphere that contains corrosive gas.

Interface: Smart Element interface	
Number	1
Connection method	Card edge connector
Number of insertion cycles	10
Function	Data transmission Communications power supply of the Smart Elements I/O power supply of the Smart Elements Connection to functional ground
Current consumption	See documentation for the system in which the Smart Elements are used

Connection data: I/O

 For electrical and/or thermal reasons, it may not be possible to use the minimum conductor cross-sections specified here for certain Smart Elements. Therefore, always observe the information in the documentation specific to the Smart Element.


Connection method	Push-in connection
Maximum current carrying capacity of the contacts	8 A

Rigid and flexible conductors without ferrules or with single ferrules

Conductor cross-section, rigid/flexible	0.25 mm ² ... 1.5 mm ² /0.25 mm ² ... 1.5 mm ²
Conductor cross-section [AWG]	24 ... 16
Stripping lengths	8 mm

Two conductors with the same cross-section, flexible with TWIN ferrule and plastic collar

Conductor cross-section	0.5 mm ² per conductor
Conductor cross-section [AWG]	20
Stripping lengths	10 mm

 Please observe the information on conductor cross-sections and stripping lengths in [Section "Conductor cross-sections, stripping and insertion lengths" on page 23](#).

Communications power supply of the Smart Element (U_{SE})

Remark	The communications power supply is provided via the Smart Element interface by the system in which you use the Smart Element.
Current consumption	See data sheet for the system in which you use the Smart Element
Power consumption	See data sheet for the system in which you use the Smart Element

24 V I/O supply (U_P)

Nominal voltage	24 V DC (using card edge connector)
Maximum permissible voltage range	19.2 V DC ... 30.0 V DC (all tolerances included, ripple included)
Current consumption	See data sheet for the Smart Element 6 A, maximum, observe possible limitations of the system in which you use the Smart Element.
Power consumption	See data sheet for the Smart Element

Electrically isolated areas

See data sheet for the Smart Element

Test voltages (default values for the 24 V area; for deviations and the low voltage area, see documentation specific to the Smart Element)

Isolating distance	Test voltage
Communications power supply/24 V supply (I/O)	500 V AC, 50 Hz, 1 min
Communications power supply/functional ground	500 V AC, 50 Hz, 1 min
24 V supply (I/O)/functional ground	500 V AC, 50 Hz, 1 min

Mechanical tests (default values; for deviations, see documentation specific to the Smart Element)

Vibration resistance in accordance with EN 60068-2-6/IEC 60068-2-6	5g
Shock testing in accordance with EN 60068-2-27/IEC 60068-2-27	30g
Bump endurance test in accordance with EN 60068-2-27/IEC 60068-2-27	10g

Conformance with EMC Directive 2004/108/EC

Immunity test in accordance with EN 61000-6-2/IEC 61000-6-2	See data sheet for the Smart Element used
Noise emission test in accordance with EN 61000-6-4/IEC 61000-6-4	Class A

Voltage dips and interruptions of I/O supply U_P

See system in which you use the Smart Element.


Approvals

For the latest approvals, please visit phoenixcontact.net/products.

Manufacturer's declarations

The latest manufacturer's declarations can be found at phoenixcontact.net/products.

13.2 Ordering data

 The complete product catalog is available in electronic form at phoenixcontact.net/products.

Ordering data for Axioline Smart Elements


Ordering data for the Axioline Smart Elements is available on the Internet at phoenixcontact.net/products.

Ordering data for accessories

Description	Type	Item No.	Pcs./Pkt.
Tools			
Screwdriver, bladed, VDE-insulated, size: 0.4 mm x 2.5 mm x 80 mm, 2-component handle, with non-slip grip	SZS 0,4X2,5 VDE	1205037	1
Crimping pliers, for ferrules without insulating collar in accordance with DIN 46228 Part 1 and ferrules with insulating collar in accordance with DIN 46228 Part 4, 0.25 mm ² ... 6.0 mm ² , lateral entry, trapezoidal crimp	CRIMPFOX 6	1212034	1
Crimping pliers, type of contact: insulated and uninsulated ferrules, standards/regulations: DIN 46228-1, DIN 46228-4, cross-section, minimum: 0.14 mm ² , cross-section, maximum: 10 mm ² , for TWIN ferrules up to 2 mm ² x 4 mm ² , automatic cross-section adjustment, rotating dies, lateral and front entry, crimping: trapezoidal crimp, black/green	CRIMPFOX DUO 10	1031721	1
Crimping pliers, type of contact: insulated and uninsulated ferrules, standards/regulations: DIN 46228-1, DIN 46228-4, cross-section, minimum: 0.14 mm ² , cross-section, maximum: 10 mm ² , for TWIN ferrules up to 2 mm ² x 4 mm ² , automatic cross-section adjustment, rotating dies, lateral and front entry, crimping: trapezoidal crimp, black/green	CRIMPFOX 10T-F	1134913	1
Test probes			
Test probe, blue	MPS-MT 1-S4-B	1974614	50
Test probe, red	MPS-MT 1-S4-B RD	1982800	50
Test probe, red	MPS-MT 1-S4-B RD VPE1	1020292	1
Marking material			
Label, continuous, cassette, transparent with black imprint, mounting type: adhesive, can be marked with THERMO-FOX	MM-TML (EX4,2)R C1 TR/BK	0803979	1
Marker strip, roll, white, unmarked, can be marked with: THERMOMARK ROLL 2.0, THERMOMARK ROLL, THERMOMARK ROLL X1, THERMOMARK ROLLMAS-TER 300/600, THERMOMARK X1.2, mounting type: adhesive, for terminal block width: 5 mm, lettering field size: continuous x 5 mm	SK 5,0 WH:REEL	0805221	1
Markers, 24-section, unmarked, can be marked with THERMOMARK CARD and BLUEMARK, color: white	UM6M-TM (5X12)	0830928	10

Description	Type	Item No.	Pcs./Pkt.
Markers, sheet, white, unmarked, can be marked with: THERMOMARK CARD, THERMOMARK CARD 2.0, THERMOMARK PRIME, BLUEMARK ID, BLUEMARK ID COLOR, TOPMARK LASER, TOPMARK NEO, mounting type: snap into a high marker groove, for terminal block width: 5.2 mm, lettering field size: 4.17 mm x 11.3 mm	UCT6M-TM 5	0830756	10
Ferrules			
Ferrules with insulating collar (plastic collar), in accordance with DIN 46228-4; sleeve length: 8 mm	AI ...	See "Marking systems, tools, and mounting material" catalog	
Cross-section 0.5 mm ²	AI 0,5 - 8 WH -1000	3200881	1000
Cross-section 0.75 mm ²	AI 0,75- 8 GY -1000	3200894	1000
Cross-section 1.0 mm ²	AI 1 - 8 RD -1000	3200904	1000
Ferrules without insulating collar (plastic collar), in accordance with DIN 46228-1; length: 8 mm	A ...	See "Marking systems, tools, and mounting material" catalog	
Cross-section 0.5 mm ²	A 0,5 - 8	3202481	1000
Cross-section 0.75 mm ²	A 0,75- 8	3202504	1000
Cross-section 1.0 mm ²	A 1 - 8	3202517	1000
TWIN ferrules with insulating collar (plastic collar), in accordance with DIN 46228-4; sleeve length: 10 mm	AI-TWIN ...	See "Marking systems, tools, and mounting material" catalog	
Cross-section 0.5 mm ²	AI-TWIN 2X 0,5-10 WH	3203309	100

Ordering data for documentation

 The documentation can be downloaded at phoenixcontact.net/products.
Make sure you always use the latest documentation.

A Technical appendix: altitudes above 3000 m

Use of Axioline Smart Elements at altitudes above 3000 meters

This section applies to Smart Elements that are operated with a DC voltage of <60 V DC.

⚠ WARNING: Dangerous contact voltage. Loss of the safety function.

This section does **not** apply to the following Smart Elements or applications:

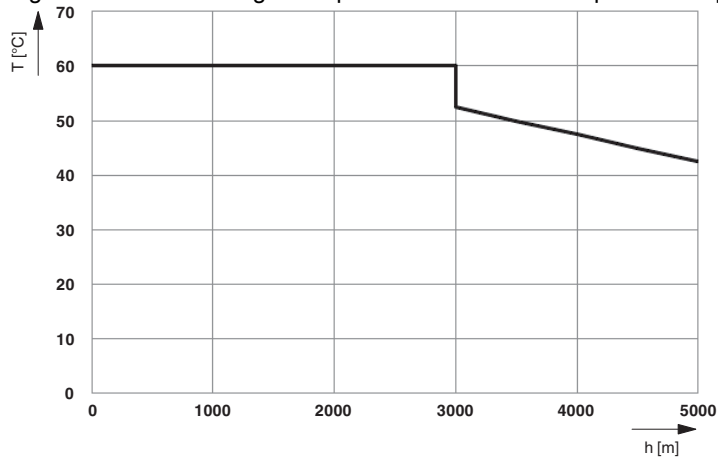
- Smart Elements that are not operated with PELV (protective extra-low voltage) (e.g., 230 V)
- Smart Elements with safety functions (e.g., SafetyBridge, PROFIsafe)
- Use of a safe signal path

In these cases, consider the individual Smart Element or application separately.

The Smart Elements are approved for use at altitudes up to 3000 m above mean sea level, see ["Technical data" on page 37](#).

The maximum permissible ambient temperature decreases at altitudes above this level. Therefore, keep temperature derating in mind when using the Smart Elements at altitudes above 3000 m up to 5000 m.

Figure A-1 Derating of the permissible ambient temperature depending on the altitude



Key:

- T [°C] Maximum ambient temperature (operation) in °C
- h [m] Altitude in m

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A Revision history

Table A-1 Revision history

Revision	Date	Contents	
00	2019-11-13	First publication	
01	2020-08-26	Section 4.3, Section 10.1	Additions: AXL SE SC
02	2020-11-30	Entire document	Additions: <ul style="list-style-type: none"> - New Smart Elements - Low voltage range - Safety notes - TWIN ferrules
03	2021-04-03	Section 7.2	Table 7-2: TWIN ferrules added
			CABLE-FLK14/AXIO/OE/0,14/... added
		Section 7.5	Addition: Please note in general
		Section 8.3	New: Smart Elements with 1-conductor technology
		Section 13.1	IEC added
	Appendix A	Addition in the warning note	

Please observe the following notes

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