Axioline Smart Elements

User manual

PHŒNIX CONTACT

INSPIRING INNOVATIONS

User manual

Axioline Smart Elements

UM EN AXL SE SYS INST, Revision 02   2020-12-02

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

Table of contents

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 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	Content
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 (incl. 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 safety function are delivered with a packing slip. It contains key information for the electrical installation. This includes, for example: – EU declaration of conformity – Safety notes – Brief description/Intended use – Mounting, removing and installation – Additional applicable documentation Smart Elements without safety function are not supplied with a package insert. 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.

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

Document	Content
Data sheets	The data sheet for each Smart Element contains the complete information required for use.
	This includes at the very least:
	– Function description
	– Technical data
	– Connection assignment or terminal point assignment
	– Local diagnostic and status indicators
	– Connection examples
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 about special topics.
Up-to-date PDF	
Generate product PDF	By clicking the "Generate product PDF" button on the Internet, you can access up-to-date information on the product (see Section "Documentation on the Internet" on page 8).

2.2   Documentation on the Internet

The documentation can be downloaded at
phoenixcontact.net/<Order Number of your Smart Elements>.
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" button to receive 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   On the "Downloads" tab, you can access the **complete** documentation and all other downloads related to a product.
Comprehensive and product-specific documentation can be found in the download area for the respective Smart Element.

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 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.

As Axioline Smart Elements do not require parameterization or just little parameterization for startup or replacement, startup times can be reduced.

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 Smart Elements. Within an Axioline F station, they provide the I/O voltage and communications power supply for the Smart Elements.
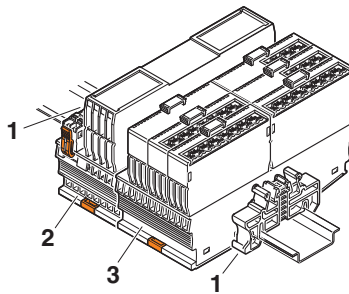
Figure 3-1   Example: Smart Elements in an Axioline F station

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

Setup

Figure 4-1 shows the setup of a Smart Element.
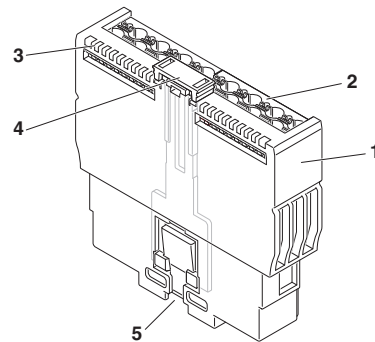
Figure 4-1   Components of a Smart Element

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 low-level signals 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 low-level signal

In addition to the housing versions for low-level signals , 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

Dimensions relay module

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

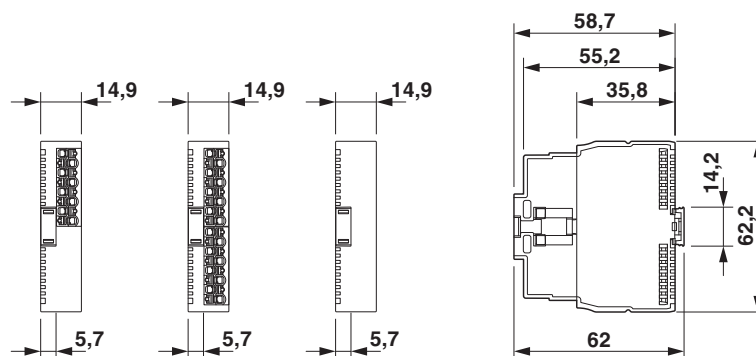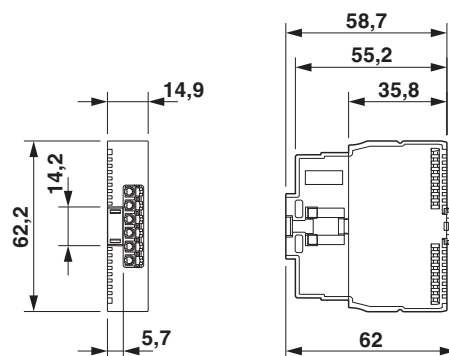| **Functions**	Smart Elements with various functions are available within the Axioline Smart Elements product group.

- 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	**Product groups**	**Nominal voltage used**	**Permissible voltage range**	**Examples**
Protective extra-low voltage	Small-signal Smart Element	24 V DC	19.2 V DC...30 V DC	AXL SE DI16/1
Low voltage	Low-voltage Smart Element	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 according to 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 power supply (U_{SE})   The communications power supply 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 Element, please refer to the associated data sheet.

4.2   Approvals

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

4.3   Order designations

The order 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 order 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 connecting resistance temperature detectors
	CNT	Counter
	INC	Incremental encoder input
	RS485	Communication, serial data transmission via RS-485
	IOL	IO-Link
	SC	Slot cover for an unused Smart Element slot
	SC-A	Slot cover for an unused Smart Element slot, with diagnostic function

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

Number of inputs or outputs	1 ... 16	1 channel ... 16 channels
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	Shunt Pt 100
	PT1000	Shunt Pt 1000
	SYM	Symmetrical incremental encoders
	ASYM	Asymmetrical incremental encoders
	NPN	NPN-wired
	W 230	Changeover contact (PDT), 230 V AC
	2A	2 A output
	EF	Extended function

4.4   Color and marking

Color

The following housing colors are currently 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 occupied terminal point is marked on the side according to its function.
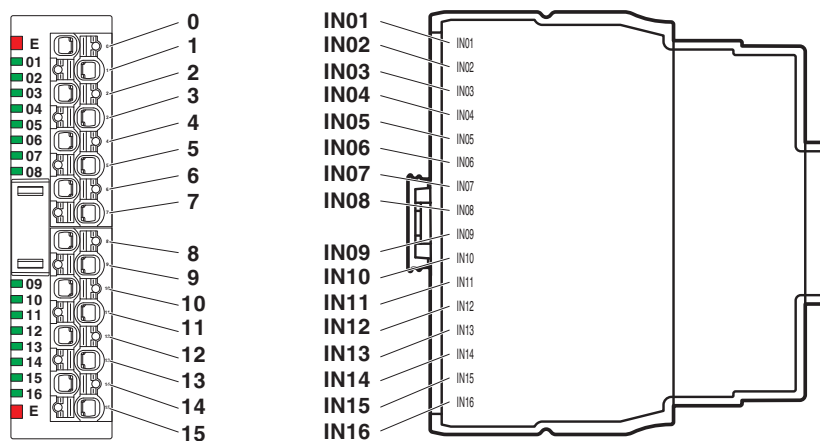
Bild 4-4   Terminal marking (Example: AXL SE DI16/1)

Indication elements

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

Equipment identification by the user

You can apply an equipment identification to the Smart Element. Two options are available:
–   Stick a label to the release mechanism (1 in Figure 4-5).
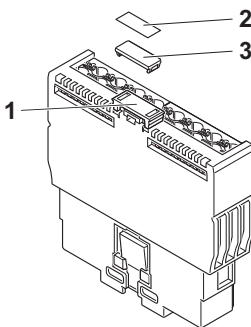
Or

–   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 from Phoenix Contact:

Table 4-4   Marking material

No. in Figure 4-5	Description	Type	Order 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 width: 5 mm, lettering field size: continuous x 5 mm	SK 5,0 WH:REEL	0805221	1
3	Markers for marking, 24-section, unmarked, can be marked with THERMOMARK CARD and BLUEMARK, color: white	UM6M-TM (5X12)	0830928	10
3	Markers for marking, sheet, white, unmarked, can be labeled with: THERMOMARK CARD, THERMOMARK CARD 2.0, THERMOMARK PRIME, BLUEMARK ID, BLUEMARK ID COLOR, TOPMARK LASER, TOPMARK NEO, mounting type: snapped into 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 supplied in a tubular bag.

• Please observe the notes on the packaging.

Suitable transport packaging

• Only transport the device in its original packaging or in a 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 36.

5.2 Storage

Suitable storage location

The storage location must meet the following requirements:

– Dry
– Protected against unauthorized access
– Protected against harmful environmental influences such as UV light

Technical data and environmental conditions

• For storage/transport, observe the humidity and air pressure specifications, and the temperature range.
See Section "Technical data" on page 36.

5.3 Unpacking

Checking the delivery

• Check 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 of Smart Elements

NOTE: Damage to contacts or malfunction
- Before performing work on a Smart Element, disconnect the power to the Smart Element.
  This means:
  – Disconnect the connected I/O devices from the power.
  – Switch off I/O supply voltage U_P.
  – Switch off communications power 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 according to 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 (Figure 6-1).

Wall mounting on a horizontal DIN rail on the wall is the **preferred** mounting position (Figure 6-1, A). This mounting position provides optimum air flow for the Smart Elements.
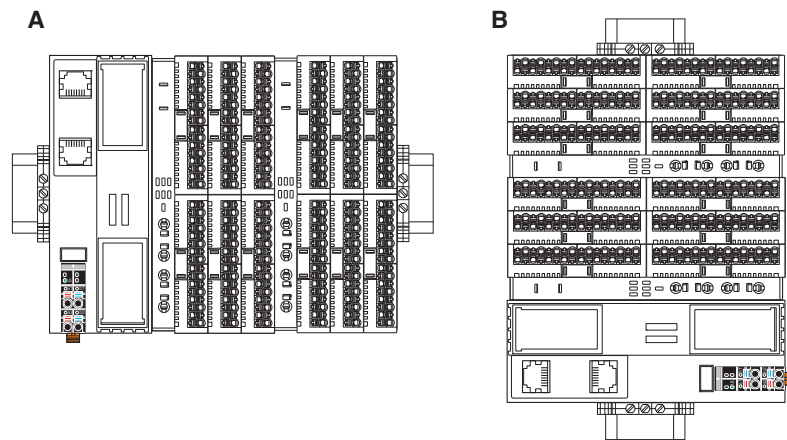
A   **B**

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.
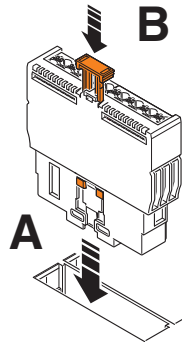

Figure 6-2   Inserting and latching the Smart Element in its slot

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).
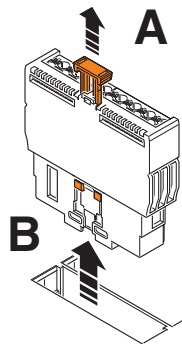•   Pull the Smart Element out of its slot (Figure 6-3, B).

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.

i	For use in applications where UL approval is required: Observe any specifications in the Smart Element-specific documentation, and the rating on the Smart Elements.

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, in particular for small cross sections.

i	If using ferrules, use those which correspond to the specifications in Section "Conductor cross sections, and stripping and insertion lengths" on page 23.

7.2 Conductor cross sections, and stripping and insertion lengths

ℹ 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 Smart Element-specific documentation.

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)

ℹ 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	

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 ferrule: 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 function:
Make sure that the stripping length of a conductor without ferrule or the insertion length of a conductor with ferrule corresponds to the corresponding specifications.

For crimping, we recommend crimping pliers for trapezoidal crimp: CRIMPFOX 6, CRIMPMFOX DUO 10 or CRIMPFOX 10T-F, see Section "Ordering data for accessories" on page 39.
According to the current state, they meet the general conditions with regard to the wiring space for Axioline Smart Elements (according to DIN EN 60947-1 (DIN VDE 0660-100)-A1 internal cylindrical gauge).

TWIN ferrules

When using TWIN ferrules, please observe the following:

Tabelle 7-4   Use and alignment of TWIN ferrules

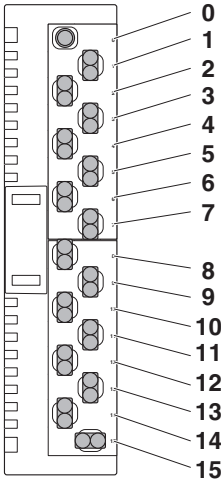| Terminal point	Use/alignment
0	TWIN ferrule is **not permitted**.
1 ... 14	Align the TWIN ferrules **vertically**.
15	Align the TWIN ferrules **horizontally**.

Bild 7-1   Use and alignment of TWIN ferrules

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

Single ferrule

TWIN ferrule (vertical plugging mode)

TWIN ferrule (horizontal plugging mode)

Ferrules

See .

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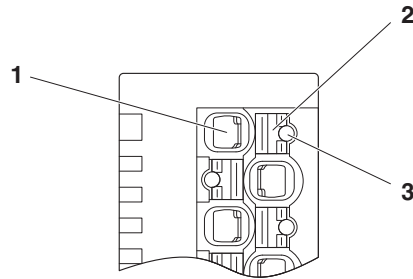
Figure 7-2   Terminal point with associated spring lever, and associated touch connection

1   Terminal point

2   Associated spring lever

3   Touch connection (for test pins see Section "Ordering data" on page 39)

7.4   Connecting unshielded cables

Wire the Smart Element according to your application.

> ℹ️ For the terminal point assignment, please refer to the corresponding Smart Elements-specific data sheet.

When wiring, proceed as follows:
- Strip 8 mm off the cable.

Without tools

Suitable for:
- Conductor cross sections: 0.5 mm^2 or larger
- Rigid cables
- Flexible cables with ferrules

- Insert the cable into the terminal point. It is clamped into place automatically.
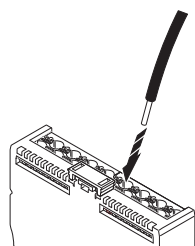
Figure 7-3   Connecting a cable without tools

With tools

Suitable for:
- Rigid cables
- Flexible cables
- Flexible cables with ferrules

- Open the spring by pressing the spring lever with the screwdriver (Figure 7-4, A).
  Use, for example, a bladed screwdriver with a blade width of 2.5 mm.
  Phoenix Contact recommends the SZS 0,4x2,5 screwdriver (see Section "Ordering data" on page 39).
- Insert the cable into the terminal point (Figure 7-4, B).
- Remove the screwdriver to secure the cable.

A

2,5 mm

B
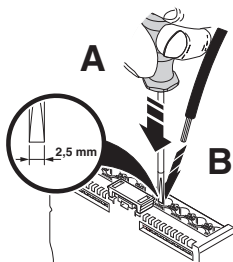
Figure 7-4   Connecting a cable using tools

7.5 Connecting shielded cables

i

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.

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 the SZS 0,4x2,5 screwdriver (see Section "Ordering da-
  ta" on page 39).
• Remove the conductor (Figure 7-5, B).
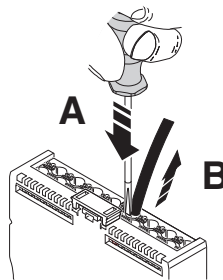
Figure 7-5   Removing the cable

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 36.

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:

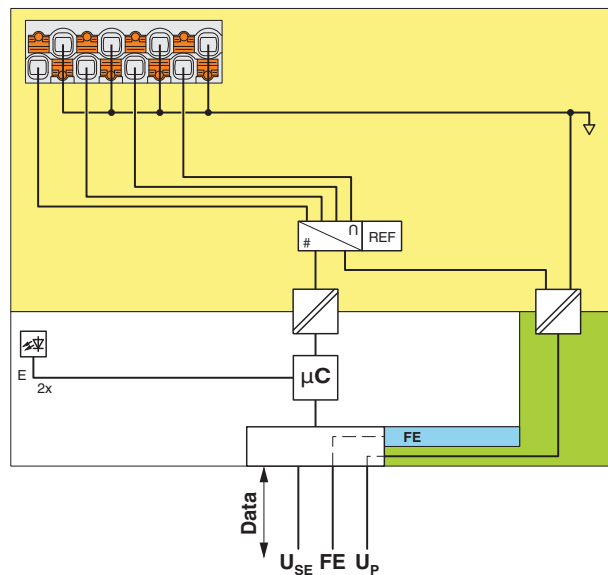|	
Data	Data transmission
U_{SE}	Communications power supply of the Smart Element
FE	Functional ground
U_P	I/O supply of the Smart Element

Symbol		Symbol	
µC	Microcontroller		Analog-to-digital converter
	Electrical isolation for data or power supply	**REF**	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 power 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 low-level signal Smart Elements are designed exclusively for operation with protective extra-low voltage (PELV) according to 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 circuit.

> ⚠ **WARNING: Dangerous contact voltage in the event of ground faults**
> • Only operate the Smart Elements for the low-voltage range in grounded grids.

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.
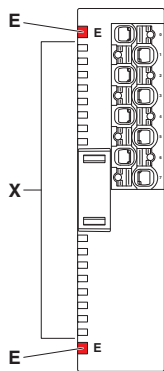

Figure 9-1   Diagnostic and status indicators

Table 9-1   Diagnostics and status indicators

Marking 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

Designa-tion	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 plugged in correctly.
		On	I/O error Possible causes: – I/O supply voltage not present – Short-circuit or overload of an output – Open circuit 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.

> **i** 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 Smart Element-specific data sheet.

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.
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 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 increases.

> **i** 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 diagnostics details.

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

10.3 Saving 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, not 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 defect and repair

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, release 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 defect and repair

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 will continue to be used correctly:

• Please observe the storage and transport requirements.
  See Section "Transport, storage, and unpacking" on page 17.

The device will no longer be used:

Dispose of the device

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

Dispose of the packaging

• 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

> **ℹ** **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.

> **ℹ** The following values are default values.
>
> **For deviating values, please refer to the Smart Element-specific documentation.**

13.1   Technical data

General data (standard values; for deviations see Smart Element-specific documentation)	
Ambient temperature (operating)	-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 sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	Low-level signal: 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 degree of protection)
Overvoltage category	Low-level signal: II (EN 60664-1) Low voltage: III (EN 61010-2-201)
Pollution degree	Low-level signal: 2 (EN 60664-1) Low voltage: 2 (EN 61010-2-201)
Air clearances and creepage distances	Low-level signal: according to EN 60664-1 Low voltage: according to EN 61010-2-201
Housing material	Plastic

> **ℹ** 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

> ℹ 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 Smart Element-specific documentation.

Connection method	Push-in connection
Maximum current carrying capacity of the contacts	8 A
Solid and flexible conductors without ferrules or with single ferrules	
Conductor cross section, rigid/flexible	0.25 mm² ... 1.5 mm²/0.25 mm² ... 1.5 mm²
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 mm² per conductor
Conductor cross section [AWG]	20
Stripping lengths	10 mm

> ℹ Please observe the information provided on conductor cross sections and stripping lengths in Section "Conductor cross sections, and stripping and insertion lengths" on page 23.

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

Comment	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 connectors)
Maximum permissible voltage range	19.2 V DC ... 30.0 V DC (including all tolerances, 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 (standard values for the 24 V area; for deviations and the low-voltage area see Smart Element-specific documentation)

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 (standard values; for deviations see Smart Element-specific documentation)

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	See data sheet for the Smart Element used
Noise emission test in accordance with EN 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.

13.2   Ordering data

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

Ordering data for Axioline Smart Elements

For the ordering data of the Axioline Smart Elements, please refer to the Smart Element-specific documentation.
It is also available on the Internet at phoenixcontact.net/products.

Ordering data for accessories

Description	Type	Order No.	Pcs./Pkt.
Tool			
Screwdriver, bladed, VDE-insulated, size: 0.4 x 2.5 x 80 mm, 2-component handle, with non-slip grip	SZS 0,4X2,5 VDE	1205037	1
Crimping pliers, for ferrules without insulating collar according to DIN 46228 Part 1 and ferrules with insulating collar according to DIN 46228 Part 4, 0.25 mm² ... 6.0 mm², lateral entry, trapezoidal crimp	CRIMPFOX 6	1212034	1
Crimping pliers, type of contact: Insulated and uninsulated ferrules, standards/specifications: DIN 46228-1, DIN 46228-4, min. cross section: 0.14 mm², max. cross section: 10 mm², for TWIN ferrules up to 2 x 4 mm², automatic cross section adjustment, rotating die, lateral and frontal insertion, compression: Trapezoidal crimp, black/green	CRIMPFOX DUO 10	1031721	1
Crimping pliers, type of contact: Insulated and uninsulated ferrules, standards/specifications: DIN 46228-1, DIN 46228-4, min. cross section: 0.14 mm², max. cross section: 10 mm², For TWIN ferrules up to 2 x 4 mm², automatic cross section adjustment, frontal insertion, compression: Trapezoidal crimp, black	CRIMPFOX 10T-F	1134913	1
Test pins			
Test pin, blue	MPS-MT 1-S4-B	1974614	50
Test pin, red	MPS-MT 1-S4-B RD	1982800	50
Test pin, 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 ROLLMASTER 300/600, THERMOMARK X1.2, mounting type: adhesive, for terminal width: 5 mm, lettering field size: continuous x 5 mm	SK 5,0 WH:REEL	0805221	1
Markers for marking, 24-section, unmarked, can be marked with THERMOMARK CARD and BLUEMARK, color: white	UM6M-TM (5X12)	0830928	10

Description	Type	Order No.	Pcs./Pkt.
Markers for marking, sheet, white, unmarked, can be labeled with: THERMOMARK CARD, THERMOMARK CARD 2.0, THERMOMARK PRIME, BLUEMARK ID, BLUEMARK ID COLOR, TOPMARK LASER, TOPMARK NEO, mounting type: snapped into 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), according to 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	1000

Ordering data for documentation

i	The comprehensive and specific 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 F 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 safety function.**
This section does **not** apply to the following Smart Elements or applications:
– Smart Elements with safety functions (e.g., SafetyBridge, PROFIsafe)
In these cases, consider the individual Smart Element or application separately.

The Smart Elements are approved for use at an altitude up to 3000 m above sea level, see "Technical data" on page 36.

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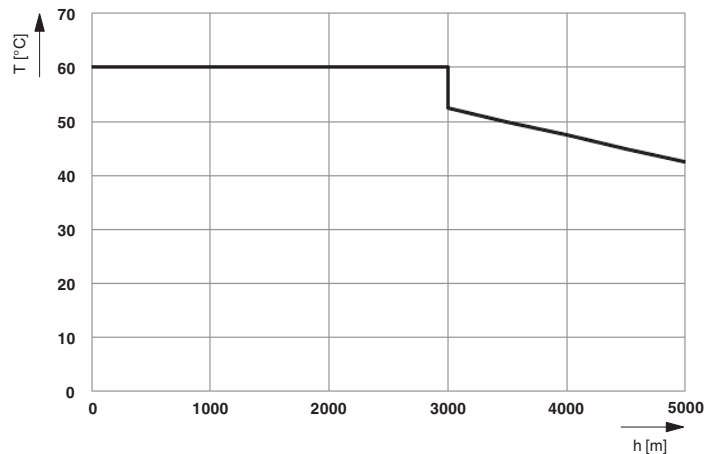
Figure A-1   Derating of the permissible ambient temperature depending on the altitude

Key:

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

B Index

C   Revision history

Tabelle C-1   Revision history

Revision	Datum	Inhalt	
00	2019-11-13	First publication	
01	2020-08-26	Section 4.3, Section 10.1	Additions: AXL SE SC
02	2020-12-02	Entire document	Additions: – New Smart Elements – Low voltage range – Safety notes – TWIN ferrules

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