# AXL SE DO16/1



## Axioline Smart Elements, digital output module, digital outputs: 16, 24 V DC, 500 mA, connection technology: 1-conductor

Data sheet
108700_en_05

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## 1 Description

You can integrate Axioline Smart Elements into systems with the Smart Element interface.
This Smart Element emits digital signals.

**Features**

- 16 digital outputs
- 24 V DC, 500 mA
- Connection of actuators in 1-conductor technology
- Substitute value behavior of the outputs can be parameterized for the Smart Element
- Device rating plate stored

**Observe these notes**

This data sheet is only valid in association with the UM EN AXL SE SYS INST user manual.

Make sure you always use the latest documentation.
It can be downloaded at: phoenixcontact.com/product/1088129

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# 3 Ordering data

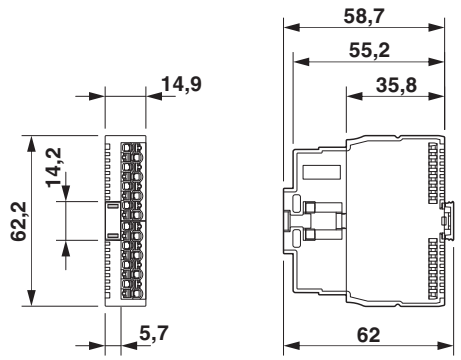
| Description | Type | Item no. | Pcs./Pkt. |
|---|---|---|---|
| Axioline Smart Elements, Digital output module, Digital outputs: 16, 24 V DC, 500 mA, connection technology: 1-conductor, degree of protection: IP20 | AXL SE DO16/1 | 1088129 | 1 |

| Documentation | Type | Item no. | Pcs./Pkt. |
|---|---|---|---|
| User manual, English, Axioline Smart Elements | UM EN AXL SE SYS INST | - | - |
| User manual, English, Axioline F: System and installation | UM EN AXL F SYS INST | - | - |
| User manual, English, Axioline F: Diagnostic registers, and error messages | UM EN AXL F SYS DIAG | - | - |

| Additional ordering data | |
|---|---|
| For additional ordering data (accessories), go to: | www.phoenixcontact.com/product/1088129 |

# 4 Technical data

**Dimensions (nominal sizes in mm)**




| | |
|---|---|
| Width | 14.9 mm |
| Height | 62.2 mm |
| Depth | 62 mm |

| General data | |
|---|---|
| Color | Housing: traffic gray A (RAL 7042) |
| Weight | 37 g |
| Ambient temperature (operation) | -25 °C … 60 °C |
| Ambient temperature (storage/transport) | -40 °C … 85 °C |
| Permissible humidity (operation) | 5 % … 95 % (non-condensing) |
| Permissible humidity (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) |

| General data | |
|---|---|
| Degree of protection | IP20 |
| Protection class | III (IEC 61140, EN 61140, VDE 0140-1) |
| Overvoltage category | II (IEC 60664-1, EN 60664-1) |
| Degree of pollution | 2 (IEC 60664-1, EN 60664-1) |
| Mounting type | Plug-in mounting (Smart Element slot) |
| Mounting position | See the system in which the Smart Element is used. |

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

| Connection data: I/O | |
|---|---|
| Connection method | Push-in connection |
| Conductor cross-section, rigid | 0.25 mm² ... 1.5 mm² |
| Conductor cross-section, flexible | 0.25 mm² ... 1.5 mm² |
| Conductor cross-section [AWG] | 24 ... 16 |
| Conductor cross-section flexible, with ferrule with plastic sleeve | 0.25 mm² ... 1.5 mm² |
| Conductor cross-section flexible, with ferrule without plastic sleeve | 0.25 mm² ... 1.5 mm² |
| Stripping length | 8 mm |

Please observe the information provided on conductor cross-sections in the “Axioline Smart Elements” user manual.

With a small conductor cross-section and high current, the terminal point temperature can reach up to 45 K above the ambient temperature.

When selecting the cables, observe the permissible operating temperature in accordance with IEC or UL.

| Interface: Smart Element interface | |
|---|---|
| Number of interfaces | 1 |
| Connection method | Card edge connector |
| Start time until ready to operate | < 500 ms |

| Communications power supply of the Smart Elements ($U_{SE}$) | |
|---|---|
| Supply voltage | using card edge connectors |
| Current draw | See documentation for the system in which the Smart Element is used. |

| I/O supply ($U_P$) | |
|---|---|
| Nominal supply voltage | 24 V DC (using card edge connectors) |
| Supply voltage range | 19.2 V DC ... 30 V DC (including all tolerances, including ripple) |
| Current consumption | min. 40 mA (without connected peripherals)<br>max. 6 A |
| Surge protection | See the system in which the Smart Element is used. |
| Reverse polarity protection | parallel diode |

| I/O supply ($U_P$) | |
|---|---|
| Protection | See the system in which the Smart Element is used. |

**NOTE: Damage to the electronics**

To ensure reverse polarity protection, provide external protection for the Smart Element in the system that you are using it in. If you use a fuse, the power supply unit must be capable of supplying four times the nominal current of the fuse. This ensures that the fuse trips reliably in the event of a fault.

When starting up the Smart Element for the first time in the system that you have installed it, protect the system with a 5 A fuse. When all Smart Elements in the system are correctly connected, the 5 A fuse can be replaced with a fuse as specified for the system that you have installed the Smart Element in.

After that, you can load the Smart Element by up to 6 A. Loads over 6 A are not permitted.

| Power dissipation | |
|---|---|
| Maximum power dissipation for nominal condition | 1.2 W |

| Digital outputs | |
|---|---|
| Number of outputs | 16 |
| Connection method | Push-in connection |
| Connection technology | 1-conductor |
| Nominal output voltage | 24 V DC |
| Output current per channel | max. 500 mA |
| Output current of the device | max. 6 A (Also make sure that the maximum permissible current of 6 A is not exceeded!) |
| Nominal load, ohmic | 12 W (48 Ω, with nominal voltage) |
| Nominal load, inductive | 12 VA (1.2 H, 48 Ω, with nominal voltage) |
| Nominal load, lamp | 12 W (at nominal voltage) |
| Load min. | 10 kΩ |
| Energy consumption | see diagram |
| Limitation of the voltage induced on circuit interruption | -32.8 V DC … -15 V DC |
| Output voltage when switched off | max. 1 V |
| Output current when switched off | max. 300 µA |
| Signal delay | max. 100 µs (when switched on)<br>max. 100 µs (when switched off, with at least 50 mA load current) |
| Switching frequency | max. 1200 per second (With resistive load, at least 50 mA load current)<br>max. 1 per second (with inductive load)<br>max. 16 per second (with nominal lamp load) |

The specified switching frequency is limited by the device hardware. The switching frequency that can actually be achieved depends on the update time of the overall system, including the cycle times of the controller, network, etc.

| | |
|---|---|
| Short-circuit and overload protection | electronic |
| Behavior with overload | Shutdown with automatic restart |
| Behavior with inductive overload | Output can be destroyed |

| Digital outputs | |
|---|---|
| Reverse voltage resistance to short pulses | limited protection up to 0.5 A for 1 s |

**NOTE: Electronic damage due to feedback**

In the event of an incorrectly applied external voltage (feedback) at an output, the affected channel can be destroyed.

Feedback occurs when a voltage greater than $U_P$ is connected to an output. In this case, a current flows into the output. If the supply $U_P$ is switched off, the feedback can also lead to an unintentional supply to the module. If the voltage is routed to other modules, this also applies to these modules.

Prevent feedback at an output.

| | |
|---|---|
| Overcurrent shut-down | min. 0.7 A |
| Output current with ground connection interrupt when switched off | < 1 mA |
| Process data update | typ. 370 µs |

| Input and output address area | |
|---|---|
| Input address area | 0 Byte |
| Output address area | 2 Byte |

| Configuration and parameter data in a PROFIBUS system | |
|---|---|
| Required parameter data | 9 Byte |
| Required configuration data | 6 Byte |

| Electrical isolation/isolation of the voltage areas | |
|---|---|
| **Test section** | **Test voltage** |
| Communications supply / 24 V supply (I/O) | 500 V AC, 50 Hz, 1 min |
| Communications 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 | |
|---|---|
| Vibration resistance in accordance with EN 60068-2-6/IEC 60068-2-6 | 5g |
| Shock in accordance with EN 60068-2-27/IEC 60068-2-27 | 30g |
| Continuous shock in accordance with EN 60068-2-27/IEC 60068-2-27 | 10g |

| Conformance with EMC Directive 2014/30/EU | |
|---|---|
| **Immunity test in accordance with EN IEC 61000-6-2** | |
| Electrostatic discharge (ESD)<br>IEC 61000-4-2 | Criterion B, ±6 kV contact discharge, ±8 kV air discharge |
| Electromagnetic fields<br>IEC 61000-4-3 | Criterion A, Field intensity: 10 V/m |
| Fast transients (burst)<br>IEC 61000-4-4 | Criterion B, ±2 kV |
| Transient overvoltage (surge)<br>IEC 61000-4-5 | Criterion B, I/O cables: ±1 kV asymmetrical |
| Conducted interference<br>IEC 61000-4-6 | Criterion A, Test voltage 10 V |
| **Noise emission test in accordance with EN IEC 61000-6-4** | Class A |

| Approvals and manufacturer's declarations | |
|---|---|
| The latest documents can be found at: | www.phoenixcontact.com/product/1088129 |

# 5 Maximum outputs power consumption when inductive loads are switched off

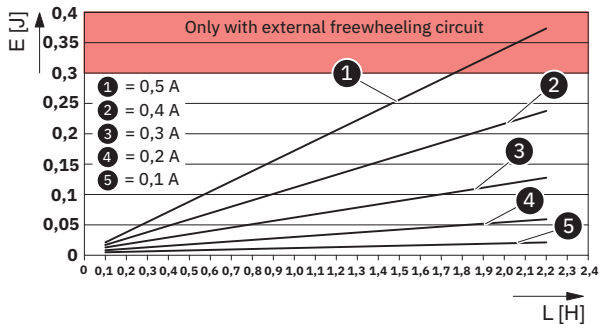
**NOTE: Damage to the electronics**

When you use an external freewheel limit, the free-wheeling voltage to a maximum of -15 V.

The value **must** be above -15 V, so -12 V, for example.

The external freewheel limit has no function with a higher negative voltage.

Figure 1 Maximum outputs power consumption when inductive loads are switched off




Where:

| | |
|---|---|
| E | Power consumption |
| L | Inductance |
| Red-highlighted area | Only with external freewheeling circuit |

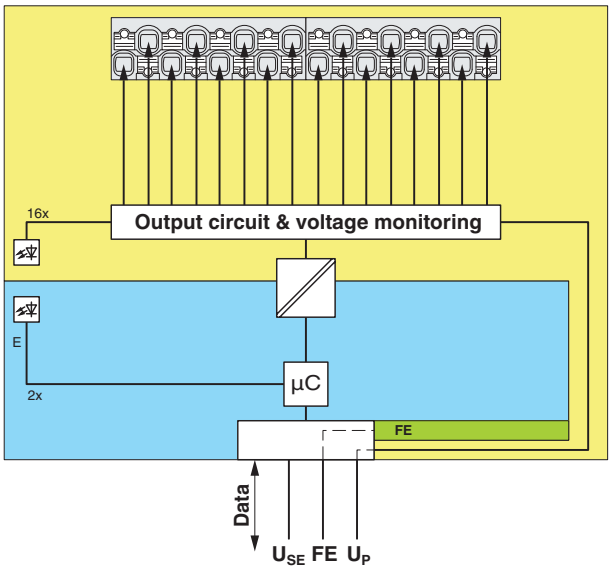
The specifications in the diagram refer to a maximum switching frequency of 1 Hz.

The diagram shows the maximum amount of energy that may be fed back into the corresponding output groups (outputs 1 to 8, 9 to 16) for each switch-off procedure when switching off an inductive load without external freewheeling circuit.

The current data refers to the ohmic DC voltage component of the inductive load.

# 6 Internal circuit diagram

Figure 2 Internal wiring of the terminal points




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 |
| µC | Microcontroller |
| | Electrical isolation for data or power supply |
| | LED |
| Output circuit ... | Output circuit and voltage monitoring |
| | Electrically isolated areas |

# 7 For your safety

## 7.1 Intended use

Use Smart Elements exclusively in accordance with the specifications in the data sheet and the “Axioline Smart Elements” user manual.
Please also refer to the documentation for the system in which the Smart Elements are used.

If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired.

## 7.2 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.

## 7.3 Installation

**CAUTION: Fire hazard**

- The device must be installed in the final protective housing, which provides sufficient resistance to mechanical strain and protection against the spreading of fire in accordance with the standards UL/IEC/EN 61010-1 and UL/IEC/EN 61010-2-201.
- The external circuits intended to be connected to this device must be galvanically separated from mains supply or hazardous live voltage by reinforced or double insulation and meet the requirements of SELV/PELV (Class III) circuits in accordance with UL/CSA/IEC/EN 61010-1, UL/CSA/IEC/EN 61010-2-201.

## 7.4 Disconnecting or plugging in a Smart Element

**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 the I/O supply voltage $U_P$.
- Switch off the communications power $U_{SE}$. For the system in which the Smart Element is used, this means the following: Switch off the voltage that generates the $U_{SE}$.

## 7.5 Strain relief

**NOTE: Damage to the contacts**

Physical overloads can result in damage to the terminal points.

- Relieve strain in the connected cables.

## 7.6 Locking a Smart Element

Make sure that each Smart Element is locked in its slot. This is only ensured if the unlocking mechanism has been pushed into the guide as far as it will go.

See “Axioline Smart Elements” user manual.

## 7.7 Using round cables CABLE-FLK14/AXIO/OE/0,14/...

For this Smart Element, the use of assembled round cables CABLE-FLK14/AXIO/OE/0,14/... is permitted. The conductors of these cables are fitted with ferrules and have a conductor cross-section of 0.14 mm², AWG 26.

**UL approval does not apply**

For applications with UL approvals, the AWG 24-16 conductor cross-section is certified.

Due to the smaller conductor cross-section of AWG 26, **UL approval** does **not** apply when using the Smart Element in combination with a round cable.

## 7.8 Applications with UL approval

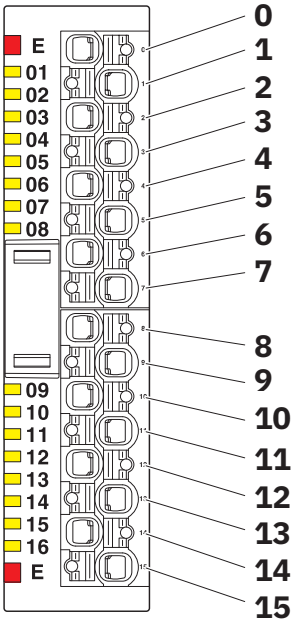
Information:

To install the device in accordance with UL/CSA/IEC standard, the following notes must be observed.

– Minimum temperature rating of the cables to be connected to the field wiring terminals:
  105 °C, AWG 24 ... 16
– Use copper conductors only.

# 8 Terminal point assignment as well as diagnostics and status indicators

Figure 3 Terminal point assignment as well as diagnostics and status indicators




## 8.1 Terminal point assignment

| Terminal point | Assignment | Channel | Signal |
|---|---|---|---|
| 0 | Digital output | 1 | OUT01 |
| ... | ... | ... | ... |
| 15 | Digital output | 16 | OUT16 |

## 8.2 Local diagnostics and status indicators

| Designation | Color | Description | |
|---|---|---|---|
| E | Red | Error | |
| | | Off | No error |
| | | Flashing (0.5 Hz) | Error in Smart Element<br>Replace the Smart Element. |
| | | Flashing (4 Hz) | Communication error<br>Check whether the Smart Element has been plugged in correctly. |
| | | On | I/O error<br>Check the connected components and wiring. Remove the error. |
| 01 ... 16 | Yellow | Output status | |
| | | On | Output is set. |
| | | Off | Output is not set. |

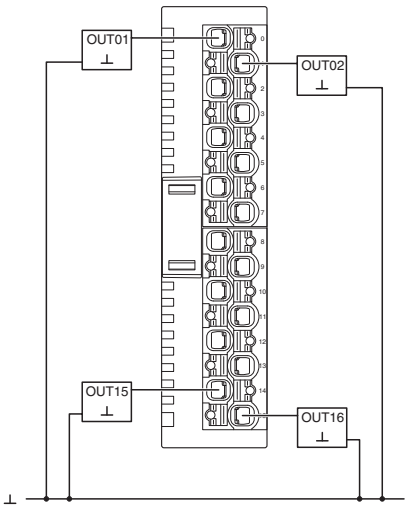
See also “Diagnostic state ($0018_{hex}$: DiagState)” section, “Possible error codes” table.

# 9 Connection examples

Make sure that the GND of the actuators and the GND for $U_P$ have the same potential.

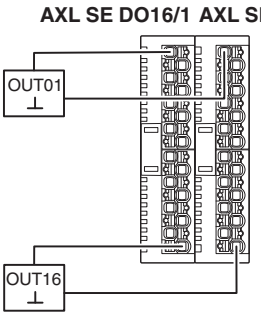
## 9.1 Using equipotential busbars

Figure 4 Connection in 1-conductor technology




## 9.2 Using AXL SE PD ...

Figure 5 Connection in 2-conductor technology




To implement the connections of this Smart Element in multi-conductor technology on Smart Elements, you can use the following Smart Elements for potential distribution:

| Item No. | Type | Features |
|---|---|---|
| 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 electronic switch, 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.

# 10 Process data

The process data is mapped in Motorola format (Big Endian).

| Byte | 0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bit** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| Signal | OUT08 | OUT07 | OUT06 | OUT05 | OUT04 | OUT03 | OUT02 | OUT01 |
| Terminal point | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |

| Byte | 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bit** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| Signal | OUT16 | OUT15 | OUT14 | OUT13 | OUT12 | OUT11 | OUT10 | OUT09 |
| Terminal point | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |

# 11 Parameter, diagnostics and information (PDI)

## 11.1 PDI objects

The module has PDI objects. They are used to map parameters, diagnostic data, and information about the module. The PDI objects can be read and/or written acyclically.

You can find out how to access the PDI objects in the documentation for the bus coupler or the controller used.

The PDI objects necessary for operation are described in the following section.

You will find an explanation of the data types in the user manual UM EN AXL F SYS INST.

The following applies to all tables below:

| Abbreviation | Meaning |
|---|---|
| Length in bytes | Maximum length of the elements in bytes |
| R | Read |
| W | Write |
| [x] | Number of elements in an array or record |

Each visible string is terminated with a null terminator ($00_{hex}$). The length of a visible-string-type element is therefore at least one byte larger than the number of user data items.
If the number of user data items plus null terminator is smaller than the specified length of the element, the visible string will be populated with a null character ($00_{hex}$).

You will find detailed information on the PDI objects in the user manual UM EN AXL F SYS INST.

## 11.2 Retentive storage

Axioline Smart Elements can have retentively (non-volatilely) and volatilely stored parameters.

Retentively stored parameters retain their values even after the module voltage is reset.

When the parameterization is reset (via object $002D_{hex}$), certain retentively stored parameters are reset to their default settings. You can find out which parameters are reset in the description for object $002D_{hex}$.

For writeable parameters, the following tables indicate whether they are stored retentively or volatilely.

A write operation to the module memory is only triggered if the value of at least one retentive parameter has been changed.

Due to the storage technology used, parameters that are stored retentively only allow a certain number of write access operations (typ. 100,000 to 1,000,000 times). **They are not suitable for being changed cyclically.**

**NOTE: Damage to the Flash memory during cyclic write access**

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

- Make sure that write access operations are not performed too often and, in particular, are not performed cyclically.
- Note this behavior when programming function blocks.
- For systems with initial parameterization (e.g., PROFINET), avoid parameterization from the application program.

# 12 Standard objects

| Index (hex) | Object name | Data type | Length in bytes | Rights | Meaning/contents | | Retentive storage | |
|---|---|---|---|---|---|---|---|---|
| **Device type** | | | | | | | | |
| 0037 | DeviceType | Octet string | 8 | R | Device type | 0040 0002 0000 $1D19_{hex}$ | | |
| **Diagnostics objects** | | | | | | | | |
| 0018 | DiagState | Record [11] | 74 | R | Diagnostic state | | | * |
| 0019 | ResetDiag | UINT8 | 1 | R/W | Handling diagnostic messages | | No | * |
| **Objects for process data management** | | | | | | | | |
| 0024 | ResetCode | UINT16 | 2 | R/W | Substitute value behavior during bus reset (PDOUT) | | Yes | * |
| 0025 | PDIN | Octet string | 2 | R | Input process data is not available. | | | |
| 0026 | PDOUT | Octet string | 2 | R | OUT process data<br>The structure corresponds to the representation in the “Process data” section. | | | |
| **Objects for device management** | | | | | | | | |
| 002D | ResetParam | UINT8 | 1 | R/W | Reset parameterization | | No | * |

The objects identified with * in the last column are described in more detail in the following sections.

The description of the other objects is to be found in the user manual UM EN AXL F SYS INST.

### 12.1 Diagnostics state ($0018_{hex}$: DiagState)

This object is used for a structured message of an error.

Read off all information via subindex 00 to receive all information on an error number. Access to individual elements of the object is not permitted.

A detailed description of the object is provided in user manual UM EN AXL F SYS INST.

Possible error codes

| Element | 02 | 03 | 04 | 08 | 0B | | |
|---|---|---|---|---|---|---|---|
| **Error** | **Priority** | **Channel** | **Error code** | **Function group** | **Text** | **E LED** | **Corrective** |
| | **hex** | **hex** | **hex** | | | | |
| No error | 00 | 00 | 0000 | General | Status OK | ○ | |
| Overload or short circuit of an output | 01 | FF | 2344 | DO | Overload or short circuit (output) | ● | Check the connected components and wiring. |
| I/O supply voltage ($U_P$) is not present. | 01 | FF | 3130 | General | Supply missing ($U_P$) | ● | Check the supply voltage. |
| Error in the Smart Element firmware | 01 | FF | 6100 | General | Firmware error, update required | ● | Replace the Smart Element. |
| Problem communicating with the Smart Element | 01 | FF | 6130 | General | Smart Element missing | ✹ | Check whether the Smart Element has been plugged in correctly. If the error is still present, replace the Smart Element. |
| Error in the parameter memory | 01 | FF | 6320 | General | Parameter error, repeat parameterization | ● | Error in the parameter memory. Parameterize the Smart Element. |

Key

| | | |
|---|---|---|
| Priority | $00_{hex}$ | No error |
| | $01_{hex}$ | Error |
| Channel | $00_{hex}$ | No error |
| | $FF_{hex}$ | Entire device |

| | | |
|---|---|---|
| LED | ○ | Off |
| | ● | On |
| | ✹ | Flashing (4 Hz) |

### 12.2 Handling diagnostic messages ($0019_{hex}$: ResetDiag)

You can use this object to specify how the Smart Element should handle diagnostic messages.

| Handling diagnostic messages | |
|---|---|
| **Value (hex)** | **Meaning** |
| **00** | **Permit all diagnostic messages (default)** |
| 02 | Delete all diagnostic messages that are still pending |
| 06 | Delete all diagnostic messages and do not permit new ones |
| Other | Reserved |

### 12.3 Substitute value behavior during bus reset (PDOUT) ($0024_{hex}$: ResetCode)

Use this object to parameterize the behavior of the Smart Element outputs in the event that process data is missing.

| $0024_{hex}$: substitute value behavior during bus reset (PDOUT) (read, write) | | | |
|---|---|---|---|
| **Subindex (hex)** | **Data type** | **Length in bytes** | **Meaning/contents** |
| 00 | UINT16 | 2 | Read or write entire object. |
| | | | Substitute value behavior of the outputs |

| Value range | |
|---|---|
| **Value (hex)** | **Meaning** |
| **0000** | **0 is output to all output bits (default)** |
| 0001 | 1 is output to all output bits |
| 0002 | Hold last value |
| Other | Reserved |

### 12.4 Reset parameterization ($002D_{hex}$: ResetParam)

Use this object to reset certain parameters to the factory default settings (default values).

To reset the parameters, value $01_{hex}$ must be transferred during write access.

Reset the following parameters using this object:

| Index (hex) | Object name | Meaning |
|---|---|---|
| 0024 | ResetCode | Substitute value behavior during bus reset (PDOUT) |

## 13 Device descriptions

The device is described in the device description files. The device descriptions for controllers from Phoenix Contact are included in PC Worx and PLCnext Engineer, as well as in the corresponding service packs.

The device description files for other systems are available for download in the download area of the installed bus coupler at the following address: www.phoenixcontact.com/products.