AXL SE DO16/1 NPN



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

Data sheet
109551_en_04

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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, NPN-wired
- 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/1105560

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3 Ordering data

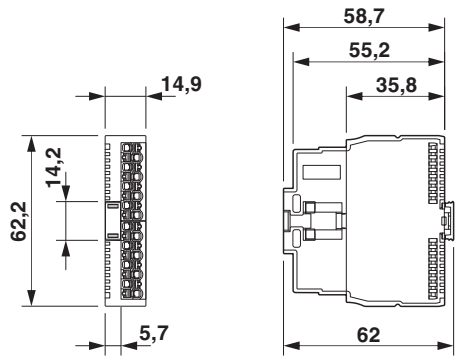
Description	Type	Item no.	Pcs./Pkt.
Axioline Smart Elements, Digital output module, Digital outputs: 16 (NPN), 24 V DC, 500 mA, connection technology: 1-conductor, degree of protection: IP20	AXL SE DO16/1 NPN	1105560	1

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/1105560

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	35 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 31 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. 14 mA (without connected peripherals) 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	1.85 W

Digital outputs	
Number of outputs	16 (NPN)
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	30 V DC … 55 V DC
Output voltage when switched off	min. 23 V (At U_P = 24 V DC)
Output current when switched off	max. 100 µA
Signal delay	max. 100 µs (when switched on) 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) max. 1 per second (with inductive load) 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 GND potential that is below the GND potential of the voltage U_P is connected to an output. In this case, a current flows out of 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
Process data update	typ. 334 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) IEC 61000-4-2	Criterion B, ±6 kV contact discharge, ±8 kV air discharge
Electromagnetic fields IEC 61000-4-3	Criterion A, Field intensity: 10 V/m
Fast transients (burst) IEC 61000-4-4	Criterion B, ±2 kV
Transient overvoltage (surge) IEC 61000-4-5	Criterion B, I/O cables: ±1 kV asymmetrical
Conducted interference 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/1105560

5 Maximum outputs power consumption when inductive loads are switched off

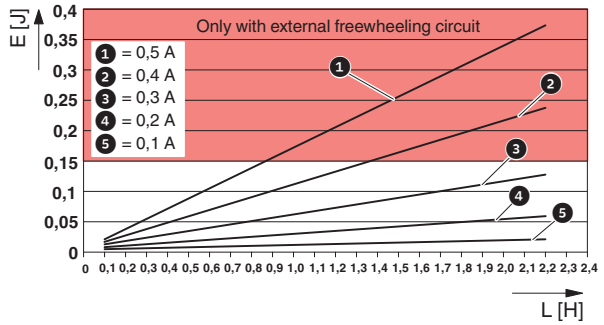
NOTE: Damage to the electronics

Restrict freewheeling voltage to a maximum of 30 V when using an external freewheeling circuit.

It is **essential** for the value to be a maximum of 30 V.

The external freewheeling circuit has no function at a higher 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

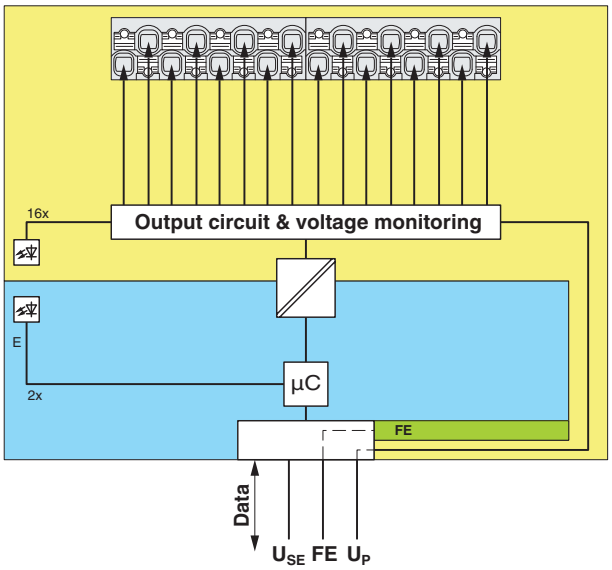
The specifications in the diagram refer to a maximum switching frequency of 1 Hz.

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:
  95 °C, AWG 24 ... 16
– Use copper conductors only.

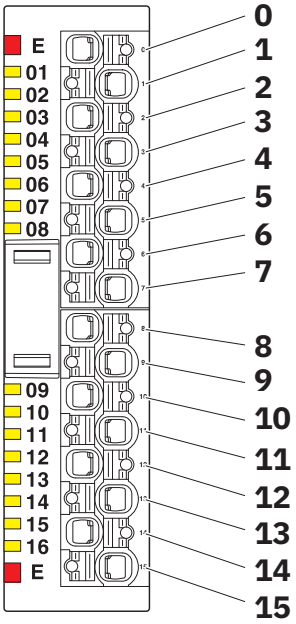
Derating

Specification for ohmic and inductive loads.

Ambient temperature	AWG	Output			
		Voltage	Number of channels	Current per channel	Total current
55 °C	24 ... 16	24 V DC	16	0.5 A	max. 6 A
60 °C	20 ... 16	24 V DC	16	0.5 A	max. 6 A
	24 ... 21	24 V DC	16	0.5 A	max. 4 A

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

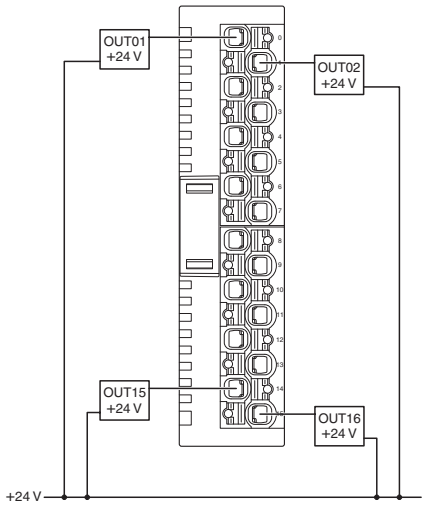
Designation	Color	Description	
E	Red	Error	
		Off	No error
		Flashing (0.5 Hz)	Error in Smart Element Replace the Smart Element.
		Flashing (4 Hz)	Communication error Check whether the Smart Element has been plugged in correctly.
		On	I/O error Check the connected components and wiring. Remove the error.
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

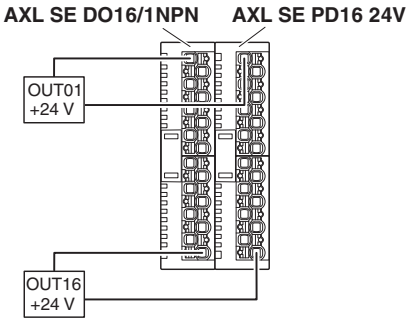
9.1 Using equipotential busbars

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
1337223	AXL SE PD16 24V	16 x 24 V (U_P)
		2 electronic switches, 2 A each
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 004E 1D21$_{hex}$		
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 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.