

# AXL F DI16/1 DO16/1 2H

**Axioline F digital input and output module,  
16 inputs, 24 V DC, 16 outputs, 24 V DC,  
500 mA, 1-wire connection technology**

Data sheet  
106378\_en\_00

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## 1 Description

The module is designed for use within an Axioline F station.

It is used to acquire and output digital signals.

The filter times of the inputs can be set to increase noise immunity.

Filter times of 100  $\mu$ s allow the user to implement a counter function with a maximum input frequency of 5 kHz in the application.

The outputs are short-circuit and overload-protected .

### Input features

- 16 digital inputs according to EN 61131-2 type 1 and type 3
- 24 V DC, 2.4 mA
- Connection of sensors in 1-wire technology
- Filter times can be set in three increments: < 100  $\mu$ s, 1000  $\mu$ s or 3000  $\mu$ s
- Maximum input frequency: 5 kHz

### Output features

- 16 digital outputs
- 24 V DC, 500 mA
- Connection of actuators in 1-wire technology

### Features of Axioline F

- Minimum update time < 100  $\mu$ s
- Device type label stored
- Diagnostic and status indicators



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



Make sure you always use the latest documentation.  
It can be downloaded from the product at [phoenixcontact.net/products](http://phoenixcontact.net/products).

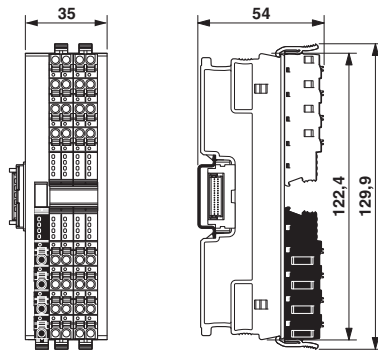
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### 3 Ordering data

Description	Type	Order No.	Pcs. / Pkt.
Axioline F digital input and output module, 16 inputs, 24 V DC, 16 outputs, 24 V DC, 500 mA, 1-wire connection technology (including bus base module and connectors)	AXL F DI16/1 DO16/1 2H	2702106	1
Accessories	Type	Order No.	Pcs. / Pkt.
Axioline F bus base module for housing type H (Replacement item)	AXL F BS H	2700992	5
Zack marker strip for Axioline F (device labeling), in 2 x 20.3 mm pitch, unprinted, 25-section, for individual labeling with B-STIFT 0.8, X-PEN, or CMS-P1-PLOTTER (Marking)	ZB 20,3 AXL UNPRINTED	0829579	25
Zack marker strip, flat, in 10 mm pitch, unprinted, 10-section, for individual labeling with M-PEN 0.8, X-PEN, or CMS-P1-PLOTTER (Marking)	ZBF 10/5,8 AXL UNPRINTED	0829580	50
Documentation	Type	Order No.	Pcs. / Pkt.
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	-	-

### 4 Technical data

#### Dimensions (nominal sizes in mm)



Width	35 mm
Height	129.9 mm
Depth	54 mm
Note on dimensions	The depth is valid when a TH 35-7.5 DIN rail is used (according to EN 60715).

#### General data

Color	traffic grey A RAL 7042
Weight	159 g (with connectors and bus base module)
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
Mounting position	Any (no temperature derating)

### Connection data

Designation	Axioline F connector
Connection method	Push-in technology
Conductor cross section solid / stranded	0.2 mm <sup>2</sup> ... 1.5 mm <sup>2</sup> / 0.2 mm <sup>2</sup> ... 1.5 mm <sup>2</sup>
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm

### Interface Axioline F local bus

Connection method	Bus base module
Transmission speed	100 MBit/s

### Communications power

Communications power $U_{BUS}$	5 V DC (via bus base module)
Current consumption from $U_{BUS}$	max. 120 mA
Power consumption at $U_{BUS}$	max. 600 mW

### I/O supply

Digital input and output module supply $U_{IO}$	24 V DC
Maximum permissible voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption from $U_{IO}$	max. 8 A (external fuse)
Power consumption at $U_{IO}$	typ. 325 mW (Without actuators), max. 240 W (of which 0.5 W internal losses)
Surge protection of the supply voltage	Electronic (35 V, 0.5 s)
Polarity reversal protection of the supply voltage	Parallel diode; with external 5 A fuse (for startup only)
Protection	max. 8 A (polarity reversal protection up to 5 A)



When using for the first time, protect the module with a 5 A fuse. If all the modules are correctly connected in the system, the 5 A fuse can be replaced by an 8 A fuse. you can now load the module up to 8 A. Loads over 8 A are not permitted.



**NOTE: Damage to the electronics**

Provide the module with an external fuse to protect it against polarity reversal. The power supply unit must be able to supply four times the nominal current of the external fuse, to ensure that it trips in the event of an error.

### Digital inputs

Number of inputs	16
Connection method	Push-in technology
Connection method	1-wire
Description of the input	EN 61131-2 types 1 and 3
Nominal input voltage	24 V DC
Nominal input current	2.4 mA
Current flow	Linear until nominal current is reached, then constantly approx. 2.4 mA
Input voltage range "0" signal	-3 V DC ... 5 V DC
Input voltage range "1" signal	11 V DC ... 30 V DC
Input filter time	3000 $\mu$ s (default), 1000 $\mu$ s, < 100 $\mu$ s
Process data update	< 100 $\mu$ s
Polarity reversal protection of the inputs	Parallel diode (30 V, 5 s)

### Digital outputs

Number of outputs	16
Connection method	Push-in technology
Connection method	1-wire
Nominal output voltage	24 V DC
Maximum output current per channel	500 mA
Maximum output current per device	8 A (external fuse)
Nominal load, ohmic	max. 12 W (48 Ω; with nominal voltage)
Nominal load, inductive	max. 12 VA (1.2 H; 48 Ω; with nominal voltage)
Nominal load, lamp	max. 12 W (at nominal voltage)
Signal delay	max. 100 μs (when switched on)
Signal delay	max. 100 μs (when switched off; with at least 50 mA load current)
Switching frequency	max. 10000 per second (with at least 50 mA load current)
Switching frequency	max. 1 per second (with inductive load)
Switching frequency	max. 16 per second (with nominal lamp load)
Load min.	10 kΩ
Energy consumption	see diagram
Limitation of the voltage induced on circuit interruption	-25.8 V ... -15 V
Output voltage when switched off	max. 1 V
Output current when switched off	max. 300 μA
Behavior with overload	Shutdown with automatic restart
Behavior with inductive overload	Output can be destroyed
Reverse voltage resistance to short pulses	Limited protection up to 0.5 A for 1 s



**NOTE: Damage to the electronics**

If there is a faulty external voltage (reverse voltage) at one of the outputs, the output may be destroyed. This may cause unintentional setting of further outputs.

Overcurrent shut-down	as of 0.7 A
Output current with ground connection interrupt when switched off	< 1 mA
Short-circuit protection, overload protection of the outputs	Electronic

### Configuration and parameter data in a PROFIBUS system

Required parameter data	3 Byte
Need for configuration data	7 Byte

### Error messages to the higher level control or computer system

I/O supply failure	Yes
Short-circuit / overload of the digital outputs	Yes

### Electrical isolation/isolation of the voltage areas

Test section	Test voltage
5 V communications power (logic), 24 V supply (I/O)	500 V AC, 50 Hz, 1 min
5 V supply (logic)/functional earth ground	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min

### Mechanical tests

Vibration resistance in acc. with EN 60068-2-6/IEC 60068-2-6	5g
Shock in acc. with EN 60068-2-27/IEC 60068-2-27	30g
Continuous shock according to EN 60068-2-27/IEC 60068-2-27	10g

**Conformance with EMC Directive 2004/108/EC**

**Noise immunity test in accordance with EN 61000-6-2**

Electrostatic discharge (ESD) EN 61000-4-2/IEC 61000-4-2	Criterion B; 6 kV contact discharge, 8 kV air discharge
Electromagnetic fields EN 61000-4-3/IEC 61000-4-3	Criterion A; Field intensity: 10 V/m
Fast transients (burst) EN 61000-4-4/IEC 61000-4-4	Criterion B, 2 kV
Transient surge voltage (surge) EN 61000-4-5/IEC 61000-4-5	Criterion B; DC supply lines: $\pm 0.5$ kV/ $\pm 0.5$ kV (symmetrical/asymmetrical)
Conducted interference EN 61000-4-6/IEC 61000-4-6	Criterion A; Test voltage 10 V

**Noise emission test according to EN 61000-6-3**

Radio interference properties EN 55022	Class B
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**Approvals**

For the latest approvals, please visit [phoenixcontact.net/products](http://phoenixcontact.net/products).

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



**NOTE: Damage to the electronics**  
 Restrict freewheeling voltage to a maximum of -17 V when using an external freewheeling circuit! The external freewheeling circuit does not function in the case of higher negative voltages.

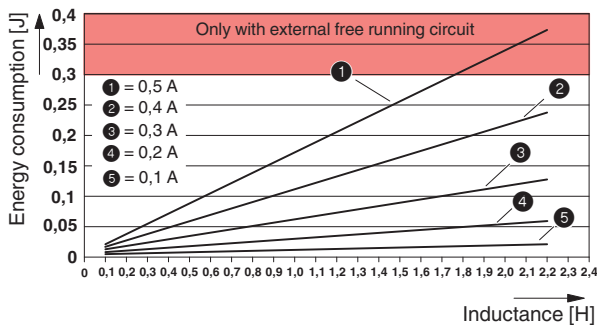


Figure 1 Maximum outputs power consumption when inductive loads are switched off

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

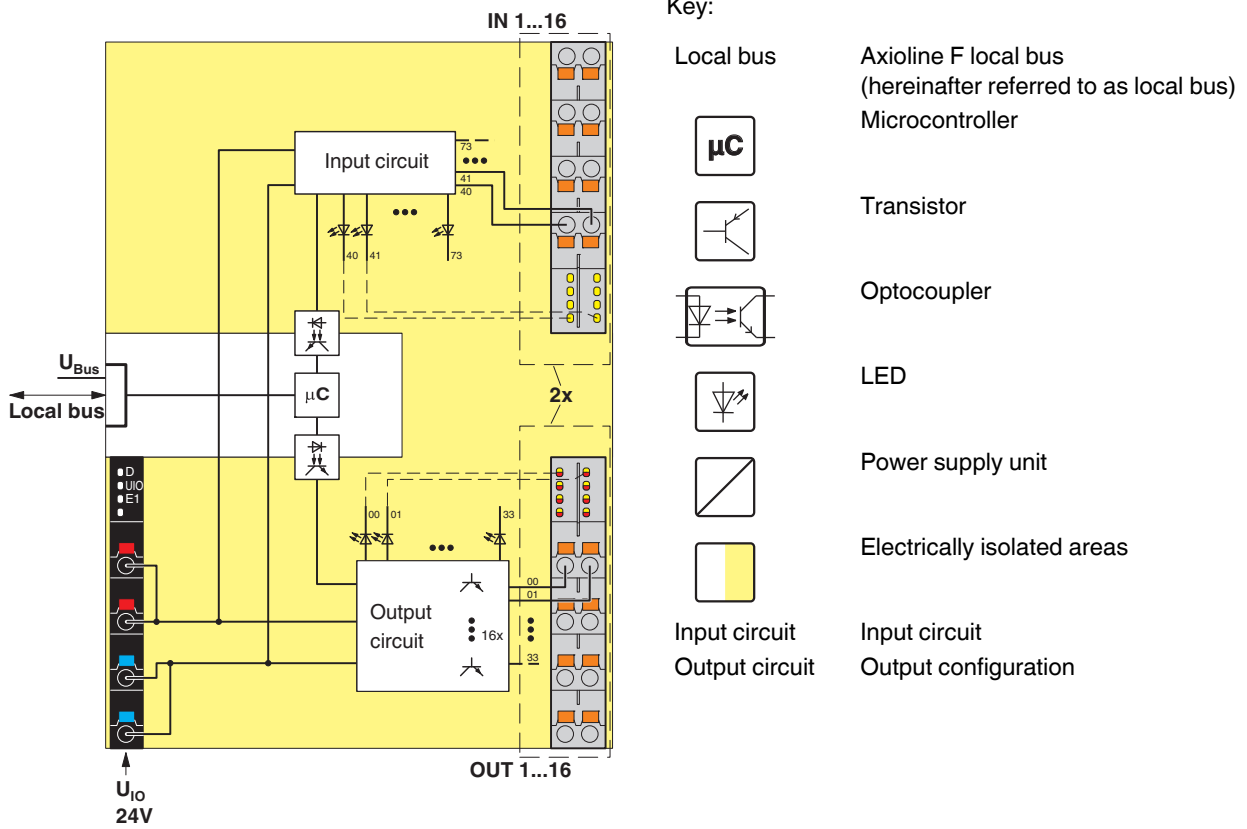


Figure 2 Internal wiring of the terminal points

## 7 Terminal point assignment

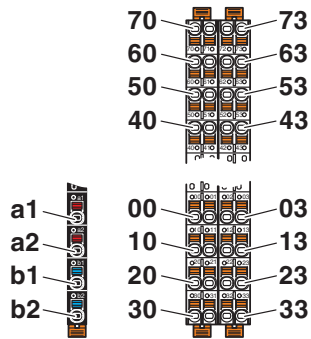


Figure 3 Terminal point assignment

Terminal point	Color	Assignment	
<b>Supply voltage input</b>			
a1, a2	Red	24 V DC (U <sub>IO</sub> )	Supply to digital input and output modules (internally jumpered)
b1, b2	Blue	GND	Reference potential of the supply voltage (internally jumpered)
<b>Digital outputs</b>			
00 ... 03	Orange	OUT1 ... OUT4	Digital outputs 1 ... 4
10 ... 13	Orange	OUT5 ... OUT8	Digital outputs 5 ... 8
20 ... 23	Orange	OUT9 ... OUT12	Digital outputs 9 ... 12
30 ... 33	Orange	OUT13 ... OUT16	Digital outputs 13 ... 16
<b>Digital inputs</b>			
40 ... 43	Orange	IN1 ... IN4	Digital inputs 1 ... 4
50 ... 53	Orange	IN5 ... IN8	Digital inputs 5 ... 8
60 ... 63	Orange	IN9 ... IN12	Digital inputs 9 ... 12
70 ... 73	Orange	IN13 ... IN16	Digital inputs 13 ... 16

## 8 Connection example

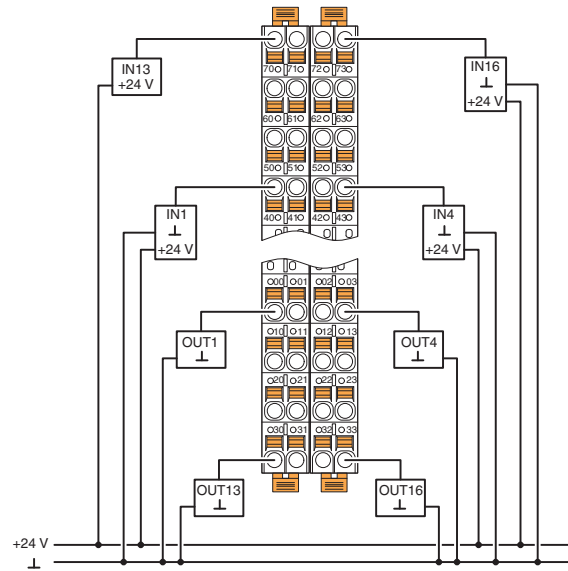


Figure 4 Typical connection of sensors and actuators when using external busbars

Ensure that GND of the sensors and actuators and GND for U<sub>IO</sub> have the same potential.



## 9 Local status and diagnostic indicators

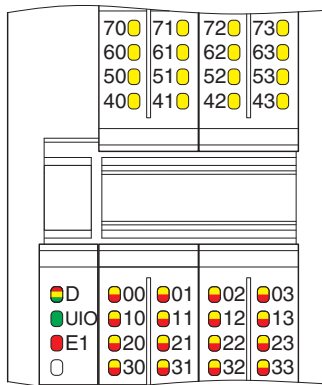


Figure 5 Local status and diagnostic indicators

Designation	Color	Meaning	State	Description
D	Red/ yellow/ green	Diagnostics of local bus communication		
		Run	Green ON	The device is ready for operation, communication within the station is OK. All data is valid. There are no faults.
		Active	Green flashing	The device is ready for operation, communication within the station is OK. The data is <b>not</b> valid. Valid data from the controller/higher-level network not available. There is no fault in the module.
		Device application not active	Flashing green/yellow	The device is ready for operation, communication within the station is OK. Output data <b>cannot</b> be outputted and/or input data <b>cannot</b> be read. There is a fault on the periphery side of the module..
		Ready	Yellow ON	The device is ready for operation but did not detect a valid cycle after power-on.
		Connected	Yellow flashing	The device is not (yet) part of the active configuration.
		Reset	Red ON	The device is ready for operation but has lost the connection to the bus head.
		Not connected	Red flashing	The device is ready for operation but there is no connection to the previously existing device.
		Power down	OFF	Device in (power) reset.
UIO	Green	U <sub>input/output</sub>	ON	Supply for digital input and output modules is available.
			OFF	Supply for digital input and output modules is not available.
E1	Red	Peripheral fault	ON	Short-circuit/overload of an output
			OFF	No I/O error.

Designation	Color	Meaning	State	Description
00 ... 03, 10 ... 13, 20 ... 23, 30 ... 33	Red/ yellow	Diagnos- tics / Status of the out- puts	Red ON	Short-circuit/overload of the output.
			Yellow ON	Output is set.
			OFF	No error, output is not set.
40 ... 43, 50 ... 53, 60 ... 63, 70 ... 73	Yellow	Status of the inputs	ON	Input is set.
			OFF	Input is not set.

## 10 Process data

The I/O data is displayed in S7-compatible format.

### OUT process data

Byte	0							
Bit	7	6	5	4	3	2	1	0
Output	8	7	6	5	4	3	2	1
Terminal point	13	12	11	10	03	02	01	00

Byte	1							
Bit	7	6	5	4	3	2	1	0
Output	16	15	14	13	12	11	10	9
Terminal point	33	32	31	30	23	22	21	20

### IN process data

Byte	0							
Bit	7	6	5	4	3	2	1	0
Input	8	7	6	5	4	3	2	1
Terminal point	53	52	51	50	43	42	41	40

Byte	1							
Bit	7	6	5	4	3	2	1	0
Input	16	15	14	13	12	11	10	9
Terminal point	73	72	71	70	63	62	61	60

## 11 Parameter, diagnostics and information (PDI)

Parameter and diagnostic data as well as other information is transmitted via the PDI channel of the Axioline F station.

The standard and application objects stored in the module are described in the following section.

The following applies to all tables below:

Please refer to the UM EN AXL F SYS INST for an explanation of the object codes and data types.

Abbreviation	Meaning
A	Number of elements
L	Length of the elements
R	Read
W	Write



Every visible string is terminated with a zero terminator (00<sub>hex</sub>). The length of a visible string element is therefore one byte larger than the amount of user data.



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

## 12 Standard objects

### 12.1 Objects for identification (device rating plate)

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning	Contents
<b>Manufacturer</b>								
0001	VendorName	Var	Visible String	1	16	R	Vendor name	Phoenix Contact
0002	VendorID	Var	Visible String	1	7	R	Vendor ID	00A045
0003	VendorText	Var	Visible String	1	49	R	Vendor text	Components and systems for industrial automation
0012	VendorURL	Var	Visible String	1	23	R	Vendor URL	www.phoenixcontact.com
<b>Module - general</b>								
0004	DeviceFamily	Var	Visible String	1	19	R	Device family	I/O digital IN-OUT
0006	ProductFamily	Var	Visible String	1	6	R	Product family	AXL F
000E	CommProfile	Var	Visible String	1	4	R	Communication profile	633
000F	DeviceProfile	Var	Visible String	1	5	R	Device profile	0010
0011	ProfileVersion	Record	Visible String	2	11; 20	R	Profile version	2011-12-07; Basic Profile V2.0
003A	VersionCount	Array	Unsigned 16	4	4 * 2	R	Version counter	e.g., 0007 0001 0000 0000 <sub>hex</sub>
<b>Module - special</b>								
0005	Capabilities	Array	Visible String	1	8	R	Features	Nothing
0007	ProductName	Var	Visible String	1	23	R	Product name	AXL F DI16/1 DO16/1 2H
0008	SerialNo	Var	Visible String	1	11	R	Serial number	xxxxxxxx (e. g., 1234512345)
0009	ProductText	Var	Visible String	1	57	R	Product text	16 digital inputs, adjustable filter, 16 digital outputs
000A	OrderNumber	Var	Visible String	1	8	R	Order No.	2702106
000B	HardwareVersion	Record	Visible String	2	11; 3	R	Hardware version	e. g., 2011-02-04; 00
000C	FirmwareVersion	Record	Visible String	2	11; 3	R	Firmware version	0000-00-00; --
000D	PChVersion	Record	Visible String	2	11; 6	R	Parameter channel version	2010-01-08; V1.00
0037	DeviceType	Var	Octet string	1	8	R	Module identification	00 C0 00 02 00 00 0D 04 <sub>hex</sub>
<b>Use of the device</b>								
0014	Location	Var	Visible String	1	59	R/W	Location	Can be filled out by the user.
0015	EquipmentIdent	Var	Visible String	1	59	R/W	Equipment identifier	Can be filled out by the user.
0016	ApplDeviceAddr	Var	Unsigned 16	1	2	R/W	Application device address	Can be filled out by the user.

12.2 Object for multilingual capacity

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning	Contents
0017	Language	Record	Visible String	2	6; 8	R	Language	en-us; English

12.3 Diagnostics objects

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment/content
0018	DiagState	Record		6	2; 1; 1; 2; 1; 1	R	Diagnostic state

**Diagnostics state (0018<sub>hex</sub>: DiagState)**

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

0018 <sub>hex</sub> : DiagState (Read)					
Subindex	Data type	Length in bytes	Meaning	Contents	
0	Record	8	Diagnostic state	Complete diagnostics information	
1	Unsigned 16	2	Error number	0 ... 65535 <sub>dez</sub>	
2	Unsigned 8	1	Priority	00 <sub>hex</sub>	No error
				01 <sub>hex</sub>	Error
				02 <sub>hex</sub>	Warning
				81 <sub>hex</sub>	Error removed
				82 <sub>hex</sub>	Warning eliminated
3	Unsigned 8	1	Channel/group/module	00 <sub>hex</sub>	No error
				FF <sub>hex</sub>	entire device
4	Unsigned 16	2	Error code	See table below	
5	Unsigned 8	1	More follows	00 <sub>hex</sub>	
6	Visible String	1	Text	00 <sub>hex</sub>	



The message with the priority 81<sub>hex</sub> or 82<sub>hex</sub> is a one-time internal message to the bus coupler that is implemented onto the error mechanisms of the higher-level system by the bus coupler.

Error and status of the local status and diagnostics indicators

Subindex	2	3	4					
Error	Priority	Channel/ group/ module	Error code		LED			
	hex	hex	hex	dec	D	UIO	E1	xx
No error	00	00	0000	0	Green ON	ON	OFF	OFF
Short-circuit/overload of an output	02	FF	2344	9028	Green ON	ON	Red ON	Red ON
I/O supply failure	01	FF	3400	13312	Flashing green/ yellow	OFF	OFF	OFF

xx LED                      Diagnostics of the output  
 xx                            00 ... 03, 10 ... 13, 20 ... 23, 30 ... 33, 40 ... 43, 50 ... 53, 60 ... 63, 70 ... 73



After all errors have been eliminated, it is automatically reset.

#### 12.4 Objects for process data management

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment
0025	PDIN	Var	Octet string	1	2	R	Input process data
0026	PDOUT	Var	Octet string	1	2	R	Output process data
003B	PDIN_Descr	Array of Records		3	8; 2; 2	R	Description of the IN process data
003C	PDOUT_Descr	Array of Records		3	8; 2; 2	R	Description of the output process data

The objects 003B<sub>hex</sub> and 003C<sub>hex</sub> are only applicable to tools.

#### IN process data (0025<sub>hex</sub>: PDIN)

You can read the IN process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0025 <sub>hex</sub> : PDIN (Read)			
Subindex	Data type	Length in bytes	Meaning
0	Octet string	2	Input process data

#### OUT process data (0026<sub>hex</sub>: PDOUT)

You can read the OUT process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0026 <sub>hex</sub> : PDOUT (Read)			
Subindex	Data type	Length in bytes	Meaning
0	Octet string	2	Output process data

## 13 Application objects

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment
FF8D	PD Output Substitute Configuration	Var	Unsigned 8	1	1	R/W	Substitute value behavior
FF8F	Input_Filter	Var	Unsigned 8	1	1	R/W	Filter time

In the case of valid parameters, the parameterization is stored in the module permanently.

### 13.1 Substitute value behavior (FF8D<sub>hex</sub>: PD Output Substitute Configuration)

With this object, you parameterize the behavior of the module so that an application reset can be detected if necessary.

FF8D <sub>hex</sub> : PD Output Substitute Configuration (Read, write)				
Subindex	Data type	Length in bytes	Contents	
0	Var	1	00 <sub>hex</sub> (Default)	"0" output to all output bits
			01 <sub>hex</sub>	Hold last value

### 13.2 Filter time (FF8F<sub>hex</sub>: Input\_Filter)

You parameterize the filter time of the module with this object.

FF8F <sub>hex</sub> : Input_Filter (read, write)				
Subindex	Data type	Length in bytes	Contents	
0	Var	1	00 <sub>hex</sub> (Default)	3000 μs
			01 <sub>hex</sub>	1000 μs
			02 <sub>hex</sub>	< 100 μs

## 14 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 the corresponding service packs.

The device description files for other systems are available for download at [phoenixcontact.net/products](http://phoenixcontact.net/products) in the download area of the bus coupler used.