AXL F DI16/4 XC 2F



Axioline F, digital input module, digital inputs: 16, 24 V DC, Extreme Conditions version

Data sheet
105961_en_10

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1 Description

The module is designed for use within an Axioline F station.
It is used to acquire digital signals.
You can adjust the filter times of the inputs to increase noise immunity.
Filter times of 100 µs enable you to implement a counter function with a maximum input frequency of 5 kHz in the application.

Features

- 16 digital inputs in accordance with EN 61131-2 type 1 and type 3
- 24 V DC, 2.4 mA
- Connection of sensors in 2-, 3-, and 4-conductor technology
- Filter times can be adjusted in two increments: < 100 µs or 500 µs
- Maximum input frequency: 5 kHz
- Maximum permissible load current per sensor: 2 A
- Maximum permissible load current of the module: 4 A (2 A for each group of a max. 8 sensors)
- Minimum update time of < 100 µs
- Device rating plate stored
- Can be used under extreme ambient conditions
- Extended temperature range of -40 °C ... +70 °C (see “Tested successfully: use under extreme ambient conditions” in the data sheet)
- Partially coated PCBs

Observe these notes

WARNING: Explosion hazard when used in potentially explosive areas
When using the module in potentially explosive areas, observe the corresponding notes.

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 at: phoenixcontact.com/product/2701224

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3 Ordering data

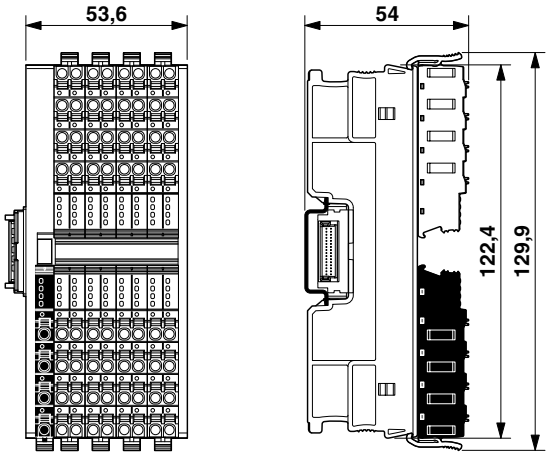
Description	Type	Item no.	Pcs./Pkt.
Axioline F, Digital input module, Digital inputs: 16, 24 V DC, connection technology: 4-conductor, Extreme conditions version, transmission speed in the local bus: 100 Mbps, degree of protection: IP20, including bus base module and Axioline F connectors	AXL F DI16/4 XC 2F	2701224	1

Documentation	Type	Item 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	-	-

Additional ordering data	
For additional ordering data (accessories), go to:	www.phoenixcontact.com/product/2701224

4 Technical data

Dimensions (nominal sizes in mm)



Width	53.6 mm
Height	129.9 mm
Depth	54 mm
Note on dimensions	The depth applies when a TH 35-7.5 DIN rail is used (in accordance with EN 60715).

General data	
Color	Housing: traffic gray A (RAL 7042)
Weight	231 g (with connectors and bus base module)
Ambient temperature (operation)	-25 °C … 60 °C (Standard, applications with UL approval, use in zone 2 potentially explosive area) -40 °C … 70 °C (Extended, see section “Tested successfully: use under extreme ambient conditions” in the data sheet.)
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)
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	DIN rail mounting
Mounting position	any (no temperature derating)

Connection data: Axioline F connector	
Connection method	Push-in connection
Conductor cross-section, rigid	0.2 mm² … 1.5 mm²
Conductor cross-section, flexible	0.2 mm² … 1.5 mm²
Conductor cross-section [AWG]	24 … 16
Stripping length	8 mm

Please observe the information provided on conductor cross-sections in the “Axioline F: system and installation” user manual.

Interface: Axioline F local bus	
Number of interfaces	2
Connection method	Bus base module
Transmission speed	100 Mbps

Axioline F local bus supply (U_{Bus})	
Supply voltage	5 V DC (via bus base module)
Current consumption	max. 120 mA (HW 00) max. 60 mA (from HW 01)

Supply for digital input modules (U_I)	
Supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption	typ. 25 mA (without sensors) max. 4 A (Sensor supply U_S)
Surge protection	electronic (35 V, 0.5 s)
Reverse polarity protection	parallel diode; with external 5 A fuse (only for commissioning)
Protection	max. 8 A (polarity reversal protection up to 5 A)

NOTE: Damage to the electronics

Provide external protection for the module to ensure reverse polarity protection. 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 using the module for the first time, protect it with a 5 A fuse. When all modules in the system are correctly connected, the 5 A fuse can be replaced with an 8 A fuse. After that, you can load the module up to 8 A.

Sensor supply (U_S)	
Supply voltage	24 V DC (from U_I)
Load current	max. 2 A (per sensor) max. 2 A (per each group of max. 8 sensors) max. 4 A (per each module of 2 groups)
Short-circuit/overload protection	electronic

Power dissipation	
Maximum power dissipation for nominal condition	2.3 W

Digital inputs	
Number of inputs	16
Connection method	Push-in connection
Connection technology	4-conductor
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	500 µs (Default), < 100 µs
Process data update	< 100 µs
Polarity reversal protection of the inputs	electronic

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

Configuration and parameter data in a PROFIBUS system	
Required parameter data	3 Byte
Required configuration data	6 Byte

Electrical isolation/isolation of the voltage areas	
Test section	**Test voltage**
5 V supply of the local bus (U_{Bus}) / 24 V supply (I/Os)	500 V AC, 50 Hz, 1 min
5 V supply of the local bus (U_{Bus}) / functional ground	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional ground	500 V AC, 50 Hz, 1 min

Test (noxious gas)	
Test standard	ISA-71.04-2013 G3 Harsh Group A IEC 60068-2-60:2015 Method 4
Temperature	25 °C ±1 K
Humidity (relative)	75 % ±3 %
Test duration	21 Days
Volume concentration H_2S (Hydrogen sulfide)	50 ppb
Volume concentration NO_2 (Nitrogen dioxide)	1250 ppb
Volume concentration Cl_2 (Chlorine)	10 ppb
Volume concentration SO_2 (Sulfur dioxide)	300 ppb

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

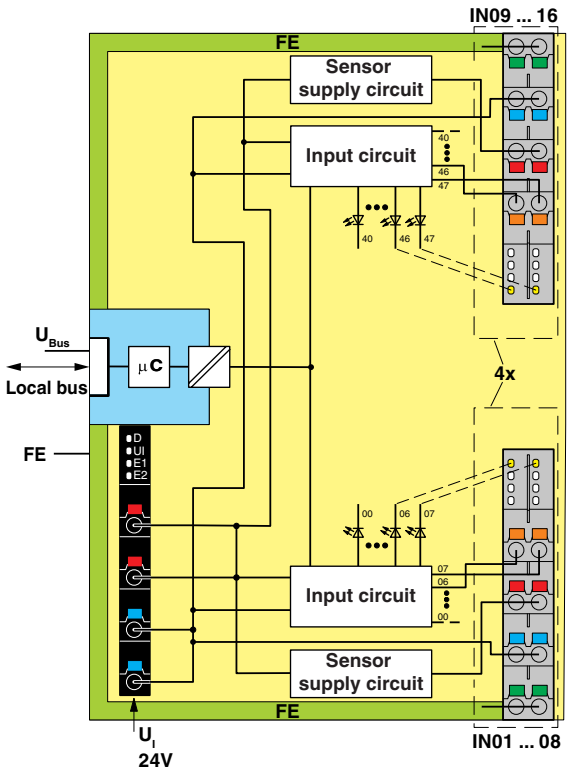
Conformance with EMC Directive 2014/30/EU	
Immunity test in accordance with EN IEC 61000-6-2	
Electrostatic discharge (ESD) IEC 61000-4-2	Criterion B, ±6 kV contact discharge, ±8 kV air discharge
Electromagnetic fields IEC 61000-4-3	Criterion A, Field intensity: 10 V/m
Fast transients (burst) IEC 61000-4-4	Criterion B, ±2 kV
Transient overvoltage (surge) IEC 61000-4-5	Criterion B, DC supply lines: ±0.5 kV/±1.0 kV (symmetrical/ asymmetrical)
Conducted interference IEC 61000-4-6	Criterion A, Test voltage 10 V
Noise emission test in accordance with EN IEC 61000-6-3	Class B

Approvals	
For the current approvals, go to:	www.phoenixcontact.com/product/2701224
ATEX (UL 20 ATEX 2441X)	Ⓔx II 3 G Ex ec IIC T4 Gc EN IEC 60079-0, EN IEC 60079-7
IECEx (IECEx ULD 20.0026X)	Ex ec IIC T4 Gc IEC 60079-0 Ed. 7, IEC 60079-7 Ed. 5.1
UL, USA/Canada (E238705)	cULus
UL Ex, USA / Canada (E366272)	Class I, Zone 2, AEx ec IIC T4 Class I, Division 2, Groups A, B, C, D, T4 Ex ec IIC T4 Gc X UL 60079-0, Ed. 7 / CSA C22.2 NO. 60079-0, Ed. 4 UL 60079-7, Ed. 5 / CSA C22.2 NO. 60079-7, Ed. 2
CCC / China-Ex (㊿, 2021122309114456)	Ex ec IIC T4 Gc GB/T 3836.1-2021, GB/T 3836.3-2021

Manufacturer's declarations	
For the current manufacturer’s declarations, go to:	www.phoenixcontact.com/product/2701224

5 Internal circuit diagram

Figure 1 Internal wiring of the terminal points



Key:

Local bus	Axioline F local bus (hereinafter referred to as local bus)
FE	Functional ground
µC	Microcontroller
	Electrical isolation for data or power supply
Sensor supply circuit	Sensor supply circuit
Input circuit	Input circuit
	LED
	Electrically isolated areas

6 Tested successfully: Use under extreme ambient conditions

WARNING:

In the following applications, the module is only approved for use in the temperature range from -25°C to 60°C:

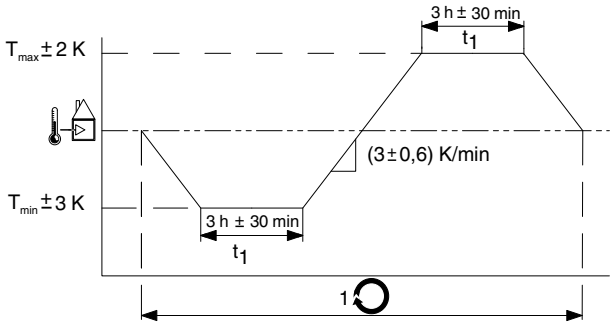
- Applications with UL approval
- Use in zone 2 potentially explosive areas

XC modules have been tested successfully over 250 temperature change cycles according to IEC 61131-2 in the range from -40°C to +70°C.

The following conditions were observed:

- The Axioline F devices for all connecting cables were connected with a minimum conductor cross-section of 0.5 mm²
- The Axioline F station was installed on a wall-mounted horizontal DIN rail
- Fans were used to ensure continuous movement of air in the control cabinet
- The Axioline F station was not exposed to vibration or shock
- The Axioline F station was operated with a maximum of 24.5 V (ensured by using electronically regulated power supply units)

Figure 2 Temperature change cycle



Temperature in the control cabinet/ambient temperature

Cycle

7 For your safety

7.1 Intended use

Use the Axioline F modules exclusively in accordance with the specifications in the accompanying data sheet and the “Axioline F: System and Installation” user manual.

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 Electrical safety

WARNING: Loss of electrical safety

If used incorrectly, device safety may be impaired.

The instructions given in this data sheet as well as the UM EN AXL F SYS INST user manual must be observed during installation, startup, and operation.

7.4 Installation

Only install the Axioline F modules in a control cabinet or junction box.

NOTE: 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 supply and external circuits intended to be connected to this device shall be galvanically separated from the mains supply or hazardous live voltage by reinforced or double insulation and meet the requirements of SELV/PELV (Class III) circuits of UL/CSA/IEC/EN 61010-1, UL/CSA/IEC/EN 61010-2-201.

NOTE: Damage to the contacts

Physical overloads can result in damage to the terminal points.

- Relieve strain in the connected cables.

8 Installation in potentially explosive area

WARNING: Explosion hazard

Before using the device in a potentially explosive area, make sure that your device has the required approval.

The approvals are printed on the device.

WARNING: Explosion hazard

Please make sure that the following notes and instructions are observed.

- The category 3 device is designed for installation in zone 2 potentially explosive areas.
- The device satisfies the requirements of the following standards:

  EN/IEC 60079-0, EN/IEC 60079-7

  For detailed information, refer to the declarations of conformity that accompany the product. For the latest version, go to the item page at www.phoenixcontact.com/products.
- Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described. When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as general technical regulations, must be observed. The safety data is listed in this document and in the certificates.
- Observe the specified conditions for use in potentially explosive areas. Also observe the requirements of IEC/EN 60079-14.
- The device must not be opened or modified. Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from violation.
- Do not subject the product to mechanical and/or thermal stress that exceeds the specified limits.
- The device must be stopped and immediately removed from the Ex area if it is damaged, was subject to an impermissible load, stored incorrectly or if it malfunctions.
- Electrical isolation, rated insulation voltage: 85 V DC in accordance with EN/IEC 600079-7 Annex H.

Specific conditions of use

- Install the device in such a way that a degree of protection of at least IP54 is achieved in accordance with EN/IEC 60529. To this end, a suitable, approved housing that meets the requirements of EN/IEC 60079-0, GB/T 3836.1 must be used.
- Only devices that are designed for operation in Ex Zone 2 and the conditions at the installation location may be connected to the circuits in Zone 2.
- In potentially explosive areas, only connect and disconnect cables and plug-in connections (e.g., connector, bus base module, SD card, etc.) when the power is disconnected.
- For safe operation, lockable plug-in connections must be fully inserted and have a functional interlock (e.g., locking clips, screw connection, etc.). Insert the interlock. Repair any damaged plug-in connections immediately.
- Only connect one cable per terminal point.
- Use only cables that are suitable for a temperature of at least 80°C.
- The air pressure during operation is limited to 106 kPa.
- Use the device in an environment that does not exceed pollution degree 2 in accordance with EN/IEC 60664-1, GB/T 16935.1.
- Use transient protection so that short-term surge voltages do not exceed 119 V.

Areas with a danger of dust explosions

- The device is not designed for use in atmospheres with a danger of dust explosions.

9 UL notes

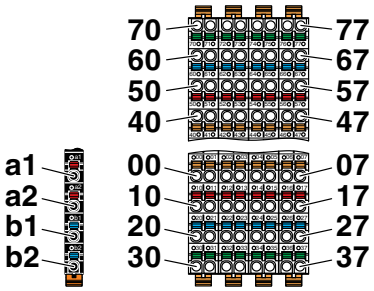
- Use copper conductors only.

UL Hazardous Location

- This device must be mounted in an enclosure certified for use in Class I, Zone 2, minimum, and rated IP54, minimum, in accordance with UL/CSA 60079-0 when used in a Class I, Zone 2 environment.
- This device is to be installed within an area of not more than pollution degree 2, as defined in IEC 60664-1.
- Only connect one cable per terminal point.
- Use only cables that are suitable for a temperature of at least 80°C.
- WARNING - Do not separate terminal blocks when energized!

10 Terminal point assignment

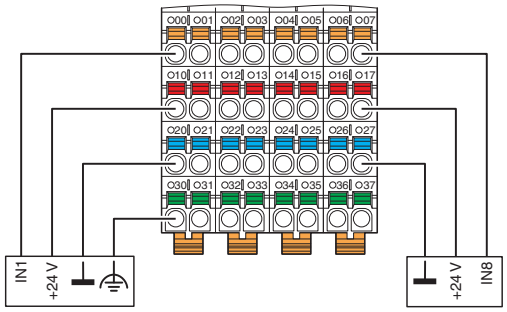
Figure 3 Terminal point assignment



Terminal point	Color	Assignment	
Supply voltage input			
a1, a2	Red	24 V DC (U_I)	Supply for digital input modules (bridged internally)
b1, b2	Blue	GND	Reference potential of the supply voltage (bridged internally)
Digital inputs			
00 ... 07	Orange	IN01 ... IN08	Digital inputs 1 ... 8
40 ... 47	Orange	IN09 ... IN16	Digital inputs 9 ... 16
10 ... 17, 50 ... 57	Red	24 V DC (U_S)	Sensor supply
20 ... 27, 60 ... 67	Blue	GND	Reference potential for all channels
30 ... 37, 70 ... 77	Green	FE	Functional ground FG

11 Connection example

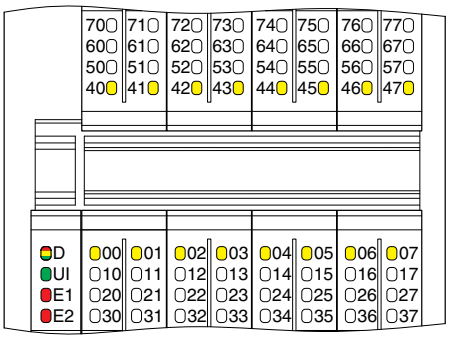
Figure 4 Connection in 4- and 3-conductor technology



12 Local diagnostic and status indicators

As of hardware revision 01

Figure 5 Local diagnostic and status 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. An error has not occurred.
		Active	Flashing green	The device is ready to operate, communication within the station is OK. The data is **not** valid. The controller or higher-level network is not delivering valid data. There is no error on the module.
		Device application not active	Flashing green/ yellow	The device is ready for operation, communication within the station is OK. Output data **cannot** be outputted and/or input data **cannot** 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-up.
		Connected	Flashing yellow	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 is in (power) reset.
UI	Green	U_{Input}	On	Supply for digital input modules (U_I) is present.
			Off	Supply for digital input modules (U_I) is not present.
E1	Red	Supply voltage error	On	Feed-in for digital input modules (U_I) is faulty.
			Off	Feed-in for digital input modules (U_I) is OK.
E2	Red	I/O error	On	Sensor supply overload or short circuit (U_S)
			Off	No I/O error.
00 ... 07, 40 ... 47	Yellow	Status of the inputs	On	Input is set.
			Off	Input is not set.

Deviating behavior for hardware revision 00

E1 and E2 LEDs: Inputs 1 to 8 form group 1, inputs 9 to 16 form group 2. If an error occurs on at least one of the inputs of a group, this will be indicated with the corresponding LED.

Designation	Color	Meaning	State	Description
E1	Red	I/O error in group 1	On	Failure or overload/short circuit of the sensor supply (U_S) group 1.
			Off	No I/O error.
E2	Red	I/O error in group 2	On	Failure or overload/short circuit of the sensor supply (U_S) group 2.
			Off	No I/O error.

13 Process data

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

IN process data

Byte	0							
Bit	7	6	5	4	3	2	1	0
Signal	IN08	IN07	IN06	IN05	IN04	IN03	IN02	IN01
Terminal point	07	06	05	04	03	02	01	00

Byte	1							
Bit	7	6	5	4	3	2	1	0
Signal	IN16	IN15	IN14	IN13	IN12	IN11	IN10	IN09
Terminal point	47	46	45	44	43	42	41	40

14 Parameter, diagnostics and information (PDI)

14.1 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 created in the module are described in the following sections.

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.

14.2 Retentive storage

Axioline F modules can have retentively (non-volatilely) and volatilely stored parameters.

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

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.

15 Standard objects

You can only access these objects via subindex 00, i.e., you access the entire object in each case.

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning/contents		Retentive storage	
0005	Capabilities	Visible String	8	R	Capabilities	Nothing		
0037	DeviceType	Octet string	8	R	Device type	0080 0002 0000 00D0$_{hex}$		
Diagnostics objects								
0018	DiagState	Record [6]	58	R	Diagnostic state			*
0019	ResetDiag	UINT8	1	R/W	Handling diagnostic messages		No	*
Objects for process data management								
0025	PDIN	Octet string	2	R	Input process data The structure corresponds to the representation in the "Process data" section.			

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.

15.1 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.

As of hardware revision 01

Error and status of the local diagnostics and status indicators

Element	2	3	4	6				
Error	Priority	Channel/ group/ module	Error code	Text	LED			
	hex	hex	hex		D	UI	E1	E2
No error	00	00	0000	Status OK	◐	●	○	○
Failure of the supply for digital input modules (U_I)	01	FF	3412	Missing I/O supply UI, terminal point a1/a2, b1/b2	☼	○	●	○
Sensor supply overload or short circuits (U_S) for inputs 1 to 8 (group 1)	01	01	2211	Overload / short circuit sensor supply 1 ... 8	◐	●	○	●
Sensor supply overload or short circuits (U_S) for inputs 9 to 16 (group 2)	01	02	2211	Overload / short circuit sensor supply 9 ... 16	◐	●	○	●

Key

Priority	00_{hex}	No error
	01_{hex}	Error
	02_{hex}	Warning
Channel/group/ module	00_{hex}	No error
	01_{hex}	Group 1 (inputs 1 to 8)
	02_{hex}	Group 2 (inputs 9 to 16)
	FF_{hex}	Entire device
LED	○	Off
	●	On
	◐	Green on
	☼	Flashing green/yellow

Once the cause of the fault has been removed, the message is automatically reset.

Deviating behavior for hardware revision 00

Error and status of the local diagnostics and status indicators

Subindex	2	3	4				
Error	Priority	Channel/ group/module	Error code	LED			
	hex	hex	hex	D	UI	E1	E2
No error	00	00	0000	◐	●	○	○
Failure of the supply for digital input modules (U_I)	01	FF	3412	☼	○	○	○
Sensor supply overload or short circuits (U_S) for inputs 1 to 8 (group 1)	01	01	2211	◐	●	●	○
Sensor supply overload or short circuits (U_S) for inputs 9 to 16 (group 2)	01	02	2211	◐	●	○	●

15.2 Handling diagnostic messages (0019_{hex}: ResetDiag)

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

Handling diagnostic messages	
Code (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

16 Application objects

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning/contents	Retentive storage
FF8F	Input_Filter	UINT8	1	R/W	Filter time	Yes

Filter time ($FF8F_{hex}$: Input_Filter)

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

Filter time	
Code (hex)	**Meaning**
00	**500 µs (default)**
01	< 100 µs

17 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.