AXL F AO4 XC 1H

Axioline F, analog output module, analog outputs: 4, Extreme conditions version



Data sheet
106225_en_06

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1 Description

The module is designed for use within an Axioline F station.
It is used to output analog voltage and current signals.

Features

- 4 analog output channels for the connection of either voltage or current signals
- Bipolar voltage outputs, unipolar current outputs
- Connection of actuators in 2-conductor technology
- Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V
- Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA
- Short-circuit-proof outputs
- No derating in all ranges
- Short signal rise times
- Driving of high loads
- 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/2702153

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3 Ordering data

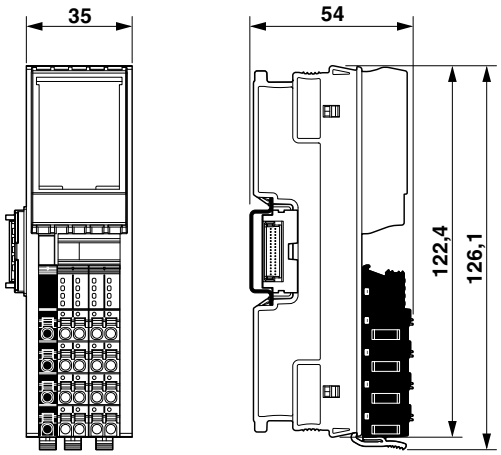
Description	Type	Item no.	Pcs./Pkt.
Axioline F, Analog output module, Analog outputs: 4, 0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, connection technology: 2-conductor, transmission speed in the local bus: 100 Mbps, Extreme conditions version, degree of protection: IP20, including bus base module and Axioline F connectors	AXL F AO4 XC 1H	2702153	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/2702153

4 Technical data

Dimensions (nominal sizes in mm)



Width	35 mm
Height	126.1 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	145 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	typ. 120 mA max. 150 mA

Supply for analog modules (U_A)	
Supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption	min. 40 mA (Internal current consumption, 4 voltage channels, output 0 V, load > 10 MΩ) typ. 60 mA (4 voltage channels, 10 V output) max. 85 mA (4 voltage channels, 10 V output) max. 110 mA (4 current channels, 20 mA output, 500 Ω load) max. 125 mA (4 current channels, 24 mA output, 500 Ω load)
Surge protection	electronic (35 V, 0.5 s)
Reverse polarity protection	Polarity protection diode
Transient protection	Suppressor diode

Power dissipation	
Maximum power dissipation for nominal condition	3.4 W

Analog outputs	
Number of outputs	4
Connection method	Push-in connection
Connection technology	2-conductor, shielded, twisted pair
Current output signal	0 mA ... 20 mA, 4 mA ... 20 mA
Voltage output signal	0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V
D/A converter resolution	16 bit
Representation of output values	16 bits (15 bits + sign)
Data formats	IB IL, S7-compatible
Process data update	140 µs
Load/output load current output	≤ 500 Ω
Load/output load voltage output	≥ 1 kΩ
Tolerance, relative	typ. 0.1 % (of output range final value) see tables for tolerance values
Tolerance, absolute	see tables for tolerance values
Short-circuit and overload protection	electronic
Transient protection	Suppressor diode

Input and output address area	
Input address area	8 Byte
Output address area	8 Byte

Configuration and parameter data in a PROFIBUS system	
Required parameter data	14 Byte
Required configuration data	7 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})/analog outputs	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)/analog outputs	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional ground	500 V AC, 50 Hz, 1 min
Analog outputs/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/ unsymmetrical), ±1.0 kV to shielded I/O cables
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/2702153
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/2702153

5 Tolerance data

Tolerances at T_A = +25°C				
	Absolute tolerance		Relative tolerance	
	Typ.	Max.	Typ.	Max.
0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V	±10 mV	±30 mV	±0.10 %	±0.30 %
0 mA ... 20 mA, 4 mA ... 20 mA	±20 µA	±60 µA	±0.10 %	±0.30 %

Typical data contains offset error, gain error, and linearity error in the respective default setting.

All tolerances indicated as a percentage are related to the positive output range final value.

The data is valid for nominal operation (U_A= 24 V in the default configuration.

Default configuration: IB IL format

Please also observe the values for temperature drift and the tolerances under influences of electromagnetic interferences.

The maximum tolerance values represent the worst case measurement inaccuracy. Besides maximum offset and gain drift, they also comprise longtime drift as well as the maximum tolerances of the test and calibration equipment.

Tolerance and temperature response at T_A = -25 °C ... +60 °C		
	Drift	
	Typical	Maximum
0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V	±25 ppm/K	±70 ppm/K
0 mA ... 20 mA, 4 mA ... 20 mA	±25 ppm/K	±70 ppm/K

The drift values refer to the relevant output range final value.

The values refer to nominal operation with default settings.

Additional tolerances influenced by electromagnetic interference		
Electromagnetic fields	IEC 61000-4-3	< 0.1 %
Fast transients (burst)	IEC 61000-4-4	< 0.1 %
Conducted interference	IEC 61000-4-6	< 0.1 %

All tolerances indicated as a percentage are related to the positive output range final value.

Additional tolerances may occur due to the influence of high-frequency electromagnetic interference caused by wireless transmission systems in the immediate vicinity. The specified values refer to nominal operation. The components are directly exposed to interference without the use of additional shielding measures (e.g., steel cabinet). The tolerances specified above can be reduced through additional shielding for the I/O module (e.g., use of a shielded control box/control cabinet, etc.).

6 Signal rise times

Voltage step 0 V ... 10 V (typical values)

Load	Time for 0 % ... 99 %
R_L = 1 kΩ	30 µs
R_L = 1 kΩ II C_L = 10 nF	30 µs
R_L = 1 kΩ II C_L = 220 nF	215 µs
R_L = 1 kΩ + L_L = 3 mH	35 µs

Current step 0 mA ... 20 mA (typical values)

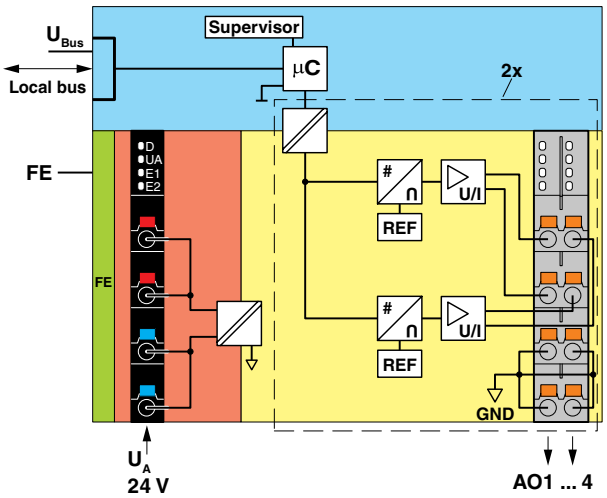
Load	Time for 0 % ... 99 %
R_L = 500 Ω	125 µs
R_L = 500 Ω II C_L = 10 nF	130 µs
R_L = 500 Ω II C_L = 220 nF	300 µs
R_L = 500 Ω + L_L = 2 mH	1 ms

Key to the tables

R_L	Ohmic load
C_L	Capacitive load
L_L	Inductive load
II	Parallel connection
+	Serial connection

7 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
Supervisor	Hardware monitoring
µC	Microcontroller
	Electrical isolation for data or power supply
#	Digital/analog converter
U/I	Output level for current (I) or voltage (U)
REF	Reference voltage source
	Analog I/O reference ground
	Logic reference ground
	Electrically isolated areas

8 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:

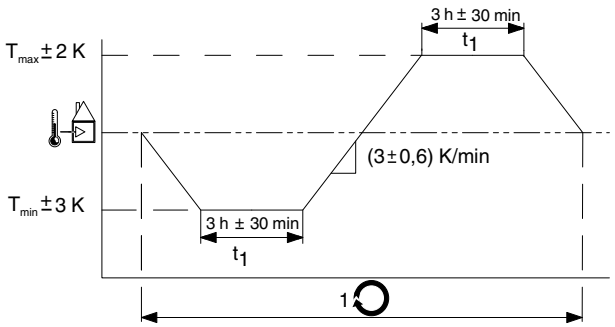
- Applications with UL approval
- Use in zone 2 potentially explosive areas

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

9 For your safety

9.1 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.

9.2 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.

9.3 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.

9.4 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.

10 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.

11 UL notes

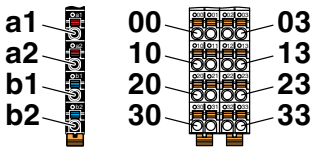
- Use copper conductors only.

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!

12 Terminal point assignment

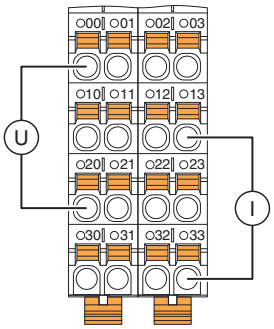
Figure 3 Terminal point assignment



Terminal point	Color	Assignment	
Supply voltage input			
a1, a2	Red	24 V DC (U_A)	Supply for analog modules (bridged internally)
b1, b2	Blue	GND	Reference potential of the supply voltage (bridged internally)
Analog outputs			
00 ... 03	Orange	U1 ... U4	Voltage connection for channel 1 ... 4
10 ... 13	Orange	I1 ... I4	Current connection for channel 1 ... 4
20 ... 23, 30 ... 33	Orange	GND	Reference potential for all channels

13 Connection example

Figure 4 Connection for voltage and current output



14 Connection notes

Observe the connection notes by the actuator manufacturer.

Shielding

Always connect the analog actuators using shielded twisted-pair cables.

In environments with high levels of interference, unshielded cables may cause values to be outside the specified tolerance limits.

For installation in a control cabinet: Connect the cable shield to the functional ground at a suitable point immediately after entry into the control cabinet. Route the cable in the control cabinet in a shielded manner.

If a closed control cabinet is not available, connect the shield to a shield bus.

Use the AXL SHIELD SET Axioline shield connection set for an optimized connection directly in front of the module.

In general, you can use Phoenix Contact products for shielding, see www.phoenixcontact.com/webcode/#0845.

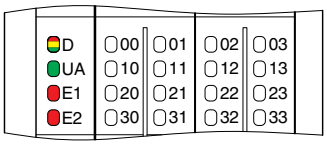
For further information on shielding, please refer to the user manual UM EN AXL F SYS INST.

Strain relief

Do not use the shield contact as a strain relief. Carry out the shielding and the strain relief separately.

15 Local diagnostic and status indicators

Figure 5 Local diagnostic and status indicators



Channel errors are errors that can be associated with a channel.
I/O errors are errors that affect the entire module.

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.
UA	Green	U_{Analog}	On	Supply for analog modules (U_A) present.
			Off	Supply for analog modules (U_A) not present.
E1	Red	Supply voltage error	On	Supply for analog modules (U_A) is faulty.
			Off	Supply for analog modules (U_A) is OK.
E2	Red	Error	On	I/O or channel error has occurred.
			Off	No error

Error code and status of the E1 and E2 LEDs

Error	LED E1	LED E2
No error	off	off
Short-circuit	off	on
Wire break	off	on
Supply voltage faulty (supply for analog modules (U_A))	on	on
Parameter table invalid	off	on
Device error	off	on
Flash format error	off	on

A short circuit or wire break is detected when the output value is >5% of the output range final value.

The module can only detect a short circuit or open circuit if a value is set.

16 Process data

The module uses four words of IN process data and four words of OUT process data.

Each channel is mapped to a word.

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

16.1 OUT process data

The output values are transmitted from the controller board or the computer to the module using process data output words.

Order of the process data words

OUT0	...	OUT3
Channel 1	...	Channel 4
AV	...	AV

AV Output value

Output value

The output values are mapped in IB IL format or S7-compatible format. In both formats the output value is represented in bits 14 to 0. An additional bit (bit 15) is available as a sign bit.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V	Analog value														

V Sign bit

Observe the notes in the section "Writing the analog values via the PDI channel".

16.2 IN process data

In the case of Sercos, the IN process data is hidden and therefore unavailable.

The following data is transmitted in the input process data:

– During normal error-free operation, the output value is mirrored in the input process data for each channel.
– If an error occurs, the diagnostic message is mirrored (in IB IL format) in the input process data for each channel. The diagnostics message is deleted as soon as the error is eliminated.

Order of the process data words

IN0	...	IN3
Channel 1	...	Channel 4
AW*/Diag	...	AW*/Diag

AW*/Diag Mirrored output value or diagnostics messages (in IB IL format)

Diagnostic message (in IB IL format)

Code (hex)	Cause
8002	Wire break
8003	Short-circuit
8010	Parameter table invalid
8020	Faulty supply voltage
8040	Device faulty

In the event of error, a currently existing error is mirrored in the process data on the corresponding channel.

17 Significant values in various formats

17.1 Significant values in IB IL format

Output data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	4 mA ... 20 mA
hex	dec	V	V	V	V	mA	mA
7FFF ... 7F01		+10.837	+10.837	+5.419	+5.419	+21.6747	+21.3397
7F00	32512	+10.837	+10.837	+5.419	+5.419	+21.6747	+21.3397
7530	30000	+10.0	+10.0	+5.0	+5.0	+20.0	+20.0
3A98	15000	+5.0	+5.0	+2.5	+2.5	+10.0	+12.0
0001	1	+333.33 µV	+333.33 µV	+166.67 µV	+166.67 µV	+0.6667 µA	+4.0005333
0000	0	0	0	0	0	0	+4.0
FFFF	-1	0	-333.33 µV	0	-166.67 µV	0	+4.0
C568	-15000	0	-5.0	0	-2.5	0	+4.0
8AD0	-30000	0	-10.0	0	-5.0	0	+4.0
8100	-32512	0	-10.837	0	-5.419	0	+4.0
80FF ... 8000*		Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value
8001	Overrange	+10.837	+10.837	+5.419	+5.419	+21.6747	+21.3397
8080	Underrange	0	-10.837	0	-5.419	0	Hold last value

* without 8001, 8080

17.2 Significant values in S7-compatible format

Output data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	4 mA ... 20 mA
hex	dec	V	V	V	V	mA	mA
7FFF ... 7F00	Overrange	0	0	0	0	0	0
7EFF	32511	+11.759	+11.759	+5.879	+5.879	+23.5157	+22.8142
6C00	27648	+10.0	+10.0	+5.0	+5.0	+20.0	+20.0
5100	20736	+7.5	+7.5	+3.75	+3.75	+15.0	+16.0
0001	1	+361.69 µV	+361.69 µV	+180.85 µV	+180.85 µV	+0.7234 µA	+4.0005787
0000	0	0	0	0	0	0	+4.0
FFFF	-1	0	-361.69 µV	0	-180.85 µV	0	+3.9994
E501	-6911	0	-2.4996	0	-1.2498	0	0.578 µA
E500	-6912	0	-2.5	0	-1.25	0	0
AF00	-20736	0	-7.5	0	-3.75	0	0
9400	-27648	0	-10.0	0	-5.0	0	0
8100	-32512	0	-11.759	0	-5.879	0	0
80FF ... 8000	Underrange	0	0	0	0	0	0

18 Parameter, diagnostics and information (PDI)

18.1 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.

18.2 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.

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.

19 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	Energ_0; FwUpdt0		
0037	DeviceType	Octet string	8	R	Device type	0010 0008 0000 00A7$_{hex}$		
Diagnostics objects								
0018	DiagState	Record [6]	21	R	Diagnostic state			*
0019	ResetDiag	UINT8	1	R/W	Handling diagnostic messages		No	*
Objects for process data management								
0024	ResetCode	Array [4] of UINT16	8	R/W	Substitute value behavior during bus reset (PDOUT)		Yes	*
0025	PDIN	Octet string	8	R	Input process data The structure corresponds to the representation in the "Process data" section.			
0026	PDOUT	Octet string	8	R/W	OUT process data The structure corresponds to the representation in the “Process data” section.		No	
0027	GetExRight	UINT8	1	R/W	Get exclusive process data write rights		No	*
002F	PDOUT_Subst	Array [8] of UINT16	16	R/W	Substitute value for the OUT process data		Yes	*
Objects for device management								
001D	Password	Octet string	9	W	Password		No	*
0029	ParamSetWrite-Control	UINT8	1	R/W	Parameter set write control		No	*
002A	ConflictDictionary	Record	12	R	Conflict dictionary			*
002D	ResetParam	UINT8	1	R/W	Reset parameterization		No	*
002E	CheckSum	UINT32	4	R	Checksum		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.

19.1 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.

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	UA	E1	E2
No error	00	00	0000	Status OK	◐	●	○	○
Short-circuit	01	01 ... 04	2130	Short-circuit	◐	●	○	●
Faulty supply voltage	01	FF	5160	Supply fail	☀	○	●	●
Device error	01	FF	6301	CS FLASH	◐	●	○	●
Flash format error	01	FF	6302	FO FLASH	◐	●	○	●
Parameter table invalid	01	FF	6320	Invalid para	◐	●	○	●
Wire break	01	01 ... 04	7710	Open circuit	◐	●	○	●

Key

Priority	00_{hex}	No error
	01_{hex}	Error
	02_{hex}	Warning
Channel	00_{hex}	No error
	01_{hex}	Channel 1
	:	:
	04_{hex}	Channel 4
	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.

19.2 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

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

With this object, you parameterize the behavior of the module in the event that process data is missing.

After a reset, the module operates with the last retentively stored data. In the delivery state, the module works with the default data (default setting).

Element	Data type	Length in bytes	Meaning
1	UINT16	2	Substitute value behavior channel 1
:	:	:	:
4	UINT16	2	Substitute value behavior channel 4

Value range:

Code (hex)	Behavior
0000	Output of zero value (0 V / 0 mA / 4 mA) at output
0001	Output of final value (10 V / 5 V / 20 mA) at output
0002	**Hold last value (default)**
0003	Substitute value (PDOUT): Copy the substitute value from the “Substitute value for the output process data” object ($002F_{hex}$)

Behavior of the outputs when the supply voltage fails

U_A	U_{Bus}	Behavior of the outputs
Available	Available	Nominal operation or see object 0024_{hex}
Missing	Available	Outputs to 0 V/0 mA
Available	Missing	Outputs to 0 V/0 mA

Special features

– You can only access this object via subindex 0, i. e., you access the entire object.
– In the case of valid parameters, the object is stored permanently.
– After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

19.4 Request exclusive write access (0027_{hex}: GetExRight)

This object allows you to determine which channel (process data channel or PDI channel) gets the rights for writing the outputs.

Get exclusive process data write rights	
Code (hex)	**Meaning**
00_{hex}	Rights for writing output data over the PD channel (process data channel)
01_{hex}	Rights for writing output data via the PDI channel

All other values are invalid and will be acknowledged with an error.

Please note the following for your process:
The parameterization in object 0027_{hex} “Rights for writing the output data via the PDI channel” overwrites the output process data transmitted via the process data channel with the values from object 0026_{hex} PDOUT.
From now on, changes to the output process data can only be made via the PDI object. Changes on the process data channel will have no effect.
If the value from the process data channel is to be used again, write access must be changed to “Rights for writing the output data via the PD channel (process data channel)” via the GetExRight object.
After a power reset, the values transmitted via the process data channel are always valid.

19.5 Substitute value for the OUT process data ($002F_{hex}$: PDOUT_Subst)

This object is used to parameterize the substitute values that are to be output at the analog outputs in the event that process data is missing. The condition is that option 0003 is selected in the “Substitute value behavior when process data is missing” object (0024_{hex}).

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

After a reset, the module operates with the last retentively stored data. In the delivery state, the module works with the default data (default setting).

There are 2 bytes available for each channel, starting with channel 1.

The values are used in the parameterized format.

Example:

Channel 1: 1 V, channel 2: 2 V ... channel 4: 4 V, IB IL format
0B B8 17 70 23 28 2E E0

Special features

- You can only access this object via subindex 0, i. e., you access the entire object.
- In the case of valid parameters, the object is stored permanently.
- The parameterized values are compared with the selected output range. If the substitute value does not correspond to the output range, an error message is issued.

19.6 Password ($001D_{hex}$: Password)

By entering the "Superuser" password you permit writing to the "Exclusiv right received" object. These rights are required to transmit process data over the PDI channel.

19.7 Parameter record write control (0029_{hex}: ParamSetWriteControl)

Firmware version 1.10 or later.

This object is used to control block parameterization.

Parameter set write control	
Code (hex)	**Meaning**
00_{hex}	Termination of block parameterization
01_{hex}	Initiation of block parameterization

Block parameterization serves to enable the joint transfer of interdependent parameters.

If you attempt to parameterize dependent parameters individually, this may result in the error message “Dependency of other parameter not taken into consideration”. Block parameterization should be used in this case.

The plausibility check for the parameterization data is disabled during block parameterization, the data is only stored temporarily. However, the data length and subindex are checked.

The plausibility check is only performed when block parameterization is terminated with data item 00_{hex}.

If the check was completed with no errors, the temporarily stored parameterization data is applied and stored in the Flash memory.

If errors were detected in the temporarily stored parameterization data, the service is acknowledged negatively. The exact cause of the error can be read in object $002A_{hex}$. The error codes are indicated by object 0080_{hex}.

You do not necessarily have to write all the startup objects.

The following actions are carried out when the parameter contents are modified:

Write control changes from 00_{hex} to 01_{hex}: initiation of block parameterization

– Block parameterization is initiated
– Conflict dictionary is reset

Write control changes from 01_{hex} to 00_{hex}: termination of block parameterization

– Block parameterization is terminated
– Individual parameterization is active
– Parameterization is checked for compatibility

  Parameters are compatible:
  - The parameter contents are accepted.
  - Write access to the write control parameter is acknowledged positively.

  Parameters are not compatible:
  - The old contents of all the parameters required for block parameterization remain in effect.
  - The conflict dictionary is updated.
  - Write access to the write control parameter is acknowledged negatively.

Error code in the event of negative acknowledgment:

Code (hex)	Additional code (hex)	Meaning	Corrective
0800 or 0801	0040	Dependent values were not taken into consideration.	Check the parameterization.

To use block parameterization without tools, proceed in the following sequence:

- Initiate block parameterization by writing the value 01_{hex} to object 0029_{hex}.
- Write the parameter table (ParaTable) to object 0080_{hex}.
- Write the substitute value behavior when process data is missing (ResetCode) to object 0024_{hex}.
- Write the substitute value for the OUT process data in the event of an error (PDOUT_Subst) to object $002F_{hex}$.
- Terminate block parameterization by writing the value 00_{hex} to object 0029_{hex}.

19.8 Conflict dictionary ($002A_{hex}$: ConflictDictionary)

Firmware version 1.10 or later.

This object contains the indices and error messages (additional code) for the parameters involved in the conflict.

Meaning	Length in bytes	Example	
Subslot	1	00	No subslot
Index	2	00 2F	PDOUT_Subst
Subindex	1	02	Substitute value for OUT02
Parameter number	1	01	
Error code and class	1	80	
Additional error code	2	02 40	Substitute value for OUT02 outside the limit values

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

Firmware version 1.10 or later.

This object is used to reset the module to the default settings.

To reset the parameters, value 01_{hex} must be transferred during write access. All other values are invalid and will be acknowledged with an error.

Then the default settings of the channels are loaded and all the user-set parameters are reset.

19.10 Checksum ($002E_{hex}$: CheckSum)

Firmware version 1.10 or later.

The module calculates the checksum for all retentively stored PDI objects (without 0014_{hex} to 0016_{hex}).
As long as the checksum does not change, the PDI objects of the module are not saved again.

20 Application objects

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning/contents	Retentive storage
0080	ParaTable	Array [6] of UINT16	12	R/W	Parameter table	Yes

Parameter table (0080_{hex}: ParaTable)

Parameterize the module using this object.

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

After a reset, the module operates with the last retentively stored data. In the delivery state, the module works with the default data (default setting).

0080_{hex}: Parameter table (read, write)				
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**	**Default value**
0	Array [6] of UINT16	12	Read/write all elements	See subindices
1	UINT16	2	Parameterization of channel 1	0000_{hex}
:	UINT16	2	:	0000_{hex}
4	UINT16	2	Parameterization of channel 4	0000_{hex}
5	UINT16	2	Data format	0000_{hex}
6	UINT16	2	Reserved	0000_{hex}

Parameterization channel 1 ... channel 4

Parameterization word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	Output range			

Output range	Code (bin)	Code (hex)
0 V ... 10 V (default)	**0000**	**0**
±10 V	0001	1
0 V ... 5 V	0010	2
±5 V	0011	3
0 mA ... 20 mA	0100	4
Reserved	0101	5
4 mA ... 20 mA	0110	6
Channel inactive	1111	F
Other	Reserved	

Parameterize unused channels as “Channel inactive”.

Data format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	Data format		0	0	0	0	0	0	0	0

Data format	Code (bin)	Code (hex)
IB IL (default)	**00**	**0**
Reserved	01	1
S7-compatible	10	2
Reserved	11	3

Set all reserved bits to 0.

21 Writing the analog values over the PDI channel

PDI = Parameters, Diagnostics and Information

The exclusive right must be changed first, if the analog values are not to be output via the process data, but via the PDI channel. To do this, proceed as follows.

- Write the ASCII string "Superuser" to the "Password" ($001D_{hex}$) object.
- Write the value 01_{hex} to the “Request exclusive write access” object (0027_{hex}).

You may now write to the "Output process data" (0026_{hex}) object.

22 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.