# AXL F AI2 AO2 1H

**Axioline F analog input and output module, 2 inputs, 2 outputs**

Data sheet
106048_en_02

## 1 Description

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

It is used to acquire and output analog voltage and current signals.

**Input features**

– 2 analog differential input channels
– Connection of sensors in 2-wire technology
– Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
– Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V

**Output features**

– 2 analog outputs
– Connection of actuators in 2-wire technology
– Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
– Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V

**General features**

– Process data update < 150 µs
– Device type label stored
– Diagnostic and status indicators

| | |
|---|---|
| ℹ | This data sheet is only valid in association with the UM EN AXL F SYS INST user manual. |
| ℹ | Make sure you always use the latest documentation. It can be downloaded from the product at phoenixcontact.net/products. |

PHŒNIX CONTACT

INSPIRING INNOVATIONS

## 2    Table of contents

# 3    Ordering data

| Description | Type | Order No. | Pcs./Pkt. |
|---|---|---|---|
| Axioline F analog input and output module, 2 inputs, 2 outputs, 0 - 10 V, ±10 V, 0 - 5 V, ±5 V, 0 - 20 mA, 4 - 20 mA, ±20 mA, 2-conductor connection technology (including bus base module and connectors) | AXL F AI2 AO2 1H | 2702072 | 1 |

| Accessories | Type | Order No. | Pcs./Pkt. |
|---|---|---|---|
| Axioline F bus base module for housing type H (Replacement item) | AXL F BS H | 2700992 | 5 |
| Axioline shield connection set (contains 2 busbar holders and 2 SK 5 shield connection clamps) | AXL SHIELD SET | 2700518 | 1 |
| 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 |
| Insert label, Roll, white, unlabeled, can be labeled with: THERMOMARK ROLL,  THERMOMARK ROLL X1,  THERMOMARK X,  THERMOMARK S1.1, Mounting type: snapped into marker carrier, Lettering field: 35 x 28 mm (Marking) | EMT (35X28)R | 0801602 | 1 |

| 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)**
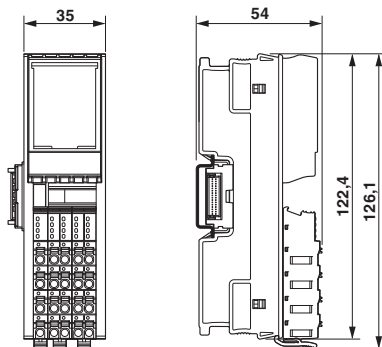


| Width | 35 mm |
|---|---|
| Height | 126.1 mm |
| Depth | 54 mm |
| Note on dimensions | The depth is valid when a TH 35-7.5 DIN rail is used (according to EN 60715). |

**General data**

| Color | traffic grey A RAL 7042 |
|---|---|
| Weight | 200 g (with connectors and bus base module) |
| Ambient temperature (operation) | -25 °C ... 60 °C |
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |

## General data

| | |
|---|---|
| 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 |
| Mounting position | Any (no temperature derating) |

## Connection data

| | |
|---|---|
| Designation | Axioline F connector |
| Connection method | Push-in connection |
| Conductor cross section solid / stranded | 0.2 mm² ... 1.5 mm² / 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

| | |
|---|---|
| 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 $U_{Bus}$ | typ. 120 mA, max. 150 mA |
| Power consumption at $U_{Bus}$ | typ. 0.6 W, max. 0.75 W |

## I/O supply

| | |
|---|---|
| Supply for analog modules $U_A$ | 24 V DC |
| Maximum permissible voltage range | 19.2 V DC ... 30 V DC (including all tolerances, including ripple) |
| Current consumption from $U_A$ | typ. 40 mA<br>max. 80 mA |
| Power consumption at $U_A$ | typ. 0.96 W, max. 1.92 W |
| Surge protection | Electronic (35 V, 0.5 s) |
| Protection against polarity reversal | Polarity protection diode |
| Transient protection | Suppressor diode |

## Total power consumption of the module

| | |
|---|---|
| Power consumption | typ. 1.56 W (at $U_{Bus}$ and $U_A$), max. 2.67 W (at $U_{Bus}$ and $U_A$) |

## Analog inputs

| | |
|---|---|
| Number of inputs | max. 2 (Differential inputs, voltage or current can be chosen separately) |
| Connection method | Push-in connection |
| Connection method | 2-wire (shielded) |
| Resolution A/D | 16 bit |
| A/D conversion time | 2 µs |
| Limit frequency (3 dB) | 30 Hz, 12 kHz |
| Measured value representation | 16 bits (15 bits + sign bit) |
| Data formats | IB IL, S7-compatible, standardized representation |
| Process data update | 150 µs |

## Analog inputs

| | |
|---|---|
| Input filter | 30 Hz, 12 kHz and mean-value generation (can be parameterized) |
| Precision | 0.1 % (of measuring range final value for active mean-value generation and 30 Hz filter) |
| Transient protection of inputs | Suppressor diode |

## Differential inputs, voltage

| | |
|---|---|
| Number of inputs | 2 |
| Voltage input signal | 0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V |
| Input resistance of voltage input | 268 kΩ (typical) |
| Open circuit response | Goes to 0 V |
| Common mode voltage range signal - ground | -50 V DC ... 50 V DC |
| Overload protection | ±30 V DC, maximum |

## Differential inputs, current

| | |
|---|---|
| Number of inputs | 2 |
| Current input signal | 0 mA ... 20 mA, 4 mA ... 20 mA, -20 mA ... 20 mA |
| Input resistance current input | 104 Ω (typical) |
| Open circuit response | Going to 0 mA; open-circuit detection from 4 mA ... 20 mA |
| Overload protection | No; ±5.2 V DC, maximum, $I_{max}$ = 50 mA |

## Analog outputs

| | |
|---|---|
| Number of outputs | 2 |
| Connection method | Push-in connection |
| Connection method | 2-wire (shielded, twisted pair) |
| D/A resolution | 16 bit |
| Representation of output values | 16 bits (15 bits + sign) |
| Data formats | IB IL, S7-compatible, standardized representation |
| Process data update | 150 µs |
| Short-circuit and overload protection | Electronic |
| Transient protection | Suppressor diode |

## Analog outputs, Current

| | |
|---|---|
| Current output signal | 0 mA ... 20 mA, 4 mA ... 20 mA, -20 mA ... 20 mA |
| Load/output load current output | ≤ 500 Ω |
| Precision | typ. 0.1 % (of output range final value) |

## Analog outputs, Voltage

| | |
|---|---|
| Voltage output signal | 0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V |
| Load/output load voltage output | > 2 kΩ |
| Precision | typ. 0.1 % (of output range final value) |

## Configuration and parameter data in a PROFIBUS system

| | |
|---|---|
| Required parameter data | 11 Byte |
| Need for configuration data | 7 Byte |

## 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)/analog inputs and outputs | 500 V AC, 50 Hz, 1 min |
| 5 V supply (logic)/functional earth ground | 500 V AC, 50 Hz, 1 min |

| Electrical isolation/isolation of the voltage areas | |
| --- | --- |
| **Test section** | **Test voltage** |
| 24 V supply (I/O)/analog inputs and outputs | 500 V AC, 50 Hz, 1 min |
| 24 V supply (I/O) / functional earth ground | 500 V AC, 50 Hz, 1 min |
| Analog inputs and outputs/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; supply lines DC: ±0.5 kV/±0.5 kV (symmetrical/asymmetrical); ±1 kV to shielded I/O cables |
| 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 |

| Approvals |
| --- |

For the latest approvals, please visit phoenixcontact.net/products.

# 5 Tolerance data

**The following applies for tolerance values:**

**Analog inputs:**

The data is valid for nominal operation ($U_A$ = 24 V) in the default parameterization (unless documented otherwise).

Default parameterization: filter with 30 Hz, 16-sample mean value, IB IL format.

**Analog outputs:**

The data is valid irrespective of the parameterization.

| Tolerances at $T_A$ = 25°C | | | | |
|---|---|---|---|---|
| | **Absolute** | | **Relative** | |
| | **Typ.** | **Max.** | **Typ.** | **Max.** |
| **Analog inputs** | | | | |
| 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA | ±20 µA | ±60 µA | ±0.10% | ±0.30% |
| 0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V | ±10 mV | ±30 mV | ±0.10% | ±0.30% |
| **Analog outputs** | | | | |
| 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA | ±20 µA | ±60 µA | ±0.10% | ±0.30% |
| 0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V | ±10 mV | ±30 mV | ±0.10% | ±0.30% |

300 µs update time, 12 kHz filter, without mean-value generation

| Tolerances at $T_A$ = 25°C | | | | |
|---|---|---|---|---|
| | **Absolute** | | **Relative** | |
| | **Typ.** | **Max.** | **Typ.** | **Max.** |
| **Analog inputs** | | | | |
| 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA | ±100 µA | ±160 µA | ±0.5% | ±0.8% |
| 0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V | ±50 mV | ±80 mV | ±0.5% | ±0.8% |

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 measuring range final value.

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

| Tolerance and temperature response at $T_A$ = -25°C to +60°C | | |
|---|---|---|
| | **Drift** | |
| | **Typical** | **Maximum** |
| **Analog inputs** | | |
| 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA | ±45 ppm/K | ±65 ppm/K |
| 0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V | ±40 ppm/K | ±55 ppm/K |
| **Analog outputs** | | |
| 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA | ±65 ppm/K | ±80 ppm/K |
| 0 V ... 5 V, ±5 V, 0 V ... 10 V, ±10 V | ±30 ppm/K | ±40 ppm/K |

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

| Tolerances influenced by electromagnetic interference | | |
|---|---|---|
| Electromagnetic fields | EN 61000-4-3/ IEC 61000-4-3 | < ±0.3 % |
| Fast transients (burst) | EN 61000-4-4/ IEC 61000-4-4 | < ±1.2 % |
| Conducted interference | EN 61000-4-6/ IEC 61000-4-6 | < ±1.0% |

Additional tolerances may occur due to the influence of high-frequency electromagnetic interference caused by wireless transmission systems in the near vicinity. The values specified refer to nominal operation in the event of direct interference to components without additional shielding such as a steel cabinet, etc.

The above mentioned tolerances can be reduced by providing further shielding measures 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 % |
|---|---|
| $R_L = 2$ kΩ | 7.5 µs |
| $R_L = 2$ kΩ II $C_L = 10$ nF | 15 µs |
| $R_L = 2$ kΩ II $C_L = 220$ nF | 140 µs |
| $R_L = 2$ kΩ + $L_L = 3.3$ mH | 20 µs |

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

| Load | Time for 0 % ... 99 % |
|---|---|
| $R_L = 500$ Ω | 20 µs |
| $R_L = 500$ Ω II $C_L = 10$ nF | 20 µs |
| $R_L = 500$ Ω II $C_L = 220$ nF | 240 µs |
| $R_L = 500$ Ω + $L_L = 3.3$ mH | 90 µs |

**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
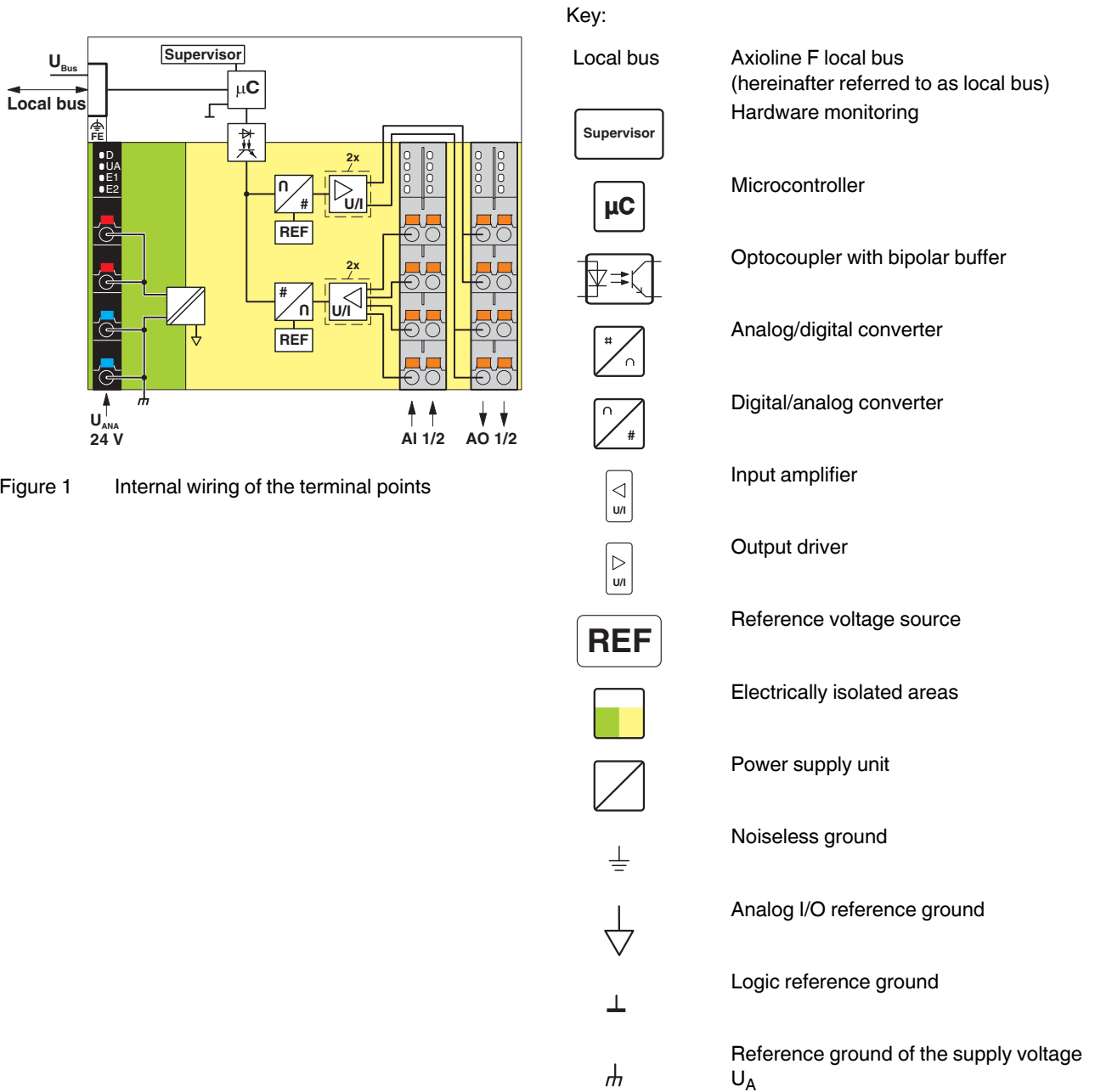


Figure 1    Internal wiring of the terminal points

Key:

| | |
|---|---|
| Local bus | Axioline F local bus (hereinafter referred to as local bus) |
| Supervisor | Hardware monitoring |
| μC | Microcontroller |
| | Optocoupler with bipolar buffer |
| | Analog/digital converter |
| | Digital/analog converter |
| | Input amplifier |
| | Output driver |
| REF | Reference voltage source |
| | Electrically isolated areas |
| | Power supply unit |
| | Noiseless ground |
| | Analog I/O reference ground |
| | Logic reference ground |
| | Reference ground of the supply voltage $U_A$ |

# 8    Terminal point assignment



Figure 2    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 (internally jumpered) |
| **Analog inputs** | | | |
| 00, 01 | Orange | U1+, U2+ | Positive voltage connection for channel 1 and 2 |
| 10, 11 | Orange | U1-, U2- | Negative voltage connection for channel 1 and 2 |
| 20, 21 | Orange | I1+, I2+ | Positive current connection for channel 1 and 2 |
| 30, 31 | Orange | I1-, I2- | Negative current connection for channel 1 and 2 |
| **Analog outputs** | | | |
| 02, 03 | Orange | U1, U2 | Voltage connection for channel 1 and 2 |
| 12, 13 | Orange | I1, I2 | Current connection for channel 1 and 2 |
| 22, 23 | Orange | GND | Reference potential for all AO channels |
| 32, 33 | Orange | GND | |

# 9    Connection examples
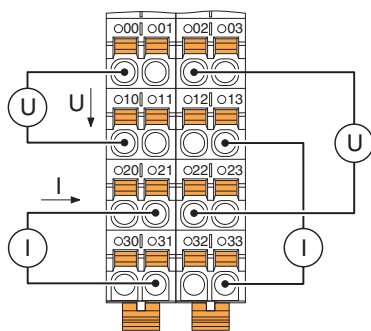


Figure 3    Connection for measuring voltage and current as well as voltage and current output

## 9.1    Analog inputs
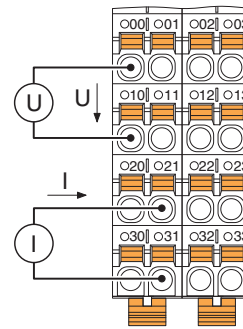


Figure 4    Connection for voltage and current measurement
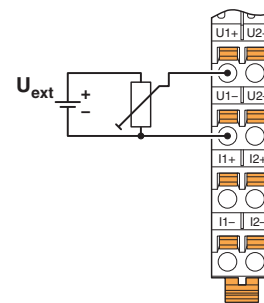


Figure 5    Connection of potentiometric position sensors

The values of potentiometric position sensors can be acquired with voltage measurement. Supply the potentiometer via an external power supply unit ($U_{ext}$ = 10 V).
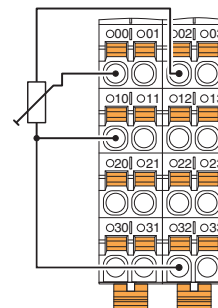


Figure 6    Connection of positiometers for detecting the position (OUT1 channel is used for supplying the positiometer)
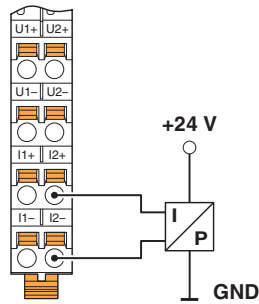
Figure 7    Passive pressure sensor at a differential current input
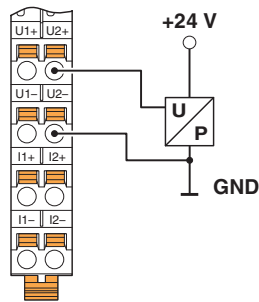


Figure 8    Differential voltage input with active 3-wire transmitter

### 9.2    Analog outputs
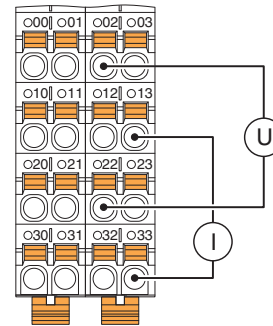


Figure 9    Connection for voltage and current output

## 10    Connection notes

**NOTE: Damage to the electronics/measuring errors**

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

Unshielded cables may lead to values outside the specified tolerance limits in environments subject to heavy noise.

Connect the cable shield to functional earth immediately after the cables enter the control cabinet.

If there is no closed control cabinet, 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.

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

# 11    Local status and diagnostic indicators
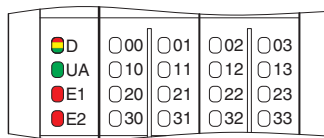


| | |
|---|---|
| **i** | Channel errors are errors that can be associated with a channel.<br>Periphery errors are errors that affect the entire module. |

Figure 10    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.<br>All data is valid. There are no faults. |
| | | Active | Green flashing | The device is ready for operation, communication within the station is OK.<br>The data is **not** valid. Valid data from the controller/higher-level network not available.<br>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.<br>Output data **cannot** be outputted and/or input data **cannot** be read.<br>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. |
| 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 | E1 LED | E2 LED |
|-------|--------|--------|
| No error | OFF | OFF |
| Underrange | OFF | ON |
| Overrange | OFF | ON |
| Open circuit | OFF | ON |
| Faulty supply voltage | ON | ON |
| Parameter table invalid | OFF | ON |
| Device error | OFF | ON |
| Flash format error | OFF | ON |

**i** The error that can actually be reported depends on the measuring range. For additional information please refer to the tables with significant measured values in various formats.

# 12 Process data

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

The measured values are transmitted to the controller board or the computer using process data input words IN1 and IN2.

The output values are transmitted from the controller board or the computer to the module using process data output words OUT1 and OUT2.

| Output value OUT1 | Output value OUT2 |
|-------------------|-------------------|

| Measured value IN1 | Measured value IN2 |
|--------------------|--------------------|

Each channel is mapped to a word.

The output values and measured values are depicted in IB IL, S7-compatible or standardized representation format. For all formats, the measured value is displayed in 16-bit format. The data type is Integer 16 from a technical programming point of view.

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

In IB IL and standardized representation format, a diagnostic code is mapped to the input data in the event of an error:

| Code (hex) | Cause |
|------------|-------|
| 8001 | Measuring range exceeded (overrange) |
| 8002 | Open circuit |
| 8004 | Measured value invalid/no valid measured value available |
| 8010 | Parameter table invalid |
| 8020 | Faulty supply voltage |
| 8040 | Device faulty |
| 8080 | Below measuring range (underrange) |

# 13 Significant values in various formats

## 13.1 Significant values in IB IL format

> [i] The measured values and output values are identical for input and output data, except in the event of overrange or underrange. Therefore, in these special cases, the values for the inputs and outputs are specified in the tables.

| I/O data | | 0 V ... 10 V | ± 10 V | 0 V ... 5 V | ± 5 V | 0 mA ... 20 mA | ± 20 mA | 4 mA ... 20 mA |
|---|---|---|---|---|---|---|---|---|
| hex | dec | V | V | V | V | mA | mA | mA |
| 8001 | Overrange (output) | +10.837 | +10.837 | +5.419 | +5.419 | +21.6764 | +21.6764 | +21.3397 |
| 8001 | Overrange (input) | > +10.837 | > +10.837 | > +5.419 | > +5.419 | > +21.6764 | > +21.6764 | > +21.3397 |
| 7FFF ... 7F01 | | +10.837 | +10.837 | +5.419 | +5.419 | +21.6764 | +21.6764 | +21.3397 |
| 7F00 | 32512 | +10.837 | +10.837 | +5.419 | +5.419 | +21.6764 | +21.6764 | +21.3397 |
| 7530 | 30000 | +10.0 | +10.0 | +5.0 | +5.0 | +20.0 | +20.0 | +20.0 |
| 3A98 | 15000 | +5.0 | +5.0 | +2.5 | +2.5 | +10.0 | +10.0 | +12.0 |
| 0001 | 1 | +333.33 µV | +333.33 µV | +166.67 µV | +166.67 µV | +0.6667 µA | +0.6667 µA | +4.0005333 |
| 0000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +4.0 |
| FFFF | -1 | 0 | -333.33 µV | 0 | -166.67 µV | 0 | -0.6667 µA | +4.0 |
| C568 | -15000 | 0 | -5.0 | 0 | -2.5 | 0 | -10.0 | +4.0 |
| 8AD0 | -30000 | 0 | -10.0 | 0 | -5.0 | 0 | -20.0 | +4.0 |
| 8100 | -32512 | 0 | -10.837 | 0 | -5.419 | 0 | -21.6764 | +4.0 |
| 80FF ... 8000* | (Output) | Hold last value | Hold last value | Hold last value | Hold last value | Hold last value | Hold last value | Hold last value |
| 8080 | Under-range (output) | 0 | -10.837 | 0 | -5.419 | 0 | -21.6764 | Hold last value |
| 8080 | Under-range (input) | 0 | < -10.837 | 0 | < -5.419 | 0 | < -21.6764 | |

\*    without 8001, 8080

The maximum output value or measured value is 7F00$_{hex}$.

Depending on the output range or measuring range, the minimum output value or measured value is 0000$_{hex}$ or 8100$_{hex}$.

## 13.2 Significant values in S7-compatible format

| I/O data | | 0 V ... 10 V | ± 10 V | 0 V ... 5 V | ± 5 V | 0 mA ... 20 mA | ± 20 mA |
|---|---|---|---|---|---|---|---|
| hex | dec | V | V | V | V | mA | mA |
| 7FFF ... 7F00 | Overrange | 0 | 0 | 0 | 0 | 0 | 0 |
| 7EFF | 32511 | +11.7589 | +11.7589 | +5.8800 | +5.8800 | +23.5150 | +23.5150 |
| 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 | +15.0 |
| 0001 | 1 | +361.69 µV | +361.69 µV | +180.845 µV | +180.845 µV | +0.7234 µA | +0.7234 µA |
| 0000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| FFFF | -1 | 0 | -361.69 µV | 0 | -180.845 µV | 0 | -0.7234 µA |
| 9400 | -27648 | 0 | -10.0 | 0 | -5.0 | 0 | -20.0 |
| 8100 | -32512 | 0 | -11.7589 | 0 | -5.8800 | 0 | -23.5157 |
| 80FF ... 8000 | Underrange | 0 | 0 | 0 | 0 | 0 | 0 |

| Output data | | 4 mA ... 20 mA |
|---|---|---|
| hex | dec | mA |
| 7FFF ... 7F00 | Overrange | 0 |
| 7EFF | 32511 | +22.8100 |
| 6C00 | 27648 | +20.0 |
| 5100 | 20736 | +16.0 |
| 0001 | 1 | +4.000578 |
| 0000 | 0 | +4.0 |
| FFFF | -1 | +3.99942 |
| F940 | -1728 | +3.0 |
| E501 | -6911 | 0.578 µA |
| E500 | -6912 | 0 |
| 8100 | -32512 | 0 |
| 80FF ... 8000 | Underrange | 0 |

| Input data | | 4 mA ... 20 mA |
|---|---|---|
| hex | dec | mA |
| 7EFF | 32511 | +22.8100 |
| 6C00 | 27648 | +20.0 |
| 5100 | 20736 | +16.0 |
| 0001 | 1 | +4.000578 |
| 0000 | 0 | +4.0 |
| FFFF | -1 | +3.99942 |
| F940 | -1728 | +3.0 |
| 8000 | Open circuit | <1.1852 |

The maximum output value or measured value is 7EFF$_{hex}$.

Depending on the output range or measuring range, the minimum output value or measured value is 0000$_{hex}$ or 8100$_{hex}$.

### 13.3 Significant values in standardized representation format

> The measured values and output values are identical for input and output data, except in the event of overrange or underrange. Therefore, in these special cases, the values for the inputs and outputs are specified in the tables.

| I/O data | | 0 V ... 10 V | ± 10 V | 0 V ... 5 V | ± 5 V | 0 mA ... 20 mA | ± 20 mA | 4 mA ... 20 mA |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|
| hex | dec | V | V | V | V | mA | mA | mA |
| 8001 | Overrange (output) | +10.837 | +10.837 | +5.419 | +5.419 | +21.674 | +21.674 | +21.339 |
| 8001 | Overrange (input) | > +10.837 | > +10.837 | > +5.419 | > +5.419 | > +21.674 | > +21.674 | > +21.339 |
| 54AA | 21674 | | | | | +21.674 | +21.674 | |
| 4E20 | 20000 | | | | | +20.0 | +20.0 | |
| 43BB | 17339 | | | | | | | 21.339 |
| 2A55 | 10837 | +10.837 | +10.837 | | | | | |
| 2710 | 10000 | +10.0 | +10.0 | | | +10.0 | +10.0 | +14.0 |
| 152B | 5419 | | | +5.419 | +5.419 | | | |
| 1388 | 5000 | +5.0 | +5.0 | +5.0 | +5.0 | +5.0 | +5.0 | +9.0 |
| 0001 | 1 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +4.001 |
| 0000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +4.0 ... +3.2 |
| FFFF | -1 | | -0.001 | | -0.001 | | -0.001 | |
| EC78 | -5000 | | -5.0 | | -5.0 | | -5.0 | |
| EAD5 | -5419 | | | | -5.419 | | | |
| D8F0 | -10000 | | -10.0 | | | | -10.0 | |
| D5AB | -10837 | | -10.837 | | | | | |
| B1E0 | -20000 | | | | | | -20.0 | |
| AB56 | -21674 | | -21.674 | | | | | |
| 8080 | Under-range (output) | | -10.837 | | -5.419 | | -21.674 | |
| 8080 | Under-range (input) | < -10.837 | | < -5.419 | | < -21.6747 | | |

Depending on the output range or measuring range, the maximum output value or measured value is 54AA$_{hex}$, 43BB$_{hex}$ or 152B$_{hex}$.

Depending on the output range or measuring range, the minimum output value or measured value is EAD5$_{hex}$, D5AB$_{hex}$ or AB56$_{hex}$.

## 13.4 Calculation of the measured value from the process data input value

The following examples explain the calculation of the measured value from the process data input value for the measuring range 4 mA to 20 mA.

PD IW = Process data input word = input data

### IB IL format

Resolution = (20 mA - 4 mA) / 30000 = 0.0005333

Measured value = PD-EW x 0.0005333 mA +4 mA

#### Example 1

| | |
|---|---|
| PD IW | $493F_{hex} = 18751_{dec}$ |
| Value x resolution | 18751 x 0.000533 mA = 10 mA |
| + 4 mA | 10 mA + 4 mA = 14 mA |
| Measured value | 14 mA |

### S7-compatible format

Resolution = (20 mA - 4 mA) / 27648 = 0.0005787

Measured value = PD IW x 0.0005787 mA + 4 mA

#### Example 1

| | |
|---|---|
| PD IW | $6C00_{hex} = 27648_{dec}$ |
| Value x resolution | 27648 x 0.0005787 mA = 16 mA |
| + 4 mA | 16 mA + 4 mA = 20 mA |
| Measured value | 20 mA |

#### Example 2

| | |
|---|---|
| PD IW | $F940_{hex}$ -> $FFFF_{hex}$ - $F940_{hex}$ + 1 = $-1728_{dec}$ |
| Value x resolution | -1728 x 0.0005787 mA = -1 mA |
| + 4 mA | -1 mA + 4 mA = 3 mA |
| Measured value | 3 mA |

## 14 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 in bytes |
| R | Read |
| W | Write |

> **i** Every visible string is terminated with a zero terminator ($00_{hex}$). The length of a visible string element is therefore one byte larger than the amount of user data.

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

# 15 Standard objects

## 15.1 Objects for identification (device rating plate)

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Meaning | Contents |
|---|---|---|---|---|---|---|---|---|
| **Manufacturer** | | | | | | | | |
| 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 | 30 | R | Vendor URL | http://www.phoenix-contact.com |
| **Module - general** | | | | | | | | |
| 0004 | DeviceFamily | Var | Visible String | 1 | 20 | R | Device family | I/O analog 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; Basis - Profil V2.0 |
| 003A | VersionCount | Array | Unsigned 16 | 4 | 4 * 2 | R | Version counter | e. g., 0007 0001 0001 0001$_{hex}$ |
| **Module - special** | | | | | | | | |
| 0005 | Capabilities | Var | Visible String | 1 | 8 | R | Features | Energ_0 |
| 0007 | ProductName | Var | Visible String | 1 | 17 | R | Product name | AXL F AI2 AO2 1H |
| 0008 | SerialNo | Var | Visible String | 1 | 11 | R | Serial number | xxxxxxxxxx (e. g., 1234512345) |
| 0009 | ProductText | Var | Visible String | 1 | 36 | R | Product text | 2 input and 2 output analog channels |
| 000A | OrderNumber | Var | Visible String | 1 | 8 | R | Order No. | 2702072 |
| 000B | HardwareVersion | Record | Visible String | 2 | 11; 3 | R | Hardware version | e. g., 2010-06-21; 01 |
| 000C | FirmwareVersion | Record | Visible String | 2 | 11; 6 | R | Firmware version | e. g., 2010-06-21; V1.10 |
| 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 30 00 08 00 00 00 A9$_{hex}$ |
| **Use of the device** | | | | | | | | |
| 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. |

## 15.2 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 |

## 15.3 Object descriptions

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Meaning |
|---|---|---|---|---|---|---|---|
| 0038 | ObjDescrReq | Record | | 2 | 3 | Read, write | Object description request |
| 0039 | ObjDescr | Record | | 16 | See subindices | Read | Object description |

| i | These objects are only important for tools and are therefore not described in more detail here. |
|---|---|
| | Please refer to the basic profile for comprehensive information. |

### 15.4 Diagnostics objects

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Assignment |
|---|---|---|---|---|---|---|---|
| 0018 | DiagState | Record | | 6 | 2; 1; 1; 2; 1; 14 | R | Diagnostic state |
| 0019 | ResetDiag | Var | Unsigned 8 | 1 | 1 | W | Reset diagnostics |

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

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

| 0018$_{hex}$: DiagState (Read) | | | | | |
|---|---|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning | Contents | |
| 0 | Record | 21 | Diagnostic state | Complete diagnostics information | |
| 1 | Unsigned 16 | 2 | Error number | 0 ... 65535$_{dez}$ | |
| 2 | Unsigned 8 | 1 | Priority | 00$_{hex}$ | No error |
| | | | | 01$_{hex}$ | Error |
| | | | | 02$_{hex}$ | Warning |
| | | | | 81$_{hex}$ | Error removed |
| | | | | 82$_{hex}$ | Warning eliminated |
| 3 | Unsigned 8 | 1 | Channel/group/module | 00$_{hex}$ | No error |
| | | | | 01$_{hex}$ | Channel 1 |
| | | | | : | : |
| | | | | 04$_{hex}$ | Channel 4 |
| | | | | FF$_{hex}$ | entire device |
| 4 | Unsigned 16 | 2 | Error code | See table below | |
| 5 | Unsigned 8 | 1 | More follows | 00$_{hex}$ | |
| 6 | Visible String | 14 | Text (14 characters) | See table below | |

> **i** The message with the priority 81$_{hex}$ or 82$_{hex}$ 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 | 6 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Error | Priority | Channel/ group/ module | Error code | Text | Process data | LED | | | | |
| | hex | hex | hex | | | D | UA | E1 | E2 | |
| No error | 00 | 00 | 0000 | Status OK | xxxx | Green ON | ON | OFF | OFF | |
| Short-circuit | 01 | 03 ... 04 | 2130 | Short-circuit | -- | Green ON | ON | OFF | ON | |
| Supply voltage faulty (supply for analog modules U$_A$) | 01 | FF | 5160 | Supply fail | 8020 | Flashing green/yellow | OFF | ON | ON | |
| Device error | 01 | FF | 6301 | CS FLASH | 8040 | Green ON | ON | OFF | ON | |
| Flash format error | 01 | FF | 6302 | FO FLASH | 8040 | Green ON | ON | OFF | ON | |
| Parameter table invalid | 01 | FF | 6320 | Invalid para | 8010 | Green ON | ON | OFF | ON | |
| Open circuit | 01 | 01 ... 04 | 7710 | Open circuit | 8002 | Green ON | ON | OFF | ON | |
| Overrange | 02 | 01 ... 02 | 8910 | Overrange | 8001 | Green ON | ON | OFF | ON | |
| Underrange | 02 | 01 ... 02 | 8920 | Underrange | 8080 | Green ON | ON | OFF | ON | |

**Special notes for the analog outputs**

In the event of errors at the outputs, no process data codes are written to the input data, only a message is generated via the DiagState object.

The following two error messages are supported:

Open circuit: current output, but open terminal blocks

Short circuit: voltage output, but short circuit between the terminal points

An open circuit or short circuit is only indicated when the process data value of the channel is > 512$_{dec}$, corresponding to 1.7% of the output range final value.

### 15.4.2 Reset diagnostic mesages (0019$_{hex}$: ResetDiag)

You can delete the diagnostics memory and acknowledge the diagnostic messages with this object.

| 0019$_{hex}$: ResetDiag (Write) | | | | | |
|---|---|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning | Contents | |
| 0 | Unsigned 8 | 1 | Reset diagnostics | 00$_{hex}$ | All diagnostic messages approved |
| | | | | 02$_{hex}$ | Deletes and acknowledges all pending diagnostic messages that have not been read out |
| | | | | 06$_{hex}$ | Deletes and acknowledges all the diagnostic messages, resets the error counter, and allows no further diagnostic messages |
| | | | | Other | Reserved |

### 15.5 Objects for process data management

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Assignment |
|---|---|---|---|---|---|---|---|
| 0024 | ResetCode | Array | Unsigned 16 | 2 | 2 | R/W | Substitute value behavior when process data is missing |
| 0025 | PDIN | Var | Octet string | 1 | 4 | R | Input process data |
| 0026 | PDOUT | Var | Octet string | 1 | 4 | R/W | Output process data |
| 0027 | GetExRight | Simple variable | Unsigned 8 | 1 | 1 | R/W (access-protected) | Get exclusive process data write rights |
| 002F | PDOUT_Subst | Array | Unsigned 16 | 2 | 2 | R/W | Substitute value for the OUT process data |
| 003B | PDIN_Descr | Record | | 6 | 12 | R | Description of the IN process data |
| 003C | PDOUT_Descr | Record | | 6 | 12 | R | Description of the output process data |

> **i** Objects 003B$_{hex}$ and 003C$_{hex}$ are only applicable to tools and are therefore not described in more detail here.
>
> Please refer to the basic profile for comprehensive information.

### 15.5.1 Substitute value behavior when process data is missing (0024$_{hex}$: ResetCode)

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

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

| 0024$_{hex}$: BusResetCode (Read, write) | | | | | |
|---|---|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning | Contents | Default value |
| 0 | Array | 2 * 2 | Substitute value behavior when process data is missing | | |

| Element | Data type | Length in bytes | Meaning | Contents | Default value |
|---|---|---|---|---|---|
| 1 | Unsigned 16 | 2 | Behavior of channel OUT1 | 0000 ... 0003$_{hex}$ | 0002$_{hex}$ |
| 2 | Unsigned 16 | 2 | Behavior of channel OUT2 | 0000 ... 0003$_{hex}$ | 0002$_{hex}$ |

**Value range:**

| Code (hex) | Behavior |
|---|---|
| 0000 | Output of zero values (0 V/0 mA/4 mA) at output |
| 0001 | Output of final values (10 V/5 V/20 mA) at output |
| 0002 | Hold last value |
| 0003 | Transfer the substitute values from the "Replace output process data" (002F$_{hex}$) object |

**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 | Hold the last values (as with object $0024_{hex}$, code 0002) |

**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).

For error message, see object $0080_{hex}$.

### 15.5.2 IN process data ($0025_{hex}$: 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.

| $0025_{hex}$: PDIN (Read) | | | |
|---|---|---|---|
| **Subindex** | **Data type** | **Length in bytes** | **Meaning** |
| 0 | Octet string | 4 | Input process data |

### 15.5.3 OUT process data ($0026_{hex}$: PDOUT)

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

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

| $0026_{hex}$: PDOUT (Read) | | | |
|---|---|---|---|
| **Subindex** | **Data type** | **Length in bytes** | **Meaning** |
| 0 | Octet string | 4 | Output process data |

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

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

### 15.5.4 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.

| 0027$_{hex}$: GetExRight (read, write) | | | | | |
|---|---|---|---|---|---|
| **Subindex** | **Data type** | **Length in bytes** | **Meaning** | **Contents** | |
| 0 | Simple variable | 1 | Get exclusive process data write rights | 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.

**i**

**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 OUT process data transmitted via the process data channel with the values from object 0026$_{hex}$ PDOUT.
From now, the OUT process data can only be changed using 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.

**15.5.5  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 in the module permanently.

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

| 002F$_{hex}$: PDOUT_Subst (Read, write) | | | |
|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning |
| 0 | Array of Un-signed 16 | 2 * 2 | Replace output process data |

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, IB IL format
0B B8 17 70

**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.

For error message, see object 0080$_{hex}$.

## 15.6 Objects for device management

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Meaning |
|---|---|---|---|---|---|---|---|
| 001D | Password | Simple variable | Octet string | 1 | 9 | W | Password |
| 0029 | ParamSetWrite-Control | Byte | Unsigned 8 | 1 | 1 | R/W | Parameter set write control |
| 002A | ConflictDictionary | Record | | N | 12 | R | Conflict dictionary |
| 002D | ResetParam | Simple variable | Unsigned 8 | 1 | 1 | R/W | Reset parameterization |
| 002E | CheckSum | Simple variable | Unsigned 32 | 1 | 4 | R | Checksum |

### 15.6.1 Password (001D$_{hex}$: Password)

This object can be used to enable protected module functions, e.g., for the GetExRight object.

| 001D$_{hex}$: password (Write) | | | |
|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning |
| 0 | Simple variable | 9 | Password |

### 15.6.2 Parameter record write control (0029$_{hex}$: ParamSetWriteControl)

This object is used to control block parameterization.

| 0029$_{hex}$: ParameterSetWriteControl (read/write) | | | | |
|---|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning | |
| 0 | Unsigned 8 | 1 | Parameter record write control | |
| | | | 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 with 08, 00, 0040$_{hex}$.

The exact cause of the error can be read in object 002A$_{hex}$. The error codes are indicated by object 0080$_{hex}$.

Not all startup objects have to be written.

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$_{hex}$.
- Schreiben Sie das Ersatzwertverhalten beim Ausbleiben von Prozessdaten (ResetCode) auf Objekt 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$_{hex}$.

### 15.6.3  Conflict dictionary (002A<sub>hex</sub>: ConflictDictionary)

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

| 002A$_{hex}$: ConflictDictionary (Read) | | | |
|---|---|---|---|
| **Subindex** | **Data type** | **Length in bytes** | **Meaning** |
| 0 | | 12 | Conflict dictionary |

| Meaning | Length in bytes | Example | |
|---|---|---|---|
| Subslot | 1 | 00 | No subslot |
| Index | 2 | 00 2F | PDOUT_Subst |
| Subindex | 1 | 02 | Substitute value for OUT2 |
| Parameter number | 2 | 0001 | |
| Error code and class | 2 | 0080 | |
| Additional error code | 4 | 0000 0240 | Substitute value for OUT2 outside the limit values |

### 15.6.4  Reset parameterization (002D<sub>hex</sub>: ResetParam)

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

To reset the module value $01_{hex}$ must be transferred during write access. Any other values are not permissible and will be acknowledged with an error.

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

### 15.6.5  Checksum (002E<sub>hex</sub>: Checksum)

The data of the startup objects is verified with this CRC32 checksum.

Checksum for the default setting:        6B F7 35 CF$_{hex}$

# 16    Application objects

| Index (hex) | Object name | Object type | Data type | A | L | Rights | Assignment |
|---|---|---|---|---|---|---|---|
| 0080 | ParaTable | Array | Unsigned 16 | 6 | 6 * 2 | R/W | Parameter table |
| 0082 | Measured Value Float | Array | Record | 2 | 2 * 6 | R | Measured values in the extended float format |
| 0083 | PD Min | Array | Integer 16 | 2 | 2 * 2 | R | Minimum process data value |
| 0084 | PD Max | Array | Integer 16 | 2 | 2 * 2 | R | Maximum process data value |
| 00F1 | StartupObjects | Var | Octet string | 1 | 11 | R | Startup objects |

## 16.1    Parameter table (0080$_{hex}$: ParaTable)

Parameterize the module using this object.

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

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

| 0080$_{hex}$: ParaTable (read, write) | | | | |
|---|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning | Default value |
| 0 | Array of Unsigned 16 | 6 * 2 | Read/write all elements | See subindices |
| 1 | Unsigned 16 | 2 | Parameterization of channel IN1 | 0000$_{hex}$ |
| 2 | Unsigned 16 | 2 | Parameterization of channel IN2 | 0000$_{hex}$ |
| 3 | Unsigned 16 | 2 | Parameterization of channel OUT1 | 0000$_{hex}$ |
| 4 | Unsigned 16 | 2 | Parameterization of channel OUT2 | 0000$_{hex}$ |
| 5 | Unsigned 16 | 2 | Data format | 0000$_{hex}$ |
| 6 | Unsigned 16 | 2 | Reserved | 0000$_{hex}$ |

**Parameterization of channel IN1/2, OUT1/2**

**Parameterization word**

| Parameterization of the analog inputs | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | 0 | 0 | Filter | 0 | 0 | Mean-value | | 0 | 0 | 0 | 0 | Measuring range | | | |

| Parameterization of the analog outputs | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | |

| Filter | Code (bin) | Code (hex) |
|---|---|---|
| **30 Hz (default)** | 0 | 0 |
| 12 kHz | 1 | 1 |

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

| Mean-value | Code (bin) | Code (hex) |
|---|---|---|
| **16-sample (default)** | 00 | 0 |
| No mean-value | 01 | 1 |
| 4-sample | 10 | 2 |
| 32-sample | 11 | 3 |

**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 for-mat | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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

ℹ️ Set all reserved bits to 0.

The validity of the values parameterized in object $0080_{hex}$ (ParaTable) is checked.

If everything is OK, the specifications for object $0024_{hex}$ (ResetCode) and object $002F_{hex}$ (PDOut-Subst) are checked as these depend on the output range and format.

If errors are detected, they are indicated with additional error code $xx40_{hex}$ (collision with other values).

In the case of an invalid parameterization value, a negative write conformation with the error message 08, 00, $xx30_{hex}$ is generated.

The low byte of the additional error code is $30_{hex}$ (value is out of range), the high byte contains the number of the element in question.

Example: ParaTable is completely filled with data (subindex 0) and the entry for channel 2 is invalid.

In this case the error message is 8, 0 with additional error code $0230_{hex}$.

In the case of valid parameters, ParaTable is stored permanently.

Die gespeicherten Daten werden mit einer Prüfsumme gesichert. Nach Spannungszuschalten wird die ParaTable zusammen mit den Ersatzwerten (Objekt $002F_{hex}$) und dem Wert für das Verhalten beim Ausbleiben von Prozessdaten (Objekt $0024_{hex}$) aus dem Flash geladen.

**Error messages:**

| Parameterization error | Code (hex) | Additional code (hex) | Meaning | Corrective |
|---|---|---|---|---|
| Object $0080_{hex}$, subindex = 0, length ≠ 12 bytes | 0605 | 0000 | Inconsistent object attributes | Check the call. |
| Object $0080_{hex}$, subindex ≠ 0, length ≠ 2 bytes | 0605 | 0000 | Inconsistent object attributes | |
| The element contains an invalid value | 0800 | xx30 | A reserved bit was set or a reserved code was used during parameterization xx: number of the element in question 30: value is out of range | Check the parameterization. |
| The ResetCode for channel xx is set to $0003_{hex}$ and the substitute value is outside the process data limit values | 0800 | xx40 | Collision with other values | |
| | 0800 | 0540 | Channel OUT1, substitute value > positive limit value | |
| | 0800 | 1540 | Channel OUT1, substitute value < negative limit value | |
| | 0800 | 2540 | Channel OUT2, substitute value > positive limit value | |
| | 0800 | 3540 | Channel OUT2, substitute value < negative limit value | |

## 16.2 Measured value in extended float format (0082hex: Measured Value Float)

You can read the IN process data in IB IL or S7-compatible format with the 0025hex object.

The 0082hex object is also available.

This object provides the measured value in the highest internal accuracy of the terminal in the float format.

| 0082hex: Measured Value Float (Read) | | | |
|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning |
| 0 | Array of Records | 2 * 6 | Read all elements |
| 1 | Record | 6 | Measured value IN1 |
| 2 | Record | 6 | Measured value IN2 |

**Measured values IN1 and IN2**

| Element | Data type | Length in bytes | Meaning |
|---|---|---|---|
| 1 | Float 32 | 4 | Measured value in float format according to IEEE 754 |
| 2 | Unsigned 8 | 1 | Status |
| 3 | Unsigned 8 | 1 | Unit |

Structure of the float format according to IEEE 754 in the bit representation:

| VEEE EEEE | EMMM MMMM | MMMM MMMM | MMMM MMMM |
|---|---|---|---|

V    1 sign bit, 0: positive, 1: negative
E    8 bits exponent with offset 7Fhex
M    23 bits mantissa

Some example values for conversion from floating point to hexadecimal representation:

| Floating point | Hexadecimal representation |
|---|---|
| 1.0 | 3F 80 00 00 |
| 10.0 | 41 20 00 00 |
| 1.03965528 | 3F 85 13 6D |
| - 1.0 | BF 80 00 00 |

**Extended Float Format**

Extended Float Format is a specially defined format. It consists of the measured value in float format, a status, and a unit.

Status is necessary because the float format defines no patterns providing information on the status of the numerical value.

The status corresponds to the LSB of the diagnostic code in IB IL format (e.g., overrange: status = 01, diagnostic code = 8001hex). If status = 0, the measured value is valid.

| Unit | Code |
|---|---|
| Milliampere (mA) | 39 (27hex) |
| Volt (V) | 58 (3Ahex) |

| Status | Code |
|---|---|
| Measured value is valid | 00hex |
| Measured value is invalid | Other |

### 16.3 Minimum process data value (0083hex: PD Min)

Object 0083hex can be used to read the minimum IN process data values.

The values are initialized after each parameterization. The highest value is assigned for the minimum process data value.

PD Min = 7FFF 7FFFhex

On every analog conversion, the PD Min value is compared with the current measured values and overwritten if necessary.

| 0083hex: PD Min (Read) | | | |
|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning |
| 0 | Array of Integer 16 | 2 * 2 | Read all elements |
| 1 | Integer 16 | 2 | Minimum process data value channel IN1 |
| 2 | Integer 16 | 2 | Minimum process data value channel IN2 |

### 16.4 Maximum process data value (0084hex: PD Max)

Object 0084hex can be used to read the maximum IN process data values.

The values are initialized after each parameterization. The lowest value is assigned for the maximum process data value.

PD Max = 8000 8000hex

On every analog conversion, the PD Max value is compared with the current measured values and overwritten if necessary.

| 0084hex: PD Max (Read) | | | |
|---|---|---|---|
| Subindex | Data type | Length in bytes | Meaning |
| 0 | Array of Integer 16 | 2 * 2 | Read all elements |
| 1 | Integer 16 | 2 | Maximum process data value channel IN1 |
| 2 | Integer 16 | 2 | Maximum process data value channel IN2 |

## 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 the corresponding service packs.
The device description files for other systems are available for download at phoenixcontact.net/products in the download area of the bus coupler used.