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TURCK

excom I/O System for the Non-Ex Area

System description

Contents

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

1 About this manual

This manual describes the setup, functions, components and use of the system and helps you to plan and design the system for its intended purpose.

Read this manual carefully before planning, engineering and commissioning. This will prevent the risk of personal injury and damage to property. Keep this manual safe during the service life of the product. If the product is passed on, hand over this manual as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols used

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.
	**WARNING** WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided.
	**CAUTION** CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.
	**NOTICE** NOTICE indicates a situation which may lead to property damage if not avoided.
	**NOTE** NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.
▶	**CALL TO ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULTS OF ACTION** This symbol denotes relevant results of actions.

1.3 Other documents

Besides this document the following material can be found on the Internet at www.turck.com:

- Integration manuals
- Data sheet
- Quick start guides
- EU declarations of conformity
- Approvals

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

2 Notes on the product

2.1 Product identification

This system description applies to the excom I/O system for the non-Ex area.

2.2 Turck service

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database under www.turck.com contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats.

The contact details of Turck subsidiaries worldwide can be found on p. [▷ 261].

3 For your safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Intended use

The excom system for the non-Ex area is used to exchange and process signals between peripheral devices (actuators or sensors) and the higher-level controller via the fieldbus. The system supports the PROFIBUS-DP fieldbus protocol PROFIBUS and Industrial Ethernet protocols PROFINET, EtherNet/IP as well as Modbus TCP.

The devices may only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 General safety instructions

- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for industrial areas. When used in residential areas, take measures to avoid radio interference.
- Only combine devices for which the technical data is suitable for joint use.
- Faulty repairs may cause device failure resulting in injury to persons and damage to property. Do not interfere with system components or modify them. The devices are not intended for repair. Decommission faulty devices. Observe our return acceptance conditions when returning the device to Turck.

4 System overview

4.1 System setup

excom is an I/O system for the PROFIBUS, PROFINET, EtherNet/IP and Modbus TCP fieldbus systems. The system is based on a module rack with an integrated backplane for the power supply and data transfer of the following system components:

- Gateways for PROFIBUS or multiprotocol gateways for the Ethernet fieldbus protocols PROFINET, EtherNet/IP and Modbus TCP
- Decentralized I/O modules with protection type IP20 for connecting analog and digital field devices
- Temperature modules with protection type IP20 for connecting analog field devices
- Frequency and counter modules with protection type IP20 for connecting analog and digital field devices

The system is powered with an AC voltage by power supply modules. Segment couplers and repeaters are optional elements of the excom system for the non-Ex area.

4.1.1 excom – system components, slots and connections

excom system with PROFIBUS gateways

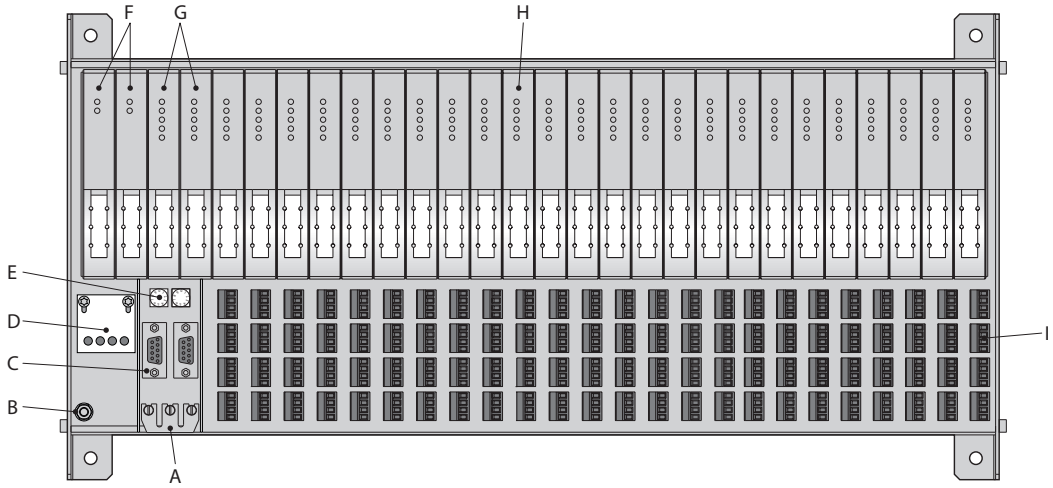


Fig. 1: excom system – PROFIBUS

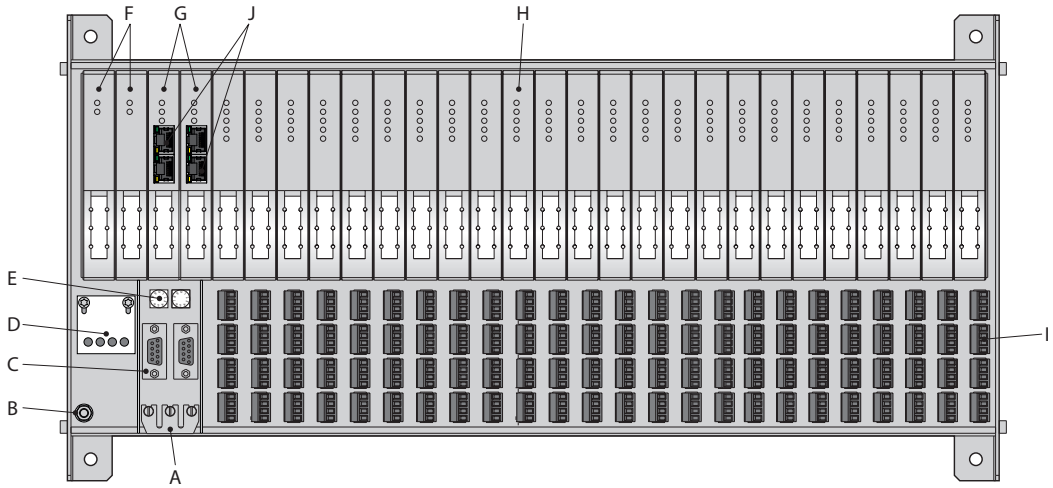


Fig. 2: excom system – Ethernet

Position	Explanation
A	Shield terminals
B	Grounding bolt
C	RS485 connection (PROFIBUS, stays unused with Ethernet connection)
D	Connection for external power supply
E	Rotary switch for setting the PROFIBUS address (stays unused with Ethernet connection)
F	24 VDC power supply modules
G	Gateways (PROFIBUS or Ethernet)
H	I/O modules
I	Connection level for the field devices
J	Ethernet female connectors

4.1.2 excom – I/O system in the system enclosure

Different system enclosures with an integrated excom I/O system are available for protection against dust, dirt, humidity and other environmental influences. Turck offers the excom I/O system including the system enclosure as a standard variant or with accessory equipment according to individual requirements. The customer determines the specific combination of I/O modules used.

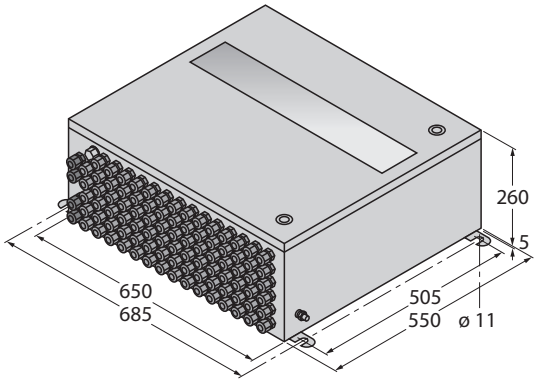
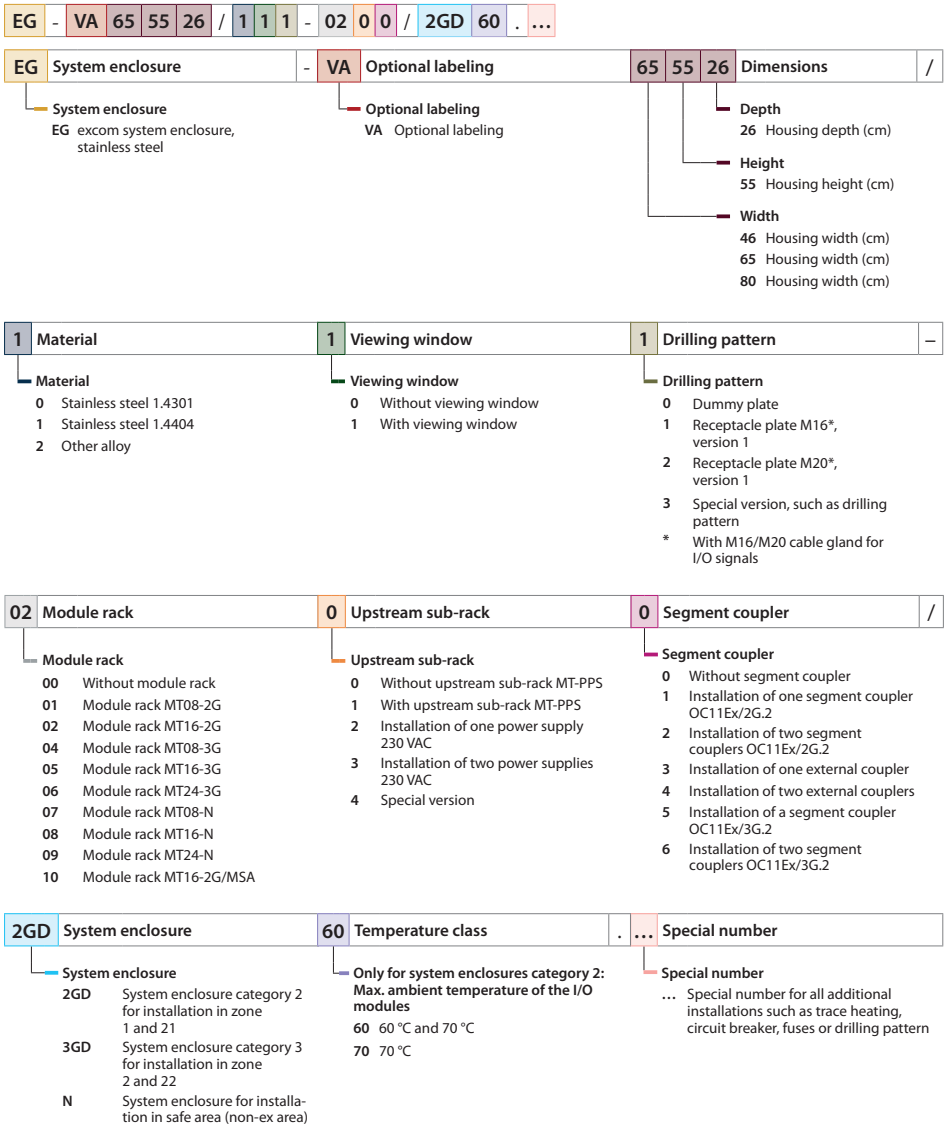


Fig. 3: System enclosure with integrated excom I/O system

The standard variant of the system enclosure with integrated excom I/O system consists of the following standard accessory equipment:

- 1 × module rack
- 2 × power supply modules
- 2 × optocouplers

The following excom system components are available for integration in excom systems in the non-Ex area:



Number of cable glands for I/O signals

Housing width	Version 1
46 cm	66
65 cm	96
80 cm	108

Number of cable glands per flange plate	
4 × M25	Power supply
4 × M20	Fieldbus
1 × M20	Breather-drainer element

Fig. 4: Type code

The user is provided with an Excel template of all system enclosures with an integrated excom I/O system in order to determine the power loss and to check the ambient temperature.

4.2 Operating principle

excom is an I/O system for the PROFIBUS-DP fieldbus protocol and the PROFINET, EtherNet/IP industrial Ethernet protocols, as well as Modbus TCP. Depending on the fitted gateway, the system communicates either via a PROFIBUS cable or via an Ethernet cable. The system is provided with bus-capable, decentralized I/O modules with protection type IP20 for connecting analog and digital field devices. The data traffic between the I/O modules and the field devices is processed via the gateway. The gateway is the slave of the process control system (DCS) at the same time and executes the commands sent from the controller level on the module level. The gateway is thus the master for internal data traffic as well as the device (slave) for the process control system and controls the entire data traffic between the I/O modules and the process control system. In this way, the gateway is able to provide the user with extended fieldbus diagnostics. The fieldbus diagnostics cannot display error messages down to the channel level.

The connection between the excom system and the process control system depends on the fieldbus protocol.

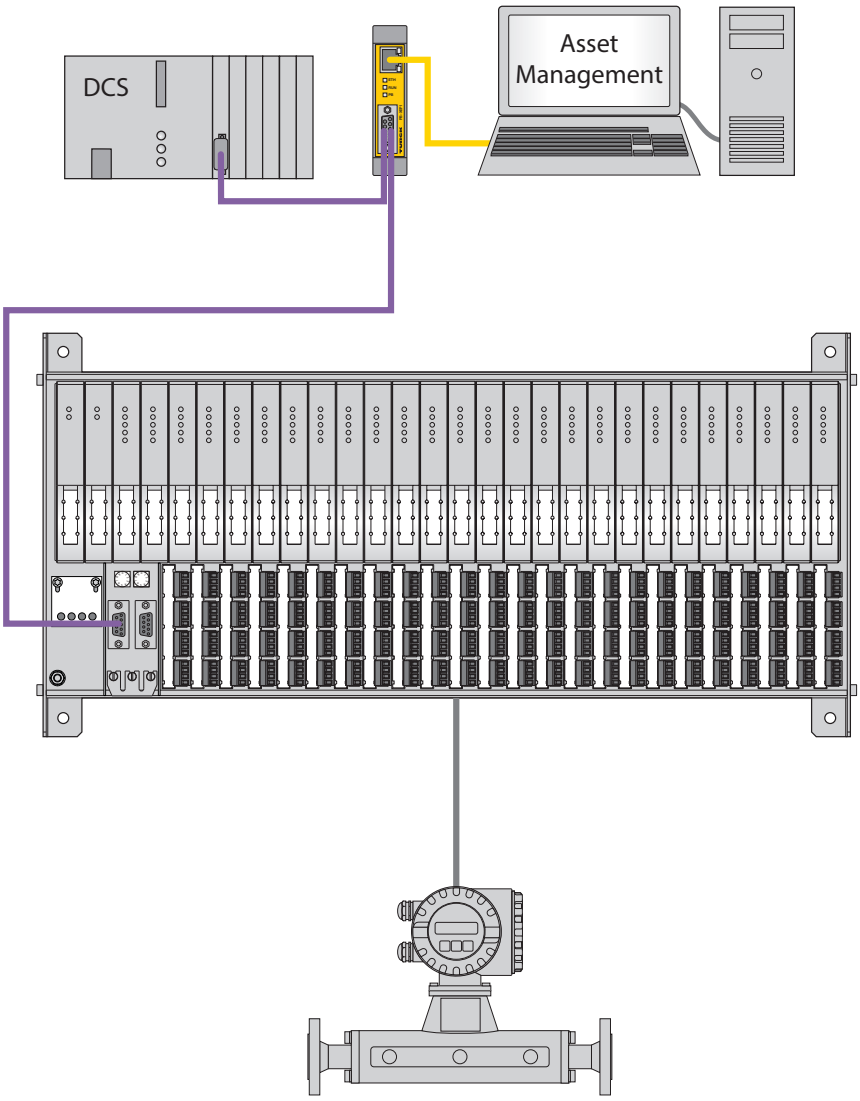


Fig. 5: Connection of an excom station to the process control system (DCS) via PROFIBUS

To connect the excom system to the process control system via PROFIBUS, up to two PROFIBUS cables – starting from the SUB-D female connectors on the rack of the excom system – are connected to the process control system. The asset management system is accessed directly via the controller or via an Ethernet PROFIBUS interface, as shown in the figure above.

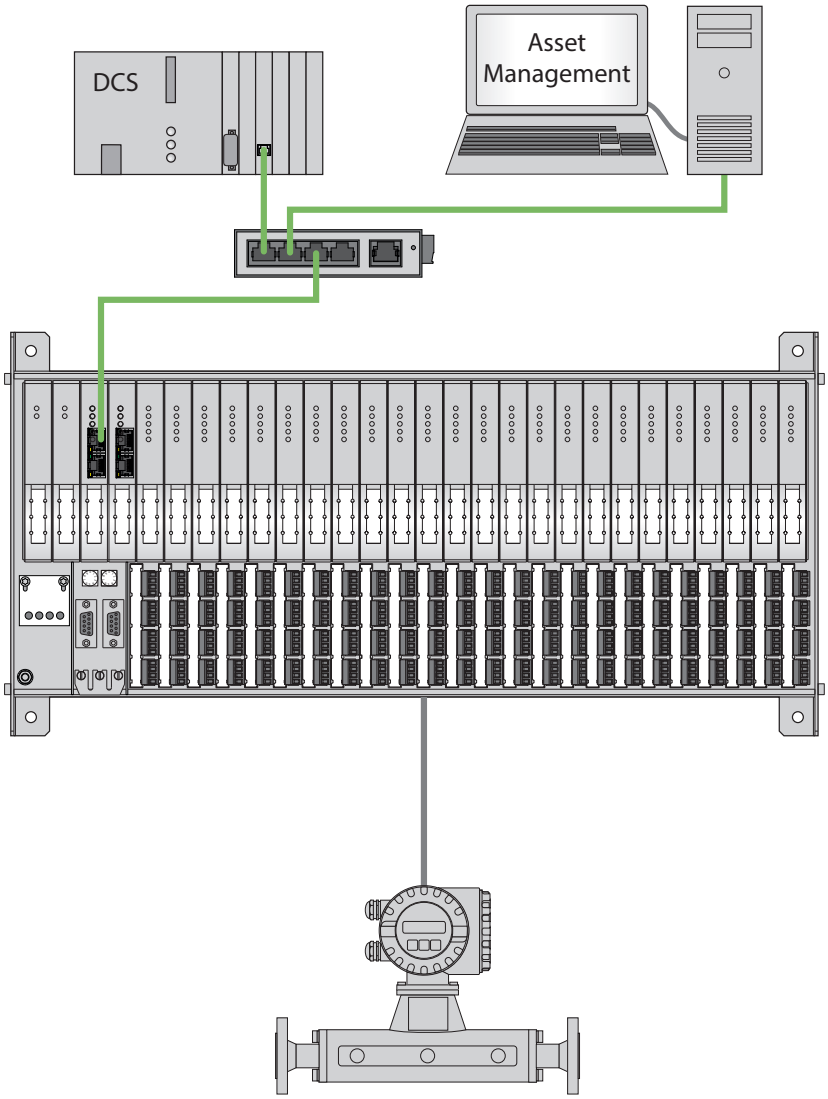


Fig. 6: Connection of an excom station to the process control system (DCS) via Ethernet

The Ethernet connectors on the fitted GEN-N gateway are used to connect the excom system to the process control system via Ethernet. The above figure shows an Ethernet switch between the excom system, process control system and asset management since the excom system can also be connected to the asset management system.

The module racks are each provided with an integrated backplane. The backplane is used for the power supply and for transferring the data of the installed gateways and I/O modules. Depending on their design, different module rack sizes allow the following number of components to be fitted:

- 8 I/O modules (MT08-N)
- 16 I/O modules (MT16-N)
- 24 I/O modules (MT24-N)
- 2 gateways
- 2 power supply modules

Two gateways and two power supply modules (redundancy) increase system availability. If two power supply modules are used, the load is distributed evenly. The power supply modules provide the excom system with the required voltage and galvanic isolation up to 40 V.

4.3 System features

- Different module rack sizes and packing densities
- Hot swapping:
  All I/O modules can be fitted or removed (hot swapped) during operation without disconnecting the power supply. The system checks automatically whether the new module complies with the configuration stored in the control system. If the configuration matches, the individual module channels are assigned parameters by the process control system via the gateway. The module also starts cyclic data exchange with the process control system. The existing data exchange of the remaining system remains undisturbed.
- Hot configuration in run (HCIR):
  The HCIR function enables the user to extend the configuration of the I/O modules or to change the parameters of the module channels during operation. The PROFIBUS communication of the excom station is stopped during the HCIR sequence. All outputs are frozen for the predefined time. Diagnostics messages are not sent during the HCIR sequence. After a configuration is changed successfully, data is transferred to the cyclic bus communication according to the new configuration and the slave continues to operate in normal mode.
- Redundancy:
  The system can be operated redundantly with two gateways (different redundancy concepts for PROFIBUS-DP and Ethernet fieldbus systems) and with two power supply modules, thus increasing the availability of the system.
- HART-compatibility:
  HART-compatible field devices can be connected to the system. Consistent HART communication up to the process control system (DCS) or asset management is possible via the fieldbus system.
- Asset management:
  The following I/O system functions can be managed with the modular excom DTM:
  - Commissioning
  - Parameterization
  - Simulation
  - Diagnostics
  - Identification
  - Configuration

  The individual functions are arranged in the Rack, Module, Channel and Connected device levels in an FDT frame. The hierarchical arrangement makes it possible to click on the individual components and stations selectively in the browser. Field devices with their DTMs can also be configured and parameterized via the HART function.
- Diagnostics:
  LEDs indicate diagnostics and status on the front of each system component. All indications comply with NAMUR NE 107. Detailed diagnostics are provided via the fieldbus.

4.4 Functions and operating modes

4.4.1 HART functions

HART-compatible field devices can be connected to the system. Depending on the field device, consistent HART communication up to the process control system (DCS) or asset management is possible via the fieldbus system.

HART compatibility with I/O modules without a HART controller

- HART compatibility:
  - Connection of HART-compatible sensors to the I/O module
  - Parameterization of the field devices with FSK modem via connection terminals on the module rack
  - Burden already integrated in the module: no additional impedance required

HART compatibility with I/O modules with a HART controller

- HART-compatibility:
  - HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
  - HART field device parameterization via DTM (FDT technology)
  - Transfer of HART data between DCS and HART-compatible field device with extended process information of the field devices (e.g. current position of a control valve)

4.4.2 Redundancy functions

Gateway redundancy (PROFIBUS-DP)

- **Line redundancy**: Only one active master is needed to implement line redundancy. The redundancy is achieved by dividing a fieldbus line into two redundant fieldbus lines close to the fieldbus master. Both gateways are each coupled to a redundant bus line, with one gateway communicating with the master. The second gateway is in standby mode.
- **System redundancy**: With system redundancy, two separate and independent fieldbus masters are connected to an excom station. The two independent fieldbus masters are set to cyclic data exchange via the two gateways of the excom station. The redundant gateways are given identical configurations and parameterizations via the fieldbus master.

Gateway redundancy (Ethernet)

Multiprotocol gateways can be used to set up redundant communication in ring topologies. Automatic support is provided here for PROFINET MRP and EtherNet/IP DLR.

The GEN-N supports the S2 redundancy for PROFINET. Application-specific system redundancy can be used for EtherNet/IP and Modbus TCP.

Power supply module redundancy

The power supply modules are directly connected by plugging them onto the module rack. The power supply modules provide the excom modules and gateways with the required power in this way. In order to prevent a possible power supply failure, two power supply modules are plugged in next each other in the slots provided for them.

All the types of redundancy mentioned are described in greater detail in the chapter “Planning redundancy concepts”.

NOTE
The rated output values of the individual modules must be added up and compared with the rated output of the power supply module for the engineering.
The output of the power supply module is normally sufficient for any combination of I/O modules on each module rack. In exceptional cases, however, the output limit of the power supply module may be exceeded, e.g. in the case of a fully expanded module rack of modules with a high power consumption. The user must therefore check whether the supply output of a power supply module is sufficient or whether a second power supply module is required. The second power supply module in this case is not a redundant power supply module.

4.5 Typical application areas

excom I/O systems can be used in various areas of process automation:

- Food industry
- Pharmaceutical industry
- Chemical industry
- Oil and gas
- Marine industry

5 Planning and preparation

5.1 Overview of all system components

Module rack

Type	ID	Function	Channels	Galvanic isolation
MT08-N	9100689	Module racks for fastening the system components and the AC power supply distribution: ■ Max. 2 gateways ■ Max. 8 I/O modules	Max. 64 binary inputs/ outputs or max. 32 analog inputs/outputs or a combination	–
MT16-N	9100686	Module racks for fastening the system components and the AC power supply distribution: ■ Max. 2 gateways ■ Max. 16 I/O modules	Max. 128 binary inputs/ outputs or max. 64 analog inputs/outputs or a combination	–
MT24-N	9100683	Module racks for fastening the system components and the AC power supply distribution: ■ Max. 2 gateways ■ Max. 24 I/O modules	Max. 192 binary inputs/ outputs or max. 96 analog inputs/outputs or a combination	–

Power supply

Type	ID	Function	Channels	Galvanic isolation
PSM24-N	6881723	Power supply module converting externally fed DC voltage into AC voltage and supplying the excom system (non-Ex) with AC voltage	–	Provided (complete)

Gateways

Type	ID	Function	Channels	Galvanic isolation
GDP-N	6884277	Gateway as the interface between the excom I/O system and the higher-level fieldbus system (PROFIBUS)	–	Provided (complete)
GEN-N	100000129	Gateway as the Ethernet interface between the excom I/O system and the higher-level fieldbus system (multiprotocol)	–	Provided (complete)

Analog input/output modules

Type	ID	Function	Channels	Galvanic isolation
AI40-N	6884215	Analog input module for connecting passive 2-wire transmitters and active 4-wire transmitters	4	Provided (complete)
AI41-N	6884216	Analog input module for connecting active 4-wire transmitters	4	Provided (complete)
AI43-N	6884217	Analog input module for connecting active 3- or 4-wire potentiometers	4	Provided (complete)
AIH40-N	6884219	Analog input module for connecting 2-wire transmitters with HART functionality	4	Galvanic isolation from the power supply and backplane, channels is not provided. The channels are not galvanically isolated from each other.
AIH41-N	6884220	Analog input module for connecting 4-wire transmitters with HART functionality	4	Galvanic isolation from the power supply and backplane, channels is not provided. The channels are not galvanically isolated from each other.
AIH401-N	6884269	Analog input module for connecting active and/or passive 2- or 4-wire transmitters with HART functionality	4	Provided (complete)
AO40-N	6884218	Analog output module for connecting analog field devices	4	Provided (complete)
AOH40-N	6884221	Analog output module for connecting analog field devices with HART functionality	4	Galvanic isolation from the power supply and backplane, channels is not provided. The channels are not galvanically isolated from each other.
AOH401-N	6884270	Analog output module for connecting analog field devices (e.g. control valves or process displays) with HART functionality	4	Provided (complete)

Digital input and output modules

Type	ID	Function	Channels	Galvanic isolation
DM80-N	6884211	Binary input/output module for connecting NAMUR sensors and actuators	8	Galvanic isolation from the power supply and backplane, channels is not provided. The channels are not galvanically isolated from each other.
DI40-N	6884213	Binary input module for connecting up to four sensors according to NAMUR (EN 60947-5-63), 3-wire sensors (NPN, PNP) or mechanical contacts	4	Provided (complete)
DI80-N	6884273	Binary input module for connecting eight 3-wire PNP/ NPN sensors (IEC 61131, Type 3)	8	Inputs are galvanically isolated from each other.
DO40-N	6884214	Binary output module for connecting low-power field devices (e.g. valves or signal transmitters)	4	Provided (complete)
DO60R-N	6884196	Relay module for connecting digital field devices (e.g. valves or signal transmitters)	6	Provided (complete)
DO80-N	6884274	Binary output module for connecting eight 24 VDC field devices (e.g. 0.5 A rated valves or indicator elements)	8	Two output groups are galvanically isolated from each other and from the power supply as well as from the backplane bus.

Temperature and frequency modules

Type	ID	Function	Channels	Galvanic isolation
TI40-N	6884222	Analog input module for connecting 2-, 3- or 4-wire temperature resistors and thermo-couples	4	Provided (complete)
TI41-N	6884223	Analog input module for connecting 2-, 3- or 4-wire temperature resistors	4	Provided (complete)
DF20-N	6884212	Input modules for the pulse counting or frequency measurement of binary pulse sequences	2	Galvanic isolation from the power supply and backplane, channels is not provided. The channels are not galvanically isolated from each other.

Couplers

Type	ID	Function	Channels	Galvanic isolation
OC11 Ex/3G.2	6890428	Fiber optic coupler for signal transmission and conversion to an RS485 signal on fiber optic cable	–	Provided (complete)
SC11-3G	100000548	Segment coupler for the extension of PROFIBUS-DP and Modbus RTU networks with additional regeneration of data telegrams	–	Provided (complete)

5.2 Planning hardware components

NOTE
The following instructions describe the general procedure for planning the hardware components.
Turck plans each project together with the user right from the start and provides the user with all the necessary details during the joint planning.

5.2.1 Selecting I/O modules

- Before specific I/O modules can be selected:
  Identify the type of input and output functions required for the system.
- Before the number of specific I/O modules can be selected:
  Identify the required number for each type of input and output functions.
  From the number required by each type of input and output function, determine the number of corresponding I/O modules.

5.2.2 Planning cable routes

- Define the precise installation locations.
- Identify and evaluate cable routes based on defined installation locations.
- Check whether the determined cable length requires the use of segment couplers (OC11Ex/3G.2) or repeaters (REP-DP 0002). If necessary, define the number of segment couplers and repeaters required (see table for transmission rate and bus cable length).

5.2.3 Defining the baud rate

The PROFIBUS-DP master determines the system's baud rate depending on the cable length. Baud rates from 9.6 kbps…1500 kbps are permissible.

The internal cycle time T_I for the signal processing of a fully developed excom system is with

- digital signals: 5 ms (10 ms with MT24… module rack).
- analog signals: 20 ms (40 ms with MT24… module rack).

The following table shows the maximum cable length of the bus segment depending on the baud rate:

Baud rate in kbps	Bus segment (length of bus cable in m)
9.6	1200
19.2	1200
45.45	1200
93.75	1200
187.5	1000
500	400
1500	200

Further information can be found in the PROFIBUS system description, e.g. the maximum permissible number of repeaters or segment couplers that can be used.

5.2.4 Calculating the cycle time

The cycle times of the higher level bus T_B and the process control system T_{PLS} have to be added to the cycle time of the excom system.

The following generally applies:

$T_R \geq 2 \times (T_I + T_B + T_{PLS})$

T_R = response time

T_I internal cycle time excom (see "Defining the baud rate")

T_B Cycle time of the higher-level bus

T_{PLS} Cycle time of the process control system

5.2.5 Specifying a mounting variant

The location of the system determines the choice of connection and mounting concept.
The following two connection and mounting concepts are possible:

- Installation in the control room
- Installation in the field

▶ Decide whether installation in an enclosure is required according to the intended installation location.
▶ If required: Install in an enclosure to protect against environmental influences (e.g. dust, dirt or moisture).
▶ Select the IP protection type of the enclosure according to the environmental influences.

5.2.6 Carry out a temperature test

The operator must take the operating temperature of the excom system into account to ensure its availability. The following steps refer to installation in a system enclosure.

▶ Determine the maximum possible ambient temperature that can occur at the installation location of the excom I/O system and enter it in table 2.
▶ Select the appropriate temperature range on the nameplate of the system enclosure in the table column T_{amb} in °C.
▶ On the nameplate, select the value of the maximum total permissible power loss $P_{admissible}$ that corresponds to the selected temperature range.
▶ Enter the maximum permissible total power loss $P_{admissible}$ of the modules in table 2.
▶ For each module type: Enter the number of planned modules in table 2, column n_{module}.
▶ For each module type: Multiply the power P_{module} by the number n_{module} and enter the result in table 2, column P_{total}.
▶ Add values of column P_{total} and enter sum $\Sigma (P_{total})$ in table 2.

If $\Sigma (P_{total}) \leq P_{admissible}$: The temperature test has been successful, i.e. the total power loss of the modules is less than or equal to the permissible total loss. The intended modules can be installed.

▶ Include the temperature test in the system documentation.

If $\Sigma (P_{total}) > P_{admissible}$: The temperature test has not been successful, i.e. the maximum total power loss of the modules exceeds the permissible total power loss.

▶ Reduce the number of modules.
▶ Repeat the temperature test.

Table 1

Type Label T_{amb} in °C	$P_{admissible}$ in W
-20…+40	≤ 55
-20…+45	≤ 38
-20…+50	≤ 22
-20…+55	≤ 6

Table 2

P_{total} (T_{amb} ≤ … °C)	P_{module} in W	n_{module}	$P_{total} = P_{module} \times n_{module}$
Module type			**with P_{module} in W**
AI40-N	2.2		
AI41-N	2.0		
AI43-N	1.5		
AIH40-N	3.0		
AIH41-N	1.5		
AIH401-N	3.0		
AO40-N	2.5		
AOH40-N	3.0		
AOH401-N	3.0		
DM80-N	1.0		
DI40-N	2.0		
DI80-N	2.2		
DO40-N	4.5		
DO60R-N	2.0		
DO80-N	3.0		
TI40-N	1.0		
TI41-N	1.0		
DF20-N	1.0		
Σ (P_{total})			
$P_{admissible}$			**… W**

Example of temperature test

Requirements:

- The ambient temperature at the installation location of the excom I/O system must not exceed 48 °C.
- $P_{admissible} \leq 22$ W for T_{amb} -20…+50 °C according to nameplate on housing (see Table 1)
- The temperature test must be performed for $P_{admissible} \leq 22$ W.
- 10 modules are to be installed in the system enclosure.

A successful temperature test is described in table 3: The modules provided achieve a maximum total power loss of 22 W. The temperature test for $P_{admissible}$ (max. 22 W) is therefore successful.

Table 3

P_{total} ($T_{amb} \leq 48$ °C)	**P_{module} in W**	**n_{module}**	**$P_{total} = P_{module} \times n_{module}$**
Module type			**with P_{module} in W**
AI40-N	2.2		
AI41-N	2.0	1	2.0
AI43-N	1.5	1	1.5
AIH40-N	3.0	1	3.0
AIH41-N	1.5		
AIH401-N	3.0		
AO40-N	2.5	1	2.5
AOH40-N	3.0	1	3.0
AOH401-N	3.0		
DM80-N	1.0		
DI40-N	2.0	1	1.9
DI80-N	2.2		
DO40-N	4.5		
DO60R-N	2.0	1	2.0
DO80-N	3.0	1	3.0
TI40-N	1.0	1	1.0
TI41-N	1.0	1	1.0
DF20-N	1.0	1	1.0
Σ (Π_{total})			22.0
$P_{admissible}$			22.0 W

5.2.7 Setting up the system

After all preparatory planning measures have been completed, the system can be set up and tested in advance with PACTware.

5.3 Planning redundancy concepts

Gateway redundancy (PROFIBUS-DP)

Line redundancy

Line redundancy increases availability with little effort and can be implemented with only one active master.

In line redundancy the bus line is split into two redundant bus lines close to the master. The Turck PROFIBUS-DP repeater REP-DP 0002, for example, can be used to decouple the lines.

The excom station must have two gateways for the line redundancy function. Line redundancy is set in the master. The standby gateway monitors the communication of the associated PROFIBUS segment without actively participating in the process data exchange. Each gateway is then connected separately to one of the two redundant bus lines.

The switchover can be initiated both by the master as well as independently via the gateways, e.g. if there is a fault in the PROFIBUS line. If a gateway fails, or the connection to the master is interrupted, the second gateway is automatically activated. This switchover causes a short interruption of the cyclic data exchange.

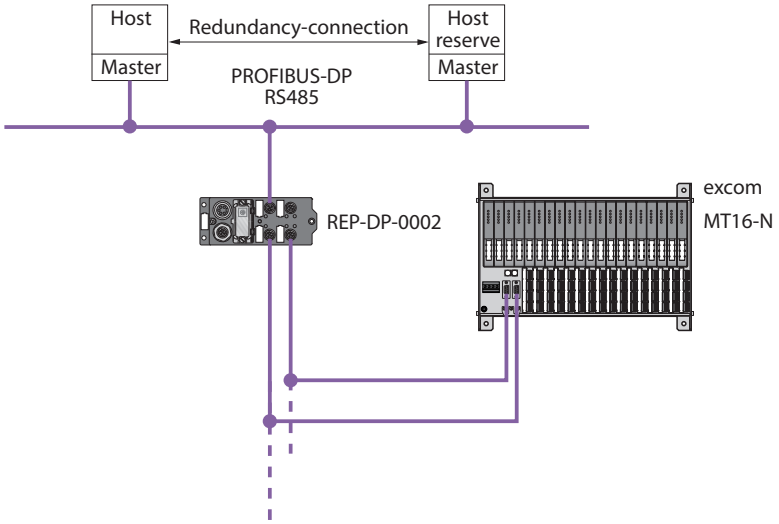


Fig. 7: Line redundancy

System redundancy

System redundancy is achieved by connecting two separate and independent PROFIBUS masters with an excom station. With system redundancy, the excom station has two gateways that are put into cyclic data exchange by their assigned masters. Both masters must configure and parameterize the redundant gateways identically.

One of the two gateways operates as a primary device (slave), the second as a secondary device. The primary device receives the output data transferred by the master and transmits these to the output modules. The primary gateway also forwards the currently valid input values to the master. The secondary gateway ignores the received output data and supplies only the currently valid input values. Both masters always know the current status of the inputs. Both gateways always know the current status of the outputs.

In the event of a switchover, the primary gateway transfers to the secondary gateway the function of being able to send output data to the output modules. With system redundancy, the gateway or the master can trigger a switchover.

Switching via the gateway is automated. If communication is lost on the primary line or by unplugging the primary gateway, the gateway performs a time-controlled automatic switchover (watchdog timeout). If the master forces a switchover, the switchover happens via the cyclic data of the gateway.

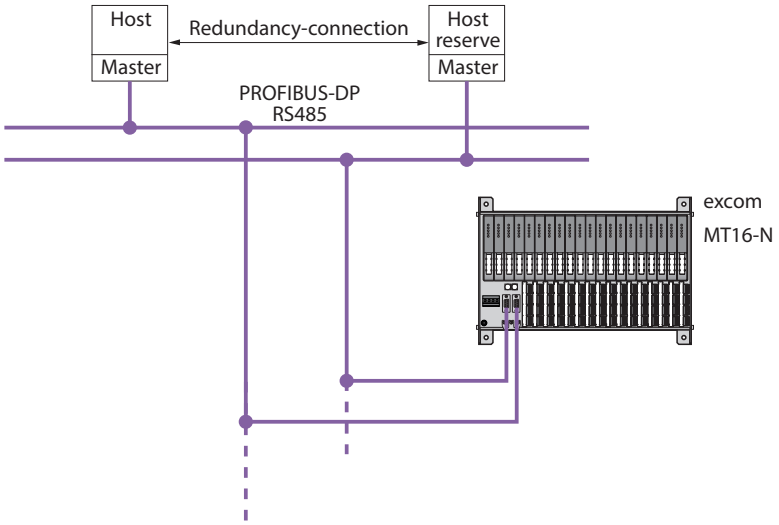


Fig. 8: System redundancy

Gateway redundancy (Ethernet)

Multiprotocol gateways can be used to establish redundant communication in ring topologies. The following protocols are suitable for checking the functionality of the ring topologies:

- Device level ring (DLR):
  Device level ring (DLR) is used to increase the availability of EtherNet/IP networks. DLR-compatible products have an integrated switch and can thus be integrated into a ring topology. The DLR protocol is used to detect a break in the ring. In the event of a data line interruption, there is a bumpless switchover to communication on the remaining active line. DLR supervisor network nodes are equipped with advanced diagnostic functions that locate a point of failure, thus speeding up troubleshooting and maintenance work. The excom gateways act in DLR as participants without a supervisor function.
- Media redundancy protocol (MRP):
  MRP is a standardized protocol acc. to IEC 62439. The protocol describes a mechanism for media redundancy in ring topologies. The Media Redundancy Manager (MRM) checks the correct functioning of the ring structure of a PROFINET network specified in the configuration. The excom system acts as a Media Redundancy Client (MRC). For more information about MRP on PROFINET, visit the PROFIBUS User Organization website at **www.profibus.com**.

Power supply module redundancy

The power supply modules are directly connected by plugging them onto the module rack. In this way, the power supply modules provide the excom modules and gateways with the required power.

Two power supply modules are plugged in next to each other in the slots provided for them in order to prevent a possible power supply failure. Redundant power supply modules provide an equal power supply to the plugged modules.

NOTE
The rated output values of the modules must be added up and compared with the rated output of the power supply module for the engineering. The output supplied is normally sufficient for any combination of I/O modules on each station.
In exceptional cases, however, the output limit of the power supply module may be exceeded, e.g. in the event of a fully expanded module rack of modules with a high power consumption. The second power supply module in this case is not a redundant power supply module. The user must therefore check whether the power supply output of just one power supply module is sufficient.

5.4 Implement shielding and grounding concepts (PROFIBUS-DP)

NOTE
For a grounding concept, observe the relevant local requirements.

5.4.1 Direct grounding on both sides

- Connect the connection at the supplying device and at the excom station to the ground potential - ground directly on both sides.
- An additional equipotential bonding cable must be connected in order to prevent equalizing currents across the cable shield.
- Use equipotential bonding cables with a wire cross section of ≥ 6 mm².
- In order to keep the shield area small, lay the equipotential bonding cable parallel to the fieldbus cable.
- The shield of the PROFIBUS cable must also be connected to the connector body inside the PROFIBUS-DP connector.
- Route the shield and equipotential bonding cable separately from the control room.

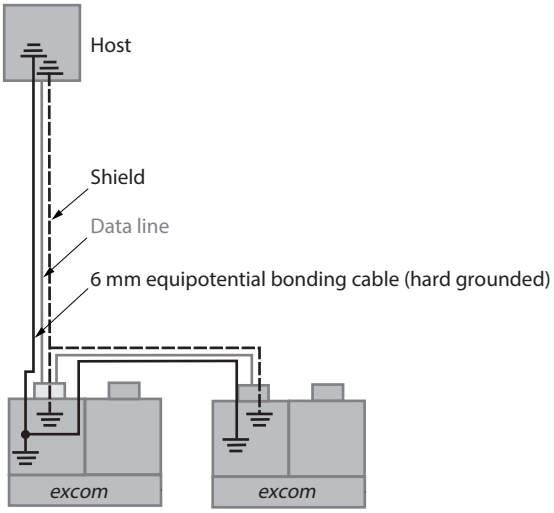


Fig. 9: Direct grounding on both sides

- If the equipotential bonding cable is to be omitted: Check whether the shielding concept with direct grounding on one side at the feeding device is suitable for the overall concept.

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5.4.2 Direct grounding at the feeding device

- Ground the connection at the feeding device directly with the ground potential.
- Capacitively ground the connections of all segment participants. An equipotential bonding cable routed parallel to the fieldbus is not required, since no compensating currents can flow.
- The shield of the PROFIBUS cable must also be connected to the connector body inside the PROFIBUS-DP connector.

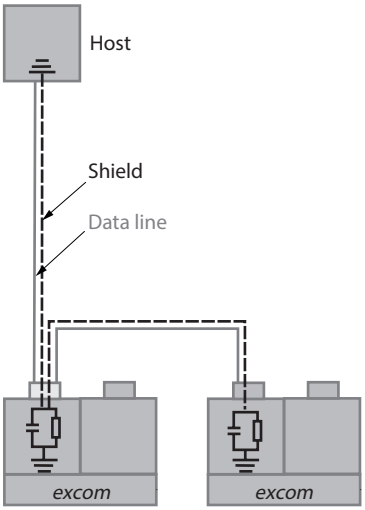

Fig. 10: Direct grounding at the feeding device

6 System components

6.1 MT08-N, MT16-N, MT24-N module racks

6.1.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with compatible components for the non-Ex area.

The module rack with an integrated backplane is used for the mounting and power supply of the system components as well as for data transfer between the field level, the I/O system level and the higher-level controller, the process control system (DCS).

6.1.2 Device overview

Module rack – MT08-N

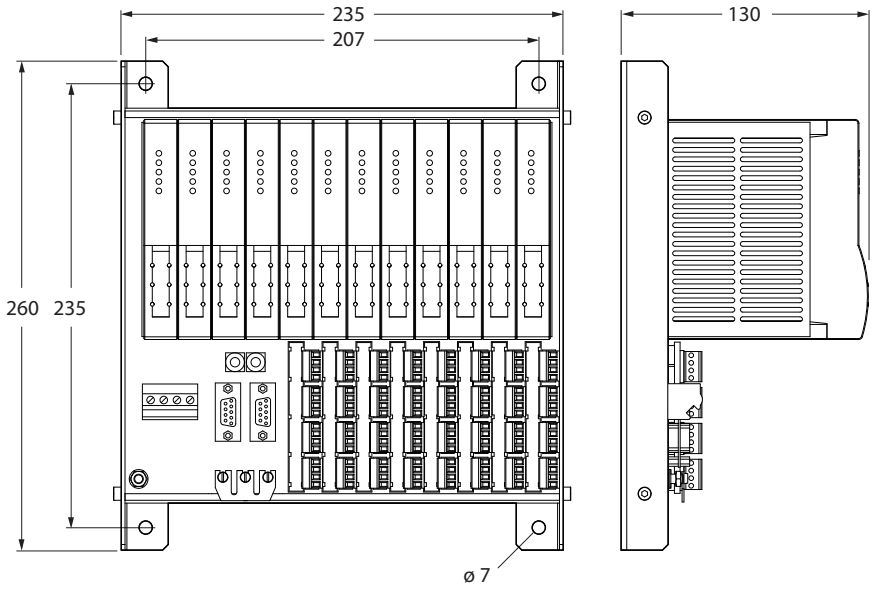

Fig. 11: Setup and dimensions

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Module rack – MT16-N

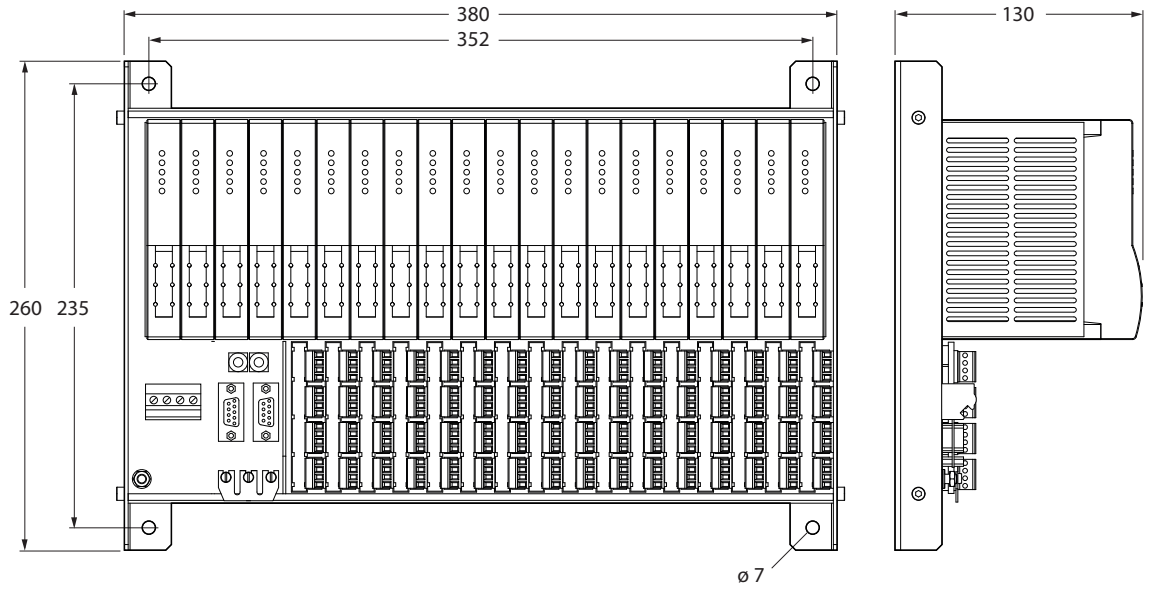

Fig. 12: Setup and dimensions

Module rack – MT24-N

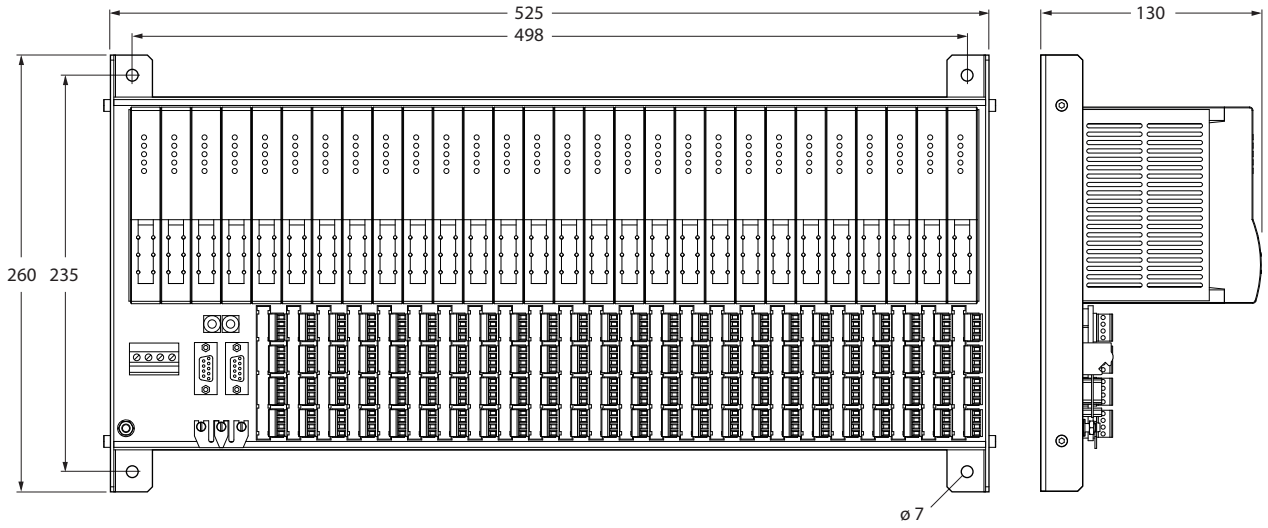

Fig. 13: Setup and dimensions

6.1.3 Properties and features

Module rack types

MT08-N	MT16-N	MT24-N
■ 24 VDC power supply ■ Max. 2 power supply modules ■ Max. 2 gateways ■ Max. 8 I/O modules ■ Max. 64 binary inputs/outputs or max. 32 analog inputs/outputs or a combination	■ 24 VDC power supply ■ Max. 2 power supply modules ■ Max. 2 gateways ■ Max. 16 I/O modules ■ Max. 128 binary inputs/outputs or max. 64 analog inputs/outputs or a combination	■ 24 VDC power supply ■ Max. 2 power supply modules ■ Max. 2 gateways ■ Max. 24 I/O modules ■ Max. 192 binary inputs/outputs or max. 96 analog inputs/outputs or a combination

6.1.4 Functions and operating modes

The connected I/O modules are fed with power via the backplane. The data traffic between the I/O modules and the gateways is processed via the internal backplane bus.

6.1.5 Installing

The module racks are suitable for mounting on mounting plates or support systems.

- ▶ Only mount the device via the drill holes provided (Ø 7 mm) with M6 screws or M6 bolts.
- ▶ Mounting in a stainless steel enclosure (EG-VA…): Use type GM306 sliding nuts, type GS406 threaded pins and M6 nuts in accordance with DIN 934.

DANGER
Electrical charge on the device
Danger of electric shock

- ▶ Before replacing or dismounting individual parts that are not connected by plug fitting on the module rack: isolate equipment.
- ▶ Only use approved original Turck parts.

6.1.6 Connection

Connecting an external power supply

▶ Connect the device as shown in the “Wiring diagrams”.

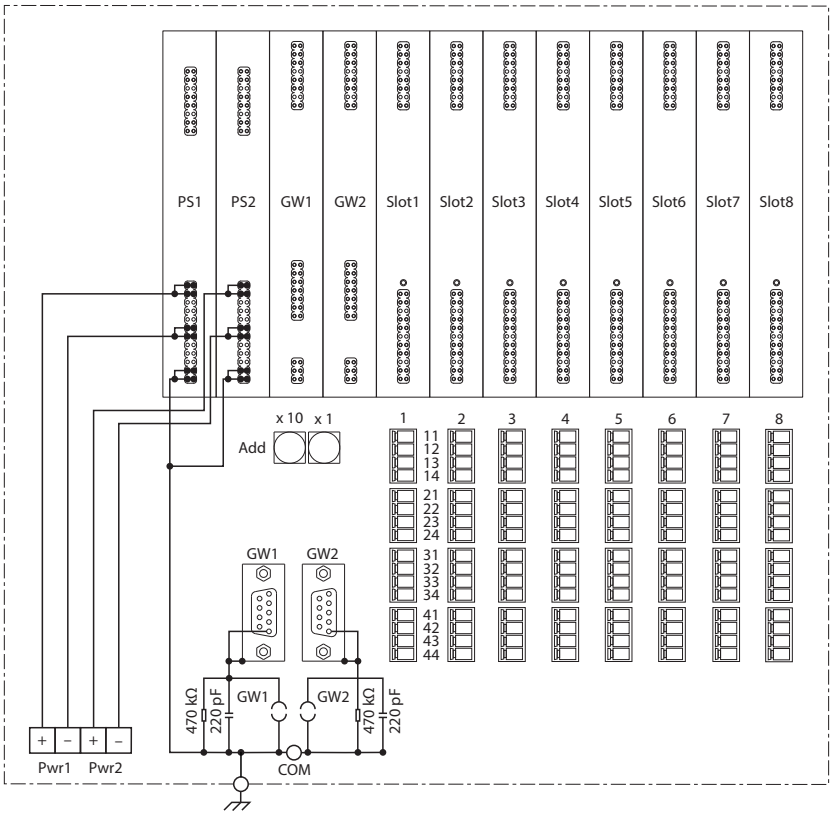

Fig. 14: Wiring diagram – MT08-N

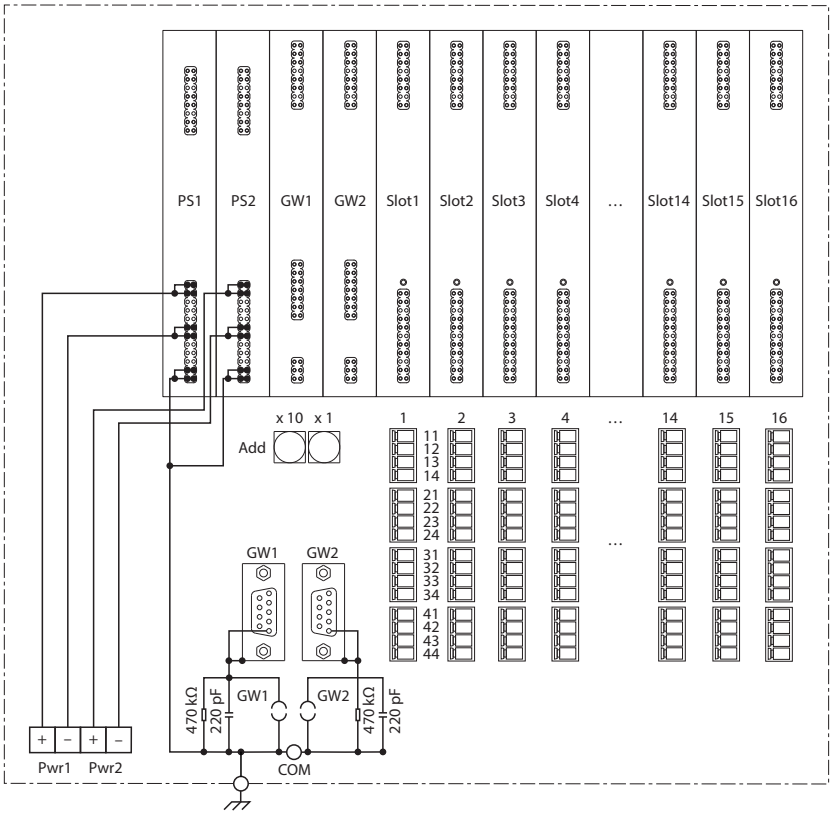

Fig. 15: Wiring diagram – MT16-N

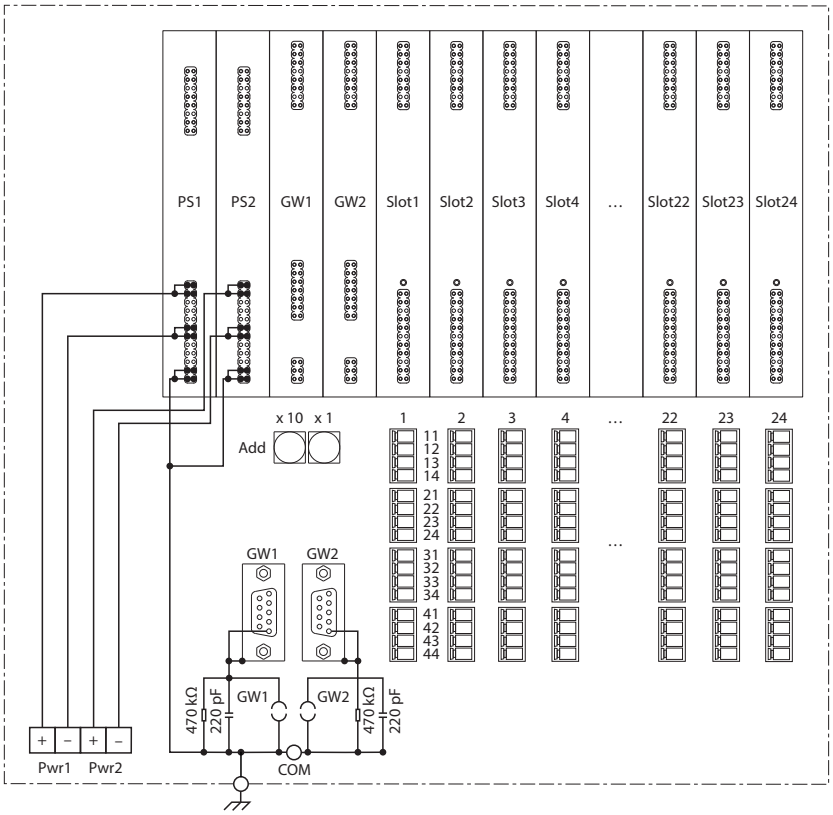

Fig. 16: Wiring diagram – MT24-N

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- ▶ Connect the external power supply to the terminals provided on the module rack.

Power is fed to the 24 V power supply modules via the module rack.

NOTE
If required (e.g. with long cable runs), Turck offers system solutions with 230/115 VAC.

Connecting PROFIBUS

- ▶ When using two gateways (redundancy), connect PROFIBUS lines to the excom station via two 9-pin SUB-D female connectors.

The assignment complies with the PROFIBUS-DP standard.

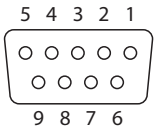

Fig. 17: SUB-D female connector – pin assignment

Assignment of SUB-D pins

Pin no.	RS485	Meaning
1	n. c.	Not connected
2	n. c.	Not connected
3	RxD/TxD-P	Receive data/send data B line (red)
4	n. c.	Not connected
5	DGND	Bus termination GND
6	DP	Bus termination DP
7	n. c.	Not connected
8	RxD/TxD-N	Receive data/send data of A line (green)
9	n. c.	Not connected

Ground shield of the fieldbus line via the module rack

The excom module rack connects the shield connection of the RS485 line to ground via an integrated R/C combination. A bridge for shorting the R/C combination can be installed if required. On delivery, park position B of the bridge is located on the left fixing bracket.

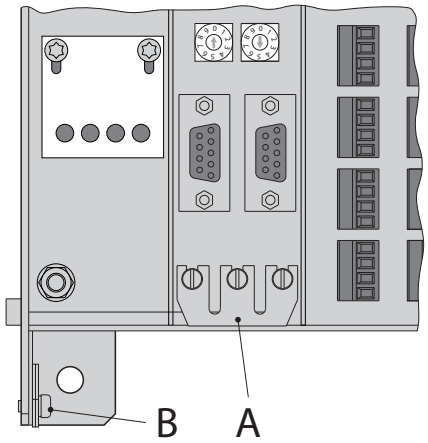

Fig. 18: Shield connection and park position of the bridge

- Protect RS485 fieldbus lines from interference by using a suitable shielding and grounding concept (see “Implementing shielding and grounding concepts (PROFIBUS)”).

Ground the module rack directly on both sides:

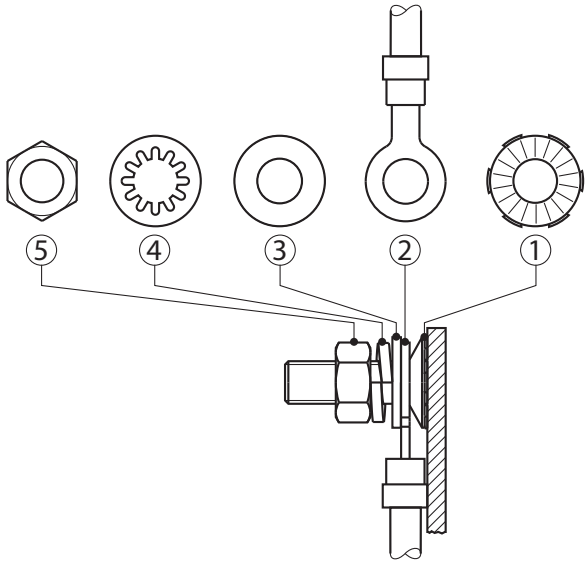

Fig. 19: Fitting the connection bolt

- Ground the shield of the fieldbus line directly via the center screw of the bridge (see Fig. “Shield connection and park position of the bridge” – position “A”).
- Connect the PA equipotential bonding conductor to the ground terminal bolt. The min. cable cross section is 4 mm^2. The order of fitting the connection bolt is shown in the figure above.

6.1.7 Setting

Setting the PROFIBUS address

A station in a PROFIBUS-DP network is identified by a bus address. The station in this case is the excom station. The excom station is assigned its bus address by a manual setting on the module rack.

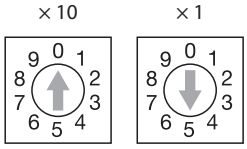

Fig. 20: Setting a fieldbus address

- Set a PROFIBUS-DP address with the rotary switches on the module rack.
- A maximum of 01 to 99 addresses (99 stations) can be assigned.
- Bus address 00 is not used.

The switches represent the digits of the network address. The figure above shows an example of the setting of the network address “05”.

Coding module rack slots

The user has the option of coding the module rack via mechanical coding pins. The coding on the module rack ensures that a module can only be exchanged with a module of the same type. Coding is carried out with hexagonal coding pins. The coding is implemented with hexagonal coding pins that are inserted in the appropriate recesses on the module rack. Each slot has four recesses, two of which can be used for coding the module. The other two recesses are used for coding the type (Ex module: left; non-Ex module: right). Each module has two hard coded pins for module coding when delivered.

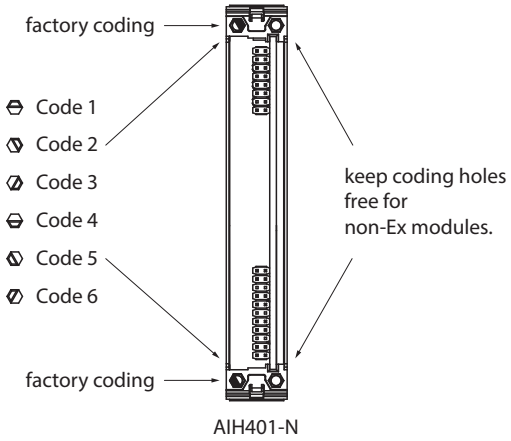

Fig. 21: Example coding AIH401-N – rear view with coding position

System components	Factory coding of the modules on delivery (left)	Coding on the module rack to be carried out by the user if required
GDP-N	1 1	4 4
AI40-N	1 5	4 2
AI41-N	2 4	5 1
AI43-N	3 5	6 2
AIH40-N	2 5	5 2
AIH41-N	3 4	6 1
AIH401-N	2 5	5 2
AO40-N	1 2	4 5
AOH40-N	3 2	6 5
AOH401-N	3 2	6 5
DM80-N	1 3	4 6
DI40-N	2 3	5 6
DI80-N	5 3	2 6
DO40-N	2 2	5 5
DO60R-N	4 2	2 2
DO80-N	5 2	2 5
PSM24-N	6 6	3 3
TI40-N	1 4	4 1
TI41-N	4 4	1 1
DF20-N F/P	1 3	4 6

6.1.8 Technical data

Type code	MT08-N
ID	9100689
Slots	
DC power supply module	2
Gateway	2
I/O modules	8
I/O module connection cross-section	1.5 mm^2
Power supply connection cross-section	Rigid: 4.0 mm^2
	Flexible: 2.5 mm^2
Bus connection	2 × 9-pin SUB-D
Bus address	2 × decimal coded rotary switch
Housing material	Aluminum profile
Fixing type	Mounting plate
Type of protection	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to NAMUR NE21 acc. to EN 61326-1
Dimensions	235 × 260 × 130 mm

Type code	MT16-N
ID	9100686
Slots	
DC power supply module	2
Gateway	2
I/O modules	16
I/O module connection cross-section	1.5 mm^2
Power supply connection cross-section	Rigid: 4.0 mm^2
	Flexible: 2.5 mm^2
Bus connection	2 × 9-pin SUB-D
Bus address	2 × decimal coded rotary switch
Housing material	Aluminum profile
Fixing type	Mounting plate
Type of protection	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to NAMUR NE21 acc. to EN 61326-1
Dimensions	380 × 260 × 130 mm

Type code	MT24-N
ID	9100683
Slots	
DC power supply module	2
Gateway	2
I/O modules	24
I/O module connection cross-section	1.5 mm^2
Power supply connection cross-section	Rigid: 4.0 mm^2
	Flexible: 2.5 mm^2
Bus connection	2 × 9-pin SUB-D
Bus address	2 × decimal coded rotary switch
Housing material	Aluminum profile
Fixing type	Mounting plate
Type of protection	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	1211 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions	525 × 260 × 130 mm

6.2 PSM24-N power supply module

6.2.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The power supply module is used for the power supply of the excom I/O system with AC voltage.

6.2.2 Device overview

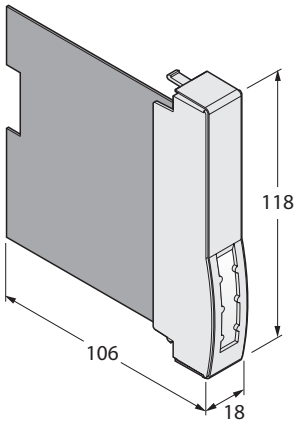

Fig. 22: Dimensions

6.2.3 Properties and features

- 24 VDC power supply
- Connections of the external power supply via terminals on the module rack
- Knurled screws prevent the unintentional pulling out of the power supply modules under power and mechanical release of the power supply
- Full galvanic isolation

6.2.4 Functions and operating modes

Supplying the excom system with power

The power supply module requires a 24 VDC power supply and feeds all connected excom modules with AC voltage. The power supply modules can be operated individually or redundantly.

Supplying the excom system redundantly with power

In redundancy mode, the load is divided between both power supply modules. If one device fails or the power supply is interrupted, the intact device takes over the power supply of the entire system. Different power sources can be used for the supply. One PSM24-N power supply module is sufficient for the proper operation of the excom system. Redundant power supply modules increase availability.

NOTE
The rated output values of the modules must be added up and compared with the rated output of the power supply module for the engineering. The output supplied is normally sufficient for any combination of I/O modules on each station.
In exceptional cases, however, the output limit of the power supply module may be exceeded, e.g. in the event of a fully expanded module rack of modules with a high power consumption. The second power supply module in this case is not a redundant power supply module. The user must therefore check whether the power supply output of just one power supply module is sufficient.

6.2.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.2.6 Connection

- ▶ If an external power supply is not yet connected to the module rack: Connect the power supply to the module rack.

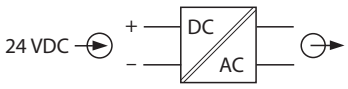

Fig. 23: Wiring diagram – PSM24-N

- ▶ Connect the external power supply to the module rack with terminals.
- ▶ Make sure that the power supply module clicks into place.
- ▶ If the power supply module clicks into place: fully tighten the knurled screws underneath the module.
- ⇨ The power supply is enabled.

In redundant operation, 24 VDC power supply modules can be replaced under power.

▶ If redundancy is required, connect two power supply modules.

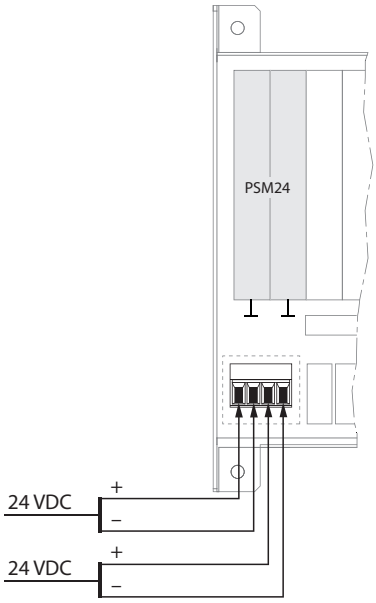

Fig. 24: Connecting redundant power supply modules

▶ Connect each power supply module to a separate supply line.

6.2.7 LED indications

LED	Indication	Meaning
PWR	Green	Ready for operation
	Off	No power supply
ERR	Red	Error
	Off	Error-free

6.2.8 Technical data

Type code	PSM24-N
ID	6881723
Power supply	
Rated voltage	24 VDC
Supply voltage range	19.2…32 VDC
Power consumption	≤ 66.5 W
Output power	≤ 60 W
Galvanic isolation	Safe between input and output circuit, rated voltage 40 V
LEDs	
Operational readiness	1 × green
Status/error	1 × red
Terminal cross-section	Rigid: 4.0 mm^2
	Flexible: 2.5 mm^2
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	61 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.3 Gateway GDP-N

6.3.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The gateway forms the interface between the excom I/O system and the higher-level PROFIBUS-DP fieldbus system. The gateway may be configured for a maximum transmission rate of 1500 kbps. The gateways (2 × GDP-N/FW2.3) support line redundancy and system redundancy.

The excom system can be connected to any host system containing a class 1 PROFIBUS DP master and operated via the interface to PROFIBUS-DP acc. to IEC 61158.

6.3.2 Device overview

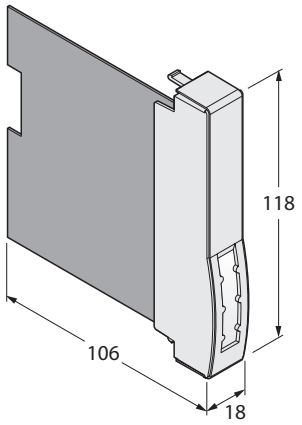

Fig. 25: Dimensions

6.3.3 Properties and features

- Gateway for PROFIBUS-DP communication
- PROFIBUS interface for connecting the higher-level fieldbus master and the excom station according to the PROFIBUS user organization (PNO)
- Baud rate: max. 1.5 Mbps
- Diagnostic scope: Channel-based diagnostics and diagnosis of manufacturer-specific errors
- Availability of different redundancy concepts
- Full galvanic isolation

6.3.4 Functions and operating modes

The gateway connects the excom modules to the PROFIBUS-DP fieldbus system. The gateway handles all process data traffic and generates diagnostic information for the higher-level control system. The gateway also transfers manufacturer-specific error codes.

The PROFIBUS-DP standards ensure the correct cyclic data exchange between master and excom, correct configuration and parameterization, and the correct display of diagnostic messages. The DPV1 extensions are implemented in excom in order to process acyclic data via PROFIBUS-DP.

The GSD files fully define the behaviors of excom on PROFIBUS-DP and store the configuration and parameters of the individual modules.

To increase availability, two gateways can be used redundantly.

NOTE

▶ Only redundantly operate gateways with the same hardware and firmware status.

Redundancy types

The different types of redundancy can be selected in the control system via the gateway parameters. Different parameter settings must be made depending on the selected redundancy type.

- **Line redundancy:** Only one active master is required for line redundancy. The redundancy is achieved by dividing a fieldbus line into two redundant fieldbus lines close to the fieldbus master. A gateway is connected to each one of the two bus lines. The “Redundancy mode“ parameter in the gateway is set at the “Line redundancy” value. The “Address offset” parameter is also set to “on”. A value is also defined under the “Offset value” parameter, e.g. in a system all active stations with an even bus address (2, 4, 6, 8, …16, …) and all passive stations with an odd bus address (3, 5, 7, 9 , …17, …) can be set. To do this, set the “Offset value” to “1”. The active gateway is then assigned the address “2” and the redundant gateway the address “3”. This virtual address enables the redundant gateway to recognize its readiness for communication without actively participating in the process data exchange. Besides the variant described above, it is also possible, for example, to set the offset to “64”. All redundant stations then have an address above 64.
  When selecting the offset, make sure
  - when using several excom stations that all have the same offset value.
  - the virtual address (base address + offset) is not occupied by configured PROFIBUS stations.
  - the virtual address is lower than the HSA (Highest Station Address) set at the master.

- **System redundancy:** With system redundancy, two separate and independent fieldbus masters are connected to an excom station. The two independent fieldbus masters activate cyclic data exchange on the two gateways of the excom station. Both fieldbus masters must configure and parameterize the redundant gateways identically. The Redundancy mode gateway parameter must be set for System redundancy. System redundancy involves the use of two separate fieldbus systems.
  Identical PROFIBUS addresses are assigned to the redundant gateways. The gateway with address “2” has a redundant partner with the same address. The cyclic data of the gateway in the “GDP-… C” configuration is used to monitor and control both line and system redundancy.

All the stated types of redundancy are described in more detail in chapter “Planning redundancy concepts”.

6.3.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.3.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication.

- ▶ Connect the device as shown in the "Wiring diagram".

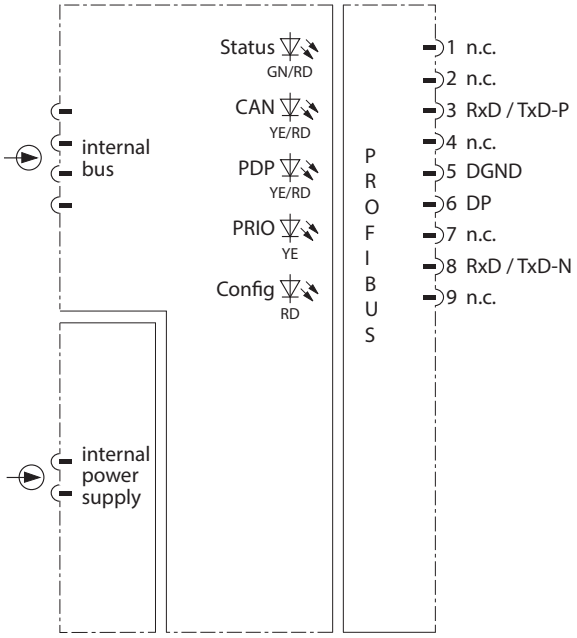

Fig. 26: Wiring diagram – GDP-N

Connecting the gateway to higher-level systems

The excom system can be connected to any host system with a PROFIBUS-DP master class 1 via its interface to PROFIBUS-DP according to EN 61158.

A standard SUB-D connector on the module rack serves to connect the fieldbus.

- ▶ Connect the device to the fieldbus with copper cables.
- ▶ Use an FO coupler pair (see "FO coupler OC11Ex/3G.2").
- ▶ Use repeaters (REP-DP 0002).

6.3.7 Setting

The devices are set via the controller level. The configuration files are available free of charge for download from www.turck.com. A configuration change and parameterization during operation is possible with hot configuration in run (HCIR) compatible host systems.

Configuration via GSD files

The GDP-N gateway can be configured using GSD files. The GSD files are available in German and English. The GSD files are provided with two variants. The difference between the two GSD file variants is the support and therefore also the use of DPV1-specific functions and keywords, such as those used in the implementation of PNO redundancy.

Depending on the gateway entry (configuration) used in the network configurator of the controller software, the gateway can be provided with additional status information on the states of the respective gateways. These additional functions are identified by the additions “C” (cyclic data) or “YO” (control data for Yokogawa redundancy) after the product name.

GDP-… C: The gateway provides input and output data in this configuration. The input data and the output data are used as status and control registers of the gateway. This status information indicates which of the two gateways is currently active and which one is passive. If a gateway fails, this status information can be recorded and the neighboring gateway can also be activated as a measure via the output data word.

GDP-…YO: Settings are activated that are required for the use of Yokogawa redundancy (with ALP 111). The gateway provides input and output data in this configuration. The input data and the output data are used as status and control registers of the gateway. This status information indicates during redundancy operation which of the two gateways is currently active and which one is passive. If a gateway fails, this status information can be recorded and the neighboring gateway can also be activated as a measure via the output data word.

The following configurations are possible:

Gateway designation in the GSD file “T…FF9F”	Data exchange	Input data	Output data
GDP-…		0	0
GDP-… C	Cyclic data	1 word	1 word
GDP-… YO	Cyclic data	1 bytes	1 bytes

Configuration with a DTM

A DTM is available for configuration via an FDT frame. The modules are displayed in an optimized user interface. The parameters entered are checked for plausibility. The resulting data model (I/O image) is transferred to the engineering tool. The user interface also supplies information online on the status of the I/O level and the overall system. The following FDT frames support the configuration by DTM:

- ABB Freelance
- ABB Melody
- Schneider Foxboro

Parameters – GDP

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Network frequency	**50 Hz** 60 Hz	Choose filter: Either a 50 Hz filter or a 60 Hz filter can be selected in order to suppress superimposed power supply interference with analog signals.
Analog data format	**Status MSB** Status LSB No status	Define status bit position: The status bit of an analog input channel can be mapped into the process input data of the channel and the position (MSB or LSB) can be defined. ■ Status MSB: Status bit at bit position 2^{15} ■ Status LSB: Status bit at 2^{0} ■ No status: Measured value without status bit
Module rack	MT08 **MT16** MT24	Select the module rack used: ■ MT08 (8 I/O modules) ■ MT16 (16 I/O modules) ■ MT24 (24 I/O modules)
Redundancy mode	**Off** Line redundancy System redundancy	Select redundancy type: ■ Gateway without redundancy function ■ Line redundancy ■ System redundancy
Power supply module	**Simple** Redundant	Select diagnostics Simple: Both power supply modules feed the excom station with voltage, however, status information on the redundant supply is not output. Redundant: Both power supply modules feed the excom station with voltage and station information on the redundant supply.
HCIR active	**Off** On	Enable online configuration This bit must be set by the PROFIBUS master before the HCIR sequence is started. Nothing changes at the outputs during the HCIR sequence. After the HCIR sequence is completed, the outputs are set to the current state of the process values.
HCIR WCBC factor	**Base × 1** Base × 16	Choose the factor for generating the maximum switching time between old and new configuration
HCIR WCBC base (× 100 ms)	0…63 (default: **5**)	Define the base of the switching time
Address offset	**Off** On	Activate or deactivate the address offsets with line redundancy
Offset value	0…124 (default: 0)	Select address offsets to generate a virtual address for the redundant gateway (default value: 0, must be at least 1)
CAN redundancy	Off **On**	Activate or deactivate internal communication redundancy (gateway module communication)
SF2/ SF3		Reserved
The following parameter only applies to the gateway configuration with a suffix “C” (cyclic data) or “YO” (control data for Yokogawa redundancy) of ALP111.		
Cyclic data		The default value of this parameter is “0“ and must not be changed.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	SF1 0: Selection 0 1: Selection 1	Module rack 00: not used 01: MT8 (8 I/O modules) **10: MT16** **(16 I/O modules)** 11: MT24 (24 I/O modules)		Analog data format **00: Status MSB** 01: Status LSB 10: No status 11: PNO profile		Network frequency **0: 50 Hz** 1: 60 Hz	Prm. mode **01: mode** (parameter mode: set by the GSD file as a constant parameter)	
1	2	SF2 00: Selection 0 01: Selection 1 10: Selection 2 11: Selection 3		Reserved 00		Power supply module **0: Single** 1: Redundant	SF 3 0: Selection 0 1: Selection 1	Redundancy mode **00: Off** 01: Line redundancy 11: System redundancy	
2	3	Address offset **0: Off** 1: On	Address offset value **0**…124						
3	4	HCIR active **0: Off** 1: On	HCIR WCBC factor **0: Base × 1** 1: Base × 16	HCIR WCBC base (× 100 ms) **0** …63 (5)					

6.3.8 LED indications

LED	**Indication**	**Meaning**
Status	Green	Ready for operation
	Off	No power supply
CAN	Yellow	Internal communication error-free
	Red	No communication via the backplane possible
PDP	Yellow flashing	Invalid PROFIBUS-DP address (000)
	Red	No data exchange with PROFIBUS-DP master
	Yellow	Data exchange with PROFIBUS-DP master
PRIO (redundancy status)	Off	Gateway passive
	Yellow	Gateway active
	Yellow flashing	Redundant gateway missing, different firmware detected
Config	Off	Configuration error-free
	Flashing red	Configuration error (missing or incorrectly fitted modules)

6.3.9 Bit assignment of the input word

The status of the current gateway is stored in the input word. If line redundancy is configured, only the active gateway sends its status information.
The passive gateway communicates via FDL telegrams whether it participates in fieldbus communication or not. With system redundancy, both gateways send their status to their respective PROFIBUS master.

Assignment of the status bits

	Bit							
Status bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not used			Left power supply module	Right power supply module	Gateway redundancy	Gateway slot	Redundancy status
1	Not used							

Meaning of the status bits

Designation	**Meaning**
Left power supply module	0: Left power supply module failed
	1: Left power supply module error-free
Right power supply module	0: Right power supply module failed
	1: Right power supply module error-free
Gateway redundancy	0: Redundant gateway not available
	1: Redundant gateway available
Gateway slot	0: Right slot
	1: Left slot
Redundancy status	0: Passive
	1: Active

Redundancy switchover

Bits 0…2 control the redundancy switchover. The redundancy switchover only responds if bits 0 and 1 change their status from 11 to 01 or from 11 to 10. Bit 2 defines the response to an edge change.

If Bit 2 = 0, a redundancy switchover is initiated irrespective of the position of the gateways.

If Bit 2 = 1, the left or the right gateway is activated selectively. Bit 2 can be used statically. Bit 2 = 1 is re-evaluated with each edge change.

Bit assignment of the command bits

	Bit							
Status bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not used					See “Meaning of the command bits”		
1	Not used							

Meaning of the command bits

Behavior Bit 2	Behavior Bit 0 and 1
Redundancy switchover is initiated (Bit 2 = 0)	11→ 01 : The receiver is the passive gateway. The passive gateway requests control from the active gateway and becomes active.
	11 → 10 : The receiver is the active gateway. The active gateway gives control to the passive gateway and becomes passive.
Activation of the right or left gateway (Bit 2 = 1)	11 → 01 : The receiver is the left gateway. The left gateway requests control from the right gateway and becomes active.
	11 → 10 : The receiver is the right gateway. The right gateway requests control from the left gateway and becomes active.

6.3.10 PROFIBUS: diagnostic information

The gateway supplies manufacturer-specific error codes via slot 0 and channel 0.

Error code	No.	Meaning
Specific	16	ROM error
	17	RAM error
	18	EEPROM error
	19	Startup after cold start
	20	Different configuration (with redundancy)
	21	Different firmware (with redundancy)
	22	Malfunction of internal bus (CAN error)
	23	Malfunction of internal bus (passive) (CAN error)
	24	Error in power supply module 1
	25	Error in power supply module 2
	26	Startup after watchdog reset
	27	Redundancy switchover executed
	28	Redundant gateway missing
	29	Redundant gateway not ready
	30	Redundant gateway has an error
	31	Redundant gateway does not have PROFIBUS-DP communication

6.3.11 Technical data

Type code	GDP-N
ID	6884277
Power supply	Via the module rack, central power supply module
Power consumption	≤ 1 W
Galvanic isolation	Complete galvanic isolation
Baud rate	9.6 kbps to 1.5 Mbps
Address range	1…99
LEDs	
Operational readiness	1 × green/red
Int. communication (CAN)	1 × yellow/red
Ext. communication (PDP)	1 × yellow/red
Redundancy readiness (PRIO)	1 × yellow/red
Error message	1 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	144 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.4 Gateway GEN-N

6.4.1 Intended use

The gateway forms the interface between the excom I/O system and the higher-level fieldbus system. Multiprotocol gateways support the Industrial Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP. The devices are suitable for the implementation of redundant communication. A ring master enables gateways to be networked in a ring topology.

6.4.2 Device overview

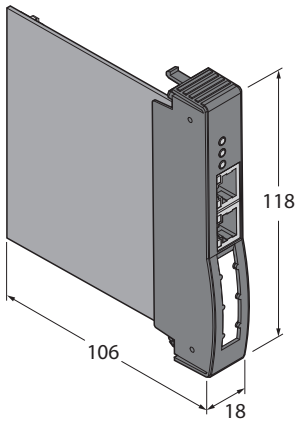

Fig. 27: Dimensions

6.4.3 Properties and features

- Supports Industrial Ethernet protocols PROFINET, EtherNet/IP and Modbus TCP
- Baud rate: 10/100 Mbps
- Half/full duplex
- Autonegotiation
- Autocrossing
- Diagnostic scope: Channel, module and system specific errors
- Full galvanic isolation

6.4.4 Functions and operating modes

The gateway connects the excom modules to the Ethernet fieldbus system. The gateway handles all process data traffic and generates diagnostic information for the higher-level control system. The device also transfers manufacturer-specific error codes.

The gateway features an integrated Ethernet switch that can be used to implement ring topologies via DLR (Device Level Ring) and MRP (Media Redundancy Protocol). The gateway supports 10/100 Mbps, full/half duplex, autonegotiation and autocrossing.

6.4.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.4.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication.

Two Ethernet ports are provided for connection to the fieldbus.

- ▶ Use RJ45 connectors with integrated status LEDs for the fieldbus connection.
- ▶ Connect the device as shown in the "Wiring diagram".

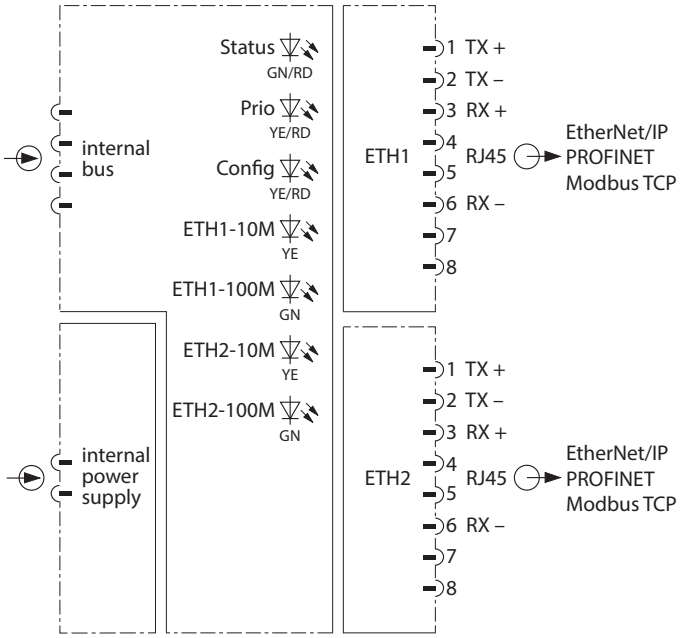

Fig. 28: Wiring diagram – GEN-N

- ▶ Retain the specified assignment when autocrossing is switched off.

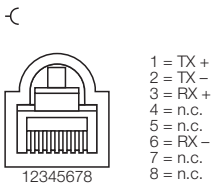

Fig. 29: Pin assignment – Ethernet male connector

6.4.7 LED indications

LED	Indication	Meaning
Status	Off	No power supply
	Green	Ready for operation
	Red	Memory error
	Flashing red	No or faulty communication via the internal CAN bus
	Red/green alternate flashing	Wink command active Service mode active: Firmware update loading
PRIO (redundancy status)	Off	Gateway passive
	Yellow	Gateway active
	Yellow flashing	Deviating firmware version on redundant gateway
Config	Off	No configuration
	Yellow	Configuration and master communication error-free
	Yellow flashing	Configuration error (missing or incorrectly fitted modules)
	Red	IP address conflict or no IP address set
	Flashing red	Gateway ready for operation, no communication with master active
	Yellow/red alternate flashing	Autonegotiation and/or GEN-N wait/waits for IP address allocation in DHCP mode
10M	Off	No Ethernet connection (10 Mbps)
	Yellow	Ethernet connection (10 Mbps)
	Yellow flashing	Data transfer (10 Mbps)
100M	Off	No Ethernet connection (100 Mbps)
	Green	Ethernet connection (100 Mbps)
	Green flashing	Data transfer (100 Mbps)

6.4.8 Setting

The device can be configured and parameterized via the control level with an FDT frame or web server.
Configuration files for setting the system can be obtained from www.turck.com. Parameterization during operation is possible with HCIR compatible host systems.

Configuration files

The following configuration files are available for the GEN-N gateway:

- EDS (EtherNet/IP): English
- GSDML (PROFINET): German, English

Parameter overview – GEN-N

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Grid	**50 Hz** 60 Hz	Choose filter: Either a 50 Hz filter or a 60 Hz filter can be selected in order to suppress superimposed power supply interference with analog signals.
Analog data format	**Status MSB** Status LSB No status	Define status bit position: The status bit of an analog input channel can be mapped into the process input data of the channel and the position (MSB or LSB) can be defined. ■ Status MSB: Status bit at bit position 2^{15} ■ Status LSB: Status bit at 2^{0} ■ No status: Measured value without status bit
Redundancy mode	**Off** Line redundancy System redundancy	Select redundancy type: ■ Gateway without redundancy function ■ Line redundancy ■ System redundancy
Power supply module	**Single** Redundant	Select diagnostics Simple: Both power supply modules feed the excom station with voltage, however, status information on the redundant supply is not output. Redundant: Both power supply modules feed the excom station with voltage and station information on the redundant supply.
CAN redundancy	Off **On**	Activate or deactivate internal communication redundancy (gateway module communication)

6.4.9 Bit assignment of the input word

Status information of the respective gateway can be queried via the input word. The status information can be used for redundancy concepts, for example.

Assignment of the status bits

	Bit							
Status bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not used			Left power supply module	Right power supply module	Gateway redundancy	Gateway slot	Redundancy status
1	Not used							

Meaning of the status bits

Designation	Meaning
Left power supply module	0: Left power supply module failed
	1: Left power supply module error-free
Right power supply module	0: Right power supply module failed
	1: Right power supply module error-free
Gateway redundancy	0: Redundant gateway not available
	1: Redundant gateway available
Gateway slot	0: Right slot
	1: Left slot
Redundancy status	0: Passive
	1: Active

Redundancy switchover

Bits 0…2 control the redundancy switchover. The redundancy switchover only responds if bits 0 and 1 change their status from 11 to 01 or from 11 to 10. Bit 2 defines the response to an edge change.

If Bit 2 = 0, a redundancy switchover is initiated irrespective of the position of the gateways.

If Bit 2 = 1, the left or the right gateway is activated selectively. Bit 2 can be used statically. Bit 2 = 1 is re-evaluated with each edge change.

Bit assignment of the command bits

	Bit							
Status bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not used					See “Meaning of the command bits”		
1	Not used							

Meaning of the command bits

Behavior Bit 2	**Behavior Bit 0 and 1**
Redundancy switchover is initiated (Bit 2 = 0)	11→ 01 : The receiver is the passive gateway. The passive gateway requests control from the active gateway and becomes active.
	11 → 10 : The receiver is the active gateway. The active gateway gives control to the passive gateway and becomes passive.
Activation of the right or left gateway (Bit 2 = 1)	11 → 01 : The receiver is the left gateway. The left gateway requests control from the right gateway and becomes active.
	11 → 10 : The receiver is the right gateway. The right gateway requests control from the left gateway and becomes active.

6.4.10 Technical data

Type code	GEN-N
ID	100000129
Power supply	Via the module rack, central power supply module
Power consumption	≤ 1.5 W
Galvanic isolation	Complete galvanic isolation
Ethernet connection technology	2 × RJ45, female connector
Protocol detection	Automatic
Baud rate	10/100 Mbps, full/half duplex, autonegotiation and autocrossing
Web server	DHCP, 192.168.1.254 (fallback)
LEDs	
Operational readiness	1 × green/red
Redundancy readiness (PRIO)	1 × yellow/red
Configuration	1 × yellow/red
Baud rate detection	2 × yellow, 2 × green
EtherNet/IP	
Addressing	As per EtherNet/IP specification
Device Level Ring (DLR)	Supported
Class 1 connections (CIP)	24
Input assembly instance	107
Output assembly instance	104
Configuration assembly instance	106
PROFINET	
Addressing	DCP
Conformity class	B (RT)
MinCycleTime	1 ms
Diagnostics	According to PROFINET Alarm Handling
Topology detection	Supported
Automatic addressing	Supported
Media redundancy protocol (MRP)	Supported
Modbus TCP	
Addressing	Static IP, BOOTP, DHCP
Supported function codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of TCP connections	8
Amout of input data (PAE)	Max. 1024 registers
Input register start address	0 (0x0000)
Amount of output data (PAA)	Max. 1024 registers
Output register start address	2048 (0x0800)
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack

Type code	GEN-N
Protection type	IP20
Ambient temperature	-20…+70 °C
Storage temperature	-40…+85 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	58 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.5 AI40-N analog input module

6.5.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel AI40-N analog input module is used to connect passive 2-wire transmitters and active 4-wire transmitters.

6.5.2 Device overview

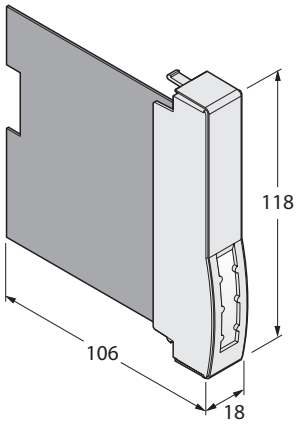

Fig. 30: Dimensions

6.5.3 Properties and features

- Four channels
- Connection of 2-wire or 4-wire transmitters
- Measuring range acc. to NAMUR specification
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus
- HART compatibility (no HART variables):
  - Connection of HART-compatible sensors to the I/O module
  - Parameterization of the field devices with HART modem via connection terminals on the module rack
  - Burden already integrated in the module: no additional impedance required

6.5.4 Functions and operating modes

The module converts an analog input signal of 0…21 mA to a digital value of 0…21000 digits. This corresponds to a resolution of 1 µA per digit.

HART-compatible field devices and sensors can be connected to the module. The user can parameterize the relevant field device directly via the connection terminals on the module rack via a HART modem. An additional impedance is not required since the corresponding burden is already integrated in the module.

Operating modes

The user can select from three operating modes. A separate operating mode can be used for each channel as the channels are galvanically isolated from each other.

No separate configuration is required to distinguish the three operating mode. The module is configured in the configuration tool of the process control system via the entry “AI40-N…”.

Operating mode I (active input):

In operating mode I, the particular channel of the module supplies the power supply for the field device via terminals 11 and 12 (n1 - n2). The particular current consumption of the device corresponds to the physical process value and is represented within the set measuring range with an analog value from 4…20 mA. A value above 21 mA initiates a diagnostic message for an overflow of the measuring range and a value below 3.6 mA an underflow. The measuring range must be set to 0…20 mA in order to send an underflow signal.

Operating mode II (passive input):

In operating mode II, the respective channel does not supply the supply voltage for the field device. The power supply must be connected separately to the field device. The field device supplies an analog value of 0/4…20 mA via terminals 13 and 14 (n3 - n4), which corresponds to the physical process value within the set measuring range. A value above 21 mA initiates a diagnostic message for an overflow of the measuring range and a value below 3.6 mA an underflow.

Operating mode III (active input with additional auxiliary power):

Operating mode III is suitable for applications in which the 2-wire field device does not receive the required operating voltage via the power supply. In this case, an auxiliary power supply can be connected in series. The series connection of field device and auxiliary power acts like an active device and is connected to terminals 13 and 14 (n3 - n4).

6.5.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.5.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- Connect the device as shown in the "Wiring diagram".

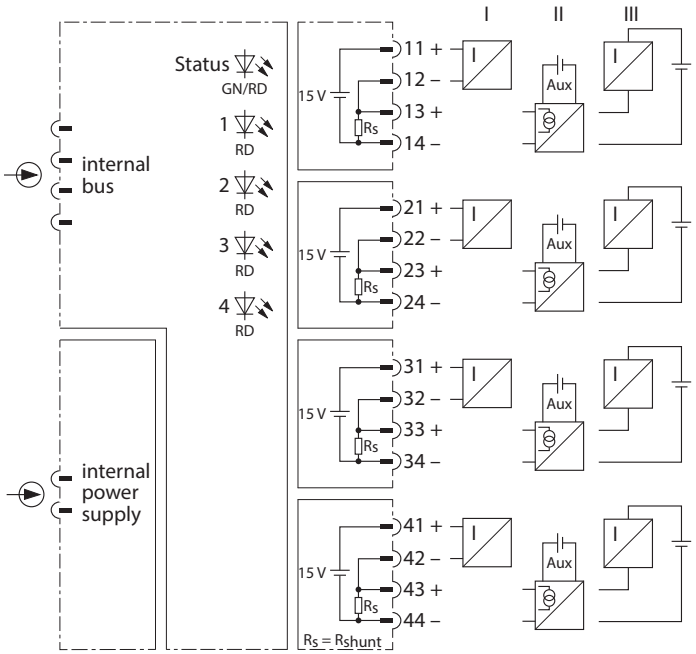

Fig. 31: Wiring diagram – AI40-N

The AI40-N input module has active inputs for connecting 2-wire transmitters. The input module also has passive inputs for connecting 4-wire transmitters.

- Assign parameters for the connection via the GSD file and either the value "passive" or "active".
- With active connection: Connect the transmitter to the input terminal of the excom station (see "Wiring diagram - AI40-N": I).
- With passive connection: Connect the transmitter to the external supply (see "Wiring diagram - AI40-N": II) .
- With active connection but with no voltage: Connect the auxiliary power (see "Wiring diagram - AI40-N": III) .

6.5.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire-break, short circuit), measuring range overflow or underflow: Channel diagnostics present

6.5.8 Setting

The user can set the following parameters on the module:

Parameter overview – AI40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activating or deactivating short circuit monitoring by channel
Wire-break monitoring	**On** Off	Activating or deactivating the wire-break monitoring by channel
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
Connection	**Active** Passive	Setting the power supply (field device) If the transmitter is to be supplied via the input terminal of the excom station, the parameter must be active. If the transmitter is to be supplied externally, the parameter must be passive.
Measuring range	**0…20 mA** 4…20 mA	Define measuring range 0…20 mA: Diagnostics on measuring range underflow not possible (cf. Substitute values) 4…20 mA: Underflow and overflow diagnostics according to NAMUR recommendation
Filter (PT1)	**Off** 0.1 s 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Connection **0: Active** 1: Passive	Measuring range 0: 0…20 mA **1:** **4…20 mA**	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Connection **0: Active** 1: Passive	Measuring range 0: 0…20 mA **1:** **4…20 mA**	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Connection **0: Active** 1: Passive	Measuring range 0: 0…20 mA **1:** **4…20 mA**	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Connection **0: Active** 1: Passive	Measuring range 0: 0…20 mA **1:** **4…20 mA**	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **00000000**								

6.5.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The following table shows the measuring range limits:

Measuring range	Meaning
< 2 mA	Wire break
< 3.6 mA	Measuring range underflow
3.6…21 mA	Valid measured value
> 21 mA	Measuring range overflow
> 24 mA	Short circuit

The measuring range of 0…3.6 mA is only monitored with the “live zero” setting (0…20 mA).

6.5.10 Bit assignment of the input word

Configuring the input word

The AI40-N module acts exclusively as an input card with four input words and an additional status bit (SB) for each of the four channels.

When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation at bit 15 or bit 0).

- ▶ In the Analog data format gateway parameter, select whether the status bit is to be mapped left-justified, right-justified or not at all in the process data.

	Channel	Bit															
Para-meters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…21000 corresponds to 0…21 mA)														
Status LSB		Measured value (0…21000 corresponds to 0…21 mA)															SB
Without status		–	Measured value (0…21000 corresponds to 0…21 mA)														

6.5.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	2	Understeer
	3	Overmodulation
	6	Wire break
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.5.12 Technical data

Type code	AI40-N
ID	6884215
Power supply	Via the module rack, central power supply module
Power consumption	2.2 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Input circuits	0/4…20 mA
Supply voltage	15 VDC at 21 mA
Overmodulation	> 21 mA
Understeer	< 3.6 mA (only with “live zero”)
Short circuit	> 24 mA
Wire break	< 2 mA (only with “live zero”)
Resolution	1 µA
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.1 % of 20 mA at 25 °C
Linearity deviation	≤ 0.05 % of 20 mA at 25 °C
Temperature drift	≤ 0.005 % of 20 mA/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	0.1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	77 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.6 AI41-N analog input module

6.6.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The AI41-N 4-channel analog input module is used to connect active 4-wire transmitters.

6.6.2 Device overview

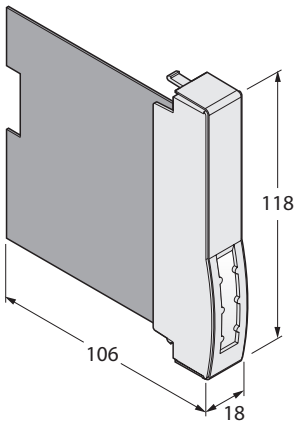

Fig. 32: Dimensions

6.6.3 Properties and features

- Four channels
- Input module for connecting active transmitters (passive inputs)
- Measuring range acc. to NAMUR specification
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus
- HART compatibility:
  - Connection of HART-compatible sensors to the I/O module
  - Parameterization of the field devices with HART modem via connection terminals on the module rack
  - Burden already integrated in the module: no additional impedance required

6.6.4 Functions and operating modes

The module converts an analog current signal of 0…21 mA to a digital value of 0…21000 digits. This corresponds to a resolution of 1 µA per digit. The module converts an analog voltage signal of 0…10 V to a digital value of 0…10000 digits. This corresponds to a resolution of 1 mV per digit.

HART-compatible field devices and sensors can be connected to the module. The user can parameterize the relevant field device directly via the connection terminals on the module rack via a HART modem. An additional impedance is not required since the corresponding burden is already integrated in the module.

6.6.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.6.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".
- ▶ Connect transmitters to the external power supply.

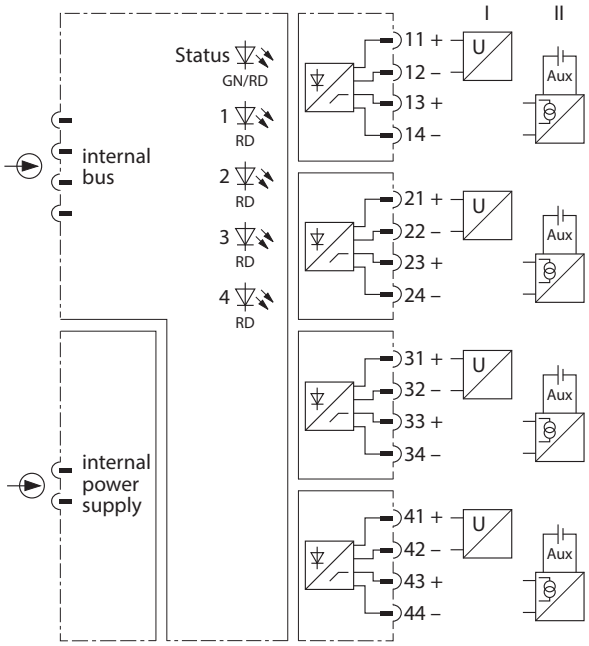

Fig. 33: Wiring diagram – AI41-N

The input module is provided with four passive inputs for connecting 4-wire transmitters.

6.6.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire-break, overflow or underflow), measuring range overflow or underflow: Channel diagnostics present

6.6.8 Setting

The user can set the following parameters on the module:

Parameter overview – AI41

The default parameter values are shown in the following table in **bold** type.

The diagnostics for the measuring range overflow is active and cannot be deactivated.

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
Measuring range	0…20 mA **4…20 mA** 0…10 V 2…10 V	Define measuring range 0…20 mA: Dead zero diagnostics on measuring range underflow and wire break not possible 0…10 V: Dead zero diagnostics on measuring range underflow and wire break not possible 4…20 mA: Live zero diagnostics for measuring range underflow and overflow, diagnostics for wire break switchable 2…10 V: Live zero diagnostics for measuring range underflow and overflow, diagnostics for wire break switchable
Filter (PT1)	**Off** 0.1 s 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Measuring range 00: 0…10 V 01: 2…10 V 10: 0…20 mA **11: 4…20 mA**		Filter (PT1) 00: Off 01: 0.1 s 10: 2.6 s **11: 29.2 s**	
1	2	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Measuring range 00: 0…10 V 01: 2…10 V 10: 0…20 mA **11: 4…20 mA**		Filter (PT1) 00: Off 01: 0.1 s 10: 2.6 s **11: 29.2 s**	
2	3	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Measuring range 00: 0…10 V 01: 2…10 V 10: 0…20 mA **11: 4…20 mA**		Filter (PT1) 00: Off 01: 0.1 s 10: 2.6 s **11: 29.2 s**	
3	4	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Measuring range 00: 0…10 V 01: 2…10 V 10: 0…20 mA **11: 4…20 mA**		Filter (PT1) 00: Off 01: 0.1 s 10: 2.6 s **11: 29.2 s**	
4	Reserved **00000000**								

6.6.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA
0…10 V	Min. value: 0 V Max. value: 10.5 V
2…10 V	Min. value: 1.8 V Max. value: 10.5 V

The following table shows the measuring range limits:

Measuring range		Meaning
< 2 mA	< 1 V	Wire break
< 3.6 mA	< 1.8 V	Measuring range underflow
3.6…21 mA	1.8…10.5 V	Valid measured value
> 21 mA	> 10.5 V	Measuring range overflow

The measuring range of 0…3.6 mA or 0…1.8 V is only monitored with the “live zero” setting (4…20 mA or 2…10 V).

6.6.10 Bit assignment of the input word

The AI41-N module acts exclusively as an input card with four input words and additional status bit (SB) for each of the four channels.

When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation at bit 15 or bit 0).

- ▶ Select in the Analog data format gateway parameter whether the status bit is to be mapped left-justified, right-justified or not at all in the process data.

	Channel	Bit															
Para-meters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…21000 corresponds to 0…21 mA) or Measured value (0…10000 corresponds to 0…10 V)														
Status LSB		Measured value (0…21000 corresponds to 0…21 mA) or Measured value (0…10000 corresponds to 0…10 V)															SB
Without status		–	Measured value (0…21000 corresponds to 0…21 mA) or Measured value (0…10000 corresponds to 0…10 V)														

6.6.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	2	Understeer
	3	Overmodulation
	6	Wire break
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.6.12 Technical data

Type code	AI41-N
ID	6884216
Power supply	Via the module rack, central power supply module
Power consumption	≤ 2 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Input circuits	0/4…20 mA 0/2…10 V
Overmodulation	> 22 mA
Understeer	< 3.6 mA
Wire break	< 2 mA (only with “live zero”)
Resolution	1 µA 1 mV
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.1 % of full scale at 25 °C
Temperature drift	≤ 0.005 % of full scale/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: 0.1 % of full scale at 25 °C With shielded signal cable: 1 % of full scale at 25 °C
Linearity deviation	≤ 0.1 % of full scale at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	98 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.7 AI43-N analog input module

6.7.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The AI43-N 4-channel analog potentiometer module is used to connect active 3- or 4-wire potentiometers.

6.7.2 Device overview

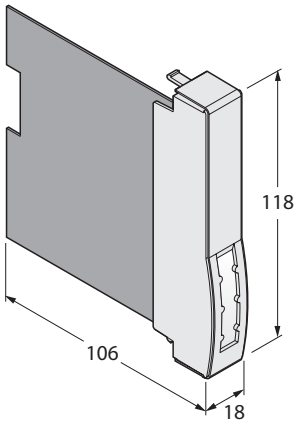

Fig. 34: Dimensions

6.7.3 Properties and features

- Four channels
- Input module for connecting potentiometers
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.7.4 Functions and operating modes

The module has four channels for scanning 3-wire or 4-wire potentiometers. The potentiometer inputs are monitored for line faults. The device detects the line faults of a single as well as multiple connection cables of an input. No short-circuit monitoring is possible. After a line fault has occurred, the set substitute value is output immediately and the Invalid bit of the input word is set until valid measured values are restored. The analog value of 0…100 % is converted to a 15-bit digital value with a resolution of 0.1% per digit and sent to the host system.

6.7.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.7.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

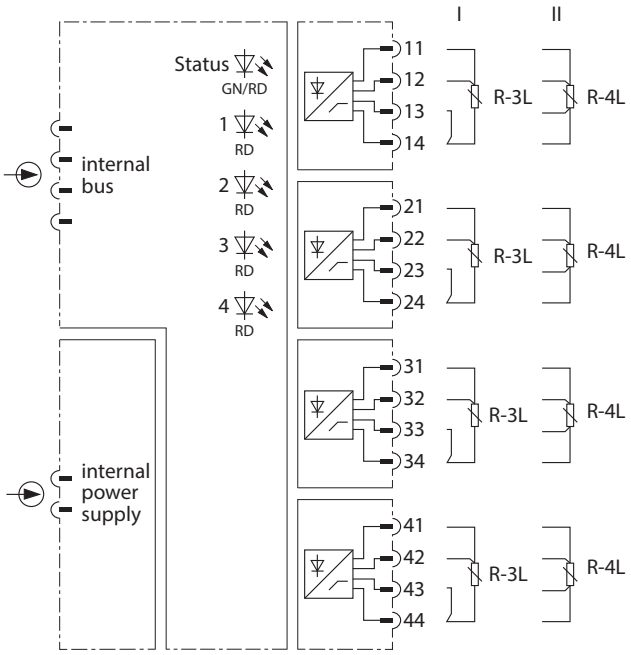

Fig. 35: Wiring diagram – AI43-N

The AI43-N input module is provided with four inputs for connecting 3- or 4-wire potentiometers. Peripheral devices can be connected as required.

- ▶ When connecting 3-wire potentiometers: Set the bridge at the connection terminals of the module rack.

Resistance measurements, i.e. the evaluation of potentiometers with a 2-wire connection, are not possible.

6.7.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for the current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel diagnostics present

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

6.7.8 Setting

The user can set the following parameters on the module:

Parameter overview – AI43

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate line monitoring (only wire-break)
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
Filter (PT1)	**Off** 0.1 s 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value				Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value				Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value				Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value				Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **00000000**								

6.7.9 Measuring range and substitute values

In the event of an error, the following substitute values are set:

Measuring range	Substitute values
0…100 %	Min. value: 0 % Max. value: 100 %

6.7.10 Bit assignment of the input word

The AI43-N module acts exclusively as an input card with four input words and additional status bit (SB) for each of the four channels.

When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation at bit 15 or bit 1).

- ▶ In the Analog data format gateway parameter, select whether the status bit is to be mapped left-justified, right-justified or not at all in the process data.

	Channel	Bit															
Para-meters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…10000 corresponds to 0…100 %)														
Status LSB		Measured value (0…10000 corresponds to 0…100 %)															SB
Without status		–	Measured value (0…10000 corresponds to 0…100 %)														

6.7.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	6	Wire break
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.7.12 Technical data

Type code	AI43-N
ID	6884217
Power supply	Via the module rack, central power supply module
Power consumption	1.5 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Input circuits	3-/4 wire potentiometer 0…100 %
Line fault	if < 400 Ω or if >12 kΩ
Nominal resistance	400 Ω …12 kΩ
Resolution	0.1 %
Linearity deviation	≤ 0.1 % of full scale at 25 °C
Temperature drift	≤ 0.005 % of full scale/K
Rise time/fall time	≤ 50 ms (10…90 %)
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	71 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.8 AIH40-N analog input module

6.8.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The AIH40-N 4-channel analog input module is used to connect passive 2-wire transmitters. HART compatible sensors, which communicate with the integrated HART controller can be connected to the module.

6.8.2 Device overview

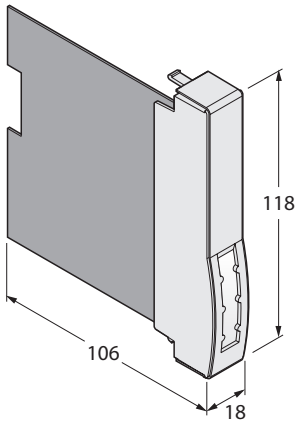

Fig. 36: Dimensions

6.8.3 Properties and features

- Four channels
- Input module for connecting passive 2-wire transmitters
- Measuring range acc. to NAMUR specification
- Galvanic isolation:
  - Input circuits galvanically isolated from the power supply
  - Input circuits galvanically isolated from the internal bus
- HART-compatibility:
  - HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
  - Transmission of HART data between DCS and HART-compatible field device with extended process information of the field devices

6.8.4 Functions and operating modes

The module converts an analog input signal of 0…21 mA to a digital value of 0…21000 digits. This corresponds to a resolution of 1 µA per digit.

Up to eight HART variables (maximum four per channel) can be read via the cyclic user data traffic of the fieldbus. The acyclic data exchange offers enhanced communication options such as the diagnostics and parameter setting of the HART field devices.

Configurations – AIH40-N

Input words	Output words	Type	Configuration
4	-	AIH40-N	Without cyclic HART data
6	-	AIH40-N 1H	1 cyclic HART variables
12	-	AIH40-N 4H	4 cyclic HART variables
20	-	AIH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

6.8.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.8.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

▶ Connect the device as shown in the "Wiring diagram".

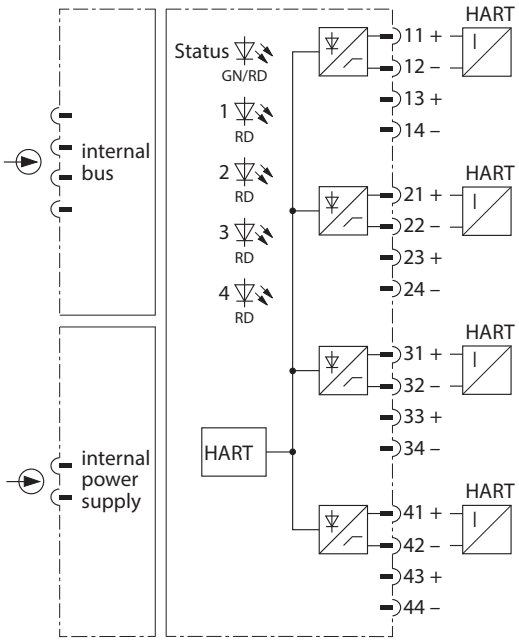

Fig. 37: Wiring diagram – AIH40-N

The AIH40-N input module is provided with four active inputs for connecting passive 2-wire transmitters.

NOTE
The inputs are not galvanically isolated from each other. When connecting the field devices bear in mind that all inputs are connected to a common ground potential.

6.8.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for the current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire-break, short circuit, measuring range overflow or underflow): Channel diagnostics present

6.8.8 Setting

Different parameters are available depending on the configuration. All channels are preset for wire-break, short circuit monitoring and for HART status polling. The monitoring for the measuring range overflow is active and cannot be deactivated. The software filter for generating an average value is preset with an input delay of 0.1 s.

The user can set the following parameters on the module:

Parameter overview – AIH40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break and measuring range underflow not possible Off/4…20 mA: Live zero without HART status polling; diagnostics for measuring range underflow active, wire-break diagnostics switchable On/4…20 mA: Live zero with HART status request
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

Parameters for AIH40 1H

In this configuration, the module also adds a HART variable to the cyclic data fieldbus traffic.

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break and measuring range underflow not possible Off/4…20 mA: Live zero without HART status polling; diagnostics for measuring range underflow active, wire-break diagnostics switchable On/4…20 mA: Live zero with HART status request
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value
HART variable	Primary **Secondary 1** Secondary 2 Secondary 3 Secondary 4	Select HART variables
HART variable of channel	**Channel 1** Channel 2 Channel 3 Channel 4	Select channel number belonging to the HART variable

Parameters for AIH40 4H and 8H

In this configuration, the module also adds four or eight HART variables to the cyclic data traffic. The module represents the measuring range from 4…20 mA. The monitoring of measuring range underflows and overflows is active. The HART status polling is only for channels querying the secondary variables.

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum or last valid value The min. value is 3.6 mA.
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value
Channel 1: SV1…SV4 Channel 2: SV1…SV4 Channel 3: SV1…SV4 Channel 4: SV1…SV4	**On**/off **On**/off **On**/off **On**/off	Activate or deactivate secondary variables SV1…4 of channels 1…4 The first secondary variable (SV1) is active by default for all four channels.

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping – AIH40-N

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **00000000**								

Parameter data mapping – AIH40 1H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **000**				HART variable 000: Primary **001: Secondary 1** 010: Secondary 2 011: Secondary 3 100: Secondary 4			HART variable of channel 00: Channel 1 01: Channel 2 10: Channel 3 11: Channel 4	

Parameter data mapping – AIH40 4H and 8H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K1: SV4 **0: Off** 1: On	K1: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K2: SV4 **0: Off** 1: On	K2: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K3: SV4 **0: Off** 1: On	K3: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K4: SV4 **0: Off** 1: On	K4: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4		K4: SV2 0: Off 1: On	K4: SV1 0: Off 1: On	K3: SV2 0: Off 1: On	K3: SV1 0: Off 1: On	K2: SV2 0: Off 1: On	K2: SV1 0: Off 1: On	K1: SV2 0: Off 1: On	K1: SV1 0: Off 1: On

6.8.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The substitute values apply to all previously listed variants of AIH40-N.

The following table shows the measuring range limits:

Measuring range	Meaning
< 2 mA	Wire break
< 3.6 mA	Measuring range underflow
3.6…21 mA	Valid measured value
> 21 mA	Measuring range overflow
< 5 V terminal voltage	Short circuit

The measuring range of 0…3.6 mA is only monitored with the “live zero” setting (4…20 mA).

6.8.10 Bit assignment of the input word

Configuring the input word

The AIH40-N module acts exclusively as an input card with 4, 6, 12 or 20 input words and an additional status bit (SB) for each channel.

If a status message is present, the status bit of the corresponding channel is set to 1 in the input word.

Depending on the selection of the Analog data format gateway parameter, the status bit is mapped left-justified, right-justified or not at all in the process data.

Depending on the fieldbus, the module is configured in the configuration tool of the control system with an FDT frame or web server of an Ethernet-based system connection via the AIH40-N… entry (see table column "Type"). Different data rates are possible, depending on the configuration. The following configurations are possible:

Input words	Output words	Type	Configuration
4	-	AIH40-N	Without cyclic HART data
6	-	AIH40-N 1H	1 cyclic HART variables
12	-	AIH40-N 4H	4 cyclic HART variables
20	-	AIH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

	Channel	Bit															
Parameters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…20000 corresponds to 0…20 mA)														
Status LSB		Measured value (0…20000 corresponds to 0…20 mA)															SB
Without status		–	Measured value (0…20000 corresponds to 0…20 mA)														

In the event of an error, the module sends, according to the set measuring range, an error message via the status bit in the input word.

Input data mapping overview

The module input data and the HART variables are mapped as follows. The following table shows a module with eight cyclic HART variables as an example:

Wort no. (1 word = 2 bytes)	Contents
1	Input channel 1
2	Input channel 2
3	Input channel 3
4	Input channel 4
5…6	HART variable 1
7…8	HART variable 2
9…10	HART variable 3
11…12	HART variable 4
13…14	HART variable 5
15…16	HART variable 6
17…18	HART variable 7
19…20	HART variable 8

All dynamic HART variables that were activated at parameterization are assigned a space in the mapped input data. The order starts with channel 1 and HART variable 1. If more than four or eight HART variables are selected, only the first four or eight selected HART variables are transmitted. A HART-compatible device must be connected to the corresponding channels for the assignment. If no HART-compatible device is connected or the device does not provide a value for the selected dynamic HART variable, the module sets the variable “NaN”.

The HART variables are presented in the floating point data format.

6.8.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	7	Above upper limit
	8	Below lower limit
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)
	30	HART status error
	31	HART communication error

The system sends two different HART error codes to the DCS:

- Error code 30: The HART variables are valid. The HART device status is reported.
- Error code 31: The HART variables are not valid. The HART communication is faulty.

6.8.12 Technical data

Type code	AIH40-N
ID	6884219
Power supply	Via the module rack, central power supply module
Power consumption	3 W
Galvanic isolation	From the internal bus and from the power supply circuit
Number of channels	4-channel
Input circuits	0/4…20 mA
Supply voltage	15.1 VDC at 21 mA
HART impedance	> 240 Ω
Overmodulation	> 21 mA
Understeer	< 3.6 mA
Short circuit	< 5 V
Wire break	< 2 mA (only with “live zero”)
Resolution	1 µA
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.1 % of 20 mA at 25 °C
Linearity deviation	≤ 0.1 % of 20 mA at 25 °C
Temperature drift	≤ 0.005 % of 20 mA/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: ≤ 0.1 % of 20 mA at 25 °C With unshielded signal cable: ≤ 0.1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+60 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	61 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.9 AIH41-N analog input module

6.9.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The AIH41-N 4-channel analog input module is used to connect active 4-wire transmitters. HART compatible sensors, which communicate with the integrated HART controller can be connected to the module.

6.9.2 Device overview

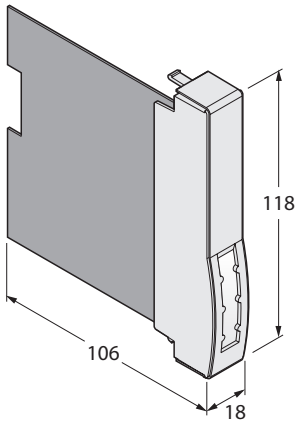

Fig. 38: Dimensions

6.9.3 Properties and features

- Four channels
- Input module for connecting active 4-wire transmitters
- Measuring range acc. to NAMUR specification
- Galvanic isolation:
  - Input circuits galvanically isolated from the power supply
  - Input circuits galvanically isolated from the internal bus
- HART-compatibility:
  - HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
  - Transmission of HART data between DCS and HART-compatible field device (sensor) with extended process information of the field devices

6.9.4 Functions and operating modes

The module converts an analog input signal of 0…21 mA to a digital value of 0…21000 digits. This corresponds to a resolution of 1 µA per digit.

Up to eight HART variables (maximum four per channel) can be read via the cyclic user data traffic of the fieldbus. The acyclic data exchange offers enhanced communication options such as the diagnostics and parameter setting of the HART field devices.

AIH41-N configurations

Input word	Output word	Type	Configuration
4	-	AIH41-N	Without cyclic HART data
6	-	AIH41-N 1H	1 cyclic HART variables
12	-	AIH41-N 4H	4 cyclic HART variables
20	-	AIH41-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

6.9.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.9.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

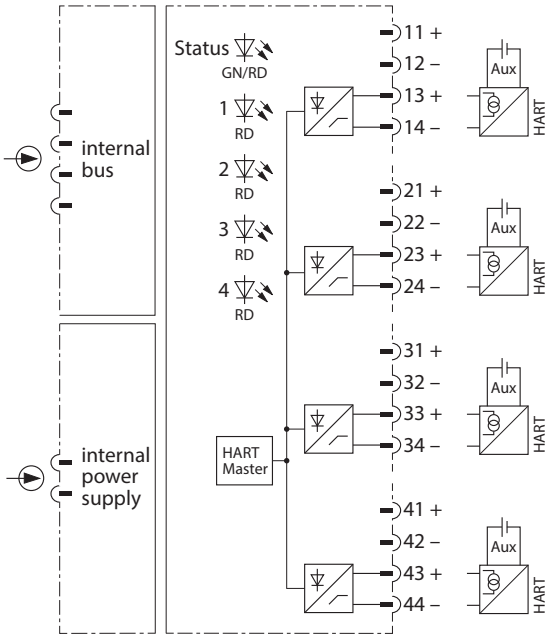

Fig. 39: Wiring diagram – AIH41-N

The AIH41-N input module is provided with four passive inputs for connecting active 4-wire transmitters.

NOTE
The inputs are not galvanically isolated from each other. When connecting the field devices bear in mind that all inputs are connected to a common ground potential.

6.9.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for the current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire-break, short circuit, measuring range overflow or underflow): Channel diagnostics present

6.9.8 Setting

Different parameters are available depending on the configuration. All channels are preset for wire-break, short circuit monitoring and for HART status polling. The monitoring for the measuring range overflow is active and cannot be deactivated. The software filter for generating an average value is preset with an input delay of 0.1 s.

The user can set the following parameters on the module:

Parameter overview – AIH41

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break and measuring range underflow is not possible Off/4…20 mA: Live zero without HART status polling; diagnostics for measuring range underflow and overflow is active, wire-break diagnostics connectable On/4…20 mA: Live zero with HART status polling; diagnostics for measuring range underflow and overflow as well as wire break connectable
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

Parameters for AIH41 1H

In this configuration, the module also adds a HART variable to the cyclic data fieldbus traffic. Compared to the parameter overview for AIH41, the parameter overview of the AIH41 1H configuration just has two additional parameters, which are shown in the following table:

Parameter name	Value	Meaning
HART variable	Primary **Secondary 1** Secondary 2 Secondary 3 Secondary 4	Select HART variables
HART variable of channel	**Channel 1** Channel 2 Channel 3 Channel 4	Select channel number belonging to the HART variable

Parameters for AIH41 4H and 8H

In this configuration, the module also adds four or eight HART variables to the cyclic data traffic. Compared to the parameter overview of the AIH40 configuration, the parameter overview for AIH40 4H and 8H makes it possible to select four or eight secondary variables per channel as parameters. The total number of HART variables is limited to four or eight and must not be exceeded. The additional parameters are shown in bold type in the following table:

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum or last valid value The min. value is 3.6 mA.
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value
Channel 1: SV1…SV4 Channel 2: SV1…SV4 Channel 3: SV1…SV4 Channel 4: SV1…SV4	**On**/off **On**/off **On**/off **On**/off	Activate or deactivate secondary variables SV1…4 of channels 1…4 The first secondary variable (SV1) is active by default for all four channels.

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping – AIH41-N

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved: **00000000**								

Parameter data mapping – AIH41 1H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Channel 1…4: **00000000 (reserved)**				HART variable 000: Primary **001: Secondary 1** 010: Secondary 2 011: Secondary 3 100: Secondary 4			HART variable of channel 00: Channel 1 01: Channel 2 10: Channel 3 11: Channel 4	

Parameter data mapping – AIH41 4H and 8H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K1: SV4 **0: Off** 1: On	K1: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K2: SV4 **0: Off** 1: On	K2: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K3: SV4 **0: Off** 1: On	K3: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Line monitoring **0: On** 1: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K4: SV4 **0: Off** 1: On	K4: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4		K4: SV2 0: Off 1: On	K4: SV1 0: Off 1: On	K3: SV2 0: Off 1: On	K3: SV1 0: Off 1: On	K2: SV2 0: Off 1: On	K2: SV1 0: Off 1: On	K1: SV2 0: Off 1: On	K1: SV1 0: Off 1: On

6.9.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The substitute values apply to all previously listed variants of AIH41-N.

The following table shows the measuring range limits:

Measuring range	Meaning
< 2 mA	Wire break
< 3.6 mA	Measuring range underflow
3.6…21 mA	Valid measured value
> 21 mA	Measuring range overflow

The measuring range of 0…3.6 mA is only monitored with the “live zero” setting (4…20 mA).

6.9.10 Bit assignment of the input word

Configuring the input word

The AIH41-N module acts exclusively as an input card with 4, 6, 12 or 20 input words and an additional status bit (SB) for each channel.

If a status message is present, the status bit of the corresponding channel is set to 1 in the input word.

Depending on the selection of the Analog data format gateway parameter, the status bit is mapped left-justified, right-justified or not at all in the process data.

Different data rates are possible, depending on the configuration. The following configurations are possible:

Input word	Output word	Type	Configuration
4	-	AIH41-N	Without cyclic HART data
6	-	AIH41-N 1H	1 cyclic HART variables
12	-	AIH41-N 4H	4 cyclic HART variables
20	-	AIH41-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

	Channel	Bit															
Parameters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…20000 corresponds to 0…20 mA)														
Status LSB		Measured value (0…20000 corresponds to 0…20 mA)															SB
Without status		–	Measured value (0…20000 corresponds to 0…20 mA)														

In the event of an error the module provides an error message via the status bit of the data telegram, depending on the set measuring range (0…20 mA, 4…20 mA).

Input data mapping overview

The module input data and the HART variables are mapped as follows. This example is based on a module with eight cyclic HART variables:

Wort no. (1 word = 2 bytes)	Contents
1	Input channel 1
2	Input channel 2
3	Input channel 3
4	Input channel 4
5…6	HART variable 1
7…8	HART variable 2
9…10	HART variable 3
11…12	HART variable 4
13…14	HART variable 5
15…16	HART variable 6
17…18	HART variable 7
19…20	HART variable 8

All dynamic HART variables that were activated at parameterization are assigned a space in the mapped input data. The order starts with channel 1 and HART variable 1. If more than four or eight HART variables are selected, only the first four or eight selected HART variables are transmitted. A HART-compatible device must be connected to the corresponding channels for the assignment. If no HART-compatible device is connected or the device does not provide a value for the selected dynamic HART variable, the module sets the variable “NaN”.

The HART variables are presented in the floating point data format.

6.9.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	7	Above upper limit
	8	Below lower limit
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)
	30	HART status error
	31	HART communication error

The system sends two different HART error codes to the DCS:

- Error code 30: The HART variables are valid. The HART device status is reported.
- Error code 31: The HART variables are not valid. The HART communication is faulty.

6.9.12 Technical data

Type code	AIH41-N
ID	6884220
Power supply	Via the module rack, central power supply module
Power consumption	≤ 1.5 W
Galvanic isolation	From the internal bus and from the power supply circuit
Number of channels	4-channel
Input circuits	0/4…20 mA
HART impedance	> 240 Ω
Overmodulation	> 21 mA
Understeer	< 3.6 mA
Wire break	< 2 mA (only with “live zero”)
Resolution	1 µA
Linearity deviation	≤ 0.1 % of 20 mA at 25 °C
Temperature drift	≤ 0.005 % of 20 mA/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: ≤ 0.1 % of 20 mA at 25 °C With unshielded signal cable: ≤ 1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+60 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	93 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.10 AIH401-N analog input module

6.10.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel AIH401-N analog input module is used to connect passive 2-wire transmitters and active 4-wire transmitters. HART compatible sensors, which communicate with the integrated HART controller can be connected to the module. The module is 100 % compatible with the AIH40-N and AIH41-N input modules.

6.10.2 Device overview

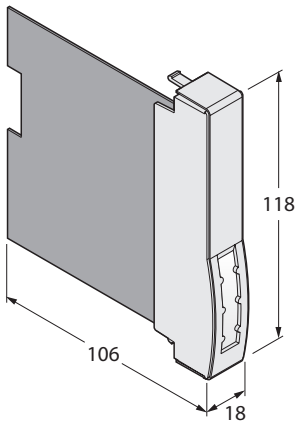

Fig. 40: Dimensions

6.10.3 Properties and features

- Four channels
- Input module for connecting passive 2-wire transmitters or active 4-wire transmitters
- Measuring range acc. to NAMUR specification
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus
- HART-compatibility:
  - HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
  - Transmission of HART data between DCS and HART-compatible field device (sensor) with extended process information of the field devices
  - A HART controller for each channel for faster access to HART data

6.10.4 Functions and operating modes

The module converts an analog input signal of 0…21 mA to a digital value of 0…21000 digits. This corresponds to a resolution of 1 µA per digit.

Up to eight HART variables (maximum four per channel) can be read via the cyclic user data traffic of the fieldbus. The acyclic data exchange offers enhanced communication options such as the diagnostics and parameter setting of the HART field devices.

AIH401-N configurations

Input word	Output word	Type	Configuration
4	-	AIH40-N	Without cyclic HART data
6	-	AIH40-N 1H	1 cyclic HART variables
12	-	AIH40-N 4H	4 cyclic HART variables
20	-	AIH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

Operating modes

The user can select from three operating modes. A separate operating mode can be used for each channel as the channels are galvanically isolated from each other.

No separate configuration is required to distinguish the three operating mode. All listed configurations are supported.

Operating mode I (active input)

In operating mode I, the particular channel of the module supplies the power supply for the field device via terminals 11 and 12 (n1 - n2). The particular current consumption of the device corresponds to the physical process value and is represented within the set measuring range with an analog value from 4…20 mA. A value above 21 mA initiates a diagnostic message for an overflow of the measuring range and a value below 3.6 mA an underflow. The measuring range must be set to 0…20 mA in order to send an underflow signal.

Operating mode II (passive input)

The power supply must be connected separately to the field device. The field device supplies an analog value of 0/4…20 mA via terminals 13 and 14 (n3 - n4), which corresponds to the physical process value within the set measuring range. A value above 21 mA initiates a diagnostic message for an overflow of the measuring range and a value below 3.6 mA an underflow.

Operating mode III (active input with additional auxiliary power)

Operating mode III is suitable for applications in which the 2-wire field device does not receive the required operating voltage via the power supply. In this case, an auxiliary power supply can be connected in series. The series connection of field device and auxiliary power acts like an active device and is connected to terminals 13 and 14 (n3 - n4).

6.10.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.10.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

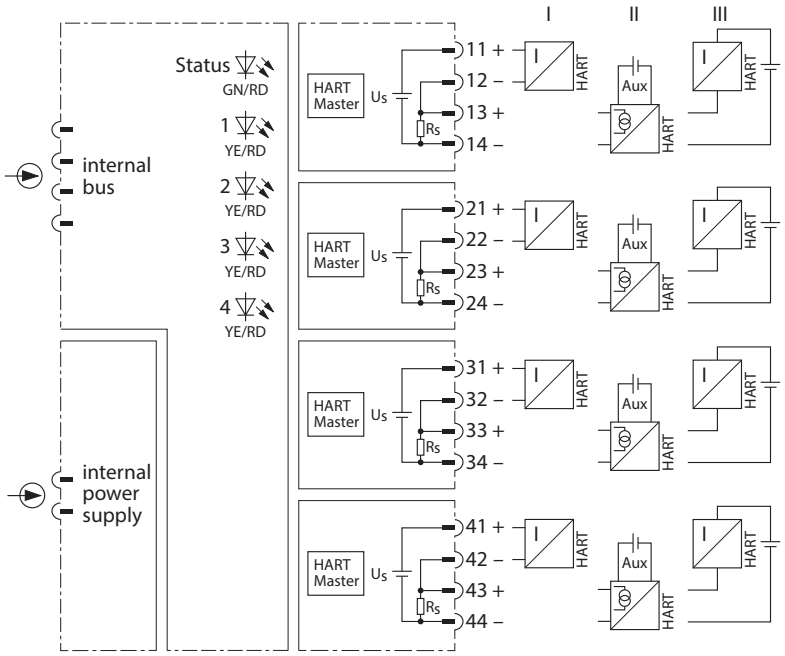

Fig. 41: Wiring diagram – AIH401-N

The AIH401-N input module has active inputs for connecting 2-wire transmitters. The AIH401-N input module also has passive inputs for connecting 4-wire transmitters.

- ▶ With active connection: Connect the transmitter to the input terminal of the excom station (operating mode I).
- ▶ With passive connection: Connect the transmitter to the external power supply (operating mode II).
- ▶ With active connection but with no voltage: Connect the transmitter to the input terminal of the excom station and to the auxiliary power (operating mode III).

6.10.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Green	Power supply and communication error-free
	Red	No communication possible: Module error present
	Flashing red	Module not configured for the current slot
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	HART status request is switched off, with error-free acyclic HART communication in ON state for approx. 300 ms
	Yellow	HART status polling switched on and HART communication error-free
	Yellow flashing (every second momentarily switched off)	HART status polling switched on and HART communication disrupted
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.10.8 Setting

Different parameters are available depending on the configuration. All channels are preset for wire-break, short circuit monitoring and for HART status polling. The monitoring for the measuring range overflow is active and cannot be deactivated. The software filter for generating an average value is preset with an input delay of 0.1 s.

The user can set the following parameters on the module:

Parameter overview – AIH40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Define HART status/measuring range Select from three HART status/measuring ranges: Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break and measuring range underflow is not possible. Off/4…20 mA: Live zero without HART status polling; diagnostics for measuring range underflow active, wire-break diagnostics switchable On/4…20 mA: Live zero with HART status request
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value

AIH40 1H

In this configuration, the module also adds a HART variable to the cyclic data fieldbus traffic.

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Define HART status/measuring range Select from three HART status/measuring ranges: Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break and measuring range underflow is not possible. Off/4…20 mA: Live zero without HART status polling; diagnostics for measuring range underflow and overflow is active. Wire-break and short circuit monitoring are possible. On/4…20 mA: Live zero with HART status polling; diagnostics for measuring range underflow and overflow is active. Wire-break and short circuit monitoring are possible.
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value
HART variable	Primary **Secondary 1** Secondary 2 Secondary 3 Secondary 4	Select a HART variable
HART variable channel based	**Channel 1** Channel 2 Channel 3 Channel 4	Select channel number belonging to the HART variable

AIH40 4H and 8H

In this configuration, the module also adds four or eight HART variables to the cyclic data traffic. The module represents the measuring range from 4…20 mA. The monitoring of measuring range underflows and overflows is active. The HART status polling is only for channels querying the secondary variables.

Parameter name	Value	Meaning
Line monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum or last valid value The min. value is 3.6 mA.
Filter (PT1)	Off **0.1 s** 2.6 s 29.2 s	Activate or deactivate software filter for generating an average value
Channel 1: SV1…SV4 Channel 2: SV1…SV4 Channel 3: SV1…SV4 Channel 4: SV1…SV4	**On**/off **On**/off **On**/off **On**/off	Activate or deactivate secondary variables SV1…4 of channels 1…4 The first secondary variable (SV1) is active by default for all four channels.

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Compatibility behavior

The AIH401-N module can be used as a substitute for AIH40-N and AIH41-N. In an already configured system, AIH401-N takes over the settings of AIH40-N or AIH41-N and operates according to the set parameters. For new configurations with AIH401-N, active and passive field devices can be operated together on one module if the AIH40… configuration is used.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **00000000**								

Parameter data mapping – AIH401 1H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4	Reserved **000**				HART variable 000: Primary **001: Secondary 1** 010: Secondary 2 011: Secondary 3 100: Secondary 4			HART variable of channel 00: Channel 1 01: Channel 2 10: Channel 3 11: Channel 4	

Parameter data mapping – AIH401 4H and 8H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K1: SV4 **0: Off** 1: On	K1: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K2: SV4 **0: Off** 1: On	K2: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K3: SV4 **0: Off** 1: On	K3: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K4: SV4 **0: Off** 1: On	K4: SV3 **0: Off** 1: On	Filter (PT1) 00: Off **01: 0.1 s** 10: 2.6 s 11: 29.2 s	
4		K4: SV2 0: Off 1: On	K4: SV1 0: Off 1: On	K3: SV2 0: Off 1: On	K3: SV1 0: Off 1: On	K2: SV2 0: Off 1: On	K2: SV1 0: Off 1: On	K1: SV2 0: Off 1: On	K1: SV1 0: Off 1: On

6.10.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The substitute values apply to all previously listed variants of AIH401-N.

The following table shows the measuring range limits:

Measuring range	Meaning
< 2 mA	Wire break
< 3.6 mA	Measuring range underflow
3.6…21 mA	Valid measured value
> 21 mA	Measuring range overflow
> 25 mA	Short circuit

The measuring range of 0…3.6 mA is only monitored with the “live zero” setting (4…20 mA).

6.10.10 Bit assignment of the input word

The AIH401-N module acts exclusively as an input card with 4, 6, 12 or 20 input words and an additional status bit (SB) for each channel.

When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation at bit 15 or bit 0).

Depending on the selection of the Analog data format gateway parameter, the status bit is mapped left-justified, right-justified or not at all in the process data.

Different data rates are possible, depending on the configuration. The following configurations are possible:

Input word	Output word	Type	Configuration
4	-	AIH40-N	Without cyclic HART data
6	-	AIH40-N 1H	1 cyclic HART variables
12	-	AIH40-N 4H	4 cyclic HART variables
20	-	AIH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

	Channel	Bit															
Parameters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		SB	Measured value (0…20000 corresponds to 0…20 mA)														
Status LSB		Measured value (0…20000 corresponds to 0…20 mA)															SB
Without status		–	Measured value (0…20000 corresponds to 0…20 mA)														

Input data mapping overview

The module input data and the HART variables are mapped as follows. This example is based on a module with eight cyclic HART variables:

Input word no. (1 word = 2 bytes)	Contents
1	Input channel 1
2	Input channel 2
3	Input channel 3
4	Input channel 4
5…6	HART variable 1
7…8	HART variable 2
9…19	HART variable 3
11…12	HART variable 4
13…14	HART variable 5
15…16	HART variable 6
17…18	HART variable 7
19…20	HART variable 8

All dynamic HART variables that were activated at parameterization are assigned a space in the mapped input data. The order starts with channel 1 and HART variable 1. If more than four or eight HART variables are selected, only the first four or eight selected HART variables are transmitted. A HART-compatible device must be connected to the corresponding channels for the assignment. If no HART-compatible device is connected or the device does not provide a value for the selected dynamic HART variable, the module sets the variable “NaN”.

The HART variables are presented in the floating point data format.

6.10.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
	7	Above upper limit
	8	Below lower limit
Specific	16	Line fault
	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)
	30	HART status error
	31	HART communication error

The system sends two different HART error codes to the DCS:

- Error code 30: The HART variables are valid. The HART device status is reported.
- Error code 31: The HART variables are not valid. The HART communication is faulty.

6.10.12 Technical data

Type code	AIH401-N
ID	6884269
Power supply	Via the module rack, central power supply module
Power consumption	3 W
Heat dissipation	≤ 1.5 W
Galvanic isolation	Full galvanic isolation from bus and from the power supply circuit
Number of channels	4-channel
Input circuits	0/4…20 mA
Supply voltage	17.5 VDC at 21 mA
HART impedance	> 240 Ω
Overmodulation	> 21 mA
Understeer	< 3.6 mA
Short circuit	> 25 mA
Wire break	< 2 mA (only with “live zero”)
Resolution	1µA
Linearity deviation	≤ 0.025 % of 20 mA at 25 °C
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.06 % of 20 mA at 25 °C
Temperature drift	≤ 0.0025 % of 20 mA/K
Rise time/fall time	≤ 40 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: ≤ 0.06 % of 20 mA at 25 °C With unshielded signal cable: ≤ 1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	61 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.11 AO40-N analog output module

6.11.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel AO40-N analog output module is used to connect analog field devices (e.g. valves or process displays).

6.11.2 Device overview

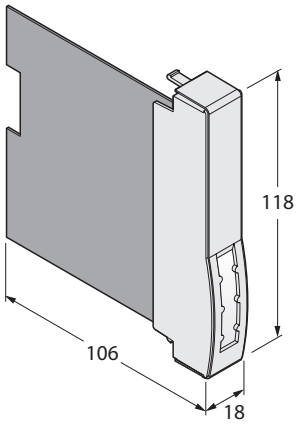

Fig. 42: Dimensions

6.11.3 Properties and features

- Four channels
- Analog output module for connecting analog field devices such as control valves or process displays
- Measuring range acc. to NAMUR specification
- Full galvanic isolation of the output circuits:
  - From each other
  - From the power supply
  - From the internal bus
- HART compatibility:
  - Connection of HART compatible field devices
  - Parameterization of the field devices with HART modem via connection terminals on the module rack possible
  - Burden already integrated in the module: no additional impedance required

6.11.4 Functions and operating modes

The module converts a digital value of 0…21000 digits to an analog output signal of 0…21 mA. This corresponds to a resolution of 1 µA per digit.

HART-compatible field devices and actuators can be connected to the module. The user can parameterize the relevant field device directly via the connection terminals on the module rack via a HART modem. An additional impedance is not required since the corresponding burden is already integrated in the module.

6.11.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.11.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

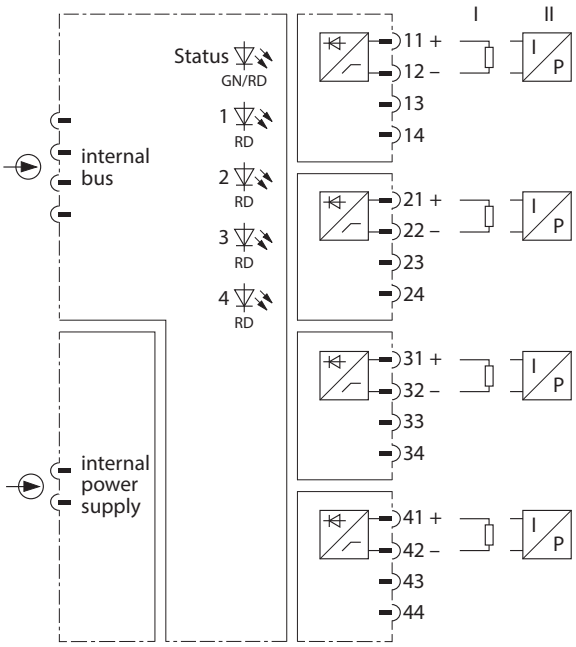

Fig. 43: Wiring diagram – AO40-N

The AO40-N analog output module has four outputs for connecting analog field devices.

6.11.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for the current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…4	Off	No channel error
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.11.8 Setting

The user can set the following parameters on the module:

Parameter overview – AO40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
Measuring range	0…20 mA **4…20 mA**	0…20 mA: Diagnostics for wire break and short circuit not possible 4…20 mA: Wire break and short circuit diagnostics according to NAMUR recommendation

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: last valid value		Re-served: 0	Measuring range 0: 0…20 mA **1: 4…20 mA**		
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: last valid value		Re-served: 0	Measuring range 0: 0…20 mA **1: 4…20 mA**		
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: last valid value		Re-served: 0	Measuring range 0: 0…20 mA **1: 4…20 mA**		
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: last valid value		Re-served: 0	Measuring range 0: 0…20 mA **1: 4…20 mA**		
4	Reserved **00000000**								

6.11.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	**Substitute values**
0…20 mA	Min. value: 0 mA Max. value: 22 mA
4…20 mA	Min. value: 3.6 mA Max. value: 22 mA

6.11.10 Bit assignment of the output word

The AO40-N module operates exclusively as an output card with four output words.

	Channel	Bit															
Para-meters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		–	Measured value (0…21000 corresponds to 0…21 mA)														
Status LSB		Measured value (0…21000 corresponds to 0…21 mA)															-
Without status		–	Measured value (0…21000 corresponds to 0…21 mA)														

6.11.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.11.12 Technical data

Type code	AO40-N
ID	6884218
Power supply	Via the module rack, central power supply module
Max. power consumption	2.5 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Output circuits	0/4…20 mA
Open circuit voltage	≥ 16 VDC
External load	≤ 640 Ω
Short circuit	< 50 Ω
Wire break	< 2 mA
Resolution	2 µA
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.06 % of 20 mA at 25 °C
Linearity deviation	≤ 0.05 % of 20 mA at 25 °C
Temperature drift	≤ 0.005 % of 20 mA/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	≤ 0.1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	78 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.12 AOH40-N analog output module

6.12.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel AOH40-N analog output module is used to connect analog field devices (e.g. control valves or process displays). HART compatible field devices, which communicate with the integrated HART controller can be connected to the module.

6.12.2 Device overview

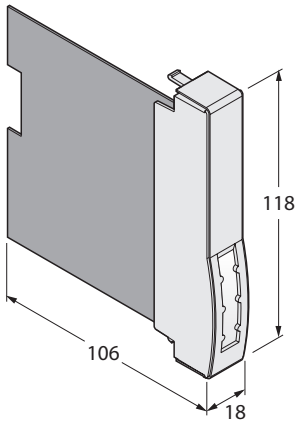

Fig. 44: Dimensions

6.12.3 Properties and features

- Four channels
- Analog output module for connecting analog field devices such as control valves or process displays
- Measuring range acc. to NAMUR specification
- Galvanic isolation:
  - Output circuits galvanically isolated from the power supply
  - Output circuits galvanically isolated from the internal bus
- HART-compatibility:
  - HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
  - Transfer of HART data between DCS and HART-compatible field device with extended process information of the field devices (e.g. current position of a control valve)

6.12.4 Functions and operating modes

The module converts a digital value of 0…21000 digits to an analog output signal of 0…21 mA. This corresponds to a resolution of 1 µA per digit.

Up to eight HART variables (maximum four per channel) can be read via the cyclic user data traffic of the fieldbus. The acyclic data exchange offers enhanced communication options such as the diagnostics and parameter setting of the HART field devices.

AOH40-N configurations

Input words	Output words	Type	Configuration
0	4	AOH40-N	Without cyclic HART data
2	4	AOH40-N 1H	1 cyclic HART variables
8	4	AOH40-N 4H	4 cyclic HART variables
16	4	AOH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

6.12.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.12.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

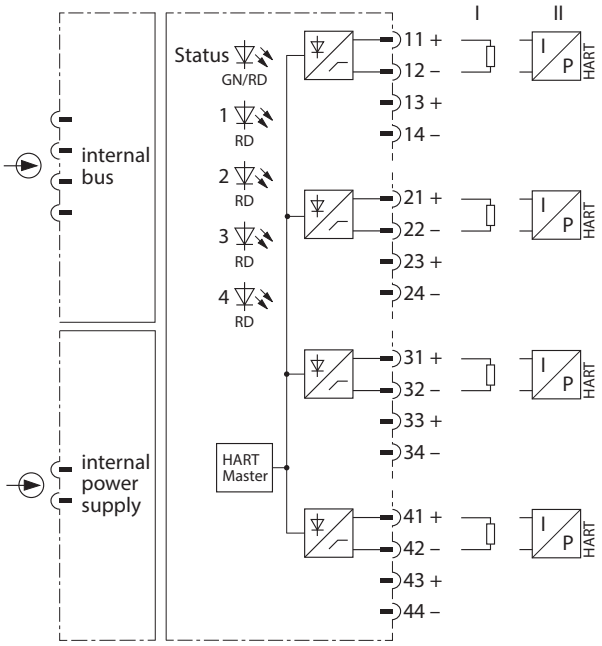

Fig. 45: Wiring diagram – AOH40-N

The AOH40-N analog output module has four outputs for connecting analog field devices.

NOTE
There is no galvanic isolation between the outputs. When connecting the field devices bear in mind that all outputs are connected to a common ground potential.

6.12.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for the current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…4	Off	No channel error
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.12.8 Setting

Different parameters are available depending on the configuration. All channels are preset for wire-break, short circuit monitoring and for HART status polling.

The user can set the following parameters on the module:

Parameter overview – AOH40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Define HART status/measuring range Off/0…20 mA: Dead zero without HART status polling, short circuit monitoring from 3.6 mA with loop resistances of < 50 Ω connectable, wire break monitoring from 3.6 mA loop current Off/4…20 mA: Live zero without HART status polling; diagnostics for wire break and short circuit measuring range connectable On/4…20 mA: Live zero with HART status polling: (HART diagnostics active), wire break and short circuit monitoring connectable

Parameters for AOH40 1H

In this configuration, the module also adds a HART variable to the cyclic data fieldbus traffic.

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Define HART status/measuring range Select from three HART status/measuring ranges: Off/0…20 mA: Dead zero without HART status polling, short circuit monitoring from 3.6 mA with loop resistances of < 50 Ω connectable, wire break monitoring from 3.6 mA loop current Off/4…20 mA: Live zero without HART status polling, wire break monitoring connectable On/4…20 mA: Live zero with HART status polling (HART diagnostics active), wire break monitoring connectable
HART variable	Primary **Secondary 1** Secondary 2 Secondary 3 Secondary 4	Select HART variables
HART variable of channel	**Channel 1** Channel 2 Channel 3 Channel 4	Select channel number belonging to the HART variable

Parameters for AOH40 4H and 8H

In this configuration, the module also adds four or eight HART variables to the cyclic data traffic.

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum or last valid value The min. value is 3.6 mA.
HART status	**On** Off	Activate or deactivate HART status polling
Channel 1: SV1…SV4 Channel 2: SV1…SV4 Channel 3: SV1…SV4 Channel 4: SV1…SV4	**On**/off **On**/off **On**/off **On**/off	Activate or deactivate secondary variables SV1…4 of channels 1…4 The first secondary variable (SV1) is active by default for all four channels.

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

NOTE
Avoid activating or deactivating more than four or eight possible dynamic HART variables. The module maps only the first dynamic HART variables by order of channel.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

Parameter data mapping – AOH40

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
4	Channel 1…4: **00000000: Reserved**								

Parameter data mapping – AOH40 1H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Substitute value strategy **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Substitute value strategy **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Substitute value strategy **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Substitute value strategy **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
4	Channel 1…4: **00000000: Reserved**				HART variable 000: Primary **001: Secondary 1** 010: Secondary 2 011: Secondary 3 100: Secondary 4			HART variable of channel 00: Channel 1 01: Channel 2 10: Channel 3 11: Channel 4	

Parameter data mapping – AOH40 4H and 8H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K1: SV4 **0: Off** 1: On	K1: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K2: SV4 **0: Off** 1: On	K2: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K3: SV4 **0: Off** 1: On	K3: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K4: SV4 **0: Off** 1: On	K4: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
4		K4: SV2 0: Off 1: On	K4: SV1 0: Off 1: On	K3: SV2 0: Off 1: On	K3: SV1 0: Off 1: On	K2: SV2 0: Off 1: On	K2: SV1 0: Off 1: On	K1: SV2 0: Off 1: On	K1: SV1 0: Off 1: On

6.12.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The substitute values apply to all previously listed variants of AOH40-N.

6.12.10 Bit assignment of the output word

The AOH40-N module operates exclusively as an output card with 0, 2, 8 or 16 input words and four output words.

Different data rates are possible, depending on the configuration. The following configurations are possible:

Input words	Output words	Type	Configuration
0	4	AOH40-N	Without cyclic HART data
2	4	AOH40-N 1H	1 cyclic HART variables
8	4	AOH40-N 4H	4 cyclic HART variables
16	4	AOH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

The measured value starts at Bit 0 or Bit 1 depending on the Analog data format gateway parameter.

	Channel	Bit															
Parameters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		–	Measured value (0…21000 corresponds to 0…21 mA)														
Status LSB		Measured value (0…21000 corresponds to 0…21 mA)															-
Without status		–	Measured value (0…21000 corresponds to 0…21 mA)														

Input and output data mapping overview

The input and output data of the module and the HART variables are mapped as follows. The following table shows a module with eight cyclic HART variables as an example:

Input word no. (1 word = 2 bytes)	Output word no.	Contents
	1	Output channel 1
	2	Output channel 2
	3	Output channel 3
	4	Output channel 4
1…2		HART variable 1
3…4		HART variable 2
5…6		HART variable 3
7…8		HART variable 4
9…10		HART variable 5
11…12		HART variable 6
13…14		HART variable 7
15…16		HART variable 8

All dynamic HART variables that were activated at parameterization are assigned a space in the mapped input data. The order starts with channel 1 and HART variable 1. If more than four or eight HART variables are selected, only the first four or eight selected HART variables are transmitted. A HART-compatible device must be connected to the corresponding channels for the assignment. If no HART-compatible device is connected or the device does not provide a value for the selected dynamic HART variable, the module sets the variable “NaN”.

The HART variables are presented in the floating point data format.

6.12.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)
	30	HART status error
	31	HART communication error

The system sends two different HART error codes to the DCS:

- Error code 30: The HART variables are valid. The HART device status is reported.
- Error code 31: The HART variables are not valid. The HART communication is faulty.

6.12.12 Technical data

Type code	AOH40-N
ID	6884221
Power supply	Via the module rack, central power supply module
Power consumption	3 W
Galvanic isolation	From the internal bus and from the power supply circuit
Number of channels	4-channel
Output circuits	0/4…20 mA
Open circuit voltage	22 VDC
HART impedance	240 Ω
External load	≤ 600 Ω
Short circuit	< 50 Ω
Wire break	> 15 V
Resolution	1 µA
Temperature drift	≤ 0.005 % of 20 mA/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: ≤ 0.1 % of 20 mA at 25 °C With unshielded signal cable: ≤ 1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+60 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	66 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.13 AOH401-N analog output module

6.13.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel AOH401-N analog output module is used to connect analog field devices (e.g. control valves or process displays). HART compatible field devices, which communicate with the integrated HART controllers can be connected to the module. The module is 100 % functionally compatible with the AOH40-N output module.

6.13.2 Device overview

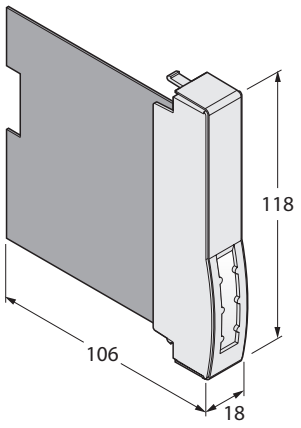

Fig. 46: Dimensions

6.13.3 Properties and features

- Four channels
- Analog output module for connecting analog field devices such as control valves or process displays
- Measuring range acc. to NAMUR specification
- Full galvanic isolation of the output circuits:
  - From each other
  - From the power supply
  - From the internal bus
- HART variables (up to eight HART variables, a maximum of four per channel) for direct data exchange between the process control system (DCS) and the field device
- Transfer of HART data between DCS and HART-compatible field device (actuator) with extended process information of the field devices (e.g. current position of a control valve)
- A HART controller for each channel for faster access to HART data

6.13.4 Functions and operating modes

The module converts a digital value of 0…21000 digits to an analog output signal of 0…21 mA. This corresponds to a resolution of 1 µA per digit.

Up to eight HART variables (maximum four per channel) can be read via the cyclic user data traffic of the fieldbus. The acyclic data exchange offers enhanced communication options such as the diagnostics and parameter setting of the HART field devices.

AOH401-N configurations

Depending on the fieldbus, the module is configured in the configuration tool of the control system with an FDT frame or web server of an Ethernet-based system connection via the AOH40-N… entry (see table column “Type”). Different data rates are possible, depending on the configuration. The following configurations are possible:

Input words	Output words	Type	Configuration
0	4	AOH40-N	Without cyclic HART data
2	4	AOH40-N 1H	1 cyclic HART variables
8	4	AOH40-N 4H	4 cyclic HART variables
16	4	AOH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

6.13.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.13.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

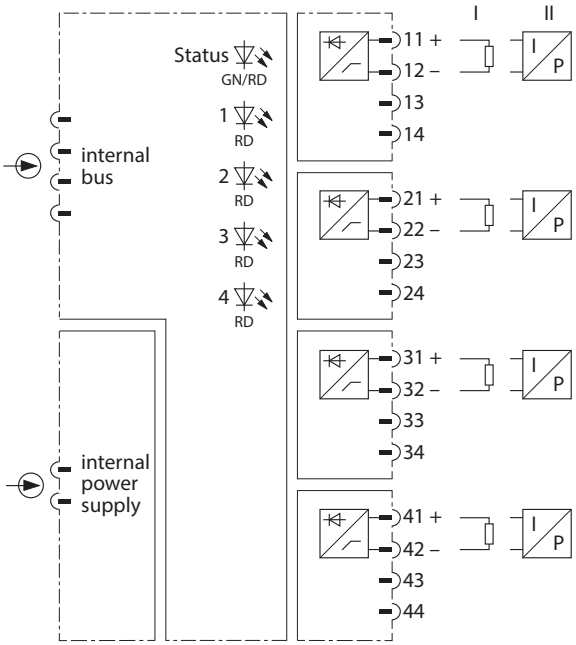

Fig. 47: Wiring diagram – AOH401-N

The AOH401-N analog output module has four outputs for connecting analog field devices.

6.13.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Green	Power supply and communication error-free
	Red	No communication possible: Module error present.
	Flashing red	Module not configured for the current slot
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…4	Off	HART status request is switched off, with error-free acyclic HART communication in ON state for approx 300 ms
	Yellow	HART status polling switched on and HART communication error-free
	Yellow flashing (every second momentarily switched off)	HART status polling switched on and HART communication disrupted
	Yellow flashing (on: 300 ms per telegram)	HART status polling switched on and acylcic HART communication error-free
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.13.8 Setting

Different parameters are available depending on the configuration. All channels are preset for wire break, short circuit monitoring and for HART status polling.

The user can set the following parameters on the module:

Parameter overview – AOH401

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break is not possible, diagnostics for short circuit possible from 1 mA Off/4…20 mA: Live zero without HART status polling; diagnostics for wire break and short circuit measuring range connectable On/4…20 mA: Live zero with HART status polling; diagnostics for wire break and short circuit connectable

AOH401 1H parameters

In this configuration, the module also adds a HART variable to the cyclic data fieldbus traffic.

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
HART status/measuring range	Off/0…20 mA Off/4…20 mA **On/4…20 mA**	Select from three HART status/measuring ranges: Off/0…20 mA: Dead zero without HART status polling; diagnostics for wire break is not possible, diagnostics for short circuit possible from 1 mA Off/4…20 mA: Live zero without HART status polling; wire break and short circuit monitoring are possible On/4…20 mA: Live zero with HART status polling; wire break and short circuit monitoring are possible
HART variable	Primary **Secondary 1** Secondary 2 Secondary 3 Secondary 4	Select HART variables
HART variable channel based	**Channel 1** Channel 2 Channel 3 Channel 4	Select channel number belonging to the HART variable

Parameters for AOH401 4H and 8H

In this configuration, the module also adds four or eight HART variables to the cyclic data traffic and by default 8 bytes for channels 1 to 4. Compared to the parameter overview of the AOH40 configuration, the parameter overview for AOH401 4H and 8H makes it possible to select four or eight secondary variables per channel as parameters. The total number of HART variables is limited to four or eight and must not be exceeded. The additional parameters are shown in bold type in the following table:

Parameter name	Value	Meaning
Short-circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum or last valid value The min. value is 3.6 mA.
HART status	**On** Off	Activate or deactivate HART status polling
Channel 1: SV1…SV4 Channel 2: SV1…SV4 Channel 3: SV1…SV4 Channel 4: SV1…SV4	**On**/off **On**/off **On**/off **On**/off	Activate or deactivate secondary variables SV1…4 of channels 1…4 The first secondary variable (SV1) is active by default for all four channels.

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

Parameter data mapping – AOH401

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
4	Channel 1…4: **00000000: Reserved**								

Parameter data mapping – AOH401 1H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		HART status/ measuring range 00: Off/0…20 mA 01: Off/4…20 mA **10: On/4…20 mA**		Reserved: **00**	
4	Channel 1…4: **00000000 (reserved)**				HART variable 000: Primary **001: Secondary 1** 010: Secondary 2 011: Secondary 3 100: Secondary 4			HART variable of channel 00: Channel 1 01: Channel 2 10: Channel 3 11: Channel 4	

Parameter data mapping – AOH401 4H and 8H

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K1: SV4 **0: Off** 1: On	K1: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K2: SV4 **0: Off** 1: On	K2: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K3: SV4 **0: Off** 1: On	K3: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		K4: SV4 **0: Off** 1: On	K4: SV3 **0: Off** 1: On	HART status **0: On** 1: Off	Reserved: **0**
4		K4: SV2 0: Off 1: On	K4: SV1 0: Off 1: On	K3: SV2 0: Off 1: On	K3: SV1 0: Off 1: On	K2: SV2 0: Off 1: On	K2: SV1 0: Off 1: On	K1: SV2 0: Off 1: On	K1: SV1 0: Off 1: On

6.13.9 Measuring range and substitute values

Depending on the measuring range, the following substitute values are set in the event of an error:

Measuring range	Substitute values
0…20 mA	Min. value: 0 mA Max. value: 21 mA
4…20 mA	Min. value: 3.6 mA Max. value: 21 mA

The substitute values apply to all previously listed configurations of AOH401-N.

6.13.10 Bit assignment of the output word

The AOH401-N module operates exclusively as an input and output card with 0, 2, 8 or 16 input words and four output words.

Different data rates are possible, depending on the configuration. The following configurations are possible:

Depending on the fieldbus, the module is configured in the configuration tool of the control system with an FDT frame or web server of an Ethernet-based system connection via the AOH40-N… entry (see table column “Type”). Different data rates are possible, depending on the configuration. The following configurations are possible:

Input words	Output words	Type	Configuration
0	4	AOH40-N	Without cyclic HART data
2	4	AOH40-N 1H	1 cyclic HART variables
8	4	AOH40-N 4H	4 cyclic HART variables
16	4	AOH40-N 8H	8 cyclic HART variables

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

Analog data format	Channel	Bit															
Para-meters	1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status MSB		–	Measured value (0…20000 corresponds to 0…20 mA)														
Status LSB		Measured value (0…20000 corresponds to 0…20 mA)															-
Without status		–	Measured value (0…20000 corresponds to 0…20 mA)														

The measured value starts at Bit 0 or Bit 1, depending on the **Analog data format** gateway parameter.

Input and output data mapping overview

The input and output data of the module and the HART variables are mapped as follows. This example is based on a module with eight cyclic HART variables:

Input word no. (1 word = 2 bytes)	Output word no.	Contents
	1	Output channel 1
	2	Output channel 2
	3	Output channel 3
	4	Output channel 4
1…2		HART variable 1
3…4		HART variable 2
5…6		HART variable 3
7…8		HART variable 4
9…10		HART variable 5
11…12		HART variable 6
13…14		HART variable 7
15…16		HART variable 8

All dynamic HART variables that were activated at parameterization are assigned a space in the mapped input data. The order starts with channel 1 and HART variable 1. If more than four or eight HART variables are selected, only the first four or eight selected HART variables are transmitted. A HART-compatible device must be connected to the corresponding channels for the assignment. If no HART-compatible device is connected or the device does not provide a value for the selected dynamic HART variable, the module sets the variable “NaN”.

The HART variables are presented in the floating point data format.

6.13.11 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)
	30	HART status error
	31	HART communication error

The system sends two different HART error codes to the DCS:

- Error code 30: The HART variables are valid. The HART device status is reported.
- Error code 31: The HART variables are not valid. The HART communication is faulty.

6.13.12 Technical data

Type code	AOH401-N
ID	6884270
Power supply	Via the module rack, central power supply module
Power consumption	3 W
Heat dissipation	1.5 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Output circuits	0/4…20 mA
Open circuit voltage	≥ 18 VDC
HART impedance	> 240 Ω
External load	≤ 680 Ω
Short circuit	< 50 Ω
Wire break	< 2 mA
Resolution	1µA
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.06 % of 20 mA at 25 °C
Linearity deviation	≤ 0.025 % of 20 mA at 25 °C
Temperature drift	≤ 0.0025 % of 20 mA/K
Rise time/fall time	≤ 40 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: ≤ 0.06 % of 20 mA at 25 °C With unshielded signal cable: ≤ 1 % of 20 mA at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red/yellow
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	40 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.14 DM80-N digital input/output module

6.14.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The DM80 digital I/O module is used to connect NAMUR sensors (EN 60947-5-6) and actuators.

6.14.2 Device overview

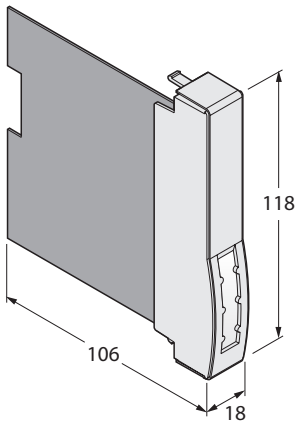

Fig. 48: Dimensions

6.14.3 Properties and features

- Eight channels
- Input/output module for NAMUR sensors and actuators
- Galvanic isolation:
  - Input and output circuits galvanically isolated from the power supply
  - Input and output circuits galvanically isolated from the internal bus
  - Inputs and outputs are on a common potential

6.14.4 Functions and operating modes

A sensor or actuator can be connected to each channel. All connection points can be configured in pairs as inputs or outputs. The following configurations are possible:

Number of inputs	Number of outputs
8	0
6	2
4	4
2	6
0	8

There is no galvanic isolation between the inputs/outputs. All inputs and outputs are on a common plus potential.

DM80-N configurations

Input bytes	Output bytes	Type	Configuration
1	1	DM80-N	Bidirectional DM80-N without status
2	1	DM80-N S	Bidirectional DM80-N with status
1	0	DM80-N 8I	DM80-N exclusively as an input module without status
2	0	DM80-N S 8I	DM80-N exclusively as an input module with status

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

6.14.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.14.6 Connection

When plugged onto the module rack, the device is connected with the internal power supply and the data communication of the module rack. Screw connection or spring-loaded terminal blocks can be used for connecting the field devices.

- ▶ Connect the device as shown in the “Wiring diagram”.
- ▶ When using mechanical contacts: Implement out a resistor circuit via a WM1 module (ID 0912101) if wire break or short-circuit monitoring is activated.

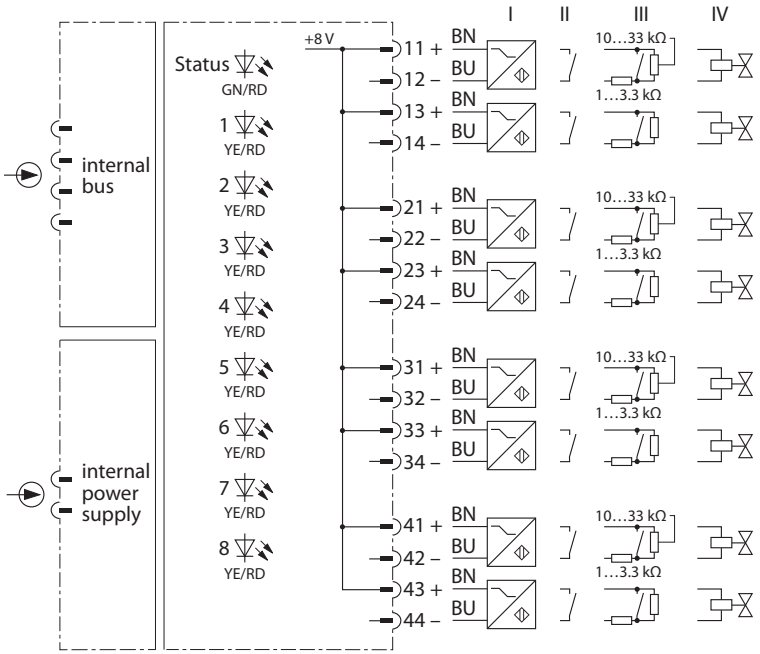

Fig. 49: Wiring diagram – DM80-N

The DM80-N binary input/output module has eight inputs or outputs for connecting NAMUR sensors and actuators.

NOTE
There is no galvanic isolation between the outputs. When connecting the field devices bear in mind that all inputs are connected to a common plus potential.

6.14.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…8	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.14.8 Setting

The user can set the following parameters on the module:

Parameter overview – DM80

The parameters are set in pairs for the particular two channels (1/2, 3/4, 5/6, 7/8).

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activate or deactivate the short circuit monitoring in pairs The output signal can only be monitored if the output is activated.
Wire-break monitoring	**On** Off	Activate or deactivate the wire-break monitoring in pairs The output signal can only be monitored if the output is activated.
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum (0), maximum (1) or last valid value (0 or 1)
Polarity	**Input** Output	Activate or deactivate input or output Input: The channels of the module are switched in groups as inputs (1/2, 3/4, 5/6, 7/8). The DM80-N S and DM80-N S8I variants provide a status. Output: The channels of the module are switched as outputs in groups (1/2, 3/4, 5/6, 7/8). The DM80-N S variant on the other hand also provides a status for the outputs.
Polarity	**Normal** Inverse	Activate or deactivate signal inversion
Debouncing	**Off** 10 ms 20 ms 50 ms	Activate or deactivate additional input debounce
Channel 1…8	**Active** Inactive	Activate or deactivate channel 1…8 If a channel is not used, it can be switched off to prevent unwanted error messages.

The behavior of the outputs is parameterized via a configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

Parameter data mapping – DM80 8I and DM80 S 8I

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1…2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
1	3…4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
2	5…6	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
3	7…8	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
4	Channel 1…8	Channel 8 **0: Active** 1: Inactive	Channel 7 **0: Active** 1: Inactive	Channel 6 **0: Active** 1: Inactive	Channel 5 **0: Active** 1: Inactive	Channel 4 **0: Active** 1: Inactive	Channel 3 **0: Active** 1: Inactive	Channel 2 **0: Active** 1: Inactive	Channel 1 **0: Active** 1: Inactive

Parameter data mapping – DM80 and DM80 S

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1…2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Polarity **0: Input** 1: Output	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
1	3…4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Polarity **0: Input** 1: Output	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
2	5…6	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Polarity **0: Input** 1: Output	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
3	7…8	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Polarity **0: Input** 1: Output	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
4	Channel 1…8	Channel 8 **0: Active** 1: Inactive	Channel 7 **0: Active** 1: Inactive	Channel 6 **0: Active** 1: Inactive	Channel 5 **0: Active** 1: Inactive	Channel 4 **0: Active** 1: Inactive	Channel 3 **0: Active** 1: Inactive	Channel 2 **0: Active** 1: Inactive	Channel 1 **0: Active** 1: Inactive

6.14.9 Bit assignment of the data byte

Configuring input and output bytes

Depending on the field of application, the DM80-N input and output module can be configured exclusively as an input card or as an input and output card (all channels are parameterized in pairs as input or output) with or without status.

With the configuration with status, the status bit of the appropriate channel is set to 1 in the status byte when a status message (short circuit or wire break message) is present.

Different data rates are possible, depending on the configuration.

The following configurations are possible:

Input bytes	Output bytes	Type	Configuration
1	1	DM80-N	Bidirectional DM80-N without status
2	1	DM80-N S	Bidirectional DM80-N with status
1	0	DM80-N 8I	DM80-N exclusively as an input module without status
2	0	DM80-N S 8I	DM80-N exclusively as an input module with status

The module hardware is the same in spite of the different configuration. The behavior of the module is only influenced by the configuration. Depending on the fieldbus or fieldbus protocol, the configuration is carried out in the higher-level control system, DTM or web server.

Status bit	Bit							
	7	6	5	4	3	2	1	0
Input byte n	Channel 8 active	Channel 7 active	Channel 6 active	Channel 5 active	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active
Status byte (input byte n+1)	SB 8	SB 7	SB 6	SB 5	SB 4	SB 3	SB 2	SB 1
Output byte (input byte n +1)	Channel 8 active	Channel 7 active	Channel 6 active	Channel 5 active	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active

Example:

- Bits 0…5 in the input byte n are the inputs of channels 1…6.
- Bits 6…7 in the output byte are the outputs of channels 7…8

The status byte is configured in the same way.

6.14.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.14.11 Technical data

Type code	DM80-N
ID	6884211
Power supply	Via the module rack, central power supply module
Power consumption	1 W
Galvanic isolation	From the internal bus and from the power supply circuit
Number of channels	8-channel
Input circuits	According to EN 60947-5-6 (NAMUR)
Open circuit voltage (input)	8 VDC
Short-circuit current	4 mA
Switching threshold on/off (input)	typ. 1.8 mA/typ. 1.4 mA
Switching frequency (input)	≤ 100 Hz with MT08…, MT16… ≤ 50 Hz with MT24…, GEN…
Short circuit (input)	< 367 Ω
Wire break (input)	< 0.2 mA
Output circuits	For low-power field devices
Open circuit voltage (output)	8 VDC
Rated current (output)	4 mA
Internal resistance R_i (output)	320 Ω
Switching frequency (output)	≤ 100 Hz
Short circuit (output)	< 367 Ω
Wire break (output)	< 0.2 mA
LEDs	
Operational readiness	1 × green/red
Status/error	8 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to DIN EN 61326-1 acc. to NAMUR NE21
MTTF	141 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.15 DI40-N digital input module

6.15.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel DI40-N digital input module is used to connect a maximum of four sensors according to NAMUR (EN 60947-5-6), 3-wire sensors (NPN, PNP) or mechanical contacts.

6.15.2 Device overview

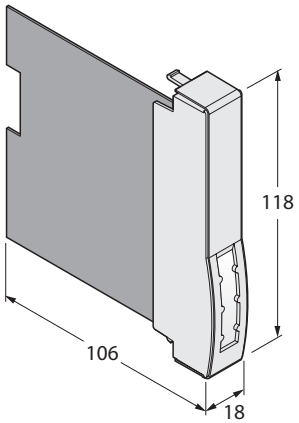

Fig. 50: Dimensions

6.15.3 Properties and features

- Four channels
- Input module (max. four) NAMUR sensors
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.15.4 Functions and operating modes

One NAMUR sensor (EN 60947-5-6), one 3-wire sensor (NPN, PNP) or one mechanical contact can be connected per channel.

6.15.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.15.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

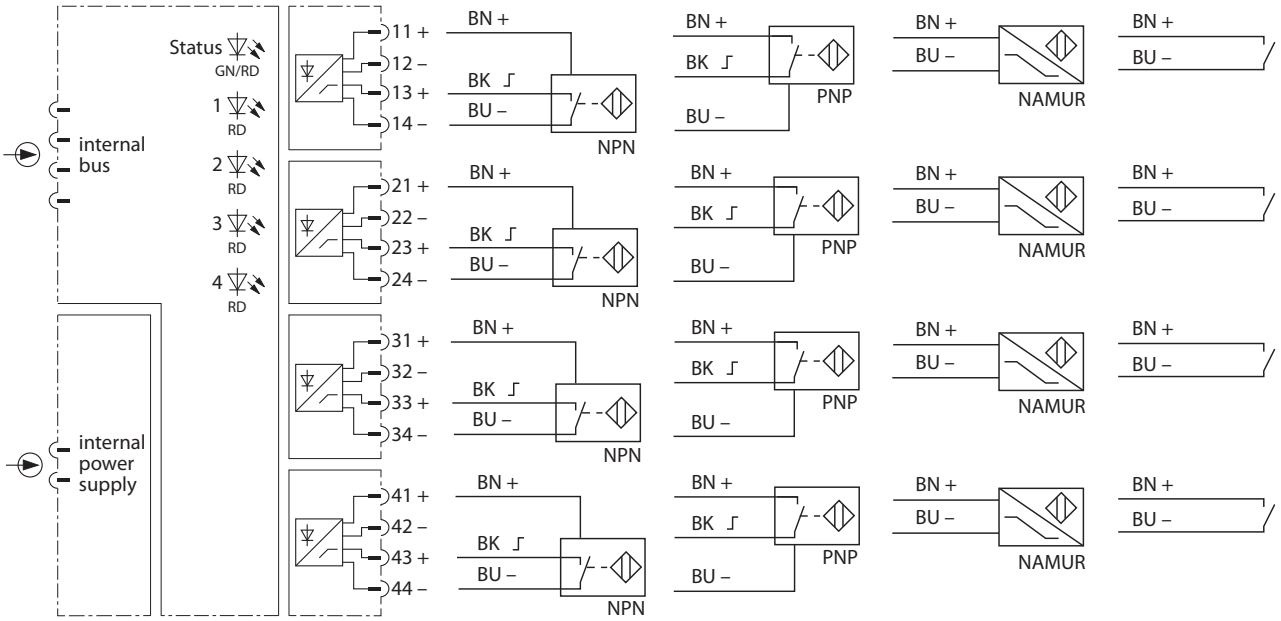

Fig. 51: Wiring diagram – DI40-N

When using 3-wire sensors, terminals 1 and 4 are monitored for wire break and short circuit respectively. With NAMUR sensors, terminals 1 and 2 are monitored for wire break and short circuit respectively.

- ▶ When using mechanical contacts: Implement out a resistor circuit via a WM1 module (ID 0912101) if wire break or short-circuit monitoring is activated.

6.15.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.15.8 Setting

The user can set the following parameters on the module:

Parameter overview – DI40.

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activating or deactivating short circuit monitoring by channel
Wire-break monitoring	**On** Off	Activating or deactivating the wire-break monitoring by channel
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum (0), maximum (1) or last valid value (0 or 1)
Polarity	**Normal** Inverse	Activate or deactivate signal inversion
Debouncing	**Off** 10 ms 20 ms 50 ms	Activate or deactivate additional damping of input signals for debouncing mechanical contacts

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted	Debouncing **00: Off** 01: 10 ms 10: 20 ms 11: 30 ms	

6.15.9 Bit assignment of the input byte

Configuring an input byte

The DI40-N input module acts exclusively as an input card with one input byte and additional status bit (SB) for each channel.

When a status message (short circuit or wire break message) is present, the status bit of the corresponding channel is set to 1 in the input byte (bit 4…7).

Status bit	Bit							
	7	6	5	4	3	2	1	0
Input byte	SB 4	SB 3	SB 2	SB 1	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active

6.15.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.15.11 Technical data

Type code	DI40-N
ID	6884213
Power supply	Via the module rack, central power supply module
Max. power consumption	1.9 W
Max. heat dissipation	1.0 W
Galvanic isolation	Full galvanic isolation
Number of channels	4-channel
Input circuits	According to EN 60947-5-6 (NAMUR)
Open circuit voltage	8.2 VDC
Short-circuit current	2.7 mA
Switching threshold on/off	typ. 1.8 / typ. 1.3 mA
Max. switching frequency	100 Hz with MT08…, MT16… 50 Hz with MT24…, GEN…
Short circuit	< 367 Ω
Wire break	< 0.15 mA
3-wire input	
Open circuit voltage	12 VDC
Current	≤ 20 mA
0 signal	≤ 4.5 V
1 signal	≥ 6.5 V
LEDs	
Operational readiness	1 × green/red
Status/error	4 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	111 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm
Remark	The supply of 3-wire sensors is also monitored for wire-break and short-circuit.

6.16 DI80-N digital input module

6.16.1 Intended Use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The DI80-N digital input module is used to connect eight 3-wire PNP/NPN sensors (IEC 61131, Type 3).

6.16.2 Device Overview

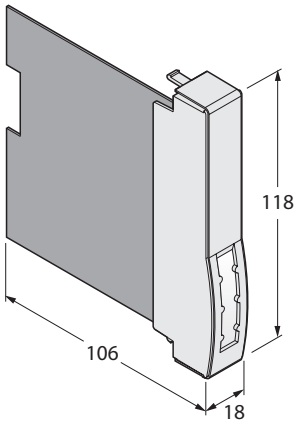

Fig. 52: Dimensions

6.16.3 Properties and Characteristics

- Eight channels
- Input module for 3-wire sensors
- Supply of the sensors: reverse polarity protected via separate auxiliary power supply
- Galvanic isolation of the inputs by group
- Bounce monitoring of the inputs

6.16.4 Functions and Operating Modes

The sensors are fed with auxiliary power (24 V). The auxiliary power is routed separately for channels 1…4 (group 1) and 5…8 (group 2) externally via the connection terminals.

Bounce monitoring

The signal bounce monitoring detects and indicates any abnormal signal patterns in the process, e.g. frequent oscillation of the input signal between 0 and 1. The occurrence of these signal patterns is an indication of faulty sensors or unstable process conditions.

A configurable monitoring time window is provided for each input channel. Monitoring is started with the first signal change of the input signal. If the number of input signal changes within the configured monitoring period is greater than the configured number of permitted signal changes, this is detected as a bounce error.

If no bounce error is detected within the monitoring period, monitoring starts again according to the configured time window at the next signal change.

If a bounce error occurs, the current signal state is entered in the process image and the status of the signal is set to “invalid”. The Bounce error diagnostic information is entered and a diagnostic alarm is triggered. Status and diagnostic information can be evaluated and processed in the user program.

If a signal change of the input signal has not been detected within 3 successive monitoring periods, the diagnostic entry is removed and a clearing diagnostic alarm is triggered. The status of the current signal is set to “valid”.

6.16.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.16.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

▶ Connect the device as shown in the "Wiring diagram".

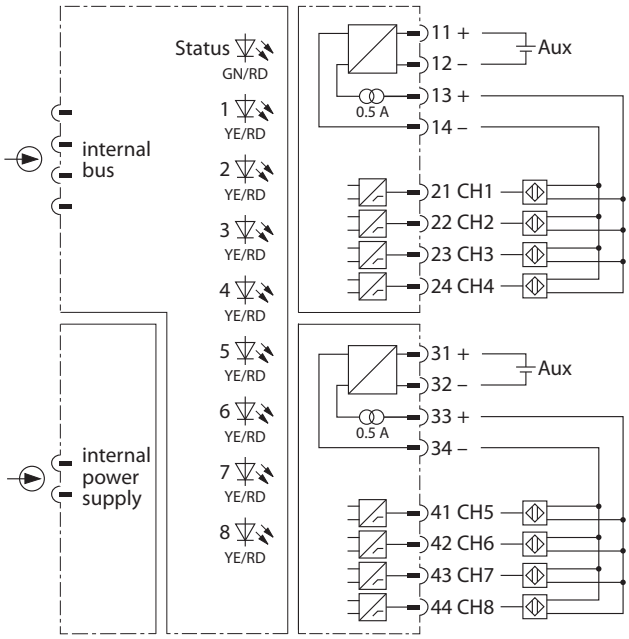

Fig. 53: Wiring diagram – DI80-N

The DI80-N digital input module is used for connecting eight 3-wire PNP/NPN sensors.

6.16.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…8	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present
	Flashing red	External power supply missing

6.16.8 Setting

The user can set the following parameters on the module:

Parameter overview – DI80

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum (0), maximum (1) or last valid value (0 or 1)
Sensor output	**PNP** NPN	Select the sensor type (either PNP or NPN)
Polarity	**Normal** Inverse	Activate or deactivate signal inversion
Flutter time frame	**Off** 0.5 s 1 s 2 s	Select monitoring time window for bounce error
Number of signal changes	**2** 4 8 16	Select the number of signal changes within the monitoring time window (for bounce errors)
K 1…8: Line monitoring	**Active** Inactive	Channel-wise activation or deactivation of the line monitoring If a channel is not used it can be switched off.

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1…2	Flutter time frame **0: Off** 01: 0.5 s 10: 1 s 11: 2 s		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Sensor output **0: pnp** 1: NPN	Polarity **0: Normal** 1: Inverted	Number of signals **00: 2** 01: 4 10: 8 11: 16	
1	3…4	Flutter time frame **0: Off** 01: 0.5 s 10: 1 s 11: 2 s		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Sensor output **0: pnp** 1: NPN	Polarity **0: Normal** 1: Inverted	Number of signals **00: 2** 01: 4 10: 8 11: 16	
2	5…6	Flutter time frame **0: Off** 01: 0.5 s 10: 1 s 11: 2 s		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Sensor output **0: pnp** 1: NPN	Polarity **0: Normal** 1: Inverted	Number of signals **00: 2** 01: 4 10: 8 11: 16	
3	7…8	Flutter time frame **0: Off** 01: 0.5 s 10: 1 s 11: 2 s		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Sensor output **0: pnp** 1: NPN	Polarity **0: Normal** 1: Inverted	Number of signals **00: 2** 01: 4 10: 8 11: 16	
4	1…8	Line monitoring channel 8 **0: Active** 1: Inactive	Line monitoring channel 7 **0: Active** 1: Inactive	Line monitoring channel 6 **0: Active** 1: Inactive	Line monitoring channel 5 **0: Active** 1: Inactive	Line monitoring channel 4 **0: Active** 1: Inactive	Line monitoring channel 3 **0: Active** 1: Inactive	Line monitoring channel 2 **0: Active** 1: Inactive	Line monitoring channel 1 **0: Active** 1: Inactive

6.16.9 Bit assignment of the input byte

Configuring an input byte

In the DI80-N configuration, the input module functions exclusively as an input card. In the DI80 S configuration, the process data contains an additional status bit (SB) for each channel.

When a status message (short circuit or wire break message) is present, the status bit of the corresponding channel is set to 1 in the input byte (bit 1…7).

Status bit	**Bit**							
	7	6	5	4	3	2	1	0
Input byte n	Channel 8 active	Channel 7 active	Channel 6 active	Channel 5 active	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active
Status byte (input byte n+1)	SB 8	SB 7	SB 6	SB 5	SB 4	SB 3	SB 2	SB 1

6.16.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	**No.**	**Meaning**
Standard	1	Short circuit (with PNP to positive supply voltage, with NPN to negative supply voltage)
	2	Undervoltage U < 19.2 V
	3	Overvoltage U > 30 V
	6	Wire break
	9	Error (field circuit processor)
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	21	Sensor supply not available
	22	Parameter not plausible (inconsistent)
	23	Short circuit of sensor supply
	24	Bounce error detected

6.16.11 Technical data

Type code	DI80-N
ID	6884273
Power supply	Via the module rack, central power supply module
Power consumption	≤ 2.2 W
Galvanic isolation	Two galvanically separated groups
Number of channels	8-channel
Input circuits	
Auxiliary supply	2 × (19.2…30 VDC)
Switching frequency	≤ 50 Hz
Short circuit	< 500 Ω
Wire break	< 0.2 mA
3-wire input	
0 signal	≤ 5.0 V
1 signal	≥ 11.0 V
Output circuits	
Output current	≤ 500 mA
Short-circuit protection	Yes/cyclic
LEDs	
Operational readiness	1 × green/red
Status/error	8 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	55 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.17 DO40-N digital output module

6.17.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel DO40-N digital output module is used to connect low-power digital field devices (e.g. control valves or signal transmitters).

6.17.2 Device overview

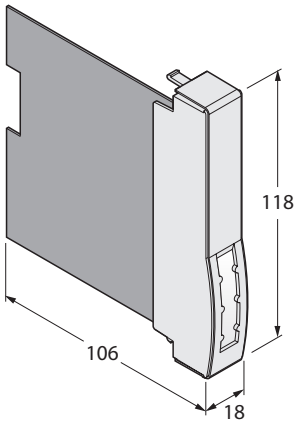

Fig. 54: Dimensions

6.17.3 Properties and features

- Four channels
- Output module for field devices
- Full galvanic isolation of the output circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.17.4 Functions and operating modes

Only one field device per channel can be connected either to terminals 1 and 2 or to terminals 3 and 4. There are two types of terminal for each channel.

Valve control

Valves that require a higher power than the maximum output power of the DO40-N module must be controlled via the DO60-R-N, DO80-N module or valve control modules. Suitable control modules can be connected directly to the outputs of DO40-N.

The values for the valve control are shown in the corresponding load curve (see “Connection”).

6.17.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.17.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

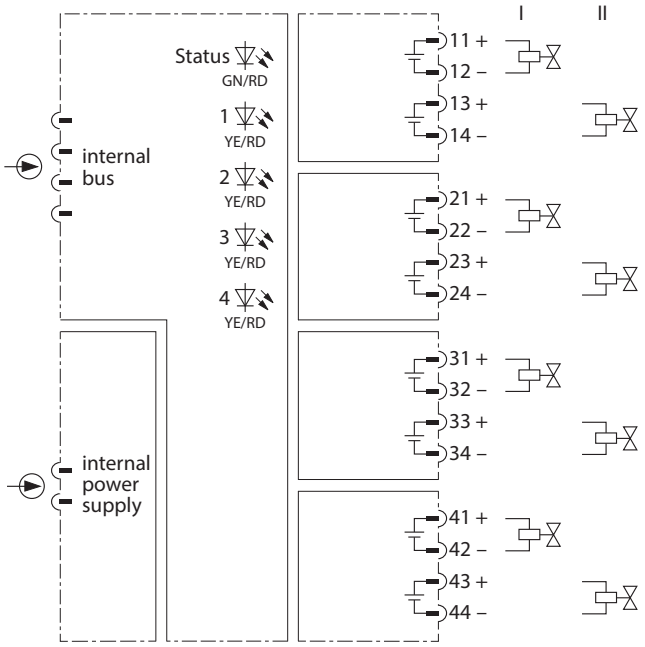

Fig. 55: Wiring diagram – DO40-N

The DO40-N digital output module has four outputs for connecting low-power field devices.

Each channel has two different connection options. These connection options have different values for open circuit voltage and can only be connected alternatively and never together. If one terminal is used, the other terminal of the same channel loses its functionality. Only one low-power field device can therefore be connected per channel.

Connection variants

Terminal connection 1 and 2

Voltage and maximum current with open circuit voltage 25 VDC	Maximum power at output
22.5 V/5 mA	112.5 mW
19 V/15 mA	285 mW

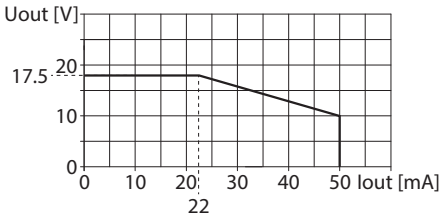

Fig. 56: Load curve – terminal connection 1 and 2

Terminal connection 3 and 4

Voltage and maximum current with open circuit voltage 19 VDC	Maximum power at output
16 V/25 mA	400 mW
14 V/35 mA	490 mW
12 V/45 mA	540 mW

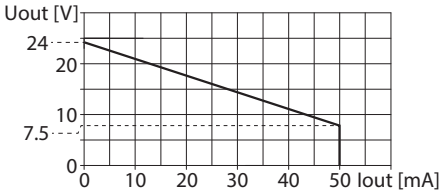

Fig. 57: Load curve – terminal connection 3 and 4

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

6.17.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…4	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present Channel errors are only detected when the output is switched.

6.17.8 Setting

The user can set the following parameters on the module:

Parameter overview – DO40

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Short circuit monitoring	**On** Off	Activating or deactivating short circuit monitoring by channel The output signal can only be monitored if the output is activated.
Wire-break monitoring	**On** Off	Activating or deactivating the wire-break monitoring by channel The output signal can only be monitored if the output is activated.
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum (0), maximum (1) or last valid value (0 or 1)
Polarity	**Normal** Inverse	Activate or deactivate signal inversion

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted		
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted		
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted		
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Reserved 0	Polarity **0: Normal** 1: Inverted		

6.17.9 Bit assignment of the output byte

The DO40-N module operates exclusively as an output card with one output byte. Unlike the digital input cards, the module is not provided with an additional status bit. The four channels are assigned to bits 0…3 of the output byte. Bits 4…7 are not assigned.

Status bit	Bit							
	7	6	5	4	3	2	1	0
Output byte	–	–	–	–	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active

6.17.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Wire break and short circuit (channel errors) are only detected when the output is switched.

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.17.11 Technical data

Type code	DO40-N
ID	6884214
Power supply	Via the module rack, central power supply module
Power consumption	≤ 4.5 W
Galvanic isolation	Complete galvanic isolation
Number of channels	4-channel
Output circuits	For low-power field devices
Open circuit voltage	24 VDC
Internal resistance R_i	300 Ω
Switching frequency	≤ 50 Hz
Short circuit	≥ 50 mA
Wire break	< 1 mA
LEDs	
Operational readiness	1 × green/red
Status/error	4 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	79 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.18 DO60R-N digital output module

6.18.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 6-channel digital relay module is used to connect digital field devices (e.g. valves or signal transmitters).

6.18.2 Device overview

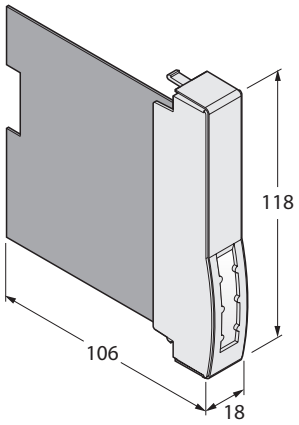

Fig. 58: Dimensions

6.18.3 Properties and features

- Six channels
- Relay output for higher switching capacity
- Configurable as output as NO contact and NC contact
- Full galvanic isolation of the output circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.18.4 Functions and operating modes

The outputs of the relay module function as isolated relay contacts for higher switching capacities. The module has four NO contacts and two changeover contacts. The four NO contacts can be set in pairs as changeover contacts.

6.18.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.18.6 Connection

NOTE
To protect the module rack, the contact circuits in the DO60R-N module are protected by fuses (1.5 AT - ceramic). Replace the module after the fuses have tripped. Connections 12…13 and 22…23 are not further protected and can be loaded with the maximum switching current of a relay contact. Preferably only use terminal 12 or 22 for connection. For trouble-free operation, even in the event of a short circuit, use a backup fuse with a melting integral <2.1 A^2s (e.g.: ESKA 522.714).

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- Connect the device as shown in the "Wiring diagram".

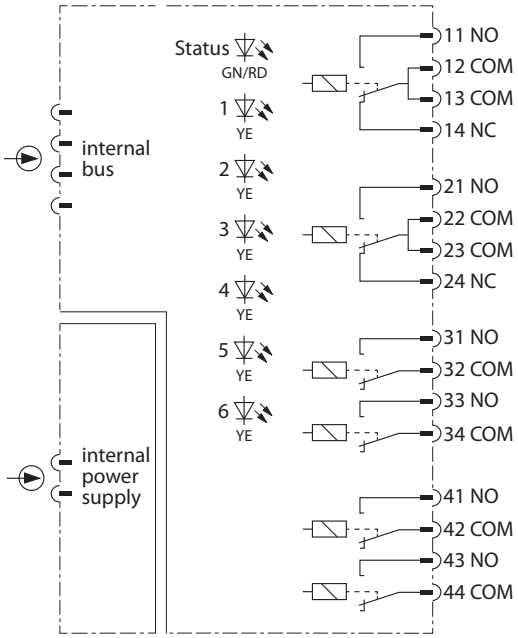

Fig. 59: Wiring diagram – DO60R-N

The DO60R-N digital output module has six outputs for connecting field devices.

- Load connections of terminals 12…13 and 22…23 max. with the switching current of a relay contact. The connections of the terminals 12…13 and 22…23 are not protected from each other.

Relay configuration

- When using channels 3 and 4 and/or 5 and 6 as changeover contacts, attach wire bridges to 32…33 and/or 42…43 accordingly and change the parameters. Terminals 34 and 44 become NC contacts due to the changeover configuration.

6.18.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…6	Off	Channel not active (not switched)
	Yellow	Channel active (switched)

6.18.8 Setting

The user can set the following parameters on the module:

Parameter overview - DO60R

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum (0), maximum (1) or last valid value (0 or 1)
Polarity	**Normal** Inverse	Activate or deactivate signal inversion
Relay configuration Channel 3 + 4 and/or 5 + 6 configurable as changeover contact	**2 NO contacts** 1 changeover	Configuring outputs (as isolated relay contacts) as NO or changeover contacts

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1 (Bit 6…4) 2 (Bit 0…2)		Polarity Channel 1 **0: Normal** 1: Inverted	Failsafe mode Channel 1 **00: Min. value** 01: Max. value 10: Last valid value			Polarity Channel 2 **0: Normal** 1: Inverted	Failsafe mode Channel 2 **00: Min. value** 01: Max. value 10: Last valid value	
1	3 (Bit 7…4) 4 (Bit 0…2)	Relay configuration Channel 3 + 4 **0: 2 NO contact** 1: 1 Changeover contact	Polarity Channel 3 **0: Normal** 1: Inverted	Failsafe mode Channel 3 **00: Min. value** 01: Max. value 10: Last valid value			Polarity Channel 4 **0: Normal** 1: Inverted	Failsafe mode Channel 4 **00: Min. value** 01: Max. value 10: Last valid value	
2	5 (Bit 7…4) 6 (Bit 7 and 2…0)	Relay configuration Channel 5 + 6 **0: 2 NO contact** 1: 1 Changeover contact	Polarity Channel 5 **0: Normal** 1: Inverted	Failsafe mode Channel 5 **00: Min. value** 01: Max. value 10: Last valid value			Polarity Channel 6 **0: Normal** 1: Inverted	Failsafe mode Channel 6 **00: Min. value** 01: Max. value 10: Last valid value	

6.18.9 Bit assignment of the output byte

The DO60R-N output module operates exclusively as an output card with one output byte. Unlike the digital input cards, the module is not provided with an additional status bit. The six channels are assigned to bits 0…5 of the output byte. Bits 6…7 are not assigned. When configured as a changeover contact, bit 2 controls channels 3 and 4, and bit 4 controls channels 5 and 6.

Status bit	**Bit**							
	7	6	5	4	3	2	1	0
Output byte	–	–	Channel 6 active	Channel 5 active	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active

6.18.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.18.11 Technical data

Type code	DO60R-N
ID	6884196
Power supply	Via the module rack, central power supply module
Max. power consumption	2 W
Galvanic isolation	Complete galvanic isolation
Number of channels	6-channel
Output circuits	6 × relays (2 x changeover contacts, 4 × NO contacts)
Switch voltage	12…60 VAC/DC
Switch current	0.01…1 A (60 VAC, 30 VDC)
	0.01…0.7 A (60 VDC)
	Switching circuits are fuse protected (1.5 AT)
Response time	Max. 15 ms/max. 8 ms
Mechanical lifespan	1×10^7 cycles
Potential isolation	Int. bus/module supply: 1500 V_{rms} Between current circuits: 500 V_{rms}
LEDs	
Operational readiness	1 × green/red
Status/error	6 × yellow
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+60 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	224 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.19 DO80-N digital output module

6.19.1 Intended Use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The DO80-N digital output module is used to connect eight 24 VDC field devices (e.g. valves or indication elements with up to 0.5 A).

6.19.2 Device Overview

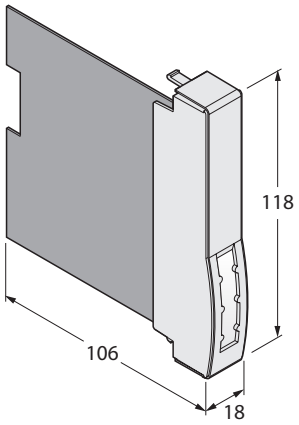

Fig. 60: Dimensions

6.19.3 Properties and Characteristics

- Eight channels
- Output module for actuators or indicator elements
- Galvanic isolation of both output groups:
  - From each other
  - From the power supply
  - From the backplane bus

6.19.4 Functions and Operating Modes

The field devices are controlled with 24 VDC. The auxiliary power is routed separately for channels 1…4 (group 1) and 5…8 (group 2) externally via the connection terminals. If the load is to be increased, the outputs within a group can be connected in parallel.

Latching and cyclic short circuit monitoring

The user can set the outputs to latching or cyclic short circuit protection. After the short-circuit has been rectified, the latching short-circuit protection is canceled by changing the signal of the control value from 0 to 1. The rising edge of the 1 signal resets the latching short-circuit protection. Latching short-circuit monitoring is restored after this step.

With cyclic short circuit protection the user does not have to reset the short circuit protection. The outputs are short circuit protected automatically until the short circuit is removed.

6.19.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.19.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

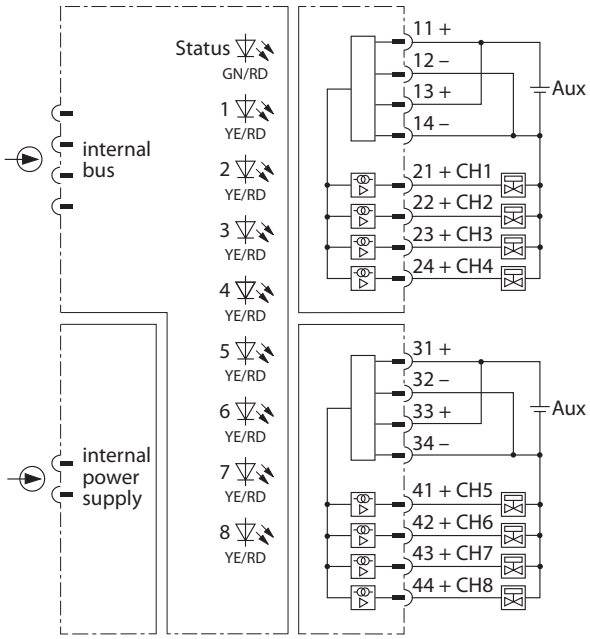

Fig. 61: Wiring diagram – DO80-N

The DO80-N digital output module has eight outputs for connecting field devices.

6.19.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
	Green flashing (fast: 2.0 Hz)	Module configured, still no data exchange between module and master
Channel 1…8	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present
	Flashing red	External power supply missing

6.19.8 Setting

The user can set the following parameters on the module:

Parameter overview – DO80

The parameters are set in pairs for the particular two channels (1/2, 3/4, 5/6, 7/8).

The default parameter values are shown in the following table in **bold** type.

Short circuit monitoring	**On** Off	Activate or deactivate the short circuit monitoring in pairs The output signal can only be monitored if the output is activated.
Wire-break monitoring	**On** Off	Activate or deactivate the wire-break monitoring in pairs The output signal can only be monitored if the output is activated.
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value in pairs: minimum (0), maximum (1) or last valid value (0 or 1)
Polarity	Normal Inverted	Activate or deactivate signal inversion in pairs
Short circuit current	**Non-locking** Locking	Set short circuit behavior parameters in pairs
Channel 1…8	**Active** Inactive	Activate or deactivate channels 1…8

The behavior of the outputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1…2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Short circuit behavior **0: Non-Locking** 1: Locking	Polarity **0: Normal** 1: Inverted	Reserved **0**	
1	3…4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Short circuit behavior **0: Non-Locking** 1: Locking	Polarity **0: Normal** 1: Inverted	Reserved **0**	
2	5…6	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Short circuit behavior **0: Non-Locking** 1: Locking	Polarity **0: Normal** 1: Inverted	Reserved **0**	
3	7…8	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Short circuit behavior **0: Non-Locking** 1: Locking	Polarity **0: Normal** 1: Inverted	Reserved **0**	
4	1…8	Channel 8 **0: Active** 1: Inactive	Channel 7 **0: Active** 1: Inactive	Channel 6 **0: Active** 1: Inactive	Channel 5 **0: Active** 1: Inactive	Channel 4 **0: Active** 1: Inactive	Channel 3 **0: Active** 1: Inactive	Channel 2 **0: Active** 1: Inactive	Channel 1 **0: Active** 1: Inactive

6.19.9 Bit assignment of the output byte

The DO80-N output module operates exclusively as an output card with one output byte. Unlike the digital input cards, the module is not provided with an additional status bit. The eight channels are assigned to bits 0…7 of the output byte.

Status bit	**Bit**							
	7	6	5	4	3	2	1	0
Output byte	Channel 8 active	Channel 7 active	Channel 6 active	Channel 5 active	Channel 4 active	Channel 3 active	Channel 2 active	Channel 1 active

6.19.10 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	2	Undervoltage U < 19.2 V
	3	Overvoltage U > 30 V
	6	Wire break
	9	Error (field circuit processor)
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	21	External power supply missing
	22	Parameter not plausible (inconsistent)

A short circuit message is triggered if the output is activated and short circuited to ground. The wire break message is triggered if outputs are activated or not activated when nothing is connected.

6.19.11 Technical data

Type code	DO80-N
ID	6884274
Power supply	Via the module rack, central power supply module
Power consumption	≤ 3 W
Galvanic isolation	Two galvanically separated groups
Number of channels	8-channel
Input circuits	
Auxiliary supply	2 × (19.2…30 VDC)
Heat dissipation	≤ 1.5 W
Output circuits	
Output current	≤ 500 mA
Switching frequency, resistive	< 50 Hz
Inductive switching frequency	< 1 Hz
Switching frequency, lamp load	< 2 Hz
Short circuit	< 48 Ω
Short-circuit protection	Yes, cyclic or latching
Wire break	with 0 signal > 10 kΩ with 1 signal > 5 kΩ
LEDs	
Operational readiness	1 × green/red
Status/error	8 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	55 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.20 TI40-N temperature module

6.20.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel temperature input module records the following temperature probes, thermocouples, extra low voltages and resistances:

Input	Types
Temperature probe: ■ 2-wire ■ 3-wire ■ 4-wire	Pt100
	Pt200
	Pt500
	Pt1000
	Ni100
	Cu100
	Pt100 (JIS)
	Pt1000 (JIS)
	Pt100 (MIL)
	Pt1000 (MIL)
	Pt100 (GOST)
Thermocouples	B
	C
	D
	E
	J
	K
	L
	L (Gost)
	N
	R
	S
	T
	U
Extra low voltages	-75…+75 mV
	-1.2…+1.2 V
Resistance measurement	0…30 Ω
	0…300 Ω
	0…3 kΩ

6.20.2 Device overview

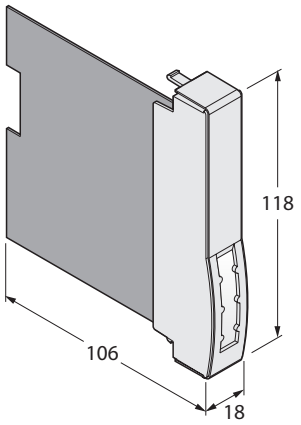

Fig. 62: Dimensions

6.20.3 Properties and features

- Four channels
- Input module for connecting RTD sensors and thermocouples
- Voltage measurement
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.20.4 Functions and operating modes

The device can be set as an input module for temperature sensors and resistors (TI40 R mode) or for thermocouples and extra low voltages (TI40 mode). All four channels operate accordingly depending on the operating mode of the device.

The digitized temperature value is output in Kelvin with a resolution of 0.1 K.

For conversion to °C, please observe an offset of 273.2. The numerical value 0…30000 corresponds to 0 to 3000 K. The following applies for conversion to °C: 0 K = -273.2 °C.

The temperature value in °C can be calculated from the numerical value with the following formula:

Temperature in °C = (digitized temperature value -2732) : 10

Line compensation

In R mode, the cable compensation function compensates the line fault for temperature measurement with temperature resistors. Cable compensation is automatic with 3-wire measurement and 4-wire measurement. With two-wire measurement a cable resistance of 0…15.5 Ω can be compensated in 0.5 Ω steps.

Cold junction compensation

In T mode, the cold junction compensation increases measuring accuracy with thermocouples. For external cold junction compensation, the comparison temperature must be measured beforehand and set in the device. Alternatively, an external cold junction compensation can be implemented for each channel by connecting temperature resistors at both free terminals. The internal cold junction compensation is implemented for all channels via an integrated Pt100 resistor.

6.20.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.20.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

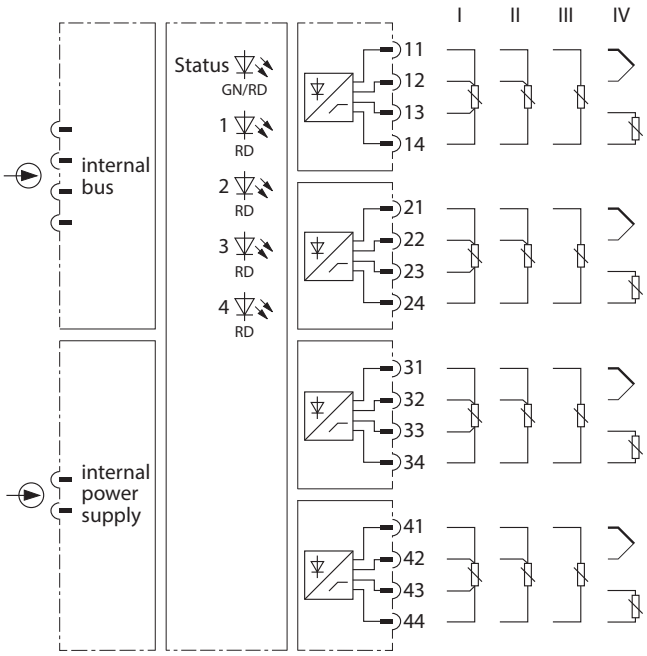

Fig. 63: Wiring diagram – TI40-N

The TI40-N analog temperature input module is provided with four inputs for connecting 2-, 3- or 4-wire temperature resistors or thermocouples.

The first channel of the device is permanently activated.

- ▶ If only one temperature sensor is used: Use channel 1.
- ▶ If channel 1 is not used: use a 100 Ω resistor to prevent diagnostic messages.

6.20.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.20.8 Commissioning

Switching on the power supply on the module rack immediately switches on the fitted device. During commissioning, the behavior of the inputs must be parameterized and the module slot configured via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

6.20.9 Setting

The user can set the following parameters on the module:

Parameter overview – TI40

The default parameter values are shown in the following table in **bold** type.

Parameters for TI40 R

Parameter name	Value	Meaning
Sensor type	**PT100 (IEC)** PT200 (IEC) PT500 (IEC) PT1000 (IEC) PT100 (JIS) PT1000 (JIS) PT100 (MIL) PT1000 (MIL) NI100 PT100 (GOST) CU100 0…30 Ω in [mΩ] 0…300 Ω [10 mΩ] 0…3 kΩ [100 mΩ]	Set the sensor type
Connection	2-wire /0 Ω Base 2-wire /8 Ω Base 3-wire **4-wire**	Choose the connection technology
Cable resistance	**Basis + 0 Ω** Basis + 0.5 Ω Basis + 1.0 Ω Basis + 2.0 Ω Basis + 2.5 Ω Basis + 3.0 Ω Basis + 3.5 Ω Basis + 4.0 Ω Basis + 4.5 Ω Basis + 5.0 Ω Basis + 5.5 Ω Basis + 6.0 Ω Basis + 6.5 Ω Basis + 7.0 Ω Basis + 7.5 Ω	Set the cable resistance With a 2-wire connection, cable resistance and base are subtracted prior to linearization. Cable resistance otherwise falsifies the result of linearization.
Short circuit monitoring	**On** Off	Activate or deactivate short circuit monitoring
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring NOTE: The wire break monitoring for channel 1 is always active. If channel 1 is not used, use a 100 Ω resistor.

Parameter name	Value	Meaning
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum (0x7FFF) or last valid value
Filter (PT1)	**Off** 1.2 s 11 s 25 s	Activate or deactivate software filter for generating an average value

Parameters for TI40 T

Parameter name	Value	Meaning
Sensor type	**Type B** Type C Type D Type E Type J Type K Type L Type L (GOST) Type N Type R Type S Type T Type U -75…+75 mV [5 µV] -1.2…+1.2 V [100 µV]	With TI40-N T set sensor type and thermocouple type
Cold junction compensation	None Internal **PT100 on terminal** External (fixed)	Choose reference point None: no cold junction compensation Internal: cold junction compensation via PT100 in the module PT100 at terminal: cold junction compensation via PT100 at the terminal of the module rack External (fixed): cold junction compensation through externally determined reference temperature (fixed value)
Wire-break monitoring	**On** Off	Activate or deactivate wire-break monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value per channel: minimum, maximum (0x7FFF) or last valid value
Filter (PT1)	**Off** 1.2 s 11 s 25 s	Activate or deactivate software filter for generating an average value
Fix junction temperature	**0 °C** 10 °C … 70 °C	Determine reference temperature with external thermocouple

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

Parameter data mapping – TI40 R

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
1	2	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
2	3	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
3	4	Short circuit monitoring **0: On** 1: Off	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
4	1…4	Connection 00: 2-wire /0 Ω Base 01: 2-wire /8 Ω Base 10: 3-wire **11: 4-wire**		Filter (PT1) **00: Off** 01: 1.2 s 10: 11 s 11: 25 s		Sensor type **0000: Pt100 (IEC 751)** 0001: Pt200 (IEC 751) 0010: Pt400 (IEC 751) 0011: Pt1000 (IEC 751) 0100: Pt100 (JIS) 0101: Pt1000 (JIS) 0110: Pt100 (MIL) 0111: Pt1000 (MIL) 1000: Ni100 1001: Pt100 (GOST) 1011: Cu100 1101: 0…30 Ω (1 mΩ) 1110: 0…300 Ω (10 mΩ) 1111: 0…3 kΩ (100 mΩ)			

Parameter data mapping – TI40 T

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Reserved: **0**	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Fix junction temperature **000: 00 °C** 001: 10 °C 010: 20 °C 011: 30 °C 100: 40 °C 101: 50 °C 110: 60 °C 111: 70 °C			Reserved: **0**
1	2	Reserved: **0**	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Fix junction temperature **000: 00 °C** 001: 10 °C 010: 20 °C 011: 30 °C 100: 40 °C 101: 50 °C 110: 60 °C 111: 70 °C			Reserved: **0**
2	3	Reserved: **0**	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Fix junction temperature **000: 00 °C** 001: 10 °C 010: 20 °C 011: 30 °C 100: 40 °C 101: 50 °C 110: 60 °C 111: 70 °C			Reserved: **0**
3	4	Reserved: **0**	Wire-break monitoring **0: On** 1: Off	Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Fix junction temperature **000: 00 °C** 001: 10 °C 010: 20 °C 011: 30 °C 100: 40 °C 101: 50 °C 110: 60 °C 111: 70 °C			Reserved: **0**

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
4	1…4	Cold junction compensation 00: None 01: Internal **10: Pt100 at terminal** 11: External (fixed)		Filter (PT1) **00: Off** 01: 1.2 s 10: 11 s 11: 25 s		**0000: Type B** 0001: Type E 0010: Type J 0011: Type K 0100: Type L 0101: Type N 0110: Type R 0111: Type S 1000: Type T 1001: Type U 1010: Type C 1011: Type D 1100: Type L (GOST) 1101: -75…+75 mV [5 µV] 1111: -1.2…+1.2 V [100 µV]			

6.20.10 Measuring ranges

Measuring range and substitute values for voltage and resistance measurement

Measuring range	**Value representation**	**Resolution**	**Not valid in event of measuring range violation**		**Substitute value with invalid measured value**	
			Underflow	**Overflow**	**min.**	**max.**
-75…+75 mV	7500… 22500	5 µV	-75 mV	+75 mV	0	32767
-1200… +1200 mV	3000… 27000	100 µV	-1200 mV	+1200 mV	0	32767
0…3000 K	0…30000	0.1 K	Sensor-specific		0	32767
0…30 Ω	0…30000	1 mΩ	0 Ω	30 Ω	0	32767
0…300 Ω	0…30000	10 mΩ	0 Ω	300 Ω	0	32767
0…3000 Ω	0…30000	100 mΩ	0 Ω	3000 Ω	0	32767

Measuring ranges of the temperature sensors

Sensor	Minimum value in K	Minimum in °C	Maximum value in K	Maximum value in °C
Pt100 (IEC)	73	- 200	1123	850
Pt200 (IEC)	73	- 200	1123	850
Pt500 (IEC)	73	- 200	1123	850
Pt1000 (IEC)	73	- 200	1123	850
Pt100 (JIS)	73	- 200	1123	850
Pt1000 (JIS)	73	- 200	1123	850
Pt100 (MIL)	73	- 200	1123	850
Pt1000 (MIL)	73	- 200	1123	850
Pt100 (GOST)	73	- 200	1373	1100
Ni100	213	- 60	523	250
Cu100	223	- 50	473	200
Type B	273	0	2093	1820
Type C	273	0	2588	2320
Type D	273	0	2588	2320
Type E	3	- 270	1273	1000
Type J	63	- 210	1473	1200
Type K	3	- 270	1645	1372
Type L	73	- 200	1173	900
Type L (GOST)	73	- 200	1073	800
Type N	3	- 270	1573	1300
Type R	223	- 50	2042	1769
Type S	223	- 50	2042	1769
Type T	3	- 270	673	400
Type U	73	- 200	873	600

6.20.11 Bit assignment of the input word

Configuring an input byte

The TI40-N module acts exclusively as an input card with eight input bytes and additional status bit (SB) for each channel. If a status message (error message) is present, the status bit of the corresponding channel is set to 1 in the input word. Depending on the selection of the **Analog data format** gateway parameter, the status bit is mapped left-justified, right-justified or not at all in the process data.

The status bit is set if there is a measuring range violation or a line error. The error can thus be evaluated consistently with regard to the measuring value.

For conversion to °C, please observe an offset of 273.2. The numerical value 0…30000 corresponds to 0 to 3000 K. The following applies for conversion to °C: 0 K = -273.2 °C.

The temperature value in °C can be calculated from the numerical value with the following formula:

Temperature in °C = (digitized temperature value -2732) : 10

Channel	Bit															
1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SB	Measured value														
	Measured value															SB
	–	Measured value														

6.20.12 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	6	Wire break
	7	Upper limit exceeded (see measuring range tables)
	8	Below lower limit (see measuring range tables)
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.20.13 Technical data

Type code	TI40-N
ID	6884222
Power supply	Via the module rack, central power supply module
Power consumption	≤ 1 W
Galvanic isolation	Complete galvanic isolation
Number of channels	4-channel
Input circuits	Pt100 (IEC)
	Pt200 (IEC)
	Pt500 (IEC)
	Pt1000 (IEC)
	Pt100 (JIS)
	Pt1000 (JIS)
	Pt100 (MIL)
	Pt1000 (MIL)
	Ni100
	Pt100 (GOST)
	Cu100
	Thermocouple: B, C, D, E, J, K, L, L (GOST), N, R, S, T, U
Measuring range for RTD 100	-200…+850 °C
Resolution	0.1 K
Full scale	Pt100: 1050 K
Linearity deviation	≤ 0.05 % of full scale at 25 °C
Temperature drift	≤ 0.005 % of full scale/K
Rise time/fall time	≤ 1.3 s (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable: 0.1 % of full scale at 25 °C
	With unshielded signal cable: 1 % of full scale at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack

Type code	TI40-N
Protection type	IP20
Ambient temperature	-20…+60 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	62 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.21 TI41-N temperature module

6.21.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The 4-channel temperature input module captures the value of 2-, 3- and 4-wire type Pt100, Ni100 and Cu100 resistors and outputs them as digital values.

6.21.2 Device overview

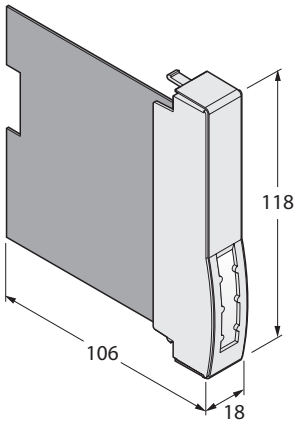

Fig. 64: Dimensions

6.21.3 Properties and features

- Four channels
- Input module for connecting RTD temperature probes
- Full galvanic isolation of the input circuits:
  - From each other
  - From the power supply
  - From the internal bus

6.21.4 Functions and operating modes

The module converts an analog input signal to a digital value of 0…16383 digits. The internal resolution is 16 bits. The digitized temperature value is output in Kelvin with a resolution of 0.1 K.

For conversion to °C, please observe an offset of 273.2. The numerical value 0…30000 corresponds to 0 to 3000 K. The following applies for conversion to °C: 0 K = -273.2 °C.

The temperature value in °C can be calculated from the numerical value with the following formula:

Temperature in °C = (digitized temperature value -2732) : 10

Line compensation

The cable compensation function compensates the line fault for temperature measurement. Cable compensation is automatic with 3-wire measurement and 4-wire measurement. With two-wire measurement a cable resistance of 0…15.5 Ω can be compensated in 0.5 Ω steps.

6.21.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.21.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

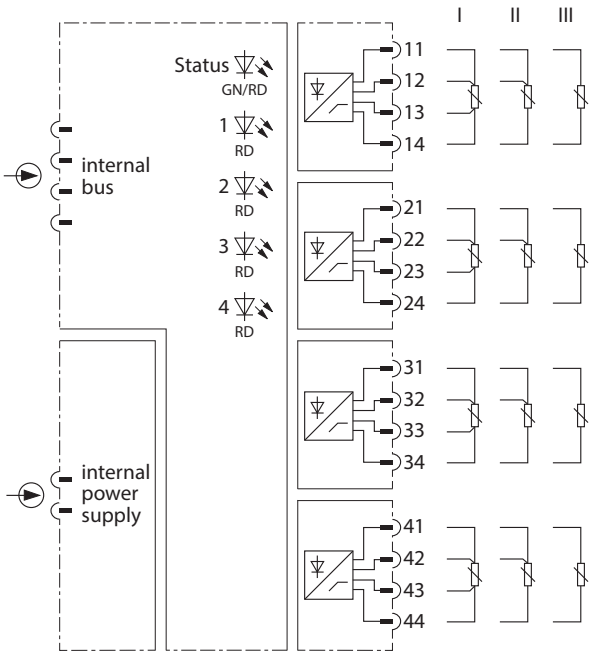

Fig. 65: Wiring diagram – T41-N

The TI41-N analog temperature input module is provided with four inputs for connecting 2-, 3- or 4-wire temperature resistors.

6.21.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module not configured for current slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…4	Off	No channel error
	Red	Channel error (wire break, short circuit): Channel diagnostics present

6.21.8 Commissioning

Switching on the power supply on the module rack immediately switches on the fitted device. During commissioning, the behavior of the inputs must be parameterized and the module slot configured via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

6.21.9 Setting

The user can set the following parameters on the module:

Parameter overview – TI41

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
Sensor type	**PT100 (IEC)** PT100 (JIS) PT100 (MIL) NI100 PT100 (GOST) CU100	Set the sensor type
Connection	2-wire /0 Ω Base 2-wire /8 Ω Base **3/4-wire**	Choose the connection technology
Cable resistance	**Basis + 0 Ω** Basis + 0.5 Ω Basis + 1.0 Ω Basis + 2.0 Ω Basis + 2.5 Ω Basis + 3.0 Ω Basis + 3.5 Ω Basis + 4.0 Ω Basis + 4.5 Ω Basis + 5.0 Ω Basis + 5.5 Ω Basis + 6.0 Ω Basis + 6.5 Ω Basis + 7.0 Ω Basis + 7.5 Ω	Set the cable resistance With a 2-wire connection, cable resistance and base are subtracted prior to linearization. Cable resistance otherwise falsifies the result of linearization.
Line monitoring	**On** Off	Activate or deactivate cable monitoring
Failsafe mode	**Min. value** Max. value Last valid value	Set substitute value by channel: minimum, maximum or last valid value
Filter (PT1)	**Off** 1.2 s 11 s 25 s	Activate or deactivate software filter for generating an average value

The behavior of the inputs is parameterized via an associated configuration tool, FDT frame or web server, depending on the higher-level fieldbus system.

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0 Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
1	2	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0 Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
2	3	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0 Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
3	4	Line monitoring **00: On** 11: Off		Failsafe mode **00: Min. value** 01: Max. value 10: Last valid value		Cable resistance: 0000: Basis + 0 Ω 0001: Basis + 0.5 Ω 0010: Basis + 1.0 Ω 0011: Basis + 1.5 Ω 0100: Basis + 2.0 Ω 0101: Basis + 2.5 Ω 0110: Basis + 3.0 Ω 0111: Basis + 3.5 Ω 1000: Basis + 4.0 Ω 1001: Basis + 4.5 Ω 1010: Basis + 5.0 Ω 1011: Basis + 5.5 Ω 1100: Basis + 6.0 Ω 1101: Basis + 6.5 Ω 1110: Basis + 7.0 Ω 1111: Basis + 7.5 Ω			
4	1…4	Connection 00: 2-wire /0 Ω Base 01: 2-wire /8 Ω Base **10: 3/4-wire**		Filter (PT1) 00: Off **01: 1.2 s** 10: 11 s 11: 25 s		Sensor type **0000: Pt100 (IEC 751)** 0100: Pt100 (JIS) 0110: Pt100 (MIL) 1000: Ni100 1001: Pt100 (GOST) 1011: Cu100			

6.21.10 Measuring ranges

Measuring ranges of the temperature sensors for TI41-N

Sensor	Minimum value in K	Minimum in °C	Maximum value in K	Maximum value in °C
Pt100 (IEC)	73	- 200	1123	850
Pt100 (JIS)	73	- 200	1123	850
Pt100 (SAMA)	73	- 200	1123	850
Pt100 (GOST)	73	- 200	1123	850[A)]
Ni100	213	- 60	523	250
Cu100	213	- 50	473	200

[A)] Not all the entire range of the GOST characteristic is supported.

6.21.11 Bit assignment of the input word

Configuring an input byte

The TI41-N module acts exclusively as an input card with eight input bytes and additional status bit (SB) for each channel. If a status message (error message) is present, the status bit of the corresponding channel is set to 1 in the input word. Depending on the selection of the **Analog data format** gateway parameter, the status bit is mapped left-justified, right-justified or not at all in the process data.

The status bit is set if there is a measuring range violation or a line error. The error can thus be evaluated consistently with regard to the measuring value.

For conversion to °C, please observe an offset of 273.2. The numerical value 0…30000 corresponds to 0 to 3000 K. The following applies for conversion to °C: 0 K = -273.2 °C.

The temperature value in °C can be calculated from the numerical value with the following formula:

Temperature in °C = (digitized temperature value -2732) : 10

Channel	Bit															
1…4	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SB	Measured value (0…30000 corresponds to 0 to 3000 K)														
	Measured value (0…30000 corresponds to 0 to 3000 K)															SB
	–	Measured value (0…30000 corresponds to 0 to 3000 K)														

6.21.12 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	6	Wire break
	7	Upper limit exceeded (see measuring range tables)
	8	Below lower limit (see measuring range tables)
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.21.13 Technical data

Type code	TI41-N
ID	6884223
Power supply	Via the module rack, central power supply module
Power consumption	1 W
Galvanic isolation	Complete galvanic isolation
Number of channels	4-channel
Input circuits	Pt100 (IEC)
	Pt100 (JIS)
	Pt100 (MIL)
	Ni100
	Pt100 (GOST)
	Cu100
Resolution	0.1 K (Cu100)
Measuring span	Normal: 10…400 Ω
	Pt100: -200…+850 °C (Cu100)
Full scale	390 mΩ (Pt100) 1050 K (Cu100)
Relative measurement deviation (including linearity, hysteresis and repeatability)	≤ 0.02 % of full scale at 25 °C
Linearity deviation	≤ 0.01 % of measuring span
Temperature drift	≤ 0.002 % of full scale/K
Rise time/fall time	≤ 50 ms (10…90 %)
Max. measurement deviation under EMC influence	With shielded signal cable ≤ 0.1 % of full scale at 25 °C
	With unshielded signal cable ≤ 0.5 % of full scale at 25 °C
LEDs	
Operational readiness	1 × green/red
Status/error	4 × red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	80 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.22 DF20-N frequency and counter module

6.22.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

Depending on the mode selected, the DF20-N frequency and counter module is used as a pulse counter of binary input signals or as a frequency counter of binary pulse sequences from NAMUR sensors according to EN 60947-5-6 or mechanical contacts.

6.22.2 Device overview

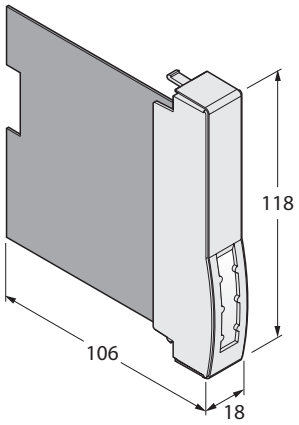

Fig. 66: Dimensions

6.22.3 Properties and features

- Two separate function blocks
- Two frequency measurement functions or counter functions
- Frequency and counter module for connecting NAMUR sensors or mechanical contacts
- Galvanic isolation:
  - Input circuits galvanically isolated from the power supply
  - Input circuits galvanically isolated from the internal bus

6.22.4 Functions and operating modes

NOTE
For error-free use, no diagnostic messages must be present at inputs or outputs of function block A or B.

The device is provided with two function blocks. Each block has one frequency or counter input as well as three control inputs and control outputs. There is no galvanic isolation between the inputs and outputs. All inputs and outputs are on a common potential. The output function provides a 4 mA current at 8 VDC.

Functions in both operating modes

- **IN A and IN B:**

  One sensor can be connected to terminals IN A and IN B each, which measures either measures the frequency or counts pulses. Both Block A as well as Block B can be used to measure frequencies or for counting pulses. The count direction (direction detection, Reset and Enable) in Counter mode can either be set externally via a control input or parameterized internally by setting a control bit. The maximum frequency in Frequency input mode with one block is 4 kHz; with 2 blocks the frequency is reduced to 2 kHz.

- **DIR A and DIR B:**

  The counter or rotation direction can be recorded with a second sensor via DIR A and DIR B. The count direction indicates whether up or down counting is active. The order in which the sensors are actuated indicates the rotation direction.

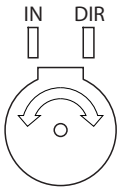

Fig. 67: Rotation direction detection with two sensors

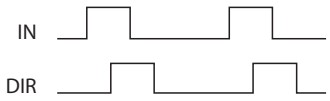

Fig. 68: Dynamic rotation direction detection IN leading

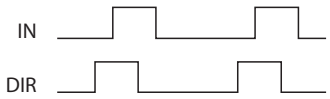

Fig. 69: Dynamic rotation direction detection IN trailing

Functions in counter mode (DF20-N P)

- **Gate A and Gate B**

  The counter process can be started via the Gate A and Gate B inputs. Alternatively, counting can be initiated via the program of the process control system (DCS):
  - 0: Counter input locked
  - 1: Counter input unlocked

- **RST A and RST B**:

  The RST A and RST B inputs are used to reset the counter. The counter is switched to the initial state (0) by resetting the overflow bit. The reset can be initiated manually via the inputs or via the software in the DCS via logic 1.

Functions in frequency counting mode (DF20-N F)

- **DIR-OUT A and DIR-OUT B**:

  The rotation direction is output via the DIR-OUT A and DIR-OUT B outputs. The output of logic 0 indicates forward motion and the output of logic 1 reverse motion.

- **ZERO A and ZERO B**

  The DCS can indicate via the ZERO A and ZERO B outputs that a measured value could be detected (1) in frequency counting or that no measured value could be detected (0). As soon as the module measures ≤ 0.1 Hz, the output value of the corresponding function block takes on the value 0.

Rotation direction detection (DF20-N F) and counter direction detection (DF20-N P) – evaluation

An input is also provided for rotation or counter direction detection in addition to the measuring input. The rotation or count direction is evaluated statically or dynamically depending on the parameters set via the host system.

Static evaluation

If static evaluation of the input signal is selected, logic 0 stands for forward motion (rotation direction) and logic 1 stands for reverse motion (rotation direction: represented as negative frequency) or down counting (count direction) .

The rotation direction detection can be set by the host system. When set by the host system, the DIR input is inactive.

Dynamic evaluation

With dynamic evaluation the rotation or counter direction is determined using the phase location between the measuring input and the input for rotation or count direction detection.

With the dynamic rotation detection, the maximum measuring frequency is 1.25 kHz.

The figures “Dynamic rotation direction IN leading” and “Dynamic rotation direction detection IN trailing” show the principle of dynamic evaluation.

Bit assignment of the input byte (measuring input) – DF20-N F Block A

The raw value corresponds to the LONG INTEGER representation, by which the resolution per digit is 0.1 mHz.

The status bits must be masked out for the conversion to Hz, and the converted untreated value must be divided by 10,000. The result is a fixed point number with four decimal places.

Status bit	Bit	7	6	5	4	3	2	1	0
1	Significance	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
	Meaning	S	0	Sign	Measured value				
2	Significance	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{18}
	Meaning	Measured value							
3	Significance	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}
	Meaning	Measured value							
4	Significance	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	Meaning	Measured value							

Designation	0	1
S: Measured value status	Valid measured value	Invalid measured value
VZ: Sign	Measured value positive	Measured value negative

Negative counter states are transferred as twos' complement values (VZ = 1) and must be converted for display. The representation can also be used on function block B. In this case bytes 5…8 are assigned.

Bit assignment of the input byte (measuring input) – DF20-N F Block A

Status bit	Bit	7	6	5	4	3	2	1	0
1	Significance	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
	Meaning	S	OV	Sign	Counter state				
2	Significance	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{18}
	Meaning	Counter state							
3	Significance	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}
	Meaning	Counter state							
4	Significance	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	Meaning	Counter state							

Designation	0	1
S: Measured value status	Valid measured value	Invalid measured value
OV: Overflow	No overflow	Overflow
VZ: Sign	Measured value positive	Measured value negative

Negative counter states are transferred as twos' complement values (VZ = 1) and must be converted for display. The representation can also be used on function block B. In this case bytes 5…8 are assigned.

Bit assignment of the output byte – DF20-N F Block A

Bit	7	6	5	4	3	2	1	0
Meaning	–	–	–	–	Up/Down	–	–	–

Designation	0	1
Up/Down: Rotation direction	Positive frequency	Negative frequency

Output byte 1 has the same structure and controls function block B.

Bit assignment of the output byte – DF20-N P Block A

Bit	7	6	5	4	3	2	1	0
Meaning	–	–	–	–	Up/Down	RST OV	Gate	RST

Designation	0	1
Up/Down: Count direction	Up	Down
RST OV: Reset of the overflow bit OV (with values that are too high for the valid number range)	Overflow bit released	Overflow bit is reset
Gate: With host controller, the counter is enabled	Counter locked	Counter unlocked
RST: Counter reset	Counter unlocked	Counter reset and locked

Output byte 1 has the same structure and controls function block B.

6.22.5 Mounting

Multiple devices can be mounted directly next to each other on the module rack. The devices can also be changed during operation.

- ▶ Protect the mounting location from thermal radiation, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- ▶ Plug the device into the designated position on the module rack so that it noticeably snaps into place.

6.22.6 Connection

When plugged into the module rack, the device is connected to the module rack's internal power supply and data communication. Terminal blocks with screw or spring-loaded terminals can be used to connect the field devices.

- ▶ Connect the device as shown in the "Wiring diagram".

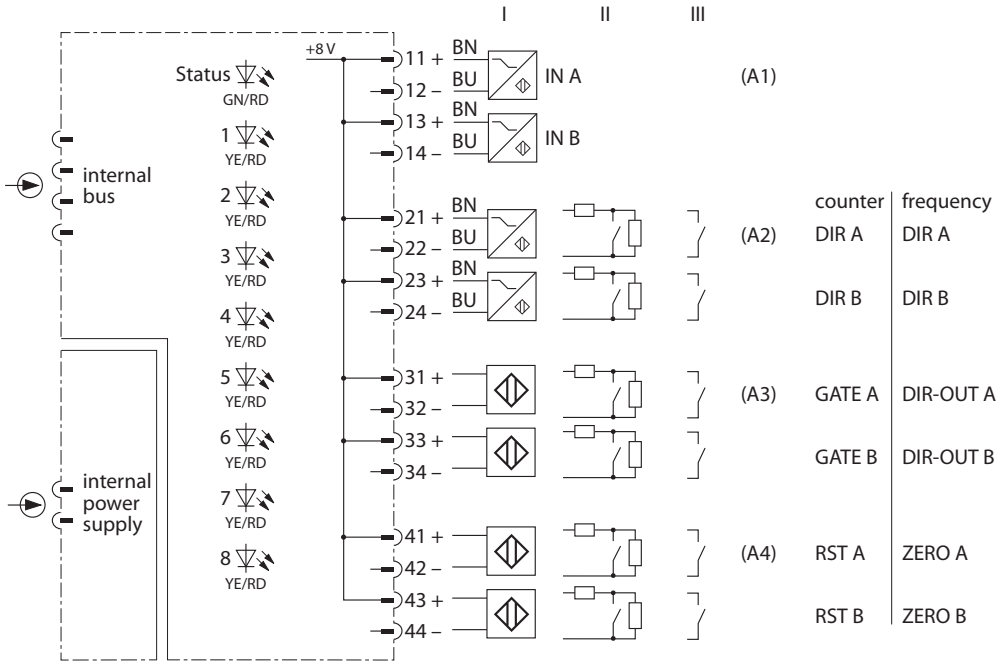

Fig. 70: Wiring diagram – DF20-N

The DF20-N digital input module is provided with eight inputs (two function blocks with four inputs each) for connecting max. four NAMUR sensors.

Depending on the operating mode, both function blocks can be used either as pulse counters or frequency counters.

NOTE
The inputs are not galvanically isolated from each other. When connecting the field devices bear in mind that all inputs are connected to a common ground potential.

6.22.7 LED indications

LEDs on the front of the module indicate module status and channel diagnostics.

LED	Indication	Meaning
Status	Off	No power supply
	Flashing red	Module is not configured for this slot
	Green	Power supply and communication error-free
	Green flashing (slow: 0.5 Hz)	Module not yet configured by the gateway and is waiting for configuration data
	Green flashing (1.0 Hz asym.)	Module in failsafe mode
Channel 1…8	Off	Channel not active (not switched)
	Yellow	Channel active (switched)
	Red	Channel error (wire break, short circuit): Channel diagnostics present

Overview of the channel LEDs DF20-N P

Channel LED	Meaning
1	IN A
2	UP/DOWN A
3	MRS A
4	RST A
5	IN B
6	UP/DOWN B
7	MRS B
8	RST B

Overview of the channel LEDs DF20-N F

Channel LED	Meaning
1	IN A
2	DIR A
3	DIR_OUT A
4	ZERO (f ≤ 0.1 Hz channel A)
5	IN B
6	DIR B
7	DIR_OUT B
8	ZERO (f ≤ 0.1 Hz channel B)

6.22.8 Setting

The DF20-N module is not provided with physical channels but function blocks (A and B). The DF20-N does not therefore require parameterization by channel but the parameterization of the function blocks.

The following example shows function block A with the corresponding signal lines A1, A2, A3 and A4 (cf. DF20-N block diagram). Function block B with the signal lines B1…B4 has behaves in the same way as function block A.

The user can set the following parameters on the module:

Parameter overview DF20 F (frequency measurement)

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
A1…A4: Line monitoring	**On** Off	Activate or deactivate wire break and short circuit monitoring
A: Failsafe mode input	**Min. value** Max. value Last valid value	Chose substitute value for the input value: Min. value: The input value of the corresponding function block assumes the value 0. Max. value: The input value of the corresponding function block assumes the value 0xFFFFFFF. Last valid value: The input value of the corresponding function block retains the last valid value.
A: Failsafe mode output	**Min. value** Max. value Last valid value	Select substitute value for the output value: Min. value: The output value of the corresponding function block assumes the value 0. Max. value: The output value of the corresponding function block assumes the value 1. Last valid value: The output value of the corresponding function block retains the last valid value (0 or 1).
A: Direction detection	**Up (f < 4 kHz)** Host controlled (f < 4 kHz) Terminal (f < 4 kHz) Terminal (auto, f < 1.25 kHz)	Select the type of rotation direction detection: Up: Rotation direction detection forward Host controlled: The rotation direction detection is set by the up/down control bit. Terminal: Rotation direction detection is controlled by the measuring inputs of channel 3 (function block A) or channel 4 (function block B) (cf. static evaluation). Terminal (auto): The rotation direction detection is carried out by the second measuring input (z. B. DIR A). This parameter setting allows the measurement of a frequency up to 1.25 kHz.

Parameter name	Value	Meaning
Cycle time	**< 300 ms (0.1 % resolution)** < 50 ms (1 % resolution)	Select the measuring cycle and the accuracy resulting from it
Average	**Off** 4 values 8 values 16 values	Number of sampling intervals for floating average forming
Damping control inputs	**Off** 50 ms	Activate or deactivate additional input debounce
A1…A4: Polarity	**Normal** Inverse	Activation or deactivation of the direction reversal of the signal

Parameter overview DF20 P (counter function)

The default parameter values are shown in the following table in **bold** type.

Parameter name	Value	Meaning
A1…A4: Line monitoring for the inputs and outputs	**On** Off	Activate or deactivate wire break and short circuit monitoring
A: Failsafe mode input	**Min. value** Max. value Last valid value	Chose substitute value for the input value: Min. value: The input value of the corresponding function block assumes the value 0. Max. value: The input value of the corresponding function block assumes the value 0x 1F FF FF FF. Last valid value: The input value of the corresponding function block retains the last valid value.
A: Failsafe mode output	**Min. value** Max. value Last valid value	Select substitute value for the output value: Min. value: The output value of the corresponding function block assumes the value 0. Max. value: The output value of the corresponding function block assumes the value 1. Last valid value: The input value of the corresponding function block retains the last valid value.
A: Direction detection	**Up (f < 4 kHz)** Host controlled (f < 4 kHz) Terminal (f < 4 kHz) Terminal (auto, f < 1.25 kHz)	Select the type of direction detection: Up: Direction detection forward (positive) Host controlled: The direction detection is set by the up/down control bit. Terminal: The direction detection is set by the up/down control bit (static). Terminal (auto): Direction detection is controlled by the measuring inputs of channel 3 (function block A) or channel 4 (function block B) (cf. dynamic evaluation).

Parameter name	Value	Meaning
A: Counter reset	**Host controlled** Terminal	The counter is either reset by the host or via the terminals.
A: Count edges	**Rising** Rising and falling	Select edge counting type Either only rising or rising and falling edges are counted.
A: Gate	**Host controlled** Terminal	Select counter enable
A: Range	100 Hz 0…1 kHz **0…4 kHz**	Select measuring range
A: Filter for control inputs	**Off** 50 ms	Activate or deactivate additional input debounce
A1…A4: Polarity	**Normal** Inverse	Activation or deactivation of the direction reversal of the signal

Parameter data mapping

The following bits and bytes can be set via the parameters.

The default parameter values are shown in the following table in **bold** type.

Parameter data mapping – DF20 F

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0		B4: Line monitoring 0: On 1: Off	B3: Line monitoring 0: On 1: Off	B2: Line monitoring 0: On 1: Off	B1: Line monitoring 0: On 1: Off	A4: Line monitoring 0: On 1: Off	A3: Line monitoring 0: On 1: Off	A2: Line monitoring 0: On 1: Off	A1: Line monitoring 0: On 1: Off
1		A: Failsafe mode input **00: Min. value** 01: Max. value 10: Last valid value		A: Failsafe mode output **00: Min. value** 01: Max. value 10: Last valid value		A: Direction detection **00: Up (f < 4 kHz)** 01: Host controlled (f < 4 kHz) 10: Terminal (f < 4 kHz) 11: Terminal (auto, f > 1.25 kHz)		A: Damping control inputs 0: Off 1: 50 ms	A: Cycle time **0: < 300 ms (0.1 % resolution)** 1: < 50 ms (1 % resolution)
2		A: Average 00: Off 01: 4 values 10: 8 values 11:16 values		Reserved **00**		A4: Polarity **0: Normal** 1: Inverted	A3: Polarity **0: Normal** 1: Inverted	A2: Polarity **0: Normal** 1: Inverted	A1: Polarity **0: Normal** 1: Inverted
3		B: Failsafe mode input **00: Min. value** 01: Max. value 10: Last valid value		B: Failsafe mode output **00: Min. value** 01: Max. value 10: Last valid value		B: Direction detection **00: Up (f < 4 kHz)** 01: Host controlled (f < 4 kHz) 10: Terminal (f < 4 kHz) 11: Terminal (auto, f > 1.25 kHz)		B: Damping control inputs **0: Off** 1: 50 ms	B: Cycle time **0: < 300 ms (0.1 % resolution)** 0: < 300 ms (0.1 % resolution) 1: < 50 ms (1 % resolution)
4		B: Average 00: Off 01: 4 values 10: 8 values 11:16 values		Reserved **00**		B4: Polarity **0: Normal** 1: Inverted	B3: Polarity **0: Normal** 1: Inverted	B2: Polarity **0: Normal** 1: Inverted	B1: Polarity **0: Normal** 1: Inverted

Parameter data mapping – DF20 P

		Bit no.							
Byte no.	**Channel no.**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0		B4: Line monitoring 0: On 1: Off	B3: Line monitoring 0: On 1: Off	B2: Line monitoring 0: On 1: Off	B1: Line monitoring 0: On 1: Off	A4: Line monitoring 0: On 1: Off	A3: Line monitoring 0: On 1: Off	A2: Line monitoring 0: On 1: Off	A1: Line monitoring 0: On 1: Off
1		A: Failsafe mode input **00: Min. value** 01: Max. value 10: Last valid value		A: Failsafe mode output **00: Min. value** 01: Max. value 10: Last valid value		A: Direction detection **00: Up** **(f < 4 kHz)** 01: Host controlled (f < 4 kHz) 10: Terminal (f < 4 kHz) 11: Terminal (auto, f > 1.25 kHz)		A: Damping control inputs 0: Off 1: 50 ms	A: Reset counter **0: Host controlled** 1: Terminal
2		A: Edge counting **0: Rising** 1: Rising and falling	A: Enable **0: Host controlled** 1: Terminal	A: Measuring range 00: 0…100 Hz 01: 0…1 kHz **10: 0…4 kHz**		A4: Polarity **0: Normal** 1: Inverted	A3: Polarity **0: Normal** 1: Inverted	A2: Polarity **0: Normal** 1: Inverted	A1: Polarity **0: Normal** 1: Inverted
3		B: Failsafe mode input **00: Min. value** 01: Max. value 10: Last valid value		B: Failsafe mode output **00: Min. value** 01: Max. value 10: Last valid value		B: Direction detection **00: Up** **(f < 4 kHz)** 01: Host controlled (f < 4 kHz) 10: Terminal (f < 4 kHz) 11: Terminal (auto, f > 1.25 kHz)		B: Damping control inputs **0: Off** 1: 50 ms	B: Rest counter **0: Host controlled** 1: Terminal
4		B: Edge counting **0: Rising** 1: Rising and falling	B: Enable **0: Host controlled** 1: Terminal	B: Measuring range 00: 0…100 Hz 01: 0…1 kHz **10: 0…4 kHz**		B4: Polarity **0: Normal** 1: Inverted	B3: Polarity **0: Normal** 1: Inverted	B2: Polarity **0: Normal** 1: Inverted	B1: Polarity **0: Normal** 1: Inverted

6.22.9 PROFIBUS: diagnostic information

The diagnostics data is structured according to EN 61158, part 1/3/10.

Besides the module status (device-specific diagnostics) and the status overview (ID diagnostics) the module supports the following channel status indications (channel-specific diagnostics):

Error code	No.	Meaning
Standard	1	Short circuit
	6	Wire break
Specific	19	Module type (set configuration) unknown
	20	Module type (actual configuration) unknown
	22	Parameter not plausible (inconsistent)

6.22.10 Technical data

Type code	DF20-N F and P
ID	6884212
Power supply	Via the module rack, central power supply module
Power consumption	1 W
Galvanic isolation	From the internal bus and from the power supply circuit
Number of channels	2-channel
Input circuits	According to EN 60947-5-6 (NAMUR)
Open circuit voltage	8 VDC
Short-circuit current	4 mA
Switching threshold on/off	Typ. 1.8/typ. 1.4 mA
Switching frequency	≤ 4000 Hz
Short circuit	< 367 Ω
Wire break	< 0.2 mA
Measurement accuracy (including linearity, hysteresis and repeatability)	≤ 0.1 % (for frequency measurement)
LEDs	
Operational readiness	1 × green/red
Status/error	8 × yellow/red
Housing material	Plastic
Fixing type	Module design, pluggable in the module rack
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	101 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	18 × 118 × 106 mm

6.23 OC11Ex/3G.2 PROFIBUS-DP FO coupler

6.23.1 Intended use

The OC11Ex/3G.2 converts the Profibus DP signals for copper lines into optical signals for fiber optic cables and vice versa. The couplers enable the isolated and interference free transmission of bus signals to a PROFIBUS-DP station (e.g. to the excom I/O system) over distances of up to 2500 m.

The OC11Ex/3G FO coupler is suitable for use in Zone 2 and converts the fiber optic signals of an OC11Ex/2G FO coupler installed in Zone 1 to a RS485 signal. By connecting two OC11Ex/3G.2 fiber optic couplers, fiber optic transmission in the safe area and zone 2 is also possible, as well as switching between RS485 and fiber optic transmission.

The couplers of the OC11Ex/…G version cannot be combined with the couplers of version OC11Ex/…G.2.

6.23.2 Notes on Ex protection

- When using the device in Ex circuits, the user must also have an additional knowledge of explosion protection (IEC/ EN 60079-14 etc.).
- Use the device only within the permissible operating and ambient conditions (see approval data and Ex approval specifications).
- Observe national and international regulations for explosion protection.
- Ensure sufficient ventilation if the devices are to mounted directly next to each other.
- Do not open the device. Otherwise, the approval will expire.

Requirements for ATEX and IECEx approval

When used in Zone 2:

- Install the device in a separately approved enclosure in accordance with IEC/EN 60079-7 (“increased safety”) with a protection type of at least IP54 per IEC/EN 60529.
- Implement electrically insulating fiber optic cables and use without shielding or armor.

6.23.3 Device overview

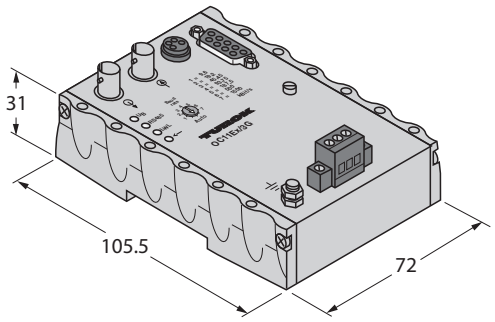

Fig. 71: Dimensions

6.23.4 Properties and features

- FO segment coupler
- Data transmission between electrical and optical fieldbus circuits
- Full galvanic isolation
- Standard RS485 Profibus interface
- Intrinsically safe optical interface with ST connectors for transmitter and receiver terminals
- PROFIBUS-Link communication interface for the connection of two OC11Ex couplers for redundancy and repeater function
- Transmission range with OM1 fiber optic cable up to 2500 m, with OM2 fiber optic cable up to 1500 m
- Automatic baud rate detection and setting of fixed baud rate
- Max. 31 bus devices (e.g. excom I/O systems) at the electrical connection
- Repeater function
- Support of various redundancy functions

6.23.5 Functions and operating modes

Segment coupler

The OC11Ex/3G FO coupler supports Profibus-DP protocols and is equipped with the following interfaces:

- Standard RS485 interface
- Optical interface with ST connectors for transmitter and receiver terminals
- Profibus link communication interface for connecting two OC11Ex3G.2 couplers for redundancy and repeater functions

The device converts standard RS485 signals into intrinsically safe optical signals and vice versa. The intrinsically safe signals are routed via the optical interface of the segment coupler to the Ex area via fiber optic cables. This enables the isolated and interference free transmission of bus signals over long distances up to Zone 1. Line errors (wire-break/short-circuit) are not transferred from one segment to the other. The OC11Ex coupler is a physical station and must therefore be considered in a segment as one of the maximum 32 possible bus participants.

The OC11Ex/3G FO coupler can be provided with a 24 VDC supply in the field without any additional isolating devices (protection type Ex e).

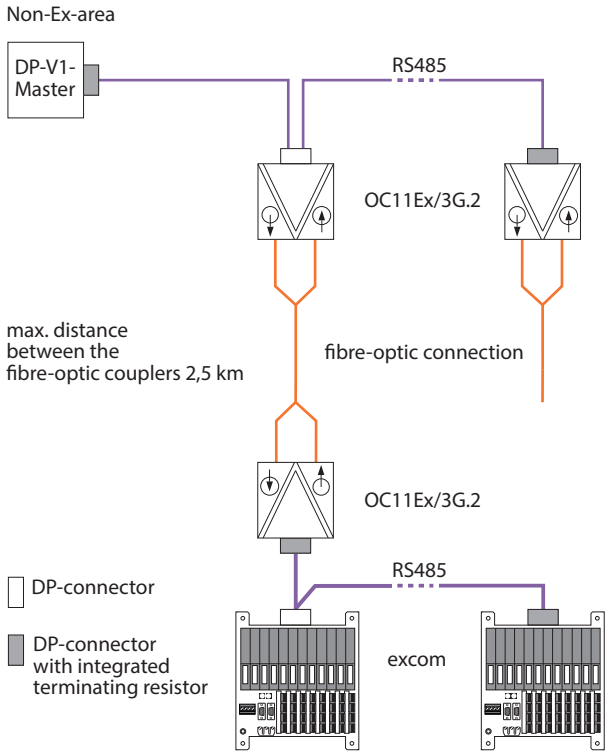

Fig. 72: Connection of two OC11EX/3G.2 couplers – signal transmission with fiber optics

Repeater function

Repeaters are required if a network consists of more than 32 physical stations or if the cable length of a bus segment is greater than the maximum permissible range. Repeaters divide up the fieldbus network into segments of up to 32 stations each, connect the different segments together and regenerate the bus signal to be transferred. This makes it possible to increase the number of stations, to electrically isolate stations and segments and cover large distances. Repeaters, unless they are diagnostic repeaters, do not have their own bus address.

The OC11Ex/3G.2 fiber optic segment coupler is not only used for Ex separation and the conversion of electrical and optical signals, but can also be used as a repeater: The coupler regenerates the signal amplitude, slew rate and bit width of the data telegram when Profibus telegrams are transmitted. PROFIBUS-DP telegrams with a valid start delimiter are forwarded, otherwise these are discarded. This makes it possible to transmit the signals over long distances and increase the number of stations both in the segment and in the network.

Redundancy connections

The device also has an M8 communication interface (8-mm snap-in socket) in addition to the SUB-D Profibus-DP terminal. This interface can be used to establish a redundancy connection between two OC11Ex3G.2 devices for setting up line and system redundancies.

Line redundancy

With line redundancy, a master is connected with an OC11Ex/3G.2 FO coupler. Another FO coupler is connected to this FO coupler. A new line is created from the second fiber optic coupler by connecting to further segments of the network. With this concept, redundancy is only provided behind the only master of the network.

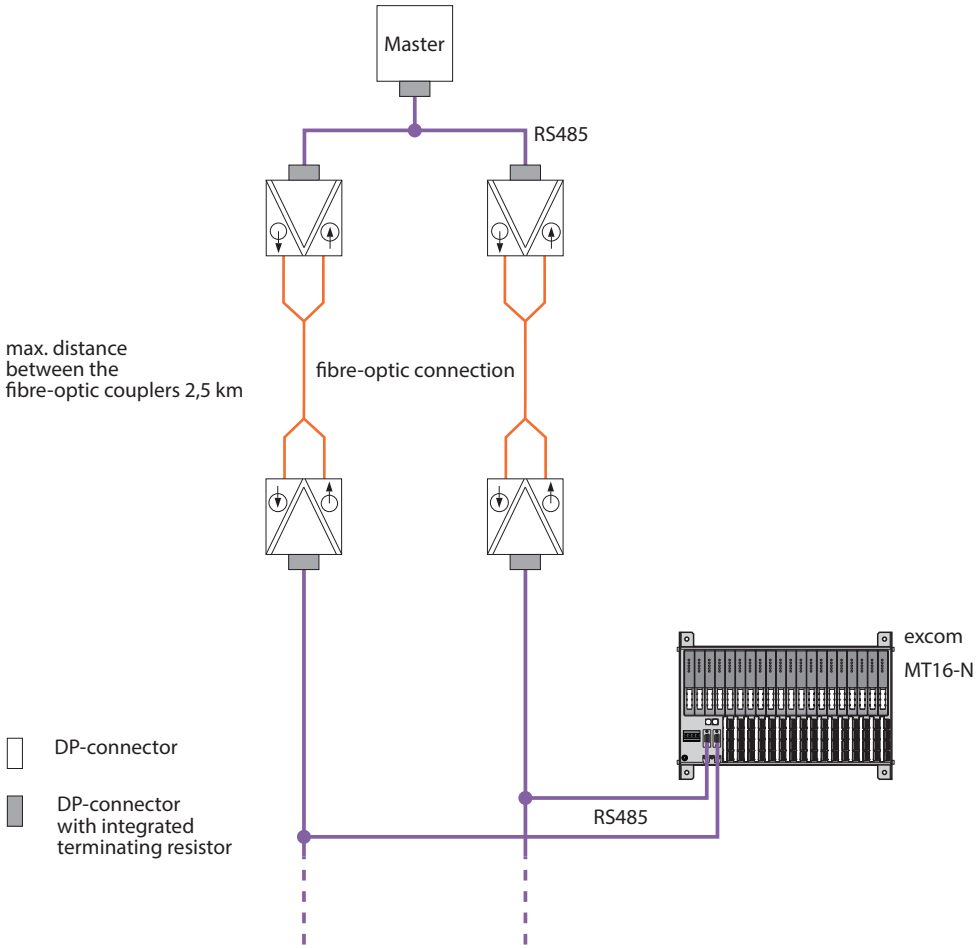

Fig. 73: Line redundancy

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

System redundancy

A continuously redundant system requires two masters. One FO coupler is connected to each master, which in turn is connected to another FO coupler or another segment of the network (max. 32 stations in the entire network). The connection of the respective master to the individual segments of the network up to the respective gateway runs in parallel. This splits the fieldbus into two separate lines after the FO connection.

With end-to-end redundancy up to the gateway, errors do not lead to data loss.

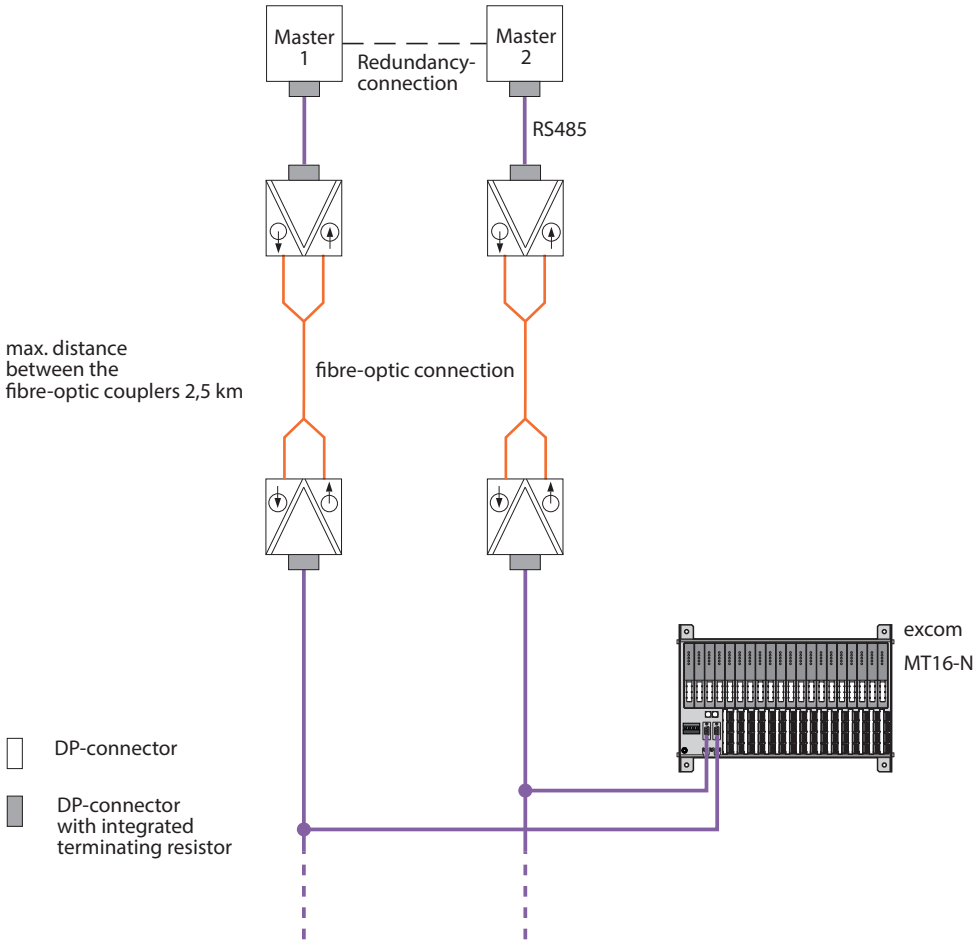

Fig. 74: End-to-end redundancy (system redundancy)

6.23.6 Installing

DANGER
Potentially explosive atmosphere
Risk of explosion through spark ignition
When used in Zone 2:

- Only install the device if there is no potentially explosive atmosphere present.
- Install the device in an Ex e housing in accordance with IEC/EN 60079-7 with a protection type of at least IP54.
- When mounting the device, ensure that its permissible operating temperature is not exceeded even in unfavorable ambient conditions.
- Implement electrically isolating fiber optic cables and use without shielding or armor.
- When connecting different areas via the FO cable: Only use additional lens systems or light amplifiers if they have been specifically approved for this purpose.

The devices can be mounted directly next to each other.

- Protect the mounting location from radiated heat, sudden temperature fluctuations, dust, dirt, humidity and other ambient influences.
- Fit the device at the intended mounting location.

6.23.7 Connection

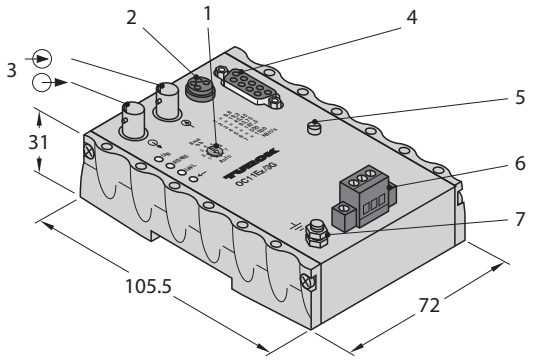

Fig. 75: OC11Ex/3G – connections and interfaces

Position	Description
1	Rotary switch for setting the baud rate
2	PROFIBUS Link communication interface for connecting two OC11Ex.3 couplers for redundancy and repeater functions
3	Intrinsically safe optical interface for transmitter and receiver terminals (2 × ST male connectors)
4	RS485 interface PROFIBUS-DP (SUB-D socket, 9-pin)
5	Shield connection for capacitive or direct grounding
6	Terminal for power supply (male connector , 3-pin)
7	Ground terminal bolt (M5 thread)

Connecting the OC11Ex/3G.2 FO coupler to the fieldbus

- Only connect the OC11Ex/3G.2 FO coupler to fiber optic cable with a multimode fiber optic core.

When using single mode cores, error-free signal transmission cannot be guaranteed.

The PROFIBUS interface is provided with a 9-pin SUB-D female connector.

- Connect the device to the fieldbus using a standard PROFIBUS SUB-D connector.

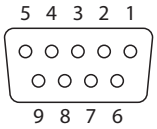

Fig. 76: SUB-D female connector

SUB-D pin layout

Pin No.	RS485	Meaning
1	n. c.	Not connected
2	n. c.	Not connected
3	RxD/TxD-P	Receive data/send data B line (red)
4	n. c.	Not connected
5	DGND	Bus termination GND
6	VP	Bus termination VP (power supply +)
7	n. c.	Not connected
8	RxD/TxD-N	Receive data/send data of A line (green)
9	n. c.	Not connected

Standard PROFIBUS-DP connectors can be used on the RS485 port. For active termination of the PROFIBUS-DP connector, the connector has a switchable resistor combination e.g. D9T-RS485 (ID 6890942) or D9T-RS485PG (ID 6890943).

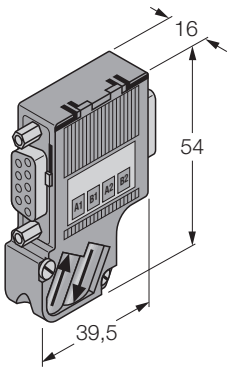

Fig. 77: D9T-RS485PG – dimensions

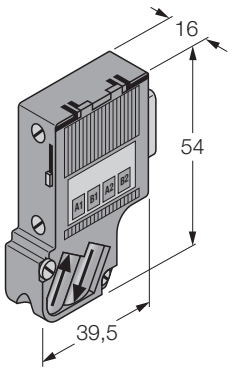

Fig. 78: D9T-RS485 – dimensions

Shielding and grounding

The FO coupler forms by design a capacitive connection between the shield of the connected fieldbus cable and the grounding bolt.

A grounding bolt with an M5 thread is provided for the equipotential bonding of the housing.

Connecting the FO coupler to fibre optic cable

- Connect the fiber optic cable via two ST connectors.

Connecting the FO coupler to the power supply

The device is provided with a 3-pin plug connectors for connecting the power supply. The maximum terminal cross section is:

	Single connection	Multi-wire connection
Rigid	4 mm^2	0.2…2.5 mm^2
Flexible	2.5 mm^2	0.2…1 mm^2

- Strip the connection cables (9 mm).
- Tighten the terminals. The tightening torque is 0.5…0.6 Nm.

Connecting the M8 interface

The device is provided with an M8 interface for internal communication.

- Connect the communication interface via a 4-pin M8 connector OC11-LINKCABLE, ID 8031339) .

The internal communication interface must only be connected with another OC11EX/3G device.

6.23.8 LED indications

DP interface (PROFIBUS) – data traffic

LED	Color	Meaning
U_B	Green	Power supply error-free
	Off	Input voltage too low
RS485	Red	Error in PROFIBUS segment
	Yellow	Device receiving valid data
	Off	No data traffic
FO	Red	Error in FO segment
	Yellow	Device receiving valid data
	Off	No data traffic
Auto	Yellow	Transmission rate detected
	Yellow flashing	Transmission rate detection active
	Off	Transmission rate set via rotary switches

6.23.9 Setting

Baud rate set via rotary switches

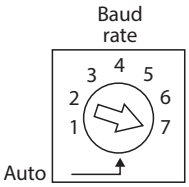

Fig. 79: Setting the baud rate

▶ Permanently set the baud rate via the rotary switch position according to the following table.

Rotary switch position	Baud rate	Max. segment length
Auto	Automatic detection	
1	9.6 kbps	1200 m
2	19.2 kbps	1200 m
3	45.45 kbps	1200 m
4	93.75 kbps	1200 m
5	187.5 kbps	1000 m
6	500 kbps	400 m
7	1.5 Mbps	200 m

NOTE
When using an ABB RLM01, a fixed transmission rate must be set (rotary switch position 1…7).
The automatic transmission rate (position Auto) can lead to faulty communication.

6.23.10 Technical data

Type code	OC11Ex/3G.2
ID	6890428
Rated voltage	24 VDC
Supply voltage range	18…32 VDC
Current consumption	≤ 100 mA
Galvanic isolation	Complete galvanic isolation acc. to IEC/EN 60079-11
Number of channels	1-channel
Baud rate	9.6 kbps to 1.5 Mbps
Ex approval acc. to conformity certificate	IECEx PTB 16.0002X
Device designation	Ex nAc [op is Gb] IIC T4
Ex approval acc. to conformity certificate	PTB 05 ATEX 2052 X
Ex device designation	Ⓔx II 3(2) G Ex nAc [op is Gb] IIC T4
LEDs	
Operational readiness	1 × green
Status/error	2 × yellow/red
Baud rate detection	1 × yellow
Interfaces/connection technology	
RS 485 PROFIBUS-DP	1 × SUB-D connector, 9-pin
FO	2 × ST male connectors
Power supply	Screw connector, 3-pin
PROFIBUS LINK communication interface	1 × M8 connector
Equipotential bonding (PA)	M5 × 1 grounding bolt
Housing material	Anodized aluminum
Front plate	FR4, gray
Fixing type	Snap-fit on DIN rail (EN 60715) or wall mounting
Protection type	IP20
Ambient temperature	-20…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
Vibration test	Acc. to EN 60068-2-6
Shock testing	Acc. to EN 60068-2-27
EMC	Acc. to EN 61326-1 acc. to NAMUR NE21
MTTF	442 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	72 × 105.5 × 31 mm

Type code	OC11Ex/3G.2
Approvals	ATEX
	TR CU
	KOSHA
	INMETRO
	GL
	DNV
	BV
	LR

6.24 SC11-3G segment coupler

6.24.1 Intended use

The SC11-3G segment coupler is used to connect PROFIBUS-DP and Modbus RTU to the excom system. The device provides an RS485 line for connecting up to 32 stations (e.g. excom stations). The data transmission between fieldbus, coupler and bus station is implemented with copper cable.

The segment coupler regenerates the data telegrams to be transmitted. This makes it possible to increase the number of stations and transmit the signals over large distances.

Different redundancy concepts (line, system or device redundancy) can be implemented by interconnecting several segment couplers.

The device is suitable for operation in Zone 2.

6.24.2 Notes on Ex protection

Installation in Zone 2:

- Do not connect or disconnect the RS485 connector when energized.

Use of devices in Zone 2 and Zone 22:

- Install the devices in a separately approved enclosure in accordance with IEC/EN 60079-7 (“increased safety”) with a protection type of at least IP54 per IEC/EN 60529.

6.24.3 Device overview

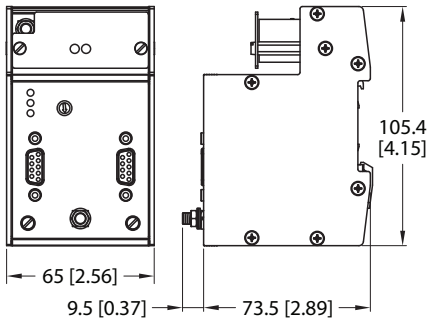

Fig. 80: Dimensions

6.24.4 Properties and features

- Segment coupler for Zone 2
- Connection of PROFIBUS-DP and Modbus RTU
- Transmission via copper cable
- 2 × PROFIBUS-DP RS485 interfaces
- Automatic baud rate detection and setting of fixed baud rate
- Connection of up to 31 stations to one coupler
- Repeater function
- Transmission routes up to 1200 m
- Line, system or device redundancy possible

6.24.5 Functions and operating modes

Segment coupler

The SC11/-3G segment coupler supports PROFIBUS-DP and Modbus RTU protocols and is equipped with the following interface:

- 2 × standard RS485 interfaces

The SC11-3G segment coupler is suitable for operation in Zone 2. Line errors (wire-break/short-circuit) are not transferred from one segment to the other. The SC11-3G coupler is a physical station and must be included when calculating the maximum number of bus stations within a segment.

Repeater function

The segment coupler also has a repeater function. This makes it possible to regenerate the signals before transmission or to extend fieldbus networks.

Repeaters are required if a network consists of more than 32 stations. Repeaters make it possible to increase the number of stations, to isolate stations and segments and cover large distances. Repeaters divide up the fieldbus network into segments of up to 32 stations each, connect the different segments together and regenerate the bus signal to be transferred. Repeaters, do not have their own bus address unless they are diagnostic repeaters.

The SC11-3G segment coupler can be used as repeater: The coupler regenerates the signal amplitude, slew rate and bit width of the data telegram when PROFIBUS telegrams are transmitted. PROFIBUS-DP telegrams with a valid start delimiter are forwarded, otherwise they are discarded. The coupler regenerates the bit length and signal amplitude of the data telegrams with Modbus RTU and other byte-oriented serial data streams. This makes it possible in the entire network to transmit the signals over long distances and increase the number of stations.

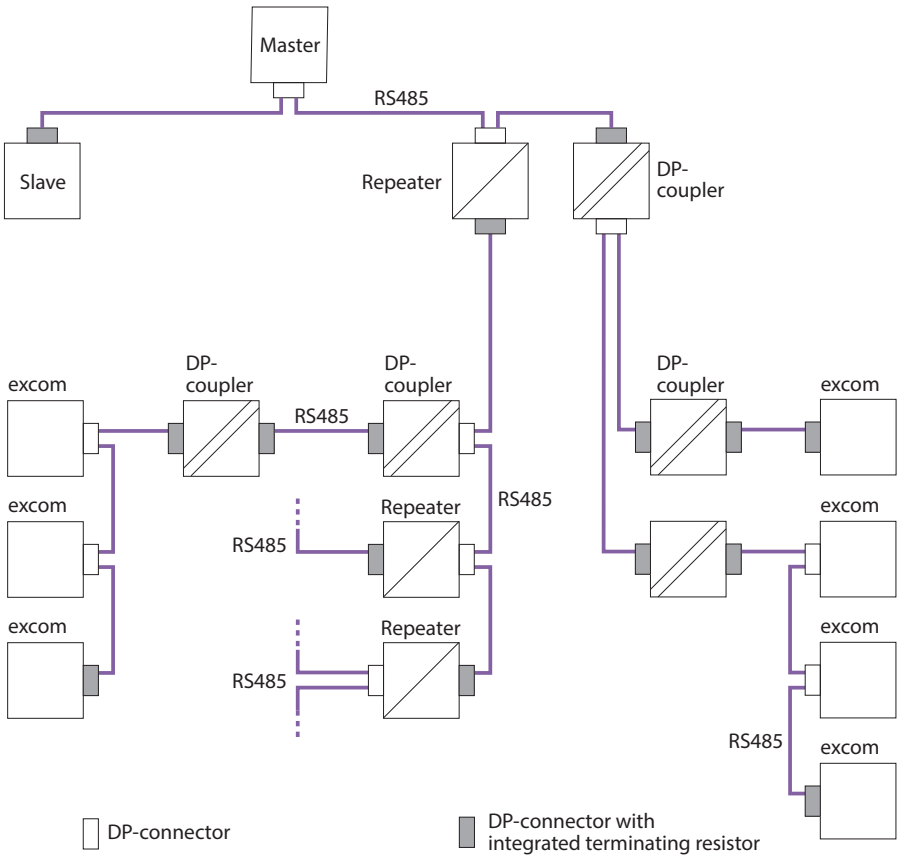

Fig. 81: System structure

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Different redundancy concepts (line, system and device redundancy) can be implemented by interconnecting several segment couplers.

Line redundancy

Line redundancy increases availability with little effort and can be implemented with only one active master. The bus line is split close to the master into two redundant bus lines. A segment coupler or repeater can be used to isolate the lines, for example, a segment coupler or repeater can be used to prevent the transmission of errors from one segment to the next segment (non-reactive). With this concept, redundancy is only provided behind the only master of the network.

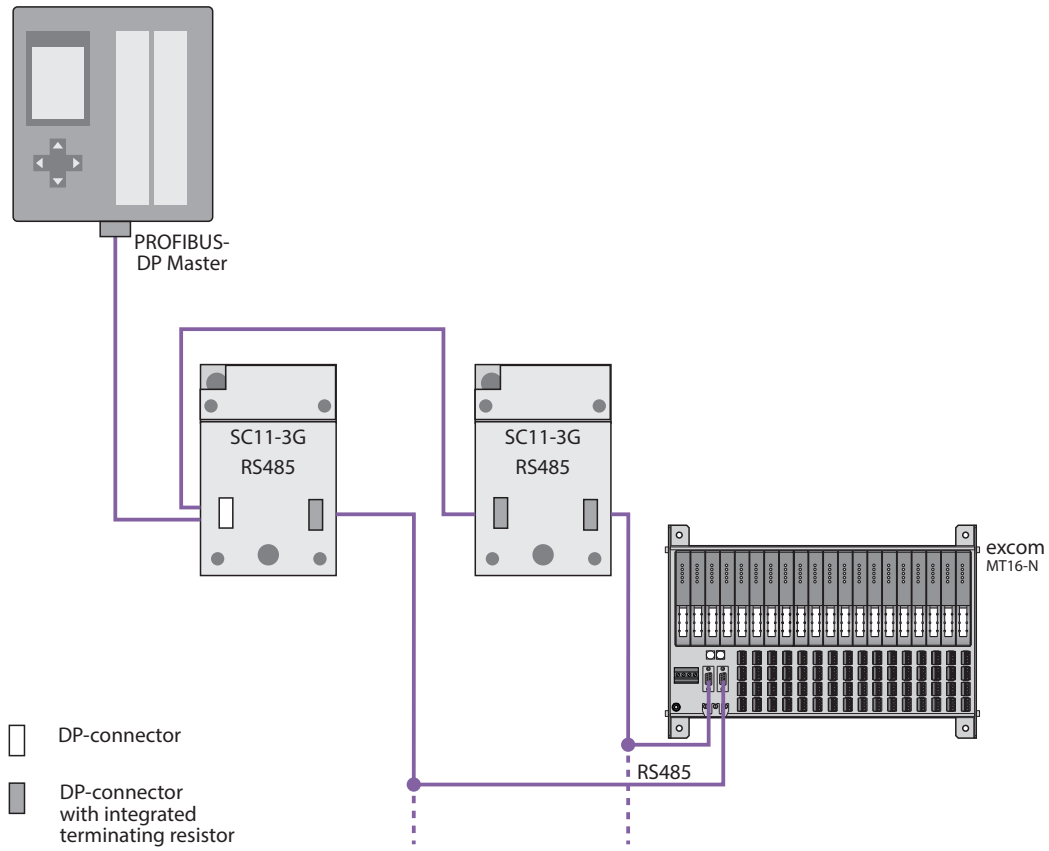


Fig. 82: Line redundancy

System redundancy

System redundancy is achieved by connecting two separate and independent each via a segment coupler to an excom station. The excom station is provided with two gateways. Each gateway is only put into cyclic data exchange by the master assigned to it. Both masters must configure and parameterize the redundant gateways identically.

With system redundancy (end-to-end redundancy) up to the gateway, valid data is always available even in the event of a redundancy switchover.

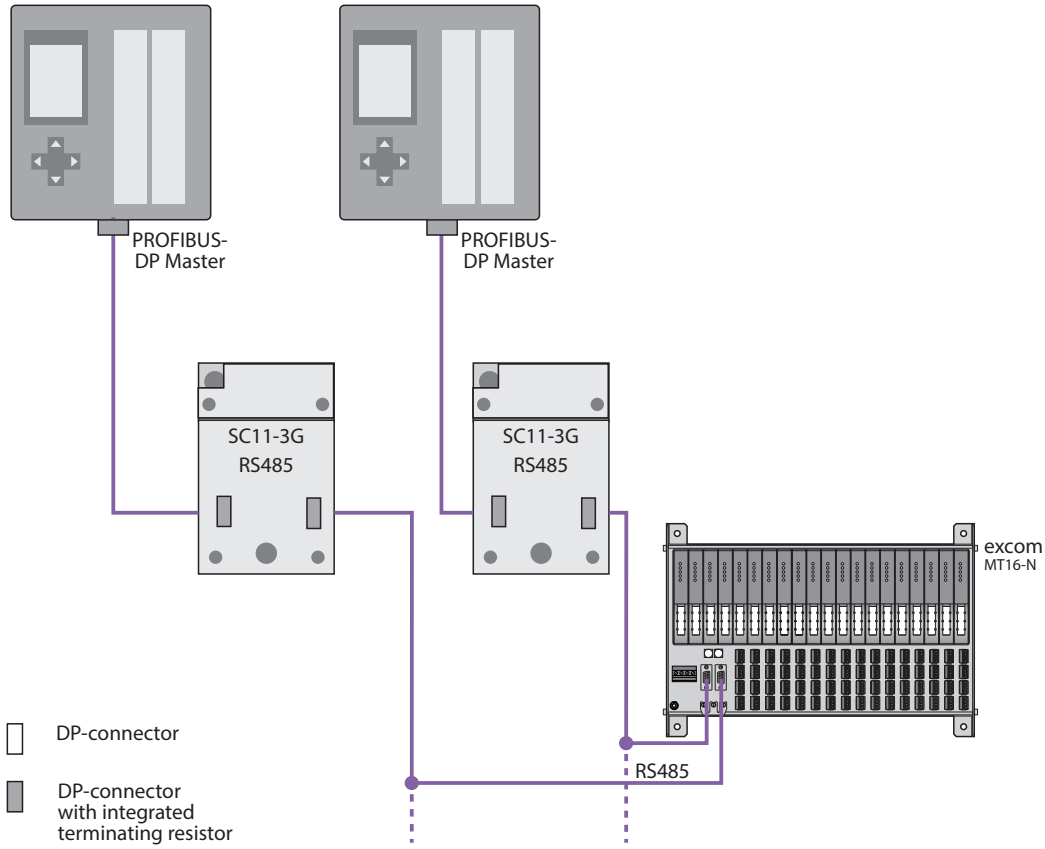


Fig. 83: System redundancy (end-to-end redundancy)

6.24.6 Installing

- Install the device on a DIN rail (TH35).
- Maintain a clearance of ≥ 5 mm from the side of the adjacent device.
- Connect the M5 × 1 bolt (case ground) on the device to the equipotential bonding.

6.24.7 Connection

Wiring diagram

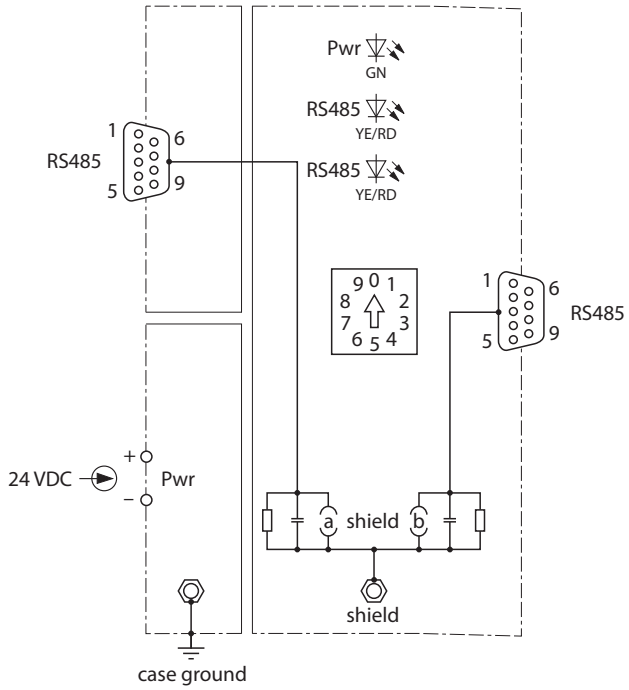


Fig. 84: Wiring diagram – SC11-3G

Connecting segment couplers to the fieldbus

- Connect the segment coupler to the fieldbus via the 9-pin RS485 SUB-D female connector (see Wiring diagram) using a PROFIBUS SUB-D male connector.

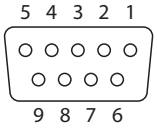


Fig. 85: SUB-D female connector

RS485 – assignment of the SUB-D pins:

Pin no.	RS485	Meaning
1	n. c.	Not connected
2	n. c.	Not connected
3	RxD/TxD-P	Receive data/send data B line (red)
4	n. c.	Not connected
5	DGND	Bus termination GND
6	DP	Bus termination VP (power supply +)
7	n. c.	Not connected
8	RxD/TxD-N	Receive data/send data of A line (green)
9	n. c.	Not connected
Housing	PE/FE	Equipotential bonding cable

Connecting bus stations to segment couplers

PROFIBUS-DP male connectors are used for the RS485 connection, e.g. the D9T-RS485 male connector (ID 6890942) or the D9T-RS485PG (ID 6890943).

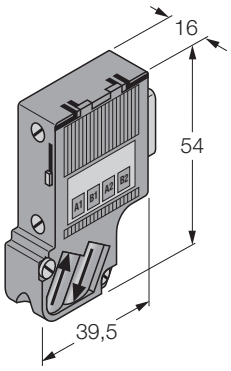


Fig. 86: D9T-RS485 – dimensions

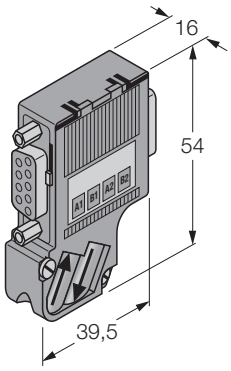


Fig. 87: D9T-RS485PG – dimensions

Switching on the terminating resistor at the RS485 interface

Terminating resistors must be activated at the start and end of each segment.

- Connect terminating resistors in the SUB-D bus connector at the non-intrinsically safe RS485 interface.
- When connecting with a Profibus SUB-D connector with an integrated resistor (e.g. Turck D9T-RS485 or D9-RS485PG): Switch on integrated pull-up/pull-down resistor of 200 Ω via the slide switch.
- When connecting with a 9-pin connector without an integrated resistor: Connect an external resistor of 150 Ω for passive termination between A (pin 8, internal A2) and B (pin 3, internal B2) of the SUB-D connector.

Connecting the segment coupler to the power supply

The device is provided with a 2-pin screw terminal for connecting the power supply.

- Push the IP30 cover back into the connection position via the connection terminal.
- Connect the device as shown in the wiring diagram. The max. cable cross section is 2.5 mm^2. The tightening torque is 0.5…0.6 Nm.
- Push the IP30 cover over the connection terminals into the covering position.

Connecting the equipotential bonding

The PE terminal of the device (M5 × 1 ground terminal bolt “Case ground” see Wiring diagram) is not connected to the PA equipotential bonding conductor.

- Connect the PA equipotential bonding cable to the “case ground” M5 × 1 ground terminal bolt. The min. cable cross section is 4 mm^2.

Grounding the shield of the Profibus DP fieldbus cable

The shield of the fieldbus cable is grounded via a separate connection. Depending on the expected interference and the installation, the user may choose between capacitive and direct grounding. The shield of both RS485 interfaces is factory fitted with a capacitive connection to the potential equalization. For this purpose, insulating washers are placed between the screw heads (marked on the housing by “Shield [a]” and “Shield [b]”) and the housing.

Grounding the shield of the Profibus DP fieldbus cable

- Unscrew the screw at the screw heads “Shield [a]” and “Shield [b]”, remove the insulating washers and screw the screw back in.
- Connect the M5 × 1 “Shield” bolt according to grounding concept with separately executed FE or PE rail.

6.24.8 LED indications

DP interface (PROFIBUS) – data traffic

LED	Indication	Meaning
Power	Green	Device is operational
	Off	Operating voltage too low
RS485	Red	Communication error
	Yellow	Bus communication active
	Yellow flashing	Searching for the transmission rate
	Off	No communication

6.24.9 Setting

Baud rate set via rotary switches

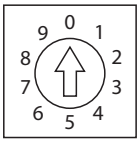


Fig. 88: Setting the baud rate

The “Automatic transmission rate detection” function of the segment coupler automatically detects the transmission rate when the rotary switch is set to “0”.

- ▶ Permanently set the transmission rate via the rotary switch position “0” to “9”.

Rotary switch position	Baud rate
Position 0	Automatic transmission rate detection
Position 1	Not used
Position 2	Not used
Position 3	9.6 kbps
Position 4	19.2 kbps
Position 5	38.40 kbps
Position 6	57.60 kbps
Position 7	115.20 kbps
Position 8	500 kbps
Position 9	1.50 Mbps

6.24.10 Technical data

Type code	SC11-3G
ID	100000548
Rated voltage	24 VDC
Supply voltage range	18…32 VDC
Current consumption	≤ 100 mA
Power consumption	≤ 2.4 W
Heat dissipation	≤ 2.4 W
Galvanic isolation	Complete galvanic isolation, test voltage 250 V
Number of channels	1-channel
Baud rate	9.6 kbps to 1.5 Mbps
Ex approval acc. to conformity certificate	IECEx EPS 17.0085X
Ex approval acc. to conformity certificate	EPS 17 ATEX 1168X
Ex approval acc. to conformity certificate	CML 21UKEX1624X
Device designation	Ex II 3 G Ex ec ic IIC T4 Gc
LEDs	
Operational readiness	1 × green
Status/error	2 × yellow/red
Housing material	Anodized aluminum
Fixing type	Snap-fit on DIN rail (EN 60715)
Protection type	IP20
Ambient temperature	-40…+70 °C
Relative air humidity	≤ 93 % at 40 °C acc. to IEC 60068-2-78
EMC	Acc. to EN 61326-1 (2013) acc. to NAMUR NE21 (2012)
MTTF	999 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions (W × H × D)	65 × 105 × 73.5 mm
Approvals	IECEx
	ATEX
	UKEX

6.25 System enclosure with integrated excom system

6.25.1 Intended use

The device is designed as equipment of the excom I/O system for the non-Ex area and must only be operated within the excom system with the MT…-N module racks.

The system enclosure protects the assembled module rack in the field from environmental influences.

Only the following modules can be retrofitted by the operator:

- AI40-N
- AI41-N
- AI43-N
- AIH40-N
- AIH401-N
- AIH41-N
- AO40-N
- AOH40-N
- AOH401-N
- DF20-N
- DI40-N
- DI80-N
- DM80-N
- DO40-N
- DO60R-N
- DO80-N
- TI40-N
- TI41-N

6.25.2 Device overview

Empty system enclosures contain the following elements:

- Base body with gutter, four welded exterior clips
- Two profiles (C profile) for fastening the module rack
- Two CU rails (nickel-plated) as shielding bus for termination of cable shields
- M6 grounding bolts welded to the inside, M8 earthing studs welded to the outside
- Flange plate and front door with base body

Components of the excom stations installed in the system housing are indicated in the type code.

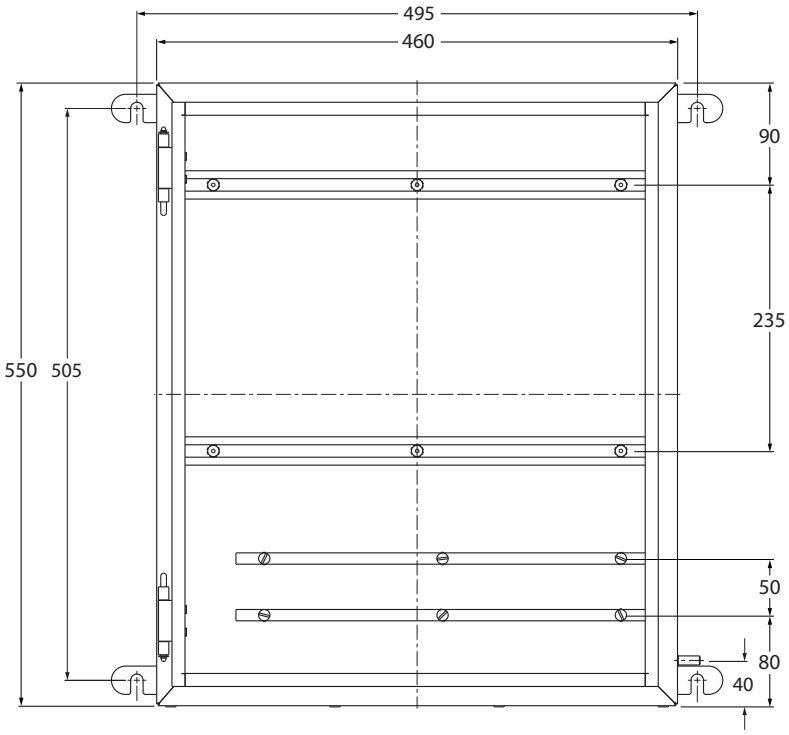


Fig. 89: Top view

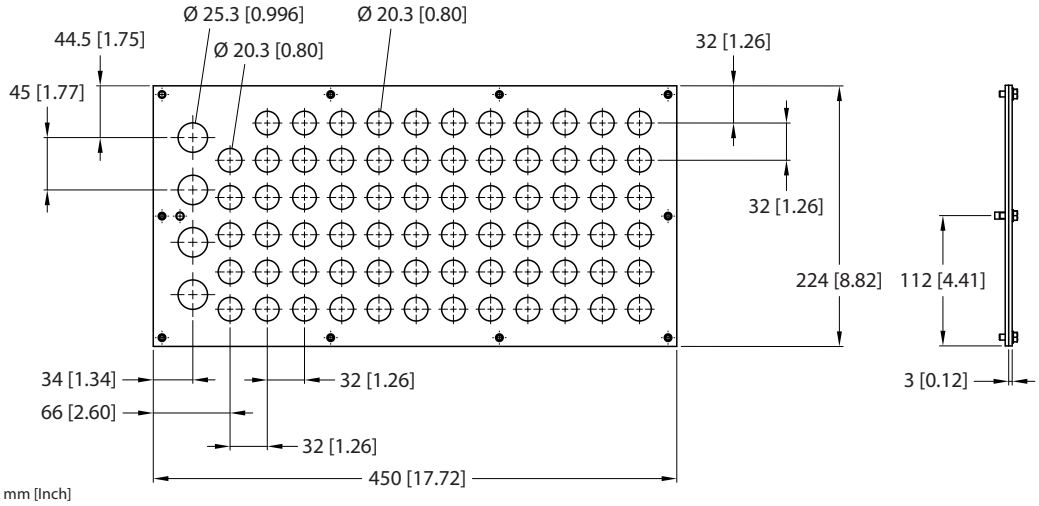


Fig. 90: Flange plate

Device overview – EG-VA655526…

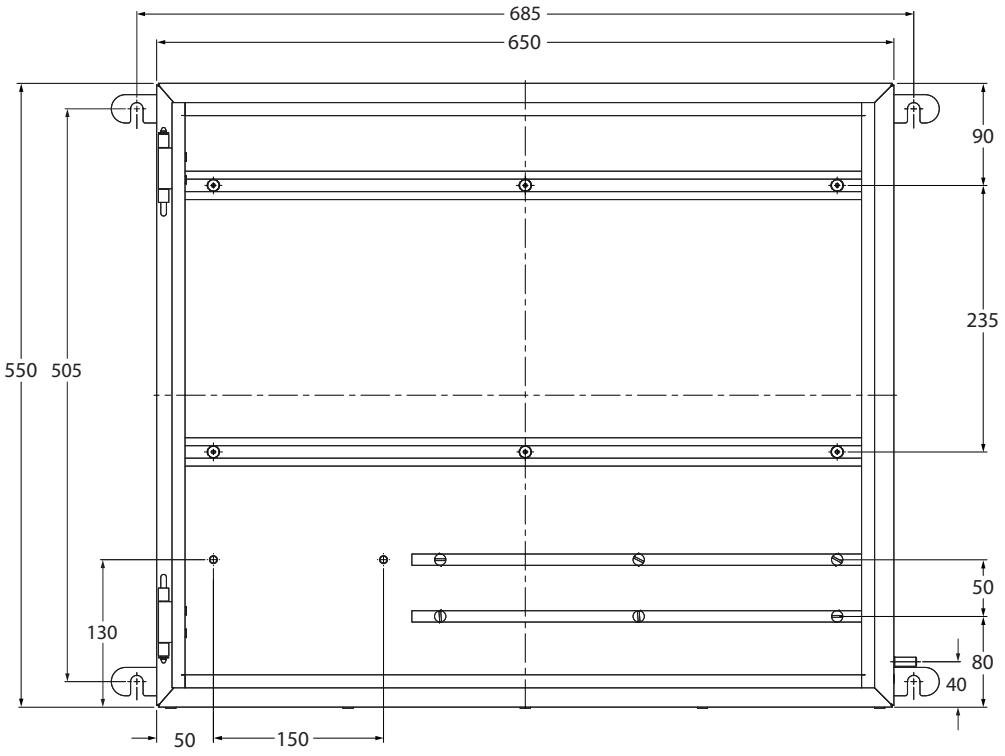


Fig. 91: Top view

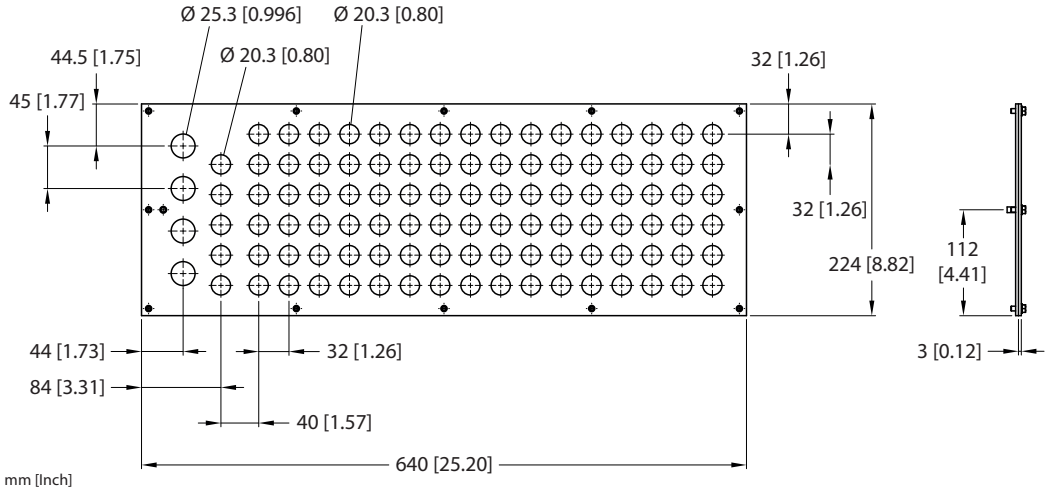


Fig. 92: Flange plate

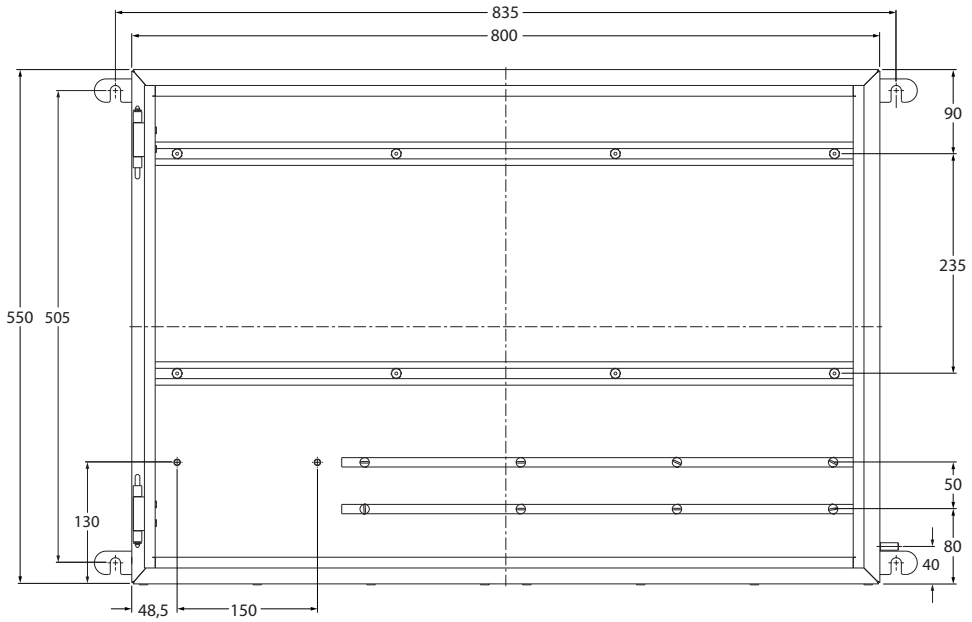


Fig. 93: Top view

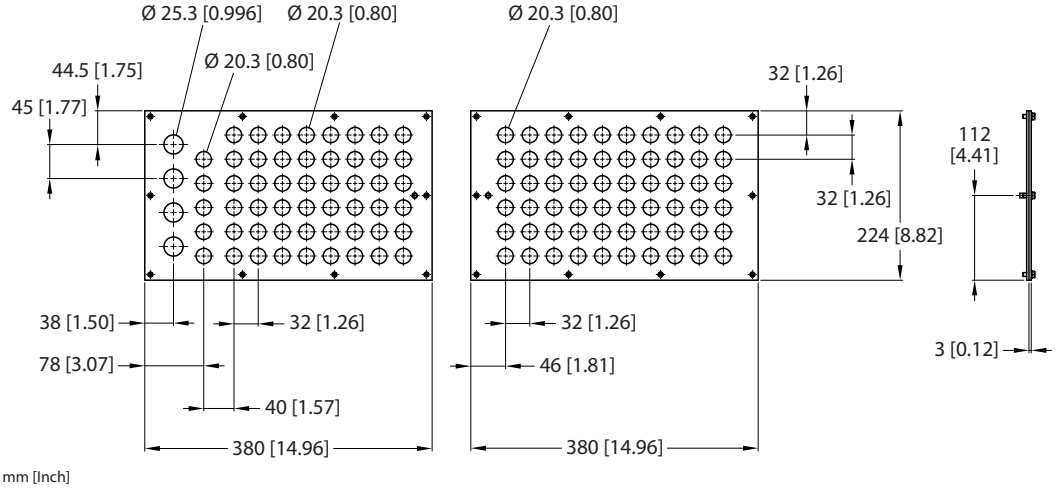


Fig. 94: Flange plate left and right

6.25.3 Properties and features

- Stainless steel enclosure with hinged cover and optional inspection window (visible area: 340 × 80 mm; 530 × 80 mm; 570 × 80 mm) for housing the excom module rack rack and flange plate.
- Standard sizes :
  - 460 × 550 × 260 mm
  - 650 × 550 × 260 mm
  - 800 × 550 × 260 mm
- Module rack:
  - MT08 (all system enclosure sizes)
  - MT16 (all system enclosure sizes)
  - MT24 (system enclosure with dimensions: 800 × 550 × 260 mm)
- M16 or M20 cable glands possible for I/O signals:
  - EG-VA 465526…: Standard: 35; maximum: 66
  - EG-VA 655526…: Standard: 65; maximum: 96
  - EG-VA 805526…: Standard: 108; maximum: 108

6.25.4 Installing

The system enclosure with integrated excom station can be mounted directly on a wall.

NOTICE
Heat buildup in the enclosure
Possible device damage due to overheating

- ▶ Protect from direct sunlight.
- ▶ Carry out a written temperature test before equipping the excom I/O system and any change to the equipment as well as before commissioning (see “Performing a temperature test”).
- ▶ During commissioning ensure that the admissible operating temperature of the excom I/O system is not exceeded.
- ▶ Do not add any additional power to the enclosure.
- ▶ If the enclosure exceeds the permissible temperature, the module rack may need to be installed in a larger system enclosure.

6.25.5 Connection

Lay the cables through the cable entries in the system enclosure. Only route permanently installed, strain-relieved cables through the cable gland. Close unused cable entries with sealing plugs.

Shielding and grounding

Power supply and fieldbus cables must be routed separately; alternatively it is possible to install shielded power cables observing a minimum distance of 30 cm to the fieldbus cable. The grounding of the shield for field devices depends on the requirements of the specific field device. If shielding is required on both sides, special attention must be paid to equipotential bonding in order to prevent potential equalization currents via the shield.

The excom system and the system enclosure are permanently connected electrically. The system enclosure is part of the equipotential bonding system.

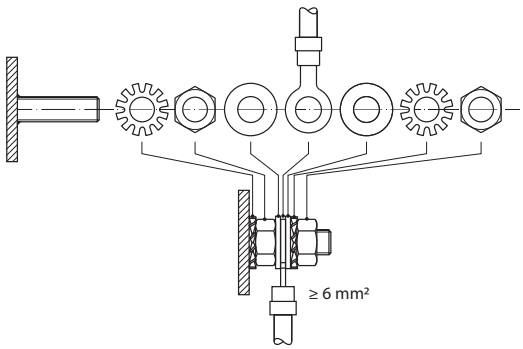


Fig. 95: Fitting the connection bolt

- Connect system enclosures to the equipotential bonding on the outside of the enclosures with a cross section of at least 6 mm². The order of fitting the connection bolt is shown in the figure above.

Direct connection of the cable shield to the integrated shielding busbar of the excom enclosure:

- Connect the shield busbar to the equipotential bonding (conductor cross-section ≥ 4 mm²) centrally or via a separate conductor in the control room.

When using shielded field cables:

- Connect the shield of the field cables to existing shield busbars on one side in the enclosure.

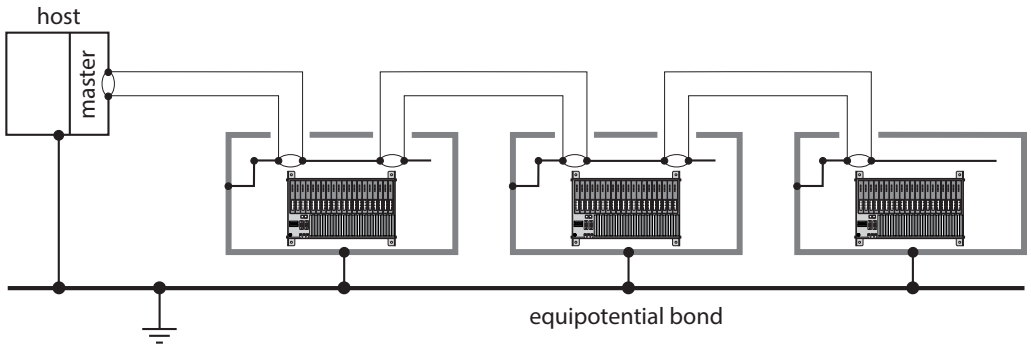


Fig. 96: Installation without separate equipotential bonding

Insulated shield busbars are provided for separate routing of the shield and the equipotential bonding cable. The insulated shield busbars must not be connected with the system enclosure and thus also not with the equipotential bonding cable.

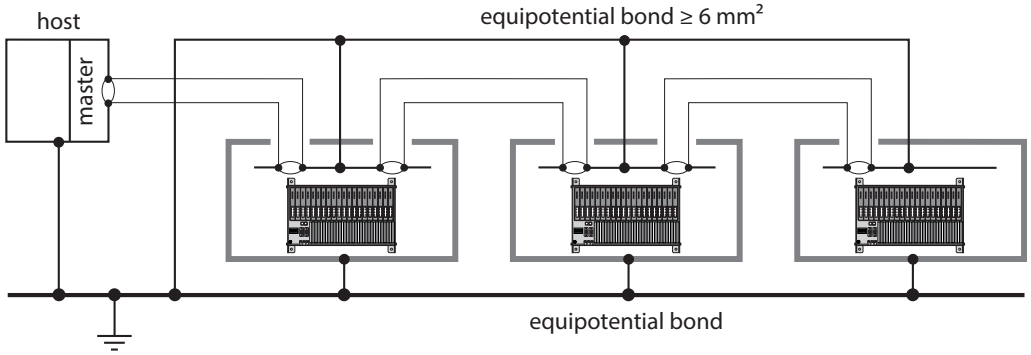


Fig. 97: Installation with separate equipotential bonding

When using non-conductive system enclosures:

- ▶ Connect the shield of the fieldbus cable and if necessary the equipotential bonding directly on the module rack, depending the grounding concept.

Equipotential bonding between the control room and the field installation is required.

6.26 Accessories

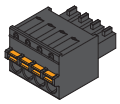
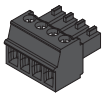
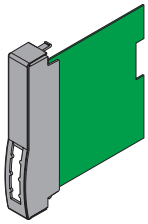
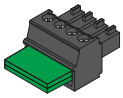
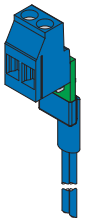
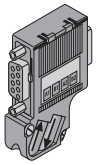
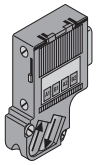
Figure	Type	ID	Description
	STB16-4RC/1.5-BK	9909625	Set of 16 4-pin terminal blocks, spring-loaded terminals, black
	STB16-4RS/1.5-BK	9909624	Set of 16 4-pin terminal blocks, screw terminals, black
	BM-N	6884226	Dummy module for unused slots on the module rack, version “-N”. The BM-N dummy module maintains IP20 protection of the excom system for the non-Ex area by covering unused slots in the module rack.
	excom-RMD1-BK	100020478	The resistor module suppresses wire break and short circuit detection with the digital input modules. With analog input modules, the messages for overflow and underflow are also suppressed.
	WM1	0912101	The WM1 resistor module is used for cable monitoring between a mechanical contact and a Turck signal processor. The input circuit is designed for sensors according to EN 60947-5-6 (NAMUR) and is equipped with a wire-break and short-circuit monitoring function.

Figure	Type	ID	Description
	TI-CJC-2 (10PCS)	6884209	The CJC-TI-2 is a temperature dependent resistor and is used as a cold junction compensation element for temperature measurement of the thermocouple connected on the TI40-N temperature module. The TI-CJC must only be used with spring-loaded terminals.
	D9T-RS485PG	6890943	The PROFIBUS terminal connector can be used on the OC11Ex/3G.2 as an alternative to the D9T-RS485. Sub-D FastConnect connector with 125° cable outlet, switchable terminating resistor, with programming device connection socket
	D9T-RS485	6890942	The PROFIBUS terminal connector can be used on the OC11Ex/3G.2 as an alternative to the D9T-RS485PG. Sub-D FastConnect connector with 125° cable outlet, switchable integrated terminating resistor

7 Turck subsidiaries – contact information

Germany	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr **www.turck.de**
Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria **www.turck.com.au**
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Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Wien **www.turck.at**
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Romania	Turck Automation Romania SRL Str. Siriului nr. 6-8, Sector 1, RO-014354 Bucuresti **www.turck.ro**
Russian Federation	TURCK RUS OOO 2-nd Pryadilnaya Street, 1, 105037 Moscow **www.turck.ru**
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Hungary	TURCK Hungary kft. Árpád fejedelem útja 26-28., Óbuda Gate, 2. em., H-1023 Budapest **www.turck.hu**
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