Electromechanical Automation North America

Parker I/O-System

PROFIBUS DP ECO + I/O-Modules

PIO-343

Manual

Technical description,
installation and configuration

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TABLE OF CONTENTS

1 Important comments 5
1.1 Legal principles 5
1.2 Symbols 6
1.3 Font Conventions 6
1.4 Number Notation 6
1.5 Safety Notes 7
1.6 Scope 8
1.7 Abbreviation 8

2 I/O-SYSTEM 9
2.1 I/O-System Description 9
2.2 Technical Data 10
2.3 Manufacturing Number 14
2.4 Storage, Assembly and Transport 14
2.5 Mechanical Setup 15
2.6 Power Supply 21
2.7 Grounding 25
2.8 Shielding (Screening) 28
2.9 Assembly Guidelines / Standards 28

3 Fieldbus Coupler 29
3.1 Fieldbus ECO-Coupler 29

4 I/O Modules 70
4.1 PIO-400 [2 DI DC 24 V 3.0 ms, high-side switching] 70
4.2 PIO-402 [4 DI DC 24 V 3.0 ms, high-side switching] 73
4.3 PIO-430 [8 DI DC 24 V 3.0 ms, high-side switching] 76
4.4 PIO-468 [4 AI DC 0-10 V, Single-Ended] 79
4.5 PIO-480 [2 AI 0-20 mA Differential Measurement Input] 83
4.6 PIO-501 [2 DO DC 24 V 0.5 A, high-side switching] 87
4.7 PIO-504 [4 DO DC 24 V 0.5 A, high-side switching] 90
4.8 PIO-530 [8 DO DC 24 V 0.5 A, high-side switching] 93
4.9 PIO-550 [2 AO DC 0-10 V] 96
4.10 PIO-552 [2 AO 0-20 mA] 99
4.11 PIO-600 [End Module] 103
4.12 PIO-602 [24 V DC Power Supply] 104

5 PROFIBUS 107
5.1 Description 107
5.2 Wiring 108

6 Use in Hazardous Environments 110
6.1 Foreword 110
6.2 Protective measures 110
6.3 Classification meeting CENELEC and IEC 110
6.4 Classifications meeting the NEC 500 113
6.5 Identification 115
6.6 Installation regulations 117

7 Glossary 118

8 Literature list 119

9 Index 120

1 Important comments

To ensure fast installation and start-up of the units described in this manual, we strongly recommend that the following information and explanation is carefully read and adhered to.

1.1 Legal principles

1.1.1 Copyright

This manual is copyrighted, together with all figures and illustrations contained therein. Any use of this manual which infringes the copyright provisions stipulated herein, is not permitted. Reproduction, translation and electronic and photo-technical archiving and amendments require the written consent. Non-observance will entail the right of claims for damages.

1.1.2 Personnel qualification

The use of the product detailed in this manual is exclusively geared to specialists having qualifications in PLC programming, electrical specialists or persons instructed by electrical specialists who are also familiar with the valid standards. The manufacturer declines all liability resulting from improper action and damage to products and third party products due to non-observance of the information contained in this manual.

1.1.3 Intended use

For each individual application, the components supplied are to work with a dedicated hardware and software configuration. Modifications are only admitted within the framework of the possibilities documented in the manuals. All other changes to the hardware and/or software and the non-conforming use of the components entail the exclusion of liability.

1.2 Symbols

Danger
Always abide by this information to protect persons from injury.

Warning
Always abide by this information to prevent damage to the device.

Attention
Marginal conditions must always be observed to ensure smooth operation.

ESD (Electrostatic Discharge)
Warning of damage to the components by electrostatic discharge. Observe the precautionary measure for handling components at risk.

Note
Routines or advice for efficient use of the device and software optimization.

More information
References on additional literature, manuals, data sheets and INTERNET pages

1.3 Font Conventions

Italic	Names of path and files are marked italic i.e.: *C:\programs*
Italic	Menu items are marked as bold italic i.e.: ***Save***
****	A backslash between two names marks a sequence of menu items i.e.: ***File\New***
END	Press buttons are marked as bold with small capitals i.e.: **ENTER**
< >	Keys are marked bold within angle brackets i.e.: **<F5>**
`Courier`	Program code is printed with the font `Courier`. i.e.: `END_VAR`

1.4 Number Notation

Number Code	Example	Note
Decimal	100	normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	Within ', Nibble separated with dots

1.5 Safety Notes

Attention
Switch off the I/O-System prior to working on bus modules!

In the event of deformed contacts, the module in question is to be replaced, as its functionality can no longer be ensured on a long-term basis.

The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials is: e.g. aerosols, silicones, triglycerides (found in some hand creams).

If it cannot be ruled out that these materials appear in the component environment, then additional measures are to be taken:
- installation of the components into an appropriate enclosure
- handling of the components only with clean tools and materials.

Attention
Cleaning of soiled contacts may only be done with ethyl alcohol and leather cloths. Thereby, the ESD information is to be regarded.

Do not use any contact spray. The spray may impair the functioning of the contact area.

The I/O-SYSTEM and its components are an open system. It must only be assembled in housings, cabinets or in electrical operation rooms. Access must only be given via a key or tool to authorized qualified personnel.

The relevant valid and applicable standards and guidelines concerning the installation of switch boxes are to be observed.

ESD (Electrostatic Discharge)
The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. gold contacts.

1.6 Scope

This manual describes the field bus independent I/O-SYSTEM with the Fieldbus Coupler for PROFIBUS.

Components
ECO-coupler PROFIBUS 12 MBd

1.7 Abbreviation

AO	Analog Output Module
AI	Analog Input Module
DI	Digital Input
DO	Digital Output
I/O	input/output
ID	Identifier
PI	Process Images
PLC	Programmable Logic Control
RTS	Running Time System
SM	Special Module

2 I/O-SYSTEM

2.1 I/O-System Description

The I/O-SYSTEM is a modular, fieldbus independent I/O system. The structure described here consists of an ECO fieldbus coupler (1) and up to 64 connected fieldbus modules (2) for any kind of signal. Together, these make up the fieldbus node. The end module (3) completes the node.

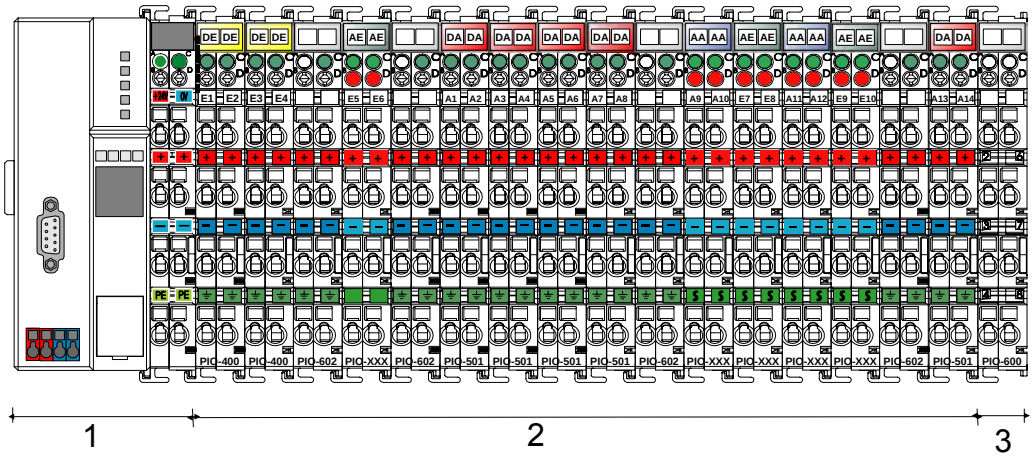


Fig. 2-1: Fieldbus node

ECO couplers for fieldbus systems such as PROFIBUS DP, CANopen and DeviceNet are available.

The ECO coupler contains the fieldbus interface, electronics and a power supply terminal. The fieldbus interface forms the physical interface to the relevant fieldbus. The electronics process the data of the bus modules and make it available for the fieldbus communication. The 24 V system supply are fed in via the integrated power supply terminal.
The fieldbus coupler communicates via the relevant fieldbus.

At first the ECO coupler is concepted for applications with digital I/O functions. Bus modules for diverse digital and analog I/O functions and special functions can be connected as well. The communication between the ECO coupler and the bus modules is carried out via an internal bus.

The I/O-SYSTEM has a clear port level with LEDs the status indication, insertable mini WSB markers and pullout group marker carriers. The 3-wire technology supplemented by a ground wire connection allows for direct sensor/actuator wiring.

2.2 Technical Data

Mechanic	
Material	Polycarbonate, Polyamide 6.6
Dimensions Coupler	50 mm x 65* mm x 97 mm
Dimensions I/O module, single	12 mm x 64* mm x 100 mm
Dimensions I/O module, double	24 mm x 64* mm x 100 mm
Installation	on DIN 35 with interlock
modular by	double featherkey-dovetail
Mounting position	any position
Length of entire node	≤ 831 mm
Marking	marking label type 247 and 248 paper marking label 8 x 47 mm
Wire range	
Wire range	CAGE CLAMP® Connection 0,08 mm² ... 2,5 mm² AWG 28-14 8 – 9 mm Stripped length
Contacts	
Power jumpers contacts	blade/spring contact self-cleaning
Current via power contacts $_{max}$	10 A
Voltage drop at I_{max}	< 1 V/64 modules
Data contacts	slide contact, hard gold plated 1,5µ, self-cleaning
Climatic environmental conditions	
Operating temperature	0 °C ... 55 °C
Storage temperature	-20 °C ... +85 °C
Relative humidity	95 % without condensation
Resistance to harmful substances	acc. to IEC 60068-2-42 and IEC 60068-2-43
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gasses – ionization radiation.
Mechanical strength	
Vibration resistance	acc. to IEC 60068-2-6
Shock resistance	acc. to IEC 60068-2-27
Free fall	acc. to IEC 60068-2-32 ≤ 1m (module in original packing)

* from upper edge of DIN 35 rail

Safe electrical isolation			
Air and creepage distance	acc. to IEC 60664-1		
Degree of protection			
Degree of protection	IP 20		
Electromagnetic compatibility*			
Directive	**Test values**	**Strength class**	**Evaluation criteria**
Immunity to interference acc. to EN 50082-2 (96)			
EN 61000-4-2	4kV/8kV	(2/4)	B
EN 61000-4-3	10V/m 80% AM	(3)	A
EN 61000-4-4	2kV	(3/4)	B
EN 61000-4-6	10V/m 80% AM	(3)	A
Emission of interference acc. to EN 50081-2 (94)		**Measuring distance**	**Class**
EN 55011	30 dBµV/m	(30m)	A
	37 dBµV/m		
Emission of interference acc. to EN 50081-1 (93)		**Measuring distance**	**Class**
EN 55022	30 dBµV/m	(10m)	B
	37 dBµV/m		

Range of application	**Required specification emission of interference**	**Required specification immunity to interference**
Industrial areas	EN 50081-2 : 1993	EN 50082-2 : 1996
Residential areas	EN 50081-1 : 1993*)	EN 50082-1 : 1992

*) The I/O-System meets the requirements on emission of interference in residential areas with the fieldbus coupler for:

CANopen PIO-337

DeviceNet PIO-306

With a special permit, the I/O-System can also be implemented with other fieldbus couplers in residential areas (housing, commercial and business areas, small-scale enterprises). The special permit can be obtained from an authority or inspection office. In Germany, the Federal Office for Post and Telecommunications and its branch offices issues the permit.

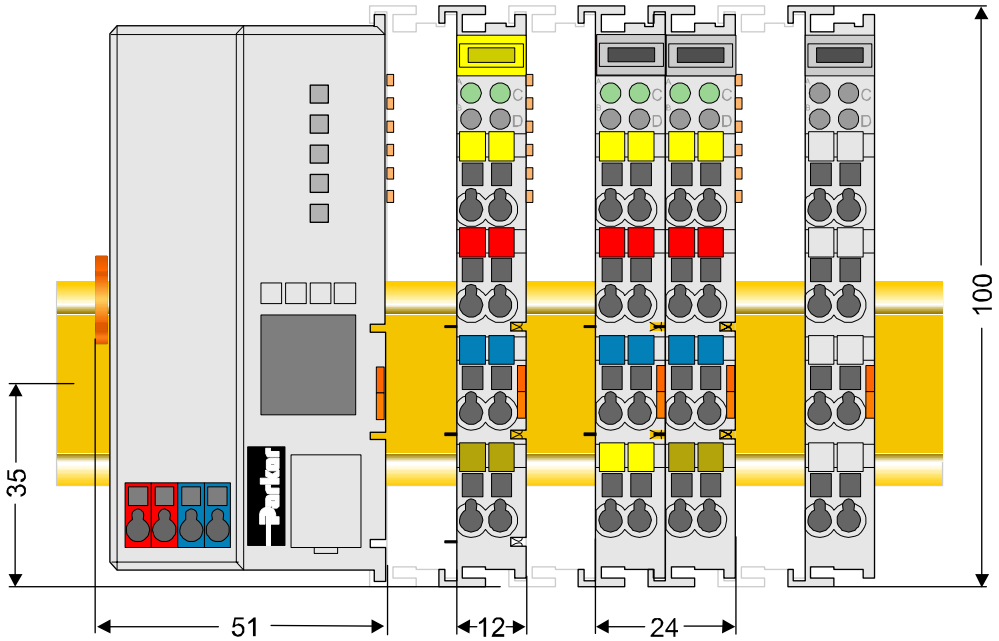
It is possible to use other field bus couplers under certain boundary conditions. Please contact the manufacturer.

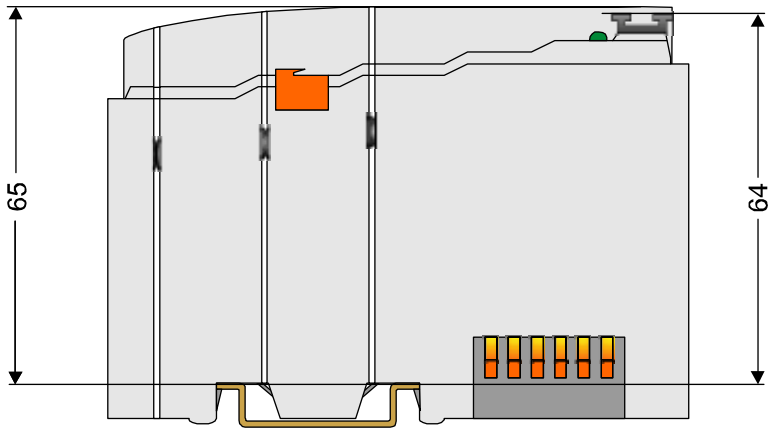
Maximum power dissipation of the components	
Bus modules	0,8 W / bus terminal (total power dissipation, system/field)
ECO Fieldbus coupler	2,0 W / coupler

Warning
The power dissipation of all installed components must not exceed the maximum conductible power of the housing (cabinet).

When dimensioning the housing, care is to be taken that even under high external temperatures, the temperature inside the housing does not exceed the permissible ambient temperature of 55 °C.

Dimensions





Side view

Dimensions in mm

Fig. 2-2: Dimensions

2.3 Manufacturing Number

The manufacturing number is part of the lateral marking on the component.

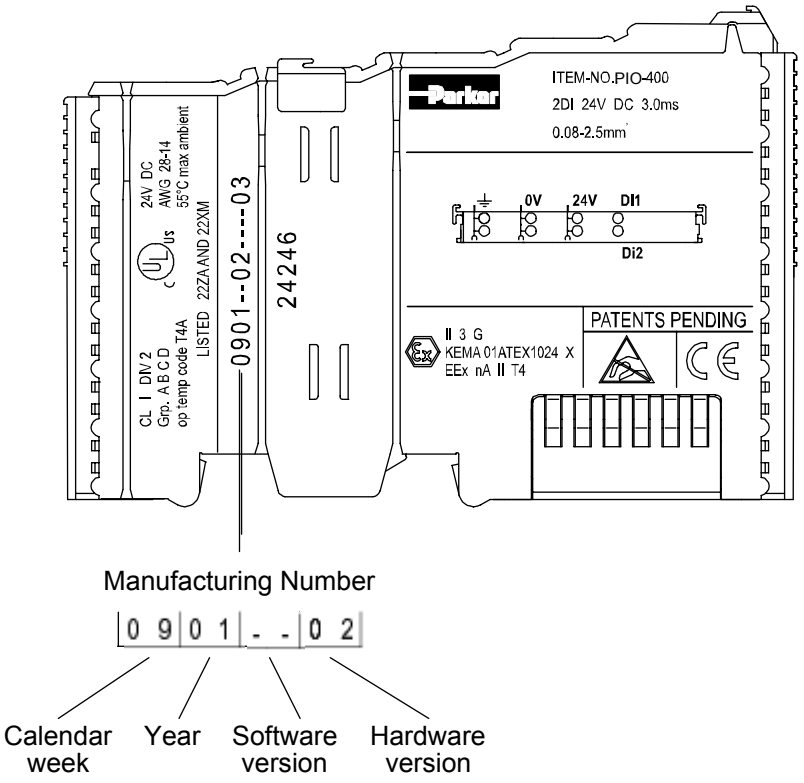


Fig. 2-3: Manufacturing Number

The manufacturing number consists of the production week and year, the software version (if available), the hardware version of the component, the firmware loader (if available) and further internal information for the manufacturer.

The production number is also printed on the cover of the configuration and programming interface of the fieldbus coupler.

2.4 Storage, Assembly and Transport

Wherever possible, the components are to be stored in their original packaging. Likewise, the original packaging provides optimal protection during transport.

When assembling or repacking the components, the contacts must not be soiled or damaged. The components must be stored and transported in appropriate containers/packaging. Thereby, the ESD information is to be regarded.

Statically shielded transport bags with metal coatings are to be used for the transport of open components for which soiling with amine, amide and silicone has been ruled out, e.g. 3M 1900E.

2.5 Mechanical Setup

2.5.1 Installation Position

Along with horizontal and vertical installation, all other installation positions are allowed.

Attention
In the case of vertical assembly, an end stop has to be mounted as an additional safeguard against slipping.

2.5.2 Total Expansion

The maximum total expansion of a node is calculated as follows:

Quantity	Width	Components
1	50 mm	ECO coupler
64	12 mm	bus modules - inputs / outputs – power supply modules - etc.
1	12 mm	end module
sum	**830 mm**	

Warning
The maximal total expansion of a node must not exceed 830 mm.

2.5.3 Assembly onto Carrier Rail

Carrier Rail Properties

All I/O-System components can be snapped directly onto a carrier rail in accordance with the European standard EN 50022 (DIN 35).

Carrier rails have different mechanical and electrical properties. For the optimal I/O-System setup on a carrier rail, certain guidelines must be observed:

- The material must be non-corrosive.
- Most components have a contact to the carrier rail to ground electro-magnetic disturbances. In order to avoid corrosion, this tin-plated carrier rail contact must not form a galvanic cell with the material of the carrier rail which generates a differential voltage above 0.5 V (saline solution of 0.3% at 20°C) .
- The carrier rail must optimally support the EMC measures integrated into the I/O-System and the shielding of the bus module connections.
- A sufficiently stable carrier rail should be selected and, if necessary, several mounting points (every 20 cm) should be used in order to prevent bending and twisting (torsion).
- The geometry of the carrier rail must not be altered in order to secure the safe hold of the components. In particular, when shortening or mounting the carrier rail, it must not be crushed or bent..
- The base of the I/O components extends into the profile of the carrier rail. For carrier rails with a height of 7.5 mm, mounting points are to be riveted under the node in the carrier rail (slotted head captive screws or blind rivets).

2.5.4 Spacing

The spacing between adjacent components, cable conduits, casing and frame sides must be maintained for the complete field bus node.

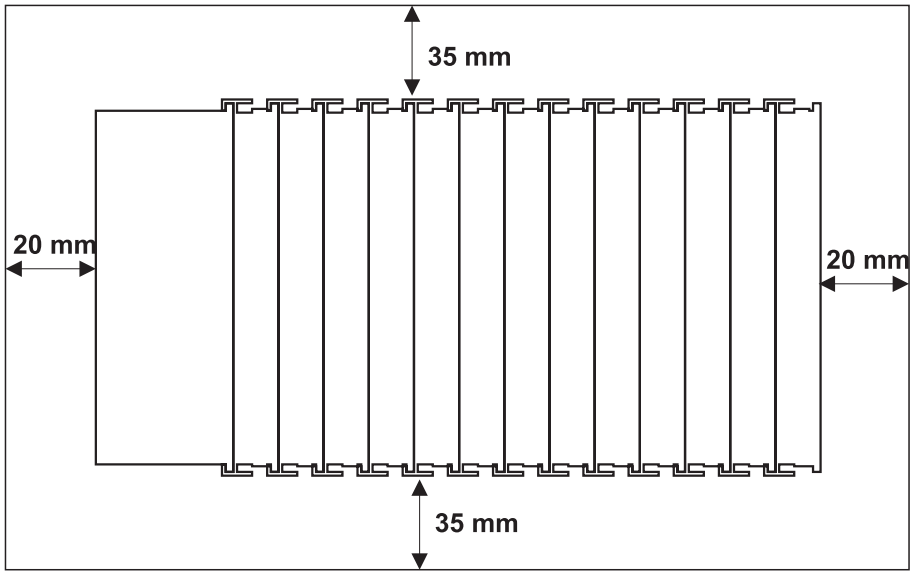


Fig. 2-4: Spacing

The spacing creates room for heat transfer, installation or wiring. The spacing to cable conduits also prevents conducted electromagnetic interferences from influencing the operation.

2.5.5 Plugging and Removal of the Components

Warning
Before work is done on the components, the voltage supply must be turned off.

In order to safeguard the ECO coupler from jamming, it should be fixed onto the carrier rail with the locking disc To do so, push on the upper groove of the locking disc using a screwdriver.

To pull out the fieldbus coupler, release the locking disc by pressing on the bottom groove with a screwdriver and then pulling the orange colored unlocking lug.

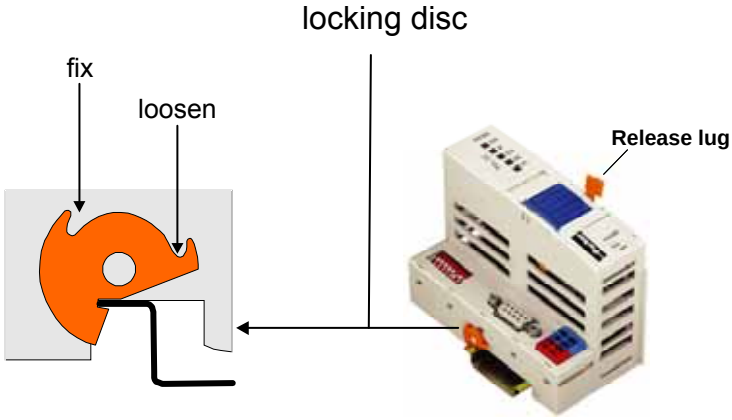


Fig. 2-5: Coupler and unlocking lug

It is also possible to release an individual I/O module from the unit by pulling an unlocking lug.

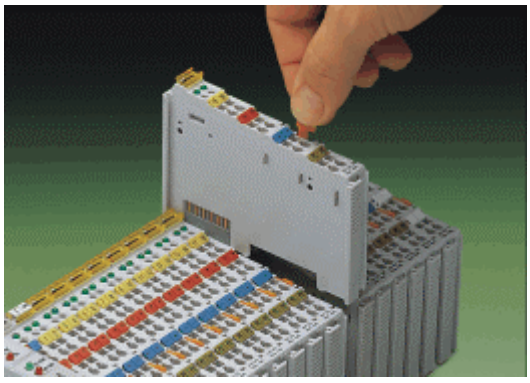


Fig. 2-6: removing bus terminal

Danger
Ensure that an interruption of the PE will not result in a condition which could endanger a person or equipment!
For planning the ring feeding of the ground wire, please see chapter "Grounding Protection“

2.5.6 Assembly Sequence

All I/O-System components can be snapped directly on a carrier rail in accordance with the European standard EN 50022 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual components are securely seated on the rail after installing.

Starting with the ECO coupler, the bus modules are assembled adjacent to each other according to the project planning. Errors in the planning of the node in terms of the potential groups (connection via the power contacts) are recognized, as the bus modules with power contacts (male contacts) cannot be linked to bus modules with fewer power contacts.

Attention
Always link the bus modules with the ECO coupler, and always plug from above.

Warning
Never plug bus modules from the direction of the end terminal. A ground wire power contact, which is inserted into a terminal without contacts, e.g. a 4-channel digital input module, has a decreased air and creepage distance to the neighboring contact.
Always terminate the fieldbus node with an end module.

2.5.7 Internal Bus / Data Contacts

Communication between the ECO coupler and the bus modules as well as the I/O-System supply of the bus modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

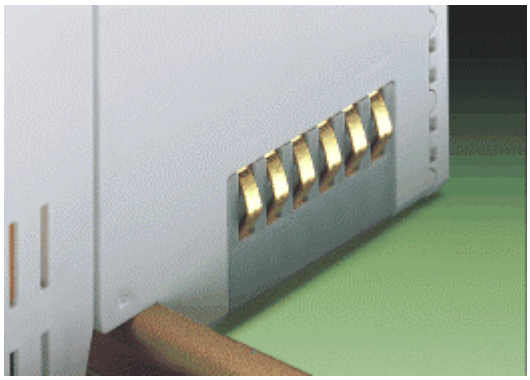


Fig. 2-7: Data contacts

Warning
Do not touch the gold spring contacts on the I/O Modules in order to avoid soiling or scratching!

ESD (Electrostatic Discharge)
The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. gold contacts.

2.5.8 Power Contacts

Self-cleaning power contacts , are situated on the side of the components which further conduct the supply voltage for the field side. These contacts come as touchproof spring contacts on the right side of the coupler and the bus module. As fitting counterparts the module has male contacts on the left side.

Danger
The power contacts are sharp-edged. Handle the module carefully to prevent injury.

Attention
Please take into consideration that some bus modules have no or only a few power jumper contacts. The design of some modules does not allow them to be physically assembled in rows, as the grooves for the male contacts are closed at the top.

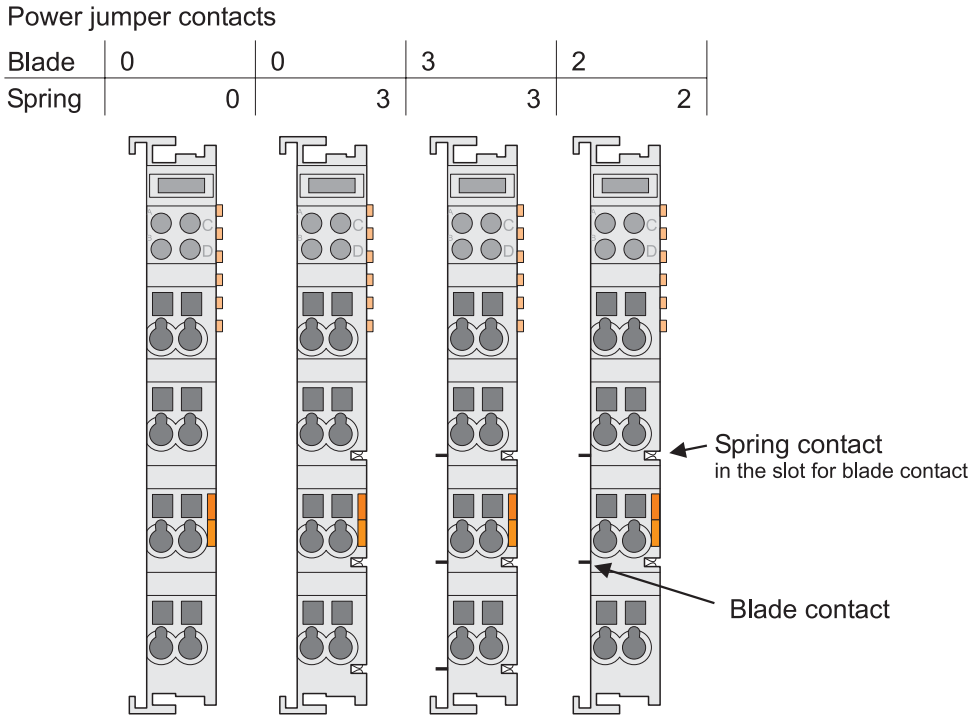


Fig. 2-8: Example for the arrangement of power contacts

2.5.9 Wire Connection

All components have CAGE CLAMP® connections.

The CAGE CLAMP® connection is appropriate for solid, stranded and fine–stranded conductors. Each clamping unit accommodates one conductor.

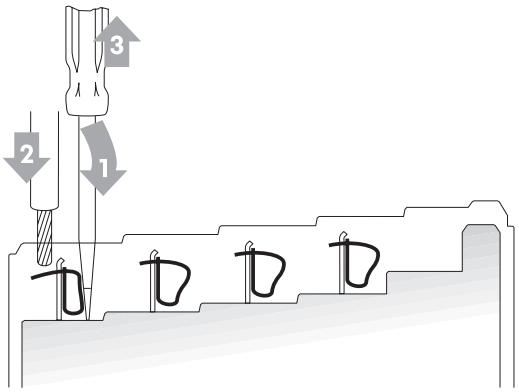


Fig. 2-9: CAGE CLAMP® Connection

The operating tool is inserted into the opening above the connection. This opens the CAGE CLAMP®. Subsequently the conductor can be inserted into the opening. After removing the operating tool, the conductor is safely clamped.

More than one conductor per connection is not permissible. If several conductors have to be made at one connection point, then they should be made away from the connection point using Terminal Blocks. The terminal blocks may be jumpered together and a single wire brought back to the I/Omodule connection point.

Attention
If it is unavoidable to jointly connect 2 conductors, then a ferrule must be used to join the wires together.
Ferrule:

Length	8 mm
Nominal cross section$_{max.}$	1 mm^2 for 2 conductors with 0.5 mm^2 each

2.6 Power Supply

2.6.1 Isolation

Within the fieldbus node, there are three electrically isolated potentials.

- Operational voltage for the fieldbus interface.
- Electronics of the couplers and the bus modules (internal bus).
- All bus modules have an electrical isolation between the electronics (internal bus, logic) and the field electronics. Some analog input modules have each channel electrically isolated, please see catalog.

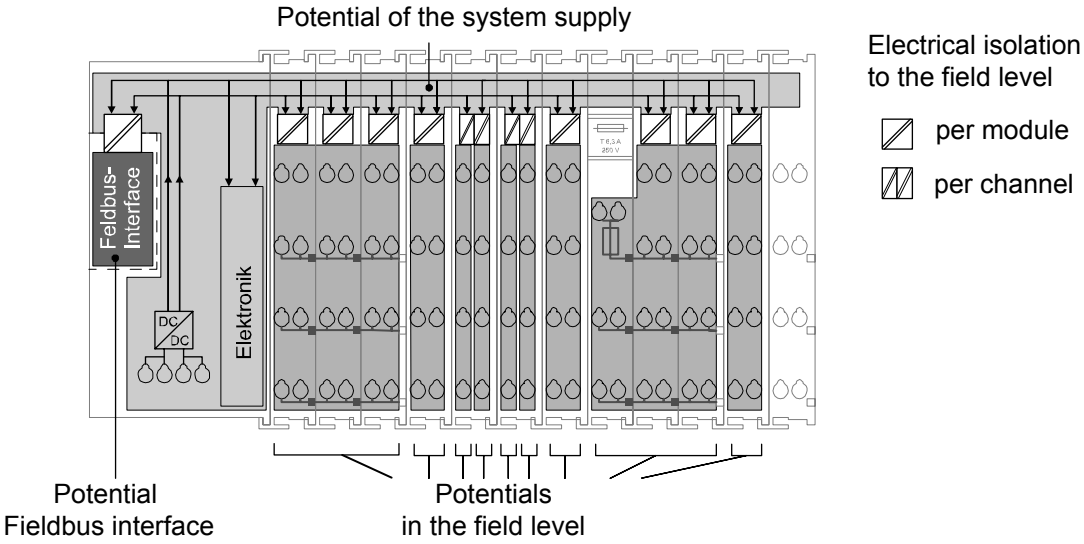


Fig. 2-10: Isolation

Attention
The ground wire connection must be present in each group. In order that all protective conductor functions are maintained under all circumstances, it is recommended that a ground wire be connected at the beginning and end of a potential group. (ring format, please see chapter Grounding Protection"). Thus, if a bus module comes loose from the node during servicing, then the protective conductor connection is still guaranteed for all connected field devices.
When using a joint power supply unit for the 24 V system supply and the 24 V field supply, the electrical isolation between the internal bus and the field level is eliminated for the potential group.

2.6.2 System Supply

Connection

The I/O-SYSTEM requires a 24 V direct current system supply (-15% or +20 %). The power supply is provided via the coupler. The voltage supply is reverse voltage protected.

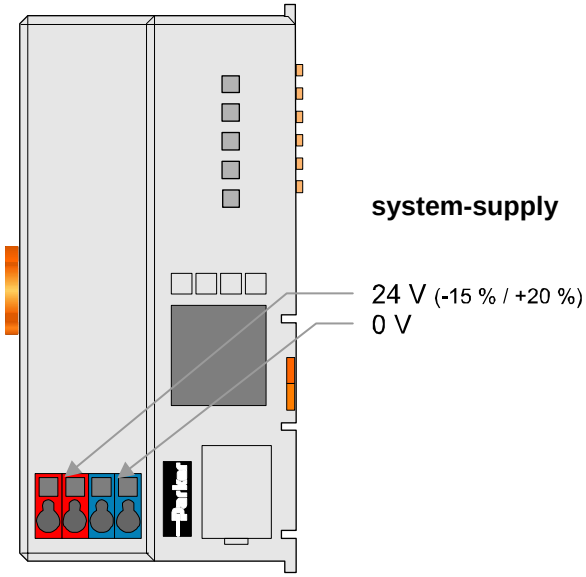


Fig. 2-11: System Supply

The direct current supplies all internal I/O-System components, e.g. ECO coupler electronics, fieldbus interface and bus modules via the internal bus (5 V system voltage). The 5 V system voltage is electrically connected to the 24 V system supply.

Alignment

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

The supply capacity of the ECO coupler can be taken from the technical data of the components.

Internal current consumption *)	Current consumption via system voltage: 5 V for electronics of the bus modules and ECO coupler
Residual current for bus terminals *)	Available current for the bus modules. See technical data ECO coupler.

Example **ECO coupler:**
internal current consumption : 350 mA at 5V
residual current for bus modules : 650 mA at 5V
sum $I_{(5V)\ total}$: 1000 mA at 5V

The internal current consumption is indicated in the technical data for each bus terminal. In order to determine the overall requirement, add together the values of all bus modules in the node.

Example: A node with a PROFIBUS ECO Coupler consists of 16 digital output modules (PIO-530) and 14 digital input modules (PIO-430).

Current consumption:
16*25 mA = 400 mA
14*17 mA = 238 mA
Sum : 638 mA

The coupler can provide 638 mA (max. 650 mA) for the bus modules.

The maximum input current of the 24 V system supply is 260 mA. The exact electrical consumption ($I_{(24\ V)}$) can be determined with the following formulas:

ECO Coupler

$I_{(5\ V)\ total.}$ = Sum of all the internal current consumption of the connected bus modules
+ internal current consumption of the ECO coupler

$I_{(5\ V)\ total.}$ = Sum of all the internal current consumptions of the connected bus modules

Input current $m\ I_{(24\ V)}$ = $5\ V / 24\ V * I_{(5\ V)\ total.} / \eta$

$\eta = 0.80$ *(at nominal load)*

Note
If the electrical consumption of the power supply point for the 24 V-system supply exceeds 260 mA for the ECO coupler, then the cause may be an improperly aligned node or a defect.

During the test, all outputs must be active.

2.6.3 Field Supply

Connection

Sensors and actuators can be directly connected to the relevant channel of the bus module in 1-/4 conductor connection technology. The bus module supplies power to the sensors and actuators. The input and output drivers of some bus modules require the field side supply voltage.

Power supply modules provides field side power. The connections are linked in pairs with a power contact.

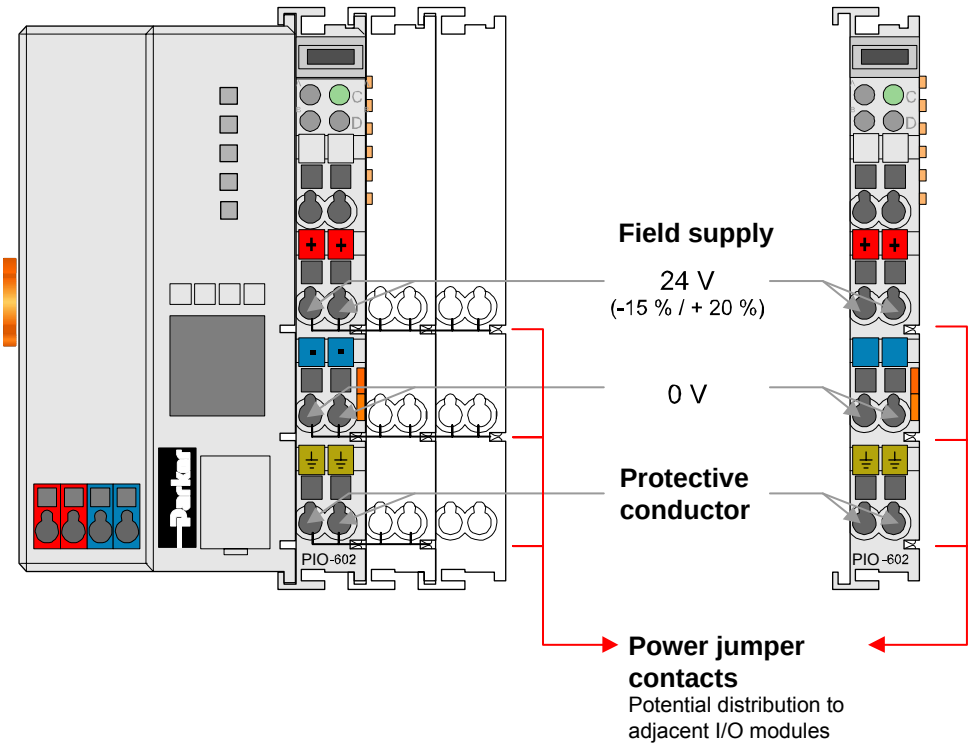


Fig. 2-12: Field Supply (Sensor / Actuator)

The supply voltage for the field side is automatically passed to the next module via the power jumper contacts when assembling the bus modules .

The current load of the power contacts must not exceed 10 A on a continual basis. The current load capacity between two connection terminals is identical to the load capacity of the connection wires.

By inserting an additional power supply module, the field supply via the power contacts is disrupted. From there a new power supply occurs which may also contain a new voltage potential.

Attention
Some bus modules have no or very few power contacts (depending on the I/O function). Due to this, the passing through of the relevant potential is disrupted. If a field supply is required for subsequent bus modules, then a power supply module must be used.
Note the data sheets of the bus modules.

2.6.4 Power Supply Unit

The I/O-SYSTEM requires a 24 V direct current system supply with a maximum deviation of -15% or +20 %.

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

A buffer (200 µF per 1 A current load) should be provided for brief voltage dips. The I/O system buffers for approx. 1 ms.

The electrical requirement for the field supply is to be determined individually for each power supply point. Thereby all loads through the field devices and bus modules should be considered. The field supply as well influences the bus modules, as the inputs and outputs of some bus modules require the voltage of the field supply.

Note
The system supply and the field supply should be isolated in order to ensure bus operation in the event of short circuits on the actuator side.

2.7 Grounding

2.7.1 Grounding the DIN Rail

Framework Assembly

When setting up the framework, the carrier rail must be screwed together with the electrically conducting cabinet or housing frame. The framework or the housing must be grounded. The electronic connection is established via the screw. Thus, the carrier rail is grounded.

Attention
Care must be taken to ensure the flawless electrical connection between the carrier rail and the frame or housing in order to guarantee sufficient grounding.

Insulated Assembly

Insulated assembly has been achieved when there is constructively no direct conduction connection between the cabinet frame or machine parts and the carrier rail. Here the earth must be set up via an electrical conductor.

The connected grounding conductor should have a cross section of at least 4 mm^2.

Recommendation
The optimal insulated setup is a metallic assembly plate with grounding connection with an electrical conductive link with the carrier rail.

2.7.2 Grounding Function

The grounding function increases the resistance against disturbances from electro-magnetic interferences. Some components in the I/O system have a carrier rail contact that dissipates electro-magnetic disturbances to the carrier rail.

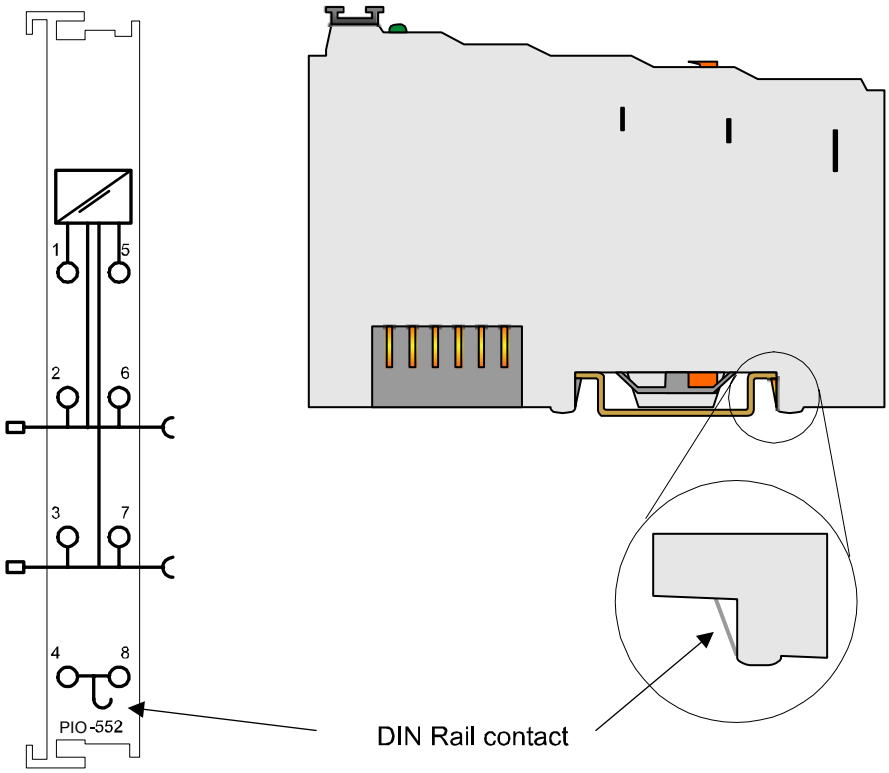


Fig. 2-13: Carrier rail contact

Attention
Care must be taken to ensure the direct electrical connection between the carrier rail contact and the carrier rail.
The carrier rail must be grounded.
For information on carrier rail properties, please see chapter "Carrier Rail Properties".

2.7.3 Grounding Protection

For the field side, the ground wire is connected to the lowest connection terminals of the power supply module. The ground connection is then connected to the next module via the Power Jumper Contact (PJC). If the bus module has the lower power jumper contact, then the ground wire connection of the field devices can be directly connected to the lower connection terminals of the bus module.

Attention
Should the ground conductor connection of the power jumper contacts within the node become disrupted, e.g. due to a 4-channel bus terminal, the ground connection will need to be re-established.

The ring feeding of the grounding potential will increase the I/O-System safety. When one bus module is removed from the group, the grounding connection will remain intact.

The ring feeding method has the grounding conductor connected to the beginning and end of each potential group.

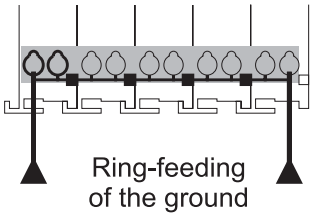


Fig. 2-14: Ring-feeding

2.8 Shielding (Screening)

2.8.1 General

The shielding of the data and signal conductors reduces electromagnetic interference thereby increasing the signal quality. Measurement errors, data transmission errors and even disturbances caused by overvoltage can be avoided.

Attention
Constant shielding is absolutely required in order to ensure the technical specifications in terms of the measurement accuracy.
The data and signal conductors should be separated from all high-voltage cables.
The cable shield should be potential. With this, incoming disturbances can be easily diverted.
The shielding should be placed over the entrance of the cabinet or housing in order to already repel disturbances at the entrance.

2.8.2 Bus Conductors

The shielding of the bus conductor is described in the relevant assembly guideline of the bus system.

2.8.3 Signal Conductors

Bus modules for most analog signals along with many of the interface bus modules include a connection for the shield.

2.9 Assembly Guidelines / Standards

DIN 60204,	Electrical equipping of machines
DIN EN 50178	Equipping of high-voltage systems with electronic components (replacement for VDE 0160)
EN 60439	Low voltage – switch box combinatio

3 Fieldbus Coupler

3.1 Fieldbus ECO-Coupler

This chapter includes:

3.1.1 Description 30
3.1.2 Hardware 31
3.1.3 Operating System 34
3.1.4 Process Image 35
3.1.5 Configuration 39
3.1.6 Configuring the Coupler 43
3.1.7 Configuring the Process Data Channel 45
3.1.8 Configuration of I/O Modules 46
3.1.9 Diagnostics 55
3.1.10 LED Signaling 62
3.1.11 Fault Behavior 68
3.1.12 Technical Data 69

3.1.1 Description

The Fieldbus Coupler maps the peripheral data of all I/O modules in the I/O-SYSTEM on PROFIBUS DP.

In the initialization phase, the Fieldbus Coupler determines the physical structure of the node and creates a process image with all inputs and outputs. I/O modules with a bit width smaller than 8 can be combined to form one byte in order to optimize the address space.

In addition the possibility exists to deactivate projected I/O modules. In this manner the physical structure of the node can be individually designed with regard to the peripheral signals, without undertaking any changes to an already existing control application. This is done by correspondingly configuring the modules with the aid of the software configuration tool (for instance, COM PROFIBUS, STEP7, ProfiMap, etc.)

The diagnostics feature is based on an identification and channel based diagnostics in accordance with EN 50170 (PROFIBUS). Thus it is not necessary to program modules for the evaluation of manufacturer specific diagnostics information.

- Process data length
  Max. 32 byte input process image
  Max. 32 byte output process image
- Automatic recognition of transmission speed on the PROFIBUS from 9.6 kBd to 12 MBd
- All I/O modules from theI/O-SYSTEM are supported
- Process image can accept virtual placeholders for future expansion
- Configurable substitute value for each channel
- D-Sub 9 pole bus connection

3.1.2 Hardware

View

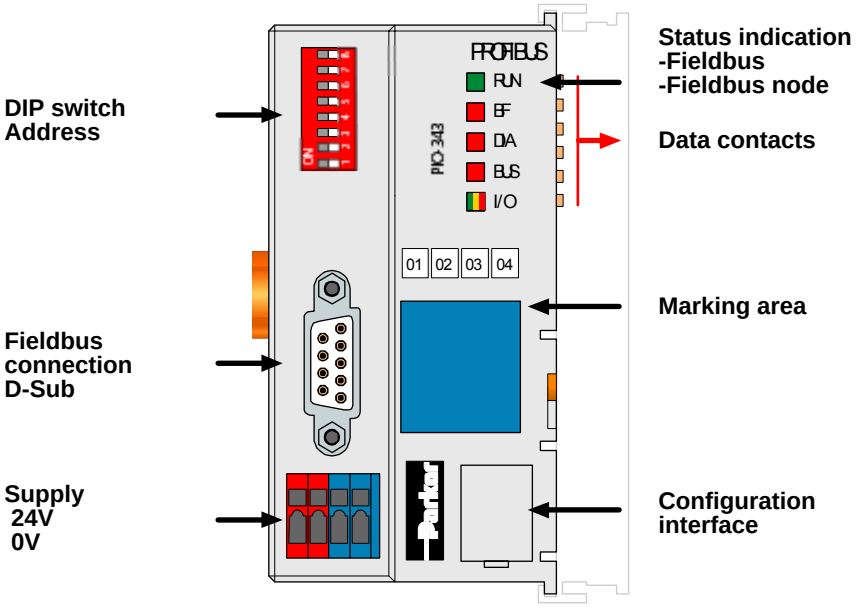


Fig. 3-1: Fieldbus ECO-Coupler PROFIBUS DP

The Fieldbus Coupler comprises of:

- Supply module with internal system supply module for the system supply.
- Fieldbus interface with the bus connection
- DIP switch for the node address (binary)
- Display elements (LED's) for status display of the operation, the bus communication, the operating voltages as well as for fault messages and diagnostics
- Configuration Interface
- Electronics for communication with the I/O modules (internal bus) and the fieldbus interface

Device Supply

The supply is made via terminal bocks with CAGE CLAMP® connection. The device supply is intended both for the I/O-System and the field units.

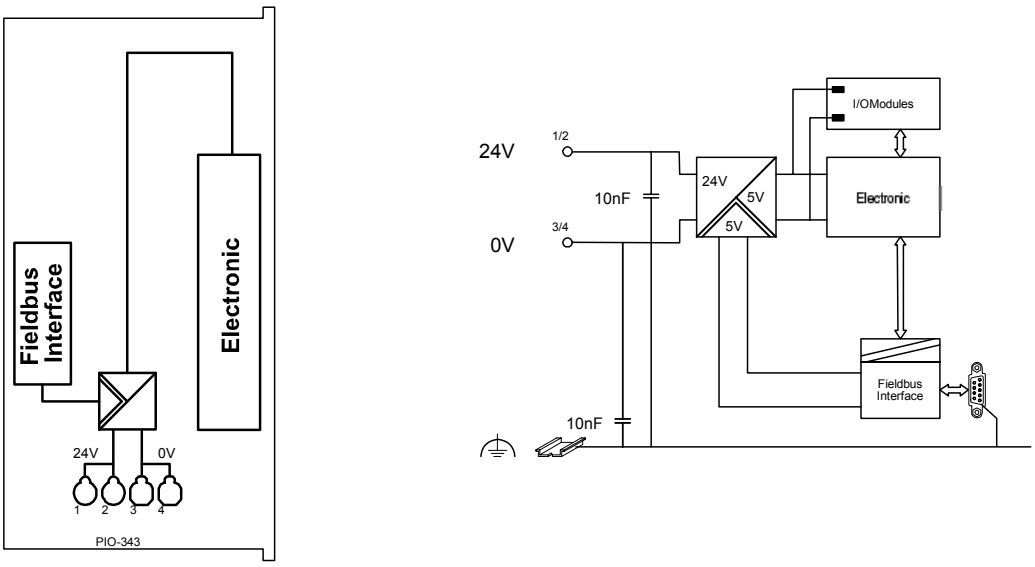


Fig. 3-2: Device supply

The integrated internal system supply module generates the necessary voltage to supply the electronics and the connected I/O modules.

The fieldbus interface is supplied with electrically isolated voltage from the internal system supply module.

Fieldbus Connection

The PROFIBUS interface is designed as a D-Sub connection in accordance with the US Standard EIA RS 485 for cable linked data transmission.

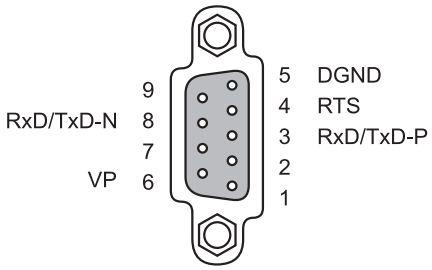


Fig. 3-3: Bus connection, D-Sub female connector

Pin	Signal	Description
3	RxD(TxD)-P	Transmit (receive) signal
4	RTS	Ready To Send
5	GND	Supply ground (earth)
6	Vcc	Voltage supply
8	RxD(TxD) N	Transmit (receive) signal

The electrical isolation between the fieldbus system and the electronics is achieved by means of DC/DC converters and optocouplers located in the fieldbus interface.

The fieldbus connection point is designed to permit the node to fit into an 80 mm high switch box once connected.

Display Elements

The operating condition of the Fieldbus Coupler or node is signaled via light diodes (LED).

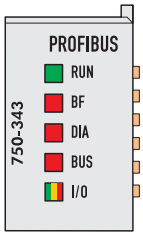


Fig. 3-4: Display elements PIO-343

LED	Color	Meaning
RUN	green	The RUN-LED indicates to the operator if the Fieldbus Coupler is correctly initialized.
BF	red	The BF-LED indicates whether the communication functions via the PROFIBUS.
DIA	red	The DIA-LED indicates external diagnostics. The signaling is not supported by all devices.
BUS	red	The BUS-LED signals a projecting fault.
IO	red / green / orange	The I/O-LED indicates the operation of the node and signals faults encountered.

Node Address

The node address (decimal) is determined using two rotary switches on the electronic module.

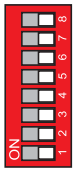


Fig. 3-5: Setting the node address

The binary significance of the individual DIP switches increases according to the switch number, i.e. the module ID 1 is set by DIP1 = ON, the module ID 8 by DIP4 = ON, etc.

The binary value (2^0–2^7) of the dip switches increases from switch 1 to switch 8, a logic 1 being represented by “ON“.

Address	DIP8	DIP7	DIP6	DIP5	DIP4	DIP3	DIP2	DIP1
0	-	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1*)	-	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	-	OFF	OFF	OFF	OFF	OFF	ON	OFF
:								
127	-	ON	ON	ON	ON	ON	ON	ON

*) default setting

Node addresses between 0 and 127 can be set.

If an invalid address is set, the coupler adopts the address that has been assigned via Set_Slave_Address. This address is stored in the power fail safe EEPROM. The default address is 126.

The node address is saved in the Fieldbus Coupler after switching on the device (initialization phase). Adjustments of the switch have no effect during operation.

Configuration Interface

The configuration interface used for the communication or for firmware upload is located behind the cover flap.

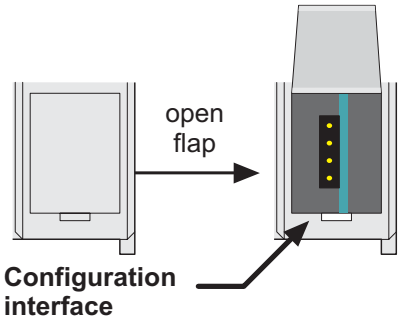


Fig. 3-6: Configuration interface

3.1.3 Operating System

Once the node is configured in the software, the node address is set and the node is wired properly, the power can be applied.

After switching on the supply voltage, the coupler performs a self-test of all of the device functions, the I/O module and the fieldbus interface. If the power supply is working correctly the I/O-LED is green. Following this the I/O modules and the present configuration is determined, whereby an internal list is generated. This list includes an input and an output area on which is represented the fieldbus RAM of the protocol chip.

In the event of a fault the Coupler changes to the "Stop" condition. The I/O-LED flashes red. After a fault free start up the Coupler changes to the "Fieldbus start" status.

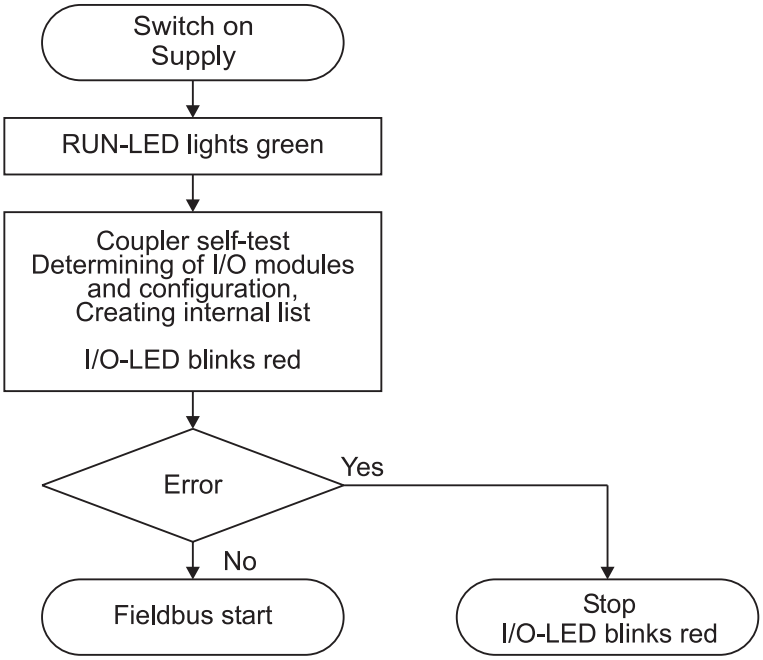


Fig. 3-7: Operating system PIO-343

3.1.4 Process Image

Local Process Image

After switching on, the Coupler recognizes all I/O modules plugged into the node which supply or wait for data (data width/bit width > 0). Both analog and digital I/O modules can be used in the same node.

Note
For the number of input and output bits or bytes of the individual I/O module please refer to the corresponding I/O module description.

The Coupler produces an internal process image from the data width and the type of I/O module as well as the position of the I/O modules in the node. It is divided into an input and an output data area.

Allocation of the Input and Output Data

The process data is exchanged via the PROFIBUS master. A maximum of 32 bytes of data is transmitted from the master to the Coupler or from the node to the output data. The Coupler responds by returning a maximum of 32 bytes input data to the master.

Modules are configured according to their position in the node. The information covering the possible modules is contained in the GSD files.

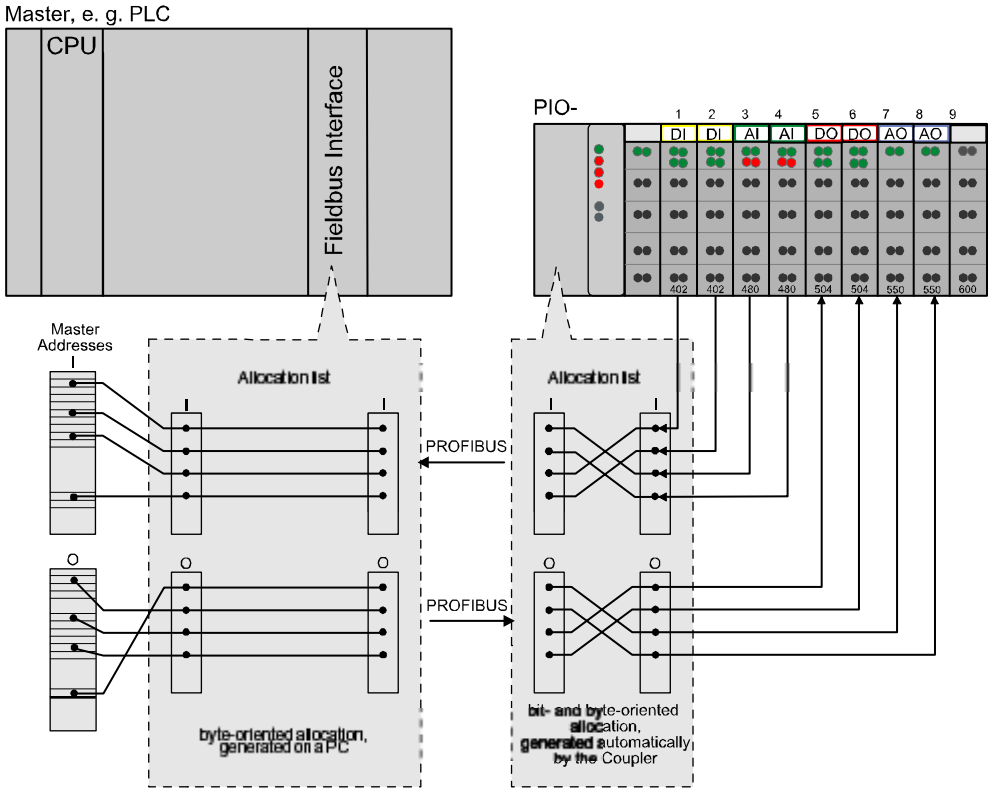


Fig. 3-8: Allocation of the input and output data

Process Images of the I/O-Modules with PROFIBUS-DP

The input and output data of the digital modules are mapped to the Profibus bit by bit. The configuration of the node determines whether each module occupies a byte or the data of several modules is grouped in one byte.
The input and output data of the analog modules (D0...Dn) are mapped via bytes. In addition to data bytes, specialty modules (counter modules, pulse width output module, etc.) also send Status Bytes (S) to the Master or receive Control Bytes (C) from the Master.
Depending on the configuration of the coupler, the status, control and data bytes of the byte-oriented modules are sent in the Motorola or in the Intel format.

Note
For the number of input and output bits or bytes of the individual I/O modules please refer to the corresponding I/O module description.

2 DI I/O-Modules

PIO-400,

Process Image [bit]		
	Input	Output
PROFIBUS-DP	2	0

4 DI I/O-Modules

PIO-402

Process Image [bit]		
	Input	Output
PROFIBUS-DP	4	0

8 DI I/O-Modules

PIO-430

Process Image [bit]		
	Input	Output
PROFIBUS-DP	8	0

2 DO I/O-Modules

PIO-501

Process Image [bit]		
	Input	Output
PROFIBUS-DP	0	2

4 DO I/O-Modules

PIO-504

Process Image [bit]		
	Input	Output
PROFIBUS-DP	0	4

8 DO I/O-Modules

PIO-530

Process Image [bit]			
		Input	Output
PROFIBUS-DP		0	8

2 AI I/O-Modules

PIO-480

Process Image [byte]				
	Input		Output	
PROFIBUS-DP	4		0	
PROFIBUS-DP Mapping				
	MOTOROLA		INTEL	
	Input	Output	Input	Output
Channel 1	D1	-	D0	-
	D0	-	D1	-
Channel 2	D3	-	D2	-
	D2	-	D3	-

4 AI I/O-Modules

PIO-468

Process Image [byte]				
	Input		Output	
PROFIBUS-DP	8		0	
PROFIBUS-DP Mapping				
	MOTOROLA		INTEL	
	Input	Output	Input	Output
Channel 1	D1	-	D0	-
	D0	-	D1	-
Channel 2	D3	-	D2	-
	D2	-	D3	-
Channel 3	D5	-	D4	-
	D4	-	D5	-
Channel 4	D7	-	D6	-
	D6	-	D7	-

2 AO I/O-Modules

PIO-550, PIO-552

Process Image [byte]				
	Input		Output	
PROFIBUS-DP	0		4	
PROFIBUS-DP Mapping				
	MOTOROLA		INTEL	
	Input	Output	Input	Output
Channel 1	-	D1	-	D0
	-	D0	-	D1
Channel 2	-	D3	-	D2
	-	D2	-	D3

3.1.5 Configuration

The configuration of the node is performed in accordance with the physical placement of the Fieldbus Coupler and I/O modules.

The Fieldbus Coupler or the process data channel is to be configured on the first slot.The other slots are configured in accordance with the physical placement of the I/O modules. Here only I/O modules with process data are relevant.

There are one or two entries in the hardware cataloge for each I/O module.
The module appear as ***PIO-xyz ...***, for example ***PIO-400 2 DI/24 V DC/3.0 ms***.

For all binary modules an additional entry is made, ****PIO-xyz ...***. When using this notation the Coupler adds the binary information to the current module in a byte which was previously opened with ***PIO-xyz ...***. The use of a „*“ module is only permitted when the number of channels is less than or equal to the remaining bits in the previously opened byte. The binary I/O modules combined in a byte can be arranged at separate locations, i.e. binary I/O modules with a different signal type or also byte orientated I/O modules can be combined.

GSD Files

Under PROFIBUS DP, the modules features are defined by the manufacturers in the form of a GSD file (unit basic data).

Structure, content and coding of this unit basic data are standardized and made available to the user allowing for optional DP slaves using the GSD files of various manufacturers.

Further information
The PNO provides information about the GSD files of all listed manufacturers.

GSD and symbol files for the configuration of the I/O modules are available under the order number PIO-910 on disks or from the PARKER INTERNET page.

http://www.wago.com

GSD file for I/O-Module PIO-343	**PARKERB757.GSD**

The GSD file is read by the configuration software and the corresponding settings transmitted. For the necessary inputs and handling steps please refer to the software user manuals.

Identification Bytes

The identification bytes contain information about the design and structure of the module inputs and outputs. For the configuration, each I/O module, or each channel is allocated an identification (module).

Bit								Meaning
7	6	5	4	3	2	1	0	
				0 0 0 ... 1	0 0 0 ... 1	0 0 1 ... 1	0 1 0 ... 1	**Data length** 1 byte or word 2 bytes or words 3 bytes or words ... 16 bytes or words
		0 0 1 1	0 1 0 1					**Input and output** spec. identification formats Input Output Input and output
	0 1							**Format** 0 = Byte structure 1 = Word structure
0 1								**Consistence over** Byte or word Total length

This information is saved in the GSD file. During configuring the I/O module is selected in accordance with the article number using the configuration software in the hardware cataloge.

Modules are compiled in the table to make things simpler.

Module	Description	Example
Module	Configuration of I/O modules	PIO-400 2 DI/24 V DC/3.0 ms
*-Module	Configuration of digital I/O modules. Binary data is mapped to a byte that has already been started by “Module”.	*PIO-400 2 DI/24 V DC/3.0 ms

Example

The allocation of a fieldbus node with a Coupler and 17 I/O modules is shown below.

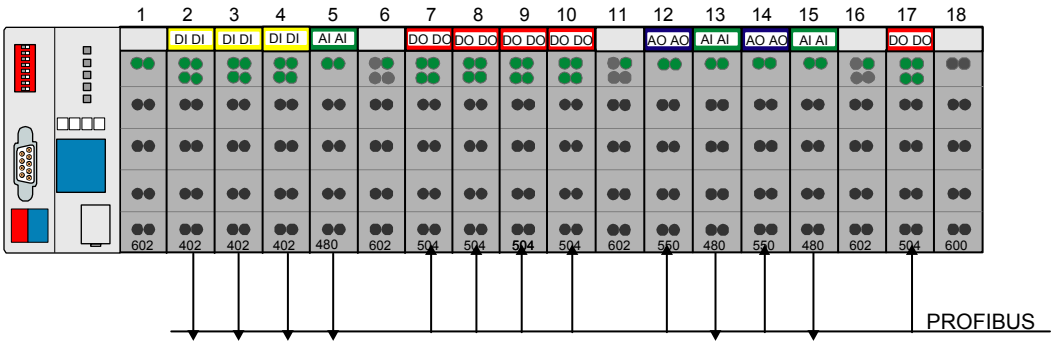


Fig. 3-9: Example application

No.	I/O modules	Module Identification	PI Master *	
			Inputs	Outputs
1	Potential supply	Potential supply	---	---
2	Digital input	PIO-402 4 DI/24 V DC/3.0 ms	EB13.0	
	Digital input	0x10	EB13.1	
	Digital input		EB13.2	
	Digital input		EB13.3	
3	Digital input	*PIO-402 4 DI/24 V DC/3.0 ms	EB12.4	
	Digital input	0x00	EB12.5	
	Digital input		EB12.6	
	Digital input		EB12.7	
4	Digital input	PIO-402 4 DI/24 V DC/3.0 ms	EB13.0	
	Digital input	0x10	EB13.1	
	Digital input		EB13.2	
	Digital input		EB13.3	
5	Analog input	PIO-452 2 AI/0-20 mA/diff. PIO-480 ?	EW0	
	Analog input	0x51	EW2	
6	Potential supply	Potential supply	---	---
7	Digital output	PIO-504 4 DO/24 V DC/0.5 A		AB8.0
	Digital output	0x20		AB8.1
	Digital output			AB8.2
	Digital output			AB8.3
8	Digital output	*PIO-504 4 DO/24 V DC/0.5 A		AB8.4
	Digital output	0x00		AB8.5
	Digital output			AB8.6
	Digital output			AB8.7

No.	I/O modules	Module Identification	PI Master *	
			Inputs	Outputs

9	Digital output	PIO-504 4 DO/24 V DC/0.5 A		AB9.0
	Digital output	0x20		AB9.1
	Digital output			AB9.2
	Digital output			AB9.3
10	Digital output	*PIO-504 4 DO/24 V DC/0.5 A		AB9.4
	Digital output	0x00		AB9.5
	Digital output			AB9.6
	Digital output			AB9.7
11	Potential supply	Potential supply	---	---
12	Analog output	PIO-550 2 AO/0-10 V		AW0
	Analog output	0x61		AW2
13	Analog input	PIO-452 2 AI/0-20 mA/diff.	EW4	
	Analog input	0x51	EW6	
14	Analog output	PIO-550 2 AO/0-10 V		AW4
	Analog output	0x61		AW6
15	Analog input	PIO-452 2 AI/0-20 mA/diff.	EW8	
	Analog input	0x51	EW10	
16	Potential supply	Potential supply	---	---
17	Digital output	PIO-504 4 DO/24 V DC/0.5 A		AB10.0
	Digital output	0x20		AB10.1
	Digital output			AB10.2
	Digital output			AB10.3
18	End module	End module	---	---

* The master addresses listed in the table correspond to the allocation of the process data given in the master configuration.

3.1.6 Configuring the Coupler

Before a data exchange is possible between the master and slaves, configuring the coupler is necessary.

The extended parameters (extended User_Prm_Data) is available as a selectable text in the configuration programs using the GSD files.

Description	Value	Meaning
Restart the internal bus after a fault	POWER ON RESET*) AUTORESET	Restart of the internal bus following a fault, such as missing termination module, after interruption of the I/O module supply immediately after overcoming I/O module fault
I/O module diagnostics	released*) lock	The diagnostics information about all diagnostics capable I/O modules, with which the diagnostics is released are transferred to PROFIBUS DP master not transferred to PROFIBUS DP master
Process value display	INTEL MOTOROLA*)	Word or double word orientated process data is transferred to the PROFIBUS DP master in: „Little Endian Format“ „Big Endian Format“
Behavior in case of a PROFIBUS DP fault	Stop internal bus transmission Set start image to zero Freeze starting image Write substitute values*)	In the case of a fault with the PROFIBUS DP communication the status of the inserted output periphery can be influenced in various manners: the process data exchange of the internal bus is stopped, all outputs drop out after a module specific monitoring time of 100 ms all outputs are reset immediately all outputs contain the last status before the fault all outputs switch a parameter substitute value
Reaction to internal bus faults	Stop PROFIBUS data exchange*) Set start image to zero Freeze starting image	In the case of a fault with the internal communication between the Fieldbus Coupler and I/O modules, such as, for example: no termination module, the data exchange with the PROFIBUS master is stopped. the input information is set to zero the input information before the fault is maintained

*) Default settings

The complete parameter record encompasses 34 configuration bytes. The first 10 bytes are laid down by the DP and DPV1 standard. The others contain manufacturer specific parameters.

Byte No.	Bit No.	Value	Meaning
Standard Parameters			
0	0-7		Stations status (see EN 50170)
1	0-7	2-255	Watchdog factor 1
2	0-7	2-255	Watchdog factor 2
			Watchdog: The reaction monitoring is determined in accordance with the Watchdog_Factor_1 x Watchdog_Factor_2 x 10 ms (1 ms)
3	0-7	11-255	Min T_{SDR}, Earliest time in T_{Bit} after which the slave may answer
4	0-7	183, 0xB7	Manufacturer code (high byte)
5	0-7	84, 0x54	Manufacturer code (low byte)
6	0-7		Group allocation, Broad and multicast telegrams (SYNC, FREEZE)
7	0-7		DPV1 status 1 (see EN 50170)
8	0-7		DPV1 status 2 (see EN 50170)
9	0-7		DPV1 status 3 (see EN 50170)
Manufacturer Parameters			
10	0-7	0	Table 0, register 0 LB, reserved
11	0-7	0	Table 0, register 0 HB, reserved
12	0-7	0	Table 0, register 1 LB, reserved
13	0-7	0	Table 0, register 1 HB, reserved
14			Table 0, register 2 LB
	0	0	Module diagnostics locked
	0	1 *)	Module diagnostics released
	1	0	Internal bus restart after fault: POWER-ON-RESET
	1	1 *)	Internal bus restart after fault: AUTORESET
	2-7	0	reserved
15	0-7	0	Table 0, register 2 HB, reserved
16			Table 0, register 3 LB
	0-2	'011'	reserved
	3	0	Data format byte orientated I/O modules: INTEL
	3	1 *)	Data format byte orientated I/O modules: MOTOROLA
	4-7	'1100'	reserved
17			Table 0, register 3 HB
	0-2		Reaction to fieldbus fault:
		'000'	- Internal bus transmission stopped
		'001'	- Set output image to zero
		'010'	- Freeze output image
		'011' *)	- Write substitute values
		'100' - '111'	- not possible
	3-5		Reaction to internal bus fault:
		'000' *)	- Leave data exchange
		'001'	- Set input image to zero
		'010'	- Freeze input image
		'011' - '111'	- not possible
	6-7	'00'	reserved
18	0-7	'1100.0011'	Table 0, register 4 LB, reserved
19	0-7	'0111.1111'	Table 0, register 4 HB, reserved
20	0-7	'0000.0000'	Table 100, register 0 LB, reserved
21	0-7	'0000.0001'	Table 100, register 0 HB, reserved
22	0-7	'0000.0000'	Table 100, register 1 LB, reserved
23	0-7	'0000.0000'	Table 100, register 1 HB, reserved
24	0-7	'0000.0000'	Table 100, register 2 LB, reserved
25	0-7	'0000.0000'	Table 100, register 2 HB, reserved

3.1.7 Configuring the Process Data Channel

The process data channel serves for the communication between the Coupler and the higher ranking systems (Master or project and diagnostics PC).
This channel is allocated to the Coupler and can not be used. When designing the node, this position should therefore always show “PIO-343 No process data channel”.

Module	Identification hex	Identification dec.
PIO-343 No process data channel	0x00	0
PIO-343 2 byte process data channel	0xB1	177

Process Image	Input Image in [byte]	Output Image in [byte]
Internal bus	0	0
PROFIBUS DP	2	2

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - set to zero by the Coupler

*) Default settings

Parameter								
Offset	Information							
0	7 *1*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*
1	7 *0*	6 *0*	5 *1*	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 Reg Intf	0 *0*

$RegIntf_1$	0	Register Interface switched off (PIO-343 No process data channel)
	1	Register Interface switched on (PIO-343 2 byte process data channel)
italic		Cannot be changed

Attention
One of these configuration modules has to be selected for the first module slot of the configuration table. Otherwise, the bus coupler signals a configuration error on the BUS-LED and in the status signal of the PROFIBUS diagnostics if it was released when configuring the bus coupler.

3.1.8 Configuration of I/O Modules

Digital I/O Modules

All binary I/O modules contain configuration information extended by 3 bytes, to serve, amongst others, for identification on the internal bus and the structure of the mapping table. With diagnostics capable terminals the diagnostics message can be suppressed or released for a channel or module. Binary outputs offer the alternative to switch to configured default values in the case of a master failure.

Note
For simplification, the tables only show the article number for the module designation. The module „PIO-400“ thus corresponds to the module „PIO-400 2 DI/24 V DC/3.0 ms“

2 DI I/O Modules

Module	Identification hex	Identification dec
PIO-400	0x10	16
*PIO-400	0x00	0

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	2	0
PROFIBUS DP	2	0

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - set to zero by the Coupler

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
Italic		Cannot be changed

4 DI I/O Modules

Module	Identification hex	Identification dec
PIO-402	0x10	16
*PIO-402	0x00	0

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	4	0
PROFIBUS DP	4	0

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - Set to zero by the Coupler

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
Italic		Cannot be changed

8 DI I/O Modules

Module	Identification hex	Identification dec
PIO-430	0x10	16

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	8	0
PROFIBUS DP	8	0

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - Set to zero by the Coupler

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *1*	0 *1*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
Italic		Cannot be changed

2 DO I/O Modules

Module	Identification hex	Identification dec
PIO-501	0x20	32
*PIO-501	0x00	0

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	0	2
PROFIBUS DP	0	2

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied to the I/O module - ignored by the Coupler
Substitute channel x	0*) 1	If, in the case of a PROFIBUS DP fault, the switching of substitute values is enabled by the Coupler configuration, this data is transmitted to the periphery in the case of a fault.

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *1*	0 *0*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 SV1	0 SV0

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
$SV0_0$		Substitute value for channel 1
$SV0_1$		Substitute value for channel 2
Italic		Cannot be changed

4 DO I/O Modules

Module	Identification hex	Identification dec
PIO-504	0x20	32
*PIO-504	0x00	0

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	0	4
PROFIBUS DP	0	4

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - ignored by the Coupler
Substitute channel x	0*) 1	If, in the case of a PROFIBUS DP fault, the switching of substitute values is enabled by the Coupler configuration, this data is transmitted to the periphery in the case of a fault.

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *0*	0 *1*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *1*	0 *0*
2	7 *0*	6 *0*	5 *0*	4 *0*	3 SV3	2 SV2	1 SV1	0 SV0

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
$SV0_0$		Substitute value for channel 1
$SV0_1$		Substitute value for channel 2
$SV0_2$		Substitute value for channel 3
$SV0_3$		Substitute value for channel 4
Italic		Cannot be changed

8 DO I/O Modules

Module	Identification hex	Identification dec
PIO-530	0x20	32

Process Image	Input Image in [bit]	Output Image in [bit]
Internal bus	0	8
PROFIBUS DP	0	8

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - ignored by the Coupler
Substitute channel x	0*) 1	If, in the case of a PROFIBUS DP fault, the switching of substitute values is enabled by the Coupler configuration, this data is transmitted to the periphery in the case of a fault.

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *1*	0 *1*
1	7 *0*	6 *0*	5 *0*	4 *0*	3 *0*	2 *0*	1 *1*	0 *0*
2	7 SV7	6 SV6	5 SV5	4 SV4	3 SV3	2 SV2	1 SV1	0 SV0

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
$SV0_0$		Substitute value for channel 1
$SV1_1$		Substitute value for channel 2
$SV2_2$		Substitute value for channel 3
$SV3_3$		Substitute value for channel 4
$SV4_4$		Substitute value for channel 5
$SV5_5$		Substitute value for channel 6
$SV6_6$		Substitute value for channel 7
$SV7_7$		Substitute value for channel 8
Italic		Cannot be changed

Analog I/O Modules

All analog I/O modules have 2 bytes of extendable configuration information, which serves for identification on internal bus and the formation of a mapping table.
Analog inputs are followed by 2 bytes reserved for future options. The diagnostics message can be suppressed or released for each individual channel by means of modules capable of diagnostics.
Analog outputs have 2 byte configuration data for each channel. These are used to save the substitute values for corresponding channel.

2 AI I/O Modules

Module	Identification hex	Identification dec
PIO-480	0x51	81

Process Image	Input Image in [byte]	Output Image in [byte]
Internal bus	6	6
PROFIBUS DP	4	0

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - set to zero by the Coupler
Diagnostics channel x	released*) locked	The diagnostics information of the corresponding channel is - transmitted to PROFIBUS DP master - not transmitted to PROFIBUS DP master

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 Diag En1	2 Diag En0	1 *0*	0 *0*
1	7 *0*	6 *1*	5 ID5	4 ID4	3 ID3	2 ID2	1 ID1	0 ID0
2	15 *reserved*	14	13	12	11	10	9	8
3	7 *reserved*	6	5	4	3	2	1	0

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
$DiagEn0_2$	0	Diagnostics channel 1 locked
	1	Diagnostics channel 1 released
$DiagEn1_3$	0	Diagnostics channel 2 locked
	1	Diagnostics channel 2 released
ID5 .. ID0		Order number less 450
Italic		Cannot be changed

4 AI I/O Module

Module	Identification hex	Identification dec
PIO-468	0x53	83

Process Image	Input Image in [byte]	Output Image in [byte]
Internal bus	12	12
PROFIBUS DP	8	0

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - set to zero by the Coupler
Diagnostics channel x	released*) locked	The diagnostics information of the corresponding channel is - transmitted to PROFIBUS DP master - not transmitted to PROFIBUS DP master

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 Diag En1	2 Diag En0	1 Diag En3	0 Diag En2
1	7 *0*	6 *1*	5 ID5	4 ID4	3 ID3	2 ID2	1 ID1	0 ID0
2	15	14	13	12	11	10	9	8
	reserved							
3	7	6	5	4	3	2	1	0
	reserved							

$Plug_5$	0	Module is physically not present
	1	Module is physically present (default)
$DiagEn2_0$	0	Diagnostics channel 3 locked
	1	Diagnostics channel 3 released
$DiagEn3_1$	0	Diagnostics channel 4 locked
	1	Diagnostics channel 4 released
$DiagEn0_2$	0	Diagnostics channel 1 locked
	1	Diagnostics channel 1 released
$DiagEn1_3$	0	Diagnostics channel 2 locked
	1	Diagnostics channel 2 released
ID5 .. ID0		Order number less 450
Italic		Cannot be changed

2 AO I/O Modules

Module	Identification hex	Identification dec
PIO-550, PIO-552	0x61	97

Process Image	Input Image in [byte]	Output Image in [byte]
Internal bus	6	6
PROFIBUS DP	0	4

Parameter	Value	Meaning
I/O module is physically	plug fitted*) not plug fitted	The I/O module process data is: - supplied by the I/O module - ignored by the Coupler
Diagnostics channel x	released locked*)	The diagnostics information of the corresponding channel is - transmitted to PROFIBUS DP master - not transmitted to PROFIBUS DP master
Substitute value channel x	0x0000 or 0x8000 0 or -32767 ... 0x7FFF ... 32767	If, in the case of a PROFIBUS DP fault, the switching of substitute values is enabled by the Coupler configuration, this data is transmitted to the periphery in the case of a fault.

*) Default settings

Parameter								
Offset	Information							
0	7 *0*	6 *0*	5 Plug	4 *0*	3 *0*	2 *0*	1 *0*	0 *0*
1	7 *1*	6 *0*	5 ID5	4 ID4	3 ID3	2 ID2	1 ID1	0 ID0
2	15 SubVal_Ch1_HB	14	13	12	11	9	8	7
3	7 SubVal_Ch1_LB	6	5	4	3	2	1	0
4	15 SubVal_Ch2_HB	14	13	12	11	10	9	8
5	7 SubVal_Ch2_LB	6	5	4	3	2	1	0

$Plug_5$	0 1	Module is physically not present Module is physically present (default)
SubVal_Ch1	0x0000 : 0xFFFF	Substitute value channel 1
SubVal_Ch2	0x0000 : 0xFFFF	2
ID5 .. ID0		Order number less 550 (e.g. PIO-550 would be coded as (550-550) = 0
Italic		Cannot be changed

3.1.9 Diagnostics

The slave diagnostics of the Coupler now comprises of a 6 byte standard diagnostics, a 9 byte identification diagnostics, a 7 byte device status and an up to 42 byte channel based diagnostics.

In the reply telegram of the diagnostics, selection the identification based diagnostics and the device status are transmitted together with the standard diagnostics. This can be followed by up to 14 channel based diagnostics messages (3 byte per message).

Byte		
0		
1		Station status 1 to 3
2		
3		PROFIBUS DP master address
4		Manufacturer identification
5		
6		
7		Identification based diagnostics
:	:	
14	:	
15		
		Device status
21		
22		
		Channel based diagnostics
		(3 bytes per channel)
63		

Station Status 1 to 3

see EN 50170

PROFIBUS DP Master Address

The PROFIBUS DP master address is located in byte 3 of the slave diagnostics and includes the address of the master which has been configured at the node and which has read and write access.

Manufacturer‘s Identification

The manufacturer’s identification is located in byte 4 and 5 and includes a 16 bit code, which serves for the identification of the device or the device class.

Identification Based Diagnostics

The identification based diagnostics is comprised of a bit field, which contains one bit of information for each connected module. The individual bit provides evidence about the current operating status. A 0 means no fault, a 1 indicates a faulty module condition. The Coupler can be equipped with up to 63 modules, so that the identification based diagnostics including the header covers 9 bytes from byte 6 to byte 14.

Byte	Information								Meaning
6	0	1	0	0	1	0	0	1	Header byte (9 byte identification based diagnostics incl. header)
7	7	6	5	4	3	2	1	0	
8	15	14	13	12	11	10	9	8	
9	23	22	21	20	19	18	17	16	Diagnostics allocation to
10	31	30	29	28	27	26	25	24	I/O module n (n=1 ... 63)
11	39	38	37	36	35	34	33	32	Coupler (n=0)
12	47	46	45	44	43	42	41	40	
13	55	54	53	52	51	50	49	48	
14	63	62	61	60	59	58	57	56	

Device Status

The device status encompasses 7 bytes including the required overhead and transmits status information of an internal nature and relating to the I/O module (internal bus), PROFIBUS DP and the PFC-RTS to the master or the higher ranking controls.

Byte	Information								Meaning
15	0	0	0	0	0	1	1	1	Header byte (7 byte status information incl. header)
16	1	0	1	0	0	0	0	0	Status type (manufacturer specific device status)
17	0	0	0	0	0	0	0	0	Slot number 0
18	0	0	0	0	0	0	0	0	Status differentiation (none)
19	q	q	n	n	n	n	n	n	Status message q – Status source '00' Internal status '01' Internal bus status '10' PROFIBUS DP status n – Status number
20	x	x	x	x	x	x	x	x	Status argument
21	0	0	0	0	0	0	0	0	Reserved

Internal Status Messages and Arguments

Status Message	Status Argument	Description
0x00	0x00	No fault
0x01	0x01	Overflow inline code buffer
0x01	0x02	Unknown data type
0x01	0x03	EEPROM checksum fault
0x01	0x04	Fault when writing into the serial EEPROM
0x01	0x05	Fault when reading from the serial EEPROM
0x01	0x06	Changed I/O modules configuration determined following AUTORESET
0x01	0x07	Reserved
0x01	0x08	Timeout when writing into the serial EEPROM

Internal Bus Status Messages and Arguments

Status Message	Status Argument	Description
0x43	0xFF	At least one module cannot interpret an internal bus command
0x44	0x00	A data fault or an internal bus interruption exists after the Coupler
0x44	n	An internal bus interruption exists after the module n
0x45	n	Fault in the register communication with module n

PROFIBUS DP Status Messages and Arguments

Status message	Status argument	Description
0x81	0x01	Insufficient configuration data configuration data
0x81	0x02	Too much configuration data
0x82	n	n. parameter byte faulty
0x83	0x01	Insufficient configuration data
0x83	0x02	Too much configuration data
0x84	n	n. configuration byte (module) faulty
0x85	0x01	maximum input data length exceeded
0x85	0x02	maximum output data length exceeded
0x86	0x01	Compiled buffer overflow for DP process image

Channel Based Diagnostics

The channel based diagnostics is intended for detailing the identification based diagnostics. A structure is added to the device status for each faulty slot comprised of a header byte, a byte, the channel type supplying the channel number and a third byte, which describes the fault type and the channel organization.

Byte	Information								Meaning
22	1	0	x	x	x	x	x	x	Header channel based diagnostics (x: 1 to 63, slots of the module)
23	a	a	x	x	x	x	x	x	Channel type (a) and channel number x: 0 to 3
	0	1							Input channel
	1	0							Output channel
	1	1							Input / output channel
24	t	t	t	x	x	x	x	x	Channel type (t) and fault type (x)
	0	0	0						No allocation
	0	0	1						1 Bit
	0	1	0						2 Bit
	0	1	1						4 Bit
	1	0	0						1 Byte
	1	0	1						1 Word
	1	1	0						2 Words
25-27	Next channel based diagnostics message (as byte 22 – 24)								
28-30	Next channel based diagnostics message (as byte 22 – 24)								
...	...								
61-63	Last displayable channel based diagnostics message (such as byte 22 – 24)								

Fault Types of I/O Modules with Diagnostic Capability

The fault types refer to standardized types.

Fault type	Meaning
0	Not specified
1	Short circuit
2	Low voltage
3	High voltage
4	Overload
5	Over temperature
6	Line break
7	Upper limit value exceeded
8	Lower limit value exceeded
9	Fault
10 ... 15	Reserved
16 ... 31	Manufacturer specific
17	Field voltage fault
18	Fuse fault
19	Buffer overflow
20	Check sum fault
21	Parity fault
22	Receive Timeout (partner)
23	Receive Timeout
26	SSI_IN fault
27	SSI FRAME fault
31	I/O module fault

I/O Modules Fault Cases

Part Number	Channel Type	Fault Type	Meaning
	'001	0.1001'	Fault (line break, overload or short circuit)
	'001	0.0001' 0.0010' 0.0110' 0.1001'	Short circuit Lower voltage Line break Error
	'101	0.0110' 0.1000' 1.0000' 1.1111'	Line break Lower limit value gone below Configuration fault I/O module fault
PIO-468, PIO-480	'101	0.0111' 0.1000' 1.0000' 1.1111'	Upper limit value exceeded Lower limit value gone below Configuration fault I/O module fault
	'101	0.0011' 0.0111' 1.1111'	Voltage overrun Upper limit value exceeded I/O module fault
	'001	1.0001' 1.0010'	Field voltage fault Fuse fault
	'110	1.1010' 1.1011' 1.0000' 1.1111'	SSI_IN fault (external fault) SSI FRAME fault Configuration fault I/O module fault
	'110	0.1001' 1.0000' 1.1111'	Error Configuration fault I/O module fault
	'000	0.1001' 1.0000' 1.1111'	Error Configuration fault I/O module fault
	'110 ('000)	0.1001' 1.0000' 1.1111'	Buffer overflow Configuration fault I/O module fault

3.1.10 LED Signaling

The Coupler possesses several LED's for on site signaling of the Coupler operating status or the complete node

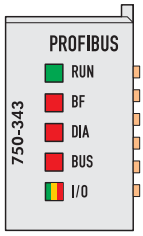


Fig. 3-10: Display elements PIO-343

The upper four LEDs (RUN, BF, DIA, BUS) display the state of the PROFIBUS communication.

The lower LED (I/O) displays the internal state of the complete node.

Blink Code

Detailed fault messages are displayed with the aid of a blink code. A fault is cyclically displayed with up to 3 blink sequences.

- The first blink sequence (approx. 10 Hz) starts the fault display.
- The second blink sequence (approx. 1 Hz) following a pause. The number of blink pulses indicates the **fault code**.
- The third blink sequence (approx. 1 Hz) follows after a further pause. The number of blink pulses indicates the **fault argument**.

Fieldbus Status

The upper four LED's signal the operating conditions of the PROFIBUS communication.

LED	Color	Meaning
RUN	green	The RUN-LED indicates the correct power supply of the Fieldbus Coupler.
BF	red	The BF-LED indicates that the communication functions via the PROFIBUS.
DIA	red	The DIA-LED indicates an external diagnostics.
BUS	red	The BUS-LED signals a configuration fault.

RUN	BF	DIA	BUS	Meaning	Remedy
off	off	off	off	No operating voltage to the Coupler (status LED of the Coupler supply does not light up) or a hardware fault is present.	Check the voltage supply for the bus coupler and replace the bus coupler if necessary.
on	on	*	off	PROFIBUS interface started, baud rate was not yet recognized.	Check to see whether the PROFIBUS is connected. Check to see whether the baud rate configuration on the master is supported by the coupler. Replace the bus coupler because there is a hardware defect.
on	blinks	*	off	Baud rate recognized, node not yet configured.	Check the configuration and the slave addresses. Load the configuration and start the coupler by switching the supply voltage off and on again.
on	blinks	on	blinks cyclic ally	Slave was incorrectly configured. Fault message via blink code	Evaluate the blink code.
on	off	*	off	The Coupler is exchanging data.	OK
on	*	on	*	The Coupler signals an existing diagnostics.	The data exchange is functioning without any problems so that you may obtain diagnostic information, for instance on a cable break in an analog input terminal.

* Not relevant

Fault Message via Blink Code of the BUS-LED

Fault Argument	Fault Description	Remedy
Fault code 1: Fault in Configuration Telegram		
1	Insufficient configuration data The GSD file is defective or the parameter data were entered improperly.	Get in contact with PARKER support.
2	Excessive configuration data The GSD file is defective or the configuration data was entered improperly.	Get in contact with PARKER support.
Fault code 2: Fault in Configuration Telegram		
n	Faulty configuration byte n	Get in contact with PARKER support.
Fault code 3: Fault in Configuration Telegram		
1	Insufficient configuration data	Check the configuration because a module was probably forgotten in the configuration. Load the configuration and start the coupler by switching the supply voltage off and on again.
2	Excessive configuration data	Check the configuration because a module was probably forgotten in the configuration. Load the configuration and start the coupler by switching the supply voltage off and on again.
Fault code 4: Fault in Configuration Telegram		
n	Configuration byte (module) n is faulty	Check the nth module in the configuration. Load the configuration and start the coupler by switching the supply voltage off and on again.
Fault code 5: Fault in the Data Length		
1	Maximum input data length exceeded (more than 128 byte input data), more than 244 Byte from SW 03).	Switch off the supply voltage of the coupler. Remove some modules from the node and switch the supply voltage on again.
2	Maximum output data length exceeded (more than 128 byte output data), more than 244 Byte from SW 03).	Switch off the supply voltage of the coupler. Remove some modules from the node and switch the supply voltage on again.
Fault code 6: Compiled Buffer Overflow		
1	Compiled buffer overflow for DP process image	Get in contact with PARKER support.

Node Status

The I/O-LED indicates the node operation and signals faults occurring.

I/O	Meaning
green	Data cycle on the internal bus
off	No data cycle on the internal bus
red	Coupler hardware defective
red blinks	When starting: internal bus is initialized During operation: general internal bus fault
red blinks cyclically	Fault message during internal bus reset and internal fault:
orange	Firmware loader active

The Coupler starts after switching on the supply voltage. The I/O-LED flashes red. Following a fault free start up the I/O-LED changes to a green steady light.
In the case of a fault, the I/O-LED continues blinking red. The fault is cyclically displayed with the blink code.

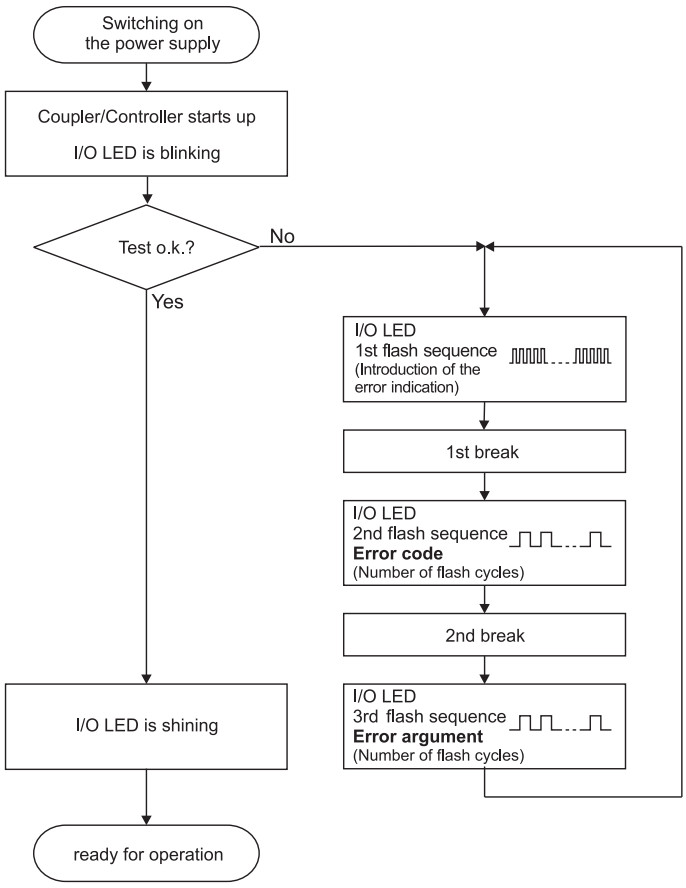


Fig. 3-11: Signaling the node status

After fixing a fault, restart the Coupler by switching off and on the supply voltage.

Fault Message via the Blink Code of the I/O LED

Fault Argument	Fault Description	Remedy
Fault code 1: Hardware and Configuration Fault		
1	Overflow of the internal buffer memory for the inline code	Replace the Coupler
2	Unknown data type	Replace the Coupler
3	EEPROM checksum fault	Replace the Coupler
4	Fault during writing into the flash memory	Replace the Coupler
5	Fault during reading from the FLASH memory	Replace the Coupler
6	Changed I/O module configuration found after AUTORESET	Adapt the configuration to the changed physical node arrangement. Load the configuration and start the coupler by switching the supply voltage off and on again.
7	Reserved	Replace the Coupler
8	Timeout when writing into the serial EEPROM	Replace the Coupler
Fault code 2: Not Used		
-	-	-
Fault code 3: Internal Bus Command Fault		
0	I/O module(s) has (have) identified internal bus command as incorrect	Check out at what point the communication bus is interrupted. Therefore disconnect the Profibus cable from the coupler!. Then plug the end module into the middle of the node. Switch the coupler off and on again. If the I/O LED continues to flash, shift the end module again. If there is only one module on the coupler and the I/O Err LED is illuminated, either this module or the coupler is defective. Replace the defective component.

Fault Argument	Fault Description	Remedy
Fault code 4: Internal Bus Data Fault		
0	Data fault on internal bus or Internal bus interruption on Coupler	Replace the Coupler
n* (n>0)	Internal bus interrupted after I/O module n	Switch off the supply voltage of the coupler. Replace the nth module and switch the supply voltage on again.
Fault code 5: Register Communication Fault		
n*	Internal bus fault during register communication with the I/O module n	Switch off the supply voltage of the coupler. Replace the nth module and switch the supply voltage on again.

* The number of blink pulses (n) indicates the position of the I/O module. I/O modules without data are not counted (e.g. supply module without diagnostics)

Example: the 13th I/O Module is Removed.	
1.	The I/O-LED generates a fault display with the first blink sequence (approx. 10 Hz)
2.	The first pause is followed by the second blink sequence (approx. 1 Hz). The I/O-LED blinks four times and thus signals the fault code 4 (internal bus data fault).
3.	The third blink sequence follows the second pause. The I/O-LED blinks twelve times. The fault argument 12 means that the internal bus is interrupted after the 12th I/O module.

3.1.11 Fault Behavior

Fieldbus Failure

A fieldbus failure has occurred when the master is switched off or the bus cable is interrupted. A fault in the master can also lead to a fieldbus failure.

The red BF-LED lights up.

The failure of the fieldbus can activate the substitute value of the I/O modules. During configuring of the inputs and outputs a substitute value can be laid down for each channel.

Substitute Value Strategy	Value (bit orientated) Digital Output Modules	Value (byte orientated) Analog Output Modules
Minimum value	0	0 or 4 mA, 0 V
Maximum value	1	20 mA, 10 V
Substitute value	0 or 1	0/4 ... 20 mA, -10 ... +10 V
Stop internal bus	Behavior determined by I/O module	

The value is entered in the output process image by the Coupler. With I/O modules with byte orientated data width, e.g. the pulse width module, the substitute value is determined via the value area.

As soon as the fieldbus is active the process data is transmitted and the output correspondingly set in the nodes.

Internal Bus Fault

An internal bus fault is created, for example, if an I/O module is removed. If this fault occurs during operation the output modules behave in the same manner as an I/O module stops.

The I/O-LED blinks red. The slave generates a detailed fault message.

Once the internal bus fault has been fixed the Coupler starts up automatically in accordance with the configured restart routine. The process data transfer is then restarted and the outputs reset in the nodes.

3.1.12 Technical Data

System Data	
Number of I/O modules	125 with repeater
Number of I/O points	approx. 6000 (master dependent)
Transmission medium	Cu cable in accordance with EN 50170
Bus segment length	100 m ... 1200 m (baud rate dependent / cable dependent)
Transmission rate	9.6 kBaud ... 12 MBaud
Transmission time with 10 modules each with 32 DI and 32 DO, 12 MBaud	typically 1 ms max. 3.3 ms
Bus connection	1 x D-SUB 9; female
Standards and Approvals	
UL (UL508)	E198563
Standard	EN 50170
Conformity marking	CE
Technical Data	
Number of I/O modules	63
Protocol	DP
Input process image	max. 32 byte
Output process image	max. 32 byte
Configuration	via PC or controls
Voltage supply	DC 24 V (-15 % / + 20 %)
Input current$_{max}$	260 mA at 24 V
Internal system supply module efficiency	80 %
Internal power consumption	350 mA at 5 V
Total current for I/O modules	650 mA at 5 V
Voltage via power jumper contacts	DC 24 V (-15 % / + 20 %)
Current via power jumper contact$_{max}$	DC 10 A
Dimensions (mm) W x H x L	50 x 65* x 100 *from upper edge of DIN 35 rail
Weight	ca. 120 g
EMC interference resistance	acc. to EN 50082-2 (96)
EMC interference transmission	acc. to EN 50081-2 (94)

4 I/O Modules

4.1 PIO-400 [2 DI DC 24 V 3.0 ms, high-side switching]

2-Channel Digital Input Module DC 24 V 3.0 ms,
2-, 3- or 4-conductor connection; high-side switching

4.1.1 View

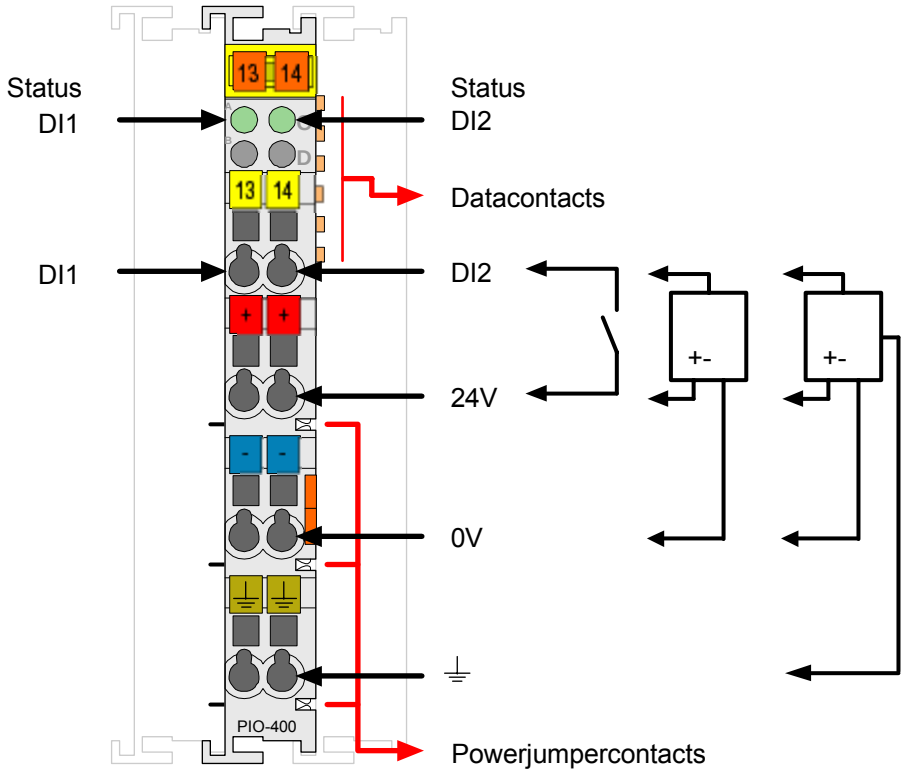


Fig. 4.1.1-1: 2-Channel Digital Input Module PIO-400

4.1.2 Description

The digital input module PIO-400 receives control signals from digital field devices (sensors, switches, etc.).
The module is a 2- to 4-conductor device and has two input channels. Two sensors may be directly connected to the module.
Two 4-conductor sensors with ground (earth) wire may be directly connected to 24 V, 0 V, PE (earth potential), signal input DI 1 or signal input DI 2.
Each input module has an RC noise rejection filter with a time constant of 3.0 ms.
The status of the input channels is indicated via status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the input modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The field side supply voltage of 24 V for the input module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital input module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.1.3 Display Elements

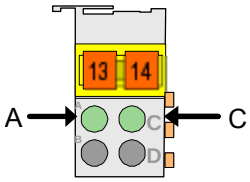


Fig. 4.1.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Status DI 1	off	Input DI 1: Signal voltage (0)
			on	Input DI 1: Signal voltage (1)
C green	2	Status DI 2	off	Input DI 2: Signal voltage (0)
			on	Input DI 2: Signal voltage (1)

4.1.4 Schematic Diagram

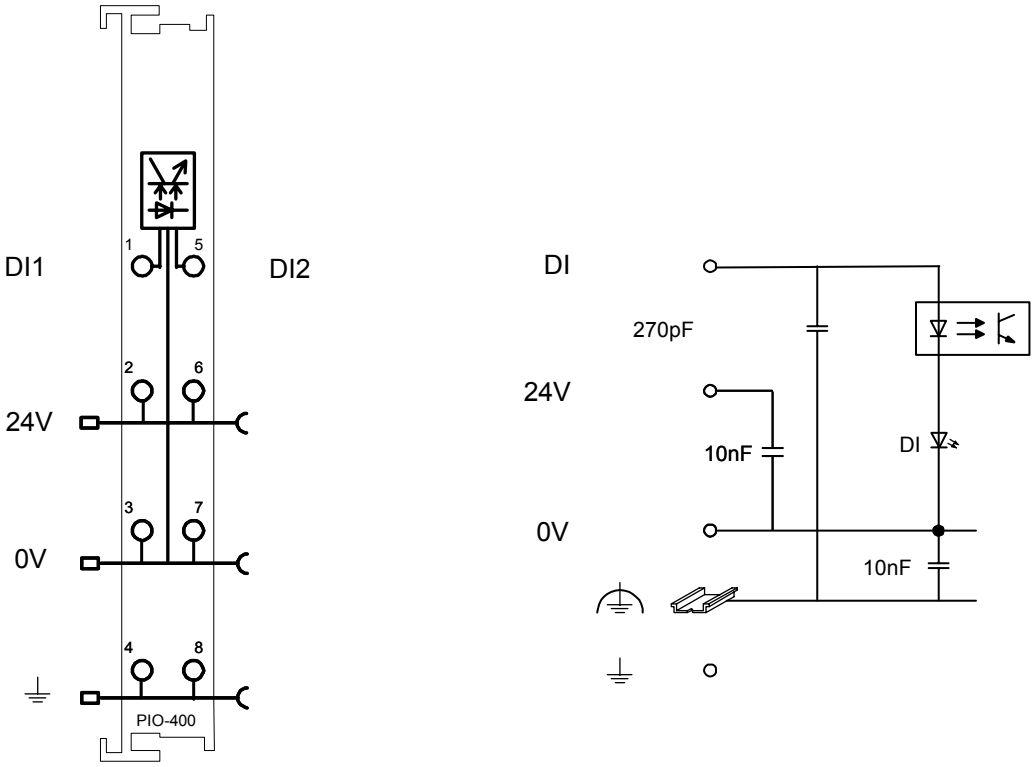


Fig. 4.1.4-1: 2-Channel Digital Input Module PIO-400

4.1.5 Technical Data

Module Specific Data	
Number of inputs	2
Current consumption (internal)	3.7 mA
Nominal voltage	DC 24 V (-15 % / +20%)
Signal voltage (0)	DC -3 V to +5 V
Signal voltage (1)	DC 15 V to 30 V
Input filter	3.0 ms
Current supply $_{typ.}$	4.5 mA
Isolation	500 V_{eff} (Field/System)
Internal bit width	2 Bit
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.1.6 Process Image

Input bit	B1	B0
Meaning	Signal status DI 2 – Channel 2	Signal status DI 1 – Channel 1

4.2 PIO-402 [4 DI DC 24 V 3.0 ms, high-side switching]

4- Channel Digital Input Module DC 24 V 3.0 ms,
2- or 3- conductor connection; high-side switching

4.2.1 View

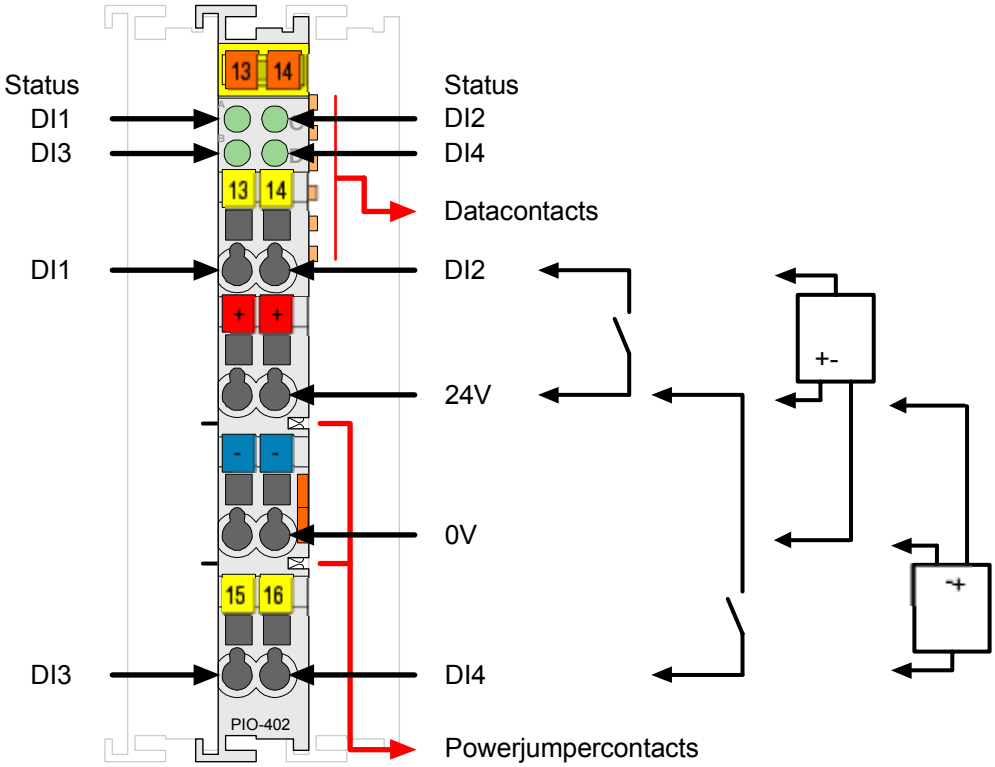


Fig. 4.2.1-1: 4- Channel Digital Input Module PIO-402

4.2.2 Description

The digital input module PIO-402 receives control signals from digital field devices (sensors, switches, etc.).
The module is a 2- to 3-conductor device and has 4 input channels. Two sensors may be directly connected to the module.
As an example, two 3-conductor sensors can be directly connected using connection 24V, 0V and signal input DI1 or DI2.
Each input module has an RC noise rejection filter with a time constant of 3.0 ms.
The status of the input channels is indicated via status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the input modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The field side supply voltage of 24V for the input module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital input module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.2.3 Display Elements

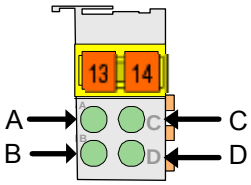


Fig. 4.2.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Status DI 1	off	Input DI 1: Signal voltage (0)
			on	Input DI 1: Signal voltage (1)
C green	2	Status DI 2	off	Input DI 2: Signal voltage (0)
			on	Input DI 2: Signal voltage (1)
B green	3	Status DI 3	off	Input DI 3: Signal voltage (0)
			on	Input DI 3: Signal voltage (1)
D green	4	Status DI 4	off	Input DI 4: Signal voltage (0)
			on	Input DI 4: Signal voltage (1)

4.2.4 Schematic Diagram

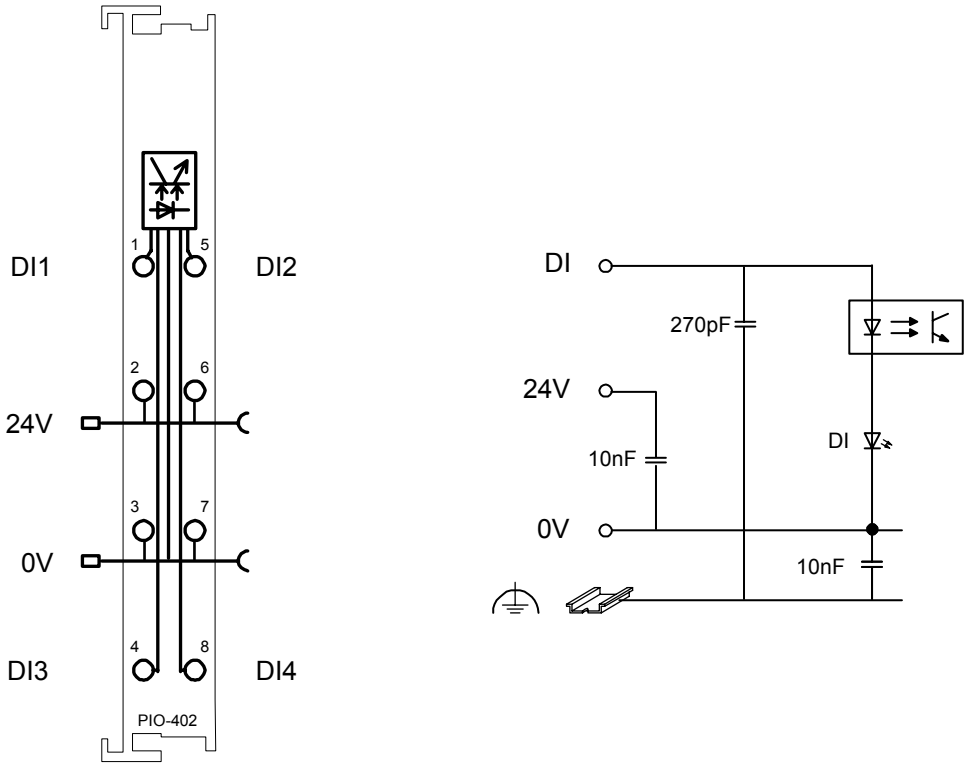


Fig. 4.2.4-1: 4-Channel Digital Input Module PIO-402

4.2.5 Technical Data

Module Specific Data	
Number of inputs	4
Current consumption (internal)	7.5 mA
Nominal voltage	DC 24 V (-15 % / +20 %)
Signal voltage (0)	DC -3 V to +5 V
Signal voltage (1)	DC 15 V to 30 V
Input filter	3.0 ms
Current supply $_{typ.}$	4.5 mA
Isolation	500 $V_{eff.}$ (Field/System)
Internal bit width	4 Bit
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.2.6 Process Image

Input bit	**B3**	**B2**	**B1**	**B0**
Meaning	Signal status DI 4 – Channel 4	Signal status DI 3 – Channel 3	Signal status DI 2 – Channel 2	Signal status DI 1 – Channel 1

4.3 PIO-430 [8 DI DC 24 V 3.0 ms, high-side switching]

8-Channel Digital Input Module DC 24 V 3.0 ms,
1-conductor connection; high-side switching

4.3.1 View

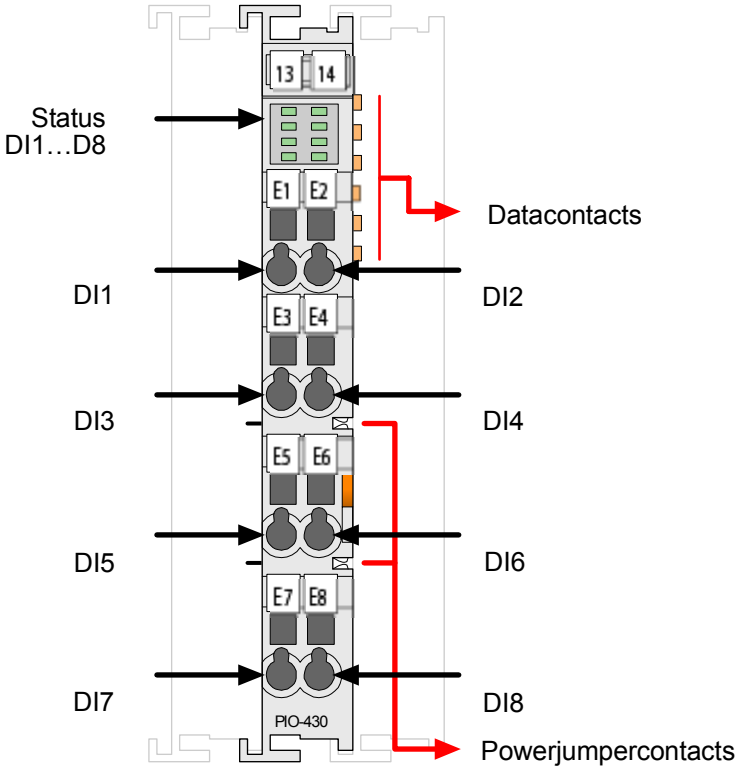


Fig. 4.3.1-1: 8-Channel Digital Input Module PIO-430

4.3.2 Description

The digital input module PIO-430 receives control signals from digital field devices (sensors, switches, etc.).
The module is a 1-conductor device and has eight input channels. Eight 1-conductor sensors may be directly connected to signal input DI 1, ... DI 8.
Each input module has an RC noise rejection filter with a time constant of 3.0 ms.
All inputs are isolated.
The status of the input channels is indicated via status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the input modules is possible when designing the fieldbus node.
Grouping of module types is not necessary.

Note
The module possesses power jumper contacts to pass through supply voltage for the field side to the following modules.

The field side supply voltage of 24V for the input module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital input module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.3.3 Display Elements

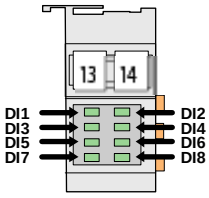


Fig. 4.3.3-1:
Display Elements

LED	Channel	Designation	State	Function
green	1	Status DI 1	off	Input DI 1: Signal voltage (0)
			on	Input DI 1: Signal voltage (1)
green	2	Status DI 2	off	Input DI 2: Signal voltage (0)
			on	Input DI 2: Signal voltage (1)
green	3	Status DI 3	off	Input DI 3: Signal voltage (0)
			on	Input DI 3: Signal voltage (1)
green	4	Status DI 4	off	Input DI 4: Signal voltage (0)
			on	Input DI 4: Signal voltage (1)
green	5	Status DI 5	off	Input DI 5: Signal voltage (0)
			on	Input DI 5: Signal voltage (1)
green	6	Status DI 6	off	Input DI 6: Signal voltage (0)
			on	Input DI 6: Signal voltage (1)
green	7	Status DI 7	aus	Input DI 7: Signal voltage (0)
			on	Input DI 7: Signal voltage (1)
green	8	Status DI 8	off	Input DI 8: Signal voltage (0)
			on	Input DI 8: Signal voltage (1)

4.3.4 Schematic Diagram

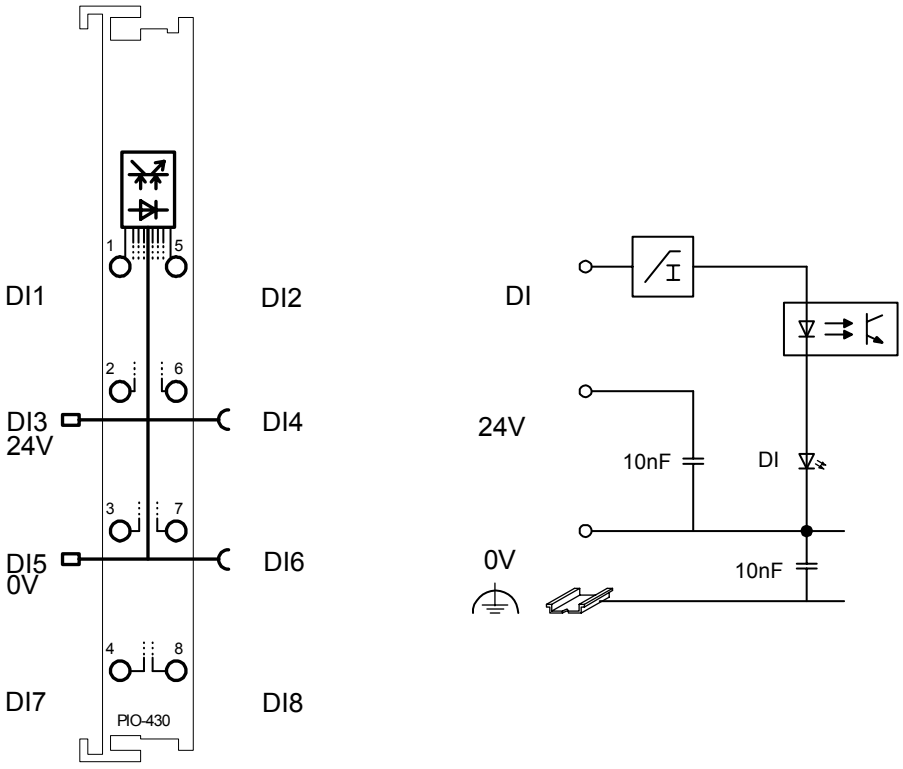


Fig. 4.3.4-1: 8-Channel Digital Input Module PIO-430

4.3.5 Technical Data

Module Specific Data	
Number of inputs	8
Current consumption (internal)	17 mA
Signal voltage (0)	DC -3 V to +5 V
Signal voltage (1)	DC 15 V to 30 V
Input filter	3.0 ms
Current supply $_{typ.}$	2.8 mA
Isolation	500 V_{eff} (Field/System)
Internal bit width	8 Bit
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
DEMKO	02 ATEX 132273 X II 3 GD EEx nA II T4
Conformity marking	CE

4.3.6 Process Image

Input bit	B7	B6	B5	B4	B3	B2	B1	B0
Meaning	Signal status DI 8 – Channel 8	Signal status DI 7 – Channel 7	Signal status DI 6 – Channel 6	Signal status DI 5 – Channel 5	Signal status DI 4 – Channel 4	Signal status DI 3 – Channel 3	Signal status DI 2 – Channel 2	Signal status DI 1 – Channel 1

4.4 PIO-468 [4 AI DC 0-10 V, Single-Ended]

4-Channel Analog Input Module (0-10V, Single-Ended)

4.4.1 View

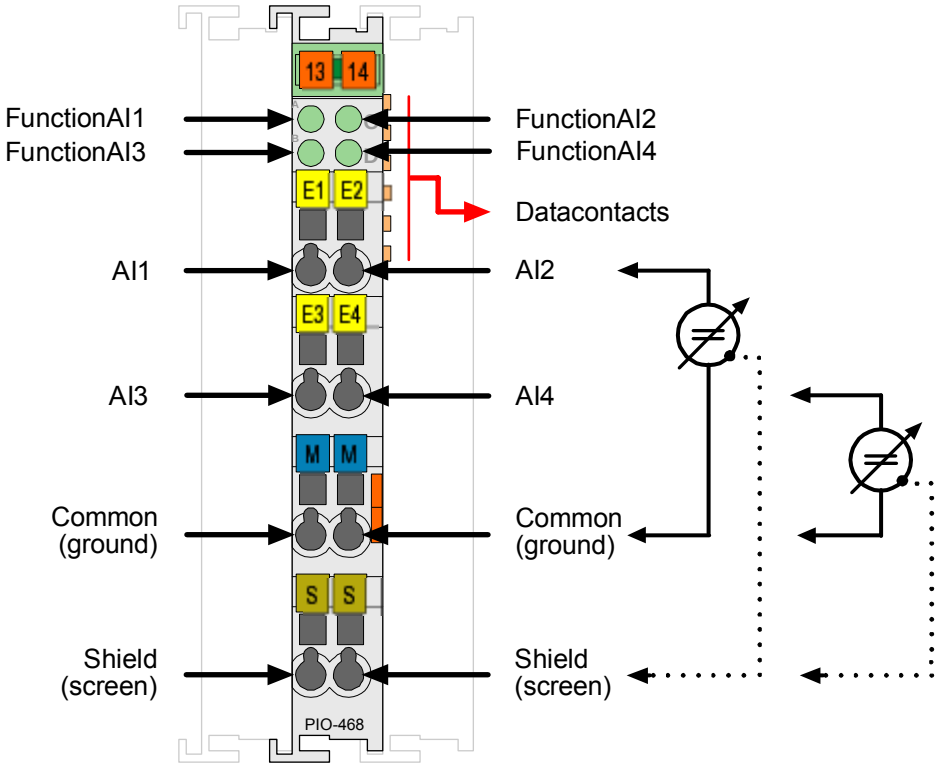


Fig. 4.4.1-1: 4-Channel Analog Input Module PIO-468

4.4.2 Description

The analog input module receives signals with the standardized values of 0-10 V.
The module has four input channels. As an example, the fieldside signals may be received via the connections AI 1 and Common (ground) or AI 2 and Common (ground). The connection of more sensors to signal inputs AI 3 and AI 4 requires a suitable measure for the Common (ground) and the Shield (screen) connection, if need be.
The input channels of a module have a common ground and a shield (screen) connection (S). The Shield (sreen) is directly connected to the DIN rail.
A capacitive connection is made automatically when snapped onto the DIN rail.
The input signal of each channel is electrically isolated and will be transmitted with a resolution of 12 bits.
The operational readiness and the trouble-free internal data bus communication of the channels are indicated via a green function LED.
Any configuration of the input modules is possible when designing the fieldbus node.
Grouping of module types is not necessary
The voltage supply is done via system voltage.

Attention
This module has no power contacts. For field supply to downstream I/O modules, a supply module will be needed.

The analog input module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.4.3 Display Elements

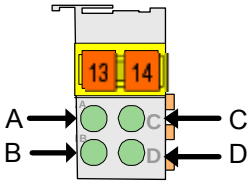


Fig. 4.4.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Function AI 1	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
C green	2	Function AI 2	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
B green	3	Function AI 3	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
D green	4	Function AI 4	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication

4.4.4 Schematic Diagram

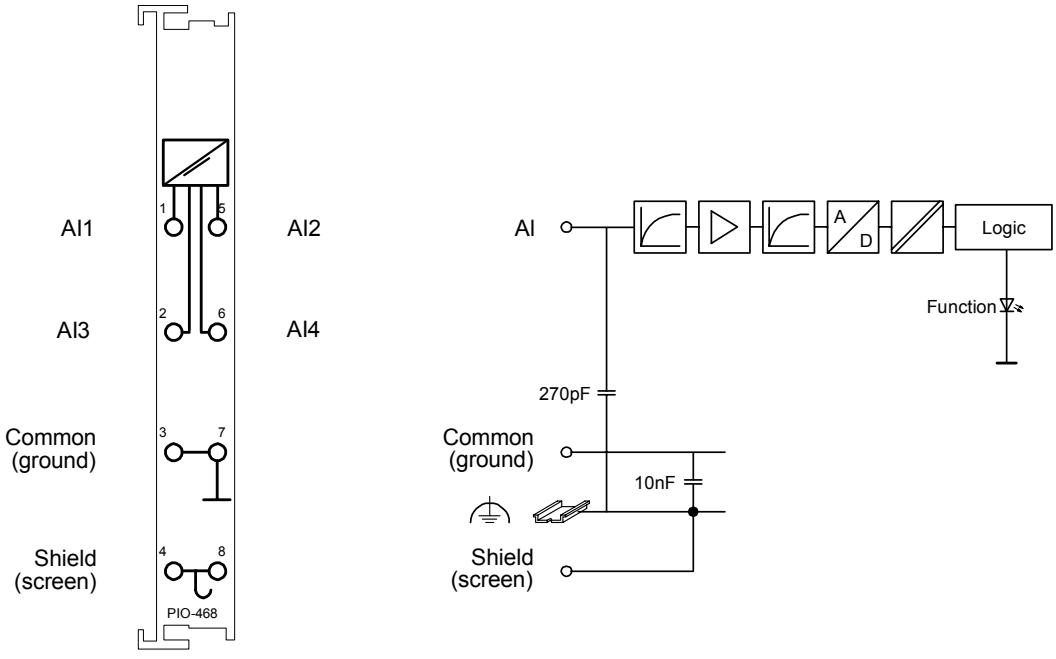


Fig. 4.4.4-1: 4-Channel Analog Input Module PIO-468

4.4.5 Technical Data

Module Specific Data	
Number of inputs	4
Voltage supply	via system voltage DC /DC
Current consumption $_{typ.}$ (internal)	60 mA
Input voltage $_{max.}$	35 V
Signal voltage	0 V... 10 V
Internal resistance $_{typ.}$	133 kΩ
Resolution	12 Bit
Conversion time $_{typ.}$	4 ms
Measuring error $_{25\ °C}$	<± 0,2 % of the full scale value
Temperature coefficient	<± 0,01 % /K of the full scale value
Isolation	500 V_{eff} (system/supply)
Bit width	4 x 16 bits data 4 x 8 bits control / status(option)
Weight	ca. 55 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.4.6 Process Image

The analog input module PIO-468 transmit 16-bit measured values and 8 status bits per channel.
The digitalized measured value is transmitted in a data word (16 bits) as input byte 0 (low) and input byte 1 (high) into the process image of the coupler / controller.
This value is represented with a 12 bit resolution on bit B3 ... B14.
From the manufacturing number |32|02|XX|XX| onwards, the status information included in the three least significant bits (B0 ... B2) can be parsed in the event of an error. Bit B0 = 1 is set when the range of measurement is overranged.
For modules having a previous manufacturing number, the last 3 bits are not parsed.
The manufacturing number is part of the lateral marking on the module enclosure.
Some fieldbus systems can process input channel status information by means of a status byte.
However, the coupler / controller process operation is optional, which means that accessing or parsing the status information depends on the fieldbus system.

Attention
The representation of the process data of some fieldbus modules in the process image depends on the fieldbus coupler/-controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus specific design of the process data" included in the description of the process image of the corresponding coupler/ controller.

4.4.7 Standard Format

For the standard module PIO-468, the input voltage ranging from < 0 V to > 10 V is scaled on the numerical values ranging from 0x0000 to 0x7FF9.

Process values of module PIO-468					
Input current	numerical value				status-byte
	binary		hex.	dec.	
0 - 10 V	value	*) X F Ü			hex.
0	0000 0000 0000 0	000	00 00	0	00
5	0100 0000 0000 0	000	40 00	16384	00
10	0111 1111 1111 1	000	7F F8	32760	00
> 10	0111 1111 1111 1	001	7F F9	32761	42

*) status bits: X = not used, F = short-circuit, Ü = oversize

4.5 PIO-480 [2 AI 0-20 mA Differential Measurement Input]

2-Channel Analog Input Module 0-20 mA,
differential measurement input

4.5.1 View

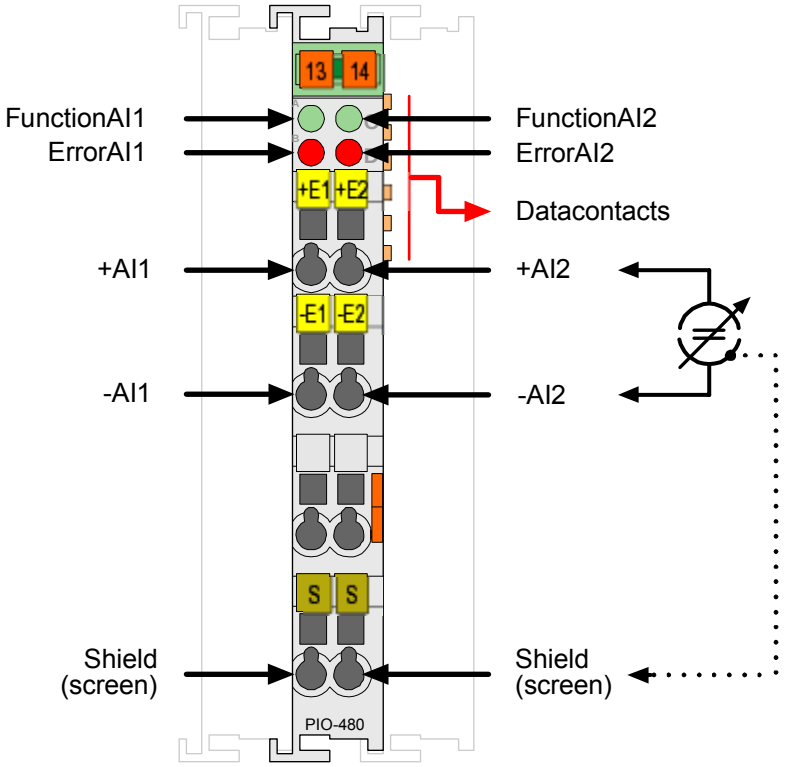


Fig. 4.5.1-1: 2-Channel Analog Input Module 0-20 mA

4.5.2 Description

The analog input module receives differential signals of values 0-20 mA.
The module has two differential input channels and can receive differential signals via the connections +AI 1 and -AI 1 or +AI 2 and -AI 2.
The shield (sreen) is directly connected to the DIN rail. A capacitive connection is made automatically when snapped onto the DIN rail.
The input signal of each channel is electrically isolated and will be transmitted with a resolution of 13 bits.
The operational readiness and trouble-free internal data bus communication of the channels are indicated via a Function LED. Overrange or underflow of the measuring range is indicated via an Error LED.
Any configuration of the input modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The voltage supply is done via system voltage.

Attention
This module has no power contacts. For field supply to downstream I/O modules, a supply module will be needed.

The analog input module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.5.3 Display Elements

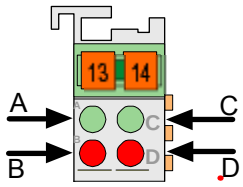


Fig. 4.5.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Function AI 1	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
B red		Error AI 1	off	Normal operation
			on	Overrange/underflow of the admissible measuring range
C green	2	Function AI 2	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
D red		Error AI 2	off	Normal operation
			on	Overrange/underflow of the admissible measuring range

4.5.4 Schematic Diagram

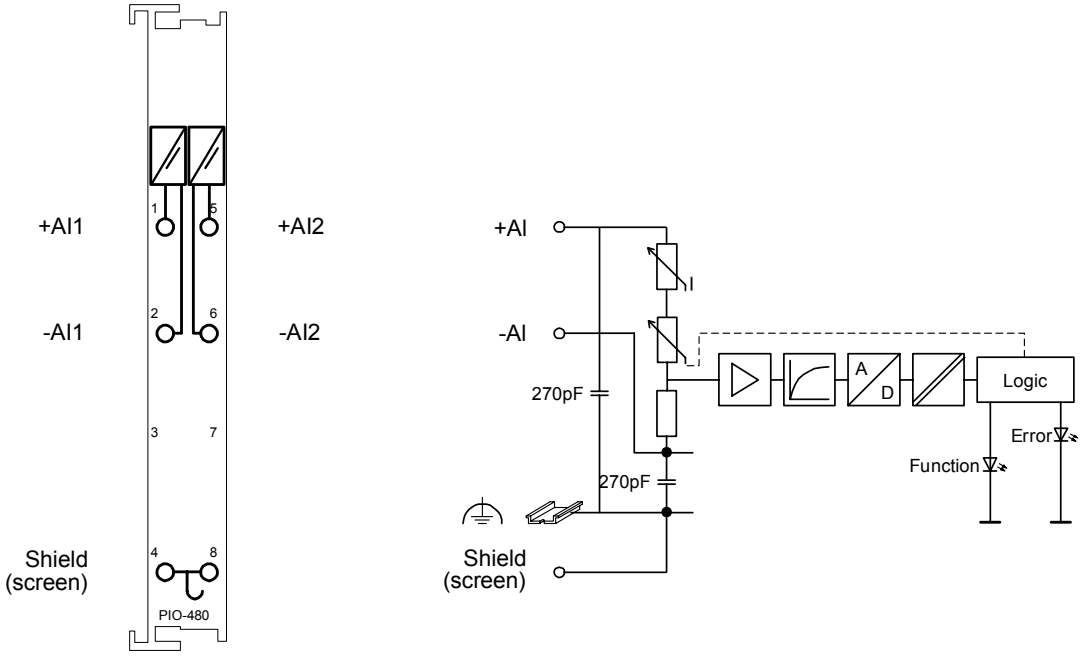


Fig. 4.5.4-1: 2-Channel Analog Input Module 0-20 mA

4.5.5 Technical Data

Module Specific Data	
Number of outputs	2, electrically isolated from each other
Measured-value acquisition	time synchronous (both inputs)
Voltage supply	via system voltage DC /DC
Current consumption (internal)	≤ 100 mA
Signal current	0 ... 20 mA
Internal resistance	< 270 Ω at 20 mA
Overrange/ measuring range underflow	status byte and LED
Input filter	low pass first order, fG = 5 kHz
Resolution of the A/D converter	14 Bit
Monotonicity without missing codes	yes
Resolution of the measured value	13 Bit
Value of a LSB (Bit 2) (Least Significant Bit)	2.4 µA
Measuring error $_{25\ °C}$	≤ ±0.05% of the full scale value
Temperature coefficient	< ±0.01%/K of the full scale value
Measuring error	≤ 0.4 % over whole temperature range ≤ 0.1 % of upper range value (non-linearity)
Crosstalk attenuation	≥ 80 db
Sampling time of repetition	1 ms
Sampling delay (module)	1 ms
Sampling delay (channel/channel)	≤ 1 µs
Sampling duration	≤ 5 µs
Method of conversion	SAR (Successive Approximation Register)
Operating mode	continuously sampling (preset)
Protection	non-linear limiting
Admissible continuous overload	30 V
Voltage resistance	DC 500V channel/channel or channel/system
Bit width	2 x 16 bits data 2 x 8 Bit bits control/status (option)
Weight	ca. 55 g
Approvals	
UL	E198563, UL508
DEMKO	02 ATEX 132273 X II 3 GD EEx nA II T4
Conformity marking	CE

4.5.6 Process Image

The analog input module PIO-480 transmits 16-bit measured values and 8 optional status bits per channel.
The digitalized measured value is transmitted in a data word (16 bits) as input byte 0 (low) and input byte 1 (high) into the process image of the coupler / controller.
This value is represented with a 13 bit resolution on bit B2 ... B14.
The most significant bit15 (MSB) is always '0'.
The states of the first two least significant bits B0 and B1 are not defined in the range between 0 and 20 mA. Therefore, they are represented with a ‘X‘ in the table.
The hexadecimal and decimal measured values are listed in the table provided that the first two bits have the state '0'. If the state '1' is taken into consideration for both bits, the decimal measured value will be higher by the value 3 as it is indicated in the table.
Some fieldbus systems can process input channel status information by means of a status byte.
However, processing via the coupler / controller is optional, which means that accessing or parsing the status information depends on the fieldbus system.

Attention
The representation of the process data of some I/O modules in the process image depends on the fieldbus coupler/-controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus Specific Design of the Process Data" included in the description concerning the process image of the corresponding coupler/controller.

4.5.7 Standard Format

For the standard module PIO-480, the input current ranging from < 0 mA to > 20 mA is scaled on the numerical values ranging from 0x0000 to 0x7FFF.

Process values of module PIO-480					
Input current 0 - 20 mA	numerical value			status-byte hex.	LED error AI 1, 2
	binary	hex.	dec.		
> 21	'0111.1111.1111.11XX'	0x7FFC	32764	0x42	on
> 20	'0111.1111.1111.11XX'	0x7FFC	32764	0x00	off
20,00	'0111.1111.1111.11XX'	0x7FFC	32764	0x00	off
17,50	'0111.0000.0000.00XX'	0x7000	28672	0x00	off
15,00	'0110.0000.0000.00XX'	0x6000	24576	0x00	off
12,50	'0101.0000.0000.00XX'	0x5000	20480	0x00	off
10,00	'0100.0000.0000.00XX'	0x4000	16384	0x00	off
7,50	'0011.0000.0000.00XX'	0x3000	12288	0x00	off
5,00	'0010.0000.0000.00XX'	0x2000	8192	0x00	off
2,50	'0001.0000.0000.00XX'	0x1000	4096	0x00	off
0,00	'0000.0000.0000.00XX'	0x0000	0	0x00	off
< 0	'0000.0000.0000.00XX'	0x0000	0	0x00	off
< -1	'0000.0000.0000.00XX'	0x0000	0	0x41	on

4.6 PIO-501 [2 DO DC 24 V 0.5 A, high-side switching]

2-Channel Digital Output Module DC 24 V 0.5 A,
short-circuit-protected, high-side switching

4.6.1 View

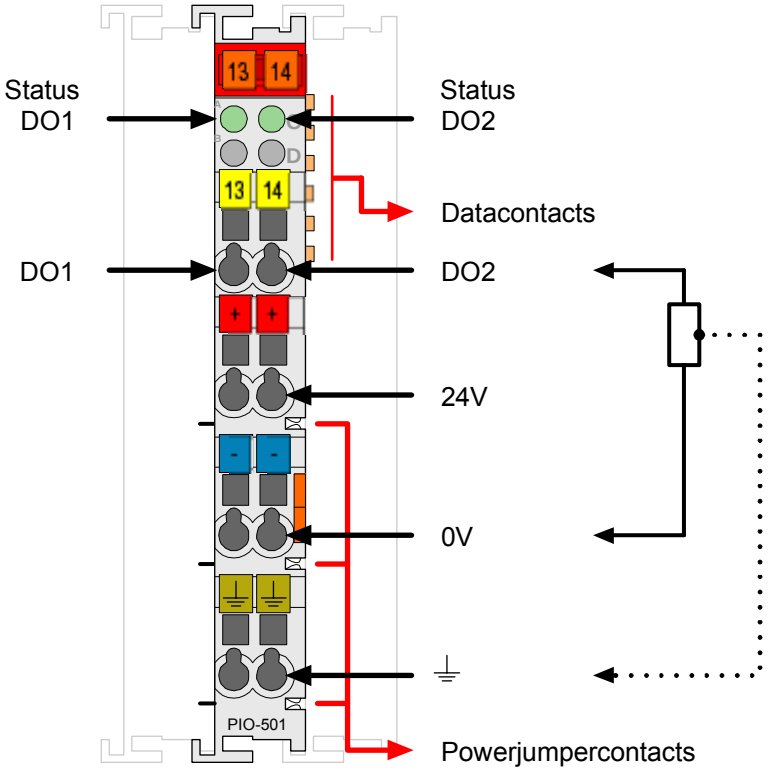


Fig. 4.6.1-1: 2-Channel Digital Output Module PIO-501

4.6.2 Description

The connected load is switched via the digital output from the control system.
The module has two output channels. Two actuators with ground (earth) wire may be directly connected to signal output DO 1, 0V and PE (earth potential) or signal output DO 2, 0V and PE.

Note
For the connection of inductive loads a protected circuit, e. g. a recovery diode, has to be switched parallel to this load.

The output channels are electrically short-circuit-protected and high-side switching. Which means that the status of the output channels is "high" if the output channels switch to the 24 V supply voltage for the field side.
The status of the two output channels is indicated via green status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the output modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The field side supply voltage of 24 V for the output module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital output module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.6.3 Display Elements

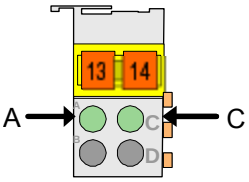


Fig. 4.6.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Status DO 1	off	Output DO 1: not active
			on	Output DO 1: active
C green	2	Status DO 2	off	Output DO 2: not active
			on	Output DO 2: active

4.6.4 Schematic Diagram

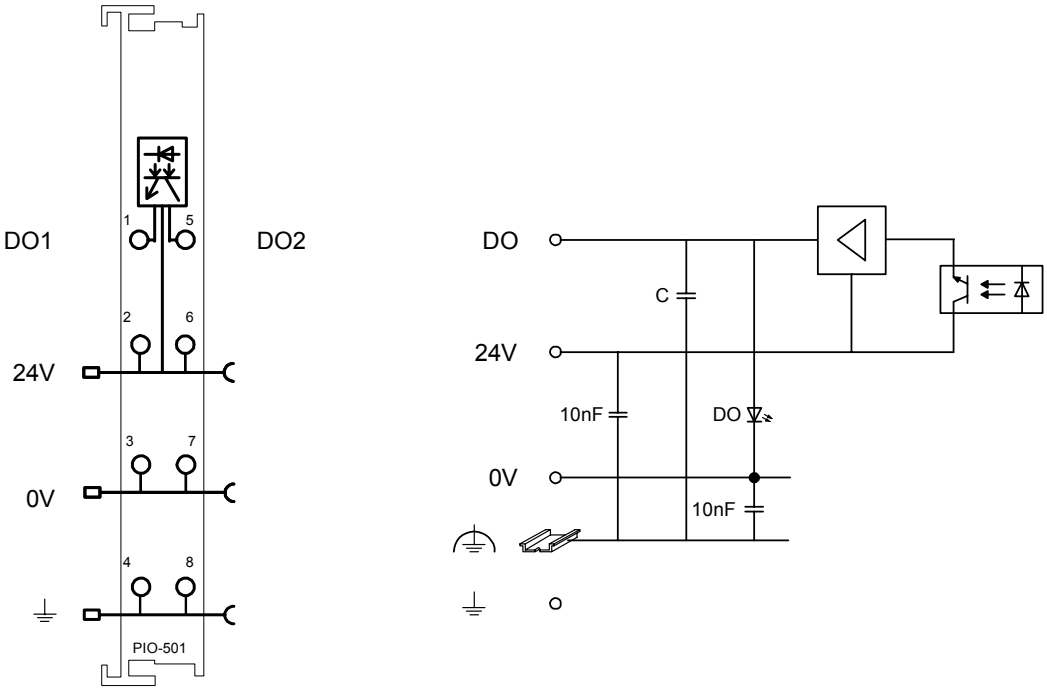


Fig. 4.6.4-1: 2-Channel Digital Output Module PIO-501

4.6.5 Technical Data

Module Specific Data	
Number of outputs	2
Current consumption (internal)$_{max.}$	3.5 mA
Voltage via power jumper contacts	DC 24 V (-15 % / +20%)
Type of load	resistive, inductive, lamps
Switching rate $_{max.}$	5 kHz
Reverse voltage protection	no
Output current	0.5 A
Absorbable energy $W_{max.}$ (unique switching off)	0.5 J $L_{max.} = 2\ W_{max.} / I^2$
Isolation	500 V (system/field)
Current consumption $_{typ.}$(field side)	15 mA (per module) + load
Internal bit width	2 Bit out
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D (EMC1)
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.6.6 Process Image

Output bit	**B1**	**B0**
Meaning	controls DO 2 Channel 2	controls DO 1 Channel 1

4.7 PIO-504 [4 DO DC 24 V 0.5 A, high-side switching]

4-Channel Digital Output Module DC 24 V 0.5 A,
short-circuit-protected, high-side switching

4.7.1 View

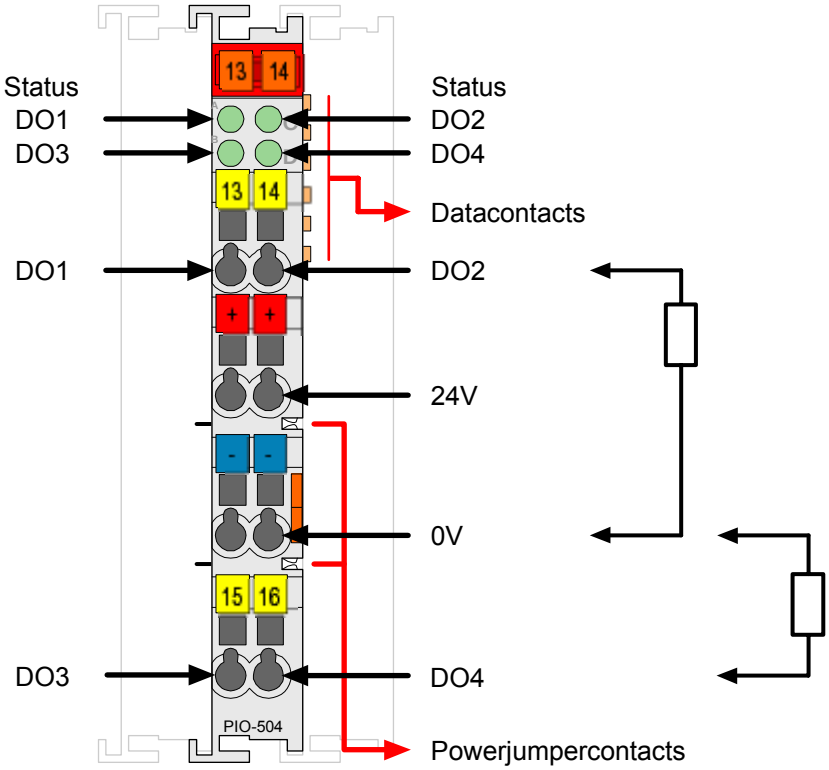


Fig. 4.7.1-1: 4-Channel Digital Output Module PIO-504

4.7.2 Description

The connected load is switched via the digital output from the control system.
The module has four output channels. Two actuators may be directly connected to the module.
As an example, two 2-conductor actuators may be directly connected using connection 0 V and signal output DO 1 or 0 V and signal output DO 2.

Note
For the connection of inductive loads a protected circuit, e. g. a recovery diode, has to be switched parallel to this load.

The output channels are electrically short-circuit-protected and high-side switching. Which means that the status of the output channels is "high" if the output channels switch to the 24 V supply voltage for the field side.
The supply voltage for the field side is derived from an adjacent supply module by means of power jumper contacts.
The status of the four output channels is indicated via green status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the output modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The field side supply voltage of 24 V for the output module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital output module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.7.3 Display Elements

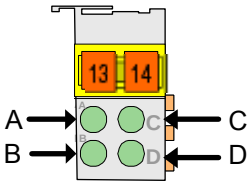


Fig. 4.7.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Status DO 1	off	Output DO 1: not active
			on	Output DO 1: active
C green	2	Status DO 2	off	Output DO 2: not active
			on	Output DO 2: active
B green	3	Status DO 3	off	Output DO 3: not active
			on	Output DO 3: active
D green	4	Status DO 4	off	Output DO 4: not active
			on	Output DO 4: active

4.7.4 Schematic Diagram

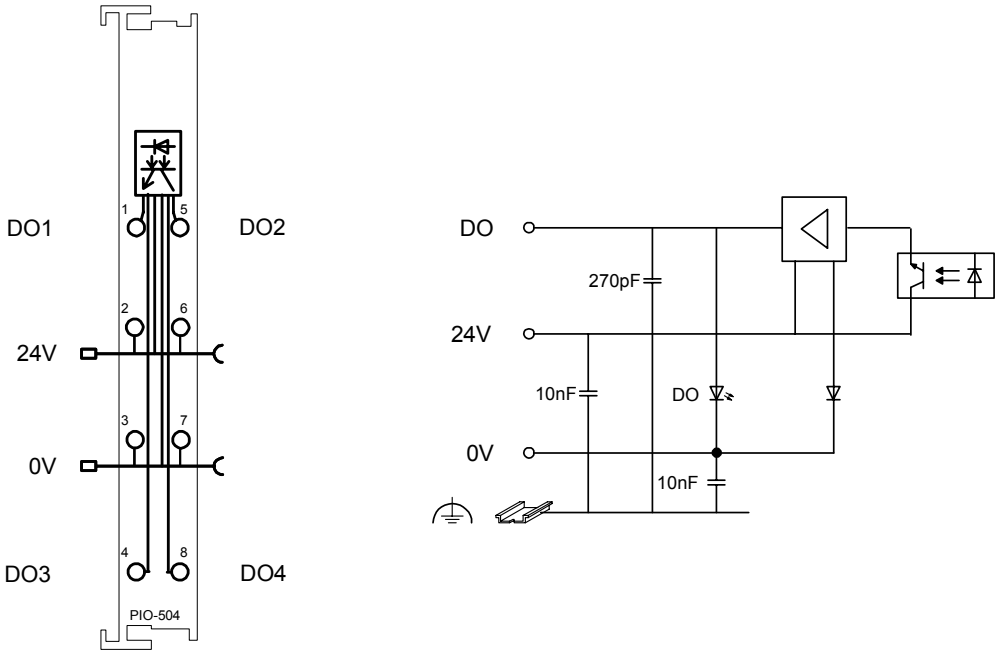


Fig. 4.7.4-1: 4-Channel Digital Output Module PIO-504

4.7.5 Technical Data

Module Specific Data	
Number of outputs	4
Current consumption (internal)$_{max.}$	7 mA
Voltage via power jumper contacts	DC 24 V (-15 % / + 20 %)
Type of load	resistive, inductive, lamps
Switching rate $_{max.}$	1 kHz
Reverse voltage protection	no
Output current	0.5 A short-circuit-protected
Absorbable energy $W_{max.}$ (unique switching off)	0.3 J $L_{max.} = 2\ W_{max.} / I^2$
Isolation	500 V (system/field)
Current consumption $_{typ.}$(field side)	30 mA (per module) + load
Internal bit width	4 Bit out
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D (EMC1)
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.7.6 Process Image

Output bit	B3	B2	B1	B0
Meaning	controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

4.8 PIO-530 [8 DO DC 24 V 0.5 A, high-side switching]

8-Channel Digital Output Module DC 24 V 0.5 A,
short-circuit-protected, high-side switching

4.8.1 View

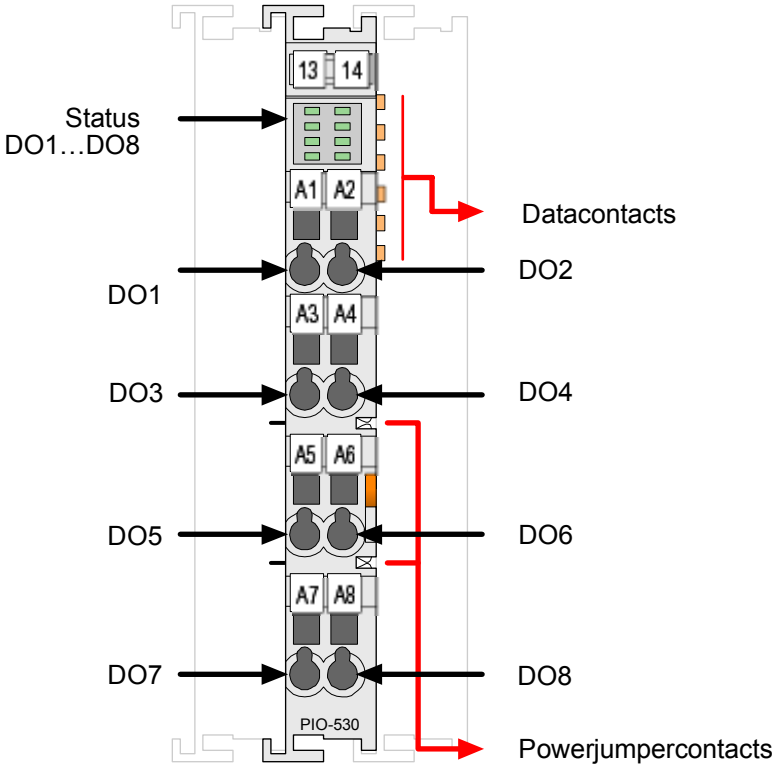


Fig. 4.8.1-1: 8-Channel Digital Output Module PIO-530

4.8.2 Description

The connected load is switched via the digital output from the control system.
The module has eight output channels. Eight actuators may be directly connected using the connections signal output DO 1 to DO 8.

Note
For the connection of inductive loads a protected circuit, e. g. a recovery diode, has to be switched parallel to this load.

The output channels are high-side switching. This means that the status of the output channels is "high" when the 24 V field side supply voltage is internally connected to the output channels.
This voltage is fed in via the power jumper contacts of an adjacent supply module.
The status of the eight short-circuit-protected output channels is indicated via green status LEDs.
An optocoupler is used for electrical isolation between the bus and the field side.
Any configuration of the output modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The field side supply voltage of 24 V for the output module is derived from adjacent I/O modules or from a supply module. The supply voltage for the field side is made automatically through the individual I/O modules by means of power jumper contacts.
The digital output module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.8.3 Display Elements

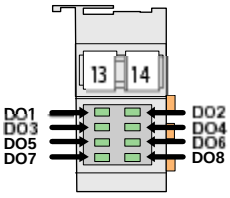


Fig. 4.8.3-1:
Display Elements

LED	Channel	Designation	State	Function
green	1	Status DO 1	off	Output DO 1: not active
			on	Output DO 1: active
green	2	Status DO 2	off	Output DO 2: not active
			on	Output DO 2: active
green	3	Status DO 3	off	Output DO 3: not active
			on	Output DO 3: active
green	4	Status DO 4	off	Output DO 4: not active
			on	Output DO 4: active
green	5	Status DO 5	off	Output DO 5: not active
			on	Output DO 5: active
green	6	Status DO 6	off	Output DO 6: not active
			on	Output DO 6: active
green	7	Status DO 7	off	Output DO 7: not active
			on	Output DO 7: active
green	8	Status DO 8	off	Output DO 8: not active
			on	Output DO 8: active

4.8.4 Schematic Diagram

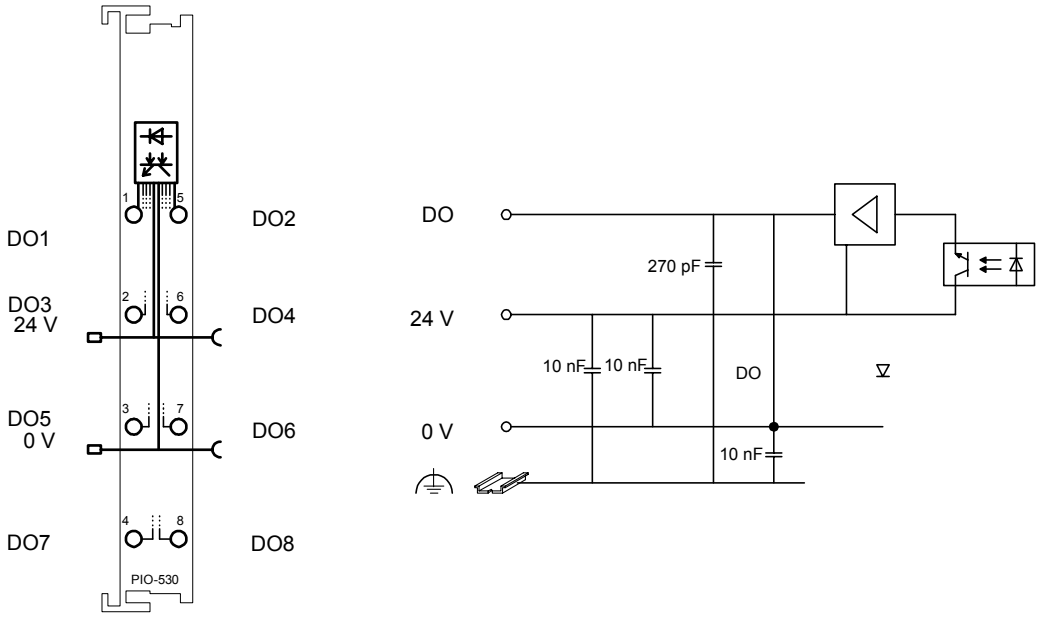


Fig. 4.8.4-1: 8-Channel Digital Output Module PIO-530

4.8.5 Technical Data

Module Specific Data	
Number of outputs	8
Current consumption (internal)	25 mA
Voltage via power jumper contacts	DC 24 V (-15 % / +20%)
Type of load	resistive, inductive, lamps
Switching rate $_{max.}$	2 kHz
Reverse voltage protection	yes
Output current	0.5 A short-circuit-protected
Absorbable energy $W_{max.}$ (unique switching off)	0.9 J $L_{max.} = 2\ W_{max.}\ /I^2$
Isolation	500 V (system/field)
Current consumption $_{typ.}$(field side)	15 mA (per module) + load
Internal bit width	8 Bit out
Weight	ca. 50 g
Approvals	
UL	E198563, UL508
DEMKO	02 ATEX 132273 X II 3 GD EEx nA II T4
Conformity marking	CE

4.8.6 Process Image

Output bit	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
Meaning	controls DO 8 – Channel 8	controls DO 7 – Channel 7	controls DO 6 – Channel 6	controls DO 5 – Channel 5	controls DO 4 – Channel 4	controls DO 3 – Channel 3	controls DO 2 – Channel 2	controls DO 1 – Channel 1

4.9 PIO-550 [2 AO DC 0-10 V]

2-Channel Analog Output Module 0-10 V

4.9.1 View

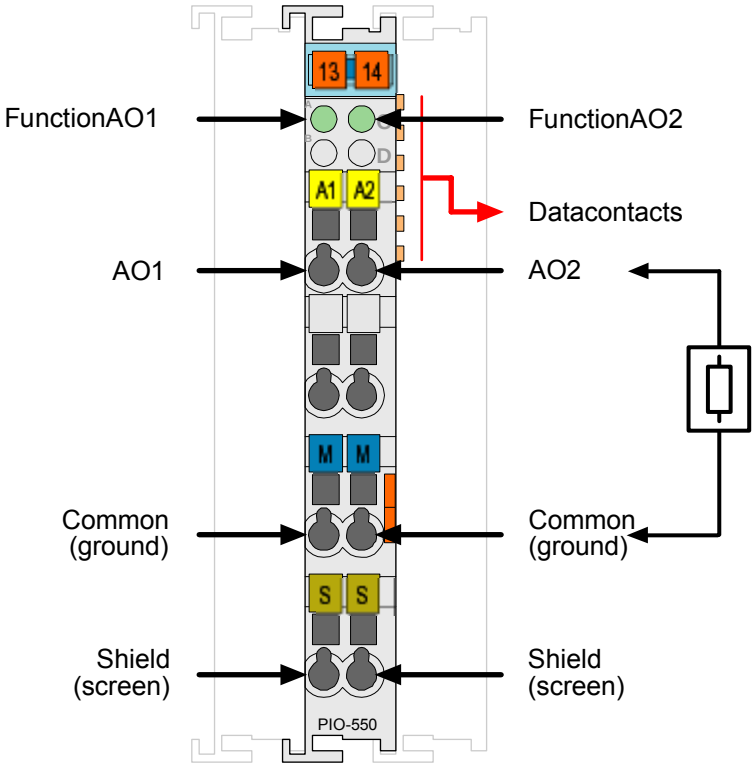


Fig. 4.9.1-1: 2-Channel Analog Output Module PIO-550

4.9.2 Description

The analog output module PIO-550 create a standardized signal of 0-10 V.
The module has two short circuit protected output channels and enables the direct wiring of two 2-conductor actuators to AO 1 and ground or AO 2 and ground. The signals are transmitted via AO 1 or AO 2.
The channels have a common ground and a shield (screen) (S). The shield (screen) is directly connected to the DIN rail. A capacitive connection is made automatically when snapped onto the DIN rail.
The input signal is electrically isolated and will be transmitted with a resolution of 12 bits.
The operational readiness and the trouble-free internal data bus communication of the channels are indicated via a function LED.
Any configuration of the input modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The voltage supply is done via the internal system voltage.

Attention
This module is not provided with integrated power jumper contacts. For field supply to downstream I/O modules, a supply module will be needed.

The analog output module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.9.3 Display Elements

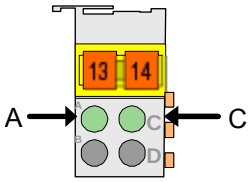


Fig. 4.9.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Function AO 1	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free operational readiness
C green	2	Function AO 2	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free operational readiness

4.9.4 Schematic Diagram

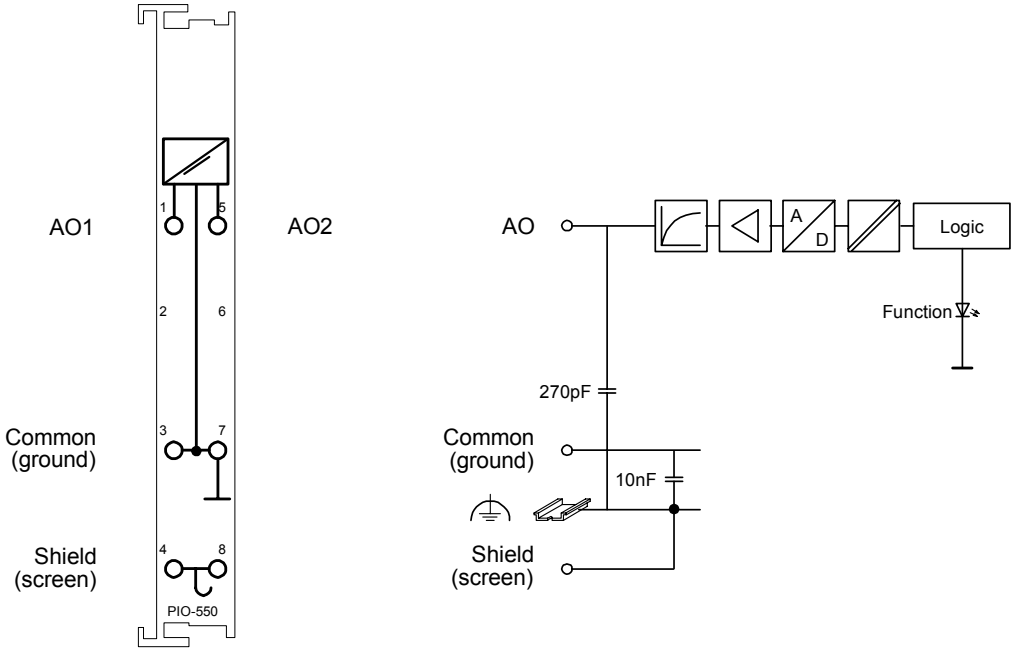


Fig. 4.9.4-1: 2-Channel Analog Output Module PIO-550

4.9.5 Technical Data

Module Specific Data	
Number of outputs	2
Voltage supply	via system voltage DC/DC
Current consumption $_{typ.}$ (internal)	65 mA
Signal voltage	0 ... 10 V
Load impedance	> 5 kΩ
Resolution	12 Bit
Conversion time $_{typ.}$	2 ms
Measuring error $_{25°C}$	<± 0,1 % of the full scale value
Temperature coefficient	<± 0,01 %/°K of the full scale value
Isolation	500 V_{eff} (system/supply)
Bit width	2 x 16 bits data 2 x 8 bits control/status(option)
Weight	ca. 55 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II3G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A,B,C,D (EMC1)
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.9.6 Process Image

The analog output module PIO-550 transmit 16-bit data and 8 status bits per channel.
The digitalized output value is transmitted in a data word (16 bits) as output byte 0 (low) and output byte 1 (high) into the process image of the coupler / controller.
This value is represented with a 12 bit resolution on bit B3 ... B14.
The three least significant bits (B0 ... B2) are not parsed.
Some fieldbus systems can process status information by means of a status byte.
As the returned status byte of this output module is always zero, it will not be parsed.

4.9.7 Standard Format

For the standard module PIO-550, the numerical values ranging from 0x0000 to 0x7FFF are scaled on the output voltage ranging from 0 V to 10 V.

Process values of module PIO-550				
Output voltage	numerical value			status-byte
0 - 10 V	binary ouptput value	hex.	dec.	hex.
0	0000 0000 0000 0000	00 00	0	00
1,25	0001 0000 0000 0000	10 00	4096	00
2,5	0010 0000 0000 0000	20 00	8192	00
3,75	0011 0000 0000 0000	30 00	12288	00
5	0100 0000 0000 0000	40 00	16384	00
6,25	0101 0000 0000 0000	50 00	20480	00
7,5	0110 0000 0000 0000	60 00	24576	00
8,75	0111 0000 0000 0000	70 00	28672	00
10	0111 1111 1111 1111	7F FF	32764	00

4.10 PIO-552 [2 AO 0-20 mA]

2-Channel Analog Output Module 0-20 mA.

4.10.1 View

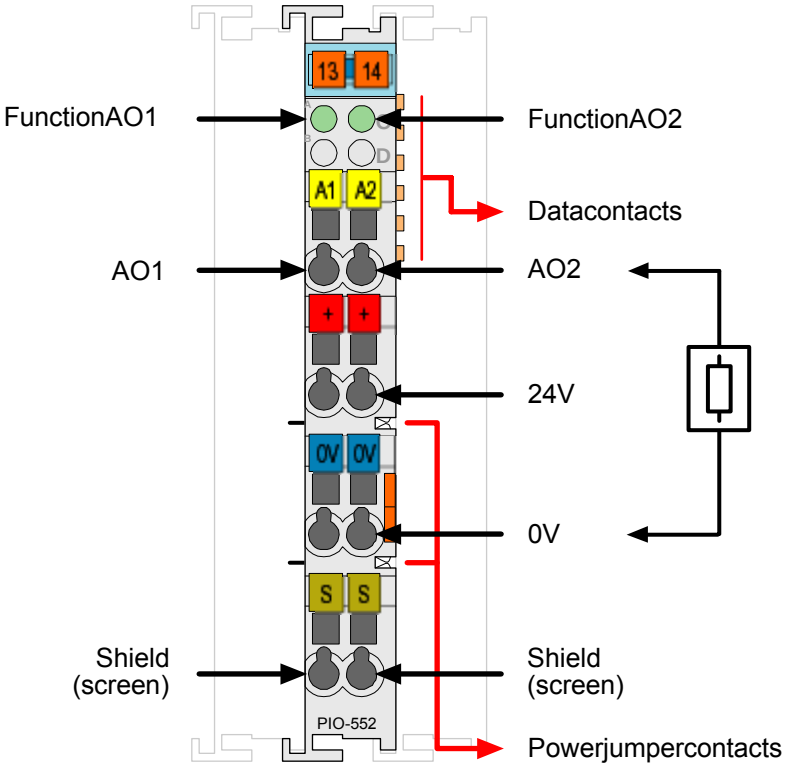


Fig. 4.10.1-1: 2-Channel Analog Output Module PIO-552

4.10.2 Description

The analog output module PIO-552 create a standardized signal of 0-20 mA.
The module has two output channels and enables, for example, the direct wiring of two 2-conductor actuators to the connections AO 1 and 0V or AO 2 and 0V. The signals are transmitted via AO 1 or AO 2.
The channels have a common ground and a shield (screen) (S). The shield (screen) is directly connected to the DIN rail. A capacitive connection is made automatically when snapped onto the DIN rail.
The input signal is electrically isolated and will be transmitted with a resolution of 12 bits.
The operational readiness and the trouble-free internal data bus communication of the channels are indicated via a green function LED.
Any configuration of the input modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The voltage supply is done via the field supply.
The field side supply voltage of 24 V for the output module is derived from an adjacent I/O module or from a supply module. A capacitive connection of the supply potential to the adjacent I/O modules is made automatically via the internal power contacts when snapping the output modules.

Note
Use an appropriate supply module (e.g. PIO-602) if an electrically isolated voltage supply is required!

The analog output module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.10.3 Display Elements

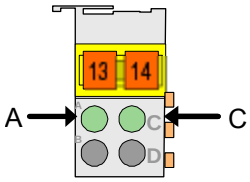


Fig. 4.10.3-1:
Display Elements

LED	Channel	Designation	State	Function
A green	1	Function AO 1	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication
C green	2	Function AO 2	off	No operational readiness or the internal data bus communication is interrupted
			on	Operational readiness and trouble-free internal data bus communication

4.10.4 Schematic Diagram

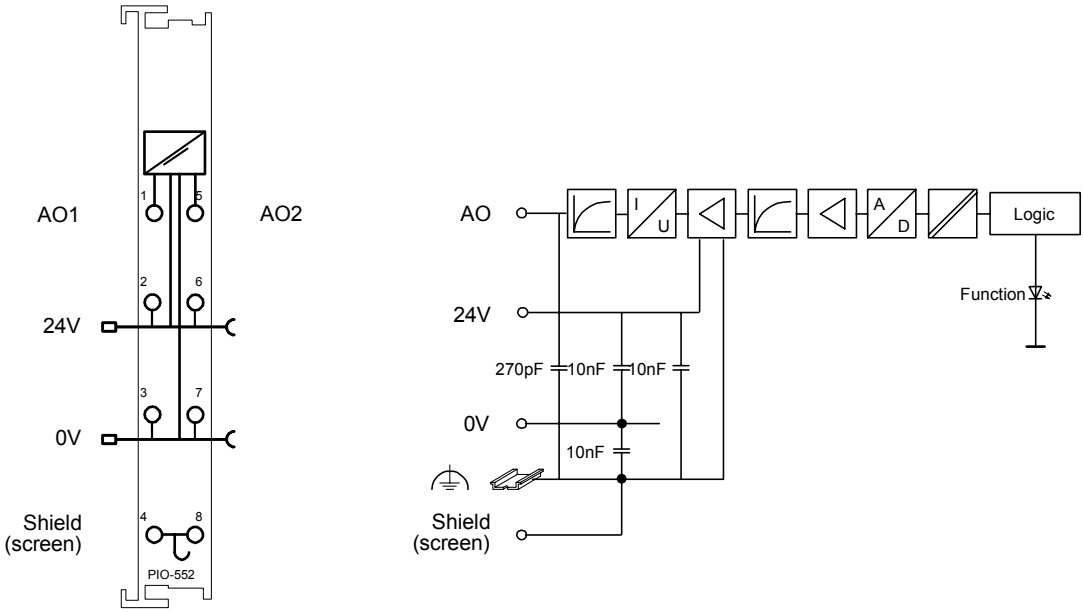


Fig. 4.10.4-1: 2-Channel Analog Output Module PIO-552

4.10.5 Technical Data

Module Specific Data	
Number of outputs	2
Voltage supply	via system voltage DC 24 V (-15% ... +20%)
Current consumption $_{typ.}$ (internal)	60 mA
Signal voltage	0... 20 mA
Load impedance	< 500 Ω
Linearity	± 2 LSB
Resolution	12 Bit
Conversion time $_{typ.}$	2 ms
Measurung error $_{25°C}$	<± 0,1 % of the full scale value
Temperature coefficient	<± 0,01 %/°K of the full scale value
Isolation	500 V_{eff} (system/supply)
Bit width	2 x 16 bits data 2 x 8 bits control/status(option)
Weight	ca. 55 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D (EMC1)
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.10.6 Process Image

The analog output module PIO-552 transmit 16-bit data and 8 status bits per channel. The digitalized output value is transmitted in a data word (16 bits) as output byte 0 (low) and output byte 1 (high) via the process image of the coupler / controller.
This value is represented with a 12 bit resolution on bit B3 ... B14.The three least significant bits (B0 ... B2) are not parsed.
Some fieldbus systems can process the status information using by means of a status byte.
As the returned status byte of this output module is always zero, it will not be parsed.

4.10.7 Standard Format

For the standard module PIO-552, the numerical values ranging from 0x0000 to 0x7FFF are scaled on the output current ranging from 0 mA to 20 mA.

Process values of module PIO-552				
Ouput current	numerical value			status-byte
0 - 20 mA	binary output value	hex.	dec.	hex.
0	0000 0000 0000 0000	00 00	0	00
2,5	0001 0000 0000 0000	10 00	4096	00
5	0010 0000 0000 0000	20 00	8192	00
7,5	0011 0000 0000 0000	30 00	12288	00
10	0100 0000 0000 0000	40 00	16384	00
12,5	0101 0000 0000 0000	50 00	20480	00
15	0110 0000 0000 0000	60 00	24576	00
17,5	0111 0000 0000 0000	70 00	28672	00
20	0111 1111 1111 1111	7F FF	32764	00

4.11 PIO-600 [End Module]

End Module

4.11.1 View

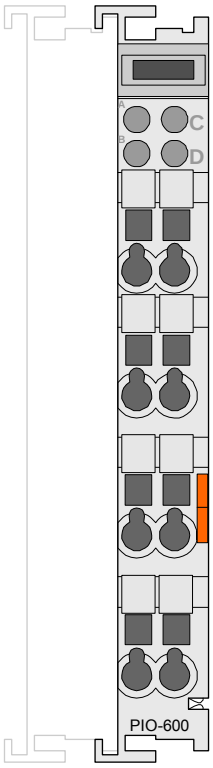


Fig. 4.11.1-1: End Module PIO-600

4.11.2 Description

After the fieldbus node is assembled with the correct buscoupler and selected I/O modules , the end module PIO-600 is snapped onto the assembly.
This module completes the internal data circuit and ensures correct data flow.
The end module is a necessary component to all PARKER-I/O-SYSTEM PIO fieldbus nodes.

4.11.3 Technical Data

Module Specific Data	
Weight	ca. 35 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd)	40 197-01 HH Cat. A, B, C, D (EMC1)
LR (Lloyd's Register)	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas)	A-8471 Cl. B
RINA (Registro Italiano Navale)	MAC30402CS1
ABS (American Bureau of Shipping)	03-HG374860-PDA
Conformity marking	CE

4.12 PIO-602 [24 V DC Power Supply]

Supply Module DC 24 V, passive

4.12.1 View

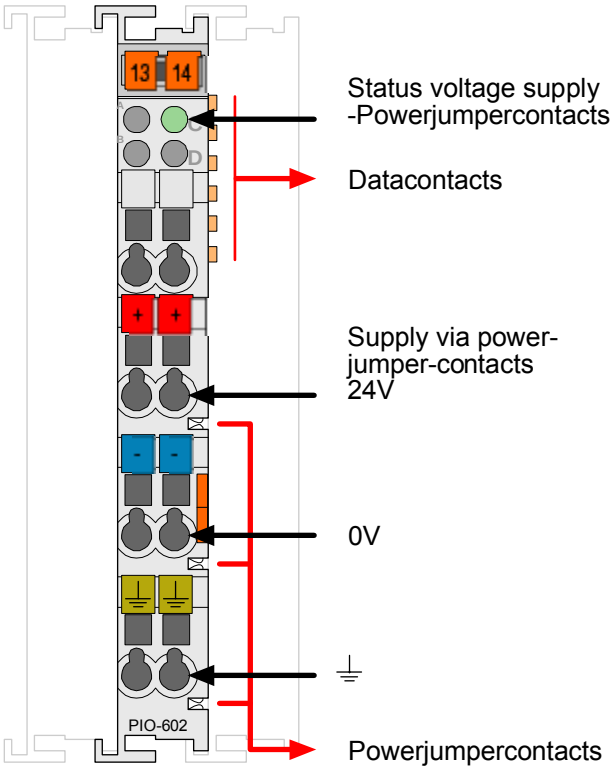


Fig. 4.12.1-1: Suppy Module PIO-602

4.12.2 Description

The supply module PIO-602 provides an electrically isolated DC 24 V fieldside power to the adjacent I/O modules.
The module is fed in external via the 24 V, 0V and PE (earth potential) connections.
A capacitive connection of the potentials to the adjacent I/O modules is made automatically via the internal power contacts when snapping the I/O modules together.

Note
Maximum current supply to all connected modules is 10 A. Should more current be needed, additional supply modules may be added in the assembly.

Note
Pay particular attention to the admissible voltage of each I/O module when using the supply modules.

The operating voltage of 24 V is indicated via a green status LED.
Any configuration of the output modules is possible when designing the fieldbus node. Grouping of module types is not necessary.
The supply module can be used with all couplers/controllers of the PARKER-I/O-SYSTEM PIO.

4.12.3 Display Elements

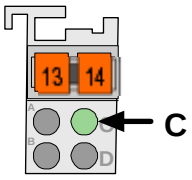


Fig. 4.12.3-1:
Display Elements

LED	Designation	State	Function
C green	Status voltage supply –Power jumper contacts	off	No DC 24 V voltage supply via power jumper contacts.
		on	DC 24 V voltage supply via power jumper contacts.

4.12.4 Schematic Diagram

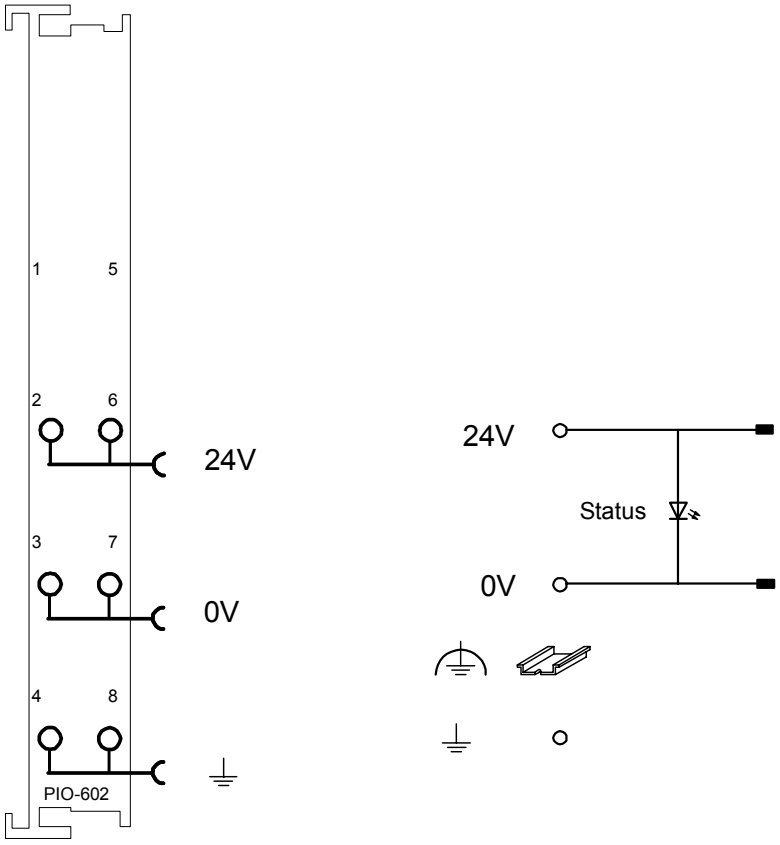


Fig. 4.12.4-1: Supply Module PIO-602

4.12.5 Technical Data

Module Specific Data	
Voltage via power jumper contacts $_{max}$	DC 24 V
Current via power jumper contacts $_{max.}$	10 A
Weight	ca. 45 g
Approvals	
UL	E198563, UL508
KEMA	01ATEX1024 X II 3 G EEx nA II T4
GL (Germanischer Lloyd) [1)]	40 197-01 HH Cat. A, B, C, D
LR (Lloyd's Register) [1)]	02/20026 Env. 1, 2, 3, 4
DNV (Det Norske Veritas) [1)]	A-8471 Cl. B
RINA (Registro Italiano Navale) [1)]	MAC30402CS1
ABS (American Bureau of Shipping) [1)]	03-HG374860-PDA
Conformity marking	CE

[1)] Note information on “Voltage Supply“!

5 PROFIBUS

5.1 Description

PROFIBUS is an open fieldbus standard, laid down in the European Standard EN 50170, Vol. 2 (also IEC).

PROFIBUS DP has been designed for a fast and efficient data exchange between a control (PLC / PC) and decentralized peripheral equipment, for example sensors and actuators, digital or analog input and output modules.

A DP System consists of a master and up to 124 slaves:

Master: A DP Master exchanges the data with the slaves via PROFIBUS DP and controls the bus. It transfers the data between a supervisory control and the decentralized peripheral equipment.

Slave: DP Slaves are the link to the field side. They edit the input data of the peripheral equipment for the communication with the master and output the Master data to the peripheral equipment.

PROFIBUS uses the master/slave method for data transmission. The master cyclically reads the input data from the slaves and cyclically writes the output data to the slaves. PROFIBUS DP V1 also supports an acyclic data exchange. PROFIBUS DP has baud rates from 9.6 kbaud up to 12 Mbaud.

PROFIBUS DP features:

- fast system response times
- high immunity to interference
- master and slave diagnostic
- single slaves may fail or be turned off without the fieldbus operations being interrupted.
- Every configuration is stored in the master.
- Every slave has a manufacturer-specific identifier that has been assigned by the PNO (PROFIBUS Nutzerorganisation).

The slaves are described in the GSD files. The GSD file is imported into the configuration software which makes the configuration of the slave easier.

Further information
The PNO provides further documentation for its members in INTERNET:
- Technical descriptions
- Guidelines

http://www.profibus.com/

5.2 Wiring

On the PROFIBUS with RS 485 transmission technology all devices are connected in a line structure. The bus line comprises of a twisted and screened pair of wires.

The fieldbus line is specified in EN 50170 as a line type A and must provide certain line parameters. The line type B also described in the EN 50170 is an old type and should no longer be used.

Parameter	Value
Wave resistance	135 ... 165 Ω
Operating capacity	< 30 pF/m
Loop resistance	110 Ω/km
Wire diameter*)	> 0.64 mm
Wire cross section*)	> 0.34 mm^2

*) The wire cross sections used must conform with connection possibilities on the bus plug.

Line type A allows maximum line lengths for a bus segment dependent upon the transmission speed.

Transmission speed	Max. bus segment length
9.6 / 19.2 / 45.45 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1500 kBaud	200 m
3000 / 6000 / 12000 kBaud	100 m

The plugs available on the market offer the possibility that arriving and departing data cables can be directly connected to the plug. In this manner drop cables are avoided and the bus plug can be connected to or disconnected from the bus at any time without interrupting the data traffic. A cut-in type bus connection is integrated in these plugs. Due to the capacitative load of the subscribers and the resulting generated line reflection the connection plugs used should have integrated length inductivity. This is indispensable for transmission rates of > 1.5 MBaud.

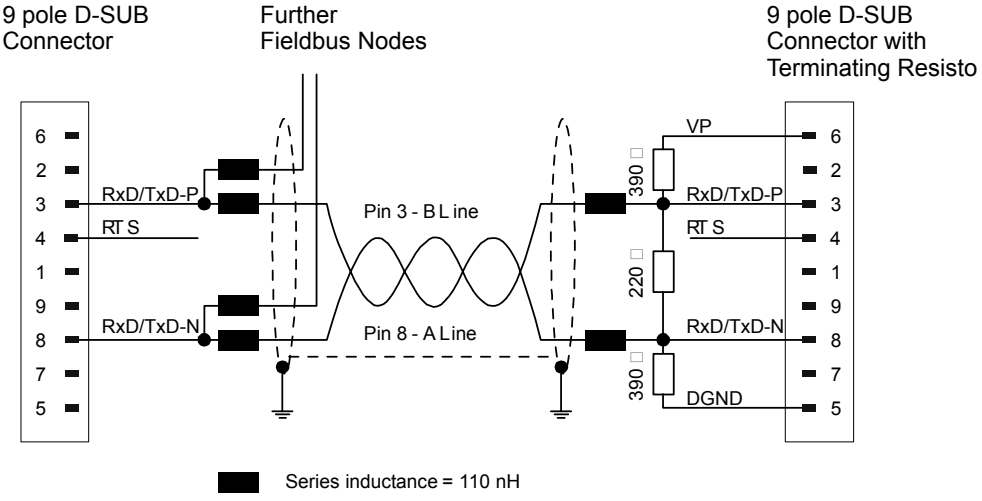


Fig. 5-1: Bus connection

Note
When connecting the subscriber ensure that the data lines are not mixed up.
The bus termination at the start and end of the bus line must be installed. The bus connection requires the supply voltage VP from the device. For this reason ensure that the slave unit installed on the bus termination, is always supplied with voltage.
Due to the integrated length inductivity in the connection plug ensure that the plug is installed without connected field devices as the missing capacity of the device could cause transmission faults.

In order to achieve a high disturbance resistance of the I/O-System against electromagnetic radiated interference ensure that a screened PROFIBUS cable is used. Where possible connect the screen at both ends with good conduction and using large surface area screen clips. In addition ensure that the cables are laid separated from all power line cables if possible. With a data rate of ≥1.5 Mbit/s ensure that spur lines are avoided.

Further information
The PNO provides further documentation for its members in INTERNET. Cable specification information can be obtained from, for example, the „Installation Guideline for PROFIBUS-FMS/DP", 2.112

http://www.profibus.com/

Note
PARKER offers this screen connection I/O-System for the optimum connection between fieldbus screening and function earth.

6 Use in Hazardous Environments

6.1 Foreword

Today's development shows that many chemical and petrochemical companies have production plants, production, and process automation machines in operation which use gas-air, vapor-air and dust-air mixtures which can be explosive. For this reason, the electrical components used in such plants and I/O-systems must not pose a risk of explosion resulting in injury to persons or damage to property. This is backed by law, directives or regulations on a national and international scale. The I/O-SYSTEM (electrical components) is designed for use in zone 2 explosive environments. The following basic explosion protection related terms have been defined.

6.2 Protective measures

Primarily, explosion protection describes how to prevent the formation of an explosive atmosphere. For instance by avoiding the use of combustible liquids, reducing the concentration levels, ventilation measures, to name but a few. But there are a large number of applications, which do not allow the implementation of primary protection measures. In such cases, the secondary explosion protection comes into play. Following is a detailed description of such secondary measures.

6.3 Classification meeting CENELEC and IEC

The specifications outlined here are valid for use in Europe and are based on the following standards: EN50... of CENELEC (European Committee for Electrotechnical Standardization). On an international scale, these are reflected by the IEC 60079-... standards of the IEC (International Electrotechnical Commission).

6.3.1 Divisions

Explosive environments are areas in which the atmosphere can potentially become explosive. The term explosive means a special mixture of ignitable substances existing in the form of air-borne gases, fumes, mist or dust under atmospheric conditions which, when heated beyond a tolerable temperature or subjected to an electric arc or sparks, can produce explosions. Explosive zones have been created to describe the concentrations level of an explosive atmosphere. This division, based on the probability of an explosion occurring, is of great importance both for technical safety and feasibility reasons. Knowing that the demands placed on electrical components permanently employed in an explosive environment have to be much more stringent than those placed on electrical components that are only rarely and, if at all, for short periods, subject to a dangerous explosive environment.

Explosive **areas resulting from gases, fumes or mist:**

- Zone 0 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.
- Zone 1 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).
- Zone 2 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

Explosive areas subject to air-borne dust:

- Zone 20 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.
- Zone 21 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).
- Zone 22 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

6.3.2 Explosion protection group

In addition, the electrical components for explosive areas are subdivided into two groups:

Group I: Group I includes electrical components for use in fire-damp endangered mine structures.

Group II: Group II includes electrical components for use in all other explosive environments. This group is further subdivided by pertinent combustible gases in the environment.
Subdivision IIA, IIB and IIC takes into account that different materials/substances/gases have various ignition energy characteristic values. For this reason the three sub-groups are assigned representative types of gases:

- IIA – Propane
- IIB – Ethylene
- IIC – Hydrogen

Minimal ignition energy of representative types of gases				
Explosion group	I	IIA	IIB	IIC
Gases	Methane	Propane	Ethylene	Hydrogen
Ignition energy (µJ)	280	250	82	16

Hydrogen being commonly encountered in chemical plants, frequently the explosion group IIC is requested for maximum safety.

6.3.3 Unit categories

Moreover, the areas of use (zones) and the conditions of use (explosion groups) are subdivided into categories for the electrical operating means:

Unit categories	Explosion group	Area of use
M1	I	Fire-damp protection
M2	I	Fire-damp protection
1G	II	Zone 0 Explosive environment by gas, fumes or mist
2G	II	Zone 1 Explosive environment by gas, fumes or mist
3G	II	Zone 2 Explosive environment by gas, fumes or mist
1D	II	Zone 20 Explosive environment by dust
2D	II	Zone 21 Explosive environment by dust
3D	II	Zone 22 Explosive environment by dust

6.3.4 Temperature classes

The maximum surface temperature for electrical components of explosion protection group I is 150 °C (danger due to coal dust deposits) or 450 °C (if there is no danger of coal dust deposit).

In line with the maximum surface temperature for all ignition protection types, the electrical components are subdivided into temperature classes, as far as electrical components of explosion protection group II are concerned. Here the temperatures refer to a surrounding temperature of 40 °C for operation and testing of the electrical components. The lowest ignition temperature of the existing explosive atmosphere must be higher than the maximum surface temperature.

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T3	200 °C	> 200 °C to 300 °C
T4	135 °C	> 135 °C to 200 °C
T5	100 °C	>100 °C to 135 °C
T6	85°C	> 85 °C to 100 °C

The following table represents the division and attributes of the materials to the temperature classes and material groups in percent:

Temperature classes						
T1	T2	T3	T4	T5	T6	Total*
26.6 %	42.8 %	25.5 %				
94.9 %			4.9 %	0 %	0.2 %	432
Explosion group						
IIA	IIB	IIC				Total*
85.2%	13.8 %	1,0 %				501

* Number of classified materials

6.3.5 Types of ignition protection

Ignition protection defines the special measures to be taken for electrical components in order to prevent the ignition of surrounding explosive atmospheres. For this reason a differentiation is made between the following types of ignition protection:

Identification	CENELEC standard	IEC standard	Explanation	Application
EEx o	EN 50 015	IEC 79-6	Oil encapsulation	Zone 1 + 2
EEx p	EN 50 016	IEC 79-2	Overpressure encapsulation	Zone 1 + 2
EEx q	EN 50 017	IEC 79-5	Sand encapsulation	Zone 1 + 2
EEx d	EN 50 018	IEC 79-1	Pressure resistant encapsulation	Zone 1 + 2
EEx e	EN 50 019	IEC 79-7	Increased safety	Zone 1 + 2
EEx m	EN 50 028	IEC 79-18	Cast encapsulation	Zone 1 + 2
EEx i	EN 50 020 (unit) EN 50 039 (system)	IEC 79-11	Intrinsic safety	Zone 0 + 1 + 2
EEx n	EN 50 021	IEC 79-15	Electrical components for zone 2 (see below)	Zone 2

Ignition protection “n" describes exclusively the use of explosion protected electrical components in zone 2. This zone encompasses areas where explosive atmospheres can only be expected to occur rarely or short-term. It represents the transition between the area of zone 1, which requires an explosion protection and safe area in which for instance welding is allowed at any time.

Regulations covering these electrical components are being prepared on a world-wide scale. The standard EN 50 021 allows electrical component manufacturers to obtain certificates from the corresponding authorities for instance KEMA in the Netherlands or the PTB in Germany, certifying that the tested components meet the above mentioned standards draft.

Type “n” ignition protection additionally requires electrical components to be marked with the following extended identification:

- A – non spark generating (function modules without relay /without switches)
- AC – spark generating, contacts protected by seals (function modules with relays / without switches)
- L – limited energy (function modules with switch)

Further information
For more detailed information please refer to the national and/or international standards, directives and regulations!

6.4 Classifications meeting the NEC 500

The following classifications according to NEC 500 (National Electric Code) are valid for North America.

6.4.1 Divisions

The "Divisions" describe the degree of probability of whatever type of dangerous situation occurring. Here the following assignments apply:

Explosion endangered areas due to combustible gases, fumes, mist and dust:	
Division 1	Encompasses areas in which explosive atmospheres are to be expected occasionally (> 10 h ≤ 1000 h /year) as well as continuously and long-term (> 1000 h /year).
Division 2	Encompasses areas in which explosive atmospheres can be expected rarely and short-term (>0 h ≤ 10 h /year).

6.4.2 Explosion protection groups

Electrical components for explosion endangered areas are subdivided in three danger categories:

Class I (gases and fumes):	Group A (Acetylene) Group B (Hydrogen) Group C (Ethylene) Group D (Methane)
Class II (dust):	Group E (Metal dust) Group F (Coal dust) Group G (Flour, starch and cereal dust)
Class III (fibers):	No sub-groups

6.4.3 Temperature classes

Electrical components for explosive areas are differentiated by temperature classes:

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T2A	280 °C	> 280 °C to 300 °C
T2B	260 °C	> 260 °C to 280 °C
T2C	230 °C	>230 °C to 260 °C
T2D	215 °C	>215 °C to 230 °C
T3	200 °C	>200 °C to 215 °C
T3A	180 °C	>180 °C to 200 °C
T3B	165 °C	>165 °C to 180 °C
T3C	160 °C	>160 °C to 165 °C
T4	135 °C	>135 °C to 160 °C
T4A	120 °C	>120 °C to 135 °C
T5	100 °C	>100 °C to 120 °C
T6	85 °C	> 85 °C to 100 °C

6.5 Identification

6.5.1 For Europe

According to CENELEC and IEC

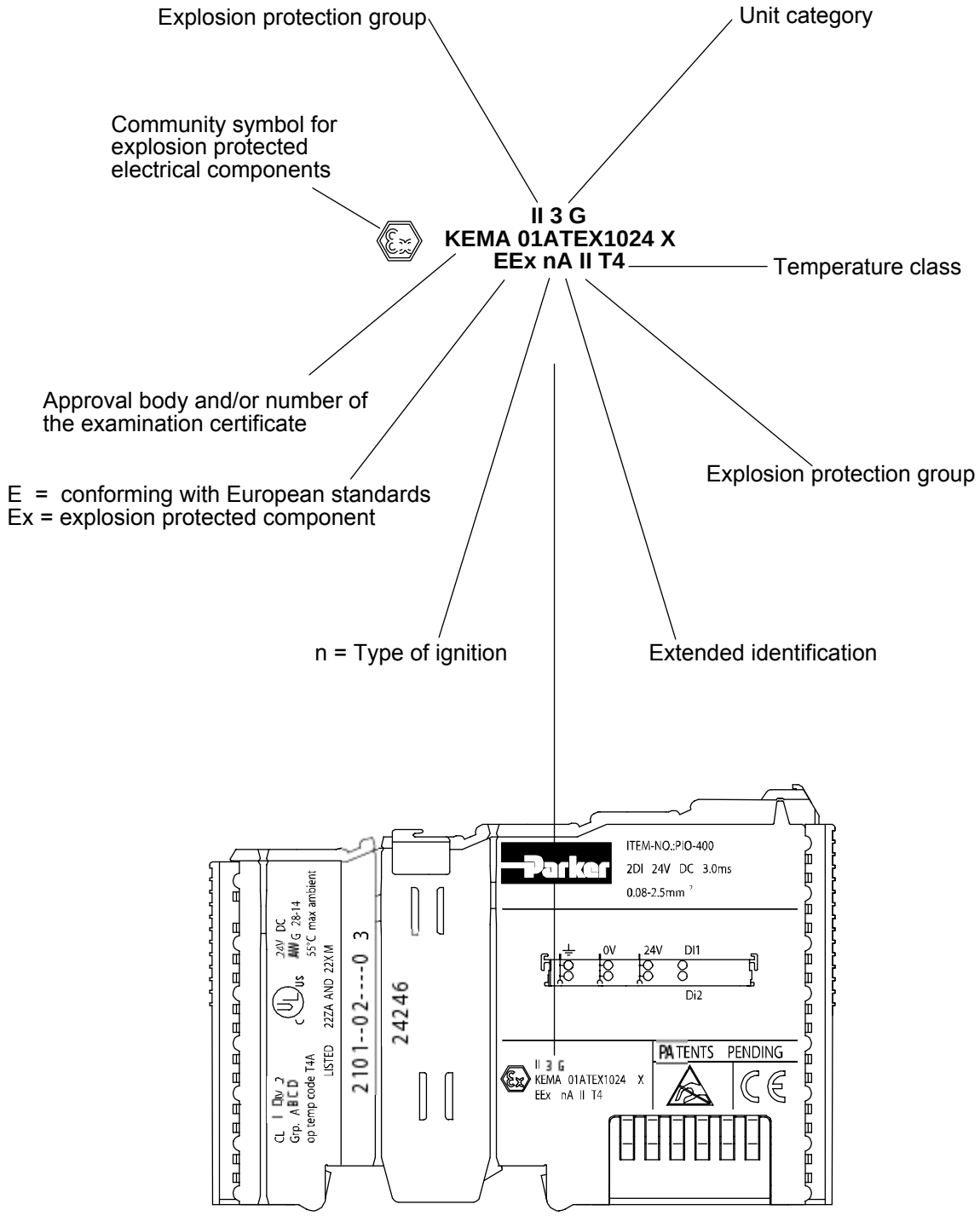


Fig. 6-1: Example for lateral labeling of bus modules
(PIO-400, 2 channel digital input module 24 V DC)

6.5.2 For America

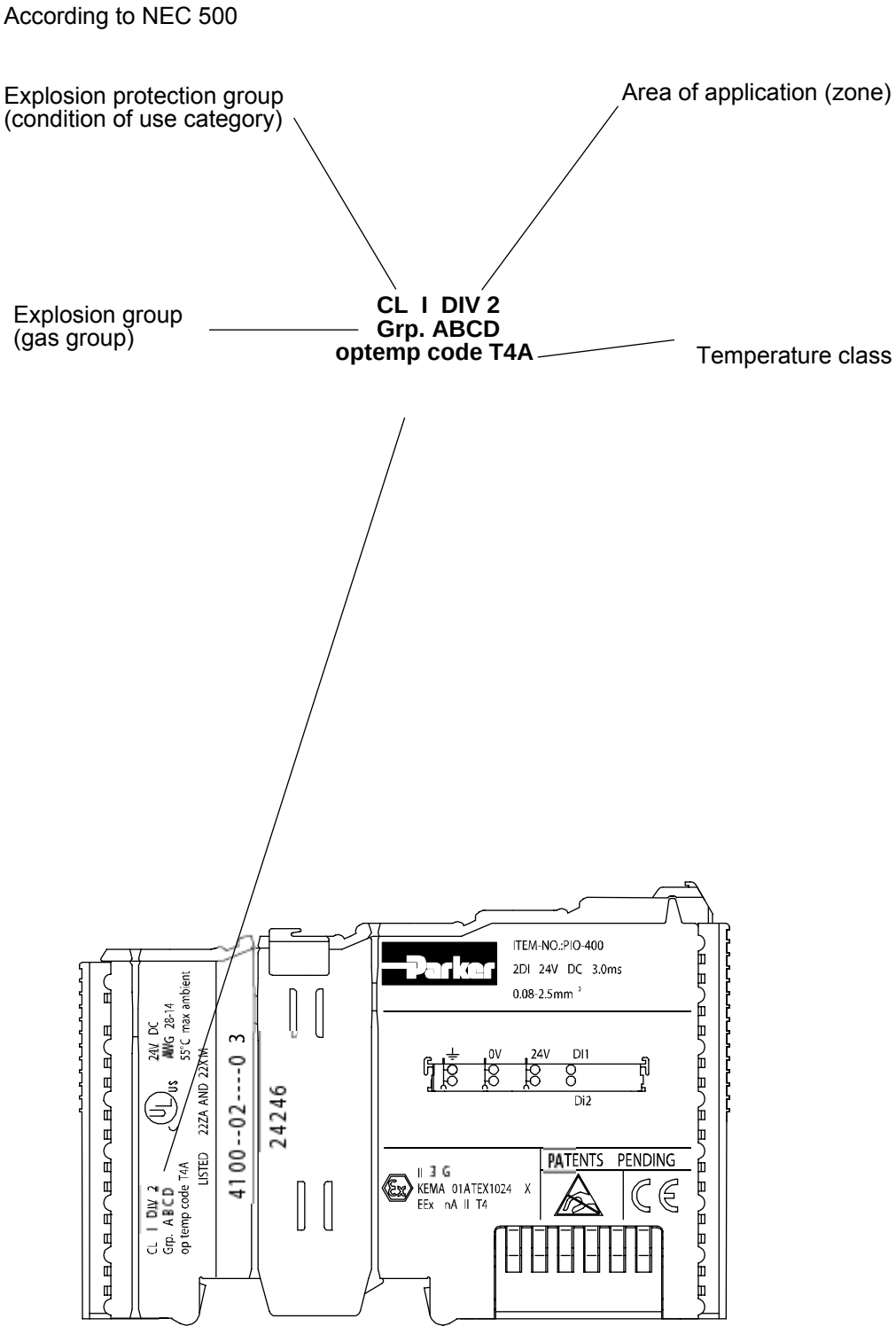


Fig. 6-2: Example for lateral labeling of bus modules
(PIO-400, 2 channel digital input module 24 V DC)

6.6 Installation regulations

In the **Federal Republic of Germany,** various national regulations for the installation in explosive areas must be taken into consideration. The basis being the ElexV complemented by the installation regulation DIN VDE 0165/2.91. The following are excerpts from additional VDE regulations:

DIN VDE 0100	Installation in power plants with rated voltages up to 1000 V
DIN VDE 0101	Installation in power plants with rated voltages above 1 kV
DIN VDE 0800	Installation and operation in telecommunication plants including information processing equipment
DIN VDE 0185	lightning protection I/O-systems

The **USA** and **Canada** have their own regulations. The following are excerpts from these regulations:

NFPA 70	National Electrical Code Art. 500 Hazardous Locations
ANSI/ISA-RP 12.6-1987	Recommended Practice
C22.1	Canadian Electrical Code

- **Danger**
  When using the I/O-SYSTEM (electrical operation) with Ex approval, the following points are mandatory:

A. The fieldbus independent I/O-system Modules Type PIO-xxx are to be installed in enclosures that provide for the degree of ingress protection of at least IP54. For use in the presence of combustible dust, the above mentioned modules are to be installed in enclosures that provide for the degree of ingress protection of at least IP64.

B. The fieldbus independent I/O-system may only be installed in hazardous areas (Europe: Group II, Zone 2 or America: Class I, Division 2, Group A, B, C, D) or in non-hazardous areas!

C. Installation, connection, addition, removal or replacement of modules, fieldbus connectors or fuses may only take place when the I/O-system supply and the field supply are switched off, or when the area is known to be non-hazardous.

D. Ensure that only approved modules of the electrical operating type will be used. The Substitution or Replacement of modules can jeopardize the suitability of the I/O-system in hazardous environments!

E. Operation of intrinsically safe EEx i modules with direct connection to sensors/actuators in hazardous areas of Zone 0 + 1 and Division 1 type requires the use of a 24 V DC Power Supply EEx i module!

F. DIP switches and potentiometers are only to be adjusted when the area is know to be non-hazardous.

Further Information
Proof of certification is available on request.

Also take note of the information given on the module technical information sheet.

7 Glossary

B

Bit

Smallest information unit. Its value can either be 1 or 0.

Bit rate

Number of bits transmitted within a time unit.

Bus

Line for bit serial or bit parallel, clocked data transfer. A bus for the bit parallel data transmission comprises of address, data, control and supply bus. The width of the data bus (8-,16-, 32-, 64 bit) and its clock speed is decisive for the speed at which data can be transferred. The address bus width limits the possible architecture of a network.

Byte

Binary Yoked Transfer Element. A data element greater than one bit and smaller than a word. Generally a byte contains 8 bits. With a 36 bit computer a byte may contain 9 bits.

Bootstrap

Operating mode of the Fieldbus Coupler in which the device awaits a firmware upload.

D

Data bus

see *Bus*.

F

Fieldbus

I/O-System for serial information transmission between devices in automation technology in field areas close to the process.

Fieldbus variable

[PFC variable]
Process data from the user program of the fieldbus controller.

H

Hardware

Electronic, electric and mechanical components of an assembly group.

O

Operating system

Software, which links the user programs with the hardware.

S

Segment

A network is generally structured by *Router* or *Repeater* in various physical network segments.

Server

Serving device within a Client Server System. The service to be provided is requested by the *Client*.

Sub-network

Sub-division of a network into logical sub-networks.

8 Literature list

Further information
The PNO provides further documentation for its members in INTERNET. Cable specification information can be obtained from, for example, the „Installation Guideline for PROFIBUS-FMS/DP", 2.112

http://www.profibus.com/

9 Index

C

carrier rail 16, 18
contacts
  data- 18
  power- 24

D

data contacts 18

L

locking disc 17

P

PIO-400 [2 DI DC 24 V 3.0 ms, High-Side Switching] 70
PIO-402 [4 DI DC 24 V 3.0 ms, High-Side Switching] 73
PIO-430 [8 DI DC 24 V 3.0 ms, High-Side Switching] 76
PIO-468 [4 AI DC 0-10 V, Single-Ended] 79
PIO-480 [2 AI 0-20 mA Differential Measurement Input] 83
PIO-501 [2 DO DC 24 V 0.5 A, High-Side Switching] 87
PIO-504 [4 DO DC 24 V 0.5 A, High-Side Switching] 90
PIO-530 [8 DO DC 24 V 0.5 A, High-Side Switching] 93
PIO-550 [2 AO DC 0-10 V] 96
PIO-552 [2 AO 0-20 mA] 99
PIO-600 [End Module] 103
PIO-602 [24 V DC Power Supply] 104
Power contacts 19, 24
  not carried out 24

U

unlocking lug 17