BECKHOFF New Automation Technology

Documentation | EN

Fieldbus Box I/O-Modules

Signal Types, Installation and Configuration

2013-11-28 | Version: 2.0.0

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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation Issue Status

Requirements

Version	Comment
2.0.0	• UL notes extended • Nut torque for connectors added • Accessories extended • Technical data updated • IP-Link LED diagnostic display updated
1.9.1	• System overview updated
1.9.0	• Introduction and signal Connection of IE2808 updated • Special type IE2808-0001 added • Block diagram of IP/IE5109 updated • Mounting instructions for ZS1022 added
1.8.1	• Mapping of IP5209 corrected • Description of feature registers for IP/IE3312 updated
1.8.0	• Extension Box IE2403added
1.7.4	• IL230x-B110 added at the dimensions chapter • Third party products chapter updated
1.7.3	• Mapping of IE2808 corrected
1.7.2	• Technical Data of IE2808 updated • Block diagram of IE2808 corrected
1.7.1	• IP/IE1502, Gate-Input is mapped to the Status-Byte
1.7.0	• Extension Box IE2808 added • Mounting Rail ZS5300-0001 added • IP-Link Direct Connector added
1.6.2	• Diagnostic Chapter enhanced
1.6.1	• Technical Data of Fieldbus Box Modules updated • Minor routine corrections (typing errors, orthography etc.)
1.6.0	• Register settings IP/IE5009 corrected • Minor routine corrections (typing errors, orthography etc.)
1.5	• Numbering of channels at the mapping descriptions adapted to display in TwinCAT and KS2000 • Minor routine corrections (typing errors, orthography etc.)
1.4	• Description of the mappings extended for Ethernet
1.3	• Expanding of the specification for IP-Link up to 15 meters • Chapter about IP-Link completed and over-worked • Description of IP/IE3202 register settings corrected
1.2	• Description of control und status bytes for all modules over-worked • Description of mappings and configuration for the IP/IE2512 and IP/IE5009 modules updated
1.1	• Description of the mappings adapted to the view of the registers in KS2000 Configuration Software
1.0	• more Fieldbus Box Modules added
0.8	• first preliminary Version

2 System Overview

2.1 The Fieldbus Box System

Fieldbus box modules are robust fieldbus stations for a large number of different fieldbus systems. They offer a wide range of I/O functionality. All relevant industrial signals are supported. As well as digital and analog inputs and outputs including thermocouple and RTD inputs, there are also incremental encoder interfaces available for displacement and angle measurement as well as serial interfaces to solve a large number of communications tasks.

Three varieties of signal connection

The digital inputs and outputs can be connected with snap-on 8 mm diameter plugs, screw-in M8 connectors, or with screw-in M12 pendants. The M12 version is provided for analog signals.

All important signal types

Special input and output channels on the combination I/O modules can be used for either input or output. It is not necessary to configure them, since the fieldbus interface is available for every combination channel as well as for input and output data. The combination modules give the user all of the advantages of fine signal granularity.

The processor logic, the input circuitry and the power supply for the sensor are all fed from the control voltage. The load voltage for the outputs can be supplied separately. In those Fieldbus Boxes in which only inputs are available, the load power supply, UP, can optionally be connected in order to pass it on downstream.

The states of the Fieldbus Box, the fieldbus connection, the power supplies and of the signals are indicated by LEDs.

The label strips can be machine printed elsewhere, and then inserted.

Fieldbus Boxes can be combined for greater flexibility

In addition to the Compact Box, the Fieldbus Box series also includes extendable devices, namely the Coupler Box and the Extension Box, as well as intelligent devices, the PLC Boxes.

Compact Box

The Compact Box makes the I/O data from the connected digital and analog sensors and actuators available to the fieldbus.

Coupler Box

The Coupler Box also collects I/O data from the Extension Boxes via an interference-proof optical fiber connection (IP-Link). Up to 120 Extension Boxes can be connected to a Coupler Box. In this way a distributed IP67 I/O network is formed with only one fieldbus interface.

The Coupler Box is capable of automatically recognizing the extension modules connected to it during start-up, and maps the I/O data automatically into the fieldbus process image – a configuration is not necessary. The Coupler Box appears, from the fieldbus point of view, along with all of the networked Extension Boxes, as a single participating bus device with a corresponding number of I/O signals.

The Coupler Box corresponds to the Bus Coupler in the BECKHOFF Bus Terminal system. BECKHOFF fieldbus devices made to protection class IP 20 (Bus Terminals) and IP 67 (Fieldbus Box) can be combined without difficulty – the data is handled in the same way in either case.

IP-Link

The IP-Link is an optical fiber connection with a transmission rate of 2 MBits/s which is capable of transmitting 1000 items of binary I/O data in approx. 1 ms, rapidly and securely. Smaller configurations are correspondingly faster. Because of the high usable data rate, the coupling via IP-Link does not reduce the performance of the fieldbus at all.

Low-priced plug connectors made according to Protection Class IP 67 can be used for the rapid and simple preparation of the IP-Link cable, in situ. The connection does not require special tools, and can be performed quickly and simply. The IP-Link cables can also be obtained with prepared plugs if required.

The separate supply of the output voltage allows output groups to be switched off individually. Differing potentials can also be created within an extension ring without difficulty, since the IP-Link naturally has optimum electrical isolation.

Extension box

Like the Compact Boxes, the Extension Boxes cover the full spectrum of I/O signals, and may be up to 15 m apart. They are remarkably small in size, and lead to particularly economical I/O solutions with high levels of protection. Here again, the digital inputs and outputs may optionally be connected via snap-on 8 mm connectors, or via screw-in connectors (M8 and M12). Analog signal types are provided with the M12 version. The snap-on connectors lock in place positively, forming a shake-proof connection, while the screw-in connectors offer the advantage of high resistance to being pulled out.

PLC Box

The PLC Box is an intelligent Fieldbus Box with PLC functionality for distributed pre-processing of the I/O signals. This allows parts of the application to be farmed out from the central controller. This reduces the load on the CPU and the fieldbus. Distributed counting, controlling and switching are typical applications for the PLC Box. The reaction times are independent of the bus communication and of the higher-level controller.

In the event of a bus or controller failure, maintenance of function (e.g. bringing the process to a safe state in an orderly manner) is possible.

Programming is carried out with TwinCAT in accordance with IEC 61131-3. Five different programming languages are available:

- Instruction List (IL)
- Function Block Diagram (FBD)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)
- Structured Text (ST)

The program download occurs either via the fieldbus or via the programming interface.

Extensive debugging functions (breakpoint, single step, monitoring, etc) are also available. The PLC Box contains a powerful 16 bit controller, 32/96 kByte program memory and 32/64 kByte data memory. A further 512 bytes of non-volatile memory are available for remanent flags.

PLC Box with IP-Link

The programmable PLC Box with IP-Link provides almost unlimited I/O possibilities. Up to 120 extension modules, with more than 2000 I/Os, can be directly addressed from the PLC program. The PLC Box is thus also suitable for use as a small, autonomous controller for the operation of parts of equipment or small machines.

2.2 Fieldbus Box - Naming conventions

The identifications of the Fieldbus Box modules are to be understood as follows:
IXxxxy-zyyy

IX describes the design:

"IP" stands for the Compact Box design [▶ 14]
"IL" stands for the Coupler Box design (with IP-Link) [▶ 14]
"IE" stands for the Extension Box design [▶ 14]

xxxy describes the I/O connection:

xxx describes the I/O property:
"10x" - 8 x digital inputs
"15x" - counter module
"20x" - 8 x digital outputs
"25x" - PWM module
"23x" - 4 x digital inputs and 4 x digital outputs
"24x" - 8 x digital inputs and 8 x digital outputs
"3xx" - 4 x analog inputs
"4xx" - 4 x analog outputs
"5xx" - incremental encoder or SSI transducer
"6xx" - Gateway module for RS232, RS422, RS485, TTY

y represents the mechanical connection:
"0" stands for 8mm snap-on connection,
"1" stands for M8 bolted connection
"2" stands for M12 bolted connection and
"9" stands for M23 bolted connection

zyyy describes the programmability and the fieldbus system

z distinguishes whether the device is a slave or is a programmable slave:

"B" - not programmable
"C" - programmable (PLC Box)

"yyy" stands for the fieldbus system and the bus connection:
"110" - EtherCAT
"200" - Lightbus
"310" - PROFIBUS
"318" - PROFIBUS with integrated tee-connector
"400" - Interbus
"510" - CANopen
"518" - CANopen with integrated tee-connector
"520" - DeviceNet
"528" - DeviceNet with integrated tee-connector
"730" - Modbus
"800" - RS485
"810" - RS232
"900" - Ethernet TCP/IP with RJ45 for the bus connection
"901" - Ethernet TCP/IP with M12 for the bus connection
"903" - PROFINET
"905" - EtherNet/IP

Compact Box

Compact Box

The Compact Box modules offer a wide range of I/O functionality. All relevant industrial signals are supported. The digital inputs and outputs can be connected either with snap-on 8 mm diameter plugs, screw-in M8 connectors, or screw-in M12 connectors. The M12 version is made available for analog signals.

Depending on the module, the I/O section and the power supply section can differ.

Coupler Box

Coupler Box

There are three versions of the coupler box named IL230x-Bxxx. It differs from the compact box in that this module offers an interface to what are known as extension boxes. This interface is a subsidiary bus system based on the optical fiber what is known as IP Link. This powerful subsidiary bus system can handle up to 120 extension boxes at one coupler box.

Extension Box

Extension Box

Extension Modules, that are independent of the fieldbus and that can only be operated together with a coupler box via IP Link.

PLC Box

PLC Box

A PLC Box differ from the Coupler Box in that this module can be programmed in IEC 61131-3. This means that this slave is also capable of working autonomously, without a master, for instance for control or regulation tasks.

Also see about this

Fieldbus Box - Naming conventions [▶ 14]

2.3 Firmware and hardware issue status

The documentation refers to the hardware and software status that was valid at the time it was prepared. The properties are subject to continuous development and improvement. Modules having earlier production statuses cannot have the same properties as modules with the latest status. Existing properties, however, are always retained and are not changed, so that these modules can always be replaced by new ones. The number beginning with a *D* allows you to recognize the firmware and hardware status of a module.

Syntax:

D . ww yy x y z u

ww - calendar week
yy - year
x - bus board firmware status
y - bus board hardware status
z - I/O board firmware status
u - I/O board hardware status

Example:

D.22081501

- Calendar week 22
- in the year 2008
- bus board firmware status: 1
- bus board firmware hardware status: 5
- I/O board firmware status: 0 (no firmware is necessary for this board)
- I/O board hardware status: 1

3 I/O-Modules

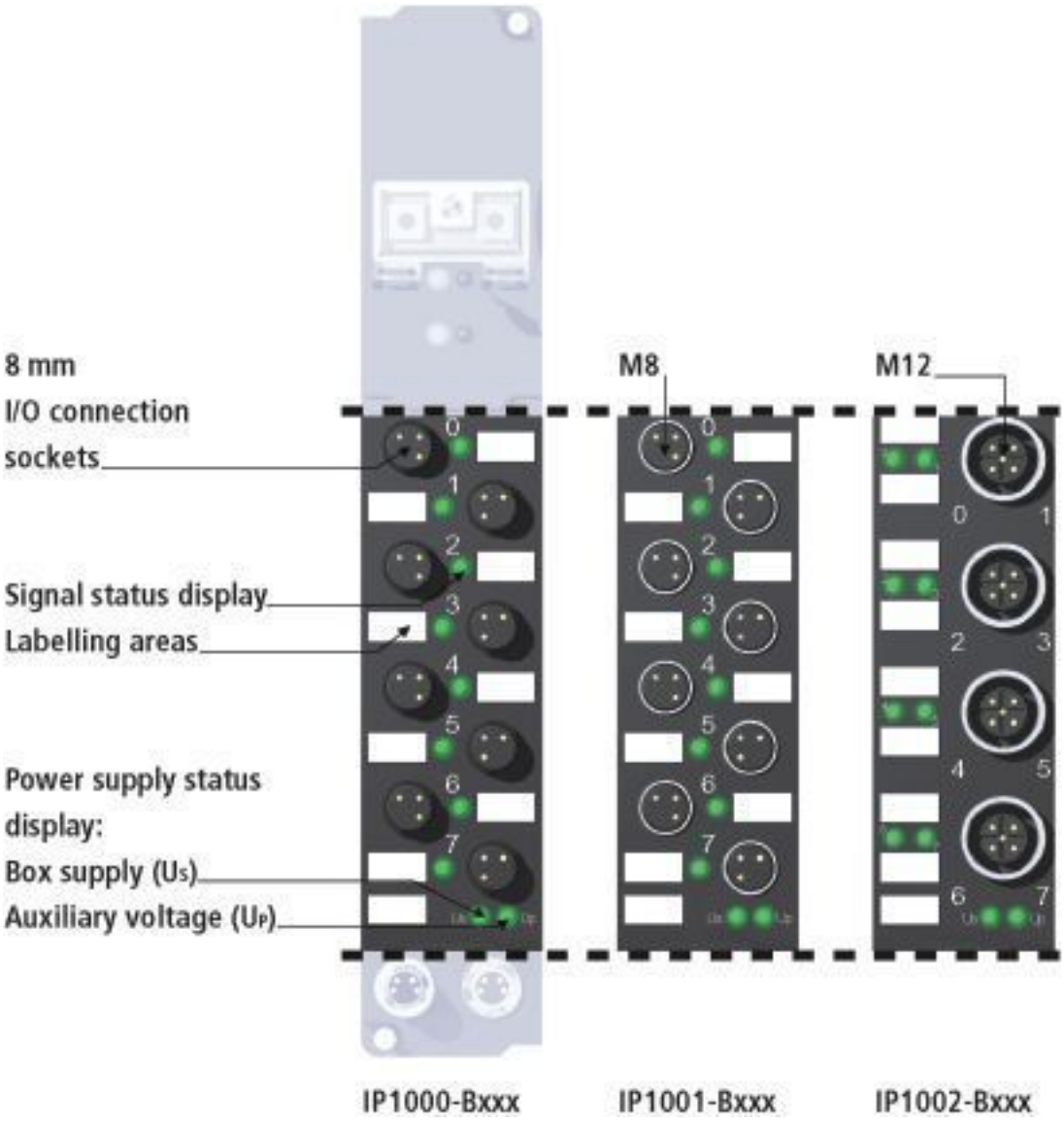
3.1 Module Descriptions

3.1.1 Digital Input Modules

3.1.1.1 IP100x-Bxxx, IE100x

8 Channel Digital Input (Filter 3.0 ms) 24 V_{DC}

The IP100x digital input modules acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The state of the signals is indicated by light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP1000), screw-in M8 connectors (IP1001) or screw-in M12 connectors (IP1002). The sensors are supplied from the control voltage U_S. The load voltage U_P is not used in the input module, but may be connected in order to be relayed downstream.



Technical data	IP1000-Bxxx, IE1000	IP1001-Bxxx, IE1001	IP1002-Bxxx, IE1002
Number of inputs	8		
Input connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	3.0 ms		
Nominal input voltage	24 V_{DC} (20 V ... 29 V)		
Signal voltage '0'	-3 V ... 5 V (EN61131-2, type 2)		
Signal voltage '1'	11 V ... 30 V (EN61131-2, type 2)		
Input current	typical 6 mA (EN61131-2, type 2)		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	8 bits input		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 96] for the connector pin assignment.

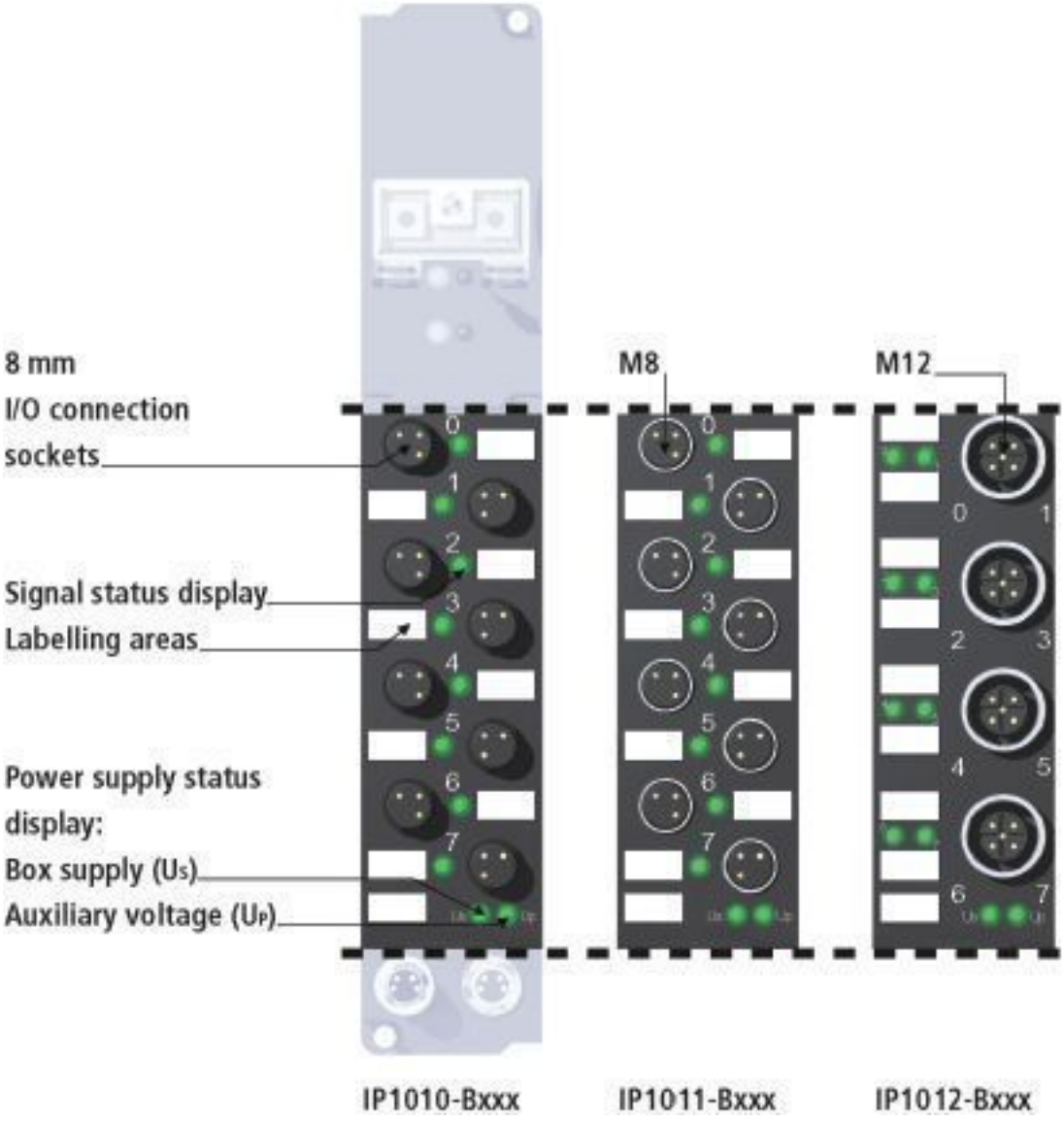
See the mapping description [▶ 150] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.1.2 IP101x-Bxxx, IE101x

8 Channel Digital Input 24 V_{DC}, Filter 0.2 ms

The IP101x digital input modules acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The state of the signals is indicated by light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP1010), screw-in M8 connectors (IP1011) or screw-in M12 connectors (IP1012). The sensors are supplied from the control voltage U_S. The load voltage U_P is not used in the input module, but may be connected in order to be relayed downstream.



Technical data	IP1010-Bxxx / IE1010	IP1011-Bxxx / IE1011	IP1012-Bxxx / IE1012
Number of inputs	8		
Input connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	0.2 ms		
Nominal input voltage	24 V_{DC} (20 V ... 29 V)		
Signal voltage '0'	-3 V ... 5 V (EN61131-2, type 2)		
Signal voltage '1'	11 V ... 30 V (EN61131-2, type 2)		
Input current	typical 6 mA (EN61131-2, type 2)		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	8 bits input		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 97] for the connector pin assignment.

See the mapping description [▶ 150] for details of the mapping.

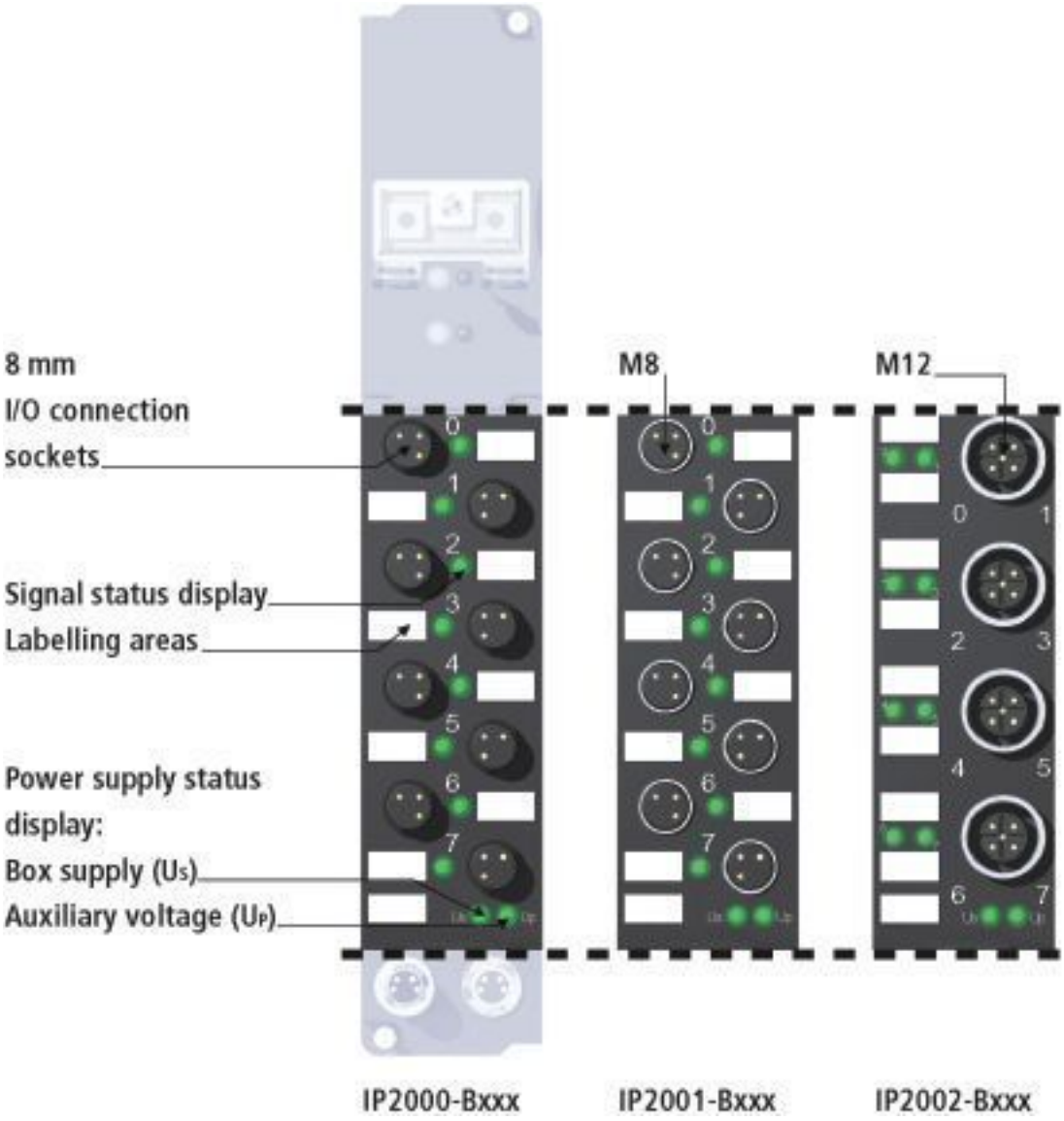
See dimension page [▶ 68] for weight and dimensions.

3.1.2 Digital Output Modules

3.1.2.1 IP200x-Bxxx, IE200x

8 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A

The IP200x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2000), screw-in M8 connectors (IP2001) or screw-in M12 connectors (IP2002). The outputs are short-circuit proof and protected against inverse connection.



Technical data	IP2000-Bxxx / IE2000	IP2001-Bxxx / IE2001	IP2002-Bxxx / IE2002
Number of outputs	8		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Load type	ohmic, inductive, lamp load		
Nominal voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 0.5 A on each channel, individually short-circuit proof		
Short circuit current	typical 1.5 A		
Load voltage current consumption	typical 20 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	8 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 99] for details of the connection.

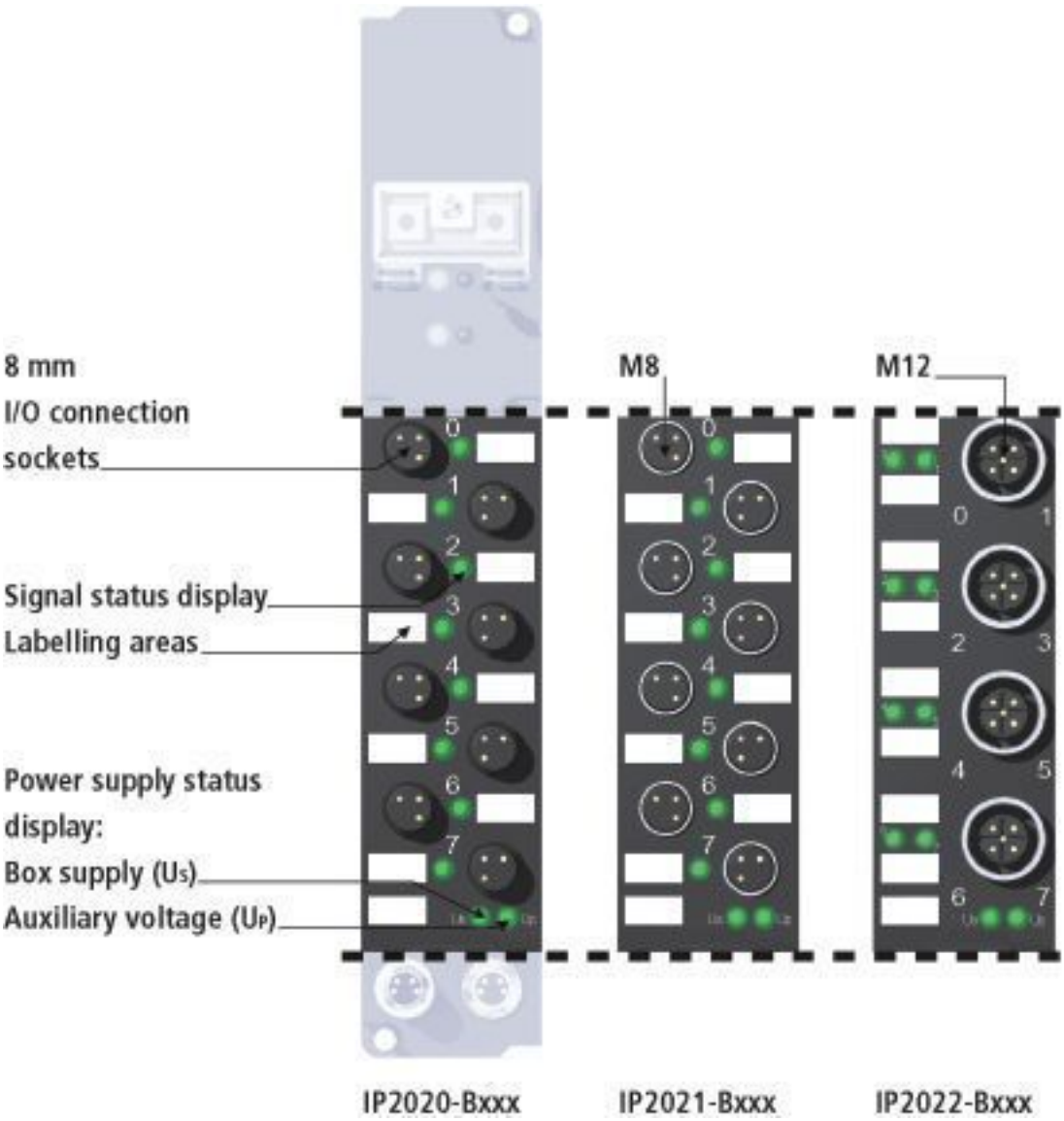
See the mapping description [▶ 153] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.2.2 IP202x-Bxxx, IE202x

8 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A (total current max. 4 A)

The IP202x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 2 A each, although the total current is limited to 4 A. This makes these modules particularly suitable for applications in which not all of the outputs are active at the same time, or in which not all of the actuators draw 2 A signal current. The signal state is indicated by means of light emitting diodes.
The signals are optionally connected via 8 mm snap-in plugs (IP2020), screw-in M8 connectors (IP2021) or screw-in M12 connectors (IP2022). The outputs are short-circuit proof and protected against inverse connection.



Technical data	IP2020-Bxxx / IE2020	IP2021-Bxxx / IE2021	IP2022-Bxxx / IE2022
Number of outputs	8		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Load type	ohmic, inductive, lamp load		
Nominal voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 2.0 A each channel, individually short-circuit proof, total current max. 4 A		
Short circuit current	typical 4.0 A		
Load voltage current consumption	typical 30 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	8 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 100] for details of the connection.

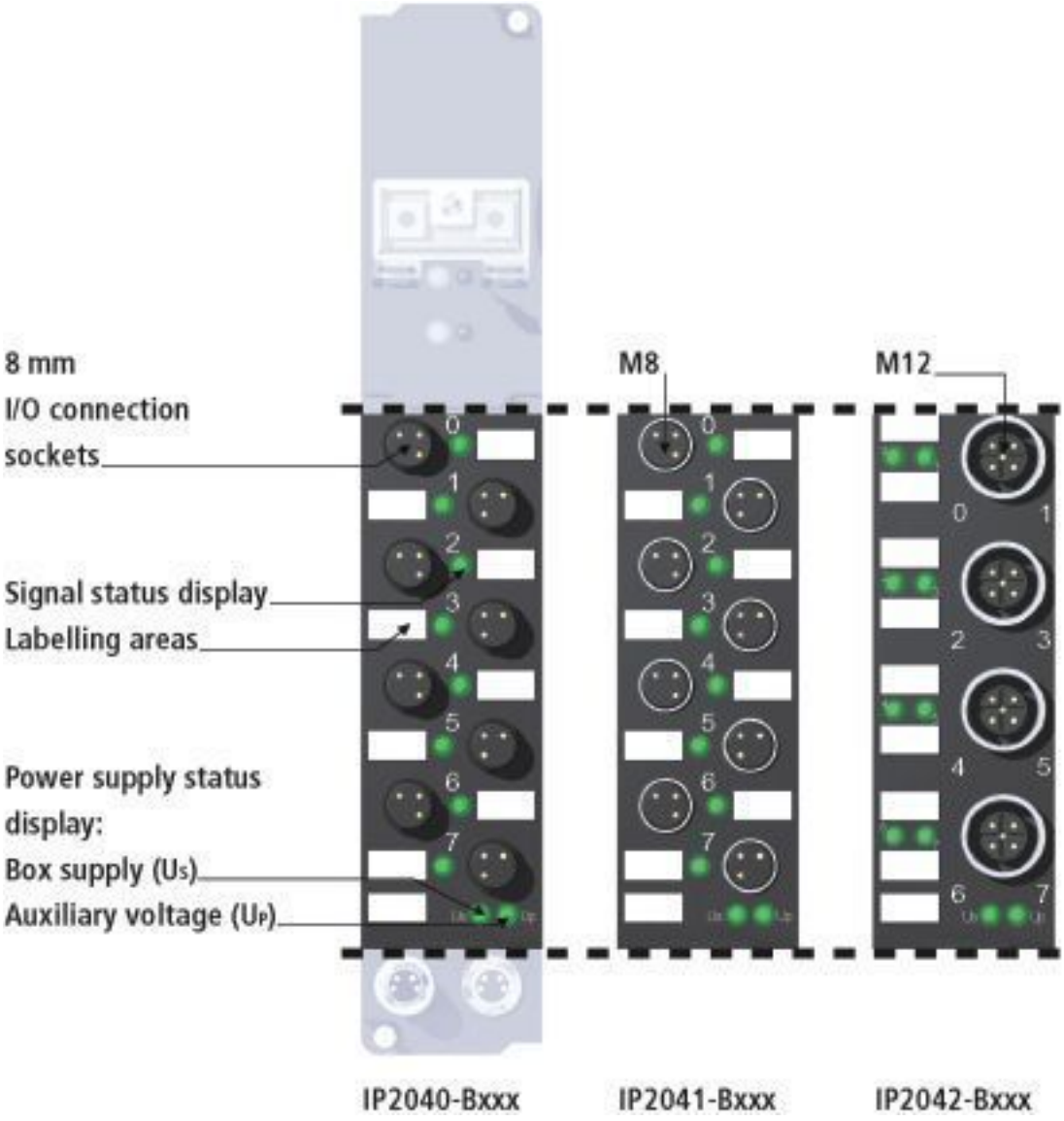
See the mapping description [▶ 153] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.2.3 IP204x-Bxxx, IE204x

8 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A (total current max. 12 A)

The IP204x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 2 A each, although the total current is limited to 12 A. The outputs are supplied by three load circuits; for this reason these modules do not relay the supply voltage. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs (IP2040), screw-in M8 connectors (IP2041) or screw-in M12 connectors (IP2042). The outputs are short-circuit proof and protected against inverse connection.



Technical data	IP2040-Bxxx / IE2040	IP2041-Bxxx / IE2041	IP2042-Bxxx / IE2042
Number of outputs	8		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Load type	ohmic, inductive, lamp load		
Nominal voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 2.0 A per channel, individually short-circuit proof, total current 12 A: - channels 0...3: S 4 A - channels 4...5: S 4 A - channels 6...7: S 4 A		
Short circuit current	typical 4.0 A		
Load voltage current consumption	typical 50 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 2 x M8 connector, 4-pin; no downstream connection		
Bits in process image	8 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 101] for details of the connection.

See the mapping description [▶ 153] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

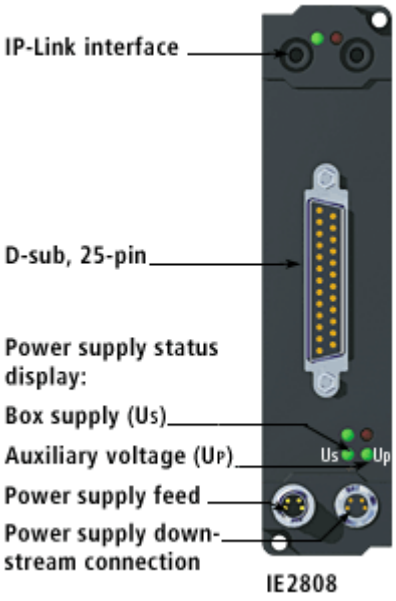
3.1.2.4 IE2808

16 Channel Digital Output 24 V_{DC}, I_{max} = 2,0 A (total current max. 4A)

The IE2808 digital output module connects the binary control signals from the automation unit on to the actuators at the process level. The 16 outputs handle load currents of up to 0.5 A each, although the total current is limited to 4 A. This makes these modules particularly suitable for applications in which not all of the outputs are active at the same time, or in which not all of the actuators draw 0.5 A current. An output short-circuit is recognized and passed on to the controller. The signal state is indicated by means of light emitting diodes. The signal connection is realized by the 25-pin D-sub socket. The outputs are short-circuit safe and protected against inverse connection.

Via register R32 and R33 default values can be activated, this means these values are set when communication is lost.

With R32 this error handling can be activated. In register R33 the value (On or OFF) is specified for every output.



Technical data	IE2808-0000	IE2808-0001
Number of outputs	8	
Output connection	D-sub socket, 25-pin, UNC tread	
Load type	resistance, inductive, lamp load	
Rated load voltage	24 V_{DC} (20 V ... 29 V)	
Output current	max. 0,5 A per channel, individually short-circuit safe, total current max. 4 A	
Short circuit current	maximal 1,5 A	
Load voltage current consumption	typical 5 mA per channel	
Power supply	Feed: 1 x M8 male socket, 4-pole downstream connection: 1 x M8 female socket, 4-pole	
Bits in process image	16 bit output, 16 bit input (diagnostic), optional: control/status byte	
Reset of error display [▶ 200]	manually	automatically
Electrical isolation	control voltage / fieldbus: yes, via IP-Link channels / control voltage: no between the channels: no	
Permissible ambient temperature during operation	0°C ... +55°C	
Permissible ambient temperature during storage	-25°C ... +85°C	
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27	
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP65, IP66, IP67 (conforms to EN 60529)	
Installation position	variable	

See the connection diagramm [▶ 110] for details of connection.

See the mapping description [▶ 158] for details on the mapping.

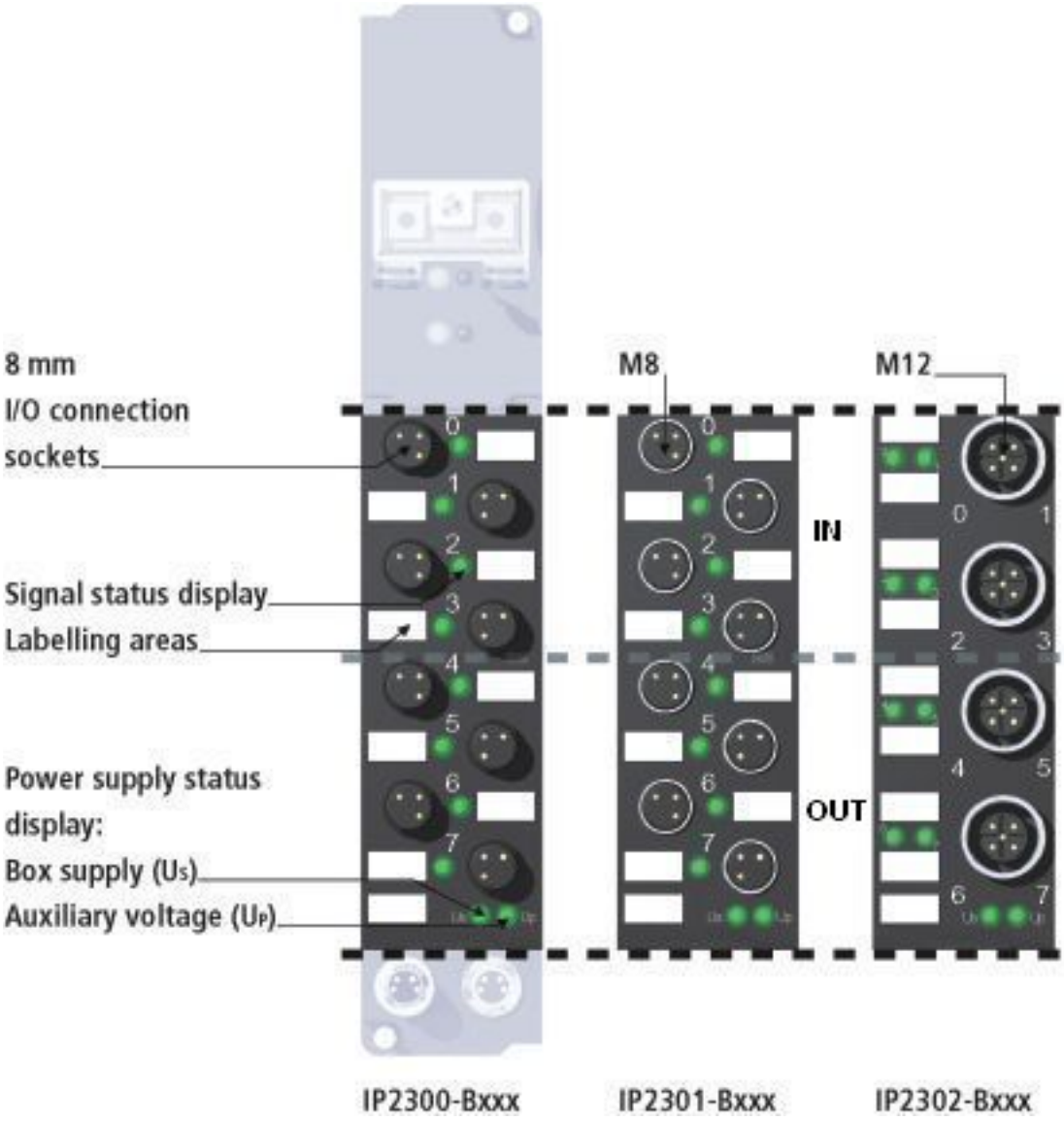
See dimension page [▶ 68] for weight and dimensions.

3.1.3 Digital Combi Modules

3.1.3.1 IP230x-Bxxx, IE230x

4 digital inputs (3.0 ms input filter) and 4 digital outputs, 24 V_{DC}, I_{max} = 0.5 A

The IP230x digital I/O modules combine 4 digital inputs with a 3 ms input filter and four digital outputs in one device. The outputs handle load currents of up to 0.5 A, are short-circuit proof and protected against inverse polarity. The state of each signal is indicated by means of light emitting diodes. The signals are connected optionally via 8 mm snap-on plugs (IP2300), screw-in M8 connectors (IP2301) or screw-in M12 connectors (IP2302).



Technical data	IP2300-Bxxx / IE2300	IP2301-Bxxx / IE2301	IP2302-Bxxx / IE2302
Number of outputs	4 inputs and 4 outputs		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	3.0 ms		
Signals „0“ / „1“	-3 ... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)		
Load type	ohmic, inductive, lamp load		
Rated load voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 0.5 A on each channel, individually short-circuit proof		
Short circuit current	typical 1.5 A		
Load voltage current consumption	typical 20 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	4 bits input and 4 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no, between the channels: no,		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 102] for details of the connection.

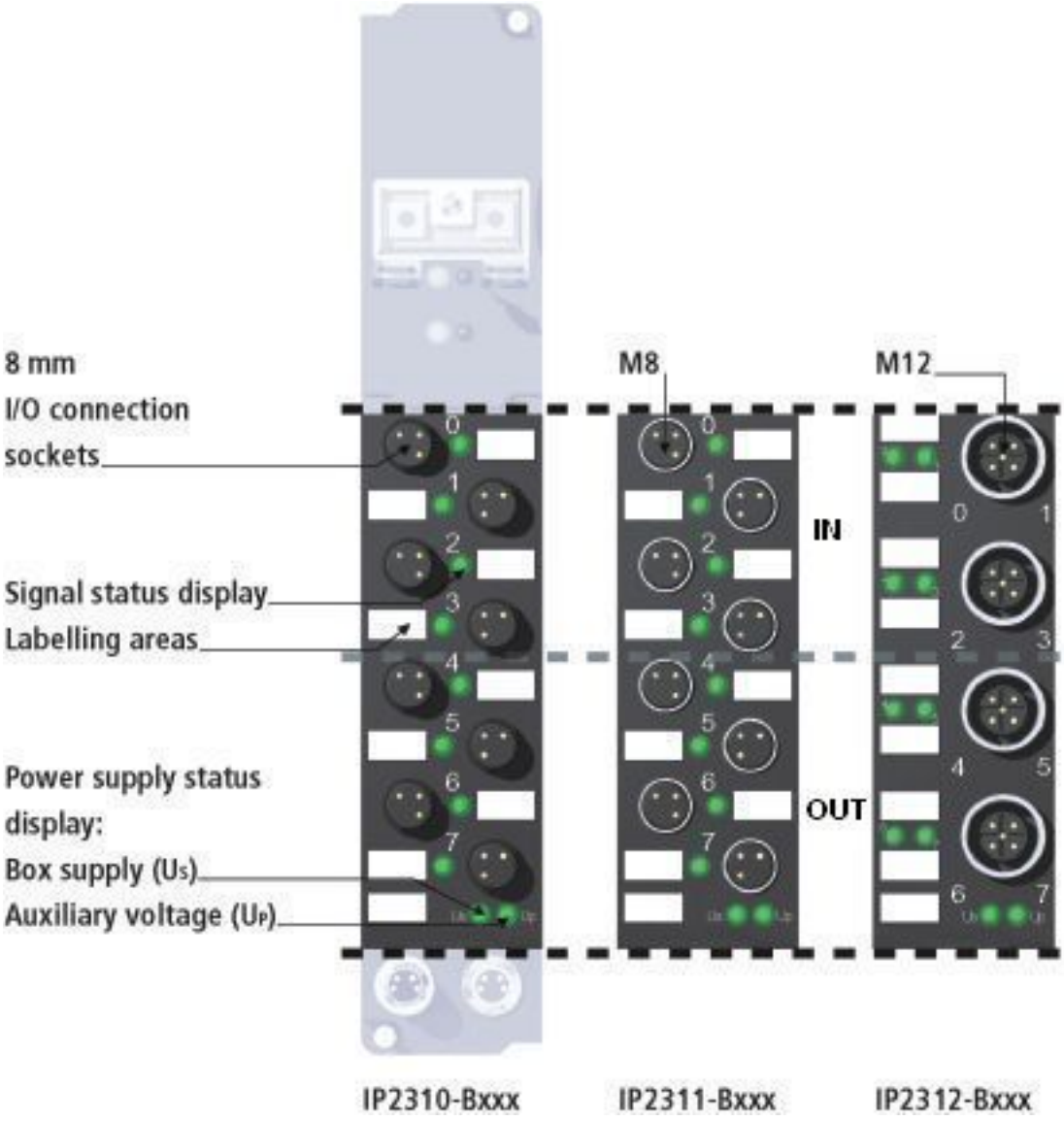
See the mapping description [▶ 154] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.3.2 IP231x-Bxxx, IE231x

4 digital inputs (0.2 ms input filter) and 4 digital outputs, 24 V_{DC}, I_{max} = 0.5 A

The IP231x digital I/O modules combine 4 digital inputs with a 0.2 ms input filter and four digital outputs in one device. The outputs handle load currents of up to 0.5 A, are short-circuit proof and protected against inverse polarity. The state of each signal is indicated by means of light emitting diodes. The signals are connected optionally via 8 mm snap-on plugs (IP2310), screw-in M8 connectors (IP2311) or screw-in M12 connectors (IP2312).



Technical data	IP2310-Bxxx / IE2310	IP2311-Bxxx / IE2311	IP2312-Bxxx / IE2312
Number of outputs	4 inputs and 4 outputs		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	0.2 ms		
Signals „0“ / „1“	-3... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)		
Load type	ohmic, inductive, lamp load		
Rated load voltage	24 V_{DC} (20 V ... 9 V)		
Output current	max. 0.5 A on each channel, individually short-circuit proof		
Short circuit current	typical 1.5 A		
Load voltage current consumption	typical 20 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	4 bits input and 4 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram for details of the connection.

See the mapping description [▶ 154] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

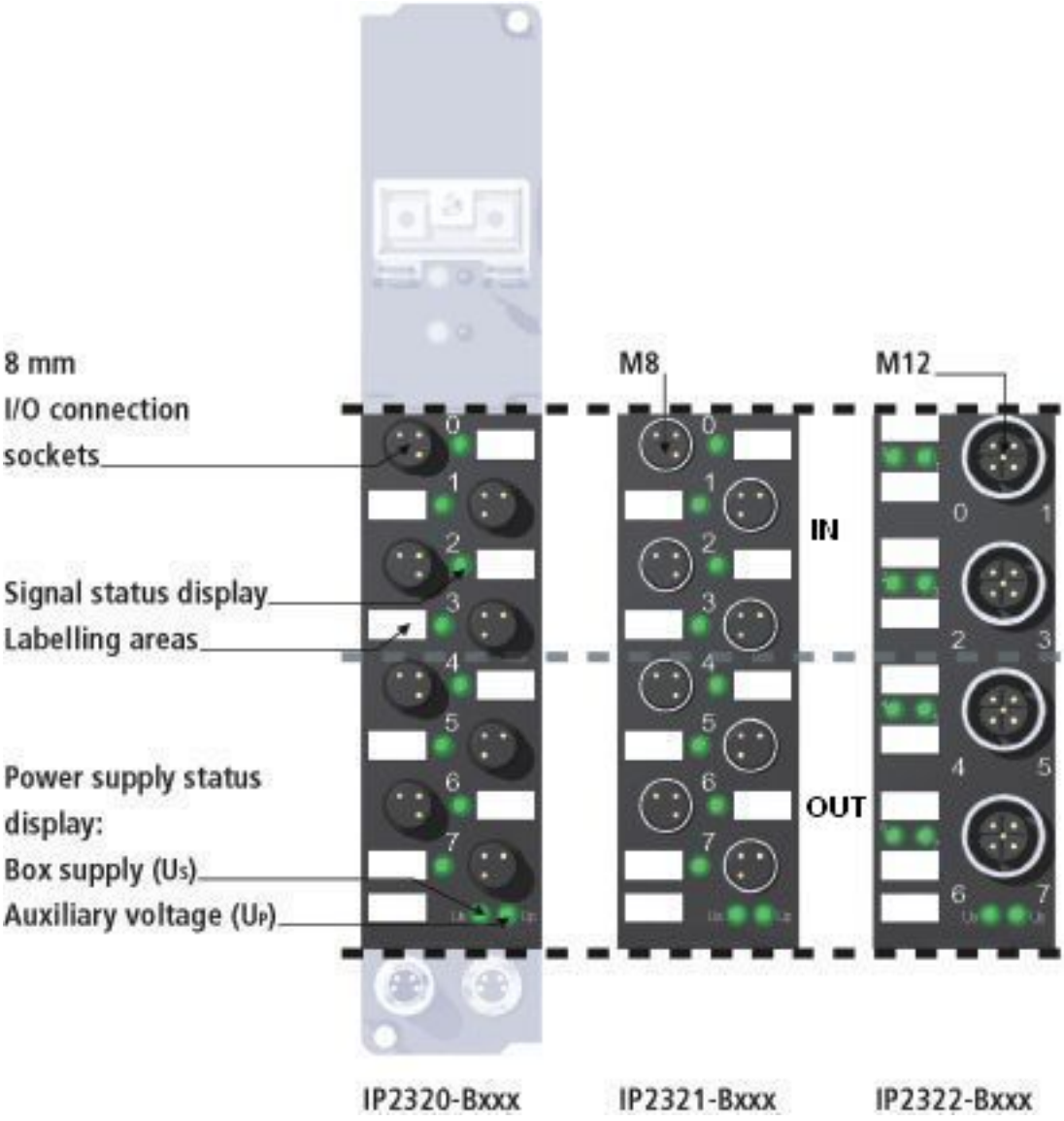
Also see about this

- IP231x-Bxxx, IE231x Signal Connection [▶ 103]

3.1.3.3 IP232x-Bxxx, IE232x

4 digital inputs (3.0 ms input filter) and 4 digital outputs, 24 V_{DC}, I_{max} = 2.0 A, total current 4 A

The IP232x digital I/O modules combine 4 digital inputs with a 3 ms input filter and four digital outputs in one device. The outputs handle load currents of up to 2.0 A, are short-circuit proof and protected against inverse polarity. The state of each signal is indicated by means of light emitting diodes. The signals are connected optionally via 8 mm snap-on plugs (IP2320), screw-in M8 connectors (IP2321) or screw-in M12 connectors (IP2322).



Technical data	IP2320-Bxxx / IE2320	IP2321-Bxxx / IE2321	IP2322-Bxxx / IE2322
Number of outputs	4 inputs and 4 outputs		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	3.0 ms		
Signals „0“ / „1“	-3 ... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)		
Load type	ohmic, inductive, lamp load		
Rated load voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 2.0 A each channel, individually short-circuit proof, total current 4 A		
Short circuit current	typical 4.0 A		
Load voltage current consumption	typical 30 mA per channel		
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	4 bits input and 4 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram [▶ 104] for details of the connection.

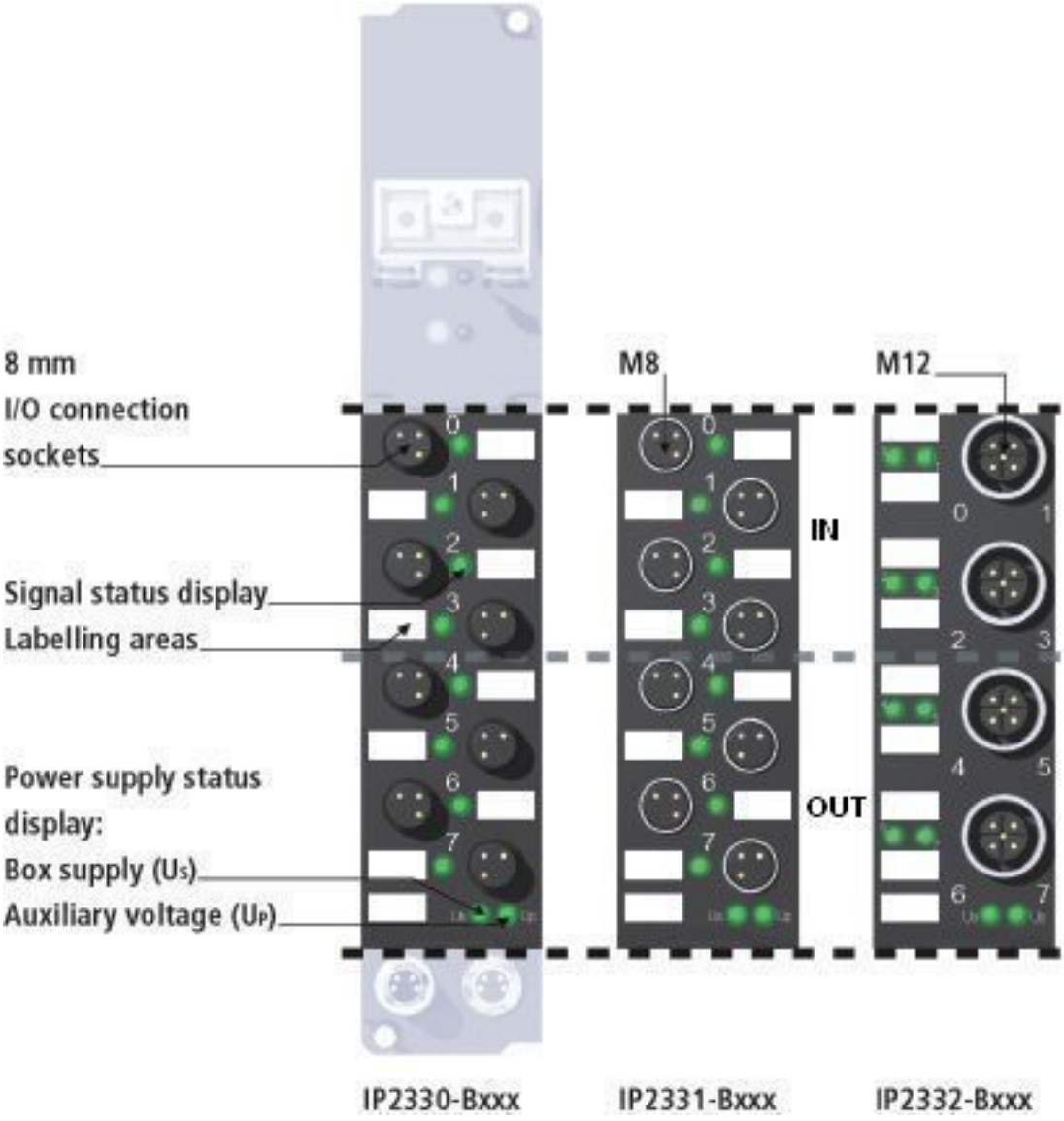
See the mapping description [▶ 154] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.3.4 IP233x-Bxxx, IE233x

4 digital inputs (0.2 ms input filter) and 4 digital outputs 24 V_{DC}, I_{max} = 2.0 A, total current 4 A

The IP233x digital I/O modules combine 4 digital inputs with a 0.2 ms input filter and four digital outputs in one device. The outputs handle load currents of up to 2.0 A, are short-circuit proof and protected against inverse polarity. The state of each signal is indicated by means of light emitting diodes. The signals are connected optionally via 8 mm snap-on plugs (IP2330), screw-in M8 connectors (IP2331) or screw-in M12 connectors (IP2332).



Technical data	IP2330-Bxxx / IE2330	IP2331-Bxxx / IE2331	IP2332-Bxxx / IE2332
Number of outputs	4 inputs and 4 outputs		
Output connections	Ø 8 snap on	M8 screw-in	M12 screw-in
Input filter	0.2 ms		
Signals „0“ / „1“	-3... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)		
Load type	ohmic, inductive, lamp load		
Rated load voltage	24 V_{DC} (20 V ... 29 V)		
Output current	max. 2.0 A each channel, individually short-circuit proof, total current 4 A		
Short circuit current	typical 4.0 A per channel		
Load voltage current consumption	typical 30 mA		
Sensor supply	derived from the control voltage, max. 2.0 A per channel, fully short-circuit proof		
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin		
Bits in process image	4 bits input and 4 bits output		
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no		
Permissible ambient temperature during operation	0°C ... +55°C		
Permissible ambient temperature during storage	-25 °C ... +85°C		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP65, IP66, IP67 (conforms to EN 60529)		
Installation position	variable		

See the connection diagram for details of the connection.

See the mapping description [▶ 154] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

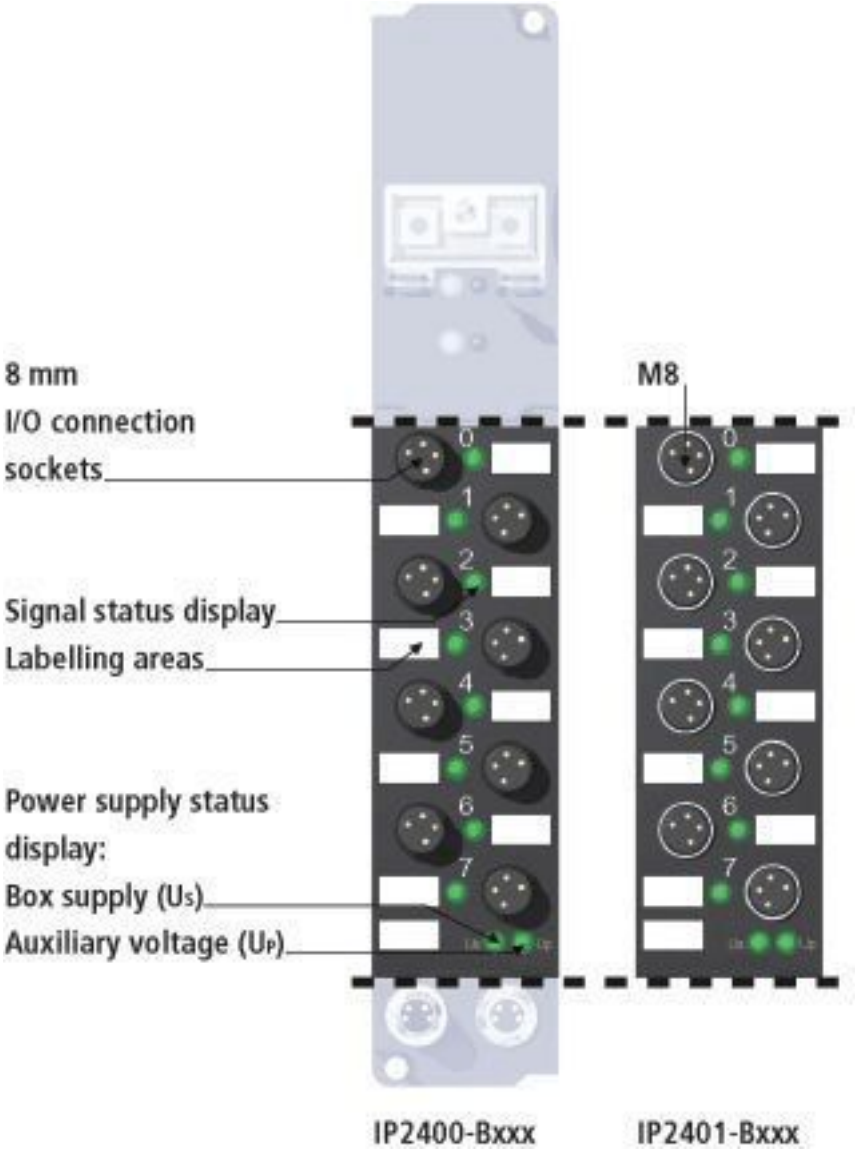
Also see about this

- IP233x-Bxxx, IE233x Signal Connection [▶ 105]

3.1.3.5 IP240x-Bxxx, IE240x

8 digital inputs (3.0 ms input filter) and 8 digital outputs 24 V_{DC}, I_{max} = 0.5 A

The IP240x digital I/O modules have 8 channels that can be used either as inputs or as outputs. The device can therefore be flexibly adapted to the requirements of the application. The signals are connected optionally through snap-on 8 mm connectors (IP2400) or through screw-in M8 connectors (IP2401), both of which have 4 pins (with separate input and output pins). This makes it possible to connect antivalent sensors. Adapter cables are available for use in input-only or output-only cases, as well as connectors for field assembly. It is also possible to use the power supply cable directly as the sensor cable. The outputs handle load currents of up to 0.5 A, are short-circuit proof and protected against inverse polarity. The state of each signal is indicated by means of light emitting diodes.



Technical data	IP2400-Bxxx / IE2400	IP2401-Bxxx / IE2401
Number of outputs	8 inputs and 8 outputs	
Output connections	Ø 8 snap on	M8 screw-in
Input filter	3.0 ms	
Signals „0“ / „1“	-3 ... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)	
Load type	ohmic, inductive, lamp load	
Rated load voltage	24 V_{DC} (20 V ... 29 V)	
Output current	max. 0.5 A on each channel, individually short-circuit proof	
Short circuit current	typical 1.5 A	
Load voltage current consumption	typical 20 mA per channel	
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof	
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin	
Bits in process image	8 bits input and 8 bits output	
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no	
Permissible ambient temperature during operation	0°C ... +55°C	
Permissible ambient temperature during storage	-25 °C ... +85°C	
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27	
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP65, IP66, IP67 (conforms to EN 60529)	
Installation position	variable	

See the connection diagram for details of the connection.

See the mapping description [▶ 155] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

Also see about this

- IP240x-Bxxx, IE240x Signal Connection [▶ 106]

3.1.3.6 IE2403

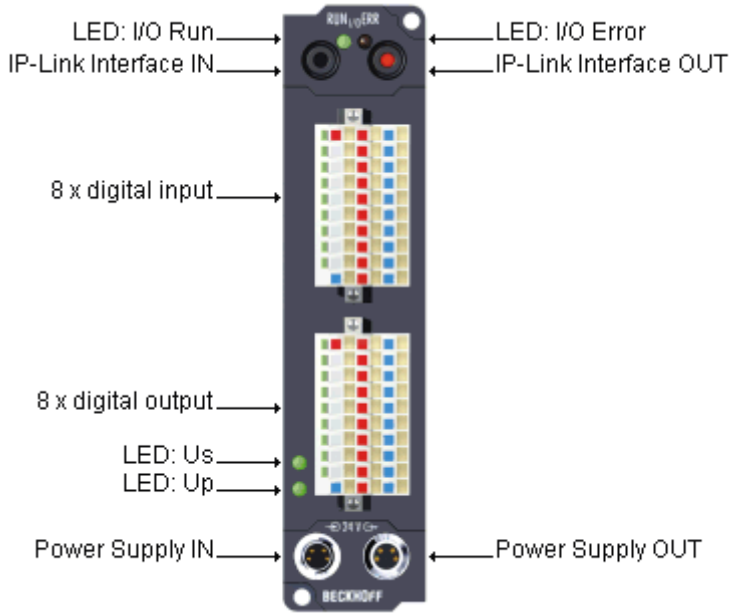
8 digital inputs (3.0 ms input filter) and 8 digital outputs 24 V_{DC}, Imax = 0.5 A

The digital IE2403 combi module has 16 channels with 8 inputs and 8 outputs. The device can therefore be flexibly adapted to the requirements of the application. The outputs handle load currents of up to 0.5 A. They are short-circuit-proof and protected against inverse polarity. KM-connectors with a spring-loaded system are used for the signal connection. These connectors are optionally available with 1 or 3 pins. The module is supplied without KM-connectors.

NOTE

Attention

The IE2403 combi module conforms to protection class IP20. It is intended to be used within switch boards, control panels or switch cabinets to integrate their signals into IP link.The IE2403 combi module conforms not to protection classes IP65/IP67!



Technical data	IE2403
Number of channels	16 (8 inputs and 8 outputs)
Input connections	Via KM connector ZS2001 (not included in delivery of IE2403). Please order the desired type for single- or tree-wire technique (see ordering information [▶ 125] and technical data [▶ 126]).
Input filter	3.0 ms
Signals „0“ / „1“	-3 ... 5 V / 11 ... 30 V, 6 mA input current (EN61131-2, type 2)
Sensor supply	derived from the control voltage, max. 0.5 A per channel, fully short-circuit proof
Output connections	Via KM connector ZS2001 (not included in delivery of IE2403). Please order the desired type for single- or tree-wire technique (see ordering information [▶ 125] and technical data [▶ 126]).
Rated load voltage	24 V_{DC} (20 V ... 29 V)
Load type	ohmic, inductive, lamp load
Output current	max. 0.5 A on each channel, individually short-circuit proof
Short circuit current	typical 1.5 A
Load voltage current consumption	typical 20 mA per channel
Power supply	Feed: 1 x M8 connector, 4-pin downstream connection: 1 x M8 socket, 4-pin
Bits in process image	8 bits input and 8 bits output
Electrical isolation	control voltage / fieldbus: yes, via IP-Link channels / control voltage: no between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25°C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Mounting position	any

See the connection description [▶ 107] for details of the connection.

See the mapping description [▶ 155] for details of the mapping.

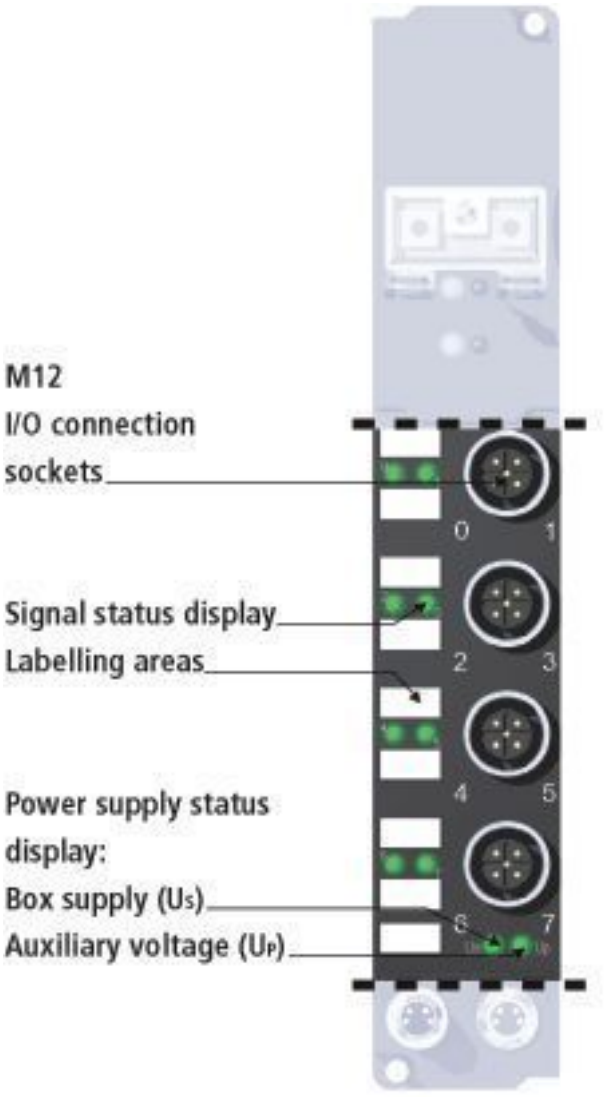
See dimension page [▶ 68] for weight and dimensions.

3.1.4 Analog Input Modules

3.1.4.1 IP3102-Bxxx, IE3102

4 Channel Analog Input ± 10 V

The IP3102 analog input module handles signals in the range from -10 V to +10 V. The voltage is digitized to a resolution of 16 bits, and is transmitted, electrically isolated, to the higher-level automation device. The input channels have differential inputs and possess a common, internal ground potential. The applied load voltage (which can be any value up to 30 V_{DC}) is fed through to supply the sensor. It is thus possible, for instance, to supply a measuring potentiometer with 10 V_{DC} from an external voltage source. The module is quite versatile, but default settings have been selected in such a way that in most cases it is not necessary to perform configuration. The input filter and associated conversion times can be set within a wide range, and several data output formats may be chosen. The inputs can, if required, be scaled differently, and automatic limit monitoring is also available. Parameterization may be carried out either via the fieldbus or using the KS2000 software tool.



IP3102-Bxxx

Technical data	IP3102-Bxxx / IE3102
Number of channels	4 analog inputs
Output connections	M12 screw-in
Nominal input range	-10 V ... +10 V
Input resistance	> 100 kΩ
Common mode voltage	35 V max.
Conversion time	250 ms (default), configurable to 5 ms
Resolution	15 bits + arithmetic sign
Relative measurement error	< ± 0,3% of the full scale value
Input filter	10 variations inc. averaging, configurable
Sensor supply	from load supply voltage U_P, DC, any value up to 30 V
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I: 4 x 16 bits, optional I/O: 4 x 8 bits control/state + 4 x 16 bits
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: 500 V between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the Connection diagram [▶ 111] for details of the connection.

See the Parameterization description [▶ 206] for details of the parameterization.

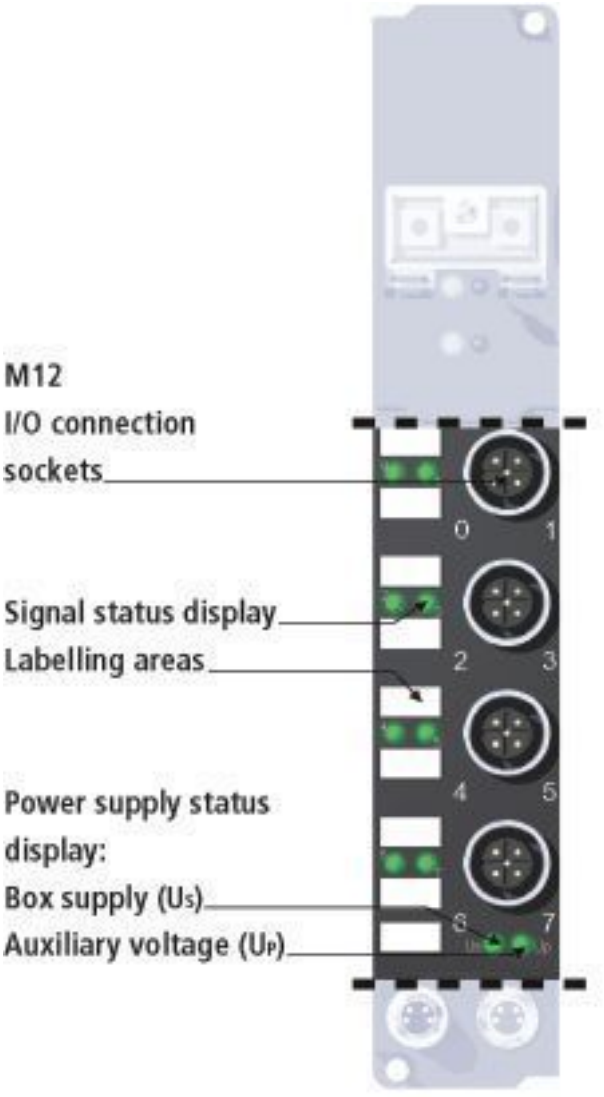
See the Mapping description [▶ 159] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.4.2 IP3112-Bxxx, IE3112

4 Channel Analog Input, from 0 to 20 mA

The IP3112 analog input module handles signals in the range from 0 to 20 mA. The input current is digitized to a resolution of 16 bits (the default is 15 bits), and is transmitted, electrically isolated, to the higher-level automation device. The input channels have differential inputs and possess a common, internal ground potential. The applied load voltage (which can be any value up to 30 V_{DC}) is fed through to supply the sensor. The module is quite versatile, but default settings have been selected in such a way that in most cases it is not necessary to perform configuration. The input filter and associated conversion times can be set within a wide range, and several data output formats may be chosen. The inputs can, if required, be scaled differently, and automatic limit monitoring is also available. Parameterization may be carried out either via the fieldbus or, using the KS2000 software tool, through the configuration interface. The parameters are stored in the module.



IP3112-Bxxx

Technical data	IP3112-Bxxx / IE3112
Number of channels	4 analog inputs
Output connections	M12 screw-in
Nominal input range	0 ... 20 mA
Input resistance	80 Ω measuring resistance
Common mode voltage	max. 35 V
Conversion time	140 ms
Resolution	15 bits + arithmetic sign
Relative measurement error	< ± 0,3% of the full scale value
Input filter	10 variations inc. averaging, configurable
Sensor supply	from load supply voltage Up, DC, any value up to 30 V
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I: 4 x 16 bits, optional I/O: 4 x 8 bits control/state + 4 x 16 bits
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: 500 V between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 112] for details of the connection.

See the parameterization description [▶ 213] for details of the parameterization.

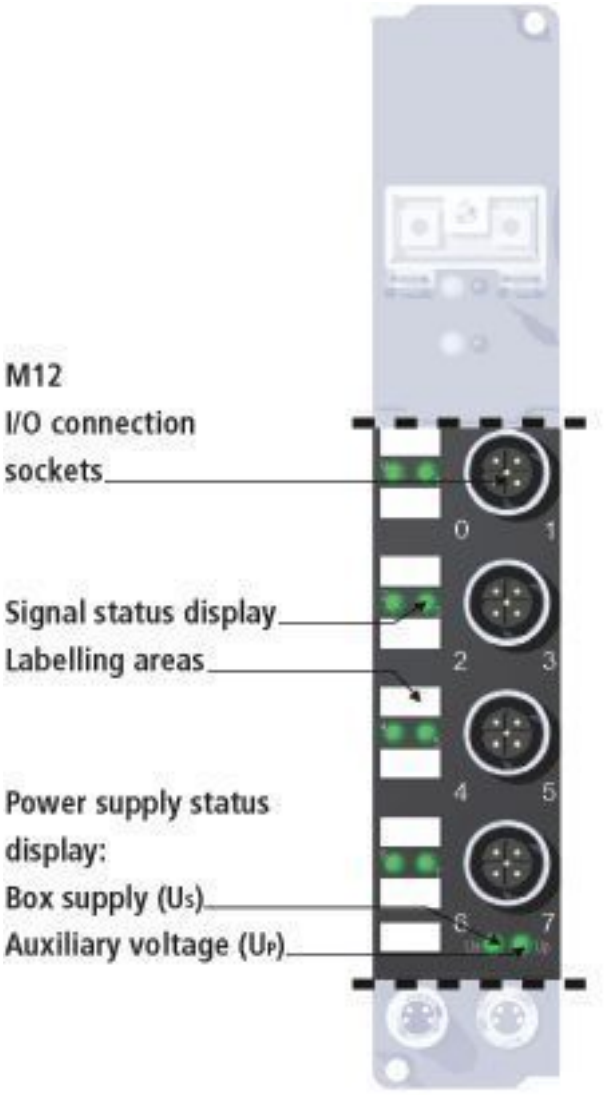
See the mapping description [▶ 161] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.4.3 IP3202-Bxxx, IE3202

4 Channel Analog Input PT100 (RTD)

The IP3202 analog input module allows resistance sensors to be connected directly. The module's circuitry can operate the sensors using 2-wire or 4-wire connection techniques. Linearization over the full temperature range is realized with the aid of a microprocessor. The temperature range can be selected freely. The module can also be used for resistance measurement, with the output in ohms. The module's standard settings are: Resolution 0.1 °C in the temperature range of PT100 sensors in 4-wire connection. Sensor malfunctions such as broken wires are indicated by error LEDs. The module is quite versatile, but default settings have been selected in such a way that in most cases it is not necessary to perform configuration. The input filter and associated conversion times can be set within a wide range, and several data output formats may be chosen. The inputs can, if required, be scaled differently, and automatic limit monitoring is also available. Parameterization may be carried out either via the fieldbus or using the KS2000 software tool.



Technical data	IP3202-Bxxx / IE3202
Number of channels	4 analog inputs
Output connections	M12 screw-in
Nominal input range	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000, resistance measurement (e.g. potentiometer)
Resolution	0.1°C per digit
Measuring current	typical 0.5 A
Conversion time	260 ms
Measurement error	< +/-1°C
Input filter	4 versions
Sensor supply	From the load voltage, U_S
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I: 4 x 16 bits, optional I/O: 4 x 8 bits control/state + 4 x 16 bits
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: 500 V between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 113] for details of the connection.

See the parameterization description [▶ 219] for details of the parameterization.

See the mapping description for details of the mapping.

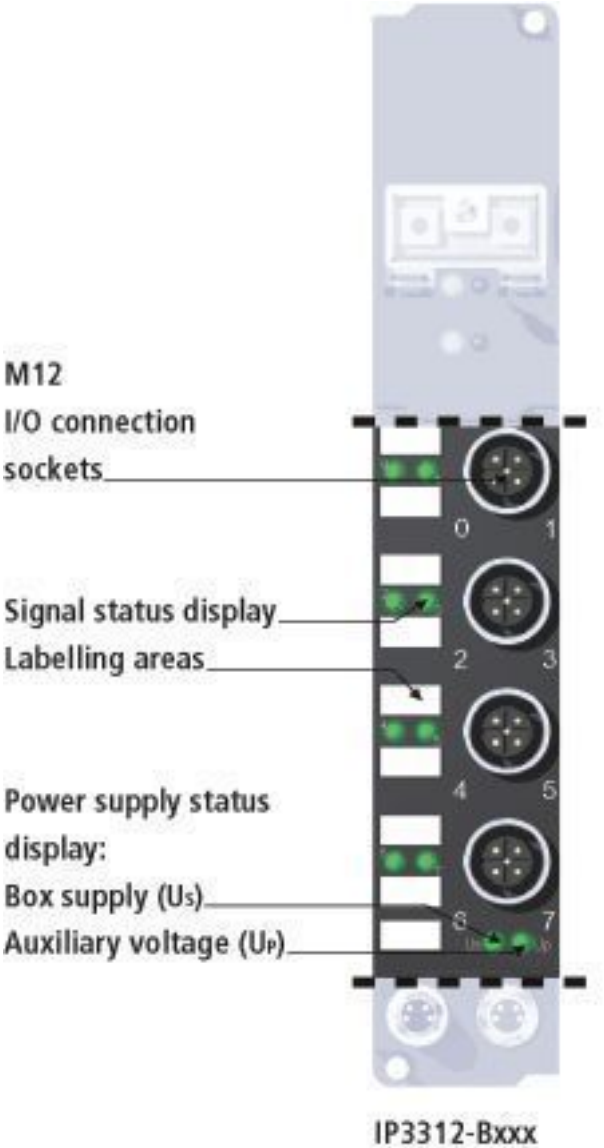
See dimension page [▶ 68] for weight and dimensions.

3.1.4.4 IP3312-Bxxx, IE3312

4 Channel Analog Input Thermocouple

The IP3312 analog input module permits four thermocouples to be directly connected. The module's circuit can operate thermocouple sensors using the 2-wire technique. Linearization over the full temperature range is realized with the aid of a microprocessor. The temperature range can be selected freely. The module can also be used for voltage measurements in the mV range. The module's standard settings are: Resolution 0.1 °C over the temperature range of type K sensors. Sensor malfunctions such as broken wires are indicated by error LEDs. Compensation for the cold junction is made through a temperature measurement in the connecting plug. This means that standard extension leads can be connected.

The module is quite versatile, but default settings have been selected in such a way that in most cases it is not necessary to perform configuration. The input filter and associated conversion times can be set within a wide range, and several data output formats may be chosen. The inputs can, if required, be scaled differently, and automatic limit monitoring is also available. Parameterization may be carried out either via the fieldbus or using the KS2000 software tool.



IP3312-Bxxx

Technical data	IP3312-Bxxx / IE3312
Number of channels	4 analog inputs
Output connections	M12 screw-in
Nominal input range	Types J, K, L, B, E, N, R, S, T, U (default setting type K), mV measurement
Resolution	0.1°C per digit
Conversion time	260 ms
Measurement error	< +/- 0.5 % (of the full scale value)
Input filter	4 versions
Cold junction compensation	via ZS2000-3712
Sensor supply	From the load voltage, U_S
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I: 4 x 16 bits, optional I/O: 4 x 8 bits control/state + 4 x 16 bits
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: 500 V between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 115] for details of the connection.

See the parameterization description [▶ 228] for details of the parameterization.

See the mapping description for details of the mapping.

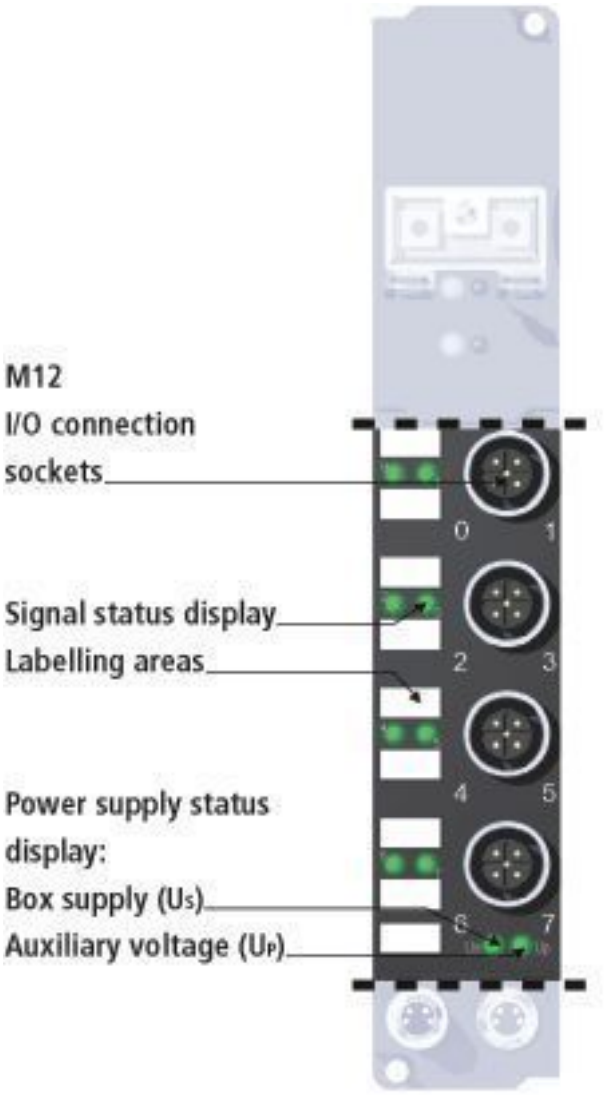
See dimension page [▶ 68] for weight and dimensions.

3.1.5 Analog Output Modules

3.1.5.1 IP4112-Bxxx, IE4112

4 Channel Analog Output, from 0 to 20 mA

The IP/IE4112 analog output module generates analog output signals in the range from 0 to 20 mA. The power is supplied to the process level with a resolution of 15 bits (default), and is electrically isolated. If the input is transmitted without an arithmetical sign, 16 bit resolution may also be selected. If necessary, the output scaling can be altered.
Ground potential for the four output channels is common with the 24 V_{DC} supply. The output drivers are powered by the control voltage. The applied load voltage (which can be any value up to 30 V_{DC}) is fed through to supply the actuators.



IP4112-Bxxx

Technical data	IP4112-Bxxx, IE4112
Number of channels	4
Output connections	M12 screw-in
Output range	0 ... 20 mA
Load impedance	< 500 Ω
Resolution	15 bit, configurable to 16 bit
Conversion time	< 4 ms
Accuracy	< ± 0.1% of the full scale value
Actuator power supply	from the load voltage, U_P
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	O: 4 x 16 bits data, optional: 4 x 8 bits control/status
Electrical isolation	control voltage / fieldbus: depends on the bus system channels / control voltage: yes between the channels: no
Permissible ambient temperature during operation	0 °C ... 55 °C
Permissible ambient temperature during storage	-25 °C ... + 85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See connections [▶ 116] for connection details.

See the parameterization description [▶ 236] for details of the parameterization.

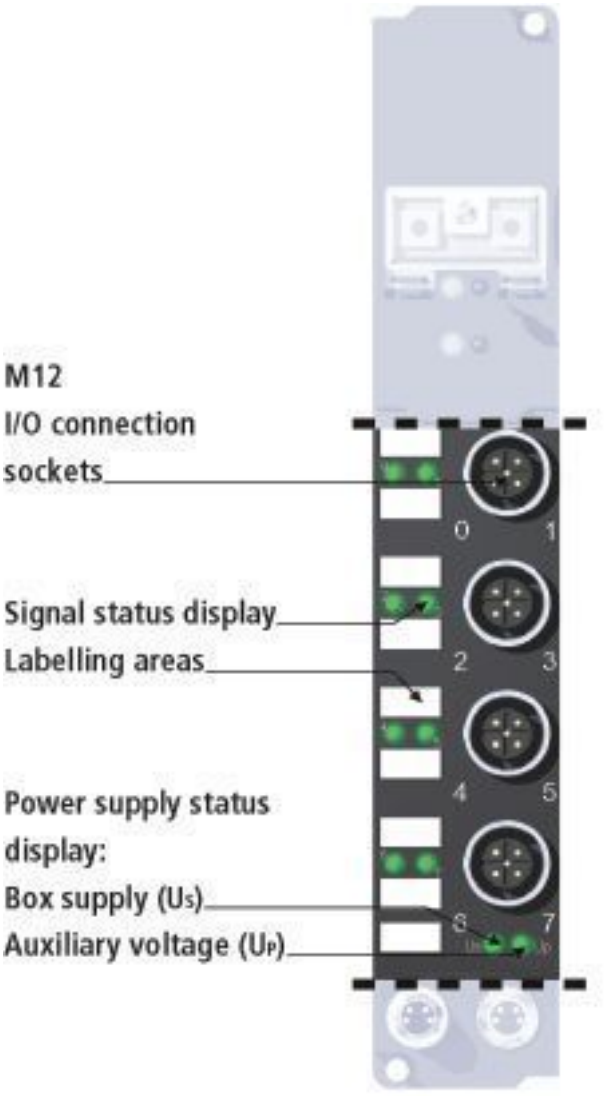
See the mapping description [▶ 167] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.5.2 IP4132-Bxxx, IE4132

4 Channel Analog Output, from -10 V to +10 V

The IP/IE4132 analog output module generates analog output signals in the range from -10 V to + 10 V. The voltage is supplied to the process level with a resolution of 16 bits, and is electrically isolated. If necessary, the output scaling can be altered.
Ground potential for the four output channels is common with the 24 V_{DC} supply. The output drivers are powered by the control voltage. The applied load voltage (which can be any value up to 30 V_{DC}) is available for supply of the actuators.



IP4132-Bxxx

Technical data	IP4132-Bxxx
Number of channels	4
Output connections	M12 screw-in
Output range	-10 V / 0 ... 10 V
Load impedance	> 5 kΩ
Resolution	16 bit
Conversion time	< 4 ms
Accuracy	< ± 0.1% of the full scale value
Actuator power supply	from the load voltage, U_P
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	O: 4 x 16 bits data, optional: 4 x 8 bits control/status
Electrical isolation	control voltage / fieldbus: depends on the bus system channels / control voltage: yes between the channels: no
Permissible ambient temperature during operation	0 °C ... 55 °C
Permissible ambient temperature during storage	-25 °C ... + 85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IIP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 117] for details of the connection.

See the parameterization description [▶ 241] for details of the parameterization.

See the mapping description [▶ 244] for details of the mapping.

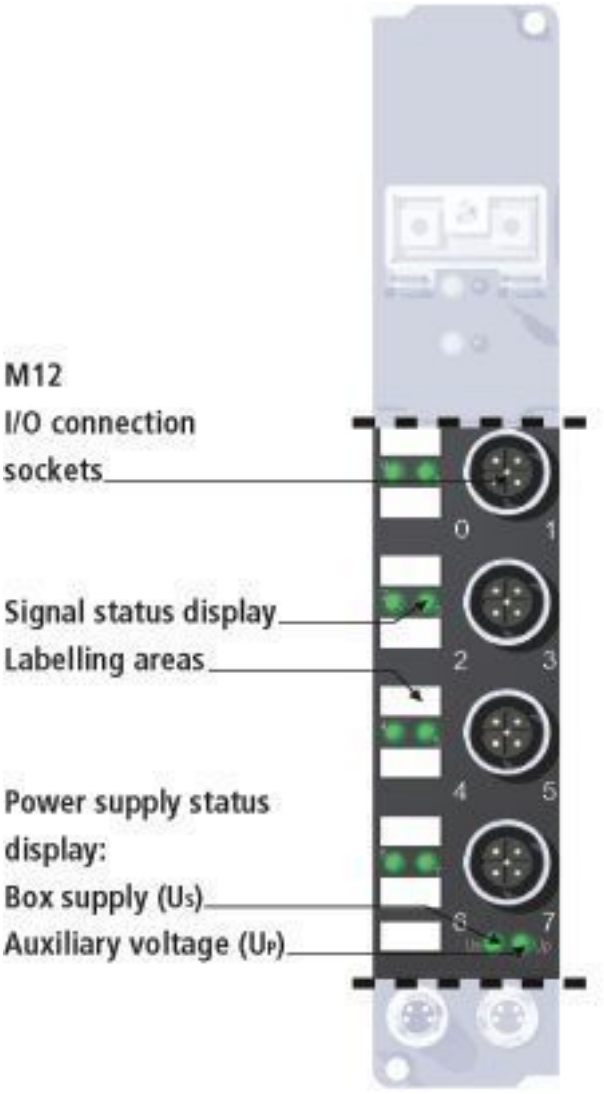
See dimension page [▶ 68] for weight and dimensions.

3.1.6 Modules for Special Functions

3.1.6.1 IP1502-Bxxx, IE1502

Counter module

The counter module has two fast counters running at up to 100 kHz. It counts binary pulses, and transmits the counter state to the higher-level automation unit. The Up/Down input allows the counters to be switched between upwards and downwards counting (in 32 bits). The gate signals (gate inputs) allow the counters to be triggered: depending on the level at the gate input, the counting function is halted or enabled. The outputs can be switched or pulsed depending on the counter state, and can therefore be used as fast control signals for field devices. From the controller it is possible to set the counter state, to start or halt the counter functions, and to set the outputs. The module shows the states of the input and output signals by means of light emitting diodes.



IP1502-Bxxx

Technical data	IP1502-Bxxx / IE1502
Number of counters	2, each with a depth of 32 bits
Switching frequency	100 kHz (2 kHz when switching between up and down)
Signal connection	M12 screw-in
Number of inputs	2 counter inputs, 2 gate inputs, 2 up/down changeovers
Nominal input voltage	24 V_{DC} (20 V ... 29 V)
Signal voltage "0"	-3 V ... 5 V (EN61131-2, type 2)
Signal voltage "1"	11 V ... 30 V (EN61131-2, type 2)
Number of outputs	one output per counter, max. 0.5 A, short circuit proof
Sensor supply	derived from control voltage, max. 0.5 A over all, short-circuit proof
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	64 bits output (2 x 32) and 64 bits input (2 x 32) for process data, 8 bits output for Control Byte and 8 bits input for Status Byte
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 98] for the connector pin assignment.

See the Parameterization description [▶ 183] for details of the parameterization.

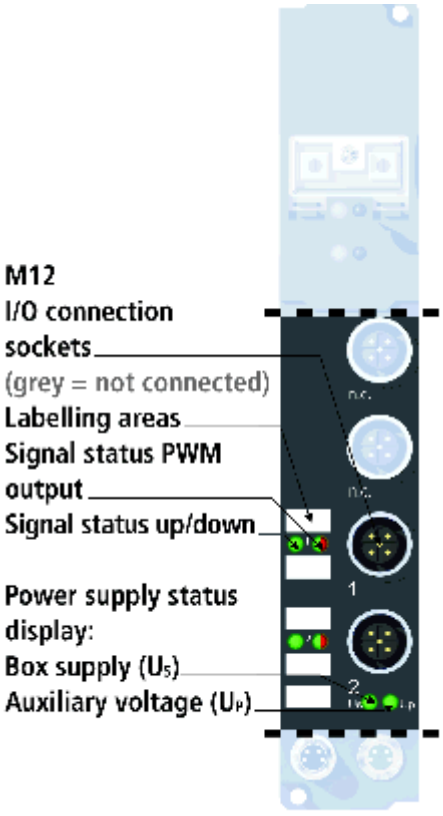
See the Mapping description [▶ 151] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.6.2 IP2512-Bxxx, IE2512

2-channel pulse width output 24 V_{DC}

The outputs of the IP25x2 modules provide a pulse width modulated version of a binary signal. The mark/space ratio is prescribed by a 16 bit value from the automation unit. The output stage is protected against overload and short-circuit, the maximum output current is 2.5 A per channel. In addition to the pulse width modulation operating mode, the outputs can also be frequency modulated, or can be used to control stepper motors with specified pulses and direction. The modules contain two channels that indicate their signal state by means of light emitting diodes. The LEDs are driven in time with the outputs, and show the mark/space ratio by their brightness.



IP2512-Bxxx

Technical data	IP2512-Bxxx / IE2512
Number of outputs	2
Signal connection	M12 screw type
Load type	resistive, inductive
Rated load voltage	24 V_{DC} (-15%/+20%)
Output current	max. 2.5 A on each channel, individually short-circuit safe
Base frequency	2 Hz ... 80 kHz, Default: 250 Hz
Keying ratio	0 % ... 100 % (T_{on} > 750 ns, T_{off} > 500 ns)
Resolution	max. 10 bit
Freewheeling diode (output)	yes
Power supply connection	Feed: 1 x M8 male socket, 4-pin; downstream connection: 1 x M8 female socket, 4-pin
Bits width in process image	2 x 16 output bits for process data, 2 x 8 output bits for control bytes and 2 x 8 input bits for status bytes
Electrical isolation	control voltage / fieldbus: yes channels / control voltage: no between the channels: no
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 109] for the connector pin assignment.

See the parameterization description [▶ 191] for details of the parameterization.

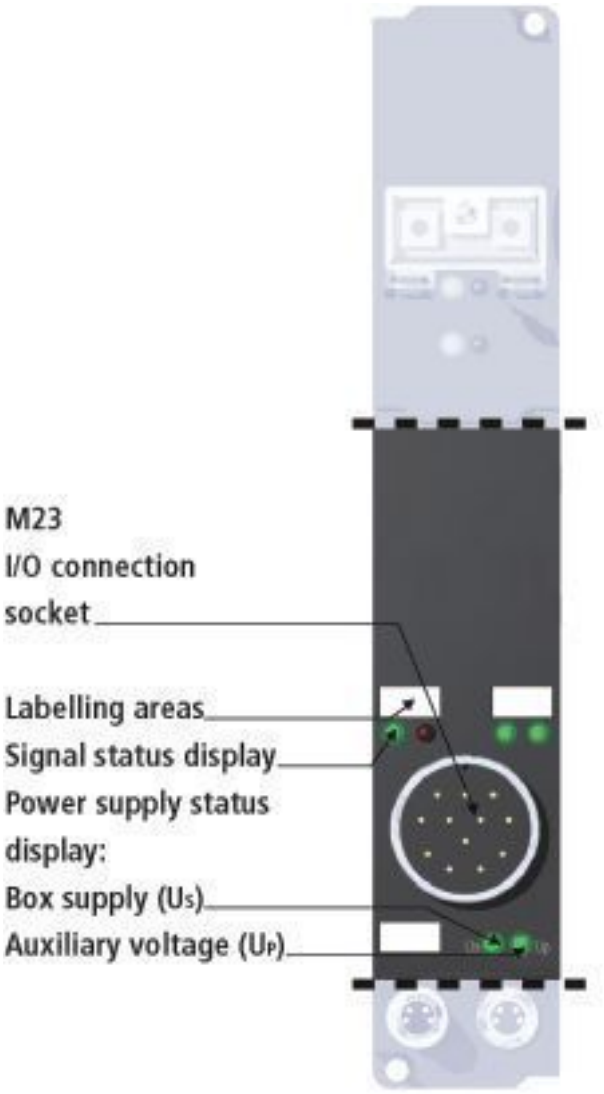
See the mapping description [▶ 156] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.6.3 IP5009-Bxxx, IE5009

1 channel SSI sensor interface

The IP5009 SSI interface module allows an SSI sensor to be connected directly. The sensor is powered via the SSI interface. The interface circuit generates a pulse for reading the sensor, and makes the incoming data stream available to the controller as a data word in the process image. The module can optionally provide the data as binary numbers or as a Gray code. Adaptation for the direction of rotation can be configured. Various operating modes, transmission frequencies and bit widths can be permanently stored in a control register.



IP5009-Bxxx

Technical data	IP5009-Bxxx / IE5009
Number of channels	1
Encoder connection	M23 screw-in, 12-pin
Signal type	Differential signal (RS485)
Sensor supply	24 V_{DC}, from load voltage
Data transfer rate	adjustable up to 1 MHz, 250 kHz preset
Serial input	24 bits (adjustable)
Data direction	read
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	32 input bits for process data, Optional: 8 output bits for control byte and 8 input bits for status byte
Electrical isolation	depends on the bus system
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 118] for the connector pin assignment.

See the parameterization description [▶ 246] for details of the parameterization.

See the mapping description [▶ 171] for details of the mapping.

See the derating description [▶ 194] for details of the output current vs. frequency.

See dimension page [▶ 68] for weight and dimensions.

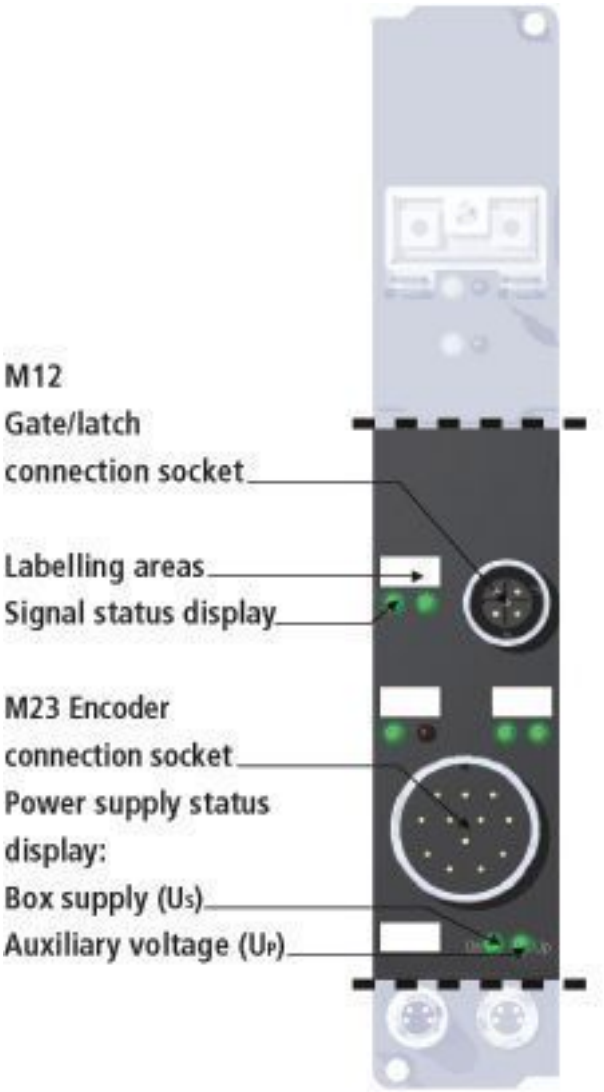
3.1.6.4 IP5109-Bxxx, IE5109

1 channel Incremental Encoder Interface 1 MHz

The IP5109 module is an interface for the direct connection of incremental encoders with differential inputs (RS485/5V) or with single inputs. A 16 bit counter with a quadrature decoder and a 16 bit latch for the zero pulse can be read, set or enabled. The inputs can optionally be used as complementary or as single inputs.

The encoder's fault signal output, if there is one, can be connected to the status input of the interface. Interval measurement with a resolution of 200 ns is possible. The gate input allows the counter to be locked (high = stop).

A rising edge at the latch input from the encoder or an external sensor will store the current counter value.



IP5109-Bxxx

Technical data	IP5109-Bxxx / IE5109
Number of channels	1
Encoder connection	M23 screw-in, 12-pin
Gate/latch connection	M12 screw-in
Sensor supply	derived from control voltage, max. 0.5 A total, short-circuit safe
Counter	16 bit binary
Sensor supply	5 V_{DC}
Limit frequency	1 MHz (with 4-fold evaluation)
Quadrature decoder	1, 2, or 4-fold evaluation
Zero pulse latch	16 bit
Commands	Read, set, enable
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I/O: 2 x 16 bit data, 1 x 8 bit control/status
Electrical isolation	depends on the bus system
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Resistance to vibration	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 119] for the connector pin assignment.

See the parameterization description [▶ 251] for details of the parameterization.

See the mapping description [▶ 173] for details of the mapping.

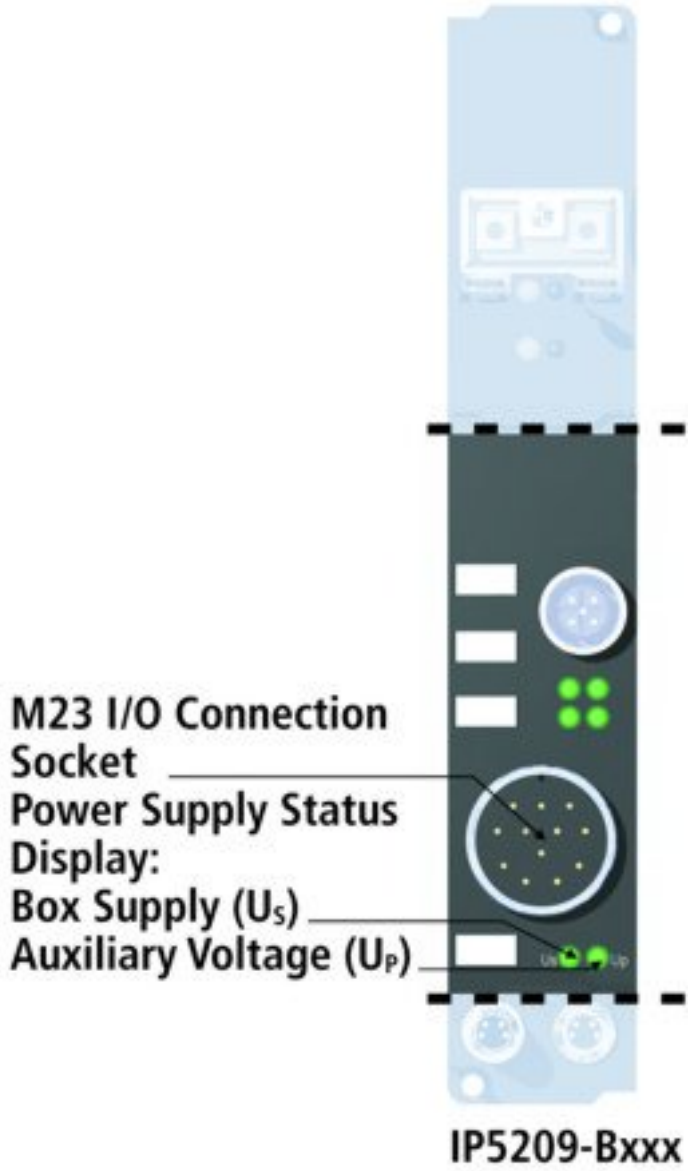
See dimension page [▶ 68] for weight and dimensions.

3.1.6.5 IP5209-Bxxx

1 channel SinCos encoder interface

The IP5209 Sinus/Cosinus module functions as a interface to the higher level fieldbus for direct connection of an measuring sensor, such as a sensing switch or encoder with 1Vss sinusoidal voltage output. The measuring signal is processed, interpolated and made available as a 32 bit value. The signal period resolution is 10 bit, i.e. 1024 steps. The interpolation rate can be changed via the register R35. The change of counting direction is set via R32. The reference mark (Latch) is also stored in a 32 bit value. The current value of the counter and the value of the reference mark can be read and can be set. The maximum frequency for the signal input is 100 kHz.

The input frequency and therefore the velocity of the sensor, can be checked against a preset limit. If this limit is exceeded, an error bit in the Status byte will be set!



Technical data	IP5209-Bxxx
Number of counters	1
Encoder connection	M23 screw-in, 12-pin
Sensor supply	5 V_{DC} from the control voltage, max. 0.5 A
Limit frequency	100 kHz (scanning of the input signals with 500 kHz)
Resolution	10 bit, 1024 steps per period
Commands	Clear/set counter value, reference mark – latch, counting direction, scaling
Power supply	Feed: 1 x M8 connector, 4-pin; downstream connection: 1 x M8 socket, 4-pin
Bits in process image	I/O: 2(1) x 32 bit data (1 x 8 bit control/status)
Electrical isolation	depends on the bus system
Permissible ambient temperature during operation	0°C ... +55°C
Permissible ambient temperature during storage	-25 °C ... +85°C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 120] for the connector pin assignment.

See the parameterization description [▶ 257] for details of the parameterization.

See the mapping description [▶ 175] for details of the mapping.

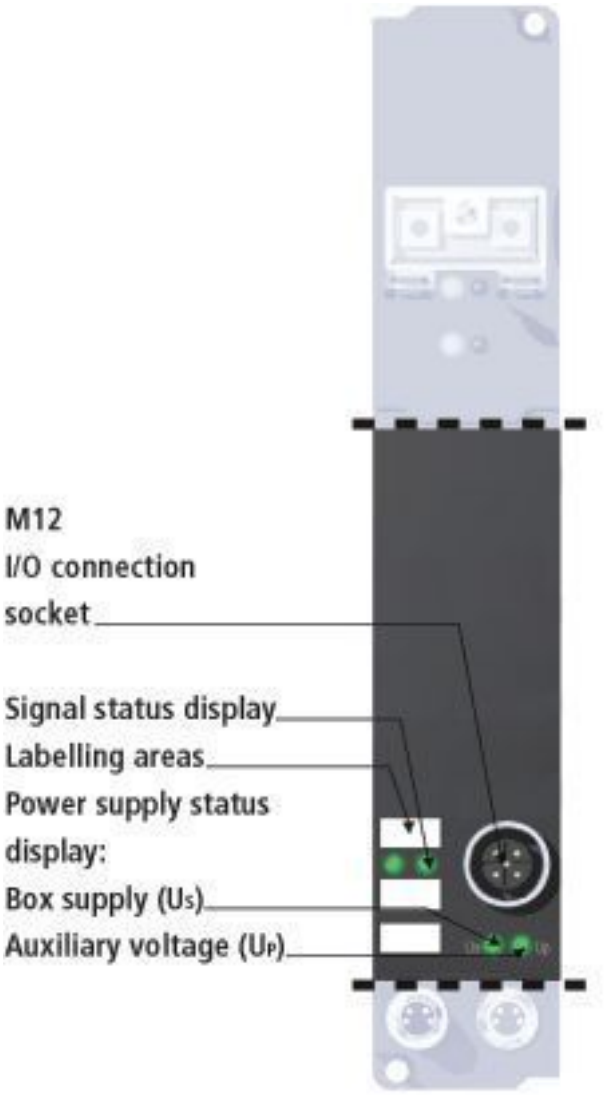
See dimension page [▶ 68] for weight and dimensions.

3.1.7 Gateway Modules

3.1.7.1 IP6002-Bxxx, IE6002

1 channel RS 232 gateway

The IP/IE6002 serial interface module allows the connection of devices with a RS232 interface. The interface operates in conformity with the CCITT V.28/DIN 66 259-1 standards. The module transmits the data in a fully transparent manner to the higher-level automation device. The data is transferred via the fieldbus using a simple handshake protocol. This does not have any effect on the protocol of the serial interface. The active serial communication channel functions independently of the higher-level bus system in full duplex mode at up to 19200 baud, while a 128 byte receive buffer and a 16 byte send buffer are available. The RS232 interface guarantees high immunity to interference through electrically isolated signals.



IP6002-Bxxx

Technical data	IP6002-Bxxx, IE6002
Number of channels	1 TxD and RxD, full duplex
Data transfer rate	1200 ... 19200 baud, 9600 baud (8 data bits, no parity, one stop bit)
RS 232 connection	5 pin M12 socket, screw connection
Bit distortion	< 3 %
RS 232 cable length	max. 15 m
Signal voltage LOW	3 V ... 18 V
Signal voltage HIGH	-18 V ... -3 V
Data buffer	128 byte receive buffer and 16 byte send buffer
Bytes in the process image	I/O: 5 bytes user data, 1 byte control/status
Electrical isolation	control voltage / fieldbus: depends on the bus system RS232 / control voltage: 500 V
Permissible ambient temperature during operation	0 °C ... 55 °C
Permissible ambient temperature during storage	-25 °C ... + 85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 121] for details of the connection.

See the parameterization description [▶ 264] for details of the parameterization.

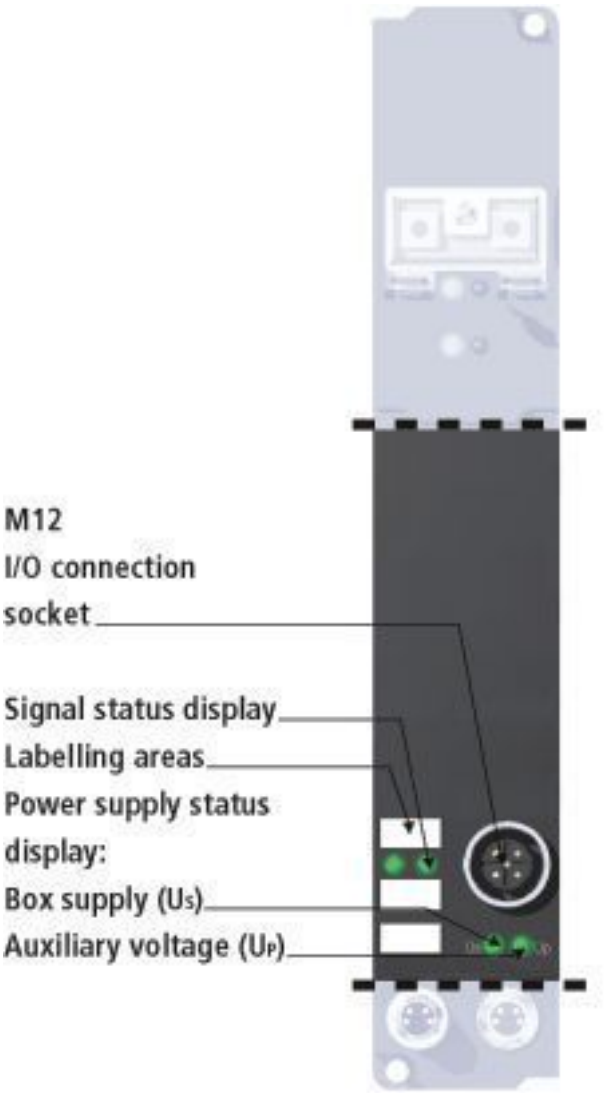
See the mapping description [▶ 177] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.7.2 IP6012-Bxxx, IE6012

1 channel TTY gateway

The IP/IE6012 module allows the connection of devices with a 20 mA current interface. The interface operates passively. The module transmits the data in a fully transparent manner to the higher-level automation device. The data is transferred via the fieldbus using a simple handshake protocol. This does not have any effect on the protocol of the serial interface. The active serial communication channel functions independently of the higher-level bus system in full duplex mode at up to 19200 baud, while a 128 byte receive buffer and a 16 byte send buffer are available.
The current interface guarantees high immunity to interference through electrically isolated signals with injected current.



IP6012-Bxxx

Technical data	IP6012-Bxxx, IE6012
Number of channels	1
Data transfer rate	1200 ... 19200 baud, 9600 baud (8 data bits, no parity, one stop bit)
TTY connection	5 pin M12 socket, screw connection
Bit distortion	< 3 %
TTY cable length	max. 1000 m twisted pair
Signal voltage LOW	0 ... 3 mA
Signal voltage HIGH	14 ... 20 mA
Data buffer	128 byte receive buffer and 16 byte send buffer
Bytes in the process image	I/O: 5 bytes user data, 1 byte control/status
Electrical isolation	control voltage / fieldbus: depends on the bus system TTY interface / control voltage: 500 V
Permissible ambient temperature during operation	0 °C ... 55 °C
Permissible ambient temperature during storage	-25 °C ... + 85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 122] for details of the connection.

See the parameterization description [▶ 264] for details of the parameterization.

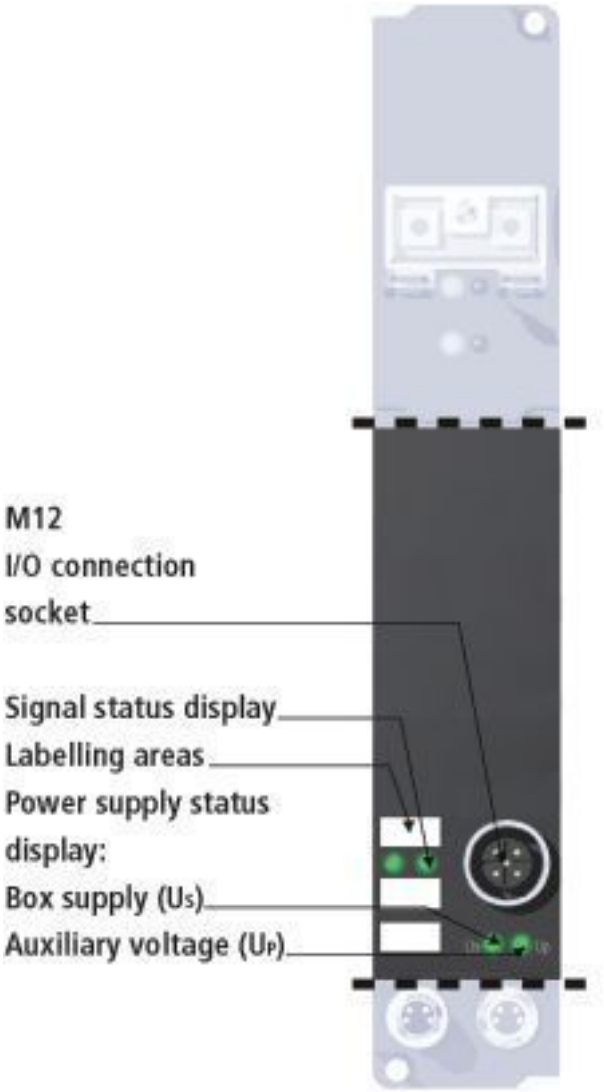
See the mapping description [▶ 177] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.1.7.3 IP6022-Bxxx, IE6022

1 channel RS422/RS485 gateway

The IP/IE6022 module allows devices with an RS422 or RS485 interface to be connected. The module transmits the data in a fully transparent manner to the higher-level automation device. The data is transferred via the fieldbus using a simple handshake protocol. This does not have any effect on the protocol of the serial interface. The active serial communication channel functions independently of the higher-level bus system in full duplex mode at up to 19200 baud, while a 128 byte receive buffer and a 16 byte send buffer are available. The transmission of differential signals according to RS232 guarantees high immunity to interference through electrically isolated signals.



IP6022-Bxxx

Technical data	IP6022-Bxxx, IE6022
Number of channels	1 RS 422 full duplex, RS 485 half duplex
Data transfer rate	1200 ... 19200 baud, 9600 baud (8 data bits, no parity, one stop bit)
RS 422/485 connection	5 pin M12 socket, screw connection
Bit transmission	using differential signal
Cable impedance	120 Ω
RS 422/485 cable length	max. 500 m twisted pair
Data buffer	128 byte receive buffer and 16 byte send buffer
Common mode voltage	-7 V ... 12 V to ground
Bytes in the process image	I/O: 5 bytes user data, 1 byte control/status
Electrical isolation	control voltage / fieldbus: depends on the bus system RS422/485 / control voltage: 500 V
Permissible ambient temperature during operation	0 °C ... 55 °C
Permissible ambient temperature during storage	-25 °C ... + 85 °C
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP65, IP66, IP67 (conforms to EN 60529)
Installation position	variable

See the connection diagram [▶ 124] for details of the connection.

See the parameterization description [▶ 264] for details of the parameterization.

See the mapping description [▶ 177] for details of the mapping.

See dimension page [▶ 68] for weight and dimensions.

3.2 Mounting

3.2.1 Dimensions

All dimensions are given in millimeters.

General

Technical data	Fieldbus Box
Material	PA6 (polyamide), casting compound: polyurethane
Assembly	2 x fixing holes for M3
Metal parts	Brass, nickel-plated
Contacts	CuZn, gold-plated
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	according to EN 61000-6-2 (EN 50082) / EN 61000-6-4 (EN 50081)
Permissible ambient temperature during operation	0 ... 55°C
Permissible ambient temperature during storage	-25 ... + 85°C
Installation position	any
Type of protection	IP65/66/67 when screwed together
Approvals	CE, UL E172151

IPxxxx-Bxx8, IL230x-Bxx8, IL230x-B110, IXxxxx-B400, IXxxxx-B90x, IXxxxx-C900

Technical data	Compact and Coupler Box with integrated tee connector
Dimensions (H x W x D)	ca. 210 x 30 x 26,5 mm (height to upper edge of fieldbus socket: 30 mm)
Weight	ca. 260 g - 290 g, depending on module type

IPxxxx-Bxx0, IL230x-Bxx0, IL230x-Cxx0

Technical data	Compact and Coupler Box
Dimensions (H x W x D)	Approx. 175 x 30 x 26.5 mm (height to upper edge of fieldbus socket: 30 mm, with T- connector ZS1031-2600 height approx. 65 mm)
Weight	Approx. 250 g - 280 g, depending on module type

IExxxx

Technical data	Extension box
Dimensions (H x W x D)	Approx. 126 x 30 x 26.5 mm
Weight	Approx. 120 g - 200 g, depending on module type

3.2.2 Fixing

NOTE

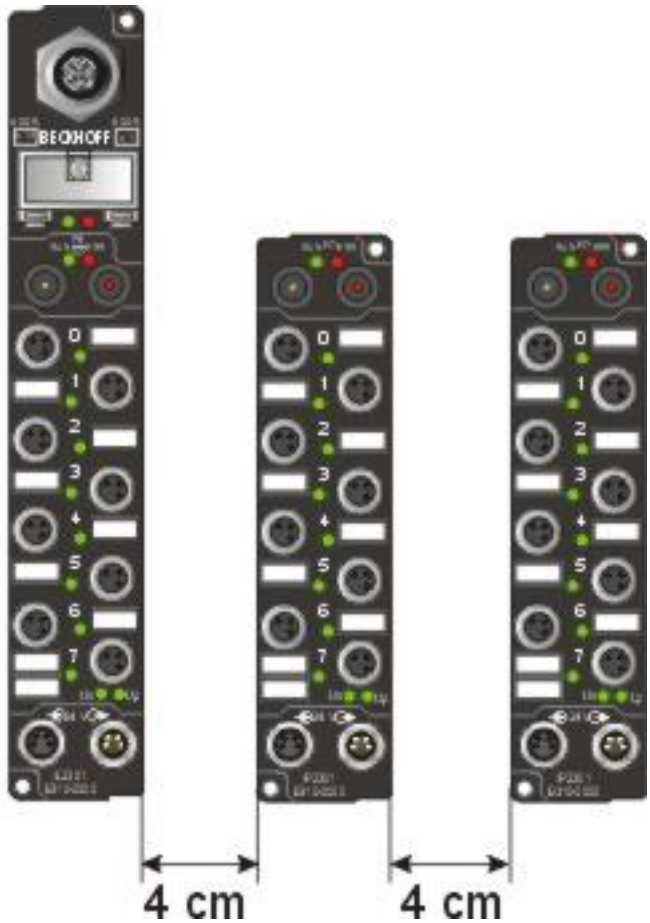
Attention

While mounting the modules, protect all connectors, especially the IP-Link, against contamination!Only with connected cables or plugs the protection class IP67 is guaranteed! Unused connectors have to be protected with the right plugs (see for plug sets in the catalogue)!

Fieldbus Boxes are fastened with two M3 bolts. The bolts must be longer than 15 mm. The fixing holes are not threaded. When assembling, remember that a Y or T piece for fieldbus connection increases the overall height. See chapter accessories [▶ 282].

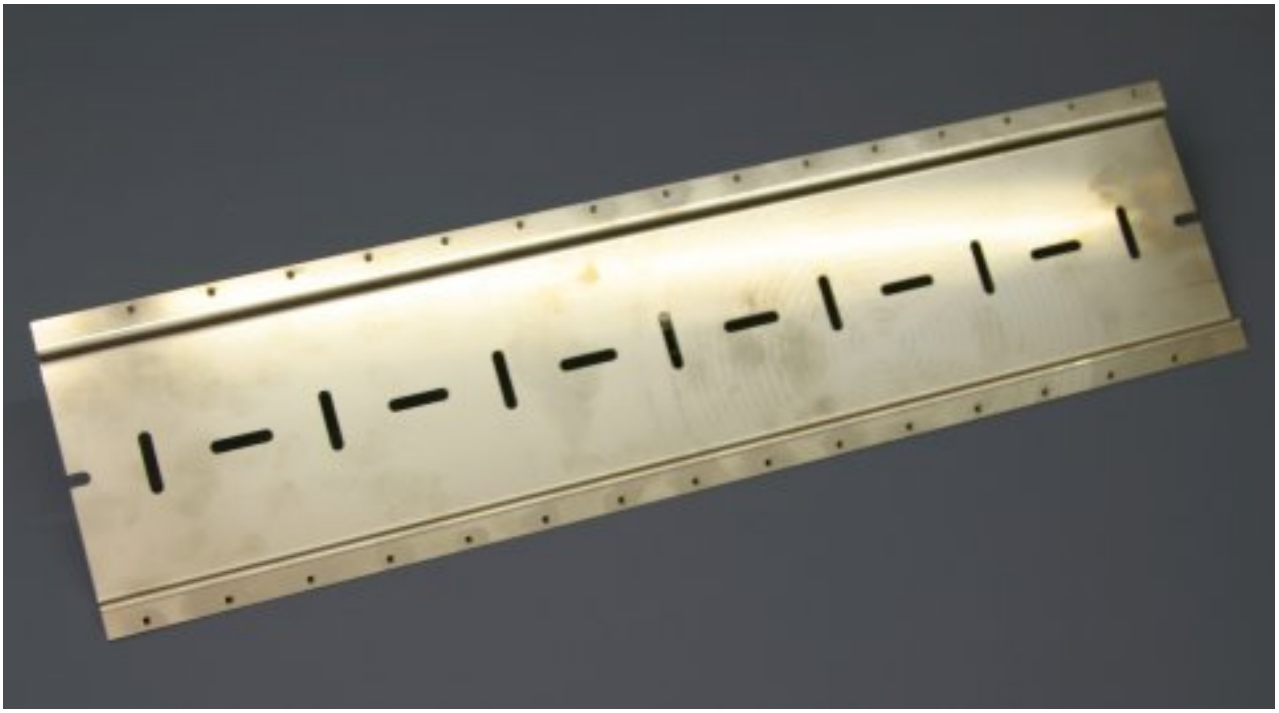
The space between the modules should be at least 4 cm, so that the IP-Link cable [▶ 81] is not bent to a radius smaller than 50 mm. The extension modules may be mounted close to one another, provided you observe the following:

- The bending radius of the IP-Link cable must not be tighter than the permitted minimum.
- The ambient temperature must not exceed 55°C.



Mounting Rail ZS5300-0001

ZS5300-0001



The mounting rail ZS5300-0001 (500 mm x 129 mm) allows the time saving assembly of Extension Box modules. The rail is made of stainless steel, 1.5 mm thick, with already premade M3 threads for the modules. The rail can be mounted at the machine with M5 screws (5.3mm slots).

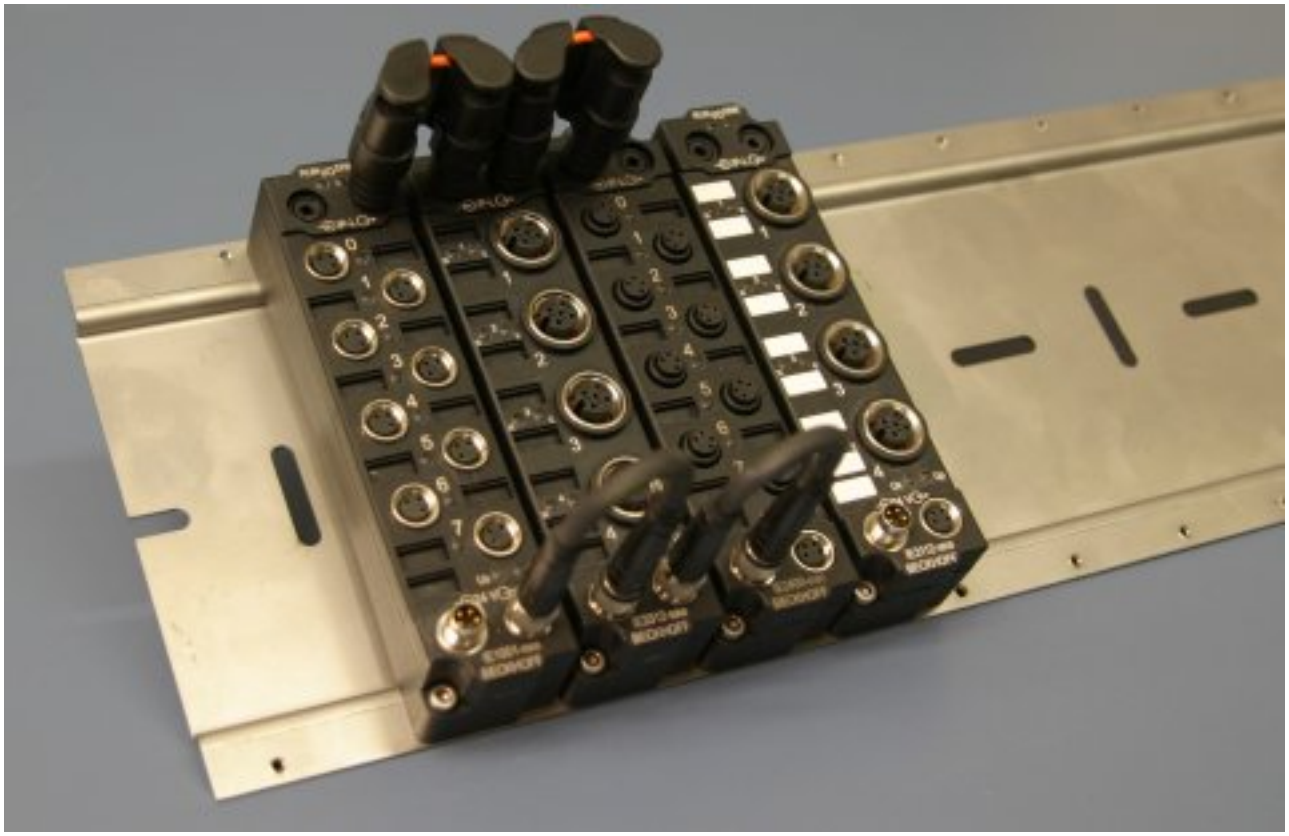


Fig. 1: ZS5300-0001_Appl

The rail is 500 mm long, that way 15 modules can be mounted with a distance of 2 mm between two modules. The rail can be cut to length for the application.

NOTE

Attention

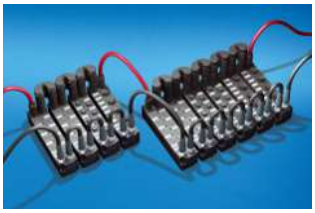
With mounting rail ZS5300-0001 use the IP-Link Direct Connector ZK1020-0101-1000 to avoid to fall below the minimum bending radius (50 mm) for standard IP-Link cable.

IP-Link Direct ConnectorZK1020-0101-1000

ZK1020-0101-1000

The IP-Link direct connector allows the direct connection of two Extension Box modules for an easy side-by-side mounting.

With IP-Link Direct Connector, the mounting distance between the modules is from 0 to 5 mm.

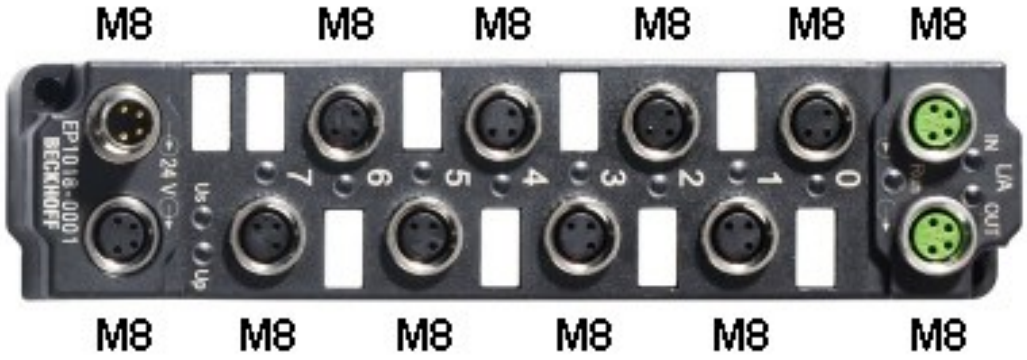


3.3 Cabling

3.3.1 Nut torque for connectors

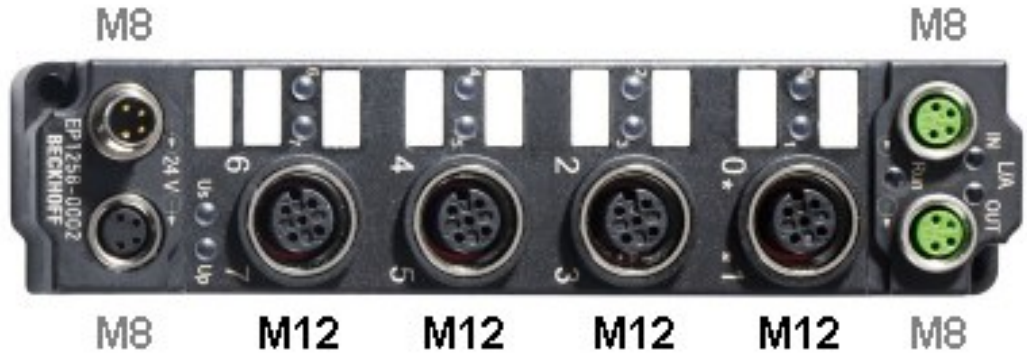
M8 connectors

It is recommended to pull the M8 connectors tight with a nut torque of **0.4 Nm**.



M12 connectors

It is recommended to pull the M12 connectors tight with a nut torque of **0.6 Nm**.



Torque socket wrenches

Ensure the right torque

Use the torque socket wrenches available by Beckhoff to pull the connectors tight (see accessories)!

Also see about this

Accessories [▶ 282]

3.3.2 Power Supply

3.3.2.1 Power Connection

Control voltage U_s: 24V

Power is supplied to the fieldbus, the processor logic, the inputs and the sensors from the 24 V_{DC} control voltage U_s. The control voltage is electrically isolated from the fieldbus circuitry.

Load voltage U_p 24V

The load voltage U_p supplies the digital outputs; it can be brought in separately. If the load voltage is switched off (e.g. if the emergency off has been used) the fieldbus functions and the power supply and functionality of the inputs are retained.

Redirection of the supply voltages

The IN and OUT power connections are bridged in the module (not IP204x-Bxxx and IE204x). The supply voltages U_s and U_p can thus easily be transferred from Fieldbus Box to Fieldbus Box.

NOTE

Warning

For the redirection of the supply voltage Us and Up, the maximum permissible current of 4 A must not be exceeded!

Electrical isolation

Digital modules

In the digital input/output modules, the grounds (GND) of the control voltage and the load voltage are connected!

Analog modules

In the analog input/output modules these grounds are separated in order to ensure electrical isolation of the analog signals from the control voltage. In some of the analog modules the sensors or actuators are supplied by U_p - this means, for instance, that in the case of 0..10V inputs, any reference voltage (0...30V) may be connected to Up; this is then available to the sensors (e.g. smoothed 10 V for measuring potentiometers). Details of the power supply to analog modules should therefore be consulted in the section on *Signal types*.

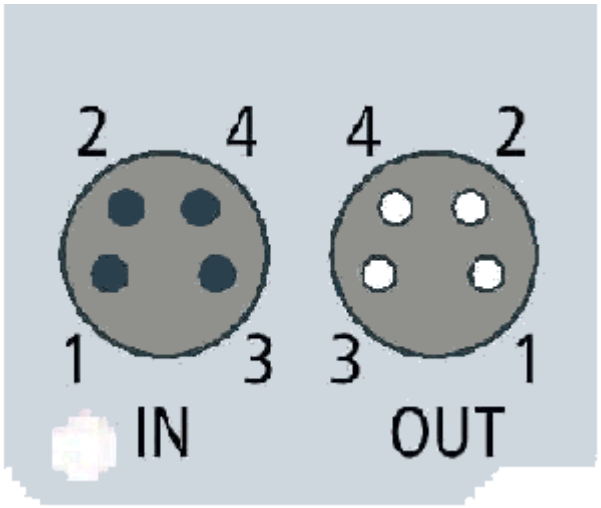
NOTE

Warning

If digital and analog fieldbus boxes are connected directly via four-core power leads, the analog signals in the fieldbus boxes are no longer electrically isolated from the control voltage!

PIN assignment (not IP204x-Bxxx and IE204x)

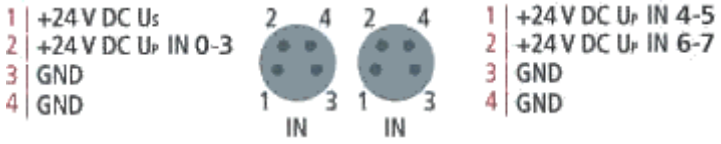
IP204x-Bxxx and IE204x



1 | + 24 V DC Us
2 | + 24 V DC Up
3 | GND
4 | GND

PIN assignment (IP204x-Bxxx and IE204x)

IP204x-Bxxx and IE204x



See also potential groups [▶ 101] in Chapter *IP204x-Bxxx / IE204x signal connection*.

3.3.2.2 Supply Line and Power Supplies

General

In Fieldbus Boxes, a maximum of 4 A may flow through each pin - this applies to every module, and to all the connection versions: S8, M8 and M12.

Points you must watch

- Current consumption of the Fieldbus Boxes (see Current consumption) [▶ 77]
- Current consumption of the sensors
- Current consumption of the actuators
- Cable length, and losses in the leads (see Conductor losses) [▶ 76]
- If the power line is taken on to other devices, ensure that the maximum current is not exceeded (see previous points)

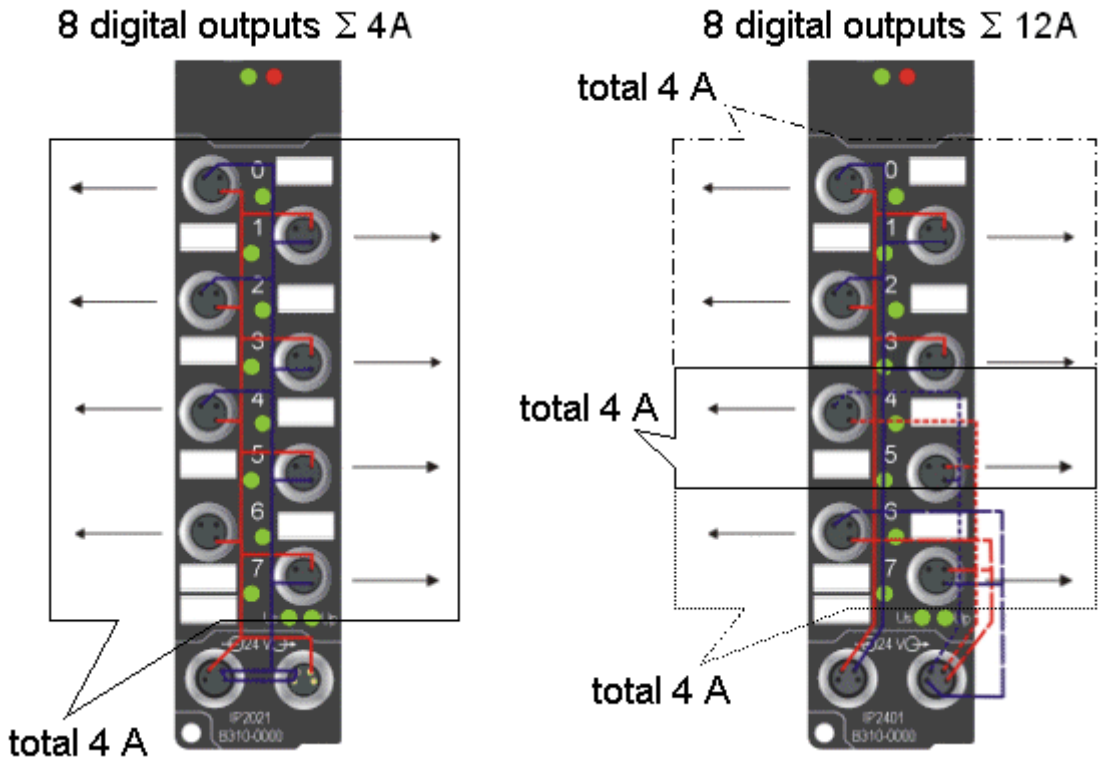
Note:

Example 1:

If, for example, all 8 outputs of an IP2001-Bxxx are loaded simultaneously with 0.5 A, then in this case the power continuation facility must not be used, as this could result in destruction of the connection or of the device.

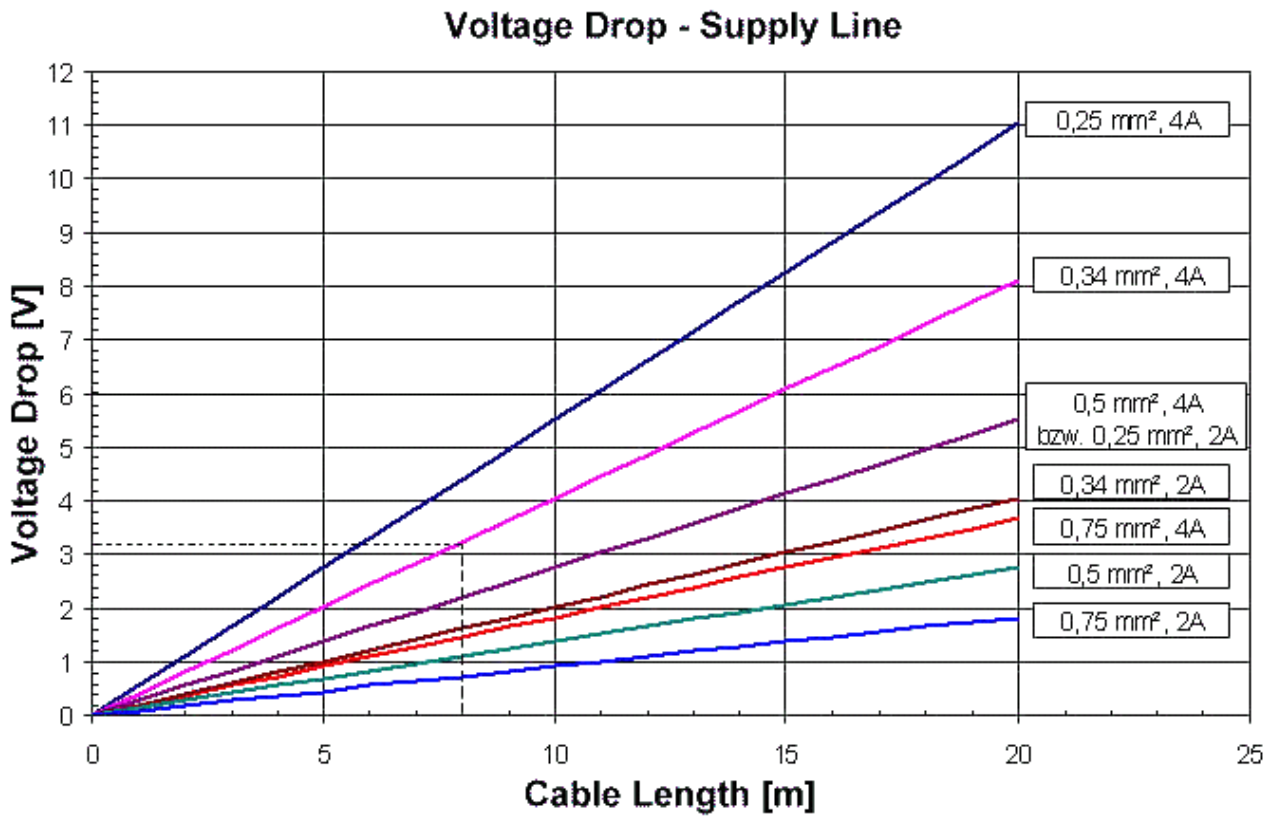
Example 2:

Channels 0..3 of an IP/IE204x are connected, which means that only 2 of the 4 channels may be loaded with 2 A.



3.3.2.3 Power cable conductor losses

The ZK2020-xxxx-yyyy power cables should not exceed the total length of 15 m at 4 A (with continuation). When planning the cabling, note that at 24 V nominal voltage, the functionality of the module can no longer be assured if the voltage drop reaches 6 V. Variations in the output voltage from the power supply unit must also be taken into account.



Example

8 m power cable with 0.34 mm² cross-section has a voltage drop of 3.2 V at 4 A.

3.3.2.4 Current Consumption

It is important to know the current consumption of the individual modules in order to know how much current is available, and for fusing the modules as well as considering the voltage drop in the power lead supply. The following table contains the current consumption at 24 V_{DC}. Current for supplying the sensors and that eventually required for the outputs must be added on to these figures.

Table 1: I/O type Compact Box

Modules	−B310	−B510, −B520	−B730, −B800, −B810
IP1000−Bxxx, IP1001−Bxxx, IP1002−Bxxx, IP1010−Bxxx, IP1011−Bxxx, IP1012−Bxxx	Is = 85 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP1502-Bxxx	Is = 85 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP2000−Bxxx, IP2001−Bxxx, IP2002−Bxxx	Is = 90 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP2020−Bxxx, IP2021−Bxxx, IP2022−Bxxx	Is = 90 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP2040−Bxxx, IP2041−Bxxx, IP2042−Bxxx	Is = 90 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP2300−Bxxx, IP2301−Bxxx, IP2302−Bxxx, IP2310−Bxxx, IP2311−Bxxx, IP2312−Bxxx	Is = 90 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA
IP2320−Bxxx, IP2321−Bxxx, IP2322−Bxxx, IP2330−Bxxx, IP2331−Bxxx, IP2332−Bxxx	Is = 90 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA
IP2400−Bxxx, IP2401−Bxxx	Is = 90 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA	Is = 50 mA Ip = 5 mA
IP2512−Bxxx	Is = 85 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA	Is = 45 mA Ip = 5 mA
IP3102−Bxxx	Is = 140 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA
IP3112−Bxxx	Is = 140 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA
IP3202−Bxxx	Is = 110 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA
IP3312−Bxxx	Is = 110 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA
IP4112−Bxxx	Is = 115 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA
IP4132−Bxxx	Is = 140 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA
IP5009−Bxxx	Is = 140 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA
IP5109−Bxxx	Is = 140 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA	Is = 105 mA Ip = 5 mA
IP5209−Bxxx	Is = 110 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA	Is = 70 mA Ip = 5 mA
IP6002−Bxxx	Is = 115 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA
IP6012−Bxxx	Is = 115 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA

Modules	−B310	−B510, −B520	−B730, −B800, −B810
IP6022−Bxxx	Is = 115 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA	Is = 85 mA Ip = 35 mA

Table 2: I/O type Coupler Box

Modules	−B310	−B510, −B520	−B730, −B800, −B810
IL2300−Bxxx, IL2301−Bxxx, IL2302−Bxxx	Is = 100 mA Ip = 5 mA	Is = 60 mA Ip = 5 mA	Is = 60 mA Ip = 5 mA
IL2300−Cxxx, IL2301−Cxxx, IL2302−Cxxx	Is = 100 mA Ip = 5 mA	–	–

Table 3: I/O type Extension Box

Modules	
IE1000, IE1001, IE1002, IE1010, IE1011, IE1012	Is = 25 mA Ip = 5 mA
IE1502	Is = 25 mA Ip = 5 mA
IE2000, IE2001, IE2002	Is = 25 mA Ip = 5 mA
IE2020, IE2021, IE2022	Is = 25 mA Ip = 5 mA
IE23xx, IE240x	Is = 25 mA Ip = 5 mA
IE2512	Is = 25 mA Ip = 5 mA
IE2808	Is = 40 mA Ip = 5 mA
IE3102	Is = 55 mA Ip = 5 mA
IE3112	Is = 55 mA Ip = 5 mA
IE3202	Is = 40 mA Ip = 5 mA
IE3312	Is = 40 mA Ip = 5 mA
IE4112	Is = 40 mA Ip = 5 mA
IE4132	Is = 40 mA Ip = 5 mA
IE5009	Is = 55 mA Ip = 5 mA
IE5109	Is = 55 mA Ip = 5 mA
IE6002	Is = 40 mA Ip = 5 mA
IE6012	Is = 40 mA Ip = 5 mA
IE6022	Is = 40 mA Ip = 5 mA

3.3.3 IP-Link

3.3.3.1 Wiring the IP-Link

IP-Link is the subsidiary bus system for Fieldbus Boxes. Topologically, it is a ring. The IP-Link master is located in the Coupler Box (IL230x-Bxxx or IL230x-Cxxx). The extension boxes (IExxxx) are slaves. A maximum of 120 extension boxes may be connected. Additionally the available address range of the according Fieldbus Box coupler has to be considered. The distance between two extension boxes may not exceed 15 meter. When planning and installing the extension boxes, note that the last extension box in the optical fiber ring must be connected to the coupler box.

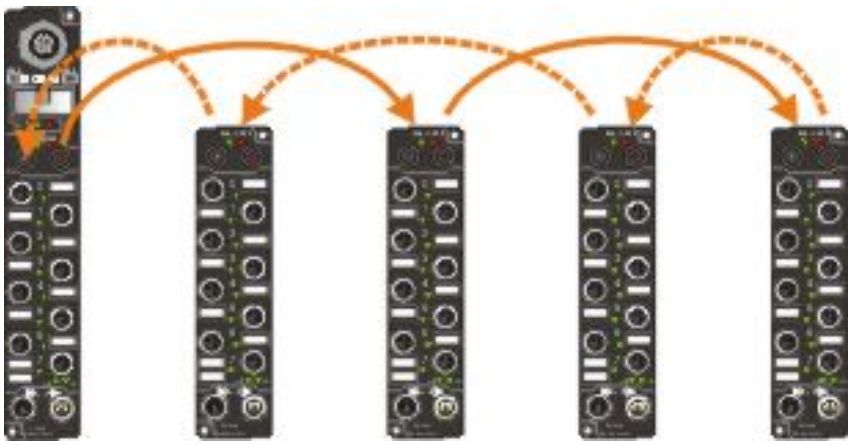
Structure/Topology

Line structure

In this case only every second extension boxes is connected. Note here that the maximum distance of the last extension box is halved.

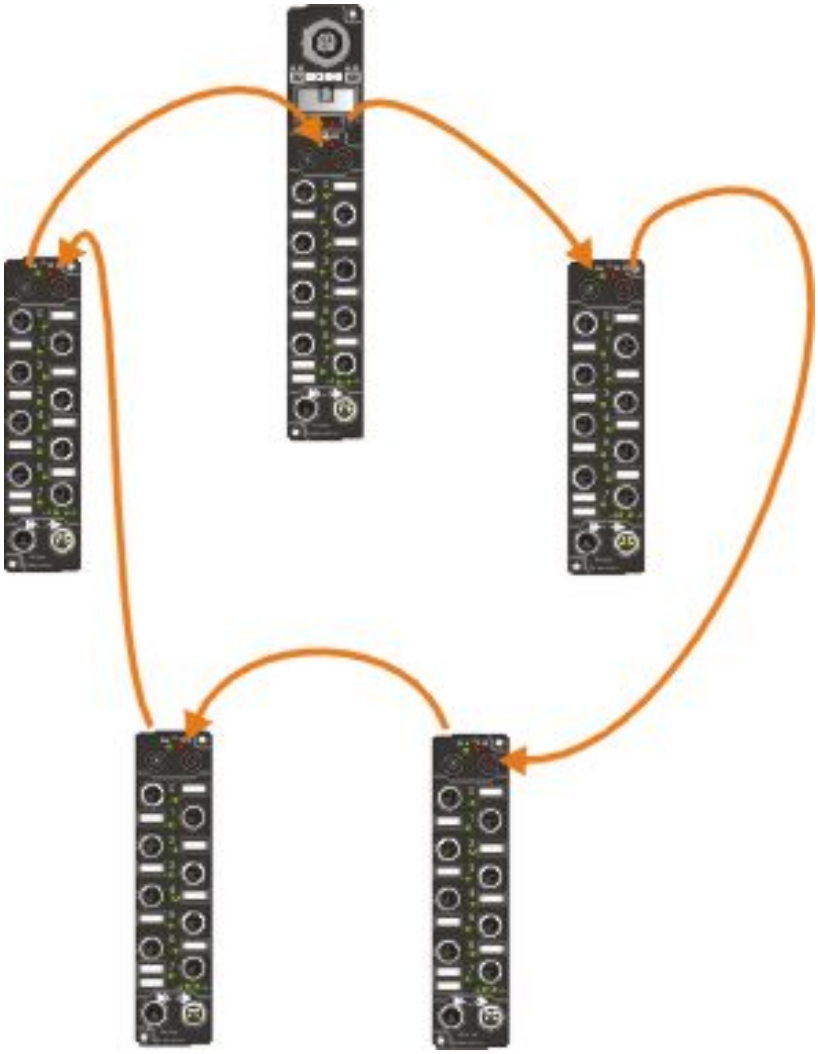
Example

You have 4 extension boxes (4 x 15 m = 60 m). Because only every second extension box is connected to the outward line, the maximum distance for the last extension box becomes 30 meter.



Ring structure

In this case the first and last extension box must each be no more than 15 meter from the Coupler Box.



Technical Data

Table 4: IP-Link

	IP-Link
Baud Rate	2 Mbaud
Medium	Light
Number of devices	max. 120
Distance between two stations	15 m
Cable	Plastic optical fiber 1000 um - single fiber core, PUR cladding with Kevlar fiber, diameter 5.5 mm
IP link connector	only ZS1020-0010 is permitted
Extraction force	20 N - 30 N

Table 5: IP-Link Z1101 Cable

	Z1101
Nominal external diameter	5.5 mm
Cladding thickness	1.4 mm
Fiber	Plastic fiber optic 980/1000 µm, PMMA
Core	PE cladding, 2.2 mm nominal diameter
Temperature	-20...+70°C
External cladding material	PUR
Nominal weight kg/km	25
Tensile strength (DIN VDE 0888 Part 100 Procedure 501)	Continuous 100 N Momentary 400 N
Bending radius	Radius minimum 50 mm
Alternating bending strength (DIN VDE 0888 Part 100 Procedure 509)	30,000 cycles
drag chain approval	Radius 10 x diameter, 2 Mio. cycles
Attenuation at 650 nm	< 200 dB/km

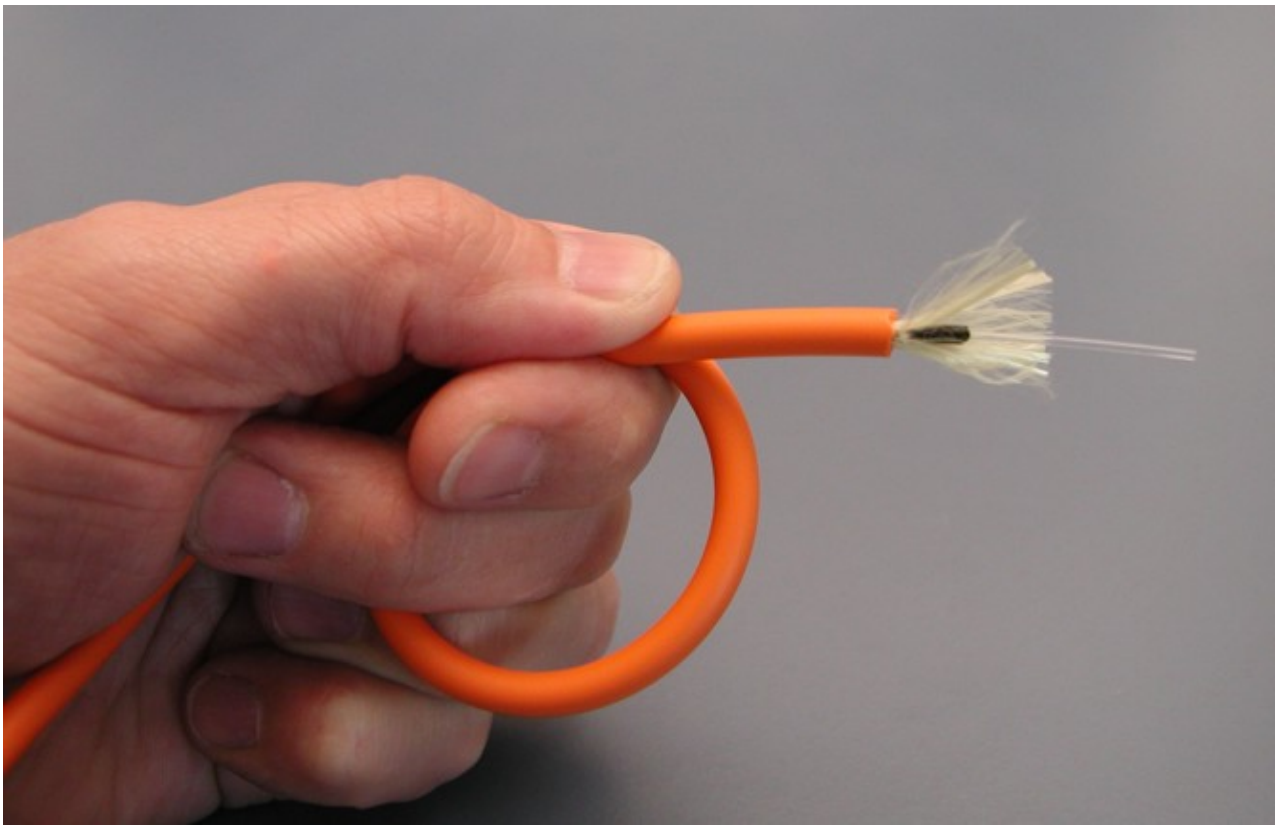
3.3.3.2 Preparing the IP-Link cable

Required tools:

- Side cutter
- Stripping tool
- Abrasive paper (grain size 600)

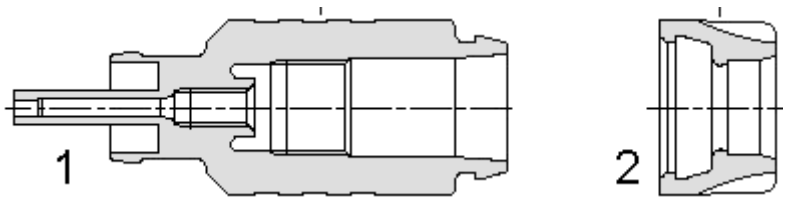
During stripping of the insulation and installation please ensure that

- the optical fiber is not kinked and
- the bending radius is not below the minimum radius of 50 mm! Tighter bending radii my damage the optical fiber.
- during the mounting, it is very helpful to fix the core against movement. This can be done by holding the fiber in a loop (picture). The smaller bending radius does not damage the cable, if it is only for short while.



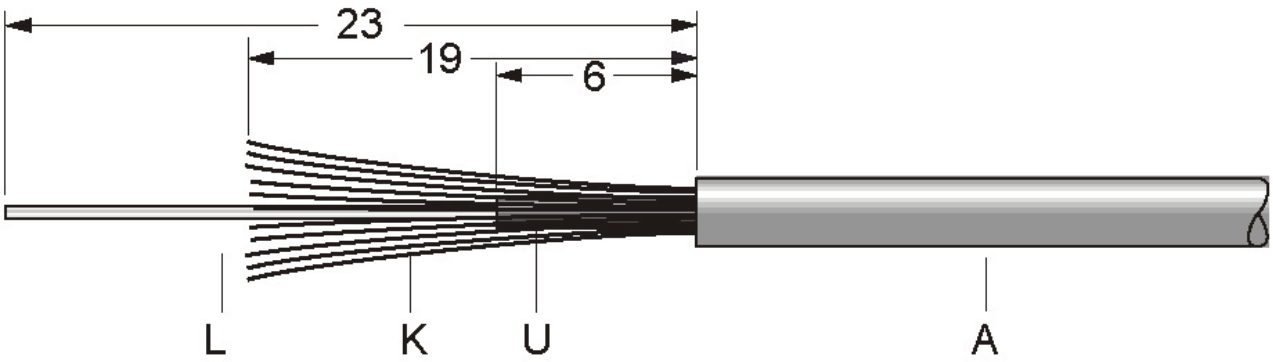
Fixing the fiber core for preparing

IP Link Connector



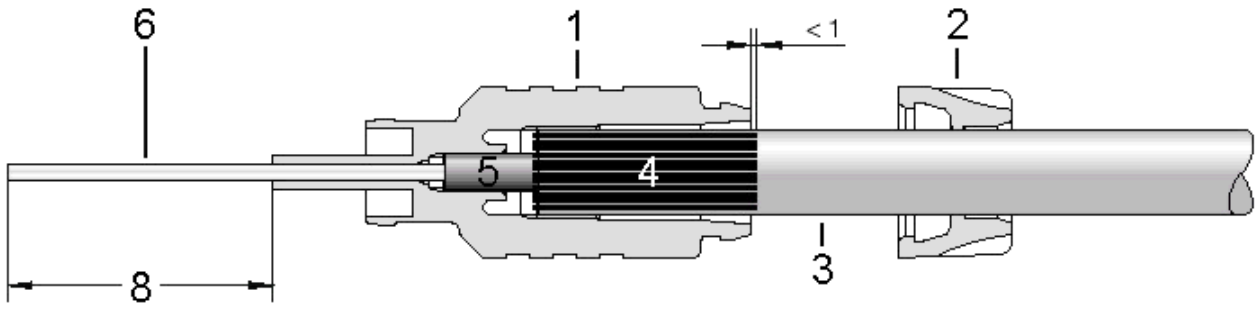
IP-Link connector (1) with cap (2)

Preparing the cable end



- First slide the cap of the IP-Link connector (2) onto the optical fiber cable.
- Shorten the orange-colored outer sheath (A) by approximately 23 mm without damaging the Kevlar fibers (K) below.
- Shorten the Kevlar (K) to approx. 19 mm.
- Fold back the yellow Kevlar fibers (K) over the outer sheath (A).
- Shorten the black fiber sheath (U) by approximately 17 mm without damaging the optical fiber (L) below.

Installation of the IP-Link connector



- Slide the IP-Link connector (1) onto the optical fiber cable until it is in contact with the Kevlar fibers (4) that were folded over the outer sheath (3).
- Screw the connector clockwise onto the outer sheath until it cannot be turned further by hand (hand-tight). Do not use any tools! The plug is designed to cut a thread into the black fiber sheath (5) during this process.
  If the cable was stripped correctly, the optical fiber (6) now protrudes approximately 8 mm from the IP-Link connector (1).
- Cut the Kevlar fibers protruding from the back of the IP-Link connector without damaging the outer sheath.
- Slide the cap (2) on the optical fiber cable against the IP-Link connector (1) from behind until it engages.
- Cut the optical fiber protruding from the front of the IP-Link connector approximately 2 mm from the tip of the connector. Be careful not to cut shorter, since the fiber is very hard and can splitter.
- Sand the optical fiber with abrasive paper, grain size 600, until only approximately 0.4 mm protrude from the tip of the connector. Avoid damaging the connector!
- Remove any grinding dust and an eventual burr using a clean, lint-free cloth.

Checking the fiber ends (visual inspection)

Check the sanded fiber ends:

- The end of the optical fiber cable must have a clean, level surface at right angles to the connector guide, protruding approximately 0.4 mm from the tip of the connector.
- Point one cable end to a light source. At the other cable end, no scratches, cracks or splintering should be visible in the illuminated fiber.

Order information

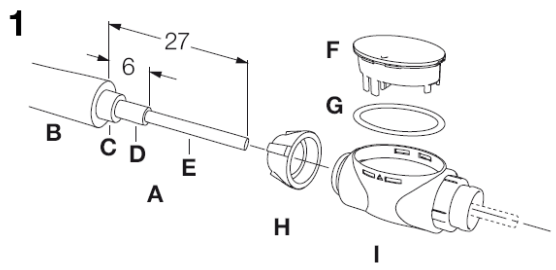
ZS1020-0010: IP-Link connector, packaging unit 1 item
ZS1021-0010: IP-Link connector, packaging unit 10 items

Also see about this

Fixing [▶ 69]
Fixing [▶ 71]

3.3.3.3 Assembling of the ZS1022-0010 IP-Link Plug (clip type)

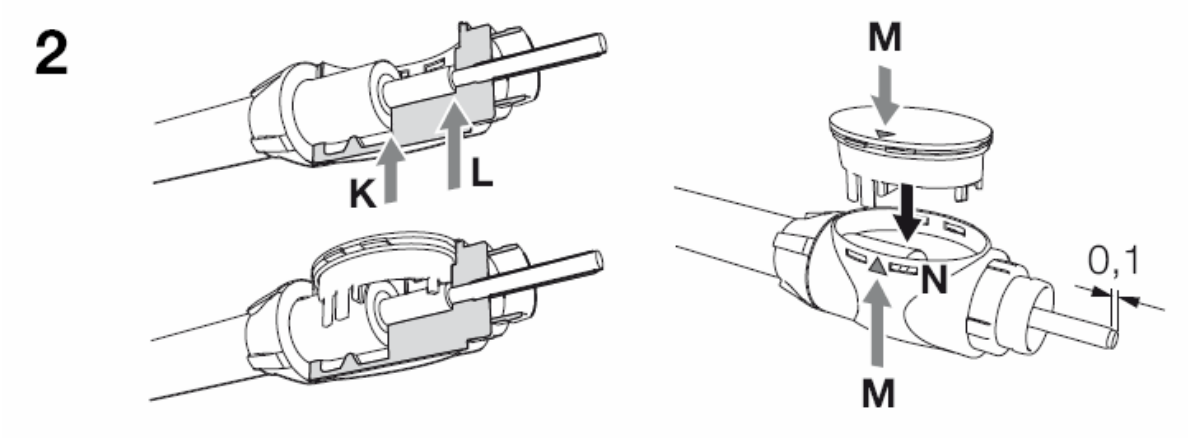
Preparation (Exploded view)



A: fiber optic
B: outer jacket
C: Kevlar fiber
D: fiber jacket
E: fiber core
F: locking cap
G: O-ring
H: sleeve
I: connector housing

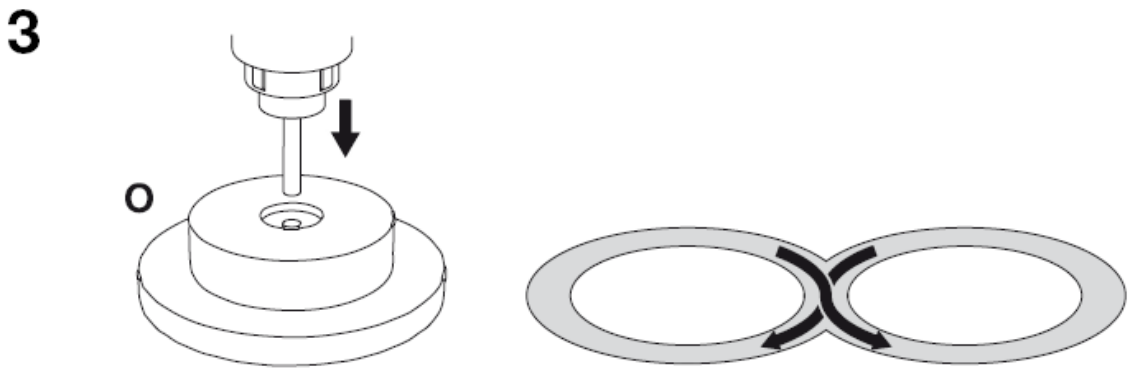
1. Strip cable jacket according to indicated lengths of outer and fiber jacket.
   ATTENTION:
   The fiber core should not be damaged!
2. Cut the Kevlar fiber to the same length of the outer jacket.
   ATTENTION:
   In order to reach maximum clamping force outer and fiber jacket have to be free of deformation (scores, etc.) as well as of grease, oil and lubricant.

Assembly



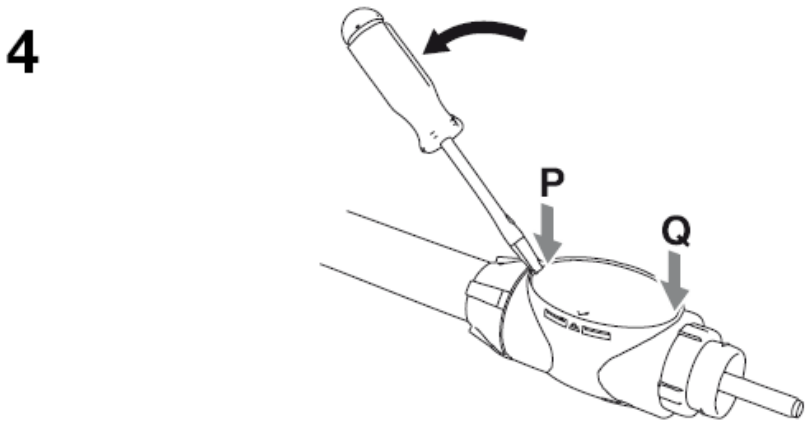
1. Pull the sleeve over the outer jacket and the O-ring over the locking cap.
2. Insert the prepared fiber-optic in the connector housing until outer jacket hits **L** and fiber jacket hits **K** simultaneously.
3. Align the connector housing as required in order to prevent a possible torsion of cable.
4. Pull the sleeve over the connector housing until it radially latches.
5. Press the locking cap into the connector housing until all 4 nibs latch. This operation can be implemented without tools or with corresponding pliers. Keep correct mounting position **M** of the locking cap. The correct mounting of the O-ring can be checked with the latching holes **N**.

Surface treatment



1. Treat the fiber core with grinding gauge **O** up to the final dimension and intended quality.
   For this purpose take sand paper with grain size 600, and work on a smooth surface.
2. Insert the mounted connector in the grinding gauge and treat the surface with a rotary movement.
3. Remove grinding dust with a clean lint-free cloth.
4. Check the quality of the grinded surface.
   The surface has to be smooth and free of scratches, grooves and splinters.

Disassembly



1. Apply appropriate tool at cut-out **P** or **Q**.
2. Lift out the locking cap from the closed connector housing.
   ATTENTION:
   Damaged or deformed components should not be applied again after disassembly.
3. Prepare fiber-optic sensor after disassembly according to point 1 again.

Ordering note

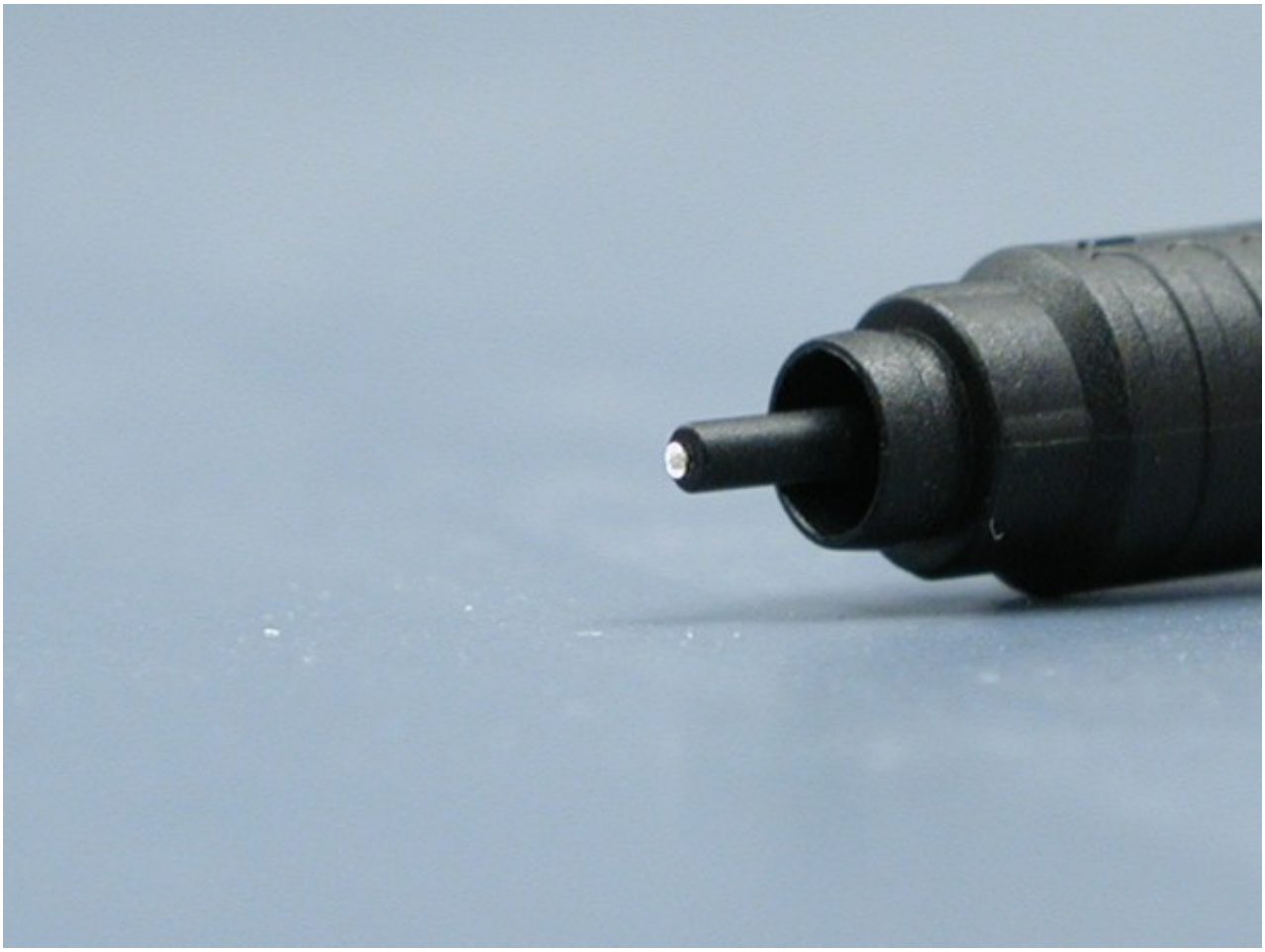
ZS1022-0010: IP-Link connector (clip type), packaging unit 10 items

3.3.3.4 Examples for prepared IP-Link connectors

The photos were taken by using a white flash light shining into the opposite end of the cable.

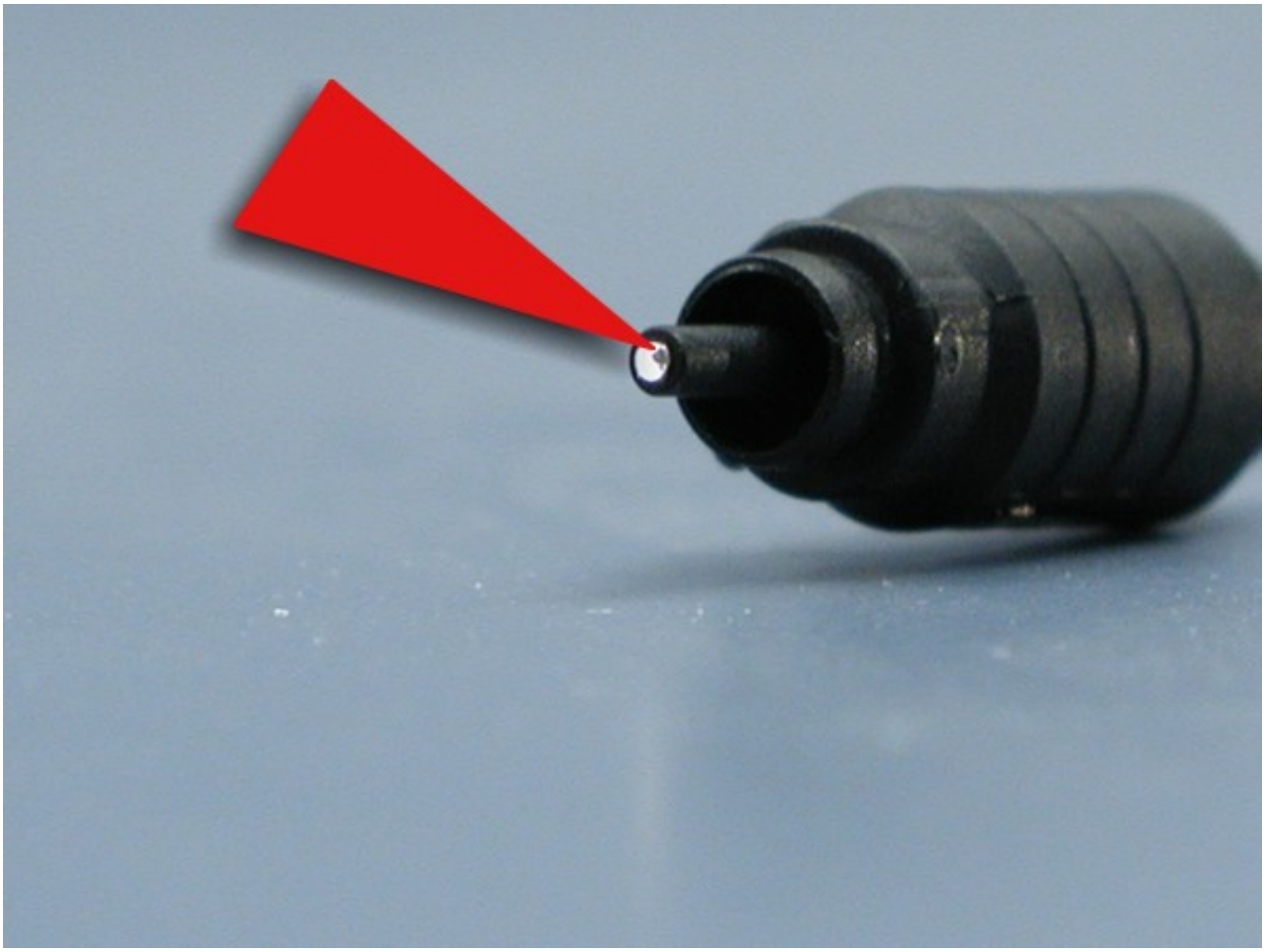
Right:

A correct IP-Link connector should look like this:



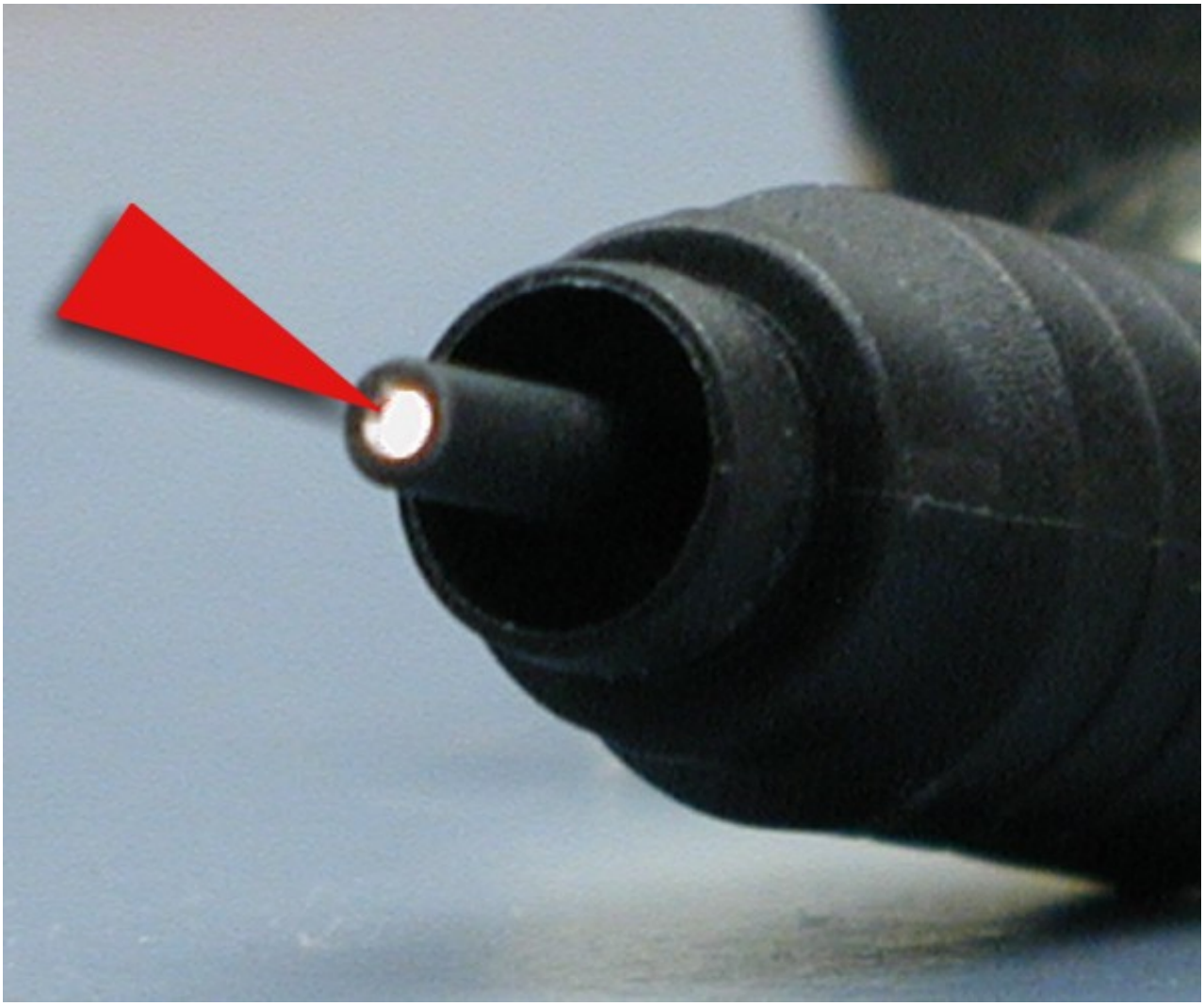
The fiber is stays slightly above the connector tip and is almost rectangular. No damage of the fiber is visible.

Wrong:



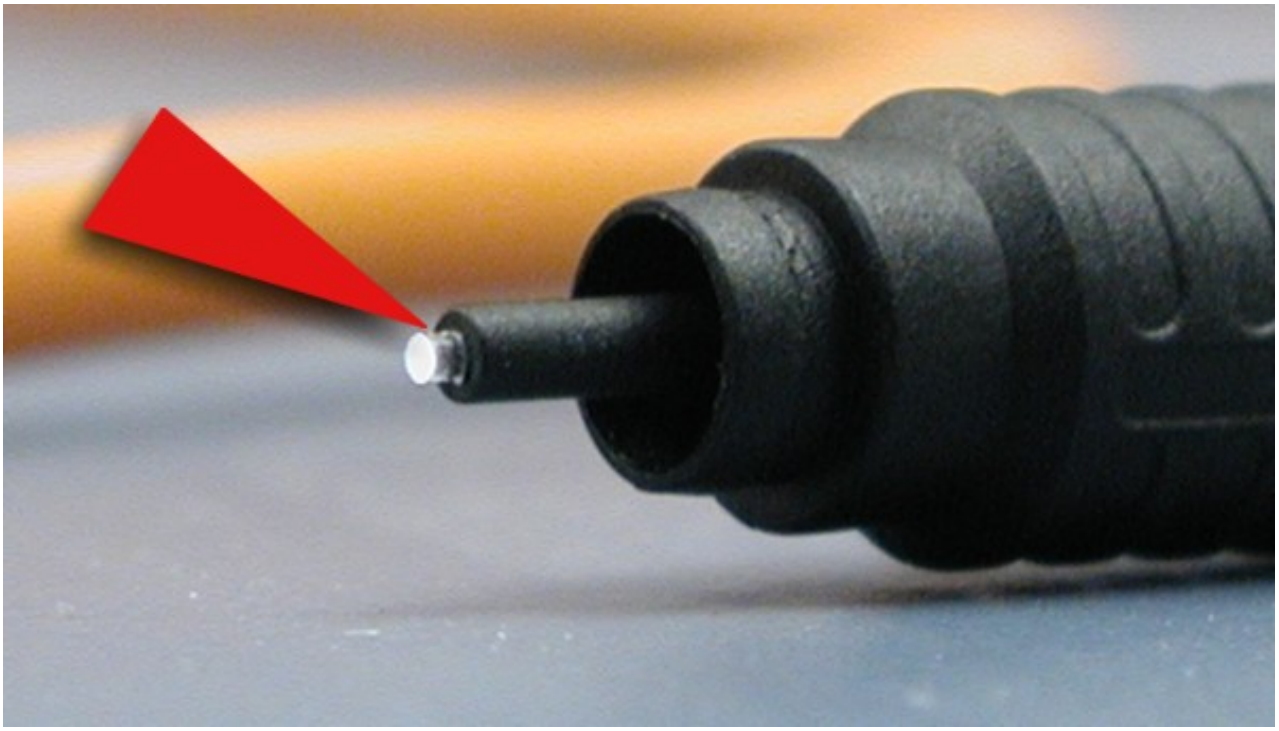
This fiber was cut to short before the connector, it split into the connector and cannot be sanded correctly (dark part is visible).
This connector has be done over.

Wrong:



Here, the fiber was cut to short in the preassemble phase. the fiber does not even reach the connector tip. This whole connector has to be done over.

Wrong:



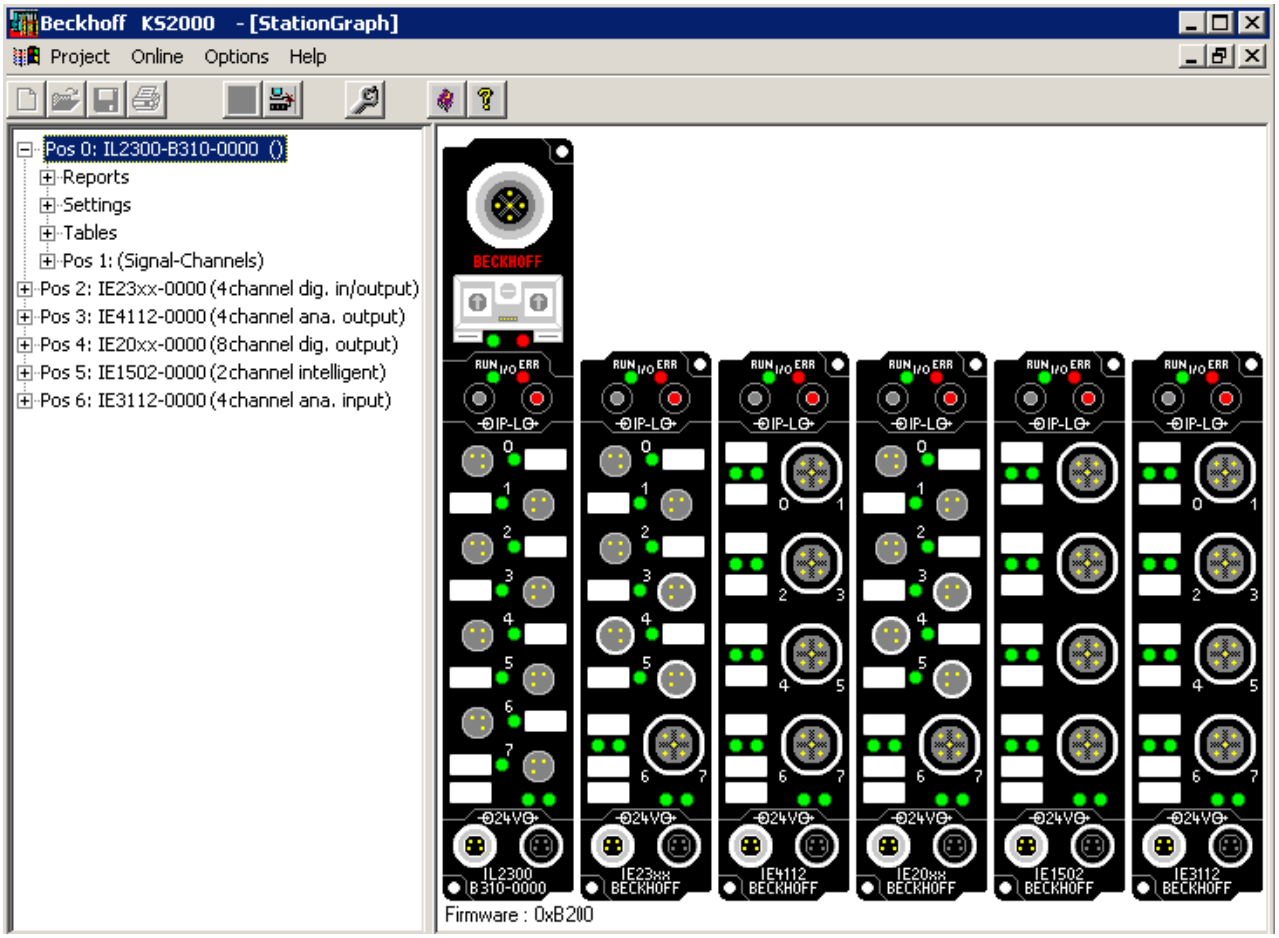
The fiber was sanded correctly. It has a clean, undisturbed light emission.

But the fiber is to long. This way it could damage the optical elements of the modules.
It can very simply be corrected by sanding down the fiber carefully to the correct measurement.

3.3.3.5 Check of the IP-Link connection

A correct assembled IP-Link cable will assure an error free transmission.

An additional testing of the transmission quality and error diagnostics is possible with the KS2000 configuration software.



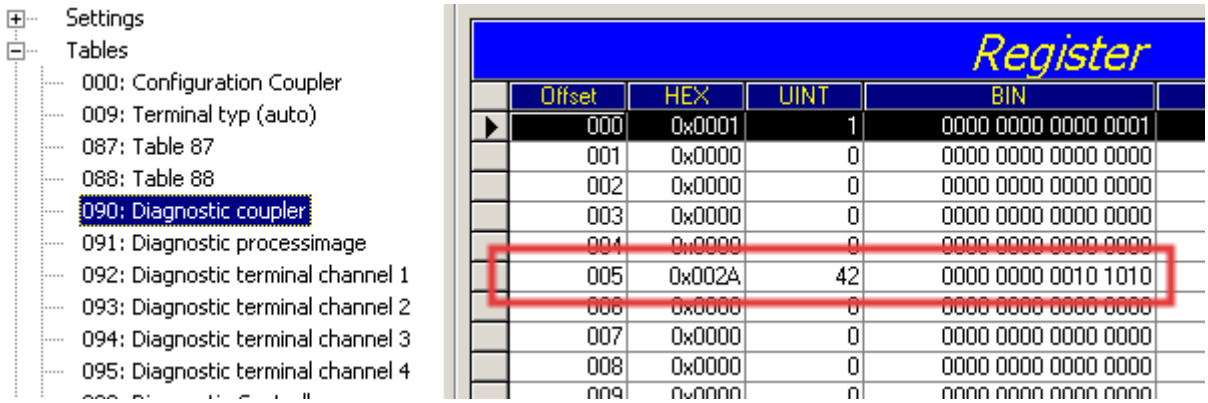
For this test, the fieldbus master (e.g. a PROFIBUS PC Card) should be on the bus and it should transmit data cyclical. Another way to generate cyclic data is, to switch the coupler to *free running* via the KS2000 software.

The result should be, that the I/O RUN LED flashes in a bright green. This shows, that a data exchange with the connected extension boxes takes place. A red blinking I/O ERR LED shows faulty IP-Link telegrams. These faulty telegrams will be repeated automatically like in any other fieldbus system. This way a transmission of the data is guaranteed.

Error counter

Table 90, offset 005 shows possible IP-Link errors. Sporadic appearing errors do not mean any problem for the communication, as long as they do not reach a critical limit.

This error counter is only reset by the Power ON/OFF.



If lots of errors occur in a very short time, this will be interpreted as a heavy disturbance of the communication and the coupler box will report this error. This can be seen at offset 006 and 007. Both values will show a value > 200 and the I/O ERR LEDs of the coupler box will blink the according error code.

Note

The KS2000 Configuration Software communicates with the Coupler Box via the serial channel. The content of the registers will not be refreshed automatically.

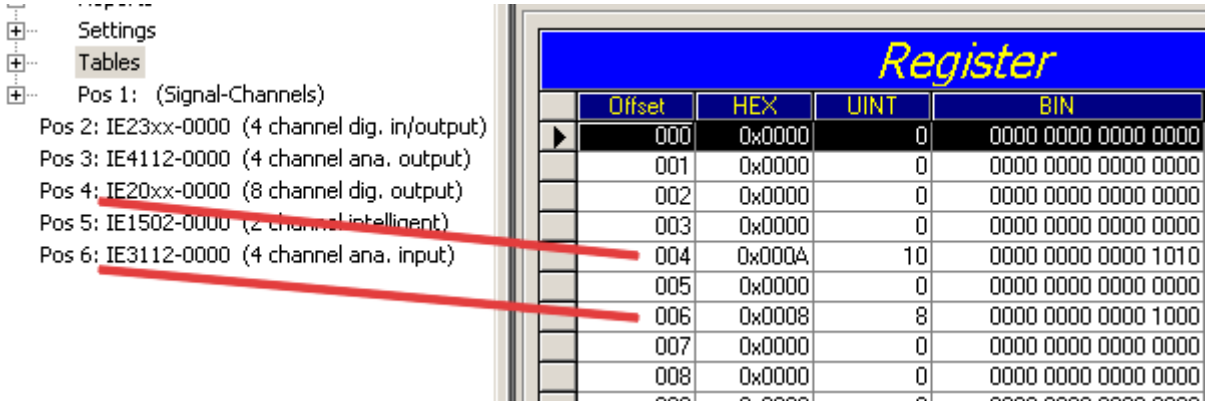
Position of the error

In case of an IP-Link error, the Coupler Box tries to read the error location from the register of the Extension Box. If the fiber optic ring is interrupted or the communication is heavily disturbed, this is not possible. Only the position of the last functioning Extension Box before the receiver of the Coupler Box can be recognized. The box will then flash this error code via the I/O ERR LED.

If the communication via IP-Link is still running, table 87 shows the error counter of each Extension Box.

The offset register corresponds to the position of the Extension Box in the KS2000 tree (left side of graphic). This example shows errors at offset 004 and 006.

In the "real" world the faulty IP-Link telegram was reported from the IE20xx and the IE3112, that means the problem has to looked for before these modules.



The error can be up to:

- the sending module
- the receiving module
- the IP-Link cable
- the connectors

If there is an error in table 90 and none in table 87, the faulty transmission is between the last Extension Box and the Coupler Box.

In most cases the transmission errors can be traced back to bad configured IP-Link connectors or a too high attenuation of the cable due to sharp bending.

The values of table 87 directly come from the extension boxes. In case of an IP-Link interruption these values will be set to zero and only table 90 can be used.

Note

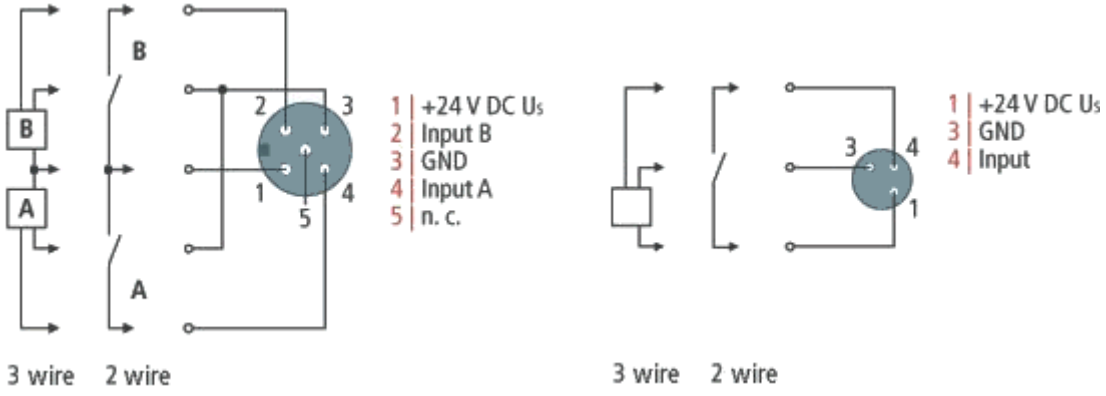
If you want to operate a Coupler Box (e.g. IL2300-Bxxx, IL2301-Bxxx or IL2302-Bxxx) totally without Extension Box Modules (IExxxx), you have to connect the send and receive socket of this Coupler Box directly by using an IP Link Cable! For this the IP Link Jumper ZK1020-0101-1000 fits perfect.

3.3.4 Signal Connection

3.3.4.1 IP100x-Bxxx, IE100x Signal Connection

8 Channel Digital Input 24 V_{DC}, Filter 3.0 ms

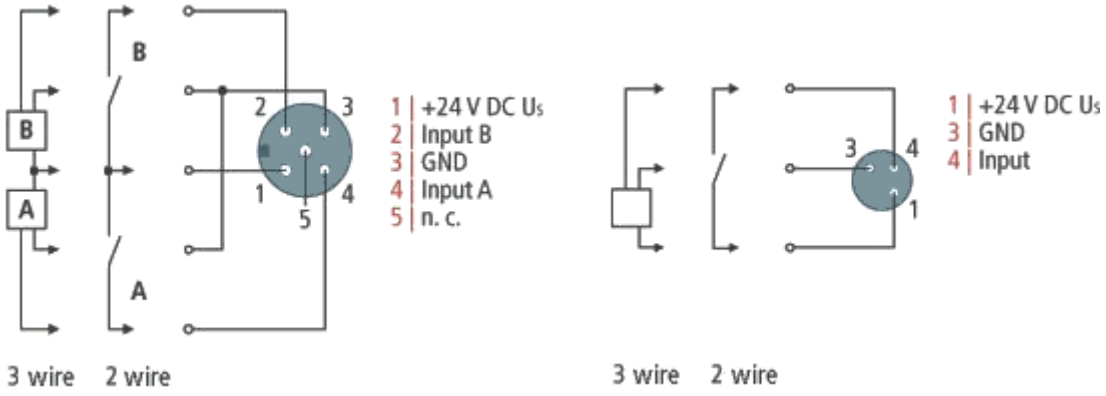
The IP100x digital input modules acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The state of the signals is indicated by light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP1000), screw-in M8 connectors (IP1001) or screw-in M12 connectors (IP1002). The sensors are supplied from the control voltage Us. The load voltage Up is not used in the input module, but may be connected in order to be relayed downstream.



3.3.4.2 IP101x-Bxxx, IE101x Signal Connection

8 Channel Digital Input 24 V_{DC}, Filter 0.2 ms

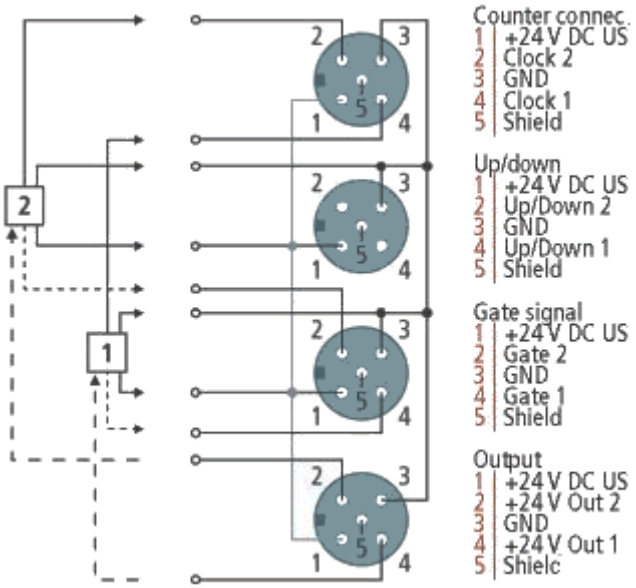
The IP101x digital input modules acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The state of the signals is indicated by light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP1010), screw-in M8 connectors (IP1011) or screw-in M12 connectors (IP1012). The sensors are supplied from the control voltage U_S. The load voltage U_P is not used in the input module, but may be connected in order to be relayed downstream.



3.3.4.3 IP1502-Bxxx, IE1502 Signal Connection

2 Channel, up/down counter, 24 V_{DC}, 100 kHz

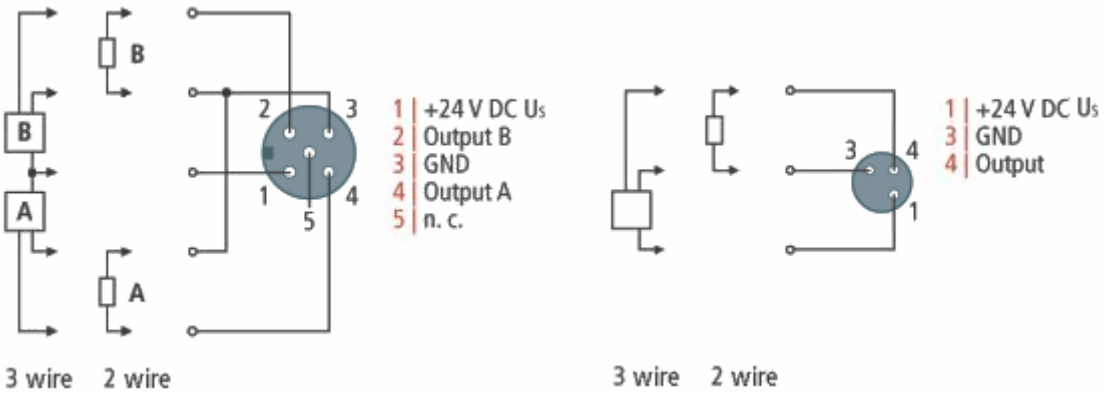
The counter module is connected as follows:
The counting pulse for counters 1 and 2 is connected via socket A (counter connection). The counting direction (up/down) can be specified via socket B. At socket C (gate signal), the gate signal can freeze the counter state; the clock signals are ignored. The output is provided via socket D. The outputs are powered via U_P. The Fieldbus Box and the signals for the sensor are controlled via U_S.



3.3.4.4 IP200x-Bxxx, IE200x Signal Connection

8 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A

The IP200x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2000), screw-in M8 connectors (IP2001) or screw-in M12 connectors (IP2002). The outputs are short-circuit safe and protected against inverse connection.



3.3.4.5 IP202x-Bxxx, IE202x Signal Connection

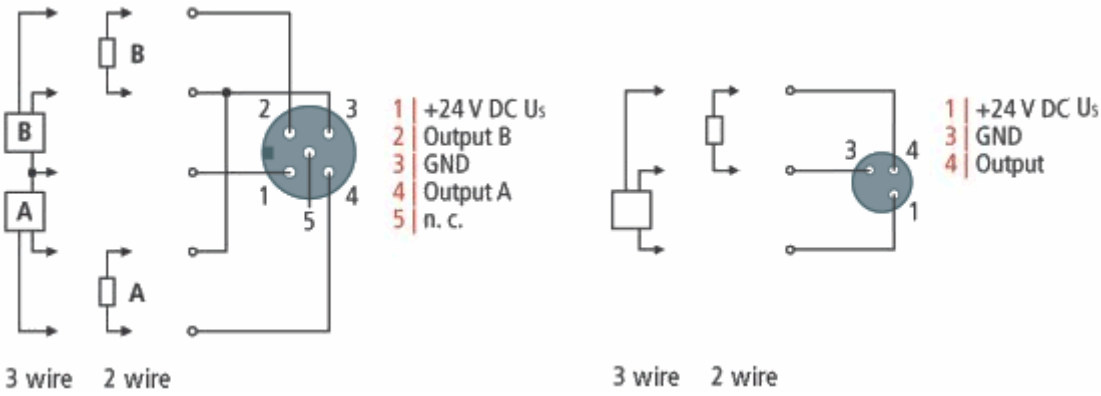
8 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A, total current 4 A

The IP202x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 2.0 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2020), screw-in M8 connectors (IP2021) or screw-in M12 connectors (IP2022). The outputs are short-circuit safe and protected against inverse connection.

NOTE

Warning

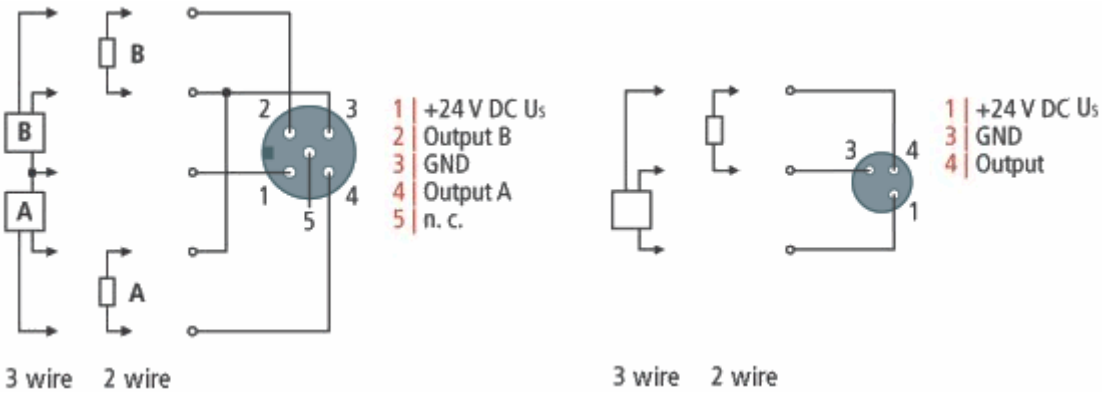
The total current must not be exceeded. This means that a maximum of two outputs with a load of 2 A each may be switched on at the same time.



3.3.4.6 IP204x-Bxxx, IE204x Signal Connection

8 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A, total current 12 A

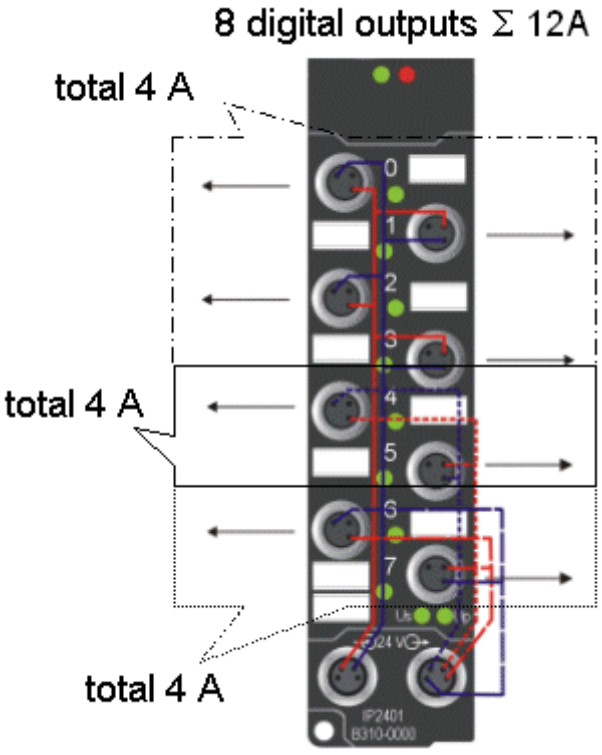
The IP204x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 2.0 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2040), screw-in M8 connectors (IP2041) or screw-in M12 connectors (IP2042). The outputs are short-circuit safe and protected against inverse connection.



Potential Groups

There are three inlets for this module's load voltage. U_P1 for channels 0-3 (total current 4 A), U_P2 for channels 4-5 (total current 4 A) and U_P3 for channels 6-7 (total current 4 A).

The total current must not be exceeded. This means that a maximum of two outputs from channels 0-3 with a load of 2 A each may be switched on at the same time.



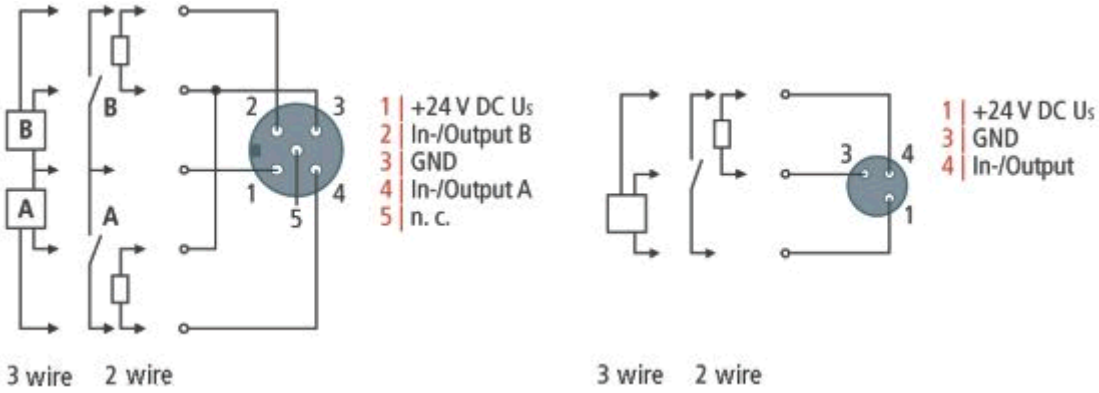
See also Chapter Technical data [▶ 24].

3.3.4.7 IP230x-Bxxx, IL230x-Bxxx, IL230x-Cxxx, IE230x Signal Connection

4 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A, 4 digital inputs, 3.0 ms filter

The IP230x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 4 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via Ø 8 mm snap-in plugs (IP2300), screw-in M8 connectors (IP2301) or screw-in M12 connectors (IP2302). The outputs are protected against short circuit and against inverse connection, and are located on the lower half of the Fieldbus Box. In the S8 and M8 these are the lower 4 sockets, and on the devices with M12 connections they are the bottom two; in the M12 version, 2 outputs are located at one socket.

The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs, screw-in M8 connectors or screw-in M12 connectors. The inputs are located on the upper half of the Fieldbus Box. In the S8 and M8 these are the upper 4 sockets, and on the devices with M12 connections they are the upper two; in the M12 version, 2 inputs are located at one socket.
The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If Up and U_S are used for passing the power on, the maximum current must not exceed 4 A.

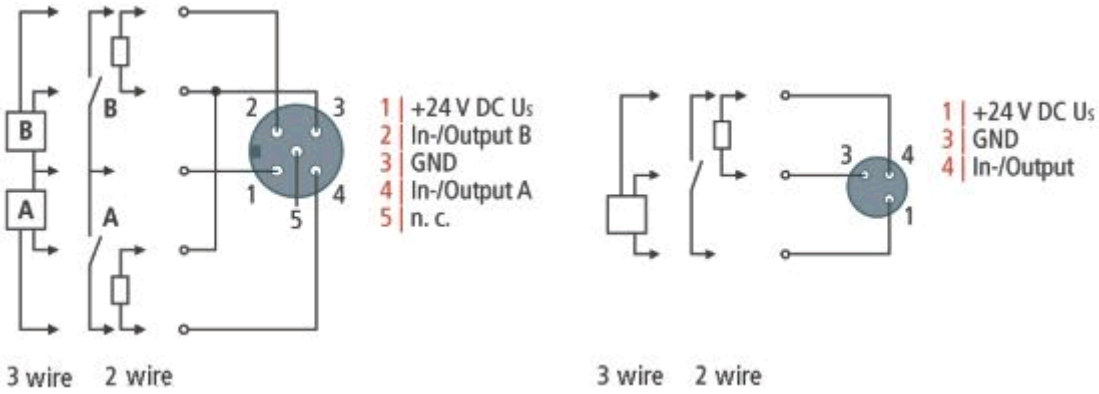


3.3.4.8 IP231x-Bxxx, IE231x Signal Connection

4 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A, 4 digital inputs, 0.2 ms filter

The IP231x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 4 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2300), screw-in M8 connectors (IP2301) or screw-in M12 connectors (IP2302). The outputs are short-circuit safe and protected against inverse connection. The outputs are located on the lower half of the Fieldbus Box. In the S8 and M8 these are the lower 4 sockets, and on the devices with M12 connections they are the bottom two; in the M12 version, 2 outputs are located at one socket.

The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The state of the signals is indicated by light emitting diodes. The signals are optionally connected via Ø 8 mm snap-in plugs, screw-in M8 connectors or screw-in M12 connectors. The inputs are located on the upper half of the Fieldbus Box. In the S8 and M8 these are the upper 4 sockets, and on the devices with M12 connections they are the upper two; in the M12 version, 2 inputs are located at one socket. The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If U_P and U_S are used for passing the power on, the maximum current must not exceed 4 A.

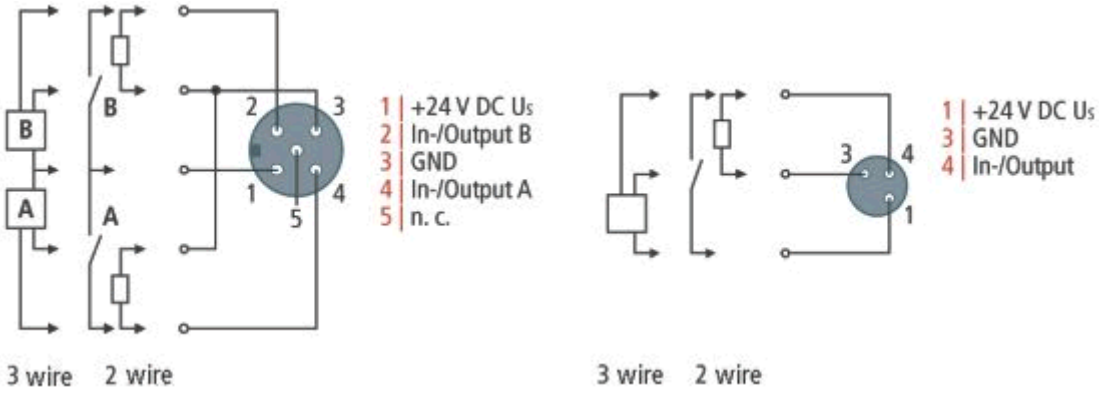


3.3.4.9 IP232x-Bxxx, IE232x Signal Connection

4 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A, 4 digital inputs, 3.0 ms filter

The IP232x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 4 outputs handle load currents of up to 2.0 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2320), screw-in M8 connectors (IP2321) or screw-in M12 connectors (IP2322). The outputs are protected against short circuit and against inverse connection, and are located on the lower half of the Fieldbus Box. In the S8 and M8 these are the lower 4 sockets, and on the devices with M12 connections they are the bottom two; in the M12 version, 2 outputs are located at one socket.

The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs, screw-in M8 connectors or screw-in M12 connectors. The inputs are located on the upper half of the Fieldbus Box. In the S8 and M8 these are the upper 4 sockets, and on the devices with M12 connections they are the upper two; in the M12 version, 2 inputs are located at one socket.
The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If U_P and U_S are used for passing the power on, the maximum current must not exceed 4 A.

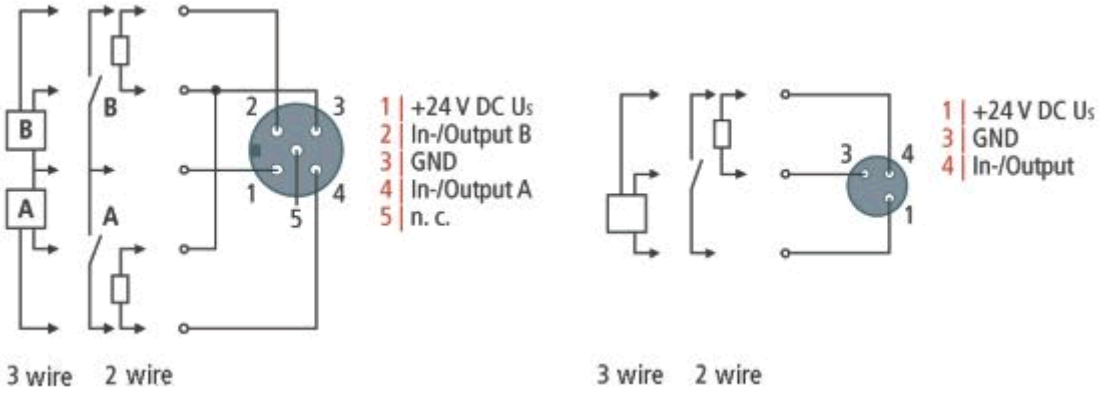


3.3.4.10 IP233x-Bxxx, IE233x Signal Connection

4 Channel Digital Output 24 V_{DC}, I_{max} = 2.0 A, 4 digital inputs, 0.2 ms filter

The IP233x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 4 outputs handle load currents of up to 2.0 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-in plugs (IP2330), screw-in M8 connectors (IP2331) or screw-in M12 connectors (IP2332). The outputs are short-circuit safe and protected against inverse connection. The outputs are located on the lower half of the Fieldbus Box. In the S8 and M8 these are the lower 4 sockets, and on the devices with M12 connections they are the bottom two; in the M12 version, 2 outputs are located at one socket.

The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs, screw-in M8 connectors or screw-in M12 connectors. The inputs are located on the upper half of the Fieldbus Box. In the S8 and M8 these are the upper 4 sockets, and on the devices with M12 connections they are the upper two; in the M12 version, 2 inputs are located at one socket.
The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If U_P and U_S are used for passing the power on, the maximum current must not exceed 4 A.

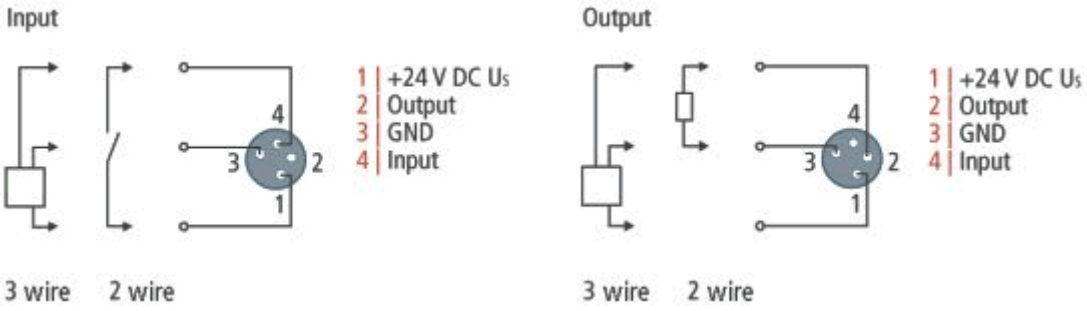


3.3.4.11 IP240x-Bxxx, IE240x Signal Connection

8 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A, 8 digital inputs, 3.0 ms filter

The IP240x digital output modules connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs (IP2400) or screw-in M8 connectors (IP2400). The outputs are short-circuit safe and protected against inverse connection. One output is located together with one input on an S8 or M8 socket.

The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via 8 mm snap-on plugs or screw-in M8 connectors.
The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If U_P and U_S are used for passing the power on, the maximum current must not exceed 4 A.



3.3.4.12 IE2403 signal connection

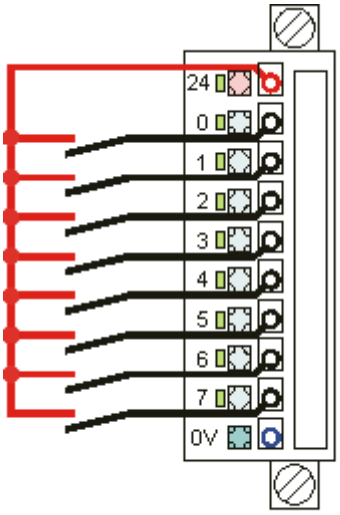
8 Channel Digital Output 24 V_{DC}, I_{max} = 0.5 A, 8 digital inputs, 3.0 ms filter

The IE2403 digital output module connect the binary control signals from the automation unit on to the actuators at the process level. The 8 outputs handle load currents of up to 0.5 A, and indicate their status through light emitting diodes. The signals are optionally connected via several KM connectors. The outputs are short-circuit safe and protected against inverse connection.

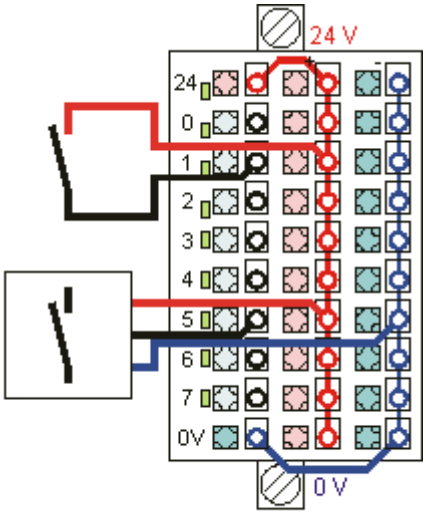
The digital inputs acquire the binary control signals from the process level and transmit them to the higher-level automation unit. The signal state is indicated by means of light emitting diodes. The signals are optionally connected via several KM-connectors.

The sensors are supplied from the control voltage U_S. The load voltage, U_P, is required for the output drivers. If U_P and U_S are used for passing the power on, the maximum current must not exceed 4 A.

Inputs



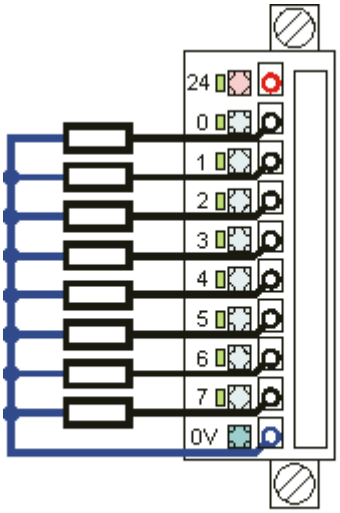
ZS2001-0002
ZS2001-0001



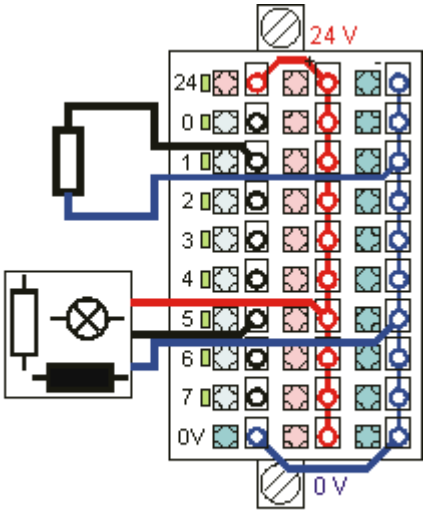
ZS2001-0004

The picture shows connection of 8 sensors in single-wire and of respectively one sensor in two- and three-wire connection.
Please pay attention for KM connector ZS2001-0004: two bridges (24 V und 0 V) are necessary to feed the terminal points for two- and three-wire connection.

Outputs



ZS2001-0002
ZS2001-0001



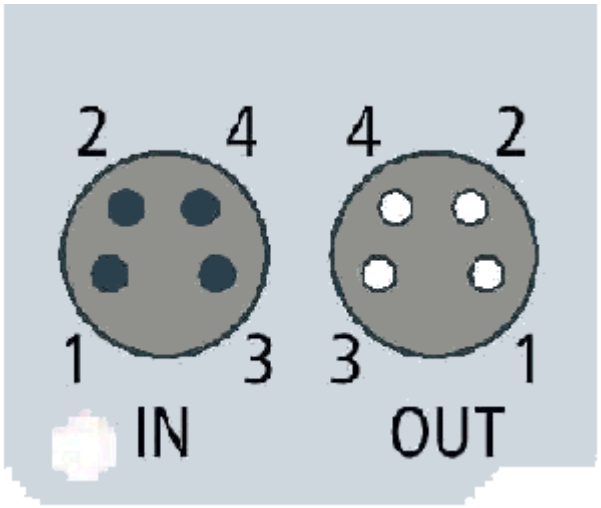
ZS2001-0004

The picture shows connection of 8 actuators in single-wire and of respectively one actuator in two- and three-wire connection.
Please pay attention for KM connector ZS2001-0004: two bridges (24 V und 0 V) are necessary to feed the terminal points for two- and three-wire connection.

Power supply

(See also chapter Power Connection [▶ 73])

The combi module IE2403 is fed via the left M8 screwing connector (IN).
The sensors are fed from control voltage U_S. The load voltage U_P is needed for the output drivers.



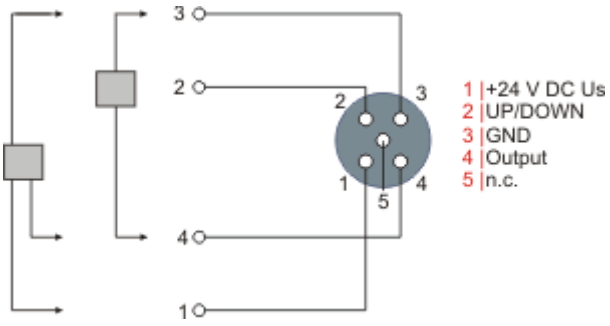
1 | + 24 V DC Us
2 | + 24 V DC Up
3 | GND
4 | GND

The right M8 screwing connector (OUT) is for forwarding the supply voltages to the next IP module.
If U_P and U_S are forewarded, the maximum current must not exceed 4 A.

3.3.4.13 IP2512-Bxxx, IE2512 Signal Connection

2 Pulse With Outputs, 24 V_{DC}

The Pulse With Module has to be connected as follows:



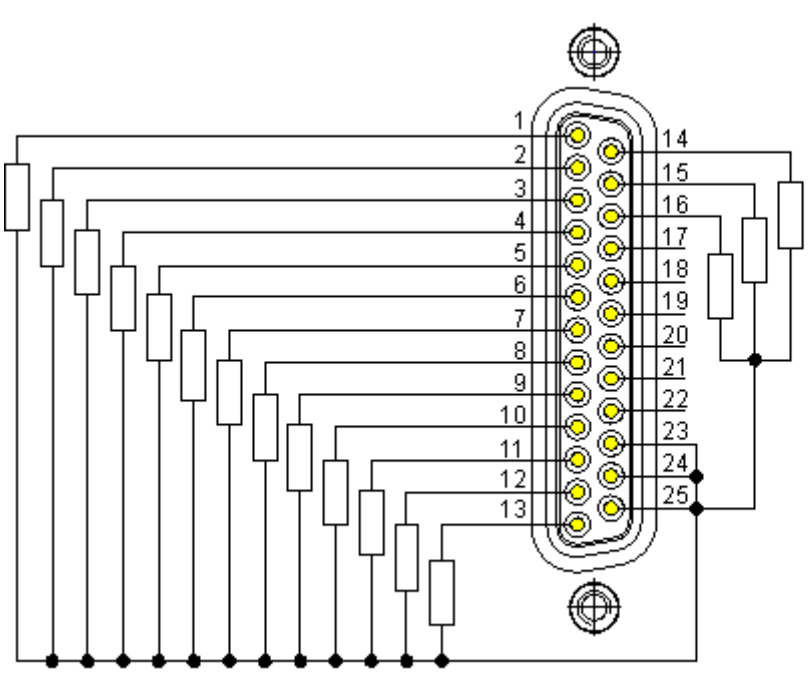
3.3.4.14 IE2808 Signal Connection

8 digital outputs 24 V_{DC}, I_{max} = 0,5 A

The IE2808 digital output module connects the binary control signals from the automation unit on to the actuators at the process level.

The 16 outputs deliver load currents of up to 0.5 A, although the total current of all outputs must not exceed 4 A.

The signal connection is realized by the 25-pin D-sub socket. The outputs are short-circuit safe and protected against inverse connection.

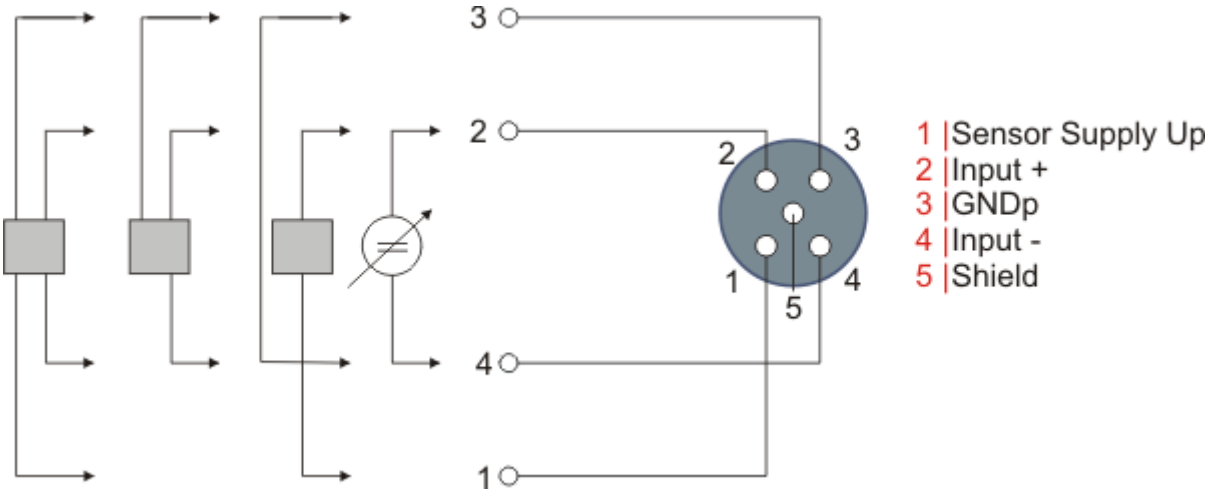


1 | Output 1
2 | Output 2
3 | Output 3
4 | Output 4
5 | Output 5
6 | Output 6
7 | Output 7
8 | Output 8
9 | Output 9
10 | Output 10
11 | Output 11
12 | Output 12
13 | Output 13
14 | Output 14
15 | Output 15
16 | Output 16
17 | GND
18 | GND
19 | GND
20 | GND
21 | GND
22 | GND
23 | GND
24 | GND
25 | GND

3.3.4.15 IP3102-Bxxx, IE3102 Signal Connection

4 Channel Analog Input, -10 to +10 V

The signal is measured using a differential signal. If two lines are not available for differential measurement at your sensor (e.g. 24 V, GND and signal), then *GND* must be short-circuited to *Input*.



Pin 5 (shield) is capacitatively coupled to the chassis of your Fieldbus Box.

Supply voltage

U_S - supplies the electronics for the fieldbus and for the sensor. It is electrically isolated from U_P.

U_P - Is not required for the function of the module, and does not have to be fed in.

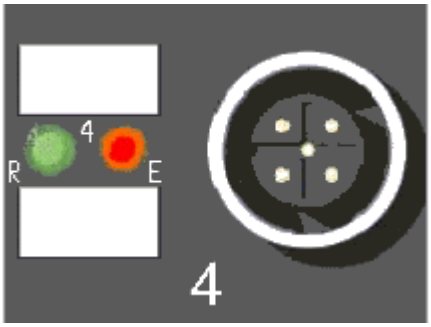
NOTE

Warning

If you use UP to pass the power on, and you connect a module in which US and UP are not electrically isolated (e.g. any digital module) then the electrical isolation is removed by the downstream connection.

LED indicators - meanings

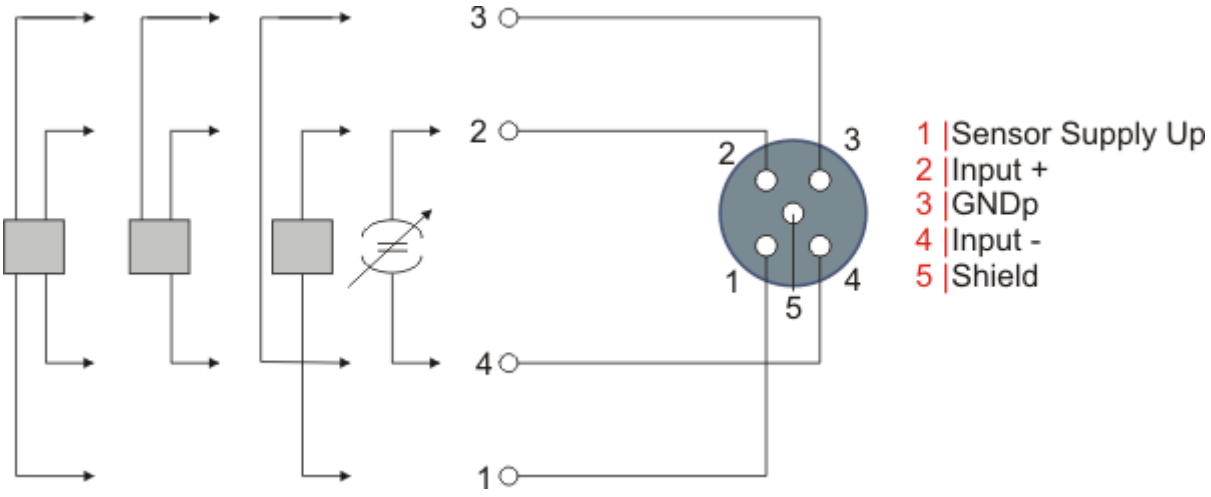
There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED indicates that there is an error (broken conductor, measured value outside the range).
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.



3.3.4.16 IP3112-Bxxx, IE3112 Signal Connection

4 Channel Analog Input 0 to 20 mA

The signal is measured using a differential signal. If two lines are not available for differential measurement at your sensor (e.g. 24 V GND and signal), then *GND* must be short-circuited to *Input*.



Pin 5 (shield) is capacitatively coupled to the chassis of your Fieldbus Box.

Supply voltage

U_S - supplies the electronics for the fieldbus and for the sensor. It is electrically isolated from U_P.

U_P - Is not required for the function of the module, and does not have to be fed in.

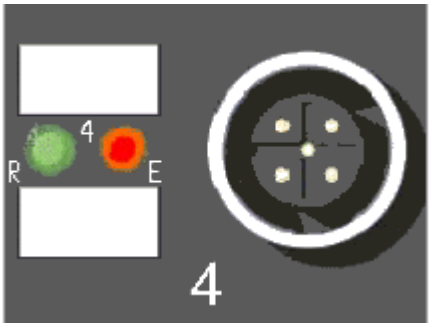
NOTE

Warning

If you use UP to pass the power on, and you connect a module in which US and UP are not electrically isolated (e.g. any digital module) then the electrical isolation is removed by the downstream connection.

LED indicators - meanings

There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED indicates that there is an error (broken conductor, measured value outside the range).
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.



3.3.4.17 IP3202-Bxxx, IE3202 Signal Connection

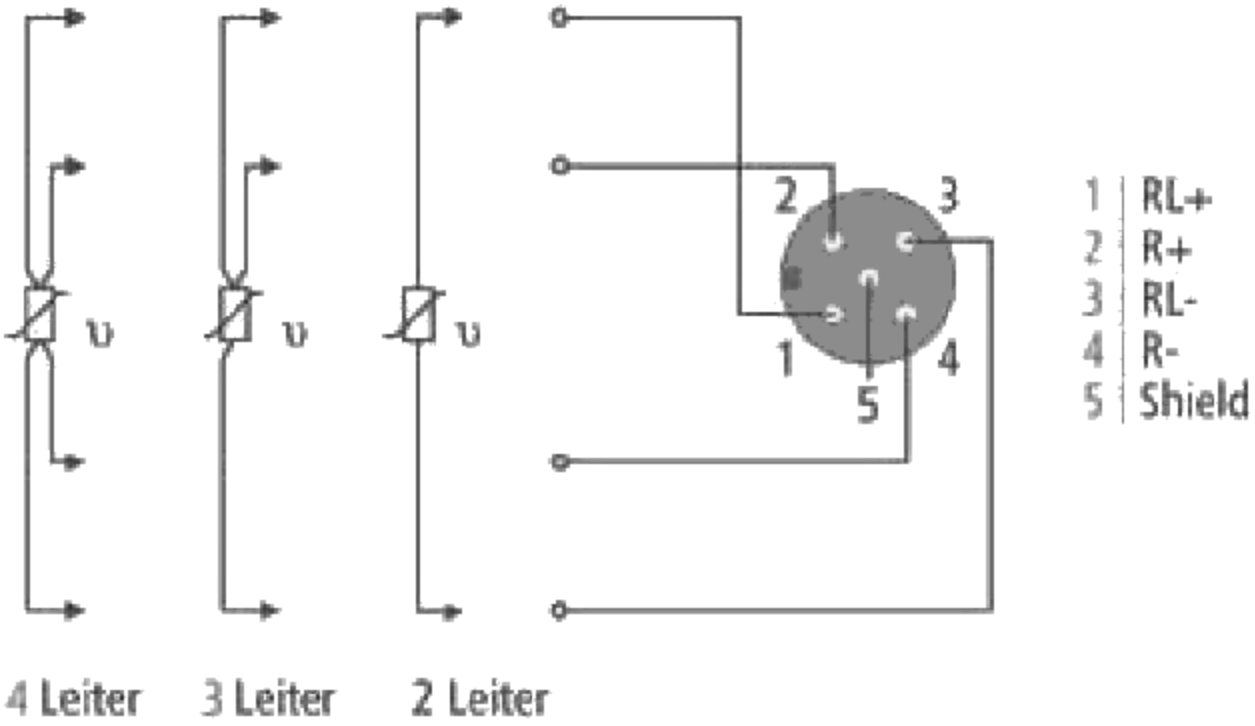
4 Channel Analog Input PT100 (RTD)

The advantage of four-wire technique is that the error resulting from the cable and contacts is included in the measurement and cancelled out. In the 3-wire technique, the conductor resistance to the resistance sensor is measured in one direction only, and is multiplied by two. This requires the outward and return lines to have approximately the same ohmic resistance. An error is present in the two-wire technique; temperature differences and cable cross-sections can make this error vary considerably.

NOTE

Warning

The connection type, 2-, 3- or 4-wire has to be the same for all four channels!



Pin 5 (shield) is capacitatively coupled to the chassis of your Fieldbus Box.

Supply voltage

U_S - supplies the electronics for the fieldbus and for the sensor. It is electrically isolated from U_P.

U_P - Is not required for the function of the module, and does not have to be fed in.

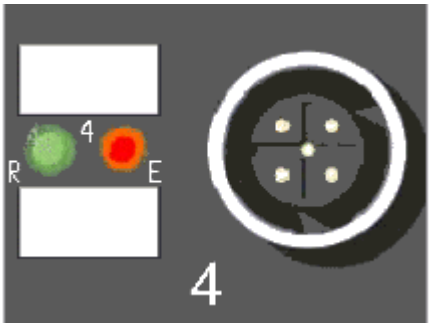
NOTE

Warning

If you use UP to pass the power on, and you connect a module in which US and UP are not electrically isolated (e.g. any digital module) then the electrical isolation is removed by the downstream connection.

LED indicators - meanings

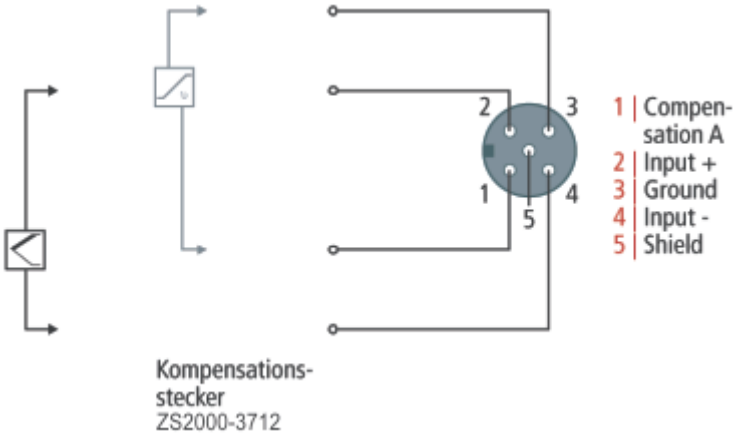
There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED indicates that there is an error (broken conductor, measured value outside the range, temperature compensation outside the valid range).
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.


4
R
E
4

3.3.4.18 IP3312-Bxxx, IE3312 Signal Connection

4 Channel Analog Input Thermocouple

The temperature compensation is brought to the outside in the IP/IE3312 modules. This means that in the connector the temperature compensation is measured directly at the connection point. This allows the temperature to be measured with significantly better accuracy. Beckhoff offer a connector (ZS2000-3712) for this. The temperature compensation can also be carried out at a location other than the Fieldbus Box. You must then wire a PT1000 between pins 1 and 3. The longer the cables you choose to use, the larger is the measurement error caused by the length of the conductor, conductor losses and interference.



Pin 5 (shield) is capacitatively coupled to the chassis of your Fieldbus Box.

Supply voltage

U_S - supplies the electronics for the fieldbus and for the sensor. It is electrically isolated from U_P.

U_P - Is not required for the function of the module, and does not have to be fed in.

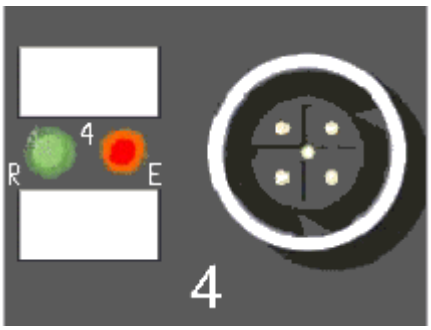
NOTE

Warning

If you use UP to pass the power on, and you connect a module in which US and UP are not electrically isolated (e.g. any digital module) then the electrical isolation is removed by the downstream connection.

LED indicators - meanings

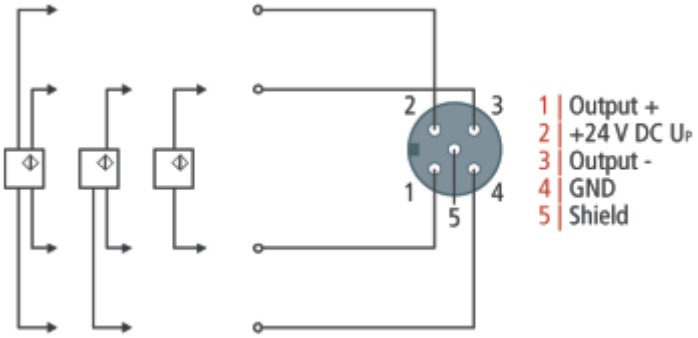
There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED indicates that there is an error (broken conductor, measured value outside the range, temperature compensation outside the valid range).
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.



3.3.4.19 IP4112-Bxxx, IE4112 Signal Connection

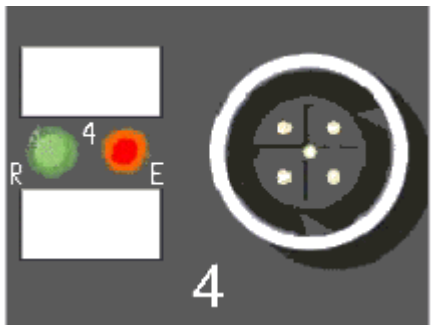
4 Channel Analog Outputs, 0 to 20 mA

The actuator is connected via Output +/-. The actuator can also optionally be operated/supplied with 24 V_{DC}. The shield his capacitatively coupled to the chassis. In order to ensure that interference is effectively dissipated, the chassis must be conductive and earthed through a low resistance.



LED indicators - meanings

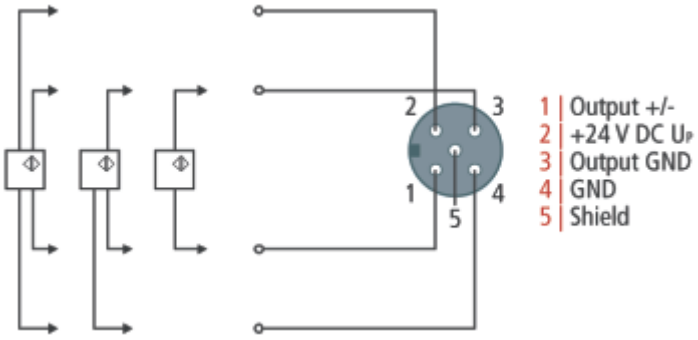
There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED has no function, and only illuminates briefly during the start-up phase.
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.



3.3.4.20 IP4132-Bxxx, IE4132 Signal Connection

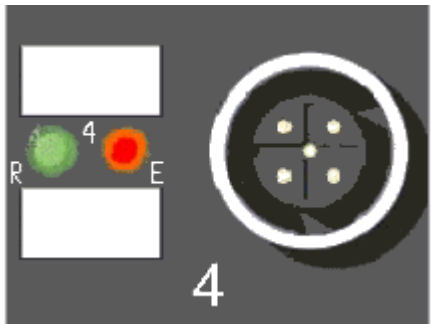
4 Channel Analog Outputs -10 to +10 V

The actuator is connected via Output +/-. The actuator can also optionally be operated/supplied with 24 V_{DC}. The shield his capacitatively coupled to the chassis. In order to ensure that interference is effectively dissipated, the chassis must be conductive and earthed through a low resistance.



LED indicators - meanings

There is a green Run LED and a red Error LED for each channel. The Run LED illuminates when data is being transferred to the D/A converter. The red Error LED has no function, and only illuminates briefly during the start-up phase.
The device is functioning correctly if the Run LED is lit and the Error LED is unlit.

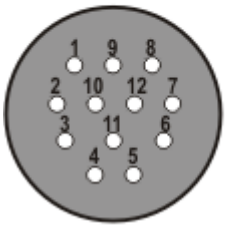


3.3.4.21 IP5009-Bxxx, IE5009 Signal Connection

1 Channel SSI Sensor Interface

The module has a M23 female connector with an external thread.

The SSI Sensor Interface has to be connected as follows:



Encoder	
1	GND
2	+24 V DC Us
3	Clock +
4	Clock -
5	Data +
6	Data -
7	n.c.
8	n.c.
9	n.c.
10	n.c.
11	n.c.
12	n.c.

Meaning of the LEDs

The green LEDs show the operation mode of the module.

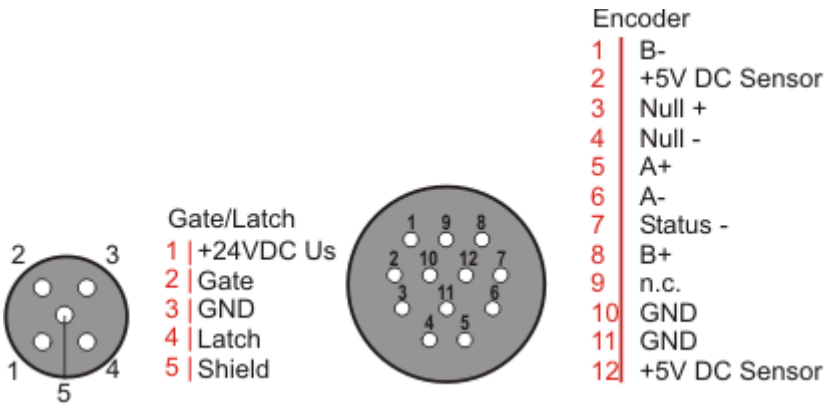
3.3.4.22 IP5109-Bxxx, IE5109 Signal Connection

1 channel Incremental Encoder Interface, 1 MHz

The module has a M23 female connector with an external thread and a M12 female connector with internal thread..

The incremental encoder interface is connected as follows:
The encoder is connected to the M23 via A, B and *Null*. If the encoder has an error signal output, this can be connected via Status input.

The encoder can be enabled by means of *Gate* on the M12 connector. *Latch* can be used, for instance, to connect an external sensor by means of which acquisition of the latched value can be enabled.



Meaning of the LEDs

The green LEDs show the status of the channels A, B and C.

3.3.4.23 IP5209-Bxxx Signal Connection

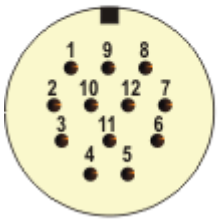
1 channel SinCos encoder interface

The module has a M23 female connector with an external thread.

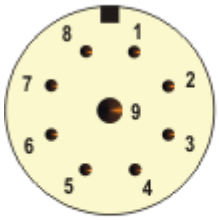
- the 1 Vss- version IP5209-Bxxx-0000 does have a 12-pin connector.
- the 11 µAss version IP5209-Bxxx-**1**000 does have a 9-pin connector.
- the model IP5209-Bxxx-**0**000 (version for 1 V_{SS}) does have a 12-pin connector.
- the model IP5209-Bxxx-**1**000 (version for 11 μA_{SS}) does have a 9-pin connector.

The sensing switch is connected via an M23 connector. This is usually directly hard-wired through a cable to the sensing switch, and contains adapting electronics. The sensing switch/encoder/sensor is supplied with the necessary voltage from the module!

The sine and cosine signals and the reference mark (zero point) are transmitted.



1	B-
2	+5V DC Sensor
3	R+ Reference Mark +
4	R- Reference Mark -
5	A+
6	A-
7	n.c.
8	B+
9	n.c.
10	0V Sensor
11	0V Sensor
12	+5V DC Sensor

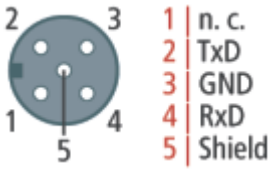


1	I1+
2	I1-
3	+5 V DC Sensor
4	GND
5	I2+
6	I2-
7	I0+.
8	I0-
9	n.c.

3.3.4.24 IP6002-Bxxx, IE6002 Signal Connection

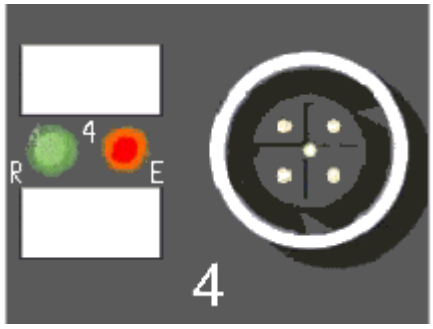
1 channel RS 232 gateway

The RS 232 interface implements full duplex data transmission.



LED indicators - meanings

There is a green *Run* LED and a red *Error* LED for each channel. The green *Run* LED lights up when data is being transmitted. The red *Error* LED lights when an error is detected in the data transmission.



3.3.4.25 IP6012-Bxxx, IE6012 Signal Connection

1 channel TTY gateway

Full duplex transmission is possible through the TTY interface. The module is entirely passive, and therefore current for the data transmission must be supplied by the connected device. If the connected device is also a passive current interface, then the current must be separately supplied (see Fig. 2).

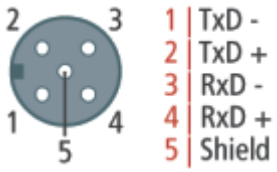


Fig. 1: TTY interface connector pin assignment

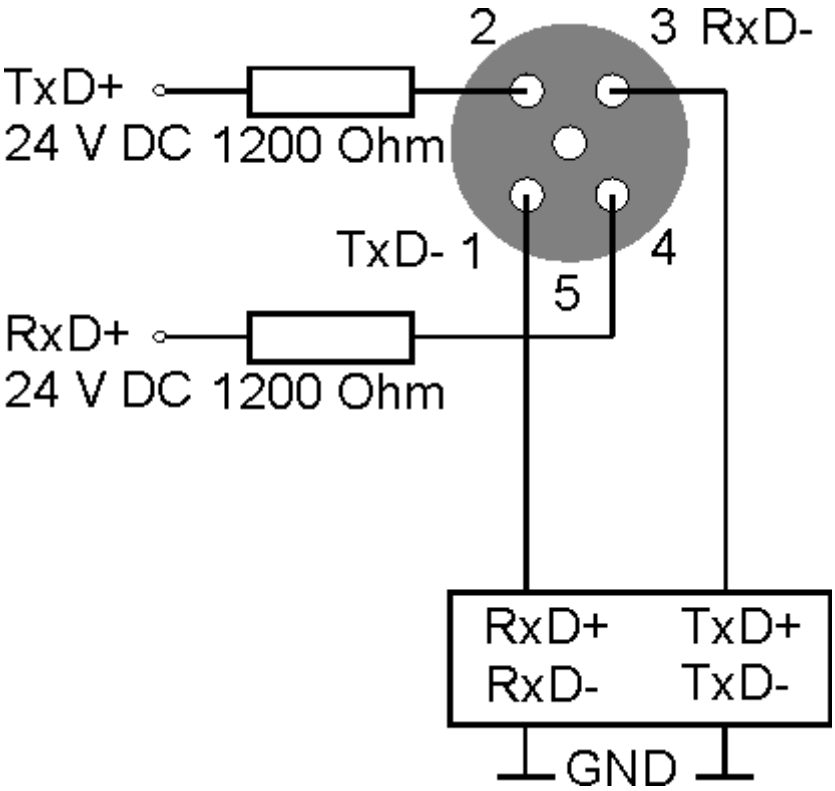
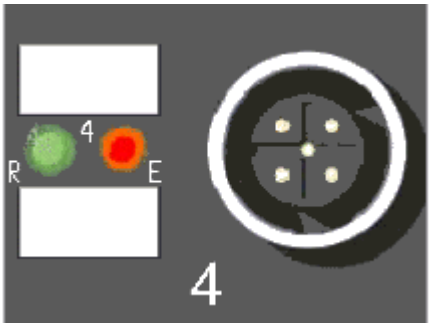


Fig. 2: Connection to a passive TTY device

LED indicators - meanings

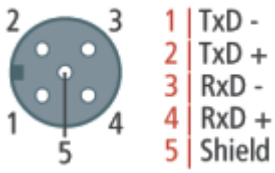
There is a green *Run* LED and a red *Error* LED for each channel. The green *Run* LED lights up when data is being transmitted. The red *Error* LED lights when an error is detected in the data transmission.


4
R
E
4

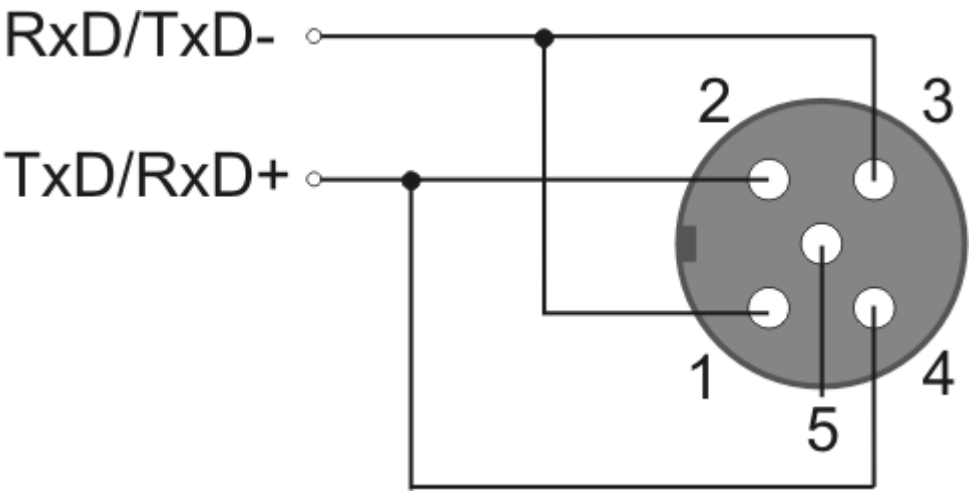
3.3.4.26 IP6022-Bxxx, IE6022 Signal Connection

1 channel RS 422 / RS 485 Gateway

The module can be operated as an RS 422 full duplex device or as an RS 485 half duplex device. To operate it as an RS485 device, ensure that PIN 1 and 3 and PIN 2 and 4 are bridged. The shield is capacitatively coupled to the chassis. If the shield is to effectively suppress interference, the chassis to which the module is fastened must have a low-resistance connection to ground.

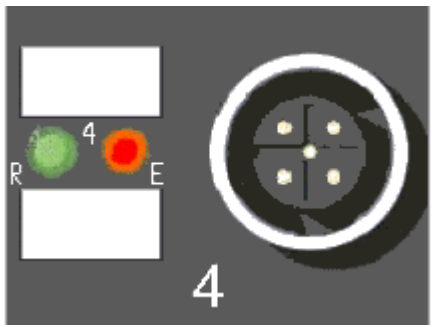


Connection example for RS 485 transmission



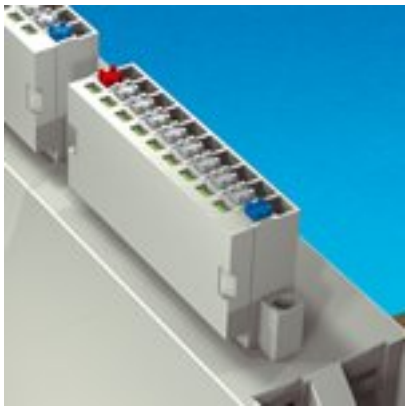
LED indicators - meanings

There is a green *Run* LED and a red *Error* LED for each channel. The green *Run* LED lights up when data is being transmitted. The red *Error* LED lights when an error is detected in the data transmission.

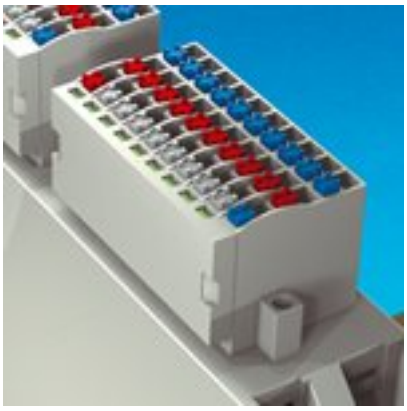


3.3.5 ZS2001 KM connectors

3.3.5.1 Ordering information for KM plug-in connector



KM plug-in connector for single-wire connection (ZS2001-0001, ZS2001-0002)



KM plug-in connector for tree-wire connection (ZS2001-0004)

Ordering name	Signal LEDs	Wiring technique		
		single-wire	two-wire	three-wire
ZS2001-0001	no	yes	no	no
ZS2001-0002	yes	yes	no	no
ZS2001-0004	yes	yes	yes	yes

3.3.5.2 Technical Data

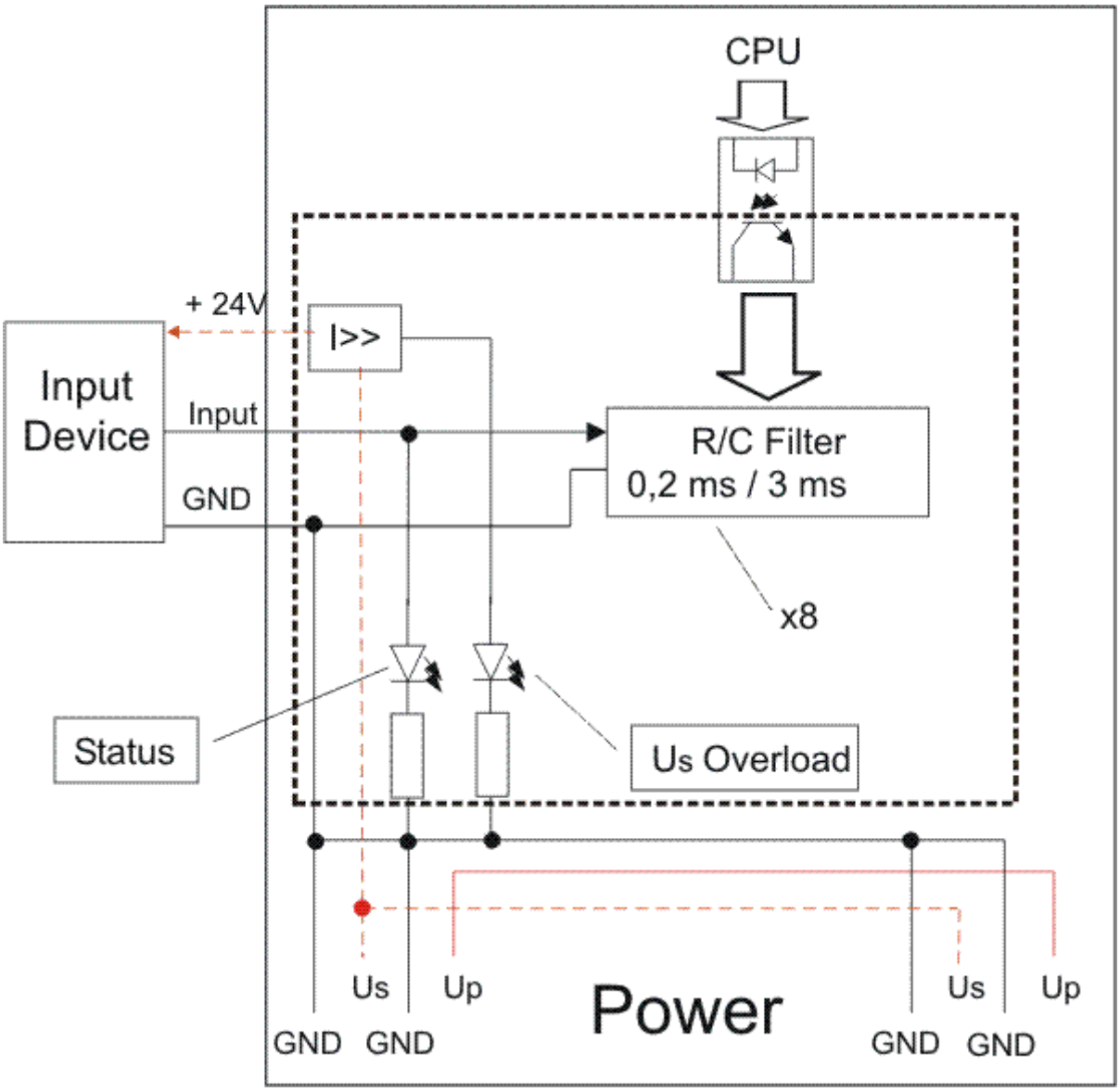
Technical Data	ZS2001-0001	ZS2001-0002	ZS2001-0004
Number of terminal points	10	10	30
Signal LEDs	no	yes	yes
Nominal voltage	50 V_{DC}	24 V_{DC}	24 V_{DC}
Nominal current	2 A		
Wire size with	0,5 mm^2 ... 1,5 mm^2		
Wire stripping length	8 mm		
Dimensions (w x h x d)	app. 42mm x 10,3mm x 26,9mm	app. 42mm x 12,7mm x 26,9mm	app. 42mm x 20,8mm x 26,9mm
Weight	app. 10 g	app. 10 g	app. 20 g
Permissible ambient temperature range during operation	0°C ... + 55°C		
Permissible ambient temperature range during storage	-25°C ... + 85°C		
Permissible relative humidity	95%, no condensation		
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29		
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP 20		
Installation position	variable		
Approval	CE		

3.4 Block Diagrams

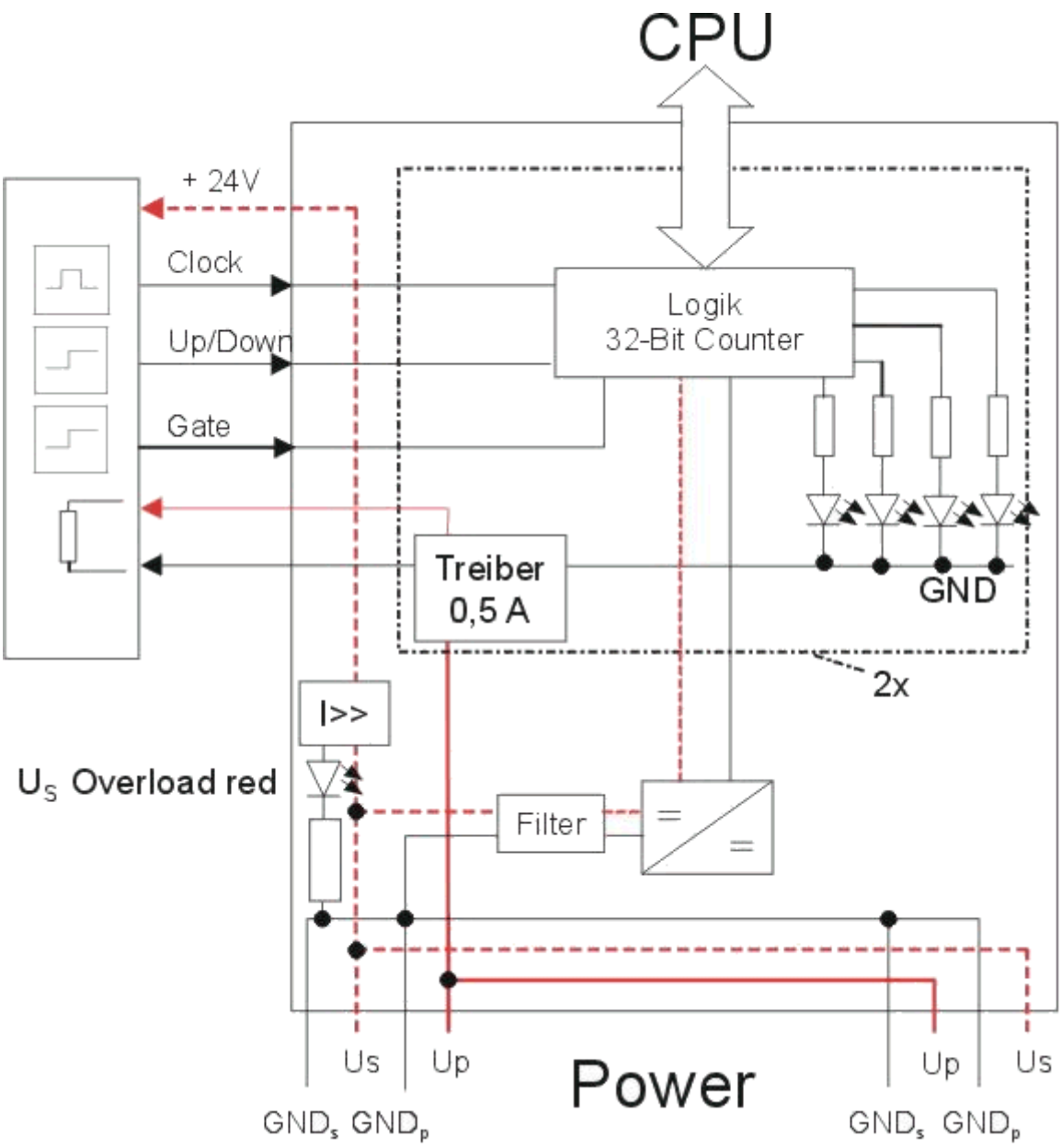
3.4.1 Overview of the Block Diagrams

Type	Description	Drawing
IP/IE1xxx	8 digital inputs 24 V_{DC}	Block Diagram [▶ 128]
IP/IE1502	Up/down counter, 24 V_{DC}, 100 kHz	Block Diagram [▶ 129]
IP/IE200x	8 digital outputs 24 V_{DC}, 0.5 A	Block Diagram [▶ 130]
IP/IE202x	8 digital outputs 24 V_{DC}, 2.0 A, total = 4 A	Block Diagram [▶ 130]
IP/IE204x	8 digital outputs 24 V_{DC}, 2.0 A, total = 12 A	Block Diagram [▶ 130]
IP/IE23xx	4 digital inputs 24 V_{DC}, 4 digital outputs 24 V_{DC}	Block Diagram [▶ 131]
IP/IE2400, IP/IE2401	8 digital inputs 24 V_{DC}, 8 digital outputs 24 V_{DC}	Block Diagram [▶ 132]
IE2403 (IP20)	8 digital inputs 24 V_{DC}, 8 digital outputs 24 V_{DC}	Block Diagram [▶ 133]
IP/IE2512	2 channel pulse-width output	Block Diagram [▶ 134]
IE2808	16 digital outputs 24 V_{DC}, 2,0 A, total = 4 A	Block Diagram [▶ 135]
IP/IE3102	4 analog differential inputs, +-10V, 16 bit	Block Diagram [▶ 137]
IP/IE3112	4 analog differential inputs, 0...20 mA, 16 bit	Block Diagram [▶ 138]
IP/IE3202	4 analog differential inputs, RTD, 16 bit	Block Diagram [▶ 139]
IP/IE3312	4 analog differential inputs, thermocouples, 16 bit	Block Diagram [▶ 140]
IP/IE4112	4 analog differential outputs 0...20 mA, 16 bit	Block Diagram [▶ 141]
IP/IE4132	4 analog differential outputs +- 10 V, 16 bit	Block Diagram [▶ 142]
IP/IE5009	SSI Sensor interface	Block Diagram [▶ 143]
IP/IE5109	Incremental encoder input	Block Diagram [▶ 144]
IP5209	Sin/cos encoder input	Block Diagram [▶ 145]
IP/IE6002	Serial interface RS232	Block Diagram [▶ 146]
IP/IE6012	Serial interface 0...20 mA (TTY)	Block Diagram [▶ 147]
IP/IE6022	Serial interface RS485	Block Diagram [▶ 148]

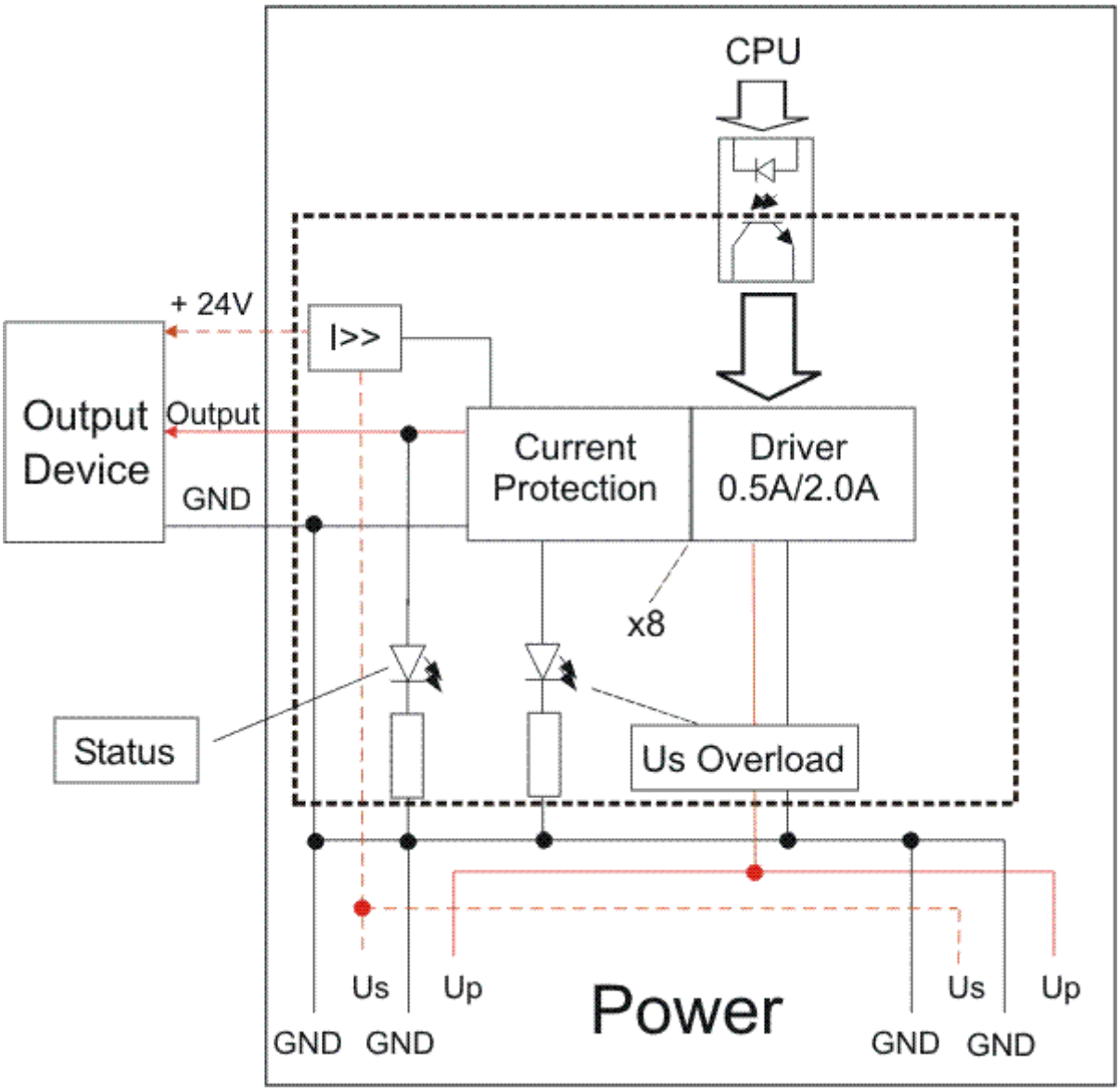
3.4.2 IP/IE1xxx Block Diagram



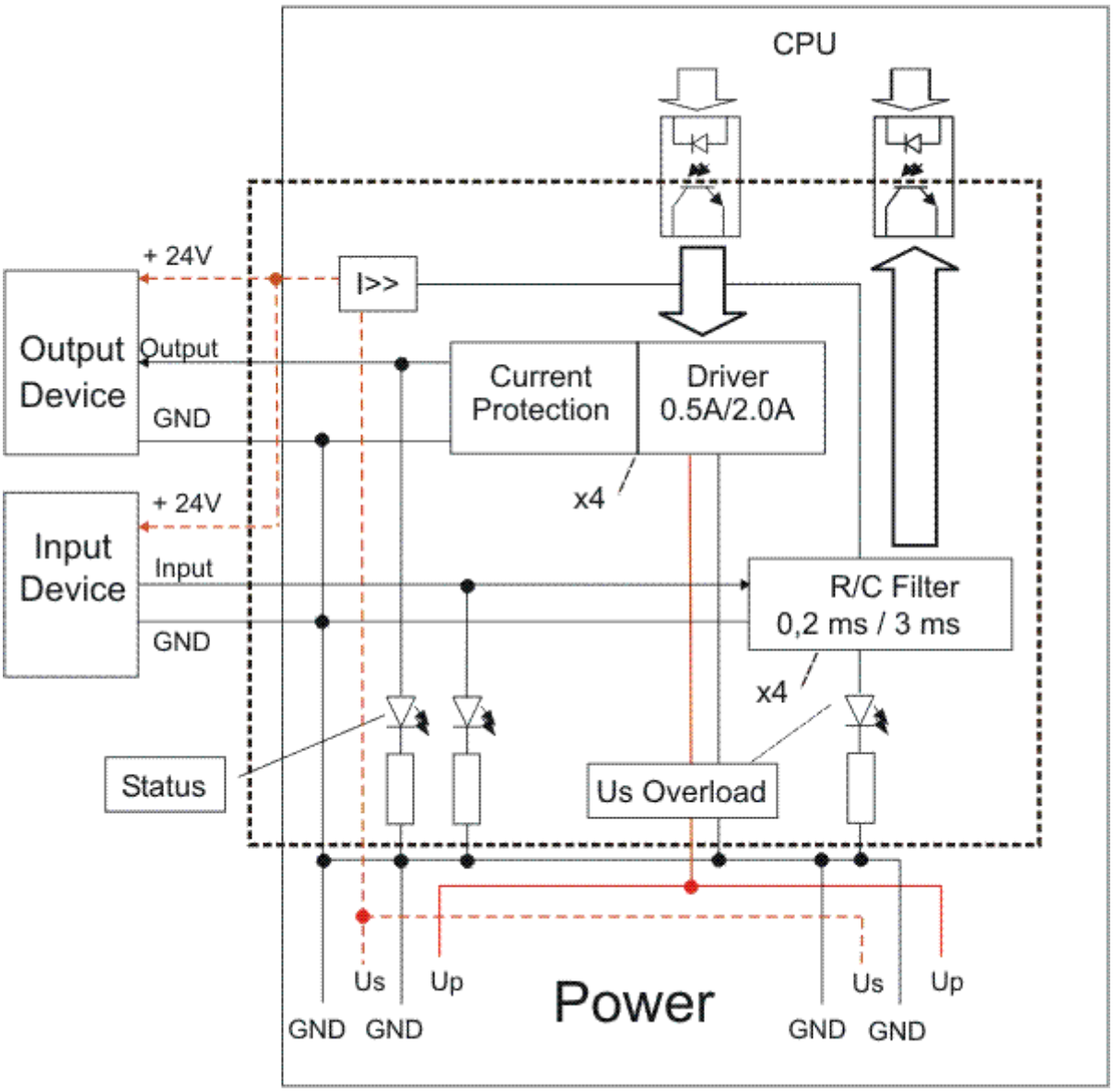
3.4.3 IP/IE1502 Block Diagram



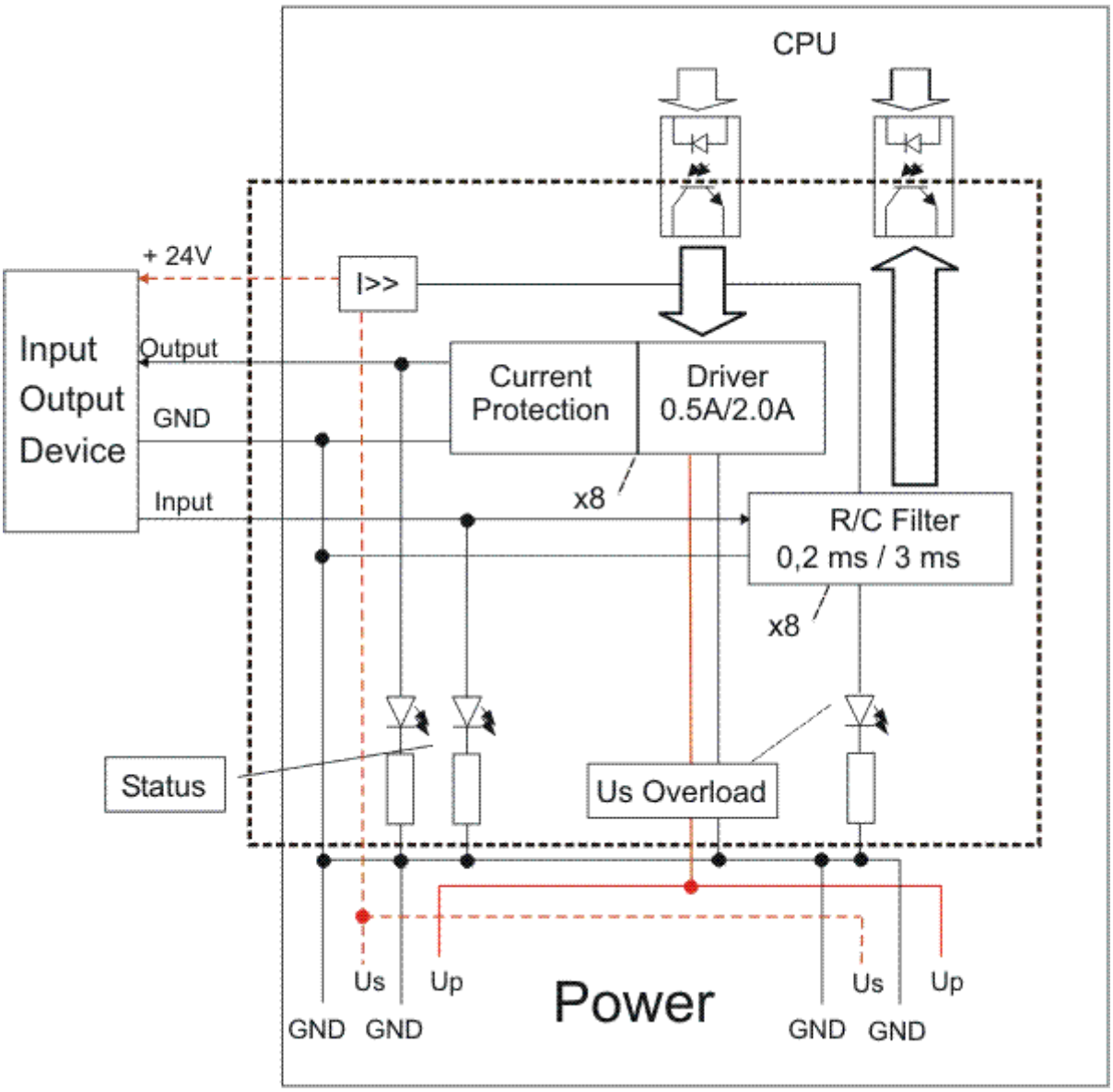
3.4.4 IP/IE20xx Block Diagram



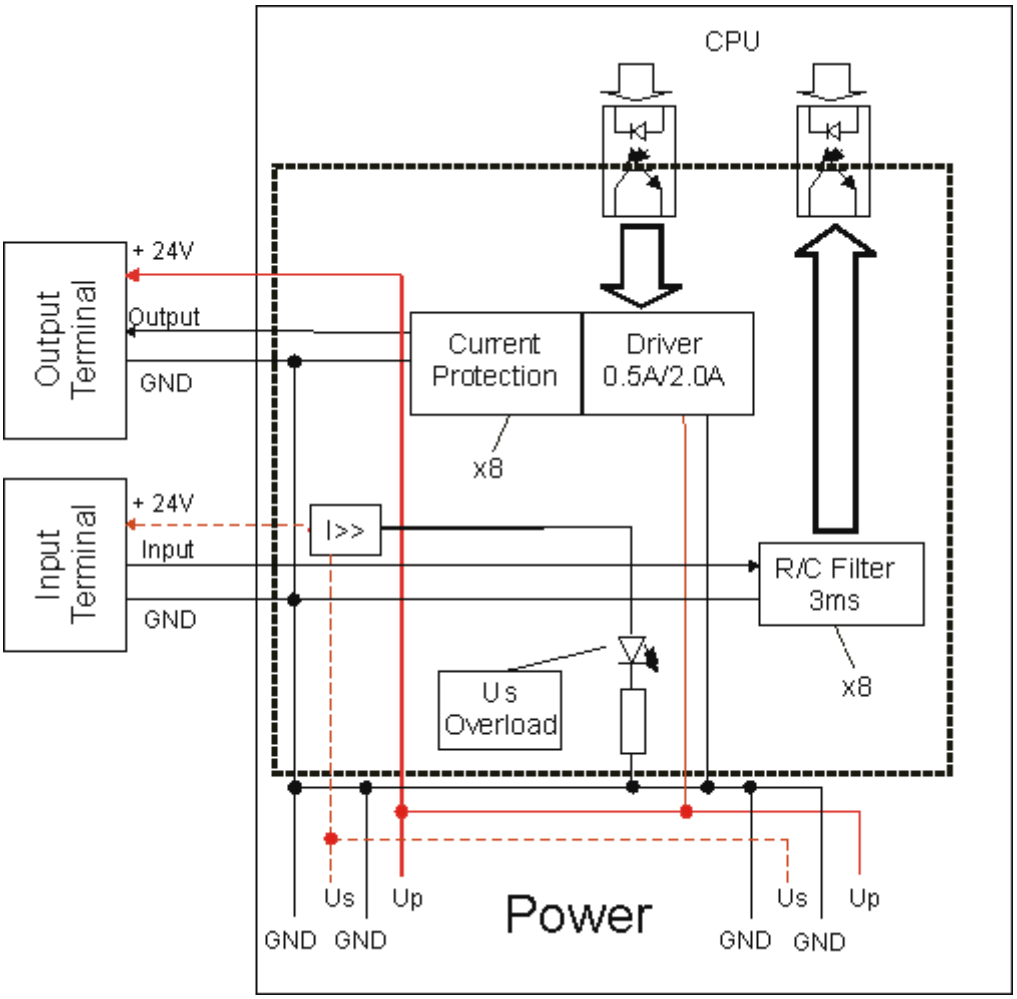
3.4.5 IP/IE23xx Block Diagram



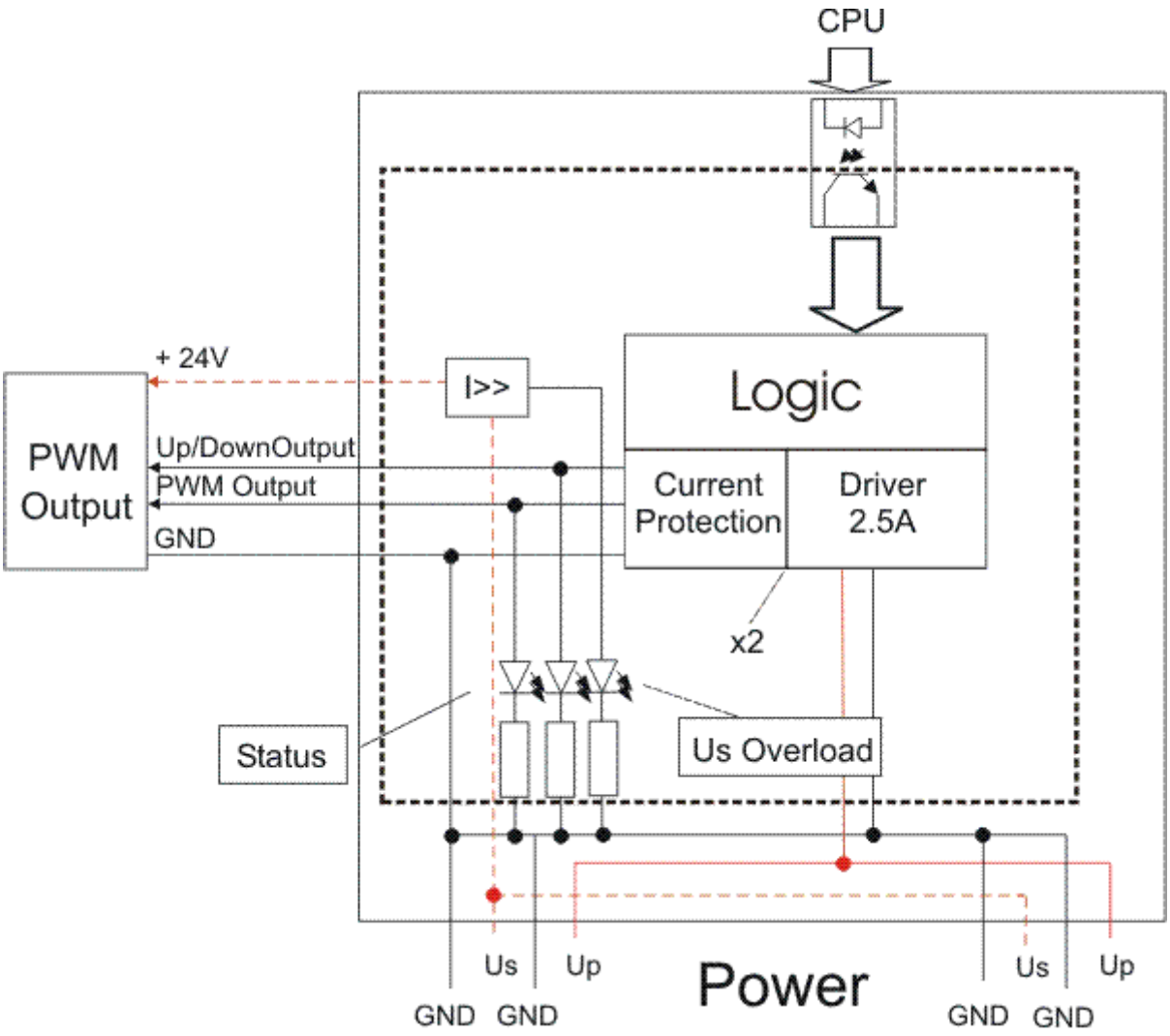
3.4.6 IP/IE2400, IP/IE2401 Block Diagram



3.4.7 IE2403 Block Diagram



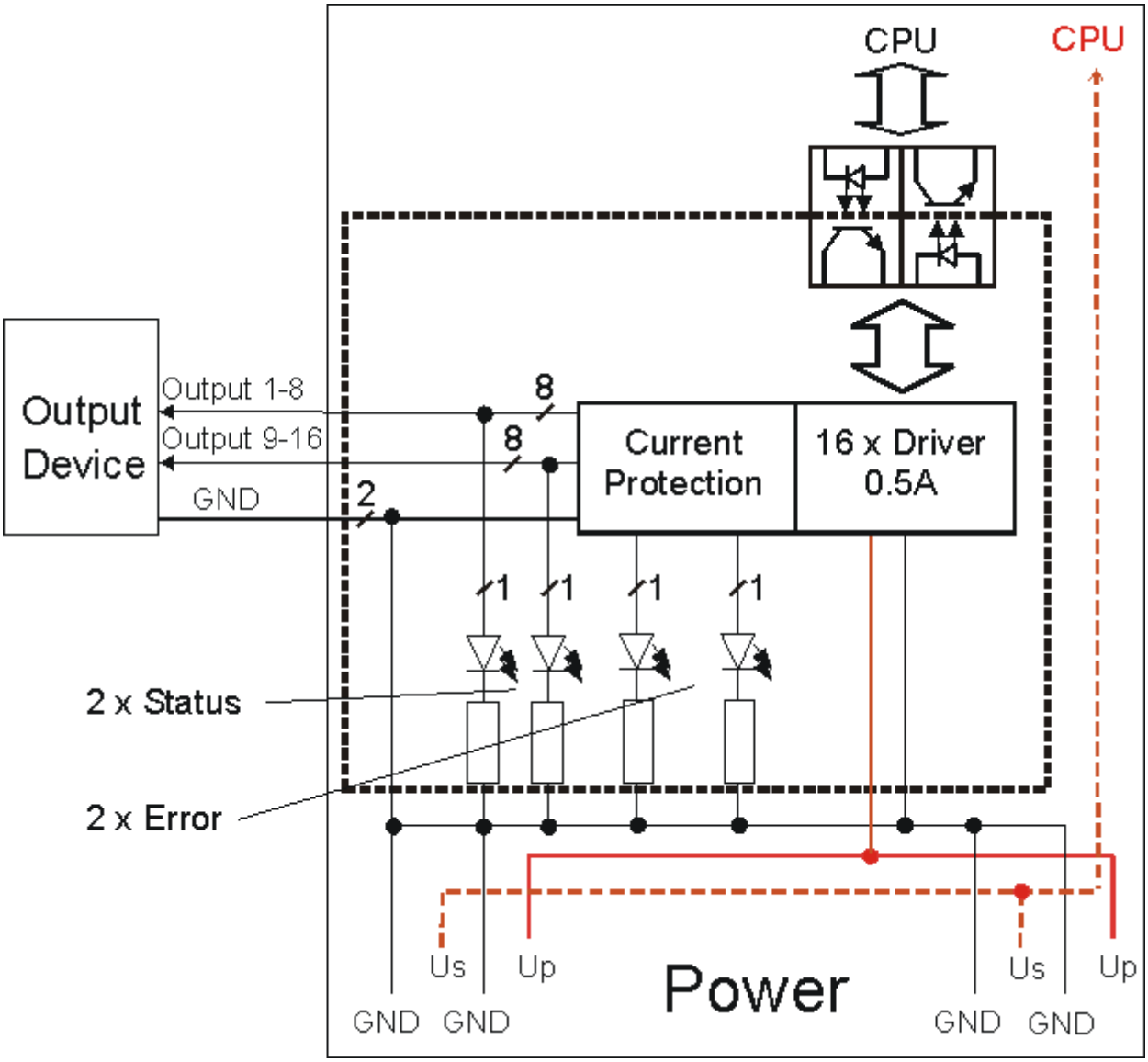
3.4.8 IP/IE2512 Block Diagram



3.4.9 IE2808 Block Diagram

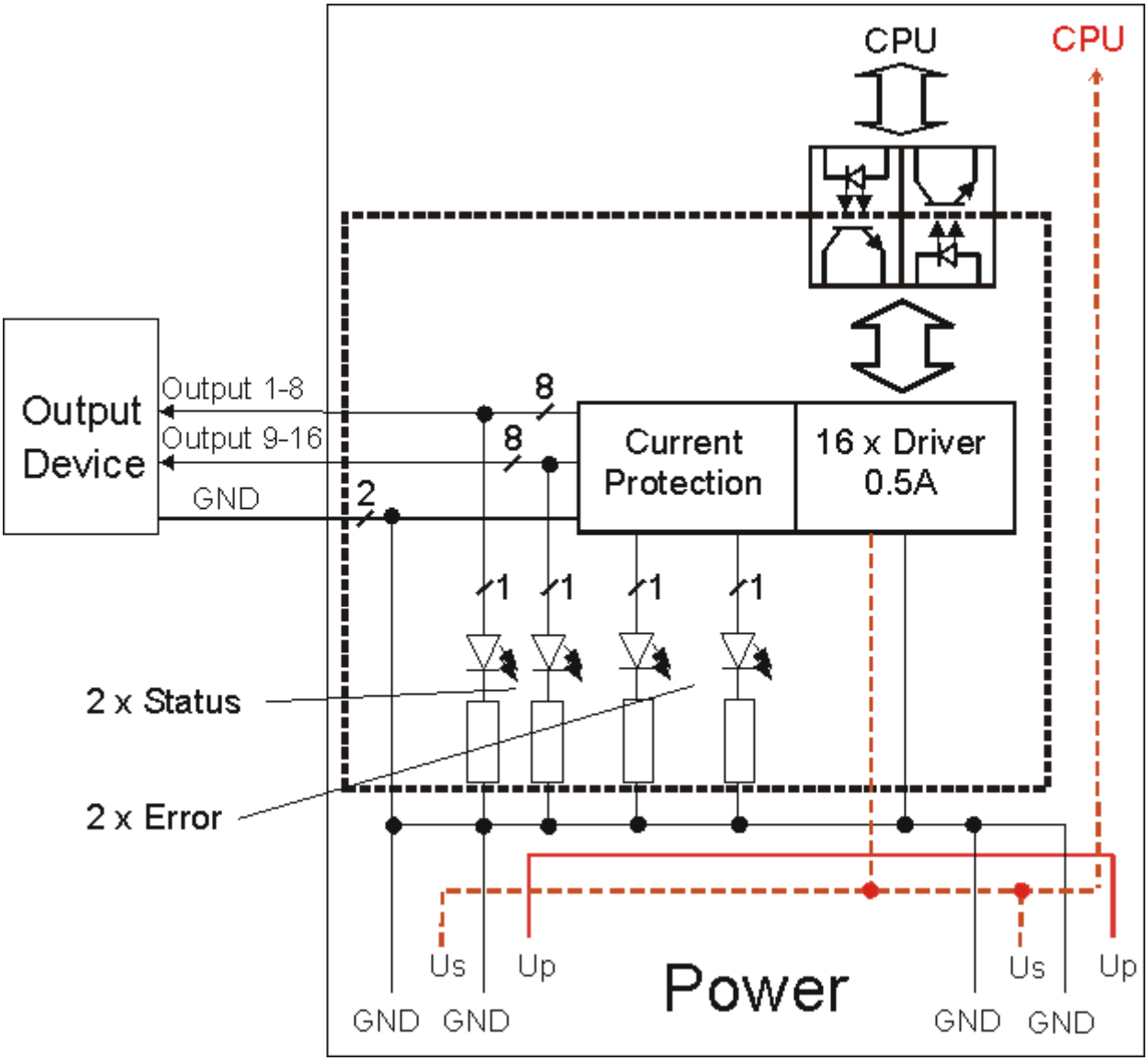
From hardware version 0012:

hardware version [▶ 15]

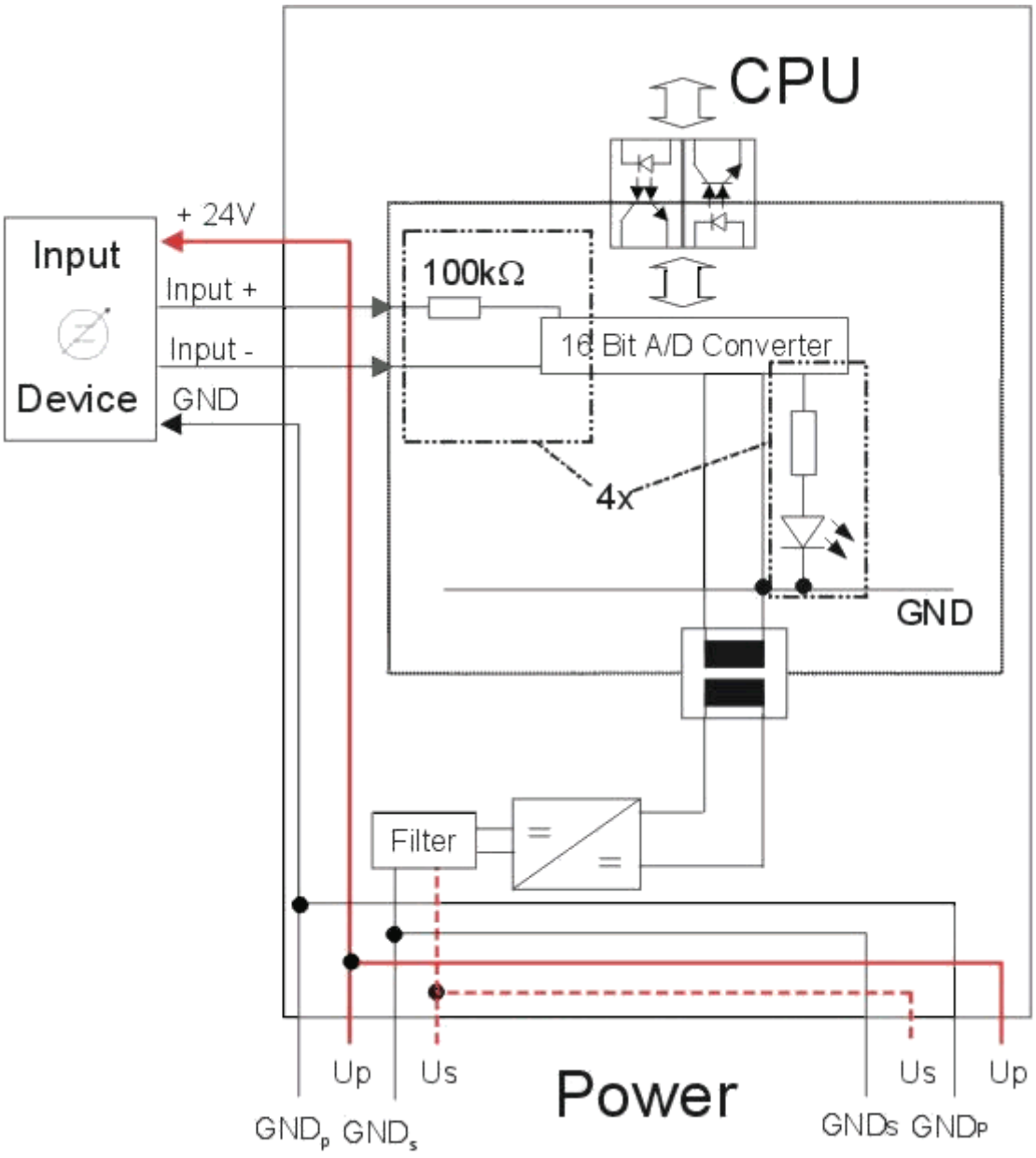


Untill hardware version 0011:

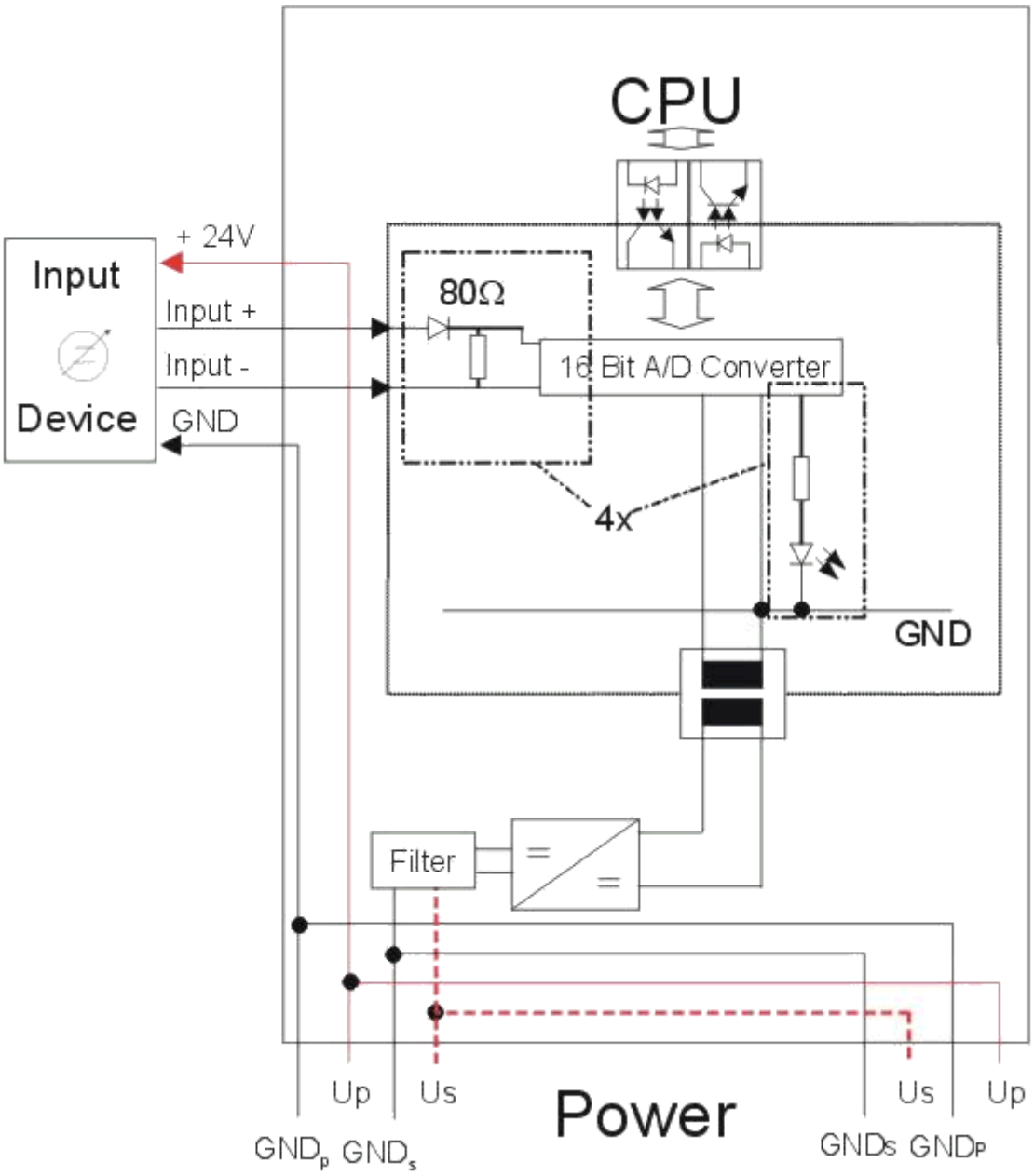
hardware version [▶ 15]


CPU
CPU
Output Device
Output 1-8
Output 9-16
GND
8
8
2
Current Protection
16 x Driver 0.5A
1
1
1
1
2 x Status
2 x Error
Us
Up
Power
Us
Up
GND
GND
GND
GND

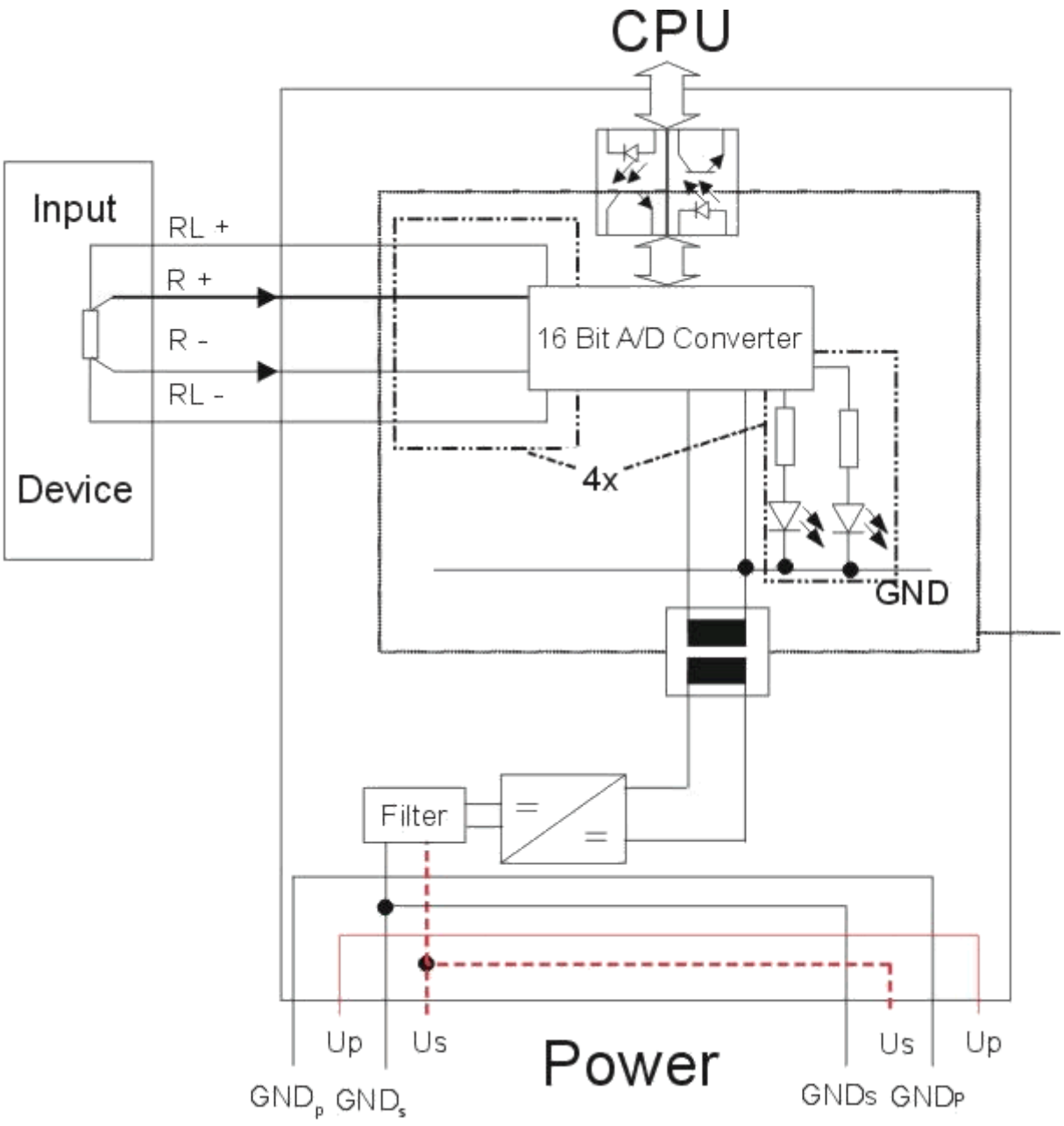
3.4.10 IP/IE3102 Block Diagram



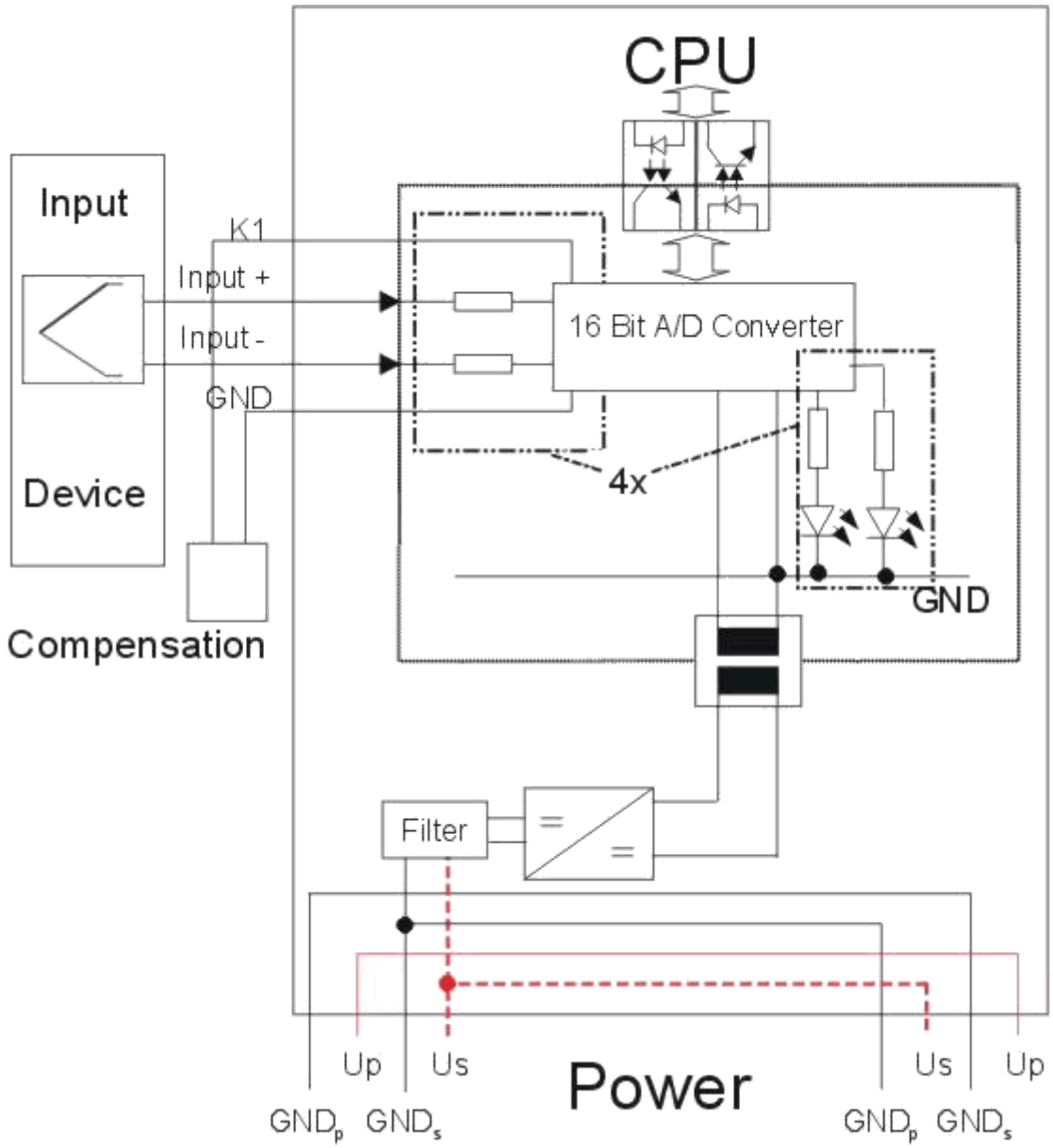
3.4.11 IP/IE3112 Block Diagram



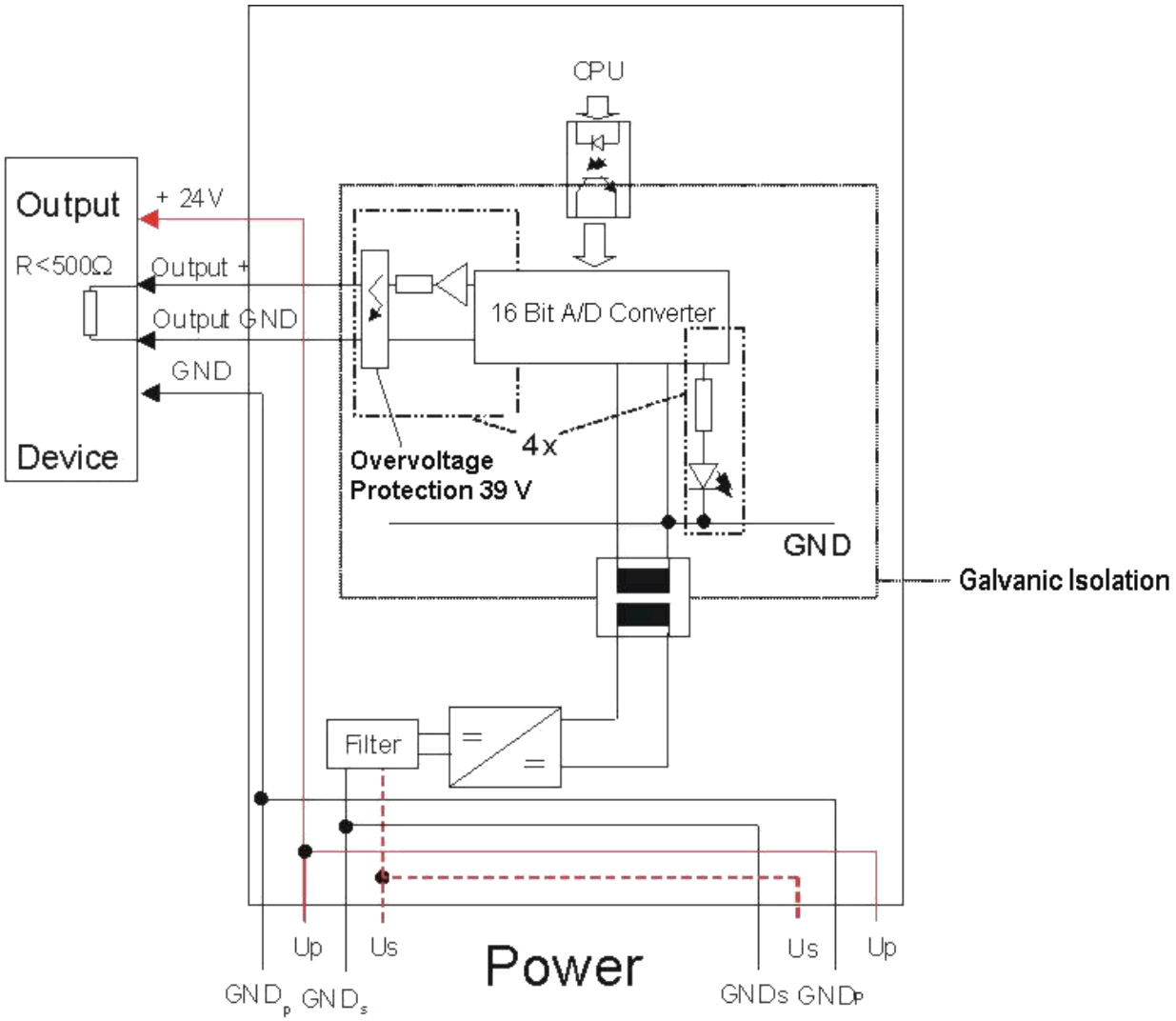
3.4.12 IP/IE3202 Block Diagram



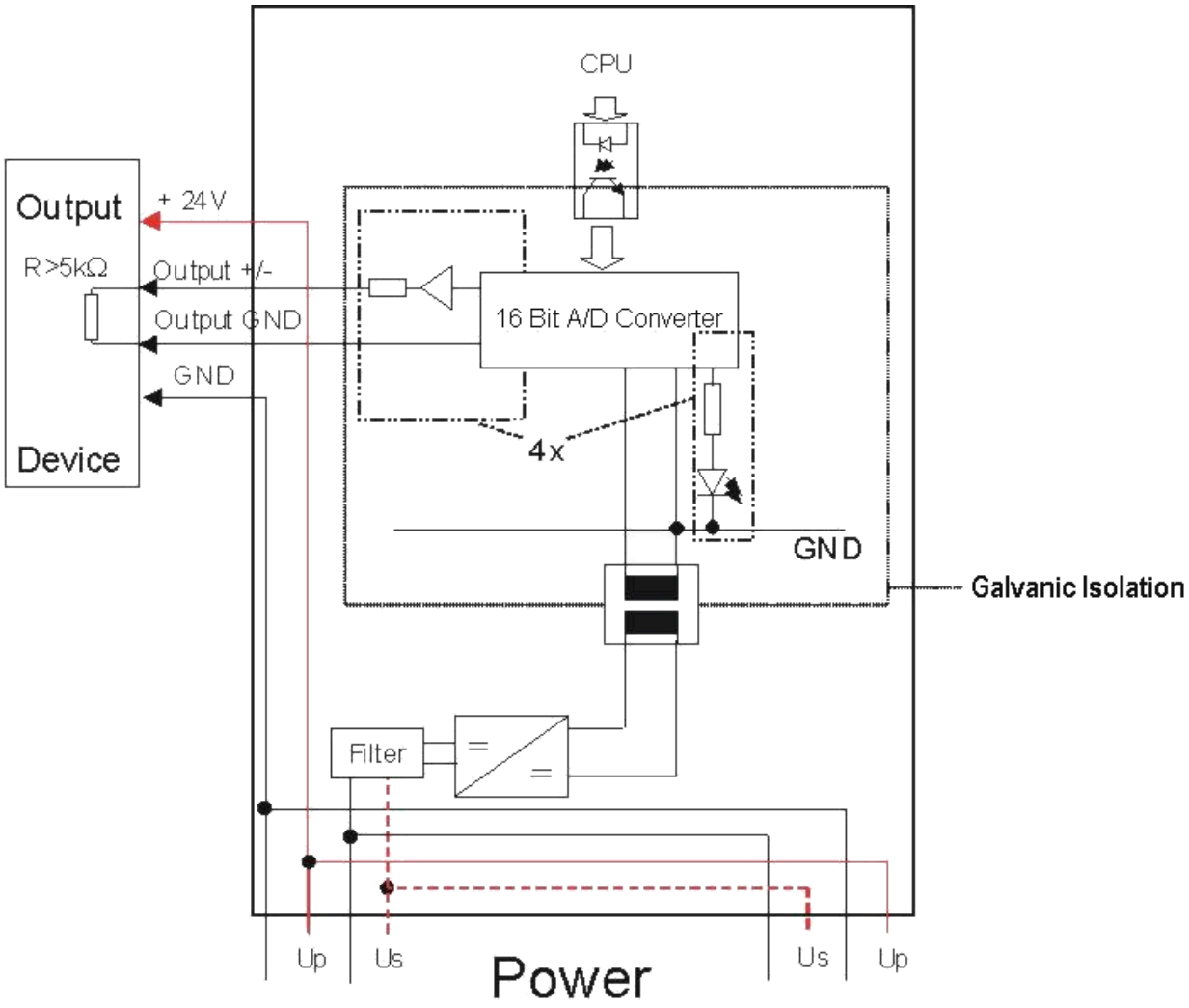
3.4.13 IP/IE3312 Block Diagram



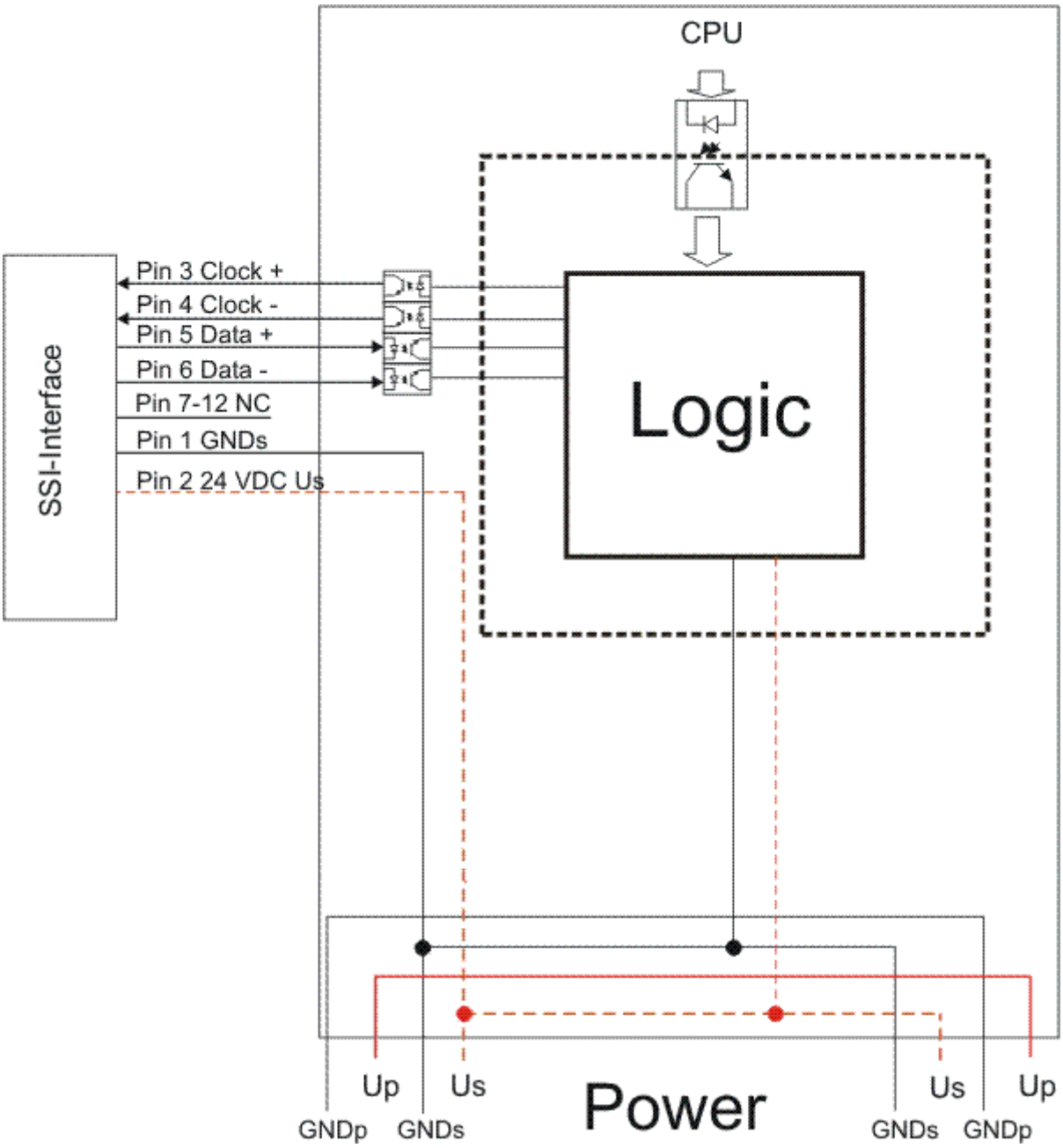
3.4.14 IP/IE4112 Block Diagram



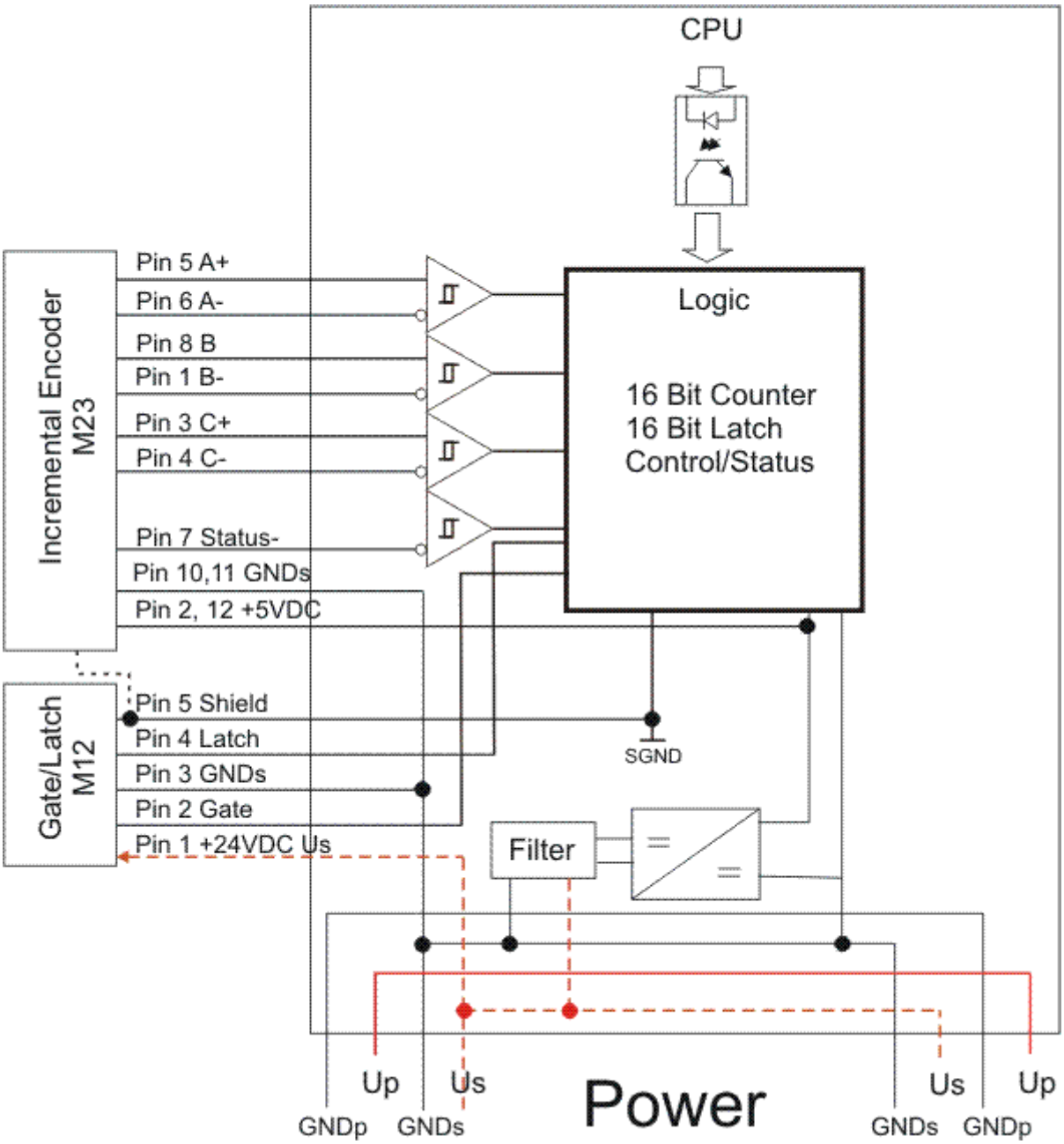
3.4.15 IP/IE4132 Block Diagram



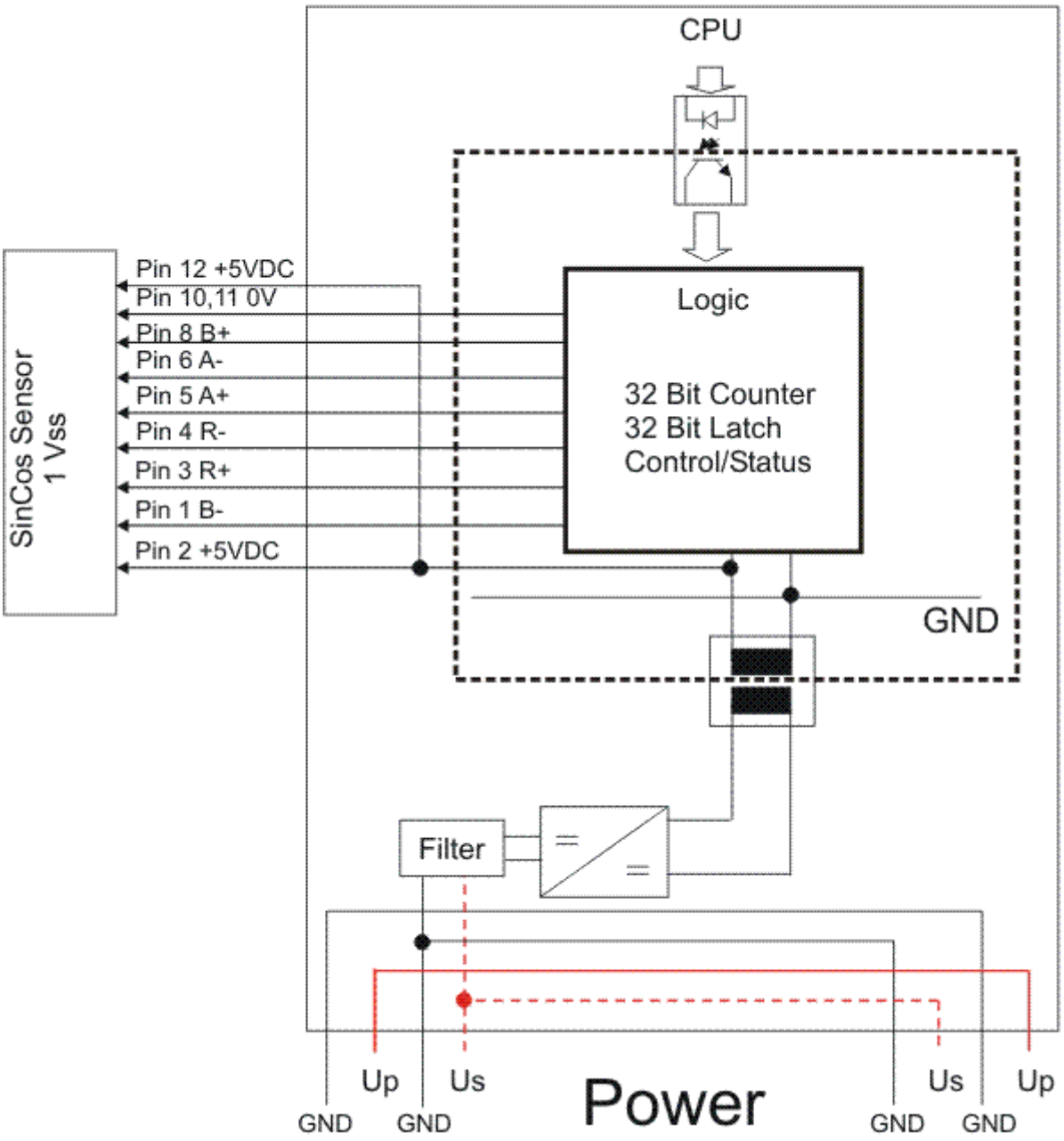
3.4.16 IP/IE5009 Block Diagram



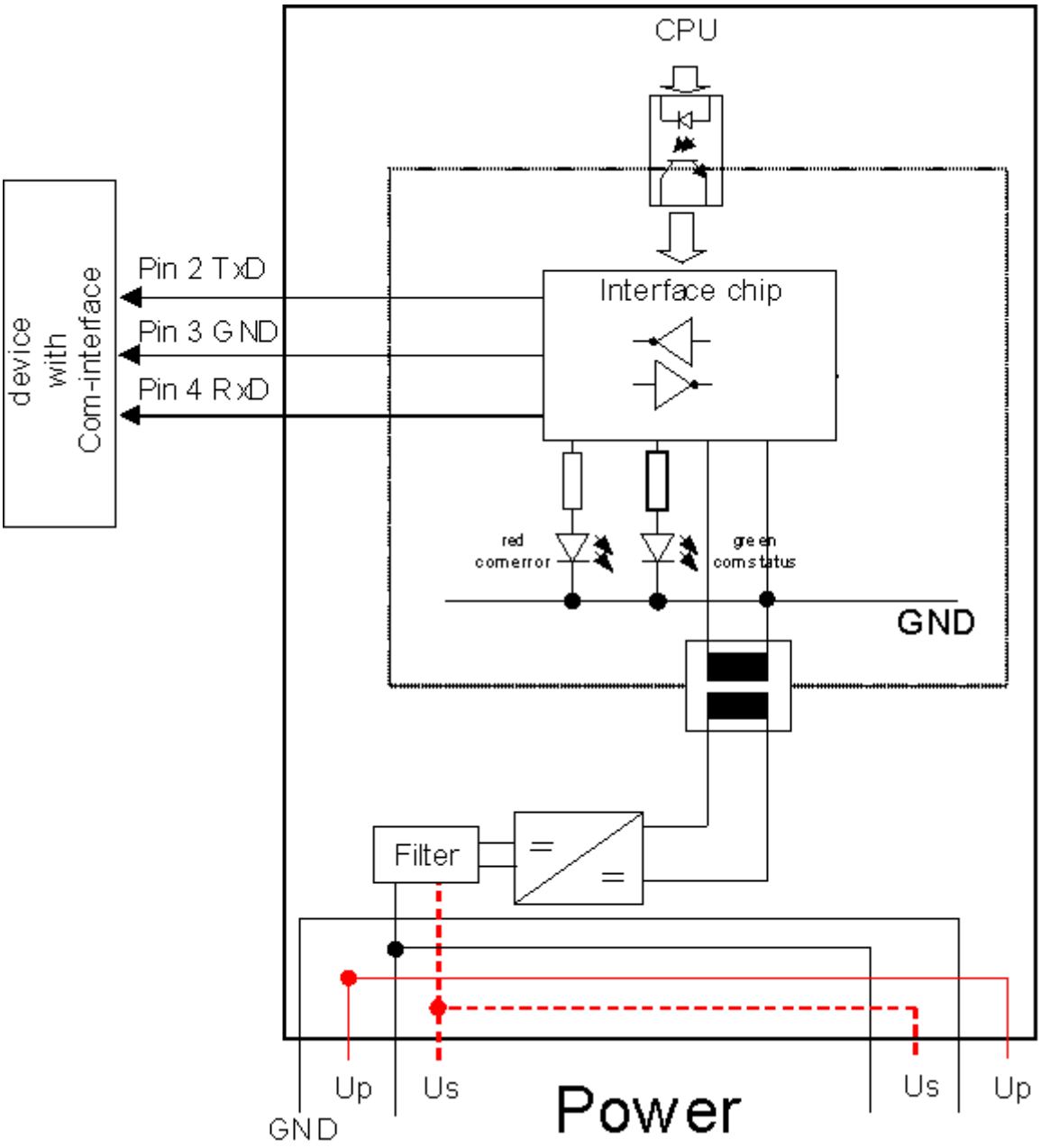
3.4.17 IP/IE5109 Block Diagram



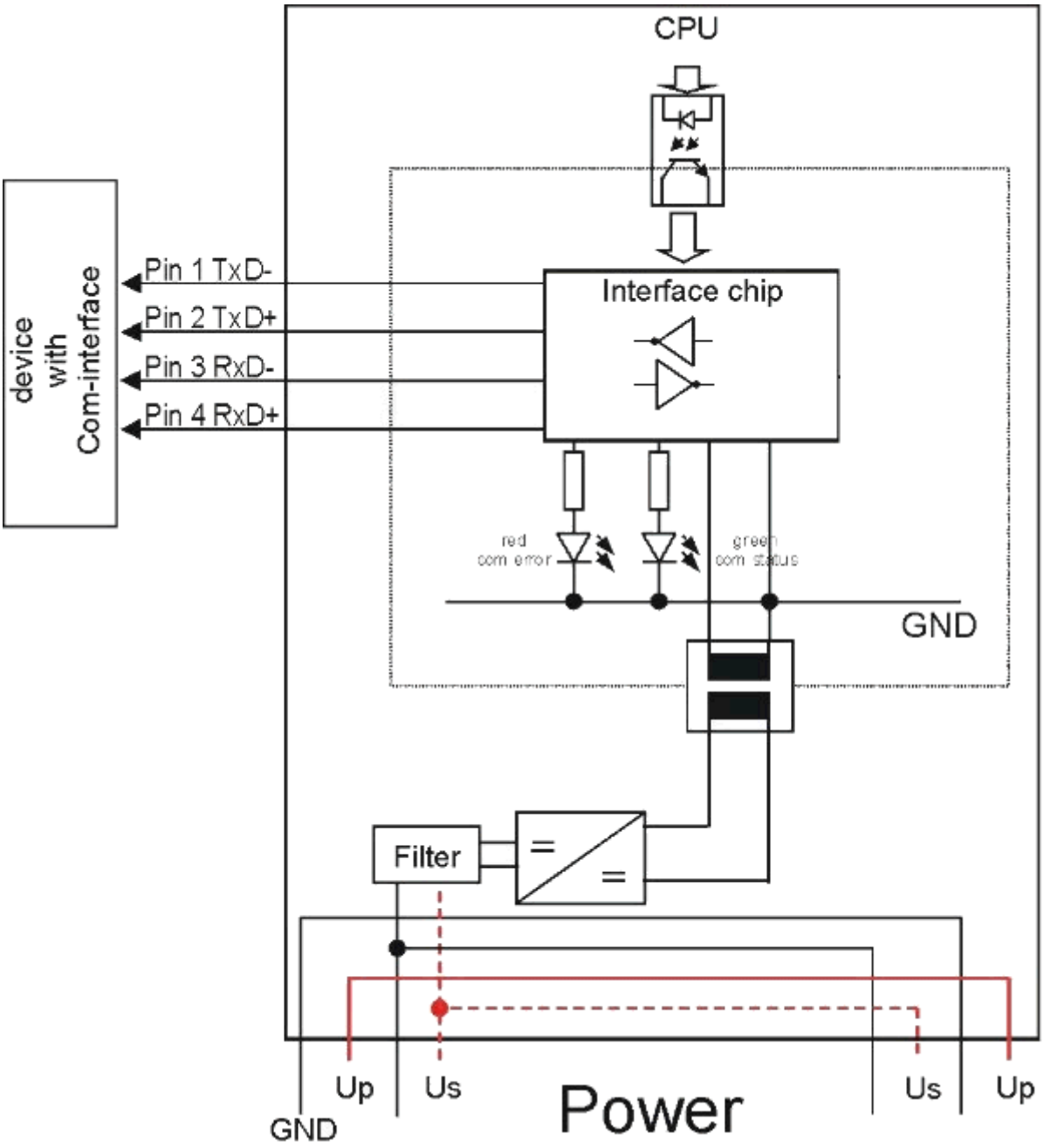
3.4.18 IP/IE5209 Block Diagram



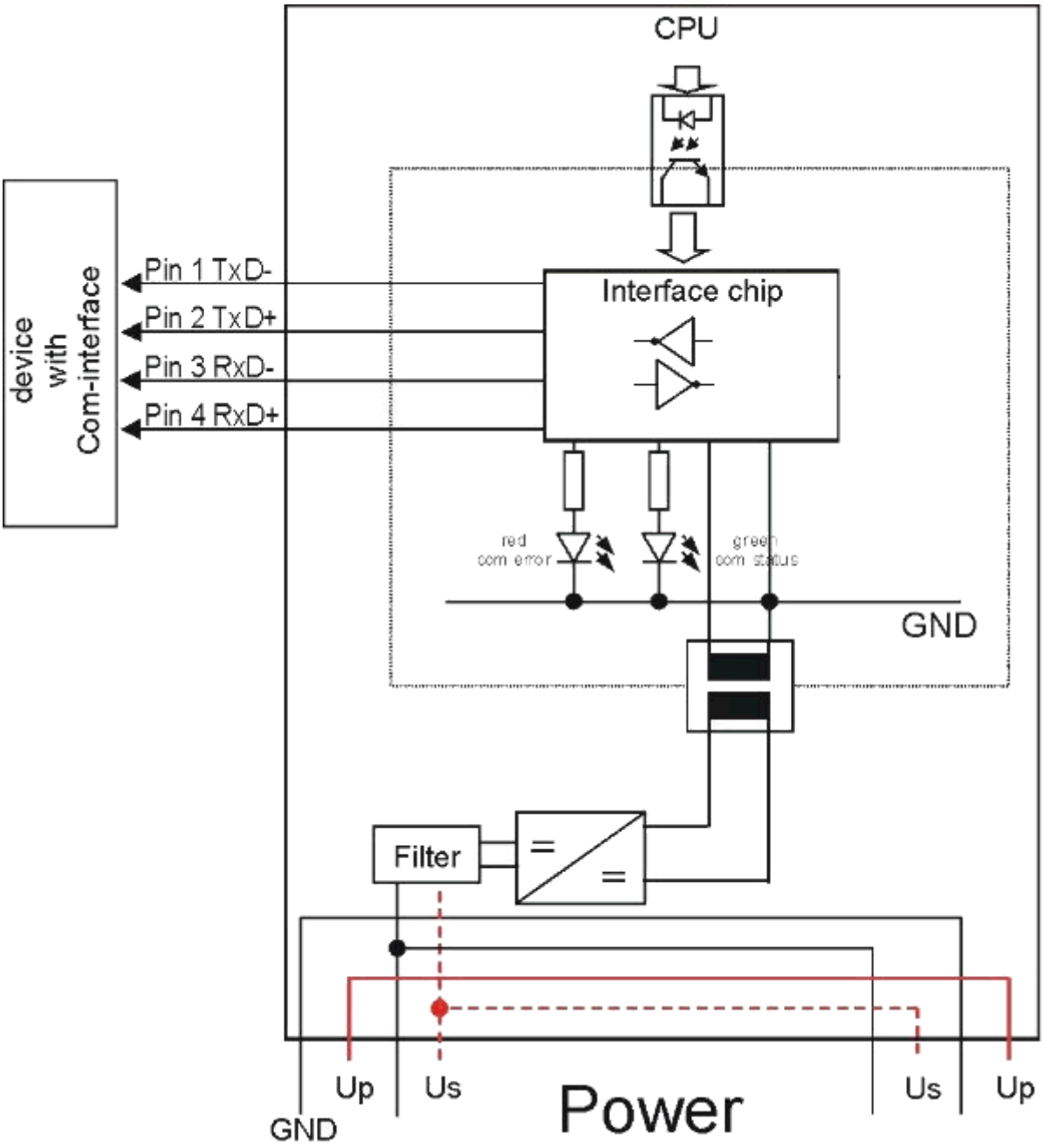
3.4.19 IP/IE6002 Block Diagram



3.4.20 IP/IE6012 Block Diagram



3.4.21 IP/IE6022 Block Diagram



3.5 Mapping of the Fieldbus Box Modules

The Fieldbus Box Modules have a memory for the image of the process data. This memory can be read from or written to by the fieldbus master. The size and the type of the process data image depends on the type of Fieldbus Box, the configuration, the fieldbus system and the fieldbus master.

- bit oriented Fieldbus Box Modules (basically digital modules) have a fixed quantity of data.
- Only in the case of the byte oriented Fieldbus Box Modules (e.g. analog modules und modules for special functions) some changes can be made:
  - compact and complete mapping
  - swapping the high and low bytes (Intel / Motorola format)
  - Word-Alignment (only LightBus and Ethernet)
- A Coupler Box has a variable mapping that depends on the type and number of extension boxes that are connected.

Bit oriented Fieldbus Box Modules

Bit oriented Fieldbus Box Modules possess a specified number of inputs and/or outputs, that cannot be changed.

	Input Data	Output Data
Module	**Number of used bits**	**Number of used bits**
IP10xx-Byyy IE10xx	8	0
IP20xx-Byyy IE20xx	0	8
IP23xx-Byyy IE23xx	4 (although the 4 most significant bit are not used, they occupy space in the process data memory)	4 (although the 4 most significant bit are not used, they occupy space in the process data memory)
IP2400-Byyy, IP2401-Byyy IE2400, IE2401, IE2403	8	8

"yyy" stands for the bus system and the bus connection (see chapter Naming Conventions).

Byte oriented Fieldbus Boxes

Byte oriented Fieldbus Box Modules can operate with compact or complete process image. The number of bytes for complete mapping are given in brackets.

	Input Data	Output Data
Module	**Number of used bytes**	**Number of used bytes**
IP15xx-Byyy IE15xx	6 (6)	6 (6)
IP25xx-Byyy IE25xx	6 (6)	6 (6)
IE2808	2 (3)	2 (3)
IP3xxx-Byyy IE3xxx	8 (12)	0 (12)
IP41xx-Byyy IE41xx	0 (12)	8 (12)
IP5009-Byyy IE5009	4 (6)	4 (6)
IP5109-Byyy IE5109	6 (8)	6 (8)
IE5209	10 (10)	10 (10)
IP6xxx-Byyy IE6xxx	6 (6)	6 (6)

With activated Word-Alignment, the number of occupied bytes can increase because not used bytes may be added. Details can be taken from the module specific mapping descriptions.

3.5.1 IP/IE10xx Mapping

All IP/IE10xx are mapped with 8 bits inputs in the process image, and are the same for all bus systems.

3.5.2 IP/IE1502 Mapping

Evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	Ch1 D2	Ch1 D1	Ch1 D2	Ch1 D1
	2	SB2	Ch1 D3	CB2	Ch1 D3
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	Ch2 D3	Ch2 D2	Ch2 D3	Ch2 D2

Evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: no	0	Ch1 D3	SB1	Ch1 D3	CB1
	1	Ch1 D1	Ch1 D2	Ch1 D1	Ch1 D2
	2	SB2	Ch1 D0	CB2	Ch1 D0
	3	Ch2 D2	Ch2 D3	Ch2 D2	Ch2 D3
	4	Ch2 D0	Ch4 D1	Ch2 D0	Ch4 D1

Evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	Ch1 D3	Ch1 D2	Ch1 D3	Ch1 D2
	3	reserved	SB2	reserved	CB2
	4	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	5	Ch2 D3	Ch2 D2	Ch2 D3	Ch2 D2

Table 6: Evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D2	Ch1 D3	Ch1 D2	Ch1 D3
	2	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	3	reserved	SB2	reserved	CB2
	4	Ch2 D2	Ch2 D3	Ch2 D2	Ch2 D3
	5	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, data byte 0 (lowest significant byte)
Ch n D1: channel n, data byte 1
Ch n D2: channel n, data byte 2
Ch n D3: channel n, data byte 3 (most significant byte)

reserved: Although this byte occupies space in the process data memory, it has no function
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.3 IP/IE20xx Mapping

All IP/IE20xx are mapped with 8 bits outputs in the process image, and are the same for all bus systems.

3.5.4 IP/IE23xx Mapping

All IP/IE23xx are mapped with 4 bits inputs and 4 bits outputs in the process image, and are the same for all bus systems.

Under PROFIBUS, the mapping can be rounded to a byte (see byte align).

3.5.5 IP/IE240x Mapping

All IP/IE240x are mapped with 8 bits inputs and 8 bits outputs in the process image, and are the same for all bus systems.

3.5.6 IP/IE2512 Mapping

Evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: no	0	Ch1 Reg0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 Reg1	CB2	Ch1 D1
	2	Ch2 Reg1	Ch2 Reg0	Ch2 D1	Ch2 D0

Evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: no	0	Ch1 Reg1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 Reg0	CB2	Ch1 D0
	2	Ch2 Reg0	Ch2 Reg1	Ch2 D0	Ch2 D1

Evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 Reg1	Ch1 Reg0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 Reg1	Ch2 Reg0	Ch2 D1	Ch2 D0

Table 7: Evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 Reg0	Ch1 Reg1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 Reg0	Ch2 Reg1	Ch2 D0	Ch2 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

Ch n Reg0: channel n, lower significant byte for register communication
Ch n Reg1: channel n, higher significant byte for register communication

reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.7 IE2808 Mapping

Table 8: Compact evaluation

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: don't care Word alignment: don't care	0	-	-	Out2	Out1

Table 9: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: don't care Word alignment: no	0	Diag1	SB	Out1	CB
	1	-	Diag2	-	Out2

Table 10: Complete evaluation in Intel format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: don't care Word alignment: yes	0	Diag1	SB	Out1	CB
	1	res.	Diag2	res.	Out2

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB: Status Byte (appears in the process image of the inputs)
CB: Control Byte (appears in the process image of the outputs)

Out1: Input bits of channel 8 to 1
Out2: Input bits of channel 16 to 9

Diag1: Diagnostic bits of channel 8 to 1
Diag2: Diagnostic bits of channel 16 to 9

res.: reserved; Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.8 IP/IE3102 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	Ch1 D1	Ch1 D0	-	-
	1	Ch2 D1	Ch2 D0	-	-
	2	Ch3 D1	Ch3 D0	-	-
	3	Ch4 D1	Ch4 D0	-	-

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	Ch1 D0	Ch1 D1	-	-
	1	Ch2 D0	Ch2 D1	-	-
	2	Ch3 D0	Ch3 D1	-	-
	3	Ch4 D0	Ch4 D1	-	-

Table 11: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	D0 Ch4	Ch4 D1	Ch4 D0

Table 12: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	reserved	SB3	reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	reserved	SB4	reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 13: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	reserved	SB3	reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	reserved	SB4	reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.9 IP/IE3112 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	Ch1 D1	Ch1 D0	-	-
	1	Ch2 D1	Ch2 D0	-	-
	2	Ch3 D1	Ch3 D0	-	-
	3	Ch4 D1	Ch4 D0	-	-

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	Ch1 D0	Ch1 D1	-	-
	1	Ch2 D0	Ch2 D1	-	-
	2	Ch3 D0	Ch3 D1	-	-
	3	Ch4 D0	Ch4 D1	-	-

Table 14: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 15: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	reserved	SB3	reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	reserved	SB4	reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 16: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	reserved	SB3	reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	reserved	SB4	reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.10 IP/IE3202, KL3204 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	Ch1 D1	Ch1 D0	-	-
	1	Ch2 D1	Ch2 D0	-	-
	2	Ch3 D1	Ch3 D0	-	-
	3	Ch4 D1	Ch4 D0	-	-

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	Ch1 D0	Ch1 D1	-	-
	1	Ch2 D0	Ch2 D1	-	-
	2	Ch3 D0	Ch3 D1	-	-
	3	Ch4 D0	Ch4 D1	-	-

Table 17: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 18: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	reserved	SB3	reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	reserved	SB4	reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 19: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	reserved	SB3	reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	reserved	SB4	reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.11 IP/IE3312, KL3314 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	Ch1 D1	Ch1 D0	-	-
	1	Ch2 D1	Ch2 D0	-	-
	2	Ch3 D1	Ch3 D0	-	-
	3	Ch4 D1	Ch4 D0	-	-

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	Ch1 D0	Ch1 D1	-	-
	1	Ch2 D0	Ch2 D1	-	-
	2	Ch3 D0	Ch3 D1	-	-
	3	Ch4 D0	Ch4 D1	-	-

Table 20: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 21: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	reserved	SB2	reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	reserved	SB3	reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	reserved	SB4	reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 22: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB1	reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	reserved	SB2	reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	reserved	SB3	reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	reserved	SB4	reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.12 IP/IE4112 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	-	-	Ch1 D1	Ch1 D0
	1	-	-	Ch2 D1	Ch2 D0
	2	-	-	Ch3 D1	Ch3 D0
	3	-	-	Ch4 D1	Ch4 D0

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	-	-	Ch1 D0	Ch1 D1
	1	-	-	Ch2 D0	Ch2 D1
	2	-	-	Ch3 D0	Ch3 D1
	3	-	-	Ch4 D0	Ch4 D1

Table 23: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 24: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	Reserved	SB1	Reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	Reserved	SB2	Reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	Reserved	SB3	Reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	Reserved	SB4	Reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 25: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	Reserved	SB1	Reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	Reserved	SB2	Reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	Reserved	SB3	Reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	Reserved	SB4	Reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

Reserved: Although this byte occupies space in the process data memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.13 IP/IE4132, KL4132 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	-	-	Ch1 D1	Ch1 D0
	1	-	-	Ch2 D1	Ch2 D0
	2	-	-	Ch3 D1	Ch3 D0
	3	-	-	Ch4 D1	Ch4 D0

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	-	-	Ch1 D0	Ch1 D1
	1	-	-	Ch2 D0	Ch2 D1
	2	-	-	Ch3 D0	Ch3 D1
	3	-	-	Ch4 D0	Ch4 D1

Table 26: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 27: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	Reserved	SB1	Reserved	CB1
	1	Ch1 D1	Ch1 D0	Ch1 D1	Ch1 D0
	2	Reserved	SB2	Reserved	CB2
	3	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	4	Reserved	SB3	Reserved	CB3
	5	Ch3 D1	Ch3 D0	Ch3 D1	Ch3 D0
	6	Reserved	SB4	Reserved	CB4
	7	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

Table 28: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	Reserved	SB1	Reserved	CB1
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1
	2	Reserved	SB2	Reserved	CB2
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	4	Reserved	SB3	Reserved	CB3
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1
	6	Reserved	SB4	Reserved	CB4
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB n: Status Byte for channel n (appears in the process image of the inputs)
CB n: Control Byte for channel n (appears in the process image of the outputs)

Ch n D0: channel n, lower significant data byte
Ch n D1: channel n, higher significant data byte

Reserved: Although this byte occupies space in the process data memory, it has no function
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.14 IP/IE5009 Mapping

Compact evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: no Word alignment: don't care	0	D1	D0	-	-
	1	D3	D2	-	-

Compact evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: no Motorola format: yes Word alignment: don't care	0	D2	D3	-	-
	1	D0	D1	-	-

Table 29: Complete evaluation in Intel format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: no	0	D0	SB	Reg0	CB
	1	D2	D1	reserved	Reg1
	2	-	D3	-	reserved

Table 30: Complete evaluation in Motorola format

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: no	0	D3	SB	Reg1	CB
	1	D1	D2	reserved	Reg0
	2	-	D0	-	reserved

Complete evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: no Word alignment: yes	0	reserved	SB	reserved	CB
	1	D1	D0	Reg1	Reg0
	2	D3	D2	reserved	reserved

Table 31: Complete evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	reserved	SB	reserved	CB
	1	D2	D3	Reg0	Reg1
	2	D0	D1	reserved	reserved

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB: Status Byte (appears in the process image of the inputs)
CB: Control Byte (appears in the process image of the outputs)

D0 - D3 : Data Bytes 0 to 3

Reg0: lower significant byte for register communication
Reg1: higher significant byte for register communication

reserved: Although this byte occupies space in the process data memory, it has no function
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.15 IP/IE5109 Mapping

Evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: no	0	D0	SB	Reg0	CB
	1	D2	D1	reserved	Reg1
	2	D4	D3	reserved	reserved

Evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: no	0	D1	SB	Reg1	CB
	1	D2	D0	reserved	Reg0
	2	D3	D4	reserved	reserved

Evaluation in Intel format with word alignment

Default mapping for Lightbus, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: yes	0	reserved	SB	reserved	CB
	1	D1	D0	Reg1	Reg0
	2	reserved	D2	reserved	reserved
	3	D4	D3	reserved	reserved

Table 32: Evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: yes	0	reserved	SB	reserved	CB
	1	D0	D1	Reg0	Reg1
	2	reserved	D2	reserved	reserved
	3	D3	D4	reserved	reserved

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB: Status Byte (appears in the process image of the inputs)
CB: Control Byte (appears in the process image of the outputs)

D0: lower significant byte of the Counter word (read/write)
D1: higher significant byte of the Counter word (read/write)
D2: the status of A, B, C (latch), gate and latch input
D3: lower significant byte of the Latch word (read) / lower byte of period length
D4: higher significant byte of the Latch word (read) / higher byte of period length

Reg0: lower significant byte for register communication
Reg1: higher significant byte for register communication

reserved: Although this byte occupies space in the process data memory, it has no function
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.16 IP5209 Mapping

Per default setting ex factory the module sends 8 byte process data and 1 byte status (Default: 8 byte process data, 9 byte overall). By changing the Feature Register R32 the process data can be set to 5 byte! In this case the data of the Latch will not be transmitted.

Evaluation in Intel format

Default mapping for CANopen, DeviceNet, Modbus, RS232 and RS485

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: no	0	D0	SB	D0	CB
	1	D2	D1	D2	D1
	2	D4	D3	reserved	D3
	3	D6	D5	reserved	reserved
	4	reserved	D7	reserved	reserved

Evaluation in Motorola format

Default mapping for PROFIBUS and Interbus

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: no	0	D3	SB	D3	CB
	1	D1	D2	D1	D2
	2	D7	D0	reserved	D0
	3	D5	D6	reserved	reserved
	4	reserved	D4	reserved	reserved

Evaluation in Intel format with word alignment

Default mapping for Lightbus and Ethernet

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: no Word alignment: yes	0	reserved	SB	reserved	CB
	1	D1	D0	D1	D0
	2	D3	D2	D3	D2
	3	D5	D4	reserved	reserved
	4	D7	D6	reserved	reserved

Table 33: Evaluation in Motorola format with word alignment

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: yes Word alignment: yes	0	reserved	SB	reserved	CB
	1	D2	D3	D2	D3
	2	D0	D1	D0	D1
	3	D6	D7	reserved	reserved
	4	D4	D5	reserved	reserved

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB: Status Byte (appears in the process image of the inputs)
CB: Control Byte (appears in the process image of the outputs)

D0, D1, D2, D3: Bytes for the Counter value (read)
D4, D5, D6, D7: Bytes for the Latch value (read)

reserved: Although this byte occupies space in the process memory, it has no function.
"-": This byte is not used or occupied by the Fieldbus Box.

3.5.17 IP/IE60x2 Mapping

Standard format

(Default: 5 bytes of user data, 6 bytes altogether)
As supplied, these modules use the standard format with 5 bytes of user data.

Table 34: Default mapping for Lightbus, PROFIBUS, Interbus, CANopen, DeviceNet, Modbus, RS232, RS485, Ethernet and Controller Box (IL230x-Cxxx)

	Address	Input data		Output data	
Conditions	**Word offset**	**High byte**	**Low byte**	**High byte**	**Low byte**
Complete evaluation: don't care Motorola format: don't care Word alignment: don't care	0	D0	SB	D0	CB
	1	D2	D1	D2	D1
	2	D4	D3	D4	D3

Key

Complete evaluation: Additionally to the process data the control and status bytes are showed in the address area
Motorola format: Motorola or Intel format can be set.
Word alignment: in order that the address area of each channel starts always on a word boundary, dummy bytes are added to the process image

SB: Status byte (appears in the process image of the inputs)
CB: Control byte (appears in the process image of the outputs)

D0, D1, D2, D3, D4: Data bytes

reserved: Although this byte occupies space in the process data memory, it has no function
"-": This byte is not used or occupied by the Fieldbus Box.

3.6 Set-Up the intelligent Modules

3.6.1 Register Communication

3.6.1.1 General Register Description

Different operating modes or functionalities may be set for the complex modules. The *General Description of Registers* explains those register contents that are the same for all complex modules. The module-specific registers are explained in the following section.
Access to the module's internal registers is described in the section on *Register Communication*.

General Description of Registers

Complex modules that possess a processor are able to exchange data bi-directionally with the higher-level controller. These modules are referred to below as intelligent modules. These include the analog inputs (0-10 V, -10-10 V, 0-20 mA, 4-20 mA), the analog outputs (0-10 V, -10-10 V, 0-20 mA, 4-20 mA), the serial interface terminals (RS485, RS232, TTY, data exchange terminals), counter terminals, encoder interface and SSI interface terminals, PWM terminals and all the modules that can be parameterized.

The main features of the internal data structure are the same for all the intelligent modules. This data area is organized as words, and includes 64 memory locations. The important data and the parameters of the module can be read and set through this structure. It is also possible for functions to be called by means of corresponding parameters. Each logical channel in an intelligent module has such a structure (so a 4-channel analog module has 4 sets of registers).

This structure is divided into the following areas:

Range	Address
Process variables	0-7
Type register	8-15
Manufacturer parameters	16-30
User parameters	31-47
Extended user region	48-63

Registers R0-R7 (in the terminal's internal RAM)

The process variables can be used in addition to the actual process image. Their function is specific to the terminal.

R0-R5

The function of these registers depends on the type of terminal.

R6

Diagnostic register. The diagnostic register can contain additional diagnostic information. Parity errors, for instance, that occur in serial interface terminals during data transmission are indicated here.

R7

Command register
- High-Byte_Write = function parameter
- Low-Byte_Write = function number
- High-Byte_Read = function result
- Low-Byte_Read = function number

Registers R8-R15 (in the terminal's internal ROM)

The type and system parameters are hard programmed by the manufacturer, and the user can read them but cannot change them.

R8

Fieldbus Box type: The Fieldbus Box type in register R8 is needed to identify the Fieldbus Box.

R9

Software version x.y.: The software version can be read as a string of ASCII characters.

R10

Data length: R10 contains the number of multiplexed shift registers and their length in bits. The Bus Coupler sees this structure.

R11

Signal channels: Related to R10, this contains the number of channels that are logically present. Thus for example a shift register that is physically present can perfectly well consist of several signal channels.

R12

Minimum data length: The particular byte contains the minimum data length for a channel that is to be transferred. If the MSB is set, the control/status byte is not absolutely necessary for the terminal's function, and if the Bus Coupler is appropriately configured it is not transferred to the controller. The information is located
- in the high byte of an output module
- in the low byte of an input module

R13

Data type register

Data type register	Description
0x00	Terminal with no valid data type
0x01	Byte array
0x02	Structure 1 byte n bytes
0x03	Word array
0x04	Structure 1 byte n words
0x05	Double word array
0x06	Structure 1 byte n double words
0x07	Structure 1 byte 1 word
0x08	Structure 1 byte 1 double word
0x11	Byte array with variable logical channel length
0x12	Structure 1 byte n bytes with variable logical channel length (e.g. 60xx)
0x13	Word array with variable logical channel length
0x14	Structure 1 byte n words with variable logical channel length
0x15	Double word array with variable logical channel length
0x16	Structure 1 byte n double words with variable logical channel length

R14

reserved

R15

Alignment bits (RAM): The analog terminal is placed on a byte boundary in the K-Bus with the alignment bits.

Registers R16-R30 (manufacturer's parameters, serial EEPROM)

The manufacturer parameters are specific for each type of terminal. They are programmed by the manufacturer, but can also be modified by the controller. The manufacturer parameters are stored in a serial EEPROM in the terminal, and are retained in the event of voltage drop-out. These registers can only be altered after a code-word has been set in R31.

Registers R31-R47 (application parameters, serial EEPROM)

The application parameters are specific for each type of terminal. They can be modified by the programmer. The application parameters are stored in a serial EEPROM in the terminal, and are retained in the event of voltage drop-out. The application region is write-protected by a code-word.

R31

Code-word register in RAM: The code-word 0x1235 must be entered here so that parameters in the user area can be modified. If any other value is entered into this register, the write-protection is active. If write protection is inactive, the code-word is returned when the register is read, but if write protection is active, then the register contains a null value.

R32

Feature register: This register specifies the terminal's operating modes. Thus, for instance, a user-specific scaling can be activated for the analog I/O modules.

R33-R47

Terminal-specific Registers: These registers depend on the type of terminal.

Registers R47-R63 (Register extension for additional functions)

These registers are provided for additional functions.

3.6.1.2 Example for Register Communication

Control Byte

The Control Byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	REG	R/W	register number					

Bit	Name	Description	
7	REG	1_{bin}	Register Communication switched on: The first two Data Bytes are not used for process data exchange, but are written to the register set of the Fieldbus Box or are read from there.
6	R/W	0_{bin}	Read: the register should be read without changing it.
		1_{bin}	Write: the register should be written.
5-0	register number	Number of the Registers, that should be read or written. 64 Registers are addressable.	

Status Byte

The Status-Byte is located in the output image und can only be read.

Bit	7	6	5	4	3	2	1	0
Name	REG	R	register number					

Bit	Name	Description	
7	REG	1_{bin}	receipt register number
6	R	0_{bin}	Read
5-0	register number	Number of the Registers, that was read or written.	

Example 1

Table 35: Reading register 8 of KL3204 or IP/IE3202

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0x88 (1000 1000_{bin})	0xXX	0xXX

Bit 0.7 set indicates register communication active
Bit 0.6 not set indicates reading the register.
Bit 0.5 to Bit 0.0 indicates with 001000_{bin} the register number 8.
The output data word (Byte 1 and Byte 2) has no function at the reading access. If you want to change a register, you have to write the desired value into the output data word.

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0x88	0x0C	0x84

The terminal/box returns the type name 0x0C84 (equivalent unsigned integer 3204) in the input data word (Byte 1 and Byte 2).

Special feature in the naming of Fieldbus Boxes:
The last figure of the delivered unsigned Integer (3204) is not the same like the last character of the Fieldbus Box name (3202), witch stands for the connector type (0 for S8, 1 for M8 and 2 for M12). It returns instead of that the number of channels (IE3204 owns 4 channels).

Note

In order to write into registers, you have to write the password (0x1235) into register 31, so that write protection is deactivated. It is activated again by writing any value other than 0x1235. Note that some of the settings that can be made in registers only become active after the next power restart (power-off/power-on) of the module.

Example 2

Process of register communication for writing into register.

Table 36: 1. Write register 31 (set code word)

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0xDF	0x12	0x35

Answer of the module/terminal

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0x9F	0xXX	0xXX

Table 37: 2. Read register 31 (verify, if code word is set)

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0x9F	0xXX	0xXX

Answer of the module/terminal

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0x9F	0x12	0x35

Table 38: 3. Write Register 32 (change register)

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0xE0	0x00	0x02

Answer of the module/terminal

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0xA0	0xXX	0xXX

Table 39: 4. Read Register 32 (verify changed register)

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0xA0	0xXX	0xXX

Answer of the module/terminal

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0xA0	0x00	0x02

Table 40: 5. Write Register 31 (set code word back)

Byte 0 (control byte)	Byte 1 (data out, high byte)	Byte 2 (data out, low byte)
0xDF	0x00	0x00

Answer of the module/terminal

Byte 0 (status byte)	Byte 1 (data in, high byte)	Byte 2 (data in, low byte)
0x9F	0xXX	0xXX

3.6.2 IP/IE1502

3.6.2.1 Functioning IP/IE1502

The Ix1502 input module counts binary pulses, and transmits the current value to the higher level controller. Two fully independent, 32 bit, gated up/down counters are available. A low level or a high level at the *GATE* input halts the associated counter, depending on the setting in the feature register (Feature.8) for the channel. The counting direction can be controlled through separate inputs (low level = up, high level = down). Two digital outputs can also be set.
The maximum input frequency is limited to 100 kHz, the minimum pulse width for the input signal being about one microsecond. The counters react to a rising edge of the input signal.
The controller can use the control byte (CB) to set the counter state (CB.5), inhibit the module's counting function (CB.4) and to activate the outputs (CB.2). An internal function can also be activated (CB.0) permitting the outputs to be set automatically at defined counter states. The bit R32.2 in the feature register can also be used to determine whether counter setting is edge triggered or level triggered.

Internal Functions

Setting/resetting the outputs and resetting the counter

When the internal function is active (Control Byte, Bit 0) the outputs are set or reset, according to the settings in the feature register (R32.4 - R32.6) and the pre-set values in registers 35 - 38. This takes away the function of the bit (Control Byte, Bit 2) for setting the outputs. Registers 39 and 40 contain the values at which the counter will be reset to zero; this function is only activated by the associated bit R32.6 in the feature register, and is independent of the control byte.

Note

The setting/resetting functions are only active in the up-counting modus! On Startup of the module, the register data from the EEPROM will be transfered to the RAM. If the values have to be changed during the run time, the new values have to be written into the RAM area (R0 - R5).

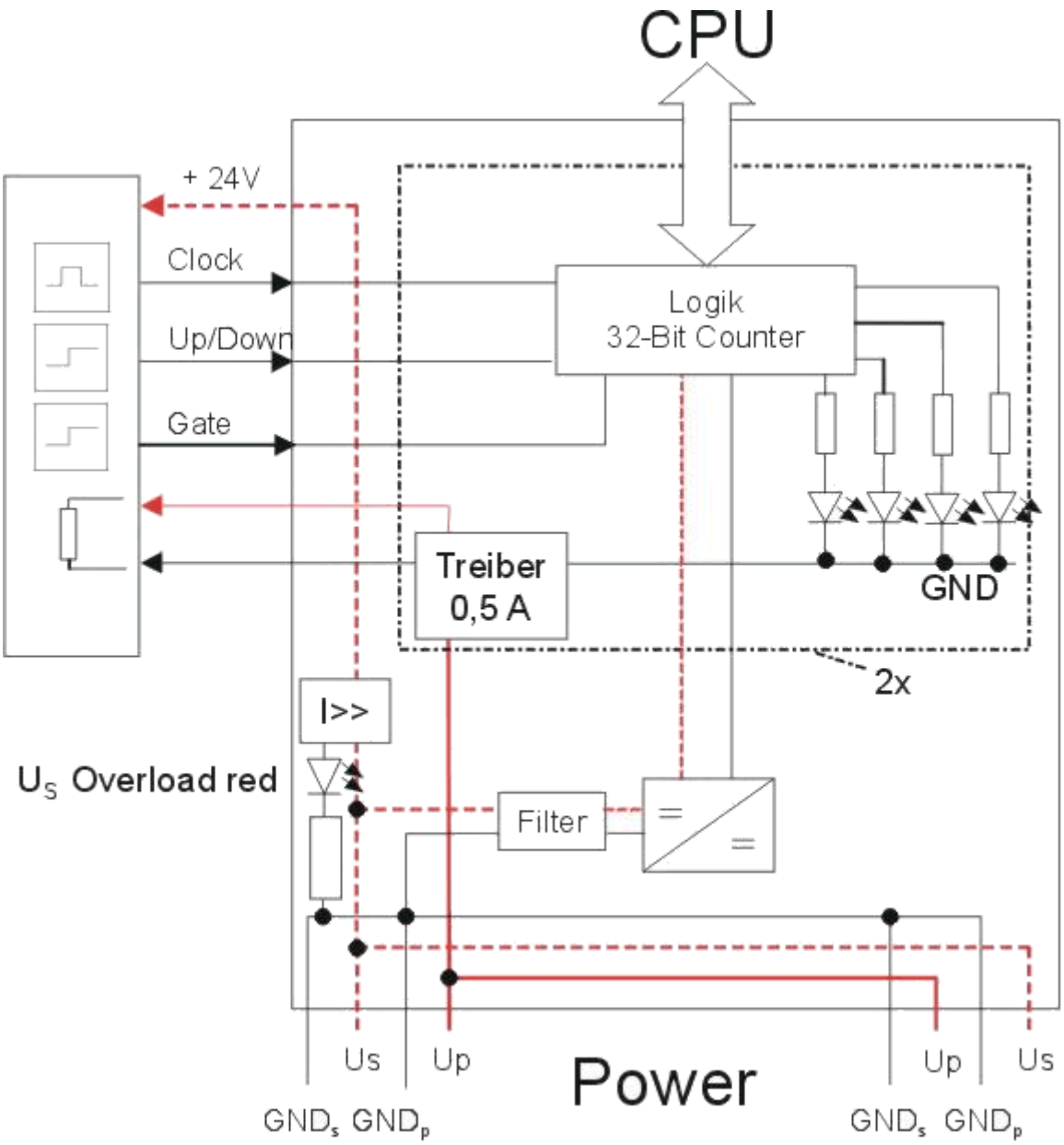
Pulse operation

If the pulse operating mode is active (R32.7 and CB.0) the associated output is set, according to the values in registers 35 and 36, for a specified pulse period (set in register 41, unit: 1µs/digit or 64 µs/digit (timer factor, Bit R32.9), shortest pulse: 250 µs, maximum pulse 4s). This means that bit R32.4 and R32.5 of the Feature Register do not have any function. The counters are reset in an identical fashion. Bit R32.10 of the feature register has influence on the way the outputs are switched off, namely whether the output is reset when the counter is reset, or not until after the pulse time has elapsed. The pre-set values in registers 35 - 41 are copied into registers 0 - 5 following a power on reset (see register table). They can be modified during operation. After the feature register, or other register values located in EEPROM, have been modified, a power on reset must follow so that these values are adopted.

Process Data

In the Ix1502 module, 5 bytes (4 bytes of user data and 1 control/status byte) are mapped. If no process data is exchanged within 100 ms (activated via bit R32.3 of Feature-Register), a watchdog switches the outputs off.

Conceptual circuit diagram



3.6.2.2 Control and Status Byte IP/IE1502

Process data mode

Control-Byte

The Control byte is always visible in the process image. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	0	CNT_SET	CNT_INH	GATE_A	SET_A	0	EN_A

Name	Description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)
CNT_SET	The module is set to the value specified by the process data. Setting the counter can be edge or level triggered (Feature register, bit 2). Level triggered: The counter module accepts the data provided, and the counter is locked until the CNT_SET bit is reset. Edge triggered: The counter module accepts the data present at a rising edge of the CNT_SET bit. The counter can then immediately continue counting.
CNT_INH	The counter is stopped as long as this bit is active. The previous counter state is retained.
GATE_A	State of the Gate-Input is activated in the Status-Byte. (from version D.xxxxxx11)
SET_A	Set the output
EN_A	This bit enables the internal functions in register 32.

Status-Byte

The status byte is always visible in the process image. The status byte is sent from the module to the controller.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	0	SET_ACC	INH_ACC	ST_GATE	ST_A	ST_V/R	0

Name	Description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)
SET_ACC	The data for setting the counter is accepted from the module.
INH_ACC	The counter is stopped for as long as this bit is set.
ST_GATE	The state of the Gate-input is given in this bit, if GATE_A is activated in the Control-Byte.
ST_A	The state of the output is given in this bit.
ST_V/R	The state of the up/down input is given in this bit.

Register Communication

Counter values cannot be transmitted during register communication.

Control Byte

The Control byte is always visible. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The status byte is always visible in the process image. The status byte is sent from the module to the controller.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.2.3 Register Overview IP/IE1502

The values of registers R35 - R40 will be mapped into R0 - R5 only after a power reset. The registers R0 - R5 can be written also directly, the values will then be valid immediately.

Attention: switch-on threshold < switch-off threshold < reset threshold!

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Switch - on threshold value / low word	variable	R/W	RAM
R1	Switch - on threshold value / high word	variable	R/W	RAM
R2	Switch - off threshold value / low word Pulse length (1 us/ digit)	variable	R/W	RAM
R3	Switch - off threshold value / high word	variable	R/W	RAM
R4	Reset threshold value / low word	variable	R/W	RAM
R5	Reset threshold value/ high word	variable	R/W	RAM
R6	reserved	0000_{hex}	R	RAM
R7	reserved	0000_{hex}	R	RAM
R8	Module type	1502dec	R	ROM
R9	Software version	$XXXX_{hex}$	R	ROM
R10	Multiplex shift register	0228_{hex}	R	ROM
R11	Signal channels	0228_{hex}	R	ROM
R12	Minimum data length	2828_{hex}	R	ROM
R13	Data structure	0006_{hex}	R	ROM
R14	reserved	0000_{hex}	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	$XXXX_{hex}$	R/W	EEPROM
R17	reserved	0000_{hex}	R/W	
...	...	...	...	...
R30	reserved	0000_{hex}	R/W	
R31	Code word register	variable	R/W	RAM
R32	Feature register	0104_{hex}	R/W	EEPROM
R33	reserved	0000_{hex}	R/W	
R34	reserved	0000_{hex}	R/W	
R35	Switch - on threshold value / low word	0000_{hex}	R/W	EEPROM
R36	Switch - on threshold value / high word	0000_{hex}	R/W	EEPROM
R37	Switch - off threshold value / low word	0000_{hex}	R/W	EEPROM
R38	Switch - off threshold value / high word	0000_{hex}	R/W	EEPROM
R39	Reset threshold value / low word	$FFFF_{hex}$	R/W	EEPROM

Register	Description	Default value	Read/*W*rite	Memory medium
R40	Reset threshold value/ high word	$FFFF_{hex}$	R/W	EEPROM
R41	Pulse length (1µs or 64µs/digit)	$00FA_{hex}$	R/W	EEPROM
R42	reserved	0000_{hex}	R/W	
...	...	...	...	...
R63	reserved	0000_{hex}	R/W	

3.6.2.4 Feature Register (R32) IP/IE1502

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register. The settings in register 32 are only effective following a power on reset (the module being switched off and on again).
Default [0x0104]

Bit	Value	Description	Manufacturer's setting
0-1	0	no function	0
2	0	Watchdog is active	0
	1	Watchdog is inactive	
3	0	The counter is set as a result of a positive signal in the CNT_SET bit in the control byte	1
	1	The counter is set as a result of a rising edge at the CNT_SET bit in the control byte	
4	0	The function for setting the output is inactive	0
	1	The function for setting the output is active	
5	0	The function for resetting the output is inactive	0
	1	The function for resetting the output is active	
6	0	The function for resetting the counter is inactive	0
	1	The function for resetting the counter is active	
7	0	Pulse operating mode is inactive	0
	1	Pulse operating mode is active	
8	0	The counter is inhibited when the *Gate* input is low (0).	1
	1	The counter is inhibited when the *Gate* input is high (1).	
9	0	Timer basis (pulse length register 41) 1 µs/digit (250 µs - 65 ms)	0
	1	Timer basis (pulse length register 41) 64 µs/digit (10 ms - 4 s)	
10	0	The output is reset when the counter is reset	0
	1	The output is reset when the pulse time has elapsed	
11-15	0	no function	0

Explanation of the watchdog
The watchdog timer is switched on by default. The output is reset if the watchdog overflows (> 100 ms).

3.6.2.5 Function Register IP/IE1502

Table 41: On/Off/Reset operation (RAM)

Register	Meaning	Place	Memory
0	Switch-on threshold value	Low word	RAM
1	Switch-on threshold value	High word	RAM
2	Switch-off threshold value	Low word	RAM
3	Switch-off threshold value	High word	RAM
4	Reset threshold value	Low word	RAM
5	Reset threshold value	High word	RAM

Table 42: On/Off/Reset operation (EEPROM)

Register	Meaning	Place	Memory
35	Switch-on threshold value	Low word	EEPROM
36	Switch-on threshold value	High word	EEPROM
37	Switch-off threshold value	Low word	EEPROM
38	Switch-off threshold value	High word	EEPROM
39	Reset threshold value	Low word	EEPROM
40	Reset threshold value	High word	EEPROM

Table 43: Pulse/Reset operation (RAM)

Register	Meaning	Place	Memory
0	Switch-on threshold value	Low word	RAM
1	Switch-on threshold value	High word	RAM
2	Pulse length	1/64 µs/digit	RAM
3	-	-	-
4	Reset threshold value	Low word	RAM
5	Reset threshold value	High word	RAM

Table 44: Pulse/Reset operation (EEPROM)

Register	Meaning	Place	Memory
35	Switch-on threshold value	Low word	EEPROM
36	Switch-on threshold value	High word	EEPROM
37	-	-	-
38	-	-	-
39	Reset threshold value	Low word	EEPROM
40	Reset threshold value	High word	EEPROM
41	Pulse length	1/64 µs/digit	EEPROM

Notes:

- The counter states are not reset when the counter underflows. In other words, the counter is only automatically set to zero if the reset value is reached from below.
- The following ranges for the threshold values must be observed:
  Switch on threshold value < switch-off threshold value < reset threshold
- Pulse length may be between 0.25 ms - 4000 ms
- In pulse operation, the counter width must not exceed the counter runtime:
  max. pulse length < reset threshold/counter frequency

3.6.3 IP/IE2512

3.6.3.1 IP/IE2512 Functioning

The special function module IP/IE2512 modulates a binary signal. Either the pulse width or the frequency is changed. The periphery side of the module electronics is electrically isolated from the fieldbus or IP-Link. The cycle (base frequency) and the pulse/pause ratio can be specified via 16-bit values in the process image of the control.
The IP/IE2512 module occupies 6 bytes in the process image. The IP/IE2512 mapping can be set via the control or via the KS2000 configuration software. In addition to PWM (pulse width modulation) mode, the IP/IE2512 can be operated in FM (frequency modulation) or, for stepper motor control, with pulse direction specification (Frq-Cnt pulse mode). The default setting of the terminal is PWM mode with a base frequency of 250 Hz and a resolution of 10 bit.

The module is temperature controlled. In case of over temperature the outputs are de-energized, an error bit in the STATUS Bytes is set an the error LED next to the M12 output is turned on (red).

Operating Modes

Operating Modes

The different operating modes of the module are set via the Feature register (R32). Three parameters are configurable:

- pulse width ratio
- pulse length
- frequency (period)

Depending on the type of operating mode, the parameters might influence each other.

NOTE

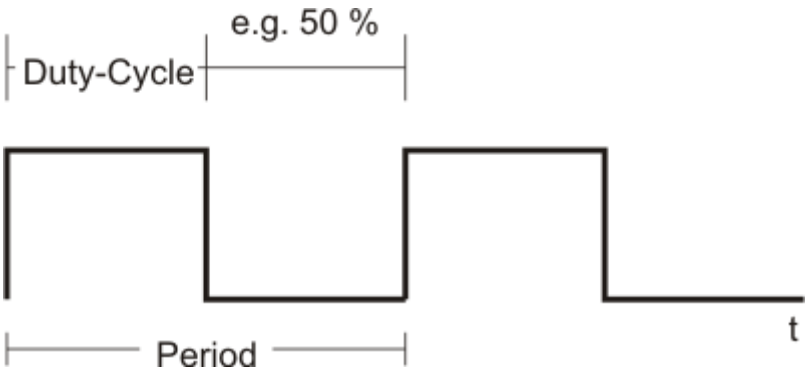
Attention

using the stepper motor functions(Frq_Cnt_PWM, Frq_Cnt_Impuls, Cnt_Cnt_PWM) only channel 1 can be used!

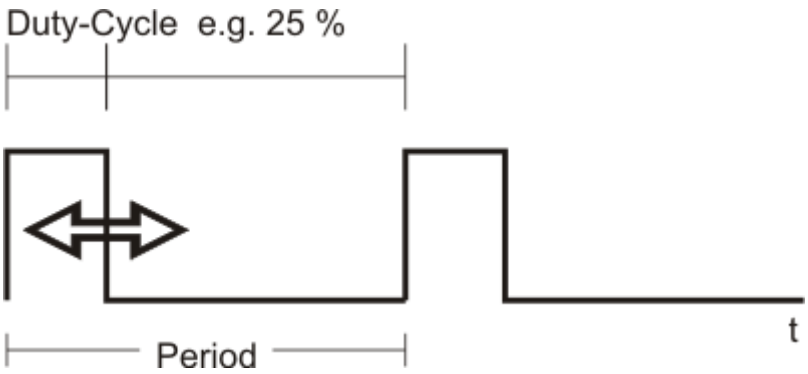
PWM mode (frequency in the register, pulse width in the process data)

PWM mode

In PWMH and PWML mode, two channels can be operated. The operating mode and the period is identical for both channels. The ratio of duty cycle and period is specified via the process data (100 % duty cycle correspond to process data 0x7FFF). The period can be specified via register R2 during the operation. It is loaded after a system start-up from register R35 (SEEROM) and entered into register R2. Therefore R35 should be programmed in the applications default setting.



or



There are two different PWM frequency ranges that can be preselected via the Feature Register (R32).

Table 45: PWMH mode

Parameter	Storage location
period	R2 (R35)
duty cycle	process data

The frequency range is from 1 kHz to 80 kHz .

The period is programmed in R2 (R35). 1 Digit = 0,25 µsec. Attention: this value differs from setting the IP20 terminal KL2502!

The duty cycle is chosen by the process data, 0x7FFF equals 100 %, 25 % therefore is 0x1FFF.

Table 46: PWML mode

Parameter	Storage location
period	R2 (R35)
duty cycle	process data

The frequency range is from 8 Hz to 1 kHz .

The period is programmed in R2 (R35). 1 Digit = 2 µsec. Attention: this value differs from setting the IP20 terminal KL2502!

The duty cycle is chosen by the process data, 0x7FFF equals 100 %, 25 % therefore is 0x1FFF.

Frq-Cnt PWM mode (pulse with ratio in the register, frequency in the process data)

Frq-Cnt PWM mode

Parameter	Storage location
pulse width ratio	R36
frequency	process data

The frequency is specified in 8 Hz per digit via the process output data of the control. The control receives the number of periods that are output by the module as process input data. In this operating mode, the count direction is determined via the sign of the output data:

- 8 Hz corresponds to the value 0x0001
- -8 Hz corresponds to the value 0xFFFF (signed integer)

The frequency range is 8 Hz to 8 kHz.

The pulses are sent to output OUTPUT, the count direction to output UP/DOWN.

- ascending count direction corresponds to signal level V_{CC}

- descending count direction corresponds to signal level GND

With rising edge of bit 0 in the control byte, the process input data is set to the value of the output data (process data mode, i.e. bit 7 of the control byte is 0). The pulse width ratio is specified via register R36.

Changes will be active only after a reset/power up.

Frq-Cnt pulse mode (pulse length in the register, frequency in the process data)

Frq-Cnt pulse mode

Parameter	Storage location
pulse width	R37
frequency	process data

The frequency is specified with 8 Hz per digit via the process output data of the control. The control receives the number of pulses that are output by the terminal as process input data. In this operating mode, the count direction is determined via the sign of the output data:

- 8 Hz corresponds to the value 0x0001
- -8 Hz corresponds to the value 0xFFFF (signed integer)

The frequency range is 8 Hz to 8 kHz.

The pulses are sent to output OUTPUT, the count direction to output UP/DOWN.

- ascending count direction corresponds to signal level V_{CC}
- descending count direction corresponds to signal level GND

With rising edge of bit 0 in the control byte, the process input data is set to the value of the output data (control byte in process data mode, i.e. bit 7=0). The pulse width is fixed for all frequencies and is specified via R37.

Changes will be active only after a reset/power up.

Cnt-Cnt PWM mode

Cnt-Cnt PWM mode

Parameter	Storage location
pulse width ratio	R36
number of pulses	process data
period	R35

The number of pulses is specified via the process output data. The control receives the number of periods that are output as process input data. The

- pulse width ratio is specified via register R36 and the
- period via register R35 (1 digit = 0.25 µsec).

The frequency ranges from 1 kHz to 32 kHz.

A rising edge of bit 0 in the control byte starts the pulse output. This can be re-triggered with every subsequent rising edge. The pulses are sent to output OUTPUT. Output UP/DOWN can be set via bit 2 of the control byte. In bit 0 of the status byte, the control receives the transfer and the simultaneous start of the pulse output as status information. Bit 1 of the status byte remains set as long as the output is active. Bit 2 of the status byte reports back the status of channel 1.

Pulse with ratio in the process data

Input format: Representation as complement on two (the integer value "-1" is represented as 0xFFFF).
The ratio of duty cycle/period is specified with a maximum resolution of 10 bit.

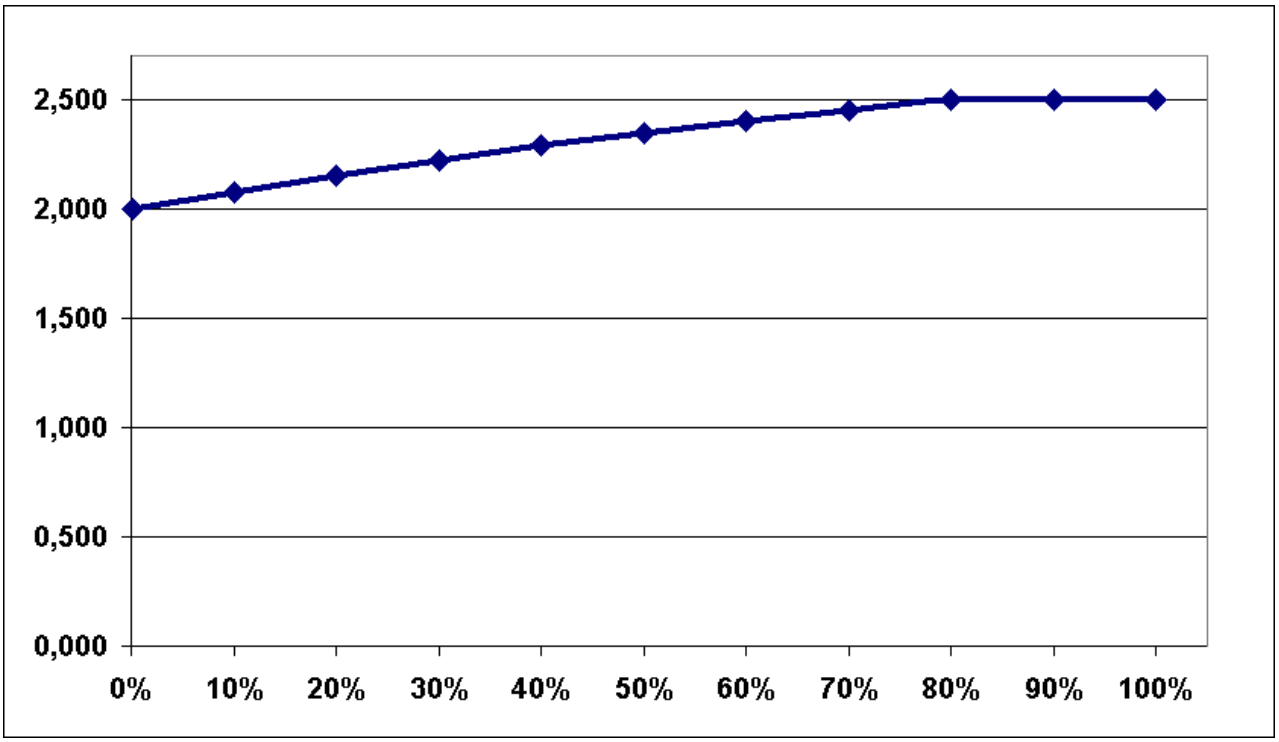
Process data	Output value
0x0000	0 % Duty Cycle
0x3FFF	50 % Duty Cycle
0x7FFF	100 % Duty Cycle

3.6.3.2 Output current (derating), IP/IE2512

When using the PWM modules, the power loss in the modules has to be taken in account.

The maximum current for the inductive case, e.g. using a proportional valve, is given in the following graph.

If pure ohmic loads are used, the line will be horizontally at 2.5 A, independent of the frequency.



Current versus Duty Cycle

NOTE

Warning

Modules with hardware revision D.xxxxxx00 (see hard-software revisions) do have a different derating behavior.

Also see about this

- Firmware and hardware issue status [▶ 15]
- Output current (derating), IP/IE2512 [▶ 198]

3.6.3.3 Control and Status Byte IP/IE2512

Process data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved	0	0	0	0	0	StartPulses

Bit	**description**
RegAccess	0_{bin}: Register Communication switched off (Process data mode)
StartPulses	When in Cnt_Cnt_PWM mode a rising edge of this bit starts the pulse output. This can be re-triggered with every subsequent rising edge.

Status-Byte

The status byte is only visible in the if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	ERROR	OVR_TEMP_ERR	-	0	StateCh1	OUT	StartPulses

Name	**Beschreibung**
RegAccess	0_{bin}: Acknowledge for process data mode
ERROR	0_{bin}: general error bit, an error has happened
OVR_TEMP_ERR	0_{bin}: no error
	1_{bin}: over temperature in the module, the outputs are set to 0
StateCh1	When in Cnt_Cnt_PWM mode this bit reports back the status of channel 1.
OUT	When in Cnt_Cnt_PWM mode this bit shows the status of the output (1_{bin}: Write).
StartPulses	When in Cnt_Cnt_PWM mode this bit shows the status of control byte bit 0.

Register Communication

Counter values cannot be transmitted during register communication.

Control Byte

The control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Register communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written.

Status Byte

The status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Acknowledge for register access
R/W	0_{bin}: Read
Register number	Number of the Register, that has been read or written.

3.6.3.4 Register Overview IP/IE2512

Register	Name	Default Value	Read/*W*rite	Memory medium
R0	reserved	0x0000	R	RAM
R1	reserved	0x0000	R	RAM
R2	Period	variable	R/W	RAM
R3	fundamental frequency	variable	R/W	RAM
R4	reserved	variable	R/W	RAM
R5	Unprocessed PWM value	variable	R/W	RAM
R6	Diagnostic register - not used	0x0000	R	RAM
R7	Command register - not used	0x0000	R	RAM
R8	Module type	2502dec	R	ROM
R9	Software version number	0xXXXX	R	ROM
R10	Multiplex shift register	0x0218	R	ROM
R11	Signal channels	0x0218	R	ROM
R12	Minimum data length	0x1818	R	ROM
R13	Data structure	0x0000	R	ROM
R14	reserved	0x0000	R	
R15	Alignment-Register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	reserved	0x0000	R/W	
R18	reserved	0x0000	R/W	
R19	Manufacturer scaling: Offset	0x0000	R/W	
R20	Manufacturer scaling: Gain	0x0000	R/W	
R21	reserved	0x0000	R/W	
...	...	...	...	...
R30	reserved	0x0000	R/W	
R31	Codeword Register	variable	R/W	RAM
R32	Feature Register	0x0004	R/W	SEEROM
R33	User Offset	0x0000	R/W	SEEROM
R34	User Gain	0x0100	R/W	SEEROM
R35	Period PWM	0x0FA0	R/W	SEEROM
R36	Duty-Cycle	0x0000	R/W	SEEROM
R37	Pulse duration	0x0000	R/W	SEEROM
R38	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.3.5 Feature Register (R32) IP/IE2512

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default 0x0004

Bit	Value	Description		default
0	0_{bin}	User scaling not active		0_{bin}
	1_{bin}	User scaling active		
1	0_{bin}	Manufacturer scaling not active		0_{bin}
	1_{bin}	Manufacturer scaling active		
2	0_{bin}	Watchdog not active		1_{bin}
	1_{bin}	Watchdog active If the terminal receives no Data for 100 ms, the PWM Signal is set to 0% duty cycle.		
12 - 3	reserved			0
15 - 13		Operating Mode [▶ 191]	Frequency range	000_{bin}
	000_{bin}	PWMH-Mode [▶ 191]	250 Hz to 20 kHz	
	001_{bin}	PWML-Mode [▶ 191]	2Hz to 250 Hz	
	011_{bin}	Frq-Cnt-PWM-Mode [▶ 193]	2Hz to 2 kHz	
	101_{bin}	Frq-Cnt-Impuls-Mode [▶ 193]	2Hz to 2 kHz	
	111_{bin}	Cnt-Cnt-PWM-Mode [▶ 193]	250 Hz to 8 kHz	

3.6.3.6 Output current (derating), IP/IE2512

When using the PWM modules with hardware revision D.xxxxxx00, the power loss in the modules has to be taken in account.

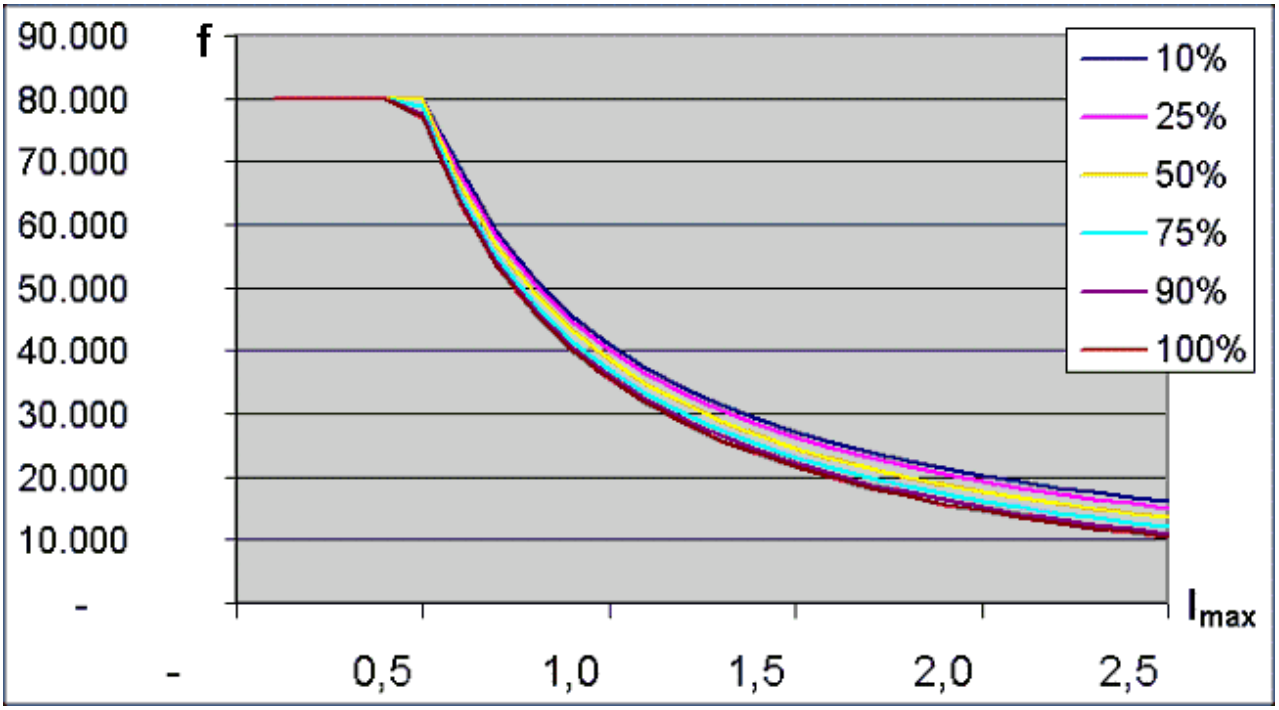
The power loss consists of 3 different components and can be 1W max. ($P = P_I + P_f + P_L$).

1. current dependent power loss
   $P_I = I_{max}^2$ x 0,15 Ohm
2. frequency dependent power loss
   $P_f = U \times I_{max} \times 10^{-6}$sec x f
3. inductive feed back
   $P_L = I_{max}^2 \times L / (2 \times f)$

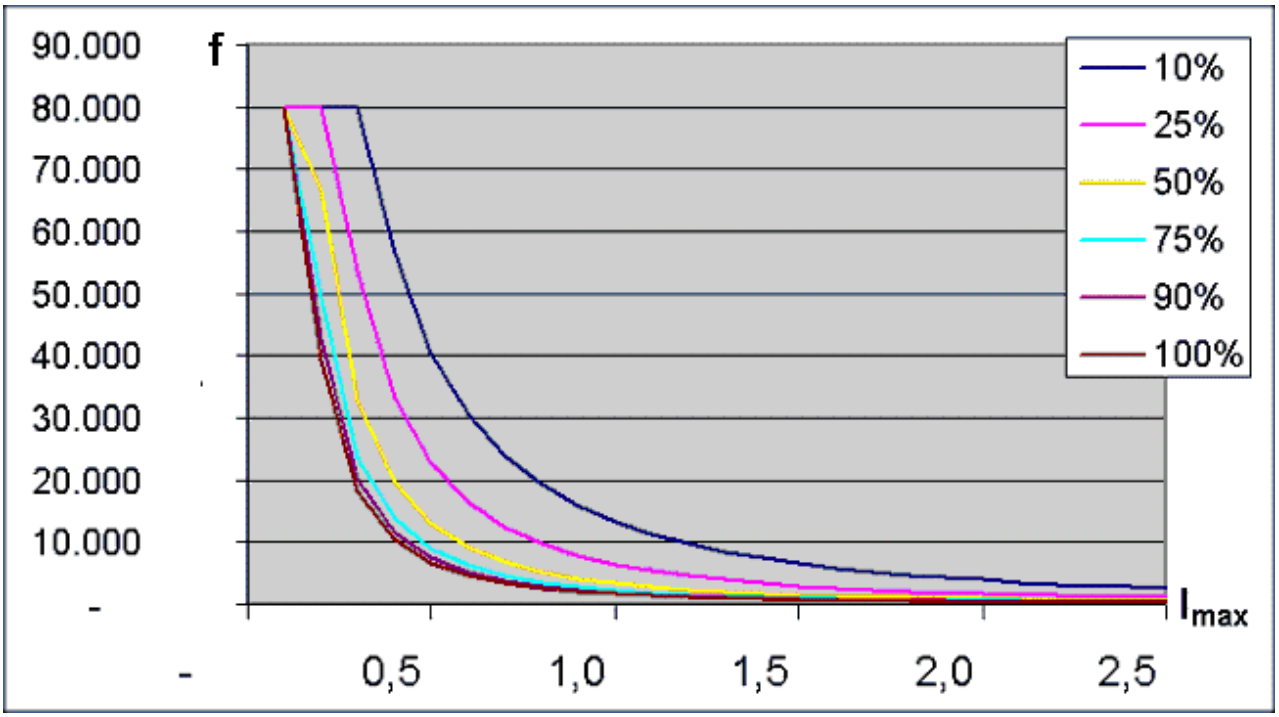
Key
I_{max}: max output current (duty cycle has to be calculated into it)
U: output voltage
f: frequency
L: inductivity

The inductive component is released via a 39 V internal diode. By an external Schottky diode with the right power loss range and min. 45V, the energy can be released externally. The cathode of the diode has to be connected to Pin 4, the anode to pin 3.

The two diagrams show the possible frequency / output current ratios for different duty cycles.



Derating without inductive components



Derating with 1mH inductive load

3.6.4 IE2808

3.6.4.1 IE2808 functionality

The output module IE2808 has got 16 outputs with current carrying capacity of 0,5 A each. The total current of the module can have a maximum of 4,0 A.

Error display

Every channel can be diagnosed individually, this means at an error case an error bit is set for this channel in the process data input area.

For IE IE2808-0000 this error bit has to be reset manually by setting a bit within the control byte [▶ 200].
For IE IE2808-0001 this error bit is reset automatically after removing the error case.

LEDs

The module has got 4 LEDs. Us and Up show the existence of power supply for logic and the outputs.

ERR 1-8 und ERR 9-16 show the state of the outputs in groups.

LED	green	red
ERR 1-8	at least one output of the group 1-8 is switched on	at least one output of the group 1-8 has got a short circuit
ERR 9-16	at least one output of the group 9-16 is switched on	at least one output of the group 9-16 has got a short circuit

3.6.4.2 Control and Status Byte IE2808

Process data mode

Control Byte

The Control Byte (CB) is only visible if the Fieldbus Box is set to complete mode. It is located in the output image, and can be read or written.

Bit	CB.7	CB.6	CB.5	CB.4	CB.3	CB.2	CB.1	CB.0
Name	RegAccess	ResetErr	SetDefaultStatus	-	-	-	-	-

Bit	Name	description	
CB.7	RegAccess	0_{bin}	Register Communication switched off (Process data mode)
CB.6	ResetErr	1_{bin}	Sets back errors, displayed at status byte
CB.5	SetDefaultStatus	1_{bin}	Sets outputs to default status defined by Register R33 [▶ 203]
CB.4	-	0_{bin}	reserved
...	...	...	...
CB.0	-	0_{bin}	reserved

Status Byte

The Status Byte (SB) is only visible if the Fieldbus Box is set to complete mode. It byte is located in the input image, and can only be read.

Bit	SB.7	SB.6	SB.5	SB.4	SB.3	SB.2	SB.1	SB.0
Name	RegAccess	Error	UnderVoltage	OvrCurrentGrp2	OvrCurrentGrp1	-	DefaultStatus	-

Bit	Name	description	
SB.7	RegAccess	0_{bin}	Acknowledgement for process data mode
SB.6	Error	0_{bin}	general error bit: no error has occurred
		1_{bin}	general error bit: an error has occurred
SB.5	UnderVoltage	0_{bin}	Load voltage $U_L \geq 18$ V
		1_{bin}	Load voltage $U_L < 18$ V, U_L-LED shines red, but the outputs stay switched
SB.4	OvrCurrentGrp2	0_{bin}	no error
		1_{bin}	Short circuit detected at an output of group 2. The concerned output is displayed by the input byte Diag2 [▶ 158]. After repair this error display has to be set back by bit CB.6 [▶ 200] of control byte.
SB.3	OvrCurrentGrp1	0_{bin}	no error
		1_{bin}	Short circuit detected at an output of group 1. The concerned output is displayed by the input byte Diag1 [▶ 158]. After repair this error display has to be set back by bit CB.6 [▶ 200] of control byte.
SB.2	-	0_{bin}	reserved
SB.1	DefaultStatus	0_{bin}	Outputs in operation
		1_{bin}	Outputs have been set to default status, defined by R33
SB.0	-	0_{bin}	reserved

Register Communication

Control Byte

The Control Byte (CB) is only visible if the Fieldbus Box is set to complete mode. It is located in the output image, and can be read or written.

Bit	CB.7	CB.6	CB.5	CB.4	CB.3	CB.2	CB.1	CB.0
Name	RegAccess	R/W	Register number					

Bit	Name	description	
CB.7	RegAccess	1_{bin}	register access switched on
CB.6	R/W	0_{bin}	Read
		1_{bin}	Write
CB.5 - CB.0	Register number	Number of the register that is to be read or written.	

Status Byte

The Status Byte SB is only visible if the Fieldbus Box is set to complete mode. It byte is located in the input image, and can only be read.

Bit	SB.7	SB.6	SB.5	SB.4	SB.3	SB.2	SB.1	SB.0
Name	RegAccess	R/W	Register number					

Bit	Name	description	
SB.7	RegAccess	1_{bin}	Acknowledgement for register access
SB.6	R/W	0_{bin}	Read
SB.5 - SB.0	Register number	Number of the register that has been read or written.	

3.6.4.3 Register Overview IE2808

Register	Name	Default Value	Read/*W*rite	Memory medium
R0	reserved	0x0000	R/W	RAM
...	...	...	...	...
R5	reserved	0x0000	R/W	RAM
R6	Diagnose-Register - not used	0x0000	R	RAM
R7	Command register - not used	0x0000	R	RAM
R8	Module type	2808_{dec}	R	ROM
R9	Firmware Version number	e.g. 0x3142	R	ROM
R10	Multiplex shift register	0x0118	R	ROM
R11	Signal channels	0x0118	R	ROM
R12	minimum Data length	0x9898	R	ROM
R13	Data structure	0x0001	R	ROM
R14	reserved	0x0000	R/W	RAM
...	...	...	...	...
R30	reserved	0x0000	R/W	RAM
R31	Code word register	variable	R/W	RAM
R32	Enable Default Status register	0x0000	R/W	SEEROM
R33	Default Status Register	0x0000	R/W	SEEROM
R34	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.4.4 Watchdog feature (R32-R33) IE2808

Via the Enable Default Status Register R32 and the Default Status Register R33 the behavior of the outputs for communication breakdown can be set:

- Register R32 activates or deactivates the watchdog feature.

- Register R33 defines for each single channel the switching state of its output in error case (if watchdog was activated).

For changing the register at first the write protection must be disabled. This is done by writing the user code word (0x1235) into register R31.

NOTE

Attention

For using the watchdog feature pay attention, that at powering on the system no communication connection exists, that means the outputs are set to the pre-defined values.

Register	Description	Output	Description	default
32	Watchdog active	00 - 15	1 = activated; 0 = deactivated	0xFFFF

Register	Description	Output	Description	default
33	Output State	00 - 15	1 = ON; 0 = OFF	0x0000

In delivery state the watchdog is activated and the pre-defined output states are set to 0. So all outputs are switched off in error case!

Example

Register 32 = 1111 1111 1111 1111
Register 33 = 1000 0000 0000 0000
Process data from the higher level controller = ON for all outputs

Now at a communication breakdown all outputs except output 16 are set to OFF. Output 16 is set to ON.

3.6.4.5 Default Status register (R33) IE2808

The Default Status register defines the default status in case of communication error for every single output.

Bit	Value	Description	Manufacturer-setting
0	0_{bin}	Default status for output 1 is OFF	0_{bin}
	1_{bin}	Default status for output 1 is ON	
1	0_{bin}	Default status for output 2 is OFF	0_{bin}
	1_{bin}	Default status for output 2 is ON	
...	0_{bin}	...	0_{bin}
	1_{bin}	...	
15	0_{bin}	Default status for output 16 is OFF	0_{bin}
	1_{bin}	Default status for output 16 is ON	

3.6.4.6 Enable Default Status Register (R32) IE2808

The Enable Default Status register defines for every singe output, if this output is set to the it's default value (defined by Register R33) in case of communication error.

Bit	Value	Description	Manufacturer-setting
0	0_{bin}	Default status disabled for output 1	0_{bin}
	1_{bin}	Default status enabled for output 1	
1	0_{bin}	Default status disabled for output 2	0_{bin}
	1_{bin}	Default status enabled for output 2	
...	0_{bin}	...	0_{bin}
	1_{bin}	...	
15	0_{bin}	Default status disabled for output 16	0_{bin}
	1_{bin}	Default status enabled for output 16	

3.6.5 IP/IE3102

3.6.5.1 Functioning IP/IE3102

The analog input module handle signals from -10 V up to 10 V with a resolution of 16 bits. The filter constants and the associated conversion times can be adjusted over a wide range.

Process data (hex)	Process data (decimal)	Measured value
0x8000	-32768	-10 V
0xC001	-16383	-5 V
0x0000	0	0 V
0x3FFF	16383	5 V
0x7FFF	32767	10 V

Representation corresponds to the integer number format (INT). The default setting is for the process data to be entered in twos complement (-1 corresponds to 0xFFFF).

Process data

The process data written by the controller is output as follows:
x_adc = output value from the A/D converter
y_aus = process data to the PLC controller
B_a, A_a = manufacturer scaling (registers 17, 18)
B_h, A_h = manufacturer scaling (registers 19, 20)
B_w, A_w = user scaling (registers 33, 34)
Y_dac = output value to the D/A converter

Neither user nor manufacturer scaling are active

Y_a = (B_a + x_adc)*A_a
Y_aus = Y_a

Manufacturer scaling active (default)

Y_1 = B_h + A_h * Y_a
Y_aus = Y_1

User scaling active

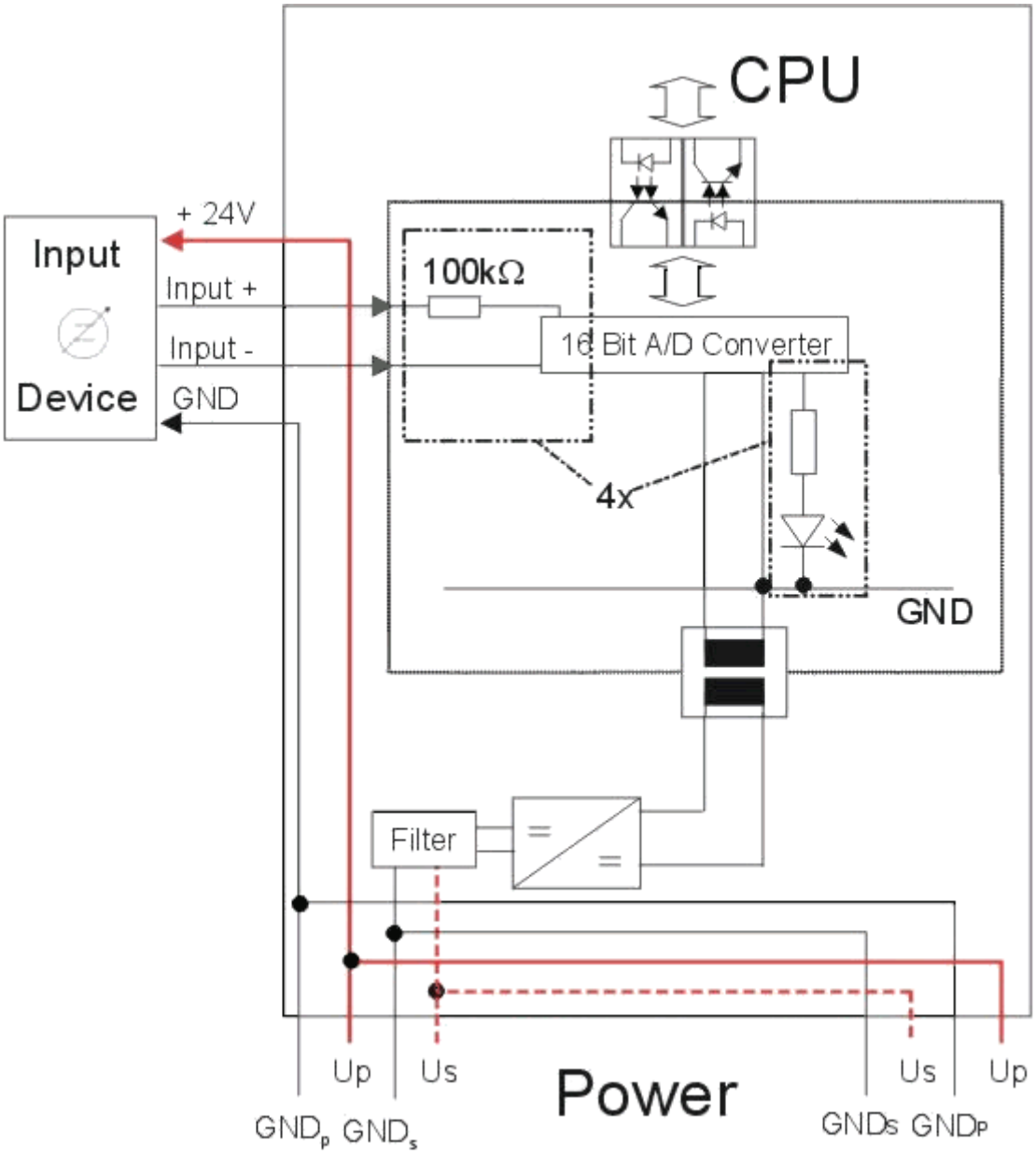
Y_2 = B_w + A_w * Y_a
Y_aus = Y_2

Manufacturer and user scaling active

Y_1 = B_h + A_h *Y_a
Y_2 = B_w + A_w * Y_1
Y-aus = Y_2

The linear equations are activated via register 32.

Conceptual circuit diagram



3.6.5.2 Control and Status Byte IP/IE3102

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	-						

Key:

Bit	Name	description	
7	RegAccess	0_{bin}	Register Communication switched off (Process data mode)
6...0	-	reserved	

Status byte

The Status byte is only visible if the Fieldbus Box is set to complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	Error	Limit value 2		Limit value 1		Over-Range	Under-Range

Key:

Bit	Name	description	
7	RegAccess	0_{bin}	Acknowledgement for process data mode
6	Error	general error bit	
5,4	Limit value 2	00_{bin}	Limit value 2 not active
		01_{bin}	Process data > limit value 2
		10_{bin}	Process data < limit value 2
		11_{bin}	Process data = limit value 2
3,2	Limit value 1	00_{bin}	Limit value 1 not active
		01_{bin}	Process data > limit value 1
		10_{bin}	Process data < limit value 1
		11_{bin}	Process data = limit value 1
1	Over-Range	1_{bin}	if R32 Bit 4 = 0: Range of measurement exceeded (>0x7FFF)
			if R32 Bit 4 = 1: Measured value ≥ 10.5 V
0	Under-Range	1_{bin}	if R32 Bit 4 = 0: Measurement is below range (> 0x8000)
			if R32 Bit 4 = 1: Measured value ≤ -10.5 V

Note

The user scaling must be modified in order to change the under/over range limits. Example: You want to set an over range value of 10.6 V. You therefore have to activate the user scaling, and change the gain in register 34 to 0x00F0. The measuring range now goes up to 10.6 V (the maximum possible is 11.8 V).

Register Communication

Measured values cannot be transmitted during register communication.

Control Byte

The Control byte is only visible if the Fieldbus Box is set to complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Key:

Bit	Name	description	
7	RegAccess	1_{bin}:	Register Communication switched on
6	R/W	0_{bin}	Read
		1_{bin}	Write
5...0	Register number	Number of the register that is to be read or written	

Status Byte

The Status byte is only visible if the Fieldbus Box is set to complete mode. It byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Key:

Bit	Name	description	
7	RegAccess	1_{bin}	Acknowledgement for register access
6	R/W	0_{bin}	Read
5...0	Register number	Number of the register that has been read or written	

3.6.5.3 Register Overview IP/IE3102

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Unprocessed ADC value	variable	R	RAM
R1	reserved	0x0000	R	
...	...	...	...	...
R7	reserved	0x0000	R	
R8	Module type	3102dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x0098	R	ROM
R13	Data structure	0x0004	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	Hardware compensation: Offset	specific	R/W	SEEROM
R18	Hardware compensation: Gain	specific	R/W	SEEROM
R19	Manufacturer scaling: Offset	0x0000	R/W	SEEROM
R20	Manufacturer scaling: Gain	0x0100	R/W	SEEROM
R21	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0010	R/W	SEEROM
R33	User offset	0x0000	R/W	SEEROM
R34	User gain	0x0100	R/W	SEEROM
R35	Limit value 1	0x0000	R/W	SEEROM
R36	Limit value 2	0x0000	R/W	SEEROM
R37	Filter register	0x3200	R/W	SEEROM
R38	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.5.4 Feature Register (R32) IP/IE3102

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default [0x0010]

Bit	Value	Description	Manufacturer's setting
0	0_{bin}	User scaling is inactive	0_{bin}
	1_{bin}	User scaling is active	
1	0_{bin}	Manufacturer scaling is inactive	0_{bin}
	1_{bin}	Manufacturer scaling is active	
2	0_{bin}	reserved	0_{bin}
3	0_{bin}	The arithmetic sign of numerical quantities is not represented	0_{bin}
	1_{bin}	The arithmetic sign of numerical quantities is active (-1 = 0x8001)	
4	0_{bin}	Overflow offset is inactive: process data is monitored for to be greater than 0x7FFF (or 0xFFFF, depending on the manufacturer scaling) and the result is indicated in the status byte.	1_{bin}
	1_{bin}	Overflow offset is active: the measured value (the actual voltage) is monitored and the result is indicated in the status byte.	
5	0_{bin}	reserved	0_{bin}
...	...	...	...
8	0_{bin}	reserved	0_{bin}
9	0_{bin}	Limit value 1 is inactive	0_{bin}
	1_{bin}	Limit value 1 is active (the limit value 1 is specified in Register R35 [▶ 210])	
10	0_{bin}	Limit value 2 is inactive	0_{bin}
	1_{bin}	Limit value 2 is active (the limit value 2 is specified in Register R36 [▶ 210])	
11	0_{bin}	reserved	0_{bin}
...	...	...	...
15	0_{bin}	reserved	0_{bin}

3.6.5.5 Filter Register (R37) IP/IE3102

The IP/IE3102 possesses two low-pass filter stages. The first stage consists of a sin³ filter. This is always active. The second consists of a 22nd order FIR filter. This can be deactivated. The filter settings always apply to all the channels, and are set in the first register for channel 1. The settings are not effective until after a power on reset (switch the Fieldbus Box off and on again).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	SF11	SF10	SF9	SF8	SF7	SF6	SF5	SF4	SF3	SF2	SF1	SF0	0	0	SKIP	Fast

FAST

1 - Active
0 - Inactive
When active there is a fast reaction to input steps (in spite of the filter stage being active); in this case the filter is being bypassed.

SKIP

0 - FIR filter active
1 - FIR filter is bypassed

Bits 2, 3

must be zero.

SF0-11

This is the filter constant itself. It specifies the 3dB limit frequency of the sin³ filter. The value ranges from 150 to 2,047. The 3 dB limit frequency and the 64.5 dB stop frequency F_{stop} are listed in the following table and are calculated as follows:

SKIP = 0
SF = 11981/ F_{limit}
SF = 43008/ F_{stop}

SKIP = 1
SF = 80486/ F_{limit}

Example: You want to set a limit frequency of 75 Hz
SF = 11981/ F_{limit} = 11981/75 = 160_{dec} » 0000_1010_0000 bin + Low-Byte = $0000\_1010\_0000\_0000_{bin}$ = 0x0A00

Default register setting is 0x35C0.

	Register 37	F_{stop} [Hz]	F_{limit} [Hz]	Cycle time [ms]
SKIP =0 Fast = 0	0x0A00	270	75	50
	0x1400	135	38	100
	0x1E00	90	25	150
	0x2800	68	19	200
	0x3200	54	15	250
SKIP = 0 Fast =1	0x0781			5
	0x0F01			10
	0x1681			15
	0x1E01			20
	0x2581			25
SKIP = 1 Fast = x	0x0782		671	5
	0x0F02		335	10
	0x1682		224	15
	0x1E02		168	20
	0x2582		134	15

3.6.6 IP/IE3112

3.6.6.1 Functioning IP/IE3112

The analog input module handles signals from 0 to 20 mA with a resolution of 16 bits. The filter constants and the associated conversion times can be adjusted over a wide range.

Process data (hex)	Process data (decimal)	Measured value
0x0000	0	0 mA
0x3FFF	16383	10 mA
0x7FFF	32767	20 mA

As from software version [IP3112-Bxxx "3"; IE3112 "0"] (see Appendix) it is also possible to set the range from 4..20 mA in register 32 (bit 5 = 1). This setting in the feature register can be set separately for each channel.

Process data (hex)	Process data (decimal)	Measured value
0x0000	0	4 mA
0x3FFF	16383	12 mA
0x7FFF	32767	20 mA

Representation corresponds to the INT (integer) number format. The default setting is for the process data to be entered in twos complement (-1 corresponds to 0xFFFF).

Process data

The process data written by the controller is output as follows:
x_adc = output value from the A/D converter
y_aus = process data to the PLC controller
B_a, A_a = manufacturer scaling (registers 17, 18)
B_h, A_h = manufacturer scaling (registers 19, 20)
B_w, A_w = user scaling (registers 33, 34)
Y_dac = output value to the D/A converter

Neither user nor manufacturer scaling are active

Y_a = (B_a + x_adc)*A_a
Y_aus = Y_a

Manufacturer scaling active (default)

Y_1 = B_h + A_h * Y_a
Y_aus = Y_1

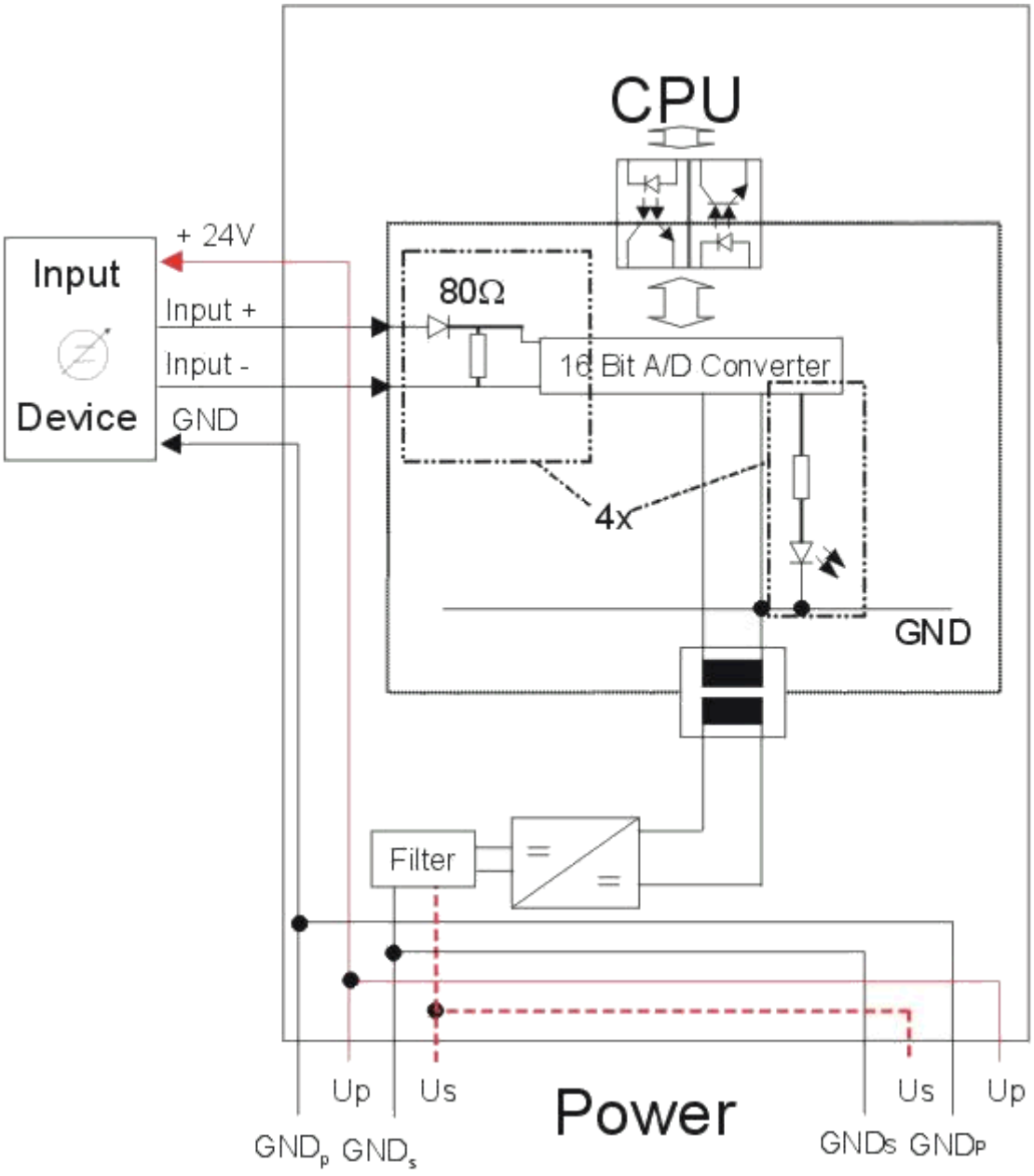
User scaling active

Y_2 = B_w + A_w * Y_a
Y_aus = Y_2

Manufacturer and user scaling active

Y_1 = B_h + A_h * Y_a
Y_2 = B_w + A_w * Y_1
Y-aus = Y_2
The linear equations are activated via register 32.

Conceptual circuit diagram



3.6.6.2 Control and Status Byte IP/IE3112

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	Error	Limit value 2		Limit value 1		Over-Range	Under-Range

Name	description	
RegAccess	0_{bin}: Acknowledgement for process data mode	
Error	general error bit (value >21mA or <3mA in 4...20mA mode)	
Limit value 2 Limit value 1	00_{bin} Limit value not active 10_{bin} Process data < limit value 01_{bin} Process data > limit value 11_{bin} Process data = limit value	
Over-Range	R32 Bit 4 = 0: Range of measurement exceeded >0x7FFF or 0xFFFF	R32 Bit 4 = 1: Measured value > 20 mA
Under-Range	R32 Bit 4 = 0 und R32 Bit 5 = 0: no function	R32 Bit 4 = 1 und R32 Bit 5 = 1: Measured value < 4 mA

Register Communication

Measured values cannot be transmitted during register communication.

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.6.3 Register Overview IP/IE3112

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Unprocessed ADC value	variable	R	RAM
R1	reserved	0x0000	R	
...	...	...	...	...
R7	reserved	0x0000	R	
R8	Module type	3112dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x0098	R	ROM
R13	Data structure	0x0004	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	EEPROM
R17	Hardware compensation offset	specific	R/W	EEPROM
R18	Hardware compensation gain	specific	R/W	EEPROM
R19	Manufacturer scaling: Offset	0x0000	R/W	EEPROM
R20	Manufacturer scaling: Gain	0x0080	R/W	EEPROM
R21	reserved	0x0000	R/W	
...	...	...	...	...
R30	reserved	0x0000	R/W	
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0012	R/W	EEPROM
R33	User offset	0x0000	R/W	EEPROM
R34	User gain	0x0100	R/W	EEPROM
R35	Limit value 1	0x0000	R/W	EEPROM
R36	Limit value 2	0x0000	R/W	EEPROM
R37	Filter register	0x3200	R/W	EEPROM
R38	reserved	0x0000	R/W	
...	...	...	...	...
R63	reserved	0x0000	R/W	

3.6.6.4 Feature register (R32) IP/IE3112

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default [0x0012]

Bit	Value	Description	Manufacturer's setting
0	0_{bin}	User scaling is inactive	0_{bin}
	1_{bin}	User scaling is active	
1	0_{bin}	Manufacturer scaling is inactive	1_{bin}
	1_{bin}	Manufacturer scaling is active	
2	0_{bin}	reserved	0_{bin}
3	0_{bin}	The arithmetic sign of numerical quantities is not represented	0_{bin}
	1_{bin}	The arithmetic sign of numerical quantities is active (-1 = 0x8001)	
4	0_{bin}	Overflow offset is inactive	1_{bin}
	1_{bin}	Overflow offset is active	
5) [1]	0_{bin}	0..20 mA mode	0_{bin}
	1_{bin}	4..20 mA mode	
6	0_{bin}	reserved	0_{bin}
...	...	...	...
8	0_{bin}	reserved	0_{bin}
9	0_{bin}	Limit value 1 is inactive	0_{bin}
	1_{bin}	Limit value 1 is active (R35)	
10	0_{bin}	Limit value 2 is inactive	0_{bin}
	1_{bin}	Limit value 2 is active (R36)	
11	0_{bin}	reserved	0_{bin}
...	...	...	...
15	0_{bin}	reserved	0_{bin}

Overflow offset

If this bit is set, the measured value (the actual current) is monitored and indicated in the status byte.
If this bit is not set, then process data greater than 0x7FFF (or 0xFFFF, depending on the manufacturer scaling) is indicated in the status byte.

)[1] as from I/O circuit board software version [▶ 15] IP3112-Bxxx "3" IE3112 "0"

3.6.6.5 Filter Register (R37) IP/IE3112

The IP/IE3112 possesses two low-pass filter stages. The first stage consists of a sin³ filter. This is always active. The second consists of a 22nd order FIR filter. This can be deactivated. The filter settings always apply to all the channels, and are set in the first register for channel 1. The settings are not effective until after a power on reset (switch the Fieldbus Box off and on again).

Bit	SF11	SF10	SF9	SF8	SF7	SF6	SF5	SF4	SF3	SF2	SF1	SF0	0	0	SKIP	Fast
Name	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

FAST

1 - active
0- inactive
When active there is a fast reaction to input steps (in spite of the filter stage being active); in this case the filter is being bypassed.

SKIP

0 - FIR filter active
1 - FIR filter is bypassed

Bits 2, 3

must be zero.

SF0-11

This is the filter constant itself. It specifies the 3dB limit frequency of the sin³ filter. The value ranges from 150 to 2,047. The 3 dB limit frequency and the 64.5 dB stop frequency F_{stop} are listed in the following table and are calculated as follows:

SKIP = 0
SF = 11981/ F_{limit}
SF = 43008/ F_{stop}

SKIP = 1
SF = 80486/ F_{limit}

Example: You want to set a limit frequency of 75 Hz
SF=11981/ F_{limit} = 11981/75 = 160_{dez} » $0000\_1010\_0000_{bin}$ + LowByte = 0000_1010_0000_0000 = 0x0A00

Default 0x3200

	Register 37	F_{stop} [Hz]	F_{limit} [Hz]	Cycle time [ms]
SKIP =0 Fast = 0	0x0A00	270	75	50
	0x1400	135	38	100
	0x1E00	90	25	150
	0x2800	68	19	200
	0x3200	54	15	250
SKIP = 0 Fast =1	0x0781			5
	0x0F01			10
	0x1681			15
	0x1E01			20
	0x2581			25
SKIP = 1 Fast = x	0x0782		671	5
	0x0F02		335	10
	0x1682		224	15
	0x1E02		168	20
	0x2582		134	15

3.6.7 IP/IE3202

3.6.7.1 Functioning IP/IE3202

The IP3202-Bxxx or IE3202 analog input module allows four resistance sensors to be connected directly. The resistance sensors can be connected according to the 2, 3 or 4 wire connection method. Calculation and linearisation of the resistance value to obtain a temperature is performed by a microcontroller in the module.

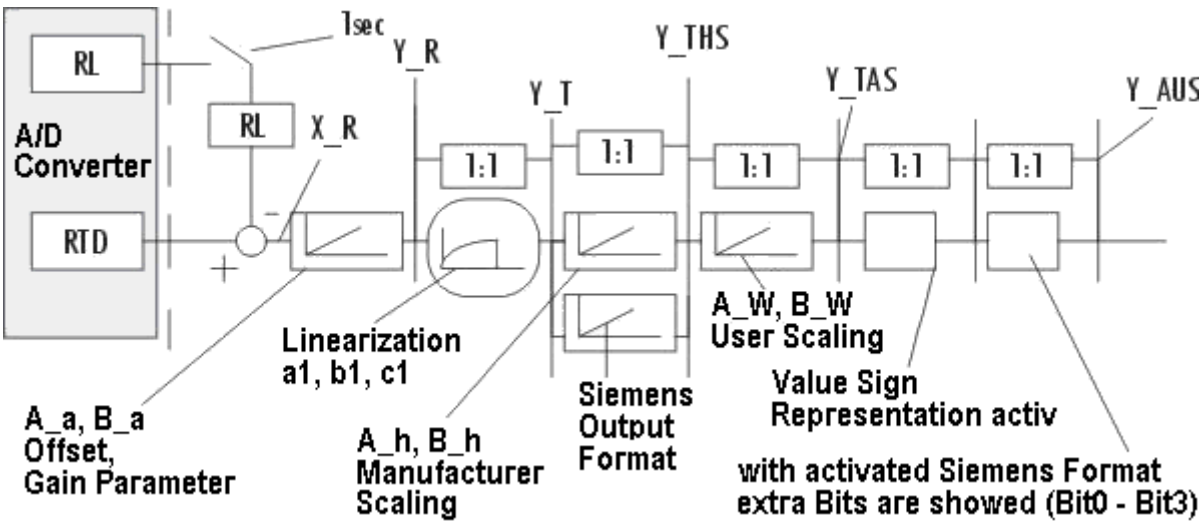
Temperatures are output in 1/10 °C (1 digit = 0.1 °C). In addition to this, a broken wire or short circuit is reported to the slave or to the controller, and indicated by the error LED.

PT100, NI100, PT200, PT500, NI120, NI1000 and PT1000 elements are implemented over their full measuring ranges as resistance sensors. The module can be fully configured over a fieldbus. A self-defined scaling of the output can, for instance, be performed, or the temperature conversion can be switched off. In the latter case, the measurement is output is in the range from 10 ohm up to 1.2/5.0 kohm with a resolution of 1/10 resp. 1/2 ohm (the internal resolution of the resistance value is 1/255 ohm).

Process data output format

Process data (hex)	Process data Decimal (Integer)	Measured value
0xF63C	-2500	-250°C
0xF830	-2000	-200°C
0xFC18	-1000	-100°C
0xFFFF	-1	-0.1°C
0x0000	0	0.0°C
0x0001	1	0.1°C
0x03E8	1000	100°C
0x07D0	2000	200°C
0x1388	5000	500°C
0x2134	8500	850°C

Process data



The process data that is transmitted to the K-Bus is calculated from the following equations:

X_RL: ADC value of the supply cables
X_RTD: ADC value of the temperature sensor, including one supply cable
X_R: ADC value of the temperature sensor
A_a, B_a: Manufacturer, gain and offset compensation (R17, R18)

A_h, B_h: Manufacturer scaling
A_w, B_w: User scaling
Y_R: Temperature sensor resistance value
Y_T: Measured temperature in 1/16 °C
Y_THS: Temperature after manufacturer scaling (1/10 °C)
Y_TAS: Temperature after user scaling
Y_AUS: Process data to PLC controller

a) Calculation of the resistance value:
X_R = X_RTD-X_RL (1.0) Y_R = A_a * (X_R -B_a) (1.1)

b) Curve linearisation:
Y_T = a1 * Y_R^2 + b1* Y_R + c1 (1.2) or Y_T = Y_R if the output is in ohms (1.3)

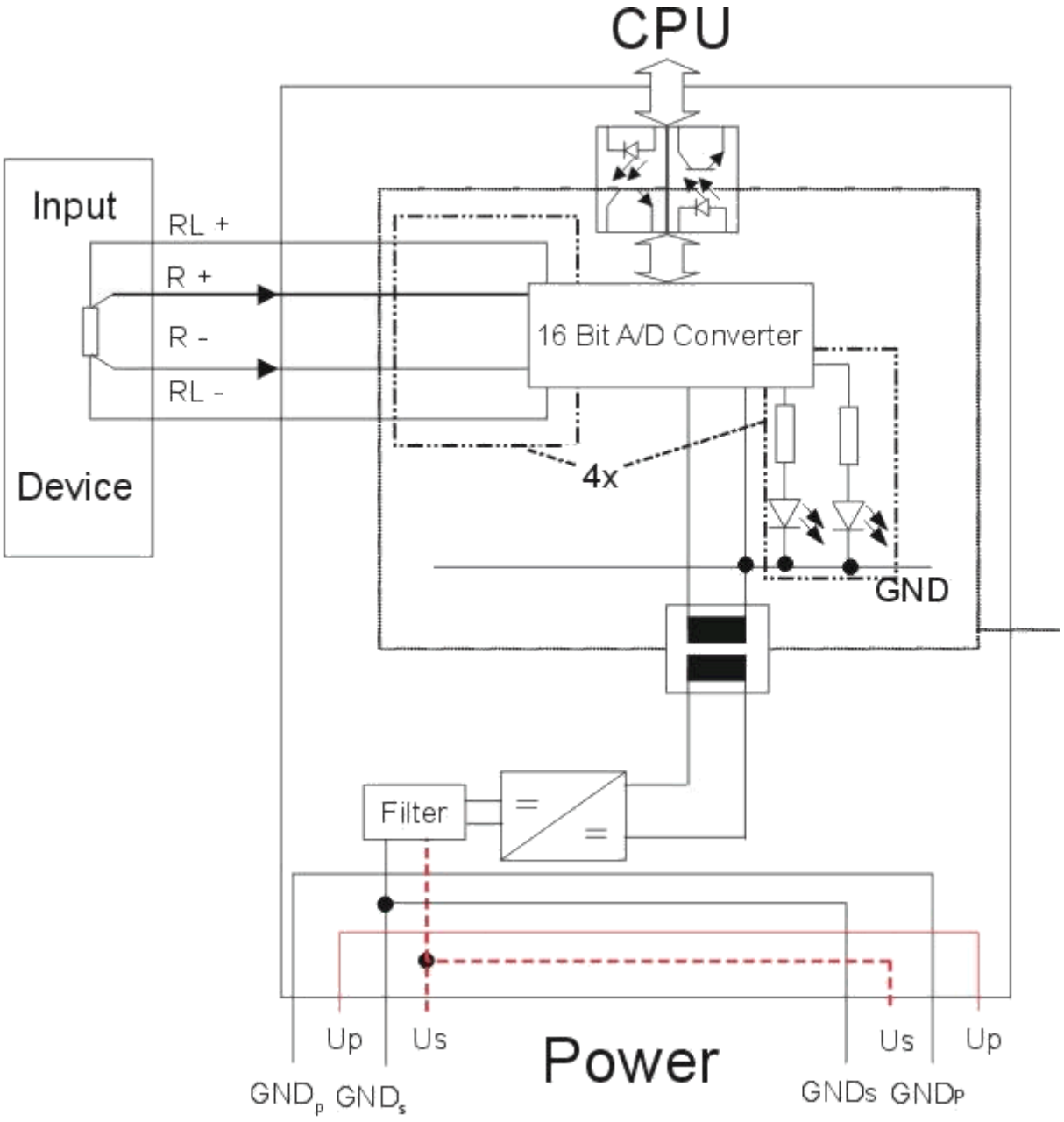
c) Neither user nor manufacturer scaling are active:
Y_AUS = Y_T (1.4)

d) Manufacturer scaling active (factory setting):
Y_THS = A_h * Y_T + B_h (1.5) Y_AUS = Y_THS

e) User scaling active:
Y_TAS = A_w * Y_T + B_w (1.6) Y_AUS = Y_TAS

f) Manufacturer and user scaling active: (1.7)
Y_1 = A_h * Y_T + B_h Y_2 = A_w * Y_1 + B_w Y_AUS = Y_2

Conceptual circuit diagram



3.6.7.2 Control and Status Byte IP/IE3202

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	Error	reserved		reserved		Over-Range	Under-Range

Name	description
RegAccess	0_{bin}: Acknowledgement for process data mode
Error	general error bit
Over-Range	R > 400 Ohm
Under-Range	R < 18 Ohm

Register Communication

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.7.3 Register Overview IP/IE3202

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Unprocessed ADC value	variable	R	RAM
R1	Unprocessed ADC value for the leads	variable	R	RAM
R2	reserved	0x0000	R	
...	...	...	...	...
R5	reserved	0x0000	R	
R6	Diagnostic register	variable	R	RAM
R7	reserved	0x0000	R	
R8	Module type	3202dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x0098	R	ROM
R13	Data structure	0x0000	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	Hardware compensation offset	specific	R/W	SEEROM
R18	Hardware compensation gain	specific	R/W	SEEROM
R19	Manufacturer scaling: Offset	0x0000	R/W	SEEROM
R20	Manufacturer scaling: Gain	0x00A0	R/W	SEEROM
R21	Offset register two-wire connection method	specific	R/W	SEEROM
R22	Offset register three-wire connection method	specific	R/W	SEEROM
...	...	...	...	...
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0102	R/W	SEEROM
R33	User offset	0x0000	R/W	SEEROM
R34	User gain	0x0100	R/W	SEEROM
R35	reserved	0x0000	R/W	SEEROM
R36	reserved	0x0000	R/W	SEEROM
R37	Filter register	0x0000	R/W	SEEROM
R38	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.7.4 Feature register (R32) IP/IE3202

The module's fundamental settings can be modified in the feature register.

Write protection must first be cancelled in the code-word register before it is possible to write into this register (default: 0x0106).

NOTE

Attention

2-, 3- or 4-wire connection has to be the same in the registers of all four channels.

Bit	Value	Description		Manufacturer's setting
0	0_{bin}	User scaling is inactive		0_{bin}
	1_{bin}	User scaling is active (registers 33, 34)		
1	0_{bin}	Manufacturer scaling is inactive		1_{bin}
	1_{bin}	Manufacturer scaling is active (registers 19, 20)		
2	0_{bin}	no function		0_{bin}
3	0_{bin}	Sign-amount representation is inactive		0_{bin}
	1_{bin}	Sign-amount representation is active		
4	0_{bin}	Hide Siemens extension bits		0_{bin}
	1_{bin}	Reveal Siemens extension bits		
5	0_{bin}	no function		0_{bin}
6	0_{bin}	no function		0_{bin}
7	0_{bin}	Deactivate manual filter setting in register 37		0_{bin}
	1_{bin}	Activate manual filter setting in register 37		
8	0_{bin}	Deactivate over range protection		1_{bin}
	1_{bin}	Activate over range protection If the temperature exceeds 850°C the status bits are correspondingly set and the output value is restricted to 850°C.		
10... 9	00_{bin}	Four-wire connection is activated (Attention: this has to be same for all four channels)		00_{bin}
	01_{bin}	Three-wire connection is activated* (Attention: this has to be same for all four channels)		
	10_{bin}	Two-wire connection is activated (Attention: this has to be same for all four channels)		
11	0_{bin}	no function		0_{bin}
15...12	0_{hex}	PT100	-200°C - 850°C ± 0.3°C	0_{hex}
	1_{hex}	NI100	-60°C - 250°C ± 0.3°C	
	2_{hex}	PT1000	-200°C - 850°C ± 0.3°C	
	3_{hex}	PT500	-200°C - 850°C ± 0.5°C	
	4_{hex}	PT200	-200°C - 850°C ± 0.3°C	
	5_{hex}	NI1000	-200°C - 850°C ± 0.3°C	
	6_{hex}	NI120	-80°C - 320°C ± 0.3°C	
	7_{hex}	RSNE1000	Nickel 1000, special Siemens temperature curve	
	E_{hex}	Ohm	10 - 5000 ohms (in 1/2 Ohm)	
	F_{hex}	Ohm	10 -1200 ohms (in 1/10 Ohm)	

*) as from I/O circuit board firmware version 2 of IP3202 resp. as from I/O circuit board firmware version 0 of IE3202

Explanation of the sign bit

The default representation is twos complement, i.e. -1 is represented as 0xFFFF

Sign-amount representation is active, i.e. -1 is represented by 0x8001

Scaling example

Manufacturers scaling active, user scaling active, output in ohms, 10-5000 ohms
Register 34 0x0500 0.100 ohm / digit
Register 34 0x0400 0.125 ohm / digit
Register 34 0x0200 0.250 ohm / digit
Register 34 0x0100 0.500 ohm / digit
Register 34 0x0080 1.000 ohm / digit

Siemens output format (S5)

If the Siemens output format is selected, the lowest three bits are used to assess the status. The process data is represented in bits 3-15, where bit 15 is the arithmetic sign bit.

Bit	Name	Description	
0	Overflow	0_{bin}	Value in Range
		1_{bin}	Value out of range
1	Error	0_{bin}	No error
		1_{bin}	Error
2	-	0_{bin}	reserverd
14...3	Value	0_{bin}	process data
15	Sign	0_{bin}	plus
		1_{bin}	minus

Two-wire connection

A resistance can be measured directly through the two-wire connection. That proportion of the resistance represented by the connecting cables can be measured and entered in register 21. For two-wire connection, it is necessary to copy the raw ADC value from register 1 into register 22 while the conductor resistance is short-circuited (+RL -RL).

User scaling

Example of scaling to Fahrenheit [▶ 288]

3.6.7.5 Filter Register (R37) IP/IE3202

The filter time of the A/D converter can be modified in the filter register. Write protection must first be cancelled in the code-word register before it is possible to write into this register. The conversion time of the A/D converter also changes when the filter time is changed. The two values depend directly upon one another. The filter settings always apply to all the channels, and are set in the first register for channel 1. The settings are not effective until after a power on reset (switch the Fieldbus Box off and on again).

Default 0x0000

Value	Filter First Notch [Hz]	Conversion time
0x0000	25	250 ms
0x0050	100	65 ms
0x00A0	50	125 ms
0x0140	25	250 ms
0x0280	12.5	500 ms

3.6.8 IP/IE3312

3.6.8.1 Functioning IP/IE3312

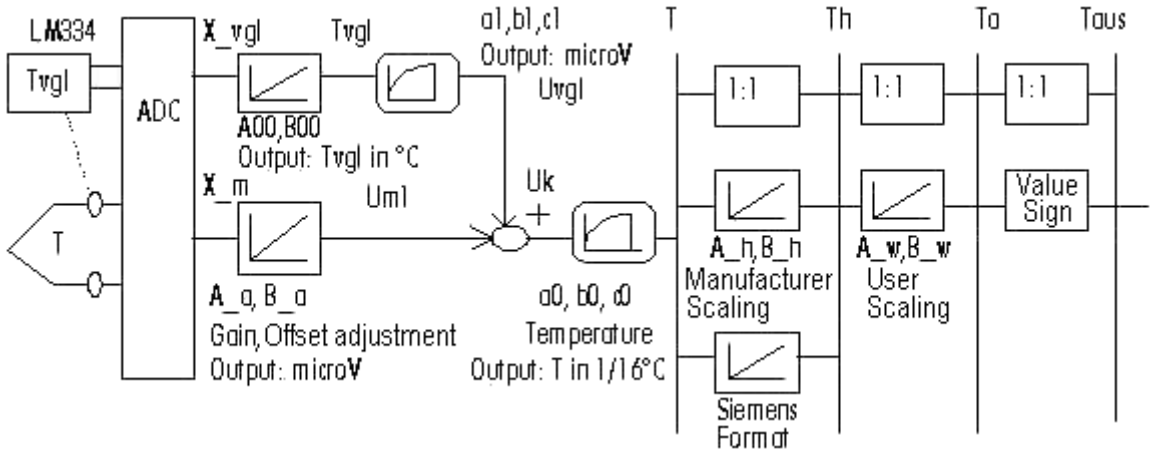
Thermocouples can be classified as active measuring sensors. They exploit the thermo-electric effect (Seebeck, Peltier, Thomson). Where two electrical conductors of different materials (e.g. iron and constantan) make contact, charge is transferred across the contact surface. A contact potential develops, and is strongly dependent on temperature. The thermally generated voltage is both a function of the temperature being measured, T, and of the comparison temperature, Tv, at the point where contact is made with the thermocouple. Since the coefficients are determined at a comparison temperature of 0°C, it is necessary to compensate for the effect of the comparison temperature. This is done by converting the comparison temperature into a comparison voltage that depends on the type of thermocouple, and adding this to the measured thermal voltage. The temperature is found from the resulting voltage and the corresponding curve.

Temperatures are measured 1/10°C (1 Digit = 0,1°C). A missing cold compensation sensor (PT1000) or wire break is reported and indicated by the Error LED.

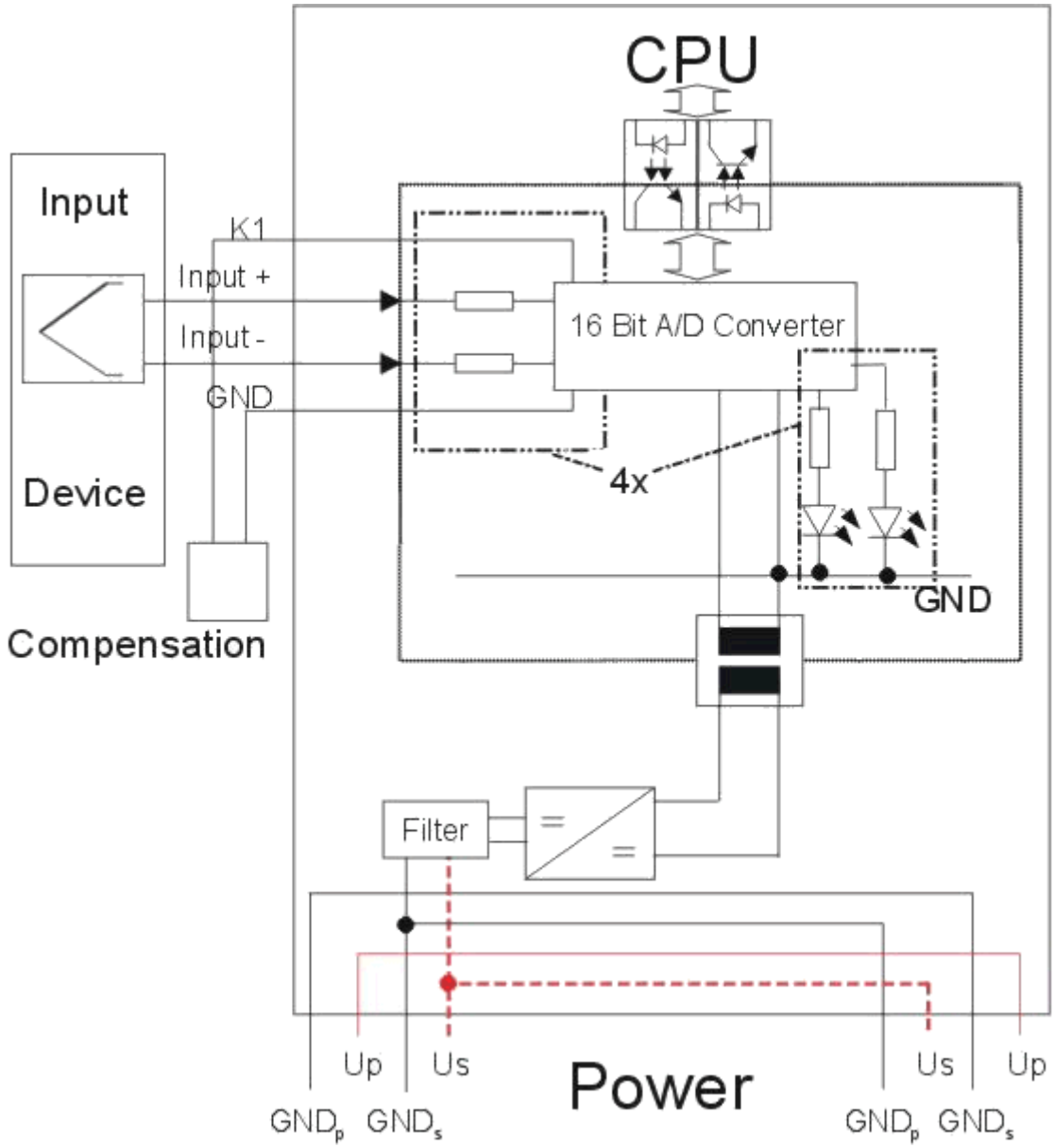
Format of the process data

process data (hex)	process data decimal (integer)	temperature value
0xF63C	-2500	-250°C
0xF830	-2000	-200°C
0xFC18	-1000	-100°C
0xFFFF	-1	-0,1°C
0x0000	0	0,0°C
0x0001	1	0,1°C
0x03E8	1000	100°C
0x07D0	2000	200°C
0x1388	5000	500°C
0x2134	8500	850°C

Block diagram



Conceptual circuit diagram



3.6.8.2 Control and Status Byte IP/IE3312

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	Error	-	-	NoColdJunction	internal Error	Over-Range	Under-Range

Name	description
RegAccess	0_{bin}: Acknowledgement for process data mode
Error	general error bit
NoColdJunction	cold junction in the plug is lost: An error is reported if the cold junction is not in the range between -50 and +100°C.
internal Error	analog part of the Fieldbus Box is faulty
Over-Range	broken wire
Under-Range	value under minimum value of the chosen thermocouple (Bit R32.12 to Bit R32.12 of the Feature Register)

Register Communication

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.8.3 Register Overview IP/IE3312

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Unprocessed ADC value	variable	R	RAM
R1	Unprocessed comparison value	variable	R	RAM
R2	Temperature comparison in 1/16°C	variable	R	RAM
R3	reserved	0x0000	R	
R4	reserved	0x0000	R	
R5	reserved	0x0000	R	
R6	Diagnostic register	variable	R	RAM
R7	reserved	0x0000	R	
R8	Module type	3314dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x0098	R	ROM
R13	Data structure	0x0000	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	Hardware compensation: Offset	specific	R/W	SEEROM
R18	Hardware compensation: Gain	specific	R/W	SEEROM
R19	Manufacturer scaling: Offset	0x0000	R/W	SEEROM
R20	Manufacturer scaling: Gain	0x00A0	R/W	SEEROM
R21	Hardware compensation comparison temperature	specific	R/W	SEEROM
R22	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x1002	R/W	SEEROM
R33	User offset	0x0000	R/W	SEEROM
R34	User gain	0x0100	R/W	SEEROM
R35	reserved	0x0000	R/W	SEEROM
R36	reserved	0x0000	R/W	SEEROM
R37	Filter register	0x0000	R/W	SEEROM
R38	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.8.4 Feature Register (R32) IP/IE3312

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default: 0x1002

Bit	Value	Description				Manufac-turer's set-ting
0	0_{bin}	User scaling is inactive				0_{bin}
	1_{bin}	User scaling is active				
1	0_{bin}	Manufacturer scaling is inactive				1_{bin}
	1_{bin}	Manufacturer scaling is active				
2	0_{bin}	reserved				0_{bin}
3	0_{bin}	Sign-amount representation is inactive				0_{bin}
	1_{bin}	Sign-amount representation is active				
4	0_{bin}	Hide Siemens extension bits				0_{bin}
	1_{bin}	Reveal Siemens extension bits				
5	0_{bin}	Deactivate manual filter setting in register 37				0_{bin}
	1_{bin}	Activate manual filter setting in register 37				
6	0_{bin}	reserved				0_{bin}
7	0_{bin}	reserved				0_{bin}
8	0_{bin}	Comparison temperature is switched on				0_{bin}
	1_{bin}	Comparison temperature is switched off				
9	0_{bin}	reserved				0_{bin}
10	0_{bin}	reserved				0_{bin}
11	0_{bin}	Do not use the comparison point for the first channel for all the other channels				0_{bin}
	1_{bin}	Use the comparison point for the first channel for all the other channels				
15-12		Thermocouple type		minimal value	maximum value	1_{hex}
	0_{hex}	Type L		-100 °C	900 °C	
	1_{hex}	Type K		-100 °C	1370 °C	
	2_{hex}	Type J		-100 °C	1000 °C	
	3_{hex}	Type E		-100 °C	800 °C	
	4_{hex}	Type T		-100 °C	400 °C	
	5_{hex}	Type N		-100 °C	1300 °C	
	6_{hex}	Type U		-100 °C	600 °C	
	7_{hex}	Type B		600 °C	1800 °C	
	8_{hex}	Type R		0 °C	1700 °C	
	9_{hex}	Type S		0 °C	1700 °C	
		Millivolt measurement, resolution:		minimal value	maximum value	
	D_{hex}	1 µV*	1,6 µV**	-30 mV	+30 mV	
	E_{hex}	2 µV*	3,2 µV**	-60 mV	+60 mV	
	F_{hex}	4 µV*	6,4 µV**	-80 mV	+80 mV	

Note

For millivolt measurement please consider, witch scaling is activated: *) no scaling active **) only manufacturer scaling active

Explanation of the sign bit

The default representation is twos complement, i.e. -1 is represented as 0xFFFF

Sign-amount representation is active, i.e. -1 is represented by 0x8001

User scaling

See Example of scaling to Fahrenheit [▶ 288]

3.6.8.5 Filter Register (R37) IP/IE3312

The filter time of the A/D converter can be modified in the filter register. Write protection must first be cancelled in the code-word register before it is possible to write into this register. The conversion time of the A/D converter also changes when the filter time is changed. The two values depend directly upon one another. The filter settings always apply to all the channels, and are set in the first register for channel 1. The settings are not effective until after a power restart (switch the Fieldbus Box off and on again).

Default 0x0000

Value	Filter First Notch [Hz]	Conversion time
0x0000	25	200 ms
0x0050	100	70 ms
0x00A0	50	120 ms
0x0140	25	200 ms
0x0280	12.5	400 ms

3.6.9 IP/IE4112

3.6.9.1 Functioning IP/IE4112

The analog output module generates output signals in the range from 0...20 mA. The module supplies the output current with a resolution of up to 16 bits.

Process data (hex)	Process data (decimal)	Output value
0x0000	0	0 mA
0x3FFF	16383	10 mA
0x7FFF	32767	20 mA

As from software version 2 (see Appendix) it is also possible to set a range from 4...20 mA in register 32 (bit 5 = 1). This setting in the feature register of the first channel then applies to all channels, and cannot be set separately for each channel.

Process data (hex)	Process data (decimal)	Output value
0x0000	0	4 mA
0x3FFF	16383	12 mA
0x7FFF	32767	20 mA

Representation corresponds to the integer number format (INT). The default setting is for the process data to be entered in twos complement (-1 corresponds to 0xFFFF).

Process data

The process data written by the controller is output as follows:
x = PLC process data (D0, D1)
B_a, A_a = manufacturer scaling (registers 17, 18)
B_h, A_h = manufacturer scaling (registers 19, 20)
B_w, A_w = user scaling (registers 33, 34)
Y_dac = output value to the D/A converter

Neither user nor manufacturer scaling are active
Y_0 = B_a + A_a * x
Y_dac = Y_0

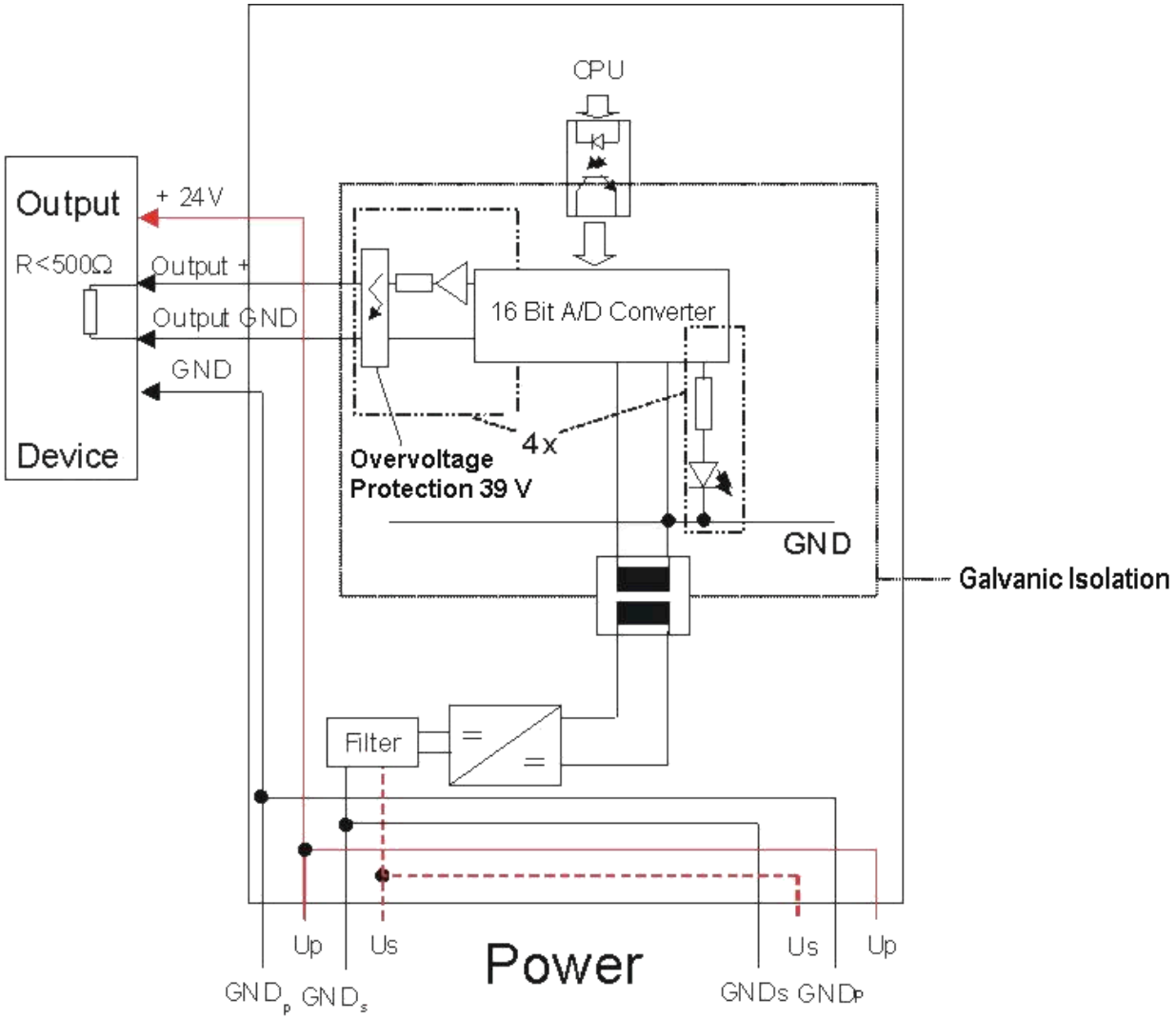
Manufacturer scaling active (default)
Y_1 = B_h + A_h * Y_0
Y_dac = Y_1

User scaling active
Y_2 = B_w + A_w * Y_0
Y_dac = Y_2

Manufacturer and user scaling active
Y_1 = B_h + A_h *Y_0
Y_dac = B_w + A_w * Y_1

The linear equations are activated via register 32.

Conceptual circuit diagram



3.6.9.2 Control and Status Byte IP/IE4112

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	**description**
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status-Byte

The Control byte is only visible if the Fieldbus Box is set to complex mode. The byte is located in the Fieldbus Box's input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Name	Description
RegAccess	0_{bin}: Acknowledgement for Process Data Mode

Register Communication

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.9.3 Register Overview IP/IE4112

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Manufacturer switch-on value	0x0000	R/W	
...	...	...	...	...
R4	reserved	0x0000	R	
R5	Raw DAC value	variable	R	RAM
R6	reserved	0x0000	R	
R7	reserved	0x0000	R	
R8	Module type	4112dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x9800	R	ROM
R13	Data structure	0x0004	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	EEPROM
R17	Hardware compensation offset	specific	R/W	EEPROM
R18	Hardware compensation gain	specific	R/W	EEPROM
R19	Manufacturer scaling: Offset	0x0000	R/W	EEPROM
R20	Manufacturer scaling: Gain	0x0200	R/W	EEPROM
R21	reserved	0x0000	R/W	
...	...	...	...	...
R30	reserved	0x0000	R/W	
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0002	R/W	EEPROM
R33	User offset	0x0000	R/W	EEPROM
R34	User gain	0x0100	R/W	EEPROM
R35	User switch-on value	0x0000	R/W	
...	...	...	...	...
R63	reserved	0x0000	R/W	

3.6.9.4 Feature register (R32) IP/IE4112

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.

Bit	Value	Description	Manufacturer's setting
0	0	User scaling is inactive	0
	1	User scaling is active	
1	0	Manufacturer scaling is inactive	1
	1	Manufacturer scaling is active	
2	0	Watchdog timer active.	0
	1	Watchdog timer inactive.	
3	0	reserved	0
4	0	reserved	0
5)1	0	0..20 mA mode	0
	1	4..20 mA mode	
8	0	Manufacturer switch-on value [0]	0
	1	User switch-on value R35	
9	0	reserved	0
...	...	...	...
15	0	reserved	0

Explanation of the watchdog timer

The watchdog timer is switched on by default. If the watchdog overflows, then either the manufacturer's or the user's switch-on value is output by the module.

NOTE

Note

For reasons of compatibility, 16 bit signed integer is selected as the standard output format. The range of positive values for 0..20 mA ranges from 0x0000 to 0x7FFF. This corresponds to 15 bits. Manufacturer scaling must be deactivated in order to exploit all 16 bits.)1 As from I/O circuit board software version IP4112-Bxxx "2" IE4112 "0"

3.6.10 IP/IE4132

3.6.10.1 Functioning IP/IE4132

The analog output module generates output signals in the range from -10...10 V. The module supplies the output voltage with a resolution of up to 16 bits.

Process data (hex)	Process data (decimal)	Output value
0x8001	-32767	-10 V
0xC001	-16383	- 5 V
0x0000	0	0 V
0x3FFF	16383	5 V
0x7FFF	32767	10 V

Representation corresponds to the integer number format (INT). The default setting is for the process data to be entered in twos complement (-1 corresponds to 0xFFFF).

Process data

The process data written by the controller is output as follows:
x = PLC process data (D0, D1)
B_a, A_a = manufacturer scaling (registers 17, 18)
B_h, A_h = manufacturer scaling (registers 19, 20)
B_w, A_w = user scaling (registers 33, 24)
Y_dac = output value to the D/A converter

Neither user nor manufacturer scaling are active
Y_0 = B_a + A_a * x
Y_dac = Y_0

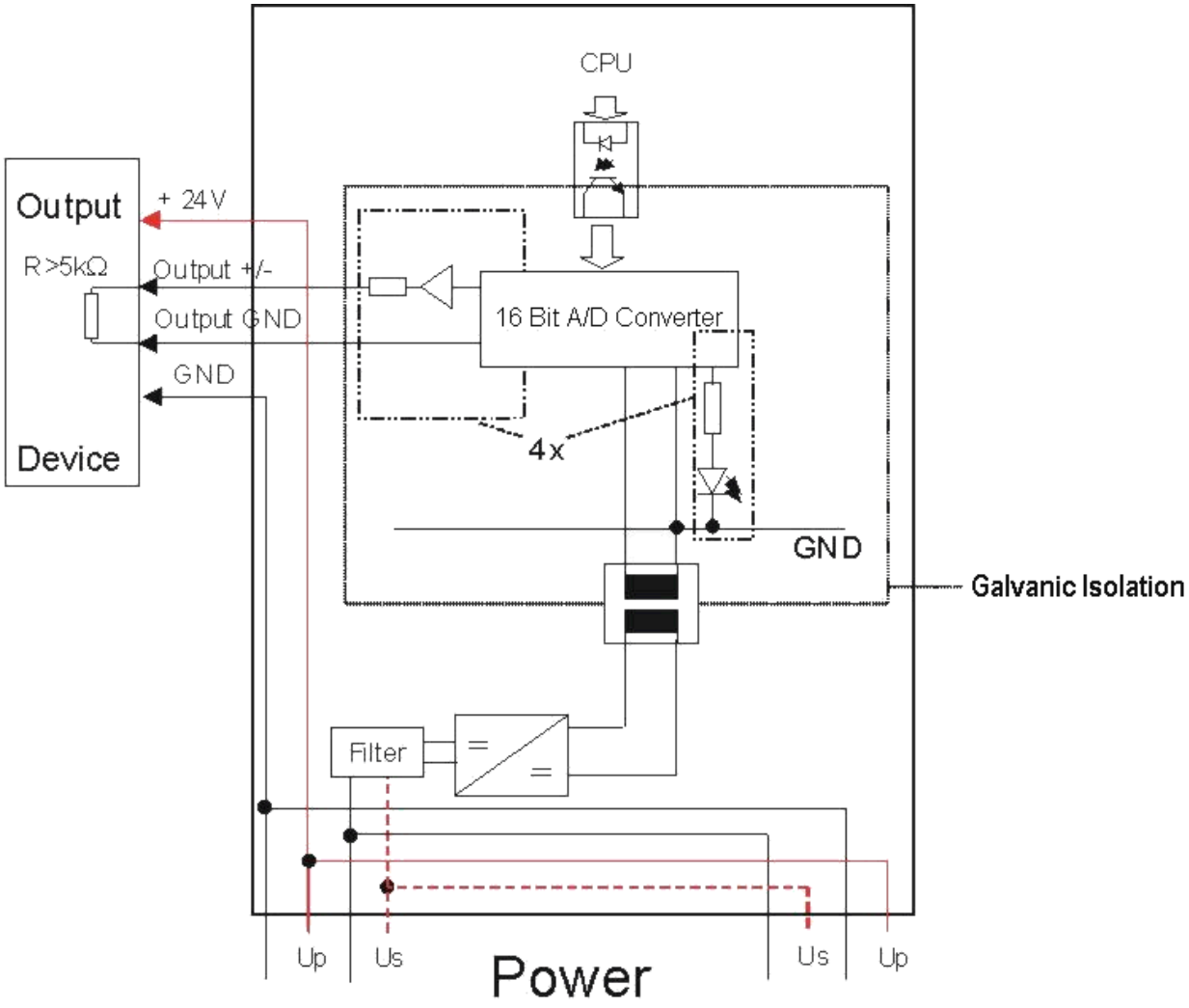
Manufacturer scaling active (default)
Y_1 = B_h + A_h * Y_0
Y_dac = Y_1

User scaling active
Y_2 = B_w + A_w * Y_0
Y_dac = Y_2

Manufacturer and user scaling active
Y_1 = B_h + A_h *Y_0
Y_dac = B_w + A_w * Y_1

The linear equations are activated via register 32.

Conceptual circuit diagram



3.6.10.2 Control and Status Bytes IP/IE4132

Process Data Mode

Control Byte

The Control byte is only visible, if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	**description**
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status-Byte

The Control byte is only visible if the Fieldbus Box is set to complex mode. The byte is located in the Fieldbus Box's input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Name	Description
RegAccess	0_{bin}: Acknowledgement for process data mode

Register Communication

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. The byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.10.3 Register Overview IP/IE4132

Register	Description	Default value	Read/*W*rite	Memory medium
R0	Manufacturer switch-on value	0x0000	R/W	
...	...	...	...	...
R4	reserved	0x0000	R	
R5	Raw DAC value	variable	R	RAM
R6	reserved	0x0000	R	
R7	reserved	0x0000	R	
R8	Module type	4132dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0418	R	ROM
R11	Signal channels	0x0418	R	ROM
R12	Minimum data length	0x9800	R	ROM
R13	Data structure	0x0004	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	Hardware compensation: Offset	specific	R/W	SEEROM
R18	Hardware compensation: Gain	specific	R/W	SEEROM
R19	Manufacturer scaling: Offset	0x0000	R/W	SEEROM
R20	Manufacturer scaling: Gain	0x0100	R/W	SEEROM
R21	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0000	R/W	SEEROM
R33	User offset	0x0000	R/W	SEEROM
R34	User gain	0x0100	R/W	SEEROM
R35	User switch-on value	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

3.6.10.4 Feature Register (R32) IP/IE4132

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.

Bit	Value	Description	Manufacturer's setting
0	0_{bin}	User scaling is inactive	0_{bin}
	1_{bin}	User scaling is active	
1	0_{bin}	Manufacturer scaling is inactive	0_{bin}
	1_{bin}	Manufacturer scaling is inactive	
2	0_{bin}	Watchdog timer active.	0_{bin}
	1_{bin}	Watchdog timer inactive.	
3	0_{bin}	reserved	0_{bin}
...	...	...	...
7	0_{bin}	reserved	0_{bin}
8	0_{bin}	Manufacturer switch-on value [0]	0
	1_{bin}	User switch-on value R35	
9	0_{bin}	reserved	0_{bin}
...	...	...	...
15	0_{bin}	reserved	0_{bin}

Explanation of the watchdog timer

The watchdog timer is switched on by default. If the watchdog overflows, then either the manufacturer's or the user's switch-on value is output by the module.

3.6.11 IP/IE5009

3.6.11.1 Functioning IP/IE5009

The SSI sensor interface module IP/IE5009 enables the direct connection of a SSI sensor to the fieldbus or the Coupler Box. The sensor is powered via the SSI interface. The module generates a pulse for reading the sensor and makes the incoming adapted data stream available to the controller in the process image. Various operating modes, transfer frequencies, bit widths and code implementations can be selected. The individual configuration is permanently stored in a register set.

The SSI interface is supplied with a data width of 24 bits and activated Graycode conversion. The baud rate to the SSI sensor is set to 250 kHz. The process data are output in the input data bytes D0 - D3. The mapping module is described in more detail in Chapter *Mapping*.

Process data

Signals	Description
Outputs clock+ / clock-	Clock output for the SSI sensor
Inputs data+ / data-	Differential signal inputs (RS485)
+24 V_{DC} U_S	Voltage output for the sensor supply
U_S	Power supply for the electronics and the encoder
U_P, GND	In order for the module to operate, a power supply of 0 V and 24 V must be connected to these contacts.

3.6.11.2 Control and Status Byte IP/IE5009

Process data mode

Control Byte

The Control byte is only visible in the process image, if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	reserved						

Bit	description
RegAccess	0_{bin}: Register Communication switched off (Process data mode)

Status byte

The status byte is only visible if the Fieldbus Box is operated in complex mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	Error	0	0	0	0	FRAME_E	SSI_IN_E

Name	Description
RegAccess	0_{bin}: Acknowledgement for process data mode
Error	A general fault has occurred. This bit is set if a fault has occurred in FRAME-E or SSI_IN-E
FRAME_E	The data frame is wrong, i.e. the data frame is not terminated with zero (perhaps wire breakage on clock cables).
SSI_IN_E	The SSI input of terminal is on low level, if no data transmission occurs. (SSI has no power supply or wire breakage on SSI data inputs D+ or D-, or data cables transposed)

Register Communication

Control Byte

The Control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Register Communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written

Status Byte

The Status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that has been read or written

3.6.11.3 Register Overview IP/IE5009

Register	Description	Default Value	Read/Write	Memory medium
R0	reserved	0000_{hex}	R	
...	...	...	...	...
R7	reserved	0000_{hex}	R	
R8	Module type	1391_{hex} (5009_{dec})	R	ROM
R9	Software version	$XXXX_{hex}$	R	ROM
R10	Multiplex shift register	0218_{hex}/0130_{hex}	R	ROM
R11	Signal channels	0128_{hex}	R	ROM
R12	Minimum data length	$00A8_{hex}$	R	ROM
R13	Data structure	0000_{hex}	R	ROM
R14	reserved	0000_{hex}	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	$XXXX_{hex}$	R/W	SEEROM
R17	reserved	0000_{hex}	R	
...	...	...	...	...
R30	reserved	0000_{hex}	R	
R31	Codeword register	variable	R/W	RAM
R32	Feature register	0007_{hex}	R/W	SEEROM
R33	Baud rate	0002_{hex}	R	
R34	Data length	0018_{hex}	R	
R35	reserved	0000_{hex}	R	
...	...	...	...	...
R63	reserved	0000_{hex}	R	

Note

Changes of the register settings are not effective before a reboot of the Fieldbus Box.

3.6.11.4 Feature Register (R32) IP/IE5009

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default: 0x0001

Bit	Value	Description	default
0	0_{bin}	Binary output	1_{bin}
	1_{bin}	Graycode The numbers are output as graycode	
1	1_{bin}	reserved	0_{bin}
2	0_{bin}	Free running	0_{bin}
	1_{bin}	Synchronous mode The data are loaded synchronous to the read cycle of the Terminal Bus.	
3	0_{bin}	Multi-turn evaluation of the sensor	0_{bin}
	1_{bin}	Single-turn evaluation of the encoder	
4	0_{bin}	Enable Frame Error	0_{bin}
	1_{bin}	Disable Frame Error After the last valid bit, no check is carried out as to whether the data line supplies a zero signal.	

3.6.11.5 Baud Rate Register (R33) IP/IE5009

The Baud Rate for the reading of the SSI data can be modified in the Baud Rate Register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
(Default: 0x0002)

Bit	Description
0	reserved
1	1 MHz
2	250 kHz (Default)
3	125 kHz
4	100 kHz
5	83 kHz
6	71 kHz
7	62,5 kHz
8	reserved
...	...
15	reserved

3.6.11.6 Data Length Register (R34) IP/IE5009

The data length, witch is displayed in the process image can be modified in the Data Length Register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.

Default: 0x0018 (24 bit data length)

Bit	Value	Description
0 to 7	0_{hex}	0 bit data length
	1_{hex}	1 bit data length
	...	...
	20_{hex}	32 bit data length
	21_{hex}	reserved
	...	...
	FF_{hex}	reserved
8 to 15	reserved	

3.6.12 IP/IE5109

3.6.12.1 Functioning IP/IE5109

The IP/IE5109 incremental encoder interface module allows any 5 V incremental encoder to be connected to the Fieldbus or Coupler Box. A 16 bit counter with a quadrature decoder and a 16 bit latch can be read, set or enabled. In addition to the encoder inputs A, B and C, an additional latch input (24 V) and a gate input (24 V) for locking the counter are available.

It is also possible for the 16-bit up/down counter operating mode to be selected. In this mode, input A is the counter input, input B defines the direction.

The feature register permits measurement of periods. In this case, the length of the period between two positive edges in input signal A is determined with a resolution of 250 ns.

Single, double or quadruple evaluation of the encoder signals A, B and C in simple or complementary form can be parameterised via the fieldbus. The module is supplied set to function as a 4-fold quadrature decoder with complementary evaluation of the encoder signals A, B and C.

If the encoder has a fault signal output, it can be connected to the STATUS input of the module.

The encoder is supplied with the necessary 5 V_{DC} power from the module.

Process data

Signals	Description
Inputs A, /A	Pulse input in the module's encoder and counter operating modes
Inputs B,/B	Phase-shifted pulse input in the module's encoder operating mode
Inputs C,/C	Zero point pulse input for the module's latch register This input is activated by means of the EN_LATC bit in the module's control byte
External latch 24 V	Additional latch input for the module This input is activated by means of the EN_LAT_EXT bit in the module's control byte. If this input is enabled, the counter value will be latched when the edge changes from 0 V to 24 V.
External gate 24 V	A high level at this contact halts counting in the terminal.
Status input	If the incremental encoder has a fault signal output, it can be connected to the status input (an active low input with internal pull up circuitry).
U_S	Power supply for the electronics and the encoder
U_P, GND	In order for the module to operate, a power supply of 0 V and 24 V must be connected to these contacts.

3.6.12.2 Control and Status Byte IP/IE5109

Process data mode

Control byte

The control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	-	-	-	-	CNT_SET	EN_LAT_EXT / RD_PERIOD	EN_LATC

Name	Description
RegAccess	0_{bin}: Register communication off (process data mode)
CNT_SET	A rising edge at CNT_SET will set the counter to the value specified in the process data.
EN_LAT_EXT	The external latch input is activated. The value of the counter is entered into the latch register at the first external latch pulse after the EN_LAT_EXT bit becomes valid. When this bit is set, the subsequent pulses do not have any effect on the latch register. It is necessary to ensure that the corresponding latch-valid bit (LAT_EXT_VAL) is cleared by the module before activating the null pulse. This functionality can be set in the feature register (default setting).
RD_PERIOD	The length of the period between two positive edges at input A is measured with a resolution of 200 ns. When the bit is set, this duration is output in data bytes D3 and D4. This functionality can be set in the feature register.
EN_LATC	The null point latch (C input) is activated. The value of the counter is entered into the latch register at the first external latch pulse after the EN_LATC bid becomes valid (it has a higher priority than EN_LAT_EXT). When this bit is set, the subsequent pulses do not have any effect on the latch register. It is necessary to ensure that the corresponding latch-valid bit (LATC_VAL) is cleared by the module before activating the null pulse. (The LATC_VAL bit can only be reset by the module when the C pulse is at a low level.)

Status byte

The status byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the Fieldbus Box's input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	-	STATUS_INPUT	OVERFLOW	UNDERFLOW	CNTSET-ACC	LAT_EXT_VAL/ RD_PERIOD_Q	LATC_VAL

Name	Description
RegAccess	0_{bin}: Acknowledgement for process data mode
STATUS_INPUT	The state of the status input can be represented with this bit. (Can be set via the feature register.)
OVERFLOW	This bit is set if the 16-bit counter overflows (65535 to 0). It is reset when the counter exceeds one third of its measuring range (21845 to 21846) or immediately an underflow occurs.
UNDERFLOW	This bit is set if the 16-bit counter underflows (65535 to 0). It is reset when the counter drops below two thirds of its measuring range (43690 tp 43689) or immediately an overflow occurs.
CNTSET_ACC	The data for setting the counter is accepted from the module.
LAT_EXT_VAL	An external latch pulse has occurred. Data D3 and D4 in the process image corresponds to the current counter value when the bit is set. In order to reactivate the latch input, it is necessary for EN_LAT_EXT first be cleared and then to be set once more.
RD_PERIOD_Q	Data bytes 3 and 4 contain the length of the period.
LATC_VAL	A zero point latch has occurred. Data D3 and D4 in the process image corresponds to the current counter value when the bit is set. In order to reactivate the latch input, it is necessary for EN_LATC first be cleared and then to be set once more.

Register Communication

Measured values cannot be transmitted during register communication.

Control byte

The control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Register communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written.

Status byte

The status byte is only visible if the Fieldbus Box is operating in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that was read or written.

3.6.12.3 Register Overview IP/IE5109

Register	Denomination	Default value	Read/*W*rite	Memory medium
R0	reserved	0x0000	R	
...	...	...	...	...
R7	reserved	0x0000	R	
R8	Module type	5109dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0218/0130	R	ROM
R11	Signal channels	0x0130	R	ROM
R12	Minimum data length	0x3030	R	ROM
R13	Data structure	0x0000	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	reserved	0x0000	R	
...	...	...	...	...
R30	reserved	0x0000	R	
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x2020	R/W	SEEROM
R33	reserved	0x0000	R	
...	...	...	...	...
R63	reserved	0x0000	R	

3.6.12.4 Data Byte D2, IP/IE5109

Byte D2

In the up/down counter operating mode, the status of the encoder and gate/latch inputs are indicated in byte D2.

Bit	7	6	5	4	3	2	1	0
Name			INPUT_A	INPUT_B	INPUT_C	INPUT_ERR	LATCH	GATE

Name	Description
INPUT_A	Status of input channel A
INPUT_B	Status of input channel B
INPUT_C	Status of input channel C
INPUT_ERR	Status of the error signal channel
LATCH	Status of the LATCH input at the M12 socket
GATE	Status of the GATE input at the M12 socket

3.6.12.5 Feature Register (R32) IP/IE5109

The module's fundamental settings can be modified in the feature register. Write protection must first be cancelled in the code-word register before it is possible to write into this register.
Default: 0x0000

Bit	Value	Description	default
0	0_{bin}	not used	0_{bin}
1	0_{bin}	Counter blocked with high level at gate input	0
	1_{bin}	Counter blocked with low level at gate input	
3, 2	00_{bin}	Status input (active low) is included in status byte 5 (ST.5).	00
	10_{bin}	ST.5 = Status input, ST.6 = status input	
	11_{bin}	ST.5 = Status input, ST.6 = !status input	
	01_{bin}	reserved	
6, 5, 4	000_{bin}	External latch function active	000
	001_{bin}	Period measurement active	
	Any other combination	Reserved, do not use	
7 - 9		Reserved, do not use	
11, 10	00_{bin}	4-fold evaluation of the encoder signals A, B and C, i.e. both rising and falling edges of the encoder signals A and B are counted.	00
	01_{bin}	Single evaluation of the encoder signals A, B and C, i.e. each period of encoder signal A is counted.	
	10_{bin}	2-fold evaluation of the encoder signals A, B and C, i.e. each edge of encoder signal A is counted.	
	11_{bin}	4-fold evaluation of encoder signals A, B and C	
14 - 12		Reserved, do not use	
15	0_{bin}	Encoder interface	0
	1_{bin}	Counter mode is active. 16 bit up/down counter Input A: counter Inputs B: Counting direction (5 V or open = up, 0 V = down Input C: latch	

3.6.13 IP5209

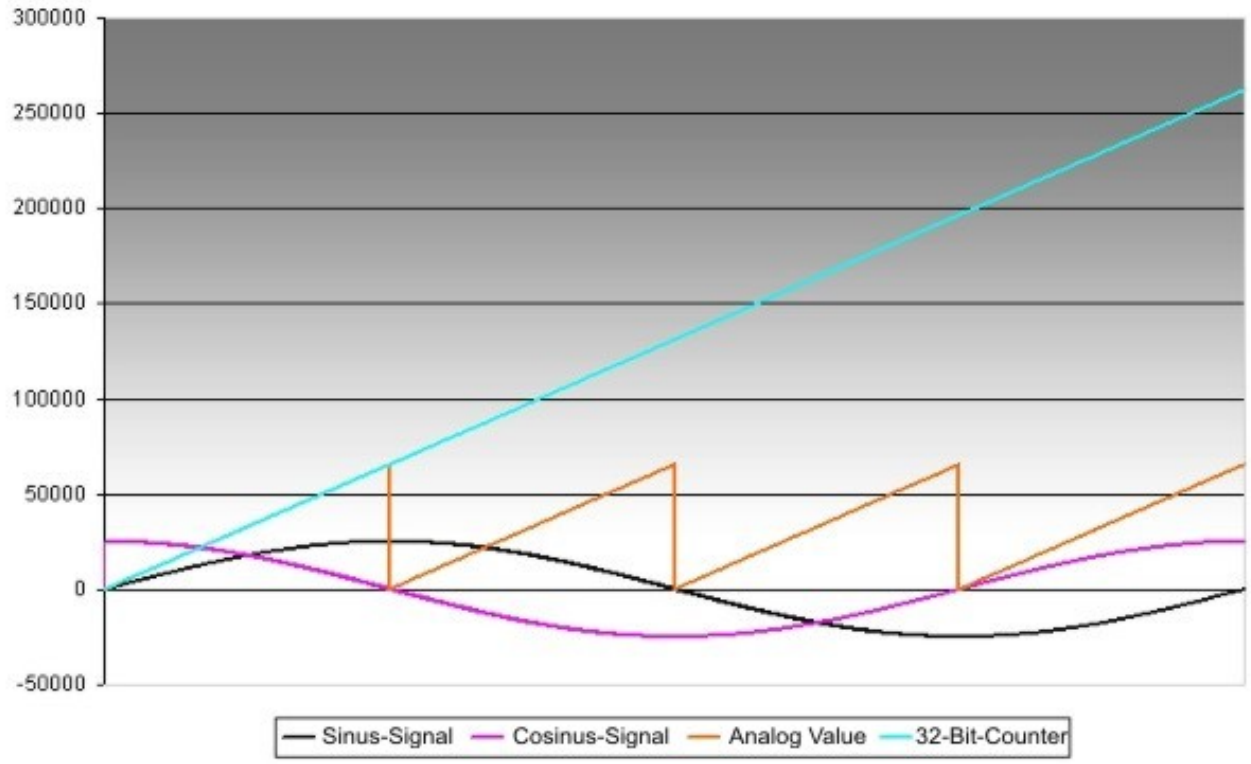
3.6.13.1 Functioning IP5209

The IP5209-Bxxx-0000 input module evaluates the 1 V_{SS} sine-cosine signals and the IP5209-Bxxx-1000 input module evaluates the 11 μA_{SS} sine-cosine signals rom an appropriate sensing switch or encoder. One signal period is represented in 10 bits, i.e. 1024 steps. Thus, for instance, a shaft encoder with 1024 signal periods yields approx. 2 million measured steps in each rotation. This corresponds to a resolution of 21 bits.

In comparison with a conventional shaft encoder with digital rectangular signals there is a significant reduction in the transmission frequency for the same resolution. In place of transmission rates in the MHz range, the shaft encoder reaches no more than 100 kHz at 6000 rpm.

The IP5209-Bxxx Fieldbus Box allows a maximum input frequency of 100 kHz.

The module occupies 9 bytes of input data and 9 bytes of output data in the process image. Alternatively the process image can be set to 5 byte. The Latch value will not be transmitted in this case.



Process data

The signal period resolution is 10 bit, i.e. 1024 steps. It is represented as a 32 bit value. Bits 31 - 10 count the periods, Bit 9 and 8 the zero crossings and Bit 7-0 the interpolation within the quarter periods.

Bit	31 ... 10	9	8	7	6	6	4	3	2	1	0
Name	Period counter	Zero crossings		Resolution within the quarter period							
Comment	4.194.304 periods	1024 steps within a period									

The reference mark is represented in the latch words in the same way (see IP5209 Mapping [▶ 175]).

Internal Functions

Resetting/setting the counter

The value of the counter is reset/set by setting the CNT_SET bit in the Control byte. The counter is set to the value of D0 - D3 of the output process image.

Save reference mark value (null latch)

Acquisition of the reference marks is activated, and the counter value that is valid when the reference marks (R+ and R-) are reached is written into the latch.

Status displays

Exceeding of the frequency limit is indicated in its status byte.

3.6.13.2 Control and Status Byte IP5209

Process data mode

Control byte

The control byte is transmitted from the controller to the Fieldbus Box. It is located in the output image, and be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	RS_FRQ_ERR	RS_CNT_LAT			CNT_SET		EN_LATC

Name	Description
RegAccess	0_{bin}: Register communication off (process data mode)
RS_FRQ_ERR	FRQ_ERR bit in the Status byte is set to zero (as long as the RS_FRQ_ERR is set, no frequency check is performed).
RS_CNT_LAT	If RS_CNT_LAT and EN_LATC are set, the counter will be set to zero by the rising edge of the Latch (C-input).
CNT_SET	The counter is set to the values of D0 - D3 by a rising edge at CNT_SET.
EN_LATC	The reference mark signal (zero point latch R+, R-input) is activated. The current value of the counter is entered into the latch register the first time the signal occurs after EN_LATC has become valid. The data is available in D4 - D7 in the process image.

Status byte

The status byte is transmitted from the Fieldbus Box to the controller. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	ERROR	NO_SIGNAL		FRQ_ERR	CNTSET_ACC		LATC_VAL

Name	Description
RegAccess	0_{bin}: Register communication off (process data mode)
ERROR	General error bit, set if NO_SIGNAL is set
NO_SIGNAL	This bit is set if no sine-cosine signal is present at the inputs (if the magnitude of the sine-cosine signal is < 0.3V)
FRQ_ERR	This bit is set when the frequency limit counter in R37 is exceeded. The FRQ_ERR bit can only be reset by the RS_FRQ_ERR bit in the Control byte.
CNTSET_ACC	The data for setting the counter is accepted from the Fieldbus Box.
LATC_VAL	A reference signal (zero point latch) has occurred. The data in D4 - D7 in the process image corresponds to the value that has been saved if this function is active (EN_LATC in the CONTROL byte). In order to latch the value again, EN_LATC must first be reset, this reset must then be acknowledged, and after this the bit must be set once more.

Register communication

Measured values cannot be transmitted during register communication.

Control byte

The control byte is located in the output image, and be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Register communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written.

Status byte

The status byte is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Register communication switched on
R/W	0_{bin}: Read
Register number	Number of the register that was read or written.

3.6.13.3 Feature-Register (R32) IP5209

The Feature-Register sets the operating mode of the module.
Default: 0x0000

Bit	Value	Description	Default
0	0_{bin}	standard counting direction	0_{bin}
	1_{bin}	reverse counting direction	
1	0_{bin}	9-Byte process data interface	0_{bin}
	1_{bin}	5-Byte process data interface (without Latch-value)	
2	0_{bin}	IP5209-Bxxx-**0**000 (Version for 1 V_{SS})	according to module type*
	1_{bin}	IP5209-Bxxx-**1**000 (Version for 11 μA_{SS})	

NOTE

Attention*)

Bit 2 is predefined to the particular module type (IP5209-Bxxx-0000 or IP5209-Bxxx-1000) und must not be changed!

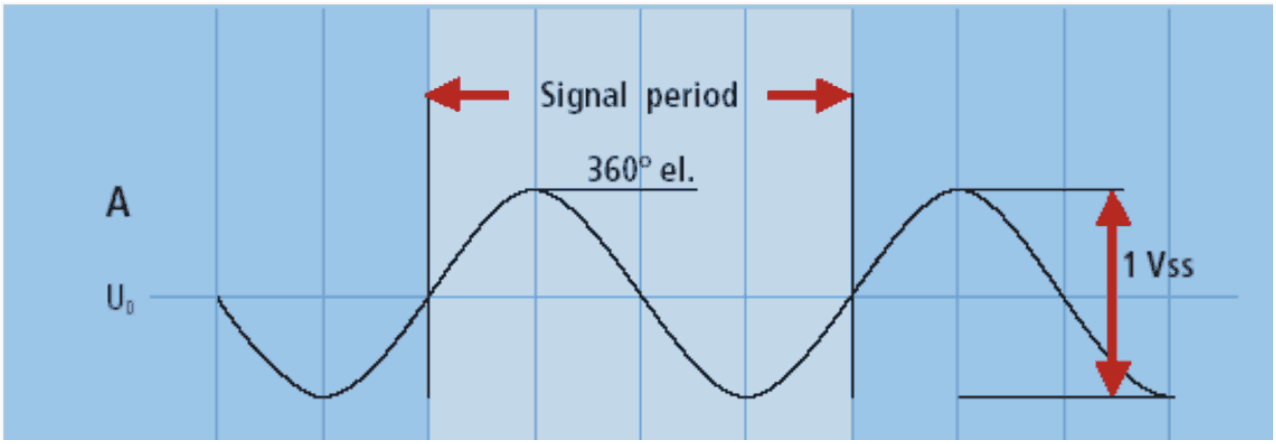
3.6.13.4 Scaling-Register (R35) IP5209

The scaling register sets the scaling or interpolation of the module. It should be adjusted to the used measuring hardware.

By scaling, the counter value can optimally be adapted to the application. Therefore a calculating in the user program is not needed.

The value in R35 sets the number of bits that are represented in the quarter period (Default: 0x0008).

The following graph shows the sinusoidal signal.



With the default setting R35 = 0x0008 the counter value D3/D2/D1/D0 of the sine/cosine input device is represented in the following way:

Bit	31 ... 10	9	8	7	6	6	4	3	2	1	0
Name	Number of signal periods	zero crossings		resolution within the quarter period							
Comment	4.194.304 periods	1024 steps within one period									

e.g. the counter value with a R35 = 0x0004:

Bit	31 ... 6	5	4	3	2	1	0
Name	Number of signal periods	zero crossings		resolution within the quarter period			
Comment	67,108,864 periods	64 steps within one period					

Calculation sample

Sine/Cosine-measuring device 2 µm signal period,

Default setting R35: 0x0008

Counter value set to zero in the released status of the input device (Control-Byte = 0x0004),

Input device pushed over the whole measuring scale.

Result:

Byte	D3	D2	D1	D0
Value	0x00	0x63	0x34	0x00

Calculation into a "real world" value:

value = input data x input_device_period / (4 x 2^{R35})

value = 0x633400 x 2 µm / (4 x 2^{8})

value = 6,501,376 x 2 µm / (4 x 256) = 0.012698 m = 12.698 mm

The measured value corresponds to the data of the input device, that gives an overall measuring range of 12 mm.

3.6.13.5 Frequency - limit - Register (R36, R37) IP5209

To control the linear or rotary velocity of a sine/cosine input device, the input frequency can be checked.

The check consists of a time frame, represented in R36, and a limit value in R37. Within this certain time, the zero crossings of the signal are counted. If they exceed the parameterized value of R37, an error bit in the Status byte is set!

R36: Frequency time frame

Default: [1600]

This time frame has a resolution of 0,0625µs/digit. The default setting is 1600_{dec}, therefore 1600 x 0,0625 µs = 100 µs = 0,1 ms.

R37: Max limit of quarter periods

Default: [41]

This register is set to he maximum number of quarter periods per time frame, that the user will allow. If the counted number reaches the register value, FRQ_ERR in the Status byte is set! The reset of the error bit can only be done via the RS_FRQ_ERR in the Control byte. The internal maximum counting frequency of the sine/cosine module is 400 kHz. Due to the quadrature evaluation this results in a maximum input device frequency of 100 kHz.

f = R37 / (R36 x 0,0625µs x 4)

e.g. per default

f = 41 / (1.600 x 0,0625µs x 4) = 102,500 Hz, that means 40 quarter periods are still ok, f = 40/ (1600 x 0,0625µs x 4) = 100 KHz. If 41 quarter periods are counted, it is a frequency of 102.5 KHz and therefore to much!

Example 1

The result should be the maximum speed with that the input device rod can be actuated.

Input device with a signal period of 2µm.

max. velocity = max_input_frequency x signal_period

max. V = 100 kHz x 2 µm = 0,2 m/s = 200 mm/s

The maximum speed for this input device is 200 mm/sec. With the registers set at default, the module will generate an error if the sensor is driven at a higher speed.

Example 2

At what value should the registers be set for a given sensor with a signal period of 10 µm and a maximum speed of 50 mm/s?

f = max_input_frequency = max. velocity / signal_period

f = 50mm/s / 10µm = 5000 Hz = 5 KHz

e.g. R36 = 25600 (just to make a reasonable time frame that gives room for more than a few zero crossings)

R37 = f x R36 x 0,0625µs x 4

R37 = 5000 Hz x 25600 x 0,0625µs x 4 = 32

R37 has to be set to the next higher value 33, R36 has to be set to 25600. Both values depend on each other, if you change one, recalculate the other.

3.6.13.6 Register Overview IP5209

Register	Denomination	Default value	Read/*W*rite	Memory medium
R0	reserved	0x0000	R	
...	...	...	...	...
R7	reserved	0x0000	R	
R8	Module type	5209dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0228	R	ROM
R11	Signal channels	0x0148	R	ROM
R12	Minimum data length	0x4848	R	ROM
R13	Data structure	0x0006	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	reserved	0x0000	R	
...	...	...	...	...
R30	reserved	0x0000	R	
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0000	R/W	SEEROM
R33	reserved	0x0000	R	
...	...	...	...	...
R63	reserved	0x0000	R	

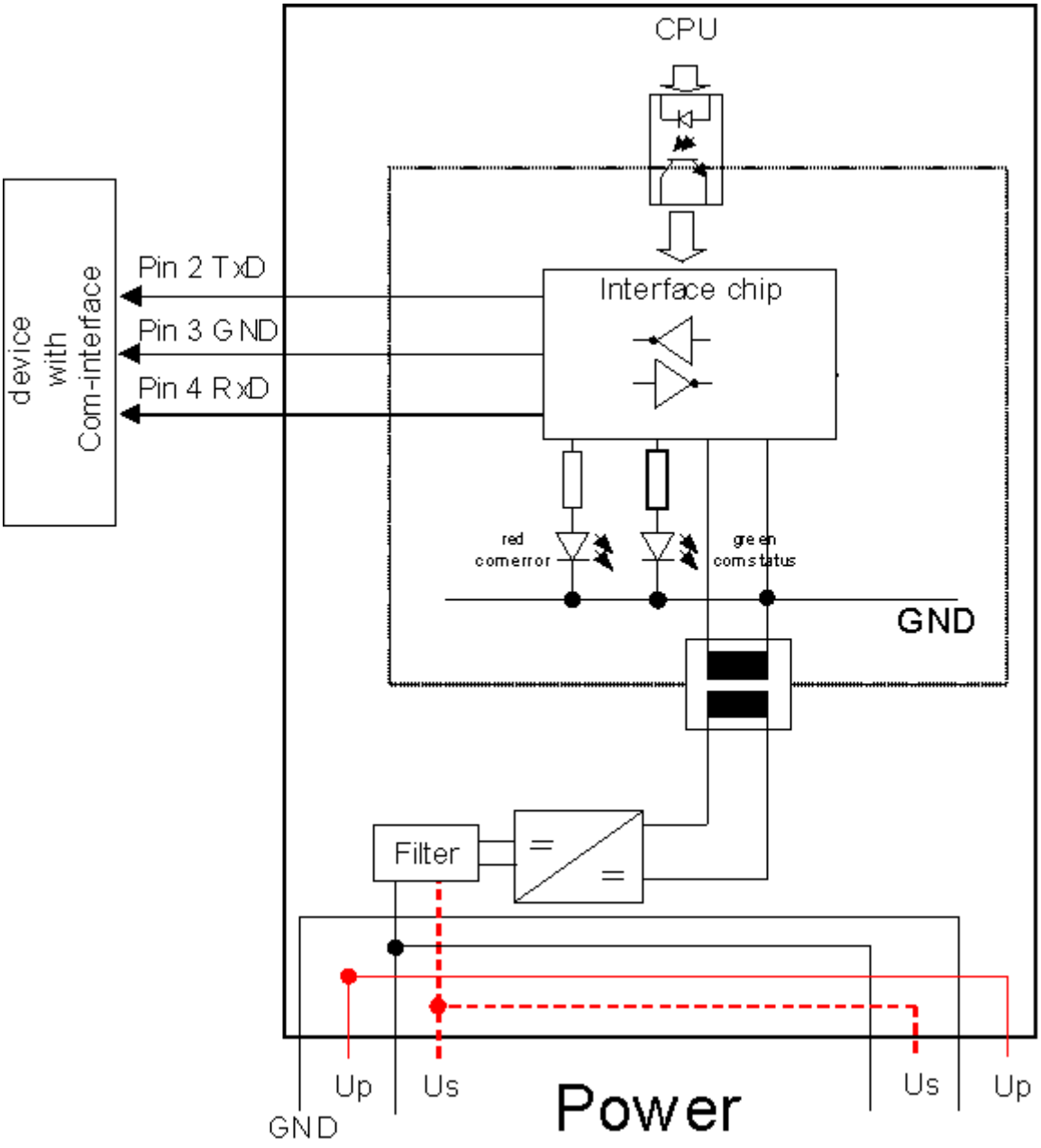
3.6.14 IP/IE60x2

3.6.14.1 Functioning IP/IE60x2

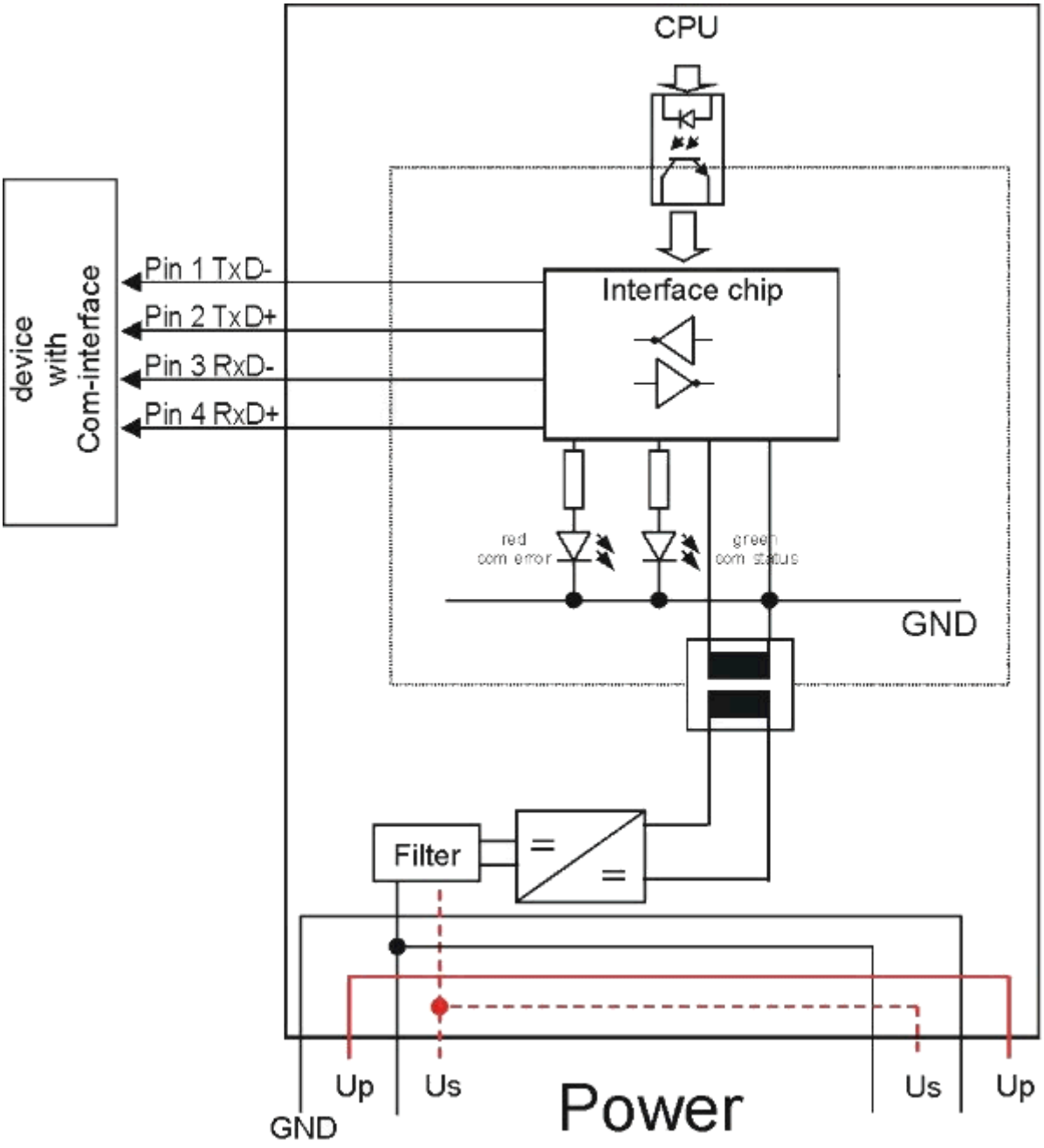
The KL60x1 serial interface terminals and IP/IE60x2 modules permit a device with a serial interface (such as barcode scanners) to be connected. Data can be exchanged in half or full duplex operation with the controller, independently of the higher level bus system. The receive buffer has a size of 128 bytes, while the send buffer is 16 bytes. Data transfer between the terminal/module and the controller is organised through a handshake in the status and control bytes. The factory setting of the terminal/module is 9600 baud, 8 data bits, 1 stop bit and no parity.

Description	Input %IB...	Output %QB...
Handshake byte	Status	Control
Data byte 0	D0	D0
Data byte 1	D1	D1
Data byte 2	D2	D2
Data byte 3	D3	D3
Data byte 4	D4	D4

IP/IE6002 conceptual circuit diagram



IP/IE6012, IP/IE6022 conceptual circuit diagram



3.6.14.2 Control and Status Byte IP/IE60x2

Process data mode

For setting up data exchange (handshake), the control and the status byte are used in process data exchange.

Control Byte

The control byte is transmitted from the controller to the mopdule. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	OL2	OL1	OL0	-	IR	RA	TR

Name	Description
RegAccess	0_{bin}: register communication switched off (Process data mode: Control and status byte in handshake)
OL2-OL1	Count of the data sent
IR	Handshake bit for initialisation of the Bus Terminal/ module If IR is high the Bus Terminal/module performs initialisation. The send and receive functions are blocked, the FIFO pointers are reset and the interface is initialised with the values from the relevant registers (R32-R35, R18). The Bus Terminal/module acknowledges execution of the initialisation with IA.
RA	Handshake bit for receiving data The Bus Terminal/module notifies the controller via a change of state in RR that the data set defined in IL0-IL1 is located in D0-D4. The data shift is acknowledged in the control byte using RA; only then will new data be transmitted by the Bus Terminal/ module to the controller.
TR	Handshake bit for sending data The handshake for data transmission is provided via this bit. A change of state in TR causes the data set defined via OL0-OL2 (5 bytes maximum) to be loaded into the transmission FIFO buffer. The Bus Terminal/module uses TA to signal execution of this command.

Status byte

The status byte is transmitted from the module to the controller. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	IL2	IL1	IL0	BUF_F	IA	RR	TA

Name	Description
RegAccess	0_{bin}: acknowledge for Process data mode (Control and status byte in handshake)
IL2-IL0	Count of the data received
BUF_F	Receive buffer full, any data now received will be lost
IA	Handshake bit for initialisation of the Bus Terminal/ module If IR is high the Bus Terminal/module performs initialisation. The send and receive functions are blocked, the FIFO pointers are reset and the interface is initialised with the values from the relevant registers (R32-R35, R18). The Bus Terminal/module acknowledges execution of the initialisation with IA.
RR	Handshake bit for receiving data The Bus Terminal/module notifies the controller via a change of state in RR that the data set defined in IL0-IL1 is located in D0-D4. The data shift is acknowledged in the control byte using RA; only then will new data be transmitted by the Bus Terminal/ module to the controller.
TA	Handshake bit for sending data The handshake for data transmission is provided via this bit. A change of state in TR causes the data set defined via OL0-OL2 (5 bytes maximum) to be loaded into the transmission FIFO buffer. The Bus Terminal/module uses TA to signal execution of this command.

Note: When the first data is received there is only one byte in the buffer, because the Bus Terminal/module does not yet know whether other data follows.

Examples

Example of data reception

Note: Evcen in case of the reception of more than 1 byte, there is always the indication for 1 byte in the beginning.

Output Control byte	Input Status byte	Description
0000_0000	0xxx_x00x	Start of data transmission
0xxx_000x	00**11**_x0**1**x	3 bytes in the data bytes are ready to be fetched
0xxx_00**1**x	0011_x01x	Acknowledgement that the data bytes have been fetched
0xxx_001x	0**101**_x0**0**x	5 bytes in the data bytes are ready to be fetched
0xxx_00**0**x	0101_x00x	Acknowledgement that the data bytes have been fetched

Table 47: Example of sending data

Output Control byte	Input Status byte	Description
0000_0000	0xxx_x0x0	Start of data transmission
0**010**_00x**1**	0xxx_x0x0	2 bytes in the data bytes are to be sent
0010_00x1	0xxx_x0x**1**	2 bytes of data have been loaded into the send FIFO, data is sent
0**101**_00x**0**	0xxx_x0x1	5 bytes in the data bytes are to be sent
0101_00x0	0xxx_x0x**0**	5 bytes of data have been loaded into the send FIFO, data is sent

Table 48: Example of initialisation

Output Control byte	Input Status byte	Description
0xxx_xxxx	0xxx_xxxx	Start of data transmission
0000_0**1**00	0xxx_xxxx	Bus Terminal/module is to be initialised
0000_0100	0000_0**1**00	Bus Terminal/module has completed initialisation
0000_0**0**00	0000_0100	Place Bus Terminal/module once more into data exchange
0000_0000	0000_0**0**00	Bus Terminal/module is ready to operate

Error handling

If a parity, framing or overrun error occurs, the corresponding data is lost in transmission and will not be loaded into the reception FIFO buffer of the Bus Terminal/module.
If the buffer is full, incoming data will be ignored.
The appropriate diagnostic bits in register 6 are set in the event of an error.

Register Communication

Serial data cannot be transmitted during register communication.

Control byte

The control byte is only visible if the Fieldbus Box is operated in complete mode. It is located in the output image, and can be read or written.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Register communication switched on
R/W	0_{bin}: Read 1_{bin}: Write
Register number	Number of the register that is to be read or written.

Status byte

The status byte is only visible if the Fieldbus Box is operating in complete mode. It is located in the input image, and can only be read.

Bit	7	6	5	4	3	2	1	0
Name	RegAccess	R/W	Register number					

Name	Description
RegAccess	1_{bin}: Acknowledgement for register access
R/W	0_{bin}: Read
Register number	Number of the register that was read or written.

3.6.14.3 Register Overview IP/IE60x2

Register	Denomination	Default value	Read/*W*rite	Memory medium
R0	Number of data bytes in the send buffer	variable	R	RAM
R1	Number of data bytes in the receive buffer	variable	R	RAM
R2	reserved	0x0000	R	
...	...	...	...	...
R5	reserved	0x0000	R	
R6	Diagnostic register [▶ 271]	variable	R	RAM
R7	reserved	0x0000	R	
R8	Module type	6002dec	R	ROM
R9	Software version	0xXXXX	R	ROM
R10	Multiplex shift register	0x0218	R	ROM
R11	Signal channels	0x0230	R	ROM
R12	Minimum data length	0x5050	R	ROM
R13	Data structure	0x0000	R	ROM
R14	reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0xXXXX	R/W	SEEROM
R17	reserved	0x0000	R/W	SEEROM
R18	Buffer size [▶ 272]	0x0080	R/W	SEEROM
R19	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Baud rate register	0x0006	R/W	SEEROM
R33	Data frame register	0x0003	R/W	SEEROM
R34	Feature register	0x0000	R/W	SEEROM
R35	Data byte register	0x0005	R/W	SEEROM
R36	reserved	0x0000	R/W	SEEROM
...	...	...	...	...
R63	reserved	0x0000	R/W	SEEROM

R6: Diagnostic register

R6

Bit no.	Value	Meaning
Bit 0	1	The receive buffer has overflowed, incoming data is lost.
Bit 1	1	A parity error has occurred
Bit 2	1	A framing error has occurred
Bit 3	1	An overrun has occurred
Bit 4	1	Buffer is full
Bits 5-16	-	reserved

R18: Buffer Size

R18

Buffer size [0x0080]
Register R18 specifies the quantity of data in the receive FIFO above which the BUF_F bit in the status byte is to be set.
Low byte: If this value is reached, BUF_F is set in the status
High byte: reserved

3.6.14.4 Baud Rate Register (R32) IP/IE60x2

The desired transmission rate can be set in the baud rate register (default 9600 baud).

Bit	Value	Baud Rate	Default
0-3	0011_{bin}	1200 baud	0110_{bin}
	0100_{bin}	2400 baud	
	0101_{bin}	4800 baud	
	0110_{bin}	9600 baud	
	0111_{bin}	19200 baud	
	1000_{bin}	38400 baud (as from hardware status [▶ 15] D.XX XX XX X**1**)	
	1001_{bin}	56600 baud (as from hardware status [▶ 15] D.XX XX XX X**1**)	
	1010_{bin}	115000 baud (as from hardware status [▶ 15] D.XX XX XX X**1**)	
4	-	reserved	0_{bin}
...	...	...	...
15	-	reserved	0_{bin}

The baud rate is set in accordance with the following equation:
Baud rate = 4 MHz/(16*(HB+1))
It is necessary for 0xFF to be written into the low byte here, while the high byte (HB) provides the operator.

3.6.14.5 Data Frame Register (R33) IP/IE60x2

The desired transmission frame can be set in the data frame register
Default: 0x0003.

Bit	Value	Data frame	default
0-2	001_{bin}	7 data bits, even parity	011_{bin}
	010_{bin}	7 data bits, odd parity	
	011_{bin}	8 data bits, no parity	
	100_{bin}	8 data bits, even parity	
	101_{bin}	8 data bits, odd parity	
3	0_{bin}	1 stop bit	0_{bin}
	1_{bin}	2 stop bits	
4	-	reserved	0_{bin}
...	...	...	0_{bin}
15	-	reserved	0_{bin}

3.6.14.6 Feature Register (R34) IP/IE60x2

The feature register in the IP/IE6002 and IP/IE6012 specifies the module's operating mode.
Default: 0x0000

Bit	Value	Description	Default
0	-	reserved	0_{bin}
1	-	reserved	0_{bin}
2	0_{bin}	not active	0_{bin}
	1_{bin}	active: The module writes the status byte into the IP-Link shift register one cycle later than the higher value data bytes. This reduces the rate of data transmission to the controller.	
3	0_{bin}	not active	0_{bin}
	1_{bin}	active: The XON/XOFF protocol is supported by the module for sending data. In other words, the module sends the data received from the controller until the XOFF character (DC3==0x13) is received from the communication partner. Once this has occurred, transmission is halted until the XON character (DC1==0x11) is received.	
4	0_{bin}	not active	0_{bin}
	1_{bin}	active: The XON/XOFF protocol is supported by the module for data reception. The module sends the XOFF control character when 118 characters are available in the Bus Terminal/module's buffer. XON is sent if XOFF has previously been sent, and if the buffer limit falls below 18 bytes.	
5	-	reserved	0_{bin}

Bit	Value	Description	Default
6	0_{bin}	not active	0_{bin}
	1_{bin}	active: Continuous transmission of data out of the FIFO. The send buffer is filled (up to 16 bytes) through the controller. A rising edge in control_byte.3 leads to the contents of the filled buffer being transmitted. When the data has been transmitted, the module acknowledges this to the controller by setting the status_byte.2 bit. Status_byte.2 is cleared in response to control_byte.3.	
7	-	reserved	0_{bin}
...	...	...	...
15	-	reserved	0_{bin}

The feature register in the IP/IE6002 specifies the module's operating mode.

Bit	Value	Description	Default
0	0_{bin}	Half duplex: reception of the transmitted data is suppressed.	0_{bin}
	1_{bin}	Full duplex: data transmitted in RS485 mode is also listened to	
1	-	reserved	0_{bin}
2	0_{bin}	not active	0_{bin}
	1_{bin}	active: The module writes the status byte into the IP-Link shift register one cycle later than the higher value data bytes. This reduces the rate of data transmission to the controller.	
3	0_{bin}	not active	0_{bin}
	1_{bin}	active: The XON/XOFF protocol is supported by the module for sending data. In other words, the module sends the data received from the controller until the XOFF character (DC3==0x13) is received from the communication partner. Once this has occurred, transmission is halted until the XON character (DC1==0x11) is received.	
4	0_{bin}	not active	0_{bin}
	1_{bin}	active: The XON/XOFF protocol is supported by the module for data reception. The module sends the XOFF control character when 118 characters are available in the module's buffer. XON is sent if XOFF has previously been sent, and if the buffer limit falls below 18 bytes.	
5	0_{bin}	The module is used in a bus structure in accordance with the RS485 standard.	0_{bin}
	1_{bin}	The module is used for point to point connections (RS 422). The module does not present a high impedance to the data line.	

Bit	Value	Description	Default
6	0_{bin}	not active	0_{bin}
	1_{bin}	active: Continuous transmission of data out of the FIFO. The send buffer is filled (up to 16 bytes) through the controller. A rising edge in control_byte.3 leads to the contents of the filled buffer being transmitted. When the data has been transmitted, the module acknowledges this to the controller by setting the status_byte.2 bit. Status_byte.2 is cleared in response to control_byte.3.	
7-15	-	reserved	0_{bin}

3.6.14.7 Data Byte Register (R35) IP/IE60x2

Specifies the number of data bytes that are transferred between the controller and the Bus Couplers/ Fieldbus Box.

Bit	Value	Description	Default
0-7	1_{hex}	1 bytes	5_{hex}
	2_{hex}	2 bytes	
	3_{hex}	3 bytes	
	4_{hex}	4 bytes	
	5_{hex}	5 bytes	
8	-	reserved	0_{bin}
...	...	...	...
15	-	reserved	0_{bin}

4 Diagnostics

4.1 Signal behavior at Bus Error

IP-Link Error

On IP-Link error

- the digital Extension Box Modules set their outputs to zero.
- the analog Extension Box Modules set their outputs to zero or to the user start-up value, if this is parameterized.

Fieldbus Error

On failure of the superior fieldbus, the outputs of the Extension Box Modules behave in the same way like the Coupler Box they are connected to.

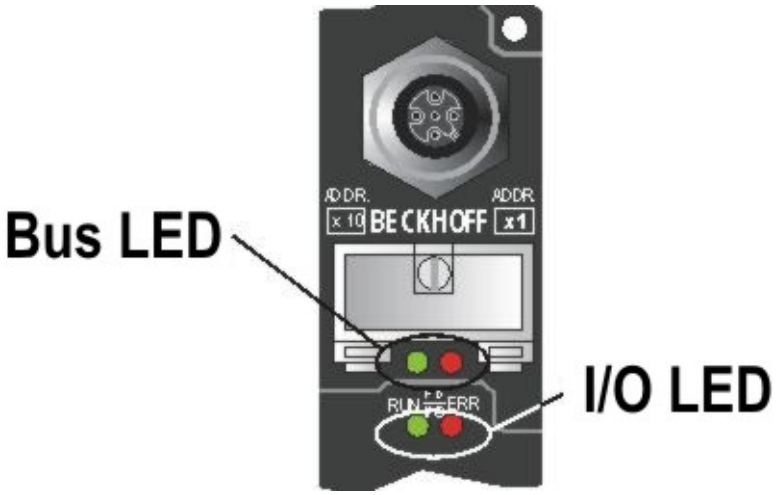
The behavior of Coupler Box and Compact Box Modules is fieldbus specific (see Fieldbus Box documentation for the superior fieldbus) and depends on the parameterizing.

4.2 Diagnostic LEDs

Error Diagnosis

There are 2 kinds of error:

- Fieldbus error
- Local errors in a Compact Box or Coupler Box



Blink Codes

Blinking sequence	Meaning
Fast blinking	Start of the error code
First slow sequence	Error code
Second slow sequence	Error argument
Third slow sequence (optional)	Error argument if more than 20 extensions

Start of the error code Error code Error argument

4.3 Diagnostic LEDs for local errors

Local error in a Coupler Box (IL230x-Bxxx/Cxxx)

The term *local error* means that an error has occurred in the Fieldbus Box or the IP-Link. IP-Link errors most often turn out to be a result of inappropriate use of the optical fiber.

LED green	LED red			Description	Remedy
off	off			No data exchange	Module in synchronous mode or - activate PROFIBUS cyclic data
off	1	0		EEPROM checksum error	Set manufacturer's setting with the KS2000 software
off	2			Reserved	-
off	3			Break location has been recognized	interruption before the master's receiver
	3	n		Break location has been recognized	n-th module before the master's receiver
	3	n	m	Break location has been recognized	(n*10)+m-th module before the master's receiver
off	4	n		Too many faulty telegrams have been detected (more than 25%)	The optical fiber wiring in front of the nth extension module should be checked
off	5	n		Register access to complex modules has failed	Check the nth module
off	11	n		Complex module working incorrectly	Exchange the nth module
off	12	n		More than 120 modules in the ring	Connect fewer modules
off	13	n		nth module unknown	Firmware update required
on	off			Module is exchanging data	no error

Note

At an interruption of the last IP-Link connection in front of the Coupler Box it is possible that instead the real error argument 0 a 1 is reported because of the receiver circuit a clear identification is not possible. If minimum one module before is right at minimum one readable telegram is received.

Local errors in an Extension Box

LED green	LED red	Description
off	on	No data is being received over the IP-Link
off	blinks, flickers	Faulty IP-Link protocols are being received (very poor data connection)
blinks, flickers	blinks, flickers	Faulty IP-Link protocols are being received (poor data connection), does not necessarily lead to an error
on	off	IP-Link protocols are being received, no error

Faulty protocols can occur, because of:

- bad configured IP-Link connectors
- IP-Link cable with higher dampening, e.g. because of a sharp curve
- contaminated sender LED (module before the faulty one)
- contaminated receiver

The internal IP-Link error counter [▶ 93] of the Coupler Box can be read with the KS2000 software.

5 Fieldbus Box accessories

The necessary accessories for the Fieldbus Box Modules are also available from Beckhoff in protection class IP67. You may get an overview from the Beckhoff catalog or from our internet pages (http://www.beckhoff.com).

Fieldbus Accessories

- Pre-assembled cable
- Plug
- Distributor

Power supply

- Pre-assembled cable
- Plug
- Distributor

Sensor power supply

- Pre-assembled cable
- Plug
- Distributor

IP-Link

- Pre-assembled cable
- Plug

5.1 Accessories

Table 49: Fixing

Ordering information	Description
ZS5300-0001	Mounting rail (500 mm x 129 mm)

Table 50: Marking material, plugs

Ordering information	Description
ZS5000-0000	Fieldbus Box set M8 (contact labels, plugs)
ZS5000-0002	Fieldbus Box set M12 (contact labels, plugs)
ZS5000-0010	plugs M8, IP67 (50 pieces)
ZS5000-0020	plugs M12, IP67 (50 pieces)
ZS5100-0000	marking labels, not printed, 4 stripes at 10 pieces
ZS5100-xxxx	printed marking labels, on request

Table 51: Tools

Ordering information	Description
ZB8800	Torque socket wrench with ratchet wrench for M8 connectors (over molded)
ZB8800-0001	ratchet wrench for M8 connectors (field assembly)
ZB8800-0002	ratchet wrench for M12 connectors (over molded)

Further accessories

Further accessories may be found at the price list for Beckhoff fieldbus components and at the internet under www.beckhoff.com.

5.2 Power cables

Ordering data

Order designation	Power lead	Screw-in connector	Contacts	Cross-section	Length
ZK2020-3200-0020	Straight socket, open end	M8	4-pin	0.34 mm^2	2.00 m
ZK2020-3200-0050					5.00 m
ZK2020-3200-0100					10.00 m
ZK2020-3400-0020	Angled socket, open end				2.00 m
ZK2020-3400-0050					5.00 m
ZK2020-3400-0100					10.00 m
ZK2020-3132-0001	Straight socket, straight socket				0.15 m
ZK2020-3132-0005					0.50 m
ZK2020-3132-0010					1.00 m
ZK2020-3132-0020					2.00 m
ZK2020-3132-0050					5.00 m
ZK2020-3334-0001	Angled socket, angled socket				0.15 m
ZK2020-3334-0005					0.50 m
ZK2020-3334-0010					1.00 m
ZK2020-3334-0020					2.00 m
ZK2020-3334-0050					5.00 m

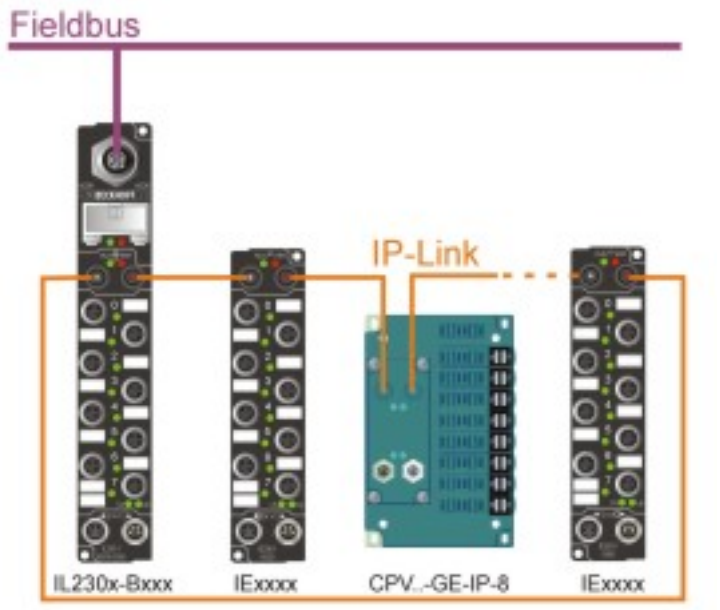
Further available power cables may be found in the Beckhoff catalog or on our internet pages (http://www.beckhoff.com).

Technical data

Technical data	
Rated voltage according to IEC60 664-1	60 V_{AC} / 75 V_{DC}
Contamination level according to IEC 60 664-1	3/2
Insulation resistance IEC 60 512-2	>10^9W
Current carrying capacity according to IEC 60512-3	4 A
Volume resistance according to IEC 60512-2	< 5 mW
Protection class according to IEC 60529	IP65/66/67, when screwed together
Ambient temperature	-30°C to +80°C

5.3 Third-party Products

Apart from Beckhoff, other manufacturers (third party) also offer products that are compatible with the IP-Ling of the Fieldbus Box system.



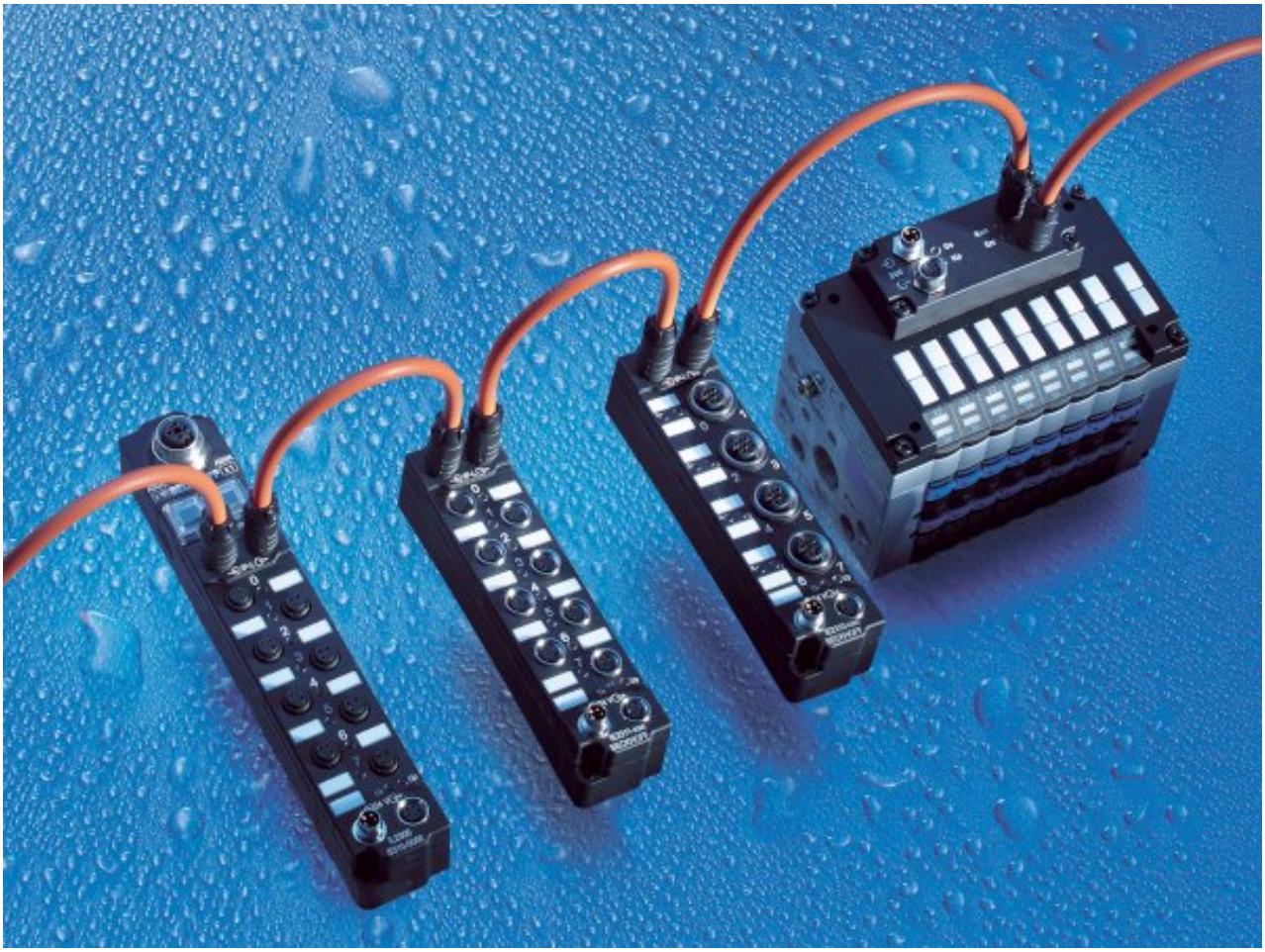
Beckhoff does not sell these products. Please contact the respective manufacturer.

Valve terminals

FESTO

CPV10-IL-IP8 and CPV14-IL-IP8 from FESTO are compact valve terminals with direct interface to the IP-Link.

In TwinCAT, these modules are represented as IE4404-0010 or IE4404-0014.

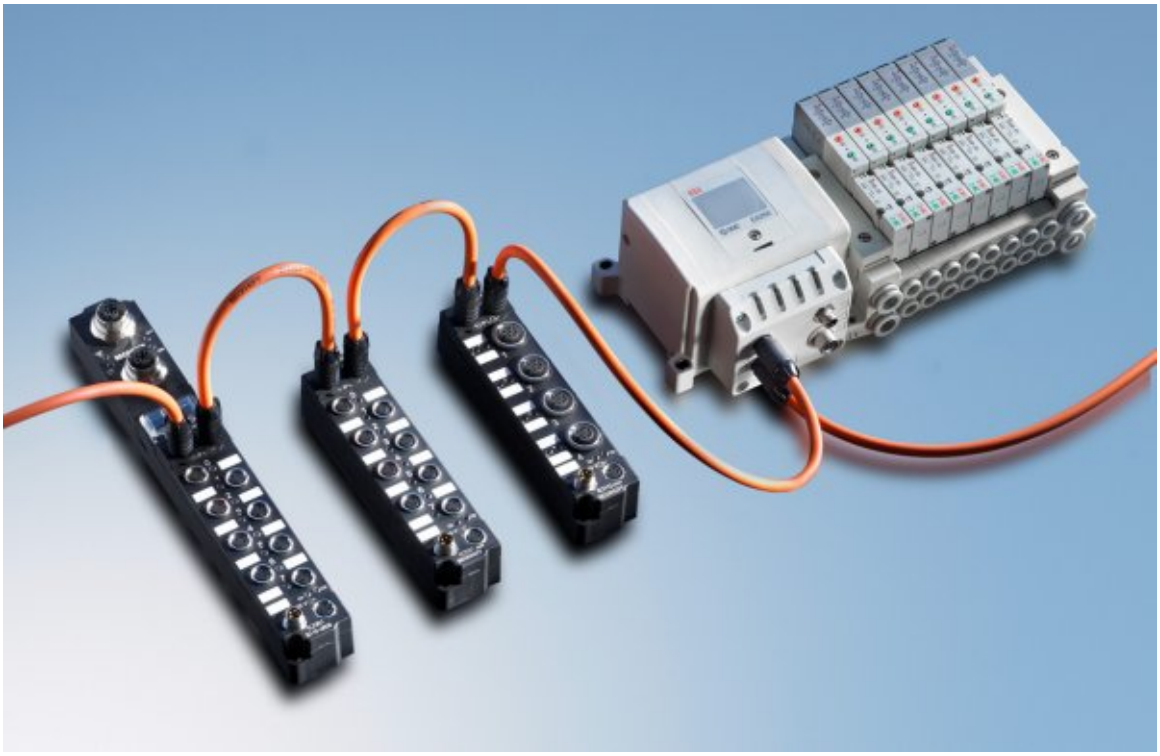


Further information can be found on the internet at http://www.festo.com.

SMC

The EX250 from SMC is a modular valve terminal with direct interface to the IP-Link.

In TwinCAT, this module is represented as IE4414.



Further information can be found on the internet at http://www.smceu.com.

6 Appendix

6.1 Custom Scaling

To change the module to Fahrenheit you have to convert the equation and set the user registers describe.

Equation:
°F = 9/5 x °C + 32

To set the scaling to 1/10 °F, the constant part (offset) is scaled with 10 multiplied..
This means :

- for offset 32 *10 =320
- for the gain (9/5 *10/16 *256) = 288

Necessary register settings:

- R31 set code word = 0x1235
- R32 disable custom scaling
- R32 enable custom scaling
- R33 custom Offset = 320_{dez}
- R34 custom Gain = 288_{dez}

Scaling changes are valid immediately and are separate for each channel adjustable.

6.2 General operating conditions

Protection degrees (IP-Code)

The standard IEC 60529 (DIN EN 60529) defines the degrees of protection in different classes.

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø12,5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø2,5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.

2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water!

Chemical Resistance

The Resistance relates to the Housing of the Fieldbus Box and the used metal parts.

Character	Resistance
Steam	at temperatures >100°C: not resistant
Sodium base liquor (ph-Value > 12)	at room temperature: resistant > 40°C: not resistant
Acetic acid	not resistant
Argon (technical clean)	resistant

Key

resistant: Lifetime several months
non inherently resistant: Lifetime several weeks
not resistant: Lifetime several hours resp. early decomposition

6.3 Approvals

Approvals

UL E172151

Conformity mark

CE

Type of protection

IP65/66/67 in accordance with EN60529

6.4 UL Requirements

The installation of the Fieldbus Box Modules certified by UL has to meet the following requirements.

Supply voltage

NOTE

- by a 24 V_{DC} supply voltage, supplied by an isolating source and protected by means of a fuse (in accordance with UL248), rated maximum 4 Amp, or
- by a 24 V_{DC} power source, that has to satisfy *NEC class 2*.
  A *NEC class 2* power supply shall not be connected in series or parallel with another (class 2) power source!

NOTE

Warning

To meet the UL requirements, the Fieldbus Box Modules must not be connected to unlimited power sources!

Networks

NOTE

Warning

To meet the UL requirements, Fieldbus Box Modules must not be connected to telecommunication networks!

Ambient temperature range

NOTE

Warning

To meet the UL requirements, Fieldbus Box Modules have to be operated only at an ambient temperature range of 0 to 55°C!

Marking for UL

All Fieldbus Box Modules certified by UL (Underwriters Laboratories) are marked with the following label.

6.5 Test standards for device testing

EMC

Resistance: EN 61000-6-2

Emission: EN 61000-6-4

Resistance to Vibration

EN 60068-2-2 Vibration test, Amplitude 2 g (Standard 1 g)

EN 60068-2-27 Shock Test, Shock count 1000 (Standard 2)

6.6 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49 5246 963 157
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e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

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- spare parts service
- hotline service

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