BECKHOFF New Automation Technology

Documentation | EN

Fieldbus Box for PROFIBUS

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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.

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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

Version	Modifications
1.2.1	• System overview updated
1.2	• Check of the IP-Link connection added
1.1	• Expanding of the specification for IP-Link up to 15 meters
1.0	• PROFIBUS-specific contents completed. • Signal types and the signals' connection assignments have been placed in the fieldbus-neutral documentation covering *Signal types (Fieldbus Box I/O Modules)*. You can find this on the internet in the *Download* area at http://www.beckhoff.com.
0.7	Further Fieldbus Box Modules for special functions added.
0.6	Fieldbus Box Modules for analog signals and special functions added.
0.4	Fieldbus Box Modules added.
0.3	First published version.

2   Product 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 [▶ 11]
"IL" stands for the Coupler Box design (with IP-Link) [▶ 11]
"IE" stands for the Extension Box design [▶ 11]

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

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

2.4 Technical Data

2.4.1 Modules - Technical Data

Technical data	IPxxxx-B31x	IL230x-B310, IL230x-C310
Extension modules	-	Max. 120 with altogether 128 bytes input and 128 bytes output
Digital peripheral signals	according to I/O type	max. 960 inputs and outputs
Analog peripheral signals	according to I/O type	max. 60 inputs and outputs
Configuration facilities	Using KS2000, via the controller (register communication, DPV1, or parameter data)	Using KS2000, via the controller (register communication or DPV1)
Baud Rate	automatic detection up to max. 12 Mbaud	
Power supply connection	Control voltage: 24V DC (-15%/+20%); load voltage: according to I/O type	
Control voltage current consumption	according to I/O type + current consumption of sensors, max. 0.5 A	
Load voltage current consumption	according to I/O type	
Power supply connection	Feed: 1 x M8 connector, 4-pin downstream connection: 1 x M8 socket, 4-pin (except IP/IE204x)	
Fieldbus connection	1 x M12 socket, 5-pin, (inverse coding)	
Electrical isolation	Channels/control voltage: no between the channels: no control voltage/fieldbus: yes	
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, EN 60068-2-29	
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP 65/66/67 (according to EN 60529)	
Installation position	variable	
Approval	CE, UL E172151	

2.4.2 Controller - Technical Data

Requirements

PLC data	IL230x-C31x
Programmability	Via the programming interface (TwinCAT) or via PROFIBUS (TwinCAT with FC310x)
Program memory	32/96 kbyte
Data memory	32/64 kbyte
Remanent flags	512 bytes
PLC cycle time	approx. 3 ms for 1000 IL commands (without I/O cycle)
Programming languages	IEC 6-3 (IL, LD, FBD, ST, SFC)

2.4.3   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

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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   Profibus

3.1   Fieldbus Overview

PROFIBUS is a manufacturer - independent, open fieldbus standard with a wide range of applications in manufacturing and process automation. Manufacturer-independence and openness are guaranteed by the International standards EN 50170 and EN 50254. PROFIBUS allows devices from different manufacturers to communicate without the need for specially adapted interfaces. PROFIBUS is suitable both for fast, time-critical applications and for complex communication tasks.

PROFIBUS offers communication protocols of different functional levels: DP and FMS. According to the application, RS-485, IEC 1158-2 or optical fiber are available as transmission techniques.

PROFIBUS specifies the technical features of a serial fieldbus system with which distributed digital automation devices can be networked together, from the field level up to the cell level. PROFIBUS is a multi-master system, and therefore permits common operation of a number of automation, engineering or visualization systems with their distributed peripheral devices on one bus.

PROFIBUS device types

PROFIBUS distinguishes the following device types:

Master devices determine the data traffic on the bus. A master may transmit messages without having received an external request when it is in possession of the bus access authorization (token). Masters are also referred to as active devices.

Slave devices are peripheral devices such as input/output devices, valves, drives, measuring transducers and the Beckhoff PROFIBUS slaves from the BK3xx0, BC3xx0, IPxxxx-B310, IL230x-B310 and IL230x-C310 series. They do not receive any bus access authorization, so that they are only allowed to acknowledge messages that have been received, or to send messages in response to a request from master. Slaves are referred to as passive devices. They only require a small proportion of the bus protocol, which means that they can be implemented with little effort.

PROFIBUS DP

PROFIBUS DP is designed for efficient data exchange at the field level. The central automation devices such as PLC/PCs or process control systems communicate here over a fast serial link with distributed field devices such as I/O, drives, valves etc.. Data is primarily exchanged with these distributed devices cyclically. The communication functions required for this are specified by the basic DP functions in accordance with EN 50170.

In addition to these basic functions, PROFIBUS DP also offers extended acyclic communication services for such purposes as parameterization and other operations. These are also supported by the Beckhoff PROFIBUS slaves of the IPxxxx-B310, IL230x-B310 and IL230x-C310 series. A central controller (master) cyclically reads the input information from the slaves, and writes the output information cyclically to the slaves. The bus cycle time here should be shorter than the central automation system's program cycle time, which lies around 10 ms in many applications.

A high data throughput is not in itself sufficient for successful use of a bus system. Ease of handling, good diagnostic facilities and secure transmission technology are also of the utmost importance if the user's demands are to be satisfied. These properties are ideally combined in PROFIBUS DP.

System configuration and device types

PROFIBUS DP allows **single master or multi-master** systems to be implemented. This permits a high level of flexibility in system configuration. A maximum of 126 devices (master or slaves) can be connected to one bus. A station address between 0 and 99 can be chosen for the Beckhoff PROFIBUS slaves from the IPxxxx-B310, IL230x- B310 and IL230x-C310 series. The specifications for the system configuration contain the number of stations, the assignment of the station addresses to the I/O addresses, data consistency of the I/O data and the format of the diagnostics messages and the bus parameters being used. Every PROFIBUS DP system consists of different device types. Three types of device are distinguished:

Type	Description
DP master class 1 (DPM1) e.g. Beckhoff PC master card FC310x	This involves a central controller that exchanges information cyclically with the distributed stations (slaves) in a specified message cycle. Typical devices include, for instance, programmable logic controllers (PLCs) or PCs.
DP master class 2 (DPM2)	Devices of this type are engineering, project design or operating devices. They are used for commissioning, for servicing and diagnosis in order to configure the connected devices, to evaluate measured values and parameters and to interrogate the status of devices.
DP slave e.g. Beckhoff Bus Coupler IPxxxx-B310	A PROFIBUS DP slave is a peripheral device (I/O, drive, measuring transducer etc.) that reads input information and passes output information on to the peripherals. It is also possible to have devices that only handle either input or output information. The quantity of input and output information is device-dependent, and may not exceed 246 bytes of input data and 246 bytes of output data.

In **single master systems** only one master is active on the bus in the operating phase of the bus system. The PLC controller is the central control element. The distributed slaves are coupled to the PLC controller via the transmission medium. The shortest bus cycle time is achieved with this system configuration.

In a **multi-master mode** there is more than one master on the bus. They either form sub-systems that are independent of one another, each consisting of one DPM1 and the associated slaves, or additional project design and diagnostic devices. All the DP masters can read the input and output images of the slaves. Writing the outputs is only possible for one DP master (the one assigned as DPM1 during the project design). Multi-master systems achieve a medium bus cycle time. In time-critical applications, the increase in bus cycle time should be observed by adding a diagnostic tool.

Basic device files (GSD)

In PROFIBUS DP, the performance characteristics of devices are documented by the manufacturers and made available to users in the form of a device data sheet and of a basic device file. The structure, content and coding of these basic device files (GSD) is standardized. They make it easy to plan a project with any PROFIBUS DP slaves using project planning devices from a various manufacturers. The PROFIBUS User Organization (PROFIBUS Nutzer Organization - PNO) archives this information for all manufacturers, and will provide information about the GSD from any manufacturer on request. The GSD files are read by a PROFIBUS master configuration software, and appropriate adjustments are transferred to the PROFIBUS master. Please see the appropriate software manual from the master manufacturer for a description.

The Beckhoff GSD files may be obtained from the internet under www.beckhoff.com.

Diagnostic functions

The extensive diagnostic functions of PROFIBUS DP allow rapid fault localization. Diagnosis of the Beckhoff Bus Coupler is not activated in the default setting of the type file or the GSD file. The diagnostic messages are transmitted over the bus and collated by the master.

They are divided into three levels:

Diagnosis type	Description
Related to the station	Messages relating to the general readiness of a device for operation such as over-temperature or under-voltage
Related to the module	These messages indicate that diagnostic signals are pending within a specific I/O sub range of the device (e.g. an 8 bit output module)
Related to the channel	Here the cause of an error is related to a single input/output bit (channel), such as a short circuit on output 2

The Beckhoff PROFIBUS slaves from the IPxxxx-B310, IL230x-B310 and IL230x-C310 series support the PROFIBUS DP diagnostic functions. Assessment of the diagnostic data by means of the controller depends on the support for the PROFIBUS master. Please refer to the device manuals for the master interfaces for details of how to handle the diagnosis.

Sync and Freeze Mode

In addition to the user data traffic related to the device, which is automatically dealt with by DPM1, a DP master has the option of sending control commands to one DP slave, to a group of them or to all of them at the same time. These control commands are transmitted as multicasts. These control commands can be used to specify the sync and freeze operating modes, in order to synchronize the DP slave. They permit event-controlled synchronization of the DP slaves.

The DP slaves start **sync mode** when they receive a sync control command from the assigned DP master. In this operating mode, the outputs of all the addressed DP slaves are frozen at their current values. In the following user data transmissions, the DP slaves store the output data, but the output states themselves nevertheless remain unchanged. Only when the next sync control command is received from the master the stored output data is switched through to the outputs. Sync operation is ended with an unsync control command.

A freeze control command similarly causes the addressed DP slaves to enter **freeze mode**. In this operating mode the states of the inputs are frozen at their current value. The input data is only updated again when the DP master has sent the next freeze control command to the devices concerned. Freeze operation is ended with an unfreeze command.

System behavior

The system behavior is also standardized in PROFIBUS DP, so that devices can to a large extent be interchanged. It is largely determined by the operating condition of the DPM1. This can either be controlled locally, or over the bus by the project design device.

The following three principal conditions are distinguished:

Operation mode	Description
Stop	There is no data traffic between the DPM1 and the DP slaves. The Bus Coupler only addresses the Bus Terminals once after the power has been switched on (none of the I/O LEDs are lit).
Clear	The DPM1 reads the input information from the DP slaves, and maintains the outputs of the DP slaves in a safe state (depending on the reaction to fieldbus errors, the green I/O LED is lit and the outputs are set).
Operate	The DPM1 is in a data transfer phase. In the course of cyclic data traffic the inputs of the DP slaves are read and the output information is transmitted to the DP slaves (the green I/O LED is lit).

The DPM1 sends its local status at a configurable time interval using a multicast command cyclically to all the DP slaves that have been assigned to it. The reaction that the system has to the occurrence of an error during the DPM1's data transfer phase, such as the failure of a DP slave, is specified in the *Auto-Clear* operating parameter. If this parameter is set to *True*, then the DPM1 switches the outputs of all the associated DP slaves into a safe state as soon as one DP slave is no longer ready for the transfer of user data. The DPM1 then switches into the Clear state. If the parameter is *False* then the DPM1 remains in the operating state even after a fault, and the user can himself specify the system's reaction.

Data traffic between the DPM1 and the DP slaves

The data traffic between the DPM1 and the DP slaves that have been assigned to it is automatically executed by the DPM1 in a specified, continuously repeated sequence. The user specifies the assignment of a DP slave to the DPM1 when the bus system's project is being planned. Those DP slaves that are included in or excluded from the cyclic user data traffic are also defined.

The data traffic between the DPM1 and the DP slaves is divided into the parameterization, configuration and data transfer phases.

Before a DP slave is included in the data transfer phase, the DPM1 checks, in the parameterization and configuration phase, whether the theoretical configuration that has been planned agrees with the actual configuration of devices. The check requires the device type, the format and length information, as well as the number of inputs and outputs, to be in agreement. The user is thus provided with reliable protection against errors in parameterization. In addition to the transfer of user data, which is automatically carried out by the DPM1, it is possible to send new parameterization data to the DP slaves at the user's request.

Protection mechanisms

In the context of distributed peripherals it is necessary, for reasons of safety and reliability, for the system to be given extremely effective functions to protect against incorrect parameterization or the failure of the transmission mechanisms. PROFIBUS DP uses monitoring mechanisms in the DP Master and in the DP Slaves. They are implemented in the form of time monitors. The monitoring interval is specified in when the DP system project is planned.

Protection mechanisms	Description
At the DP Master	The DPM1 monitors the slave's transfer of user data with the Data_Control_Timer. An individual monitoring timer is used for each assigned slave. The time monitor triggers if a proper transfer of user data does not take place within the monitoring interval. In this case the user is informed. If automatic error reaction is enabled (Auto_Clear = True) then the DPM1 leaves the *Operate* state, switches the outputs of the assigned slaves into a safe state, and then goes into the *Clear* operating mode.
At the DP Slave	The slave uses communication monitoring in order to detect errors of the master or in the transmission segment. If data is not transferred with the assigned master within the communication monitoring interval the slave switches the outputs into the safe state itself. The slave inputs and outputs further require access protection in multi-master systems, to ensure that direct access is only made from the authorized master. The slaves will make an image of the inputs and outputs available to other masters, and this can be read by any other master even if it does not have access authorization.

Ident number

Every DP slave and every DPM1 must have an individual identification number. This is required so that a DP master can identify the types of the connected devices without any significant protocol overhead. The master compares the identification numbers of the connected DP devices with the identification numbers in the project planning data specified by DPM2. The transfer of user data only starts if the correct device types are connected to the bus at the correct station addresses. This provides protection from project planning errors. Manufacturer-specific identification numbers are issued by the PROFIBUS User Organization (PNO). The PNO administers the identification numbers along with the basic device data (GSD).

3.2 Topology

- A bus segment may consist of a maximum of 32 devices (including the repeaters).
- The maximum conductor length of a segment depends on the transmission speed in use and on the quality of the bus cables being used.
- No more than 9 repeaters may be installed between two devices.
- Stubs are to be avoided, and are not permitted above 1.5 Mbaud.
- The maximum number of devices is 127
- Interrupting the supply voltage from cable ends by switching off the repeater/slave, or by pulling out the plug, is not permitted.
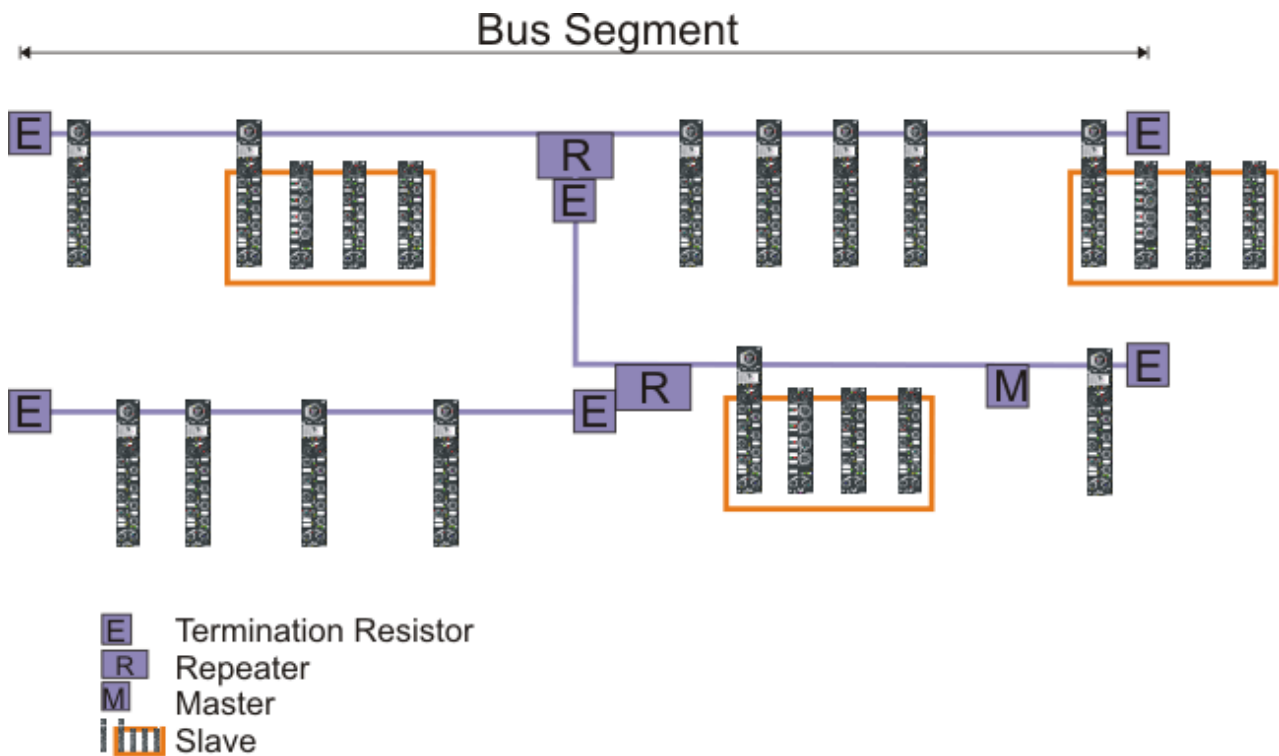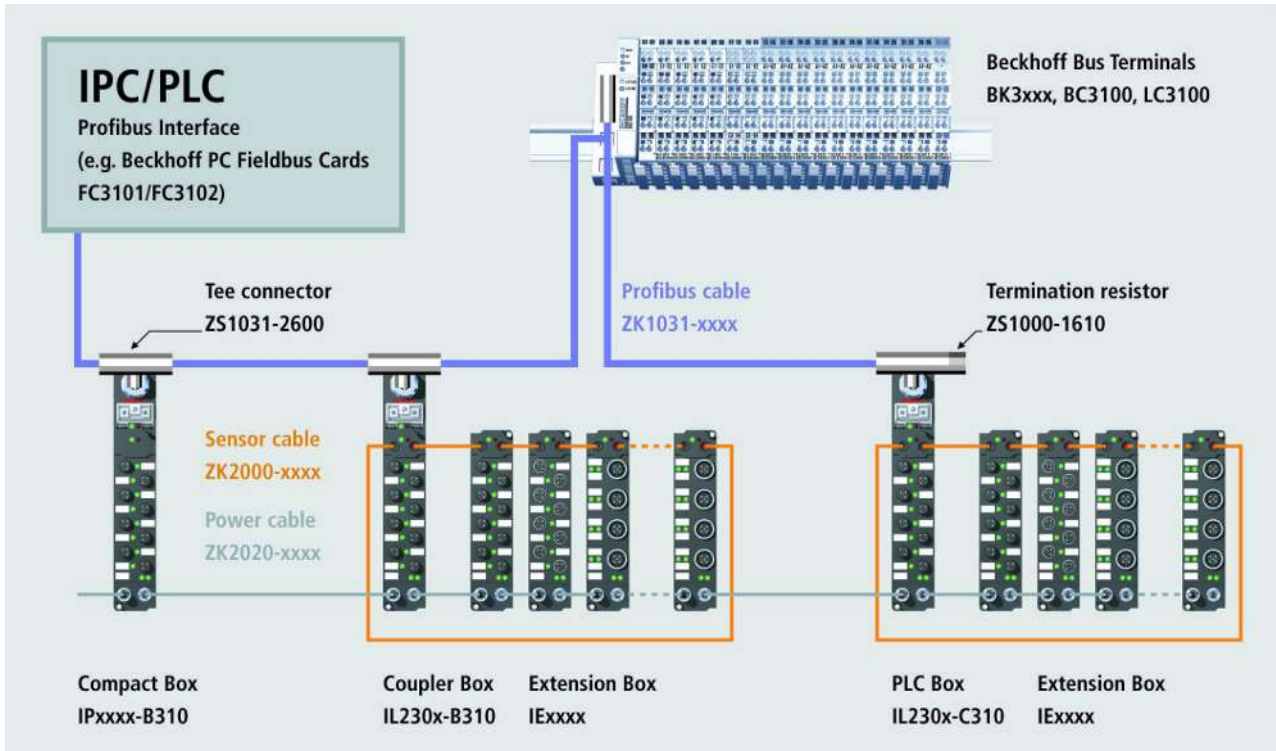

Fig. 1: RS485 topology with 3 segments and 2 repeaters.

3.3 Application

Example of an PROFIBUS Application

3.4   PROFIBUS Cabling

3.4.1   PROFIBUS Cabling

Physical aspects of the data transmission are defined in the PROFIBUS standard (see PROFIBUS layer 1: Physical Layer).

The types of area where a fieldbus system can be used is largely determined by the choice of the transmission medium and the physical bus interface. In addition to the requirements for transmission security, the expense and work involved in acquiring and installing the bus cable is of crucial significance. The PROFIBUS standard therefore allows for a variety of implementations of the transmission technology while retaining a uniform bus protocol.

Cable-based transmission

This version, which accords with the American EIA RS-485 standard, was specified as a basic version for applications in production engineering, building management and drive technology. A twisted copper cable with one pair of conductors is used. Depending on the intended application area (EMC aspects should be considered) the screening may be omitted.

Two types of conductor are available, with differing maximum conductor lengths (see the RS-485 table).

Table 4: RS485 - Fundamental properties

RS-485 transmission according to the Profibus standard	
Network topology	Linear bus, active bus terminator at both ends, stubs are possible.
Medium	Screened twisted cable, screening may be omitted, depending upon the environmental conditions (EMC).
Number of stations	32 stations in each segment with no repeater. Can be extended to 127 stations with repeater
Max. bus length without repeater	100 m at 12 MBit/s 200 m at 1500 KBit/s, up to 1.2 km at 93.75 KBit/s
Max. bus length with repeater	Line amplifiers, or repeaters, can increase the bus length up to 10 km. The number of repeaters possible is at least 3, and, depending on the manufacturer, may be up to 10.
Transmission speed (adjustable in steps)	9.6 kBit/s; 19.2 kBit/s; 93.75 kBit/s; 187.5 kBit/s; 500 kBit/s; 1500 kBit/s; 12 MBit/s
Plug connector	9-pin D-Sub connector for IP20 M12 round connector for IP65/67

**Cabling for PROFIBUS DP and PROFIBUS FMS**

Note the special requirements on the data cable for baud rates greater than 1.5 MBaud. The correct cable is a basic requirement for correct operation of the bus system. If a simple 1.5 Mbaud cable is used, reflections and excessive attenuation can lead to some surprising phenomena. It is possible, for instance, for a connected PROFIBUS station not to achieve a connection, but for it to be included again when the neighboring station is disconnected. Or there may be transmission errors when a specific bit pattern is transmitted. The result of this can be that when the equipment is not operating, PROFIBUS works without faults, but that there are apparently random bus errors after start-up. Reducing the baud rate (< 93,75 kBaud) corrects this faulty behavior.

If reducing the baud rate does not correct the error, then in many cases this can indicate a wiring fault. The two data lines maybe crossed over at one or more connectors, or the termination resistors may not be active, or they may be active at the wrong locations.

i ● **Pre-assembled cables from Beckhoff**

Installation is made a great deal more straightforward if pre-assembled cables from Beckhoff are used! Wiring errors are avoided, and commissioning is more rapidly completed. The Beckhoff range includes fieldbus cables, power supply cables, sensor cables and accessories such as terminating resistors and T-pieces. Connectors and cables for field assembly are nevertheless also available.
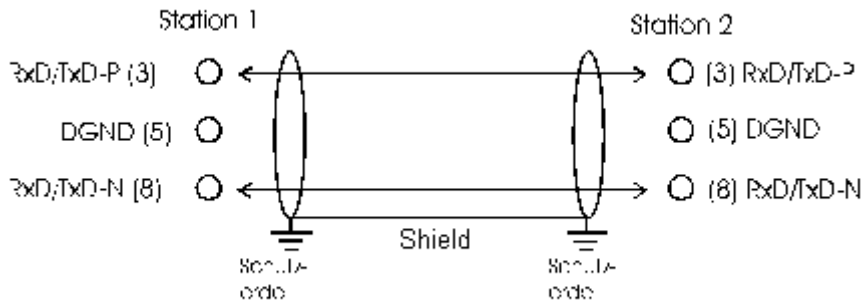
i ● **Termination resistors**

In systems with more than two stations all devices are wired in parallel. It is essential that the bus cables are terminated with resistors at the conductor ends in order to avoid reflections and associated transmission problems.

Distances

The bus cable is specified in EN 50170. This yields the following lengths for a bus segment.

Baud rate in kbits/sec	9.6	19.2	93.75	187.5	500	1500	12000
Cable length in m	1200	1200	1200	1000	400	200	100

Stubs up to 1500 kbaud <6.6 m; at 12 Mbaud stub segments should not be used.

Bus segments

A bus segment consists of at most 32 devices. 126 devices are permitted in a PROFIBUS network. Repeaters are required to refresh the signal in order to achieve this number. Each repeater is counted as one device.

IP-Link is the subsidiary bus system for Fieldbus Boxes, whose topology is a ring structure. There is an IP master in the coupler modules (IP230x-Bxxx or IP230x-Cxxx) to which up to 120 extension modules (IExxxx) may be connected. The distance between two modules may not exceed 5 m. When planning and installing the modules, remember that because of the ring structure the IP-Link master must be connected again to the last module.

Installation guidelines

When assembling the modules and laying the cables, observe the technical guidelines provided by the PROFIBUS User Organization (PROFIBUS Nutzerorganisation e.V.) for PROFIBUS DP/FMS (seewww.profibus.com).

Checking the PROFIBUS wiring

A PROFIBUS cable (or a cable segment when using repeaters) can be checked with a few simple resistance measurements. The cable should meanwhile be removed from all stations:

1. Resistance between A and B at the start of the lead: approx. 110 Ohm
2. Resistance between A and B at the end of the lead: approx. 110 Ohm
3. Resistance between A at the start and A at the end of the lead: approx. 0 Ohm
4. Resistance between B at the start and B at the end of the lead: approx. 0 Ohm
5. Resistance between screen at the start and screen at the end of the lead: approx. 0 Ohm

If these measurements are successful, the cable is okay. If, in spite of this, bus malfunctions still occur, this is usually a result of EMC interference. Observe the installation notes from the PROFIBUS User Organization (www.profibus.com).
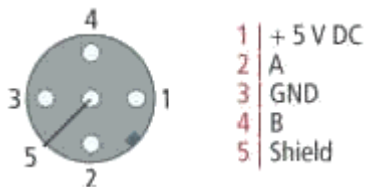
3.4.2 PROFIBUS Connection
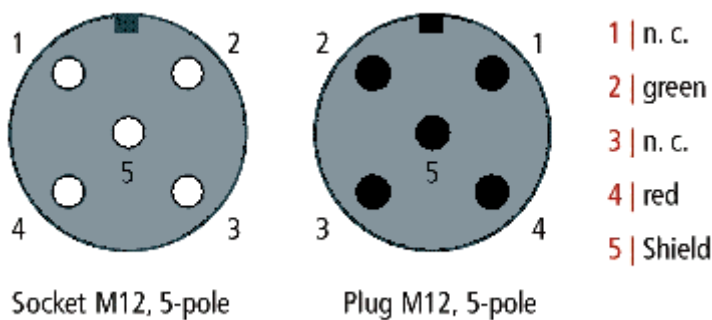
M12 circular connector

The M12 socket is inverse coded, and has five pins. Pin 1 is 5 V_{DC} and 3 is GND for the active termination resistor. These must never be misused for other functions, as this can lead to destruction of the device.

Pin 2 and pin 4 are the PROFIBUS signals. These must never be swapped over, as this will prevent communication. Pin 5 is the shield, and this is capacitatively coupled to the Fieldbus Box chassis.

M12 socket pin assignment (-B310)


```
1 | + 5 V DC
2 | A
3 | GND
4 | B
5 | Shield
```

M12 socket/plug pin assignment (-B318)

Socket M12, 5-pole   Plug M12, 5-pole

```
1 | n. c.
2 | green
3 | n. c.
4 | red
5 | Shield
```
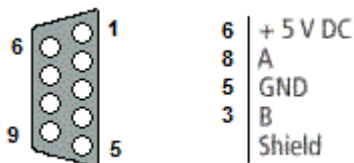
Nine pole D-Sub

Pin 6 is 5 V_{DC} und Pin 5 is GND for the active termination resistor. These must never be misused for other functions, as this can lead to destruction of the device.

Pin 3 and pin 8 are the PROFIBUS signals. These must never be swapped over, as this will prevent communication.

D-Sub socket pin assignment


```
6 | + 5 V DC
8 | A
5 | GND
3 | B
  | Shield
```

PROFIBUS conductor colors

PROFIBUS conductors	M12	D-Sub
B red	Pin 4	Pin 3
A green	Pin 2	Pin 8

Connection of Fieldbus Box modules

The connection of the Fieldbus Box modules is done direct or via a T-piece (or Y-piece).

The B318 series does have a male and female connector, that means no external T-piece is required. The supply voltage (+5V$_{DC}$) for the termination resistor is only supplied via the female M12 connector. The termination resistor ZS1000-1610 is only available with male connector.

Therefore the incoming PROFIBUS line should end in a female connector.
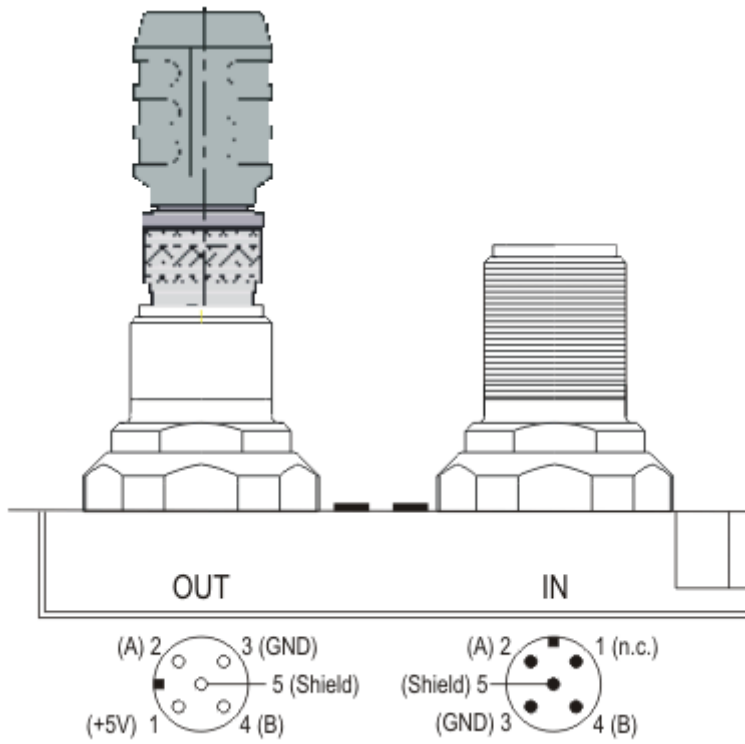
Two T-pieces are available:

- ZS1031-2600 with +5VDC on male and female connector for the termination resistor
- ZS1031-2610 with +5VDC only on the female connector

3.5 Protocol Description

3.5.1 Process Data

Once the parameter data and the configuration data has been correctly received and confirmed, the slave goes into the Data_Exch state, which means that it exchanges data with the master. The master sends the output data and the slave replies with the input data.

3.5.2   Configuration Data (Cfg Data)

Following parameterization, the master sends a configuration telegram to the slave. The configuration telegram causes the slave to check the configuration that has been sent by the master.

Structure of configuration byte:

Bit 0..3   Length of the data
00 = 1 byte/Word
15 = 16 byte/Word

Bit 4..5   Input/Output
00 = special identification format
01 = input
10 = output
11 = input/output

Bit 6   Byte/Word
0 = byte
1 = Word

Bit 7   Consistency
0 = consistency over byte/word
1 = consistency over the entire length

3.5.3 Activating the DPV1 Functions

The DPV1 functions can be activated in the parameter data (GSD, GSE). These functions are deactivated in the default setting. (Prm. byte 0 bit 15=1 activated, bit 15 =0 [default] deactivated)

DPV1 Functions

The IP/IL modules and the Economy Plus Bus Coupler (BK3120) support the following functions in the DPV1 services. The maximum length of the DP-V1 services is 48 bytes.

IP/IL configuration (IP-Link only)

The configuration of the extension modules can be read from the IP-Link coupler module. A word (of 16 bits) is transferred for each connected extension module (IExxxx). This contains the type of the module in the case of the analog modules, and the size and type of the digital extension modules.

Bit	Value: description of the digital module
0-1	If bit 4 = 0: number of 2-bit outputs, if bit 4 = 1: number of 8-bit outputs
2-3	If bit 4 = 0: number of 2-bit inputs, if bit 4 = 1: number of 8-bit inputs
4	0: Bit size 2, 1: bit size 8
5-6	0: Standard: Inputs and outputs do not have the same starting address 1: Combined I/O: Inputs and outputs to have the same starting address 2: Reserved 3: Outputs with diagnostics
7-15	always 0

The module configuration can be read with the following DPV1 parameters: (KS2000 Table 9) The modules are entered in the sequence in which they are connected at the IP-Link.

Slot number	Index	Byte	Description
0	9	0-1	Bus Coupler/module identifier
0	9	2-3	Module -1
0	9	...	...
0	9	46-47	Module 23
0	10	0-1	Module 24
0	10	...	...
0	10	46-47	Module 47
0	11	0-1	Module 48
0	...	...	...
0	13	46-47	Module 95
0	14	0-1	Module 96
0	14	...	...
0	14	30-31	Module 119

This information can also be written by DPV1. If the written configuration does not agree with the configuration contained in the table, a DPV1 error message is received.

Module Register

The register of extension modules can be read or written:

Slot number	Index	Description
1	0	Register 0 of module 1, channel 1
1	...	...
1	63	Register 63 of module 1, channel 1
1	64	Register 0 of module 1, channel 2
1	...	...
1	255	Register 63 of module 1, channel 4
2	0	Register 0 of module 2, channel 1 (from here only for IP-Link)
...	...	...
255	255	Register 63 of module 255, channel 4

IP-Link Reset

The IP-Link reset can be activated with the following DPV1 parameters: (Following an interruption of the IP-Link and its correction, the IP-Link can be started again)

Slot number	Index	Byte	Value
0	99	0	2
0	99	1	1
0	99	2	0
0	99	3	0

Measuring the IP-Link cycle time

Starting and stopping the IP-Link cycle time is set by the following DPV1 parameters:

Slot number	Index	Byte	Value
0	99	0	4
0	99	1	1
0	99	2-3	0: Stop, >0: Start

The cycle time can be read, and to reset the values it can also be written with the following DPV1 parameter:

Slot number	Index	Byte	Description
0	98	0-1	Minimum IP-Link cycle time (in µs)
0	98	2-3	Maximum IP-Link cycle time (in µs)
0	98	4-5	Current IP-Link cycle time (in µs)
0	98	6-7	Mean IP-Link cycle time (in µs)

Manufacturer's setting

The following DPV1 parameters must be written in order to adopt the manufacturer's settings:

Slot number	Index	Byte	Value
0	99	0	1
0	99	1	4
0	99	2	0
0	99	3	0

3.6 Description of the Parameter Data

3.6.1 General

3.6.1.1 Parameterisation Telegram

The *Set_Prm* service can be used to transfer not only the parameters described in the Profibus DP standard, but also manufacturer-specific operating parameters (**User_Prm_Data**). This is transmitted once from the master to the slave while the connection is being established. Generally speaking, the configuration tool for the DP master can read those operating parameters for the Fieldbus Box that can be set out of the GSD file, and can display them in plain text. The following manufacturer-specific operating parameters can be set for the Fieldbus Box:

Standard functionality	Modules that support the functions
DPV1 Services	IPxxxx-B310, IL230x-B310, IL230x-C310
Reset in the event of an IP-Link error	IL230x-B310, IL230x-C310
Process data format [▶ 37]	IPxxxx-B310, IL230x-B310, IL230x-C310
Synchronisation of the DP-/IP-Link cycle [▶ 33]	IL230x-B310, IL230x-C310
Reaction to Profibus errors [▶ 39]	IPxxxx-B310, IL230x-B310, IL230x-C310
Reaction to IP-Link errors	IL230x-B310, IL230x-C310

Expert functionality
2 byte PLC interface
IP-Link-Cycle-Counter

Also see about this

- 📄 Reaction to IP-Link Errors [▶ 40]

3.6.1.2 Updating the Process Image

Function

The K-Bus cycle (IP-Link) can be started cyclically (process image updating: free running) or synchronously, with receipt of the DP-Data_Exchange telegram (process image updating: synchronous with cycles). If updating the process image is set to be synchronous with cycles, then the K-Bus cycle is started after receipt of the Data_Exchange telegram; otherwise the K-Bus cycle (IP-Link) is started independently of the Data_Exchange telegrams. The free running and synchronous procedures for updating of the process image are represented schematically below.
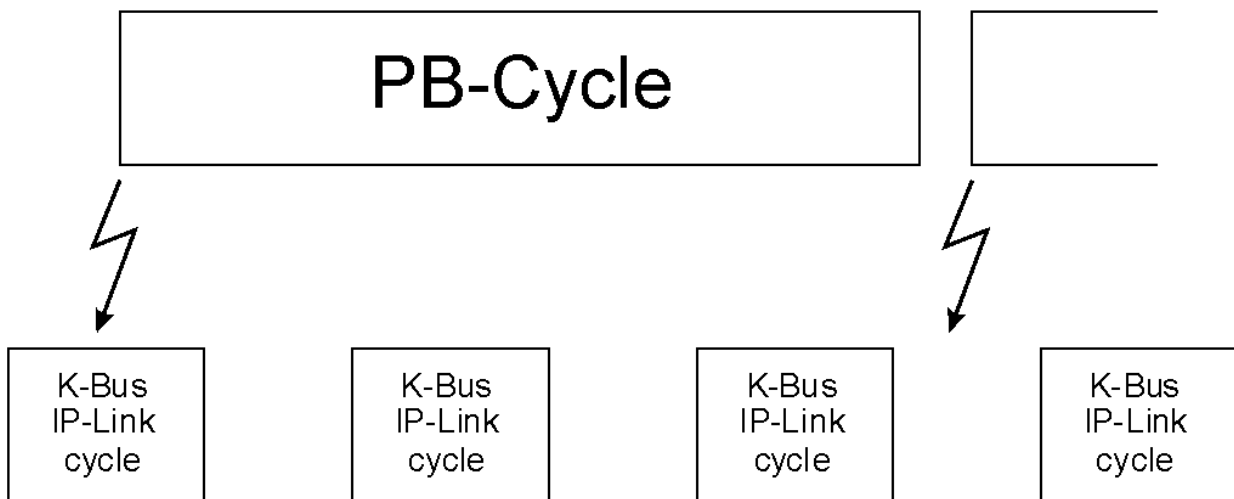
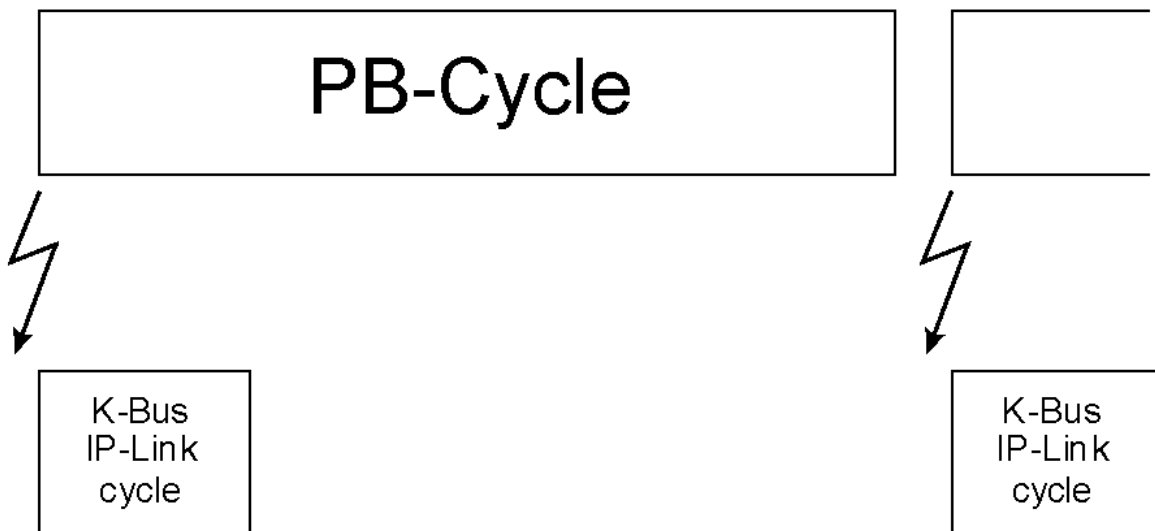**Free Run**

Figure: Free-Run-Mode

Synchronous

Figure: The principle of updating the process image

Byte	Bit	Description
9	6	Updating of the process image

> **Note**
>
> Special attention must be paid to the running and reaction times of the whole system when parameterising the process image update function.

Fast- Free- Run

In fast-free-run mode, the priority of the K-Bus/IP-Link is set higher. This activates the internal bus more frequently. This implies that the interfaces (such as KS2000 or DPV-1) are not dealt with so quickly. Fast-free-run mode is only permitted in asynchronous operation.
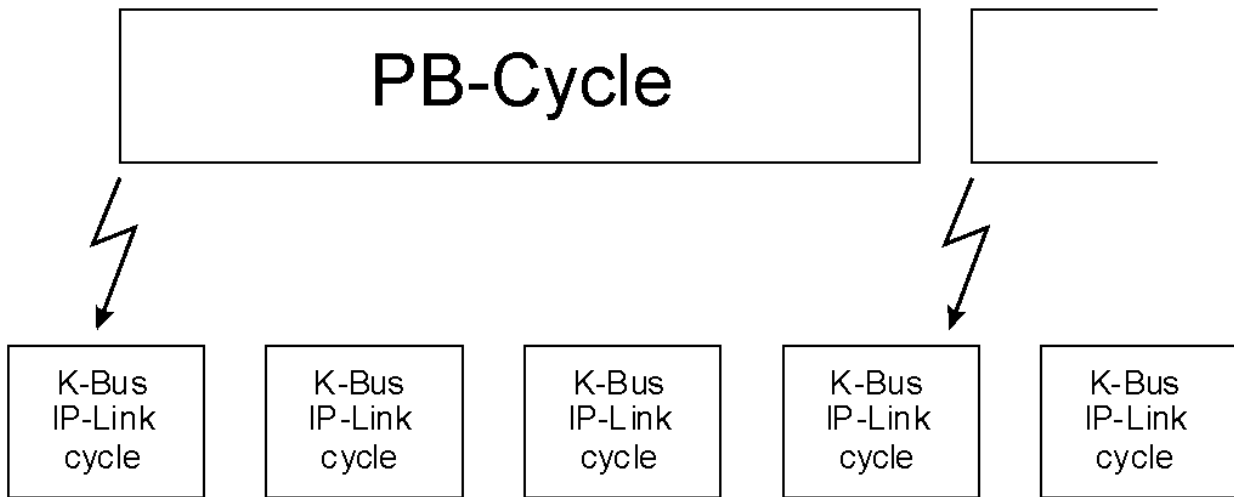
Figure: Fast-Free-Mode

Byte	Bit	Description
9	4	Fast-Free-Run-Mode

A certain running time is required to transmit the signals from the inputs to the controller and from the controller to the outputs. It is composed of a number of elements:

- Transmission from the controller to the Profibus master

- Transmission via Profibus (see Profibus reaction time [▶ 35]) and

- Transmission from the Profibus box to the outputs (see K-Bus reaction time [▶ 36]) / (see IP-Link cycle time [▶ 37])

The opposite sequence applies to the return journey.

Please see the data provided by the Profibus master manufacturer for the reaction time from the controller to the Profibus master. The times a comparatively short, and do not usually have to be taken into account.

Profibus reaction time

Profibus reaction time

The **reaction time t_{DP}** on the Profibus is made up as follows. The constants A, B and $_{TBYTE}$ depend on the baud rate.

$t =_{DP}$	Constant A	
	+ (constant B + (number of I/O bytes x T_{BYTE}))	[Slave 1]
	+ (constant B + (number of I/O bytes x T_{BYTE}))	[Slave 2]
	+ (constant B + (number of I/O bytes x T_{BYTE}))	[Slave 3]
	+ (constant B + (number of I/O bytes x T_{BYTE}))	[Slave n]

Baud Rate	Constant A (in ms)	Constant B (in ms)	TBYTE (in ms)
9.6 kBaud	64.5	25.6	1.15
19.2 kBaud	32.3	12.8	0.573
93.75 kBaud	6.6	2.62	0.118
187.5 kBaud	3.3	1.31	0.059
500 kBaud	1.6	0.49	0.022
1.5 MBaud	0.67	0.164	0.00733
3 MBaud	0.436	0.085	0.00367
6 MBaud	0.27	0.044	0.00183
12 MBaud	0.191	0.024	0.00092

K-Bus reaction time (K-Bus)

K-Bus reaction time (K-Bus)

The reaction time on the K-Bus (internal bus of the Compact Box) is determined by the shifting and saving of the data. The following table contains measured values for typical structures. It is possible to scale the calculation up for larger numbers.

Compact Box (numbers are for channels)			Running time on the K-bus
Digital OUT	Digital IN	Analog IN/OUT	T_cycle (µs)
4	0	0	150
8	0	0	170
12	0	0	170
16	0	0	200
20	0	0	200
24	0	0	220
28	0	0	220
32	0	0	245
0	4	0	150
0	8	0	180
0	12	0	180
0	16	0	200
0	20	0	200
0	24	0	230
0	28	0	230
0	32	0	250
4	4	0	170
8	8	0	195
12	12	0	220
16	16	0	250
20	20	0	275
24	24	0	300
28	28	0	325
32	32	0	350
4	4	1	630
4	4	2	700

> **Note**
>
> For physical reasons, the K-Bus cycle is always at least about 90 µs. This means that the running or cycle time of the whole system, and in particular the cycle time for the PLC task, must be greater than the running time of the K-Bus cycle. If this is not the case, unstable conditions can arise in the input and output terminals of the PROFIBUS slave.

IP-Link reaction time

IP-Link reaction time

The reaction time on the IP-Link is determined by the shifting and saving of the data. The following table contains measured values for typical structures. It is possible to scale the calculation up for larger numbers.

Extension Boxes added to Coupler Boxes			Running time on the IP-Link
Digital OUT (bits)	Digital IN (bits)	Analog IN/OUT (channels)	T_cycle (µs)
24	16	0	420
48	16	0	450
24	16	4	1500
48	16	16	2360
48	16	28	3500
48	16	40	4000

The settings for the Process image updating function are found in byte 9 of the User_Prm_Data (default settings are printed bold):

Bit no.	Description	is supported by
Bit 6	Updating of the process image 0: synchronous with cycle 1: free running	IP10xx, IP15xx; IP20xx, IP23xx, IP25xx, IP31xx, IP41xx, IP50xx, IP51xx, IP60xx

In TwinCAT the settings for the *PROFIBUS synchronisation DP/K-Bus cycle* can be transferred with ADSRead and ADSWrite (ADS: Automation Device Specification). For this purpose they should be activated in the User_Prm_Data.

The settings for the Process updating function are found in the TwinCAT System Manager on the *PrmData* tab for the corresponding Busbox.
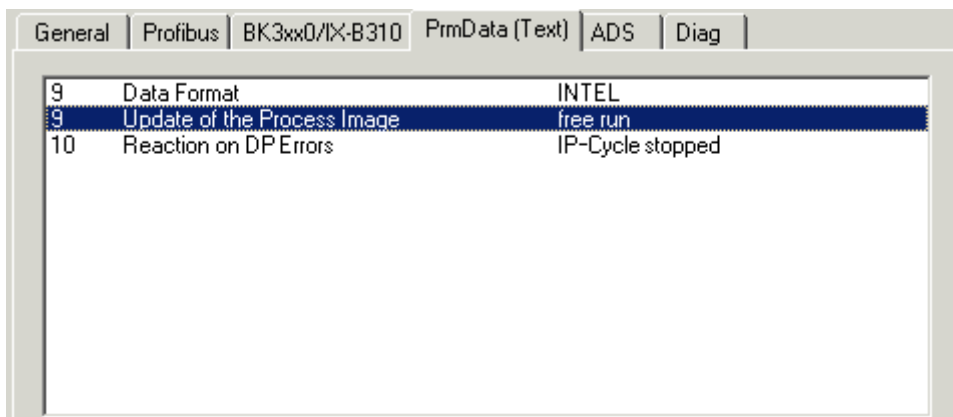
3.6.1.3   Auto-configuration data format

This parameter sets the representation format for the complex terminals. You may choose between Intel [▶ 38] and Motorola [▶ 38] formats:

- Under the Intel format, the less significant byte (low byte) of a data word is located at the lowest address offset of the memory location.
- Under the Motorola format, the more significant byte (high byte) of a data word is located at the lowest address offset of the memory location.

If you choose the Motorola format for digital terminals, then the two bytes transmitted, for instance, for 16 sequential digital channels, the high byte and the low byte will be swapped.

Representation in Intel format

Intel format

Byte 0		Byte 1		Byte 2		Byte 3		Byte 4		Byte 5	
Word 0				Word 2				Word 4			
		Word 1				Word 3					

In terms of bit addresses, the result is:

High byte								Low byte							
1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0
Byte 1								Byte 0							

Representation in Motorola format

Motorola format

Byte 1		Byte 0		Byte 3		Byte 2		Byte 5		Byte 4	
Word 0				Word 2				Word 4			

In terms of bit addresses, the result is:

| High byte								Low byte							
0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0
Byte 0								Byte 1							

Settings

The settings for the Data format auto-configuration function are found in byte 9 of the User_Prm_Data (default settings are printed bold):

Bit no.	Description	is supported by
Bit 3	Auto-configuration data format 0: Intel **1: Motorola**	IP15xx, IP25xx, IP31xx, IP41xx, IP50xx, IP51xx, IP60xx

In TwinCAT the settings for the Data format auto-configuration can be transferred with ADSRead and ADSWrite (ADS: Automation Device Specification). For this purpose they should be activated in the User_Prm_Data.

The settings for the Data format auto-configuration function are found in the TwinCAT System Manager on the *PrmData* tab for the corresponding Busbox.
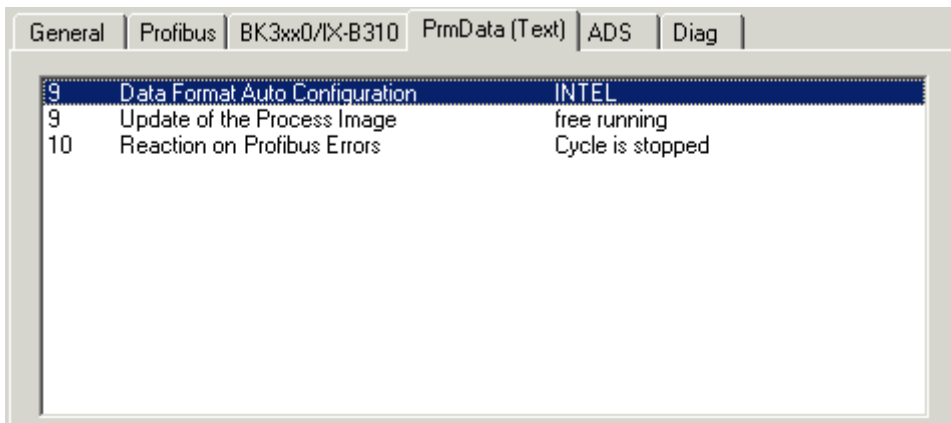
3.6.1.4 Reaction to PROFIBUS errors

The reaction to a PROFIBUS error (e.g. the plug is pulled out, STOP of the DP master, etc.) can be set. The possible reactions are:

- Stopping the K-Bus
- Resetting the outputs to 0
- Retaining the current output states

● **Note**

In the Cycle is stopped setting, the signal states of the output terminals are identical to those under the Outputs become 0 setting.

The settings for the Reaction to Profibus error function are found in byte 10 of the User_Prm_Data (default settings are printed bold):

Bit no.	Description	is supported by
Bits 0/1	Reaction to Profibus errors **0: Cycle is stopped** 1: *Outputs* become 0 2: *Outputs* remain the same	IP10xx, IP15xx, IP20xx, IP23xx, IP25xx, IP31xx, IP41xx, IP50xx, IP51xx, IP60xx

In TwinCAT the settings for the *Reaction to PROFIBUSerror* can be transferred with ADSRead and ADSWrite (**ADS: Automation Device Specification**). For this purpose they should be activated in the User_Prm_Data.

The settings for the *Reaction to PROFIBUSerror* function are found in the TwinCAT System Manager on the "PrmData" tab for the corresponding Bus Coupler.

BECKHOFF
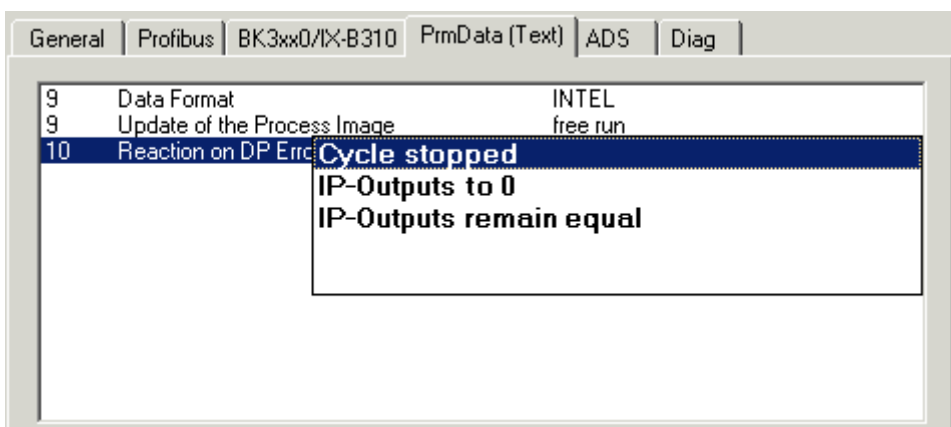
3.6.1.5   Reaction to IP-Link Errors

The error reaction can be set for an IP-Link error (such as pulling out the plug). The possible reactions are:

- Data exchange is stopped.
- Profibus inputs become 0
- Profibus inputs are retained unchanged

The settings for the reaction to Profibus error function are found in byte 10 of the User_Prm_Data (default settings are printed bold):

Byte	Bit	Description	is supported by
10	2, 3	Reaction to Profibus errors **0: Data exchange is aborted** 1: *Inputs* become 0 2: *Inputs* remain unchanged	IL230x-B3xx

In TwinCAT the settings for the *Reaction to IP-Link error* can be transferred with ADSRead and ADSWrite (**ADS: Automation Device Specification**). For this purpose they should be activated in the User_Prm_Data.

The settings for the *Reaction to IP-Link error* function are found in the TwinCAT System Manager on the "PrmData" tab for the corresponding Bus Coupler.
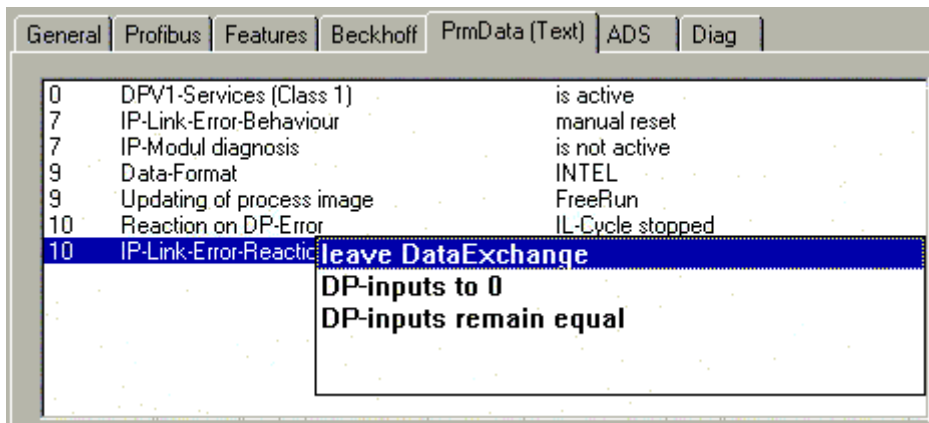
3.6.2 Parameter Data

3.6.2.1 IPxxxx-B31x - User Parameters

Data format

Data format [▶ 37]

Auto configuration (only applies to all complex devices, not necessary for digital devices)
Complex terminal data can be represented in either Intel or Motorola format, although controllers generally expect the data to be in Motorola format.

Example:
In Motorola format, an analog value from an IP3312-Bxxx is shown as 0x0016. In Intel format, the high and low bytes are exchanged, yielding 0x1600.

Updating of the process image

Updating of the process image [▶ 33]

- Synchronous with the cycle means that the data are triggered in synchronism with the PROFIBUS image. If a PROFIBUS telegram reaches the slave, the slave copies the data into the ASIC after the answer telegram has been sent. The outputs are written immediately.
- Free running means that the data is fetched and copied into the ASIC, and that this is repeated continuously.

Free running can be used when it is necessary to transfer the input data as fast as possible to the controller. The disadvantage of this is that the data is not free from jitter. If fast outputs are needed, or if it is necessary for the inputs to be jitter-free (e.g. for fast controllers) then cyclic transmission should be selected.

Reaction to PROFIBUS errors

Reaction to PROFIBUS errors [▶ 39]

- Cycle is stopped. The internal data process is stopped, and the watchdog (WD) for the channels (usually 100 ms) triggers.
- Outputs become 0. Zero is written to all the outputs in a defined manner.
- Outputs remain the same. The most recently received PROFIBUS telegram and its output data is retained. A switched output, e.g. at a IP4112 with 12 ms, is retained as long as it takes to reconstruct the PROFIBUS cycle and a new value is transmitted via the process data.

3.6.2.2 User parameters for the Coupler Box Modules (IL230x-B31x)

DPV1 Services

The DPV1 services can be activated or deactivated here. Default: Not active (see DPV1 services [▶ 31]).

Behavior in the event of an IP-Link error

The IP-Link can start up again of its own accord once an IP-Link error (such as a cable break) has been corrected. Warning: PROFIBUS data communication begins once more, and outputs are written again. The user must ensure that undesirable outputs are not written in such a case. Default: Manual reset.

Fieldbus Box Diagnostics

The diagnostic data can be activated here. Default: Not active (see Diagnostics for the Compact Box or Diagnostics for the Coupler Box).
Byte 7, bit 1:
- True activated
- False deactivated

Data format

Data that is 2 bytes in size can be transmitted either in Intel or in Motorola format. The high byte and the low byte are swapped. Default: Motorola.

Updating process data

The IP-Link can be triggered in synchronism with PROFIBUS , or can be allowed to run free. Default: Free running (see Updating process data [▶ 33]).

Reaction to PROFIBUS errors

This describes the behavior of the slave in the presence of a PROFIBUS error (such as a faulty cable). Default: The IP-Link cycle is abandoned

- The IP-Link cycle is abandoned, which means that the extension module's watchdog will trigger after 100 ms, and the outputs will be switched into a safe condition
- The IP-Link master writes a 0 to the outputs
- The outputs remain frozen in their last state

Reaction to IP-Link errors

This describes the behavior of the slave in the presence of an IP-Link error (such as a faulty cable). Default: DataExchange is abandoned

- DataExchange is abandoned, which means that the slave halts the PROFIBUS communication.
- DP inputs become 0 - A zero is written to the inputs
- DP inputs are retained - The inputs retain their most recent valid state

IL/IE Byte Alignment   )[1]

This allows all the IL/IE23xx modules with 4 bit input/outputs to be rounded to a byte.

Byte 10 bit 5 Default "0"
1   All the IE23xx modules are mapped with eight bits. In fact the inputs from 0..3 are sufficient (4..7 are not used), as are the outputs from bits 4..7 (0..3 are not used).
0   All IE23xx modules are mapped with four inputs and four outputs (default)

)[1]Firmware update is possible for the IL modules from software version 1 D:xxxx1xxx.

3.6.2.3   IL230x-C3xx - User Parameters

Copy the fieldbus and IP-Link status into the allocated flags area

Byte 13, bit 5
1   is copied into the region %MB408-411 (default)
0   is not copied into the region %MB408-411

Saving the modules when creating the boot project

Byte 13, bit 6
1   is checked (default)
0   is not checked

Copy the cycle tick counter into the allocated flags area

Byte 12, bit 0
1   is copied into the region %MB404-407 (default)
0   is not copied into the region %MB404-407

Reaction to Breakpoints

Byte 12, bit 1
1   Outputs are written as zero
0   Outputs remain unchanged (default)

3.6.2.4   Module-specific Parameter Data

User parameters for Compact Box Modules (IP3xxx-B310)

The module-specific parameter data can be used as from version D.xxxx3xxx.
Your software can be updated if the hardware version is D.xxxxx8xx or above. Please contact Support for this purpose.

IP3102-B310

- Overflow offset (can be set individually for each channel)
- Set and activate limit values (can be set individually for each channel)

IP3112-B310

- Overflow offset (can be set individually for each channel)
- Set and activate limit values(can be set individually for each channel)
- Input current range(can be set individually for each channel): 0...20 mA or 4...20 mA

IP3202-B310

- Set PT elements(can be set individually for each channel)
- Two/three/four wire connection(can be set individually for each channel)
- Over-range protection(can be set individually for each channel)

IP3312-B310

- Adjust thermocouple (can be set individually for each channel)
- Cold junction compensation(can be set individually for each channel):
- Over-range protection(can be set individually for each channel)

User parameters for Compact Box Modules IP4xxx-B310

The module-specific parameter data can be used as from version D.xxxx3xxx.
Your software can be updated if the hardware version is D.xxxxx8xx or above. Please contact Support for this purpose.

IP4112-B310

- Output current range (can only be set jointly for all channels): 0...20 mA or 4...20 mA
- Watchdog(can be set individually for each channel)

IP4132-B310

- Watchdog (can be set individually for each channel)

4 Parameterization and commissioning

4.1 Start-up behavior of the Fieldbus Box

After power up, the Fieldbus Box checks its state, configures the IP-Link (if present) and refers to the extension modules to create a structure list. If the Fieldbus Box contains a decentralized controller (IL230x-C310) the local PLC is started once the structure list has successfully been created.
The I/O LEDs illuminate and flash as the module starts up. If there are no errors, the I/O LEDs should stop flashing within about 2-3 seconds. If there is an error, then the LED that flashes will depend on the type of that error (see Diagnostic LEDs).
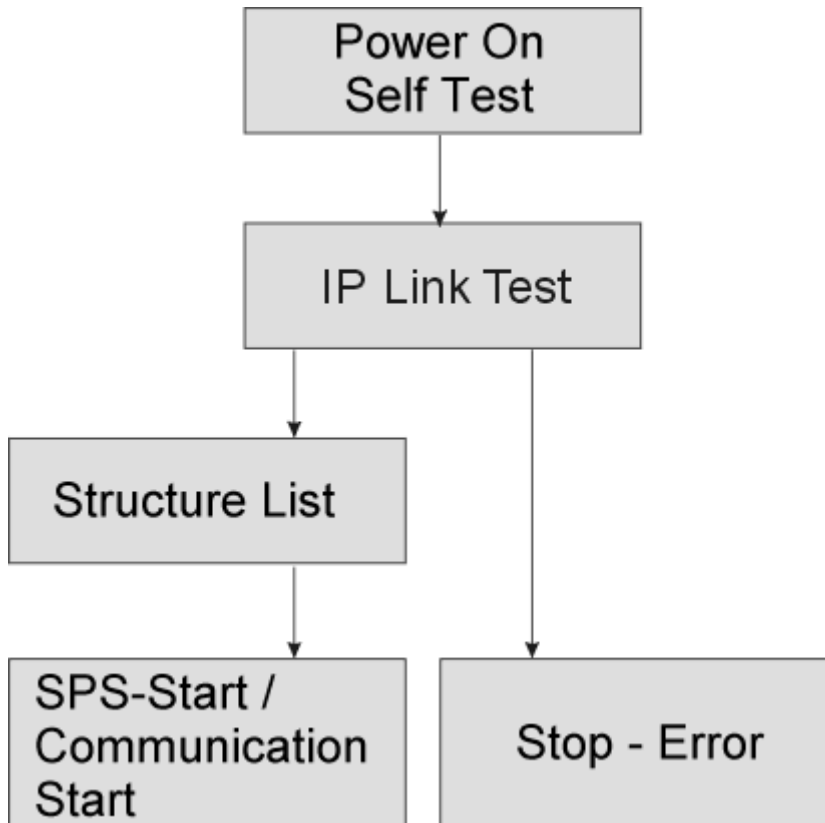
4.2   Addressing

The Profibus address must be set using the two rotary selection switches behind the transparent cover. The default setting is 11. Any address is permitted, but each address may only be used once within the network. The address is changed while the Fieldbus Box is switched off. To do this, unscrew the cover and use a screwdriver to move the switches to the desired position. Make sure that the switches engage properly. The switch on the left represents the tens, while that on the right represents the units. The change in address is active as soon as the device is switched on.

Fieldbus Box

Example

You want to set address 34.
Left-hand rotary selection switch: 3
Right hand rotary selection switch: 4

Bus Coupler

The bottom switch S311 represents the tens, while S310 the upper one represents the units.
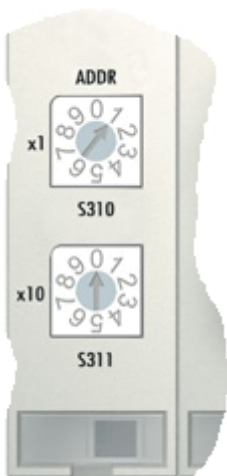
4.3   Baud Rate

The Fieldbus Box for PROFIBUS has automatic baud rate detection. As soon as the electrical power is switched on, the Fieldbus Box searches for the baud rate that is being used, and stores it for as long as the supply voltage is present.

Note

If you change the baud rate of your PROFIBUS master, you must switch the Fieldbus Box off and on again once.

Distances

The bus cable is specified in EN 50170. This yields the following lengths for a bus segment.

Baud rate in kbits/sec	9.6	19.2	93.75	187.5	500	1500	12000
Cable length in m	1200	1200	1200	1000	400	200	100

Stubs up to 1500 kbaud <6.6 m; at 12 Mbaud stub segments should not be used.

4.4 Configuration

4.4.1 Configuration Data (Cfg Data)

Cfg Data [▶ 30]

The PROFIBUS coupler creates a data area with input and output bytes (Peripheral data in the process image). The assignment of the channels in the Bus Terminals/Modules and the process image is carried out by the Bus Coupler/Fieldbus Box.

The PROFIBUS master exchanges a continuous input and output data block with each Bus Coupler/Fieldbus Box. The assignments of the bytes from this data block to the addresses in the process image is carried out by the master. In the PLC master of the IM308-C the COM PROFIBUS software supports the configuration, and in the IM308-B the COMET200 software does this job. For other PROFIBUS Masters, the appropriate tools from the manufacturer are to be used.

> **i** **Note**
>
> A configuration software is utilized to configure the PROFIBUS master. Different programs are used, depending on the manufacturer. These programs generally use the GSD file in order to be able to set the slave parameters optimally. The type file is frequently used for Siemens PROFIBUS masters; only more recent versions of the Siemens software also work with the GSD file. Copy the necessary files into the appropriate directories before you start the master configuration software. The Beckhoff GSD and type files are available for download from www.beckhoff.com.

After being switched on, the Bus Coupler or Fieldbus Box determine the configuration of the connected input/output terminals. The assignment of the physical slots for the input/output channels and the addresses in the process image is carried out automatically by the Bus Coupler. A distinction is made here between bit-oriented (digital) and byte-oriented (analog or complex) signal processing. The Bus Coupler first writes the byte oriented Bus Terminals into the process image, followed by the bit oriented terminals.

Table 5: Bus Terminals

Byte oriented Bus Terminals	Bit oriented Bus Terminals
KL1501, KL2502, KL3xxx, KL4xxx, KL5xxx, KL6xxx	KL10xx, KL11xx, KL12xx, KL17xx, KL20xx, KL21xx, KL22xx, KL26xx, KL9110, KL9160, KL9210, KL9260

Table 6: Fieldbus Boxes

Byte oriented Fieldbus Boxes	Bit oriented Fieldbus Boxes
IP/IE1501, IP/IE25x2, IE2808 IP/IE3xx2, IP/IE4xx2, IP/IE5xx2, IP/IE6xx2	IP/IE1xxx, IPIE2xxx

When configuring the master, it must be borne in mind that all the byte oriented Bus Terminals and Fieldbus Boxes must first be entered in the sequence in which they are physically inserted. No distinction is made here between input terminals and output terminals. The bit-oriented bus terminals come next. These are rounded up to a full byte, so that 12 digital signals, corresponding to 12 bits, are rounded up to two bytes. The remaining four bits are automatically filled with zeros. The GSD file contains 8/16/32, up to 1 word, digital inputs and/or outputs for the bit-oriented terminals.

For the byte oriented Bus Terminals/Modules, only the initial identification plus the "placeholder" is given (e.g. KL3xxx or IP3xxx-B310) rather than the terminal name itself. All of these terminals are equal in the size in the process image. After this, the number of channels can be specified. This is useful if it is desired to assign different addresses in the PLC to the terminal channels.

| Number of bits (input, output channels)	Meaning in the process image
16 In	only user data
24 In / 8 Out	User data plus control and status (only in the KL3xxx)
8 In / 24 Out	User data plus control and status (only in the KL4xxx)
24 In / 24 Out	Full process image

4.4.1.1   Example - Siemens S5

4.4.1.1.1   Configuration - Siemens S5 Controller with COM Profibus

Begins by copying the *.gsd files into the GSD directory of your COM Profibus software. You will find the GSD on the Beckhoff website. Your next step is to read the files into the COM Profibus software.
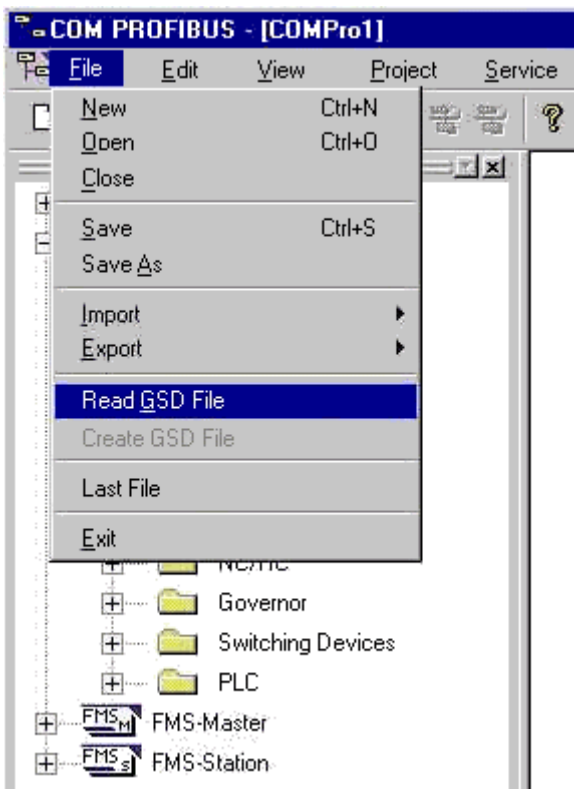
After this, you will find the files under "DP-Slave/I/O/...
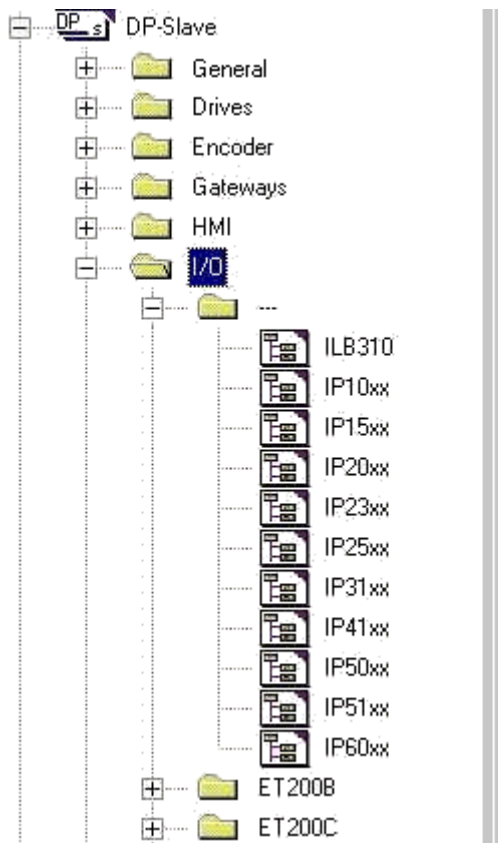
Now select the appropriate slave.

4.4.1.1.2   Configuration: IP41xx-B310

With the IP41xx-B310 you have the option of choosing between two different mapping types:

- Compact mapping simply describes the output user data, i.e. four output words (16 bits for each channel).
- Complex mapping additionally has a control and status byte; in the IP41xx.B310 this can only be used for register communication. Mapping 4 x 3 bytes input and output.

The settings can only be made for an entire module (not for individual channels).

An example of compact mapping:

BECKHOFF
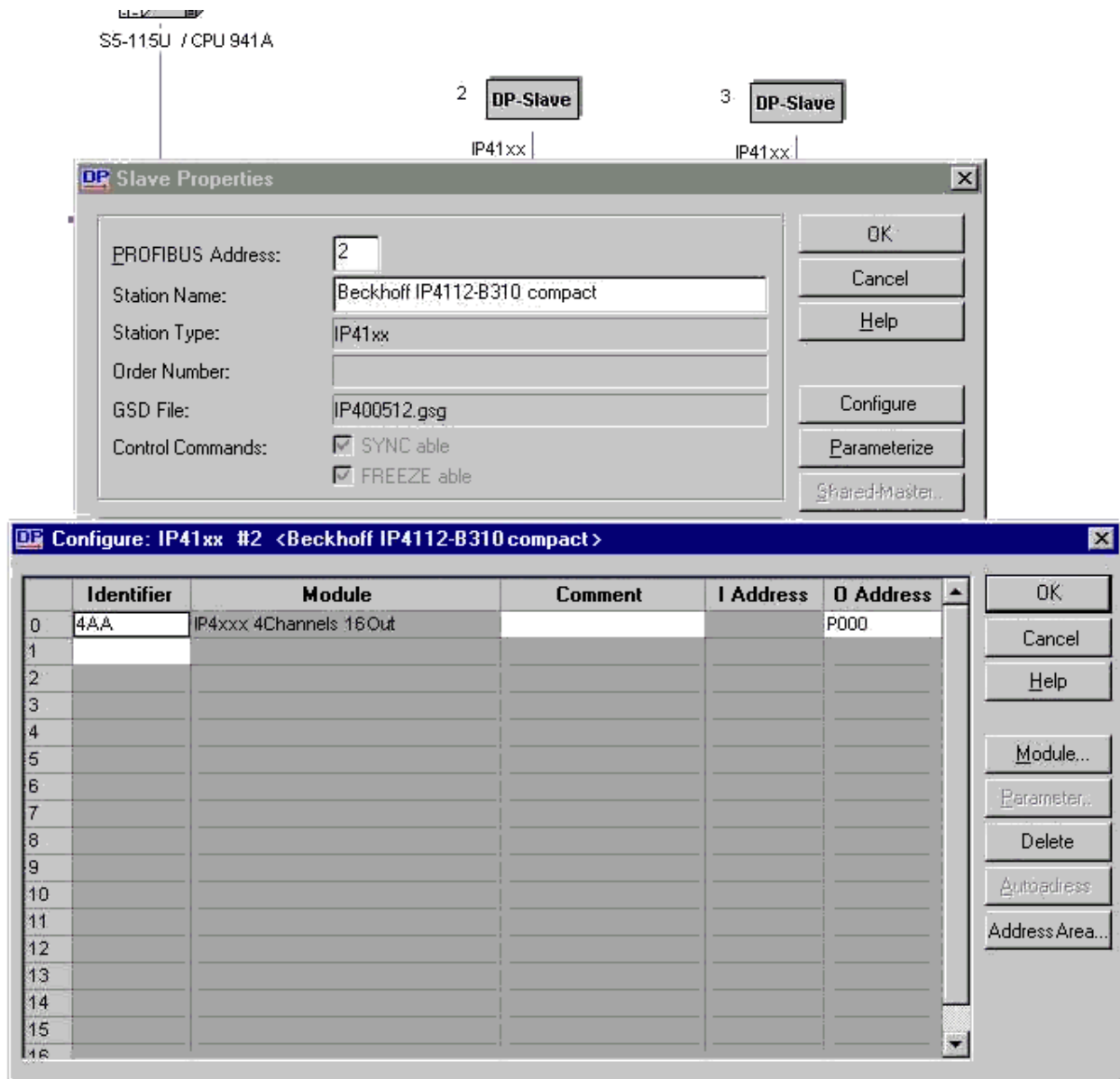
An example of complex mapping:
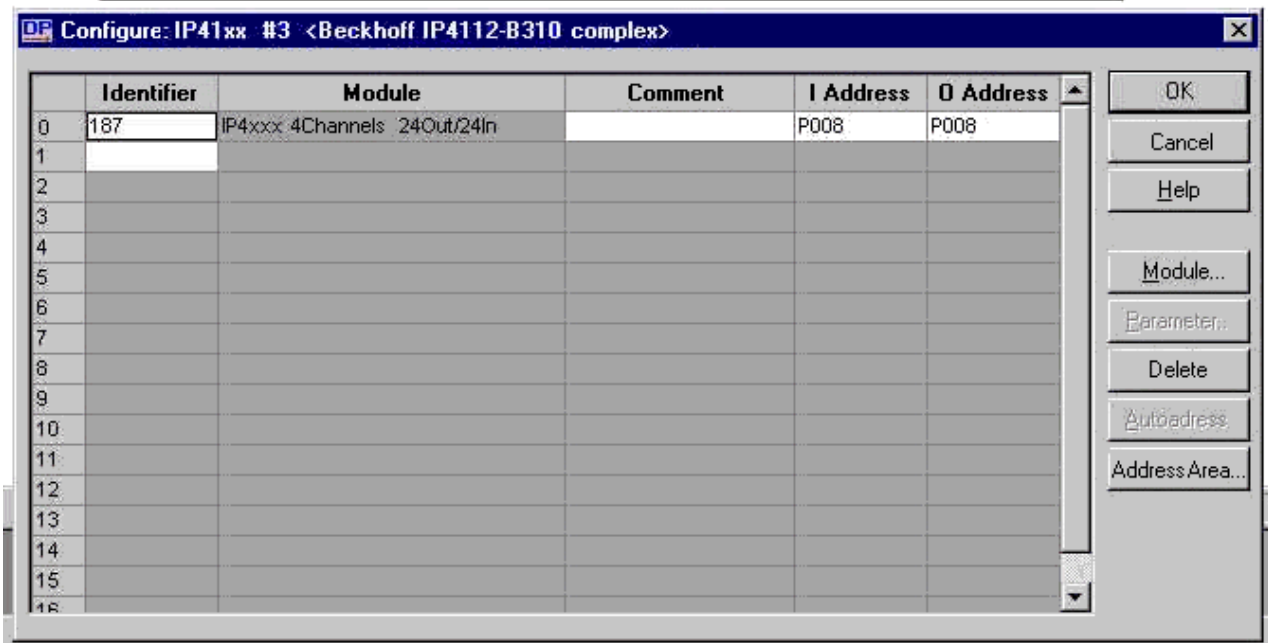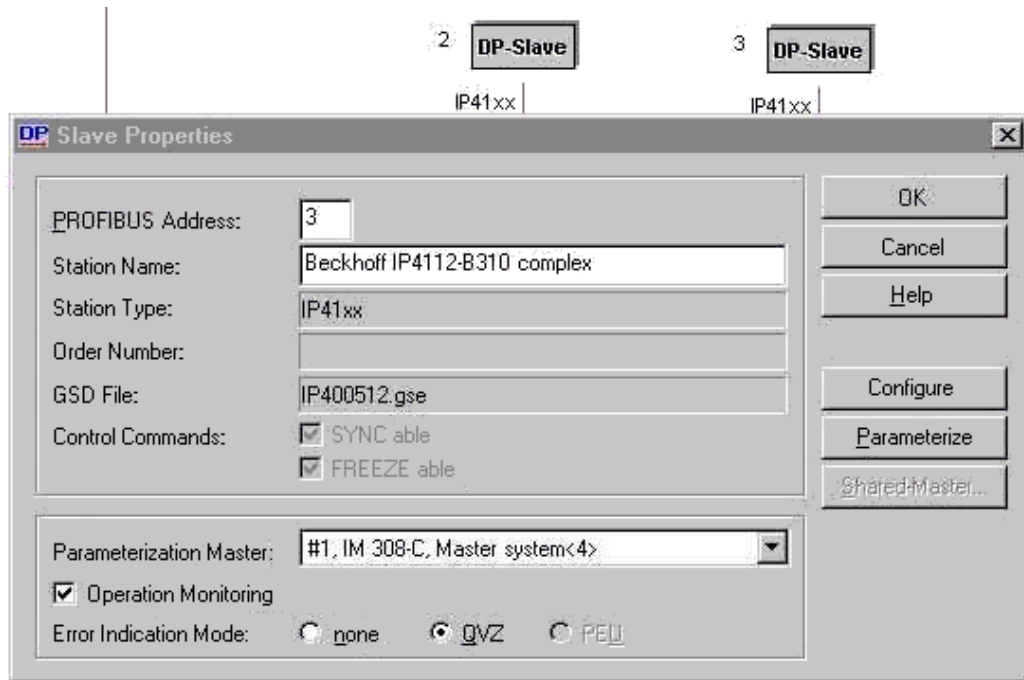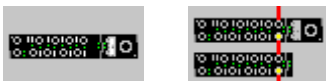
You can also change the user parameters (see).
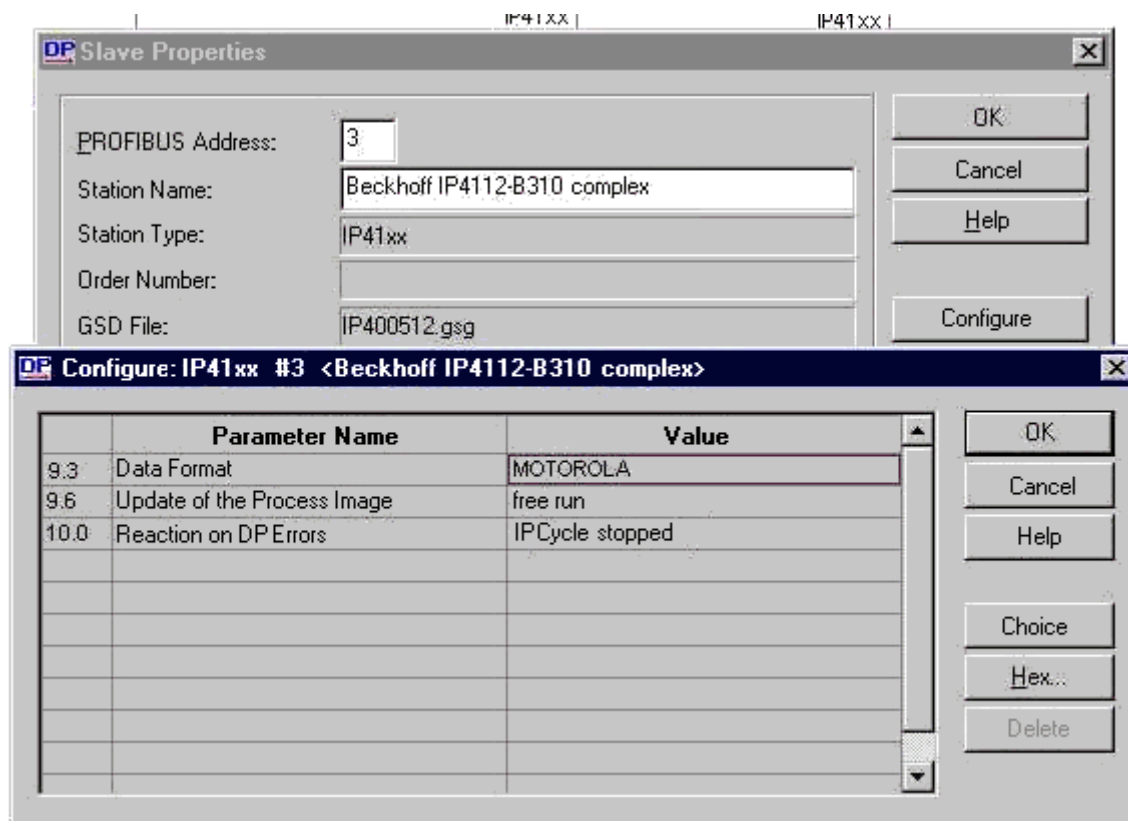
4.4.1.2 Example - Siemens S7

4.4.1.2.1 Configuration - Siemens S7 Controller with COM Profibus

Inserting the images

In order to assign an image to the devices in the Siemens software, they must be copied into the *Step7\S7Data\ncbmp* directory.
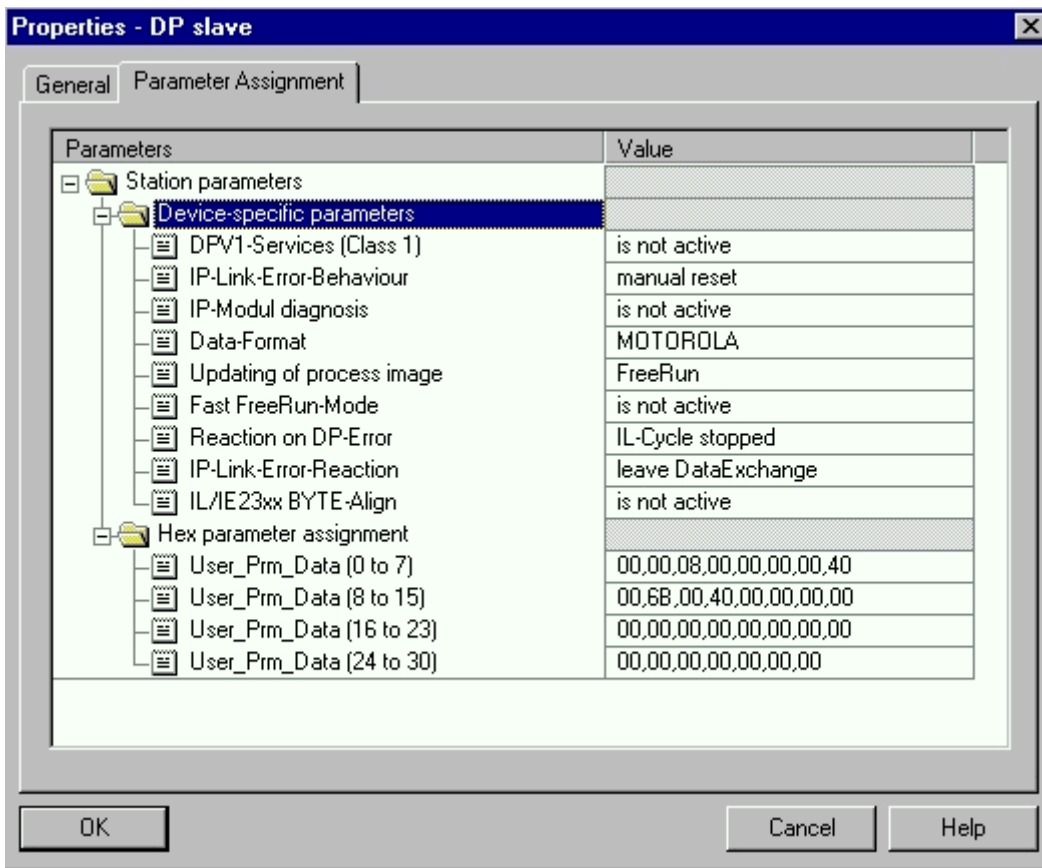

IPxxxx-B310 IL230x-B310/C310

Inserting the GSD files
- Go to *Extras\Install new GSD* in the hardware catalog for your Step7.
- Select the directory in which the Beckhoff GSD is located, and import the files.
- You will then find them in the hardware catalog under *Profibus DP\Other field devices\I/O*.

4.4.1.2.2 Configuration - IL230x-B31x

Parameter data for the IL230x-B31x

Settings

Parameter data	Denomination
DPV1-Services	DPV1 Services [▶ 31]
IP-Link-Error	Reaction to IP-Link
IP Module diagnosis	PROFIBUS diagnosis [▶ 71]
Data format	Data format [▶ 37]
Updating of process image	K-Bus update [▶ 33]
Reaction on DP-Error	Reaction to fieldbus error [▶ 39]
IP-Link-Error-Reaction	IP-Link error reaction
IL/IE23xx Byte-Align	Mapping of the 4 DI / DO (IL/IE23xx) modules

Configuration of the IL230x-B31x module with only digital inputs and outputs

Example:
1 x IL2301-B310
4 x IE1001
5 x IE2001
The sum total of digital bytes must be added together and entered.

BECKHOFF

Example:
1 x IL2301-B310
4 x IE1001
5 x IE2001

The same configuration can also be created as follows. The advantage of this method is that each byte receives a different address, and if a digital extension module is inserted, the addresses of the other modules are not shifted. A maximum of 64 modules can be inserted (slots 0-63)

Slot	Module / ...	Order number	I Address	Q Address	Comment
0	8DI	8 Bit digital inputs	0		
1	8DI	8 Bit digital inputs	10		
2	8DI	8 Bit digital inputs	11		
3	8DI	8 Bit digital inputs	15		
4	8DI	8 Bit digital inputs	20		
5	8DO	8 Bit digital outputs		10	
6	8DO	8 Bit digital outputs		20	
7	8DO	8 Bit digital outputs		21	
8	8DO	8 Bit digital outputs		22	
9	8DO	8 Bit digital outputs		0	
10	8DO	8 Bit digital outputs		1	
11					

Configuration of the IL230x-B31x module with complex and digital inputs and outputs

Complex modules are the first to be mapped into the process image. For this reason all the complex modules must be entered in the sequence in which they are attached to the IP-Link. Finally the digital signals must be rounded up to a byte.

Example:
1 x IL2301-B310
1 x IE3102 compact mapping

Example:
1 x IL2301-B310
1 x IE3102 complex mapping

4.4.2 Configuration of the complex Modules

4.4.2.1 Register Communication

4.4.2.1.1 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.

4.4.2.1.2   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 7: 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 8: 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 9: 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 10: 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 11: 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 12: 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

BECKHOFF

5 Diagnostic LEDs

Error Diagnosis

There are 2 kinds of error:

- Fieldbus error
- Local errors [▶ 65] in a Compact Box or Coupler Box
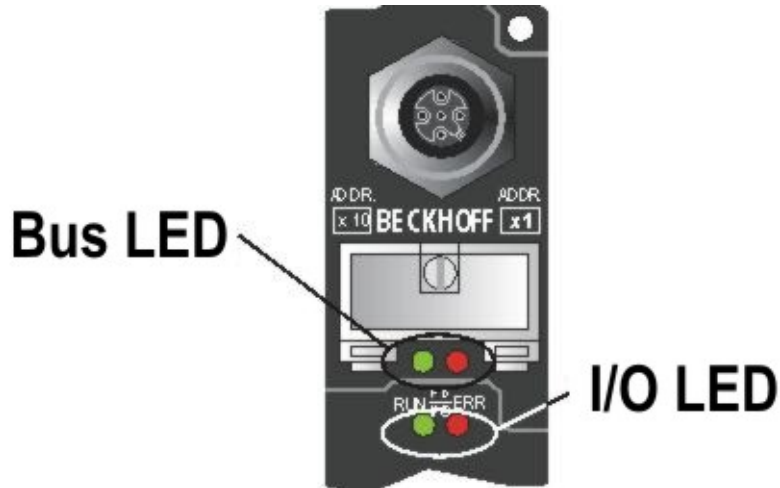
Blink Codes

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

5.1 Diagnostic LEDs for PROFIBUS

These are described by the upper two LEDs.

LED green	LED red	I/O RUN	Description	Remedy
on	on	No significance	Module waiting for communication	A baud rate has been found, start communication, incorrect identification number
off	on	No significance	Module is in *Baud rate search mode*	Start PROFIBUS, connect/check bus cable
off	off	No significance	Module waiting for cyclic communication	Start the cyclic PROFIBUS communication (start task)
on	flashing	No significance	Baud rate found, start up error	Parameter or configuration error, see blink code
on	off	off	DP start up OK, but still no Data_Exchange telegram received	Start the cyclic PROFIBUS communication (start task)
on	off	on	Module in data exchange	no error

Parameter data error

Error code 1

The reserved, fixed UserPrm data has an incorrect value. The error code argument indicates an incorrect byte (byte 0 starts with error code argument 1).

Error code 3

The combination of certain functions, using UserPrmData, is not allowed. The error code argument gives more precise information

Error code argument	Description
1	In synchronous mode it is not allowed to set the reaction to Profibus errors to "Outputs unchanged". The watchdog of the subsidiary bus system triggers more quickly than the PROFIBUS watchdog.
2-7	Reserved
8	Synchronous mode is not allowed when there are no outputs.
9-11	Reserved
12	The fast free-run mode is not allowed when synchronous mode is switched on

Error code 9

Error code 9 describes start-up errors

Error code argument	Description
1	Length of the DP input data too great
2	Length of the DP output data too great
3	Length of the DP CfgData too great
4	IP Box type not recognized
5	Configuration data of DP-interface are not OK

Configuration data (CfgData) error

Error code 2

Error when comparing the configuration data. The error code argument indicates the first incorrect byte (beginning with "1")

Error code 5

Error in the length of the digital output data. The error code argument indicates the expected number of bytes.

Error code 6

Error in the length of the digital input data. The error code argument indicates the expected number of bytes.

Error code 7

Error code 7 describes CfgData errors

Error code argument	Description
1	Length of the CfgData is not correct
2	Syntax of the CfgData is not correct
3	Length of the configuration data's calculated input data is too great
4	Length of the configuration data's calculated output data is too great

5.2 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

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 of the Coupler Box can be read with the KS2000 software.

5.3   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.
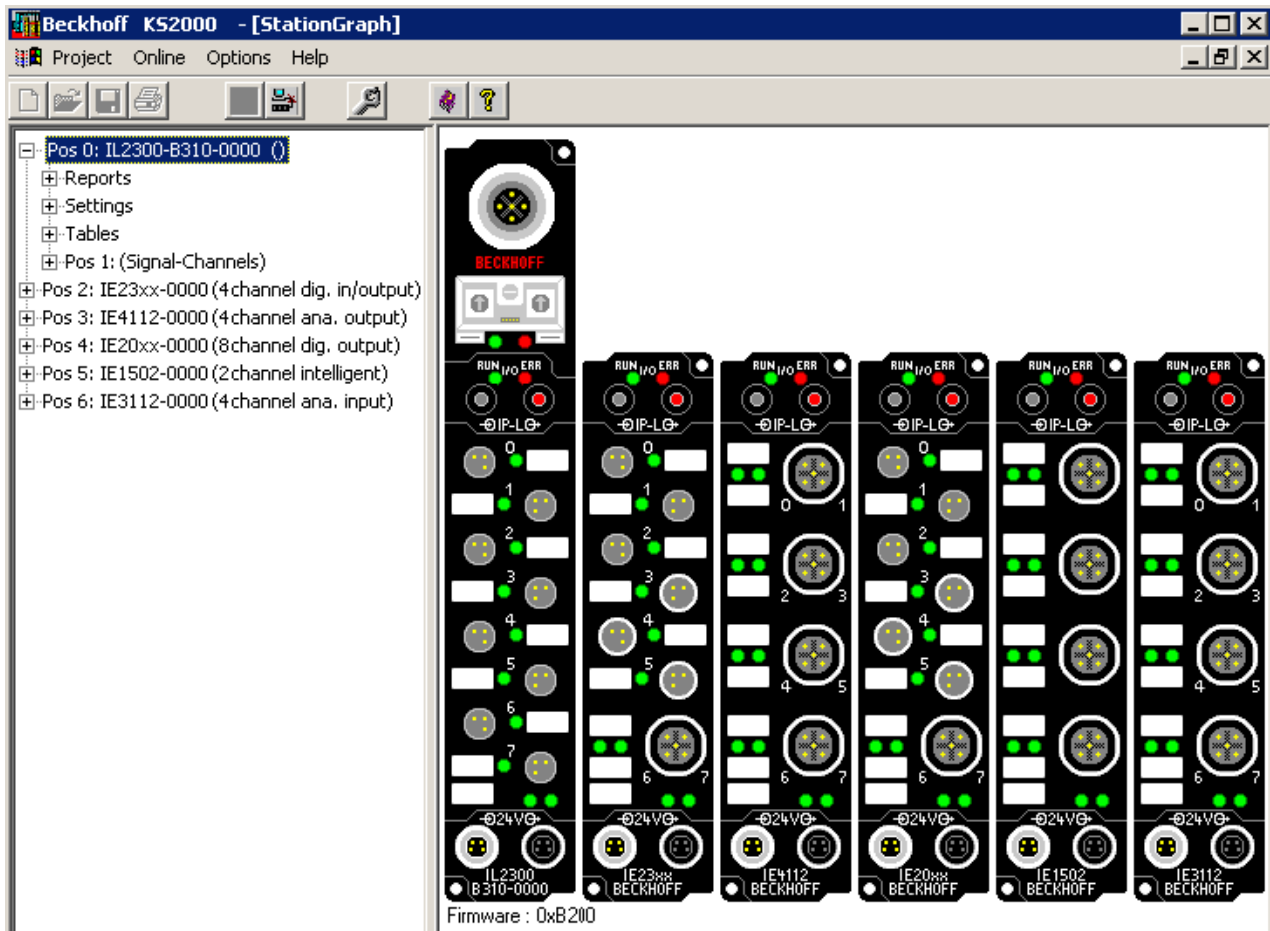
For this test, the fieldbus master (e.g. a PROFIBUS PC Card) should be on the bus and it should transmit data cyclical. Another way to generate cyclic data is, to switch the coupler to *free running* via the KS2000 software.

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**

i 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.

5.4 Trouble Shooting

If you're having problems with the module, the status LEDs provide indications of what might be the cause.

Avoiding typical errors

Checking the PROFIBUS wiring

A PROFIBUS cable (or a cable segment when using repeaters) can be checked with a few simple resistance measurements. The cable should meanwhile be removed from all stations:

Measuring points	typical resistance
Resistance between A and B at the start of the lead	approx. 110 Ohm
Resistance between A and B at the end of the lead	approx. 110 Ohm
Resistance between A at the start and A at the end of the lead	approx. 0 Ohm
Resistance between B at the start and B at the end of the lead	approx. 0 Ohm
Resistance between screen at the start and screen at the end of the lead	approx. 0 Ohm

If these measurements are successful, the cable is okay. If, in spite of this, bus malfunctions still occur, this is usually a result of EMC interference. The installation notes from the PROFIBUS User Organization should then be consulted (www.profibus.com).

Configuration sequence

When configuring an IP-Link with analog and digital extension boxes, always enter all the analog boxes first, in the sequence in which they are connected to the IP-Link. Then enter the digital boxes in the sequence in which they are connected to the IP-Link. Inputs and outputs are then mapped.

Configuration errors with the IL230x-B3xx

Fieldbus boxes that possess less than eight bits of process data in the input or output areas are rounded up to eight bits, and thus occupy eight bits in the relevant region. Note that this applies, for instance, to the IL230x-B3xx boxes, which have four inputs and four outputs.

IP-Link error

If the IP-Link error LED is lit, or if it flashes irregularly, it means that transmitted telegrams are faulty, if indeed they exist at all. The modules may indeed be amplifying each telegram, but cannot correct an error once it has occurred. The error must therefore be traced back from the last module to the first error-free module. The source of the error lies in the connection between this module and the following module.

The error is nearly always due to IP-Link cables with too much attenuation. This can, for instance, arise during cable assembly. A visual check is the simplest test. When held up to a source of light (but one that is not excessively bright), the surface of the relevant connector should be uniformly lit. Both sides should be checked.

In case of doubt, the connector must be assembled again. Ensure, when carrying out this work, that the optical fiber is not ground back too far.

Take care during the assembly that the correct length of insulation is stripped.

The finished cable can be most easily tested by connecting it between the Coupler Box and Extension Box. If the cable has been connected correctly, there will not be any faulty telegrams.

5.5   Diagnostic Telegrams

5.5.1   Diagnostic Telegrams Overview

Parameter Datea	Naming
Compact Box Modules	IPxxxx-B3xx
Coupler Box Modules	IL230x-B31x
Extension Box Modules	IExxxx

5.5.2   Diagnostic Telegrams for the Compact Box (IPxxx-B3xx)

DiagData in DPV1 Format

The diagnostic data is automatically reported to the DP master by the Fieldbus Boxes (if it has changed). The meaning of the first 6 bytes is the same for all DP slaves, after which device-specific diagnostic data follows. The structure for a Compact Box is specified according to the setting of "Old format / DPV1 format".

Usually the DP master has the ability to interrogate a flag in the PLC to determine whether diagnostic data has changed. The diagnostic data itself can then in most cases be read by means of a function block. In the S5 the diagnostic data is read with the FB IM308C function block, and in the S7 with the SFC13 and in TwinCAT it is read with the ADSREAD function block. The maximum length of the diagnostic data can be altered through User_Prm_Data (byte 11). If there is more diagnostic data available than can be sent, this is itself indicated in the diagnostic data.

Table 13: Diagnostic

Byte	Bit	Description
0	0	Slave does not answer (is set internally by the DP master)
	1	Slave is starting up (parameterization and configuration are being evaluated)
	2	Configuration error
	3	Ext_Diag_Data available (from byte 6)
	4	Function not supported
	5	Incorrect answer from slave (is set internally by the DP master)
	6	Parameterization error
	7	Slave is exchanging data with another master (is set internally by the DP master)
1	0	Slave must be parameterized again
	1	Slave has static diagnostics
	2	1
	3	DP watchdog is active
	4	Slave is in freeze mode
	5	Slave is in sync mode
	6	reserved
	7	Slave is deactivated (is set internally by the DP master)
2	0-6	reserved
	7	too much Ext_Diag_Data
3		Station address of the master with which data is being exchanged
4, 5		Ident number

Table 14: Manufacturer-specific diagnostics for the Compact Box

Byte	Bit	Description
6		Length of the Ext_Diag_Data, including length byte
7		0x81 (identification of the DPV1 diagnostic format)
8		0x00
9		0x00
10		0x00
11		0x00
12		0x00
13		0x00
14		0x00
15		0x00

Table 15: Diagnostics for the Compact Box

Byte	Bit	Description
16	0-5 6-7	In Fieldbus Boxes, bits 0-5 are always zero faulty channel number (0-3) 0x00 channel 0 0x40 channel 1 0x80 channel 2 0xC0 channel 3
17	0-5 6	Status byte of the channel (bits 0-5) General error bit
18	0-5 6-7	
19	0-5 6	
...		
60	0-5 6-7	
61	0-5 6	

● Note

ℹ Under complex mapping, the status byte is transferred from the terminal to the controller. It contains a variety of status bits depending on the terminal type involved (such as process data less than/ greater than limit value x, over range, under range etc.)

5.5.3   Diagnostic Telegrams for the Coupler Box (IL230x-B3xx)

DiagData in DPV1 Format

The diagnostic data is automatically reported to the DP master by the Fieldbus Boxes whenever it changes. The meaning of the first 6 bytes is the same for all DP slaves, after which device-specific diagnostic data follows. The structure for a Coupler Box is specified according to the setting of "Old format / DPV1 format".

Usually the DP master has the ability to interrogate a flag in the PLC to determine whether diagnostic data has changed. The diagnostic data itself can then in most cases be read by means of a function block. In the S5 the diagnostic data is read with the FB IM308C function block, and in the S7 with the SFC13 and in TwinCAT it is read with the ADSREAD function block. The maximum length of the diagnostic data can be altered through User_Prm_Data (byte 11). If there is more diagnostic data available than can be sent, this is itself indicated in the diagnostic data.

Table 16: Diagnostic

Byte	Bit	Description
0	0	Slave does not answer (is set internally by the DP master)
	1	Slave is starting up (parameterisation and configuration are being evaluated)
	2	Configuration error
	3	Ext_Diag_Data available (from byte 6)
	4	Function not supported
	5	Incorrect answer from slave (is set internally by the DP master)
	6	Parameterisation error
	7	Slave is exchanging data with another master (is set internally by the DP master)
1	0	Slave must be parameterised again
	1	Slave has static diagnostics
	2	1
	3	DP watchdog is active
	4	Slave is in freeze mode
	5	Slave is in sync mode
	6	reserved
	7	Slave is deactivated (is set internally by the DP master)
2	0-6	reserved
	7	too much Ext_Diag_Data
3		Station address of the master with which data is being exchanged
4, 5		Ident number

Table 17: Manufacturer-specific diagnostics for the Coupler Box

Byte	Bit	Description
6		Length of the Ext_Diag_Data, including length byte
7		0xA1 (identification of the DPV1 diagnostic format)
8		0x00
9		0x00
10		0x00
11	0	no error
	1	Start IP-Link error identification diagnostics
	32	General IP-Link error
12	0	no error
	3	IP-Link interruption Error code argument: error location (note: if the cable is broken, the counting direction is opposite to that of the optical fibre wiring)
	4	IP-Link timeout error Error code argument: error location
	5	Error when reading the complex module registers Error code argument: problematical module
	11	Extension module does not handle the synchronisation telegram Error code argument: problematical module
	12	More than 120 modules wired Error code argument: number of excess modules inserted
	13	Module type is not supported Error code argument: problematical module
13	0-120	Error code argument: IP-Link error (e.g. cable break) behind the nth extension box. Counting begins with n=1 from the last connected extension box in the direction of the Coupler Box (see also the description of the LED error code argument). Error code argument n=0 corresponds to an IP-Link error between the Coupler Box and the last connected extension box. Warning: if the cable is broken, the counting direction is opposite to that of the optical fibre wiring
14		0x00
15		0x00

Table 18: Diagnostics for the Coupler Box and the PLC Box

Byte	Bit	Description
16	0-7	Faulty IE Box number (1- 120 only complex modules are counted in the direction "with the light")
17	0-5 6-7	Status byte of the channel (bits 0-5) faulty channel number (0-3)
18	0-7	
19	0-5 6-7	
...	**...**	
60	0-7	
61	0-5 6-7	

Note

Under complex mapping, the status byte is transferred from the terminal to the controller. It contains a variety of status bits depending on the terminal type involved (such as process data less than/ greater than limit value x, over range, under range etc.)

5.5.4 TwinCAT - Example for Diagnostics with the FC310x Fieldbus Card

The *DiagnoseStation11* bit signals diagnosis for station 11. The diagnostic information is read with the ADS block, and copied into the *strDiagnose* array. Further processing can be done there.

NETID   NetID of the FC310x card
Port   Diagnostic port fixed 200
IDXGRP   Slave address in the high word, and the constant 0xF181 in the low word
IDXOFF   always "0", read entire diagnosis
LEN   276 bytes

Structure of the diagnostic data

Offset	Description
0	Receive Error Counter (WORD): The number of faulty telegrams occurring while communicating with this slave.
2	As from FC310x, version 1.11: Repeat Counter[9] (WORD): The repeat counters (Repeat-Counter) indicate how often it has been necessary to repeat a telegram a given number of times (1..MaxRetryLimit, MaxRetryLimit without answer). Repeat-Counter[0] indicates how often it has been necessary to repeat a telegram for this slave once, Repeat-Counter[1] shows how often a telegram for this slave has had to be repeated twice, and so on. The MaxRetryLimit parameter can be set in the PROFIBUS parameters (value range 0..8).
20	NoAnswer Counter (DWORD): The number of telegrams occurring during communication with this slave that received no answer and which have not been repeated. The first time that a slave fails to answer, the telegram is repeated up to MaxRetryLimit times, but if it does not answer even then, further telegrams are not repeated.
24-31	reserved
32-37	Profibus standard diagnostics
38-275	Profibus standard extended diagnostics (see manufacturer's documentation)

Programming Example

```
VAR
DiagnoseStation11 AT %IX100.0:BOOL;
strDiagnose : ARRAY[0..275] OF BYTE;
fbADSREAD : ADSREAD;
k: INT;
END_VAR
```

```
CASE k OF
 0: IF DiagnoseStation11 THEN fbADSREAD( NETID:= '172.16.3.106.2.1',
         PORT:=200,
         IDXGRP:=16#BF181,
         IDXOFFS:=16#0,
         LEN:=276,
         DESTADDR:=ADR(strDiagnose),
         READ:= TRUE,
         TMOUT:= t#10s, );
      k:=k+1;
    END_IF
 1:    fbADSREAD(READ:= FALSE);
    IF NOT fbADSREAD.busy THEN
      k:=0;
    END_IF
END_CASE
```
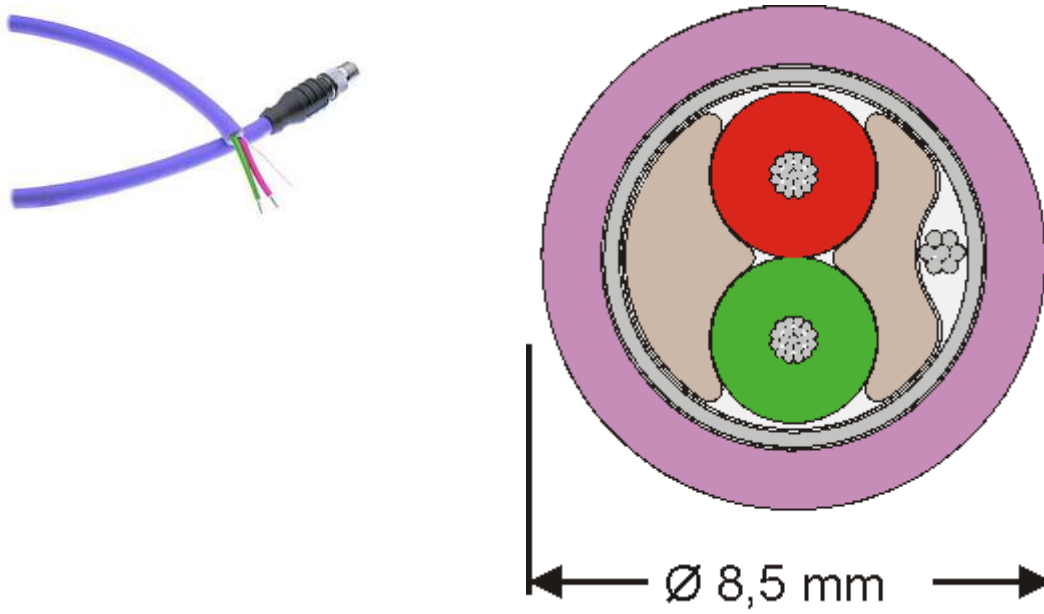
6 Accessories

6.1 PROFIBUS Accessories

These accessories can also be used for other RS485-based fieldbus systems (Modbus, RS485)

PROFIBUS cables

Ordering data

Order desig-nation	Fieldbus ca-ble	Connector	Contacts	Cross-sec-tion	Length	Fig.
ZK1031-6200 -1020	Straight socket, open end	M12 screw-in	8-pin	0.32	2.00	A
ZK1031-6200 -1050	Straight socket, open end	M12 screw-in	8-pin	0.32	5.00	A
ZK1031-6200 -1100	Straight socket, open end	M12 screw-in	8-pin	0.32	10.00	A
ZK1031-6200 -1150	Straight socket, open end	M12 screw-in	8-pin	0.32	15.00	A
ZK1031-6100 -1020	Straight plug, open end	M12 screw-in	8-pin	0.32	2.00	B
ZK1031-6100 -1050	Straight plug, open end	M12 screw-in	8-pin	0.32	5.00	B
ZK1031-6100 -1100	Straight plug, open end	M12 screw-in	8-pin	0.32	10.00	B
ZK1031-6100 -1150	Straight plug, open end	M12 screw-in	8-pin	0.32	15.00	B
ZK1031-6251 -1003	Straight plug, straight socket	M12 screw-in	8-pin	0.32	0.30	A and B
ZK1031-6251 -1005	Straight plug, straight socket	M12 screw-in	8-pin	0.32	0.50	A and B
ZK1031-6251 -1010	Straight plug, straight socket	M12 screw-in	8-pin	0.32	1.00	A and B
ZK1031-6251 -1020	Straight plug, straight socket	M12 screw-in	8-pin	0.32	2.00	A and B
ZK1031-6251 -1050	Straight plug, straight socket	M12 screw-in	8-pin	0.32	5.00	A and B
ZK1031-6251 -1100	Straight plug, straight socket	M12 screw-in	8-pin	0.32	10.00	A and B
ZK1031-6251 -1150	Straight plug, straight socket	M12 screw-in	8-pin	0.32	15.00	A and B

Ø 8,5 mm

Plug

A

M12 ø14,2

11,5

48,5

B

M12 ø14,2

18,2

55,2

Table 19: Pin assignment

1 n.c.
2 green
3 n.c.
4 red
5 shield
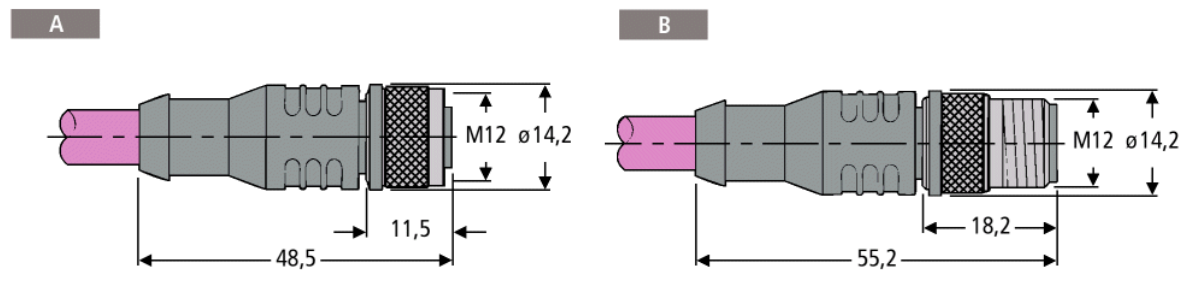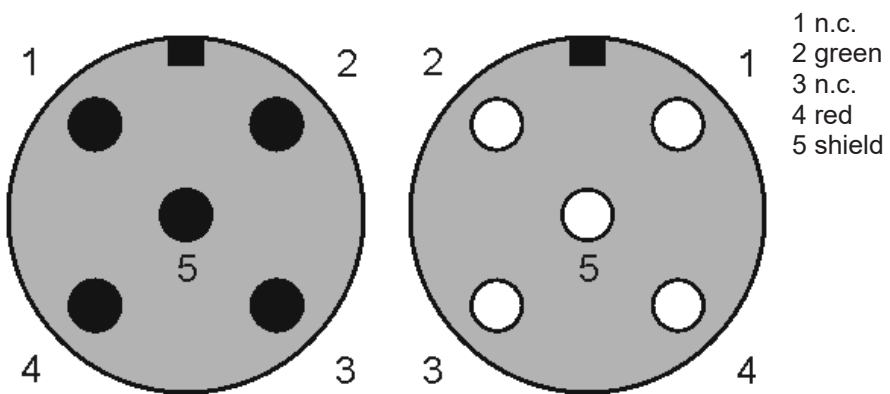
Technical data

Electrical data	
Ratings	300 V, 80°C
Material	Outer cladding PUR, inner insulation polyethylene
Cross-section	0.32 mm²
DC resistance	54.12 Ohm/km
Line capacitance	26.9 pF/m
Nominal impedance	150 Ohm at 1 MHz
Approval	UL approval, AWM, Type 20233, 80°C, 300V; CSA AWM, I/II A/B, 80°C, 300V FT1

PROFIBUS Accessories

Ordering data

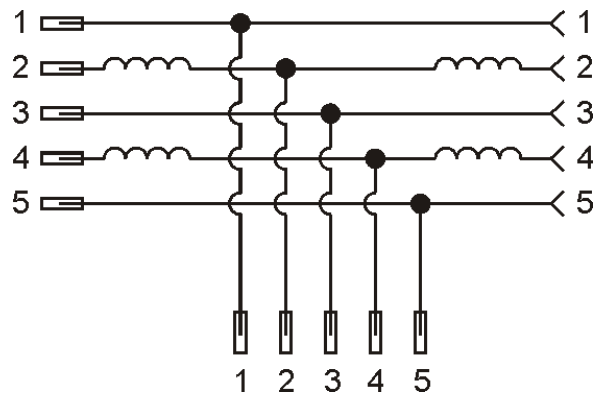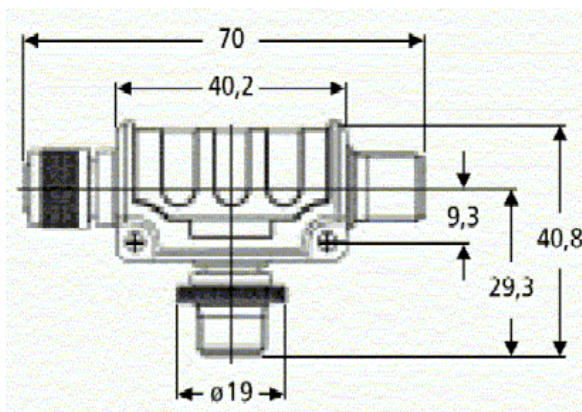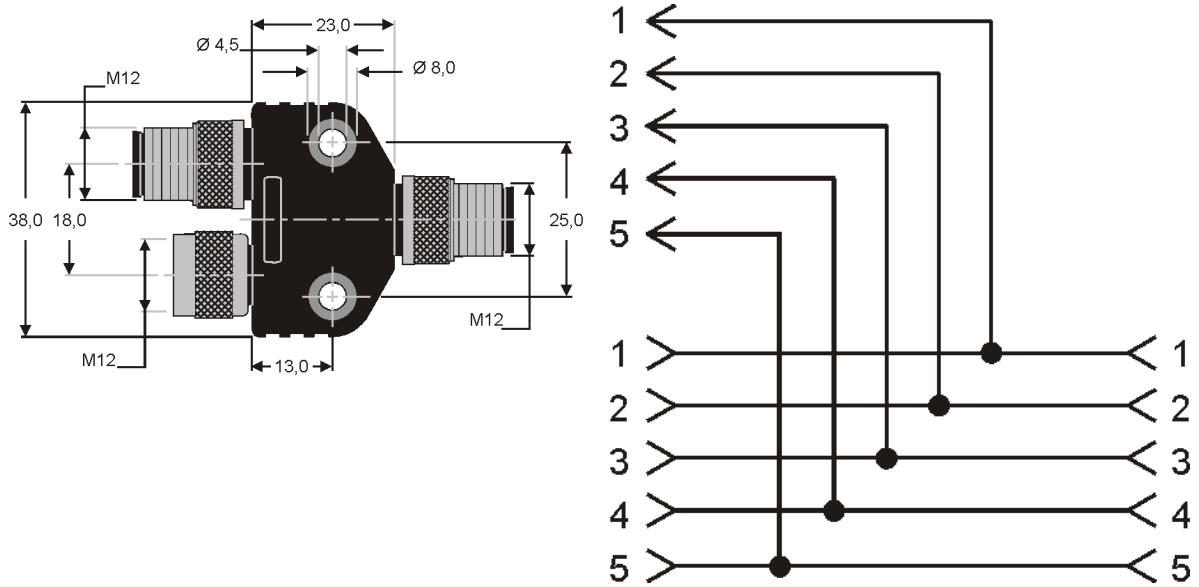| Order designation	Description
ZS1031-2600	T-piece, 12 Mbaud
ZS1000-2600	Y-piece, 12 Mbaud
ZS1000-1610	Terminating resistor (plug)
ZS1000-0620	Coupling for field assembly
ZS1000-0610	Plug for field assembly
ZS1031-6610	Control cabinet lead-through M12, plug connector

Table 20: ZS1031-2600

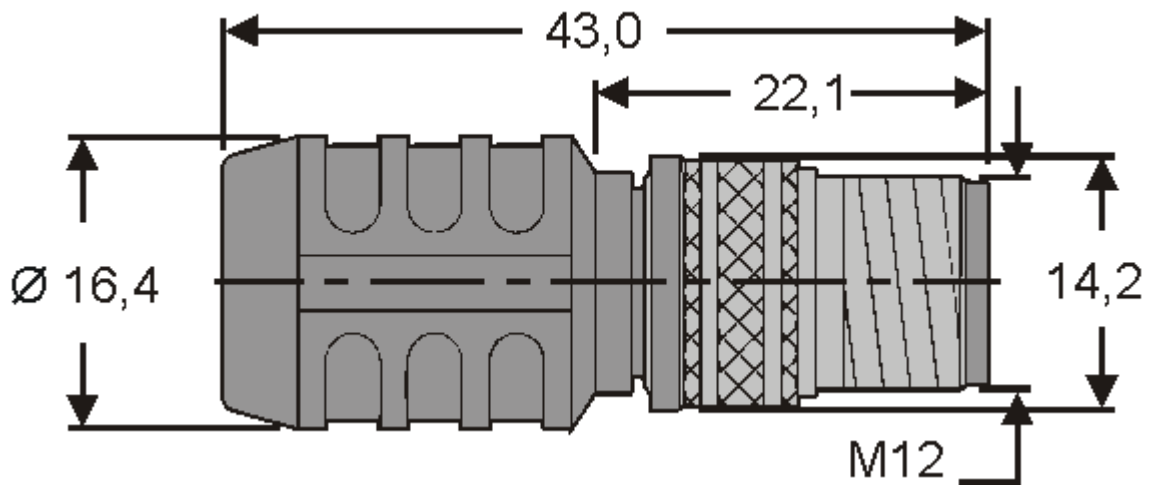*Table 21: ZS1000-2600*

ZS1000-1610

Fig. 1: Add Profibus End.gif (7936 Byte)

BECKHOFF

ZS1031-6610

Version: 1.2.1
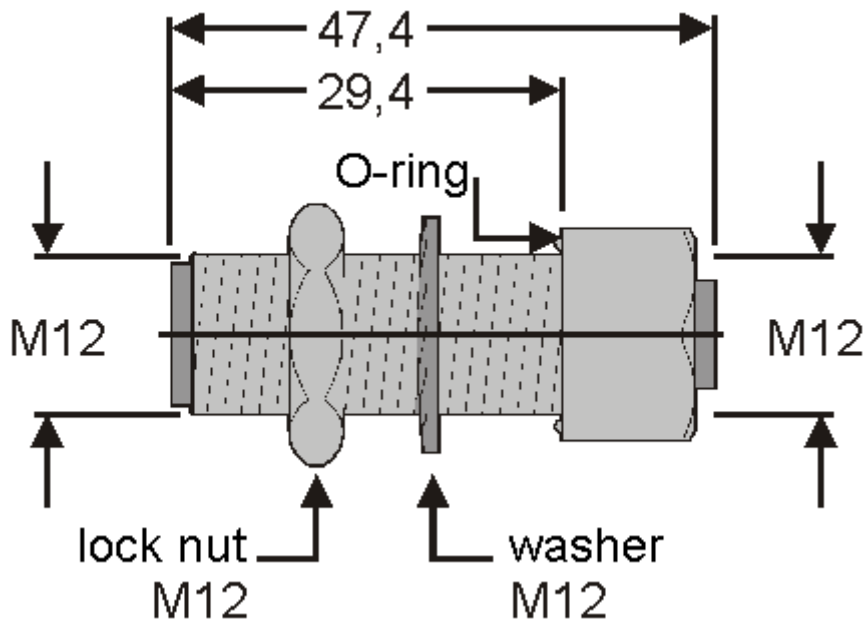
6.2 Fieldbus Box accessories

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

7 Appendix

7.1 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

7.2 Approvals

Approvals

UL E172151

Conformity mark

CE

Type of protection

IP65/66/67 in accordance with EN60529

7.3   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)

7.4 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
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