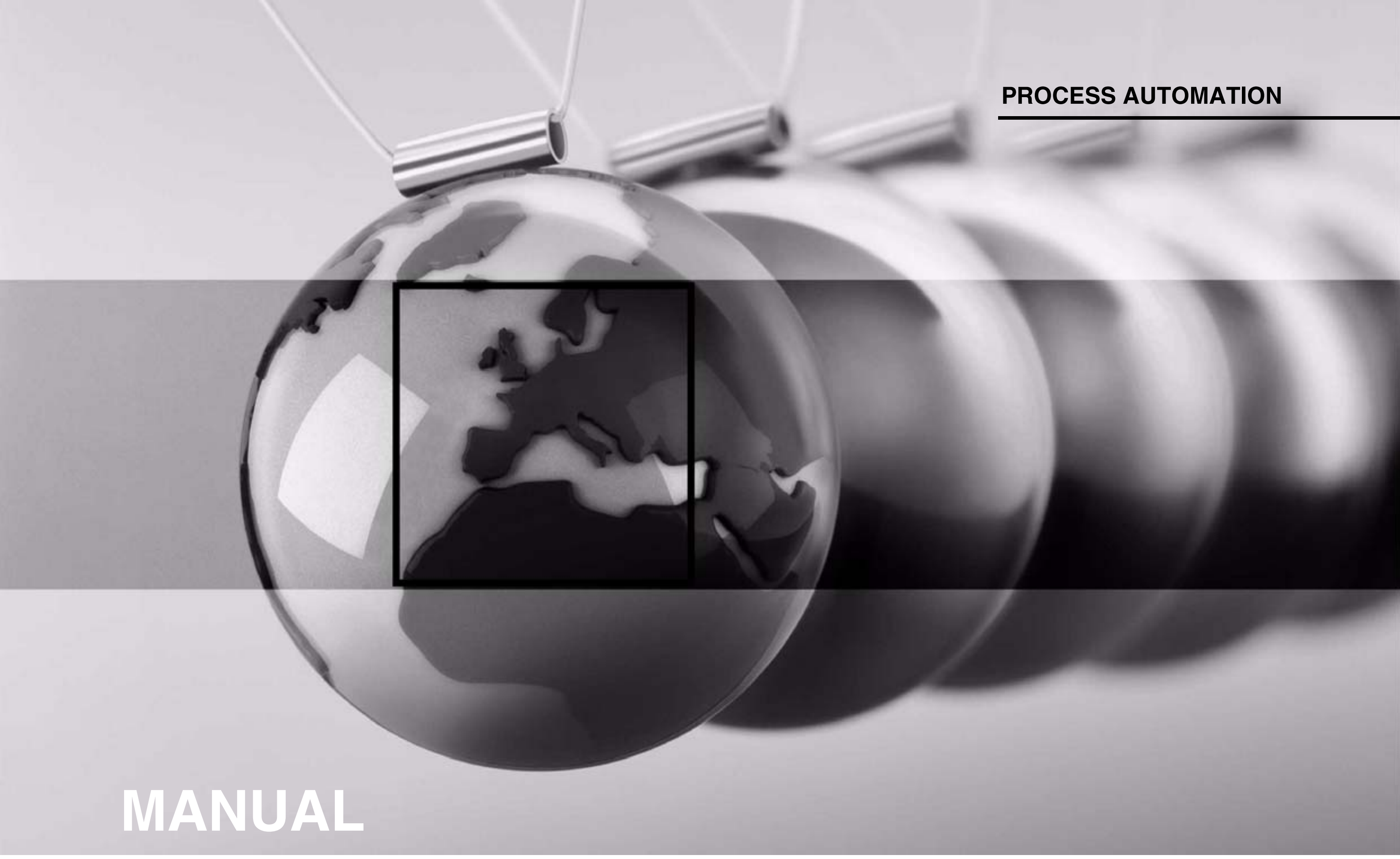
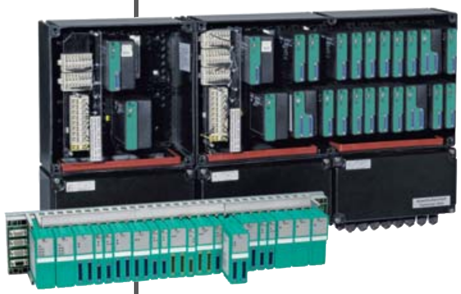


PROCESS AUTOMATION

MANUAL

PROFIBUS COM UNIT

LB 8105/FB 8205
DTM FOR FDT 1.2



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PROTECTING YOUR PROCESS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

1 Safety

1.1 General

The operator of the system is responsible in terms of planning, mounting, commissioning, operating and maintenance.

Installation and commissioning of all devices must be performed by a trained professional only.

Protection of operating personnel and the system is not ensured if the product is not used in accordance with its intended purpose.

Laws and regulations applicable to the usage or planned purpose of usage must be observed. Devices are only approved for proper usage in accordance with intended purpose. Improper handling will result in voiding of any warrantee or manufacturer's responsibility.

The Declaration of Conformity, Certificate of Compliance, Statement of Conformity, EC-type-examination certificate and data sheets are an integral part of this document.

The data sheet contains the electrical data of the Declaration of Conformity, the Certificate of Compliance and the EC-type-examination certificate.

The documents mentioned are available from http://www.pepperl-fuchs.com or contact your local Pepperl+Fuchs representative.

1.2 Intended use

The DTM software described in this manual has been developed according to FDT 1.2 specifications and is designed exclusively for configuring a Pepperl+Fuchs LB/FB Remote I/O system in combination with a Profibus class 1 or class 2 master.

1.3 Symbols used

This document contains information that you must read for your own personal safety and to avoid property damage. The warning signs are displayed in descending order depending on the hazard category, as follows:

Safety-relevant symbols

Danger!
This symbol indicates a warning about a possible danger.

In the event the warning is ignored, the consequences may range from personal injury to death.

Warning!
This symbol indicates a warning about a possible fault or danger.

In the event the warning is ignored, the consequences may course personal injury or heaviest property damage.

Caution!
This symbol warns of a possible fault.

Failure to observe the instructions given in this warning may result in the devices and any connected facilities or systems develop a fault or fail completely.

Informative symbols

Note!

This symbol brings important information to your attention.

Action

This symbol marks an acting paragraph.

1.4 Declaration of Conformity

All products have been developed and manufactured taking into consideration applicable European standards and regulations.

Note!

A Declaration of Conformity can be requested from the manufacturer.

The manufacturer of this product, Pepperl+Fuchs GmbH in 68307 Mannheim, Germany, has a certified quality assurance system in conformity with ISO 9001.

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ISO9001

1.5 LB/FB hardware

Read the LB/FB hardware manuals before using this manual to configure and commission the Remote I/O station.

Pay particular attention to the chapter on safety and all other parts of the LB/FB hardware manuals that refer to the safe area.

1.6 Profibus restart after certain procedures

Modifications to some Com Unit/I/O module device parameters and to the slot configuration change the data structure of the Profibus data telegram. These modifications cause the Profibus to restart automatically and cannot be changed online (active connection with the device).
If your system supports HCiR, the parameters below can be changed offline and activated at a later time when the system is operative.
If the system does not support HCiR, we recommend setting the following parameters to the correct values before commissioning the Remote I/O station if possible, to prevent the Profibus from restarting while the system is operating and to avoid functional interruptions:

Com Unit parameters

- **Transmit module status** parameter
- **Transmit command/status register** parameter
- **Offset module diagnostics** parameter

I/O module parameters

- Modify the operating mode of I/O module 1x03 (**Measuring method** parameter)
- Modify the number of HART auxiliary variables in the I/O module 3x02 (**Measuring method** parameter)

2 Quick start

This chapter contains brief instructions for quick-starting your Remote I/O station.

However, we recommend reading the detailed descriptions in these instructions so that you gain a better understanding of Com Units, I/O modules and configurations.

2.1 Bus connection

2.1.1 Bus – electrical test of connections

Note!

Please refer to the relevant literature to obtain more detailed information.

The bus must have **exactly 2** bus terminations per segment, one at the start and one at the end. A segment usually starts at the master, while the last Remote I/O station is the end of the segment. All Remote I/O stations on the bus are slaves.

Example(view Figure 2.1 on page 14): one line with 1 master, 4 slaves, one fiber optic link, 1 repeater (R), 3 segments, and 6 bus terminations (T): Master (T) – Slave (T) – OLM – fiber optic link – OLM (T) – Slave – (T) Repeater (T) – Slave – (T) Slave.

Note!

A new copper segment also starts or ends at a repeater or OLM (Optical Link Module = fiber optic link)

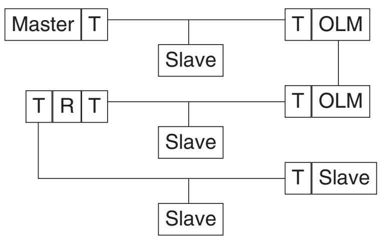

Figure 2.1: Example: bus segments with bus termination

T = bus termination
OLM = optical link module
R = repeater

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Testing the physical connection to the end of the segment

Tip

Perform all measurements from the control room!

If you do not have a multimeter available, hold an LED across B (+) (pin 8 on the bus connector) and A (-) (pin 3 on the bus connector). It should light up.

1. Remove the bus connector from the master (view Figure 2.2 on page 16).
2. Disable the bus termination on the bus connector (beginning of the bus).
3. Measure the voltage across A (pin 3) and B (pin 8) on the bus connector.

   There should be a voltage of U = 220 Ω / (220 Ω + 2 * 390 Ω) * 5 V = 1.1 V across A and B. This voltage exists because of the bus termination at the field end.
   If a voltage of 1.1 V is not present, then one of these situations may be present: there is no bus termination connected at the end of the bus, the cable is faulty, or there is no termination voltage applied to the Remote I/O station.
4. Measure the current between A (pin 3) and B (pin 8) on the bus connector.

   The current between A and B should measure I = 5 V / (2 * 390 Ω) ~ 6.4 mA.
   If the current is noticeably higher (by a factor of 2 or more), the bus is terminated with more than one termination.
   If the current equals ~0 mA, then one of these situations may exist: no bus termination is connected, the cable is faulty, or the termination voltage is not present. In this case, the resistance between A and B should measure 220 Ω.
   If measurements show no current and no resistance, then either the termination at the end of the bus is missing or the cable is faulty.
5. Enable the bus termination on the bus connector of the master.
6. Plug the bus connector back into the master.

Danger!
Risk of explosion

Measurements at the terminals of the slaves in Zone 1 are only permitted when there is no risk of explosion (hot work permit).

Testing the physical connection to the Remote I/O station

1. Remove the bus connector from the master (view Figure 2.2 on page 16).
2. Disable the bus termination at the bus connector (beginning of the bus).
3. Measure the voltage across A and B at the bus connection to each Remote I/O station.

   A voltage of U = 1.1 V should be present across A and B at every Remote I/O station.
4. Enable the bus termination on the bus connector of the master again.
5. Plug the bus connector back into the master.

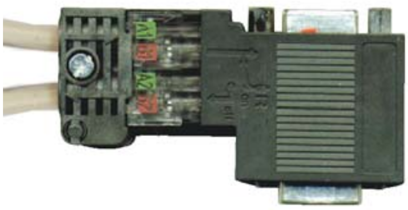

Figure 2.2: Bus connector with built-in switchable bus termination

2.1.2 Three steps for data transfer

Note!

The following DP diagnostics (DP diagnosis, etc.) are defined in the Profibus specification and user access is enabled via modern master modules. If not, the diagnostics can be obtained using a Profibus analyzer.

The bus data transfer procedure

Prerequisite: The bus must have successfully passed the electrical test (see chapter 2.1.1).

1. Make sure that the slave address is identical for both the master and slave.

   The slave can be activated via the bus (DP diagnostics station_non_existent == 0).
2. Make sure that the Profibus ID in the slave is the same as the ID in the GSD file.

   The slave accepts the parameters of the master (DP diagnostic prm_fault == 0).
3. Make sure that the HW Config (the I/O module layout) in the master is the same as the hardware configuration in the slave.
   Caution: On I/O modules 1x03 and 3x02, the data volume depends on the **Measuring method** parameter.
   Do not configure empty I/O modules at the end of the Remote I/O station. If this I/O module is not the last module in the station, one slot must be kept free after a dual-width module.
   The status/command area and the module status area change the start number for the module slot numbering.

   The slave accepts the configuration of the master (DP diagnostic cfg_fault == 0).

2.1.3 Control system-dependent parameterization

- "Suppress clear" for PCS7 = 1, otherwise = 0.
- "Redundancy" for ABB (symphony) = line redundancy, otherwise = application redundancy.
- Timeout for outputs: at least 10 times the bus cycle time. The Profibus watchdog time is a good alternative to the bus cycle time; the watchdog time is usually calculated automatically by the control system.

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2.2 Profibus speed

The following information has been taken from the literature. More detailed information can be ordered from the Profibus User Organization (PNO).

The reaction time of a Profibus system basically depends on the following factors:

- the reaction time in which a slave can respond,
- the selected transmission rate (baud rate),
- the Min_Slave_Interval,
- the agreed net data length.

The following simplified example is good for making estimates

1 master and 5 slaves are connected via the Profibus DP. 10 bytes of output data and 20 bytes of input data are to be transmitted per slave. The transmission rate is 1.5 Mbaud.
Therefore: 1 bit at 1.5 Mbaud = 1 / 1.5 Mbit/sec = 0.67 μs = 670 ns.
1 character is made up of 11 bits (1 start bit, 8 data bits, 1 parity bit, and 1 stop bit, see illustration below). Therefore, 1 character requires 11 x 670 ns = 7.33 μs.
The minimum interval for one information cycle results from the addition of the bus times and the telegram header.
TMC = 2 x length header (bytes) x 11 bits + TSDR + TSYN + TIDI (see the illustrations below).
In the data exchange, the header comprises 9 bytes. The bus time-out times for the synchronization are assumed to be TSYN = 33 bits and TIDI = 36 bits (at 1.5 Mbaud). The running times of the signals at the bus are negligible. A typical value for an ASIC is TSDR = 30 bits.
Therefore: TMC / bit = 2 x 9 x 11 + 30 + 33 + 36 = 300 or 300 x 670 ns = 201 μs.
This means that the approximate time for an information cycle is: 201 μs + quantity of net data (e.g. 10 output bytes + 20 input bytes).
201 μs + 30 x 7.33 μs = 420.9 μs per slave or approximately 2.1 ms for 5 slave stations.

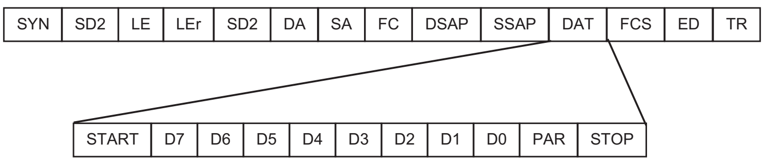

Figure 2.3: Structure of the Profibus telegram

SYN	Bus idle state	**DAT**	Data bits
SD2	Start delimiter 2	**START**	Start bit
LE	Byte length	**D7 ... D0**	Data bits
LEr	Byte length repeated	**PAR**	Parity bit
DA	Destination address	**STOP**	Stop bit
SA	Source address	**FCS**	Checksum
FC	Function code	**ED**	End delimiter
DSAP	Destination services starting point	**TR**	Minimum delay (8 bit timing)
SSAP	Source services starting point		

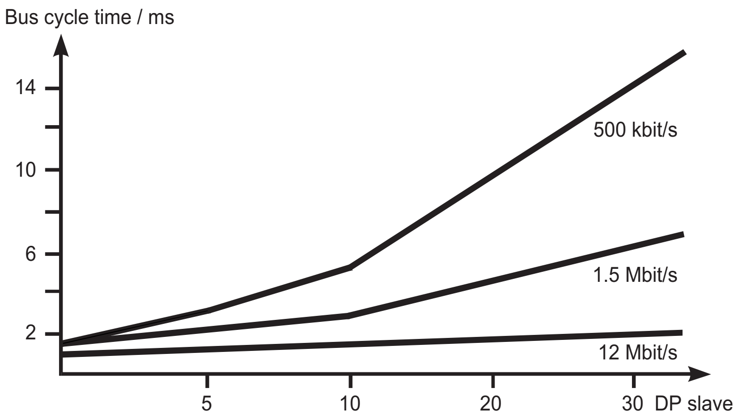

Figure 2.4: Bus cycle time for a DP Mono Master System Profibus

3 Introduction

3.1 Overview Remote I/O

This manual contains information on the configuration of Remote I/O stations. The following provides a general overview of the P+F Remote I/O system.

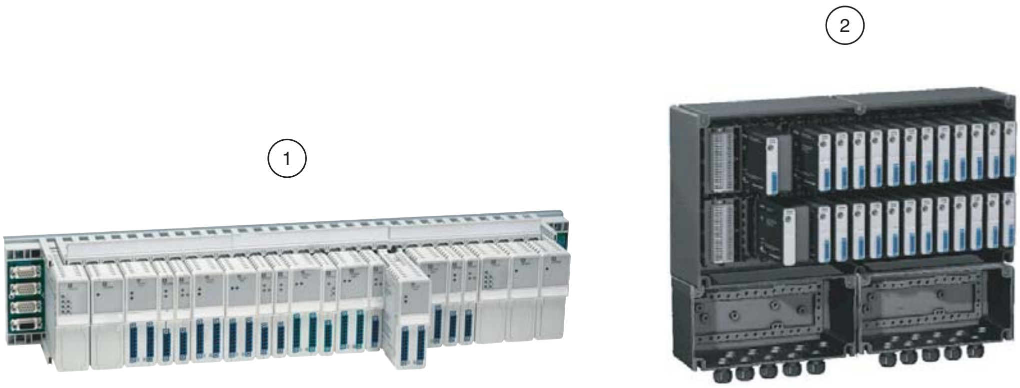

Figure 3.1: Example for LB/FB Remote I/O stations

1 LB Remote I/O station for the safe area and Zone 2

2 FB Remote I/O station for Zone 1

System concept

The system can be adapted to the plant structure. The ability to adapt is based on a flexible modular structure and a wide product spectrum.
The system architecture is determined by the number of Remote I/O stations on each bus line. The Profibus standard states that a bus line without repeaters may only contain 31 Remote I/O stations and a bus line with repeaters up to 125 Remote I/O stations.
Up to 48 I/O modules are available for each Remote I/O station, which corresponds to 80 analog or 184 digital channels (or a mixture of the two).
Specification RS485 states that the maximum physical expansion of the bus line is 1200 m at 93.75 kbaud. Even long distances can be bridged using repeaters or fiber optic couplers. The Profibus allows only limited use of branch lines or use in combination with repeaters. P+F Remote I/O stations do not require barriers, even for ZONE 1, because a connection with increased safety is used. Refer to the hardware manuals for the LB/FB Remote I/O for more information on bus lines.

Compatibility

When developing new installations, P+F always takes into consideration compatibility with existing equipment. In many cases, a software update of the Com Unit is all that is needed to make new functions work. Occasionally the Com Unit will need to be replaced in order to accommodate new features.
Currently available modules are listed elsewhere with part numbers.
Since 2001, new module enclosures and new backplanes with improved mechanical

characteristics have been provided for all LB I/O modules. The new LB I/O modules are compatible with the LB backplanes in existing plants. The new backplanes have their own order code and can only be populated with Com Units, I/O modules, and power supplies housed in the new enclosure. For details, please refer to the manuals for the modules and backplanes.

Failure strategy
Appropriate failure strategies must be implemented to guarantee the functional reliability of the plant, which requires interaction between the process control system and the Remote I/O stations.
The failure characteristics of the Remote I/O stations can be adjusted separately for each channel. The failure of an I/O module or channel is identified and signaled to the control. The start-up characteristics following a fault are essentially defined by the master (PCS).

Available I/O modules
The "x" in the following I/O module names represents different options:

- Digital input 1x01, 2-channel,
- Digital input 1x02, 3-channel,
- Frequency input 1x03, 1-channel,
- Digital input LB 1007, 7-channel (depending on the firmware version of the Com Unit),
- Digital input 1x08, 8-channel,
- Digital input LB 1014 and LB 1015, 15-channel (depending on the firmware version of the Com Unit),
- Digital output 2xxx,
- Analog input 3x01,
- HART analog input 3x02 and 3x03,
- HART analog input 3x04 and 3x05, 4-channel,
- Analog output 4x01,
- HART analog output 4x02,
- HART analog output 4x04 and 4x05, 4-channel,
- Temperature input 5x01 (Pt100),
- Temperature input 5x02 (thermocouple),
- Temperature input 5x04 4-channel (Pt100, Ni100),
- Temperature input 5x05, 4-channel (thermocouple, mV),
- Voltage input 5x06, 1-channel,
- Relay output 6x01, 2-channel,
- Relay output 6x05, 4-channel,
- Relay output 6x06, 8-channel,
- Digital output 6x08, 8-channel,
- Digital output 6x1x, 4-channel,

Diagnostics
Status diagnostics are reported to the higher level system via the system bus. An additional query via a service bus that is independent of the primary bus is also possible.
Interference signals are mostly filtered out. However, a state-of-the-art screening concept should still be applied. Some I/O modules have adjustable filter functions.
The following integral monitoring functions are available:

- System bus monitoring,
- Internal data communication monitoring,
- I/O module self-monitoring,
- Line fault detection of field signals (depending on module),
- Defined control direction in the event of a fault (depending on the Com Unit);
- Outputs are equipped with a watchdog function.

Performance of the I/O modules
P+F offers I/O modules with different channel characteristics to maximize system availability and reduce cost pressure. The different I/O modules can be combined within a Remote I/O station in any configuration.
High-availability, single-width I/O modules (1 or 2-channel) or
compact, dual-width I/O modules (8-channel (digital) / 4-channel (analog)) are available for selection.
15-channel, dual-width digital inputs are also available for Com Unit LB 8108.

Galvanic isolation
The channels on single or dual-channel, high-availability I/O modules are galvanically isolated from one another and from the internal system bus. The channels on all other I/O modules are also galvanically isolated from the internal system bus, but are not isolated from one another.

Configuration tasks
The I/O modules have neither switches nor potentiometers. When an I/O module is replaced, the new module automatically adopts the configuration of the previous module (provided the same type of module is used). Parameterization takes place once during commissioning and the parameters are stored in the non-volatile memory of the Com Unit. Reverse polarity and short circuit protection are available as well as adjustable failure characteristics. The effective direction of digital inputs and outputs can be parameterized depending on the model.

Output disable function
The electronic circuit and the load circuit of relay outputs are supplied separately. Similar to valves, an I/O module with bus-independent output disable input ensures that the position feedback is still received when the power to the valve is disconnected.

Extension/Replacement
I/O modules can be plugged in or unplugged during operation while connected to the power supply (hot swapping). Extending Remote I/O stations while the system is operating is only possible using process control systems that support HCiR (Hot Configuration in Run). If the control system does not support HCiR, a P+F UniCom Com Unit (LB/FB 8x09) can be used to extend the station while the system is operating.

Bus system
The fieldbus system fulfills the following criteria:

- Physical properties as per RS485 standard,
- Topology: Line structure,
- Nodes: 32 without repeaters, 126 with repeaters,
- Max. length expansion per bus segment: 1200 m depending on bus speed,
- Interface profile (RS485),
- Transmitting medium (twisted pair, fiber optic).

Protocol features

- Bus access as per Profibus DP standard (cyclic) or DPV1 standard (acyclic),
- Transfer rate up to 1.5 Mbaud
- Data security as per Profibus standard,
- Node communication according to the master/slave principle.

Availability
P+F Remote I/O offers:

- Redundancy (system-dependent)
- Operational reliability (adjustable failure characteristics)
- Individual availability (replacement channel by channel)
- Hot swapping
- Hot Configuration in Run (HCiR, system-dependent)
- Adjustable start-up characteristics following a power failure in conjunction with the master (must be defined in the PCS).

Com Unit
The Com Unit converts the protocol of the system bus integrated in the backplane into the protocol of the higher-level bus system. The scope of application of the Remote I/O systems is largely determined by the fieldbus system. For this reason, a connection to currently the most frequent fieldbus systems was established with support from the different Com Unit types.

Redundancy
Redundant communication with a suitable field bus system is possible, if the bus system allows. Redundancy is being successfully applied with different control systems. The high level of availability is achieved internally by means of segmenting and with the large number of selectors used for connecting the modules to the Com Unit.

Software

The quality of the system software is largely determined by how well it integrates with the engineering tools of higher-level control systems. The remote IO stations can then be configured as part of the overall system using a common user interface. This avoids the need to duplicate data entry and data storage.
The handling requirements for the software components and the resources required are low. Multilingual versions of the software are available for international use (German/English as standard). Software upgrades ensure compatibility with existing systems of the same type.
P+F offers a Device Type Manager (DTM) for integrating the field device concept (FDT) based on PNO guidelines into the system. Alternatively, you can use EDDs for Siemens' PDM tool. Large-scale engineering plants running systems from all major system manufacturers can be operated successfully on this principle.

Configuration/Parameterization

The Com Units and I/O modules can be configured via the central engineering station. Device names and installation positions can be stored for the components and TAG names can be stored for the input and output signals. The system configuration is subject to integral plausibility checks.
Functions for importing / exporting data enable the transfer of the configuration to other process control systems without significant changes being made. GSD files make component selection easier.

HART communication

Intelligent field devices can be configured and parameterized via the process control system. HART field devices can be parameterized independently of the bus system using approved handhelds connected to terminals equipped with a built-in 250 Ω communication resistor. With HART communication on the Profibus supported by FDT and DPV1, standard commercial software tools can be used for remote control via the bus.

Monitoring

The status of the system components and the signal state values of the field devices can be viewed online during operation. The installation of a separate service bus that allows the diagnosis of errors independently of the process control system is recommended here. However, the service bus is not absolutely essential for obtaining a fully operational system.

Simulation

Input and output values can be simulated for test functions and commissioning purposes.

Interfaces and data exchange

The exchange of data with other engineering tools via standard interfaces prevents redundant engineering (e.g. the import/export of ASCII files (XML document)).

3.2 Remote I/O with Profibus DPV1

3.2.1 Integration of master and slave

The growing number of Profibus installations has led to the full integration of PCS and Remote I/O systems. The configuration tool of the master now also allows the direct configuration and parameterization of slave devices. All the setting parameters are stored in a joint database from the engineering system and can be stored safely in the Com Unit of the Remote I/O stations by downloading them via the Profibus DPV1.

3.2.2 FDT as a universal software tool for process peripherals

System houses and Remote I/O manufacturers headed by the Profibus User Organization (PNO) and the ZVEI have developed the field device tool (FDT) concept, similar to a printer driver for a PC, creating a tool for the integration of device-specific configuration tools into a FDT base application, which can be implemented either in the PCS or as a "standalone" application.

The information exchanged between the master and slave, which was already standardized in the device description files to a limited extent, has now been extended in the FDT concept to include the Device Type Manager (DTM). DTMs are device drivers, similar to printer drivers on a PC. DTMs are designed for the standardized, manufacturer-independent integration of all field device functions into the engineering tool of the master. A DTM describes all features of the slave so that the master can use these features. The illustration below shows the structure of the FDT concept combined with different software components.

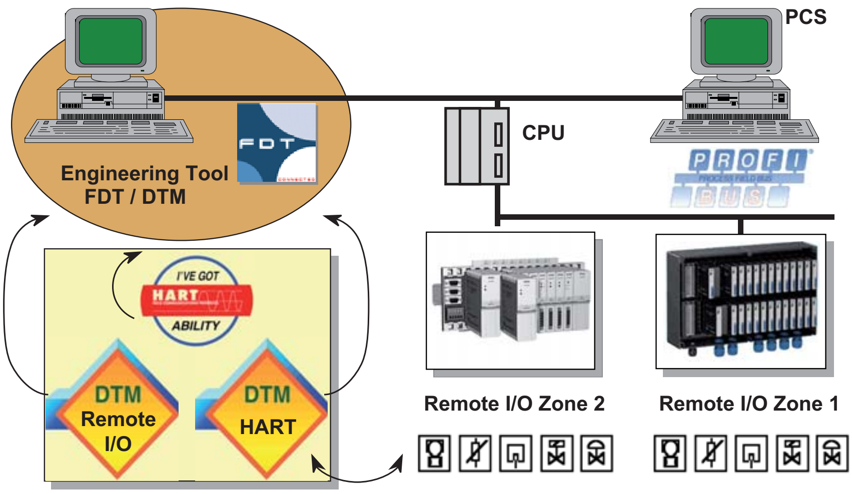

Figure 3.2: FDT concept in combination with Remote I/O

P+F supports FDT with a DTM for the P+F LB/FB Remote I/O system and with a DTM for implementing HART protocols via Profibus DPV1. By the same token, the manufacturers of HART field devices provide DTMs to operate the signal converters and actuators they manufacture.
All manufacturers observe these recognized regulations when describing their products so that users have access to all device features and not just to a few general parameters. As a result, all field devices are accessible through DTMs, from intelligent sensors and actuators to Remote I/O systems.

When using the different products, the user can quickly adapt to the respective operating system because the configuration software is almost self-explanatory due to the recognition effect, as with Microsoft® Windows®.
The following information is exchanged between the master and the slave:

- Device type,
- Parameters,
- Configuring HART communication
- Calibration and data parameters,
- Configuration data,
- Diagnostic data.

The concept also includes a plausibility check of the parameters. All data is managed in the FDT base application (e.g. PCS engineering software) throughout all the planning and commissioning phases as well as during operation and is also available in the data base for the other software tools within the system. As a result, the different tools for parameterizing the master and slave are replaced with a common software tool. The previously used Profibus device description file is still kept, but is now only integrated by users who cannot use a DPV1 master. The new device description file of the DPV1 is recognized automatically by the FDT.

3.2.3 Compatibility of Profibus DP and Profibus DPV1

The FDT concept was taken into consideration during the development of the Profibus (DPV1).
Profibus DPV1, which has some important new features, is fully compatible with the Profibus DP. This ensures that DPV1 field stations function with an existing Profibus DP in the same way as an existing slave works with a DPV1 master. However, the user can only make use of all the advantages of the DPV1 concept if both master and slave have the DPV1 features.

In addition to the synchronous cyclic data traffic of the Profibus DP, the Profibus DPV1 also provides asynchronous services that allow the exchange of parameter and configuration data between master and slave. Whereas cyclic telegrams belonging to one participant are always of the same structure and length, the data exchange of the DPV1 is characterized by a fixed buffer area into which data telegrams that are imported for the parameterization and configuration can be inserted, when required (see illustration below).

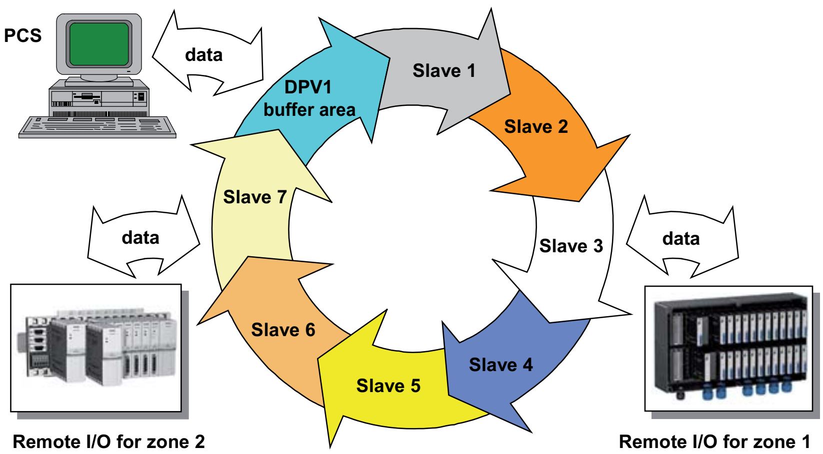

Figure 3.3: Cyclic data transfer to the Profibus

3.2.4 HART communication via Profibus DPV1

The new features of the Profibus DPV1 enable the transmission of HART telegrams. In this way, existing field devices can also be operated using the HART protocol depending on which control system functions are supported. This functionality was previously reserved for the Profibus PA.

P+F Com Units accept all types of HART data. As a result, device-specific information on all HART devices can be accessed via the Profibus, provided the manufacturer has released your HART-DTM for the FDT.

3.2.5 Remote I/O for Profibus DPV1

Hardware
For users of P+F LB/FB Remote I/O systems it is easy to use the advantages of the Profibus DPV1. All existing I/O modules can still be used, only the Com Unit needs to be replaced to enable the new function on the P+F slaves.
The main catalog contains a list of technical data for all I/O modules and system components.

Software
The system house integrates the DTM software for P+F LB/FB Remote I/O systems into the engineering tool of the master using the FDT concept. This DTM software matches the firmware in the Com Unit.
The user receives this manual and a CD ROM with the DPV1 Com Units. The manual and CD contain descriptions of the features of the Remote I/O systems as well as instructions on how to use the configuration tools.
Although the settings are made via the master, the extremely useful option of using the service bus is still available. During commissioning, the user can already carry out loop tests using this second bus while the control system is still being assembled. Further options provided by the service bus include

- Assistance during commissioning,
- Simulation of inputs and outputs,
- Fault analysis during operation,
- Remote diagnosis via modem using PC-ANYWHERE,
- Software updates.

3.2.6 Differences between Remote I/O systems using Profibus DP and DPV1

The main differences between Remote I/O systems for Profibus DP and DPV1 are summarized below.

- In P+F Remote I/O systems, the only hardware difference between Profibus DP und DPV1 is the Com Unit. All other components remain unchanged.
- In addition to the cyclic data transfer services, the DPV1 protocol software also provides acyclic services for parameterizing and configuring the slave devices using the engineering tools in the master.
- In theory, the Profibus allows parameter changes during active data exchanges (e.g. via DPV1 or SetPrm) providing these changes do not affect the Profibus configuration. How these changes are made depends on the manufacturer of the PLC or process control system.
- The P+F LB/FB Remote I/O system offers numerous diagnostic options and optionally provides cyclic status information from the Com Unit and the I/O modules. The status information from the Com Unit includes exact details of the operating mode and the reason for the fault. The module status indicates which I/O module is not working correctly (1 bit per I/O module). Apart from cyclic data, the Remote I/O station also provides new event-related diagnostic data (standard DP diagnostics + extended, manufacturer-specific diagnostic data) as soon as the error state or the status of the Remote I/O station changes. Furthermore, the Remote I/O station has diagnostics areas that can be exported using DPV1 read services if required.
- In DP systems, HART communication is only possible via the service bus. In a DPV1 Com Unit, the HART protocol is not transferred via the service bus, but via the Profibus, provided the master supports it. Otherwise, a secondary master is used.
- Depending on the Com Unit, redundancy is possible for P+F Remote I/O systems both in DP and DPV1 applications.
- Analog inputs and outputs can be scaled to the range required by the process control system. On the DP bus, one shared parameter is used to scale all the inputs and another shared parameter all the outputs. The DPV1 Com Unit allows all inputs and outputs to be scaled separately via a channel-specific parameter.
- If a DP Com Unit fails, outputs can be set to zero, 0%, or 100%. In DPV1 systems, any substitute value within the measuring range can be set for each channel.
- In addition to the choice of positive or negative logic, in DPV1 applications there is the option of defining an ON delay and OFF delay for digital inputs.
- DP Com Units allow inputs and outputs to be linked together inside a bus station without intervention from the master. DPV1 systems do not provide this option. The same applies to software tools in DP systems for programming mathematical and logical functions in the Com Units. In DPV1 Com Units this is left to the master.
- DPV1 Com Units are available for the most popular process control systems and have passed system integration tests successfully. P+F Remote I/O systems are used with more than 20 different process control systems and PLC controllers from well-known manufacturers. Hundreds of thousands of I/O modules are in use worldwide.

3.2.7 Features of different Com Units

The table below contains an overview of available Com Units and their features.

Features of different Com Units

LB hardware (Zone 2)	H 8103	H 8105	H 8106	H 8107	H 8108	H 8109
FB hardware (Zone 1)	H 8203	H 8205	H 8206	H 8207		H 8209
Firmware version (*)	4.X	6.X	6.X	7.X	8.X	9.X
Operator interface or DTM for FDT 0.98	4/5/6	6		6		
Operator interface or DTM for FDT 1.2		7	○	○	7	7
Operator interface as Profibus simulator		PACTware			PACTware	PACTware
Service bus required						
Service bus usable	●	●	●	●	●	●
HART via service bus		●	●	●	●	●
HART via Profibus	●	●	●		●	●
HART auxiliary variable, cyclic		○	○	○	○	○
GSD/GSE file	CGV40710	CGV61710	CGV61711		CGV61712	CGV61710
Profibus DP	●		●			
Profibus DPV1	●	●			●	●
Modbus				●		
Redundancy	●	●	●	○	●	●
HCIR (configure during active data exchange, depending on system)	●	●	●	●	●	●
CIR (configure during active data exchange, regardless of system)						●
Time stamp (in combination with master)					●	
1x01, 1x02, 1x03	●	●	●	●	●	●
1x08		●	●	●	●	●
1007, 1014, 1015					●	
2xxx, 2xxx (SIL)	●	●	●	●	●	●
3x01, 3x02, 3x03	●	●	●	●	●	●
3x04, 3x05		●	●	●	●	●
4x01, 4x02, 4x02 (SIL)	●	●	●	●	●	●
4x04, 4x05, 4x05 (SIL)		●	●	●	●	●
4x05 (LFD)		●	●	○	●	●
5x01, 5x02	●	●	●	●	●	●
5x04, 5x05		●	●	●	●	●
5x06	●	●	●	●	●	●
6x01	●	●	●	●	●	●
6x04, 6x05, 6x06, 6x08, 6x08 (SIL)		●	●	●	●	●
6x10 - 6x15		●	●	●	●	●
6x10 - 6x15 (SIL)		●	●	●	●	●
Max. analog channels (depending on configuration)	48	80	80	80	80	24-80
Max. digital channels (depending on configuration)	144	184	184	184	184	96-184
● = fulfilled or compatible; ○ = on request						
(*) The module support sometimes depends on the firmware subversion. X						

Table 3.1: Features of different Com Units

4 Installing configuration software and DTMs

4.1 Introduction to configuration software

Configuration
On control systems that support the FDT concept, you can configure the Remote I/O system directly from the system engineering tool. You can use this manual, apart from the sections on PACTware.
On control systems that do not support FDT, external FDT base applications (e.g. PACTware or Fieldcare) can be used. Slaves are connected via an additional Profibus class 2 master (e.g. FG-300 by Softing, FNL by ComSoft, various Siemens cards). The existing manual describes operating methods that incorporate a class 2 master and the FDT base application PACTware. P+F DTMs are not limited to PACTware, however.
Some control systems use their own drivers to configure P+F Remote I/O components from the operator level within the system and have their own configuration manual. This manual is only of limited relevance in this case. For instance, for Siemens S7 you should use their available PDM specification.

Configuration software
DTM V 7.x has been developed in accordance with the FDT specification V 1.2 and the addendum as well as the FDT style guide V 1.00. This software is used to configure Remote I/O series devices and display measured values and status information for service purposes.

4.2 Hardware and Software Requirements

Your PC or laptop must meet the following (minimum) requirements if you want to install the P+F "DTM Collection Remote I/O System LB/FB".

- Processor with 500 MHz pulse frequency,
- 128 MB RAM (requirements may be higher depending on the complexity of the project),
- 50 MB free hard disk space,
- XGA graphics card,
- Operating systems: Microsoft® Windows® NT 4.0 Service Pack 4 or higher, Windows® 2000 or Windows® XP,
- Microsoft® Internet Explorer Version 6.0 or higher for printing parameter values
- For configuration via Ethernet (Modbus TCP): Network card

Please follow the manufacturer's instructions if you want to install an FDT 1.2 base application and other DTMs (e.g., Modbus TCP communication DTM or device-specific HART DTMs).

PACTware 3.x is compatible with Microsoft® Windows® 2000 and Windows® XP, and requires Microsoft .NET Framework Release 1.1, Service Pack 1. In terms of computer hardware, the requirements for PACTware 3.x are no greater than those of the P+F "DTM Collection Remote IO System LB/FB". However, it does require an additional 50 MB of hard disk space.

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4.3 Installing the Software

This chapter explains how to install configuration software and DTMs onto the computer and in which order. The configuration software and the required DTMs are available for download at www.pepperl-fuchs.com.

Installation Sequence

Installing the required software on your computer involves three steps:

1. First, install the FDT base application in which the DTMs will run (e.g., PACTware). Refer to the description provided by the relevant manufacturer for a list of the steps required.
2. Next, install the communication DTM for the PROFIBUS master module (PROFIBUS class 2 master). Refer to the description provided by the relevant manufacturer for a list of the steps required.
3. Finally, install the Remote I/O DTMs from P+F. The paragraph below outlines the steps required.

Installing the Remote I/O DTM Collection

The Remote I/O DTM collection is suitable both for LB and FB Remote I/O products. You can either install the software from CD-ROM or use the installation package downloaded from the internet.

1. Insert the accompanying CD ROM in the CD/DVD drive. If the Setup does not start automatically, run the file "Setup.exe" from either the CD-ROM
   OR
   from the installation package downloaded from the internet.

   The installation process will now start. The language selection window opens. If a previous version of the software is already installed, the language setting from that version will be used. If you wish to choose a different language for this installation, you should first uninstall the old version.

Figure 4.1: Language selection window

2. Select the required language from the drop-down list.
3. Click **OK** to continue.

   A Welcome window now appears.
4. Click **Next** to continue.

   The **Customer Information** window opens (view Figure 4.2 on page 32).

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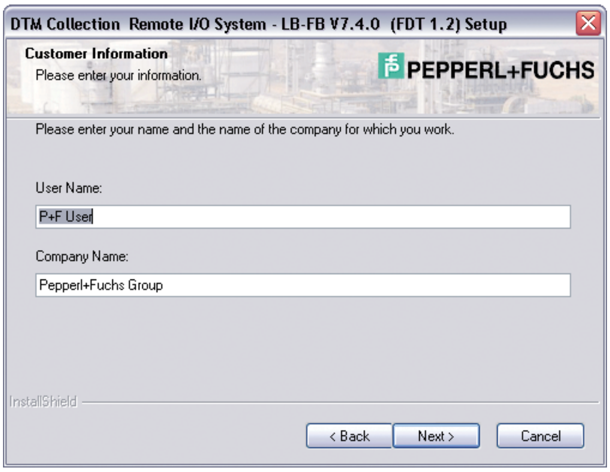

Figure 4.2: User information

5. Enter your name and the name of your company in the appropriate boxes.
6. Click **Next** to continue.

   The **Choose Destination Location** window opens (view Figure 4.3 on page 32).

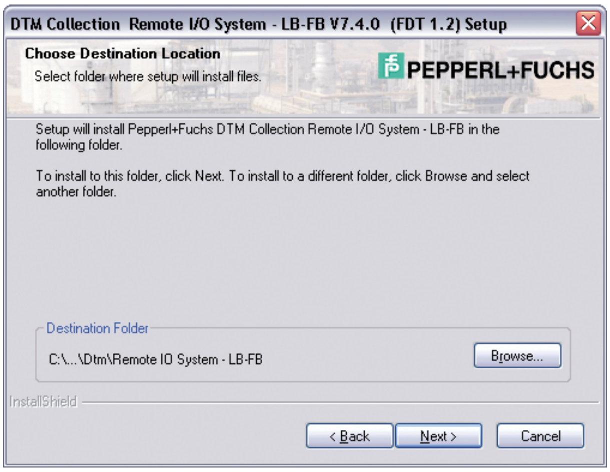

Figure 4.3: Selecting the target path

7. Click **Next** to confirm the default folder.
   Click **Browse** to select a different folder. Select a path and click **OK**.

   The selected path will be used as the destination folder.
8. Click **Next** to continue.

   The **Select Features** window appears. This allows you to select the program modules you want to install.

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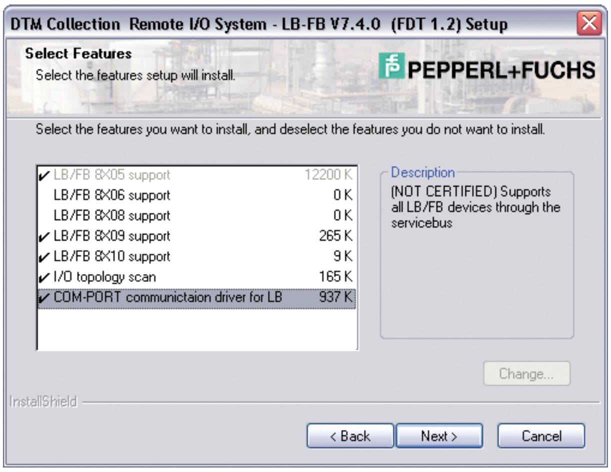

Figure 4.4: Select Features

9. From the list, select the program modules that are to be installed. Click in the empty column to the **left** of the relevant entry (where the checkmarks are). Make sure that the drivers required for the Com Unit in question and the appropriate communication interface are installed.

   Only the program components that are checked will be installed.

10. Click **Next** to continue.

    Installation begins. A message window opens when the installation process is complete.

11. Enable/Disable the check box to display/not display important information in the read-me file.

12. Click **Finish** to conclude the installation.

4.4 User Interface of the FDT Base Application

This manual documents P+F-specific DTMs. The FDT base application PACTware is described using typical examples.

Please refer to the documentation provided by the manufacturer for more detailed information on the user interface of your FDT base application. This documentation also includes information on the general functions available to the FDT base application (e.g., printing device data).

4.5 Updating the DTM catalog

After you have installed the FDT base application and the new DTMs onto the computer, it may be necessary to update the DTM catalog. In PACTware, the DTM catalog is called the "device catalog" and is usually updated automatically when PACTware starts up.
If PACTware does not automatically update the device catalog, proceed as follows.

Updating the device catalog

1. Start PACTware.
2. Select **View > Device catalog** or press the F3 key or click the **Device catalog** icon on the toolbar.

   The **Device catalog** window opens.
3. Click the **Update device catalog** button to update the device catalog (view Figure 4.5 on page 34).

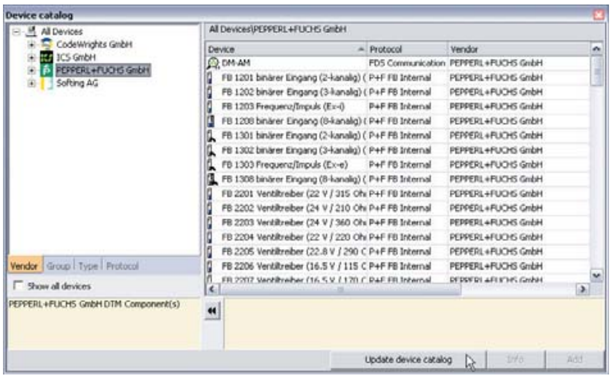

Figure 4.5: Device catalog in PACTware

4. Click **Yes** to confirm the next prompt.

   The program then searches for recently installed DTMs (view Figure 4.6 on page 34). The updated device catalog appears once the search has finished.

Figure 4.6: Search for DTMs in PACTware

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5 Creating a New Project

This section explains how to integrate the remote I/O station into PACTware® and then configure it. It shows you how to create a PACTware project and how to set up the communication link with the field devices.

Note!

For a detailed description of the I/O modules, as well as information on module configuration and measured value monitoring, please refer to the chapter entitled “Configuring I/O modules” (see chapter 7).

Note!

Screenshots of other Com Unit models may be used. In these cases, the parameters of the Com Units are identical and are also valid for the existing Com Units.

5.1 Creating a new project

Creating a new project in PACTware 3.x

Select **File** > **New** or click the **Create new project** icon on the toolbar.

A new, unnamed project appears in the main window. The project initially consists of the entry **Host PC**.

5.2 Communication Link with Remote I/O Station

The communication link between the DTM software and the remote I/O station can be established via the service bus or PROFIBUS (different communication DTMs).
The configuration can also be carried out using either the service bus or PROFIBUS. Whichever of these two types of connection is used, the process of configuring the remote I/O station is virtually identical. With just a few exceptions, the following sections in the manual assume that the connection is via PROFIBUS.

Communication via the Service Bus

By default, the communication DTM for the service bus is contained in the DTM collection "Remote I/O System LB/FB".

Components Required for a Service Bus Connection

- FDT base application (e.g., PACTware),
- DTM collection LB/FB remote I/O,
- Interface converter (RS232-RS485 converter or USB-RS485 converter) + compatible cable harness

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Because the service bus is an RS485 bus, a corresponding converter is required. For uninterrupted communication, we recommend converters approved by P+F (W&T RS232-RS485 or ICP Con i 7561 USB).

Communication via PROFIBUS

A separate PROFIBUS communication DTM is required in order to communicate via PROFIBUS. This DTM can be downloaded from www.pepperl-fuchs.com.

Components Required for a PROFIBUS Connection (Class 2 Master)

- FDT base application (e.g., PACTware),
- DTM collection LB/FB remote I/O,
- Communication DTM,
- PROFIBUS class 2 master + cable harness (e.g., Softing PROFIusb).

Components from different manufacturers are considered for DTM connections via a PROFIBUS class 2 master. Please refer to the documentation provided by the manufacturer for the necessary information.

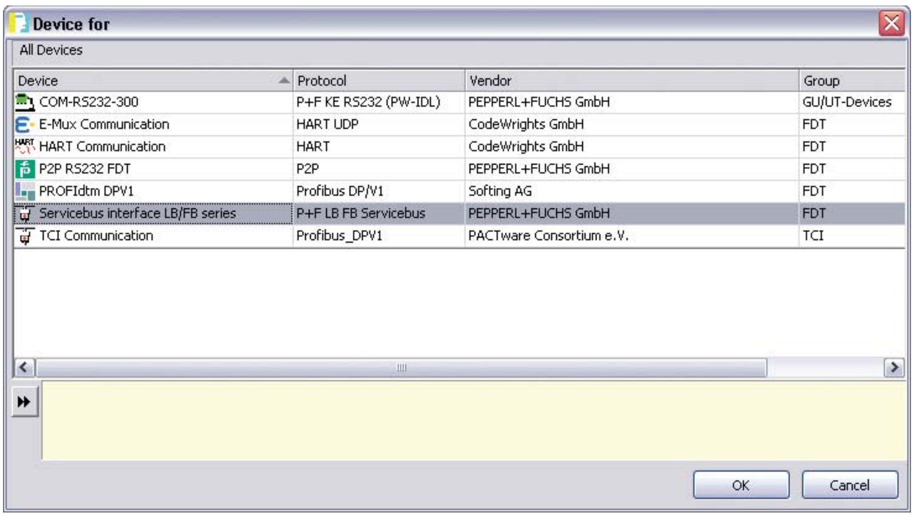
5.2.1 Adding the Communication DTM (Service Bus)

The remote I/O DTM-Collection contains a service bus CommDTM for service bus communication ("Service Bus Interface LB/FB Series"). The CommDTM must be added to the project structure of the FDT base application (e.g., PACTware) as the first DTM, before any other ones.

Adding Communication DTMs

1. Select the entry **Host PC** in the project view.
2. Select **Device** > **Add device** or click the **Add device** icon on the toolbar.

A device selection window opens (view Figure 5.1 on page 36).



Device	Protocol	Vendor	Group
COM-RS232-300	P+F KE RS232 (PW-IDL)	PEPPERL+FUCHS GmbH	GU/UT-Devices
E-Mux Communication	HART UDP	CodeWrights GmbH	FDT
HART Communication	HART	CodeWrights GmbH	FDT
P2P RS232 FDT	P2P	PEPPERL+FUCHS GmbH	FDT
PROFIdtm DPV1	Profibus DP/V1	Softing AG	FDT
Servicebus interface LB/FB series	P+F LB FB Servicebus	PEPPERL+FUCHS GmbH	FDT
TCI Communication	Profibus_DPV1	PACTware Consortium e.V.	TCI

Figure 5.1: Selecting the communication DTM

3. Select the entry **Servicebus interface LB/FB series**.
4. Click **OK**.

   The communication DTM is added and appears in the project structure.
5. As service bus communication is handled by a COM port on the PC, the CommDTM must be allocated a COM port. Click the entry **LB/FB service bus** in the project structure using the right mouse button.
6. In the context menu select **Parameter** > **Parameterization** > **Configure COM port** (view Figure 5.2 on page 37).

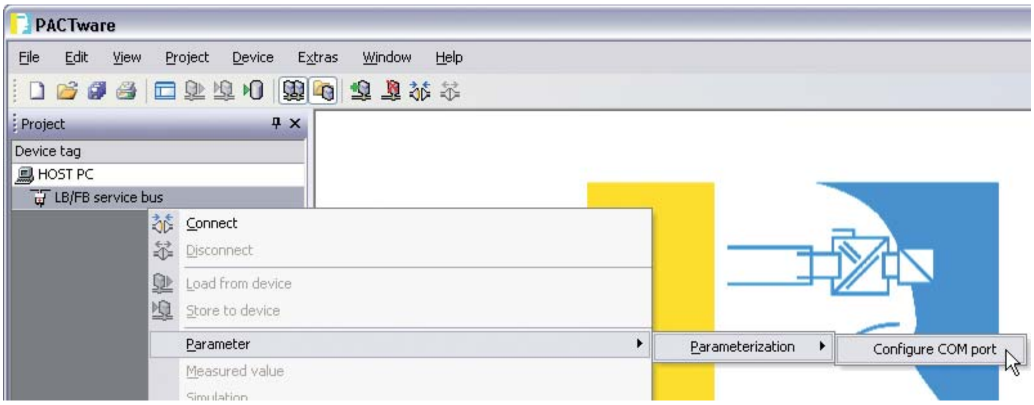


Figure 5.2: Setting the COM port

   The device data window containing the COM port settings opens.
7. Choose the required COM port (view Figure 5.3 on page 37).

Figure 5.3: Setting the COM port

8. Click **OK**

5.2.2 Adding the Communication DTM (Profibus)

If you wish to etablish a connection using the Profibus, you must add a Profibus communication DTM to the project as follows.

Note!

Class 2 Profibus masters are available from various manufacturers. A PROFIdtm manufactured by the company Softing AG is used in the example. Endress&Hauser manufacture their own interface cards.

Adding the communication DTM

The Profibus communication DTM must be installed on the PC before it can be added to the project.

1. Select the entry **Host PC** in the project view.
2. Select **Device data > Add device** or click the **Add device** icon on the toolbar.

A device selection window opens (view Figure 5.4 on page 38).

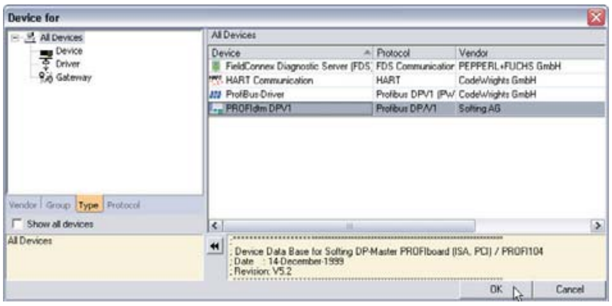


Figure 5.4: Selecting the Profibus master card

3. Select the entry **PROFIdtm DPV1**.
4. Click **OK**.

   The Profibus master card is added and appears in the project structure.

Caution!
Conflicts in the Profibus system

If existing PROFIBUS systems have a parallel coupling, integrate the Profibus master card as a class 2 master.
Use the correct baud rate and make sure that no address conflicts occur.

Modifying Profibus settings

You can adjust numerous settings on the Profibus master card. For a more detailed description of the configuration options, read the instructions/online help from the relevant manufacturer (in this case, Softing AG). To modify the Profibus settings in Pactware, proceed as follows:

1. Click the entry **PROFIdtm DPV1** in the project structure using the right mouse button.

   A context menu opens.
2. Select **Parameterization** in the context menu (view Figure 5.5 on page 39).

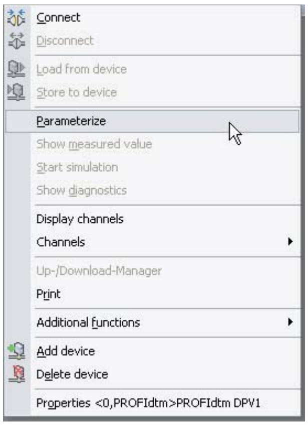


Figure 5.5: Opening the Profibus context menu

The device data window containing the bus parameters opens.

3. Edit the relevant parameters.
4. To edit other parameters, click the **PROFIdtm DPV1** entry in the project structure again using the right mouse button.
5. Select **Additional functions** in the context menu (view Figure 5.5 on page 39).

   A submenu opens.
6. Select the required command from the submenu. Changing DTM station addresses, opening the Profibus Control Panel, and accessing online help are just some of the options available.

5.3 Adding Com Units

There are two possible ways of integrating the Com Unit into the PACTware project. The two alternatives are described below:

- Manually replicate the Com Unit using the **Add device** command,
- The Com Unit can be generated automatically (**only by using the service bus!**).

Adding the Com Unit Using the **Add Device** Command

Prerequisite: The Remote I/O DTM collection must be installed on the PC before the Com Unit can be added.

1. In the project view, select the communication DTM that was added earlier (either "PRO-FIdtm" or "LB/FB service bus).
2. Select **Device** > **Add device** or click the **Add device** icon on the toolbar.

   A window opens displaying a list of available Com Units (view Figure 5.6 on page 40).

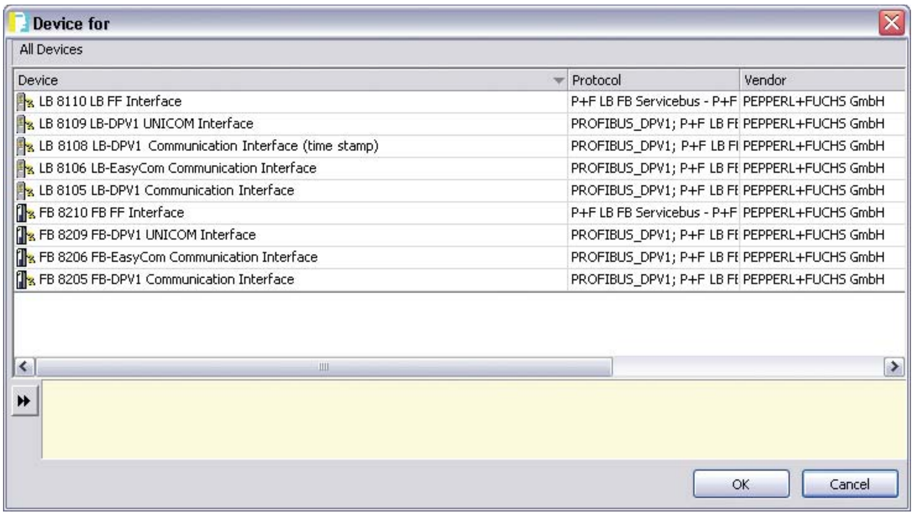


Figure 5.6: Selecting the Com Unit

3. Select the Com Unit installed in your Remote I/O station.
4. Click the **OK** button.

   The Com Unit is added and appears under the communication DTM in the project structure.
   In the right half of the program window, a device data window appears with a prompt asking you to enter the address of the Remote I/O station (view Figure 5.7 on page 40).

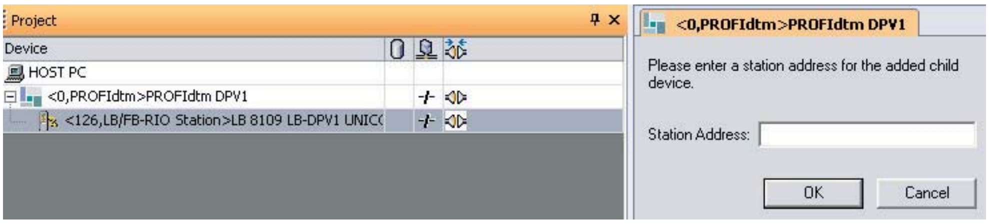


Figure 5.7: Entering the station address

5. Enter the station address.
6. Click the **OK** button.

   The Com Unit has been added to the project and can be parameterized.

Generating the Com Unit Automatically

Note!

The Com Unit can be generated automatically **only by using a service bus connection**.

Prerequisite: There is a physical connection between the components, and the service bus communication DTM has been added to the project structure.

1. Click the entry **LB/FB Service Bus** in the project structure using the right mouse button.
2. Establish a connection to the remote I/O component. Select **Establish connection** from the context menu.

The connection is established.
The entry for the communication DTM appears in bold once the connection is established.

3. Click the entry **LB/FB Service Bus** in the project structure using the right mouse button.
4. Select **Additional functions > Scan service bus**.

   The **Scan service bus** window opens.
5. Enter the address range that you wish to scan in the **Scanning area** fields.
6. Click on **Start scan**.

   A progress bar indicates the current status of the scanning process. When the scanning process finishes, all located Com Units are listed in a table.

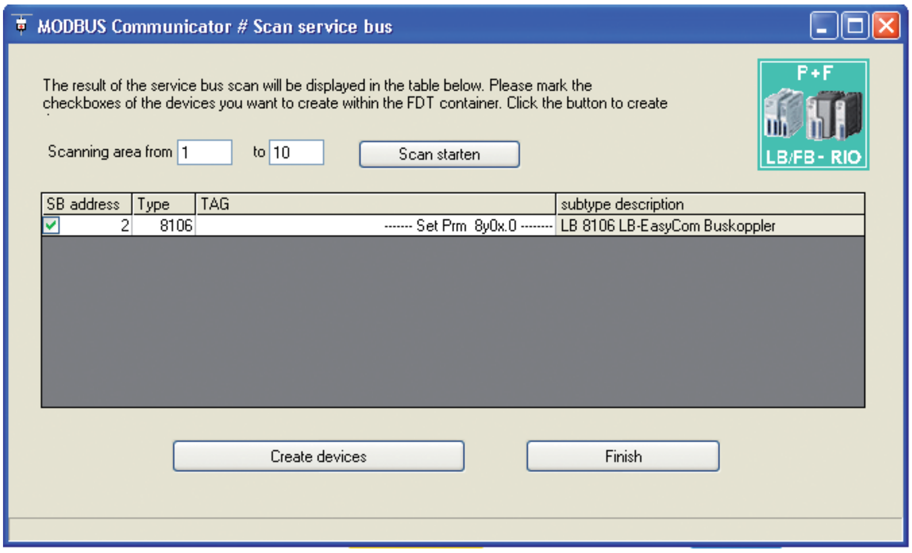


Figure 5.8: **Scan service bus** window

7. Select one or more Com Units by enabling the relevant check boxes in the **SB address** column.
8. If you would like to change the service bus address of a Com Unit, double-click on the relevant line from the list in the table.

   The **Set service bus address** window opens.

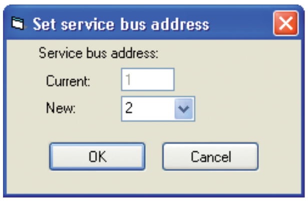


Figure 5.9: Setting the service bus address

9. Select the required service bus address from the **New** drop-down list and then click **OK**.

   The service bus address has been changed.
10. Click **Create devices** in the **Scan service bus** address window to start configuring the generation process.

    All selected Com Units are created in the project structure. The progress is displayed in the PACTware status line.

5.4 Online and offline parameterization

Note!

The functions described in this section relate to the Remote I/O DTM collection, version 7.4 or later.

The FDT base application offers the ability to edit the offline and/or online data record of the DTM, depending on the connection status with the Remote I/O station.
Data from the database (offline data records) is edited offline (data saved in the project). The current data is loaded from the connected device every time you open an online window (online data record).

- Not connected: Only the offline data record can be edited.
- Connected: Both the offline and online data record can be edited. The online and the offline window can be edited simultaneously. The window is updated whenever modifications are made. The following Com Unit parameters of the offline data record cannot be edited when a connection is active.
    - **Structure** tab: Redundancy on check box.
    - **Profibus I** tab: Bus addresses of the primary and secondary Com Unit; redundancy mode; cyclic data

The online and offline data records of the Com Unit and all I/O modules are updated using the commands **Store to device** and **Load from device** in the FDT base application.
A dialog box also appears whenever parameter modifications are made. In the dialog box, users can decide whether to store the changes in the device or whether to update the offline data record as well.
The parameters of the individual I/O modules can only be updated directly in the dialog box. Otherwise the parameters of the I/O modules are updated implicitly when the Com Unit parameters are downloaded/uploaded using the commands **Store to device** and **Load from device**.

Offline parameterization

1. Click the entry for the Com Unit or an I/O module in the project structure using the right mouse button.

   A context menu opens.

2. Select **Parameters > Parameterize > Edit device data (offline)**.

   The **Edit device data (offline)** window containing the offline data record opens. The gray box next to the P+F symbol in the status bar indicates the offline status.

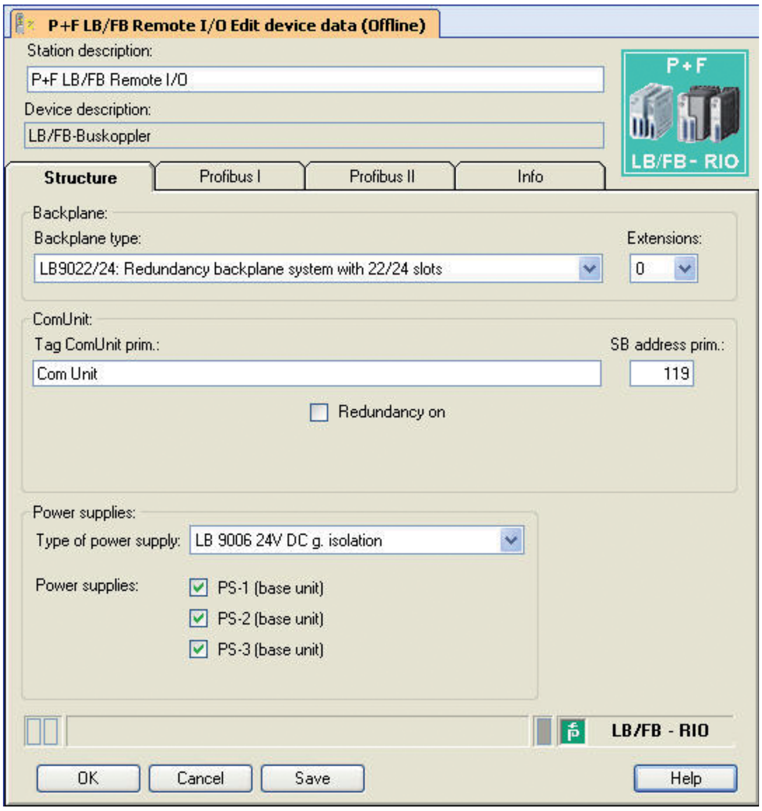


Figure 5.10: **Edit device data (offline)** window

3. Modify the relevant parameters.
4. Click **OK** (save and close window) or **Save** (save and leave window open).

   Depending on the FDT base application, user environment, and connection status, a message appears asking if you wish to write the data to the device (update the online data record as well).

Online parameterization

1. Click the entry for the Com Unit or an I/O module in the project structure using the right mouse button.

   A context menu opens.

2. Select **Parameters** > **Online parameterization** > **Edit device data (online)**.

   The **Edit device data (online)** window containing the online data record opens (data is read from the device). The yellow box next to the P+F symbol in the status bar indicates the online status.

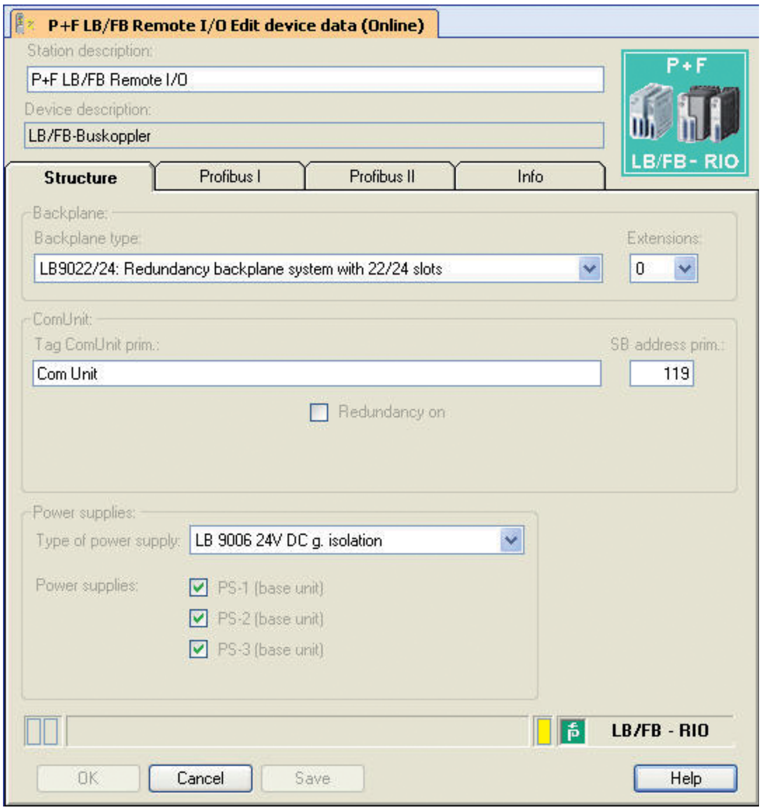


Figure 5.11: **Edit device data (online)** window

3. Modify the relevant parameters.

4. Click **OK** (data is written to the device, window is closed) or **Save** (data is written to the device, window remains open).

   Depending on the FDT base application and user environment, a message appears asking whether you wish to update the offline data record as well.

5.5 Editing application mode parameters of the Com Unit

Select appropriate configuration options for your application.

Edit the application mode parameters

Note!

If there is a PROFIBUS connection with the Com Unit, disconnect this connection first. Click on the Com Unit entry in the project structure using the right mouse button and select **Disconnect** in the context menu.

1. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.

2. Select **Additional functions** > **Edit application mode parameters** in the context menu.

   The **Edit application mode parameters** window opens listing the configuration options for the Com Unit (view Figure 5.12 on page 45).

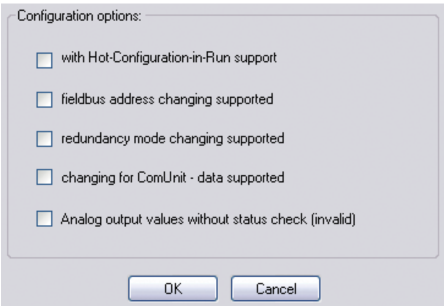


Figure 5.12: Edit the application mode parameters

3. The **With Hot Configuration in Run support** check box is enabled by default.
4. If the master does not support the PROFIBUS address configuration, enable the **Profibus address changing supported** check box. You must enter the PROFIBUS address of the Com Unit manually if the check box is enabled. Open the device data window for the Com Unit and select the **PROFIBUS I** tab (see chapter 5.7.2).
5. If you wish to select the redundancy type manually (line redundancy/application redundancy), enable the **Redundancy mode changing supported** check box. Select the redundancy type in the device data window for the Com Unit on the **PROFIBUS I** tab (see chapter 5.7.2).
6. We recommend that you enable the **Changing for additional Com Unit data supported** check box so that global status and command registers and the module status register can be integrated in the cyclic data traffic. Enable/Disable additional cyclic data in the device data window for the Com Unit on the **PROFIBUS I** tab (see chapter 5.7.2). Once you have edited all the required settings, disable this check box again to prevent structural data changes during operation.

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7. **Analog output values without status check** check box: Analog output values are transferred by default to the remote I/O system as a 16-bit date consisting of a 12-bit measured value and a 4-bit status area. The status area includes an invalidity bit, which indicates whether the 12-bit measured value is valid (0) or invalid (1).
   If the measured value is invalid, the preset substitute value strategy is initiated. Examples of the transferred substitute value include 0%, 100%, the current value or the last valid value. If the process control system issues measured values that use all 16 bits, the invalidity bit may be set unintentionally depending on the measured value. The measured value then depends on the substitute value strategy and may not be realistic. To disable the evaluation function for the invalidity bit, enable the **Analog output values without status check** check box. With 16-bit measured values, the transmitted value is always issued when the check box is enabled. The substitute value strategy is only initiated if an error such as a loss of communication occurs.
8. Click **OK** to confirm your entries.

   The application mode parameters of the Com Unit are now modified.

5.6 Selecting firmware-dependent functions

Some Com Unit and I/O module functions are only supported from a certain Com Unit firmware version. You can activate and deactivate these functions in the **Firmware-dependent functions** window for the relevant Com Unit.

Note!

The **Select firmware-dependent functions** window is only available in DTM version 7.2 or later.

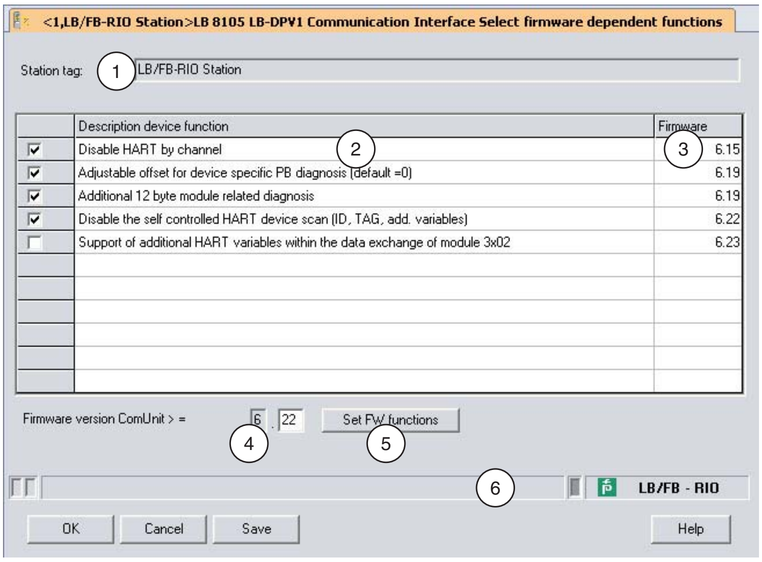

Figure 5.13: **Select firmware-dependent functions** window

1 **Station tag** box
2 **Device function description** column
3 **Firmware** column
4 **Com Unit Firmware version** box
5 **Set FW functions** button
6 Status bar

The **Station tag** field contains the name of the Remote I/O station, which you can enter in the Com Unit device data (see chapter 5.7).

Firmware-dependent functions are listed in the **Device function description** column. The minimum firmware version that the Com Unit must have to support the relevant device functions is displayed in the **Firmware** column on the right.

All parameter changes are shown in blue. As soon as a change has been made, it is indicated in the status bar in the lower part of the window (the second rectangle in the status bar colored blue, the plain text display generates the "Parameter change" string). There is another rectangle on the right next to the plain text display. This rectangle indicates the current state of the Com Unit DTM (online= yellow, offline = gray).

Activated functions can only be deactivated when they are not in use. Whenever a function is in use, the check box associated with the function appears gray and cannot be edited.

Opening and editing the **Select firmware-dependent functions** window

Note!

Applies to DTM versions ≤ 7.3

Close all other DTM windows and disconnect from the Com Unit before opening the **Select firmware dependent functions** window. otherwise the window will not open.
If you establish a connection to the Com unit while the **Select firmware dependent functions** window is open, you will not be able to save your parameter changes.

1. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.
2. Select **Parameters > Parameterize > Select firmware dependent functions** in the context menu.

   The **Select firmware-dependent functions** window opens. If there are no firmware-dependent functions, the window stays empty.
   If another DTM window is already open, an error message will appear. If so, close all other DTM windows and repeat the step.
3. You now have two options for activating the firmware-dependent functions:
   Either
   enter the subversion of your Com Unit firmware (e.g. "22") in the **Firmware version of the Com Unit** box and then click the **Set FW functions** button. All functions supported by this subversion are now activated automatically (see check box).
   Or
   Click directly on the required text or check box in the **Description device function** column to enable/disable the functions individually. The required firmware subversion is determined automatically and entered in the **Com Unit firmware version** box.
4. To save your selection without closing the window, click the **Save** button.
   To save your selection and close the window, click the **OK** button.

5.6.1 "Disable HART by channel" function

If you enable **Disable HART by channel**, you can disable HART communication for each individual channel of I/O modules 3x02, 3x03, 3x05, 4x02, and 4x05 (on the **Channel X** tab in the device data window of the relevant I/O module).
We recommend using this function if

- a HART-compatible device is not connected to the corresponding channel of the I/O module,
- HART communication fails and fault messages begin to accumulate,
- HART communication is no longer required (saves time, which can then be used for HART communication for other I/O modules or channels).

If you do not enable the **Disable HART by channel** function, HART communication for the previously mentioned I/O modules is enabled as standard.

5.6.2 "Adjustable offset for device specific PB diagnosis" function

If you enable **Adjustable offset for device specific PB diagnosis**, you can modify the **Offset module diagnostics** parameters manually on the **Profibus II** tab in the device data window of the Com Unit (see chapter 5.7.3).
You can use the Com Unit parameters **Offset module diagnostics** to influence the counting method of the module-specific Profibus diagnostics. This parameter determines whether the diagnostic data of I/O module 1 is transmitted as module diagnostics 0 (offset = 0) or module diagnostics 1 (offset = 1). We recommend using this function if the diagnostic visualization in the process control system indicates an offset in the diagnostics/module allocation (counting method).

If you do not enable **Adjustable offset for device specific PB diagnosis**, **Offset module diagnostics** is set to 0 by default.

5.6.3 "Additional 12 byte module related diagnostics" function

If you enable **Additional 12 byte module related diagnostics**, you can manually modify the parameter **Add. module diagnostics** on the **Profibus II** tab in the device data window for the Com Unit (see chapter 5.7.3).
Add. module diagnostics allows you to extend the device-specific Profibus diagnostics for each I/O module by 2 bits. We recommend using this function for systems with limited diagnostic capabilities.

If you do not enable the **Additional 12 byte module related diagnostics** function, the **Add. module diagnostics** is disabled and no additional module-specific diagnostics are transmitted.

5.6.4 "Disable the self controlled HART device scan" function

If you enable **Disable the self controlled HART device scan**, you can disable automatic scanning of each individual HART channel for I/O modules 3x02, 3x03, 3x05, 4x02, and 4x05 (on the **Channel X** tab in the device data window of the relevant I/O module).
During the HART scan, HART data is retrieved and saved to enable quicker external access. We recommend enabling this function if external access to HART data is not required.

If the **Disable the self controlled HART device scan** function is deactivated, all HART channels for the I/O modules listed above are scanned by default, provided HART is enabled for the respective channel (default setting).

5.6.5 "Support of additional HART variables within the data exchange of module 3x02" function

If you activate **Support of additional HART variables within the data exchange of module 3x02**, the **Measuring method** drop-down list appears on the **Channel X** tab in the device data window of the I/O module 3x02. Here you can activate the transfer of HART auxiliary variables in cyclic data traffic.

If you do not activate the **Support of additional HART variables within the data exchange of module 3x02** function, no HART auxiliary variables are transferred and the **Measuring method** drop-down list does not appear.

5.7 Editing Com Unit device data

P+F LB/FB Remote I/O stations can only be configured via the Profibus using version 7.2 of the FDT 1.2 DTM (V7) or earlier. Configuration via the service bus is supported from version 7.3 onwards.

The device data window of the Com Unit is divided into 4 tabs: **Structure**, **Profibus I**, **Profibus II**, and **Info**. To edit the tabs, first open the device data window.

Opening the device data window of the Com Unit

Note!

The general structure of the device data window is described in the section "Universal screen elements" (see chapter 6.1).

1. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.
2. Depending on whether you wish to parameterize online or offline, select **Parameters > Parameterize > Edit device data (offline)** or **Parameters > Parameterize > Edit device data (online)** from the context menu.

   The **Edit device data** window opens.
3. If you wish to change the station description, enter the new text in the **Station description** box (max. 32 characters). The **Device description** box cannot be edited.
4. Now edit the device data on the 4 tabs.

5.7.1 Editing the "Structure" tab

On the **Structure** tab, you can modify any settings affecting the structure of the station, such as the station description, backplane type, and redundancy.

Note!

Information on redundancy

Refer to the hardware manuals for LB/FB Remote I/O for more information on redundancy (basic information, redundancy types, power supply redundancy).

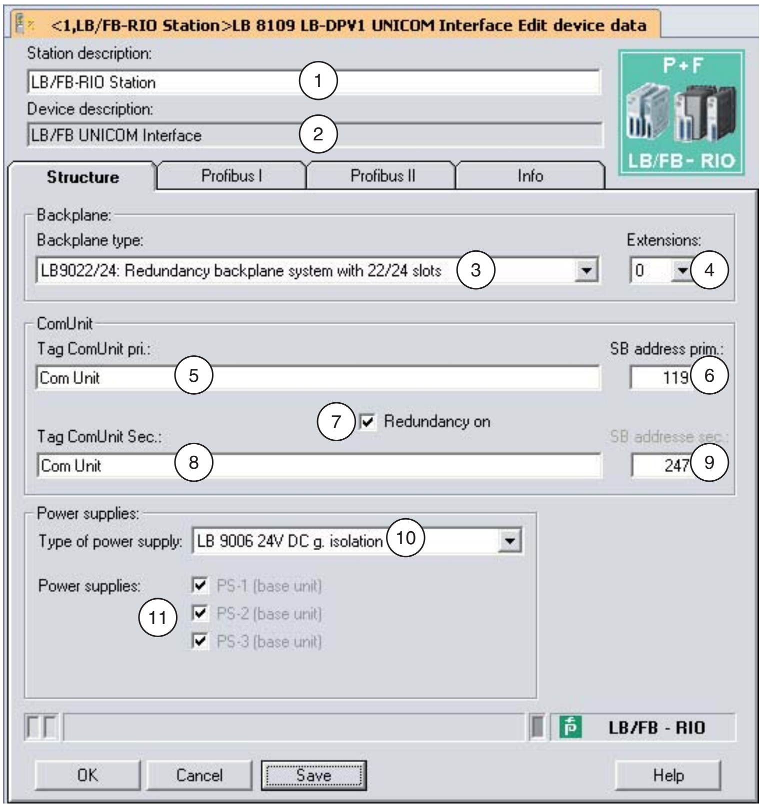

Figure 5.14: Structure tab

1 **Station description** box
2 **Device description** box
3 **Backplane type** drop-down list
4 **Extensions** drop-down list
5 **Tag Com Unit pri.** box
6 **SB primary address** box
7 **Redundancy on** check box
8 **Tag secondary Com Unit** box
9 **SB secondary address** box
10 **Type of power supply** drop-down list
11 **Power supplies** check boxes

Explanations:

1

Station description box
This box already contains a name. You can overwrite this name with a new station name if you wish (max. 32 characters).

2

Device description field
Contains a description of the Com Unit and cannot be edited.

3

Backplane type drop-down list
Select the backplane type used in the Remote I/O station. This setting also determines which power supply types are available as well as the number of possible extensions. The type "redundant backplane system with 22/24 module slots" (LB 9022/24) is selected in the example.

4

Extensions drop-down list
Specify whether an extension is available for the base backplane. The following selection options are available:
"0": No extension available,
"1": Extension available.
The selection of available extensions depends on the backplane system and may vary from 0-5 extensions.
Example: You are using the base backplane LB 9022 with 22 slots. If you select "1" in **Extensions**, a Remote I/O station with 46 slots is configured (base backplane with 22 slots + extension backplane LB 9024 with 24 slots).

5

Tag primary Com Unit box
Displays the name of the primary Com Unit. Enter up to 32 characters.

6

SB address prim. box
Enter the service bus address of the primary Com Unit.

7

Redundancy on check box
The status of the check box can only be changed offline (no connection to the Remote I/O station). If **Redundancy on** is enabled, additional entry options for the secondary Com Unit tag and the service bus address appear on the **Structure** tab.
The status of this check box also affects the configuration options for the connected power supplies displayed in the **Power supplies** area (redundancy = Com Unit and power supply redundancy).

8

Tag secondary Com Unit box
Displays the name of the secondary Com Unit (redundant Com Unit). Enter up to 32 characters. This box only appears when **Redundancy on** is enabled.

9

SB address sec.
Displays the service bus address of the secondary Com Unit. This address is allocated automatically based on the address of the primary Com Unit and cannot be edited. This box only appears when **Redundancy on** is enabled.

10

Power supply type drop-down list
Select the power supply. The options depend on the item selected in the **Backplane type** drop-down list.

11

Power supplies check boxes
Enable/Disable the relevant check boxes to specify which connected power supplies you wish to monitor. The number of check boxes depends on the settings in the **Power supply type**, **Backplane type** and **Extensions** drop-down lists. In redundant systems, power supply monitoring is automatically activated for all existing power supply slots and cannot be deactivated (power supply redundancy).

5.7.2 Editing the "Profibus I" tab

On the **Profibus I** tab, you can modify any settings affecting bus communication, such as bus addresses, redundancy mode and cyclic data.

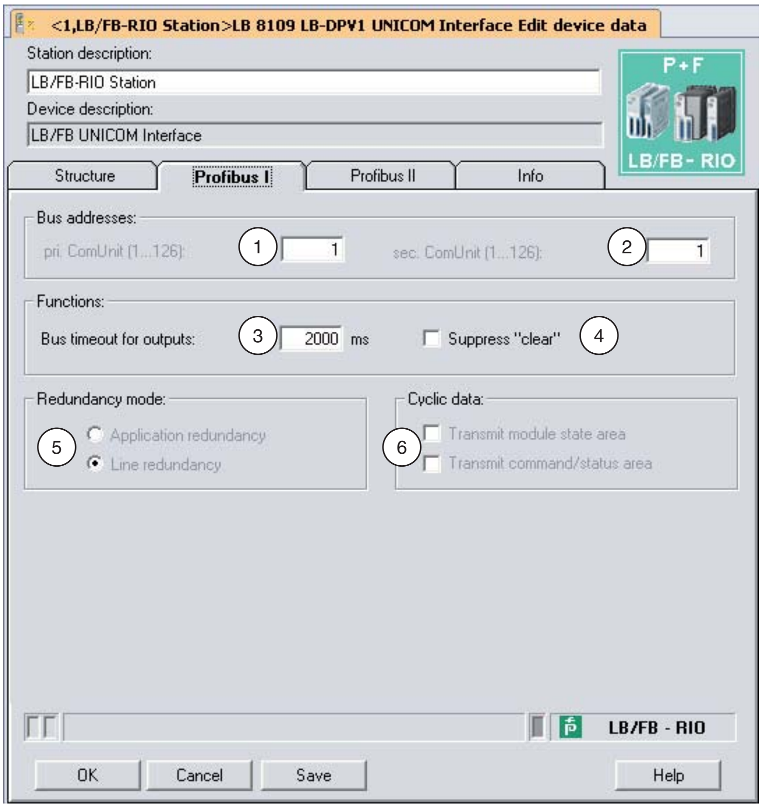

Figure 5.15: Profibus I tab

1 **Primary Com Unit** box
2 **Secondary Com Unit** box
3 **Bus timeout for outputs** box
4 **Suppress "clear"** check box
5 **Redundancy mode** area
6 **Cyclic data** area

Caution!
Profibus will restart if the parameters are changed

If you modify the **Transmit module state area** and **Transmit command/status area** parameters in the **Cyclic data** area, you must restart the Profibus! These parameters cannot be changed online (active connection with the device).
If your control system supports HciR functionality, the parameters can be changed offline (no connection to the Remote I/O station) and then activated when the system is operative.

The parameters are supported from DTM V 7.1.

Caution!
Suppress "clear" check box

If only digital outputs are available in the Remote I/O station, you will only not be able to deactivate all outputs. One output always remains active because **Suppress "clear"** is enabled and zero telegrams are suppressed or ignored. Set a minimum of one output (virtual if necessary) in the telegram so that Clear is not suppressed.

Note!

Certain parameters can only be edited offline

The following parameters can only be modified offline (no connection to the Remote I/O station):

- **Primary Com Unit (bus address)** and **secondary Com Unit (bus address)**
- **Redundancy mode**
- **Cyclic data**

1

Primary Com Unit (bus address) field
Configure the bus address of the primary Com Unit if the master does not support Profibus address configuration. This box can only be edited when you enable the second check box in the **Edit application mode parameters** window.
The configuration procedure varies depending on the FDT base application. The topology configuration is usually defined in the FDT base application. However, there are applications that are only suitable for configuration using a master class 2 card. In these applications, the address can be configured from the DTM of the Com Unit or the Profibus master. For this reason, the **Edit application mode parameters** window offers the option of enabling or disabling the input box for the bus address of the primary Com Unit. If you enable the address input box, remember to disable it again after making your entries.

2

Secondary Com Unit (bus address) field
Configure the bus address of the secondary Com Unit (only on systems with application redundancy, see **Redundancy mode** area). This box only appears if you have enabled the **Redundancy on** check box on the **Structure** tab (see chapter 5.7.1). Also, the box can only be edited if you enable the second check box in the **Edit application mode parameters** window.
If **Line redundancy** is activated in the **Redundancy mode** area (see below), the address of the secondary Com Unit is the same as the address of the primary Com Unit. Otherwise the same applies as for the **Primary Com Unit (bus address)** box.

3

Bus timeout for outputs box
Specify a time span in ms, after which the outputs initiate the preset substitute value strategy if the Profibus fails (see chapter 6.7.2).

4

Suppress "clear"
After a restart or a redundancy switchover by the master, some systems issue a "Clear" signal (DataExchange with only 00...). If **Suppress "clear"** is disabled, the slave deactivates all outputs. If you do not want the system to deactivate all the slaves because a redundant Remote I/O station has to guarantee continuous operation in case a Com Unit/bus line fails, for example, enable **Suppress "clear"**.

5

Redundancy mode area
Configure the redundancy type. This area only appears if you have enabled the **Redundancy on** check box on the **Structure** tab (see chapter 5.7.1). Also, the area can only be edited when you enable the third check box in the **Edit application mode parameters** window.
Application redundancy: Enable this option if both Com Units are meant to participate in bidirectional data transfer. The master must use the global status register to check which slave is active. (only supported from DTM version 7.1 or higher, other read-only).
Line redundancy: Enable this option if the process control system is meant to see both Com Units of a redundant Remote I/O station as a single Profibus device. Only the active Com Unit sends data to the master. In this case, the Profibus lines should then be implemented in redundant form from the master module onwards.

Note!

Information on redundancy

Refer to the hardware manuals for LB/FB Remote I/O for more information on redundancy (basic information, redundancy types, power supply redundancy).

6

Cyclic data area
Activate/Deactivate the module status register and the global command/status register (additional diagnostic data from the Remote I/O station). This area can only be edited when you enable the fourth check box in the **Edit application mode parameters** window.
Transmit module status: Enable this check box to include transmission of the module status in the cyclic data traffic (1 bit per slot, 1 = module OK, 0 = module faulty, 6 bytes input).

Transmit command/status area: Enable this checkbox to include transmission of the global status and command register in the cyclic data traffic. This function is important for application redundancy (2 bytes input/output).
Refer to the chapter "Com Unit diagnostic functions" for more detailed information on diagnostic functions.

5.7.3 Editing the "Profibus II" tab

On the **Profibus II** tab, you can modify any settings affecting bus communication, e.g. message parameters and extended functions.

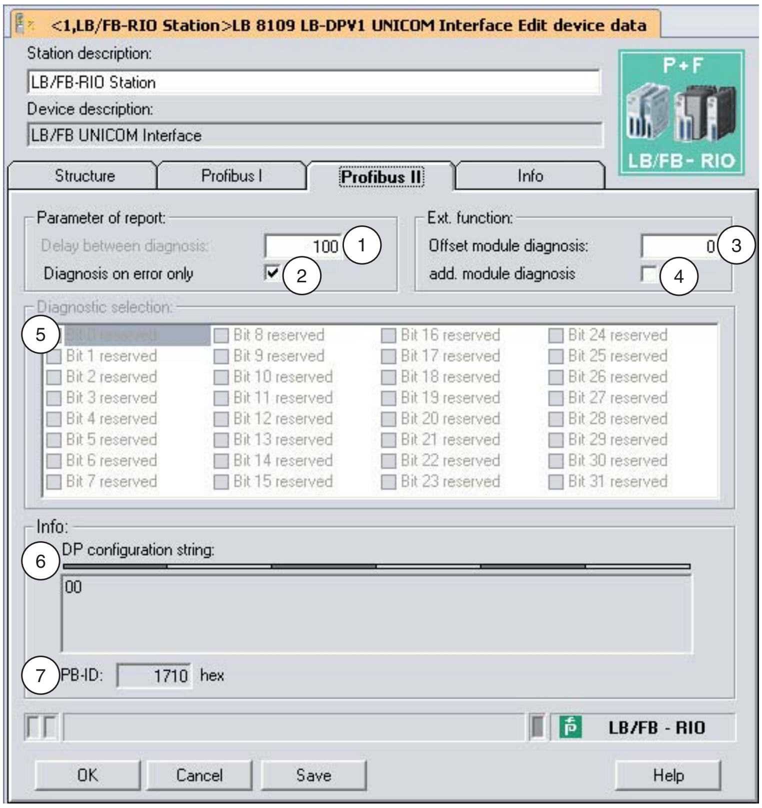

Figure 5.16: Profibus II tab

1 **Delay between diagnostics** box
2 **Diagnostics on error only** check box
3 **Offset module diagnostics** box
4 **Add. module diagnostics** check box
5 **Diagnostic selection** area
6 **DP configuration string** field
7 **PD ID** field

Warning!
Offset module diagnostics parameter change

Changing the **Offset module diagnostics** parameter represents a serious manipulation of the diagnostics and alarm handling system.

We recommend changing **Offset module diagnostics** parameter only if the module counting methods for diagnostic assignment in the master and slave are different. It is advisable to check the module counting method prior to commissioning or during a plant shutdown and then modify the parameter once if required.

Explanations:

1

Delay between diagnostics box
Indicates the minimum delay time between two Profibus diagnoses, preset to 100 ms, cannot be modified.

2

Diagnostics on error only
Checks the behavior of the Profibus diagnostics. If you enable the check box, the ExtDiag bit is only set for diagnostics when there is a fault. This bit is not set for an internal status change.

3

Offset module diagnostics box
The assignment of diagnostics to I/O modules may turn out differently due to the different counting methods used in different master and diagnostics systems. Adapt the counting method to your system using **Offset module diagnostics**. The parameter can adopt the value "0" or "1", the default value is "0". Changing the parameter is recommended if the diagnostic visualization in the PCS indicates a shift in the diagnostics/module assignment. If you enter the value "0", the diagnostics of the I/O module 1 is transferred as module diagnostics 0. With the value "1", the diagnostics of I/O module 1 is transferred as module diagnostics 1 (see also section "DP diagnostics", see chapter 8.4.2).

Note!

Offset module diagnostics box for Com Unit 8x05

On Com Unit 8x05, the **Offset module diagnostics** box can only be edited if you activate the function **Offset for module-spec. PB diagnostics adjustable** in the **Select firmware dependent functions** window for the Com Unit DTMs (only possible with Com Unit firmware version 6.19 or later).

4

Add. module diagnostics box
If you enable the **Add. module diagnostics** box, 2 more bits are transferred per I/O module slot (I/O module OK, I/O module error, incorrect I/O module type, no I/O module available). The data volume for the device-specific diagnostics therefore increases by 12 bytes (48 x 2 bits). The additional diagnostics are not transferred by default. This function is designed for systems where a diagnostics via DTM is not possible or where the diagnostic options are limited (see also section "DP diagnostics", see chapter 8.4.2).

Note!

Add. module diagnostics box for Com Unit 8x05

For Com Unit 8x05, **Add. module diagnostics** can only be edited if you have activated the **Additional 12 byte module related diagnostics** function in the **Firmware dependent functions** window for the Com Unit DTMs (only possible with Com Unit firmware version 6.19 or later).

5

Diagnostic selection area
Activate/Deactivate specific diagnostic messages for bits 0 to 31. This area cannot be edited at present.

6

DP configuration string box
Displays the current DP configuration. The entry in this box is generated from the I/O module arrangement on the backplane and from the **Cyclic data** area on the **Profibus I** tab (see chapter 5.7.2). The information is updated automatically when an I/O module is added or removed and cannot be edited.

Refer to the section "Meaning of the DP configuration string" for more information on the DP configuration string.

7

PB ID box
Displays the Profibus ID number. The Profibus ID is defined automatically as soon as the Com Unit is added and cannot be edited.

5.7.4 Editing the "Info" tab

The **Info** tab contains information on Com Units and power supplies. You may also enter notes.

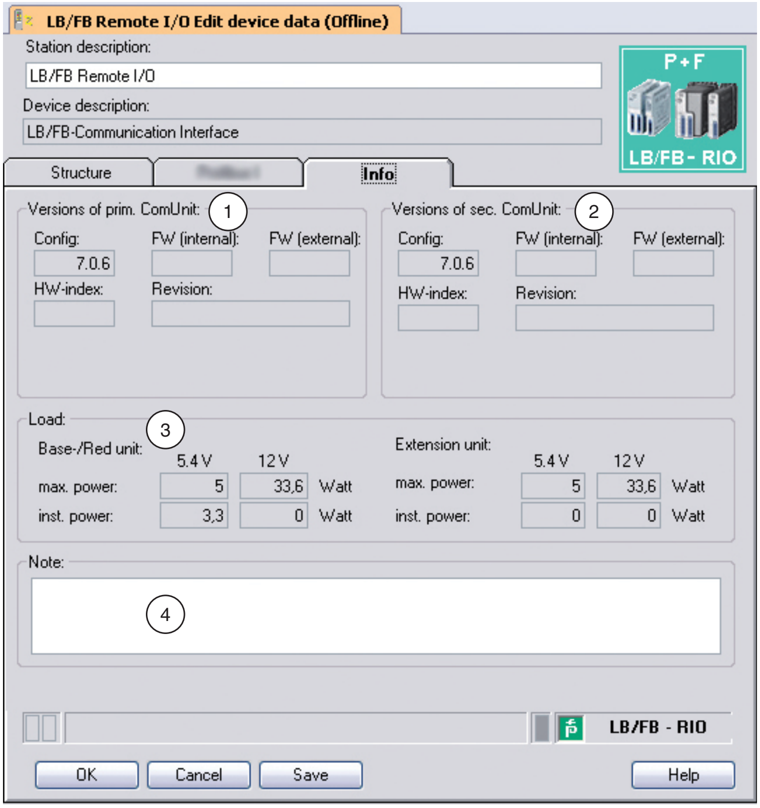

Figure 5.17: Info tab

1 **Version of primary Com Unit** area
2 **Version of secondary Com Unit** area
3 **Load** area
4 **Note** box

Explanations:

1

Version of primary. Com Unit area
This area contains the following boxes, which contain information on the primary Com Unit that cannot be edited.
Config: DTM version
FW (internal): Firmware version PIC (cannot be updated)
FW (external): Firmware version (can be updated by service)
HW index: Hardware version of the Com Unit (not yet supported)
Revision counter: Parameter revision date

2

Version of secondary Com Unit area
The same applies as for the **Version of secondary Com Unit** area. However, this area only appears if you have enabled the **Redundancy on** check box on the **Structure** tab.

3

Load area
This area displays boxes containing information relating to the load, which cannot be edited.
Power rating values appear in the boxes after the slots on the backplane are populated with actual I/O modules. During configuration, the DTM identifies any potential overload situations and flags this for the user. The user is then prevented from adding a module to the backplane.
If you wish to add another power supply to the backplane, then you can obtain more capacity for additional I/O modules (only in LB systems!).

4

Note box
Enter your own notes. The text is saved in the database and not in the Com Unit.

5.8 Meaning of the DP configuration string

Process control systems that support the FDT concept use the P+F operator interface as a component of a separate system by integrating the P+F DTM. Other process control systems have either a separate driver for P+F Remote I/O (e.g. Siemens PDM) or they use a text-based GSD file. In such cases, read the operating instructions provided by the relevant manufacturer.
The following notes will help you to understand more about Profibus communication and will be of particular use if you use the GSD file.

Note!

If you are operating a master that supports the FDT concept or has drivers/libraries, you do not need to worry about the subsequent byte strings because the master adopts the details automatically.

You can view the sequence of data words in the configuration string. The sequence corresponds to the arrangement of the I/O modules on the backplane, whereby the input and output bytes of the I/O modules are sorted into input and output blocks (view Figure 5.18 on page 62). The DP configuration string is therefore a direct representation of the I/O module arrangement and configuration on the relevant backplane. Each I/O module has a DP configuration code (e.g. digital input 1x08 = "11"). The DP configuration string is composed of individual DP configuration codes.
It is essential for successful Profibus communication that the DP configuration string in the

master and slave (= Remote I/O station) are identical.
The table (view table "Data structure on the Profibus" on page 62) is a simplified version of the same module arrangement shown in the illustration (view Figure 5.18 on page 62) and represents the relationship between the data structure of the DP configuration string and the input and output bytes of the I/O modules.

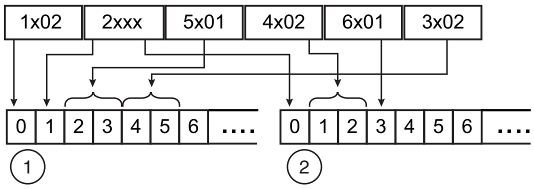

Figure 5.18: Effect of the module arrangement on the data structure

1 Input bytes
2 Output bytes

Data structure on the Profibus

Module arrangement						
Slot no.	1	2	3	4	5	6
I/O module	1x02	2xxx	5x01	4x02	6x01	3x02
DP Config. string	10	30	50	60	20	50
Data	1 byte ON	1 byte ON 1 byte OFF	1 word ON	1 word OFF	1 byte OFF	1 word ON
Byte ON	1	1	2			2
Byte OFF		1		2	1	
Input bytes						
Byte no.	0	1	2	3	4	5
I/O module (slot)	1x02 (1)	2xxx (2)	5x01 (3)		3x02 (6)	
Output bytes						
Byte no.	0	1	2	3	4	5
I/O module (slot)	2xxx (2)	4x02 (4)		6x01 (5)	Empty	Empty

Table 5.1: Data structure on the Profibus

Initially, all output data is transferred to the slave as specified in the Profibus standard (DataExchangeRequest). Then all input data is transferred to the PCS as a response (DataExchangeResponse). Refer to the following table for the individual hexadecimal values that make up the DP configuration string. The table also contains the meaning and the input and output bytes of each hexadecimal value.

Refer to the chapter "Configuring I/O modules" for more detailed information on the data and bit structure within the input and output bytes of individual I/O modules (see chapter 7).

You can view the DP configuration string of your Remote I/O station in the Com Unit measured value display in the FDT base application (see chapter 8.4).

Note!

Special feature of I/O modules 1x03 and 3x02

Depending on the configuration (function type), the length of frequency input 1x03 is 2, 4 or 6 bytes and the DP configuration code is 50, 51 or 52.

Depending on the configuration (number of HART auxiliary variables), the length of analog input 3x02 (transmitter power supply, input isolator) is 2, 6, 10, 14 or 18 bytes and the DP configuration code is 50, 52, 54, 56 or 58.

DP configuration codes

DP Config. code (hex)	DP Config. code (*) (decimal)	Length	Meaning
00	0		Empty slot or Com Unit without data
10	16	1 byte ON	Digital input (1x01, 1x02)
11	17	2 byte ON	Digital input (1x08) (1007, 1014, 1015 only with Com Unit 8x08)
15	21	6 byte ON	Com Unit with module status (8x0x)
20	32	1 byte OFF	Digital output (6x01)
30	48	1 byte ON 1 byte OFF	Digital input/output (valve with feedback) (2xxx, 6x05, 6x1x)
31	49	2 byte ON 2 byte OFF	Com Unit with global status/command register (8x0x) or digital output with status (6x06, 6x08)
50	80	1 word ON	Frequency, 12 bit counter (1x03), analog input (3x01, 3x02, 3x03), temperature input (5x01, 5x02, 5x06)
51	81	2 words ON	32 bit counter (1x03)
52	82	3 words ON	Frequency + 32 bit counter (1x03), analog input (3x02) with 1st HART auxiliary variable
53	83	4 words ON	Analog input (3x04, 3x05), temperature input (5x04, 5x05)
54	84	5 words ON	Analog input (3x02) with 1st + 2nd HART auxiliary variables
56	86	7 words ON	Analog input (3x02) with 1st – 3rd HART auxiliary variables
58	88	9 words ON	Analog input (3x02) with 1st - 4th HART auxiliary variables
60	96	1 word OFF	Analog output (4x01, 4x02)
C0 01 07	192 1 7	8 byte ON 2 byte OFF	Com Unit with global status/command register and module status (8x0x)
C0 43 40	192 67 64	1 word ON 4 words OFF	Analog output (4x04, 4x05)
(*) In many older master systems, you have to use decimal numbers instead of the hexadecimal numbers in order to parameterize the PLC (e.g. S5) using the ET200 operator interface.			

Table 5.2: DP configuration codes

In the DP configuration string, the first configuration code is always assigned to the Com Unit (the bus connection). The redundancy Com Unit (if available) is incorporated implicitly in the configuration code of the bus connection and is not listed separately.
The Com Unit may have one of four different DP codes depending on the configuration (see table below).
The global status register occupies 2 input bytes. The 6 input bytes for the module status (1 bit per I/O module) follow the input bytes of the global status register. The module status bit adopts the status 1 if the associated I/O module is active and free of faults. Otherwise the status 0 is adopted.
The DP configuration codes for the individual I/O modules only follow the Com Unit with the global status/command register and the module status (view table "Sequence of the DP configuration code in the DP configuration string" on page 64).

Sequence of the DP configuration code in the DP configuration string

Slot	Device	Description	DP Config. code
0	Com Unit (with one of the configurations on the right)	Without data	00
		With status/command register	31
		With module status	15
		With status/command register and module status	C0 01 07
1	I/O module	Type-dependent	Type-dependent
n	I/O module	Type-dependent	Type-dependent

Table 5.3: Sequence of the DP configuration code in the DP configuration string

5.9 Command register

The command register comprises two bytes. The first byte is the parameter byte, the second the command byte. These bytes can be used to transfer commands from the master to the remote I/O station via the bus.

The command they contain is only executed if the command register has changed. Therefore, a command is only executed once, namely, when the changed command register has been transferred to the Com Unit for the first time.

The command register can be transferred together with the global status register as part of the cyclic Com Unit data. The global status register occupies the first two bytes in the response telegram (DataExchangeResponse from slave to master). The command register occupies the first two bytes in the request telegram (DataExchangeRequest from master to slave).

The following commands are supported by the current PROFIBUS Com Units 8x05 (6.25), 8x06 (6.25), 8x08 (8.x) and 8x09 (9.03).

Parameter (Byte 1)	**Command** (Byte 2)	Meaning
0x00	0x08	Clear all 32-bit counters.
0xnn	0x08	Clear 32-bit counter of slot nn.
0x00	0xF8	Cold start
0x00	0xF9	Warm restart
0x00	0xF5	Become passive (command to active Com Unit). Since the two Com Units of a redundant system cannot both be passive, the partner Com Unit becomes active because of this command. The command is meaningless if sent to the passive Com Unit.
0x00	0xF6	Become active (command to passive Com Unit). Since the two Com Units of a redundant system cannot both be active, the partner Com Unit becomes passive because of this command. The command is meaningless if sent to the active Com Unit.
0x00	0xF7	Redundancy switchover This command generates a redundancy switchover, whichever Com Unit it is sent to. Therefore, it is not essential to know which Com Unit is currently active/passive.

Table 5.4: Command list of the command register

5.10 Adding I/O modules – General information

5.10.1 Using single and multichannel I/O modules

1 and 2-channel I/O modules

Important process circuits that require high availability should be configured with 1 or 2-channel, single-width I/O modules because the channels of these modules are galvanically isolated from the bus and from one another. These I/O modules each occupy one slot and can be combined with any multichannel I/O modules within a Remote I/O station.

Multichannel I/O modules

Multichannel I/O modules significantly reduce the costs for each channel. One I/O module can process up to 8 digital or 4 analog inputs or outputs.
The channels are galvanically isolated from the bus but not from one another. Multichannel I/O modules are twice as wide and therefore occupy 2 slots.
Multichannel I/O modules reduce space requirements by 30%, or as much as 50% on analog circuits.

5.10.2 Slot allocation

Multichannel I/O modules are twice as wide and occupy 2 slots. Remember, therefore, that the subsequent I/O module should be inserted in the next slot but one. For example, the 8-channel digital input 1x08 occupies slots 3 and 4, whereby slot 4 is empty.
After configuring a dual-width I/O module, always leave one slot free. **Exception**: Do not configure an empty slot if the dual-width I/O module is located in the last slot in the Remote I/O module or if you do not intend to insert any other I/O modules.

Single and dual-channel I/O modules only occupy one slot.

The 8-channel digital input with the module identifier "11" is entered in the PROFIBUS configuration string. The additional slot occupied by the dual-width module is automatically treated as an empty slot (code "00" in the PROFIBUS configuration string).

The table below shows how 1 or 2-channel and multichannel I/O modules appear in the PROFIBUS configuration string.

Example DP configuration string

Slot	I/O module	DP Config. code
1	Digital input, 2-channel	10
2	Digital output plus 2 inputs	30
3 + 4	Digital output, 8-channel	31 00
5	Digital input, 2-channel	10
6 + 7	Digital input, 8-channel	11 00
8	Analog input	50

Table 5.5: Example DP configuration string

Note!

Differing slot assignment on redundant LB backplanes

Slots 1 and 2 on redundant LB backplanes are reserved for the redundant Com Unit, regardless of whether a redundant Com Unit is actually present or not. Configure the I/O modules for these backplanes from slot 3.

5.10.3 Compatibility and maximum number of I/O modules

Single and multichannel LB or FB I/O modules can be mounted on all LB and FB backplanes.

Multichannel I/O modules are supported by Com Units of firmware version V6.x or later.

Single-channel I/O modules provide a maximum of 144 digital inputs or 48 digital outputs per station. Using multichannel I/O modules increases the number of possible digital inputs per station from 144 to 184. The number of possible digital outputs increases from 48 to 184.
Using multichannel I/O modules increases the number of analog input and output channels from 48 to 80.

The maximum number of analog and digital inputs and outputs is only limited by the number of slots on the backplanes (max. 46 slots on LB Remote I/O in Zone 2, max. 48 slots on FB Remote I/O in Zone 1).

5.11 Adding or deleting I/O modules

Until now only the Com Unit has been added to the project. Now it is time to add some I/O modules. There are two possibilities which are both described in the following:

- Adding I/O modules manually using the **Add Device** command.
- Integrating I/O modules automatically by scanning the topology.

Whenever you add an I/O module to the configuration, delete an I/O module from the configuration, or replace the I/O module with another of a different type, the structure of the Profibus data telegram changes. This change causes the Profibus to restart. If possible, configure the slots on the Remote I/O station **before commissioning** to prevent the Profibus from restarting unnecessarily.

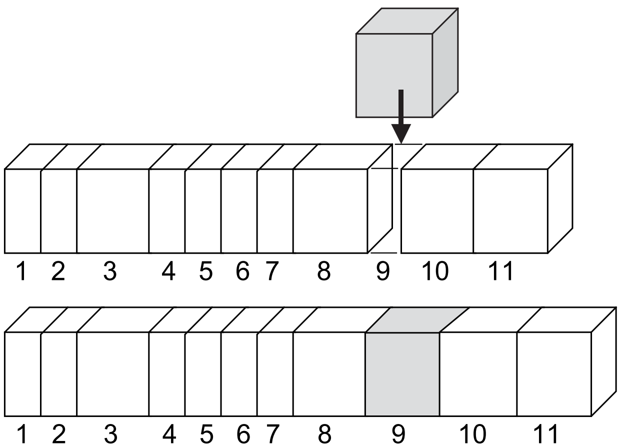

Figure 5.19: Adding an I/O module changes the structure of the Profibus data telegram

Caution!
Function interruption on control systems without HCiR function

The Com Unit can only be configured while the system is operating if the control system supports HCIR. Otherwise there is a risk of function interruptions.

If the control system does not support HCiR, do not configure the Com Unit while the system is operative. We recommend preconfiguring empty slots in the master and slave with virtual I/O modules prior to commissioning.

Note!

Process control systems with Hot Configuration in Run function (HCiR)

If your process control system supports HCiR, also read the following subchapter containing information on HCiR (see chapter 5.12).

Virtual I/O modules (not relevant for systems with HCiR support)
We recommend pre-configuring any vacant slots on the backplane with I/O modules prior to commissioning. Virtual I/O modules are included in the software configuration of the master and the slave, but are deactivated. A slot is therefore reserved for these modules in the Profibus data telegram even though they are not yet inserted in the backplane. This allows you to add a pre-configured I/O module to the Remote I/O station at a later stage without triggering a Profibus restart.
To pre-configure a virtual I/O module, add the relevant I/O module to the project structure first as described below. Then deactivate the I/O module via the DTM (Device data > **General** tab > **Module active** check box, see chapter "Configuring I/O modules"). You can now insert the pre-configured I/O module into the allocated slot on the backplane at a later stage. Finally, activate the I/O module again in the DTM.

Adding I/O modules manually using the **Add Device** command

1. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.

2. Select **Add device** in the context menu.

   A window opens displaying a list of all the available I/O modules (view Figure 5.20 on page 68).

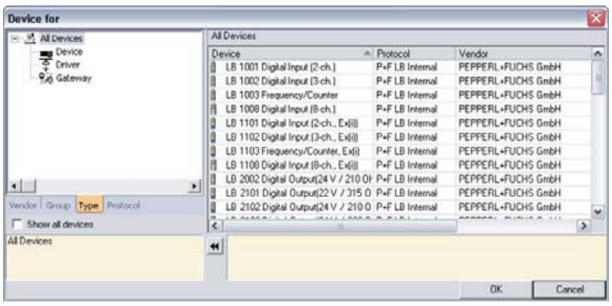

Figure 5.20: Selecting an I/O module

3. Select the I/O module that you wish to add to your project.
4. Click **OK**.

   The **Channel selection** window opens (view Figure 5.21 on page 69) displaying a list of slots.

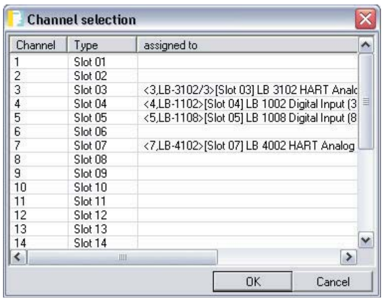

Figure 5.21: Channel selection window

5. Select the slot into which you wish to insert the I/O module. Remember that on redundant Remote I/O stations slots 1 and 2 are reserved for the redundant Com Unit (Note: The Com Unit LB 8108 does not support redundancy). Also be aware that dual-width I/O modules require 2 slots.

   If you have already added I/O modules to the project, these are displayed in the **Channel selection** window.
6. Click **OK** to confirm your selection.

   If you select a slot that is already occupied by another I/O module, a corresponding error message appears. If this happens, repeat the process and select another slot. The I/O module is added and appears below the Com Unit in the project structure.
7. If necessary, assign I/O modules to other slots by repeating steps 1 to 5.

Figure 5.22: Project structure with I/O modules in Pactware 3.5

To display the data structure, e.g. for rapid fault location, open the **Edit device data** window of the Com Unit and click the **Profibus II** tab. The DP configuration string is displayed in the **Info** area (view Figure 5.23 on page 69). This information is used at a later stage to configure Profibus data telegrams for cyclic data exchange.

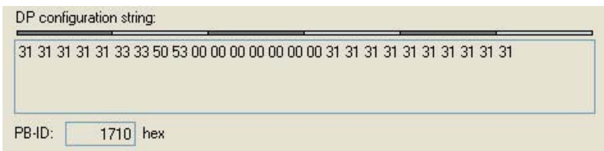

Figure 5.23: DP configuration string

Integrating I/O Modules Automatically by Scanning the Topology

Prerequisite: At least one Com Unit has been integrated in the project structure. The Com Unit parameters "Backplane type", "Extensions" and "Power supplies" reflect the actual settings in the remote I/O station.

1. Click the entry for the required Com Unit in the project structure using the right mouse button.
2. Establish a connection to the Com Unit. Select **Connect** in the context menu to do this.

   The connection is established.
   The entry for the Com Unit appears in bold once the connection is established.
3. Click the entry for the Com Unit in the project structure again using the right mouse button.
4. Select **Additional functions > Topology scan**.

   The **Topology scan** window appears. The search begins automatically. The I/O modules that are found are listed in the same sequence as the slots in the backplane.

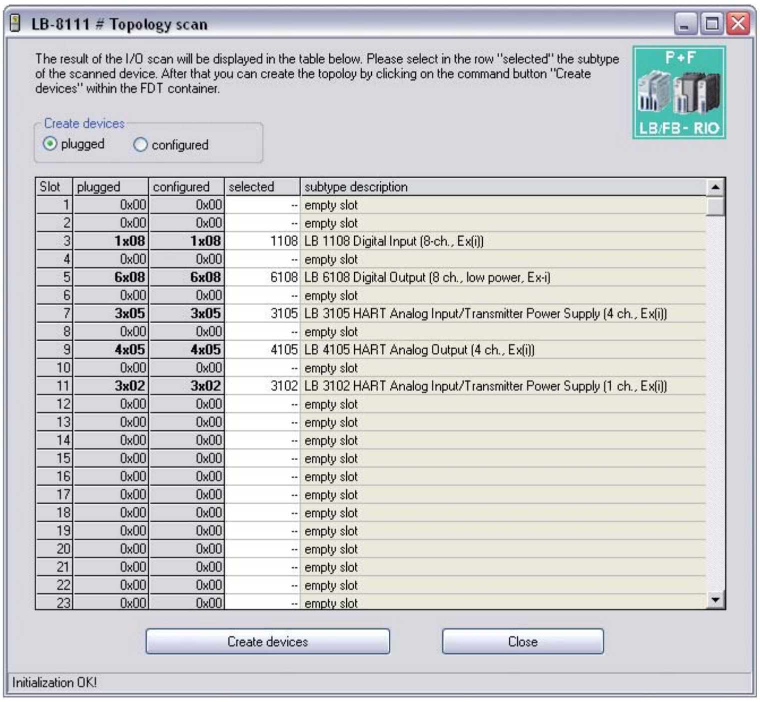

Figure 5.24: **Topology scan** window with a list of located I/O modules

5. The **plugged** column contains the I/O modules as they are currently installed in the backplane.
   The **configured** column shows the I/O modules that are currently configured (or loaded) in the Com Unit/device.
6. To integrate the I/O modules in the software in the same way as they are shown in the **plugged** column, select the **plugged** option in the **Create devices** area (top). To integrate the I/O modules in the same way as they are shown in the **configured** column, choose the **configured** option.

7. The **selected** column allows the type of module to be specified more precisely or the I/O module to be deselected (- -). Click the appropriate cell in the **selected** column (highlighted in white) and make a selection. The choice depends on the type of module in the **plugged** (or **configured**) column, depending on which option you selected in the **Create devices** area. The **subtype description** column contains more detailed information about the selected I/O module.
8. To generate the I/O modules as they are shown in the **selected** column, click **Create devices**.

   The I/O modules will be integrated into the project structure with their default parameter sets. A progress bar is displayed in the status line of the **Topology scan** window.

Deleting I/O modules

1. Click the entry for the I/O module in the project structure that you wish to delete using the right mouse button.

   A context menu opens.
2. Select **Remove device** in the context menu.

   A dialog window opens.
3. Click **Yes** in the dialog window.

   The I/O module is removed from the configuration.
4. Repeat steps 1 to 3 to delete other I/O modules.

5.12 Assigning I/O modules to slots using the HCiR function

Note!

Ignore this section if your process control system does not support Hot Configuration in Run (HCiR).

Activating/Deactivating HCiR
To activate/deactivate HCiR, proceed as described in the section "Editing the application mode of the Com Unit". New configurations and settings made using HCiR only become effective when the master restarts the Profibus. If you would like parameter modifications to take immediate effect, do not activate HCiR.

Function of HCiR (principle: Remote I/O with two data records)
The configuration of the master and slave in Profibus systems must be the same at all times otherwise data communication will not be possible. Communication cannot be guaranteed if you modify the configuration of a Remote I/O station. Measures must therefore be taken to ensure that the system can tolerate temporary differences between the master and slave configuration without entering an error state.
P+F has developed a process that allows the slave to have two configurations simultaneously, regardless of whether a redundant system is present. If HciR mode is active, a new configuration can be transferred to the slave in the form of a passive data record. The master may access the slave with the old configuration until he has implemented the necessary changes in the master system. The Profibus restarts when the

new configuration is activated in the master. When the new configuration in the slave matches the configuration in the master, the new configuration in the slave is activated automatically and the old configuration is deleted. However, if the Profibus is started with a different configuration (e.g. because of a line failure or problems loading the master), the old configuration in the slave remains active.

Caution!
Procedure depends on the control system

The procedure may deviate from the one described below depending on which control system you are using.

The following section describes the application of the HCiR functionality on a Profibus system containing a master module that supports both class 1 and class 2 services, enables the integration of FDT 1.2 DTMs, and supports HCIR functionality.
PCS systems that support HCiR (e.g. ABB Symphony) control the parameter download and Profibus restart sequences automatically. On process control systems that do not support HCiR, make sure that all parameters are downloaded to the Com Unit and only the master is configured.
Editing Profibus-relevant configuration data in control systems without HCiR assistance while the plant is operating requires maximum concentration. On control systems of this kind, we recommend preconfiguring empty slots in the master and slave with virtual I/O modules prior to commissioning. Deactivate these I/O modules to ensure that the data in the master and slave are consistent at all times. You can assign actual I/O modules to the slots and activate the I/O modules in the master at a later stage. The activation of these preconfigured I/O modules does not interrupt the exchange of Profibus data.
Alternatively you can revert to using universal modules from the Unicom Com Unit 8x09, which allow you to make configurations without HCiR functionality while the plant is operating.

5.12.1 Adding I/O modules with HCiR

Add I/O modules using HCiR

Danger!
Working in Zone 1 or Zone 2

There is a risk of explosion or damage to the station.

Always read the LB/FB hardware manual before removing or inserting I/O modules into the backplane.

1. Insert an I/O module in a free slot on the backplane and connect the wires correctly.
2. Start the FDT base application that has access to the class 2 services of the master module (e.g. PCS base application, PACTware, etc.).
3. Open the project file that contains the current configuration for the required Remote I/O station and the Profibus master class 2 connection.
4. Add the new I/O module to the project structure. Proceed as described in the section "Adding or deleting I/O modules". The slot that you configure in the software must correspond with the actual slot of the new I/O module on the backplane.
5. Now establish a connection to the Remote I/O station. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.
6. Select **Connect** in the context menu.

   A connection to the Com Unit is established.
7. Then click the Com Unit entry in the project structure again using the right mouse button.

   A context menu opens.
8. Select **Store to device** in the context menu.

   The new configuration with the additional I/O module is written to the Com Unit as a passive data record (parameter download). The Remote I/O station remains stable and continues to use the old configuration that does not yet include the new I/O module.
9. Then configure the new I/O module in the class 1 master.

   The class 1 master restarts the Profibus automatically.
   When the Profibus restarts, the outputs on the Remote I/O station retain the same the status they had prior to the restart depending on the **Watchdog time** parameter. After the watchdog time has elapsed, the system switches to the preset substitute value strategy. The master defines the watchdog time.
   After the restart, the Remote I/O station remains stable and uses the new configuration that includes the new I/O module. The old configuration is deleted.

Note!

You can use the procedure described above to add several new I/O modules simultaneously.

5.12.2 Deleting or replacing I/O modules with HCiR

Delete or replace I/O modules via HCiR

1. Start the FDT base application that has access to the class 2 services of the master module (e.g. PCS base application, PACTware, etc.).
2. Open the project file that contains the current configuration for the required Remote I/O station and the Profibus master class 2 connection.
3. Delete the relevant I/O module from the project structure. Proceed as described in the section "Adding or deleting I/O modules". If you would like to replace the deleted I/O module with a different module, add a new I/O module under the Com Unit in the project structure. The slot that you configure in the software must correspond with the actual slot of the replaced I/O module on the backplane.
4. Now establish a connection to the Remote I/O station. Click the Com Unit entry in the project structure using the right mouse button.

   A context menu opens.
5. Select **Connect** in the context menu.

   A connection to the Com Unit is established.
6. Then click the Com Unit entry in the project structure again using the right mouse button.

   A context menu opens.
7. Select **Store to device** in the context menu.

   The new configuration with the deleted/replaced I/O module is written to the Com Unit as a passive data record (parameter download). The Remote I/O station remains stable and continues to use the old configuration that still includes the current I/O module.
8. Now delete the I/O module in the class 1 master as well. If you would like to replace the removed I/O module with a new one, configure the new I/O module in the class 1 master.

   The class 1 master restarts the Profibus automatically.
   When the Profibus restarts, the outputs on the Remote I/O station retain the same the status they had prior to the restart depending on the **Watchdog time** parameter. After the watchdog time has elapsed, the system switches to the preset substitute value strategy. The master defines the watchdog time.
   After the restart, the Remote I/O station remains stable and uses the new configuration that used to contain the old I/O module or that contains the new I/O module. The old configuration is deleted.
9. Remove the relevant I/O module from the backplane or replace the current I/O module with a new one.

Note!

You can use the procedure described above to delete/replace several I/O modules simultaneously.

5.12.3 Changing the operation mode of an I/O module

The data structure of some I/O modules may vary depending on the task. For example, frequency input 1x03 can be used in "Counter" or "Frequency" mode. Although the hardware remains unchanged, the data structure of the PROFIBUS telegram changes depending on the operation mode, which is equivalent to replacing the I/O module with a new one.

Changing the operation mode of an I/O module with HCiR

1. Leave the relevant I/O module unmodified in the backplane.
2. Change the operation mode in the device data window of the respective I/O module (see chapter "Configuring I/O modules").

The rest of the procedure is identical to the procedure for replacing the I/O module with a new one. Continue with step 4 from the previous section.

5.13 Digression: Commissioning

5.13.1 Introduction

At this point we would like to give a few important tips on using the bus interfaces. For more detailed information on Profibus connections, please refer to the technical literature or internet sources such as

- PROFIBUS DP quick start,
- PROFIBUS technical documentation (obtained from the PROFIBUS User Organization in Karlsruhe),
- http://www.profibus.com (PROFIBUS User Organization in Karlsruhe).

GSD files are used as a quick means of interfacing Profibus slaves from different manufacturers to the process control system or the PLC and are supplied for P+F Remote I/O devices on a CD-ROM or can be downloaded from the internet (http://www.pepperl-fuchs.com).

Bus protocols define the structure of the data packets, which can then be recognized by bus users regardless of the transmission paths used. They define the manner in which data is requested from other devices, how devices respond to requests, and how errors can be detected and flagged. The master/slave principle is applied here.
The master is the only bus user that is allowed to request data from other devices (slaves) and issue commands to them. Class 2 masters can share the use of a single bus with class 1 masters. Token passing is used to control the bus usage times of the different master modules.
Parallel access by class 1 and class 2 masters is required in systems in which the class 1 master does not support acyclic services (DPV1) or HART functionality. HART communication via the Profibus can be established via the class 2 master.

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5.13.2 Profibus GSD file

The Profibus identification numbers (PB ID) of the GSD files for the P+F Remote I/O system are codes allocated by the Profibus User Organization (PNO). This number uniquely identifies a P+F Remote I/O station in a network containing stations from different manufacturers. The Profibus identification number varies from Com Unit to Com Unit and is printed on the sticker on the front of the unit.

5.13.3 Switching on

Do not start to operate all the slaves simultaneously, but connect each slave to the master in succession. For fault analysis, we recommend using a standard bus monitor that is capable of passively monitoring bus telegrams.

If the class 1 master does not have an option for modifying the Profibus address of a slave, the address can be modified via the class 2 master using the existing software (see chapter 5.7.2). The default Profibus address is 126, and the default service bus address is 1.

The I/O modules are addressed automatically relative to the station address.

LEDs on the front of the Com Unit indicate active data communication:

- If a yellow LED does not flash on the Com Unit when a slave is accessed, there is an interruption in the transmitting cable to the master (interface fault in the master or cable fault).
- If communication cannot be established, the wrong station address may have been selected. Alternatively, the terminator may not be connected, or connections may have been made that are not permitted.

When installing the bus, make sure that the transmitting and receiving lines RTD-P and RTD-N have not been swapped. Swapping these lines may block access to one slave but allow access to all the others. If the lines are swapped when looping through to the terminals on the slave, access to all other subsequent stations is blocked.

Make sure that the parameterization of the master and slave corresponds and that the correct Profibus ID number is selected.

In Profibus applications, the operator interface accesses the DP configuration string so that you can check whether the configuration is correct.

Configure the station either

- using your master configuration software and the GSD file,
- using appropriate master software that includes an FDT base application for the integration of DTMs and Profibus class 2 services for configuring the Remote I/O station or
- using PDM in Siemens systems.

In addition, note the following points to successfully commission the bus.

- A terminator must be present at the start and the end of the bus (available from P+F as an accessory).
- The master read cycle and the Com Unit watchdog must be adapted to one another. This is usually a standard function for the PCS or PLC.
- Remember that some process control systems can only process limited data records. Older Siemens Teleperm systems, for example, are only able to process 32 bytes of input and output data per slave as a result. However, the accuracy of analog circuits requires the transfer of 2 bytes per channel, i.e. in this case only 16 analog inputs can be used in one station.

Refer to the hardware manuals for the LB/FB Remote I/O system for more information on Remote I/O hardware.

5.14 Replacing or adding Com Units

Read the LB/FB Remote I/O hardware manuals before replacing or adding Com Units.

Note!

Default Profibus address

The default Profibus address of the Com Unit is 126 and the service bus address is 1. The Profibus address 126 is a preallocated address that is not available in Profibus systems for operative slaves. When a new Com Unit is used, this preallocated address prevents conflicts with the addresses of other slaves in the bus line.

Caution!
Conflicts when replacing redundant Com Units

Incorrect Profibus addresses can lead to conflicts.

In a redundant system, Com Units should only be replaced while the plant is operating if the Com Units have line redundancy and the Profibus address in the Com Unit is preset to 126 (default setting). The Com Units begin to exchange setting information after installation.

Replacing Com Units (1:1 replacement)

1. Make sure that the firmware version of the new Com Unit is the same as the Com Unit being replaced.
2. Make sure that the Profibus address of the new Com Unit is the same as the Com Unit being replaced. Use a separate Remote I/O configuration slot to perform checks and configure the correct Profibus address in the Com Unit.
3. Replace the old Com Unit with the new one.

Adding redundant Com Units

Note!

The redundant Com Unit automatically adopts the parameters of the primary Com Unit via an internal connection. Before installing the redundant Com Unit, establish the internal connection on the FB Remote I/O between the two Com Units via the front cable connection. With LB Remote I/O, the internal connection is established automatically via the backplane.

1. Make sure that the Com Unit being added does not occupy a Profibus address that is already used by another slave in the system. The default Profibus address setting 126 is also suitable here because another slave cannot occupy this address.
2. Add the redundant Com Unit.

6 Basic DTM software functions

This chapter includes the most important basic functions of the P+F DTM software.

6.1 Universal screen elements

In any DTM device data window, unsaved modifications to device data are displayed in blue. Changes that are saved appear in black.
The meaning of the status bar elements and buttons in all DTM windows is explained below.

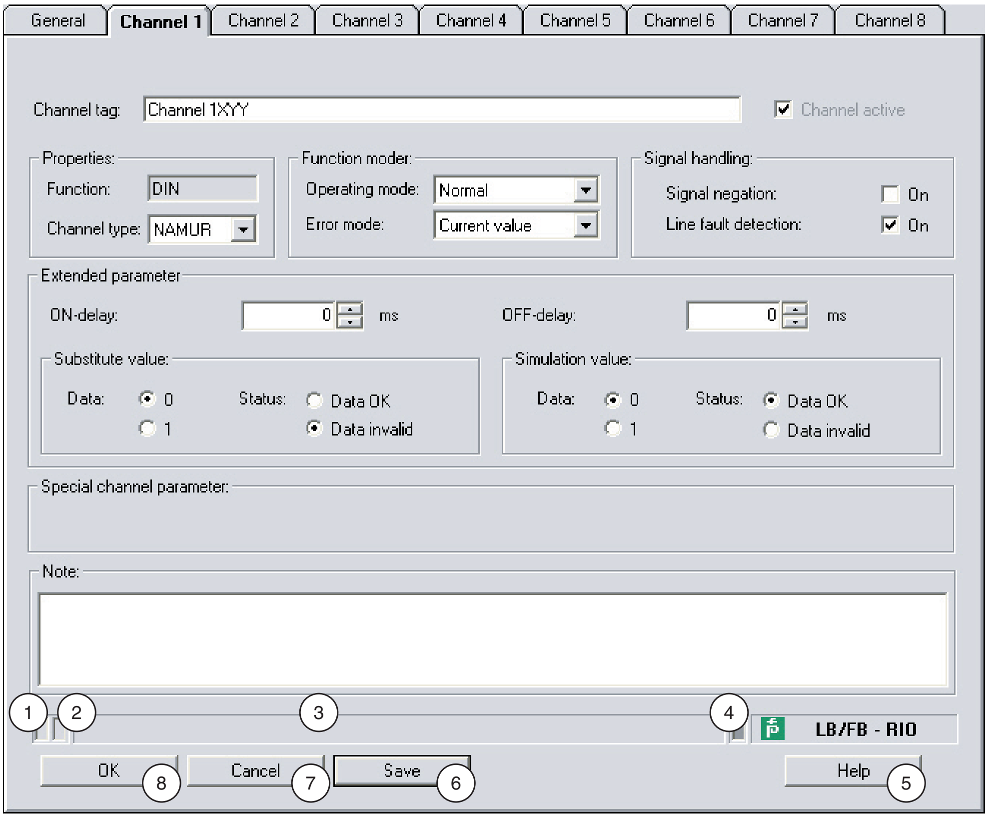

Figure 6.1: Status lines and buttons for a P+F Remote I/O DTM

1. Validity of settings
2. Memory status of settings
3. Text box
4. Connection status
5. **Help** button
6. **Save** button
7. **Cancel** button
8. **OK** button

Explanations:

1

Validity of settings
This box in the status bar indicates whether the modified settings are valid. The box is gray if the settings are valid and blue if the settings are invalid.

2

Memory status of settings
Indicates whether settings have been modified and not saved. The field appears blue if settings have not been saved.

3

Text box
Displays text message relating to certain events.

4

Connection status
Indicates whether a connection to the relevant device is established (yellow = online; gray = offline).

5

Help button
Opens the help file.

6

Save button
Saves any modified settings. The settings are saved in the database (offline, planning) and directly on the device (online) depending on the connection status. The configuration window remains open after the settings are saved.

7

Cancel button
Closes the configuration window without saving any modifications you may have made.

8

OK button
Saves modified settings and closes the configuration window.

6.2 User administration

Note!

The functions described in this section relate to the Remote I/O DTM collection, version 7.4 or later.

A user role concept is implemented in the Remote I/O DTMs according to the FDT. How you set up different users and passwords depends on your FDT base application. In PACTware® 3.5, for example, you access the user administration section via **Options > User administration**.

The FDT user role concept distinguishes between the users "Observer", "Operator", "Maintenance personnel", and "Configuration engineer". The FDT base application already assigns rights and implements limitations to the different user roles. relating to downloading or topology modifications (see FDT base application documentation).
As well as these general limitations, the DTM implements the following additional limitations:

User roles in the DTM

User role	Limitations
Configuration engineer	No limitations
Maintenance personnel	Authorized to modify all parameters except for the fieldbus address. Not authorized to make topology modifications at the system end.
Operator	Authorized to modify all parameters except for the fieldbus address that do **not** influence the data structure or the data volume. Therefore the operator may not modify the following parameters: • **Cyclic data** from Com Units • **Measuring method** of I/O module LB/FB 1x03 • **Measuring method** of I/O module LB/FB 3x02
Observer	Not authorized to modify any parameters.

Table 6.1: User roles in the DTM

6.3 Opening the "Edit device data" window

Note!

Before editing the device data, please read the section "Online and offline parameterization" (see chapter 5).

The **Edit device data** window for the I/O modules is divided into several tabs.

The first **General** tab contains parameters that affect the whole I/O module as well as information on the I/O module and available channels.
Because the layout of the **General** tab is the same for all I/O modules, one description is included here that applies to all I/O modules.

Furthermore, there is a **Channel X** tab for each channel of the I/O module, whereby the "X" replaces the channel numbers (Channel 1, 2, 3, ...). The **Channel X** tab contains parameters that affect one channel of the I/O module as well as channel-specific information. Refer to the chapter "Configuring I/O modules" for a description of the Channel X tabs (see chapter 7).

Instructions on how to open the **Edit device data** window appear first.

Opening the **Edit device data** window

Prerequisite: You have already created a project file in the FDT base application. This project file is open and the project structure contains a Com Unit and one or more I/O modules.

1. Click the entry for the required I/O module in the project structure using the right mouse button.

   A context menu opens.

2. Depending on the connection status, select **Parameters** > **Parameterization** > **Edit device data** or **Parameters** > **Online parameterization** > **Edit device data** in the context menu.

   The **Edit device data** window opens.
   The following section contains a description of the **General** tab. An explanation of the significance of each individual **Channel X** tab for each I/O module is included in the chapter "Configuring I/O modules" (see chapter 7).

6.3.1 Editing the "General" tab

You can modify module-specific parameters and obtain module-specific information on the **Channel X** tab.

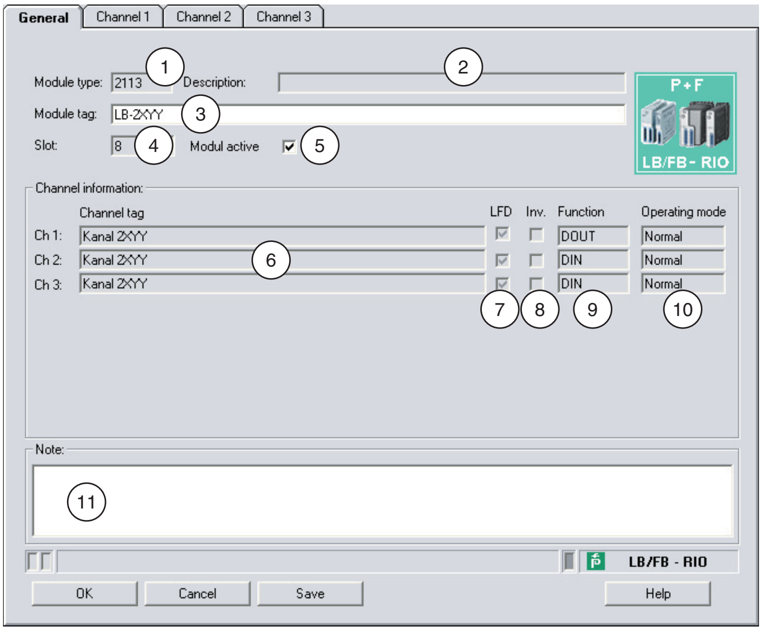

Figure 6.2: **General** tab

1 **Module type** box
2 **Description** box
3 **Module tag** box
4 **Slot** box
5 **Module active** check box
6 **Channel tag** box
7 **LFD** (line fault detection) check box
8 **Inv.** check box (Signal negation, digital I/O modules only)
9 **Channel type** box
10 **Operating mode** box
11 **Note** box

Explanations:

1

Module type box
Displays the four-digit type designation of the I/O module (cannot be edited).

2

Description field
Displays a clear text description of the I/O module (cannot be edited).

3

Module tag box
Enter any name for the I/O module (maximum 32 characters).

4

Slot box

Indicates the slot number of the I/O module. The slot number cannot be edited. If you wish to position the I/O module in another slot, delete the slot from the tree structure and insert again in a new slot. The slots in the tree structure must correspond with the actual arrangement on the backplane.

5

Module active check box

Enable or disable this check box to activate or deactivate the I/O module.

- If you deactivate the I/O module, the module is present in the cyclical data traffic, but does not generate current measured values or diagnostics data.
  This option is particularly useful for control systems that do not allow extensions while the system is operating. In cases such as these, any I/O module can be preconfigured, even if it has not yet been plugged into the backplane (virtual I/O module). This ensures that the module is already included in the DP configuration string. The I/O module can be upgraded in the relevant slot on the backplane at a later time and reactivated using the **Module active** option without triggering a Profibus restart.
- If you activate the I/O module, it operates normally and generates current measured values and diagnostics data.

6

Channel tag box
The names of the channels of the I/O module are entered here. You can enter the names in the **Channel tag** box on the **Channel X** tab for the relevant I/O module. You cannot modify the names here (see Chapter "Configuring I/O modules", see chapter 7).

7

LFD check box
The check box only appears when the I/O module has a line fault detection function. Here you can see whether line fault detection is activated for each channel. You can activate/deactivate line fault detection for each channel on the **Channel X** tab for the relevant I/O module. You cannot modify the line fault detection settings here (see Chapter "Configuring I/O modules", see chapter 7).

8

Inv. check box
This check box only appears with digital I/O modules (digital inputs, digital outputs and relay outputs).
Indicates whether signal negation is active on each channel. You can activate/deactivate signal negation for each channel on the **Channel X** tab for the relevant I/O module. You cannot modify the line fault detection settings here (see Chapter "Configuring I/O modules", see chapter 7).

9

Channel type box
Indicates the channel type for each channel ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output). The box cannot be edited.

10

Operating mode box
Indicates which operating mode is preset on each channel. You can preset the operating mode for each channel on the **Channel X** tab for the relevant I/O module. You cannot change the operating mode here (see Chapter "Configuring I/O modules", see chapter 7). See section "Setting the operating mode" (see chapter 6.7.1) for more details on the operating mode.

11

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

6.4 Opening the "View process values/diagnosis" window

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information.

Opening the **View process values/Diagnosis** window

Prerequisite: You have already created a project file in the FDT base application. This project file is open and the project structure contains a Com Unit and one or more I/O modules. Communication with the remote I/O station is working properly.

1. Click the required entry in the project structure using the right mouse button.

   A context menu opens.

2. Select **Connect** in the context menu to establish an online connection with the Remote I/O station.

   A connection is established.
   The corresponding entry appears in bold letters once the connection is established. In addition, the connection status is indicated by an icon.

3. Click the entry in the project structure once again using the right mouse button.

   A context menu opens.

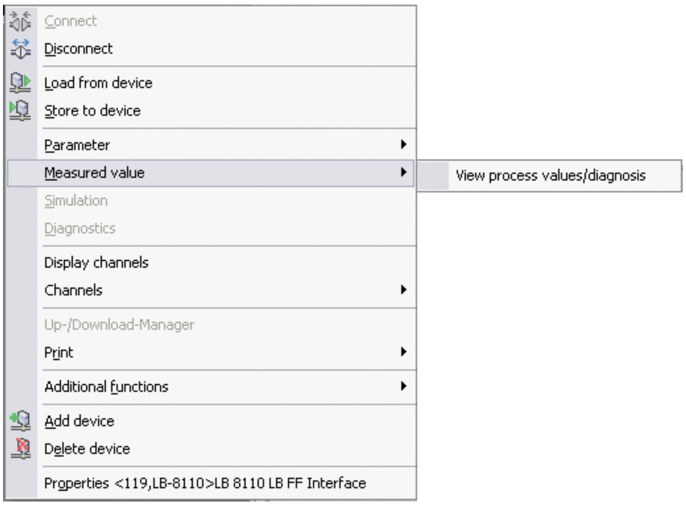

Figure 6.3: Opening the **View process values/diagnosis** window

4. Select **Measured value > View process values/Diagnosis** in the context menu. If the command is not available (grayed out), there is no connection to the Remote I/O station.

   The **View process values/Diagnosis** window opens.

The description of the measured value display can be found in the following chapters:

- Measured value display for digital inputs, digital outputs, and relay outputssee chapter 6.4.1,
- Measured value display for analog inputs, analog outputs, frequency inputs, temperature inputs, and voltage inputssee chapter 6.4.2.

6.4.1 Measured value display of digital I/O modules

The only different thing about the measured value display for digital I/O modules is the number of displayed channels. For this reason, the measured value display is only described in one example for all

- Digital inputs,
- Digital outputs,
- Relay outputs.

Open the **View process values/diagnosis** window first (see "Opening the View process values/Diagnosis window" on page 288).

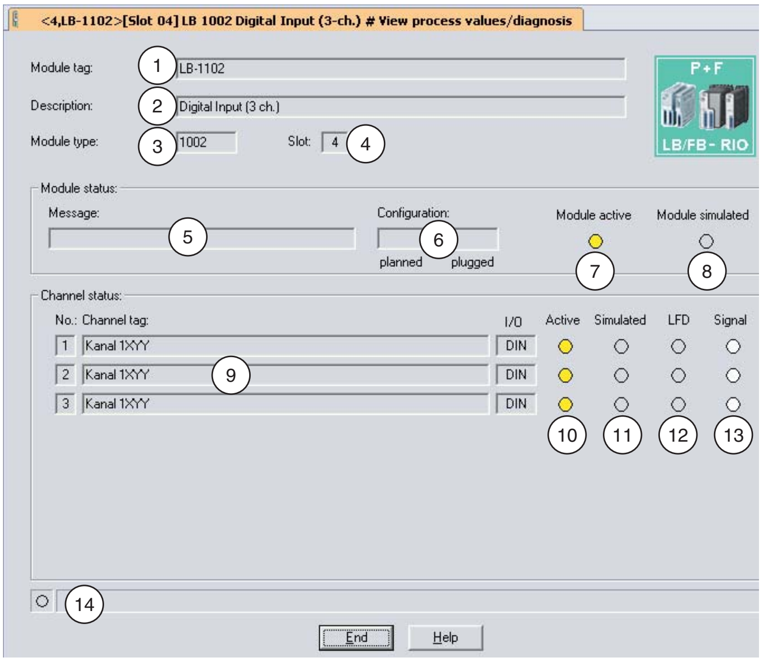

Figure 6.4: **Show measured value display** window

1. **Module tag** box
2. **Module description** box
3. **Module type** box
4. **Slot** box
5. **Messages** box
6. **Configuration** boxes
7. **Module active** indicator
8. **Module simulated** indicator
9. **Channel tag** box
10. **Active** indicator
11. **Simulated** indicator
12. **LFD** indicator
13. **Signal** indicator
14. **Data transfer** indicator

Explanations:

1

Module tag box
Displays the name of the I/O module. You can modify the name on the **General** tab in the **Edit device data** window for the relevant I/O module (see chapter 6.3).

2

Module description box
Displays a clear text description of the I/O module (cannot be edited).

3

Module type box
Displays the four-digit type designation of the I/O module (cannot be edited).

4

Slot box

Indicates the slot number of the I/O module. The slot number cannot be edited. If you wish to position the I/O module in another slot, delete the slot from the tree structure and insert again in a new slot. The slots in the tree structure must correspond with the actual arrangement on the backplane.

5

Message field
Displays messages relevant to the I/O module in clear text. Error messages are highlighted red.

6

Configuration boxes
This box indicates which I/O module was scheduled for installation (included in the active configuration of the Com Unit) and which module was actually plugged into the backplane. If the scheduled and actual I/O module types differ, the boxes appear red.

7

Module active indicator
When the indicator lights up yellow, the I/O module is active. When the indicator is gray, the I/O module is deactivated. You can activate/deactivate the I/O module on the **General** tab in the **Edit device data** window for the relevant I/O module (see chapter 6.3).

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8

Module simulated indicator
When the indicator lights up yellow, at least one channel of the I/O module is being simulated. You can activate/deactivate simulation mode for each channel on the **Channel X** tab in the **Edit device data** window for the relevant I/O module (see chapter 7).

9

Channel tag box
Displays the name of the relevant channel. You can modify the name on the **Channel X** tab in the **Edit device data** window for the relevant I/O module (see chapter 7).
The associated channel number appears on the left of the box and the channel type appears on the right (DIN = Digital Input; DOUT = Digital Output; AIN = Analog Input; AOUT = Analog Output).

10

Active indicator
When the indicator lights up yellow, the associated channel is active. As soon as an I/O module is active, all the channels associated with the module also become active (see **Module active** indicator in the same window).

11

Simulated indicator
When the indicator lights up yellow, the associated channel is being simulated. You can activate/deactivate simulation mode for each channel on the **Channel X** tab (see chapter 7) in the **Edit device data** window for the relevant I/O module.

12

LFD indicator: This indicator only appears if the I/O module has a line fault detection. When the indicator lights up red, there is a line fault on the respective channel. With some I/O modules, a distinction can be made between a lead breakage and a short circuit. In such cases, a "B" for lead breakage or an "S" for short circuit appears next to the **LFD** indicator.
You can activate/deactivate line fault detection for each channel on the **Channel X** tab (see chapter 7) in the **Edit device data** window for the relevant I/O module.

13

Signal indicator
Displays the current field signal. If the indicator lights up yellow, the signal 1 is transferred. If the indicator lights up gray, the signal 0 is transferred.

14

Data transfer indicator
Flashes yellow in rhythm with the data transfer. If a communication fault occurs, the indicator lights up red. The communication status appears in the box to the right of the indicator in the form of a clear text message.

6.4.2 Measured value display of analog I/O modules

The only thing different about the measured value display for analog I/O modules is the number of displayed channels. For this reason, the measured value display is only described in one example for all

- Frequency inputs,
- (HART) analog inputs,
- (HART) analog outputs,
- Temperature inputs,
- Voltage inputs.

Open the **Process values/diagnostics display** window first (see "Opening the View process values/Diagnosis window" on page 288).

The **Channel status** area in the **Process values/diagnostics display** window is divided into the **Overview** and **Input X** or **Output X** tabs. The "X" replaces the numbers 1, 2, 3, etc., which depend on how many input or output channels an I/O module has.

- The **Overview** tab provides an overview of the status and the measured values of all input/output channels of the I/O module (only one input channel in this example).
- The **Input X** and **Output X** tabs display the values of each individual input or output channel shown in the **Overview** tab. In addition, the measured value is displayed in large digits and in bar form, and the LFD status appears individual in an adjacent box.

In the following example, the Overview and Input X tabs are displayed simultaneously.

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Figure 6.5: **View process values/diagnosis** window

1 **Module tag** box
2 **Description** box
3 **Module type** box
4 **Slot** box
5 **Message** box
6 **Configuration** boxes
7 **Module active** indicator
8 **Module simulated** indicator
9 **Channel tag** box
10 **Active** indicator
11 **Simulated** indicator
12 **LFD** indicator
13 **Value** box
14 **Data transfer** indicator
15 **Input/Output X** tab (in this case "Input 1")

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Explanations:

1

Module tag box
Displays the name of the I/O module. You can modify the name on the **General** tab in the **Edit device data** window for the relevant I/O module (see chapter 6.3).

2

Module description box
Displays a clear text description of the I/O module (cannot be edited).

3

Module type box
Displays the four-digit type designation of the I/O module (cannot be edited).

4

Slot box

Indicates the slot number of the I/O module. The slot number cannot be edited. If you wish to position the I/O module in another slot, delete the slot from the tree structure and insert again in a new slot. The slots in the tree structure must correspond with the actual arrangement on the backplane.

5

Message field
Displays messages relevant to the I/O module in clear text. Error messages are highlighted red.

6

Configuration boxes
This box indicates which I/O module was scheduled for installation (included in the active configuration of the Com Unit) and which module was actually plugged into the backplane. If the scheduled and actual I/O module types differ, the boxes appear red.

7

Module active indicator
When the indicator lights up yellow, the I/O module is active. When the indicator is gray, the I/O module is deactivated. You can activate/deactivate the I/O module on the **General** tab in the **Edit device data** window for the relevant I/O module (see chapter 6.3).

8

Module simulated indicator
When the indicator lights up yellow, at least one channel of the I/O module is being simulated. You can activate/deactivate simulation mode for each channel on the **Channel X** tab in the **Edit device data** window for the relevant I/O module (see chapter 7).

9

Channel tag box
Displays the name of the relevant channel. You can modify the name on the **Channel X** tab in the **Edit device data** window for the relevant I/O module (see chapter 7).
The associated channel number appears on the left of the box and the channel type appears on the right (DIN = Digital Input; DOUT = Digital Output; AIN = Analog Input; AOUT = Analog Output).

10

Active indicator
When the indicator lights up yellow, the associated channel is active. As soon as an I/O module is active, all the channels associated with the module also become active (see **Module active** indicator in the same window).

11

Simulated indicator
When the indicator lights up yellow, the associated channel is being simulated. You can activate/deactivate simulation mode for each channel on the **Channel X** tab (see chapter 7) in the **Edit device data** window for the relevant I/O module.

12

LFD indicator: This indicator only appears if the I/O module has a line fault detection function.
If the indicator lights up red, there is a line fault in the relevant channel. The line fault is specified in more detail on the **Input/Output X** tabs.
You can activate/deactivate line fault detection on the **Channel X** tab (see chapter 7) in the **Edit device data** window for the relevant I/O module.

13

Value box
Displays the current measured value in the relevant unit.

14

Data transfer indicator
Flashes yellow in rhythm with the data transfer. If a communication fault occurs, the indicator lights up red. The communication status appears in the box to the right of the indicator in the form of a clear text message.

15

Input/Output X tab
(in this case "Input 1") Displays the individual values on the **Overview** tab for the respective input or output channel. The measured value is also displayed in large digits and in bar form, and the LFD status appears in an adjacent box (provided the I/O module has line fault detection).

6.5 Measured value processing

This section explains the methods for processing measured values of analog I/O modules. Detailed descriptions on each I/O module are included in the chapter "Configuring I/O modules" (see chapter 7).

6.5.1 Scaling the measuring area

Normally, analog measured data is transferred in whole numbers without a prefix within a range between 10,000 (0 %) and 50,000 (100 %). For process control systems that are not capable of processing number ranges this large, you can adapt the number range for each channel of an analog I/O module separately.

Please note that scaling is based on live zero signals (0% = 4 mA, 100% = 20 mA). Therefore, when using 10,000 (beginning of range) to 50,000 (end of range) scaling, 50% is equal to the numerical value 30,000. If the value 0 is transferred by the bus, the output assumes the value 0 mA. And so input signals of 0 mA are signaled to the PCS by the numerical value 0.
The scaling could also be set to between 4000 and 20,000 so that correspondence with the 4-20 mA signal range is maintained. This setting is also suitable for 0 to 20 mA signals with an extended range.

Enter the required number range in the **Measuring/Scaling** area in the device data window for the respective I/O module (**Scaling** column). Whole numbers within the range 0 ... 65535 are possible.

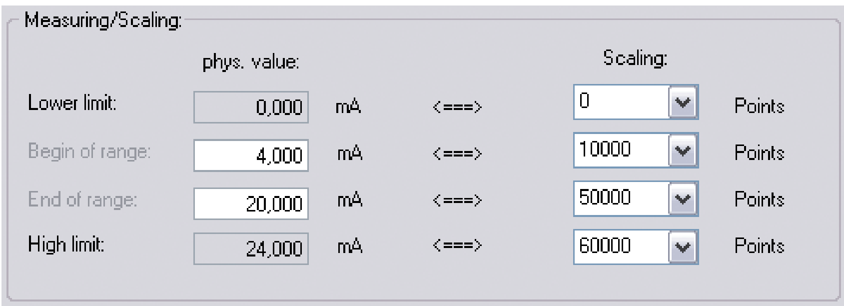

Figure 6.6: Scaling the measuring area

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Note!

For example: A process control system operates better within a range between 0 and 4095 instead of 0 and 65535. Select the following settings in the PCS to adapt the scaling:
Beginning of range: 625
End of range: 3125
Scaling factor: 1,3107
Overranges and underranges of the 4 to 20 mA signal that extend beyond the measured value can also be displayed.

Note!

On control systems that support the FDT concept, scaling is neither necessary nor appropriate. This is because the relevant channel variables that are created by the DTM and can be used directly from the process control system, use the last 12 bits (bits 4-15) of the 16-bit value and specify the validity of the measured value in bit 1.

6.6 Configuring HART communication

I/O modules

- 3x02, 3x03, 3x05,
- 4x02, and 4x05

are suitable for communication with intelligent field devices using the HART protocol. HART field devices can be addressed, activated, and operated via the Profibus.

Note!

Always use single-channel I/O modules 3x02 for HART communication with active (separately powered) field devices.
Note that the connection layout is different from that of the supply circuit.

Make sure that the output current during HART communication is between 4 and 20 mA.

HART communication is based on the transmission of frequency packages according to the Bell standard (1200 Hz = 1, 2200 Hz = 0). The frequency packages are modulated onto the 4-20 mA signals in FSK mode (Frequency Shift Keying) by the I/O modules. Two types of communication are possible.

- Communication using a certified, Ex-approved handheld connected to the I/O module terminals. A 250 Ω communications resistor is built into all analog I/O modules. Transmitters that do not use the standard HART protocol may need to be reset after they have finished operating (see section below). This problem can be identified when the measurement circuit freezes. The circuit can be reset by disconnecting the power supply (pull out the I/O module briefly).
- Communication with the Com Unit via the Profibus using acyclic DPV1 services (as per the PNO profile for HART on Profibus V 1.0) and with the I/O modules without additional equipment. For HART communication, use a suitable communications program to access the functions of the HART field devices via the Profibus. Field device manufacturers provide separate DTMs for their field devices so that all the functions of the field devices are accessible via the Profibus using the HART protocol. In addition, Profibus class 2 masters can also be used if the master PCS does not provide HART functionality. These options are also available using a PCS with suitable HART drivers (e.g. PDM).

For HART communication in FDT base applications, we offer a HART communication component that is installed using the standard setup of the LB/FB Remote I/O DTM collection. In conjunction with a HART-DTM (e.g. Generic HART DTM from the PACTware standard setup), this component gives access to connected HART devices. HART devices are planned in the same way as Com Units and I/O modules (see description below).

Configuring HART communication in PACTware

Prerequisites: You have already created a project file in the FDT base application (see chapter 5). This project file is open and the project structure contains one Com Unit and at least one HART-compatible I/O module. Communication with the Remote I/O station is working properly.

1. Click the entry for a HART-compatible I/O module in the project structure using the right mouse button.

   A context menu opens.
2. Select **Add device** in the context menu.

Figure 6.7: Add device context menu

The **Device for** window opens displaying a list of available devices.

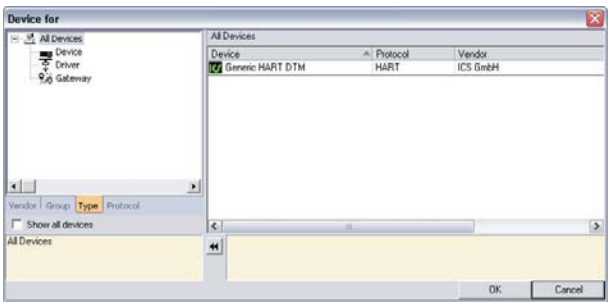

Figure 6.8: Selecting the generic HART DTM

3. Select the device "Generic HART DTM" from the list and then click **OK**.

   If you are using a multichannel I/O module, the **Channel selection** window opens. If you are using a single-channel I/O module, selecting a channel is not necessary.

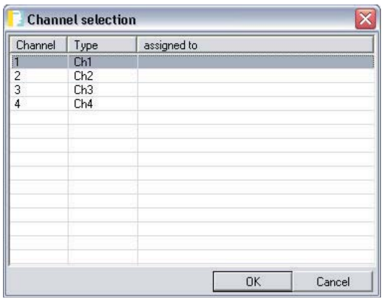

Figure 6.9: **Channel selection** window

4. Select the required I/O module channel from the list and then click **OK**.

   The Generic HART DTM is inserted below the I/O module in the project structure.

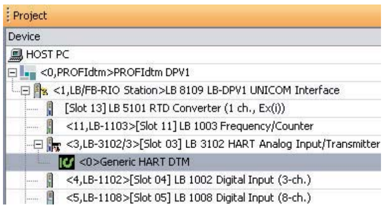

Figure 6.10: Generic HART DTM in the project structure

5. Click the entry "Generic HART DTM" using the right mouse button.

   A context menu opens.

6. Select **Parameterize > Parameterize** in the context menu and adjust the required settings or establish a connection with the field device to read out the data stored on the field device. The device DTM from the manufacturer or the selected Generic HART-DTM are responsible for all other operations.

Note!

Note on Com Units with firmware version V6 - V9

Unlike firmware version V4 Com Units, Com Units with firmware version V6 - V9 are equipped with HART cross talk protection, which makes sure that HART channels are only signaled as faulty if the fault is pending for more than 500 ms. The channel data is frozen until the HART signal faults are rectified. The channel becomes active again as soon as the HART fault is rectified.
In addition, the Com Unit resets I/O modules that have experienced a HART communication fault. A manual reset where the I/O module is disconnected and then reconnected is therefore no longer required.

6.6.1 Practical experiences

The following HART communication limitations were found during tests.

- HART communication with measuring transmitters is possible in the operating range 4 ... 20 mA. Some measuring transmitters go overrange (22 mA) or underrange (< 4 mA) when there is no input signal (lead breakage). In this situation, HART communication with this transmitter is often not possible. This is also the case for handhelds.
- HART incompatibilities: Some measuring transmitter manufacturers supply devices that work with device specific commands. However, communication via the bus in combination with Remote I/O using HART standard commands is possible,. As soon as the device-specific commands (not HART compliant) are issued, the error counter in the I/O module may reach saturation (depending on the firmware and hardware of the I/O module). This applies both for bus communication and measuring transmitters operated using intrinsically safe handhelds from the manufacturer. In this case, the field device then needs to be reset by briefly removing the I/O module and then plugging it back in (interrupting the power supply).
- HART-like signals: Some moving-coil positioners without HART functionality may generate HART-like signals in 20 mA loops. These signals can be produced by vibrations at the installation location of the positioner which fall within the HART frequency band. This causes the error counter on the I/O module 4x02 to overflow. The I/O module stops communicating with the Com Unit, which then issues an error message to the PCS.
  If you should encounter similar HART communication problems with the I/O module, a reset will be necessary. You can avoid this problem from the outset by using an I/O module without HART functionality (4x01) or by deactivating the HART function on the affected channel.

6.7 Operating mode and error mode

Different function modes for each channel of an I/O module can be selected in the DTM configuration window. The operating modes "Normal" and "Simulation" and the error modes "Current value", "Substitute value", and "Last valid value" are available. Read the following subsections and the chapter "Configuring the I/O modules" to find out more (see chapter 7).

6.7.1 Setting the operating mode

During commissioning or service work, you have the option of switching the channels of the I/O modules from "Normal" to "Simulation" operating mode. The channel then adopts a defined simulation value. You can preset both the operating mode and the simulation value for each channel in the device data window for the relevant I/O module (see chapter 7).

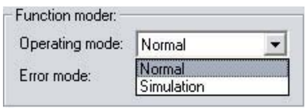

Figure 6.11: Setting the operating mode

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Tip

Saving the configuration

Before setting multiple channels to "Simulation" mode, we recommend saving a copy of the current configuration to the hard disk so that you can easily reset all channels from "Simulation" to normal mode at a later time.

The simulation function can be used while the fieldbus is operating and does not interrupt data communication. Only the channel that is switched to "simulation" is processed with simulation values rather than current field signals.
If "Simulation" is selected, the fieldbus values are simulated. Input data is transferred via the fieldbus as preset data (simulation value). Output data (simulation value) still has to run through the internal signal processing of the LB/FB Remote I/O first so that you can simulate sensor signals during commissioning without modifying the sensor to check that data is communicated correctly to the process control system. Also, you can check the function of valves, even if bus communication has not yet been established.

You can check the results of the simulation setting in the process value display. After finishing commissioning or service work, reset the operating mode to "Normal".

6.7.2 Adjusting error mode settings

In the event of a fault, the I/O modules automatically switch over to error mode. The affected channel then adopts an adjustable substitute value. You can define which value the channel adopts in the device data window for the relevant I/O module (see chapter 7).

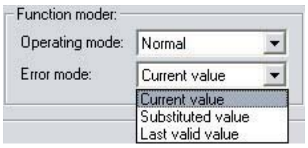

Figure 6.12: Adjusting error mode settings

Error mode for outputs
Substitute values for outputs are adopted when the watchdog time expires or the "invalid" identifier is preset in the process value. The watchdog time is preset in the Com Unit and monitors communication between the master and slave. If this time is set to zero (watchdog deactivated), the substitute value function becomes ineffective if the bus fails. If during the start-up phase (connecting the power supply) a fault condition is detected, the outputs are transferred from the status "Power off" to the corresponding substitute value as specified in the options for the selected substitute value.

The following substitute value options can be modified for error mode:

- Current value:
  The current value is the value currently being transferred from the PCS, which is still issued despite having an "Invalid" identifier.
- Substitute value:
  The substitute value can be changed manually to any permissible value within the operating range of the I/O module.
- Last valid value:
  The last valid value before the fault occurred is retrieved from the memory of the Com Unit. If an error bit is detected when the new value arrives, the Com Unit uses this value to form the output value.

If communication between the I/O module and the Com Unit fails, the affected outputs are deactivated after a watchdog time of approx. 500 ms.

Error mode for inputs

Inputs send substitute values to the PCS when a lead breakage, a short circuit, or a general module-related error (I/O module defective) is pending.
The following substitute value options can be modified for error mode:

- Current value:
  The current value is the faulty measured value that is transferred with an error bit when a sensor error occurs (invalid data).
- Substitute value:
  The substitute value can be modified manually. From version 7 of the DTM, the status of the substitute value is set to "Invalid" permanently.
- Last valid value:
  The last valid value before the fault occurred is retrieved from the memory of the Com Unit and used to form the input value if an error bit is detected when the new value arrives. The status of the last valid value is set to "Invalid".

If communication between the I/O module and the Com Unit fails, the status of the affected inputs is set to "Invalid data". An alarm bit is set in the corresponding slot from the module status area.

Error mode - Responses

The diagram and table below use an example of a digital output to demonstrate the data flow resulting from different situations and parameter settings.

- In normal mode, the data is transferred directly from the Com Unit to the output.
- If an inversion has been configured, the signals are inverted beforehand according to their parameter setting.
- If simulation values are output instead of the current bus data, these simulation values are processed in the same way as bus data and are inverted if necessary.
- If the error bit (invalid data) is set, the relevant substitute values, the last valid values, or the current values are transferred to the outputs depending on the error mode.

All processes are applied to each individual channel. The table shows a selection of the possible combinations that the diagram generates when the flow of data is traced.

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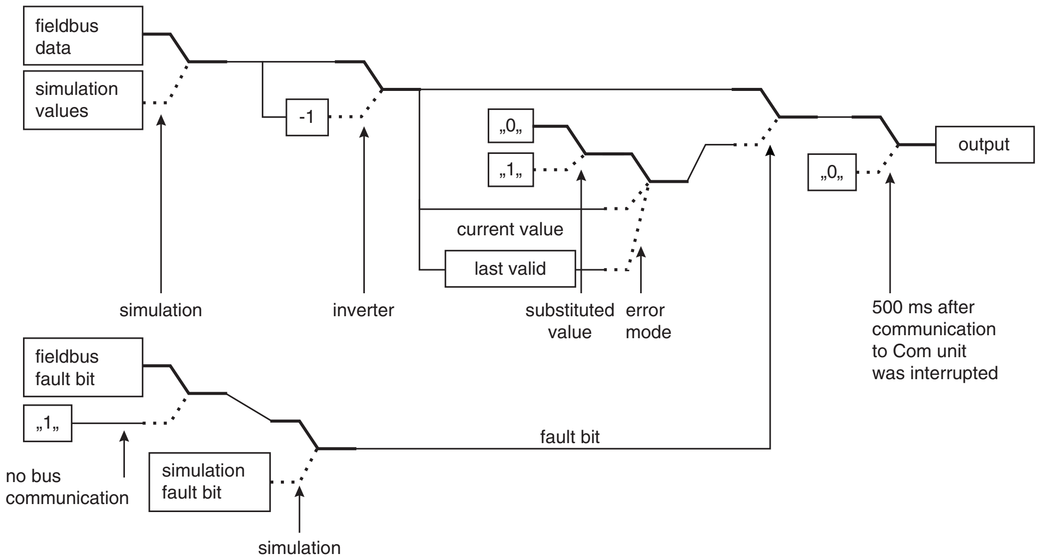

Figure 6.13: Data flow from Com Unit to a digital output

Function table (digital outputs)

	Com Unit			**I/O module**					
State	Data bit	Error bit	Com 1	Simul.	Operating mode	Com 2	Inv.	Error mode	Output
Operation	0	0	Yes	-	normal	Yes	0	-	0
Operation	1	0	Yes	-	normal	Yes	0	-	1
Operation	0	0	Yes	-	normal	Yes	1	-	1
Operation	1	0	Yes	-	normal	Yes	1	-	0
Operation Error bit	0	1	Yes	-	normal	Yes	0	Curr. value	0
Operation Error bit	1	1	Yes	-	normal	Yes	0	Curr. value	1
Operation Error bit	0	1	Yes	-	normal	Yes	1	Curr. value	1
Operation Error bit	1	1	Yes	-	normal	Yes	1	Curr. value	0
Bus fault	Old	-	No	-	normal	Yes	-	Curr. value	Old

Abbreviations: Com 1 = Communication with fieldbus; Simul. = Simulation; Com 2 = Communication with Com Unit; Inv. = Signal negation; Curr. value = current value

Table 6.2: Function table (digital outputs)

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7 Configuring I/O modules

The sections below describe the features and configuration options for I/O modules compatible with the Com Unit.

The sections are always similar in structure:

- Brief description of the relevant I/O module with block diagram,
- Information on resolution and measuring/cycle time,
- Information on data transfer, function table with bit assignment,
- Information on line fault detection and diagnostics functions,
- Description of adjustment options.

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7.1 LB/FB 1x01 digital input

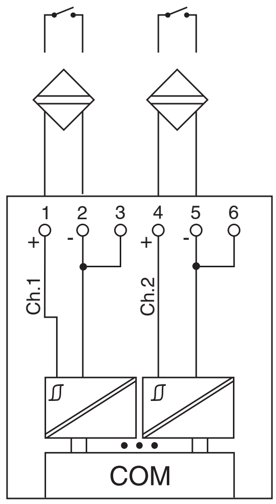

Figure 7.1: Connection diagram 1x01

The digital input is the interface between process signals from digital sensors (mechanical contacts, NAMUR initiators, optocouplers, etc.) and the process control system or PLC.

Versions

- LB 1001, not intrinsically safe
- LB 1101, intrinsically safe
- FB 1201, intrinsically safe
- FB 1301, Ex-e

Features

- Module width: 1 slot
- NAMUR in accordance with DIN 19234
- 2 channels
- Channels galvanically isolated from the bus and from one another

Refer to the corresponding data sheet and operating instructions for further information.

7.1.1 Measuring time and cycle time

The maximum input frequency of the signals is 50 Hz. Whether signals of this frequency can actually be measured, however, depends on the cycle time of the data traffic on the Profibus (e.g. only 1 Hz with 500ms sampling interval).
Short signals can be extended to suit the sampling cycles of the process control system using a parameterizable OFF delay (see section "Editing device data" for this I/O module).
The signals are transmitted to the Com Unit every 6.5 ms irrespective of the sampling interval of the process control system.

7.1.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The DP configuration code of the digital input is **10**.

Device function - bit assignment in the data telegram

Digital input 1x01		
Byte	**Bit**	**Meaning**
Input byte 1	0	Status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Status channel 2
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Empty
	5	Empty
	6	Empty
	7	Empty
Output bytes		Without output bytes

Table 7.1: Device function - bit assignment in the data telegram

7.1.3 Line fault detection

Each channel has a function for line fault detection and can distinguish between a lead breakage and a short circuit (NAMUR input only). Line fault detection can be switched on and off via software.
If you are using mechanical contacts, either deactivate line fault detection or connect the mechanical contact at the installation location using a NAMUR replacement resistor (see illustration below). The NAMUR replacement resistor replicates a NAMUR initiator. Using the NAMUR replacement resistor, the electronic circuit can distinguish between a closed switch and a short circuit. The NAMUR replacement resistor is available from P+F as an accessory.

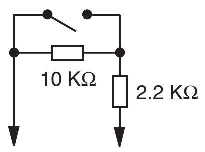

Figure 7.2: NAMUR equivalent resistance

7.1.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.1.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.1.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.1.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

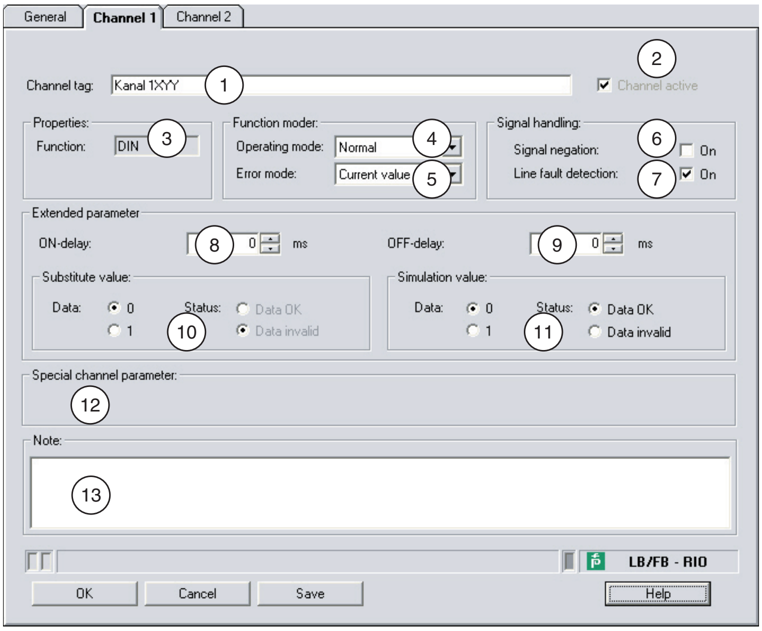

Figure 7.3: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **Line fault detection** check box
8 **ON delay** box
9 **OFF delay** box
10 **Substitute value** area
11 **Simulation value** area
12 **Special channel parameters** area
13 **Note** box

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Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.
The line fault detection function is only available for NAMUR signals. On contact inputs without a NAMUR shunt resistor, the connection at the field end cannot be monitored.

8

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1. Use the ON delay to filter out brief disturbing pulses (contact bounce) (see illustration below).

9

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0. Use the OFF delay to extend short pulses. In this way, even extremely short signals from the fieldbus cycle can be detected (e.g. go-devil control) (see illustration below).

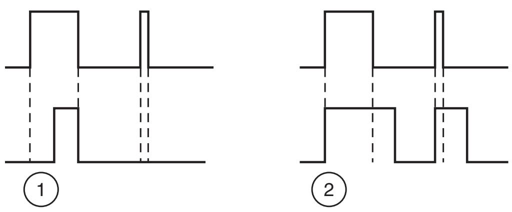

Figure 7.4: ON and OFF delay

1 ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).

2 OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

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10

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

11

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

12

Special channel parameters area

The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.1.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.2 LB/FB 1x02 digital input

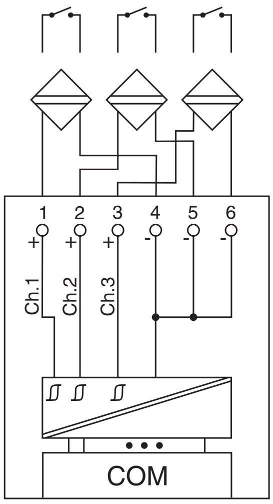

Figure 7.5: Connection diagram 1x02

The digital input is the interface between process signals from digital sensors (mechanical contacts, NAMUR initiators, optocouplers, etc.) and the process control system or PLC.

Versions

- LB 1002, not intrinsically safe
- LB 1102, intrinsically safe
- FB 1202, intrinsically safe
- FB 1302, Ex-e

Features

- Module width: 1 slot
- NAMUR in accordance with DIN 19234
- 3 channels
- Channels galvanically isolated from the bus, with shared negative conductor

Refer to the corresponding data sheet and operating instructions for further information.

7.2.1 Measuring time and cycle time

The maximum input frequency of the signals is 50 Hz. Whether signals of this frequency can actually be measured, however, depends on the cycle time of the data traffic on the Profibus (e.g. only 1 Hz with 500ms sampling interval).
Short signals can be extended to suit the sampling cycles of the process control system using a parameterizable OFF delay (see section "Editing device data" for this I/O module).
The signals are transmitted to the Com Unit every 6.5 ms irrespective of the sampling interval of the process control system.

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7.2.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The DP configuration code of the digital input is **10**.

Device function - bit assignment in the data telegram

Digital input 1x02		
Byte	**Bit**	**Meaning**
Input byte 1	0	Status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Status channel 2
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Status channel 3
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6	Empty
	7	Empty
Output bytes		Without output bytes

Table 7.2: Device function - bit assignment in the data telegram

7.2.3 Line fault detection

Each channel has a function for line fault detection and can distinguish between a lead breakage and a short circuit (NAMUR input only). Line fault detection can be switched on and off via software.
If you are using mechanical contacts, either deactivate line fault detection or connect the mechanical contact at the installation location using a NAMUR replacement resistor (see illustration below). The NAMUR replacement resistor replicates a NAMUR initiator. Using the NAMUR replacement resistor, the electronic circuit can distinguish between a closed switch and a short circuit. The NAMUR replacement resistor is available from P+F as an accessory.

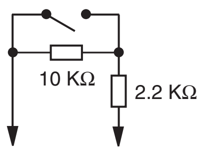

Figure 7.6: NAMUR equivalent resistance

7.2.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.2.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.2.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.2.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

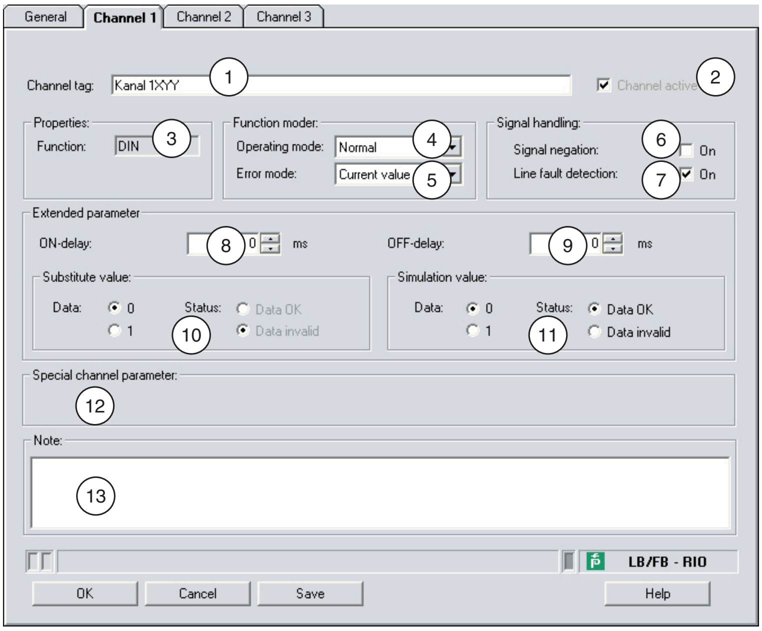

Figure 7.7: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **Line fault detection** check box
8 **ON delay** box
9 **OFF delay** box
10 **Substitute value** area
11 **Simulation value** area
12 **Special channel parameters** area
13 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

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2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

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7

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.
The line fault detection function is only available for NAMUR signals. On contact inputs without a NAMUR shunt resistor, the connection at the field end cannot be monitored.

8

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1. Use the ON delay to filter out brief disturbing pulses (contact bounce) (see illustration below).

9

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0. Use the OFF delay to extend short pulses. In this way, even extremely short signals from the fieldbus cycle can be detected (e.g. go-devil control) (see illustration below).

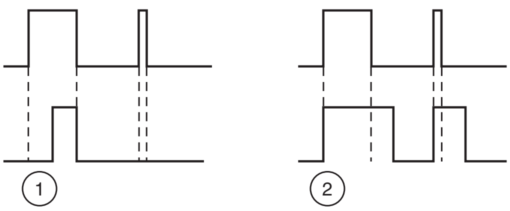

Figure 7.8: ON and OFF delay

1 ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).

2 OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

10

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

11

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

12

Special channel parameters area

The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.2.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

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7.3 LB/FB 1x03 frequency input

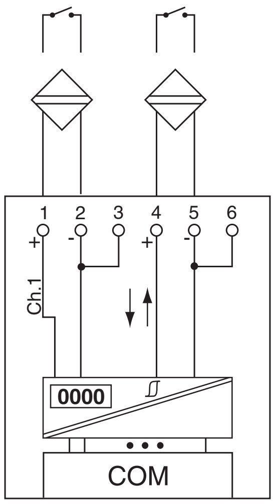

Figure 7.9: Connection diagram 1x03

The digital input is the interface between process signals from digital sensors (mechanical contacts, NAMUR initiators, optocouplers, etc.) and the process control system or PLC.

Versions

- LB 1003, not intrinsically safe
- LB 1103, intrinsically safe
- FB 1203, intrinsically safe
- FB 1303, Ex-e

Features

- Module width: 1 slot
- NAMUR in accordance with DIN 19234
- 1 channel, galvanically isolated from the bus
    - Channel 1 for frequency measurement or pulse counting
    - Additional rotation direction input for rotation direction detection (e.g. for rotating machine) or counting direction detection (forwards or backwards); no separate channel

Note!

Bandwidth limitation

The bandwidth of 15 kHz is not suitable for bouncing contacts. In this case, select a model with a bandwidth of 400 Hz (see catalog).

Refer to the corresponding data sheet and operating instructions for further information.

7.3.1 Measuring time and cycle time

The conversion time is approx. 50 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.3.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The I/O module LB/FB 1x03 has three types of function. The different function types create different data structures in the Profibus data telegram. The frequency input actually represents three devices. All require different drivers to operate in the process control system and all have different DP codes in the GSD file.

If you wish to change the function type of the I/O module, remember that changing the function type means that you will have to change the I/O module. **Changing the function type during operation is therefore only possible with HCiR.** The following function types are available:

- Frequency input up to 15 kHz (with or without direction detection) or 12-bit counter up to 15 kHz (with or without direction detection)
  DP configuration code: **50**
- 32-bit counter (with or without direction detection)
  DP configuration code: **51**
- Combined 32-bit counter and frequency input up to 50 kHz (with or without direction detection)
  DP configuration code: **52**

Device function - bit assignment in the data telegram

Frequency input 1x03				
		Frequency input or 12 bit counter up to 15 kHz	Combined with 32 bit counter and frequency input up to 50 Hz	32 bit counter up to 15 kHz
Byte	**Bit**	**Meaning**	**Meaning**	**Meaning**
Input byte 1	0	Status channel 1		High word of counted value (16 bit)
	1	Line fault detection channel 1 (0 = OK, 1 = error)		
	2	Empty		
	3	Empty or direction detection (0 = forwards, 1 = backwards)		
	4	Frequency (12 bit) or counted value (12 bit)	Frequency (12 bit)	
	5			
	6			
	7			
Input byte 2	0-7			
Input byte 3	0-7	-	High word of counted value (16 bit)	Low word of counted value (16 bit)
Input byte 4	0-7	-		
Input byte 5	0-7	-	Low word of counted value (16 bit)	-
Input byte 6	0-7	-		-
Output bytes		Without output bytes	Without output bytes	Without output bytes

Table 7.3: Device function - bit assignment in the data telegram

7.3.3 Line fault detection

Each channel has a function for line fault detection and can distinguish between a lead breakage and a short circuit (NAMUR input only). Line fault detection can be switched on and off via software.
If you are using mechanical contacts, either deactivate line fault detection or connect the mechanical contact at the installation location using a NAMUR replacement resistor (see illustration below). The NAMUR replacement resistor replicates a NAMUR initiator. Using the NAMUR replacement resistor, the electronic circuit can distinguish between a closed switch and a short circuit. The NAMUR replacement resistor is available from P+F as an accessory.

If you are using rotation direction detection, connect the rotation direction input to a NAMUR shunt resistor. The rotation direction input is ignored for devices without rotation direction detection.

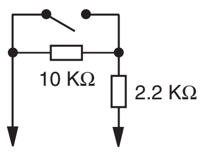

Figure 7.10: NAMUR equivalent resistance

7.3.4 Rotation direction detection

The second digital input (rotation direction input) is used to detect the direction of rotation from the phase shift between the two incoming pulses (view Figure 7.11 on page 120).

If the direction detection has not been specified in the parameter settings, then the pulse count is incremented. If the direction detection has been specified in the parameter settings, the I/O module processes the field signals as follows:

- The counter adds the incoming pulses if the rotation direction input is logic 0.
- The counter decrements the incoming pulses if the rotation direction input is logic 1.

The master detects the counting direction of the 32-bit counter by comparing the count values of successive cycles. For the 12-bit counter, a direction bit is transmitted.

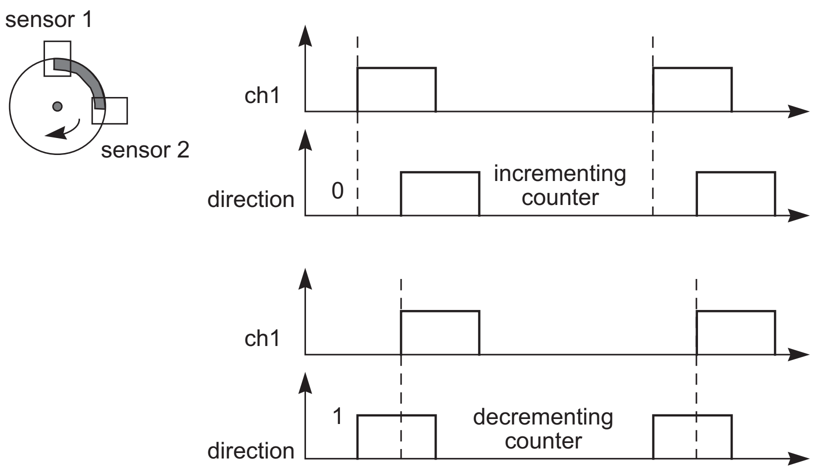

Figure 7.11: Rotation direction detection

7.3.5 Function types

Frequency input up to 15 kHz

Frequencies up to 15 kHz can be measured using this function type. The result of the frequency measurement is transferred to the Com Unit as an integer with a degree of accuracy of 0.1 %. New measured results are available in the Com Unit every 100 ms to 1000 ms (1 Hz) (every 10 seconds at 0.1Hz) depending on the frequency. The frequency measurement operates with the internal 16 MHz quartz to measure the time between 2 pulses. The shortest pulse is 20 µs.

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Counter

The module operates in the same way as a 12 bit counter and records counter values up to 4095 (corresponds to 12 out of 16 bits), whereby the first 4 bits contain status information. In the same way as a 32 bit counter, the I/O module uses a 4 bit counter in the Com Unit that records counter values up to 4294967295 (2^{32}).
A counter quotient can be applied to the counters to prevent them from reaching the maximum counter reading (overflow) before the next bus query when the counting frequencies are high. When a counter and frequency input are combined, the counter quotient is not available.

Combination of counter and frequency input

When a counter and frequency input are combined, the minimum pulse time/pulse pause is 10 ms. The maximum detectable frequency is then 50 Hz.

Frequency input up to 400 Hz

A version of the I/O module is available with a maximum frequency of 400 Hz for sensors with bouncing contacts (special order number, see catalog). Even if all functions of the 15 kHz version can be selected in the configuration software, a software package enables the suppression of pulses with a duration of < 1 ms. In spite of this, the 400 Hz version is treated in the same way as the 15 kHz version.
If the start of range setting is > 0 Hz, check whether the formula
End of range / (1 - start of range / end of range)
produces a result less than 400. The interrupt control prevents higher values from being processed.

Note!

32 bit counter values

32 bit counter values are stored in the Com Unit and are deleted when the Com Unit is removed, the power supply is disconnected (power failure), and during switching between redundant systems.

12 bit counter values are always accurate because they are stored in the actual I/O module. The PCS must add up the difference between two successive queries in order to calculate the 12 bit counter total. When adding up the values after a counter overflow, make sure that the current counter value is less than the previous one. Values are usually counted at relatively low frequencies. The master is therefore in a position to retrieve counter values so regularly that a maximum of 1 counter overflow between queries can be expected.

Note!

The bus cycle time is 500 ms and the value counted by the 12 bit counter is a maximum of 4095 resulting in a maximum frequency of 4095/0.5 sec = 8190 Hz. If the bus cycle time does not match the counting frequency, the 32 bit counter can be used subject to limitations relating to redundancy switchover and disconnection from the power supply.

7.3.6 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.3.7 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.3.8 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.3.9 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

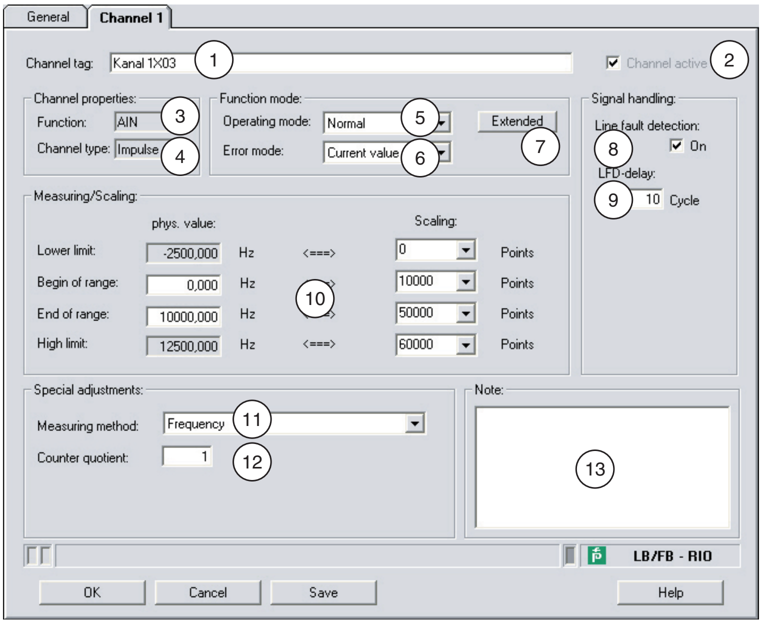

Figure 7.12: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Function** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring/Scaling** area (not always visible)
11 **Measuring method** drop-down list
12 **Counter quotient** box (not always visible)
13 **Note** box

Note!

Hidden areas

The **Measuring/Scaling** area only appears when you select a frequency measurement from the **Measuring method** drop-down list.

The **Counter quotient** box only appears when you select a counter from the **Measuring method** drop-down list.

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.
The line fault detection function is only available for NAMUR signals. On contact inputs without a NAMUR shunt resistor, the connection at the field end cannot be monitored.

9

LFD-delay box

This field only appears if you have activated **Line fault detection**.
Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This option can be used for suppressing loose contacts.

10

Measuring/Scaling area

This area only appears if you have selected a frequency measurement from the **Measuring method** drop-down list. If you have configured a frequency measurement combined with a 32-bit counter, the maximum input frequency is 50 Hz. The **Measuring methods** drop-down list is also located on this tab.
The values for the beginning of the range (0%) and end of the range (100%) in the "Phys. value" column depend on the sensor and the measuring unit. The values for the lower and upper limits in the "Phys. value" column are calculated automatically from the 0-100% range in line with the values in the "Scaling" column.
You are free to define the scaling values for mapping a physical value onto the corresponding 16-bit value.

- **Lower limit**: Indicates the smallest transferable value.
- **Beginning of range**: Indicates the value equal to 0%.
- **End of range**: Indicates the value equal to 100%.
- **High limit**: Indicates the largest transferable value.

11

Measuring method drop-down list

Select the function type for the I/O module. Online modification of the function type is restricted because the different function types have different DP configuration codes. If online modification is not possible, the DTM displays an error.
The following function types are available. Here, the rotation direction detection input can be used either to count up or down or as a status indicator for the direction of rotation.

- Frequency input: Select between "Frequency" and "Frequency and rot. direction".
- Counter: Select between "32 bit counter", "32 bit counter and rot. direction", "12 bit counter" and "12 bit counter with rot. direction". The **Counter quotient** box only appears if you have selected one of these counters as a measuring method.
- Frequency input combined with counter: The maximum input frequency in this mode is 50 Hz. Select between "Frequency + 32 bit counter" and "Frequency + 32 bit counter and rot. direction". Frequency measurement is the primary measuring method.

12

Counter quotient box

This box only appears if you use the I/O module as a counter ("Counter" setting, see paragraph above).
Enter a value x to determine how frequently the pulse is counted.

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13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

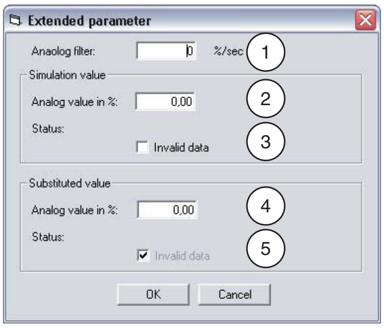

Figure 7.13: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.3.10 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.4 LB/FB 1x08 digital input

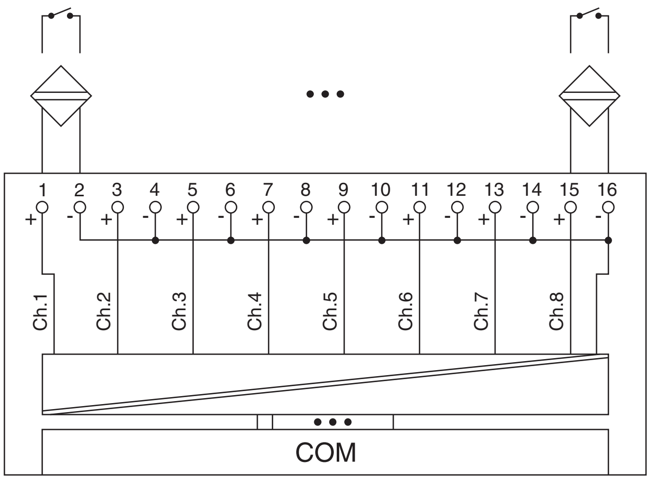

Figure 7.14: Connection diagram 1x08

The digital input is the interface between process signals from digital sensors (mechanical contacts, NAMUR initiators, optocouplers, etc.) and the process control system or PLC.

Versions

- LB 1008, not intrinsically safe
- LB 1108, intrinsically safe
- FB 1208, intrinsically safe
- FB 1308, Ex-e

Features

- Module width: 2 slots
- NAMUR as per DIN 19234 or 24 V DC or 5 V DC
- 8 channels
- Channels galvanically isolated from the bus, shared negative conductor

Refer to the corresponding data sheet and operating instructions for further information.

7.4.1 Measuring time and cycle time

The maximum input frequency of the signals is 50 Hz. Whether signals of this frequency can actually be measured, however, depends on the cycle time of the data traffic on the Profibus (e.g. only 1 Hz with 500ms sampling interval).
Short signals can be extended to suit the sampling cycles of the process control system using a parameterizable OFF delay (see section "Editing device data" for this I/O module).
The signals are transmitted to the Com Unit every 6.5 ms irrespective of the sampling interval of the process control system.

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7.4.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the digital input is **11**.

Device function - bit assignment in the data telegram

Digital input 1x08		
Byte	**Bit**	**Meaning**
Input byte 1	0	Status channel 5
	1	Line fault detection channel 5 (0 = OK, 1 = error)
	2	Status channel 6
	3	Line fault detection channel 6 (0 = OK, 1 = error)
	4	Status channel 7
	5	Line fault detection channel 7 (0 = OK, 1 = error)
	6	Status channel 8
	7	Line fault detection channel 8 (0 = OK, 1 = error)
Input byte 2	0	Status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Status channel 2
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Status channel 3
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6	Status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)
Output bytes		Without output bytes

Table 7.4: Device function - bit assignment in the data telegram

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7.4.3 Line fault detection

Each channel has a function for line fault detection and can distinguish between a lead breakage and a short circuit (NAMUR input only). Line fault detection can be switched on and off via software.
If you are using mechanical contacts, either deactivate line fault detection or connect the mechanical contact at the installation location using a NAMUR replacement resistor (see illustration below). The NAMUR replacement resistor replicates a NAMUR initiator. Using the NAMUR replacement resistor, the electronic circuit can distinguish between a closed switch and a short circuit. The NAMUR replacement resistor is available from P+F as an accessory.

24 V and 5 V inputs can only be used with line fault detection disabled.

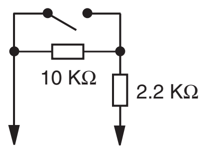

Figure 7.15: NAMUR equivalent resistance

7.4.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.4.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.4.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.4.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

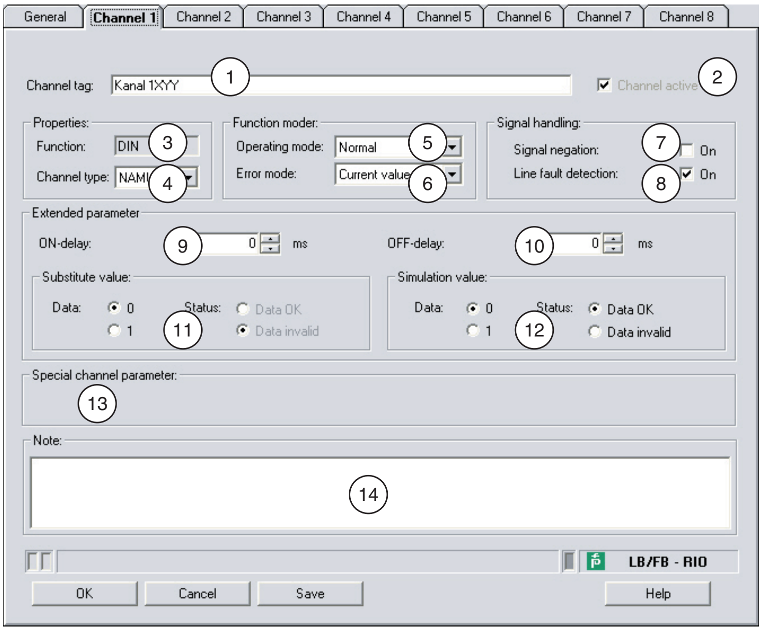

Figure 7.16: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Signal negation** check box
8 **Line fault detection** check box
9 **ON delay** box
10 **OFF delay** box
11 **Substitute value** area
12 **Simulation value** area
13 **Special channel parameters** area
14 **Note** box

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

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2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.
The line fault detection function is only available for NAMUR signals. On contact inputs without a NAMUR shunt resistor, the connection at the field end cannot be monitored.

9

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1. Use the ON delay to filter out brief disturbing pulses (contact bounce) (see illustration below).

10

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0. Use the OFF delay to extend short pulses. In this way, even extremely short signals from the fieldbus cycle can be detected (e.g. go-devil control) (see illustration below).

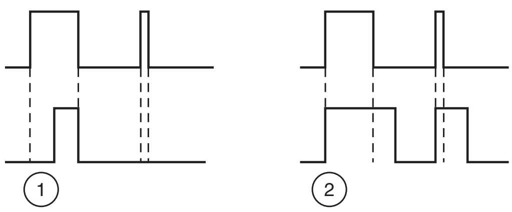

Figure 7.17: ON and OFF delay

1. ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2. OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

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11

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

12

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

13

Special channel parameters area

The area is empty for this I/O module.

14

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.4.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.5 LB/FB 2xxx digital output

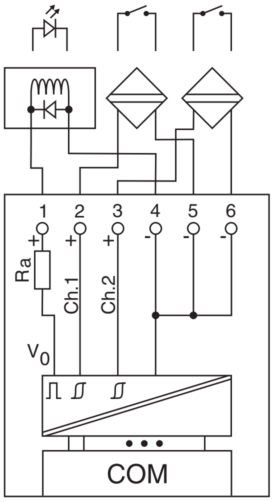

Figure 7.18: Connection diagram 2xxx without output disable input

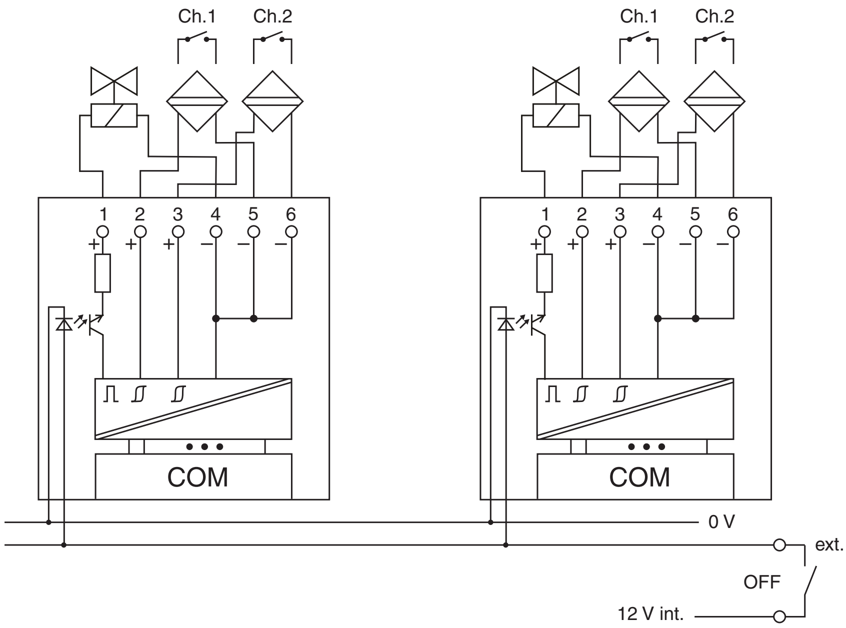

Figure 7.19: Connection diagrams 2xxx with output disable input

The digital output is the interface between the process control system or the PLC and solenoid valves, acoustic sensors or signal lamps (LED).

Versions

- LB 2002, not intrinsically safe
- LB 21xx, intrinsically safe
- FB 22xx, intrinsically safe

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Note!

"xx" replaces the different versions. Versions are available with or without both bus-independent output disable input and line fault detection. The DTM cannot identify the special features of the different versions.
Select the appropriate version from the catalog in line with the valve type. Note which backplane types are compatible with the different versions.

The module is suitable for the following applications depending on the version:

- Solenoid valve control
- Lamp and signal control,
- Processing digital inputs,
- NAMUR inputs or mechanical contacts independent of the valve circuit.

Refer to the LB/FB hardware manuals for more information on controlling or connecting solenoid valves to an LED.

Features

- Module width: 1 slot
- 1 output channel
- 2 input channels (feedback inputs) behave in the same way as the inputs on module 1x02

Refer to the corresponding data sheet and operating instructions for further information.

7.5.1 Measuring time and cycle time

The maximum input frequency of the signals is 50 Hz. Whether signals of this frequency can actually be measured, however, depends on the cycle time of the data traffic on the Profibus (e.g. only 1 Hz with 500ms sampling interval).
Short signals can be extended to suit the sampling cycles of the process control system using a parameterizable OFF delay (see section "Editing device data" for this I/O module).
The signals are transmitted to the Com Unit every 6.5 ms irrespective of the sampling interval of the process control system.

7.5.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration

and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The DP configuration code of the digital output is **30**.

Device function - bit assignment in the data telegram

Digital output 2xxx		
Byte	**Bit**	**Meaning**
Input byte 1	0	Status channel 1 (valve output)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Status channel 2 (feedback input 1)
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Status channel 3 (feedback input 2)
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6	Empty
	7	Empty
Output byte 1	0	Output value channel 1 (valve output)
	1	"Invalid" status channel 1 (0 = OK, 1 = invalid)
	2	Empty
	3	Empty
	4	Empty
	5	Empty
	6	Empty
	7	Empty

Table 7.5: Device function - bit assignment in the data telegram

7.5.3 Line fault detection

Each channel has a function for line fault detection and can distinguish between a lead breakage and a short circuit (NAMUR input only). Line fault detection can be switched on and off via software.
If you are using mechanical contacts, either deactivate line fault detection or connect the mechanical contact at the installation location using a NAMUR replacement resistor (see illustration below). The NAMUR replacement resistor replicates a NAMUR initiator. Using the NAMUR replacement resistor, the electronic circuit can distinguish between a closed switch and a short circuit. The NAMUR replacement resistor is available from P+F as an accessory.

The valve control circuit is monitored by a current pulse. This current pulse is brief enough not to operate a connected valve. The I/O module is available in a version without current pulse for use with LEDs and acoustic alarms. I/O modules delivered from 2007 onwards have a current pulse that can be disabled in the configuration software.

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It is not always possible to monitor the valve circuit when booster valves are used and so each case must be assessed individually. In many cases, monitoring is possible using an auxiliary circuit.

It is not always possible to monitor the valve circuit when booster valves are used because these valves have a storage capacitor that behaves like a short circuit when the valve is off. For some types of booster valve, line fault detection can be achieved by connecting a shunt resistor of 10 kΩ. If a lead breakage is still detected when the valve is off, even with the shunt resistor connected, disable the line fault detection function.

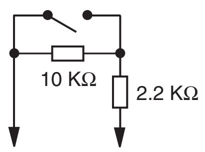

Figure 7.20: NAMUR equivalent resistance

7.5.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.5.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.5.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.5.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel numbers.
A separate tab exists for each channel in the I/O module. The digital output has one output and two input channels. The **Channel 1** tab applies to the output channel and the **Channel 2** and **Channel 3** tabs apply to the input channels. The only difference between the 3 channel tabs is the **Channel type** box, which is why only one tab is described.

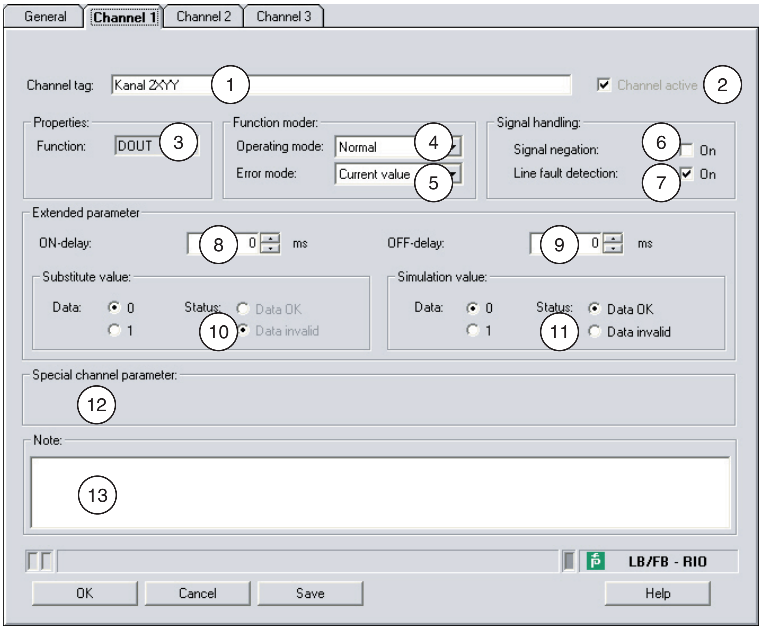

Figure 7.21: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **Line fault detection** check box
8 **ON delay** box
9 **OFF delay** box
10 **Substitute value** area
11 **Simulation value** area
12 **Special channel parameters** area
13 **Note** box

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

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2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Channel type box

Displays the channel type. "DOUT" (digital output) appears on the **Channel 1** tab and "DIN" (digital input) appears on the **Channel 2** and **Channel 3** tabs. The box cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.
The line fault detection function is only available for NAMUR signals. On contact inputs without a NAMUR shunt resistor, the connection at the field end cannot be monitored.

8

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1. Use the ON delay on both digital inputs to filter out brief disturbing pulses (contact bounce) (see illustration below).
The ON delay is of little importance for the digital output because it is located at the end of the active chain and the upstream links of the chain play an important role in determining the time response.

9

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0. Use the OFF delay on the two digital outputs to extend short pulses. In this way, even extremely short signals from the fieldbus cycle can be detected(e.g. go-devil control) (see illustration below).
The OFF delay is of little importance for the digital output because it is located at the end of the active chain and the upstream links of the chain play an important role in determining the time response.

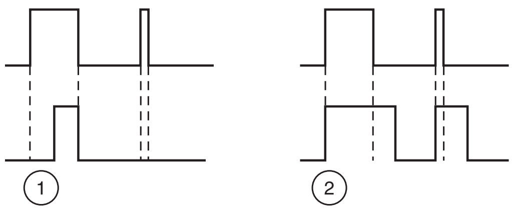

Figure 7.22: ON and OFF delay

1. ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2. OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

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10

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

11

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

12

Special channel parameters area

The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.5.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.6 LB/FB 3x01 analog input

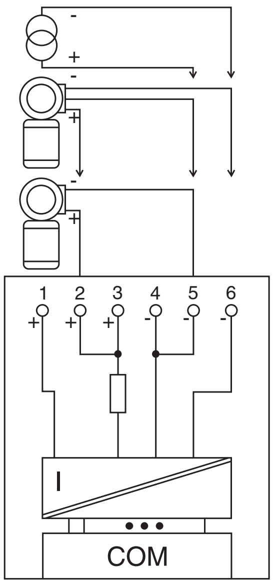

Figure 7.23: Connection diagram 3x01

- Use terminals 4 or 5 (+) and 6 (-) as input isolators for active signals from the field. The input resistance is 15 Ω.
- Use terminals 2 or 3 (+, power supply), 4 or 5 (+, return line), and 6 (-) as a transmitter supply device for 3-wire transmitters.
- Use terminals 2 or 3 (+) and 4 or 5 (-) as a transmitter supply device.

The analog input is the interface for the process signals from the pressure and differential pressure transmitters, level transmitters, externally supplied analysis devices and flow/fluid level transducers to pass to the process control system or the PLC.

Versions

- LB 3101, intrinsically safe
- FB 3201, intrinsically safe

Features

- Module width: 1 slot
- 1 channel
- Supply voltage 14.5 V
- Secondary voltage 24 V (Ex-i)
- Short-circuit current 90 mA (Ex-i)

At 20 mA, the minimum supply voltage is 14.5 V. The voltage is adapted to the needs of the field device up to this limit value. When the mA value decreases to 4 mA, the supply voltage increases to approx. 19 V.

Note!

HART bus communication is only possible via the HART analog inputs LB/FB 3x02, 3x03, or 3x05.

Refer to the corresponding data sheet and operating instructions for further information.

7.6.1 Resolution

Input signals within a range of 0 ... 25 mA are detected with a resolution of 12 bits. The actual measurement range is calculated based on this resolution.
For the range 4 to 20 mA (corresponds to 0 ... 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %. Underranges and overranges are taken into consideration.

7.6.2 Measuring time and cycle time

The conversion time is approx. 100 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.6.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

The DP configuration code of analog outputs 3x01 and 3x03 is **50**. The DP configuration codes of the analog input 3x02 are 50, 52, 54, 56, or 58, depending on the number of HART auxiliary variables being transferred (see section "Editing device data" for the analog input 3x02).

Device function - bit assignment in the data telegram

Analog output 3x01/3x02/3x03		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value (12 bit)
	5	
	6	
	7	
Input byte 2 (high byte)	0-7	
Output bytes		Without output bytes
(*) The live zero monitor transmits an error bit (=1) if the current falls below the minimum of 3.6 mA.		

Table 7.6: Device function - bit assignment in the data telegram

7.6.4 Line fault detection

The I/O module has a line fault detection function that can detect lead breakages and short circuits. Line fault detection can be switched on and off via software. You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g. < 1 mA and > 21 mA.

In addition, the circuit provides live-zero monitoring (fault bit = 1 if the current drops below the minimum level of 3.6 mA).

7.6.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

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7.6.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.6.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.6.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

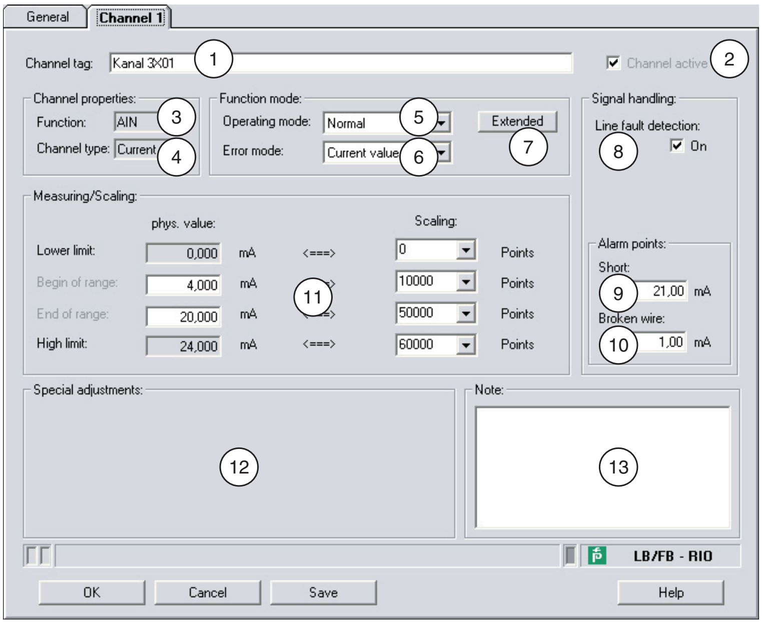

Figure 7.24: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Measuring/Scaling** area
12 **Special settings** area
13 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

Short circuit box

Enter the threshold value for short circuit detection (e.g. 21 mA). When the current strength exceeds this value, the line fault detection function reports a short circuit.

10

Lead breakage box

Enter the threshold value for lead breakage detection (e.g. 1 mA). When the current strength falls below this value, the line fault detection signals a lead breakage.

11

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or 0 mA).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or 4 mA).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or 20 mA).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or 24 mA).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

12

Special settings area
The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

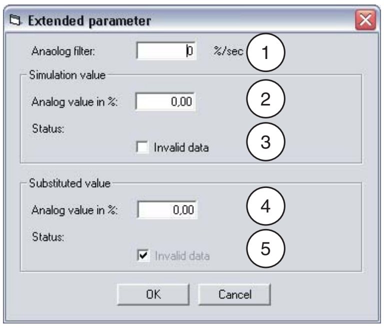

Figure 7.25: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.6.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

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7.7 LB/FB 3x02 and 3x03 HART analog inputs

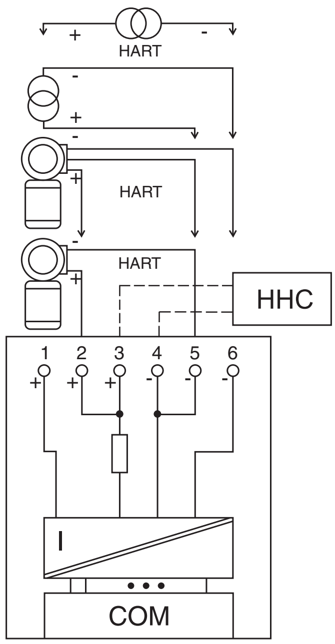

Figure 7.26: Connection diagrams 3x02 and 3x03

- Use terminals 1 (+) and 6 (-) as input isolators for active signals from the field and operate via the HART protocol. The input resistance is 236 Ω (dynamic).
- Use terminals 4 or 5 (+) and 6 (-) as input isolators for active signals from the field. The input resistance is 15 Ω.
- Use terminals 2 or 3 (+, power supply), 4 or 5 (+, return line) and 6 (-) as a transmitter supply device for 3-wire transmitters.
- Use terminals 2 or 3 (+) and 4 or 5 (-) as a transmitter supply device.
- HART handhelds with a Certificate of Conformity are connected to terminals 3 (+) and 4 (-). The communication resistor is already fitted.

The analog input is the interface for the process signals from the pressure and differential pressure transmitters, level transmitters, externally supplied analysis devices and flow/fluid level transducers to pass to the process control system or the PLC.

Versions

- LB 3002, not intrinsically safe, HART
- LB 3102, intrinsically safe, 16.5 V, HART
- LB 3103, intrinsically safe, 15 V, HART
- FB 3202, intrinsically safe, 16.5 V, HART
- FB 3203, intrinsically safe, 15 V, HART
- FB 3302, Ex-e, HART

Features

- Module width: 1 slot
- 1 channel
- Supply voltage 16.5 V or 15 V (different Ex-I data, depending on the version)

At 20 mA, the minimum supply voltage is 16.5 V or 15 V. The voltage is adapted to the needs of the field device up to this maximum value. When the mA value decreases to 4 mA, the supply voltage increases to approx. 22 V or 19 V.

Note!

Terminals 3 and 4 on modules with increased safety (FB 3302, Ex-e) are not built in. HART bus communication is possible in combination with the features of the master (PCS).

Refer to the corresponding data sheet and operating instructions for further information.

7.7.1 Resolution

Input signals within a range of 0 ... 25 mA are detected with a resolution of 12 bits. The actual measurement range is calculated based on this resolution.
For the range 4 to 20 mA (corresponds to 0 ... 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %. Underranges and overranges are taken into consideration.

7.7.2 Measuring time and cycle time

The conversion time is approx. 100 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.7.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

The DP configuration code of analog outputs 3x01 and 3x03 is **50**. The DP configuration codes of the analog input 3x02 are 50, 52, 54, 56, or 58, depending on the number of HART auxiliary variables being transferred (see section "Editing device data" for the analog input 3x02).

Device function - bit assignment in the data telegram

Analog output 3x01/3x02/3x03		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value (12 bit)
	5	
	6	
	7	
Input byte 2 (high byte)	0-7	
Output bytes		Without output bytes
(*) The live zero monitor transmits an error bit (=1) if the current falls below the minimum of 3.6 mA.		

Table 7.7: Device function - bit assignment in the data telegram

7.7.4 Line fault detection

The I/O module has a line fault detection function that can detect lead breakages and short circuits. Line fault detection can be switched on and off via software. You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g. < 1 mA and > 21 mA.

In addition, the circuit provides live-zero monitoring (fault bit = 1 if the current drops below the minimum level of 3.6 mA).

7.7.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

7.7.6 HART communication

If required, you can activate or deactivate HART communication for each channel of the I/O module. Open the device data window for the I/O module (see section below) to modify this setting.

Refer to the section "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

7.7.7 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.7.8 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.7.9 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

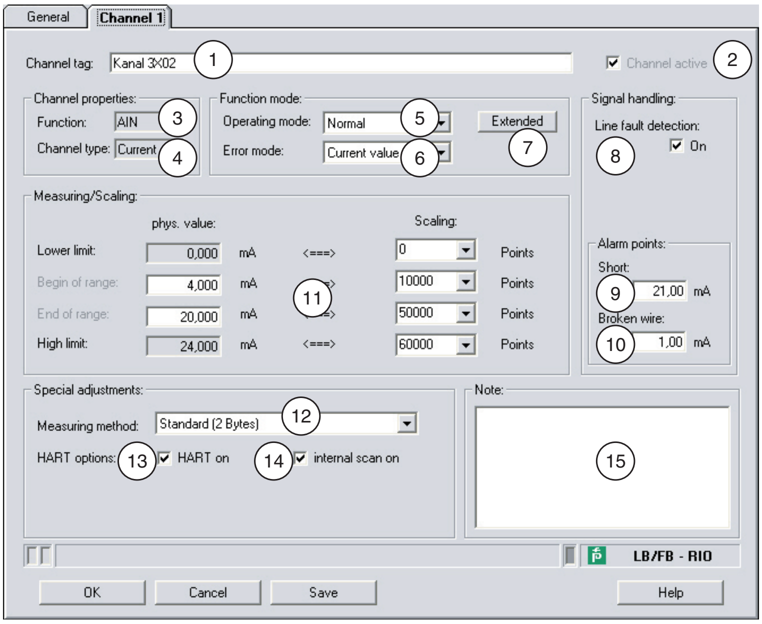

Figure 7.27: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Measuring/Scaling** area
12 **Measuring method** drop-down list (3x02 only)
13 **HART on** check box
14 **Internal scan on** check box
15 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

Short circuit box

Enter the threshold value for short circuit detection (e.g. 21 mA). When the current strength exceeds this value, the line fault detection function reports a short circuit.

10

Lead breakage box

Enter the threshold value for lead breakage detection (e.g. 1 mA). When the current strength falls below this value, the line fault detection signals a lead breakage.

11

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or 0 mA).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or 4 mA).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or 20 mA).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or 24 mA).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

Caution!
Profibus will restart if the measuring method is changed (3x02 only)

If you change the setting in the **Measuring method** drop-down list for analog input 3x02, it affects the structure of the Profibus data telegram. You will then need to restart the Profibus!
Changes to this parameter only have effect on the function of the Remote I/O station if your control system does not support HCiR (see chapter 5.12).

Note!

Measuring method drop-down list

Measuring method only appears if you have activated the **Use of the extended PROFIBUS modes for 3x02 ...** function in the **Select firmware dependent functions** window for the Com Unit DTMs (see chapter 5.6).

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Measuring method drop-down list

This drop-down list is only valid for the analog input 3x02 and not for analog input 3x03. Select the number of HART auxiliary variables that should be included in the cyclical data traffic (max. 4). HART auxiliary variables each occupy 4 bytes in the cyclical data traffic. The I/O module occupies a total of 18 bytes in the cyclical data traffic, including all 4 HART auxiliary variables. 13 of these I/O modules fill the entire data area (13*18 = 234). The HART auxiliary variables are updated less frequently than the standard process data. The following selection options are available.

- "Standard": 2 bytes of data are available in standard mode (see the table in the previous section "Data transfer" for more comprehensive details). DP Config. code (hex): 50
- "Standard + 1st HART variable": The first HART auxiliary variable is made available (2 bytes + 4 bytes = 6 bytes). DP Config. code (hex): 52
- "Standard + 1st + 2nd HART variable": The first and second HART auxiliary variables are made available (2 bytes + 8 bytes = 10 bytes). DP Config. code (hex): 54
- "Standard + 1st - 3rd HART variable": The first, second and third HART auxiliary variables are made available (2 bytes + 12 bytes = 14 bytes). DP Config. code (hex): 56
- "Standard + 1st - 4th HART variable": The first, second, third and fourth HART auxiliary variables are made available (2 bytes + 16 bytes = 18 bytes). DP Config. code (hex): 58

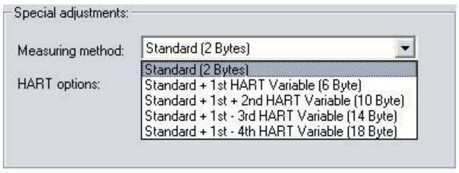

Figure 7.28: **Measuring method** drop-down list for analog input 3x02

13

HART on check box

Activate or deactivate HART communication to the channel. Deactivate HART communication,

- if no HART-compatible devices are connected,
- if HART communication fails and fault messages occur frequently,
- if HART communication to the HART-compatible I/O module is no longer required (saves time, which can be used for essential HART communication).

Refer to the Chapter "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

Note!

HART on check box

HART on can only be edited if you have activated the **Individual HART channel deactivation** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **HART on** option is enabled as standard.

14

Internal scan on check box

This check box only appears if you have activated HART communication (see paragraph above).
You can use this option to activate or deactivate the automatic scanning of HART communication IDs, tags and variables. All active HART channels are scanned automatically as standard, whereby HART data is retrieved and saved to enable quicker external access.

Note!

Internal scan on check box

Internal scan on can only be edited if you have activated the **Disable automatic HART device scan** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **Internal scan on** option is enabled as standard.

15

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

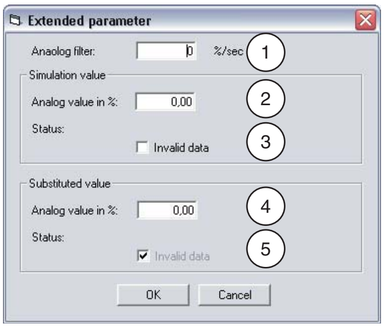

Figure 7.29: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.7.10 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.8 LB/FB 3x04 and 3x05 (HART) analog input

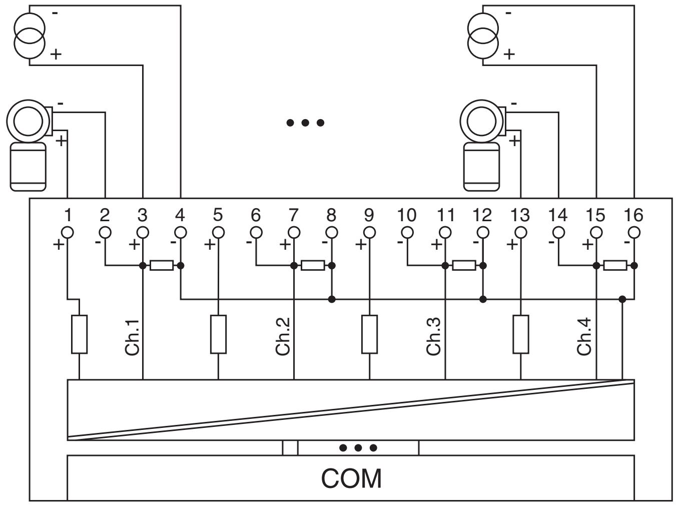

Figure 7.30: Connection diagrams 3x04 and 3x05

- Use terminals 3 (+) and 4 (-), 7 (+) and 8 (-), 11 (+) and 12 (-), and 15 (+) and 16 (-) as input isolators for active signals from the field. The input resistance is 15 Ω (without HART).
- Use terminals 1 (+) and 2 (-), 5 (+) and 6 (-), 9 (+) and 10 (-), and 13 (+) and 14 (-) as a transmitter supply device.
- HART handhelds with a Certificate of Conformity are connected in parallel to the signal converter. The communication resistor is already fitted.

The analog input is the interface for the process signals from the pressure and differential pressure transmitters, level transmitters, externally supplied analysis devices and flow/fluid level transducers to pass to the process control system or the PLC.

Versions

- LB 3005, not intrinsically safe, HART
- LB 3104, intrinsically safe
- LB 3105, intrinsically safe, HART
- FB 3204, intrinsically safe
- FB 3205, intrinsically safe, HART
- FB 3305, Ex-e, HART

Features

- Module width: 2 slots
- 4 channels
- Supply voltage 15 V

At 20 mA, the minimum supply voltage is 15 V. The voltage is adapted to the needs of the field device up to this maximum value. When the mA value decreases to 4 mA, the supply voltage increases to approx. 19 V.

Note!

HART bus communication is only possible with LB/FB 3x05 in combination with the features of the master (PCS). LB/FB 3x04 does not have HART functionality.

Refer to the corresponding data sheet and operating instructions for further information.

7.8.1 Resolution

Input signals within a range of 0 ... 25 mA are detected with a resolution of 12 bits. The actual measurement range is calculated based on this resolution.
For the range 4 to 20 mA (corresponds to 0 ... 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %. Underranges and overranges are taken into consideration.

7.8.2 Measuring time and cycle time

The conversion time for all 4 channels combined is approx. 80 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

During HART communication, new values are only transmitted to the Com Unit every third internal data cycle. 50 ms is required. In the worst case scenario, the total time is 130 ms.

7.8.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

In the cyclic data exchange process, data is communicated in the same order as the channels (channel 1, channel 2, etc.).

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the analog input is **53**.

Device function - bit assignment in the data telegram

Analog inputs 3x04/3x05		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value channel 1 (12 bit)
	5	
	6	
	7	
Input byte 2 (high byte)	0-7	
Same structure for channels 2, 3, and 4. The 4 channels are spread over 2 slots (the I/O modules is twice as wide); total of 8 input bytes		
Output bytes		Without output bytes
(*) The live zero monitor transmits an error bit (=1) if the current falls below the minimum of 3.6 mA.		

Table 7.8: Device function - bit assignment in the data telegram

7.8.4 Line fault detection

The I/O module has a line fault detection function that can detect lead breakages and short circuits. Line fault detection can be switched on and off via software. You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g. < 1 mA and > 21 mA.

In addition, the circuit provides live-zero monitoring (fault bit = 1 if the current drops below the minimum level of 3.6 mA).

7.8.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

7.8.6 HART communication

If required, you can activate or deactivate HART communication for each channel of the I/O module. Open the device data window for the I/O module (see section below) to modify this setting.

Refer to the section "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

7.8.7 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.8.8 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.8.9 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

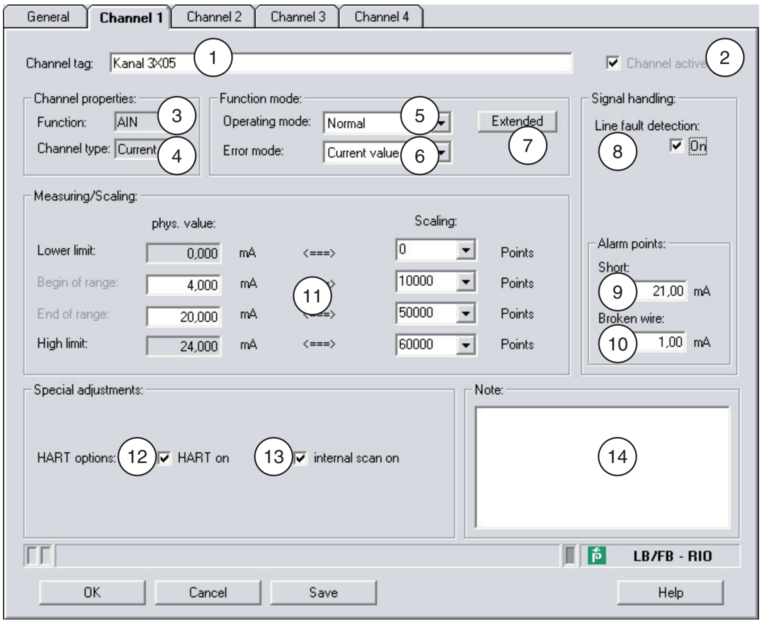

Figure 7.31: **Channel X** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Measuring/Scaling** area
12 **HART on** check box
13 **Internal scan on** check box
14 **Note** box

Note!

HART communication

The check boxes for HART functionalities are available for I/O modules 3x05/4x05, but not for I/O modules 3x04/4x04.

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

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6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

Short circuit box

Enter the threshold value for short circuit detection (e.g. 21 mA). When the current strength exceeds this value, the line fault detection function reports a short circuit.

10

Lead breakage box

Enter the threshold value for lead breakage detection (e.g. 1 mA). When the current strength falls below this value, the line fault detection signals a lead breakage.

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11

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or 0 mA).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or 4 mA).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or 20 mA).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or 24 mA).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

12

HART on check box

Activate or deactivate HART communication to the channel. Deactivate HART communication,

- if no HART-compatible devices are connected,
- if HART communication fails and fault messages occur frequently,
- if HART communication to the HART-compatible I/O module is no longer required (saves time, which can be used for essential HART communication).

Refer to the Chapter "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

Note!

HART on check box

HART on can only be edited if you have activated the **Individual HART channel deactivation** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **HART on** option is enabled as standard.

13

Internal scan on check box

This check box only appears if you have activated HART communication (see paragraph above).
You can use this option to activate or deactivate the automatic scanning of HART communication IDs, tags and variables. All active HART channels are scanned automatically as standard, whereby HART data is retrieved and saved to enable quicker external access.

Note!

Internal scan on check box

Internal scan on can only be edited if you have activated the **Disable automatic HART device scan** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **Internal scan on** option is enabled as standard.

14

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

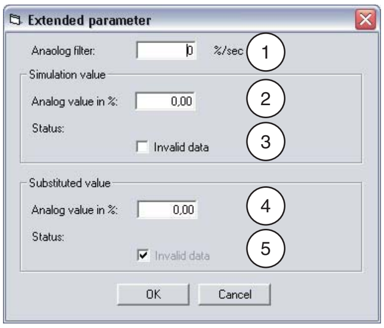

Figure 7.32: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.8.10 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.9 LB/FB 4x01 and 4x02 (HART) analog output

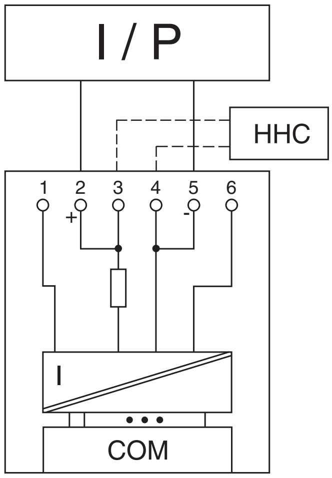

Figure 7.33: Connection diagrams 4x01 and 4x02 without output disable input

- Use terminals 2 or 3 (+) and 4 or 5 (-) for output isolators.
- HART handhelds with a Certificate of Conformity are connected to terminals 3 (+) and 4 (-). The communication resistor is already fitted.

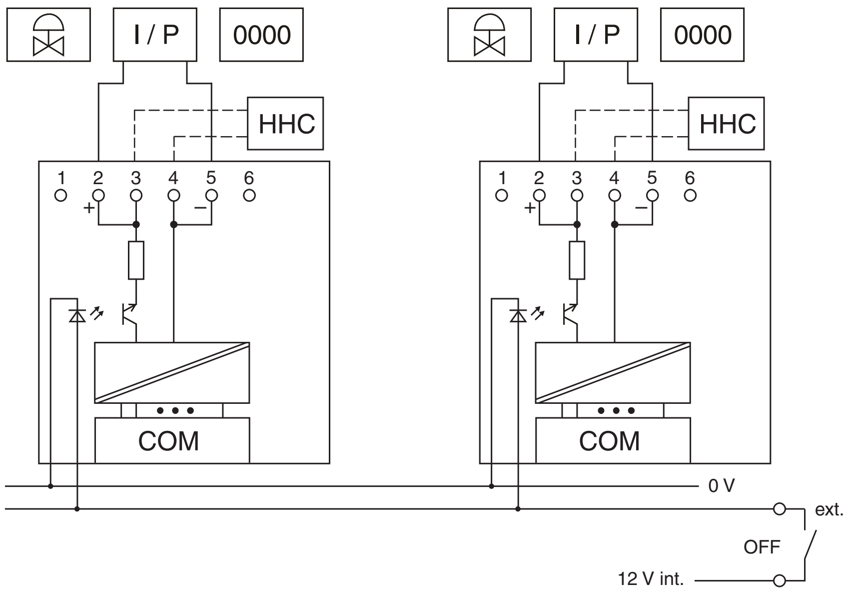

Figure 7.34: Connection diagrams 4x02 with output disable input

The analog output is the interface between process signals from actuators sensors, I/P converters, proportional valves, on-site displays and the process control system or PLC.

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Versions

- LB 4002, not intrinsically safe, HART
- LB 4101, intrinsically safe
- LB 4102, intrinsically safe, HART
- FB 4201, intrinsically safe
- FB 4202, intrinsically safe, HART
- FB 4302, Ex-e, HART

Note!

Versions of the I/O module LB/FB 4x02 are available with and without a bus-independent output disable input. Select the appropriate version from the catalog. Note which backplane types are compatible with the different versions. Refer to the LB/FB hardware manuals and the P+F SIL manual for more detailed information.

Features

- Module width: 1 slot
- 1 channel
- Output load: 750 Ω
- Output voltage: 15 V

At 20 mA, the output voltage is at least 15 V.

Note!

HART bus communication is only possible with LB/FB 4x02 in combination with the features of the master (PCS). LB/FB 4x01 does not have HART functionality.

Refer to the corresponding data sheet and operating instructions for further information.

7.9.1 Resolution

Output signals within a range of 0 ... 25 mA are generated with a resolution of 12 bits. The actual measurement range is calculated based on this resolution.
For the range 4 to 20 mA (corresponds to 0 ... 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

7.9.2 Measuring time and cycle time

The conversion time is approx. 50 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

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7.9.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The most important 12 bits are used.

Digital information can be transmitted in the remaining 4 bits.

The DP configuration code of the analog output is **60**.

Device function - bit assignment in the data telegram

Analog output 4x01/02		
Byte	**Bit**	**Meaning**
Input bytes		Without input bytes
Output byte 1 (low byte)	0	Empty
	1	Empty
	2	Empty
	3	Empty
	4	Process value (12 bit)
	5	
	6	
	7	
Output byte 2 (high byte)	0-7	

Table 7.9: Device function - bit assignment in the data telegram

7.9.4 Line fault detection

The I/O module has a line fault detection function that can detect lead breakages. The non-linear voltage of modern HART actuators means that short circuits cannot be detected.
Line fault detection can be switched on and off via software.

Line fault detection works on the basis of measuring a minimum current of 1 mA. This current still flows even when the control system specifies 0 mA. The line fault detection function is therefore unsuitable for 0 ... 20 mA outputs. When currents < 0.1 mA are detected, a lead breakage is signaled.

7.9.5 Watchdog (watchdog circuit)

The I/O module has a watchdog that switches off the output channel/channels after 500 ms if three successive unsuccessful attempts are made to communicate with the Com Unit.

7.9.6 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

7.9.7 HART communication

If required, you can activate or deactivate HART communication for each channel of the I/O module. Open the device data window for the I/O module (see section below) to modify this setting.

Refer to the section "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

7.9.8 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.9.9 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.9.10 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

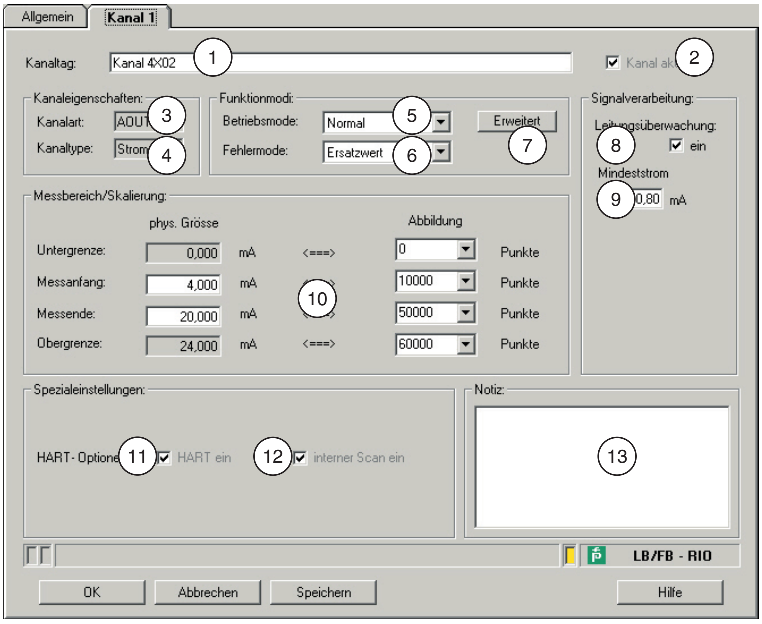

Figure 7.35: **Channel X** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Function** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **Min. current** field
10 **Measuring/Scaling** area
11 **HART on** check box (4x02 only)
12 **Internal scan on** check box (4x02 only)
13 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted via the fieldbus.
- "Simulation": In simulation mode, a process value is simulated. This parameter is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a communication fault or if the "Invalid" identifier is preset. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The process value is issued unchanged in spite of the error (the value may be simulated).
- "Substitute value": A substitute value is issued. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last valid value is issued.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (only lead breakage), the fault is transmitted together with the process value.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

Min. current field

Enter the threshold value for the lead breakage detection (e.g. 0.8 mA). When the current strength falls below this value, the line fault detection signals a lead breakage.

10

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or 0 mA).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or 4 mA).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or 20 mA).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or 24 mA).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

11

HART on check box

Activate or deactivate HART communication to the channel. Deactivate HART communication,

- if no HART-compatible devices are connected,
- if HART communication fails and fault messages occur frequently,
- if HART communication to the HART-compatible I/O module is no longer required (saves time, which can be used for essential HART communication).

Refer to the Chapter "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

Note!

HART on check box

HART on can only be edited if you have activated the **Individual HART channel deactivation** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **HART on** option is enabled as standard.

12

Internal scan on check box

This check box only appears if you have activated HART communication (see paragraph above).
You can use this option to activate or deactivate the automatic scanning of HART communication IDs, tags and variables. All active HART channels are scanned automatically as standard, whereby HART data is retrieved and saved to enable quicker external access.

Note!

Internal scan on check box

Internal scan on can only be edited if you have activated the **Disable automatic HART device scan** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **Internal scan on** option is enabled as standard.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

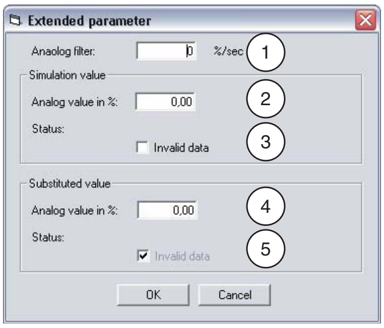

Figure 7.36: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % for defining the rate of change of the output value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is issued if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. The substitute value is issued if the check box is enabled.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is issued when a communication fault occurs or the "Invalid" identifier is set and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The status for the output signal has no other use.

7.9.11 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

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7.9.12 Configuring strain gauge measurement

The I/O modules 5x02 and 4x01 can be interconnected for strain gage readings. Use the 4x01 analog output to produce a constant current, and the measurement input of the 5x02 temperature input to process the millivolt signal from the voltage generated across the bridge. The measured value is tranmitted to the PLC or process control system via the fieldbus.
A constant current of 20 mA is suitable for supplying a 350 Ω bridge. This produces a bridge voltage of 7 V. If the bridge sensitivity is 2 mV/V, then the full-load voltage is 14 mV.

Configuring I/O modules for strain gauge measurement

Prerequisite: You have already created a project file in the FDT base application. This project file is open and the project structure contains a Com Unit and the I/O modules 4x01 and 5x02. Communication with the Remote I/O station is working properly.

1. Set either the
   operating mode of the analog output 4x01 to "Simulation" (Device data window > **Channel 1** tab > **Operating mode** drop-down list) and select the simulation value 20 mA
   or
   configure a fixed value of 20 mA via the fieldbus.
2. Set the temperature input 5x02 to millivolt measurements "mV" (device data window > **Channel 1** tab > **Sensor** drop-down list).
3. Deactivate cold reference junction compensation on temperature input 5x02 by setting the thermostat temperature of the external reference junction to 0 °C (device data window > **Channel 1** tab > **Ext. reference junction** box).

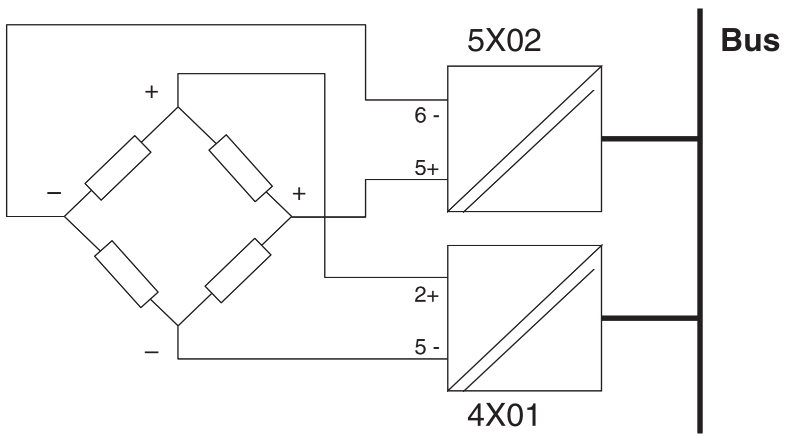

Figure 7.37: Example: Strain gage bridge

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7.10 LB/FB 4x04 and 4x05 (HART) analog output

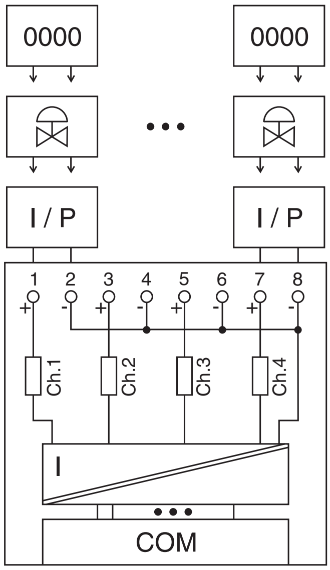

Figure 7.38: Connection diagrams 4x04 and 4x05 without output disable input

- Use terminals 1 (+) and 2 (-), 3 (+) and 4 (-), 5 (+) and 6 (-), and 7 (+) and 8 (-) for output isolators.
- HART handhelds with a Certificate of Conformity are connected in parallel to the field device. The communication resistor is already fitted.

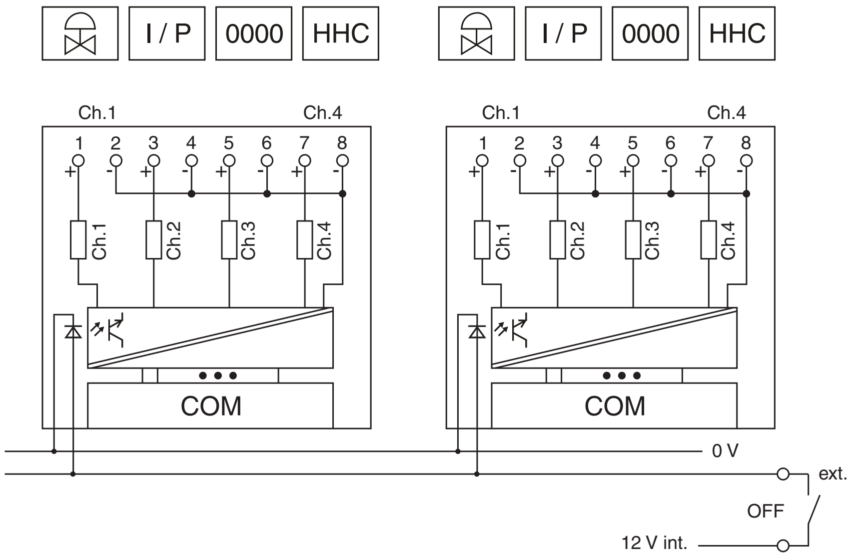

Figure 7.39: Connection diagrams 4x04 and 4x05 with output disable input

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The analog output is the interface between process signals from actuators sensors, I/P converters, proportional valves, on-site displays and the process control system or PLC.

Versions

- LB 4005, not Ex-i, HART
- LB 4104, intrinsically safe
- LB 4105, intrinsically safe, HART
- FB 4204, intrinsically safe
- FB 4205, intrinsically safe, HART
- FB 4305, Ex-e, HART

Note!

Versions are available with and without a bus-independent output disable input. Select the appropriate version from the catalog. Note which backplane types are compatible with the different versions. Refer to the LB/FB hardware manuals and the P+F SIL manual for more detailed information.

Features

- Module width: 2 slots
- 4 channels
- Output load: 750 Ω
- Output voltage: 15 V

At 20 mA, the output voltage is at least 15 V.

Note!

HART bus communication is only possible with LB/FB 4x05 in combination with the features of the master.

Refer to the corresponding data sheet and operating instructions for further information.

7.10.1 Resolution

Output signals within a range of 0 ... 25 mA are generated with a resolution of 12 bits. The actual measurement range is calculated based on this resolution.
For the range 4 to 20 mA (corresponds to 0 ... 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

7.10.2 Measuring time and cycle time

The conversion time for all 4 channels combined is approx. 60 ms. During HART communication, this time is extended to 110 ms. The immediacy of the measured value depends on the cycle time of the data traffic in the Profibus. The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.10.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the analog output is **C0 43 40**.

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Device function - bit assignment in the data telegram

Analog output 4x04/05		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Empty
	5	Line fault detection channel 2 (0 = OK, 1 = error)
	6	Empty
	7	Empty
Input byte 2 (high byte)	0	Empty
	1	Line fault detection channel 3 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Empty
	5	Line fault detection channel 4 (0 = OK, 1 = error)
	6	Empty
	7	Empty
Output byte 1 (low byte)	0	Empty
	1	Invalid channel 1
	2	Empty
	3	Empty
	4	Process value channel 1 (12 bit)
	5	
	6	
	7	
Output byte 2 (high byte)	0-7	
Other output bytes		Same structure for channels 2, 3, and 4

Table 7.10: Device function - bit assignment in the data telegram

7.10.4 Line fault detection (4x05D only)

The I/O module has a line fault detection function that can detect lead breakages. The non-linear voltage of modern HART actuators means that short circuits cannot be detected. Line fault detection can be switched on and off via software.

Line fault detection works on the basis of measuring a minimum current of 1 mA. This current still flows even when the control system specifies 0 mA. The line fault detection function is therefore unsuitable for 0 ... 20 mA outputs. When currents < 0.1 mA are detected, a lead breakage is signaled.

Note!

The I/O module 4x05 is available with or without a lead breakage monitoring function. The Com Unit and the operator interface of the two different versions are the same. Note the special code in the order number (4x05**D**).
The I/O module 4x04 does not have a line fault detection function.

7.10.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.10.6 Watchdog (watchdog circuit)

The I/O module has a watchdog that switches off the output channel/channels after 500 ms if three successive unsuccessful attempts are made to communicate with the Com Unit.

7.10.7 HART communication

If required, you can activate or deactivate HART communication for each channel of the I/O module. Open the device data window for the I/O module (see section below) to modify this setting.

Refer to the section "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

7.10.8 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.10.9 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.10.10 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

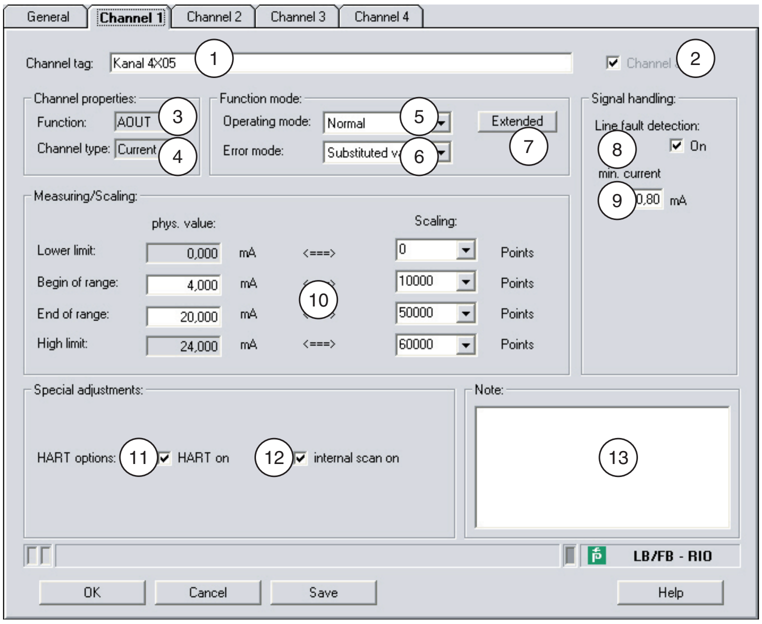

Figure 7.40: **Channel X** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **Min. current** field
10 **Measuring/Scaling** area
11 **HART on** check box
12 **Internal scan on** check box
13 **Note** box

Note!

HART communication

The check boxes for HART functionalities are available for I/O modules 3x05/4x05, but not for I/O modules 3x04/4x04.

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted via the fieldbus.
- "Simulation": In simulation mode, a process value is simulated. This parameter is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a communication fault or if the "Invalid" identifier is preset. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The process value is issued unchanged in spite of the error (the value may be simulated).
- "Substitute value": A substitute value is issued. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last valid value is issued.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (only lead breakage), the fault is transmitted together with the process value.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

Min. current field

Enter the threshold value for the lead breakage detection (e.g. 0.8 mA). When the current strength falls below this value, the line fault detection signals a lead breakage.

10

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or 0 mA).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or 4 mA).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or 20 mA).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or 24 mA).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

11

HART on check box

Activate or deactivate HART communication to the channel. Deactivate HART communication,

- if no HART-compatible devices are connected,
- if HART communication fails and fault messages occur frequently,
- if HART communication to the HART-compatible I/O module is no longer required (saves time, which can be used for essential HART communication).

Refer to the Chapter "Basic functions of DTM software" (see chapter 6) for more information on HART communication.

Note!

HART on check box

HART on can only be edited if you have activated the **Individual HART channel deactivation** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **HART on** option is enabled as standard.

12

Internal scan on check box

This check box only appears if you have activated HART communication (see paragraph above).
You can use this option to activate or deactivate the automatic scanning of HART communication IDs, tags and variables. All active HART channels are scanned automatically as standard, whereby HART data is retrieved and saved to enable quicker external access.

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Note!

Internal scan on check box

Internal scan on can only be edited if you have activated the **Disable automatic HART device scan** function in the **Select firmware-dependent functions** window of the Com Unit DTMs (see chapter 5.6). Otherwise the **Internal scan on** option is enabled as standard.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

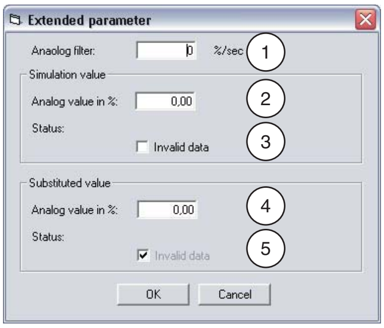

Figure 7.41: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % for defining the rate of change of the output value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is issued if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. The substitute value is issued if the check box is enabled.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is issued when a communication fault occurs or the "Invalid" identifier is set and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The status for the output signal has no other use.

7.10.11 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

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7.11 LB/FB 5x01 temperature input

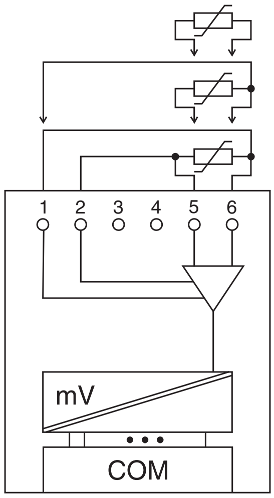

Figure 7.42: Connection diagram 5x01

- Use terminals 5 and 6 for a 2-wire configuration.
- Use terminals 1, 5, and 6 for a 3-wire configuration.

  For slide-wire sensors, bypass the central plug socket with one end of the sensor to form a 3-wire configuration connected to terminals 1, 5, and 6.
- Use terminals 1, 2, 5, and 6 for a 4-wire configuration.

The signal converter is the interface between process signals from Pt100 sensors in a 2, 3, or 4-wire configuration and the process control system or PLC. Slide-wire sensors up to 400 Ω can also be connected.

Versions

- LB 5001, not intrinsically safe
- LB 5101, intrinsically safe
- FB 5201, intrinsically safe

Features

- Module width: 1 slot
- 1 channel
- Measurement range: 0 Ω ... 400 Ω
- Smallest span: 20 Ω
- Maximum line resistance: 50 Ω
- Temperature effect: 0.025% of the max. span / 10 K
- Linearity error: 0,1 %
- Sensor current: 200 µA

Refer to the corresponding data sheet and operating instructions for further information.

7.11.1 Resolution

Temperatures within a range of -200 °C to 850 °C are detected with a resolution of 16 bits. The actual measurement range is calculated based on this resolution.
For the smallest range (0 to 100%), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

7.11.2 Measuring time and cycle time

The internal module processing times depend on the preset measuring process:

- 20 ms without line fault detection,
- 125 ms with line fault detection.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time. A filter is available for smoothing the input signals.

7.11.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

The DP configuration code of the temperature input is **50**.

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Device function - bit assignment in the data telegram

Temperature input 5x01/02		
Byte	**Bit**	**Meaning**
Input byte 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value (12 bit)
	5	
	6	
	7	
Input byte 2	0-7	
Output bytes		Without output bytes

Table 7.11: Device function - bit assignment in the data telegram

7.11.4 Line fault detection

The device has a line fault detection function that can distinguish between a lead breakage (resistance > 1 kΩ at Pt100) and short circuit (resistance < 10 Ω at Pt100). Line fault detection can be switched off via software.

The broken-wire delay function prevents measured values from being enabled after a line fault occurs so as to avoid constant toggling between OK/fault if there is a loose contact.

7.11.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

7.11.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.11.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.11.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

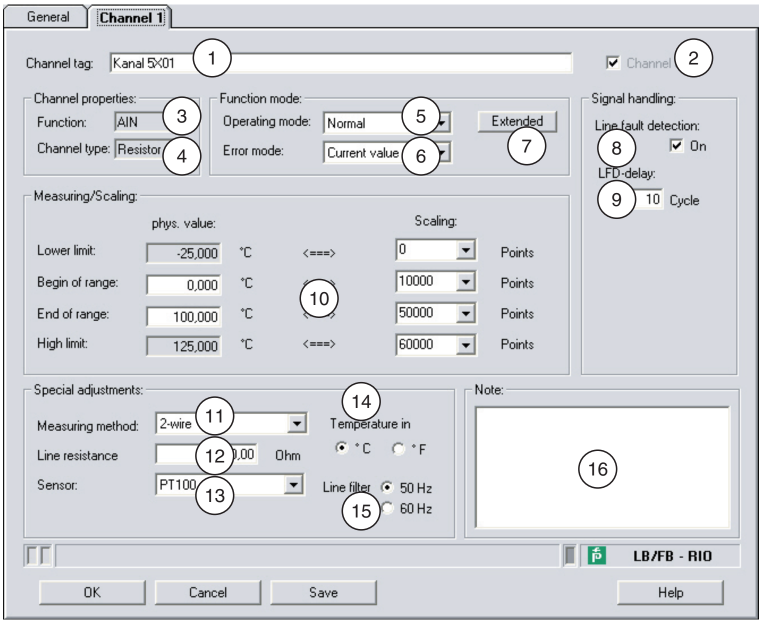

Figure 7.43: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Function** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring/Scaling** area
11 **Measuring method** drop-down list
12 **Line resistance** box (2-wire configuration only)
13 **Sensor** drop-down list
14 **Temperature in** option (Pt100 only)
15 **Line filter** option
16 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

LFD-delay box

This field only appears if you have activated **Line fault detection**.
Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This option can be used for suppressing loose contacts.

10

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or underrange).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or start of measuring range).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or end of measuring range).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or overrange).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

11

Measuring method drop-down list

Set the measuring method currently in use and select between a 2, 3, and 4-wire configuration. If you select the 2-wire configuration, enter the line resistance in the **Line resistance** box.

12

Line resistance box

This box only appears if you have preset a 2-wire configuration under **Measuring method** (see paragraph above).
Enter the resistance value of the spur to compensate for measurement errors. Refer to the hardware manuals for the LB/FB Remote I/O bus systems for information on how to measure the line resistance.

13

Sensor drop-down list

Select the sensor. Depending on the sensor, the correct linearization is automatically used.. The following table lists the sensors that can be used together with the temperature input

Sensor	Beginning of range (min.)	End of range (max.)
Resistance	0 Ω	400 Ω
Pt100	- 200 °C	850 °C

14

Temperature in option

This option can only be edited if you have selected a Ptxxx or Nixxx sensor under **Sensor**. Select the temperature unit in which you wish to enter the beginning and the end of the measuring range and display the measured value (°C or °F).

15

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

16

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

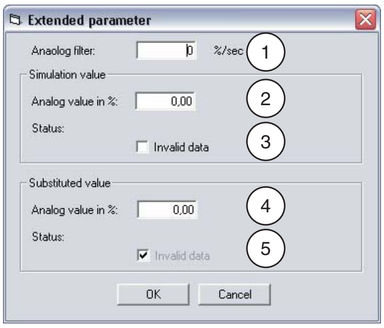

Figure 7.44: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.11.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.12 LB/FB 5x02 temperature input

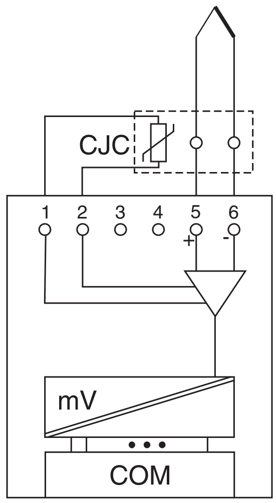

Figure 7.45: Connection diagram 5x02

- Connect the Pt100 reference junction element to terminals 1 and 2 in a 2-wire configuration. The element compensates for ambient temperature effects (not necessary for millivolt measurements or external reference junctions).
- Connect the thermocouples or millivolt sources to terminals 5 (+) and 6 (-).

The signal converter is the interface between process signals from thermocouples and the process control system or PLC. Millivolt signals can also be connected to the module.

Versions

- LB 5002, not intrinsically safe
- LB 5102, intrinsically safe
- FB 5202, intrinsically safe

Features

- Module width: 1 slot
- 1 channel
- Measurement range: -75 mV … +75 mV
- Smallest span: 5 mV for 0.1% accuracy
- Thermocouple types: U, B, E, T, K, S, R, L, J, N, and Pallaplat
- CJC internal or external (thermostat)
- Linearity error: 0,1%
- Sensor current of CJC: 200 µA

Refer to the corresponding data sheet and operating instructions for further information.

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7.12.1 Resolution

Temperatures within a range of -200 °C to 1850 °C are detected with a resolution of 16 bits. The actual measurement range is calculated based on this resolution.
For the smallest range of 5 mV (0 to 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

All conventional thermocouple curves and Pallaplat are linearized.

7.12.2 Measuring time and cycle time

The internal module processing times depend on the preset measuring process:

- **External reference junction (CJC)**
  20 ms without line fault detection; 80 ms with line fault detection
- **Internal reference junction (CJC)**
  120 ms without line fault detection; 240 ms with line fault detection

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time. A filter is available for smoothing the input signals.

7.12.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

The DP configuration code of the temperature input is **50**.

Device function - bit assignment in the data telegram

Temperature input 5x01/02		
Byte	**Bit**	**Meaning**
Input byte 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value (12 bit)
	5	
	6	
	7	
Input byte 2	0-7	
Output bytes		Without output bytes

Table 7.12: Device function - bit assignment in the data telegram

7.12.4 Line fault detection

The device has a line fault detection function for detecting lead breakages. Line fault detection can be switched off via software.

The broken-wire delay function prevents measured values from being enabled after a line fault occurs so as to avoid constant toggling between OK/fault e.g. if there is a loose contact.

- With external CJC: 0 ... 250 x 160 ms
- With internal CJC: 0 ... 250 x 240 ms.

In addition, for internal cold reference junction compensation, you can set the ratio of temperature compensation measurements to actual thermocouple measurements to give an optimum measurement time.

7.12.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

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7.12.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.12.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.12.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

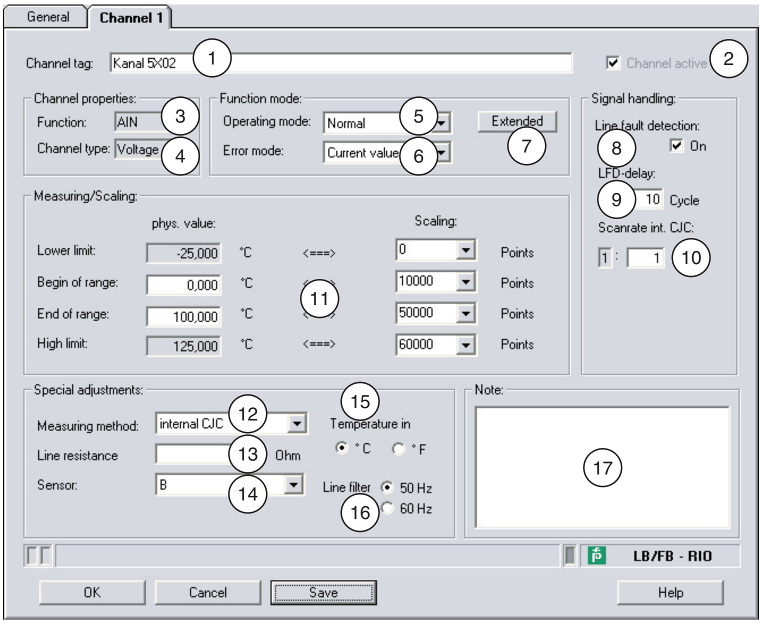

Figure 7.46: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Scan rate internal CJC** box
11 **Measuring/Scaling** area
12 **Measuring method** drop-down list
13 **Line resistance** box (for int. CJC) or **external reference junction** (for external CJC)
14 **Sensor** drop-down list
15 **Temperature in** option (not with mV measurement)
16 **Line filter** option
17 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

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6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

LFD-delay box

This field only appears if you have activated **Line fault detection**.
Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This option can be used for suppressing loose contacts.

10

Scan rate internal CJC box

This field is only visible if you select "Internal cold reference junction compensation" from the **Measuring method** drop-down list.
Specify how frequently the cold reference junction compensation temperature should be measured (in relation to the actual thermocouple measurement). The entry is effective for the duration of the measuring cycle: The more frequently the cold reference junction compensation temperature is measured, the longer a measuring cycle lasts.
Example: If you specify the ratio 1:20, the cold reference junction compensation temperature is measured after every twentieth thermocouple measurement.

11

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or underrange).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or start of measuring range).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or end of measuring range).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or overrange).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

12

Measuring method drop-down list

Preset the measuring method you wish to use. Select between internal and external reference junction. Refer to the LB/FB Remote I/O hardware manuals for more detailed information.

13

Line resistance or **Ext. reference junction** box

Enter either the line resistance (internal reference junction) or the thermostat temperature (external reference junction) in this box, depending on the **Measuring method** selected (see section above).
Line resistance: For an internal reference junction, enter the resistance value of the spur so that the measurement error can be compensated.
External reference junction: For an external reference junction, enter the thermostat temperature (e.g. 50 °C).

14

Sensor drop-down list

Select the sensor. Depending on the sensor, the correct linearization is automatically used.. The following table lists the sensors that can be used together with the temperature input

Sensor	Beginning of range (min.)	End of range (max.)
mV	-75 mV	75 mV
U	- 200 °C	600 °C
B	0 °C	1820 °C
E	-270 °C	1000 °C
T	-270 °C	400 °C
K	-200 °C	1370 °C
S	0 °C	1760 °C
R	-200 °C	900 °C
L	-50 °C	1760 °C
J	-210 °C	1200 °C
N	-210 °C	1200 °C
Pallaplat	-100 °C	1300 °C

15

Temperature in option

This option is not available if you have selected "mV" under **Sensor**.
Select the temperature unit you wish to enter and display the beginning and the end of the measuring range (°C or °F).

16

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

17

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

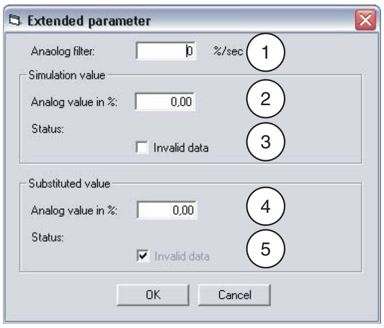

Figure 7.47: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

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4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.12.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.12.10 Configuring strain gauge measurement

The I/O modules 5x02 and 4x01 can be interconnected for strain gage readings. Use the 4x01 analog output to produce a constant current, and the measurement input of the 5x02 temperature input to process the millivolt signal from the voltage generated across the bridge. The measured value is tranmitted to the PLC or process control system via the fieldbus.
A constant current of 20 mA is suitable for supplying a 350 Ω bridge. This produces a bridge voltage of 7 V. If the bridge sensitivity is 2 mV/V, then the full-load voltage is 14 mV.

Configuring I/O modules for strain gauge measurement

Prerequisite: You have already created a project file in the FDT base application. This project file is open and the project structure contains a Com Unit and the I/O modules 4x01 and 5x02. Communication with the Remote I/O station is working properly.

1. Set either the
   operating mode of the analog output 4x01 to "Simulation" (Device data window > **Channel 1** tab > **Operating mode** drop-down list) and select the simulation value 20 mA
   or
   configure a fixed value of 20 mA via the fieldbus.
2. Set the temperature input 5x02 to millivolt measurements "mV" (device data window > **Channel 1** tab > **Sensor** drop-down list).
3. Deactivate cold reference junction compensation on temperature input 5x02 by setting the thermostat temperature of the external reference junction to 0 °C (device data window > **Channel 1** tab > **Ext. reference junction** box).

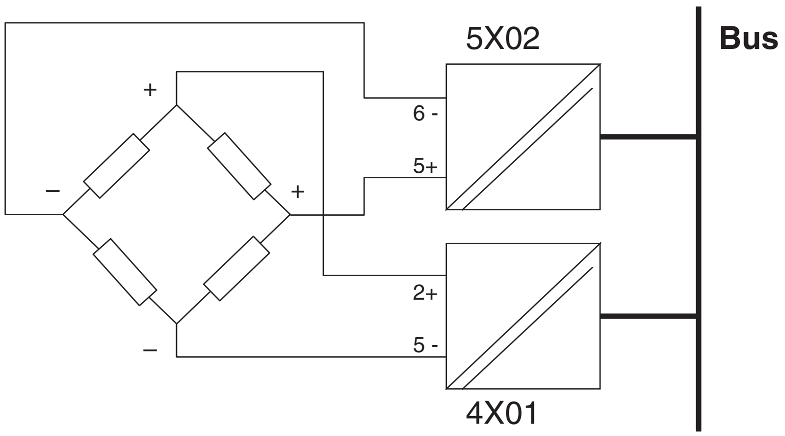

Figure 7.48: Example: Strain gage bridge

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7.13 LB/FB 5x04 temperature input

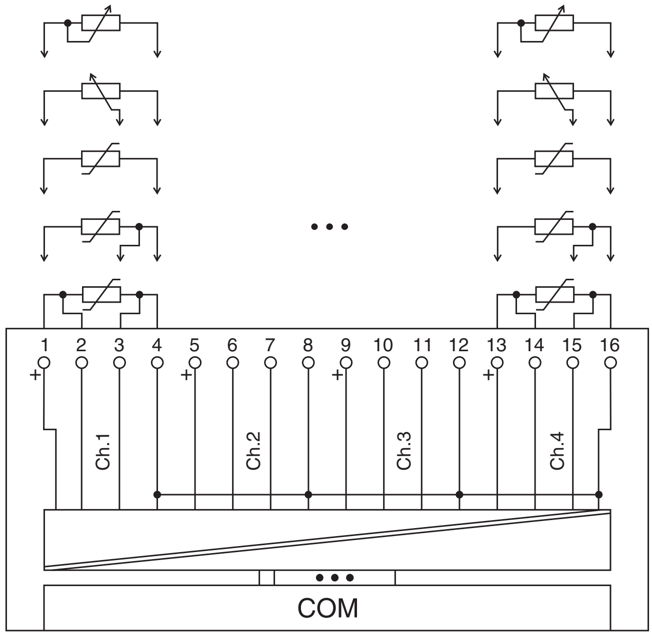

Figure 7.49: Connection diagram 5x04

- Connect slide-wire sensors in a 2-wire configuration to terminals 1 and 4, 5 and 8, 9 and 12, 13 and 16.
- Connect slide-wire sensors in a 3-wire configuration to terminals 1/3/4, 5/7/8, 9/11/12, and 13/15/16.
- Connect Pt100 sensors in a 2, 3, and 4-wire configuration as shown in the illustration.

The signal converter is the interface between process signals from Pt100 sensors in a 2, 3, or 4-wire configuration and the process control system or PLC. Slide-wire sensors up to 10000 Ω can also be connected.

Versions

- LB 5004, not intrinsically safe
- LB 5104, intrinsically safe
- FB 5204, intrinsically safe

Features

- Module width: 2 slots
- 4 channels
- Resistive sensor measuring ranges:
    - Pt100: 18 Ω ... 390 Ω, max. 500 Ω including line resistance
    - Pt200: 37 Ω ... 780 Ω
    - Pt500: 92 Ω ... 1952 Ω
    - Pt1000: 185 Ω ... 3905 Ω
    - Ni100: 69 Ω ... 270 Ω
    - Ni500: 345 Ω ... 1350 Ω
    - Ni1000: 690 Ω ... 2700 Ω
- Slide-wire sensor: 0 Ω ... 10000 Ω
- Smallest span: 50 Ω or 1/10 of the final value for 0.1% accuracy
- Maximum line resistance: 50 Ω
- Temperature effect: 0.025% of the maximum span / 10 K
- Linearity error: 0.025% of the maximum span
- Sensor current: 220 µA

Refer to the corresponding data sheet and operating instructions for further information.

7.13.1 Resolution

Temperatures within a range of -200 °C to 850 °C are detected with a resolution of 16 bits. The actual measurement range is calculated based on this resolution.
For the smallest range (0 to 100%), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

7.13.2 Measuring time and cycle time

The internal module processing times depend on the preset measuring process:

- 120 ms per active channel or 480 ms for all 4 channels;
- 240 ms for converting the signals of a resistive sensor channel in a 3-wire configuration.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time. It takes 4 x 6.25 ms = 25 ms until the values of all 4 channels are present in the Com Unit because the values are transferred one after the other. This time must be added to the AD conversion time.

A filter is available for smoothing the input signals.

It can take 15 s after downloading a configuration before the I/O module parameters are applied.

7.13.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

In the cyclic data exchange process, data is communicated in the same order as the channels (channel 1, channel 2, etc.).

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the temperature input is **53**.

Device function - bit assignment in the data telegram

Temperature inputs 5x04/5x05		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Empty
	4	Measured value channel 1 (12 bit)
	5	
	6	
	7	
Input byte 2 (high byte)	0-7	
Same structure for channels 2, 3, and 4. The 4 channels are spread over 2 slots (the I/O modules is twice as wide); total of 8 input bytes		
Output bytes		Without output bytes

Table 7.13: Device function - bit assignment in the data telegram

7.13.4 Line fault detection

The device has a line fault detection function that can distinguish between a lead breakage (resistance > 1 kΩ at Pt100) and short circuit (resistance < 10 Ω at Pt100). Line fault detection can be switched off via software.

The broken-wire delay function prevents measured values from being enabled after a line fault occurs so as to avoid constant toggling between OK/fault if there is a loose contact.

7.13.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

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7.13.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.13.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.13.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

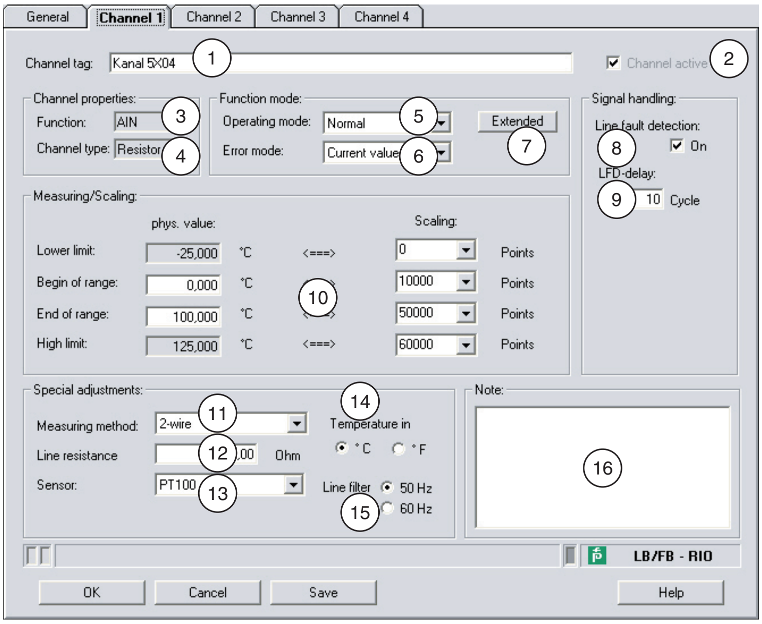

Figure 7.50: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring/Scaling** area
11 **Measuring method** drop-down list
12 **Line resistance** box (2-wire configuration only)
13 **Sensor** drop-down list
14 **Temperature in** option (Pt or Ni only)
15 **Line filter** option
16 **Note** box

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Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

LFD-delay box

This field only appears if you have activated **Line fault detection**.
Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This option can be used for suppressing loose contacts.

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10

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or underrange).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or start of measuring range).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or end of measuring range).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or overrange).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

11

Measuring method drop-down list

Set the measuring method currently in use and select between a 2, 3, and 4-wire configuration. If you select the 2-wire configuration, enter the line resistance in the **Line resistance** box.

12

Line resistance box

This box only appears if you have preset a 2-wire configuration under **Measuring method** (see paragraph above).
Enter the resistance value of the spur to compensate for measurement errors. Refer to the hardware manuals for the LB/FB Remote I/O bus systems for information on how to measure the line resistance.

13

Sensor drop-down list

Select the sensor. Depending on the sensor, the correct linearization is automatically used.. The following table lists the sensors that can be used together with the temperature input

Sensor	Beginning of range (min.)	End of range (max.)
Resistance	0 Ω	10000 Ω
Pt100, Pt200, Pt500, Pt1000	- 200 °C	850 °C
Ni100, Ni500, Ni1000	- 70 °C	230 °C

14

Temperature in option

This option can only be edited if you have selected a Ptxxx or Nixxx sensor under **Sensor**. Select the temperature unit in which you wish to enter the beginning and the end of the measuring range and display the measured value (°C or °F).

15

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

16

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

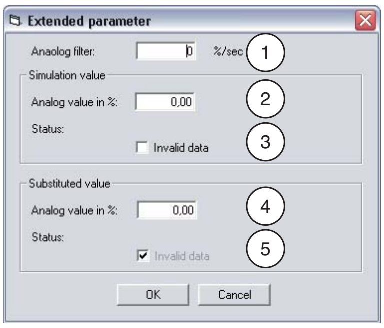

Figure 7.51: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.13.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

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7.14 LB/FB 5x05 temperature input

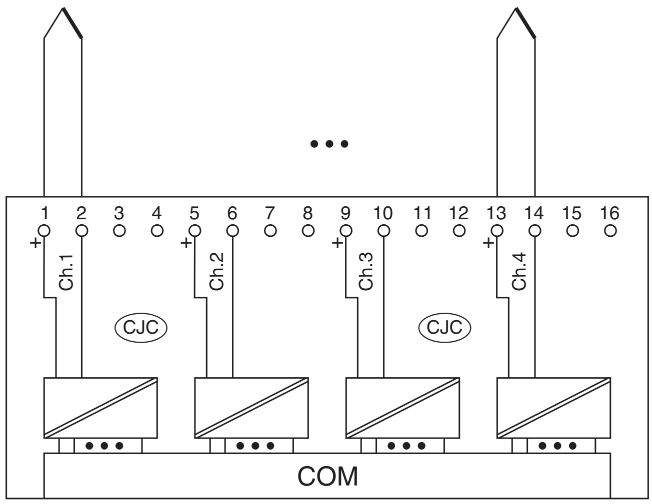

Figure 7.52: Connection diagram 5x05

- Connect the thermocouples or millivolt sources to terminals 1 and 2, 5 and 6, 9 and 10 as well as 13 and 14.
- An internal reference junction (CJC) inside the I/O module measures the temperature at the terminals.

The signal converter is the interface between process signals from thermocouples and the process control system or PLC. Millivolt signals can also be connected to the module.

Versions

- LB 5005, not intrinsically safe
- LB 5105, intrinsically safe
- FB 5205, intrinsically safe

Features

- Module width: 2 slots
- 4 channels
- Measurement range: -75 mV … +75 mV without LFD
- Measurement range: -65 mV … +75 mV with LFD
- Smallest span: 5 mV for 0.1% accuracy
- Thermocouple types: U, B, E, T, K, S, R, L, J, N, and Pallaplat.
- CJC internal or external (thermostat)
- Line fault: > 1 kΩ
- Linearity error: 0.01% (0 mV ... 50 mV)
- Temperature coefficient: 0.02% / 10 K (0 mV ... 50 mV)

Refer to the corresponding data sheet and operating instructions for further information.

7.14.1 Resolution

Temperatures within a range of -200 °C to 1850 °C are detected with a resolution of 16 bits. The actual measurement range is calculated based on this resolution.
For the smallest range of 5 mV (0 to 100 %), a resolution of 2500 measurement points is obtained, which corresponds to 0.04 %.

All conventional thermocouple curves and Pallaplat are linearized.

7.14.2 Measuring time and cycle time

The internal module processing times depend on the preset measuring process:

- 200 ms for all 4 channels without line fault detection (int./ext. reference junction),
- 350 ms for all 4 channels with line fault detection (int./ext. reference junction).

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time. It takes 4 x 6.25 ms = 25 ms until the values of all 4 channels are present in the Com Unit because the values are transferred one after the other. This time must be added to the AD conversion time.

A filter is available for smoothing the input signals.

7.14.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration

and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The 4 bits of the lowest order are of little importance for the accuracy of the measured value, which is why they are used for transferring status information.
If the scale does not fall within a range from 10000 ... 50000, the status information is omitted.

In the cyclic data exchange process, data is communicated in the same order as the channels (channel 1, channel 2, etc.).

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the temperature input is **53**.

Device function - bit assignment in the data telegram

<table>
<tr><th colspan="3">Temperature inputs 5x04/5x05</th></tr>
<tr><th>Byte</th><th>Bit</th><th>Meaning</th></tr>
<tr><td rowspan="8">Input byte 1
(low byte)</td><td>0</td><td>Empty</td></tr>
<tr><td>1</td><td>Line fault detection channel 1 (0 = OK, 1 = error)</td></tr>
<tr><td>2</td><td>Empty</td></tr>
<tr><td>3</td><td>Empty</td></tr>
<tr><td>4</td><td rowspan="5">Measured value channel 1 (12 bit)</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>Input byte 2
(high byte)</td><td>0-7</td></tr>
<tr><td colspan="3">Same structure for channels 2, 3, and 4. The 4 channels are spread over 2 slots (the I/O modules is twice as wide); total of 8 input bytes</td></tr>
<tr><td>Output bytes</td><td></td><td>Without output bytes</td></tr>
</table>

Table 7.14: Device function - bit assignment in the data telegram

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7.14.4 Line fault detection

The device has a line fault detection function for detecting lead breakages. Line fault detection can be switched off via software.

The broken-wire delay function prevents measured values from being enabled after a line fault occurs so as to avoid constant toggling between OK/fault e.g. if there is a loose contact.

- With external CJC: 0 ... 250 x 160 ms
- With internal CJC: 0 ... 250 x 240 ms.

7.14.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

The error bit in the low byte has practically no effect on the measured value. Suitable drivers in the master can evaluate the diagnostic bits.

7.14.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.14.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

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7.14.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

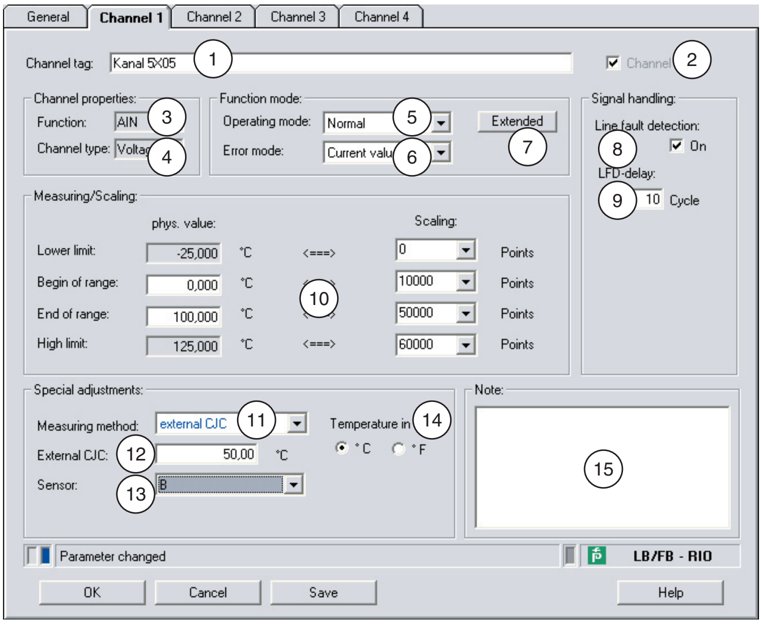

Figure 7.53: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring/Scaling** area
11 **Measuring method** drop-down list
12 **Ext. reference junction** (for external CJC)
13 **Sensor** drop-down list
14 **Temperature in** option (not with mV measurement)
15 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

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6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

9

LFD-delay box

This field only appears if you have activated **Line fault detection**.
Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This option can be used for suppressing loose contacts.

10

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or underrange).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or start of measuring range).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or end of measuring range).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or overrange).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

11

Measuring method drop-down list

Preset the measuring method you wish to use. Select between internal and external reference junction. Refer to the LB/FB Remote I/O hardware manuals for more detailed information.

Note!

Internal reference junction already fitted

The reference junction on I/O modules 5x05 is installed permanently and measures the temperature at the terminals inside the I/O module.

12

Ext. reference junction box

This field only appears if you have selected "External reference junction" under **Measuring method**.
Enter the thermostat temperature of an external reference junction (e.g. 50 °C).

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13

Sensor drop-down list

Select the sensor. Depending on the sensor, the correct linearization is automatically used. The following table lists the sensors that can be used together with the temperature input

Sensor	Beginning of range (min.)	End of range (max.)
mV	-70 mV	70 mV
U	- 200 °C	600 °C
B	0 °C	1820 °C
E	-270 °C	1000 °C
T	-270 °C	400 °C
K	-200 °C	1370 °C
S	0 °C	1760 °C
R	-200 °C	900 °C
L	-50 °C	1760 °C
J	-210 °C	1200 °C
N	-210 °C	1200 °C
Pallaplat	-100 °C	1300 °C

14

Temperature in option

This option is not available if you have selected "mV" under **Sensor**.
Select the temperature unit you wish to enter and display the beginning and the end of the measuring range (°C or °F).

15

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

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Extended parameters window

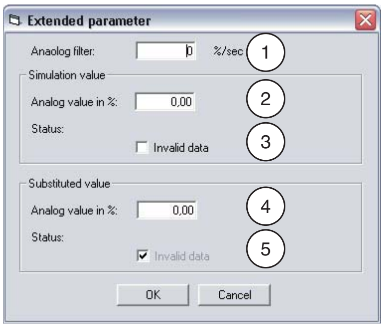

Figure 7.54: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.14.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.15 LB/FB 5x06 voltage input

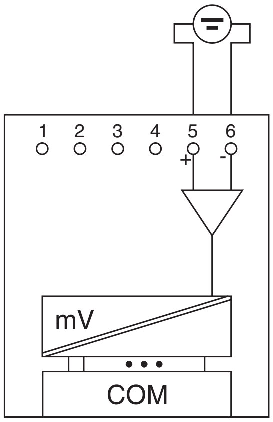

Figure 7.55: Connection diagram 5x06

- Connect the voltage source to terminals 5 (+) and 6 (-).

The voltage input is the interface between process signals from DC voltage transmitters and the process control system or PLC.

Versions

- LB 5006, not intrinsically safe
- LB 5106, intrinsically safe
- FB 5206, intrinsically safe

Features

- Module width: 1 slot
- 1 channel
- Measurement range: 0 V … 10 V
- Smallest span: 100 mV
- Linearity error: 0,1%
- Input resistance: 100 kΩ

Refer to the corresponding data sheet and operating instructions for further information.

7.15.1 Resolution

Voltages within a range of 0 V ... 10 V are detected with a resolution of 16 bits. The actual measurement range is calculated based on this resolution.
For the smallest range of 100 mV (0 to 100%), a resolution of 2500 measurement points is obtained, which corresponds to a degree of accuracy of 0.04 %.

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7.15.2 Measuring time and cycle time

The internal module processing time is 100 ms.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time. A filter is available for smoothing the input signals.

7.15.3 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The process data for each channel is transferred in whole numbers without a prefix within a range from 0 ... 65535.
A 16-bit word is available for transferring data to each channel. The most important 12 bits are used.

The DP configuration code of the temperature input is **50**.

Device function - bit assignment in the data telegram

Temperature input 5x06		
Byte	**Bit**	**Meaning**
Input byte 1 (low byte)	0	Empty
	1	Empty
	2	Empty
	3	Empty
	4	Measured value (12 bit)
	5	
	6	
	7	
Input byte 2 (high byte)	0-7	
Output bytes		Without output bytes

Table 7.15: Device function - bit assignment in the data telegram

7.15.4 Line fault detection

The "Line fault detection" function is not supported.

7.15.5 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

7.15.6 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.15.7 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.15.8 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

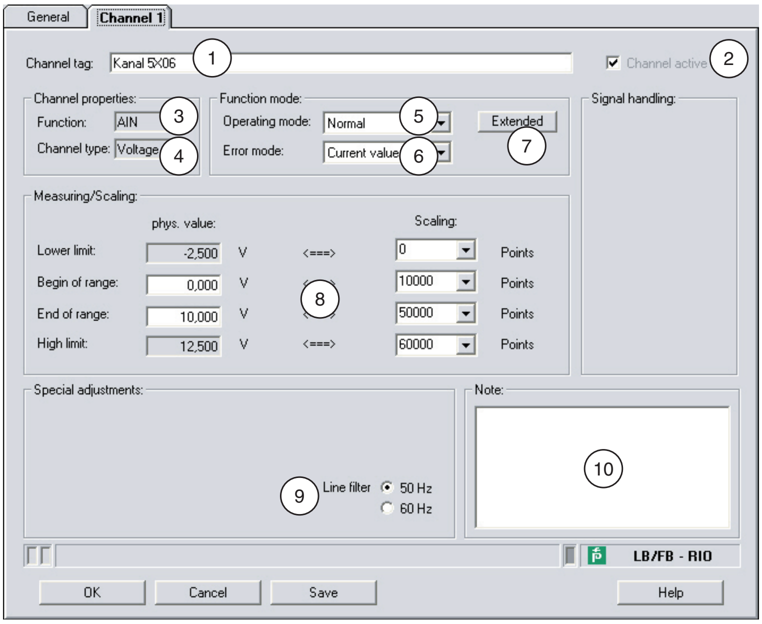

Figure 7.56: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Function** box
4 **Channel type** box
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Extended** button
8 **Measuring/Scaling** area
9 **Line filter** option
10 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Channel type box

Indicates the signal type, e.g. counter, current, resistance, NAMUR, 24 V, etc. (depending on the I/O module).

5

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the signal is transmitted from the field.
- "Simulation": A signal is simulated in simulation mode. The signal is preset in a separate window that you can open by pressing the **Extended** button.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

6

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. The substitute value is preset manually in a separate window that you can open by pressing the **Extended** button.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

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7

Extended button

Pressing this button opens a window containing more channel settings for the "Operating mode" (simulation value) and "Error mode" (substitute value) function modes. The following illustration displays the window in more detail.

8

Measuring/Scaling area

Define the scaling for the measured values. The values in the "phys. value" column cannot be edited because they are calculated automatically using the values in the "Scaling" column.
You can enter the relevant 16 bit values in the "Scaling" column.

- **Lower limit**: Indicates the smallest transferable value (e.g. 0 points or underrange).
- **Beginning of range**: Indicates the value equal to 0% (e.g. 10000 points or start of measuring range).
- **End of range**: Indicates the value equal to 100% (e.g. 50000 points or end of measuring range).
- **High limit**: Indicates the largest transferable value (e.g. 60000 points or overrange).

See section "Scaling the measuring range" (see chapter 6.5.1) for more details.

9

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

10

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

Extended parameters window

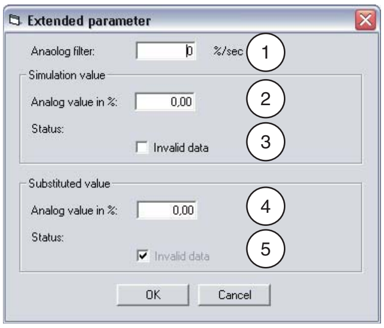

Figure 7.57: **Extended parameters** window

1 **Analog filter** box
2 **Analog value in %** box
3 **Invalid data** check box
4 **Analog value in %** box
5 **Invalid data** check box

Explanations:

1

Analog filter box

The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % for defining the rate of change of the input value for each second. The measurement range is used as the reference value (characteristic: ramp, linear). Enter the value "0" here to deactivate the filter.

2

Analog value in % box (simulation value)

Enter a simulation value in % relating to the measurement range (-25% ... 125%). The simulation value is transferred if you have selected "Simulation" from the **Operating mode** drop-down list.

3

Invalid data check box

Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status "Data invalid" and the substitute value strategy is initiated.

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4

Analog value in % box (substitute value)

Enter a substitute value in % relating to the measurement range (-25% ... 125%). The substitute value is transferred when an error occurs and you have selected "Substitute value" from the **Error mode** drop-down list.

5

Invalid data check box

The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

7.15.9 Using the measured value display

The **View process values/diagnosis display** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for analog I/O modules" (see chapter 6.4.2) for information on how to open the window for this I/O module and what the information in the window means.

7.16 LB/FB 6x01 relay output

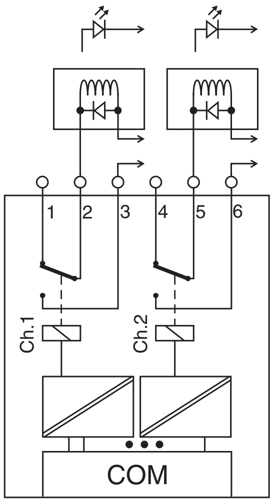

Figure 7.58: Connection diagram 6x01

The relay output can be used to control floating contacts in the process control system or the PLC and is suitable for the following application examples:

- Controlling lamps or acoustic sensors,
- Switching Ex-d valves or contactors.

Versions

- LB 6101, not intrinsically safe
- FB 6301, Ex-e

Features

- Module width: 1 slot
- 2 channels, not intrinsically safe
- One change-over contact per channel
- Switching capacity: 24 V DC/AC/1 A
- Resistive load: 30 W/30 VA
- Max. voltage 30 V DC/AC

Refer to the corresponding data sheet and operating instructions for further information.

7.16.1 Measuring time and cycle time

The response time of the relay output is 20 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

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7.16.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

The DP configuration code of the relay output is **20**.

Device function - bit assignment in the data telegram

Relay output 6x01		
Byte	**Bit**	**Meaning**
Input bytes		Without input bytes
Output byte 1	0	Output channel 1
	1	Output channel 2
	2	Empty
	3	Empty
	4	Empty
	5	Empty
	6	Empty
	7	Empty

Table 7.16: Device function - bit assignment in the data telegram

7.16.3 Line fault detection

The "Line fault detection" function is not supported.

7.16.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

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7.16.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.16.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.16.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

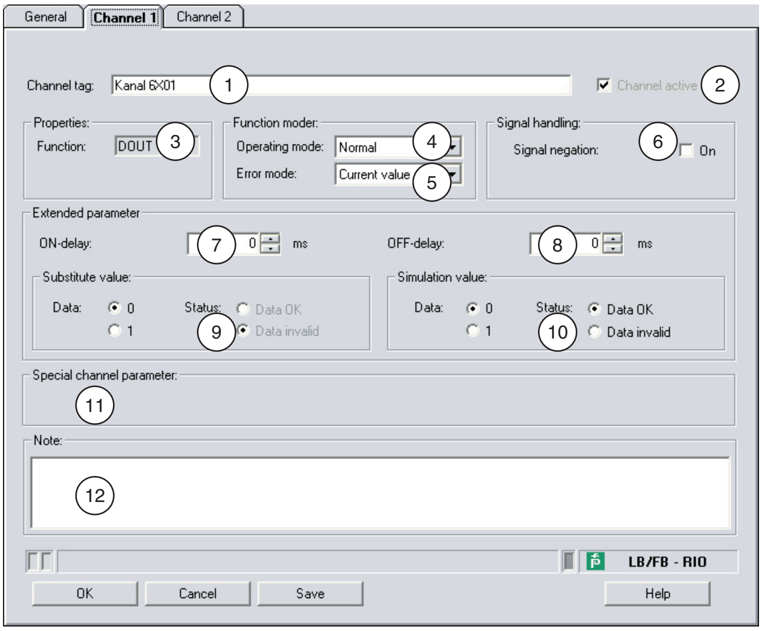

Figure 7.59: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **ON delay** box
8 **OFF delay** box
9 **Substitute value** area
10 **Simulation value** area
11 **Special channel parameters** area
12 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

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7

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1.

8

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0.

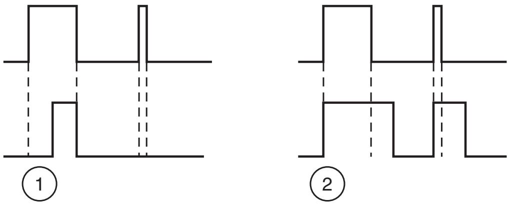

Figure 7.60: ON and OFF delay

1 ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2 OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

9

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

10

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

11

Special channel parameters area

The area is empty for this I/O module.

12

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.16.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

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7.17 LB/FB 6x05 relay output

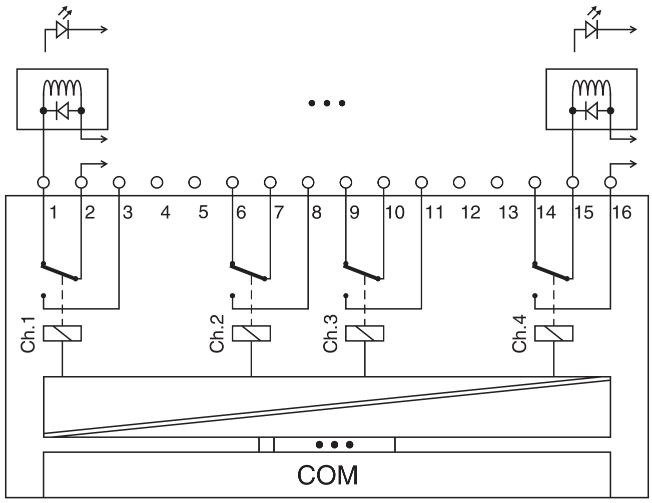

Figure 7.61: Connection diagram 6x05

The relay output can be used to control floating contacts in the process control system or the PLC and is suitable for the following application examples:

- Controlling lamps or acoustic sensors,
- Switching Ex-d valves or contactors.

Versions

- LB 6005, not intrinsically safe
- FB 6305, Ex-e

Features

- Module width: 2 slots
- 4 channels, not intrinsically safe
- One change-over contact per channel
- Switching capacity: 24 V DC / 230 V AC / 1 A
- Resistive load: 30 W / 30 VA
- Max. voltage 30 V DC / 253 V AC

Refer to the corresponding data sheet and operating instructions for further information.

7.17.1 Measuring time and cycle time

The response time of the relay output is 20 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.17.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

Input and output data
The I/O module has input and output data (see table).
The output data sets the control outputs and marks the data as valid/invalid. As soon as the "Data invalid" bit is enabled, the preconfigured substitute values are used (see section below "Editing device data").
The input data allows the master to retrieve the current output status, which is particularly useful if the input or output delay is activated (see section below "Editing device data"). The output only reaches the required status once the preset time has elapsed so the master can retrieve the current output status.

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the relay output is **30**.

Device function - bit assignment in the data telegram

Relay output 6x05		
Byte	**Bit**	**Meaning**
Input byte 1	0	Output status channel 1
	1	Empty
	2	Output status channel 2
	3	Empty
	4	Output status channel 3
	5	Empty
	6	Output status channel 4
	7	Empty
Output byte 1	0	Output channel 1
	1	Channel 1 = 0 enabled, 1 = invalid
	2	Output channel 2
	3	Channel 2 = 0 enabled, 1 = invalid
	4	Output channel 3
	5	Channel 3 = 0 enabled, 1 = invalid
	6	Output channel 4
	7	Channel 4 = 0 enabled, 1 = invalid

Table 7.17: Device function - bit assignment in the data telegram

7.17.3 Line fault detection

The "Line fault detection" function is not supported.

7.17.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

7.17.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.17.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.17.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

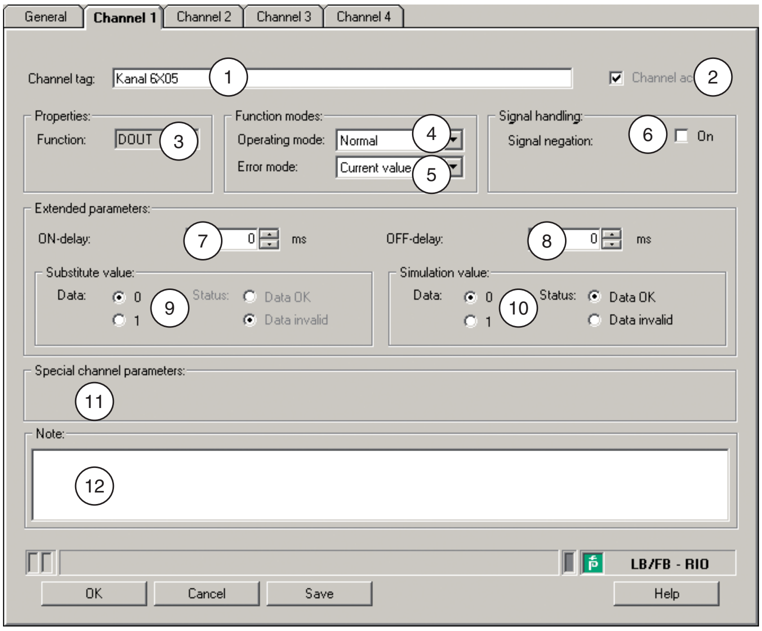

Figure 7.62: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **ON delay** box
8 **OFF delay** box
9 **Substitute value** area
10 **Simulation value** area
11 **Special channel parameters** area
12 **Note** box

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Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1.

8

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0.

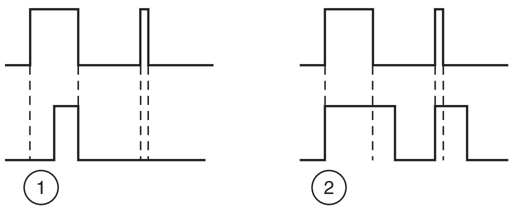

Figure 7.63: ON and OFF delay

1. ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2. OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

9

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

10

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

11

Special channel parameters area

The area is empty for this I/O module.

12

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.17.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.18 LB/FB 6x06 relay output

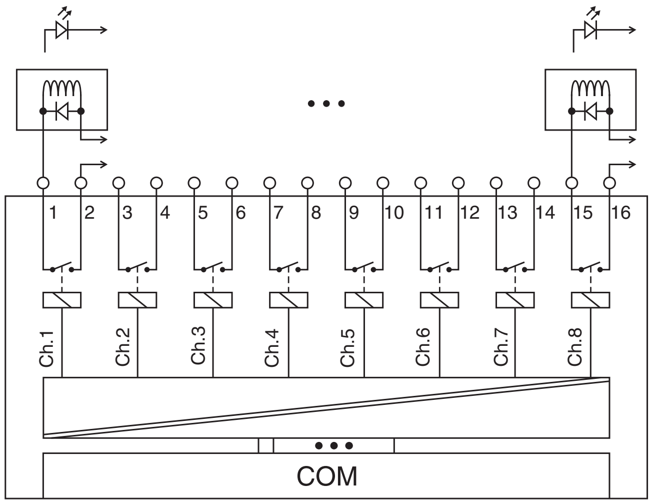

Figure 7.64: Connection diagram 6x06

The relay output can be used to control floating contacts in the process control system or the PLC and is suitable for the following application examples:

- Controlling lamps or acoustic sensors,
- Switching Ex-d valves or contactors.

Versions

- LB 6006, not intrinsically safe
- FB 6306, Ex-e

Features

- Module width: 2 slots
- 8 channels, not intrinsically safe
- One N.O. contact per channel
- Switching capacity: 24 V DC/AC/1 A
- Resistive load: 30 W/30 VA
- Max. voltage 30 V DC

Refer to the corresponding data sheet and operating instructions for further information.

7.18.1 Measuring time and cycle time

The response time of the relay output is 20 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.18.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

Input and output data
The I/O module has input and output data (see table).
The output data sets the control outputs and marks the data as valid/invalid. As soon as the "Data invalid" bit is enabled, the preconfigured substitute values are used (see section below "Editing device data").
The input data allows the master to retrieve the current output status, which is particularly useful if the input or output delay is activated (see section below "Editing device data"). The output only reaches the required status once the preset time has elapsed so the master can retrieve the current output status.

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the relay output is **31**.

Device function - bit assignment in the data telegram

Relay output 6x06		
Byte	**Bit**	**Meaning**
Input byte 1	0	Output status channel 5
	1	Empty
	2	Output status channel 6
	3	Empty
	4	Output status channel 7
	5	Empty
	6	Output status channel 8
	7	Empty
Input byte 2	0	Output status channel 1
	1	Empty
	2	Output status channel 2
	3	Empty
	4	Output status channel 3
	5	Empty
	6	Output status channel 4
	7	Empty
Output byte 1	0	Output channel 5
	1	Channel 5 = 0 enabled, 1 = invalid
	2	Output channel 6
	3	Channel 6 = 0 enabled, 1 = invalid
	4	Output channel 7
	5	Channel 7 = 0 enabled, 1 = invalid
	6	Output channel 8
	7	Channel 8 = 0 enabled, 1 = invalid
Output byte 2	0	Output channel 1
	1	Channel 1 = 0 enabled, 1 = invalid
	2	Output channel 2
	3	Channel 2 = 0 enabled, 1 = invalid
	4	Output channel 3
	5	Channel 3 = 0 enabled, 1 = invalid
	6	Output channel 4
	7	Channel 4 = 0 enabled, 1 = invalid

Table 7.18: Device function - bit assignment in the data telegram

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7.18.3 Line fault detection

The "Line fault detection" function is not supported.

7.18.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

7.18.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.18.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.18.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

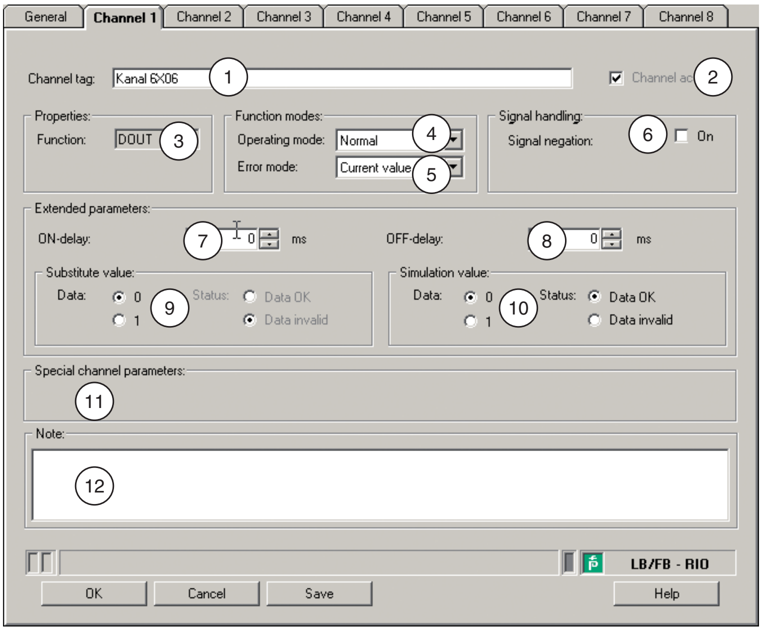

Figure 7.65: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **ON delay** box
8 **OFF delay** box
9 **Substitute value** area
10 **Simulation value** area
11 **Special channel parameters** area
12 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

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2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1.

8

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0.

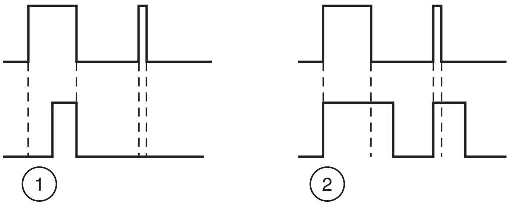

Figure 7.66: ON and OFF delay

1. ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2. OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

9

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

10

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

11

Special channel parameters area

The area is empty for this I/O module.

12

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.18.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.19 LB/FB 6x08 digital output

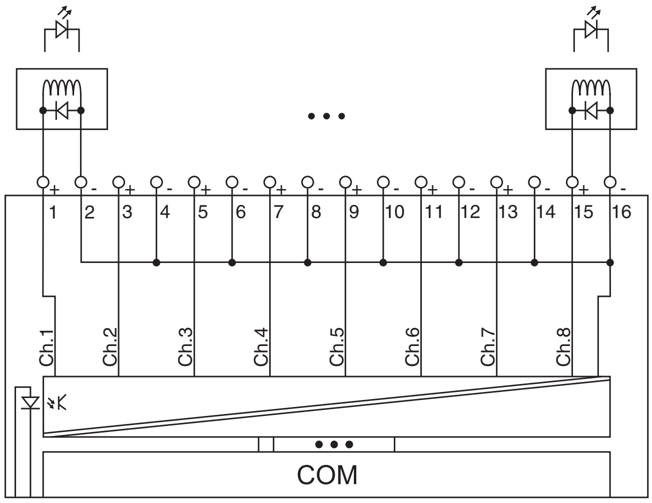

Figure 7.67: Connection diagram 6x08 with output disable input

The digital output connects lamps (LEDs), acoustic sensors and solenoid valves to the process control system or the PLC. Contactors can be activated in addition.

Versions

- LB 6008, not intrinsically safe
- LB 6108, intrinsically safe
- FB 6208, intrinsically safe
- FB 6308, Ex-e

Note!

Versions are available with and without a bus-independent output disable input. Select the appropriate version from the catalog. Note which backplane types are compatible with the different versions. Refer to the LB/FB hardware manuals and the P+F SIL manual for more detailed information.

Features

- Module width: 2 slots
- 8 low voltage channels, intrinsically safe
- Switching capacity: 20 V DC / 8 mA
- Line fault detection current: 0.3 mA, when activated

Refer to the corresponding data sheet and operating instructions for further information.

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7.19.1 Measuring time and cycle time

The response time of the digital output is 10 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.19.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

Input and output data
The I/O module has input and output data (see table).
The output data sets the control outputs and marks the data as valid/invalid. As soon as the "Data invalid" bit is enabled, the preconfigured substitute values are used (see section below "Editing device data").
The input data allows the master to retrieve the current output status, which is particularly useful if the input or output delay is activated (see section below "Editing device data"). The output only reaches the required status once the preset time has elapsed so the master can retrieve the current output status.

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the digital output is **31**.

Device function - bit assignment in the data telegram

Digital output 6x08		
Byte	**Bit**	**Meaning**
Input byte 1	0	Output status channel 5
	1	Line fault detection channel 5 (0 = OK, 1 = error)
	2	Output status channel 6
	3	Line fault detection channel 6 (0 = OK, 1 = error)
	4	Output status channel 7
	5	Line fault detection channel 7 (0 = OK, 1 = error)
	6	Output status channel 8
	7	Line fault detection channel 8 (0 = OK, 1 = error)
Input byte 2	0	Output status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Output status channel 2
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Output status channel 3
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6	Output status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)
Output byte 1	0	Output channel 5
	1	Channel 5 = 0 enabled, 1 = invalid
	2	Output channel 6
	3	Channel 6 = 0 enabled, 1 = invalid
	4	Output channel 7
	5	Channel 7 = 0 enabled, 1 = invalid
	6	Output channel 8
	7	Channel 8 = 0 enabled, 1 = invalid
Output byte 2	0	Output channel 1
	1	Channel 1 = 0 enabled, 1 = invalid
	2	Output channel 2
	3	Channel 2 = 0 enabled, 1 = invalid
	4	Output channel 3
	5	Channel 3 = 0 enabled, 1 = invalid
	6	Output channel 4
	7	Channel 4 = 0 enabled, 1 = invalid

Table 7.19: Device function - bit assignment in the data telegram

7.19.3 Line fault detection

The device has a function for line fault detection that can detect lead breakages and short circuits. Line fault detection can be switched off via software. The circuit is monitored by a test current that is low enough not to activate a connected valve.

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7.19.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.19.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.19.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.19.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

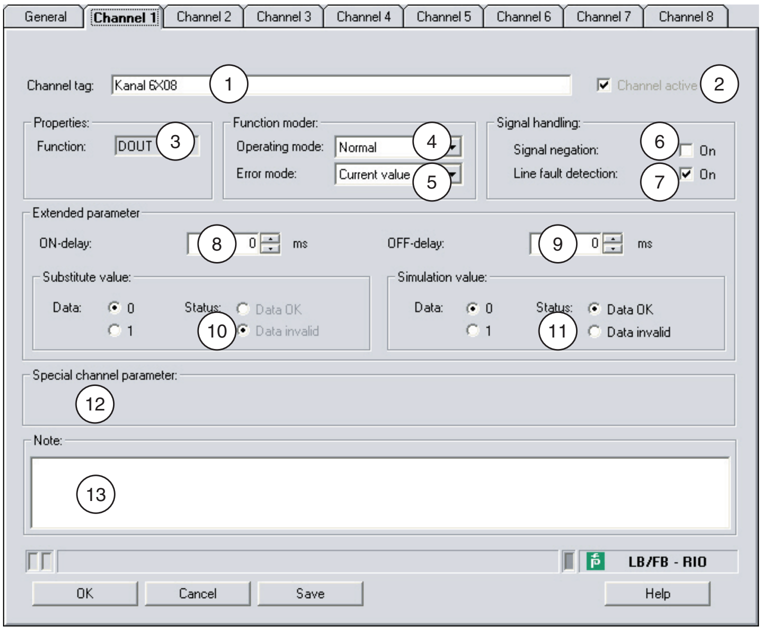

Figure 7.68: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **Line fault detection** check box
8 **ON delay** box
9 **OFF delay** box
10 **Substitute value** area
11 **Simulation value** area
12 **Special channel parameters** area
13 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

8

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1.

9

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0.

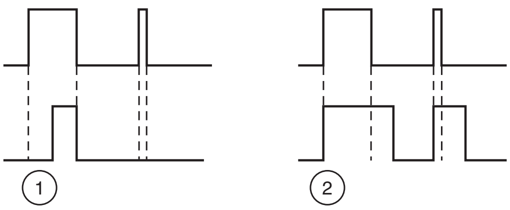

Figure 7.69: ON and OFF delay

1 ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).

2 OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

10

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

11

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

12

Special channel parameters area

The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.19.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

7.20 LB/FB 6x1x digital output

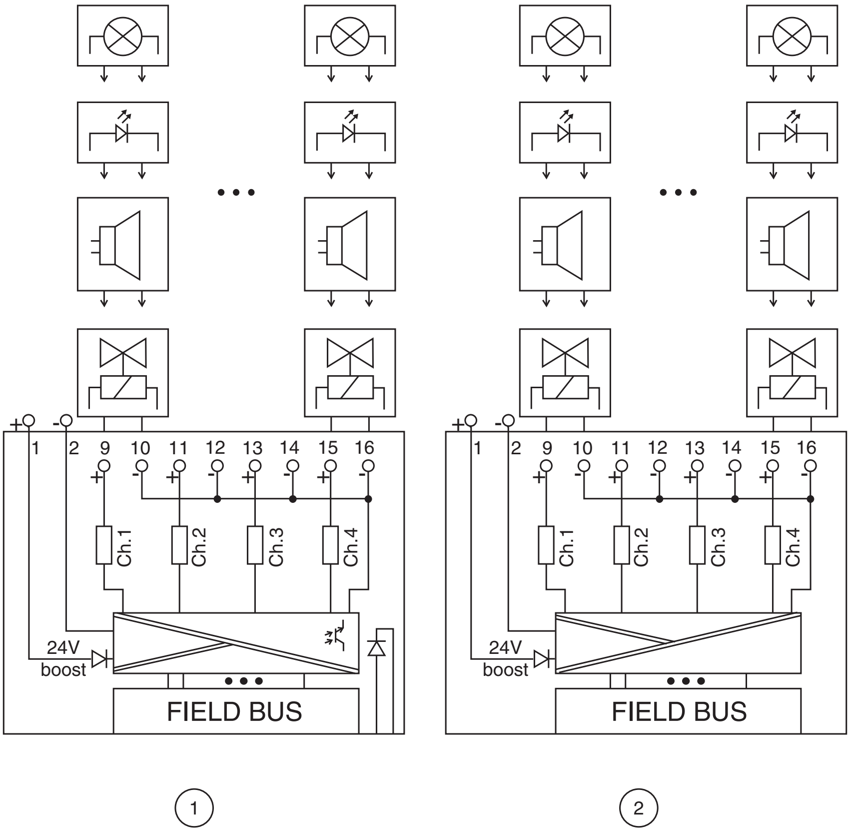

Figure 7.70: Connection diagram 6x10 - 6x15

1. with output disable input
2. without output disable input

The digital output connects lamps (LEDs), acoustic sensors and solenoid valves to the process control system or the PLC. Contactors can be activated in addition.

Versions

- LB 611x, intrinsically safe (x = 0 ... 5)
- FB 621x, intrinsically safe (x = 0 ... 5)

The electrical data of the various versions is different.

Note!

Versions are available with and without a bus-independent output disable input. Select the appropriate version from the catalog. Note which backplane types are compatible with the different versions. Refer to the LB/FB hardware manuals and the P+F SIL manual for more detailed information.

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Features

- Module width: 2 slots
- 4 low voltage channels, intrinsically safe

Refer to the corresponding data sheet and operating instructions for further information.

7.20.1 Measuring time and cycle time

The response time of the digital output is 10 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the Com Unit every 6.5 ms irrespective of the measuring time.

7.20.2 Data transfer

Data is transferred as specified in the Profibus specification.

It is important that the master and slave have the same configuration prior to the data exchange (DP configuration string). The configuration parameters are stored in the GSD file.
You can use the DTM on process control systems that support the FDT concept. The DTM ensures that the master receives all important information about the relevant configuration and is adapted automatically.
If the process control system does not support the FDT concept, the configuration must be replicated in the master. If a GSD file is integrated, the correct configuration code is automatically adopted when the I/O module is selected. If the GSD file cannot be integrated, the configuration parameters must be entered manually (see table below).

Input and output data
The I/O module has input and output data (see table).
The output data sets the control outputs and marks the data as valid/invalid. As soon as the "Data invalid" bit is enabled, the preconfigured substitute values are used (see section below "Editing device data").
The input data allows the master to retrieve the current output status, which is particularly useful if the input or output delay is activated (see section below "Editing device data"). The output only reaches the required status once the preset time has elapsed so the master can retrieve the current output status.

Note!

Dual-width I/O module

Dual-width I/O modules occupy 2 slots. Therefore, always configure an empty slot after this I/O module unless it is the last I/O module in a Remote I/O station (see chapter 5.10).

The DP configuration code of the digital output is **30**.

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Device function - bit assignment in the data telegram

Relay output 6x1x		
Byte	**Bit**	**Meaning**
Input byte 1	0	Output status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Output status channel 2
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Output status channel 3
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6	Output status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)
Output byte 1	0	Output channel 1
	1	Channel 1 = 0 enabled, 1 = invalid
	2	Output channel 2
	3	Channel 2 = 0 enabled, 1 = invalid
	4	Output channel 3
	5	Channel 3 = 0 enabled, 1 = invalid
	6	Output channel 4
	7	Channel 4 = 0 enabled, 1 = invalid

Table 7.20: Device function - bit assignment in the data telegram

7.20.3 Line fault detection

The device has a function for line fault detection that can detect lead breakages and short circuits. Line fault detection can be switched off via software. The circuit is monitored by a test current that is low enough not to activate a connected valve.

7.20.4 Diagnostics

The Com Unit supports both the DP diagnostics functions (Profibus standard) and the extended diagnostics functions (manufacturer-specific) to allow the comprehensive diagnosis of the overall Remote I/O station and the I/O modules.
If this feature was preset in the device data of the Com Unit, an I/O module error appears in the module status register and the global status register.

In addition, a channel-related error is displayed if a fault occurs in one of the channels (specifying the slot, channel, input/output ID, reason for fault).

7.20.5 Editing device data

Open the **Edit device data** window (see "Opening the Edit device data window" on page 82).

The **Edit device data** window is divided into several tabs. The first **General** tab contains parameters that affect the whole I/O module. Further, there is a **Channel X** tab containing channel-specific parameters for each channel of the I/O module, whereby the "X" replaces the channel numbers 1, 2, 3, and so on.
Because the layout of the channel-specific tabs for the I/O module is the same for each channel, only one description is included here.

7.20.6 Editing the **General** tab

Refer to the chapter "Basic functions of DTM software" for a description of the **General** tab (see chapter 6.3).

7.20.7 Editing the **Channel X** tab

You can modify channel-specific parameters and obtain channel-specific information on the **Channel X** tab. The "X" here represents the channel number(s).
A separate tab exists for each channel in the I/O module. All channel tabs in the I/O module are identical in structure.

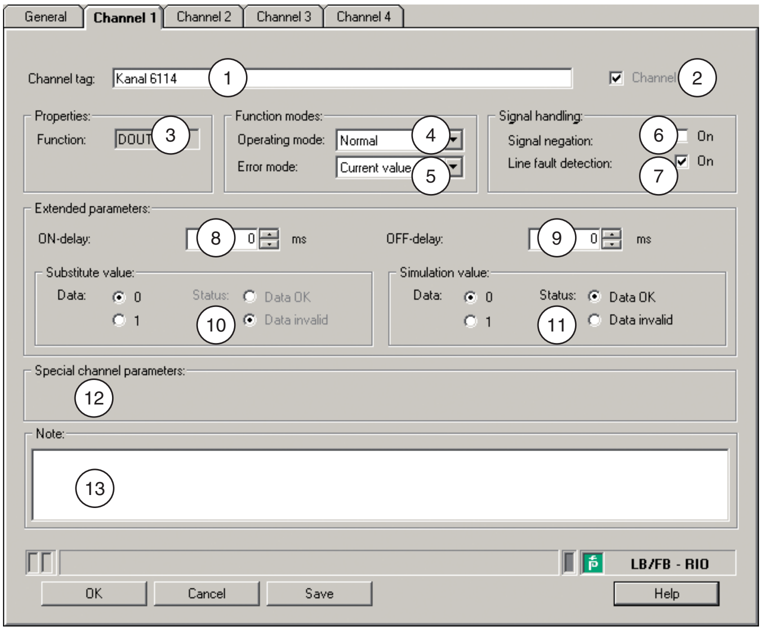

Figure 7.71: **Channel 1** tab

1 **Channel tag** box
2 **Channel active** check box
3 **Channel type** box
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Signal negation** check box
7 **Line fault detection** check box
8 **ON delay** box
9 **OFF delay** box
10 **Substitute value** area
11 **Simulation value** area
12 **Special channel parameters** area
13 **Note** box

Explanations:

1

Channel tag box

Enter a unique name for the channel (maximum 32 characters).

2

Channel active check box

Indicates whether or not the channel is active. The check box is linked to the **Module active** check box on the **General** tab and cannot be edited here (see chapter 6.3).

3

Function box

Indicates the channel function ("DIN" = Digital Input, "DOUT" = Digital Output, "AIN" = Analog Input, "AOUT" = Analog Output), cannot be edited.

4

Operating mode drop-down list

Select either "Normal" (normal mode) or "Simulation" (simulation mode):

- "Normal": In normal mode, the current signal is transmitted.
- "Simulation": A signal is simulated in simulation mode. You can preset the simulated signal in the **Simulation value** area, which is also located on this tab.

See section "Operating mode and error mode" (see chapter 6.7) for more details.

5

Error mode drop-down list

Preset how the I/O module responds in the event of a fault. Select between "Current value", "Substitute value" and "Last valid value":

- "Current value": The signal is transferred unchanged in spite of the error (the signal may be a simulated signal).
- "Substitute value": A substitute value is transferred. You can preset the substitute signal manually in the **Substitute value** area, which is also located on this tab.
- "Last valid value": The last value that was valid before the fault occurred is transferred.

See section "Operating mode and error mode" (see chapter 6.7) for more details on error mode.

6

Signal negation check box

Activate **Signal negation** to invert the signal. When negation is active, a logical "1" may become "0", for example.

7

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (for example lead breakage or short circuit), the fault is transmitted together with the process value and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
An alternative way of monitoring the I/O module is by reading and evaluating the corresponding status register.

8

ON delay box

Enter a value in ms to delay the transfer of a signal change from 0 to 1.

9

OFF delay box

Enter a value in ms to delay the transfer of a signal change from 1 to 0.

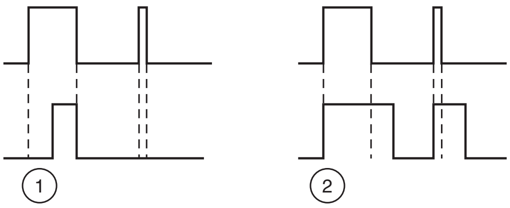

Figure 7.72: ON and OFF delay

1 ON delay: The ON delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are filtered out).
2 OFF delay: The OFF delay function is deactivated in the top half of the illustration and activated in the bottom half (short signals are extended).

10

Substitute value area

Define the substitute value used in the event of a fault (see the **Error mode** drop-down list on this tab).

- Data: Select a substitute value of either 0 or 1.
- Status: The substitute value for the faulty signal is always automatically assigned the status "Invalid data". The status is therefore preset to "Invalid data" and cannot be edited.

11

Simulation value area

Define the simulation value and the status of the value. The simulation value is transferred if you have selected "Simulation" operating mode.

- Data: Select a simulation value of either 0 or 1.
- Status: Select between the status "Data OK" and "Invalid data". If you select "Invalid data", the substitute value strategy is initiated.

12

Special channel parameters area

The area is empty for this I/O module.

13

Note box

Enter a comment of your choice here with a maximum of 256 characters. The comment is only stored in the database, storing the comment in the device is not possible. The comment applies for the entire I/O module and also appears on the other tabs in the window.

7.20.8 Using the measured value display

The **View process values/diagnosis** window for the I/O modules is used to display measured values and diagnostics information. Refer to the section "Measured value display for digital I/O modules" (see chapter 6.4.1) for information on how to open the window for this I/O module and what the information in the window means.

8 Com Unit diagnostics functions

The measured value display for the Com Unit provides you with diagnostics information relating to the overall Remote I/O station. This chapter explains how to access the measured value display, describes the structure of the measured value display and lists the diagnostics information available.

8.1 Opening the measured value display of the Com Unit

Opening the **View process values/Diagnosis** window

Prerequisite: You have already created a project file in the FDT base application. This project file is open and the project structure contains a Com Unit and one or more I/O modules. Communication with the remote I/O station is working properly.

1. Click the required entry in the project structure using the right mouse button.

   A context menu opens.
2. Select **Connect** in the context menu to establish an online connection with the Remote I/O station.

   A connection is established.
   The corresponding entry appears in bold letters once the connection is established. In addition, the connection status is indicated by an icon.
3. Click the entry in the project structure once again using the right mouse button.

   A context menu opens.

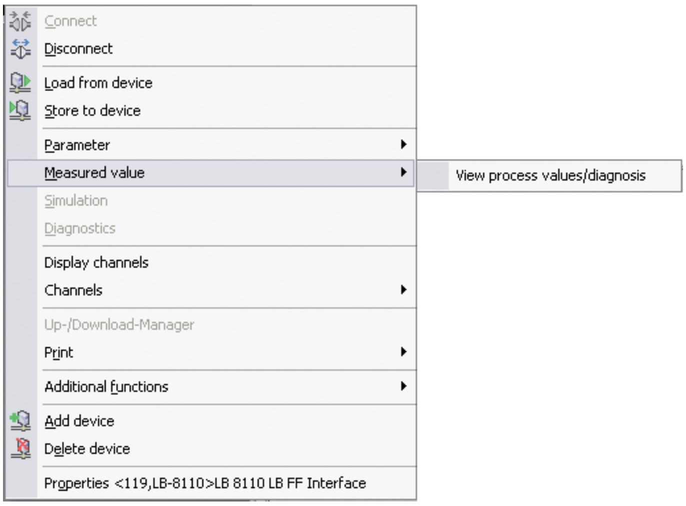

Figure 8.1: Opening the **View process values/diagnosis** window

4. Select **Measured value > View process values/Diagnosis** in the context menu. If the command is not available (grayed out), there is no connection to the Remote I/O station.

   The **View process values/Diagnosis** window opens.

8.2 Layout of the measured value display

The Com Unit measured value display is divided into four areas.

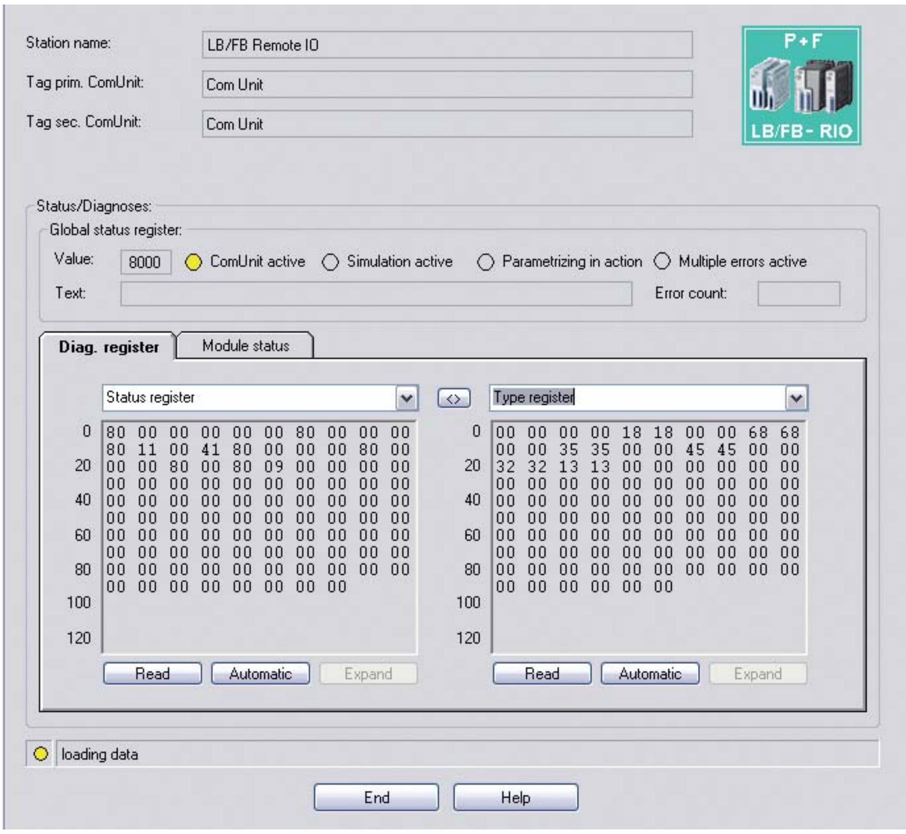

Figure 8.2: **View process values/diagnosis** window

1 **Station name** and **Tag prim./sec. Com Unit**
2 Global Status Register
3 Tabs
4 Status bar

1

Station name and **Tag prim./sec. Com Unit** boxes

The boxes contain the names of the station and the primary Com Unit. On redundant systems, the name of the secondary Com Unit also appears (redundant Com Unit).

2

Global status register

The global status register contains information about the status of the Com Unit, the I/O modules and the power supply of a station. Refer to the following section for more information on the global status register.

3

Tabs

This area contains several tabs. The first **Diagnostics register** tab displays the different diagnostic registers in raw data format. Depending on the type of Com Unit further diagnostic information is displayed on additional tabs. Refer to the following sections for more information on the tabs.

Note!

The **Module status** tab is only available from DTM version 7.3.

4

Status bar

The status bar displays information on the communication status and has an LED as well as a box for displaying clear text messages. A flashing yellow LED indicates read access in progress. The indicator lights up red if a communication fault occurs.
The current communication status appears in the box in the form of a clear text message:

- "Date loading": The read request was successful. The measured value display waits for the requested data.
- "Waiting...": The read request was unsuccessful because the communication channel is currently in use (busy).
- "Communications error": Could not transfer the requested data.

8.3 Global status register

The global status register comprises 16 bits (1 word) and contains information about the status of the Com Unit, the I/O modules, and the power supply of a Remote I/O station. The global status register is displayed in the **Process values/diagnostics display** window as a raw data value (here: "C000") and in processed format (see illustration).

You can decide whether to activate the global status register for cyclic data traffic by adjusting the relevant setting in the Com Unit device data (**Edit device data** window > **Profibus I** tab > **Cyclic data** area, see chapter 5.7).

Figure 8.3: Com Unit measured value display, **Global status register** area

The following section describes the general structure of the status register with reference to an actual example of an error message.

8.3.1 Structure of the global status register

The global status register comprises 2 input bytes located at the start of the DP configuration string (see chapter 5). The meaning of the individual bits is shown in the table below.

Structure of the global status register

Byte	Bit / State		Meaning
2	15	= 0	Com Unit is passive
		= 1	Com Unit is active
	14	= 0	Operating mode: No simulation.
		= 1	Operating mode: A minimum of one I/O module is simulated.
	13	= 0	No error
		= 1	Fault
	12	= 0	General error
		= 1	Module fault
	11		The error code consists of bits 11 to 8, e.g. 0 1 1 1 produces an error code of 7 (hexadecimal) = power supply fault. The meaning of all error codes is shown in the table below.
	10		
	9		
	8		
1	7	= 0	One error
		= 1	Multiple errors
	6	= 0	No parameterization/processing
		= 1	Parameterization/processing in progress
	5		Bits 5 to 0: • If a single error occurs (bit 7 = 0), the faulty slot can be determined with reference to the bits, e.g. 0 0 0 1 0 0 indicates slot 4 (hexadecimal). • If multiple errors occur (bit 7 = 1), the number of errors can be determined. • If only power supply faults occur (value bit 11 - 8 = 7, bit 7 = 0), one bit is assigned to each power supply (power supply 1 = bit 0, ..., power supply 6 = bit 5), whereby the status 1 represents one fault.
	4		
	3		
	2		
	1		
	0		

Error code of the global status register

Error code (hex)	Clear text message
0	No error
1	Memory error PIC (RAM)
2	Memory error PIC (register)
3	Memory error PIC (flash)
4	PIC internal error
5	Command error PIC
6	Module fault
7	Power supply fault
8	Memory error CPU32 (RAM)
9	Memory error CPU32 (flash)
A	CPU32 internal error (watchdog)
B	Redundancy error, arithmetic
C	Redundancy error, partner not present (no redundancy Com Unit)
D	Redundancy error, link
E	Redundancy error, parameter inconsistent
F	Reserved

8.3.2 Example of global status register

The example below shows a power supply fault, the **Value** box contains the raw data value "A784". The other elements display the raw data value in processed format (see illustration).

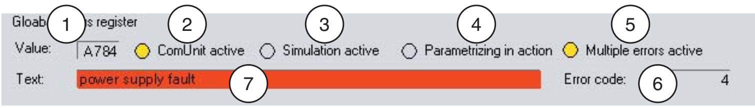

Figure 8.4: Com Unit measured value display, **Global status register** area

1 **Value** box (raw data value)
2 **Com Unit active** indicator
3 **Simulation active** indicator
4 **Parameterization in progress** indicator
5 **Multiple errors active** indicator
6 **Error code** box (for one error) or **Number of errors** box (for more than one error)
7 **Text** box (clear text message)

The raw data value is produced from the 16 bits in the status register. The table below outlines how the raw data value "A784" is compiled and on which status displays the value appears. The numbers in brackets refer to the captions for the illustration.

Example of global status register (raw data value "A784")

"A784"	Bit / State		Meaning
A	15	= 1	Com Unit is active; status indicated by **Com Unit active** (2) (yellow = active, gray = passive)
	14	= 0	Simulation is not active; status indicated by **Simulation active** (3) (yellow = minimum of 1 channel simulated, gray = no simulation)
	13	= 1	Error has occurred; status indicated by **Text** box (7) (red background = error, gray background = no error)
	12	= 0	General error; no status indicator
7	11	= 0	Bits 11 - 8 with the states 0 1 1 1 produce the error code "7". The error with the highest priority is a power supply fault. The text "Power supply fault" appears in the **Text** box (7).
	10	= 1	
	9	= 1	
	8	= 1	
8	7	= 1	Multiple errors have occurred; status indicated by **Multiple errors active** (5) (yellow = multiple errors, gray = no errors or single error)
	6	= 0	No parameterization/processing; status indicated by **Parameterization in progress** (4) (yellow = parameterization in progress, gray = no parameterization)
	5	= 0	There are 4 active errors (multiple errors); bits 5 - 0 with the states 0 0 0 1 0 0 produce the number 4; displayed in **Number of errors** box (6).
	4	= 0	
4	3	= 0	
	2	= 1	
	1	= 0	
	0	= 0	

8.4 "Diagnostics register" tab

Different diagnostics areas in the Com Unit can be read out and compared with one another in the **Diagnostics register** tab. Press the **<>** (compare) button to highlight differences between the diagnostics areas in the left and right text boxes in color until the data is updated again.

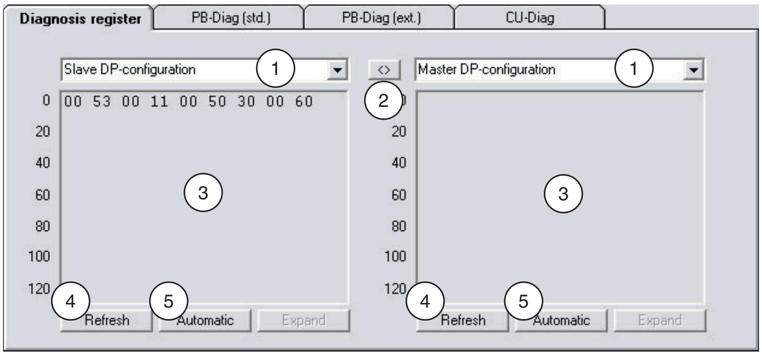

Figure 8.5: **Diagnostic register** tab

1 Drop-down lists for selecting the diagnosis areas
2 <> button (start comparison between diagnostic areas)
3 Boxes containing hexadecimal diagnostic data
4 **Refresh** button (for reading in diagnostic data manually)
5 **Automatic** button (for reading in diagnostic data automatically)

Refer to the following sections for information on data interpretation. The following selection options are available in the two drop-down lists:

- Slave DP configuration (see chapter 8.4.1),
- Master DP configuration (see chapter 8.4.1),
- DP diagnostics (see chapter 8.4.2),
- DP parameters (see chapter 8.4.3),
- DP parameter (partner) (see chapter 8.4.3),
- Redundancy status (see chapter 8.4.4),
- Redundancy status (partner) (see chapter 8.4.4),
- Status register (see chapter 8.4.5),
- Type register (see chapter 8.4.6),
- Advanced diagnostics (see chapter 8.4.7).

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8.4.1 DP configuration

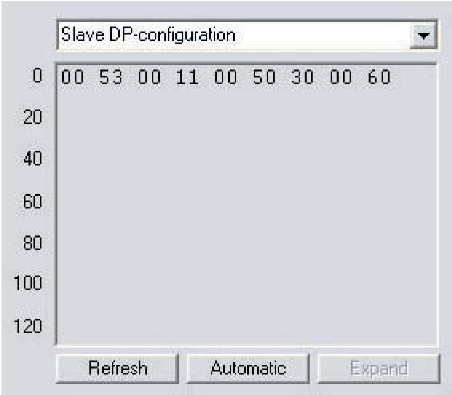

Figure 8.6: DP configuration

If you select the entry "Slave DP configuration" or "Master DP configuration" from the drop-down list, the DP configuration string for the slave or the masters appears in the text box. You have the ability to compare the DP configuration string of the slave and the master directly with one another using the left and right drop-down lists (view Figure 8.5 on page 294). When configured correctly, the DP configuration strings of the slave and master should be identical.

The DP configuration string is comprised of the hexadecimal DP configuration codes of the individual Remote I/O components (Com Unit, I/O modules, empty slots). The string is compiled automatically when the station is configured (adding, deleting, configuring Remote I/O components). As soon as the station configuration in the slave is activated, the "Slave DP configuration" for the corresponding configuration string appears in the diagnostics register.

Refer to the section "Meaning of the DP configuration string" for detailed information on the DP configuration string (see chapter 5). The section also contains a table with the DP configuration codes of the Com Unit and the I/O modules.

Structure of the DP configuration code

Bit	Meaning
7	Date consistency: 0 = byte/word, 1 = total data
6	Data format: 0 = byte, 1 = word
5	Bits 5 - 4: data type: 00 = special type, 01 = input, 10 = output, 11 = input/output
4	
3	Bits 3 - 0: data length: e.g. 0000 = 1 byte/word, 0011 = 4 byte/word, 1111 = 16 byte/word
2	
1	
0	

8.4.2 DP Diagnostics

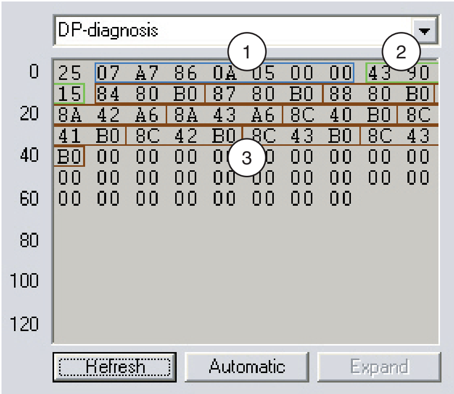

Figure 8.7: DP diagnostics

1 Device-specific diagnostic bytes
2 Module-specific diagnostic bytes
3 Channel-specific diagnostic bytes

If you select the entry "DP diagnosis" from the drop-down list, the extended PROFIBUS diagnostic bytes are displayed in the text box. This data is part of the diagnostic telegram, in addition to the PROFIBUS standard diagnostics. The slave (Remote I/O station) always transmits a diagnostic telegram as soon as the master issues a diagnostics request (DP Diag Response).
The PROFIBUS specification defines how the data is encoded as explained briefly in the following section. The diagnostic data is evaluated on the **DP-Diag. (ext.)** tab, which also forms part of the Com Unit measured value display (see chapter 8.6).

The extended PROFIBUS diagnostics is divided into 3 areas (see figure), which are described below.

Area 1: Device-specific diagnostic bytes

Device-specific diagnostic bytes in the first area contain information on the status of the remote I/O station and depend largely on the parameterization of the Com Unit. The table below includes bytes 1 to 7.

- Byte 1: Header byte with identifier for device-specific diagnostics (bit 6 = 0 and bit 7= 0) and 6 bits (bit 5 – 0) specifying the length of the device-specific diagnostics, including header byte (in the example: "07" = 7 bytes).
- Byte 2 + 3: 2-byte global status register for the active Com Unit (in the example: " A7 86", see the chapter entitled "Global status register" for an evaluation).
- Byte 4 + 5: the first two standard diagnostic bytes of the redundant Com Unit (in the example: "0A 05", evaluation in section "PB diag (std.) tab", view Figure 8.12 on page 310).
- Byte 6 + 7: 2-byte global status register for the redundant Com Unit. The passive Com Unit does not transfer error messages, so most transferred bytes are set to 0. Values other than 0 can be interpreted as described under "Global status register".

The last four bytes (7 – 4) are only relevant for redundant systems with 2 Com Units and are filled with preset values in single mode.

If you have checked the **Add. module diagnostics** check box in the device data, then, in contrast to the example above, an additional 2 bits will be transferred for each I/O slot (see chapter 5.7.3). The data volume of the device-specific diagnostics increases by 12 bytes (48 slots * 2 bits), regardless of the I/O modules that are actually configured.
The two additional bits for each slot represent the following states: 00 = no error, 01 = module error, 10 = incorrect module type, 11 = no module available. The transfer sequence is shown in the table below.

Additional Module Diagnostics

Byte	Bit	Meaning
Byte $_{n+1}$ (*)	7	Status slot 4
	6	
	5	Status slot 3
	4	
	3	Status slot 2
	2	
	1	Status slot 1
	0	
...	...	...
Byte $_{n+12}$ (*)	...	... Status slot 48
(*) byte $_n$ = last byte before the additional module diagnostics		

Area 2: Module-specific diagnostic bytes

The second extended diagnostics area contains module-specific diagnostic bytes (bytes 8 to 10 in the illustration, "43 90 15"). Here, one bit is assigned to each Com Unit and I/O module from the remote I/O station or each configuration code in the DP configuration string. If one bit is preset (= 1), diagnostics are available for the module assigned to this bit.

The number of bytes in the module-specific diagnostics depends on the configuration of the remote I/O station. The more I/O modules that are assigned to slots, the higher the number of bytes. The evaluation structure of the module-specific diagnostic bytes is shown in the following table with reference to the example in the illustration (view Figure 8.7 on page 296). The evaluation structure displayed can also be applied for longer module diagnostics, regardless of the number of diagnostic bytes. Each additional bit represents the next I/O module.

The assignment of diagnostics to modules in different master and diagnostic systems may turn out differently due to the various counting methods. If necessary, change the counting method using the Com Unit parameter **Offset module diagnosis** (Com Unit device data window > **PROFIBUS II** tab,see chapter 5.7.3).

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Module-Specific Diagnostic Bytes

Byte	Bit / State		Meaning, general	Example of meaning
Byte $_n$ Example : 43 (*)	7	= 0	Diagnostics type: 0 0 = device-spec. diagnostics; 0 1 = module-spec. diagnostics; 1 0 = channel-spec. diagnostics; 1 1 = reserved	Module-specific diagnostics (0 1) 3 bytes in length (0 0 0 0 1 1)
	6	= 1		
	5	= 0	Number of bytes in the diagnostics, including header byte	
	4	= 0		
	3	= 0		
	2	= 0		
	1	= 1		
	0	= 1		
Byte $_{n+1}$ Example : 90	7	= 1	Module 8 (diagnostic or error message)	Modules 5 and 8 have error or diagnostic messages
	6	= 0	Module 7 (no error)	
	5	= 0	Module 6 (no error)	
	4	= 1	Module 5 (diagnostic or error message)	
	3	= 0	Module 4 (no error)	
	2	= 0	Module 3 (no error)	
	1	= 0	Module 2 (no error)	
	0	= 0	Module 1 (no error)	
Byte $_{n+2}$ Example : 15			Modules 9 to 16	Modules 9, 11, and 13 have error or diagnostic messages
...	...		...	
Byte $_{n+x}$			Modules y to y + 7	Not included in the example
(*) byte $_n$ = Header byte of module-specific diagnostics				

Area 3: Channel-specific diagnostic bytes

After the module-specific diagnostics comes the channel-specific diagnostics, which contains information on the channel properties and the error/diagnostics type (bytes 11 to 40 in the illustration , view Figure 8.7 on page 296). The channel-specific diagnostics is divided into blocks three bytes long, where one block represents one channel.

The diagnostics are evaluated according to the structure displayed in the table below using the first three bytes from the example (84 80 B0). Some parts of the error/diagnostics types and associated codes are predefined in the PROFIBUS specification. Other parts can be defined independently using the GSD file from the device manufacturer (see table "Channel-specific diagnostic messages").

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The memory reserved for diagnostic information is limited. The maximum number of transferable channel-specific diagnostics is also limited because each additional channel diagnostics requires three extra bytes. If more diagnostics are present than can be transferred, the PROFIBUS standard diagnostic bit "Diagnostic data overflow" is displayed.

Channel-Specific Diagnostic Bytes

Byte	Bit / State		Meaning, general	Example of meaning
Byte $_n$ Example : 84 (*)	7	= 1	Diagnostics type: 0 0 = device-spec. diagnostics; 0 1 = module-spec. diagnostics; 1 0 = channel-spec. diagnostics; 1 1 = reserved	Channel-specific diagnostics (1 0) for module 5 or configuration code 4 (0 0 0 1 0 0) (if diagnostics offset = 0 and the configuration code counting method starts with 0)
	6	= 0		
	5	= 0	Assignment to the module or configuration code (offset-dependent)	
	4	= 0		
	3	= 0		
	2	= 1		
	1	= 0		
	0	= 0		
Byte $_{n+1}$ Example : 80	7	= 1	Input/Output: 0 0 = reserved; 0 1 = input; 1 0 = output; 1 1 = input and output	Diagnostics are based on an output value (1 0) and apply to channel 1 (0 0 0 0 0 0)
	6	= 0		
	5	= 0	Assignment of the diagnostics to a channel	
	4	= 0		
	3	= 0		
	2	= 0		
	1	= 0		
	0	= 0		
Byte $_{n+2}$ Example : B0	7	= 1	Data structure: 0 0 0 = reserved; 0 0 1 = 1 bit; 0 1 0 = 2 bits; 0 1 1 = 4 bits; 1 0 0 = 1 byte; 1 0 1 = 1 word; 1 1 0 = 2 words; 1 1 1 = reserved	Data structure = 1 word (1 0 1); diagnostic message = lead breakage or short circuit (1 0 0 0 0 = 16)
	6	= 0		
	5	= 1		
	4	= 1	Diagnostic message (see table below)	
	3	= 0		
	2	= 0		
	1	= 0		
	0	= 0		
(*) byte $_n$ = Header byte of channel-specific diagnostics				

Channel-Specific Diagnostic Messages

Identifier	Diagnostic message
PROFIBUS specification	
1	Short circuit
2	Undervoltage
3	Overvoltage
4	Overload
5	Excess temperature
6	Lead breakage
7	Upper limit exceeded
8	Lower limit exceeded
9	Error
10 - 15	Reserved
Manufacturer specification (defined in GSD file)	
16	Short circuit or lead breakage
17 - 31	Reserved

8.4.3 DP parameters

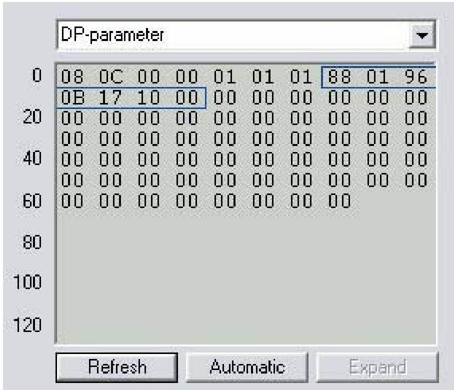

Figure 8.8: DP parameters

If you select the entry "DP parameters" from the drop-down list and then click the **Read** button, the data of the parameterization telegram (SetParam) is displayed in the text box (see outline in the illustration, bytes 7 to 13). The other bytes are not relevant for diagnostics purposes and are therefore not described here in more detail.

If you select the entry "DP parameters (partner)" from the drop-down list, you access the parameterization telegram for the redundant Com Unit (redundant systems only). The structure of the two DP parameters registers "DP parameters" and "DP parameters (partner)" is identical and is therefore only described once in the following section.

The first byte of the parameterization telegram (example: 88) represents Profibus-specific modes and functions that can be activated and deactivated via the parameterization telegram. The meaning of the individual bits is shown in the table below.

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DP parameters byte 1

Byte	Bit / State		Meaning, general	Example of meaning
Byte 1 Example : 88	7	= 1	Lock (0 = off; 1 = on)	Lock function and watchdog activated
	6	= 0	Unlock (0 = off; 1 = on)	
	5	= 0	SYNC mode (0 = off; 1 = on)	
	4	= 0	FREEZE mode (0 = off; 1 = on)	
	3	= 1	Watchdog (0 = off; 1 = on)	
	2	= 0	Reserved	
	1	= 0	Reserved	
	0	= 0	Reserved	

Explanation of terms used in the table

- **Watchdog**: When the watchdog function is activated, the Com Unit monitors communication with the master. If the master does not respond to the Com Unit correctly within a variable watchdog time, the Com Unit interprets this as an error and then reacts accordingly.
  The watchdog time is usually calculated automatically by the master and must always be longer than the maximum time required for a complete data cycle. The watchdog time is transferred in bytes 2 and 3 of the parameterization telegram (in the example: 01 96) and can be calculated as follows:
  Watchdog time = (decimal value byte 2) * (decimal value byte 3) * 10 ms = 1 (01_{hex}) * 150 (96_{hex}) * 10 ms = 1500 ms
- **FREEZE mode**: The input data of different slaves is always retrieved in succession. The point in time when signals are retrieved in normal mode therefore varies from slave to slave. FREEZE mode is used to freeze the input data of different slaves at a defined point in time and then the data is transferred in succession.
- **SYNC mode**: Like FREEZE mode, SYNC mode is used for synchronizing data, but only affects the outputs. This function allows you to transmit output data to different slaves in quick succession and then output this data simultaneously using the Sync command.
- **Lock/Unlock**: The lock/unlock function enables the master to grant or rescind access rights to a slave. If the lock bit is set and the unlock bit is not set, the slave is reserved for a certain master (identified by the master address). If the unlock bit is set, the slave is not reserved for a certain master (the status of the lock bit is irrelevant in this case). If both the lock bit and the unlock bit are not set, the slave is still not reserved for a specific master and can be locked by any master using a parameterization telegram.

Bytes 2 and 3 of the parameterization telegram contain the watchdog time mentioned previously (see explanation of terms).

Byte 4 contains the minimum time that the slave must wait before a response telegram may be transmitted (min. T_{SDR} in bit times; in the example: 11 ($0B_{hex}$) bit times).

Bytes 5 and 6 contain the high and low bytes for the Profibus ID number (in the example: 17 10). The ID number that the master transmits to the slave in the parameterization telegram must correspond to the Profibus ID number of the slave (predefined). If the ID numbers do not correspond, the parameterization telegram is not accepted and the slave cannot participate in the data exchange (parameter error).

Byte 7 is used to assign the slave to a specific component group (in the example: 00hex = group 0). Grouping in this way enables multicast communication (telegram is valid for a group of components). The group 0 (00_{hex}) is assigned to the slave by default, as shown in the example here.

8.4.4 Redundancy status

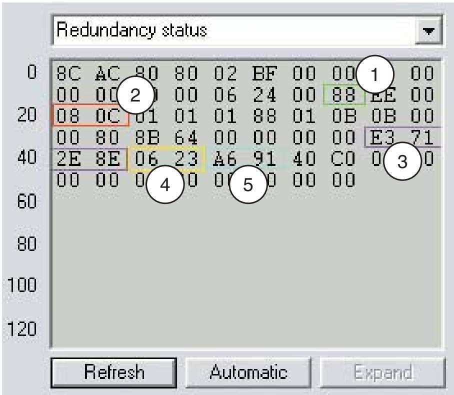

Figure 8.9: Redundancy status

1 Communication status
2 Profibus standard diagnostic bytes
3 Result of the checksum calculation (CRC)
4 Com Unit firmware version
5 Global status register

The structure of the two redundancy status registers "Redundancy status" and "Redundancy status (partner)" is identical. If you select the entry "Redundancy status (partner)" from the drop-down list (only on redundant systems), you access the data set for the redundant Com Unit via the active Com Unit. Data is exchanged between the two Com Units automatically.
Each redundancy status register contains a large amount of information. The most important information is highlighted in the illustration and explained briefly below (except the firmware version of the Com Unit).

1

Communication status
This byte contains information relating to Profibus communication. The table below shows how this byte is interpreted. The example (88) shows that the slave has found a valid baud rate and has the status "DataExchange".

Communication status

Byte	Bit / State		Meaning, general	Example of meaning
Byte n Example : 88	7	= 1	DataExchange (0 = inactive, 1 = active)	Slave has the status DataExchange, baud rate was found
	6	= 0	Reserved	
	5	= 0		
	4	= 0		
	3	= 1	Baud rate (0 = not found, 1 = found)	
	2	= 0	Reserved	
	1	= 0		
	0	= 0		

2

Profibus standard diagnostic bytes

Profibus standard diagnostic bytes 1 and 2 are stored at the position indicated (in the example: 08 0C). The byte is interpreted from the Profibus specification and is explained in more detail in section "PB diag. (std.)" (see chapter 8.5).

3

Result of the checksum calculation (CRC)

This area contains the result of the checksum calculation (CRC) for the parameter set of the Com Unit. In redundant systems (with the exception of Easy-Com connections), the data records must be identical in both Com Units. You can compare data records with one another using the <> button.

The revision counter value for the parameter set is also included in the checksum calculation. The consequence of this is that the CRC also changes when the revision version increases and provides evidence of the transmission of new parameters.

5

Global status register

This area contains the global status register. Interpretation of the bytes has already been covered in the preceding section "Global status register".

8.4.5 Status register

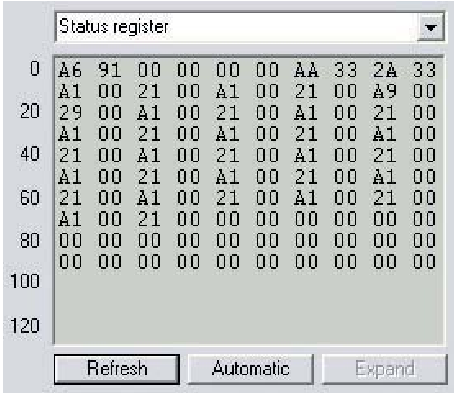

Figure 8.10: Status register

If you select the entry "Status register" from the drop-down list, the status bytes for the Com Unit and the I/O modules are displayed.

There are 2 status bytes available for each I/O module slot and for the bus connection (Com Unit or Com Unit + redundancy Com Unit). The first two bytes are allocated to the bus connection and contain the global status register already described. This is followed by two bytes for each I/O slot, beginning with slot 1. The meaning of the bytes is displayed in the following table.

The first of the two status bytes contains module diagnostic information and has the same structure for each I/O module slot (see table below). The second byte is dependent on the module type and contains channel diagnostic information (see table "Channel diagnostic information").
Some dual-width modules require two slots. These modules are represented by 4 bytes (2 bytes per slot). In theory, bytes 1 and 3 have the same structure, whereby only the first required module slot is assigned an active status. Bytes 2 and 4 then contain the module-type dependent channel diagnostic information (see table "Channel diagnostic information").

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Module status register

Byte	Bit / State		Meaning, general	Example of meaning
Byte 1 Example : AA	7	= 1	Module active (0 = inactive, 1 = active)	The I/O module is active (bit 7 = 1) and faulty (bit 5 = 1). There is an internal module error (bit 3...0 = 1 0 1 0 = error code 10_{Hex})
	6	= 0	Simulation active (min. 1 channel) (0 = inactive; 1 = active)	
	5	= 1	Error (0 = no error; 1 = error)	
	4	= 0	Reserved	
	3	= 1	Error code (see table below "Error codes bit 3...0")	
	2	= 0		
	1	= 1		
	0	= 0		
Byte 2			Channel diagnostic information (see table "Channel diagnostic information) The I/O modules **1x07**, **1x14** and **1x15** do not have **channel diagnostic information**. For these modules, this byte = 0.	

Error codes bit 3 ... 0

Error code (bit 0 ... 3)	Meaning
0	No error
1	Timeout (slot empty)
2 ... 6	Internal bus error (communication problems between Com Unit and I/O module(s))
7 ... 8	Reserved
9	Incorrect module type (inserted and configured module types do not match)
10	Internal module error (e.g. lead breakage or short circuit)
11 ... 15	Reserved

Module status (channel diagnostic information)

Module types 1x01, 1x02, 1x08, 2xxx, 6x05, 6x06, 6x08, 6x10 ... 6x15			
Byte 2	Meaning	Byte 4 (*1)	Meaning
Bit 0	Digital data channel 1 (0/1)	Bit 0	Digital data channel 5 (0/1) (*2)
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 5 (0 = valid, 1 = invalid) (*2)
Bit 2	Digital data channel 2 (0/1)	Bit 2	Digital data channel 6 (0/1) (*2)
Bit 3	Status channel 2 (0 = valid, 1 = invalid)	Bit 3	Status channel 6 (0 = valid, 1 = invalid) (*2)
Bit 4	Digital data channel 3 (0/1) (*2)	Bit 4	Digital data channel 7 (0/1) (*2)
Bit 5	Status channel 3 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 7 (0 = valid, 1 = invalid) (*2)
Bit 6	Digital data channel 4 (0/1) (*2)	Bit 6	Digital data channel 8 (0/1) (*2)
Bit 7	Status channel 4 (0 = valid, 1 = invalid) (*2)	Bit 7	Status channel 8 (0 = valid, 1 = invalid) (*2)
(*1) Byte 4 only influences dual-width I/O modules that occupy 2 slots. (*2) The bit may only be reserved, depending on the number of I/O module channels.			

Module status (channel diagnostic information)

Module type 6x01	
Byte 2	Meaning
Bit 0	Digital data channel 1 (0/1)
Bit 1	Digital data channel 2 (0/1)
Bit 2 ... 7	Reserved

Module status (channel diagnostic information)

Module type 1x03	
Byte 2	Meaning
Bit 0	Counter status
Bit 1	Status (0 = valid, 1 = invalid)
Bit 2	Reserved
Bit 3	Direction detection
Bit 4 ... 7	Reserved

Module status (channel diagnostic information)

Module types 3x01, 3x02, 3x03, 3x04, 3x05			
Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Live zero/Breakage limit exceeded channel 1	Bit 0	Live zero/Breakage limit exceeded channel 3 (*2)
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Live zero/Breakage limit exceeded channel 2 (*2)	Bit 4	Live zero/Breakage limit exceeded channel 4(*2)
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only influences dual-width I/O modules that occupy 2 slots. (*2) The bit may only be reserved, depending on the number of I/O module channels.			

Module status (channel diagnostic information)

Module types 4x01, 4x02, 4x03, 4x04, 4x05			
Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Reserved	Bit 0	Reserved
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Reserved	Bit 4	Reserved
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only influences dual-width I/O modules that occupy 2 slots. (*2) The bit may only be reserved, depending on the number of I/O module channels.			

Module status (channel diagnostic information)

Module types 5x01, 5x02, 5x04, 5x05, 5x06			
Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Reserved	Bit 0	Reserved
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Reserved	Bit 4	Reserved
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only influences dual-width I/O modules that occupy 2 slots. (*2) The bit may only be reserved, depending on the number of I/O module channels.			

8.4.6 Type register

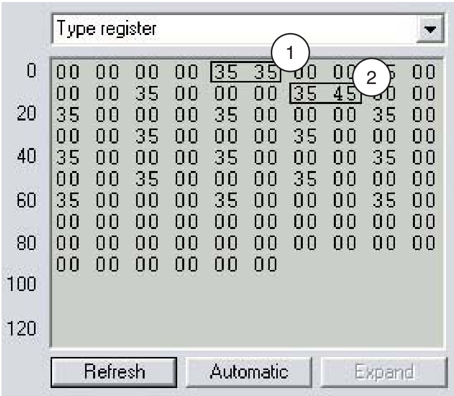

Figure 8.11: Type register

1 Slot 3

2 Slot 9

Provides you with an overview of the station structure if you have selected the entry "Type register" from the drop-down list.

In the type register, a pair of bytes is assigned to each slot. The first byte of the pair contains the I/O module type identifier configured in the Com Unit. The second byte contains the type identifier of the I/O module that is actually plugged into the respective slot in the station. Check whether the planned I/O module configuration corresponds with the configuration of the inserted I/O modules by comparing the first and second byte in each pair of bytes with one another.

The module type identifier consists of two hexadecimal characters. The first hexadecimal character is the same as the first decimal number of the I/O module type and the second hexadecimal character is the same as the last two decimal numbers of the I/O module type. The table below provides an overview of the module type identifiers.
Example: Module type identifier $2C_{hex}$ = I/O module 2x12; the first character (2_{hex}) is the same as the first number of the I/O module type (**2**x12). The second character (C_{hex}) is the same as the last two numbers of the I/O module type (2x**12**). So using this method, the module type identifier 35_{hex} would correspond to I/O module **3**x**05**.

In the illustration above, two pairs of bytes are marked as an example. The first pair of module type identifiers for slot 3 are "35 35" and so the configured I/O module type corresponds with the I/O module that is actually plugged in (4-channel analog input 3x05). The second example (35 45) shows a discrepancy between the configured I/O module type (35 = 3x05) and the type of the connected I/O module (45 = 4x05). At this point, either replace the I/O module in the Remote I/O station or adapt the configuration accordingly to ensure the system functions correctly.

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Module type identifiers

Module type identifiers			
Digital I/O modules		**Analog I/O modules**	
11	1x01 2-channel digital input	13	1x03 1-channel frequency input
12	1x02 3-channel digital input	31	3x01 1-channel analog input
17	1x07 7-channel digital input (with 8x08 only)	32	3x02 1-channel analog input
18	1x08 8-channel digital input	33	3x03 1-channel analog input
1E	1x14 15-channel digital input (with 8x08 only)	34	3x04 4-channel analog input
1F	1x15 15-channel digital input (with 8x08 only)	35	3x05 4-channel analog input
21	2x01 3-channel digital output (1 DOUT, 2 DIN)	41	4x01 1-channel analog output
...	...	42	4x02 1-channel analog output
2D	2x13 3-channel digital output (1 DOUT, 2 DIN)	43	4x03 1-channel analog output
61	6x01 2-channel relay output	44	4x04 4-channel analog output
65	6x05 4-channel relay output	45	4x05 4-channel analog output
66	6x06 8-channel relay output	51	5x01 1-channel temperature input (resistor)
68	6x08 8-channel digital input	52	5x02 1-channel temperature input (thermocouple)
6A	6x10 4-channel digital output	54	5x04 4-channel temperature input (resistor)
...	...	55	5x05 4-channel temperature input (thermocouple)
6F	6x15 4-channel digital output	56	5x06 1-channel voltage input (mV)
Special modules			
00	0x00 empty slot		

8.4.7 Advanced diagnostics

The "Advanced diagnostics" entry in the drop-down list contains status and diagnostic information based on the version. A description is not included at this point due to the wide range of information content.

8.5 "PB diag. (std.)" tab

Note!

The **PB diag (std.)** tab is only available from Com Unit firmware version 6.19 (applies to Com Unit 8x05 only).

The **PB diag (std.)** tab displays the Profibus standard diagnostics.

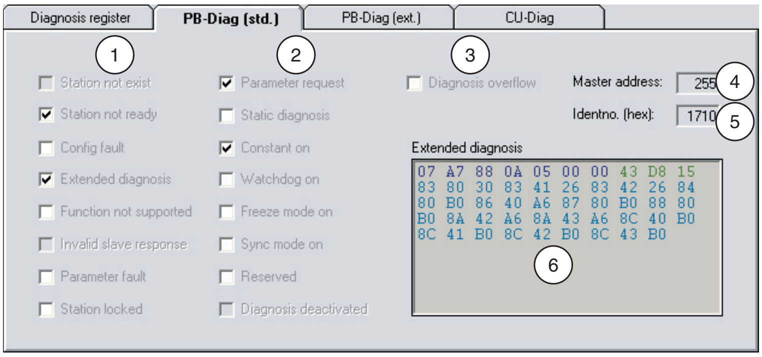

Figure 8.12: **PB diag. (std.)** tab

1 Visualization of the first standard diagnosis byte
2 Visualization of the second standard diagnosis byte
3 Visualization of the third standard diagnosis byte
4 **Master address** box
5 **Ident. no. (hex)** box
6 **Extended diagnosis** box

The Profibus standard diagnostics is generated partly by the master and partly by the slave. The **PB diag (std.)** tab only contains diagnostics data that is read from the slave (check box with white background). The diagnostic data that the master sets by default only appears as a place holder (check box with gray background) to display the bit structure of the overall diagnostics. The current states of these diagnostic bits can only be supplied by the master.

The meaning of the 3 Profibus standard diagnostic bits and examples of possible causes of error are included in the following tables.

Profibus standard diagnostic byte 1

Profibus standard diagnostic byte 1		
Bit	Diagnostic message	Note/Possible cause
0	Station does not exist	Set by the master. Possible cause: Physical bus error (e.g. interruption / short circuit), incorrect slave Profibus address.
1	Station not ready	Communication between master and slave is possible but configuration or parameterization conditions are not yet fulfilled for data exchange (see bit 2 or bit 6 in this table).
2	Configuration error	The master and slave configuration do not match. The configuration input and output data (configuration string) must match in the master and slave.
3	External diagnostics	The slave contains manufacturer-specific diagnostic data.
4	Function not supported	The slave cannot follow a function call.
5	Incorrect slave response	Set by the master, if the slave does not transmit the expected response.
6	Parameter fault	Transmitted parameters are incorrect, the slave cannot be switched over to data exchange. Possible cause: transmitted Profibus ID does not match the device.
7	Station blocked/locked	This bit shows that the slave has received correct configuration and parameter data from a master and makes process data available solely to this master when in DataExchange mode. See the **Master address** for the corresponding master address.

Profibus standard diagnostic byte 2

Profibus standard diagnostic byte 2		
Bit	Diagnostic message	Note/Possible cause
0	Parameter request	The slave uses this bit to inform the master that it requires new parameter data.
1	Statistical diagnostics	If the slave sets this bit, the master only requests diagnostic data (no current process values). Communication remains in the DataExchange state and can restart process data transmission as soon as the bit is cleared.
2	Constant set	
3	Watchdog on	The watchdog function monitors communication. The watchdog function should always be switched on (can be switched on via the parameter telegram). The function allows the slave to monitor the master and respond to communication problems by activating an appropriate substitute value strategy for the slave outputs.
4	Freeze mode on	The slave works in FREEZE mode (DP parameters section, see chapter 8.4.3).
5	Sync mode on	The slave works in SYNC mode (DP parameters section, see chapter 8.4.3).
6	Reserved	
7	Diagnostics off	Diagnostics are not used by the master.

Profibus standard diagnostic byte 3

Profibus standard diagnostic byte 3		
Bit	Diagnostic message	Note/Possible cause
0 ... 6	Reserved	
7	Profibus standard diagnostic byte 3	The slave sets this bit if more diagnostic data exists that can be transmitted (e.g. too many LFD errors during commissioning).

After Profibus standard diagnostics bytes 1 to 3, there are two further bytes for the master address (bytes 4 and 5) and two bytes for the Profibus ID (bytes 6 and 7). The values of these bytes are shown in the **Master address** and **ID no. (hex)** boxes.
The value under **Master address** shows which master has locked the slave (exclusive "DataExchange" access).
ID no. (hex) shows the Profibus slave ID. For correct data exchange, the slave must be created in the master with the same ID. On systems where the Remote I/O DTM can be linked to the master configuration interface (FDT base application), this takes place automatically, otherwise the correct GSD file must be linked or selected.

The remaining bytes in the **Advanced diagnostics** box (from byte 8 onwards) display the manufacturer-specific diagnostic data for advanced diagnosis. Interpretation of advanced diagnostic data has already been covered in the section "DP diagnostics" (see chapter 8.4.2). An automatic visual evaluation of the advanced diagnostics data is shown on the **PB diag (ext.)** tab (see chapter 8.6).

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8.6 "PB diag. (ext.)" tab

Note!

The **PB diag (ext.)** tab is only available from Com Unit firmware version 6.19 (applies to Com Unit 8x05 only).

The **PB diag (ext.)** tab contains the extended Profibus diagnostic bytes that were described in the section "DP diagnostics" and displayed as hexadecimal numbers (see chapter 8.4.2). These include

- device-specific diagnostics,
- module-specific diagnostics and
- channel-specific diagnostics.

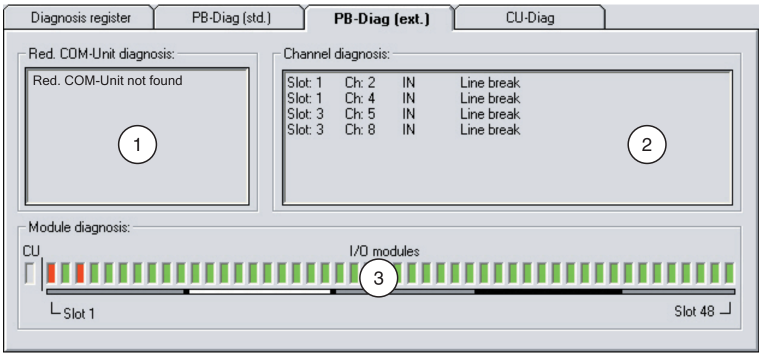

Figure 8.13: **PB diag. (ext.)** tab

1 **Redundancy Com Unit diagnosis** area
2 **Channel diagnosis** area
3 **ID/Module diagnosis** area

The **PB diag (ext.)** tab is divided into three areas, which are described in the following section.

1

Redundancy Com Unit diagnostics area
This area displays a clear text message which evaluates the first two Profibus standard diagnostic bytes of the redundancy Com Unit (partner Com Unit). These bytes are transferred during the device-specific diagnostics (see chapter 8.4.2). In contrast to the Profibus standard diagnostics, the Com Unit sets the "Redundancy Com Unit not found" bit if there is no internal communication connection to the redundancy Com Unit (equivalent to the message "Station does not exist" set by the master).
All other diagnostic messages corresponds to the defined Profibus standard diagnostics (see chapter 8.5).

2

Channel diagnostics area
This area displays the channel-specific diagnoses (see chapter 8.4.2). Each message specifies the slot number, the channel number, details of the channel (input/output) and the cause of the error.
If there is more diagnostics information available than can be transmitted, the color of the "Channel diagnostics" text changes from black to red. The "overflow" text is also added to the character string.

3

ID/Module diagnostics area
The area displays the module-specific diagnoses (see chapter 8.4.2). A rectangular indicator is assigned to each slot on the Remote I/O station. As soon as a diagnostics is available for a slot, the color of the respective rectangle changes from green (no diagnostics) to red (diagnostics available).
A slot number is assigned to each rectangle. To display a slot number, position the cursor over the relevant rectangle.

8.7 "CU Diag" tab

The **CU Diag** tab contains a large amount of diagnostic and status information and provides a comprehensive overview of the status of the Remote I/O station. The main focus of this diagnostic view is on internal and external communication between Remote I/O components.
In the example shown in the figure, the diagnostic and status information are shown for a station together with Profibus and module errors.

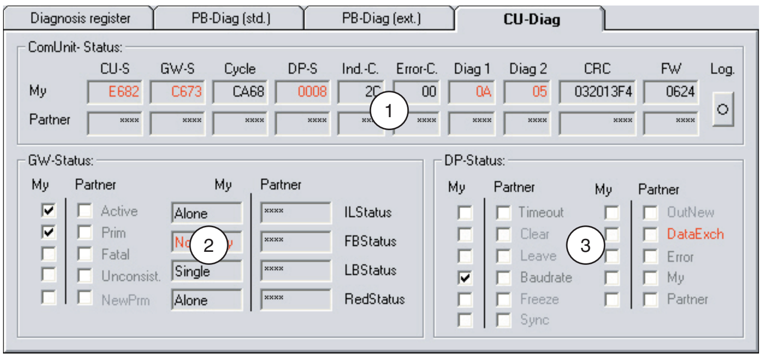

Figure 8.14: **CU Diag** tab

1 **Com Unit Status** area
2 **GW Status** area
3 **DP Status** area

The tab is divided into 3 areas (see figure above). In the first area **Com Unit Status**, the diagnostic registers are listed in compact raw data format (hexadecimal). This view provides the specialist with a quick overview of the station. The areas **GW Status** and **DP Status** are designed to partially encode the raw data from the first area. The 3 areas are described in more detail in the subsections below.

The tab is designed for redundant systems, but contains a host of information relating to non-redundant systems. In redundant systems with functioning internal communication, all exported information is stored twice. Information relating to the active Com Unit is displayed in the areas marked **My** The areas marked **Partner** contain information on the redundant Com Unit which is transferred via internal communication between Com Units. If the partner data cannot be retrieved because of an internal communication error or because a non-redundant system is being used, "*****" appears in the corresponding boxes. The **My** data contains details on the cause of the missing information (e.g. redundancy error: "AC" or "AD" in the **CU-S** box). The faulty areas turn red as soon as operation deviates from the norm.

Writing to a log file
If you would like to monitor over the long term or document diagnostic data, click the **Log** button in the **Com Unit Status** area. The function for writing to the log file is activated if the indicator on the **Log** button is yellow. If the indicator is gray, recording is inactive.
The P+F standard protocol file is used as a log file. The file is stored under the name "LBFBDumpFile1.txt" in the "C:\Temp" directory as standard and contains log entries and process/diagnostic information which can be filtered as required. Please contact P+F service for information on the parameterization of the log/dump function and the evaluation of files.

8.7.1 "Com Unit Status" area

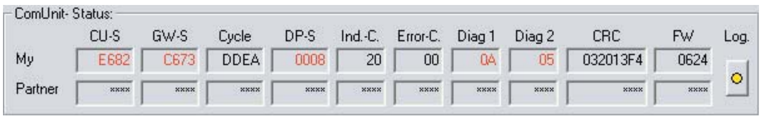

Figure 8.15: **Com Unit Status** area

CU-S box (Com Unit status)
The box contains the global status register for the Com Unit. Interpretation of the individual values has already been covered in the section "Global status register" and does therefore not require further explanation here.

GW-S (gateway status)
The gateway status provides information on internal and external communication. The basic data in this box is displayed in the **GW Status** area in encoded format and is described in more detail in the following section (see chapter 8.7.2).

Cycle box (program cycle counter)
The box indicates the status of the program cycle counter for the relevant Com Unit. The value on the counter is not relevant, but the counter must be moving continuously. A moving counter indicates that the program is running.

DP-S box (DP status)
Information relating to Profibus communication is displayed here. The hexadecimal data is partially encoded on the same tab in the **DP status** area (see chapter 8.7.3).

IND C. box (indication counter)
The indication counter monitors Profibus communication and enables the early detection of Profibus failures. The respective counter readings are displayed in the **IND. C** boxes.
In redundant systems, the counter values must increase consistently. If one counter starts to run slower than the other or stops running altogether, a Profibus communication failure has occurred on the Com Unit linked to the counter. If the counter values increase slowly or inconsistently, this does not indicate that the measured data transfer cycle has failed completely. It is more an indication that a minor communication fault has occurred.
In non-redundant systems, a counter that increases consistently indicates that Profibus communication is working properly.

Error C box (error counter)
The error counter is a component of the additional Profibus monitoring system incorporating the indication counter (see above) and draws attention to potential faults by increasing the counter reading.
The additional monitoring function is based on estimates relating to the reliability of future Profibus communication. A prognosis resulting in a "fault" must be confirmed several times in succession by the value increasing on the error counter before a preventative redundancy switchover is initiated (feasibility of switchover is checked first of all). Errors indicated by the error counter are based on prognosis and so an increase in the counter value and a switchover to preventative redundancy are not indications that an error has occurred. The error counter is more an instrument for increasing availability.
If the Com Units perform continuous switching operations, P+F Service staff should be contacted to investigate the cause of these improper operations.

Diag 1 and **Diag 2** boxes (DP diagnosis)
The **Diag 1** and **Diag 2** boxes display the first two Profibus standard diagnostic bytes. A graphic representation of the Profibus standard diagnostic bytes is displayed on the **PB diag (std.)** tab. The indicator on the **PB diag (std.)** tab is only supported by Com Units with firmware version 6.19 or higher.

CRC (checksum calculation)
The result of the checksum calculation is entered here. The checksum calculation ensures that the required data records are stored in the Com Unit correctly (parameter and configuration data). If the checksums of the Com Unit and the redundant Com Unit are identical, the two Com Units are calibrated correctly with one another. Identical values mean that the data records are the same. The checksum changes every time a parameter change is successfully transferred and the modification process is documented as a result.

FW box (firmware)
The field contains the firmware version of the Com Unit. In redundant systems, make sure that the firmware version of the Com Unit and redundant Com Unit is the same.

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8.7.2 "GW status" area

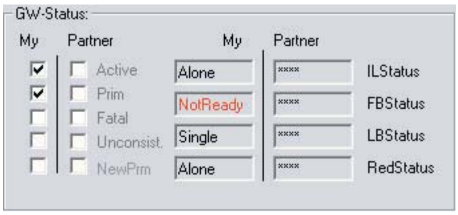

Figure 8.16: **GW status** area

Active check box (active Com Unit)
Only one Com Unit may be active in the station at any one time. **Active** indicates which of the two Com Units is active. In the above illustration, the Com Unit in the **My** column is active.

Prim check box (primary Com Unit)
The **Prim** check box allows you to assign data to Com Unit hardware. Each redundant station has a primary and a secondary Com Unit slot. In LB systems, the primary slot is the first Com Unit slot. In FB systems, the primary Com Unit slot is the Com Unit slot in the base unit.
If, for example, **Prim** is enabled in the **My** area (check mark appears, see illustration above), this means that the data in the **My** area represents the Com Unit in the primary slot.

Fatal check box (serious error)
If the Com Unit detects a fatal error, this is indicated by the corresponding **Fatal** check box. The Com Units employ error handling routines which are capable of clearing error states. If a fatal error is permanently displayed, or if a fatal error occurs repeatedly, the corresponding Com Unit should be replaced.

Inconsist. check box (Inconsistent)
The **Inconsist.** boxes are used to draw attention to system states which could prevent a redundant Remote I/O station from operating correctly. The check boxes are enabled if

- the Com Units have different firmware versions,
- the parameter data of the Com Units is different,
- both Com Units are active at the same time,
- both Com Units are passive at the same time,
- both Com Units indicate that they are the primary Com Unit,
- both Com Units indicate that they are the secondary Com Unit,
- both Com Units function as the master on the internal bus, or
- both Com Units function as the slave on the internal bus.

A transient inconsistency message is permissible during start-up or changeover phases as well as during parameterization processes.

NewPrm check box (new parameter)
This check box is set if the Com Unit has new parameters. This state is regarded as normal unless it does not clear after a parameterization process.

IL status box (Internal Link Status)
This box represents the communication path between the two Com Units. The status can be "Master", "Slave", "Alone", or "Unknown".
In redundant systems, one Com Unit must have master status and the other slave status. All other configurations are not allowed. If the "alone" status is displayed, then the corresponding Com Unit cannot find its partner (possible cause of error in FB systems: external connection between the two Com Units is faulty).
In single systems, the status "Alone" is the correct operating status. Here any deviation from the "Alone" status is classed as an error.

FB status (Profibus status)
This box indicates the status of the Profibus. The status can be

- "Offline" (no Profibus connection available),
- "NotReady" (Profibus connection available, but data exchange not possible),
- "BadComm" (data exchange possible but malfunctioning),
- "Online" (data exchange OK).

The status should always be "Online". If another status is displayed, check the Profibus communication.
Exception: On line-redundant systems, the passive Com Unit only has read access to the bus and therefore only has limited functions to maintain communication if a fault occurs. The consequence of this is that the passive Com Unit briefly loses "Online" status. However, the system automatically sets the passive Com Unit back to "Online" status.

LB status (internal system bus)
LB status represents the internal bus system (participants: primary Com Unit, secondary Com Unit, and I/O modules). Alongside start statuses, which are not dealt with in further detail here, the **LB status** can also display the following statuses:

- "Single" (OK in single systems)
- "Alone" (Com Unit cannot find partner)
- "Active" (Com Unit has bus read-write access)
- "Passive" (Com Unit only has bus read access)
- "NoSlots" (no I/O modules can be addressed)

If other statuses are displayed permanently, then an error state exists. Moreover, for proper redundant operation, one Com Unit must be active and the other must be passive.

RedStatus box
This box contains status details relating to parameter and configuration changes. As part of a change with or without HCiR functionality, the system runs through several individual statuses which will not be described here in more detail. The "OK" box must appear during normal operation.

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If "HCIR" is displayed, a new data record is written to the corresponding Com Unit, but not yet put into operation by the master. This means that the old data record has not yet been processed and the HCIR process not yet completed. This status is also indicated directly in the hardware (Com Unit: green LED flashes) but does not endanger plant operation.
All other statuses must not exist continuously and can mainly be traced back to problems arising from Com Unit to Com Unit communication (possible cause of error: partner Com Unit not "OK". Possible cause of error in FB systems: the external connection between the two Com Units is faulty).

8.7.3 "DP status" area

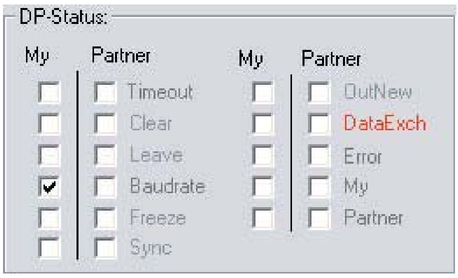

Figure 8.17: **DP status** area

The most important information in the **DP status** area is visualized by enabling the **Baud rate** and **DataExch** check boxes. All other information is not suited to user diagnostics and will not be explained here.

Baud rate check box
If **Baud rate** is enabled, the baud rate has been found. If not, a baud rate has not been found.

DataExch check box
If **DataExch** is enabled, process data is transferred. If not, process data is not transferred.

8.8 "Module status" Tab

Note!

The **Module status** tab is available on version 7.3 or higher of the P+F remote I/O DTMs. The status of the power supplies in the **Power supplies** area is displayed in DTM version 7.5 or later and also depends on the firmware.

The **Module status** tab provides an overview of the status of the I/O modules and power supplies in the overall remote I/O station. Each of the fields in the status/simulation views represents a slot or a module (I/O module or power supply) on the remote I/O station. The status of the power supplies is only displayed if the firmware of the Com Unit incorporates a power supply diagnostics function. The power supplies used must also support this diagnostics function.

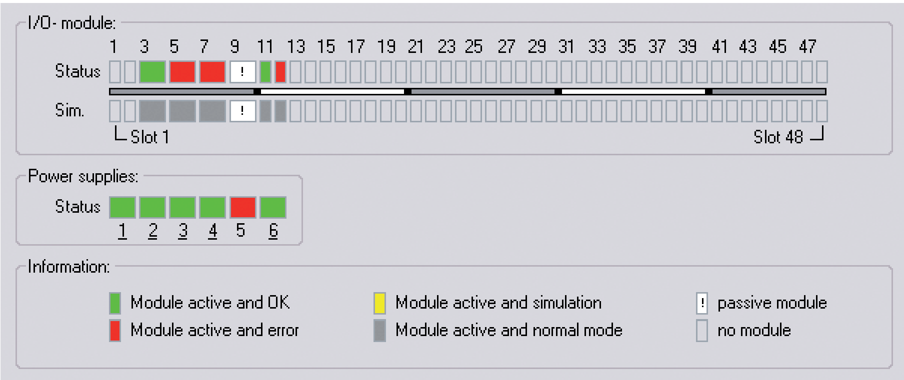

Figure 8.18: **Module status** tab

Legends on the tab explain the status information. The I/O module types (display of single/dual-width module) and corresponding status areas are requested during each update cycle.

The status of the monitored power supplies is displayed in the **Power supplies** area. Monitoring can be switched on and off in the DTM of the Com Unit (**Parameter** > **Parameterization** > **Edit device data** > **Structure** tab > **Power supplies** check boxes). An underlined power supply number indicates that a power supply is available at the relevant position, irrespective of the monitoring settings.

Accessing information about an I/O module

You have the option of viewing information about a specific I/O module directly from the **Module status** tab. There may have to be an active connection to the I/O module, depending on the FDT base application.

1. Click an I/O module in the overview using the right mouse button.

   A context menu opens.
2. Access the required information via the context menu.

9 Troubleshooting

9.1 Service call

Before booking a service call, please check that the following actions have been taken:

- the customer has consulted the Service Center by phone to locate the problem,
- the customer has tested the installation against the checklists below,
- P + F Service staff have performed remote diagnosis using PC ANYWHERE.

9.2 Communications error

If there is a communications error, work through the following checklist and take any relevant action.

Fault	Action(s)
Errors in communication with the process control system or PLC	• Check that the cables are connected properly and not damaged. • Check in the configuration software that the selected address matches the required station address. • Check that the bus termination is enabled. The PROFIBUS must have exactly 2 bus terminations per segment, one at the start and one at the end. • Check whether the bus stations have been connected to a branch in a star formation - this is not permitted. Choose a linear arrangement without branches • Check that the master and slave have matching configuration strings. The slave address must be identical for master and slave on the fieldbus. • Check that the correct GSD file is being used.
Communications error on the Service bus	• Check that the cables are connected properly and not damaged. • Check in the configuration software that the selected address matches the required station address. • Check that the bus termination is enabled. The Service bus must have exactly 2 bus terminations per segment, one at the start and one at the end. • Check whether the bus stations have been connected to a branch in a star formation - this is not permitted. Choose a linear arrangement without branches. • Check that the correct interface is set in the configuration software.
A new station will not work on a bus on which other stations are already working.	• Check whether the bus terminations are still located at the start and the end of the bus after the extension.
The software cannot find a com unit when establishing communication.	• Check that the yellow LEDs on the com unit come on when communication is being set up. • Check that the bus address is in the chosen range. If necessary, enlarge the search range. • Check that the com unit is plugged in correctly.

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Fault	Action(s)
The com unit readout does not give the expected configuration.	• The required configuration has not been saved in the com unit. Select the "Write data to device" menu option to save the configuration in the com unit.
Communication error on the service bus after communication has been established	• Check that the Service bus is DC isolated. • Use the laptop under battery power. • Use a standard commercial RS232-RS485 interface converter with automatic detection of baud rate and transmission direction.
Data missing from station download	• Check that all the data was previously saved in the station.
No HART communication	• Check whether the I/O module used supports the HART functionality. • Make sure that the HART field devices are operating in the permitted range of 4 to 20 mA. • Check that the correct address of the HART device has been used. • Check that the HART software has a DTM for the field device used. If not, only HART basic functions are available.

Table 9.1: Communications error

Fault	Action(s)
FB extension unit in Zone 1 does not function.	• Check whether the wires on the base unit and extension unit are connected correctly. • On redundant systems, check whether the required connection between the extension unit and the redundancy unit exists.

Table 9.2: Communications error

9.3 Redundancy faults

If there is a redundancy fault, work through the following checklist and take any relevant action.

Fault	Action(s)
Continuous switching between redundant systems	• Check that the correct type of redundancy is selected (line redundancy - application redundancy). • Check that the switchover time been set to a sufficiently long period in the Com Unit. • If you are using an FB system in Zone 1, check whether there is a required front connection between the Com Units. • Check that the process control system is configured for this type of redundancy.
Does not switch to redundant system when a Com Unit is removed	• Check that redundancy has been configured at the Com Unit. • Check that there is an electrical connection between the two Com Units. If not, connect them.
Modules are continuously changing the data	• Check whether one of the Com Units has not been configured for redundancy mode. If this is the case, both Com Units actively try to access the I/O modules and interfere with each other.

Table 9.3: Redundancy faults

9.4 Faults Indicated by LEDs

A number of LEDs on the com unit, the I/O modules and the power supply help to locate faults. If the LEDs indicate a fault, work through the following checklist and take any relevant action.

Incorrect error messages

An open-circuit in the output circuits may be indicated for certain loads, even though the I/O module is actually still working perfectly. For example this may happen sometimes with solenoid valves whose input impedance lies outside the lead breakage detection range. In this case, connect a large-value resistor in parallel with the output, which normally improves the situation.

With booster valves, the charging capacitor is often the culprit if the short-circuit detection activates. Connecting a small-value resistor in series usually rectifies the problem. If necessary, disable the line fault detection function.

LEDs on the Com Unit	
Error	Action(s)
Red LED (2) on Com Unit is on.	Collective fault: There is a problem with at least one remote I/O component (I/O module, power supply, or Com Unit). • Scan all slots for I/O modules displaying flashing red LEDs. All red LEDs must be off; otherwise the Com Unit will continue to indicate a fault. • Make sure that all configured remote I/O components are connected and ready for operation (green LEDs on). • Review the global status register in the measured value display of the Com Unit DTM to determine the reason for the collective error message.
Yellow LED (5) on the Com Unit is flashing even though the bus is not connected.	• The Com Unit is operational and working with the I/O modules.
Yellow LED (5) on the Com Unit is flashing in long intervals.	• The Com Unit is operational and working with the I/O modules. At least one I/O module is in simulation mode.
Fieldbus	
Yellow LEDs (3, 6) on the Com Unit do not indicate any activity while a connection is being established (LEDs = off).	• Check that the physical connection between the configuration tool and the remote I/O station has been correctly established.
Service bus	
Yellow LEDs (4, 7) on the Com Unit do not flash while the connection is being established via the service bus.	• Check that the configuration cable and the adapter are connected properly.

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LEDs on I/O modules and power supplies	
Error	Action(s)
Red LED on an I/O module illuminated	• Check that the field wiring is connected correctly. • Check that the sensor is working properly. • Check that the field devices are working properly.
Red LED on an I/O module is flashing.	I/O module cannot communicate with the Com Unit. • Check that the I/O module is plugged into the backplane properly. • Make sure that none of the pins are bent in the connector. • Plug a different I/O module into this slot. If the new module also does not work (red LED flashing), the fault may be the backplane.
Yellow LEDs on I/O modules illuminated.	• For digital inputs, the yellow LEDs provide various status indicators. • For transmitter supply modules, the yellow LED indicates that operation is outside the normal range.
Green LEDs on all modules are off.	• Check that the supply is connected to the backplane correctly. • Check that the power supply is working and is plugged into the backplane properly.
Green LED on one module is off.	• Check that the module is plugged into the backplane properly. • If necessary, replace the module. • If this does not rectify the problem, check that the backplane is working correctly.
Green LED on power supply is off.	• Check that the correct voltage is connected to the power supply unit. • Check that the power supply is plugged into the backplane correctly and that it is making contact with the backplane. • Check the supply voltage. Under maximum load, the 24 V DC voltage must not drop below 20 V including any ripple. If necessary, use an oscilloscope (fire permit may be needed). • The fuse may have blown. **FB**: The power supplies do not contain replaceable fuses and so you will have to replace the power supply with a new one. **LB**: For explosion protection, the fuses for power supplies and I/O modules must only be changed by personnel who are qualified specialists. Replace fuses with fuses of the same value.

9.5 Signal Fault

If there is a signal fault, work through the following checklist and take any relevant action.

Disabled I/O modules

Disabled I/O modules are often used for future expansions. Before disabling the I/O module, switch off its line fault detection function. This stops the I/O module from triggering an alarm every time the com unit polls the slot to see if an I/O module is installed.

Error	Action(s)
The signal is not modified if the parameters are changed.	• Check that the I/O module is working. • Check that the change has been saved in the slave station. • Download the parameter settings to find out the latest parameters for the I/O module. • Applies only to PROFIBUS Com Unit: Check whether HCiR is active. If so, then the new setting will not become active until the master has switched over to HCiR.
Erroneous signal	• Check the circuit in case there is a short circuit or line break. • Check that the field devices and sensors are working properly. • Replace the I/O module. • Check the bus signal path to the I/O module.
All the signals for a station are erroneous.	• Check that the power supply is working perfectly. • Check the bus connection. • Check the bus communication. • Use a bus monitor.
Output module switches to substitute values.	• Check the watchdog time for monitoring the bus on the Com Unit. The watchdog time must be longer than the duration of a bus cycle.
One output module switches off.	Communication with the Com Unit is interrupted. • Check that the I/O module is plugged into the backplane properly. • If necessary, switch off the status bits for analog outputs.
Input module intermittently stops supplying measured values.	Communication with the Com Unit is interrupted. • Check that the I/O module is plugged into the backplane properly.
I/O module works perfectly in one slot but not in another slot.	• Check that the connector in the faulty slot is OK and that the pins are not bent. • If necessary, stop using that slot.
Measured values are sometimes wrong.	• Check whether the measured value can become corrupted by external interference. • Check that the shielding is intact.

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Error	Action(s)
Signal does not change.	• Check whether simulation mode is enabled for the channel (does not apply to Com Unit 8x06) The signal is frozen in simulation mode. • Check that the substitute value is active as there is no bus communication. • Check for a line fault.
Module is not outputting any diagnostic messages.	• Check that line monitoring is enabled. If not, enable line monitoring. • Check that the expected diagnostic information has been activated in the Com Unit (PROFIBUS: additional module diagnostics).
No input/output data	• Check that the right I/O module is connected and ready for operation. • Check that the scaling of the analog input/output corresponds to system requirements. • Check that the wiring is in order.
I/O module is reported as not found.	• Check that the right I/O module has been connected. • Check that the green LED on the I/O module is illuminated and that the I/O module is connected correctly.
Module fault	• Check whether the green LED on the I/O module is illuminated. If not, either there is no contact with the backplane or the fuse is faulty. If all the I/O modules in a segment have failed, then the fault will be in either the power supply or the backplane. • With the help of the measured value display for the I/O module concerned, check the diagnostic information for the I/O module (e.g., no module or wrong module, line fault, etc.)

Table 9.4: Signal fault

Fault	Action(s)
6/8 LB modules fail simultaneously (LB 9121, LB 9101 backplane system).	• Check that the power supply for the segment is working correctly.

Table 9.5: Signal fault

Fault	Action(s)
24 FB modules fail simultaneously.	• Check that the power supply is working perfectly. • Check that the extension wiring is correct and intact.

Table 9.6: Signal fault

9.6 Faults and their effects

The table below shows what effect different faults will have.

Fault	Diagnostics	Effect
FB Zone 1 power supply failure (redundant)	• The master receives an error message in the global status register, provided this facility has been pre-configured. • The master also receives a redundancy error message.	• No problem in redundant system • Redundancy switchover from primary to redundant Com Unit.
FB Zone 1 power supply failure (not redundant)	• The master receives 24 error messages in the global and module status register, provided this facility has been pre-configured. • The master receives 24 module-specific and channel-specific error messages if module diagnostics have been enabled.	• 24 FB slots are lost.

Table 9.7: Faults and their effects

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Fault	Diagnostics	Effect
Power supply failure (redundant station)	• The master receives an error message in the global status register, provided this facility has been pre-configured (LB9022 and LB9024 backplanes only).	• Backplanes LB 9022, LB 9024 and LB 9029: 2-out-of-3 redundancy when using three LB9006 power supplies means full functionality is maintained even when a power supply fails. • Backplanes LB 9121 and LB 9101: when using two LB9104 power supplies, 8 modules fail immediately if a power supply fails. The com units continue to be supplied from the working power supply, however, and communication is maintained.
Power supply failure (non-redundant station)	• The master receives 8 error messages in the global and module status register, provided this facility has been pre-configured. • The master receives 8 module-specific and channel-specific error messages if module diagnostics have been enabled.	• Backplanes LB 9022, LB 9024 and LB 9029: in non-redundant use, normally just two power supplies are used. This means that if one power supply fails, the whole station may be adversely affected (depending on the number of modules used). • Backplanes LB 9121 and LB 9101: when using two LB9104 power supplies, 8 modules fail immediately if a power supply fails. The com unit continues to be supplied from the working power supply, however, and communication is maintained.

Table 9.8: Faults and their effects

Fault	Diagnostics	Effect
Bus communication failure	• The master detects the failure.	• The outputs assume substitute values, provided this option has been programmed.
Com unit failure or voltage lost	• The master detects the faulty slave.	• No voltage at the outputs, unless system has redundant design.

Fault	Diagnostics	Effect
I/O module failure	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives the message "module error" if module diagnostics have been enabled.	• No change in signal; the inputs assume substitute values, provided this option has been programmed. • No voltage at the output. • Usually the green LED is off. There are situations, however, where the green LED is still on despite a fault.
Incorrect I/O module	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives the message "incorrect module" if module diagnostics have been enabled.	• No change in signal; the inputs assume substitute values, provided this option has been programmed. • No voltage at the output • The red LED in the dual-width module flashes.
I/O module missing or removed.	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives the message "missing module" if module diagnostics have been enabled.	• The input is frozen. • No voltage at the output.
module-specific faults		
Line fault in input module	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives an error message "data invalid" if module diagnostics have been enabled	• The red LED is on. • No change in signal; the inputs assume substitute values, provided this option has been programmed. • Temperature inputs do not return to working normally until the fault has been rectified and the broken-wire delay has elapsed.
Input signal lies out of range for 3x01, 3x02, 3x03, 3x04, 3x05 analog input	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives an error message "data invalid" if module diagnostics have been enabled	• The yellow LED is on. • The signal is kept within preset limits

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Fault	Diagnostics	Effect
Line fault in output modules 2xxx, 4x01, 4x02, 6x08	• The master receives an error message in the global and module status register, provided this function has been programmed. • The master receives an error message "data invalid" if module diagnostics have been enabled	• The red LED is on. • No voltage at the output.

Table 9.9: Faults and their effects

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