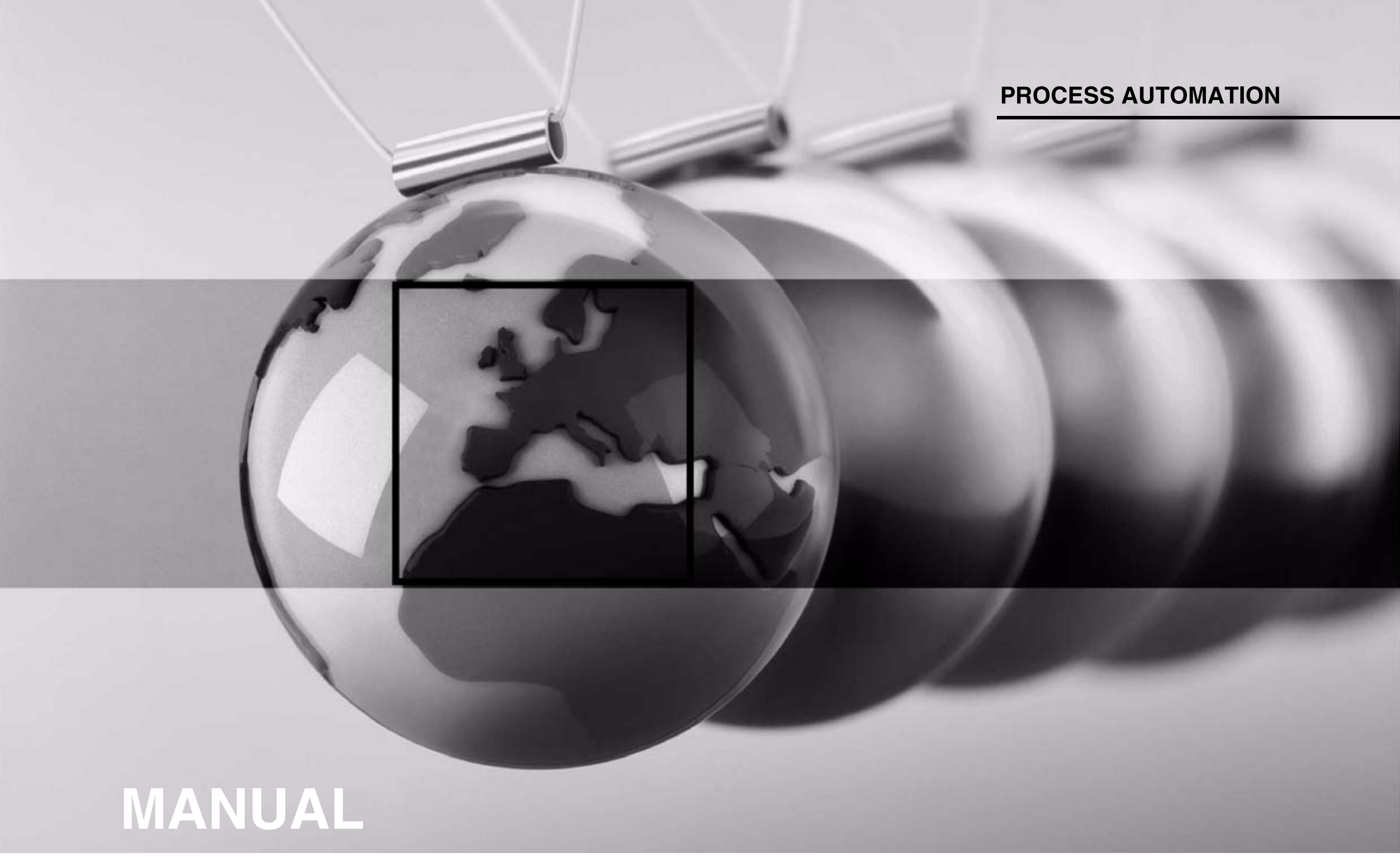


PROCESS AUTOMATION

MANUAL

PROFIBUS COM UNIT

LB 8105/FB 8205
MANUAL FOR FDT 0.98

PEPPERL+FUCHS

PROTECTING YOUR PROCESS

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 0.98 specifications and is designed exclusively for configuring a Pepperl+Fuchs LB/FB remote I/O System and for displaying measured values and status information during commissioning and maintenance.

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:

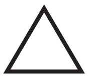
Safety-relevant symbols

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.

ISO**9001**

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

- **Module status area** parameters
- **Status+command** parameters

I/O module parameters

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

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 the 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.

200180 2009-08

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 13): 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)

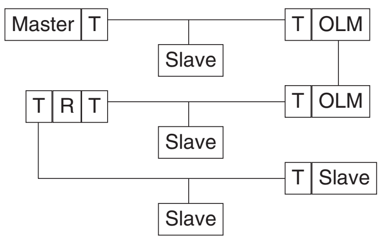


Figure 2.1: Example: bus segments with bus termination

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

200180 2009-08

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 15).
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 15).
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.

200180 2009-08

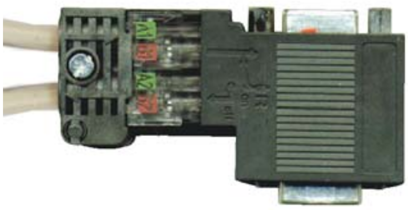


Figure 2.2: Bus connector with built-in switchable bus termination

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.

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.

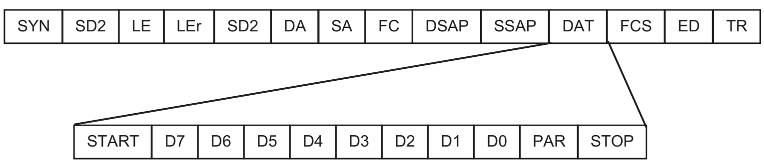


Figure 2.3: Structure of the Profibus telegram

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		

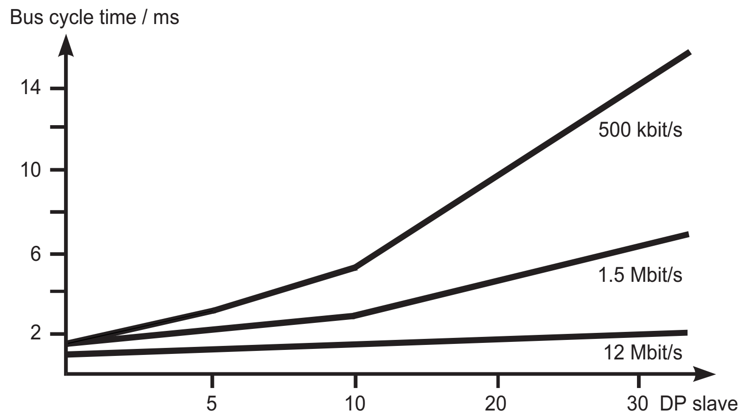


Figure 2.4: Bus cycle time for a DP Mono Master System Profibus

2.3 Preferred parameter values

The following tables provide an overview of the parameters that can be set and the preferred parameter values for the Com Unit and the I/O modules. The preferred parameter values are suitable for most systems.
To minimize the number of fault messages during initial commissioning, disable all line fault detection functions.

Unless stated otherwise, the parameters can be adjusted separately for each channel of the I/O module.

2.3.1 Com Unit

Local parameters relate to the Com Unit, global parameters relate to all the modules.

Preferred parameter values for the Com Unit

Parameter	Preferred value	Explanation
Backplane (global)	-	Specify type of backplane being used
Power supply (global)	-	Specify type of power supply being used
Redundancy (local)	No redundancy	Specify whether a redundant system is being used
Service bus (local)	-	Specify the service bus address
PROFIBUS (local)	-	Specify the PROFIBUS address
Watchdog time (local)	-	Specify watchdog time with adequate time for the master cycle
DP parameters		
Com Unit setting (local)	No command or status data	Defining the Com Unit data to be included in the cyclic data exchange process.
Suppress PROFIBUS “clear” (local)	Off	Defining whether pure null telegrams should be evaluated.
PROFIBUS diagnostics (local)	Status and error diagnostics	Defining when new diagnostic telegrams should be generated (only in the event of errors or changes in status)
Offset module diagnostics (global)	0	Defining the module counting method for diagnostic messages
Additional module diagnostics (global)	Off	Selection and de-selection of additional 2-bit diagnostics per I/O module

Table 2.1: Preferred parameter values for the Com Unit

200180 2009-08

2.3.2 Digital inputs 1x01, 1x02

Preferred parameter values for digital inputs LB/FB 1x01 and 1x02

Parameter	Preferred value	Explanation
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1".
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Extended parameters		
ON delay	0 = Off	The ON delay filters short pulses.
OFF delay	0 = Off	The OFF delay lengthens pulses.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

Table 2.2: Preferred parameter values for digital inputs LB/FB 1x01 and 1x02

2.3.3 Frequency input 1x03

Preferred parameter values for frequency input LB/FB 1x03 (frequency input function type)

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Direction detection	Off	You can use the direction detection input to count up or down, or as a status indicator for the direction of rotation.
Measurement range	0 ... 15000 Hz	
Extended parameters		
Analog filter	Off	If the input signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.3: Preferred parameter values for frequency input LB/FB 1x03 (frequency input function type)

200180 2009-08

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Preferred parameter values for frequency input LB/FB 1x03 (counter input function type)

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Direction detection	Off	You can use the direction detection input to count up or down, or as a status indicator for the direction of rotation.
Divider	1	To prevent an overflow, you can use a counter quotient for the counter.
Extended parameters		
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.

Table 2.4: Preferred parameter values for frequency input LB/FB 1x03 (counter input function type)

Preferred parameter values for frequency input LB/FB 1x03 (combined frequency/counter input function type)

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% … 100%	10000 ... 50000 (0 ... 65535)	Adapt scaling to the master range.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Direction detection	Off	You can use the direction detection input to count up or down, or as a status indicator for the direction of rotation.
Measurement range	0 ... 50 Hz	
Extended parameters for frequency		
Analog filter	Off	If the input signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is invalid.
Simulation value with status	On	
Live Zero substitute value	Off	
Live Zero simulation value	Off	
Direction substitute value	Off	
Direction simulation	Off	
Extended parameters for counter		
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.

Table 2.5: Preferred parameter values for frequency input LB/FB 1x03 (combined frequency/counter input function type)

200180 2009-08

2.3.4 Digital input 1x08

Preferred parameter values for digital input LB/FB 1x08

Parameter	Preferred value	Explanation
Contact type	NAMUR	The choice for the "Contact type" parameter is NAMUR, contact or active voltage input.
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit (only for NAMUR contact type, 5V/24V inputs do not have line fault detection).
Extended parameters		
ON delay	0 = Off	The ON delay filters short pulses.
OFF delay	0 = Off	The OFF delay lengthens pulses.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

Table 2.6: Preferred parameter values for digital input LB/FB 1x08

2.3.5 Digital output 2xxx

Preferred parameter values for digital output LB/FB 2xxx with 2 digital inputs (*)

Parameter	Preferred value	Explanation
Parameters for output		
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Although the valve output recognizes lead breakage and short circuit, the indication it gives does not distinguish between these states
Extended parameters for output		
ON delay	0 = Off	ON delay – after bus data received
OFF delay	0 = Off	OFF delay – after bus data received
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Parameters for inputs		
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Extended parameters for inputs		
ON delay	0 = Off	The ON delay filters short pulses.
OFF delay	0 = Off	The OFF delay lengthens pulses.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

200180 2009-08

Parameter	Preferred value	Explanation
(*) Note: The last two "xx" in "2xxx" identify the output driver type, e.g., "2x01" with 22 V output voltage and 315 Ω output resistance		

Table 2.7: Preferred parameter values for digital output LB/FB 2xxx

2.3.6 Analog inputs 3xxx

Preferred parameter values for analog inputs LB/FB 3xxx

Parameter	Preferred value	Explanation
HART (for 3x02/03/05 only)	On	HART power supply, only available for analog inputs 3x02, 3x03 and 3x05.
HART scan (for 3x02/03/05 only)	On	Automatic readout and storing of HART values (long address / auxiliary variables)
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Switching points	< 1 mA and > 21 mA	Threshold values for lead breakage and short circuit detection
Extended parameters		
Analog filter	0 = Off	If the input signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.8: Preferred parameter values for analog inputs LB/FB 3xxx

2.3.7 Analog outputs 4x01, 4x02

Preferred parameter values for analog outputs LB/FB 4x01 and 4x02

Parameter	Preferred value	Explanation
HART (4x02 only)	On	HART power supply, only available for analog output 4x02.
HART scan (4x02 only)	On	Automatic readout and storing of HART values (long address / auxiliary variables)
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
Minimum output current	1 mA	A minimum output current can be specified for line fault detection (for 4 ... 20 mA only).
Extended parameters		
Analog filter	0 = Off	If the signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.9: Preferred parameter values for analog outputs LB/FB 4x01 and 4x02

2.3.8 Analog outputs 4x04, 4x05

Preferred parameter values for analog outputs LB/FB 4x04 and 4x05

Parameter	Preferred value	Explanation
HART (4x05 only)	On	HART power supply, only available for analog output 4x05.
HART scan (4x05 only)	On	Automatic readout and storing of HART values (long address / auxiliary variables)
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Minimum output current	1 mA	A minimum output current can be specified here (for 4 ... 20 mA only).
Line fault detection	Off	Line fault detection recognizes lead breakage.
Extended parameters		
Analog filter	0 = Off	If the signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.10: Preferred parameter values for analog outputs LB/FB 4x04 and 4x05

2.3.9 Temperature inputs 5x01, 5x04

Preferred parameter values for temperature inputs LB/FB 5x01 and 5x04

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000 (0 ... 65535)	Adapt scaling to the master range.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit.
LFD-delay	10	Set how many cycles a lead breakage signal should remain active after the process circuit has been restored.
Measurement method	4-wire configuration	Here you can choose between a 2-, 3-, or 4-wire configuration.
Measurement range	0 ... 100 °C	Enter the required measurement range. The smallest span for an accuracy of 0.1% is 20 Ω (5x01) or 50 Ω (5x04).
Line resistance	20 Ω (only for a 2-wire configuration)	Specify the resistance value of the connection line.
Sensor type	Pt100	Select the linearization curve or an input proportional to the resistance (slide-wire sensor).
Line filter	50 Hz	
Temperature unit	°C	Choose between °C and °F.
Extended parameters		
Analog filter	0 = Off	If the signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.11: Preferred parameter values for temperature inputs LB/FB 5x01 and 5x04

200180 2009-08

2.3.10 Temperature input 5x02

Preferred parameter values for temperature input LB/FB 5x02/5x05

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Line fault detection	Off	Line fault detection recognizes lead breakage.
Reference junction	internal	Reference junction compensation either takes place internally with a Pt100 sensor on the terminals (accessories) or externally with a thermostat.
Sampling rate for line fault detection	1:10	The reference junction ratio allows faster temperature measurement or more frequent querying of the reference junction (for an internal reference junction).
External reference junction temperatures	50 °C	If reference junction compensation takes place externally with a thermostat, set the temperature here.
Measurement range	-200 ... 600 °C (*)	Enter the required measurement range. The smallest span for an accuracy of 0.1% is 5 mV.
Sensor type	K	Select sensor type for correct linearization.
Temperature unit	°C	Choose between °C and °F.
Extended parameters		
Analog filter	0 = Off	If the signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	
(*) The measurement range depends on the type of input signal selected.		

Table 2.12: Preferred parameter values for temperature input LB/FB 5x02/5x05

2.3.11 Voltage input 5x06

Preferred parameter values for voltage input LB/FB 5x06

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Scaling 0% ... 100% (Start of range/end of range)	10000 ... 50000	Adapt scaling to the master range (0 ... 65535).
Measurement range	0 ... 10 V	Enter the required measurement range. The smallest span for an accuracy of 0.1% is 100 mV.
Line filter	50 Hz	
Extended parameters		
Analog filter	Off	If the signals fluctuate, an analog filter can be activated for signal attenuation.
Transmission range (lower/upper limit)	0 ... 60000	Adapt scaling to the master range.
Substitute value	as required	Substitute values from the set error mode are used in the event of a fault.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Substitute value with status	On	
Simulation value	as required	During a simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.
Simulation value with status	On	

Table 2.13: Preferred parameter values for voltage input LB/FB 5x06

200180 2009-08

2.3.12 Relay output 6x01

Preferred parameter values for relay output 6x01

Parameter	Preferred value	Explanation
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Extended parameters		
ON delay	0 = Off	After bus data received.
OFF delay	0 = Off	After bus data received.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value		Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value		Indicates that the simulation value is flagged as invalid.

Table 2.14: Preferred parameter values for relay output 6x01

2.3.13 Relay outputs 6x05, 6x06

Preferred parameter values for relay outputs LB/FB 6x05 and 6x06

Parameter	Preferred value	Explanation
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Extended parameters		
ON delay	0 = Off	After bus data received.
OFF delay	0 = Off	After bus data received.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

Table 2.15: Preferred parameter values for relay outputs LB/FB 6x05 and 6x06

2.3.14 Digital output 6x08

Preferred parameter values for digital output LB/FB 6x08

Parameter	Preferred value	Explanation
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit and reports these states uniformly as line faults.
Extended parameters		
ON delay	0 = Off	After bus data received.
OFF delay	0 = Off	After bus data received.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

Table 2.16: Preferred parameter values for digital output LB/FB 6x08

200180 2009-08

2.3.15 Digital outputs 6x1x

Preferred parameter values for digital outputs LB/FB 6x10 - 6x15

Parameter	Preferred value	Explanation
Inverter	Off	Use the inverter if the digital input produces a "0" when you need a logical "1."
Operating mode	Normal	You can start a manual simulation here for test purposes (forcing I/O values).
Error mode	Substitute value	Specify the required response in the event of a fault.
Line fault detection	Off	Line fault detection recognizes lead breakage or short circuit and reports these states uniformly as line faults.
Extended parameters		
ON delay	0 = Off	After bus data received.
OFF delay	0 = Off	After bus data received.
Substitute value	as required	Substitute values are used in the event of a fault depending on which error mode was selected.
Invalid substitute value	On	Indicates that the substitute value is flagged as invalid.
Simulation value	as required	During a manual simulation, simulation values are used depending on which operating mode was selected.
Invalid simulation value	Off	Indicates that the simulation value is flagged as invalid.

Table 2.17: Preferred parameter values for digital outputs LB/FB 6x10 - 6x15

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.

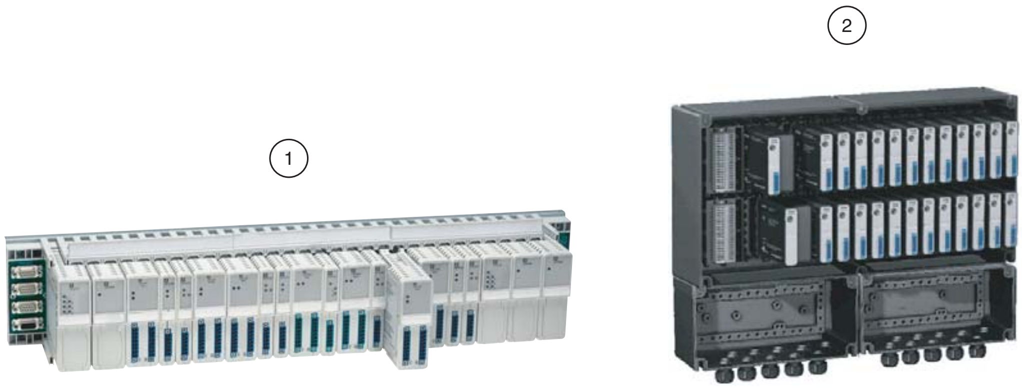

Figure 3.1: Example for LB/FB Remote I/O stations

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

200180 2009-08

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 (only with Com Unit 8108),
- Digital input 1x08, 8-channel,
- Digital input LB 1014 and LB 1015, 15-channel (only with Com Unit 8108),
- 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.

200180 2009-08

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.

200180 2009-08

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 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).

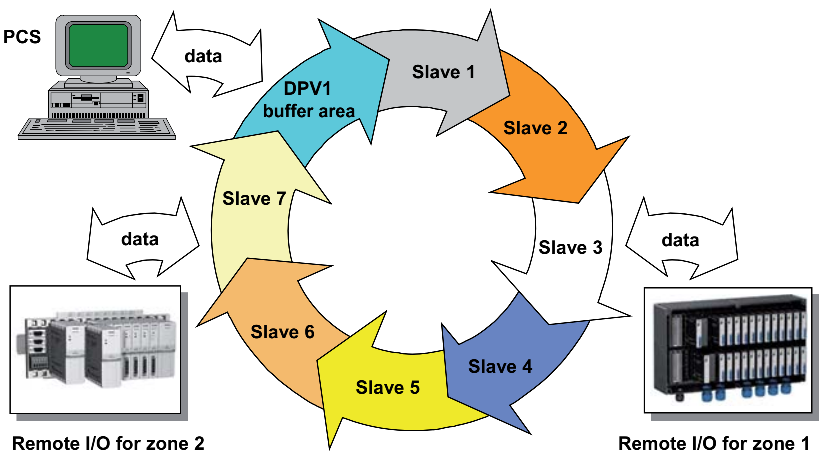

Figure 3.2: Cyclic data transfer to the Profibus

3.2.3 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.

3.2.4 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.

3.2.5 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.

3.2.6 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

200180 2009-08

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4 Installing configuration software

4.1 Introduction to configuration software

This manual applies to Com Unit 8x05 with firmware version 6.x and also, with some restrictions, to Com Unit 8x03 with firmware versions 4.x and 5.x. Only Com Unit 8x05 with firmware version 6.x supports all the functions and I/O modules described in this manual.

The remote I/O configuration software is used to configure remote I/O components and to display measured values and status information during maintenance and commissioning.

The software can be used in process control systems that support the FDT concept (FDT 0.98). There you can configure the remote I/O system directly from the system engineering tool. It is also possible to use the configuration software as an independent tool (connecting a PC to the service bus).
If your process control system supports DPV1, only use this configuration software for maintenance tasks. However, it is advisable when parameterizing the devices to use the master engineering tools, as then all the data will be managed in a database that conforms to the system.
If your process control system does not support DPV1, you can use the configuration software to edit the relevant GSD/GSE files. In this case, the configuration must also be set-up via the process control system configuration tool.
Some process control systems also 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.

4.2 Differences between DTM and firmware versions

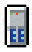
Hardware

The Com Unit supports all I/O modules produced since 1995, even multichannel analog and binary I/O modules.

DTM software

- In DTM Version 6, the graphic representation of the modules from DTM Version 4 has been replaced by a tree structure, which is familiar to you from such programs as Windows® Explorer. The tree structure makes it possible to display several remote I/O stations (Com Units) simultaneously in one project.
- DTM Version 6 no longer has a demo mode. The measured value display of the I/O modules can only be shown when there is a service bus connection to the remote I/O station.
- DTM Version 6 is downward compatible to Version 4. You can continue to use the configurations you created in earlier versions in V6. Existing configurations can also be used for the new Com Unit models, which support additional hardware options such as multichannel analog and binary I/O modules.

- Com Units and I/O modules are indicated in the DTM V6 tree structure by a symbol and a TAG number. The channels of analog I/O modules are represented by a symbolic measurement device with a right arrow (for output) or a left arrow (for input). The channels of binary I/O modules are represented by the logic symbol 0/1 with a right arrow (for output) or a left arrow (for input) (see table below).
  The configuration window of the Com Unit now allows access to the new parameters.

	redundant FB Com Unit
	multichannel I/O module
	single-channel I/O module
	binary channel (input)
	analog channel (input)

Com Unit firmware

Unlike older Com Units, Com Units with firmware version 5 also support multichannel binary I/O modules. Firmware version 6 replaces the previous versions 4 and 5 and covers all I/O modules, including multichannel analog I/O modules.

4.3 Hardware and software requirements

Your PC or laptop must meet the following (minimum) requirements so that you can install the software.

- Processor with 500 MHz pulse frequency,
- 128 MB RAM,
- CD-ROM drive,
- 30 MB free hard disk space,
- Operating systems: Microsoft® Windows® 95/98/2000/NT/XP

  .

Windows® is a registered trademark of the Microsoft Corporation.

4.4 Installing configuration software

P+F DTM software is suitable both for LB and FB remote I/O products. The CD-ROM contains full documentation for all the modules, including ATEX certifications.

Installing configuration software

1. Insert the accompanying CD ROM in the CD/DVD drive.
2. Wait until the language selection window opens automatically (view Figure 4.1 on page 45). If the language selection window does not appear automatically on your screen, open the setup.exe file in Windows Explorer.

200180 2009-08

Figure 4.1: Language selection window

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

   The welcome screen appears.
5. Click **Next** to continue.

   The **License agreement**window opens.
6. Click **Yes** to accept the license agreement.

   The **User information** window opens (view Figure 4.2 on page 45).

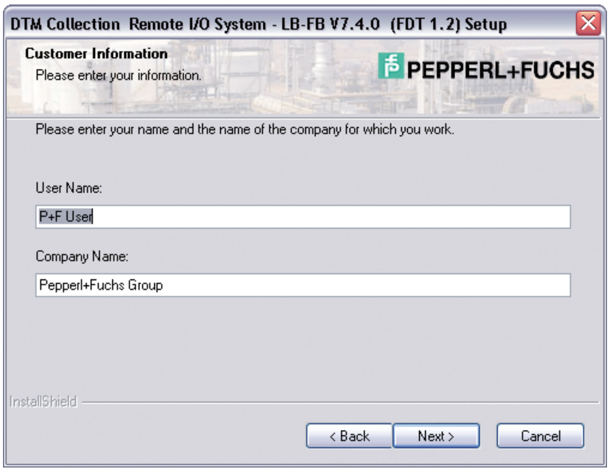


Figure 4.2: User information

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

   The **Select installation path** window opens (view Figure 4.3 on page 46).

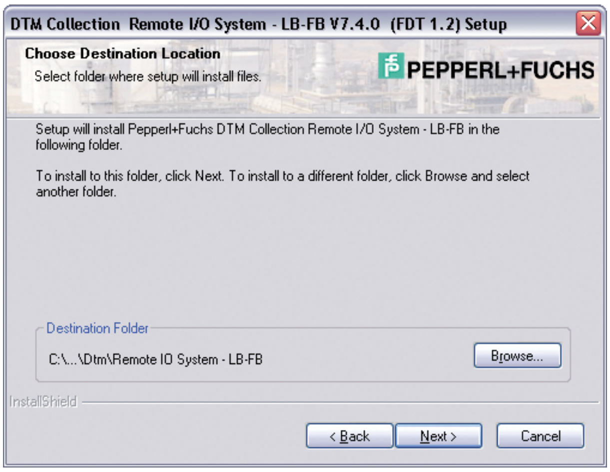


Figure 4.3: Selecting the target path

9. Click **Next** to confirm the default folder.
   Click **Browse** to select a different folder. Select a folder and then click **Next**.

   The **Setup type** window opens.

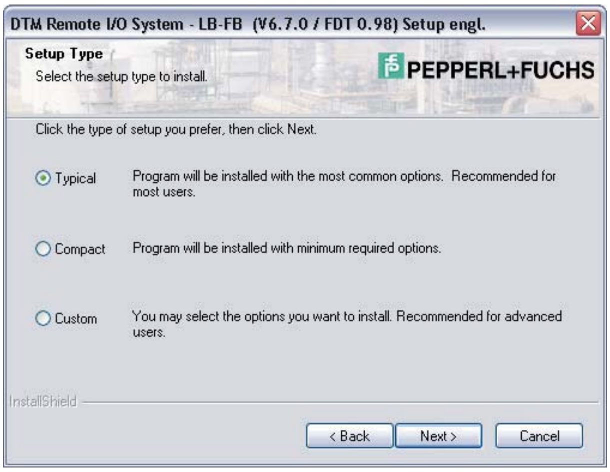


Figure 4.4: **Setup type** window

10. Select the required setup type by activating the relevant option.
11. Click **Next** to continue.

    If you selected **Standard** or **Minimum** as the setup type, installation will now begin. Skip the next step.
12. If you selected **User-defined** as the setup type, choose the components to install from the **Select options** window. Then click **Next**.

    Installation begins.
13. Enable/disable the check boxes to display/not display the read-me file containing important information and to then start/not start the configuration software.
14. Click **Finish** to conclude the installation.

5 Configuration software setup

5.1 Starting the configuration software

Starting the configuration software

1. In Windows, select **Start** > **Programs** > **LB+FB Remote I/O**.

   A dialog box opens.
2. Click **OK** to continue.

   The **Login** window appears.

Figure 5.1: **Login** window

3. If you are using the software for the first time, enter "CGD" as your user name and "Safety" as your password. These entries are case-sensitive (default master key).
   If you have already set up your own user name and password, enter them in the boxes.
4. Click **Next** to continue.

   If your user name and password were correct, an information window opens to inform you of your user rights. If you have logged on using the default master key, you are logged on as a "Supervisor" (unrestricted user rights).
   If your user name or password were incorrect, a fault message is displayed and you are merely logged on as an "Observer" (greatly restricted user rights).

Note!

Changing the default password

The default Supervisor user data allows unrestricted access to all the software functions (Supervisor rights). To prevent unauthorized access, change the Supervisor password as soon as possible (see chapter 5.3).

5.2 Overview

The program window is divided into several areas.

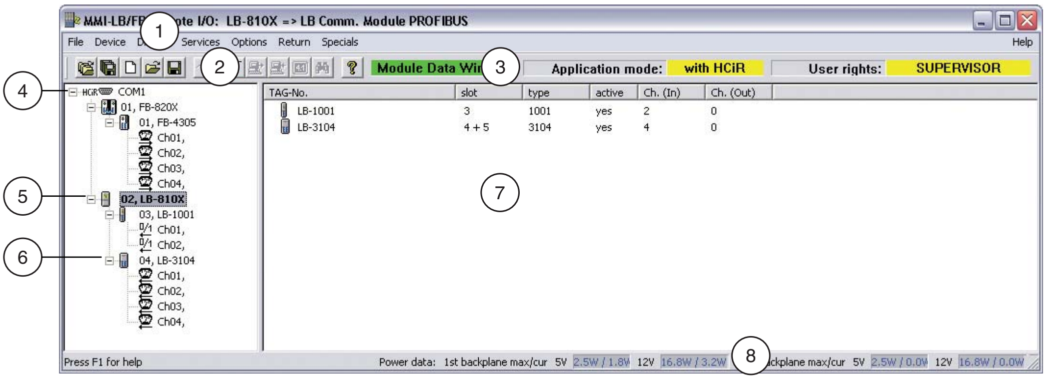


Figure 5.2: Program window overview

1 Menu
2 Toolbar
3 Header
4 Project view as tree structure
5 Com Unit of the remote I/O station (slave 2)
6 I/O module LB 3104 in slave 2, slot 4+5
7 List of slave devices with their parameters
8 Status bar, shows the power consumption of the selected slave

There are also two program window views, which are identical in structure but contain different menus:

- **Main window**: This view is active once the program is started. The menu functions in the main window are mostly general, such as connection setup, password settings, documentation functions and communication settings.
  To move from the device data window to the main window, select **Back** > **Back to main window** from the menu.
- **Device data window**: The device data window is where you parameterize Com Units and I/O modules. Functions for loading and saving configurations are also available.
  To move from the main window to the device data window, select **Device data** > **Edit device data** from the menu.

The header shows which view is currently active.

Figure 5.3: Header of the main window

Figure 5.4: Header of the device data window

200180 2009-08

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In both program windows, the toolbar gives you fast access to important functions.

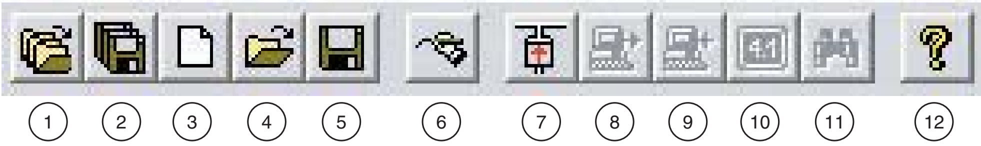

Figure 5.5: Toolbar

1 Load project from read/write tag
2 Save project on read/write tag
3 Create remote I/O station and add to project
4 Load remote I/O station from read/write tag
5 Save remote I/O station on read/write tag
6 Edit I/O module
7 Connect
8 Download (load data from configuration software to remote I/O station).
9 Upload (load data from remote I/O station to configuration software).
10 Display measured value/status of selected I/O module
11 Read out FLASH-RAM area (for service personnel only)
12 Show welcome screen with version information

5.3 Setting up password protection and user levels

Parameter settings can be protected against unauthorized modification by passwords. Whenever you start the configuration software and exit the welcome screen with **OK**, the **Login** window appears, asking you for your user name and password.

Figure 5.6: **Login** window

There are four user levels with different authorizations to allow various employees access to the different levels. The header of the program window indicates the user level to which you are currently logged on.

User level	Level	Authorization
Supervisor	3	• Changing the Supervisor password • Setting up other users (Specialists, Maintenance) • Access to all other program functions
Specialist	2	• No access to the Supervisor password • No access to other Specialist passwords, cannot set-up Specialists • Setting up Maintenance users • Access to all other program functions
Maintenance	1	• No access to the Supervisor password • No access to other passwords, cannot set-up other users • No access to the RamView storage area • Access to all other program functions
Observer (all users without a password)	0	• No access to passwords, cannot set-up other users • All program functions are disabled, apart from displaying data and measured values

If you are starting the configuration software for the first time, enter the the factory default Supervisor user data in the **Login** window (see chapter 5.1). We recommend that you change the default Supervisor password as soon as you log on to prevent unauthorized access.

Note!

Supervisor user data

As a Supervisor, you can change the Supervisor password at any time. But do not delete the Supervisor user. If you delete the Supervisor user, you will not be able to set up a new one.

As a Supervisor, the way that you set up new users is described below.

Installing new users

1. In the main window, select **Options** > **Password** > **Settings**.

   The **Change password / Install user** window opens with a list of all the installed users.

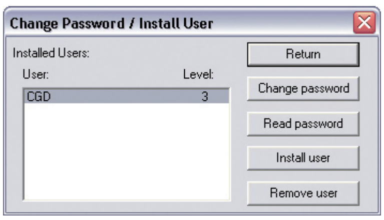

Figure 5.7: **Change password / Install user** window with 1 user (Supervisor)

2. To set up a new user, click **Install user**.

   The **Install user** window appears.

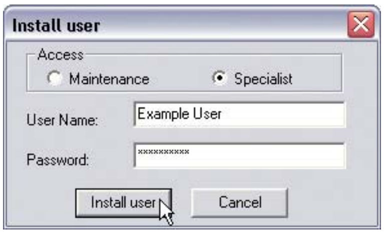

Figure 5.8: **Install** window

3. In the **Access** area, select the level of user rights for the new user.
4. Enter the required values in the **User name** and **Password** fields.
5. To finish the process, click **Install user**.

   The new user now appears in the list.

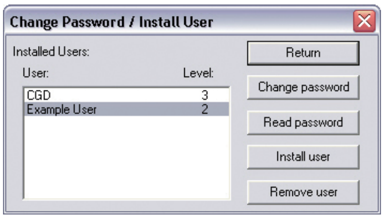

Figure 5.9: **Change password / Install user** window with 2 users

Other functions in the **Change password / Install user** window

- **Change password**: Changes the password of the selected user (your own password and the passwords of all users at a lower user level).
- **Read password**: Displays the password of the selected user (your own password and the passwords of all users at a lower user level).
- **Delete user**: Deletes the selected user (your own user and users at a lower user level).

Note!

Should the master password go missing, the CD-ROM is the key.

You only need the master password if you use the Device Type Manager as a stand-alone application (independent tool) for configuration via the service bus. If you configure the remote I/O station directly via the process control system, the master will handle password protection.

5.4 Configuring communication

The communication software communicates with the remote I/O stations via the service bus. Up to 31 nodes can be connected to the service bus. Repeaters can be used to increase the number of nodes to 119.

The service bus is designed as a Modbus.

Connect a standard RS232–RS485 interface converter (available separately) to the RS232 interface of your PC or laptop to provide a bus connection.

Note!

To meet all requirements, the standard interface converters must support automatic baud rate detection and automatic change of direction.

Before you can establish a connection to a remote I/O station via the service bus, you must set up the serial interface of your PC or laptop (Com1 ... Com4).

Configuring the PC serial interface

1. In the main window menu, select **Options** > **Communication** > **COM Port settings**.

   The **Serial interface settings** window opens.

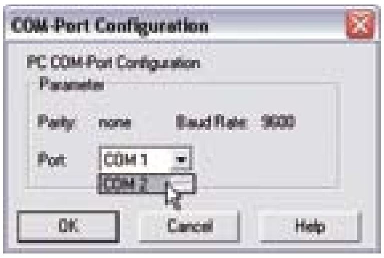

Figure 5.10: **Serial interface settings** window

2. Set which serial interface of your PC or laptop you would like to use to establish the service bus connection (COM 1, COM 2, etc.). The settings for the port connections in the Com Unit must match those in the configuration software. The defaults for the Com Units are "Baud rate = 9600" and "Parity = none".
3. To finish the process, click **OK**.

You can also specify how often the software is to access data from the remote I/O station (status and command register) in the **Options > Communication > Refresh rate for online data** menu.

200180 2009-08

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5.5 Additional settings

Figure 5.11: **Settings** window

Additional settings can be made in the **Settings** window. To open the window, select **Options** > **Settings** from the main window.

Note!

HCiR setting

This setting only applies to PROFIBUS Com Units. This setting is not used for Modbus Com Units and has no effect on them.

- Hot Configuration in Run (HCiR) (PROFIBUS only): Enable this option if your process control system supports HCiR (see chapter 6.8). When the HCiR option is enabled, the remote I/O station can be configured during operation. It is necessary to restart the bus for the new configuration to take effect.
- Display of analog measured values in the overview: Enable this option to query all the slave devices connected to the service bus and display the analog measured values in the overview. Note: Enabling this option slows down the response time of the service bus. Leave this option deactivated if you want a fast response time.

5.6 Connecting to a remote I/O station

For online configuration, the display of measured values or downloading/uploading parameters from/to the remote I/O station, it is necessary to have a hardware connection between the configuration software and the remote I/O station. The connection is established via the service bus.

Please refer to the LB/FB hardware manuals for the connection layout of the remote I/O station.

If you are using the process control system engineering tool for configuration, follow the instructions for the particular engineering tool.

Warning!
Online configuration

Not all process control systems support configuration changes without de-energizing the outputs (process control systems without HCiR support). Avoid the online configuration of parameters with process control systems of this type, as this may cause malfunctions.

Note!

Default Com Unit address

All Com Units are given the default service bus address 1.

Connecting

1. In the main window menu, select **Connections > Connect** or click **Connect** on the toolbar.

   You will then be prompted to save the data.
2. Click **Yes** or **No** to save or not save your data.
3. The **Address range for station search** window opens.

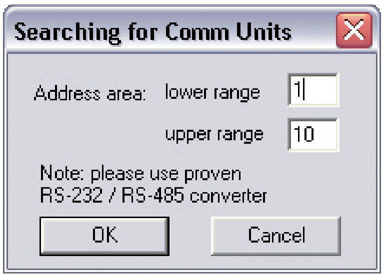

Figure 5.12: **Address range for station search** window

4. Enter the address range in which to search for Com Units (Com Unit service bus address). The setting 1 to 119 covers the possible address range in full. If you limit the address range, the search will take less time.
5. Click **OK** to confirm.

   The software will now search for connected Com Units in the specified address range. While the search is ongoing, the progress of the search is displayed as a percentage.

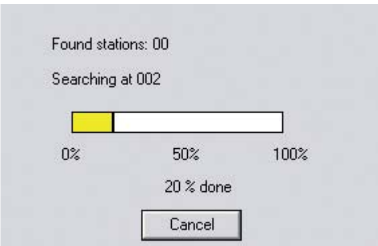

Figure 5.13: Station search status

6. If the search is unsuccessful, a fault message is displayed. In this case, read the “Troubleshooting” chapter.
   If the search was successful, a list of the Com Units that were found is displayed. The list contains the TAG No. and address for each Com Unit that has been found. Mark the Com Unit to which you would like to connect and then click **OK**.

   The connection is now established.

6 Configure Com Unit

6.1 Loading Com Units into the configuration software

To configure the Com Unit of a remote I/O station, you must first load a Com Unit into the configuration software window. There are various ways of doing this:

- Create a new project (offline configuration) (see chapter 6.1.1)
- Load an existing project from the read/write tag (offline configuration) (see chapter 6.1.2)
- Load a remote I/O station from the field (online configuration) (see chapter 6.1.3)

Note!

A project file usually contains all the remote I/O stations connected to a common service bus.

6.1.1 Creating a new project

Creating a new project

1. Start the configuration software and enter your user name and password.

   This will take you to the main window.
2. To add a Com Unit, select **Device data > Edit device data**.

   The **Select fieldbus / Local bus** window opens.

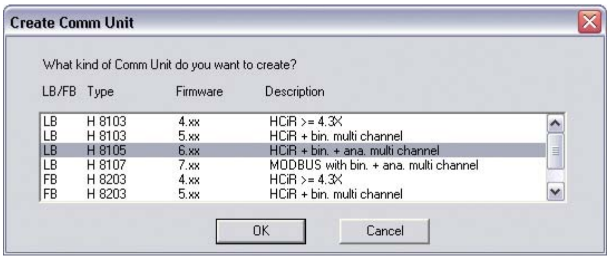

Figure 6.1: **Select fieldbus / local bus** window

3. Select a Com Unit and then click **OK**.

   This opens the Com Unit configuration window. The Com Unit configuration is described below (see chapter 6.2).

200180 2009-08

6.1.2 Loading an existing project from the read/write tag

Loading a project from the read/write tag

1. Start the configuration software and enter your user name and password.

   This will take you to the main window.
2. To load an existing project, click the **Load project from read/write tag** icon.

   The **Open** window appears.
3. Select the required project file (*.prj) and click **Open**.

   The project opens. One or more Com Units are displayed in the tree structure, depending on the project.
4. Move to the device data window by selecting **Device data > Edit device data**.
5. In the tree structure, right-click on the required Com Unit and select **File > Configure Com Unit**.

   This opens a window in which to configure the Com Unit. The Com Unit configuration is described below (see chapter 6.2).

6.1.3 Loading a remote I/O station from the field

You can load the configuration from a remote I/O station to an empty project (only Com Units without I/O modules) or to a project to which I/O modules have been assigned (Com Units with I/O modules).

First establish a connection and then select a remote I/O station (see chapter 5.6). The Com Unit is now displayed in the tree structure in single mode or redundancy mode (a Com Unit in redundancy mode is recognizable from the double Com Unit symbol).

Loading a configuration to an empty project
Now load the complete station configuration into the software. If the configuration in the Com Unit is not appropriate for the inserted modules, the software asks how it is to proceed. In this case, the user decides how to proceed.

Note!

Com Units can be configured in advance, before you insert them in the slot. This can be done in the office, for example, using a separate remote I/O configuration slot.

Loading a configuration into an existing project
If the remote I/O station has already been configured with the configuration software, the software recognizes the configuration and the slot positions of the I/O modules and the Com Units.
The software also detects whether the configuration of the remote I/O station has been modified outside the software and no longer matches the software configuration (for example, if a new I/O module has been inserted into the backplane, or an I/O module removed from the backplane). In this situation, you can decide whether to adapt the configuration in the hardware or the software.

200180 2009-08

If the Com Unit firmware does not correspond to the user interface, a warning is displayed

The occupied slots of the remote I/O station are displayed, each with their respective slot numbers and TAG nos.

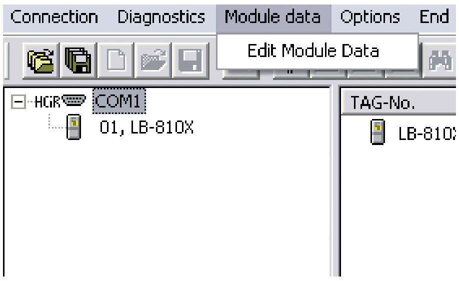

Figure 6.2: Accessing the device data window

Accessing the Com Unit configuration window

1. Move to the device data window by selecting **Device data > Edit device data**.
2. In the tree structure, right-click on the required Com Unit and select **File > Configure Com Unit**.

   This opens a window in which to configure the Com Unit. The Com Unit configuration is described below (see chapter 6.2).

6.2 Editing Com Unit device data

You can configure the remote I/O station online or offline. If you configure offline, you can load the configuration to the remote I/O station at a later date. For offline configuration, there is no service bus connection required between the software and the remote I/O station.
A service bus connection is required for online configuration.

Caution!
Online configuration only with HCiR

Online modifications to some Com Unit/I/O module device parameters and online modifications to the slot configuration change the data structure of the bus data telegram. These modifications, therefore, trigger an automatic bus restart, which may result in functions being interrupted.

Never modify these parameters online when a system is in operation (active connection to a device) unless your process control system supports Hot Configuration in Run (HCiR).

Note!

Settings in the configuration software

For settings made in the configuration software to take effect, the settings must be loaded from the configuration software to the remote I/O station. Click **Download** on the toolbar or select **Device > Save station in box** from the device data window menu.

The Com Unit configuration window is divided into various boxes and tabs.

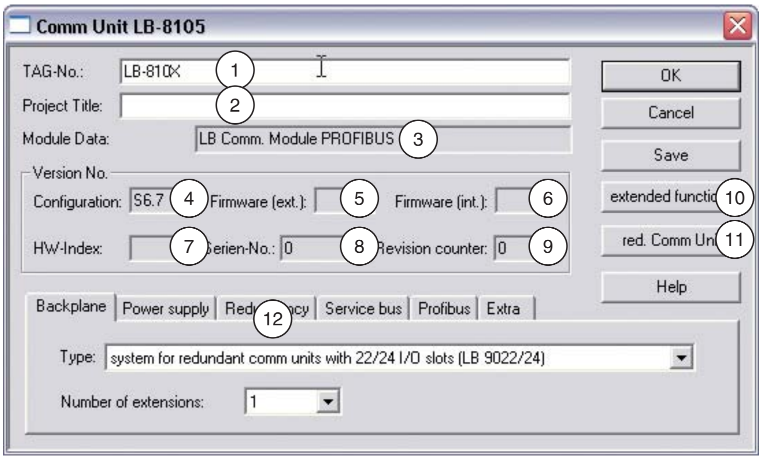

Figure 6.3: Com Unit configuration window

1 **TAG No.** box
2 **Station name** box
3 **Measuring point description** box
4 **Configuration** box
5 **Firmware (ext.)** box
6 **Firmware (int.)** box
7 **HW index** box
8 **Serial no.** box
9 **Revision counter** box
10 **Ext. functions** button
11 **Redundancy Com Unit** button
12 Tabs with additional functions

1

TAG No. box

Enter any name (max. 32 characters).

2

Station name box

Enter any name for the remote I/O station (max. 32 characters).

3

Measuring point name box

Displays the name of the measuring point (cannot be edited).

4

Configuration box

Contains the version number of the configuration software that was last used to adjust the Com Unit parameters.

5

Firmware (ext.) box

Contains the Com Unit firmware version (update possible).

6

Firmware (int.) box

Contains the chip version (update not possible).

7

HW index box

Contains the hardware index (later extensions).

8

Serial no. box

Contains the serial number of the Com Unit (later extension).

9

Revision counter box

Contains the number of parameter changes that were made with the configuration software.

10

Ext. functions button

Opens the **Firmware-dependent device functions** window. There you can activate/deactivate the functions that are dependent on the Com Unit firmware version. A detailed description of this window can be found in the section “Selecting firmware-dependent device functions” (see chapter 6.2.1).

11

Redundancy Com Unit button

Opens the configuration window for the redundancy Com Unit (if available). This button is only available to you if, on the **Redundancy** tab, you have activated the **Add red. Com Unit** tab (see chapter 6.2.4).
The configuration window for the redundancy Com Unit is identical to the Com Unit configuration window; however, some functions are deactivated.

12

Tabs with additional functions

This area contains tabs with additional Com Unit functions. The tabs are described below.

6.2.1 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.

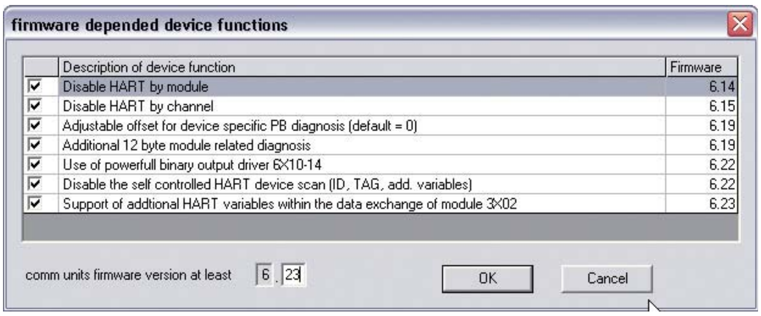

Figure 6.4: **Firmware-dependent device functions** window

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.

Opening and editing the **Firmware-dependent device functions** window

1. In the Com Unit configuration window, click the **Ext. functions** button.

   The **Firmware-dependent device functions** window opens.
2. Click on the required check box to the left of the **Description of the device function** column to (de)activate the respective functions. The required firmware revision is determined automatically and entered in the **Firmware for the selected Com Unit** box.
3. To save your selection and close the window, click the **OK** button.

Individual HART module deactivation function

This function is not supported by the configuration software.

Individual HART channel deactivation function

When you enable this function, you can deactivate the HART communication of I/O modules 3x02, 3x03, 3x05, 4x02 and 4x05 for each channel individually.
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 required HART communication).

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

Offset adjustable for module related PB diagnostics function

If you enable this function, you can modify the **Module offset for diagnostics** parameter in the **DP parameters** window (Com Unit configuration window, **PROFIBUS** tab, **DP parameters** button).
You can use the Com Unit parameter **Module offset for diagnostics** to influence the counting method of module-related 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 **Offset adjustable for module related PB diagnostics**, **Module offset for diagnostics** is set to 0 by default.

Additional 12 byte module related diagnostics function

If you enable this function, you can modify the **Additional module related parameter diagnostics** parameter in the **DP parameters** window (Com Unit configuration window, **PROFIBUS** tab, **DP parameters** button).
Additional module diagnostics allows you to extend 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, **Additional module related diagnostics** is disabled by default and no additional module-related diagnostics are transmitted.

Use powerful valve drivers 6x10 - 6x14 function

If you enable this function, you can use digital outputs 6x10 - 6x14 in the remote I/O station.

Disable automatic HART device scan function

If you enable this function, you can deactivate automatic scanning of the HART channels of I/O modules 3x02, 3x03, 3x05, 4x02 and 4x05 for each channel individually.
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 you do not enable the **Disable automatic HART device scan** function, all the active HART channels of the I/O modules listed above are scanned by default.

Use extended PROFIBUS modes for 3x02 ... function

If you enable this function, the **Data transmission mode** drop-down list appears in the device data window of I/O module 3x02. Here you can activate the transfer of HART auxiliary variables in cyclic data traffic.

If you do not enable the **Use extended PROFIBUS modes for 3x02 ...** function, no HART auxiliary variables are transferred and the **Measuring method** drop-down list does not appear.

Warning!
PROFIBUS will restart if the data transmission mode is changed (3x02 only)

If you change the setting in the **Data transmission mode** drop-down list for analog input 3x02, it can affect the structure of the PROFIBUS data telegram. You will then need to restart the PROFIBUS!
Only if your process control system supports HCiR will a change to this parameter not affect the function of the remote I/O station (see chapter 6.8).

200180 2009-08

6.2.2 Editing the "Backplane" tab

Figure 6.5: **Backplane** tab

1 **Type** box
2 **Number of extensions** drop-down list

1

Type box

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 system with 22/24 module slots (LB 9022/24)" is selected in the example.

2

Number of extensions drop-down list

Specify here whether an extension to the base backplane is available. The following selection options are available in the above example:
"0": No extension available
"1." Extension available
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).

6.2.3 Editing the "Power supply" tab

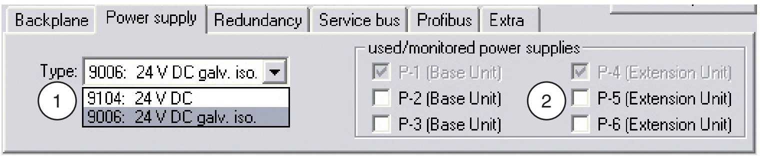

Figure 6.6: **Power supply** tab

1 **Type** drop-down list
2 **Power supplies** check boxes

1

Type drop-down list

Select the power supply. The options depend on the type of backplane being used (see **Type** drop-down list on the **Backplane** tab).

2

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 that can be edited will depend on whether or not you are using an extension (see the **Extensions** drop-down list on the **Backplane** tab).

200180 2009-08

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6.2.4 Editing the "Redundancy" tab

Figure 6.7: **Redundancy** tab,

1 **Add red. Com unit** check box
2 **Type** area

1

Add red. Com unit check box

When **Add red. Com Unit** is enabled, redundancy mode is activated with 2 Com Units. The **Redundancy Com Unit** button for opening the redundancy Com Unit configuration window also appears.
The adjustment options on the **Power supplies** tab also depend on this check box.

2

Type area

Select the redundancy type (system-dependent). This area is only visible once you have enabled the **Add red. Com Unit** window.
Application redundancy: Enable this option if both Com Units are meant to participate in bidirectional data transfer.
Media 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 device. Only the active Com Unit sends data to the master. In this case, the bus 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).

6.2.5 Editing the "Service bus" tab

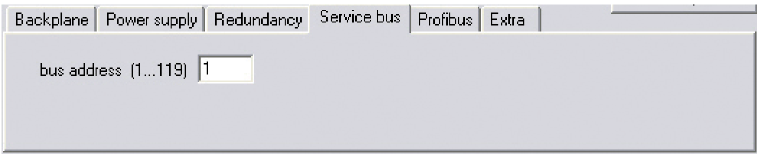

Figure 6.8: **Service bus** tab

In the bus address box, enter the Com Unit service bus address (address range 1 ... 119).

6.2.6 Editing the "PROFIBUS" tab

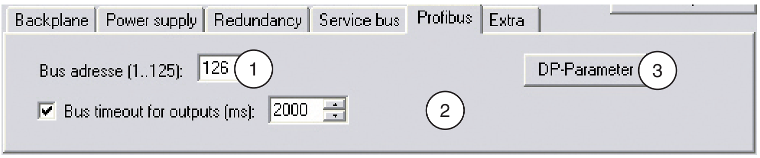

Figure 6.9: **PROFIBUS** tab

1 **Bus address** box
2 **Watchdog for outputs** check box
3 **DP parameters** button

1

Bus address box

Configure the bus address of the Com Unit if the master does not support automatic PROFIBUS address configuration (address range 1 … 125). The default Com Unit PROFIBUS address is set to 126.
The configuration procedure varies, depending on the FDT base application. The topology configuration is usually defined in the FDT base application.

2

Watchdog for outputs check box

Specify a time span in ms, after which the outputs initiate the preset substitute value strategy if bus communication fails (max. 60000 ms = 1 min). The selected time must be long enough for the master to address the slave promptly in the cycle.
Deactivate the check box to switch off the watchdog mechanism.

3

DP parameters button

Opens the DP parameters window (see screenshot).

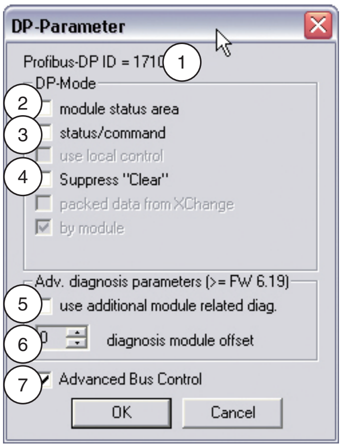

Figure 6.10: **DP parameters** window

1 Display of PROFIBUS ID number
2 **Module status area** check box
3 **Status+command** check box
4 **Suppress "clear"** check box
5 **Add. module related diagnostics** check box
6 **Module offset for diagnostics** box
7 **Additional bus monitoring** check box

Caution!
PROFIBUS will restart if the parameters are changed

If you modify the **Module status area**, **Status+command**, **Add. module related diagnostics** and **Module offset for diagnostics** parameters, this will trigger a PROFIBUS restart! For this reason, these parameters must only be changed online in systems with HCiR functionality.

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.

2

Module status area check box

Enable this checkbox to include transmission of the module status area in the cyclic data traffic. An error bit is transferred for each slot of the remote I/O station (1 bit per slot, 1 = module OK, 0 = module faulty, 6-byte input).

3

Status+command check box

Enable this check box to include transmission of the global status and command register in the cyclic data traffic (the module related errors are listed). This function is important for application redundancy (2-byte input/output).

4

Suppress "clear" check box

Following a restart or a redundancy switchover by the master, some systems issue a "Clear" signal in the initialization phase of the connection (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

Add. module related diagnostics check box

If you enable the **Add. module related 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 diagnostics via DTM is not possible or where the diagnostic options are limited.

Note!

Add. module related diagnostics box for Com Unit 8x05

For Com Unit 8x05, **Add. module related diagnostics** can only be edited if you have activated the **Additional 12 byte module related diagnostics** function in the **Firmware dependent device functions** window (only possible with Com Unit firmware version 6.19 or later). You open this window by pressing the **Ext. functions** button.

6

Module offset for diagnostics box

The assignment of diagnostics to I/O modules in different master and diagnostic systems may turn out differently due to the various counting methods. 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. The value "1" transfers the diagnostics of I/O module 1 as module diagnostics 1.

Note!

Module offset for diagnostics box for Com Unit 8x05

For Com Unit 8x05, **Module offset for diagnostics** can only be edited if you have activated the **Offset adjustable for module related PB diagnostics** function in the **Firmware dependent device functions** window (only possible with Com Unit firmware version 6.19 or later). You open this window by pressing the **Ext. functions** button.

7

Additional bus monitoring check box

It is advisable to enable additional bus monitoring. This is only effective for the outputs in combination with the watchdog time. Once the defined time has elapsed, the outputs are set to values in accordance with the substitute values strategy.

6.2.7 Editing the "Extra" tab

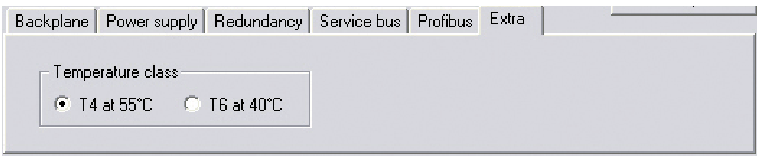

Figure 6.11: **Extra** tab

The **Temperature class** area is only visible on FB Com Units for Zone 1. On LB Com Units, the **Extra** tab stays blank.

Select the temperature class for your FB remote I/O station. Based on this, the configuration software calculates the maximum number of I/O modules for the particular remote I/O station.
This prevents the maximum permissible power consumption being exceeded. All 24 slots can normally be used without restriction.

6.3 Editing Redundancy Com Unit device data

The configuration window for the redundancy Com Unit is identical in structure to the configuration window for the (primary) Com Unit. Most of the redundancy Com Unit parameters are taken directly from the primary Com Unit, which is why the adjustment options for the redundancy Com Unit are limited to a few parameters.

TAG No. box: Enter any name (max. 32 characters).

Service bus tab: The service bus address of the redundancy Com Unit is allocated automatically on the basis of the service bus address of the primary Com Unit. The number 128 is added to the service bus address of the primary Com Unit. So overall, 2 x 119 = 238 nodes are provided on the service bus. The prerequisite is to have sufficient repeaters, as the RS485 bus standard only allows 31 nodes per repeater.

PROFIBUS tab: The bus address of the Redundancy Com Unit can be assigned manually when there is application redundancy. When there is media redundancy, the addresses of the two Com Units are identical, as the master addresses them both with the same data over separate bus lines.

6.4 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 6.12 on page 71). 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 71) is a simplified version of the same module arrangement shown in the illustration (view Figure 6.12 on page 71) and represents the relationship between the data structure of the DP configuration string and the input and output bytes of the I/O modules.

200180 2009-08

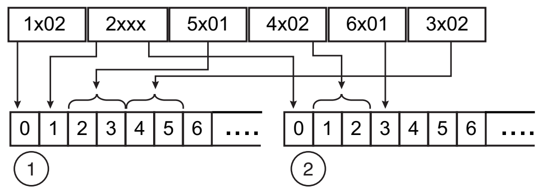

Figure 6.12: Effect of the module arrangement on the data structure

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 6.1: 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.

For more detailed information on the data and bit structure within the input and output bytes of individual I/O modules, refer to the chapter “Configuring I/O modules” (see chapter 8).

You can access the DP configuration string of your remote I/O station in the configuration software device data window. Select a Com Unit in the tree structure and select **Displays > PROFIBUS > DP configuration string**. Once you have accessed the menu, the **Character strings display** window opens.

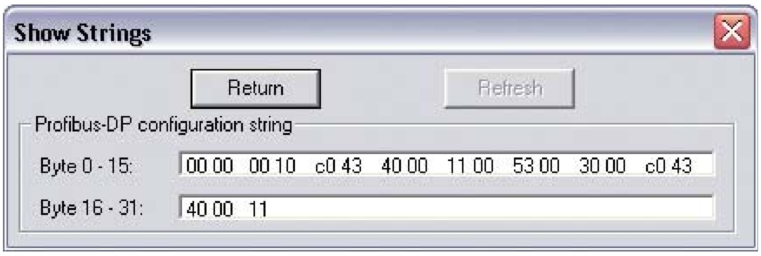

Figure 6.13: Display of DP configuration string

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 6.2: 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 74).

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 6.3: Sequence of the DP configuration code in the DP configuration string

6.5 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 6.4: Command list of the command register

6.6 Adding I/O modules – General information

6.6.1 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.

6.6.2 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 6.5: Example DP configuration string

Note!

Differing slot assignment on the LB 9121, 9022 and LB 9029 backplanes

Slots 1 and 2 on backplanes LB 9121, 9022 and 9029 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.

6.6.3 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).

200180 2009-08

6.7 Adding or deleting I/O modules

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.

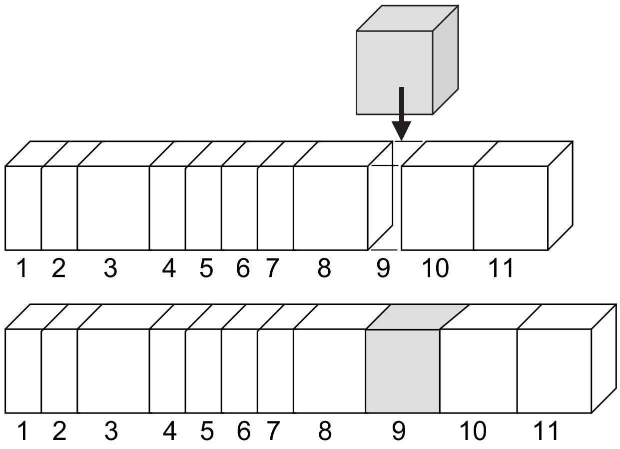

Figure 6.14: Adding an I/O module changes the structure of the Profibus data telegram

Note!

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

If your process control system supports HCiR, you should also read the following subchapter containing information on HCiR (see chapter 6.8).

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.

Virtual I/O modules
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, first add the relevant I/O module to the configuration software tree structure as described below. Then deactivate the I/O module (see chapter 7.2.2). You can insert the pre-configured I/O module into the allocated slot on the backplane at a later stage and reactivate it.

Adding I/O modules

Remember that on redundant remote I/O stations, slots 1 and 2 are reserved for the redundant Com Unit. Also be aware that dual-width I/O modules require 2 slots.

1. Right-click the required Com Unit in the tree structure.

   A context menu opens.
2. In the context menu, select **File** > **Edit station**.

   The **Station structure** window opens with an overview of all the station slots.

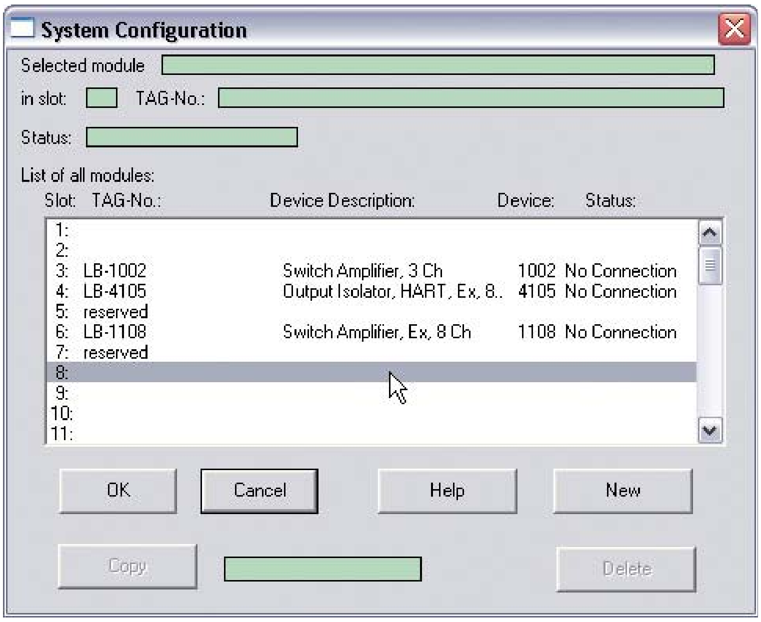

Figure 6.15: **Station structure** window

3. Double-click a vacant slot. The new I/O module is inserted in this slot.

   The **Standard module list** window opens. All the available I/O modules are listed there, divided into functions.

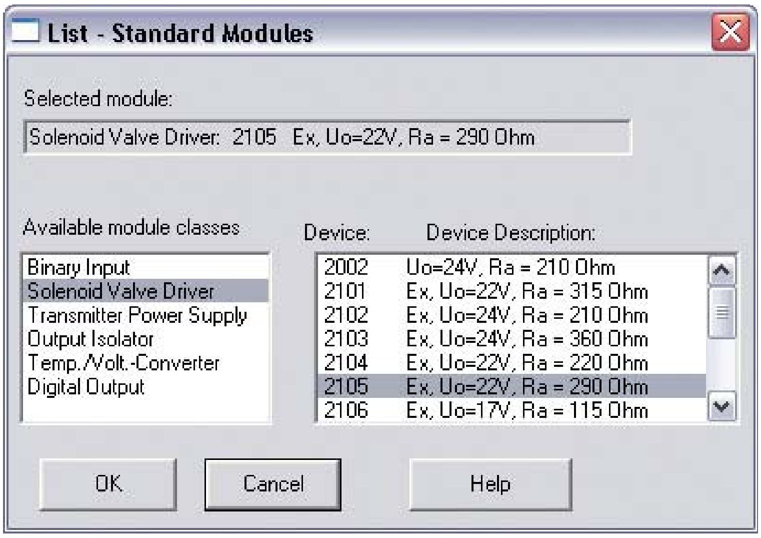

Figure 6.16: **Standard module list** window

4. First, on the left, select the basic type of I/O module you would like to add. Then double-click on the exact device description on the right.

   This opens the device data window of this I/O module.

5. To add the I/O module in the standard configuration, click **OK**. Alternatively, you can first adapt the I/O module parameters and then click **OK**.

   The software returns you to the **Station structure** window. The new I/O module appears in the list there.

6. Assign I/O modules to other slots, as required, by repeating steps 3 to 5.
   If you do not want to assign any further I/O modules, click **OK**.

   The new I/O module now appears in the tree structure.

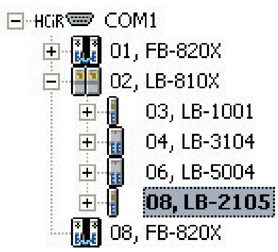

Figure 6.17: Tree structure with Com Units and I/O modules

Deleting I/O modules

1. In the tree structure, right-click on the I/O module entry you would like to delete from the configuration.

   A context menu opens.

2. In the context menu, select **File** > **Delete object(s)**.

   A dialog box opens.

3. Confirm the delete operation by clicking **Yes** in the dialog box.

   The I/O module is deleted from the configuration.

4. Repeat steps 1 to 3 to delete other I/O modules.

200180 2009-08

Tip

An easier way to delete an I/O module is to select the required I/O module in the tree structure and then press **Delete** key.

6.8 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, select **Options** > **Settings** from the main window.

New configurations and settings made using HCiR only become effective when the master restarts the PROFIBUS. If you would like parameter changes to take effect immediately, 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.

200180 2009-08

Warning!
The procedure depends on the process control system

The procedure may differ from the one that follows depending on which process control system you are using.

Process control systems that support HCiR (such as ABB Symphony), automatically control the parameter download and PROFIBUS restart sequence. On process control systems that do not support HCiR, make sure that all parameters are downloaded to the Com Unit before the master is configured.
Editing PROFIBUS-relevant configuration data in process control systems without HCiR support while the plant is operating requires maximum concentration. On process control systems of this kind, we recommend preconfiguring empty slots in the master and slave with virtual I/O modules during 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.

6.8.1 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. Now create a new configuration containing the new I/O module. To do this, start the configuration software.
3. Open the project file containing the configuration of the required remote I/O station.
4. Add the new I/O module to the tree structure. Proceed as described in the “Adding or deleting I/O modules” section (see chapter 6.7). 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, by selecting **Connection > Connect** from the main window menu or by clicking **Connect** on the toolbar. Continue as described in the "Connecting to a remote I/O station" section (see chapter 5.6).

   A connection to the Com Unit is established.
6. Right-click the Com Unit entry in the tree structure.

   A context menu opens.

7. From the context menu, select **Device** > **Save station in box**.

   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.

8. Then configure the new I/O module in the class 1 master.

   The class 1 master restarts the PROFIBUS automatically.
   During the PROFIBUS restart, the outputs of the remote I/O station retain their pre-restart status.
   After the restart, the remote I/O station remains stable and uses the new configuration containing 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.

6.8.2 Deleting or replacing I/O modules with HCiR

Delete or replace I/O modules via HCiR

1. Start the configuration software.
2. Open the project file containing the configuration of the required remote I/O station.
3. Clear the required I/O module. Proceed as described in the “Adding or deleting I/O modules” section (see chapter 6.7). If you would like to replace the deleted I/O module with a new one, add a new I/O module to the tree 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 by selecting **Connection > Connect** from the main window menu or by clicking **Connect** on the toolbar. Continue as described in the "Connecting to a remote I/O station" section (see chapter 5.6).

   A connection to the Com Unit is established.

5. Right-click the Com Unit entry in the tree structure.

   A context menu opens.

6. From the context menu, select **Device** > **Save station in box**.

   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.

7. 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.
   During the PROFIBUS restart, the outputs of the remote I/O station retain their pre-restart status.
   After the restart, the remote I/O station remains stable and uses the new configuration that either no longer contains the old I/O module or contains its replacement. The old configuration is deleted.

8. Remove the relevant I/O module from the backplane or replace the current I/O module with a new one.

200180 2009-08

Note!

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

6.8.3 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.

6.9 Digression: Commissioning

6.9.1 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

200180 2009-08

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.

6.9.2 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.

6.9.3 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.

Remote I/O stations receive their addresses via the service bus (default address: 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.

You can use the DP configuration string to check the configuration. You can access the DP configuration string in the configuration software (section “Meaning of the DP configuration string”, see chapter 6.4).

200180 2009-08

PEPPERL+FUCHS

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.

6.10 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.

7 Basic DTM software functions

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

7.1 Menu of the device data window

Figure 7.1: Header of the device data window

The most important menu functions of the device data window are explained below, if they have not already been dealt with in previous sections.

200180 2009-08

7.1.1 "File" menu

Commands in the **File** menu

Command	Use
New project	Creates a new, empty project file. The project that is currently open is abandoned, unless it has been saved. A project can contain several remote I/O stations and Com Units (all the remote I/O stations connected to a bus line).
Save project	Saves the project that is currently open to the hard disk (file extension *.prj).
Load project	Loads an existing project file from the hard disk. Before you access this menu item, save all the changes you have made to the project that is currently open. Otherwise these changes will be irretrievably lost.
New station	Creates a new remote I/O station within the project that is currently open.
Save station	Saves the currently selected remote I/O station to the hard disk (file extension *.lbu).
Load station	Loads an existing remote I/O station from the hard disk (*.lbu). This allows you to simply copy similar station configurations. The currently selected remote I/O station in the project will be replaced and unless it has been saved, will be irretrievably lost. If a remote I/O station has been loaded from the field, the station file can be reloaded at a later date, as the extensive comments that can be entered for a slot are only saved in the files and not on the Com Unit. The configuration is all that is saved on the Com Unit. You can also send your *.lbu files to our engineers for error analysis.
Edit station	Opens the **Station structure** window for the currently selected Com Unit. There you can edit the slot assignment.
Configure Com Unit	Opens the configuration window for the currently selected Com Unit.
Save module	Saves the configuration of the currently selected I/O module to the hard disk. This allows you to simply copy similar module configurations. Module files are given the file extension *.mXY (X = first digit of the module name, Y = last digit of the module name). For example, temperature input 5x04 has the file extension *.m54.
Load module	Loads an existing module configuration for the currently selected I/O module from the hard disk. The file extension must be appropriate to the I/O module. For example, if you have selected a type 5x04 I/O module, you can only load a module file with the file extension *.m54. The configuration of the currently selected I/O module will be overwritten.
Edit module	Opens the configuration window for the currently selected I/O module.
Add module	Adds a new I/O module to the currently selected remote I/O station (= Com Unit).
Delete object(s)	Deletes the selected object from the project.
Load planning parameters	Loads the planning parameters and notes from a *.lbu file to the selected remote I/O station.

200180 2009-08

PEPPERL+FUCHS

7.1.2 "Device" menu

The commands in the **Device** menu are only available if there is a service bus connection to a remote I/O station.

Commands in the **Device** menu

Command	Use
Load station from the field	Loads the configuration of the remote I/O station to the configuration software (upload). Before you access this command, save all the changes you have made to the file that is currently open. Otherwise these changes will be lost. If you have only configured an "empty" Com Unit in the software configuration (without I/O modules), you can use this command to transfer the remote I/O station configuration to the software. Since the data structure is the same for intrinsically safe and non-intrinsically safe I/O modules, when loading, you are asked which version (intrinsically safe, non-intrinsically safe or explosion-protected) should be displayed in the configuration software. If you have already mapped the remote I/O station in the software configuration, you can also use this command to transfer the remote I/O station configuration to the software. If the number of I/O modules in the remote I/O station does not match the number of I/O modules in the software configuration, a fault message is output. A fault message is also output if the Com Unit firmware does not match the configuration software. If an I/O module is detected in the remote I/O station, but is not configured in the software, a fault message will be displayed during the loading process. This enables you to automatically check during commissioning whether the planned station configuration has been correctly installed. If you do not accept the module that has been identified as incorrect into the configuration software during loading, the corresponding slot in the software will remain empty.
Save station in the field	Loads the software configuration to the remote I/O station (download). The Com Unit then restarts. Changes take effect only after they have been loaded to the remote I/O station. The progress of the data transmission is displayed as a percentage. After data transmission has finished, unused slots are deleted to prevent data conflict. This procedure must not be interrupted. If an error occurs during data transmission, a fault message is output. In this case, transmission must be repeated.
Load module from station	Loads the configuration of an I/O module from the remote I/O station to the relevant I/O module in the configuration software. This loads the complete I/O module configuration. If this was a new I/O module for the slot, the parameter default settings are loaded. If the I/O module in the remote I/O station is not the same I/O module that has been configured for this slot in the software, a fault message is displayed.
Save module to station	Loads the configuration of an I/O module from the software to the remote I/O station. Changes only take effect after they have been loaded to the I/O module.

7.1.3 "Displays" menu

Commands in the **Displays** menu

Command	Use
Measured value + status	Shows the current measured value and status of the selected I/O module (see chapter 7.3). A service bus connection to the remote I/O station is required.
PROFIBUS	Shows the DP configuration string for PROFIBUS Com Units. This command is not available (grayed out) on Modbus Com Units.

7.1.4 "Services" menu

Commands in the **Device** menu

Command	Use
Set planning parameters	Used to create feedback documentation.
Modbus register assignment	With Modbus Com Units, I/O module addressing can be edited here (see chapter 6). This command is not available for PROFIBUS Com Units.
Auto-allocation	For Modbus Com Units: compresses the data structure for the measured values. This command is not available for PROFIBUS Com Units.
Change PROFIBUS ID	Changes the PROFIBUS ID. This command is only available for type LB/FB 8x03H Com Units. This command is not available for 8x05 and 8x07 Com Units.
HCiR: Apply all changes	With this menu command, all parameter changes plus any deleted or added I/O modules for this station take effect. It triggers a PROFIBUS restart. This command is not available for Modbus Com Units.
Remove all multichannel components	Clears all multichannel I/O modules from the station view. When all multichannel I/O modules are cleared, it is possible to return to Com Units that can only support single-channel I/O modules (firmware versions < V5).
Recalculate channel data	Updates channel data.
Convert station to station with ...	Converts the configuration of the remote I/O station so that it is compatible with specific Com Unit firmware versions. A choice of two options is available: • **Binary multichannel (V5.xx)**: Only single-channel I/O modules and multichannel binary I/O modules are allowed (compatibility with Com Unit firmware version V5.xx) • **Analog + binary multichannel (V6.xx)**: Single-channel I/O modules and multichannel binary and analog I/O modules are allowed (compatibility with Com Unit firmware version V6.xx or later) Conversion is also required with ABB Symphony, for example, when making a switch from Com Unit 8x03 and FDT 0.9x to FDT 1.2. It is also necessary to replace the hardware

200180 2009-08

Command	Use
Activate/deactivate all line fault detection	Activates/deactivates the line fault detection functions for all the I/O modules of a remote I/O station.
Switch all channels to NORMAL operating mode	Switches all the I/O modules of a remote I/O station to "Normal" operating mode (cancels the simulation).

7.1.5 "Options" menu

Define the temperature class for FB remote I/O stations in Zone 1. The temperature class is important for determining the permissible self-heating of the remote I/O station.

For most I/O modules, there is no restriction regarding the maximum number of modules that can be used in a station. Depending on the power supply, temperature class T4 or T5 can be used with the required ambient temperature. Please refer to the EC type examination certificate for more detailed information.

Commands in the **Options** menu

Command	Use
Temperature class	• **T4 at 55 °C**: Permissible self-heating to 55 °C • **T6 at 40 °C**: Permissible self-heating to 40 °C

7.1.6 "Service" menu

The **Service** menu is used primarily by our service engineers for fault location. This manual contains no further description of the menu.

7.2 The "Device data" window of the I/O modules

Each I/O module in the project tree structure has its own device data window. All the parameters of an I/O module can be edited in this window. In the sections that follow, you will learn how to access the I/O module device data windows and the structure of the windows (universal screen elements).

Chapter “Configuring I/O modules” contains a detailed description of all the available I/O modules and their specific parameters (see chapter 8).

7.2.1 Accessing the "Device data" window

There are many possible ways to access the **Device data** window of an I/O module. Two of the options are described below.

If you are in the main configuration software window, you must first move to the device data window. From the main menu, select **Device data > Edit device data**.

The header of the software then looks like this.

Figure 7.2: Header of the device data window

Edit station

1. In the tree structure, right-click on the Com Unit with the I/O modules you would like to configure.

   A context menu opens.

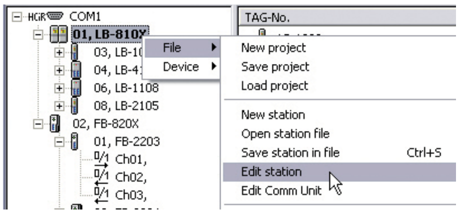

Figure 7.3: **File** > **Edit station** context menu

2. Select **File** > **Edit station**.

   The **Station structure** window opens.

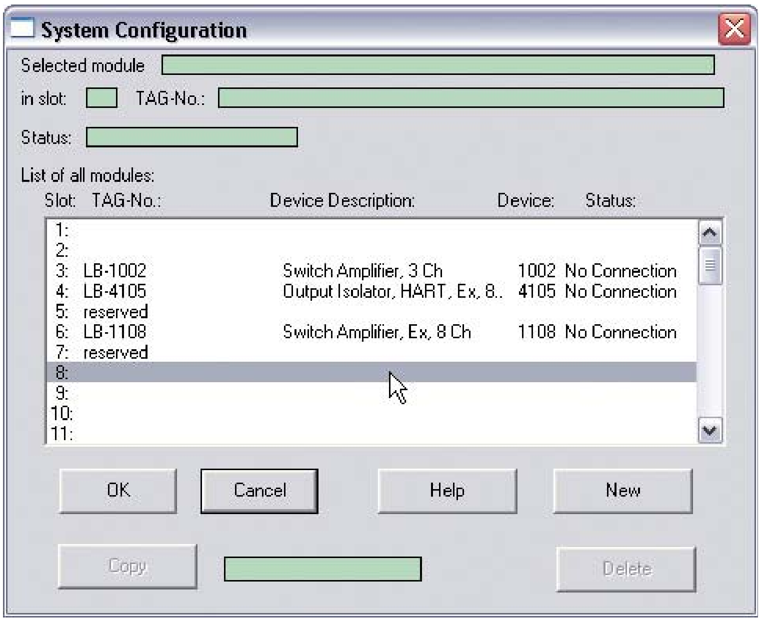

Figure 7.4: **Station structure** window

3. From the list, double-click on the I/O module that you would like to configure. If there is no I/O module in the required slot, you can first select an I/O module to insert after double-clicking.

   The **Device data** window of the particular I/O module opens.

4. Edit the parameters of the I/O module and then click **OK**.

   The software returns you to the **Station structure** window.

5. Now configure another I/O module (repeat steps 3 and 4) or close the **Station structure** window by clicking **OK**.

Editing a single I/O module

1. In the tree structure, right-click on the I/O module you would like to configure and select **File** > **Edit module** from the context menu
   or
   use the left mouse button to select the I/O module and then click **Edit module** on the toolbar.

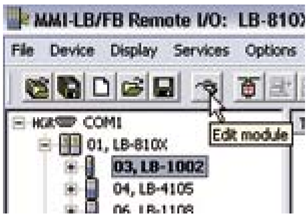

Figure 7.5: **Edit module** icon

   The **Device data** window of the particular I/O module opens.

2. Edit the parameters of the I/O module and then click **OK**.
3. Repeat steps 1 and 2 to configure additional I/O modules.

7.2.2 "Device data" window – universal screen elements

Described below are the screen elements of the **Device data** window that are identical for all I/O modules.

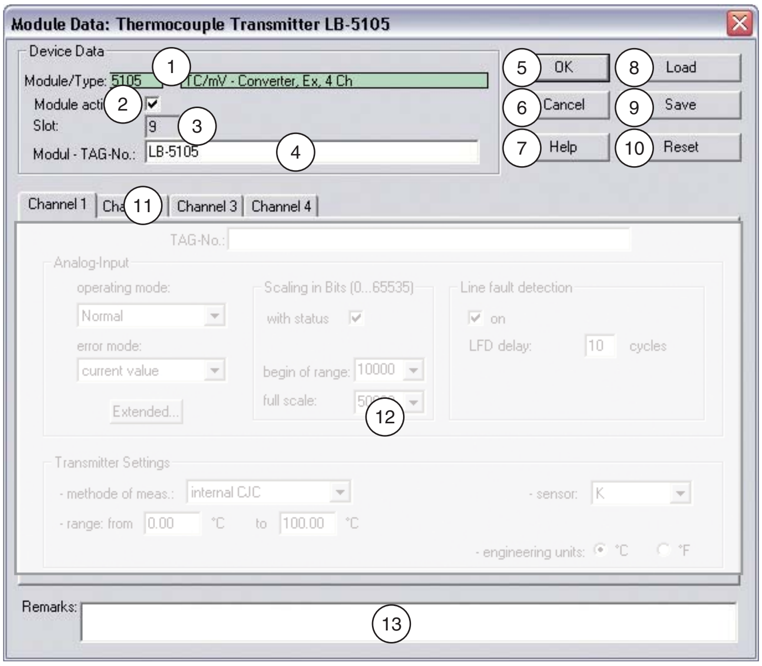

Figure 7.6: **Device data** window – universal screen elements

1 **Module/Type** box
2 **Module active** check box
3 **Slot** box
4 **Module TAG No.** box
5 **OK** button
6 **Cancel** button
7 **Help** button
8 **Load** button
9 **Save** button
10 **Reset** button
11 **Modbus register** button (only for Modbus Com Units)
12 **Channel X** tabs
13 Area with module related parameters
14 **Note** box

Explanations:

1

Module/Type box

Displays the name of the I/O module (cannot be edited)

2

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, it is present in the data traffic as a data set, but does not generate current measured values or diagnostic data.
  This option is particularly useful for process control systems that do not allow online extension. 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). The I/O module can be upgraded in the relevant slot on the backplane at a later date and re-activated via **Module active**.
- If you activate the I/O module, it operates normally and generates current measured values and diagnostics data.

3

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.

4

Module TAG No. box

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

5

OK button

Saves the current configuration and closes the window.

6

Cancel button

Closes the window without saving changes to the configuration. All changes made are lost.

7

Help button

Accesses the Help function.

8

Load button

Loads the existing configurations from a file or directly from the remote I/O station (selection in a dialog box). A service bus connection is required to load a configuration from the remote I/O station.

9

Save button

Saves the current configuration in a default file, a device file or directly to the I/O module of the remote I/O station (selection in a dialog box, see the following screenshot). The **Device data** box remains open.

- Default file: The configuration of the I/O module is saved in a default file, which applies to all I/O modules of the same type. This simplifies the configuration when there are several, similarly populated slots. Now when you add another I/O module of the same type, it is given the basic configuration you have just saved in the default file. Changes made to the default file only affect I/O modules that are added to the configuration later. I/O modules already included in the configuration are not affected by the changes.
- Device file: The configuration of the I/O module is saved in a device file with the extension *.myx (e.g., *.m52 for temperature input 5x02). This device file can be loaded for individual I/O modules of the same type as required.
- Remote I/O station: The configuration of the I/O module is saved in the remote I/O station (service bus connection required).

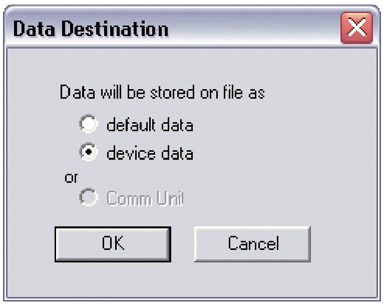

Figure 7.7: Dialog box for saving the device data of an I/O module

10

Reset button

Restores the basic settings of the I/O module. These are not the settings in the default file, but are the factory defaults.

200180 2009-08

PEPPERL+FUCHS

11

Modbus register button

Displays the Modbus address setting (applies to Modbus Com Units only). This button is not available on PROFIBUS Com Units.

12

Channel X tabs

With multichannel, analog I/O modules, each channel is displayed on a separate tab. Click on the relevant tab to display a specific channel.

13

Area with module related parameters

This area contains parameters that are specific to the relevant I/O module. A detailed description of each I/O module can be found in the chapter “Configuring I/O modules” (see chapter 8).

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.

200180 2009-08

7.3 Accessing the measured value display

The measured value display shows the current measured value and status of an I/O module. A description of the measured value display can be found in the subsections below.

Accessing the measured value display

Prerequisite: A remote I/O station with a Com Unit and at least one I/O module is open in the project view. A service bus connection is established to a remote I/O station.

1. In the tree structure, mark the required I/O module channel.

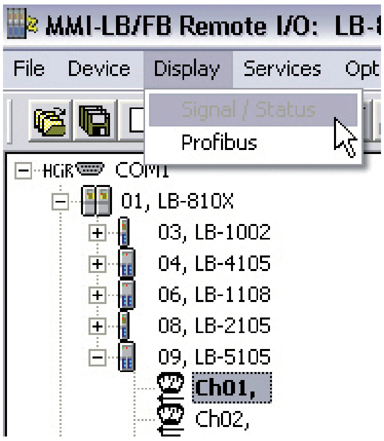

Figure 7.8: Accessing the measured value display

2. In the toolbar, click the **Measured value/Status** icon
   or
   if you are in the device data window, select **Display** > **Measured value/Status** from the menu.

   The measured value display opens.

Tip

If you would like to access the measured value display of a **digital** I/O module, you only need to mark the required I/O module in the tree structure (instead of a single channel). Reason: The measured value display shows all the channels in one window for digital I/O modules. With analog I/O modules, on the other hand, each channel has its own measured value display.

7.3.1 Measured value display for 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.

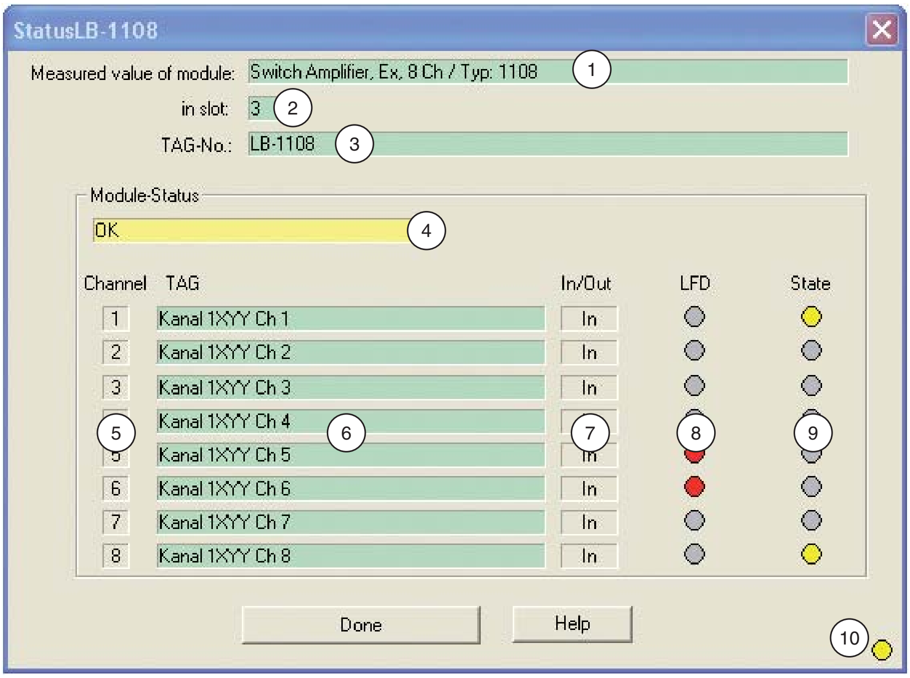

Figure 7.9: Measured value display of digital input 1x08

1 **Measured value from module** box
2 **At slot no.** box
3 **TAG No.** box (TAG number of the I/O module)
4 **Module status** box
5 **Channel** box (channel number)
6 **TAG** box (TAG number of the channel)
7 **In/Out** box (input or output channel)
8 **Line fault detection** indicator
9 **Switching state** indicator (contact open or closed)
10 Data transmission activity on the service bus

In the example shown, line breakage detection has operated for channels 5 and 6 (indicator lights up red). There are no line faults for the remaining channels (indicator stays gray).

The contacts of channels 1 and 8 are closed (indicator lights up yellow). The remaining contacts are open (status indication stays gray).

The indicator on the bottom right of the window flashes yellow when data is being transmitted on the service bus.

Note!

Line fault detection

Not all the I/O modules have line fault detection. The relevant status indicators are not present in these I/O modules.

7.3.2 Measured value display for analog I/O modules

There are only slight differences between the measured value displays of the analog I/O modules. For this reason, the measured value display is described using one example for all

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

200180 2009-08

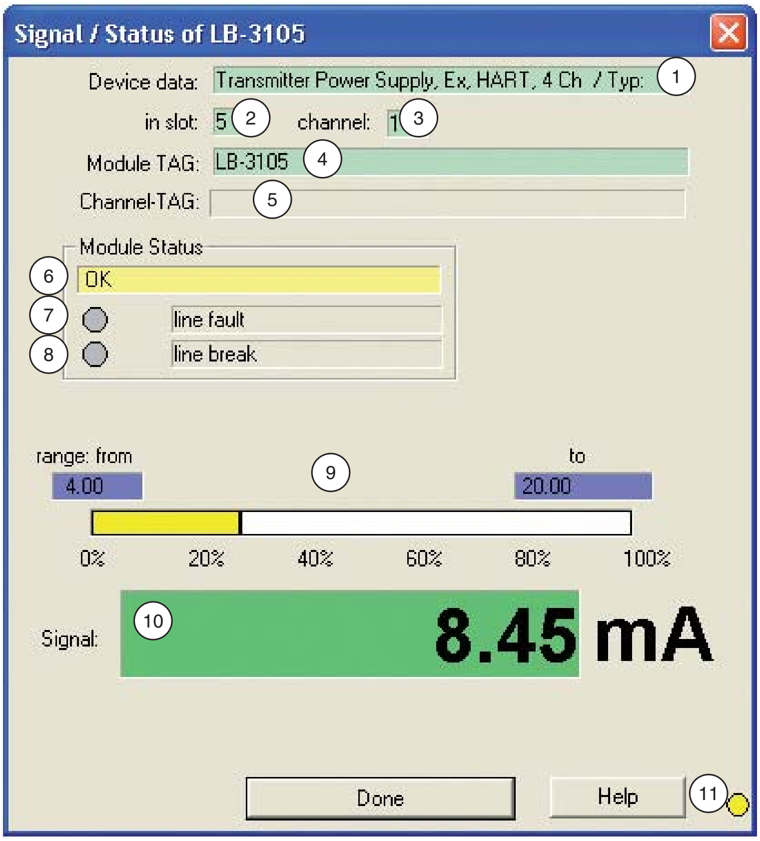

Figure 7.10: Measured value display of analog input 3x05

1 **Measured value from module** box
2 **At slot no.** box
3 **Channel no.** box
4 **Module TAG** box (TAG number of the I/O module)
5 **Channel TAG** box (TAG number of the channel)
6 **Channel status** box
7 **Line fault detection** indicator
8 **Breakage** indicator (contact open or closed)
9 Start of range, end of range and measured value on a scale of 0% ... 100%
10 Display of measured value and physical unit
11 Data transmission activity on the service bus

No errors have occurred in the example shown. The **Line fault detection** and **Breakage** indicators stay gray and the **Channel status** box displays the value "OK". When there is an error, the relevant indicators light up red.

The indicator on the bottom right of the window flashes yellow when data is being transmitted on the service bus.

Note!

Line fault detection/breakage detection

Not all the I/O modules have line fault/breakage detection. The relevant status indicators are not present in these I/O modules.

7.4 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 8).

7.4.1 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 **Scaling** area of the device data window of the particular I/O module. Permitted here are whole numbers within the range 0 ... 65535. Alternatively, you can select a few frequently used scaling values directly from the drop-down lists.

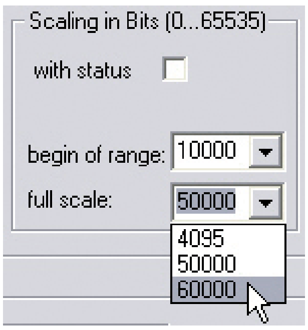

Figure 7.11: **Scaling** area

200180 2009-08

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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!

Some process control systems prefer scaling the inputs and outputs directly in the process control system instead of scaling in the remote I/O system.

7.5 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. P+F can provide drivers for standard HART software on request.

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).

Each field device requires a unique address to prevent address conflicts between the measuring points. Standard commercial software packages can automatically import the field device addresses using teach-in functions. The sequential connection of field devices described below for initial commissioning then no longer applies.

Should the software you have available not have any teach-in functions of this type, only connect one field device to begin with and establish the connection to this field device with the HART software. Give the field device a so-called long address (e.g., addressing via the TAG No.). Then commission the second field device and proceed in the same way. Follow this with the third device, etc. Once all the field devices have been given a communication address, they can each be addressed separately.

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.

200180 2009-08

7.5.1 Practical experiences

The following HART communication limitations were found during tests.

- HART communication with transmitters is possible in the operating range 4-20 mA. Some 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 transmitter manufacturers supply devices that work with a proprietary protocol. 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 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. This function is supported by Com Units running firmware version > V6. Earlier firmware versions do not provide this function.

7.6 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 8).

7.6.1 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 8).

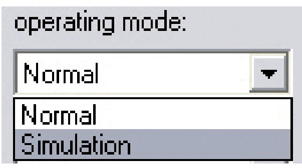

Figure 7.12: Setting the operating mode

200180 2009-08

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".

7.6.2 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 8).

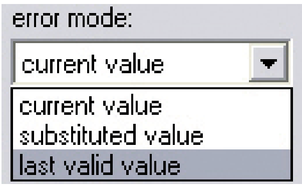

Figure 7.13: Adjusting error mode settings

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 corresponding fault condition is detected (e.g. no bus communication), the outputs are transferred from the status "Power off" to the corresponding substitute value as specified in the options for the selected substitute value.

200180 2009-08

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. From firmware version 6.17 and above, an "Invalid" identifier is also transferred here to specify the status.

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.

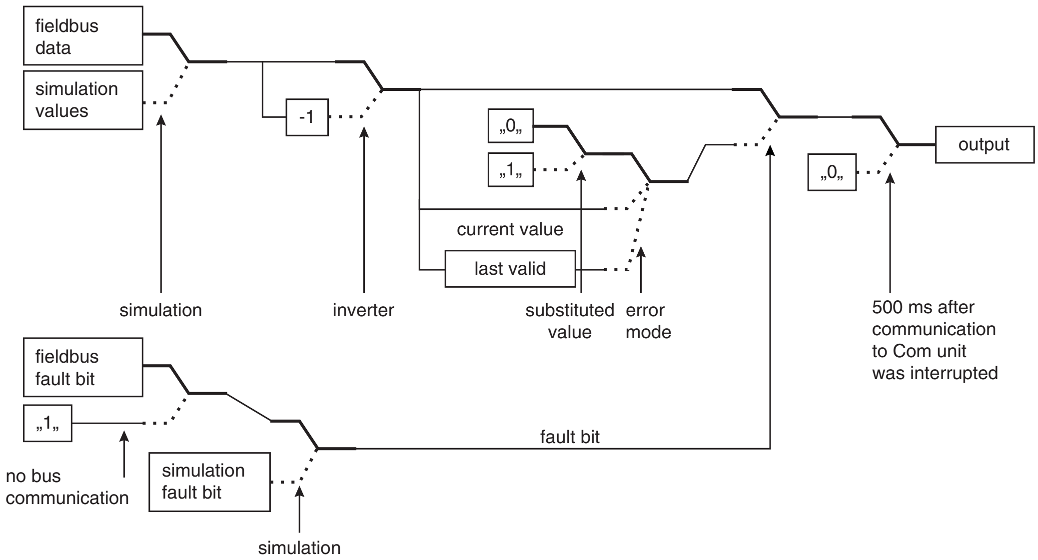

Figure 7.14: Data flow from Com Unit to a digital output

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 7.1: Function table (digital outputs)

7.7 Global status register

The global status register comprises 2 input bytes located at the start of the DP configuration string (see chapter 6.4). It contains information about the status of the Com Unit, the I/O modules and the power supply of a remote I/O station.

The settings you make in the device data of the Com Unit determine whether or not the global status register is transferred in cyclic data traffic (PROFIBUS tab > DP parameters button, see chapter 6.2.6).

200180 2009-08

Accessing the global status register

Prerequisite: A remote I/O station with a Com Unit and at least one I/O module is open in the tree structure. A service bus connection is established to this remote I/O station.

Double right-click the required Com Unit.

The window with the global status register opens.

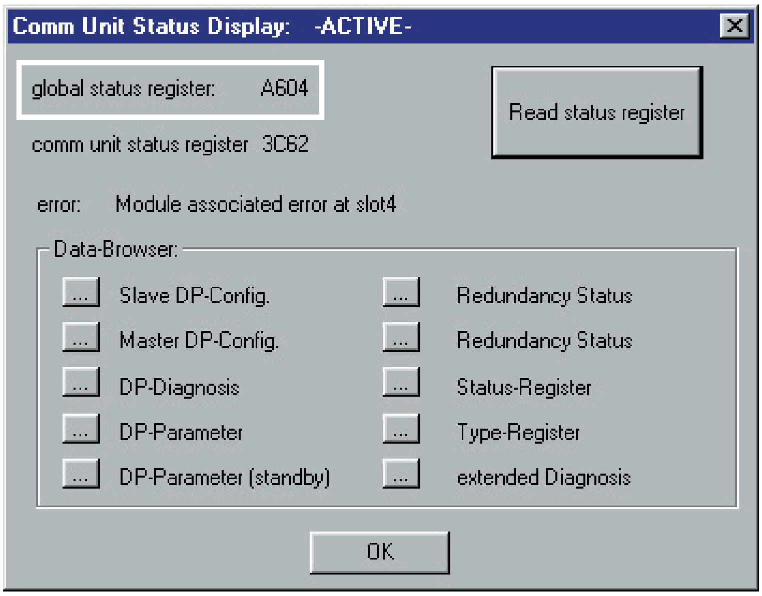

Figure 7.15: Global status register of the Com Unit

Note!

In DPV1 systems, standard DP diagnostics are automatically made available. Device, module and channel related (extended) diagnostics are also available (see screenshot). An in-depth description is not possible at this point, as the diagnostics are evaluated by the process control system and are then available as plain text based on the GSD file.

The following table explains the meaning of the individual bits of the global status register (2 bytes).

200180 2009-08

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		

200180 2009-08

PEPPERL+FUCHS

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

Note!

Character string "604"

In the screenshot, the global status register contains the hexadecimal character string "A604" (module error in slot 4). The table below shows how the character string is made up and how it is to be interpreted.

Example of the global status register (character string "A604")

"A604"	Bit / State		Meaning
A	15	= 1	The Com Unit is active.
	14	= 0	Operating mode: No simulation.
	13	= 1	Error.
	12	= 0	General error.
6	11	= 0	Bits 11 - 8 with states 0 1 1 0 produce the hexadecimal error code "6." The error with the highest priority is, therefore, a module error.
	10	= 1	
	9	= 1	
	8	= 0	
0	7	= 0	Single error (not a multiple error).
	6	= 0	No parameterization/processing at present
	5	= 0	As there is a single error (bit 7 = 0), the faulty slot can be determined with reference to these bits. In this example, the bit sequence 0 0 0 1 0 0 produces slot 4.
	4	= 0	
4	3	= 0	
	2	= 1	
	1	= 0	
	0	= 0	

7.8 Documentation

Once a station has been configured, the I/O modules appear in the tree structure in the program window. You can see from the tree structure whether the I/O modules have been arranged in the required sequence on the backplane. Your work is documented immediately.

You also have the opportunity to create printable documentation. The documentation contains detailed information about the station configuration. During installation, the backplane can be populated with I/O modules with the help of the documentation. The following information is included:

- a wiring diagram with terminal assignments,
- all the parameter settings of the Com Unit and the I/O modules,
- the slot layout of the I/O modules.

200180 2009-08

The menu options contained in the **Options** menu in the main window can be used to document the station configuration:

The commands in the **Options** menu for documentation

Command	Use
Printer setup	Opens the dialog box for setting up the printer.
Print	Prints the current station configuration
Documentation	Opens a window with input options for documentation and then displays a preview of the documentation.
Print TAG labels	This command is no longer available.
Print station layout	This command is no longer available.

The remaining items on the Options menu have already been described.

A description of how to create and print the documentation is given below.

Creating documentation

1. In the tree structure, mark the remote I/O station for which you would like to create documentation.

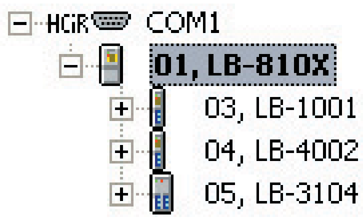

Figure 7.16: Selected remote I/O station in the tree structure

2. In the main window, select **Options** > **Documentation**.

   This opens the window **Documentation of the station parameters** (view Figure 7.17 on page 114).
3. Make entries in the drop-down lists and boxes as required. For a description, see beneath the following screenshot (view Figure 7.17 on page 114).
4. Click **Next**.

   This opens a window with the complete documentation preview (view Figure 7.18 on page 116). You can use the appropriate buttons to zoom in/zoom out, scroll through the preview or print it out.
5. To close the preview window, click **Close**.
6. So that you do not lose the entries you have made, save the project to a read/write tag. You can recall the documentation at any time by selecting **Options** > **Documentation** from the main window.

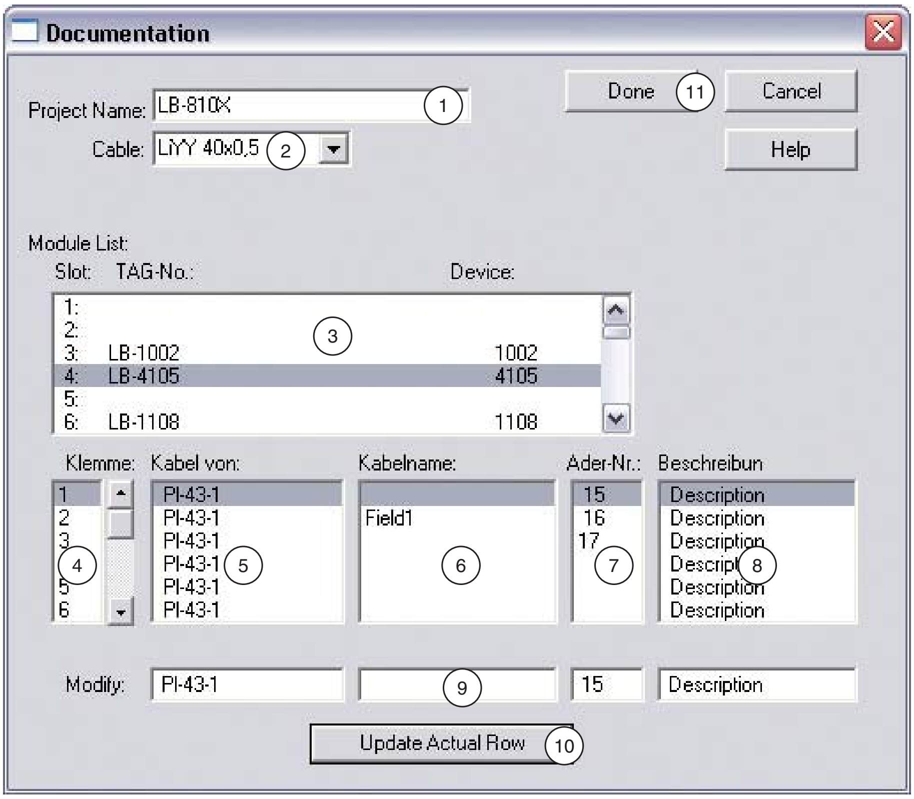

Figure 7.17: **Station parameter documentation** window

1 **Project name** box
2 **Cable** drop-down list
3 **Module list** box
4 **Connector** box
5 **Cable from** box
6 **Cable name** box
7 **Wire no.** box
8 **Description** box
9 **Modify** boxes
10 **Update actual row** button
11 **Done** button

1

Project name box

Enter the name of the remote I/O station or of the project (max. 20 alphanumeric characters).

2

Cable drop-down list

Select one of the 4 specified cable types from the list, or enter your own text.

200180 2009-08

3

Module list box

Shows the I/O modules of the remote I/O station with their associated slot number and TAG No. The boxes below (numbers 4 to 8) relate to the particular entry marked in this list.

4

Connector box

Indicates the terminals of the selected I/O module.

5

Cable from box

Contains the description of the cable destination, if one has been entered (see **Modify** boxes).

6

Cable name box

Contains the name of the cable, if one has been entered (see **Modify** boxes).

7

Wire No. box

Contains the wire number of the cable, if one has been entered (see **Modify** boxes).

8

Description box

Specify the destination of device terminal Mx:y, in plain text if necessary (see **Modify** boxes).

9

Modify boxes

To add data to boxes 4 to 8 or to modify the existing data, mark a row in boxes 4 to 8. The marked row corresponds to a specific terminal of an I/O module, in this screenshot, terminal 2 of analog output LB 4002. Then enter the required data for the marked row in the **Modify** boxes. To apply the changes, click in one of rows 4 to 8.

200180 2009-08

10

Update actual row button

Fills the complete column with the current value from the active box. If, for example, in the **Description** column of the **Modify** fields (9) you enter the word "Print" and then immediately click on **Update actual row**, all the rows of the **Description** box (8) will be assigned the value "Print".

11

Done button

Saves the entries you have made, closes the window and opens the documentation preview.

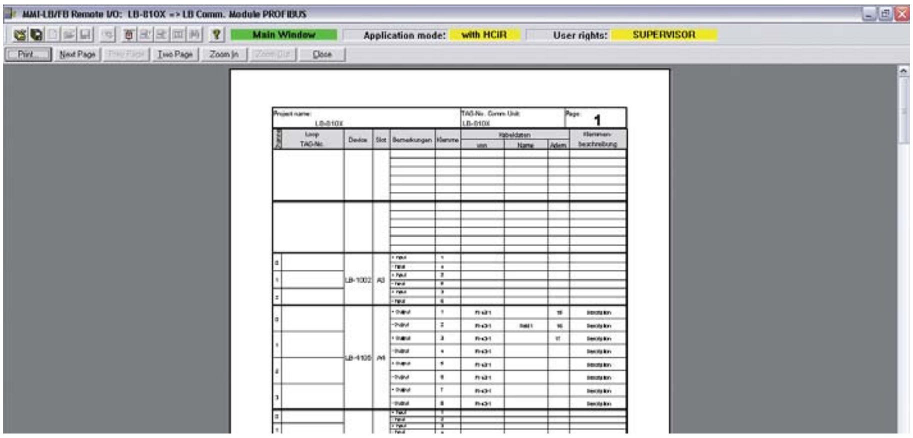

Figure 7.18: documentation preview

8 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.

200180 2009-08

8.1 LB/FB 1x01 digital input

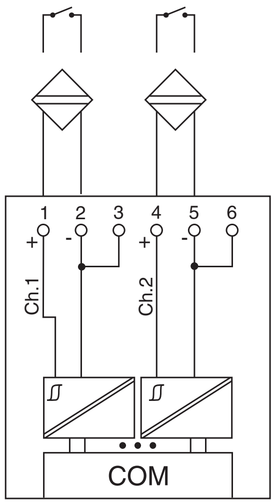

Figure 8.1: Connection diagram 1x01

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.

8.1.1 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.

200180 2009-08

8.1.2 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 8.1: Device function - bit assignment in the data telegram

8.1.3 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.

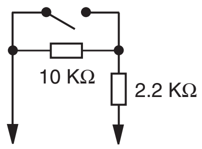

Figure 8.2: NAMUR equivalent resistance

8.1.4 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).

8.1.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

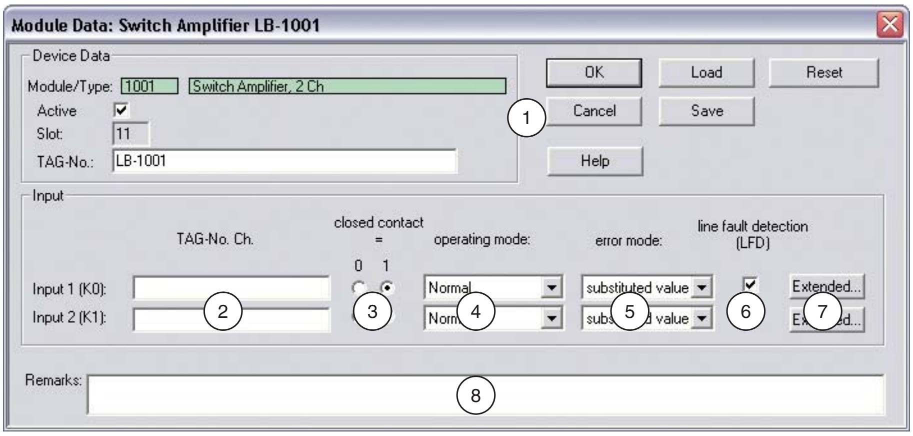

Figure 8.3: Digital input 1x01: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Closed contact =** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Short circuit / breakage detection** check box
7 **Extended** button
8 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Closed contact = option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

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.

200180 2009-08

8

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.

Digital channel window

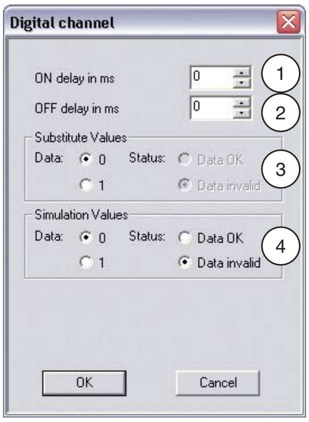

Figure 8.4: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

200180 2009-08

2

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).

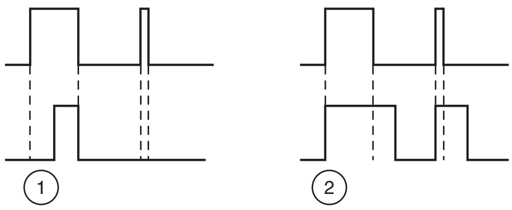

Figure 8.5: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.1.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.2 LB/FB 1x02 digital input

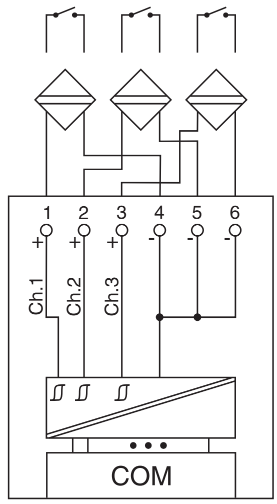

Figure 8.6: Connection diagram 1x02

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.

8.2.1 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.

200180 2009-08

8.2.2 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 8.2: Device function - bit assignment in the data telegram

8.2.3 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.

200180 2009-08

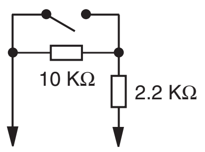

Figure 8.7: NAMUR equivalent resistance

8.2.4 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).

8.2.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

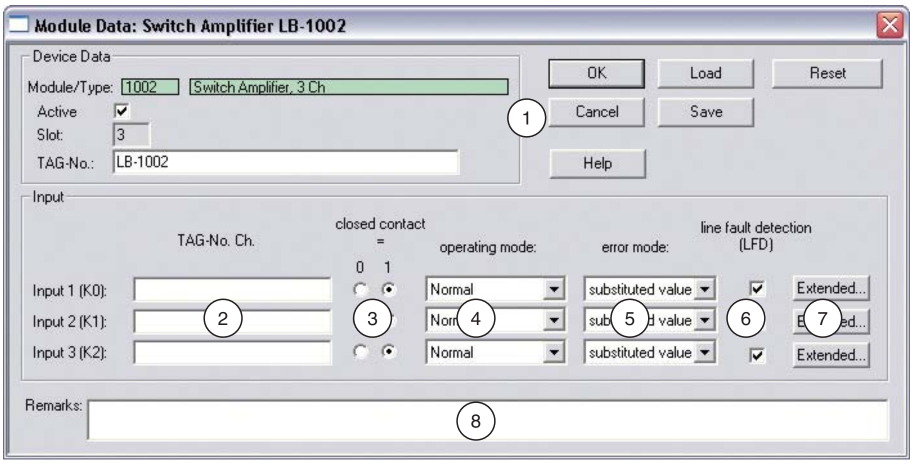

Figure 8.8: Digital input 1x02: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Closed contact =** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Short circuit / breakage detection** check box
7 **Extended** button
8 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Closed contact = option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

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

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.

Digital channel window

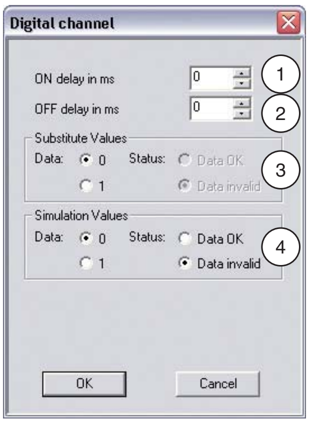

Figure 8.9: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

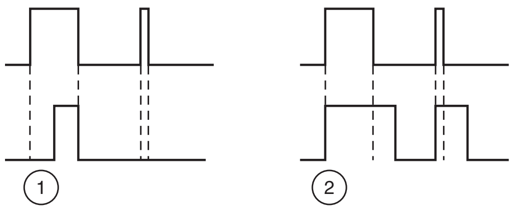

Figure 8.10: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.2.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.3 LB/FB 1x03 frequency input

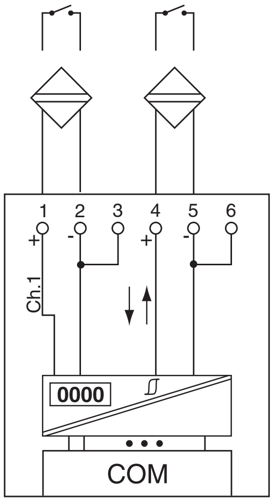

Figure 8.11: Connection diagram 1x03

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.

200180 2009-08

8.3.1 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.

8.3.2 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 8.3: Device function - bit assignment in the data telegram

8.3.3 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.

200180 2009-08

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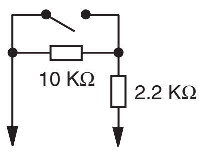

Figure 8.12: NAMUR equivalent resistance

8.3.4 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).

8.3.5 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 8.13 on page 135).

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.

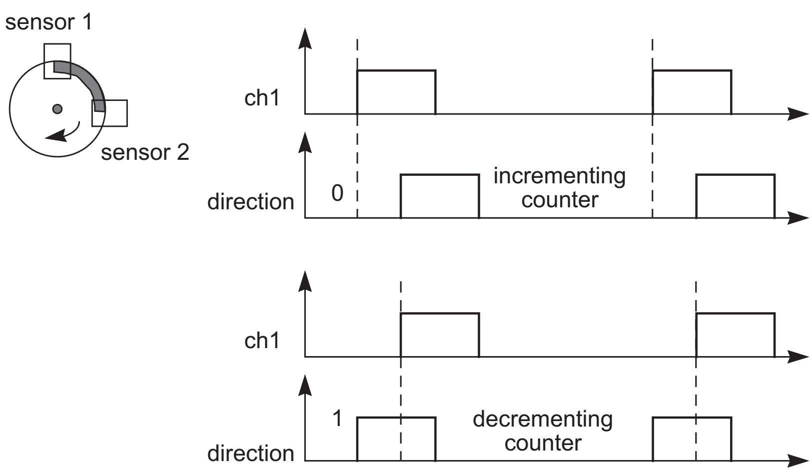

Figure 8.13: Rotation direction detection

8.3.6 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.

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. Switching between redundant systems only applies to Com Units which support redundancy (for example, LB 8108 does not support redundancy).

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.

8.3.7 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

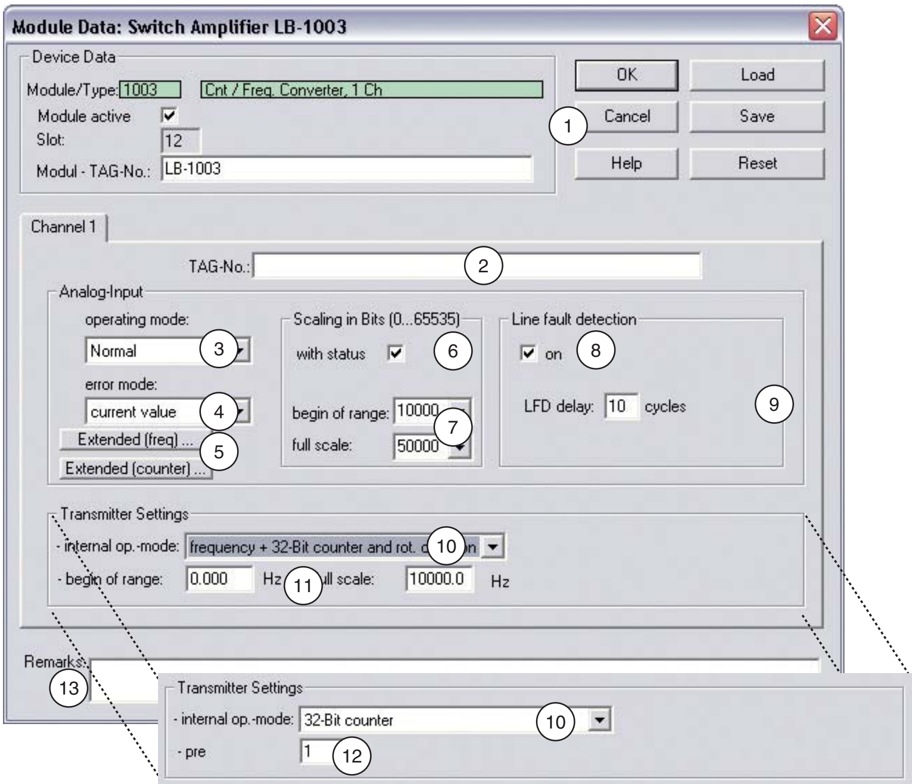

Figure 8.14: Frequency input 1x03: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists (scaling)
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Operating mode** drop-down list
11 **Start of range/End of range** boxes (physical unit)
12 **Counter quotient** box (not always visible)
13 **Note** box

200180 2009-08

Note!

Hidden areas

The **Scaling (0...65535)** area is only visible when you use the I/O module as a frequency input.

The **Counter quotient** box only appears when you use the I/O module as a counter.

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Line fault detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

200180 2009-08

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10

Operating mode 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.

11

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

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.

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.

Note!

The structure of the **Extended parameters** window that you access via the **Extended** button differs depending on which I/O module function type is selected. In the 12-bit and 32-bit counter function types, some of the areas cannot be edited (grayed out).

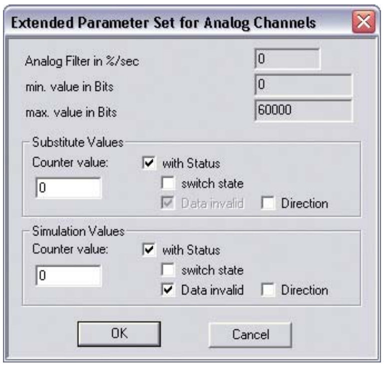

Figure 8.15: **Extended parameters** window (12-bit counter) with additional channel settings

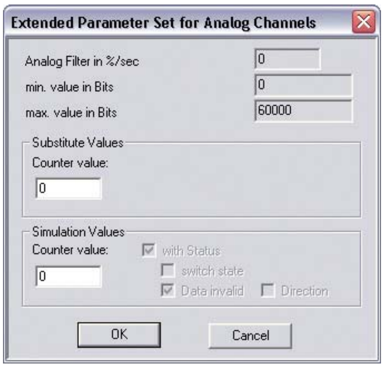

Figure 8.16: **Extended parameters** window (32-bit counter) with additional channel settings

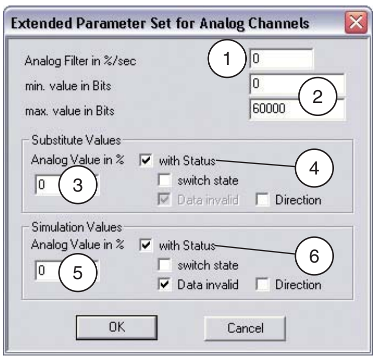

Figure 8.17: **Extended parameters** window (frequency input) with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** boxes
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

200180 2009-08

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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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

If you are using the I/O module as a counter, enter an absolute counter value rather than a % analog value.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available that you can use to (de)activate the following status information, depending on the function type of the I/O module.
Stat. input: Transfers the status of the input channel with the substitute value.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.
Direction: Transfers the direction information with the substitute value.

5

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.

If you are using the I/O module as a counter, enter an absolute counter value rather than a % analog value.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information, depending on the function type of the I/O module.
Stat. input: Transfers the status of the input channel with the simulation value.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.
Direction: Transfers the direction information with the simulation value.

8.3.8 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.4 LB/FB 1x08 digital input

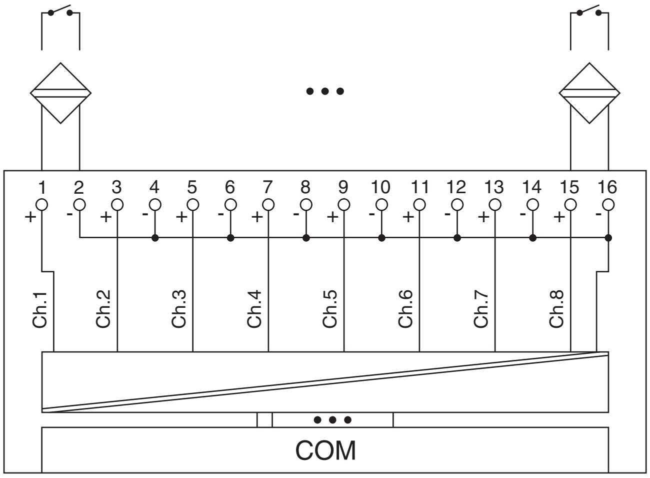

Figure 8.18: Connection diagram 1x08

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.

8.4.1 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.

200180 2009-08

8.4.2 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 6.6.2).

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 8.4: Device function - bit assignment in the data telegram

200180 2009-08

8.4.3 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.

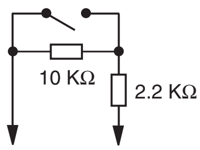

Figure 8.19: NAMUR equivalent resistance

8.4.4 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).

8.4.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

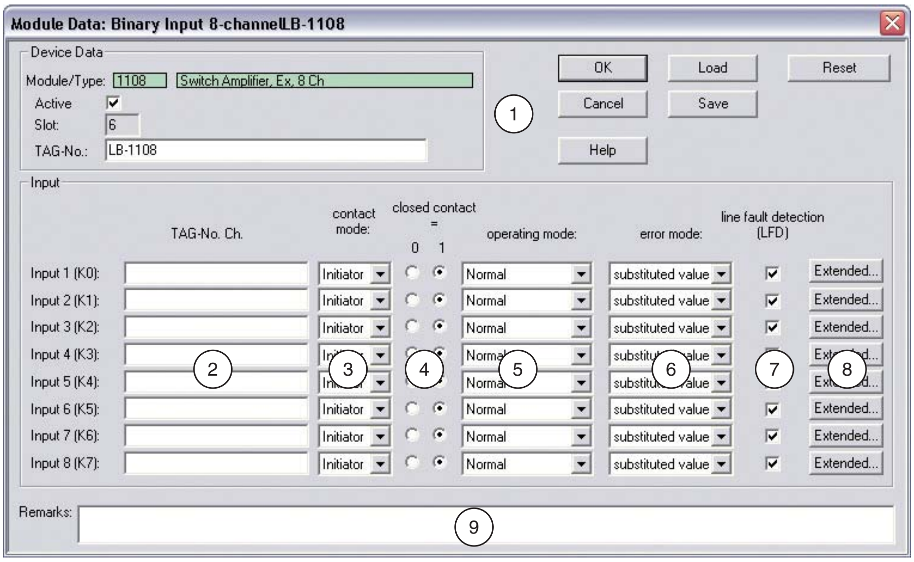

Figure 8.20: Digital input 1x08: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Contact type** drop-down list
4 **Closed contact =** option
5 **Operating mode** drop-down list
6 **Error mode** drop-down list
7 **Short circuit / breakage detection** check box
8 **Extended** button
9 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

200180 2009-08

PEPPERL+FUCHS

3

Contact type drop-down list

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

4

Closed contact = option

Choose between positive or negative logic for the digital signal.

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 7.6) 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 7.6) for more details on error mode.

7

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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

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.

9

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.

Digital channel window

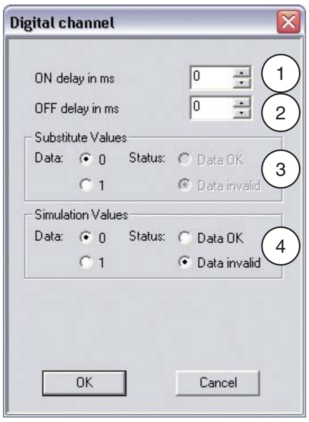

Figure 8.21: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

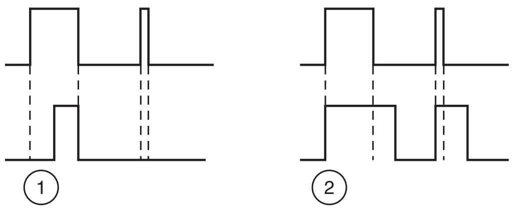

Figure 8.22: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.4.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.5 LB/FB 2xxx digital output

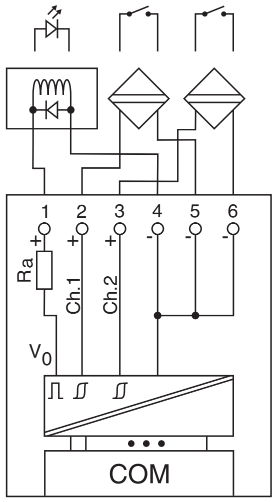

Figure 8.23: Connection diagram 2xxx without output disable input

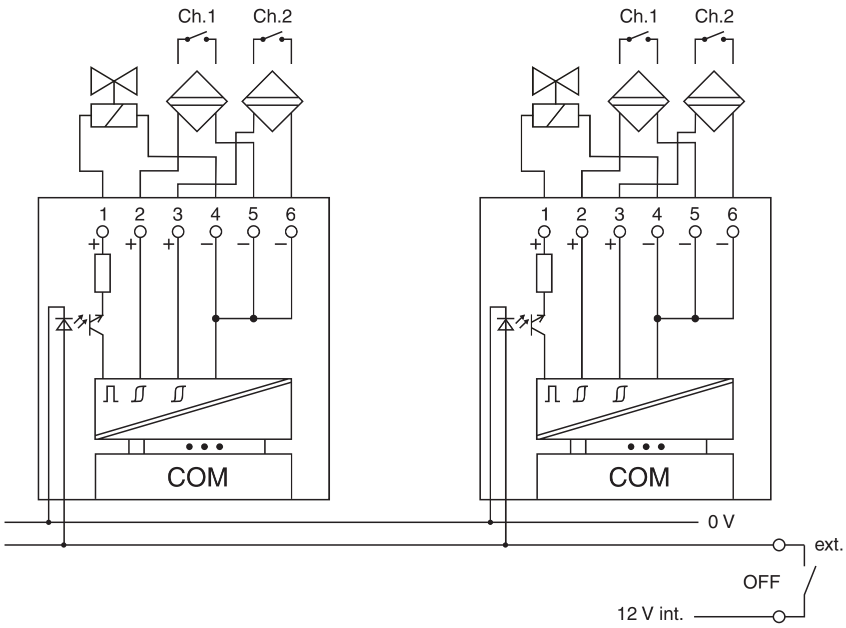

Figure 8.24: Connection diagrams 2xxx with output disable input

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

Versions

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

200180 2009-08

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.

8.5.1 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.

8.5.2 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	Valve output status
	1	Line fault detection valve output 1 (0 = OK, 1 = error)
	2	Status channel 1
	3	Line fault detection channel 1 (0 = OK, 1 = error)
	4	Status channel 2
	5	Line fault detection channel 2 (0 = OK, 1 = error)
	6	Empty
	7	Empty
Output byte 1	0	Valve output
	1	Empty
	2	Empty
	3	Empty
	4	Empty
	5	Empty
	6	Empty
	7	Empty

Table 8.5: Device function - bit assignment in the data telegram

8.5.3 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.

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.

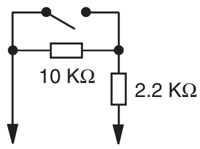

Figure 8.25: NAMUR equivalent resistance

8.5.4 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).

8.5.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

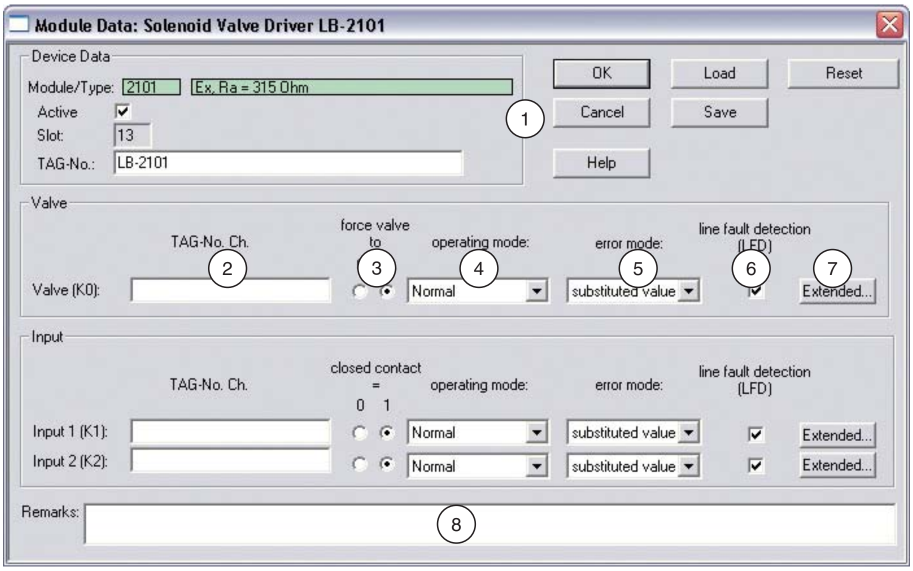

Figure 8.26: Digital input 2xxx: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set valve with** and **Closed contact =** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Short circuit / breakage detection** check box
7 **Extended** button
8 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Set valve with and **Closed contact** = option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

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

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.

Digital channel window

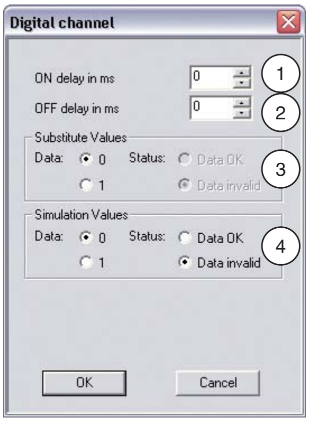

Figure 8.27: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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.

2

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.

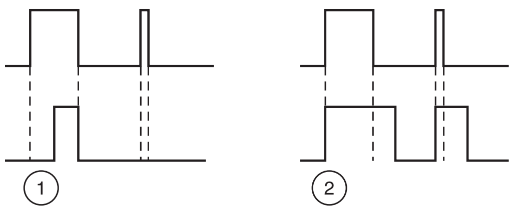

Figure 8.28: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.5.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.6 LB/FB 3x01 analog input

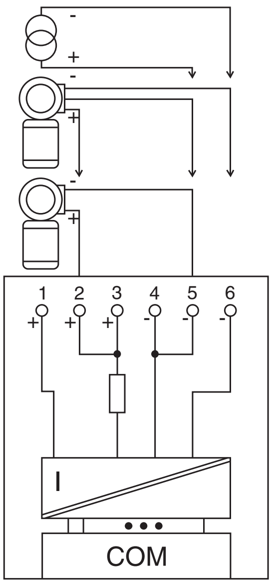

Figure 8.29: Connection diagram 3x01

- 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.

200180 2009-08

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.

8.6.1 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.

8.6.2 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.

8.6.3 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 to 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 8.6: Device function - bit assignment in the data telegram

8.6.4 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).

8.6.5 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.

8.6.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

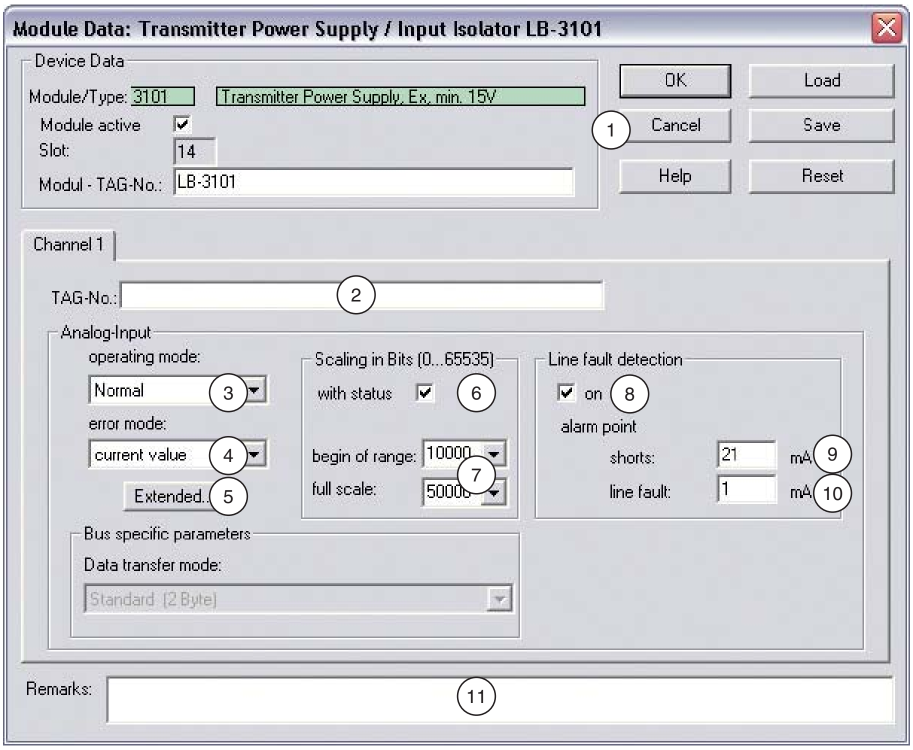

Figure 8.30: Analog input 3x01: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

200180 2009-08

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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

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.

200180 2009-08

Extended parameters window

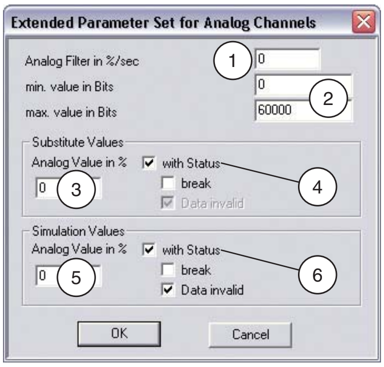

Figure 8.31: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.6.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.7 LB/FB 3x02 and 3x03 HART analog inputs

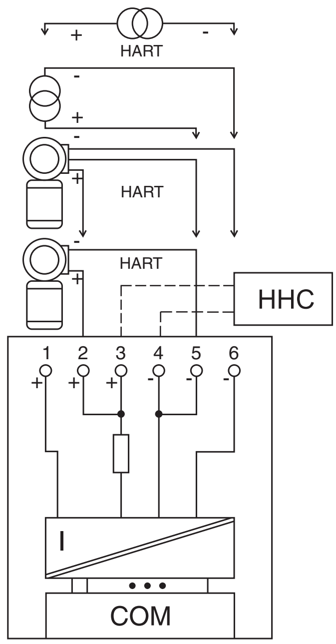

Figure 8.32: Connection diagrams 3x02 and 3x03

- 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.

8.7.1 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.

8.7.2 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.

8.7.3 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).

200180 2009-08

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 to 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 8.7: Device function - bit assignment in the data telegram

8.7.4 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).

8.7.5 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.

8.7.6 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 7) for more information on HART communication.

8.7.7 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

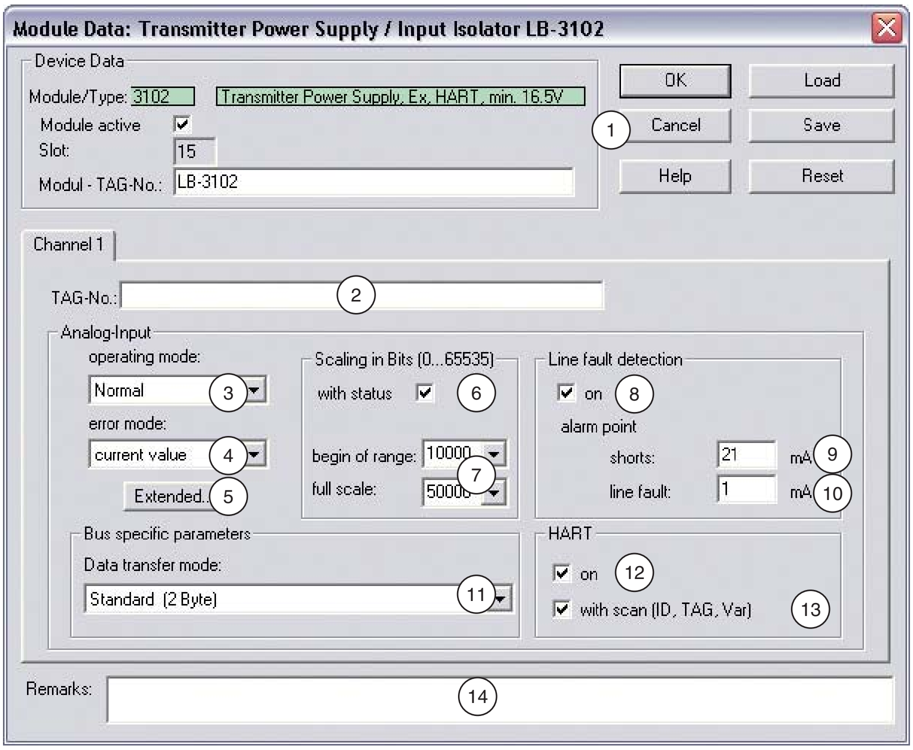

Figure 8.33: Analog input 3x02/3x03: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Data transmission mode** drop-down list (3x02 only)
12 **Active** check box
13 **With scan (ID, TAG, variables)** check box
14 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

200180 2009-08

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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.

Note!

Data transmission mode drop-down list

Data transmission mode can only be edited if, in the **Firmware-dependent device functions** window of the Com Unit you activated the function **Use of the extended PROFIBUS modes for 3x02 ...** (see chapter 6.2.1).

Warning!
PROFIBUS will restart if the data transmission mode is changed (3x02 only)

If you change the setting in the **Data transmission mode** drop-down list for analog input 3x02, it affects the structure of the PROFIBUS data telegram. You will then need to restart the PROFIBUS!
Only if your process control system supports HCiR will a change to this parameter not affect the function of the remote I/O station (see chapter 6.8).

11

Data transmission mode 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

200180 2009-08

12

Active 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 7) for more information on HART communication.

Note!

Active check box

Active can only be edited if you have activated the **Individual HART channel deactivation** function in the **firmware-dependent device functions** window of the Com Unit (see chapter 6.2.1) . Otherwise the **active** option is enabled as standard.

13

With scan (ID, TAG, variables) 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!

With scan (ID, TAG, variables) check box

With scan (ID, TAG, variables) can only be edited if you have activated the **Disable the self-controlled HART device scan** function in the **firmware-dependent device functions** window of the Com Unit DTM (see chapter 6.2.1). Otherwise the **with scan (ID, TAG, variables)** 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

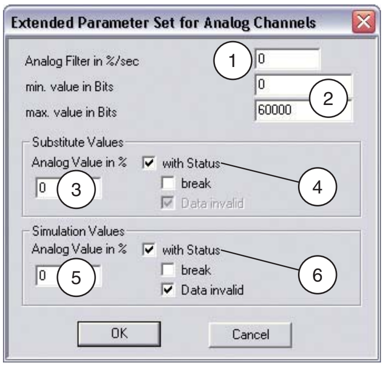

Figure 8.34: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

200180 2009-08

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4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.7.8 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.8 LB/FB 3x04 and 3x05 (HART) analog input

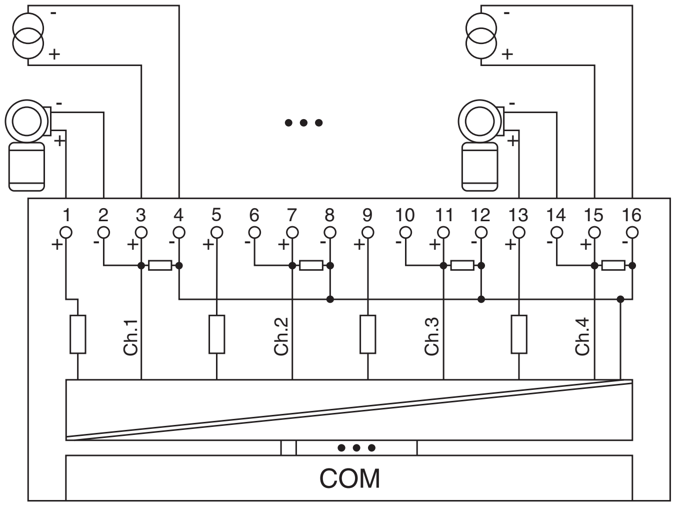

Figure 8.35: Connection diagrams 3x04 and 3x05

- 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.

8.8.1 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.

8.8.2 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.

8.8.3 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 to 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 6.6.2).

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 8.8: Device function - bit assignment in the data telegram

8.8.4 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).

200180 2009-08

8.8.5 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.

8.8.6 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 7) for more information on HART communication.

8.8.7 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

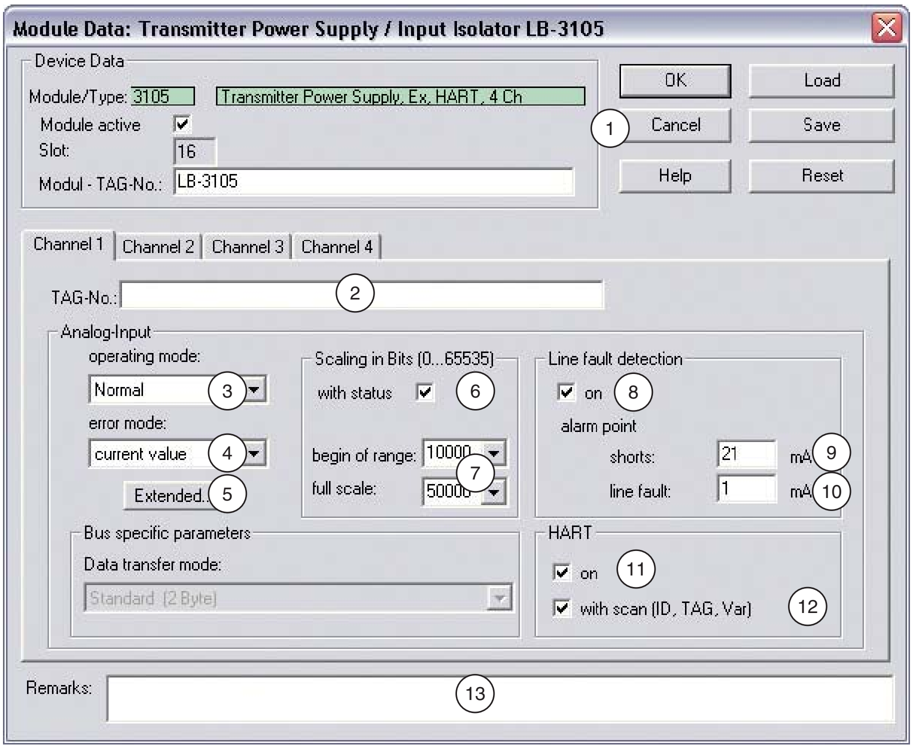

Figure 8.36: Analog input 3x04/3x05: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists
8 **Line fault detection** check box
9 **Short circuit** box
10 **Lead breakage** box
11 **Active** check box
12 **With scan (ID, TAG, variables)** 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.

200180 2009-08

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Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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.

200180 2009-08

11

Active 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 7) for more information on HART communication.

Note!

Active check box

Active can only be edited if you have activated the **Individual HART channel deactivation** function in the **firmware-dependent device functions** window of the Com Unit (see chapter 6.2.1) . Otherwise the **active** option is enabled as standard.

12

With scan (ID, TAG, variables) 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!

With scan (ID, TAG, variables) check box

With scan (ID, TAG, variables) can only be edited if you have activated the **Disable the self-controlled HART device scan** function in the **firmware-dependent device functions** window of the Com Unit DTM (see chapter 6.2.1). Otherwise the **with scan (ID, TAG, variables)** 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

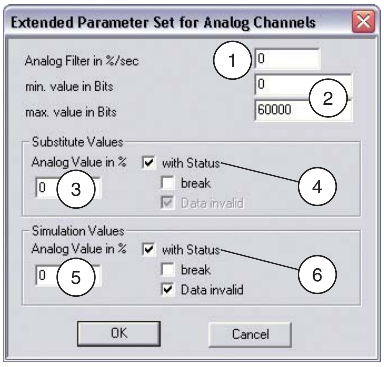

Figure 8.37: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

200180 2009-08

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.8.8 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.9 LB/FB 4x01 and 4x02 (HART) analog output

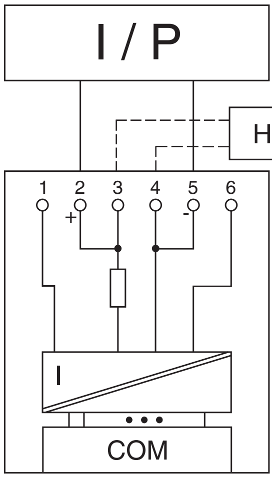

Figure 8.38: Connection diagrams 4x01 and 4x02 without output disable input

- 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.

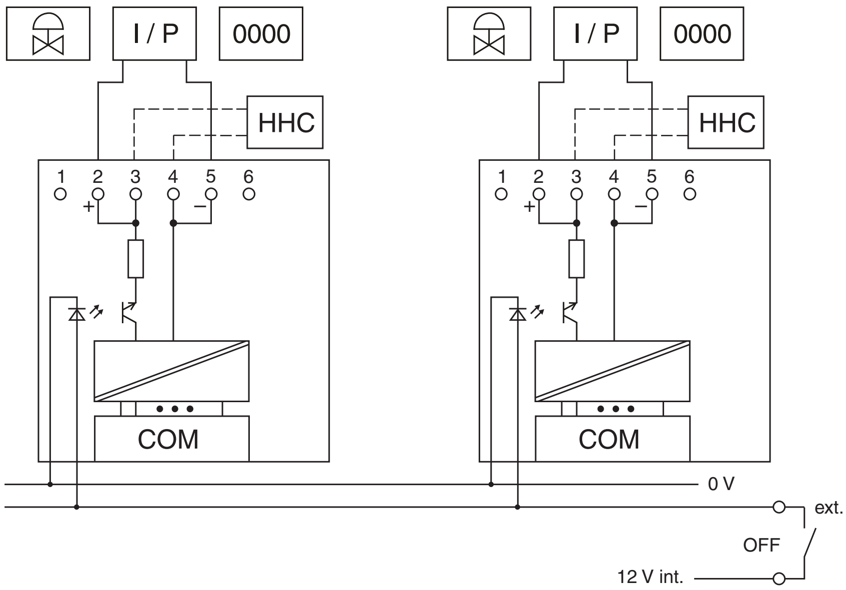

Figure 8.39: Connection diagrams 4x02 with output disable input

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.

200180 2009-08

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.

8.9.1 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 %.

8.9.2 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.

8.9.3 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 8.9: Device function - bit assignment in the data telegram

8.9.4 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.

200180 2009-08

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.

8.9.5 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.

8.9.6 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.

8.9.7 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 7) for more information on HART communication.

8.9.8

200180 2009-08

8.9.9 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

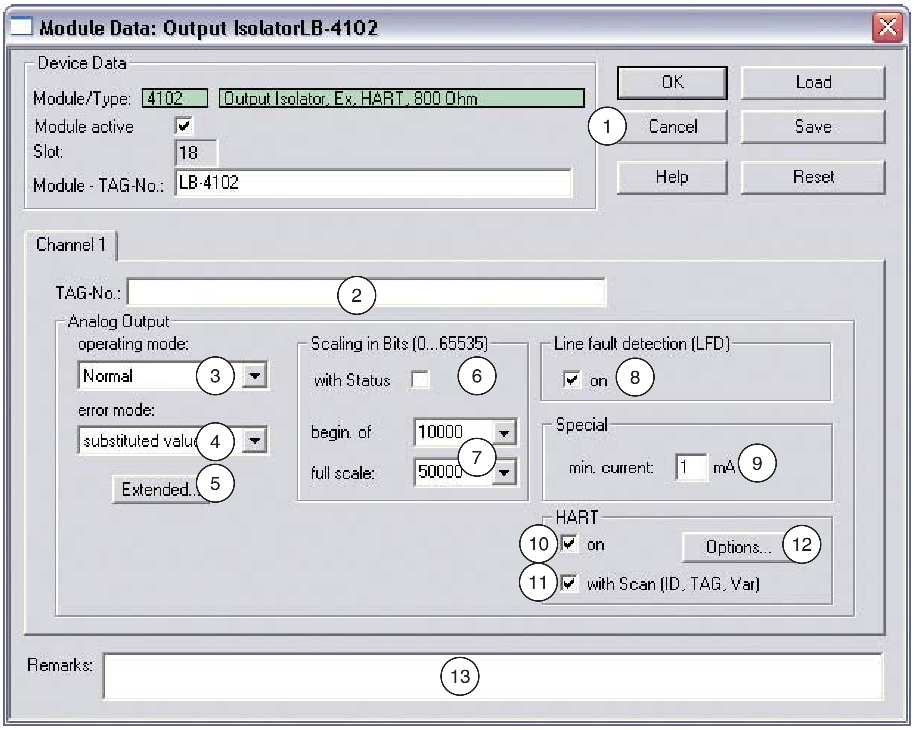

Figure 8.40: Analog output 4x01/4x02: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists
8 **Breakage detection** check box
9 **Min. current** field
10 **Active** check box (4x02 only)
11 **With scan (ID, TAG, variables)** check box (4x02 only)
12 **Further options** button (4x02 only)
13 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

8

Breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage only), a diagnosis is transmitted.

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

Active 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 7) for more information on HART communication.

Note!

Active check box

Active can only be edited if you have activated the **Individual HART channel deactivation** function in the **firmware-dependent device functions** window of the Com Unit (see chapter 6.2.1) . Otherwise the **active** option is enabled as standard.

11

With scan (ID, TAG, variables) 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!

With scan (ID, TAG, variables) check box

With scan (ID, TAG, variables) can only be edited if you have activated the **Disable the self-controlled HART device scan** function in the **firmware-dependent device functions** window of the Com Unit DTM (see chapter 6.2.1). Otherwise the **with scan (ID, TAG, variables)** option is enabled as standard.

12

Further options button

The button opens a window with HART communication adjustment options. There you can define the number of protocol preambles and enter how often telegrams with errors are to be repeated. These parameters affect the processing speed of the HART communication.

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.

200180 2009-08

Extended parameters window

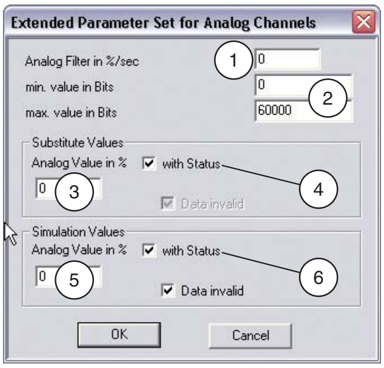

Figure 8.41: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, a further check box will become available:
Invalid data: Transfers the substitute value with an "Invalid data" identifier. The status for the output signal has no other use.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, a further check box will become available:
Invalid data: Transfers the simulation value with an "Invalid data" identifier. The substitute value is output if you activate **Invalid data**.

8.9.10 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.9.11 Configuring strain gage 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 gage measurement

Prerequisite: You have already created a project file in the configuration software. This project file is open and the tree structure contains a Com Unit and the I/O modules 4x01 and 5x02. Communication with the remote I/O station is working properly.

1. Either set
   the operating mode of analog output 4x01 to "Simulation" (Device data > **Operating mode** drop-down list) and set 20 mA as the simulation value (click the **Extended** button)
   or
   set a fixed value of 20 mA via the fieldbus.
2. Set temperature input 5x02 to millivolt measurements "mV" (Device data > **Sensor** drop-down list).
3. For temperature input 5x02, select "external reference junction" (Device data > **Measuring method** drop-down list).
4. Deactivate reference junction compensation on temperature input 5x02 by setting the thermostat temperature of the external reference junction to 0 °C (Device data > **Ext. reference junction** box).

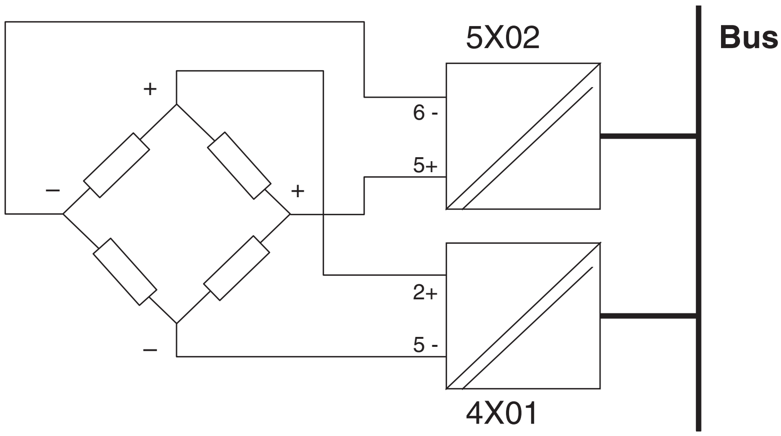

Figure 8.42: Example: Strain gage bridge

200180 2009-08

8.10 LB/FB 4x04 and 4x05 (HART) analog output

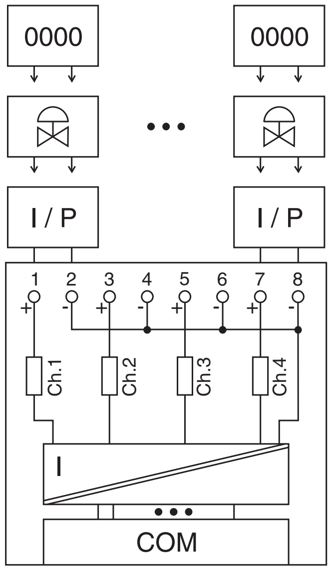

Figure 8.43: Connection diagrams 4x04 and 4x05 without output disable input

- 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.

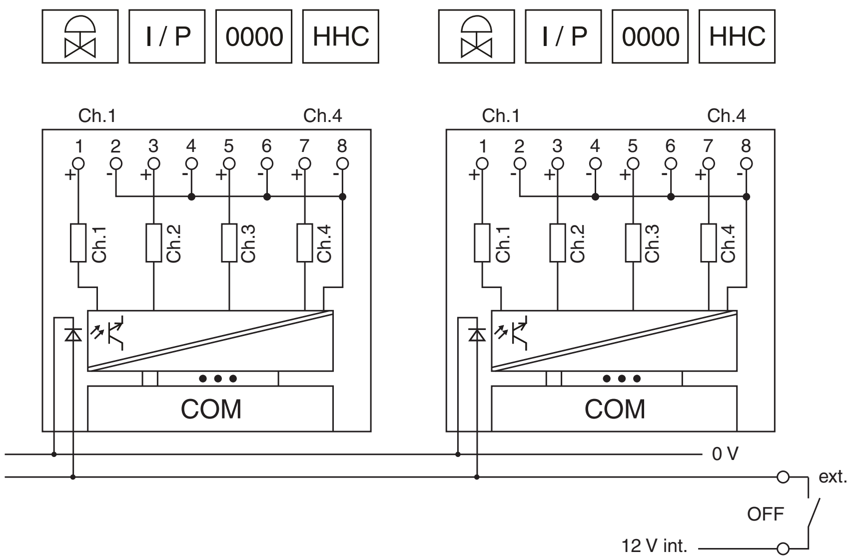

Figure 8.44: Connection diagrams 4x04 and 4x05 with output disable input

200180 2009-08

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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.

8.10.1 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 %.

8.10.2 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.

8.10.3 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 to 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 6.6.2).

200180 2009-08

The DP configuration code of the analog output is **C0 43 40**.

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 8.10: Device function - bit assignment in the data telegram

8.10.4 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.

8.10.5 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.

8.10.6 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).

8.10.7 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 7) for more information on HART communication.

8.10.8 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

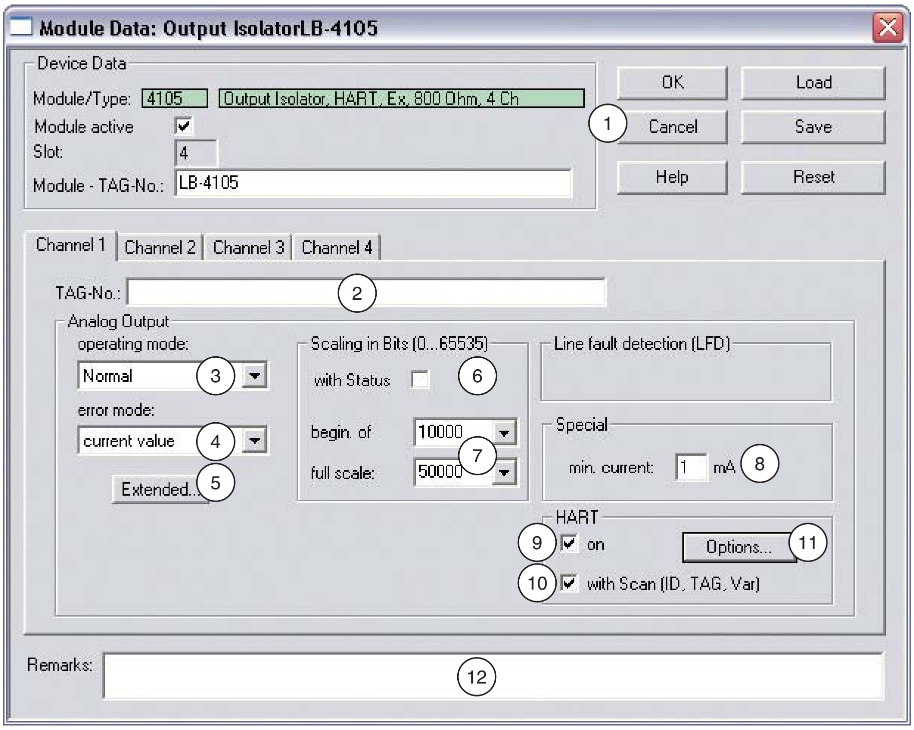

Figure 8.45: Analog output 4x04/4x05: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists
8 **Min. current** field
9 **Active** check box (4x05 only)
10 **With scan (ID, TAG, variables)** check box (4x05 only)
11 **Further options** button (4x05 only)
12 **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

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

200180 2009-08

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

8

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.

9

Active 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 7) for more information on HART communication.

Note!

Active check box

Active can only be edited if you have activated the **Individual HART channel deactivation** function in the **firmware-dependent device functions** window of the Com Unit (see chapter 6.2.1) . Otherwise the **active** option is enabled as standard.

10

With scan (ID, TAG, variables) 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!

With scan (ID, TAG, variables) check box

With scan (ID, TAG, variables) can only be edited if you have activated the **Disable the self-controlled HART device scan** function in the **firmware-dependent device functions** window of the Com Unit DTM (see chapter 6.2.1). Otherwise the **with scan (ID, TAG, variables)** option is enabled as standard.

11

Further options button

The button opens a window with HART communication adjustment options. There you can define the number of protocol preambles and enter how often telegrams with errors are to be repeated. These parameters affect the processing speed of the HART communication.

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.

200180 2009-08

Extended parameters window

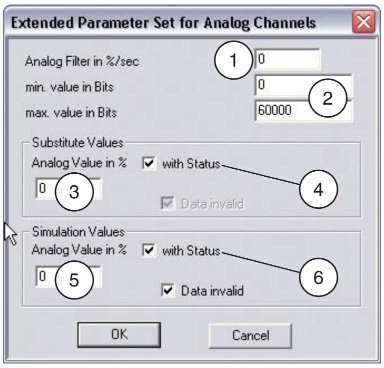

Figure 8.46: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, a further check box will become available:
Invalid data: Transfers the substitute value with an "Invalid data" identifier. The status for the output signal has no other use.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, a further check box will become available:
Invalid data: Transfers the simulation value with an "Invalid data" identifier. The substitute value is output if you activate **Invalid data**.

8.10.9 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.11 LB/FB 5x01 temperature input

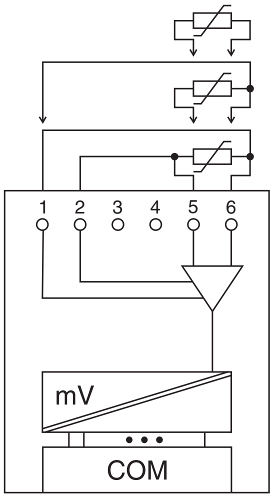

Figure 8.47: Connection diagram 5x01

- 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.

200180 2009-08

8.11.1 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 %.

8.11.2 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.

8.11.3 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 to 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 8.11: Device function - bit assignment in the data telegram

8.11.4 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.

8.11.5 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.

8.11.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

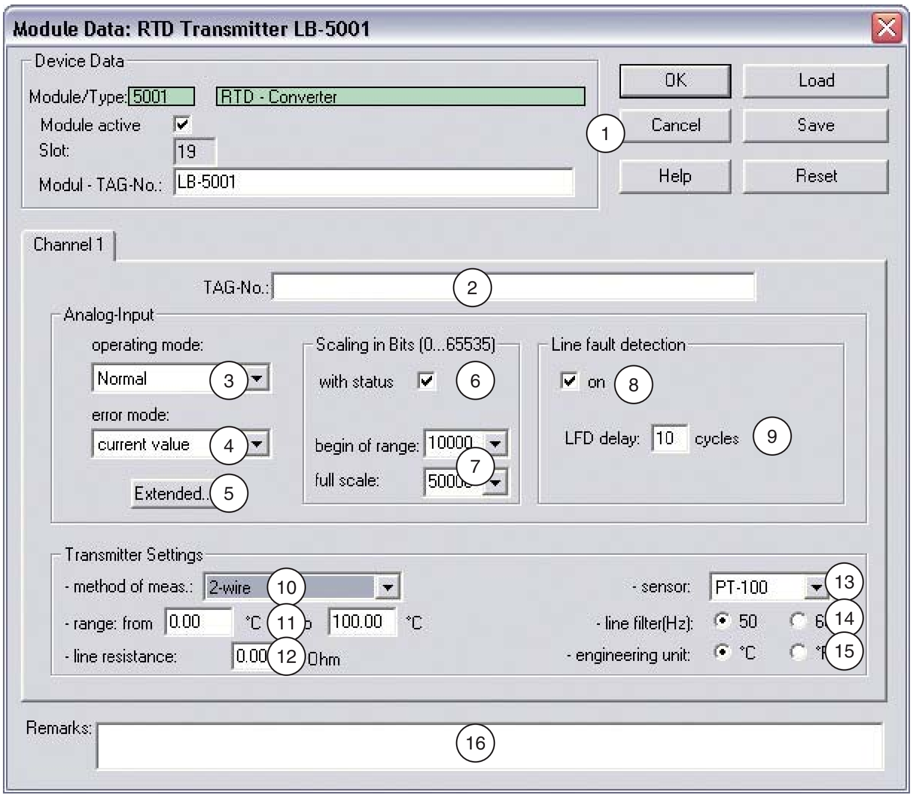

Figure 8.48: Temperature input 5x01: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists (scaling)
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring method** drop-down list
11 **Start of range/End of range** boxes (physical unit)
12 **Line resistance** box
13 **Sensor** drop-down list
14 **Line filter** option
15 **Temperature unit** option
16 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

200180 2009-08

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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 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.

11

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

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

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

15

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).

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

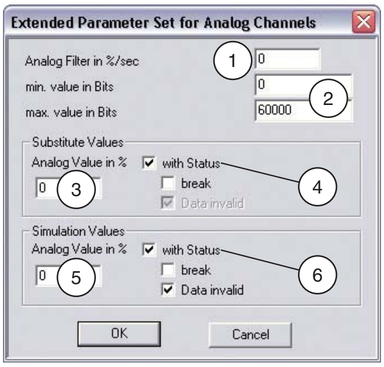

Figure 8.49: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.11.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.12 LB/FB 5x02 temperature input

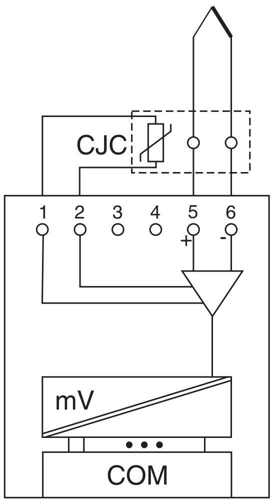

Figure 8.50: Connection diagram 5x02

- 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.

200180 2009-08

PEPPERL+FUCHS

8.12.1 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.

8.12.2 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.

8.12.3 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 to 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 8.12: Device function - bit assignment in the data telegram

8.12.4 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.

8.12.5 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.

200180 2009-08

8.12.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

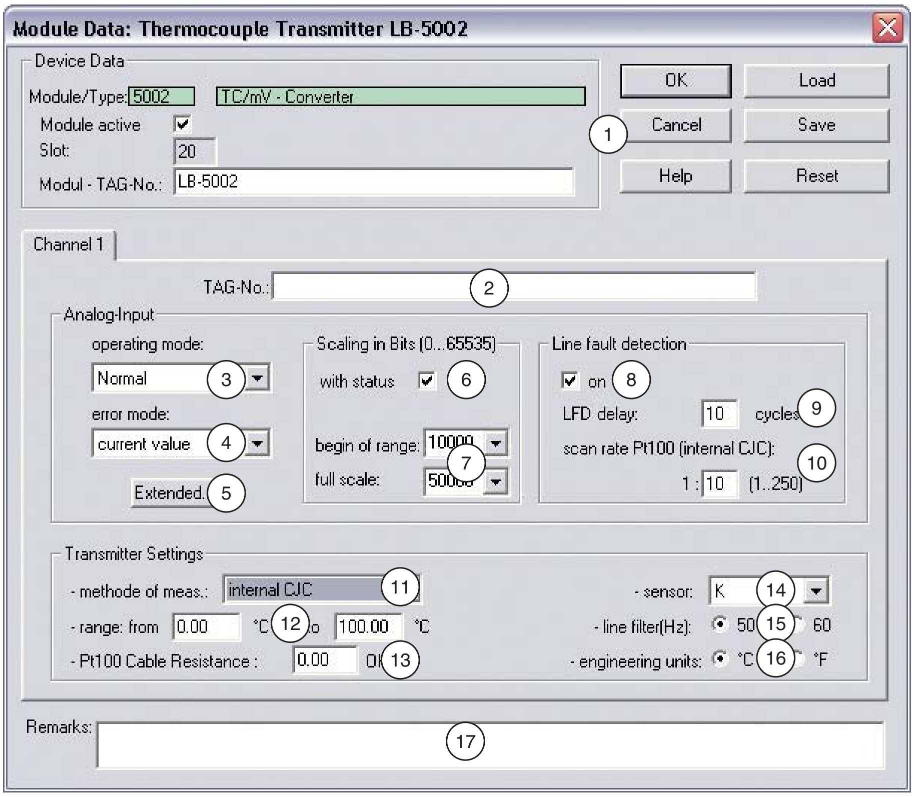

Figure 8.51: Temperature input 5x02: **Device data** window

1. **Measuring point data** area + buttons
2. **TAG No.** box
3. **Operating mode** drop-down list
4. **Error mode** drop-down list
5. **Extended** button
6. **With status**check box
7. **Start of range/End of range** drop-down lists (scaling)
8. **Line fault detection** check box
9. **LFD-delay** box
10. **Pt100 scan rate** box (with internal CJC only)
11. **Measuring method** drop-down list
12. **Start of range/End of range** boxes (physical unit)
13. **Line resistance** or **External reference junction** box
14. **Sensor** drop-down list
15. **Line filter** option
16. **Temperature unit** option (not with mV measurement)
17. **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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

Pt100 scan rate box (with internal CJC only)

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.

200180 2009-08

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.

12

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

13

Line resistance or **External 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

200180 2009-08

15

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

16

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).

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

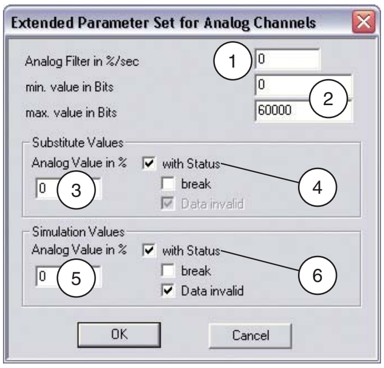

Figure 8.52: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.12.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.12.8 Configuring strain gage 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 gage measurement

Prerequisite: You have already created a project file in the configuration software. This project file is open and the tree structure contains a Com Unit and the I/O modules 4x01 and 5x02. Communication with the remote I/O station is working properly.

1. Either set
   the operating mode of analog output 4x01 to "Simulation" (Device data > **Operating mode** drop-down list) and set 20 mA as the simulation value (click the **Extended** button)
   or
   set a fixed value of 20 mA via the fieldbus.
2. Set temperature input 5x02 to millivolt measurements "mV" (Device data > **Sensor** drop-down list).
3. For temperature input 5x02, select "external reference junction" (Device data > **Measuring method** drop-down list).
4. Deactivate reference junction compensation on temperature input 5x02 by setting the thermostat temperature of the external reference junction to 0 °C (Device data > **Ext. reference junction** box).

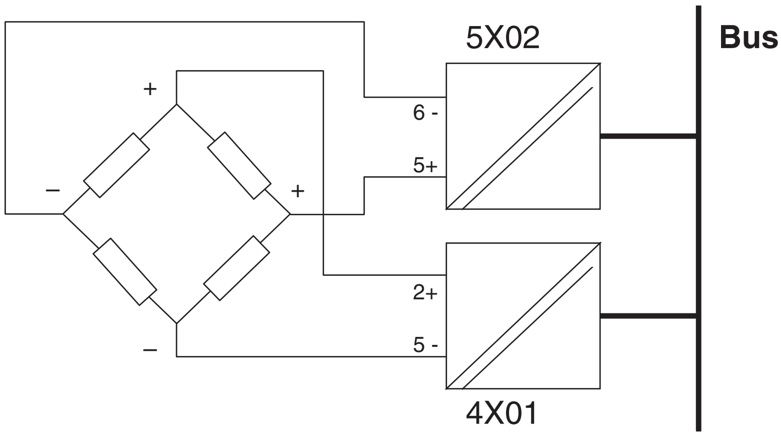

Figure 8.53: Example: Strain gage bridge

200180 2009-08

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8.13 LB/FB 5x04 temperature input

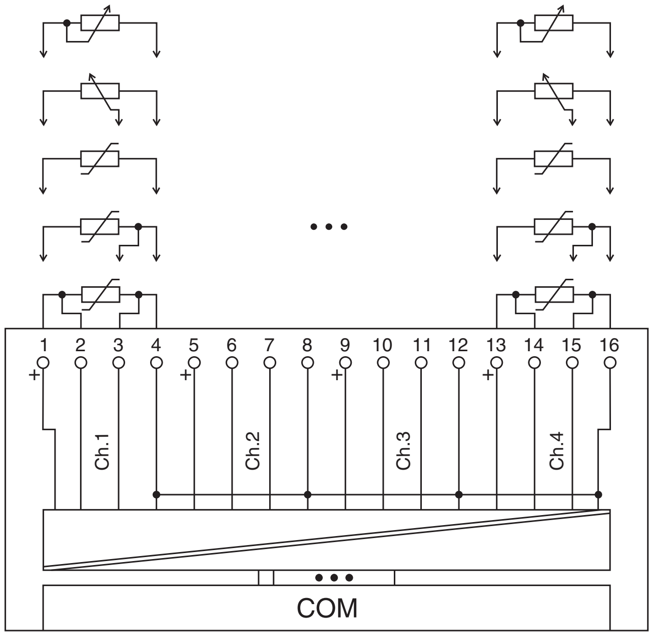

Figure 8.54: Connection diagram 5x04

- 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

200180 2009-08

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.

8.13.1 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 %.

8.13.2 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.

200180 2009-08

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8.13.3 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 to 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 6.6.2).

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 8.13: Device function - bit assignment in the data telegram

8.13.4 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.

8.13.5 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.

8.13.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

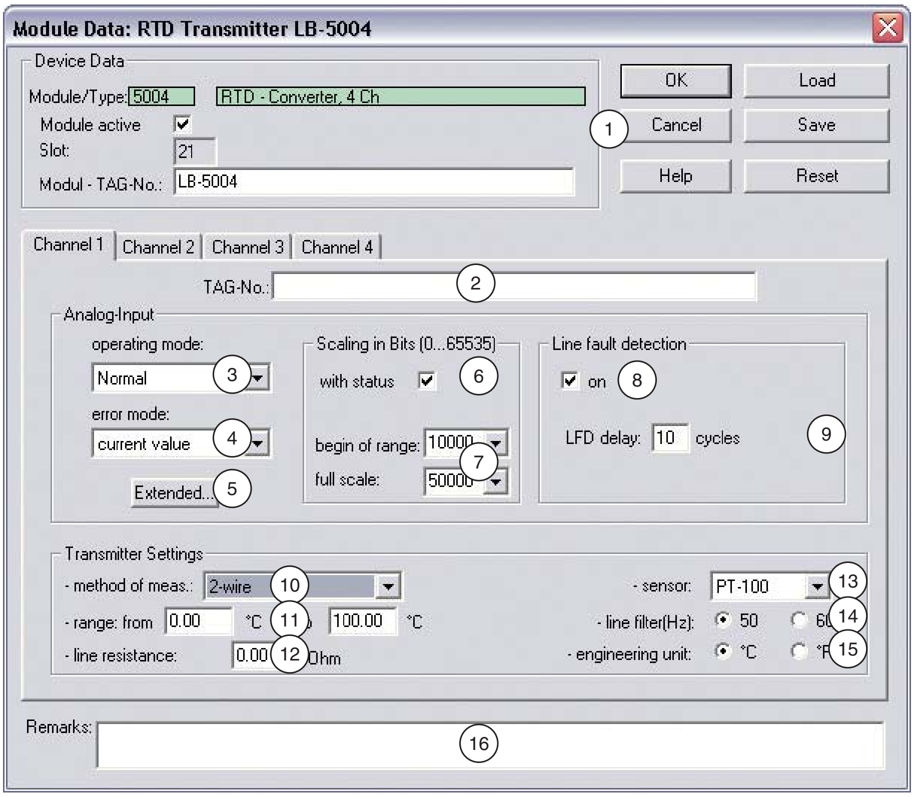

Figure 8.55: Temperature input 5x04: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists (scaling)
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring method** drop-down list
11 **Start of range/End of range** boxes (physical unit)
12 **Line resistance** box
13 **Sensor** drop-down list
14 **Line filter** option
15 **Temperature unit** option
16 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

200180 2009-08

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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 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.

11

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

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

Line filter option

Select the right line filter to compensate for system-related interference (50 Hz and 60 Hz).

15

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).

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.

200180 2009-08

Extended parameters window

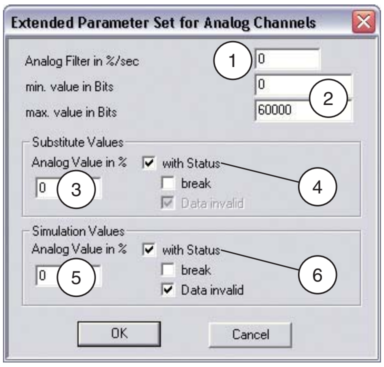

Figure 8.56: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.13.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.14 LB/FB 5x05 temperature input

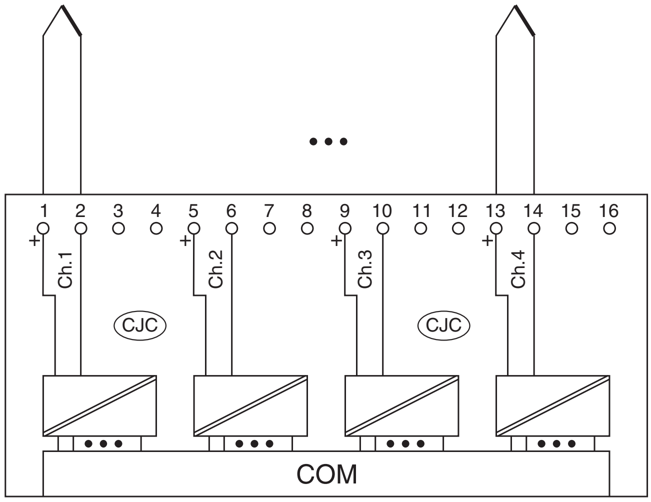

Figure 8.57: Connection diagram 5x05

- 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

200180 2009-08

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.

8.14.1 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.

8.14.2 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.

8.14.3 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 to 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 6.6.2).

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 8.14: Device function - bit assignment in the data telegram

8.14.4 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.

8.14.5 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.

200180 2009-08

8.14.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

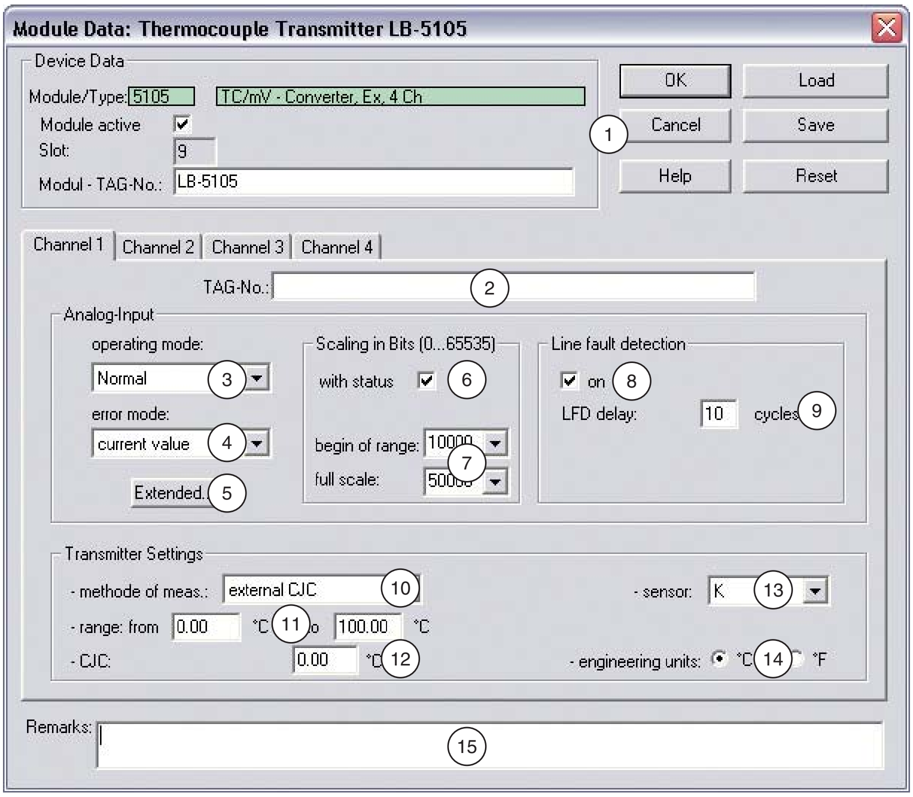

Figure 8.58: Temperature input 5x05: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists (scaling)
8 **Line fault detection** check box
9 **LFD-delay** box
10 **Measuring method** drop-down list
11 **Start of range/End of range** boxes (physical unit)
12 **External reference junction** box (for external CJC only)
13 **Sensor** drop-down list
14 **Temperature unit** option (not with mV measurement)
15 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Line fault detection check box

Enable **Line fault detection** to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.

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 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.

11

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

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

External reference junction box (for external CJC only)

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).

200180 2009-08

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.

Extended parameters window

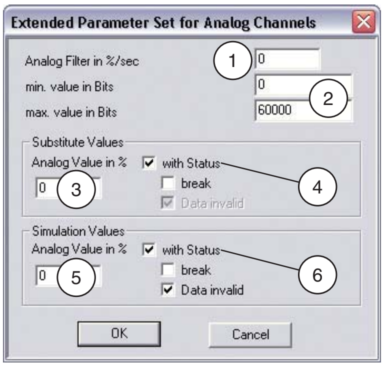

Figure 8.59: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.14.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.15 LB/FB 5x06 voltage input

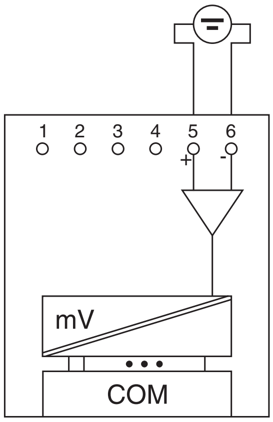

Figure 8.60: Connection diagram 5x06

- 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.

8.15.1 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 %.

200180 2009-08

8.15.2 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.

8.15.3 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 8.15: Device function - bit assignment in the data telegram

8.15.4 Line fault detection

The "Line fault detection" function is not supported.

200180 2009-08

8.15.5 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.

8.15.6 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

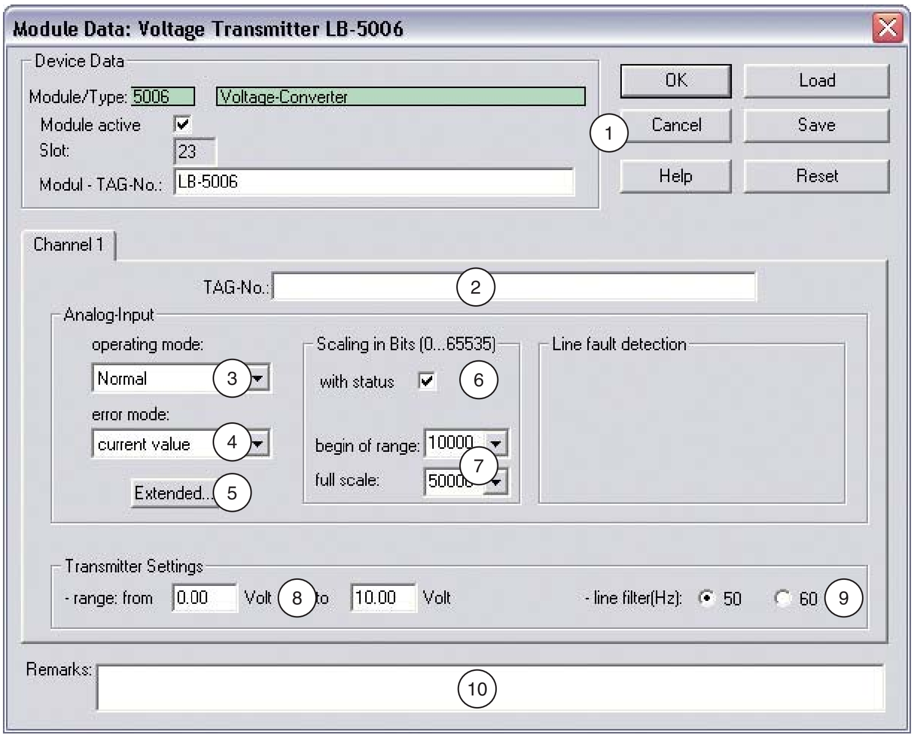

Figure 8.61: Temperature input 5x06: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No.** box
3 **Operating mode** drop-down list
4 **Error mode** drop-down list
5 **Extended** button
6 **With status**check box
7 **Start of range/End of range** drop-down lists (scaling)
8 **Start of range/End of range** boxes (physical unit)
9 **Line filter** option
10 **Note** box

200180 2009-08

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Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. box

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

3

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 7.6) for more details.

4

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 7.6) for more details on error mode.

5

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.

6

With statuscheck box

If you activate **With status**, status information is transferred in the data telegram. If the measurement range has been scaled differently from the default setting, status information will not be transferred.

7

Start of range/End of range drop-down lists (scaling)

Define scaling for the measured values (16-bit value range 0 ... 65535). In **Start of range**, enter the value that is to correspond to 0% (default setting: 0% = 10000). In **End of range** enter the value that is to correspond to 100% (default setting: 100% = 50000).
For more details, see the section “Measured value processing” (see chapter 7.4).

In the **Transmitter settings** area, enter the start of range and end of range accordingly in physical units.

8

Start of range/End of range boxes (physical unit)

Specify the start of range and end of range in the indicated physical unit.

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

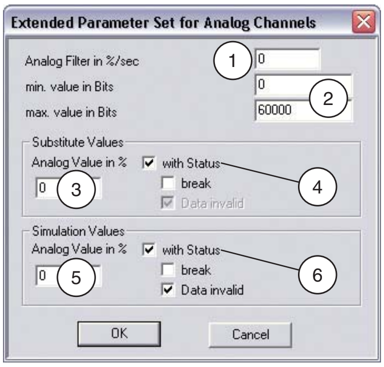

Figure 8.62: **Extended parameters** window with additional channel settings

1 **Analog filter** box
2 **Min./max. transmitted value** box
3 **Analog value as %** box (substitute value)
4 **With status** check box (substitute value)
5 **Analog value as %** box (simulation value)
6 **With status** check box (simulation value)

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

Min./max. transmitted value boxes

Specify the smallest/largest values to be transmitted (0 ... 65535). Specify the lower limit in the **Min. transmitted value** box and the upper limit in the **Max. transmitted value** box. The values for start of range and end of range are within this range.

3

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.

4

With status check box (substitute value)

Specify whether status information should be transmitted with the substitute value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the substitute value; not available for all I/O modules.
Invalid data: Transfers the substitute value with an "Invalid data" identifier. It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

5

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.

6

With status check box (simulation value)

Specify whether status information should be transmitted with the simulation value. If you activate **With status**, further check boxes will become available, which you can use to (de)activate the following status information (depending on the I/O module).
Lead breakage: Transfers information on line fault detection with the simulation value; not available for all I/O modules.
Invalid data: Transfers the simulation value with an "Invalid data" identifier. If you select **Invalid data**, the substitute value strategy is initiated.

8.15.7 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

8.16 LB/FB 6x01 relay output

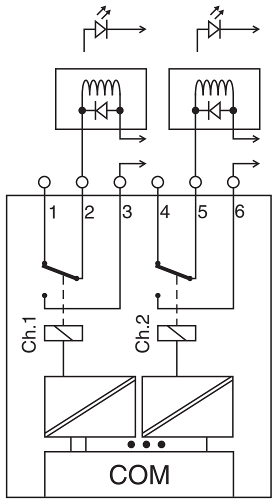

Figure 8.63: Connection diagram 6x01

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.

8.16.1 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.

200180 2009-08

8.16.2 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 8.16: Device function - bit assignment in the data telegram

8.16.3 Line fault detection

The "Line fault detection" function is not supported.

8.16.4 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.

200180 2009-08

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8.16.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

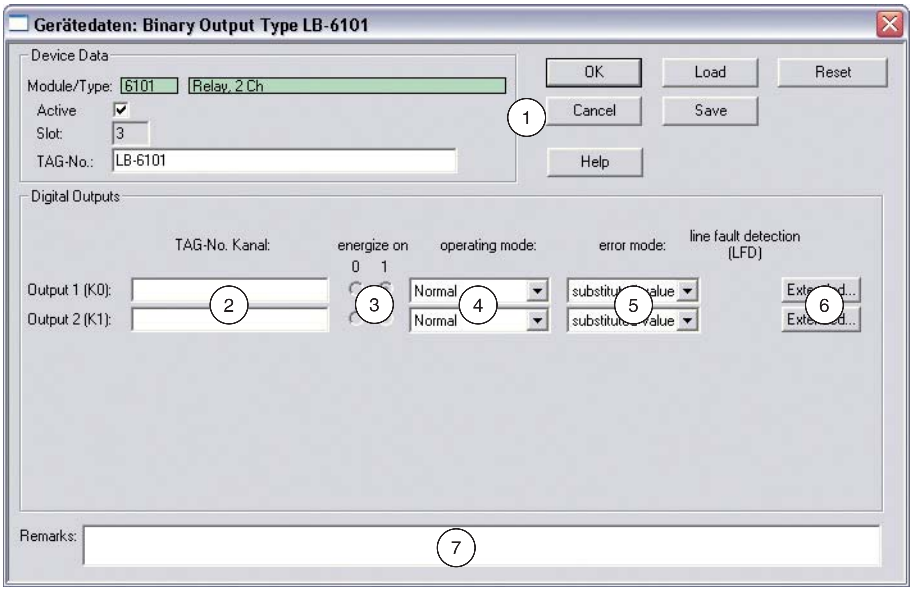

Figure 8.64: Digital input 6x01: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set output with** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Extended** button
7 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Set output with option

This option is not available for relay output 6x01.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

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.

7

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.

200180 2009-08

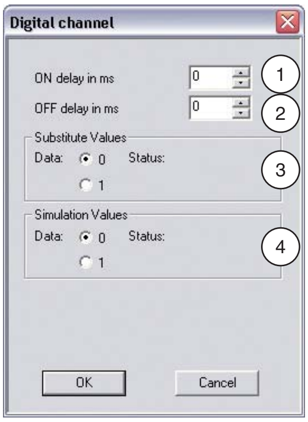

Figure 8.65: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

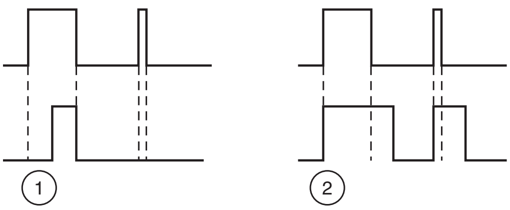

Figure 8.66: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault. Select a substitute value of either 0 or 1.

4

Simulation value area

Define the simulation value. The simulation value is transferred if you have selected "Simulation" operating mode. Select a simulation value of either 0 or 1.

8.16.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.17 LB/FB 6x05 relay output

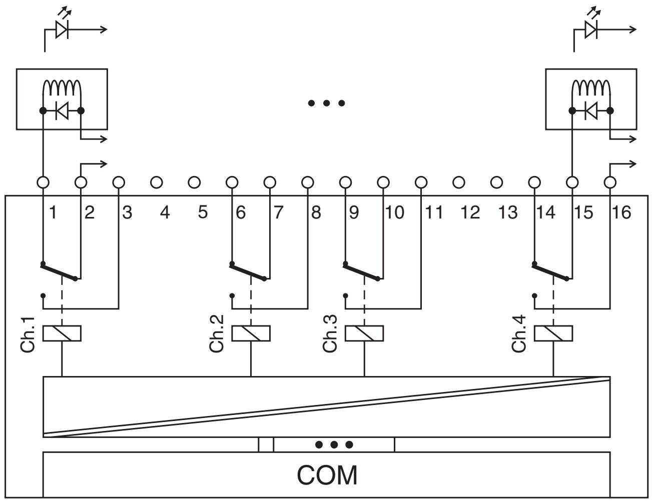

Figure 8.67: Connection diagram 6x05

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.

8.17.1 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.

200180 2009-08

8.17.2 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 6.6.2).

200180 2009-08

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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 8.17: Device function - bit assignment in the data telegram

8.17.3 Line fault detection

The "Line fault detection" function is not supported.

8.17.4 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.

8.17.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

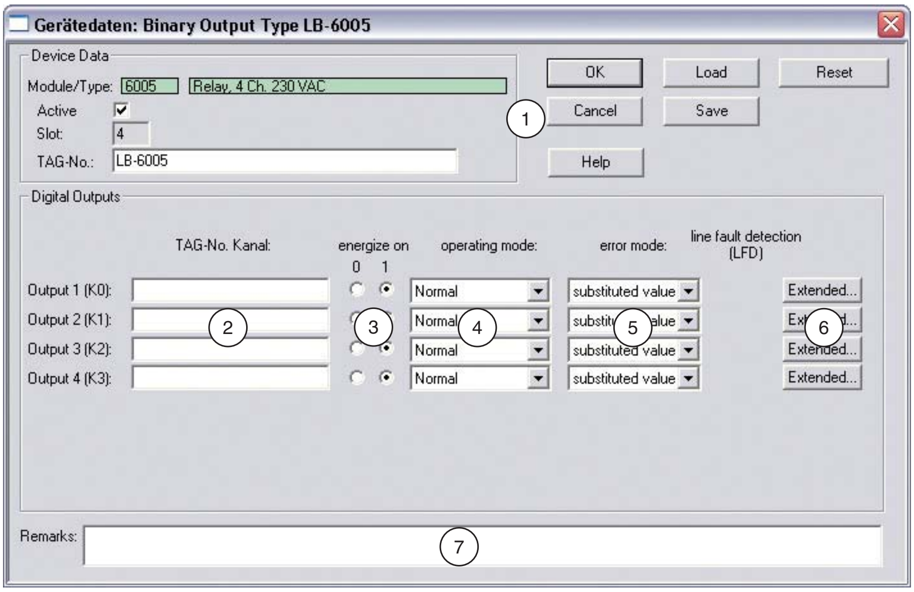

Figure 8.68: Digital input 6x05: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set output with** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Extended** button
7 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

200180 2009-08

PEPPERL+FUCHS

3

Set output with option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

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.

7

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.

Digital channel window

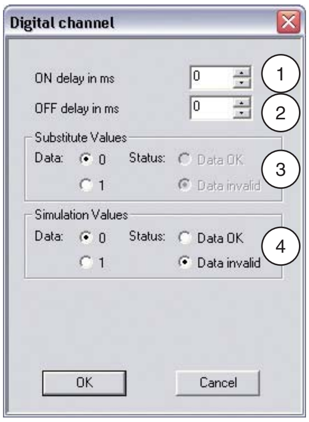

Figure 8.69: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

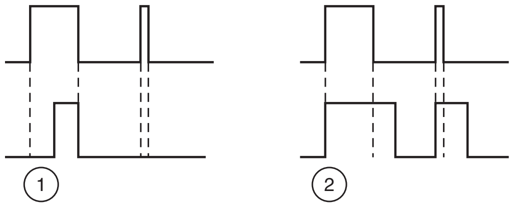

Figure 8.70: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.17.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.18 LB/FB 6x06 relay output

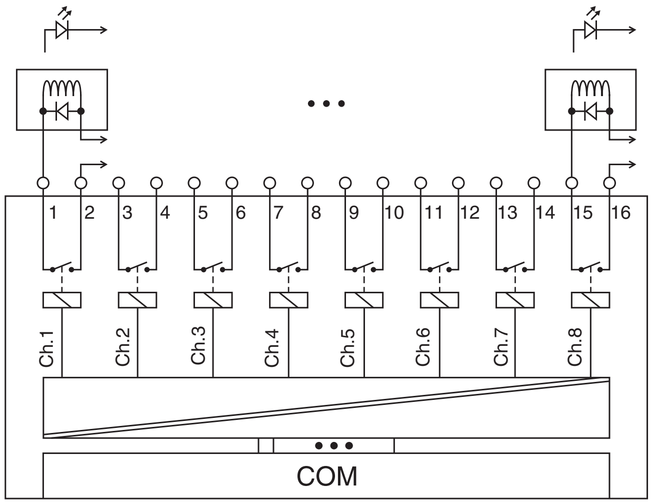

Figure 8.71: Connection diagram 6x06

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.

8.18.1 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.

200180 2009-08

8.18.2 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 6.6.2).

200180 2009-08

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 8.18: Device function - bit assignment in the data telegram

8.18.3 Line fault detection

The "Line fault detection" function is not supported.

200180 2009-08

8.18.4 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.

8.18.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

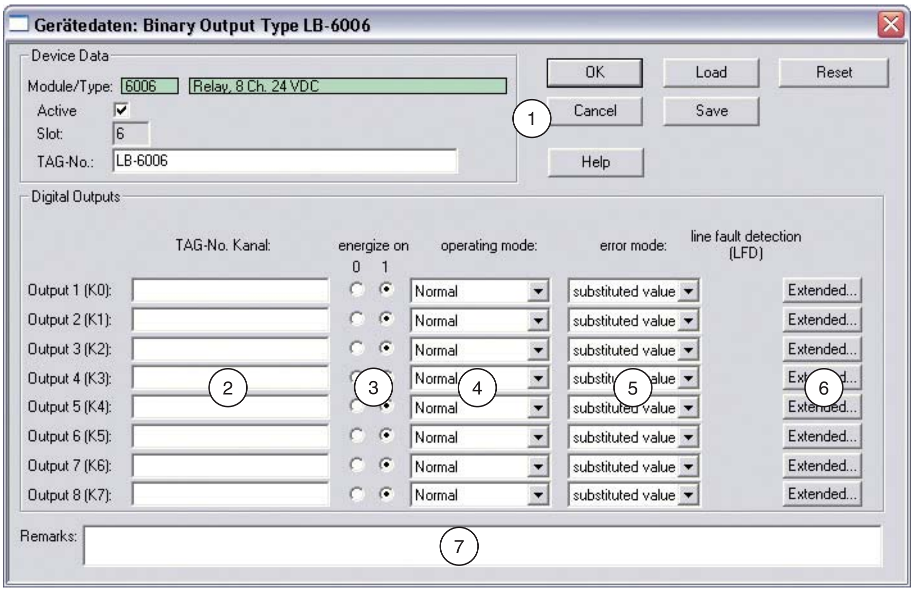

Figure 8.72: Digital input 6x06: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set output with** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Extended** button
7 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Set output with option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

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.

7

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.

Digital channel window

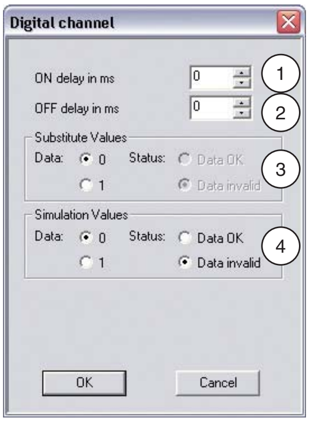

Figure 8.73: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

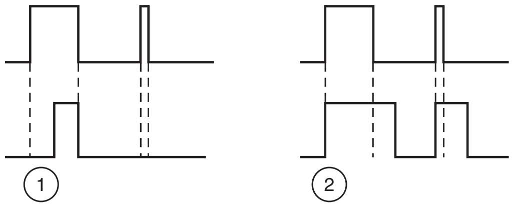

Figure 8.74: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.18.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.19 LB/FB 6x08 digital output

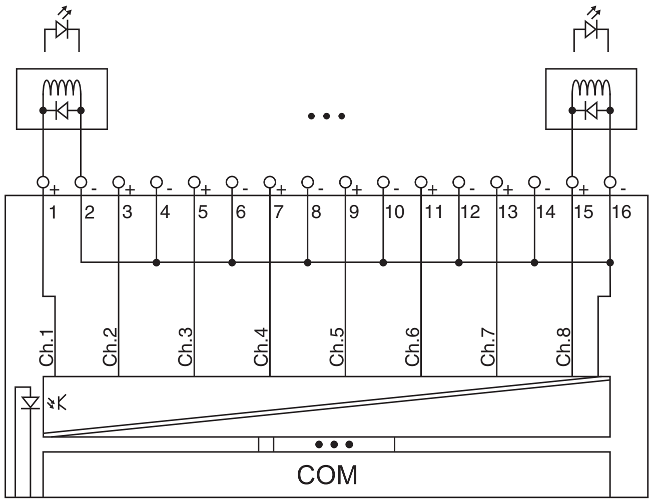

Figure 8.75: Connection diagram 6x08 with output disable input

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.

8.19.1 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.

8.19.2 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 6.6.2).

200180 2009-08

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 8.19: Device function - bit assignment in the data telegram

8.19.3 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.

8.19.4 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).

8.19.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

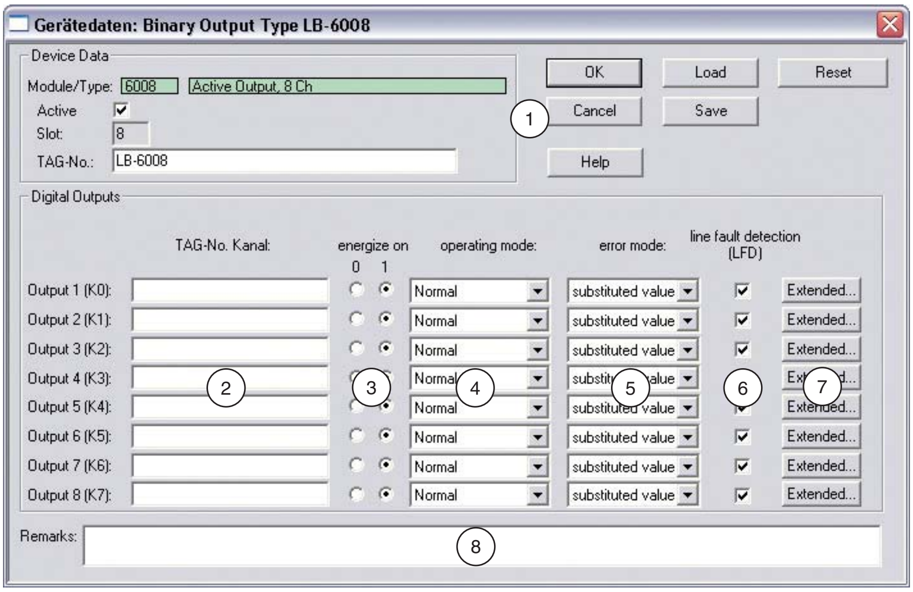

Figure 8.76: Digital output 6x08/6x1x: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set output with** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Short circuit / breakage detection** check box
7 **Extended** button
8 **Note** box

200180 2009-08

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

3

Set output with option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

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

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.

200180 2009-08

Digital channel window

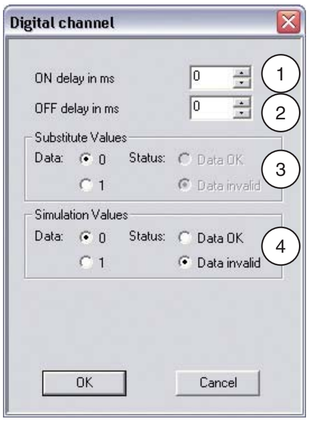

Figure 8.77: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

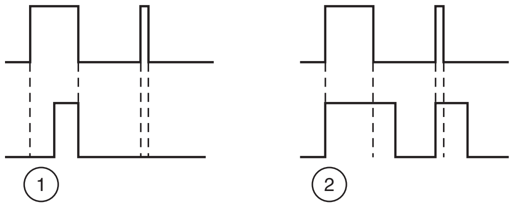

Figure 8.78: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.19.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

200180 2009-08

8.20 LB/FB 6x1x digital output

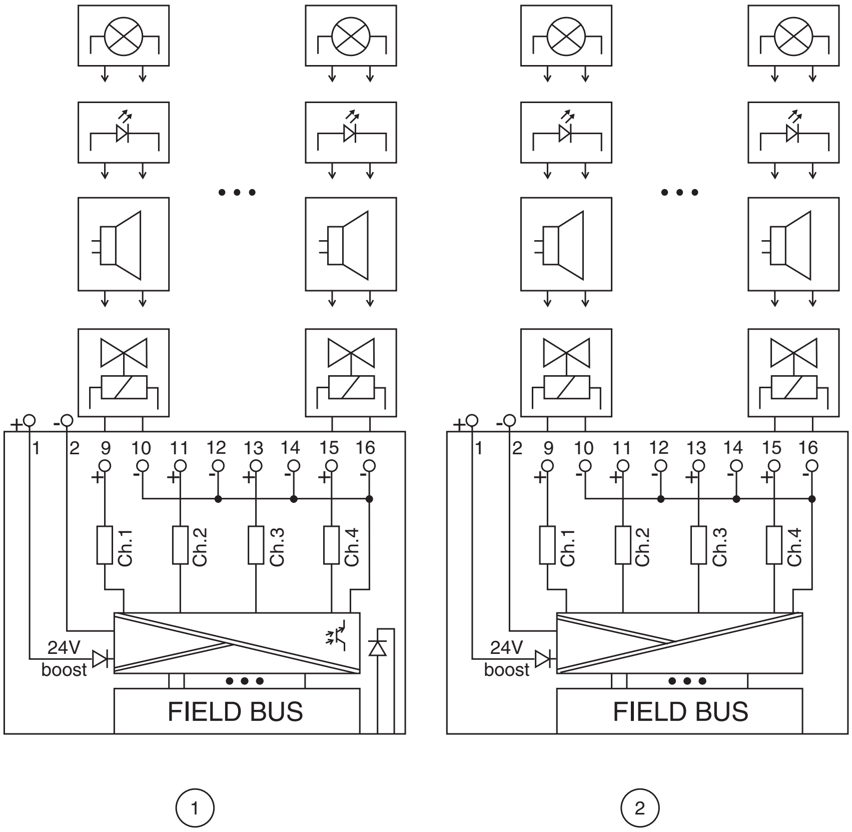

Figure 8.79: Connection diagram 6x10 - 6x15

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.

Features

- Module width: 2 slots
- 4 low voltage channels, intrinsically safe

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

8.20.1 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.

8.20.2 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 6.6.2).

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

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 8.20: Device function - bit assignment in the data telegram

8.20.3 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.

8.20.4 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).

200180 2009-08

8.20.5 Editing device data

Access the **Device data** window of the I/O module (see chapter 7.2.1).

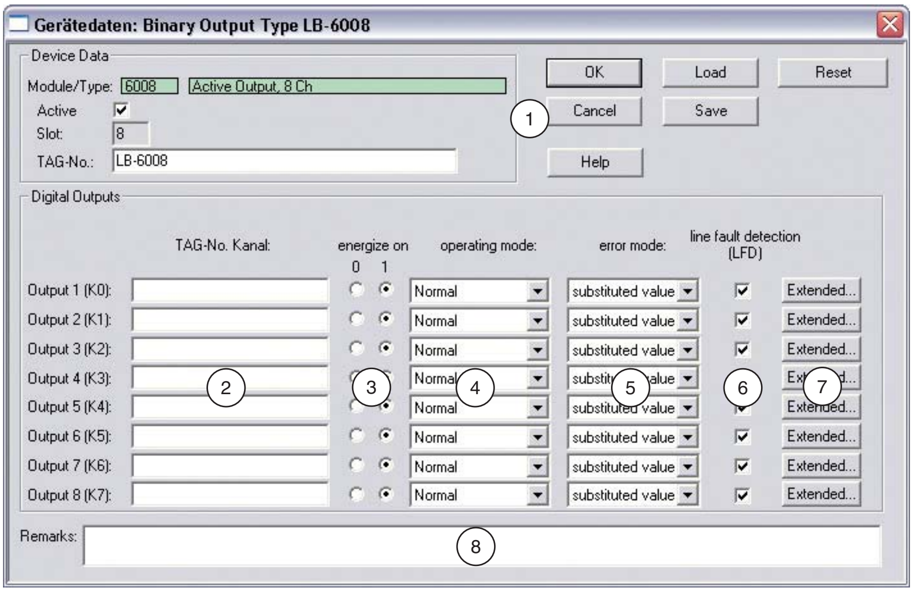

Figure 8.80: Digital output 6x08/6x1x: **Device data** window

1 **Measuring point data** area + buttons
2 **TAG No. channel** box
3 **Set output with** option
4 **Operating mode** drop-down list
5 **Error mode** drop-down list
6 **Short circuit / breakage detection** check box
7 **Extended** button
8 **Note** box

Explanations:

1

Measuring point data area + buttons

This area is identical for all I/O modules. A description of this area can be found in the section "'Device data' window – universal screen elements" (see chapter 7.2.2).

2

TAG No. channel box

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

200180 2009-08

PEPPERL+FUCHS

3

Set output with option

Choose between positive or negative logic for the digital signal.

4

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 7.6) 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. 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 7.6) for more details on error mode.

6

Short circuit / breakage detection check box

Enable line fault detection to monitor the connection at the field end. In the event of a fault (lead breakage or short circuit), a diagnosis is transmitted and the substitute value strategy preset in the **Error mode** drop-down list is initiated.
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.

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

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.

Digital channel window

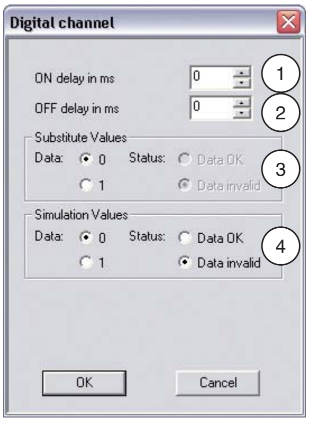

Figure 8.81: **Digital channel** window with additional channel settings

1 **ON delay** box
2 **OFF delay** box
3 **Substitute value** area
4 **Simulation value** area

Explanations:

1

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).

2

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).

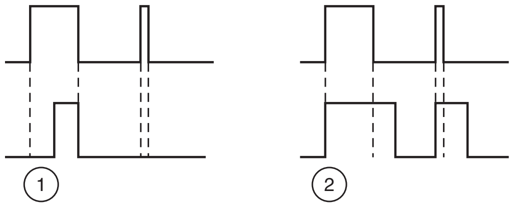

Figure 8.82: ON and OFF delay

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).

3

Substitute value area

Define a substitute value for when there is a fault.

- Data: Select a substitute value of either 0 or 1.
- Status: Define the status with which the substitute value should be transferred ("Data OK" or "Invalid data"). It makes sense to select the "Invalid data" status, as an error occurs when the substitute value is transferred.

4

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.

8.20.6 Using the measured value display

The measured value display is used to display measured values and status information. Find out how to access the measured value display and the significance of the information it contains in the section "Accessing the measured value display." (see chapter 7.3).

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.

200180 2009-08

9.2 Communications error

If there is a communications error, work through the following checklist and take any relevant action.

Error	Action(s)
Remote I/O station cannot be found in the configuration software	• Make sure that no other applications assigned to the selected port are active. This can be the case, for example, if you use the HART/SMART software of other manufacturers and this application was not closed before you started the remote I/O configuration. • Check that the connection cable between the PC and the bus stations is properly connected. • Check that all the settings have been made as described in this manual. • The yellow LEDs on the front of the Com Unit must flash when data is being exchanged.

Table 9.1: Communications error

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.

Fault	Action(s)
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.
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 9.2: 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 9.3: Communications error

200180 2009-08

PEPPERL+FUCHS

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 9.4: 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 open-circuit 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.

You cannot switch off the red LED on the com unit via the system or via the bus until all the I/O modules are working properly again (common alarm). To disable the common alarm, select the Fault monitor menu option in the configuration software.

LEDs on the Com Unit	
Fault	**Action(s)**
Red LED on Com Unit is on.	There is a problem with an I/O module in one of the slots. • 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.
Yellow LED on the Com Unit is flashing without the bus being connected.	• The Com Unit is operational and working with the I/O modules.
Yellow LED on the Com Unit is flashing at long intervals.	• The Com Unit is operational and working with the I/O modules. At least one I/O module is in simulation mode (manual operation).
Yellow LED on Com Unit is on.	• For FB Com Units: check that the polarity of the Com Unit wiring is correct. • Check that a terminator is being used and is enabled. The Modbus must have exactly 2 terminators per segment, one at the start and one at the end.
Green LED on Com Unit is flashing.	• The Com Unit is active. As soon as this Com Unit is switched off in a redundant system there will be a redundancy switchover. • If possible, only remove the Com Unit whose green LED is permanently on.
Main bus	
Yellow LEDs on Com Units do not flash while communication is being established.	• Check that the configuration cable and the adapter are connected properly.
Service bus	
Yellow LEDs on Com Units do not flash while communication is being established on the service bus.	• Check that the configuration cable and the adapter are connected properly.

LEDs on I/O modules and power supplies	
Fault	**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 lie with the backplane.

200180 2009-08

LEDs on I/O modules and power supplies	
Fault	Action(s)
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 reasons of explosion protection, the fuses for power supplies and I/O modules must only be changed by suitably qualified, specialist personnel. 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.

Fault	Action(s)
No change in signal when the parameters are changed.	• Check that the change was saved in the slave station. • Download the parameter settings to find out the current parameter settings of the I/O module. • Applicable to PROFIBUS com unit only: Check whether HCiR is active. If so, the new setting will only come into force once the master has performed the HCiR changeover.
Incorrect signal	• Check whether there is a short-circuit or open wire in the circuit. • Check that the field devices and sensors are working correctly. • Replace the I/O module. • Check the bus signal path to the I/O module.
All signals in a station are incorrect.	• Check that the power supply is working correctly. • Check the bus connection. • Check bus communication. • Use a bus monitor.
Output module switches to substitute values.	• Check the response monitoring time for bus monitoring in the com unit. The response monitoring time must be longer than the duration of a bus cycle.
An output module switches off.	Communication has been lost with the com unit. • Check that the I/O module is plugged into the backplane properly.
Input module intermittently fails to supply process values.	
I/O module works correctly in one particular slot, but not in another.	• Check that the connector for the faulty slot is OK and does not have any bent pins. • If necessary, stop using the slot.
Process values intermittently incorrect.	• Check whether external interference may be causing errors in the process value. • Check that the shielding is intact.
Signal does not change.	• Check whether the channel is set to manual operation (simulation) (not com unit 8x06). In simulation mode the signal is frozen. • Check whether the substitute value is being used because there is no bus communication. • Check that a sensible value has been chosen for the scaling. Can the process control system handle the selected range (e.g., 10,000 to 50,000) ?

200180 2009-08

Fault	Action(s)
Module is not supplying any diagnostic messages.	• Check whether the line fault detection function is enabled. If not, enable line fault detection. • Check whether the diagnostic function is enabled in the com unit.
No input data, No output.	• Check that the correct I/O module has been plugged in. • Check that the scaling of the analog input/output meets the system requirements. • Check that the wiring is OK.
I/O module reported as not present.	• Check that the correct I/O module has been plugged in. • Check that the green LED on the I/O module is on and that the I/O module is plugged in properly.
Module fault	• Check that the green LED on the I/O module is on. If not, then there may be no contact with the backplane or the fuse has blown. If all the I/O modules in a segment have failed, then the fault lies in the power supply or the backplane. • Check the diagnostic information for the I/O module (e.g., no module, incorrect module, line fault, etc.) by referring to the process-value window of the affected I/O module.

Table 9.5: 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 9.6: 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 9.7: Signal fault

200180 2009-08

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 9.8: Faults and their effects

200180 2009-08

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 9.9: 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

200180 2009-08

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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 9.10: Faults and their effects

200180 2009-08

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