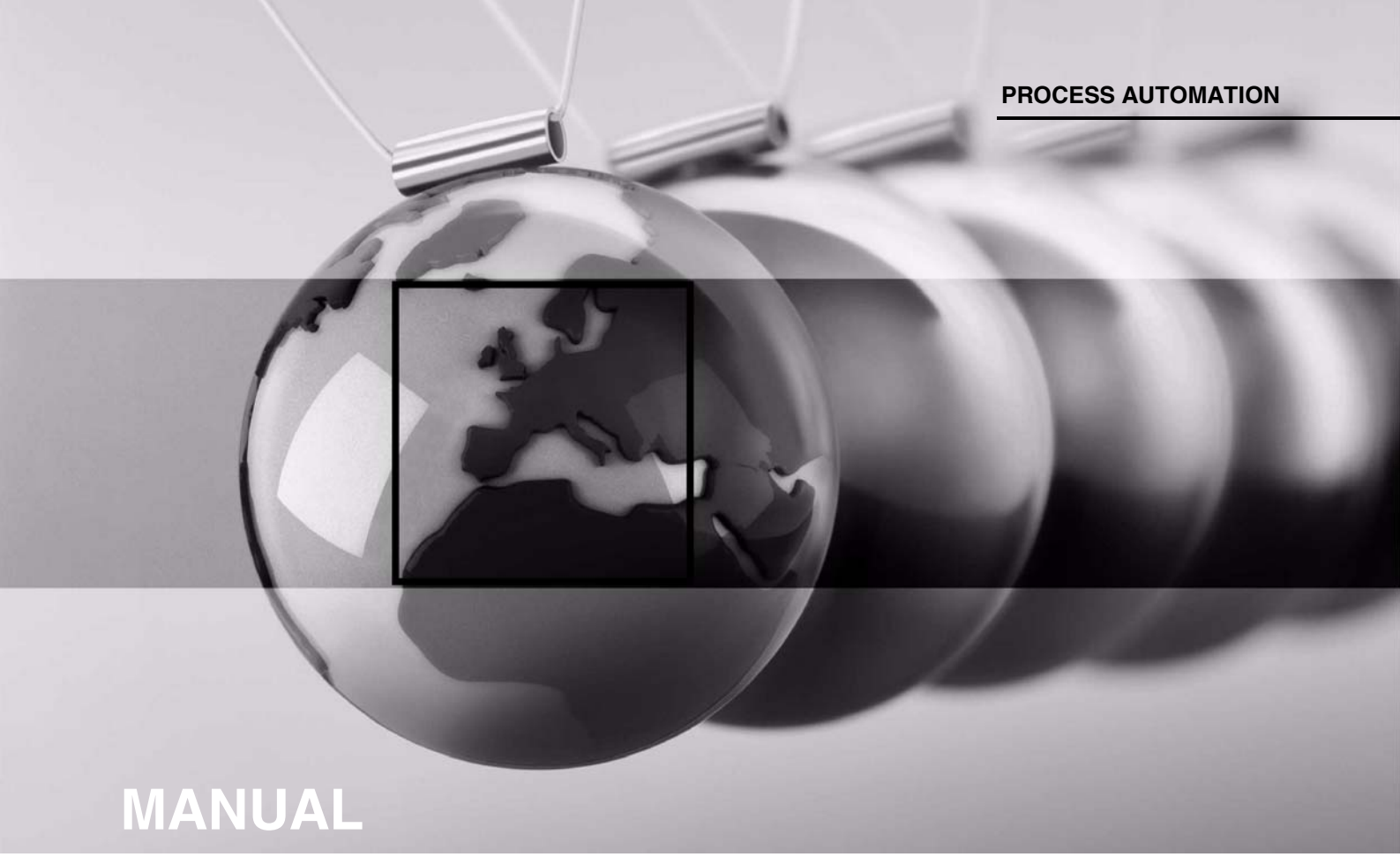
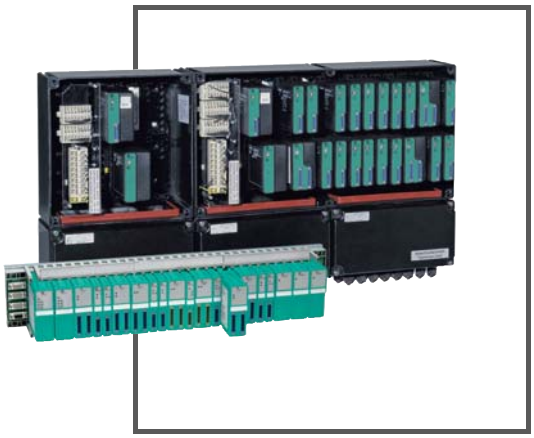


MANUAL

LB8107* / FB8207*
LB8111* / FB8211*

Com unit for
MODBUS RTU/TCP
DTM for FDT 1.2



PEPPERL+FUCHS
PROTECTING YOUR PROCESS

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

1 Safety

1.1 Validity

The chapter “Safety” is valid as instruction manual.

Specific processes and instructions in this document require special precautions to guarantee the safety of the operating personnel.

1.2 Symbols used

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

Safety-relevant symbols

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt devices and any connected facilities or systems, or result in their complete failure.

Informative symbols

Note!

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions.

1.3 Target Group / Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the system operator.

Mounting, installation, commissioning, operation, maintenance and disassembly of any devices may only be carried out by trained, qualified personnel. The instruction manual must be read and understood.

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1.4 Reference to further documentation

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

In particular, note the **Safety** chapter and all chapters in the LB and FB remote I/O system manuals referring to hazardous areas.

Due to constant revisions, documentation is subject to permanent change. Please refer only to the most up-to-date version, which can be found under www.pepperl-fuchs.com.

Laws, standards, or directives applicable to the intended use must be observed. In relation to hazardous areas, Directive 1999/92/EC must be observed.

The corresponding data sheets, declarations of conformity, EC-type-examination certificates, certificates and Control Drawings if applicable (see data sheet) are an integral part of this document. You can find this information under www.pepperl-fuchs.com.

1.5 Intended Use

The devices are only approved for appropriate and intended use. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

1.6 Improper Use

Protection of the operating personnel and the overall system is not ensured if the product is not being used according to its intended purpose.

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2 Introduction

2.1 Basics of the Remote I/O Systems

Remote I/O stations are signal modification devices that act as an interface for signals between the field devices and the process control systems. The I/O modules are mounted on the prefabricated backplanes using slots. Com units are available for various standard buses and form the interface between the I/O modules and the process control system. Power supplies are used to power the I/O modules and com units.

The system architecture is determined by the number of remote I/O stations on each bus line. Up to 48 I/O modules are available for each remote I/O station, which corresponds to 80 analog or 184 digital channels (or any mixture of the two).

Figure 2.1 Example of LB/FB remote I/O stations

1 LB remote I/O station for use in the safe area and Zone 2

2 FB remote I/O station for use in Zone 1

Configuration Tasks

The parameterization of the I/O modules is stored in the nonvolatile com unit memory. 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.

Diagnostics

Diagnostics information is reported to the process control system via the bus. Moreover, queries can be submitted via an independent service bus. However, the service bus is not absolutely essential for obtaining a fully operational system.

Interfering 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.

Redundancy

Only manufacturer-specific redundant solutions are available because the MODBUS specification is not designed for redundant connections. The com units are prepared for redundant operation. This enables the redundancy characteristics of the remote I/O station to be adapted to the redundancy characteristics of the master module. A specification is missing and we therefore recommend you check the redundancy characteristics of the remote I/O station using system tests.

Output Shutdown

The output shutdown enables bus-independent shutting down of all or selected I/O modules within the Remote I/O system. This feature requires the use of appropriately equipped backplanes and I/O modules with shutdown input.

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3 Installing Configuration Software and DTM

3.1 Introduction

For process control systems that support the FDT concept, the remote I/O station can be configured using the device type manager (DTM). The DTM ensures that the master receives all configuration information and is adapted accordingly. In this case, make use of this manual, apart from the information concerning the PACTware™ FDT base application.

In the case of process control systems that do not support the FDT concept, you can configure the remote I/O station using the DTM and an external FDT base application, such as PACTware™. In this case, the remote I/O station connection is via a class 2 master. This manual describes the configuration with a class 2 master and the PACTware™ FDT base application. Note that the DTM cannot only be used with PACTware™, but also with other FDT base applications.

You can download the DTM from the **Software** area on the www.pepperl-fuchs.com website.

3.2 System Requirements

Your computer must meet the following requirements to run the configuration software and Device Type Manager (DTM).

- Operating system: Windows NT 4.0, Service Pack 4 or later, Windows 2000, Windows XP, Windows Vista
- Processor: 500 MHz or faster
- Working memory: 128 MB or more
- Hard disk space: approx. 100 MB
- Network card
- Software: Microsoft .NET Framework
- Administrator rights for performing the installation

3.3 Installing the Software

1. Install the FDT base application, e.g., PACTware™.
2. If communication with the remote I/O station is to be carried out via the process bus using MODBUS TCP, install the communication DTM for MODBUS TCP.
3. Install the DTM LB/FB.

Installing DTM LB/FB

The DTM LB/FB is suitable both for LB and FB remote I/O stations. You can download the DTM, including the GSD/GSE file, from the **Software** area on the www.pepperl-fuchs.com website.

1. Start the installation program.

   ↳ The installation process begins. The language selection window opens. If an older version of the software is already installed, the language selection from the older version is automatically copied. To install a different language, first uninstall the existing version.

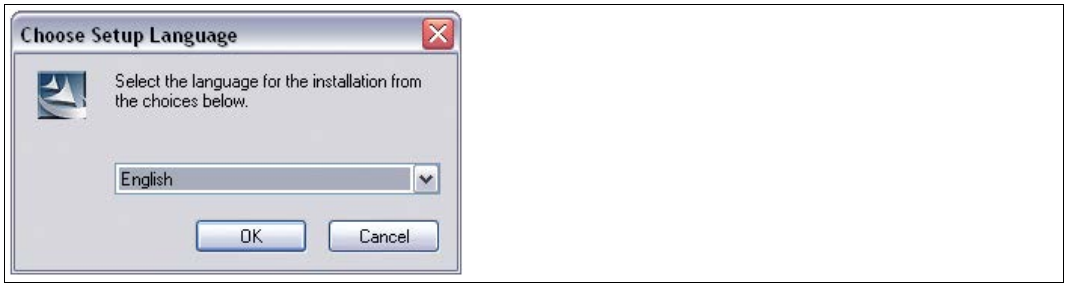

Figure 3.1 Language selection window

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

   ↳ A welcome window opens.
4. Click on **Next** to continue.

   ↳ The **User Information** window opens.

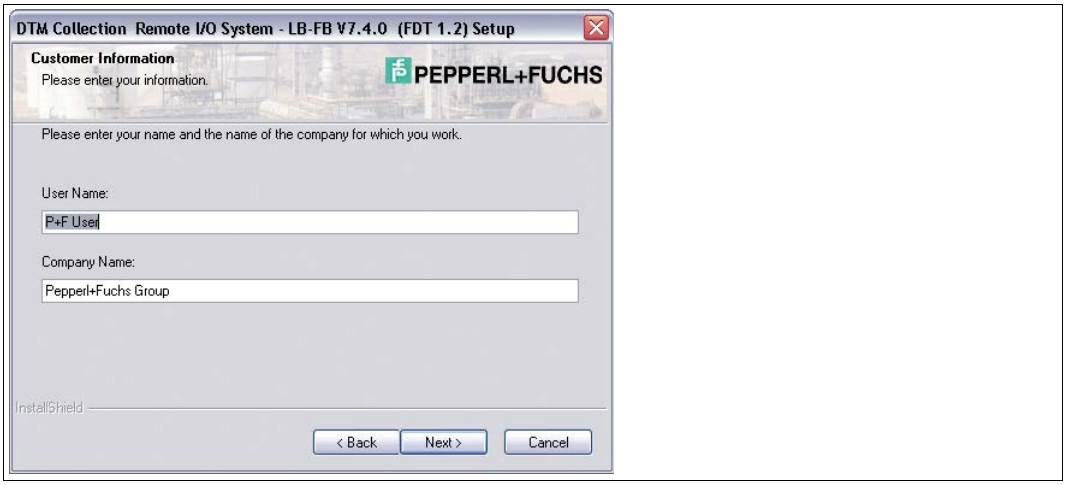

Figure 3.2 User information

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

   ↳ The **Select Installation Path** window opens.

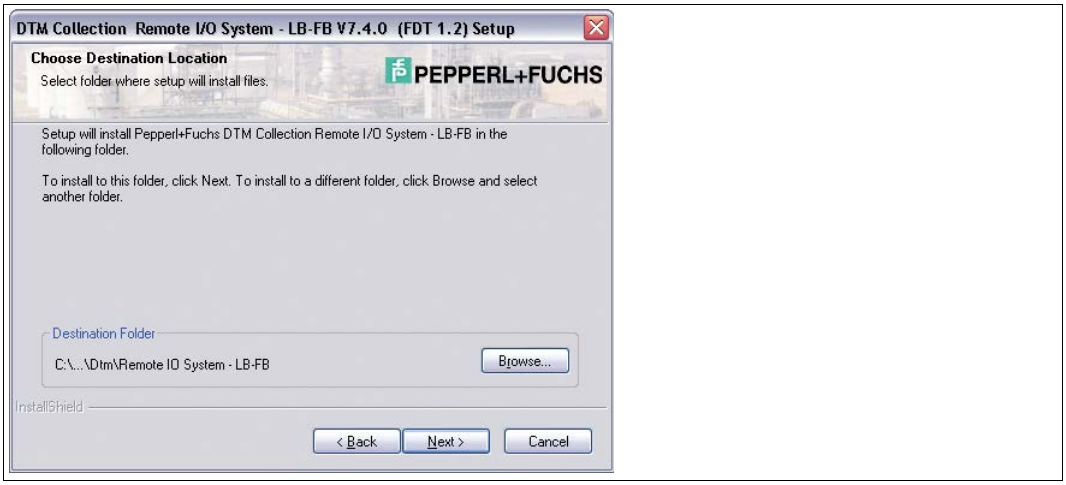

Figure 3.3 Selecting the target path

7. Click on **Next** to confirm the proposed installation path.
   To specify an installation path other than the one proposed, click on **Browse**. Select a folder and then click on **OK**.

   ↳ The selected path is copied as the destination folder.

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8. Click on **Next** to continue.

   ↳ The **Select Options** window appears. Here you can select the program components you wish to install.

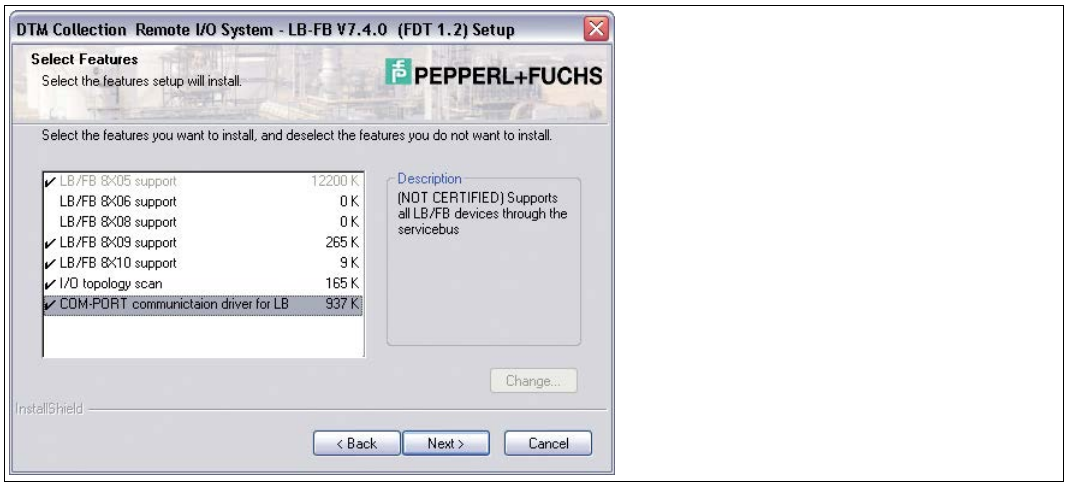

Figure 3.4 Select Features

9. In this list, select the program components to be installed. To activate or deactivate the desired entries, click to the left of the entries. When doing so, make sure the drivers for the com unit and communication link are enabled.

   ↳ Only those program components that are checked will be installed.

10. Click on **Next** to continue.

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

11. If you wish to read the `Readme` file, check the box.

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

3.4 Updating the DTM Catalog

Once you have installed the FDT base application and the Device Type Manager (DTM) on the computer, the FDT base application's DTM catalog must be updated. The PACTware™ DTM catalog is called "Device Catalog" and is normally automatically updated when PACTware™ is launched.

If PACTware™ does not update the device catalog automatically, proceed as follows.

Updating the Device Catalog

1. Start PACTware™.
2. Select **View** > **Device Catalog** or press **F3** or click on the **Device Catalog** icon in the icon bar.

   ↳ The **Device Catalog** window opens.

3. Click on the **Update Device Catalog** button to update the device catalog.

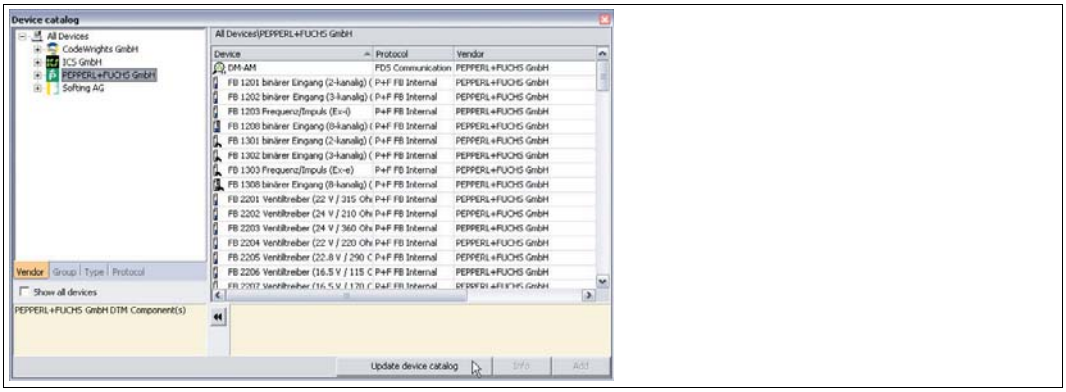

Figure 3.5 PACTware™ device catalog

4. Click on **Yes** to continue.

↳ The updated device catalog appears once the search has finished.

Figure 3.6 PACTware™ search for DTM

4 Configuring the Remote I/O station

This section describes how the remote I/O station can be integrated into PACTware™ and configured. You will learn how to create a PACTware™ project and how to set up communication with the field devices.

Note!

For more information about I/O modules and their configuration, see see chapter 6.

4.1 Communication with Remote I/O Station

Note!

- The com units LB8107* / FB8207* can be configured only via the service bus.
- The com units LB8111* / FB8211* can be configured via the fieldbus. The com unit LB8111* can also be configured via the service bus.

Components Required for a Service Bus Connection

- FDT base application, e.g., PACTware™
- DTM LB/FB
- Interface converter (RS232 to RS485 converter or USB to RS485 converter) such as W&T RS232 to RS485 or ICP Con I-7561 USB to RS485
- Compatible cable harness

The communication DTM for the service bus is contained in the DTM LB/FB.

Components Required for a Fieldbus Connection

- FDT base application, e.g., PACTware™
- DTM LB/FB
- Communication DTM for MODBUS TCP
- Ethernet TCP/IP network

4.1.1 Service Bus Connection via RS232

The W&T RS232-RS485 signal transformer can be connected to the remote I/O station using either a preassembled or self-made cable. You can order the preassembled cable together with the W&T RS232-RS485 signal transformer from Pepperl+Fuchs.
Use the following wiring diagram if you intend to make your own cable.

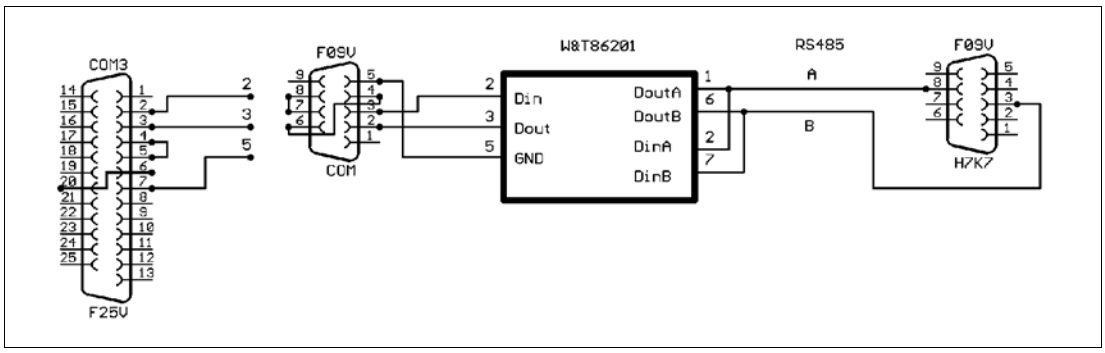

Figure 4.1 Wiring diagram W&T RS232-RS485 signal transformer

4.1.2 Service Bus Connection via USB

Connecting the USB Converter to the PC

1. Install the driver that accompanies the USB-RS485 converter.
2. Connect the USB converter to any USB port on the PC.

   ↳ The hardware wizard automatically detects and installs a new USB device. The converter is listed under connections in the hardware manager COM port list. The COM port to which the converter was assigned can be seen in this list. The COM port in use can be modified via the same entry in the device manager if required (**Properties** context menu).

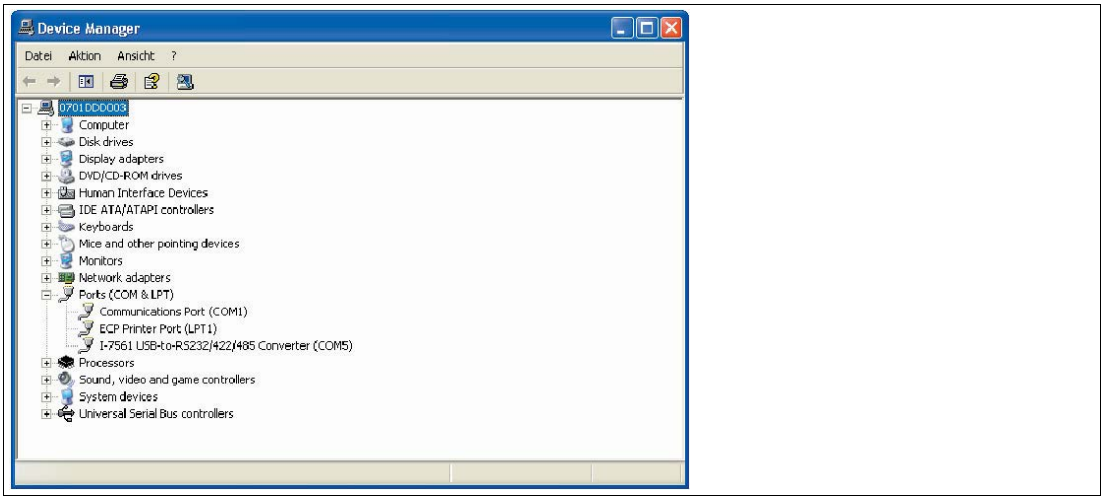

Figure 4.2 USB converter in device manager

4.2 Creating a New Project

Creating a new project in PACTware™?

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

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

4.3 Integrating the Service Bus Communication DTM

If you wish to establish a connection via the service bus, integrate the service bus communication DTM into the project as follows.

The service bus communication DTM is contained in the DTM LB/FB. The service bus communication DTM must be added to the project structure before all other DTMs.

Adding Communication DTMs

1. Select the entry **Host PC** in the project view.

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2. Select **Device Data > Add Device** or click on the **Add Device** icon on the toolbar.

↳ A device selection window opens.

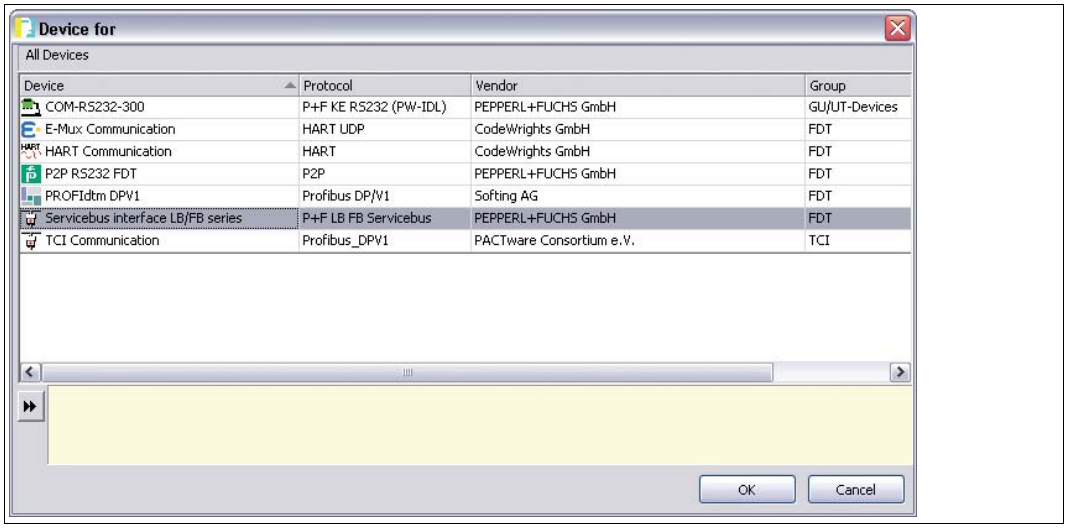

Figure 4.3 Selecting the communication DTM

3. Select the entry **Service bus interface LB/FB series**.
4. Click on **OK**.

↳ The service bus communication DTM is added and appears in the project structure.

5. As service bus communication is handled by a COM port on the computer, the service bus communication DTM must be allocated a COM port.
Right-click on the **LB/FB service bus** entry in the project structure.
6. In the context menu select **Parameter > Parameterization > Set COM Port**.

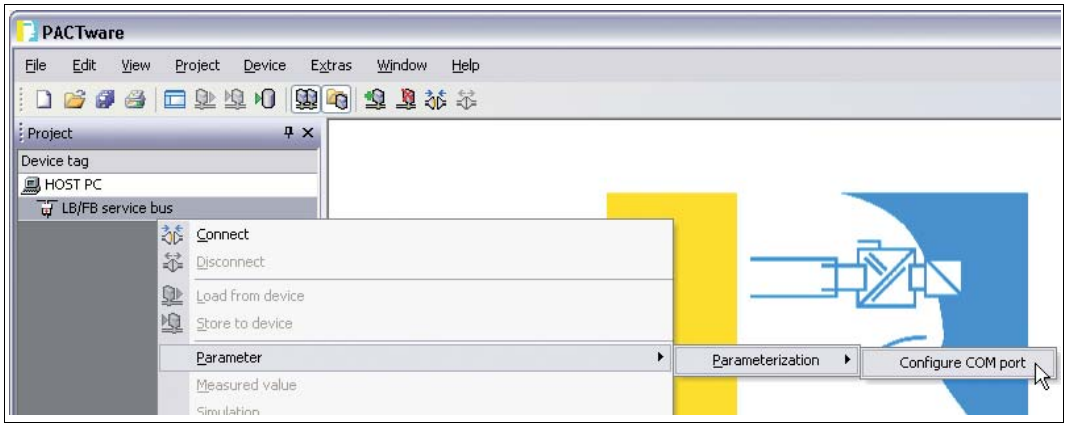

Figure 4.4 Setting the COM port

↳ The device data window containing the COM port settings opens.

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7. Set the COM port.

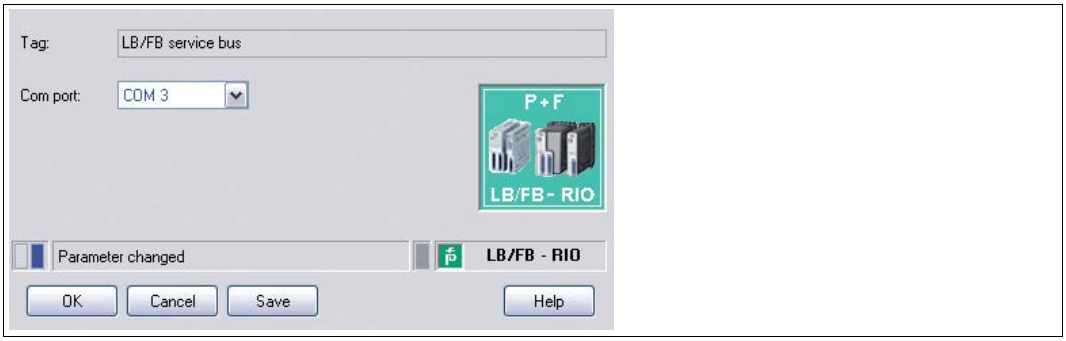


Figure 4.5 Setting the COM port

8. Click on **OK**

4.4 Adding MODBUS Communication DTMs

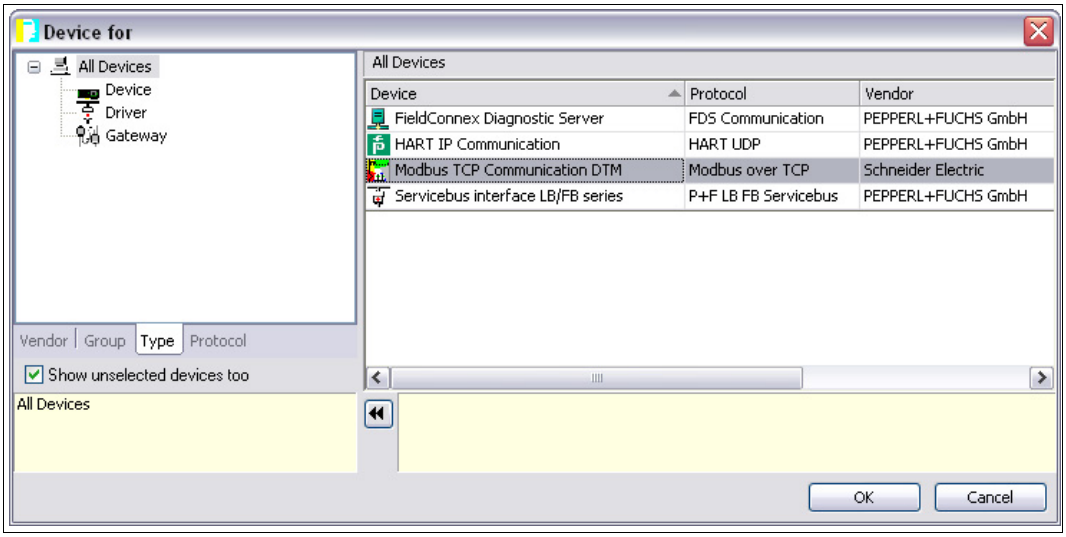
If you wish to establish a connection via the fieldbus, integrate the MODBUS communication DTM into the project as follows. In the following example, **Modbus TCP Communication DTM** is used by Schneider Electric.

Adding Communication DTMs

Before you can integrate the MODBUS communication DTM into the project, the MODBUS communication DTM must be installed on the computer.

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

↳ A device selection window opens.



3. Select the MODBUS communication DTM, in this example **Modbus TCP Communication DTM**.
4. Click **OK**.

↳ The MODBUS communication DTM is added and appears in the project structure.

Numerous adjustments can be made on the MODBUS communication DTM. For a precise description of the adjustment options, refer to the instructions from the relevant manufacturer.

To modify the MODBUS settings in PACTware™, proceed as follows.

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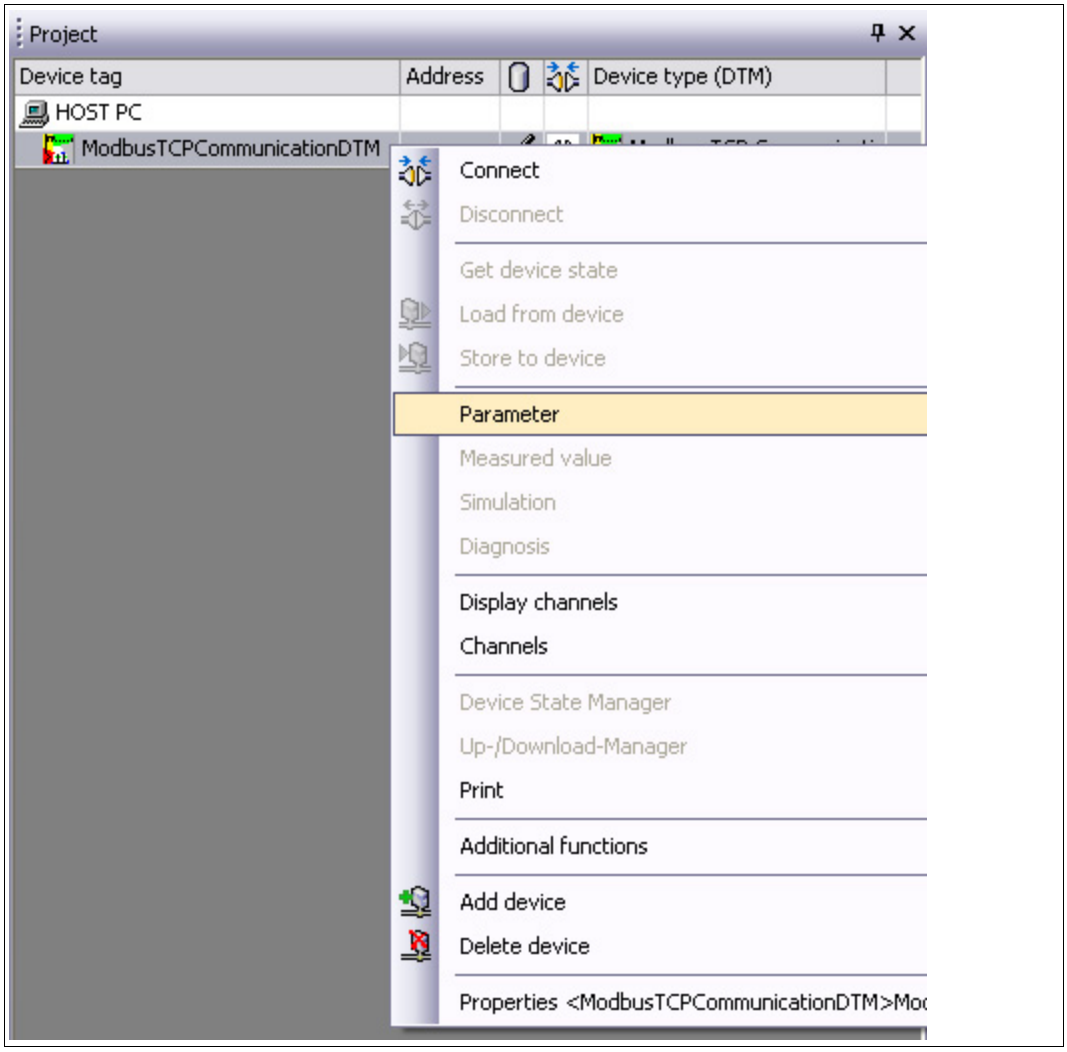
Modifying MODBUS Settings

1. Right-click on the MODBUS communication DTM in the project structure, in this example on **Modbus TCP Communication DTM**.
2. Choose **Parameter**.



↳ The device data window containing the bus parameters opens.

3. Edit the relevant parameters.
4. To make further adjustments, right-click on the **Modbus TCP Communication DTM** entry in the project structure again and select **Additional functions**.

4.5 Integrating Com Units

There are two options available for integrating com units into the PACTware™ project.

- Integrate com units via the **Add Device** command
- Generate com units automatically

Intergrating Com Units via the "Add Device" Command

Before you can integrate a com unit into the PACTware™ project, the DTM LB/FB must be installed on the computer and a communication DTM must be integrated into the project structure.

1. Select the entry for the previously integrated communication DTM in the project view.

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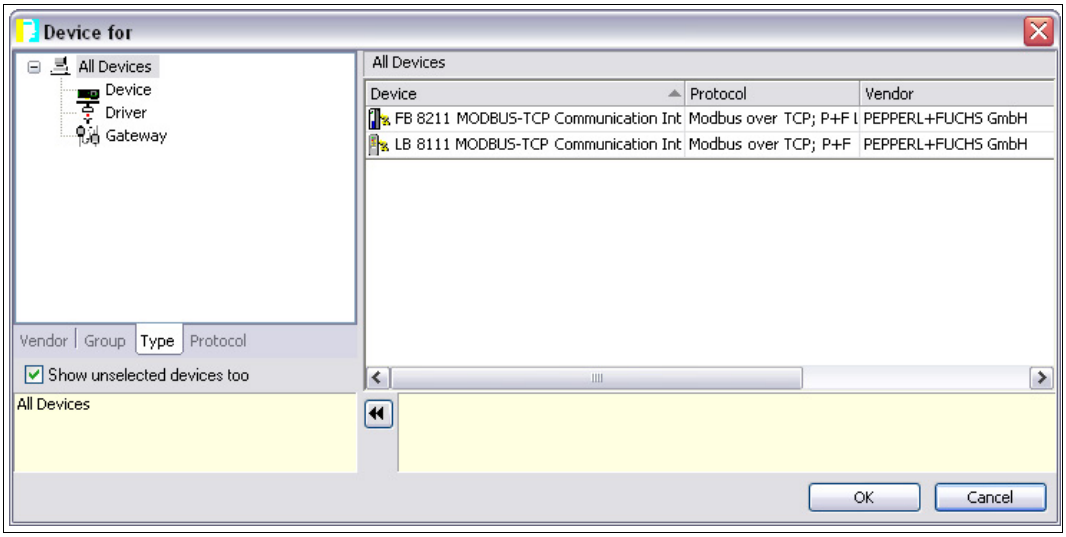
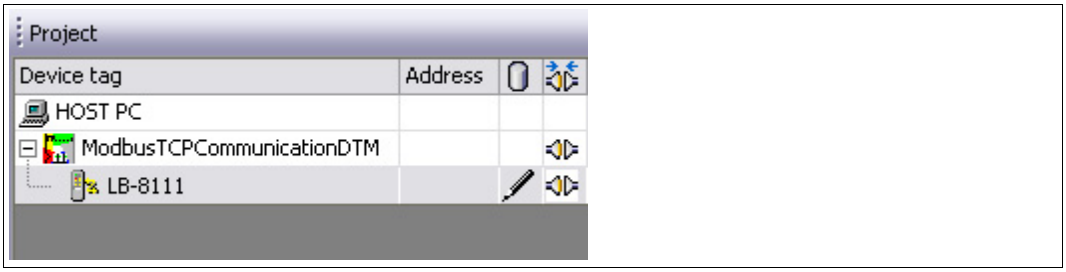
2. Select **Device Data > Add Device** or click on the **Add Device** icon on the toolbar.

↳ A window opens displaying a list of available com units.



3. Select the com unit installed in your remote I/O station.
4. Click on the **OK** button.

↳ The com unit has now been added to the project and can be parameterized. If the remote I/O station contains multiple com units, repeat the steps for each com unit.



Generate com units automatically

Note!

The com unit can only be generated automatically via a **service bus connection**.

Before allowing the com unit to be generated automatically, there must be a physical connection with the remote I/O station via the service bus, and the service bus communication DTM must have been added to the project structure.

1. Right-click on the **LB/FB Service Bus** entry in the project structure.
2. Establish a connection to the remote I/O station. Select **Connect** from the context menu.

↳ The communication DTM entry appears bold in the project structure as soon as the connection is established.

3. Right-click on the **LB/FB Service Bus** entry in the project structure.
4. Select **Additional Functions > Scan Service Bus**.

↳ The **Scan Service Bus** window appears.

5. Enter the address range that you wish to scan in the **Scan Range** fields.

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6. Click on **Start Scan**.

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

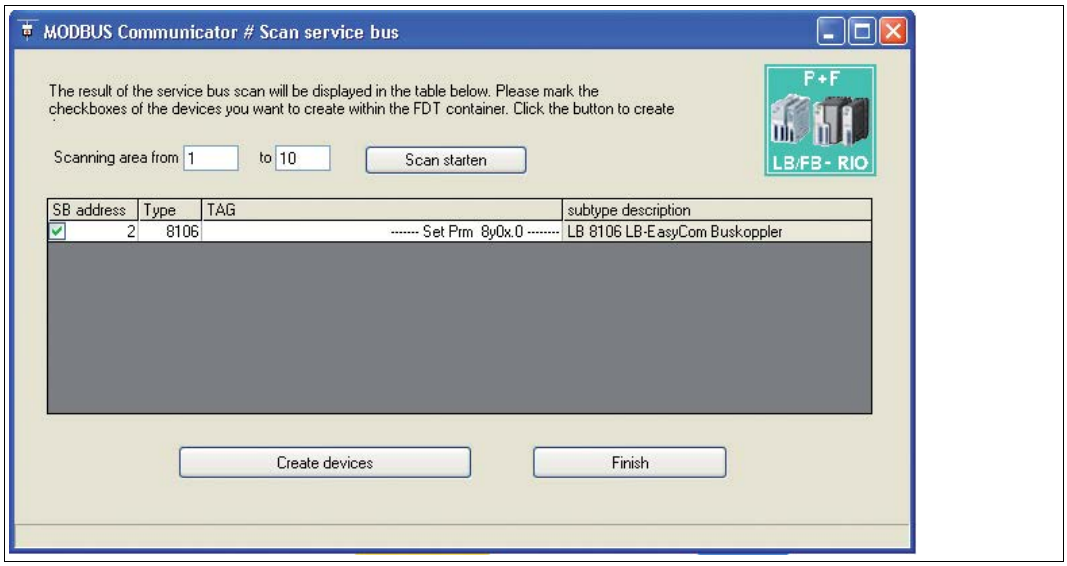

Figure 4.6 Service bus scan results

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

   ↳ The **Set Service Bus Address** window appears.

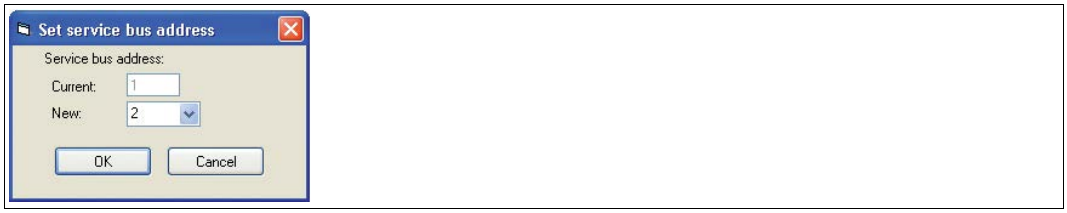

Figure 4.7 Setting the service bus address

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

   ↳ The service bus address has been changed.

10. Click on **Generate Devices** in the **Scan Service Bus** window to start configuring the generation process.

    ↳ All selected com units are created in the project structure. The progress is displayed in the PACTware™ status bar.

4.6 Online and Offline Parameterization

Note!

The functions described in this section relate to the DTM, version 7.4 or later.

The FDT base application offers the ability to edit the offline or online data record of the DTM, depending on the connection status with the remote I/O station. When you edit an offline data record, you are editing the data saved in the project. When editing an online data record, the current data from the connected device is being edited. The online and offline data records are synchronized using the commands **Store to Device** and **Read from Device**.

A dialog box appears whenever parameters are changed. In the dialog box, the user can decide whether to store the changes in the device or whether to update the offline data record as well. The parameters of the individual I/O modules can be synchronized only directly via the dialog box. Otherwise the parameters of the I/O modules are synchronized when the com unit parameters are downloaded/uploaded using the commands **Store to Device** and **Read from Device**.

- **Not connected**: Only the offline data record can be edited.
- **Connected**: Both the offline and online data records can be edited. The online and offline windows can be edited simultaneously. The windows are updated whenever they are synchronized. The following com unit parameters of the offline data record cannot be edited when a connection is active.
  - **Structure** tab: redundancy check box
  - **MODBUS I** tab: bus addresses of the primary and secondary com unit, com unit data

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Offline Parameterization

1. Right-click on the entry for the com unit or an I/O module in the project structure.
2. Select **Parameter > Parameterization > Edit Device Data (Offline)**.

   ↳ The **Edit Device Data (Offline)** window containing the offline data record opens. The gray box in the status bar indicates the offline status.

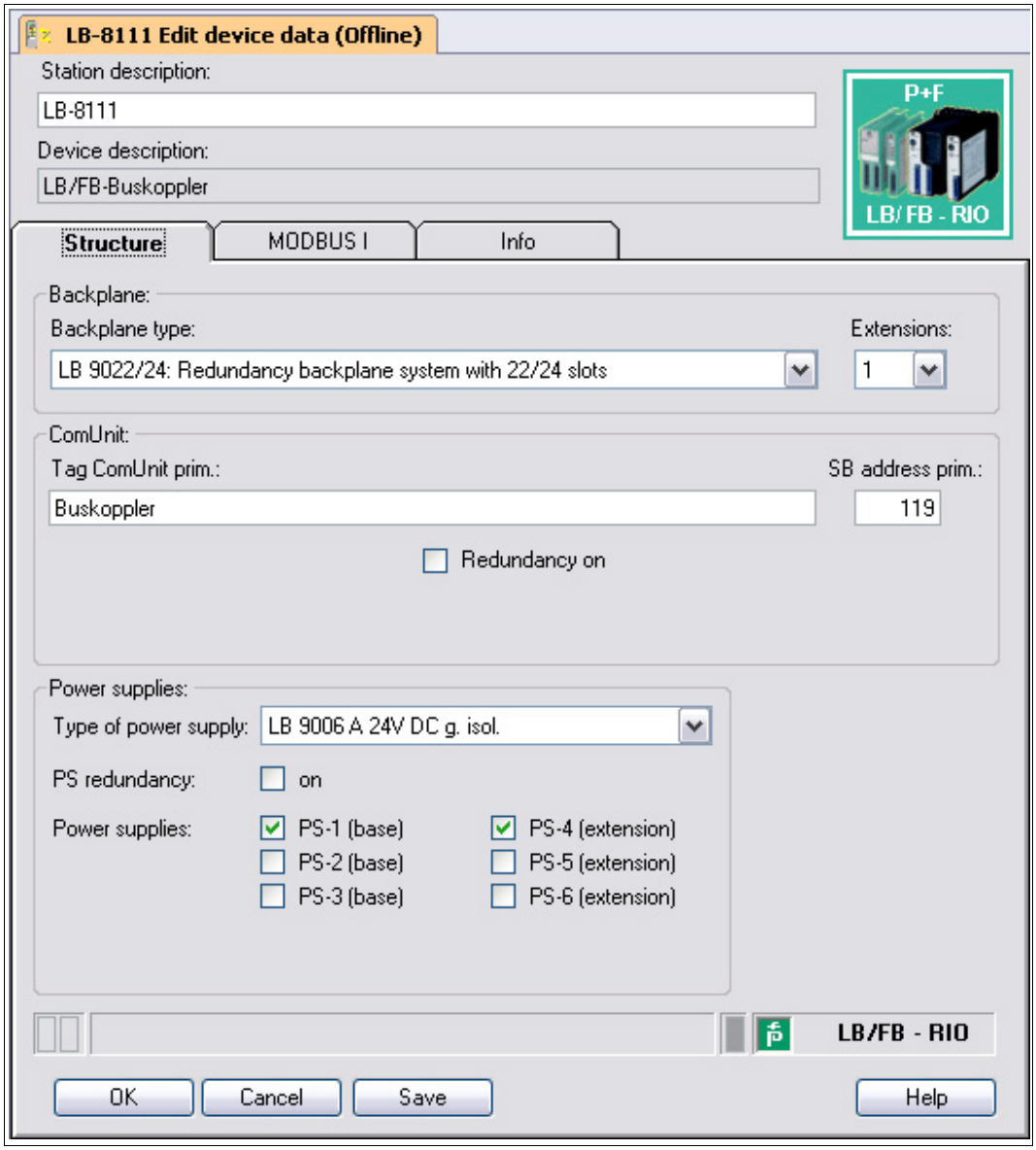

Figure 4.8 Edit Device Data (Offline)

3. Modify the relevant parameters.
4. Click on **OK** to save the settings and close the window or on **Save**.

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

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Online Parameterization

1. Right-click on the entry for the com unit or an I/O module in the project structure.
2. Select **Parameter > Online Parameterization > Edit Device Data (Online)**.

   ↳ The **Edit Device Data (Online)** window containing the online data record opens. The yellow box in the status bar indicates the online status.

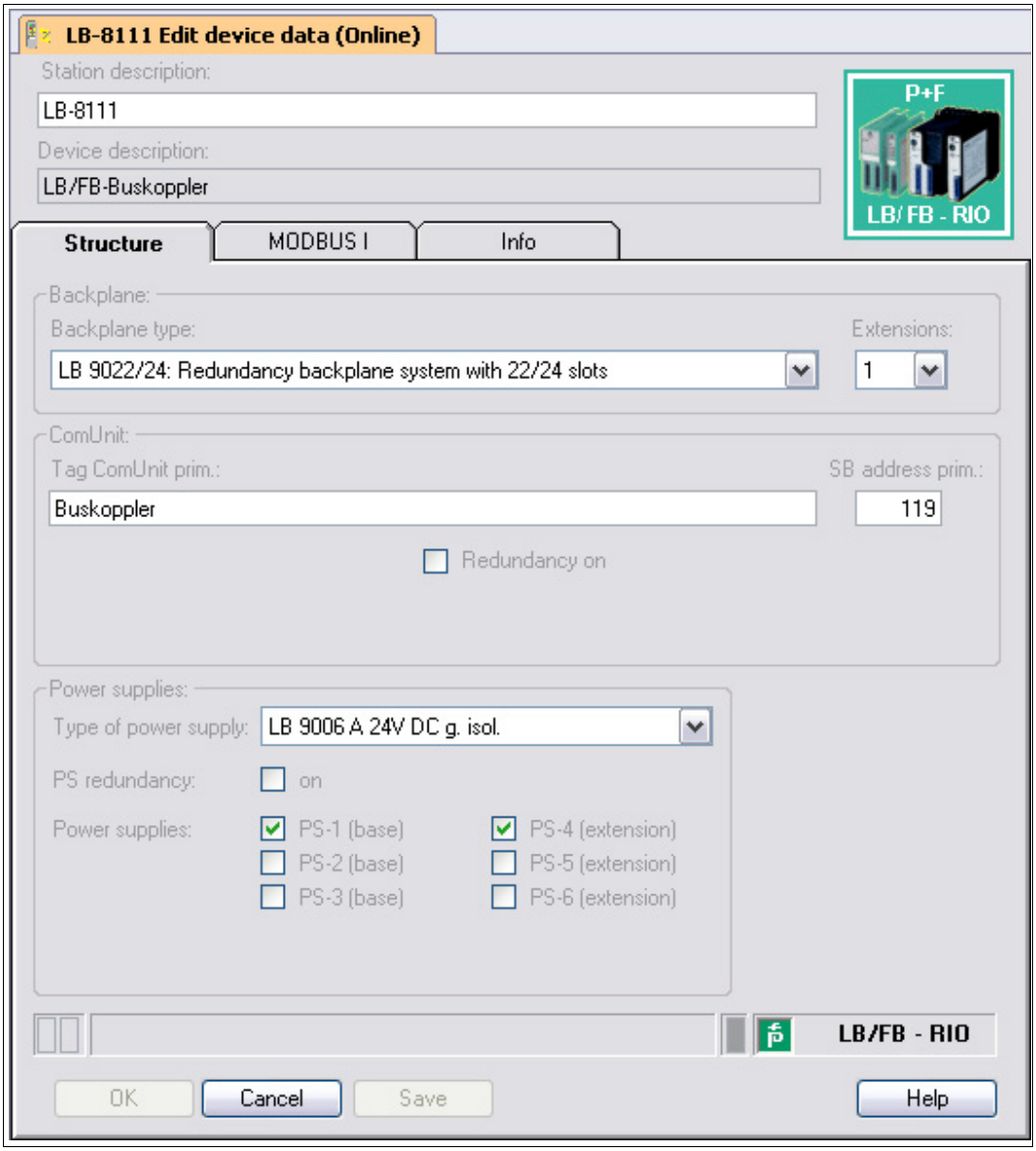

Figure 4.9 Edit Device Data (Online)

3. Modify the relevant parameters.
4. Click on **OK** to save the settings and close the window or on **Save**.

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

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4.7 Setting the Application Mode

Select the appropriate parameters for your application.

Note!

Application-mode parameters can be edited offline only. To disconnect from the com unit, right-click on the com unit entry in the project structure and select **Disconnect**.

Setting the Application Mode

1. Right-click on the com unit entry in the project structure.
2. Select **Additional Functions > Set Application Mode**.

   ↳ The **Set Application Mode** window opens.

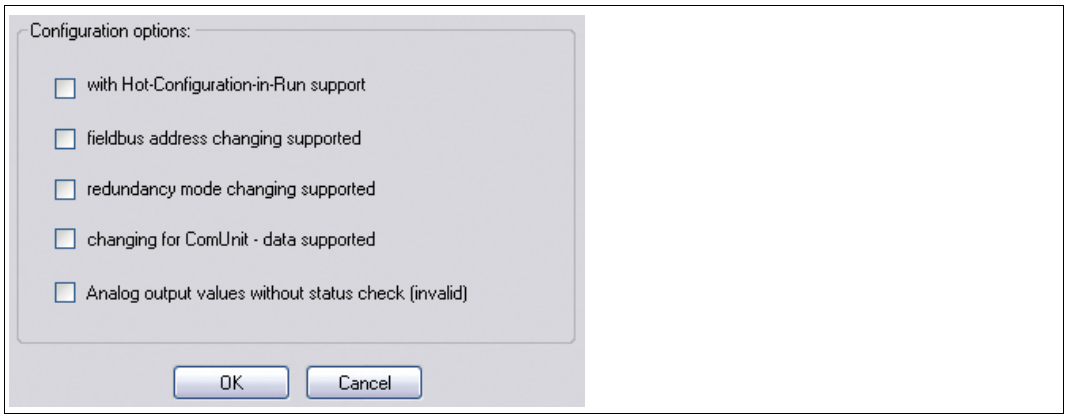

Figure 4.10 Edit the application mode parameters

3. The **with Hot-Configuration-in-Run support** function refers to PROFIBUS connections and is not relevant to MODBUS. The check box is therefore disabled by default.
4. The input box for bus addresses in the device data window for the com unit cannot be edited by default. To edit the bus address, enable the **Selection option for fieldbus address supported** check box.
   You must enter the MODBUS address of the com unit manually if the check box is activated. To do so, open the device data window for the com unit and select the **MODBUS I** tab. See chapter 4.10.2
5. If you wish to select the media redundancy and application redundancy manually, activate the **Selection option for redundancy mode supported** check box.
   You can edit the redundancy type in the com unit device data window on the **MODBUS I** tab. See chapter 4.10.2
6. The **Selection option for com unit data supported** function is not relevant to MODBUS as global status/command register data is transmitted only. Other data is not available for selection. The check box is therefore disabled by default.
7. Analog output values are transferred by default to the remote I/O system as 16-bit data consisting of a 12-bit measured value and a 4-bit status area. The status area includes an invalidity bit, which indicates whether the 12-bit measured value is valid (0) or invalid (1).
   If the measured value is invalid, the preset substitute value strategy is initiated. Examples of the transferred substitute value include 0%, 100%, the current value, or the last valid value.
   If the process control system issues measured values that use all 16 bits, the invalidity bit may be set unintentionally depending on the measured value. The measured value then depends on the substitute value strategy and may not be realistic.
   To disable the evaluation function for the invalidity bit, enable the **Analog output values without status check** check box. With 16-bit measured values, the transmitted value is always issued when the check box is enabled. The substitute value strategy is initiated only if an error such as a loss of communication occurs.
8. Click on **OK** to confirm your entries.

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4.8 Selecting Firmware-Dependent Functions

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

Note!

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

Opening and Editing the "Select Firmware-Dependent Functions" Window

Close all other DTM windows and disconnect from the com unit before opening the **Select firmware-dependent functions** window. Otherwise the window cannot be opened.
If you connect to the com unit while the **Select firmware-dependent function** window is open, you will not be able to save your parameter changes.

1. Right-click on the com unit in the project structure.
2. In the context menu, select **Parameters > Parameterization > Select firmware-dependent functions**.

   ↳ The **Select firmware-dependent functions** window opens. If there are no firmware-dependent functions, the window remains empty.
3. To activate a function, select the check box for the function in question. The required com unit firmware version is shown in the **Com unit firmware version** field according to the functional scope selected.
   Alternatively, you can enter a firmware version in the **Com unit firmware version** field and click on **Set FW functions** to enable all firmware-dependent functions supported by this version.
4. To save your selection and close the window, click on **OK**.

4.9 Configuring the IP Address for LB8111* / FB8211*

Note!

The information below applies to com units LB8111* and FB8211* only.

4.9.1 Introduction

IP Address According to IPv4

Every device in a TCP/IP network has an IP address. The IP address makes the device accessible within the network. The IP address is a 32-digit binary number that is usually represented by 4 decimal numbers between 0 and 255. Some address areas are reserved for specific applications.
An example of an IP address is 192.168.2.56.

Subnet Mask

The subnet mask a 32-digit binary number, like the IP address. The mask divides an IP address into a network part (network address) and a device part (device address). The network addresses of all devices within an IP network must be identical. However, the device addresses of these devices must be different so that each device can be addressed uniquely.

Example:
The subnet mask 255.255.255.0 indicates that the first 3 numbers of an IP address are the network address (x) and the last number is the device address (y): xxx.xxx.xxx.yyy
The subnet mask 255.255.0.0 indicates that the first 2 numbers of an IP address are the network address (x) and the last 2 numbers are the device address (y): xxx.xxx.yyy.yyy
Examples of valid IP addresses in a network with the subnet mask 255.255.255.0 and the network address 192.168.2.0 would therefore be 192.168.2.8 or 192.168.2.251, but not 192.168.134.31

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The longer the network address, the smaller the network because with a long network address, fewer bits are available for the device addresses. For example, the maximum number of network devices is 254 for the subnet mask 255.255.255.0 and 65534 for the mask 255.255.0.0.

Example!

Breakdown of an IP Address into a Network Address and Device Address

- IP address: 192.168.45.56
- Subnet mask: 255.255.255.0
- Network address: 192.168.45.0
- Device address: 0.0.0.56

4.9.2 Assigning an IP Address

The com units LB8111* and FB8211* are supplied from the factory with the following settings.

- IP address: 0.0.0.0
- Subnet mask: 255.255.255.0

In networks with a DHCP server, the DHCP server assigns an IP address to the com unit automatically. This IP address is temporary and must either be assigned permanently or modified. There are two ways of setting an IP address.

1. The network can be scanned for TCP com units. The com units found can be listed and an IP address and a subnet mask can be assigned to each com unit.
2. Each com unit has a unique MAC address. An IP address can be assigned to the com unit using the MAC address. A scan is not necessary in this case. The MAC address can also be used to assign an IP address to a com unit if the scan is unsuccessful in locating the com unit.

In networks without a DHCP server, the com unit automatically generates a random IP address from the address range 169.254.X.Y (X = 0 ... 255, Y = 0 ... 255). In this case, you may have to modify the IP address of your PC in order to locate the com unit. See chapter 4.9.3
It is simpler, however, to allocate a new IP address to the com unit using the MAC address.

Note!

IP Settings

The same subnet mask should be assigned to all com units in the network. If your network contains fewer than 254 devices, you can use the preset subnet mask 255.255.255.0. The network part of the IP address **must** be the same for all com units and for the PC used to perform the scan. See chapter 4.9.1

Note!

Assigning IP Settings for Redundant Com Units

If the remote I/O station has redundant com units, the parameter data of the com units is automatically compared when a com unit is exchanged. The new com unit adopts the configuration of the existing com unit.

However, the IP address is **not** updated. Assign the IP address for the new com unit manually.

Setting the IP Address Using a Network Scan

1. Right-click on the com unit entry in the project structure.
2. Select **Additional Functions > IP Device Configuration**.

   ↳ The **IP Device Configuration** window opens.

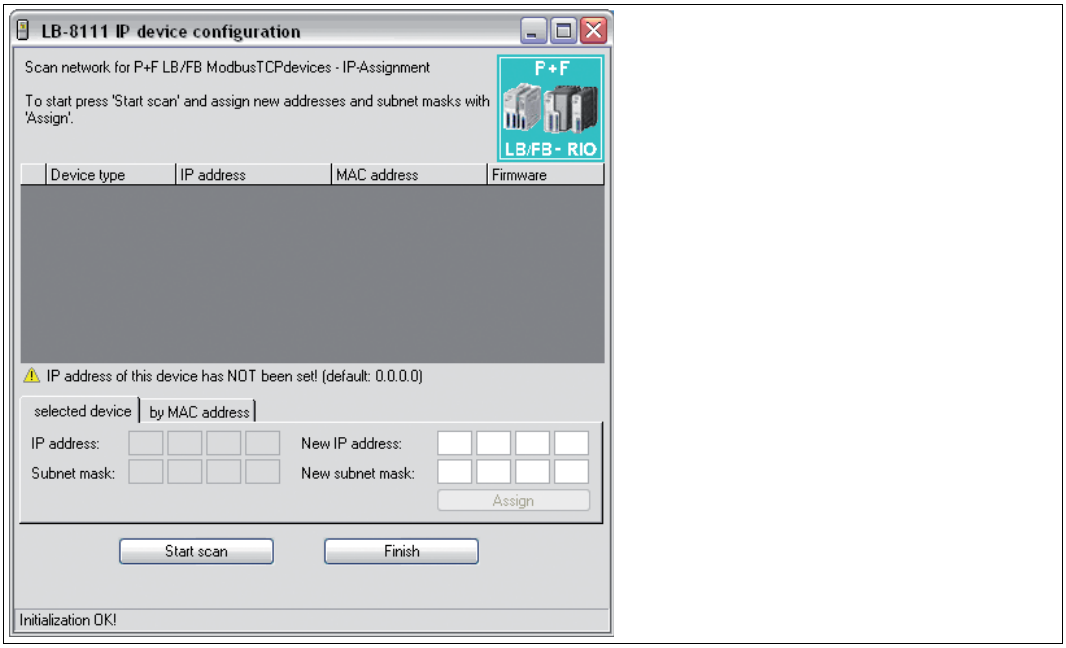

Figure 4.11 **IP device configuration** window

3. Click on the **Start Scan** button to start the scan.

   ↳ The network is scanned for com units and the devices located are displayed in a list. Devices with a yellow warning triangle still have the factory preset IP address 0.0.0.0. The displayed IP address is merely a temporary IP address assigned by the DHCP server and must be assigned permanently at a later time.

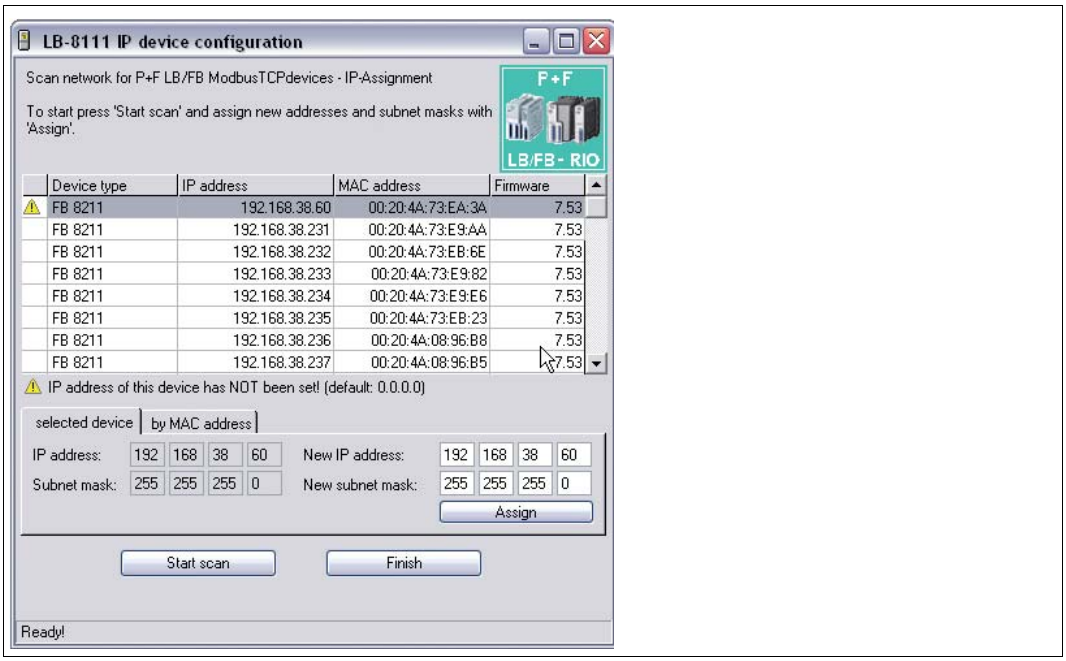

Figure 4.12 Result of the scan

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4. Select the required com unit from the list. In the example, the first com unit is selected which still has the default IP address.
5. Select the **Selected Device** tab.

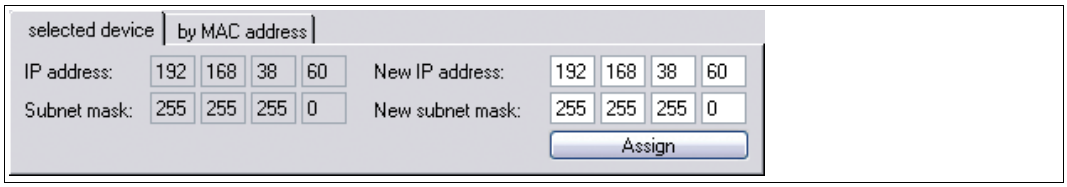

Figure 4.13 **Selected Device** tab

6. Use the IP address suggested by the DHCP server or enter a valid IP address that has not yet been allocated in the **New IP address** box.
7. If necessary, change the subnet mask in the **New subnet mask** box. The subnet mask should be the same for all network devices. See chapter 4.9.1
8. Click **Set**.

   ↳ A new scan starts automatically. The com unit appears without a yellow warning triangle with the new, permanent IP address.
9. Repeat the steps to set the IP address for another com unit. Once you have set all the IP addresses, click **Finish**.

Setting the IP Address Using the MAC Address

1. Right-click on the com unit entry in the project structure.
2. Select **Additional Functions > IP Device Configuration**.

   ↳ The **IP Device Configuration** window opens.

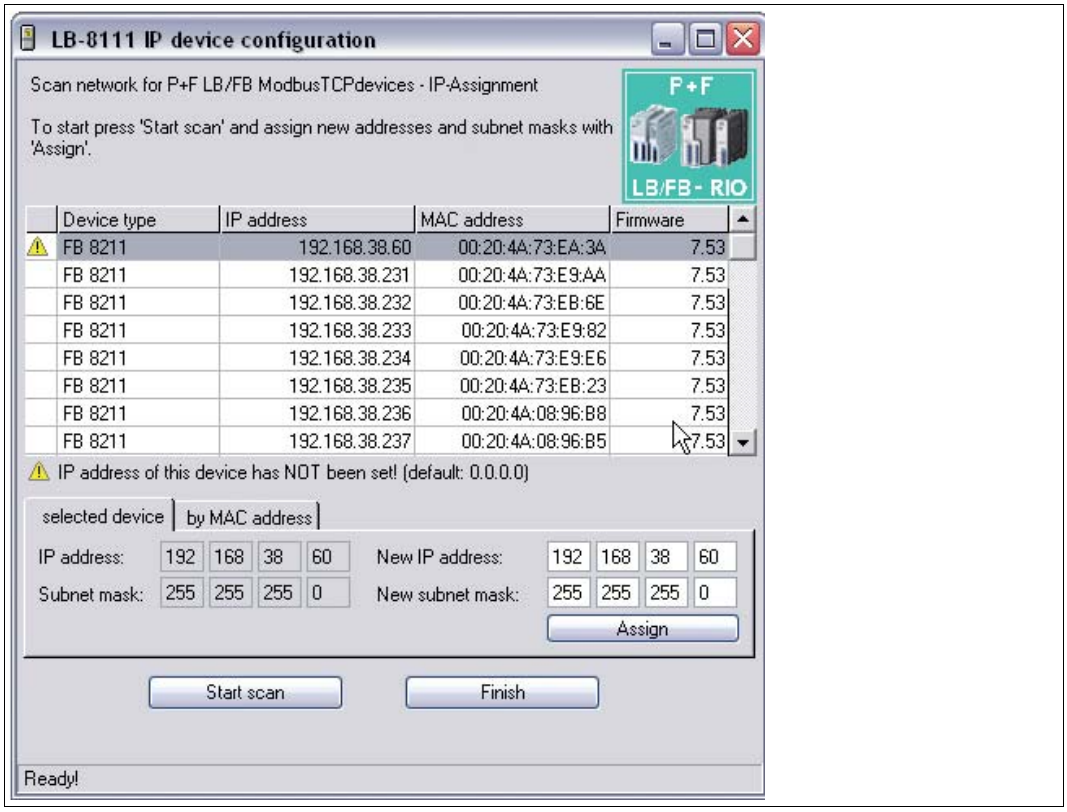

Figure 4.14 Result of the scan

3. Read the MAC address from the required com unit.

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4. Select the **Using MAC Address** tab.

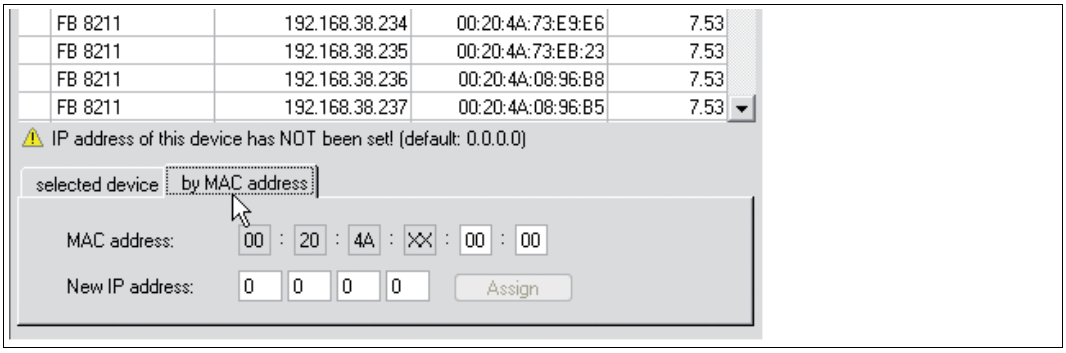

Figure 4.15 **by MAC address** tab with default IP address

5. Enter the last two elements of the MAC address under **MAC address**.
6. Enter a new, valid IP address in the **New IP address** box.

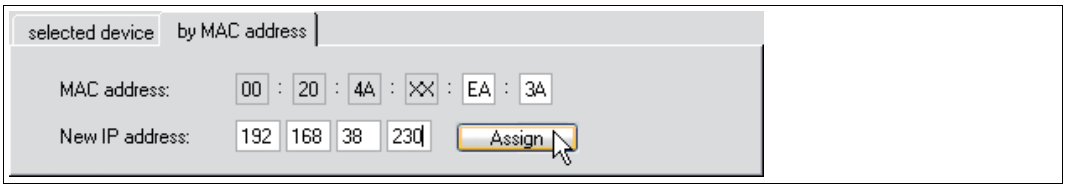

Figure 4.16 **Using MAC Address** tab

7. Click **Set**.

   ↳ A new scan starts automatically. The com unit appears without a yellow warning triangle with the new, permanent IP address.
8. Repeat the steps to set the IP address for another com unit. Once you have set all the IP addresses, click **Finish**.

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4.9.3 Modifying the IP Address of the PC

In networks with a DHCP server, the DHCP server assigns a temporary IP address to the com unit automatically. This temporary IP address can be used to locate the com unit via a scan.

In networks without a DHCP server, the com unit automatically generates a random IP address from the address range 169.254.X.Y (X = 0 ... 255, Y = 0 ... 255). In this case, you may have to modify the IP address of your PC in order to locate the com unit. Generally, the PC can locate only the com units whose IP address matches the IP address of the PC using the network scan. See chapter 4.9.1

Note!

You can assign an IP address to the com unit using the MAC address, irrespective of the IP address of your PC. See chapter 4.9.2

Modifying the IP Address of the PC

1. If you are using Windows® XP, select **Start > Settings > Control Panel > Network Connections**.
   If you are using Windows® 7, select the **Windows Symbol > Control Panel > Network and Sharing Center**
2. If you are using Windows® XP, right-click on **Local Area Connection** and select **Properties**.
   If you are using Windows® 7, click on **Local Area Connection** in the area **Show Active Connections** and then click on **Properties**.
   ↳ The **Local Area Connection Properties** window opens.

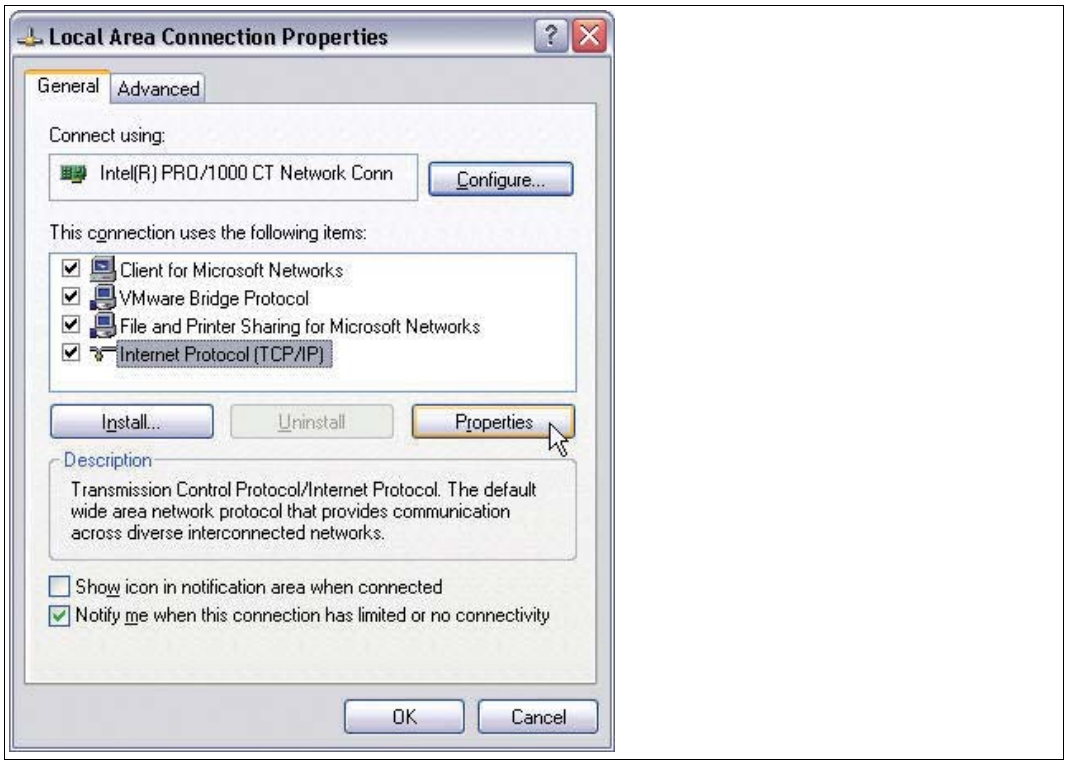

Figure 4.17 **Local Area Connection Properties** window

3. Select the entry **Internet Protocol (TCP/IP)** and then click on **Properties**.
   ↳ The **Internet Protocol (TCP/IP) Properties** window opens.
4. Select **Use the following IP address** and enter a free IP address in the **IP address** field that has the same network part as the IP address of the com unit, e.g., 169.254.1.1.

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5. Enter a suitable **subnet mask**, e.g., 255.255.0.0.

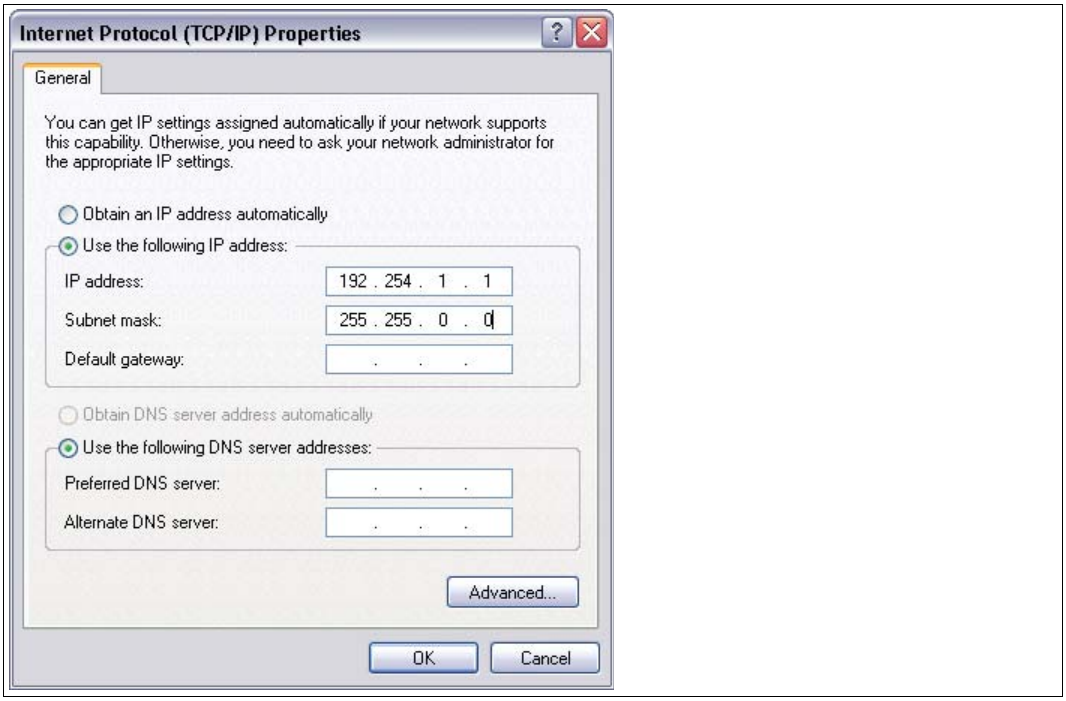

Figure 4.18 Setting the IP address

6. Click **OK**.

   ↳ The com unit with the IP address 169.254.X.Y can now be located via the network scan. See chapter 4.9.2

4.10 Editing Com Unit Device Data

Note!

Remote I/O stations can be configured with version 7.5 or later of the DTM.

- LB8107* / FB8207*

  The device data window of the com unit is divided into tabs: **Structure**, **MODBUS I**, **MODBUS II**, and **Info**.

- LB8111* / FB8211*

  The device data window of the com unit is divided into tabs: **Structure**, **MODBUS I**, and **Info**.

The tabs **Structure** and **Info** are identical for the two com units. To edit the tabs, first open the device data window.

Opening the Device Data Window of the Com Unit

Note!

For more information about the general structure of the device data window, see chapter 5.1.

1. Right-click on the com unit entry in the project structure.
2. Depending on the connection status, select **Parameters > Parameterization > Edit Device Data** or **Parameters > Online Parameterization > Edit Device Data**.

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↳ The **Edit Device Data** window opens.

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

4.10.1 "Structure" Tab

On the **Structure** tab, you can modify any settings affecting the structure of the remote I/O station, such as the backplane type, extensions, and connected power supplies used.

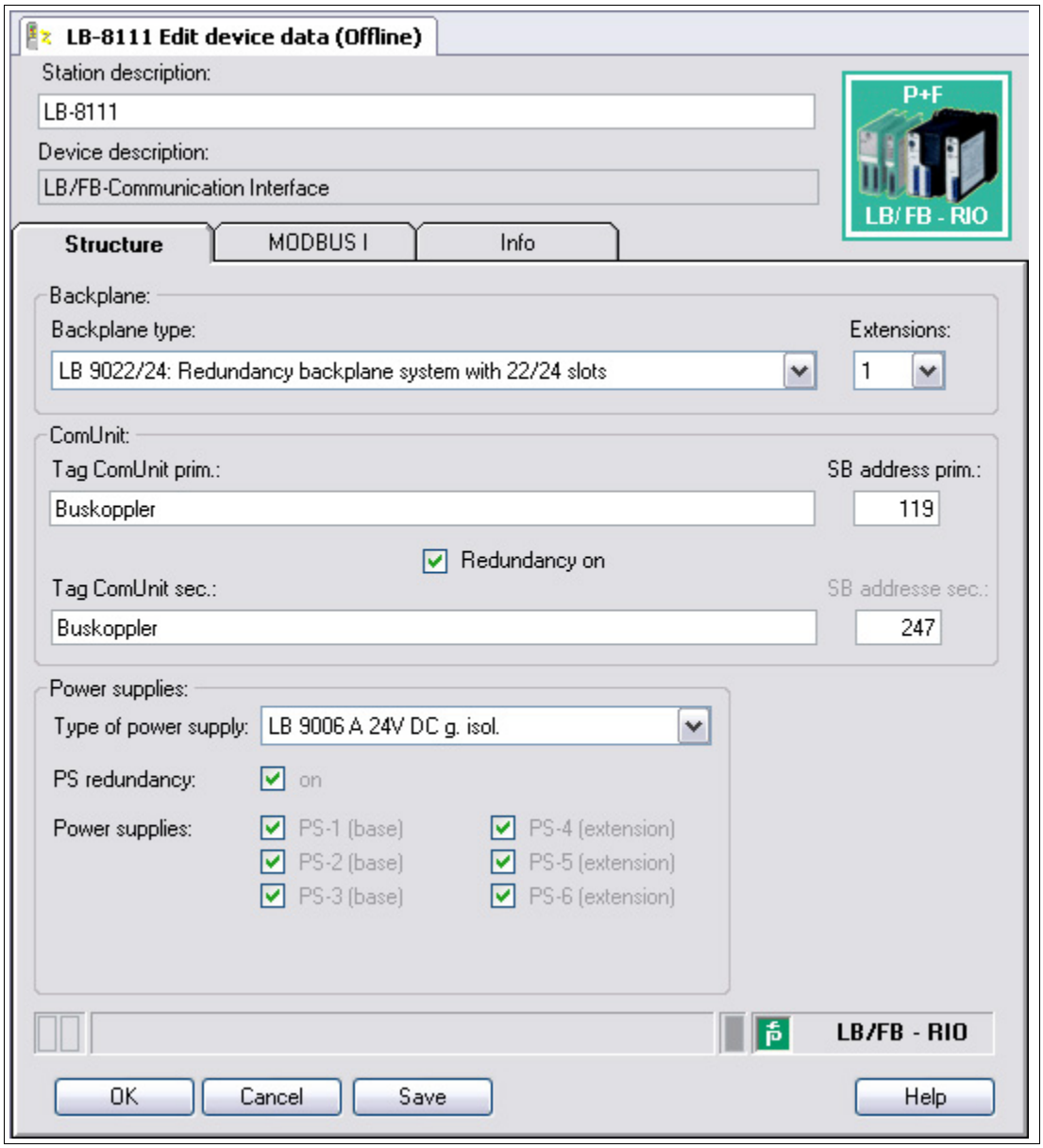

Figure 4.19 Structure tab

Note!

Offline Parameters

The following parameters can be edited offline only.

- **Backplane type**
- **SB address pri.**
- **Enabling redundancy**

Field	Explanation
Station description	This field is prepopulated. You can overwrite this description with a new station description if you wish (max. 32 characters).
Device description	Contains a description of the com unit and cannot be edited.
Backplane type	Select the backplane type used in the remote I/O station. This setting determines which power supply types are available, as well as the number of possible extensions. The "redundant system with 22/24 module slots (LB 9022/24)" type is selected in the example.
Extensions	Specify here whether an extension to the base backplane is available. 0: no extension available 1: extension available The selection of available extensions depends on the backplane system and may vary from 0 ... 5 extensions. Example: You are using the base backplane LB9022 with 22 slots. If you select 1, a remote I/O station with 46 slots is configured (base backplane with 22 slots + extension backplane LB 9024 with 24 slots).
Primary com unit tag	Contains the description for the primary com unit. Enter up to 32 characters.
SB address pri.	Enter the service bus address of the primary com unit.
Enabling redundancy	The check box can only be edited offline without any active connection to the Remote I/O station. If **Redundancy on** is enabled, additional entry options for the secondary com unit tag and the service bus address appear on the **Structure** tab. The status of this check box affects the adjustment options for the connected power supplies displayed in the **Power supplies** area (redundancy = com unit and power supply redundancy).
Secondary com unit tag	Contains the description for the secondary com unit (redundant com unit). Enter up to 32 characters. This field only appears when **Redundancy on** is activated.
SB address sec.	Contains the service bus address of the secondary com unit. This address is allocated automatically based on the address of the primary com unit and cannot be edited. This field only appears when **Redundancy on** is activated.

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Field	Explanation
Type of power supply	Select the power supply. The options depend on the item selected in the **Backplane type** drop-down list.
Power supply redundancy	If the overall Remote I/O station is supplied via redundant power supplies, the **PS redundancy** auxiliary function can be enabled in DTMs version 7.5.1 and higher. If **PS redundancy** is enabled, the remaining power available will be calculated such that the station is still adequately supplied in the event of a power supply failure. If **Redundancy on** is enabled, power supply redundancy is set automatically.
Connected power supplies	Activate the check boxes to specify which connected power supplies you wish to monitor. The number of check boxes depends on the settings in the **Type of power supply**, **Backplane type**, and **Extensions** drop-down lists. In redundant systems, power supply monitoring is automatically activated for all existing power supply slots and cannot be deactivated (power supply redundancy).

Note!

Information on Redundancy

Further information about redundancy (basics, redundancy types, power supply redundancy) can be found in the hardware manual for LB or FB Remote I/O systems.

4.10.2 "MODBUS I" Tab

You can set various bus communication parameters on the **MODBUS I** tab.

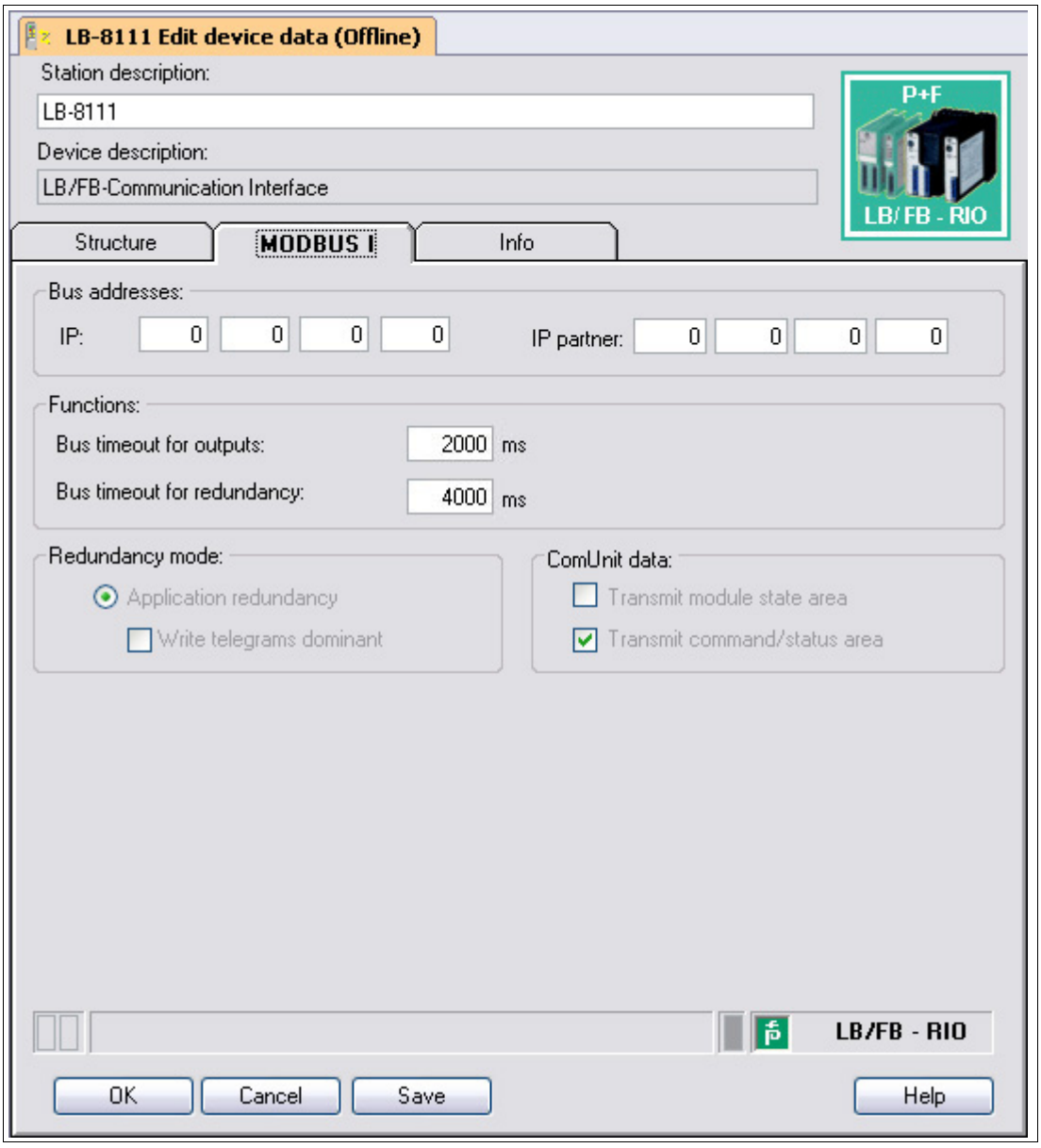

Figure 4.20 LB8111* / FB8211* MODBUS I tab

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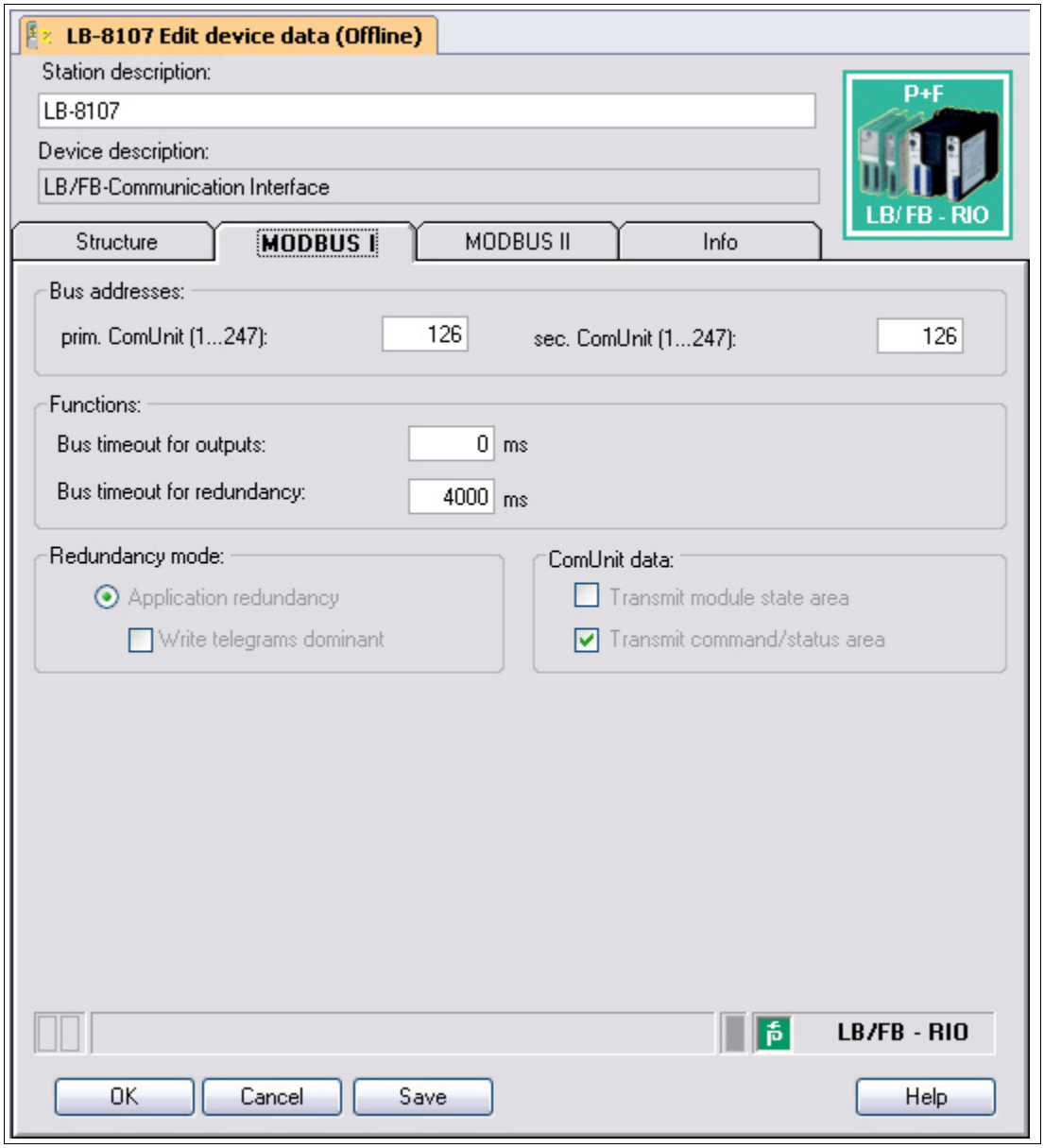

Figure 4.21 LB8107* / FB8207* MODBUS I tab

Note!

Offline Parameters

The following parameters can be edited offline only.

- **Bus addresses**
- **Redundancy mode**
- **Com unit data**

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Field		Explanation
LB8111* / FB8211*	IP	Displays the IP address of the primary com unit. You can allocate a new IP address to the com unit using a network scan or using the MAC address. See chapter 4.9.2
	IP partner	Displays the IP address of the redundant com unit. You can allocate a new IP address to the com unit using a network scan or using the MAC address. See chapter 4.9.2 When replacing a redundant com unit, the new com unit adopts the configuration of the existing com unit. However, the IP address is **not** updated. Assign the IP address for the new com unit manually. See chapter 4.9.2
LB8107* / FB8207*	Primary com unit	Enter the MODBUS address of the primary com unit. This box is write-protected by default. To deactivate the write protection, enable the **Selection option for fieldbus address supported** check box in the **Set Application Mode** window. See chapter 4.7
	Secondary com unit	Enter the MODBUS address of the redundant com unit. This box is write-protected by default. To deactivate the write protection, enable the **Selection option for fieldbus address supported** check box in the **Set Application Mode** window. See chapter 4.7
Watchdog outputs	Specify a time span in ms after which the outputs are to enter error mode in the event of a bus communication failure. The **watchdog outputs** should be at least double the value of the **watchdog redundancy**. See chapter 5.4.2	
Watchdog redundancy	Specify a time span in ms after which redundancy switchover occurs in the event of a bus communication failure. The **watchdog outputs** should be at least double the value of the **watchdog redundancy**. See chapter 5.4.2	

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Field	Explanation
Redundancy mode	Select the redundancy type. This area only appears if you have enabled the **Redundancy on** check box on the **Structure** tab. This area can be edited only when you enable the **Selection option for redundancy mode supported** check box in the **Edit Application Mode** window. See chapter 4.7 **Application redundancy**: both com units participate in bidirectional data exchange. The master uses the global status register to check which com unit is active. If the **Write telegrams dominant** function is activated, the active com unit is determined based on the writing MODBUS telegrams. The com unit which receives writing MODBUS telegrams is active or becomes active. This function is designed for master systems that can read on one bus line only (passive line) and that can read and write on the other bus line (active line). If **Write telegrams dominant** is activated, the active com unit is always on the active bus line (read and write) by default.
Com unit data	This area cannot be edited because the com unit data is predefined. The module status is not provided via the allocated area. Detailed module status information is available for evaluation outside of the allocated area. The command/status register is provided via the allocated area by default. The command/status register can be used to monitor and control the status of com units.

Note!

Information on Redundancy

Further information about redundancy (basics, redundancy types, power supply redundancy) can be found in the hardware manual for LB or FB Remote I/O systems.

4.10.3 "MODBUS II" Tab

Note!

The information below applies to com units LB8107* and FB8207* only.

You can set data transfer parameters on the **MODBUS II** tab.

Figure 4.22 MODBUS II Tab

Field	Explanation
Baud rate	Select the baud rate for data transfer. The baud rate of the com unit must match the baud rate of the master.
Parity	Select the parity to be used by the com unit when checking and generating data packets. Parity is used to detect data transmitted incorrectly. The setting in the master and in the com unit must be identical.

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4.10.4 "Info" Tab

The **Info** tab contains information on com units and power supplies. You also have the ability to enter notes.

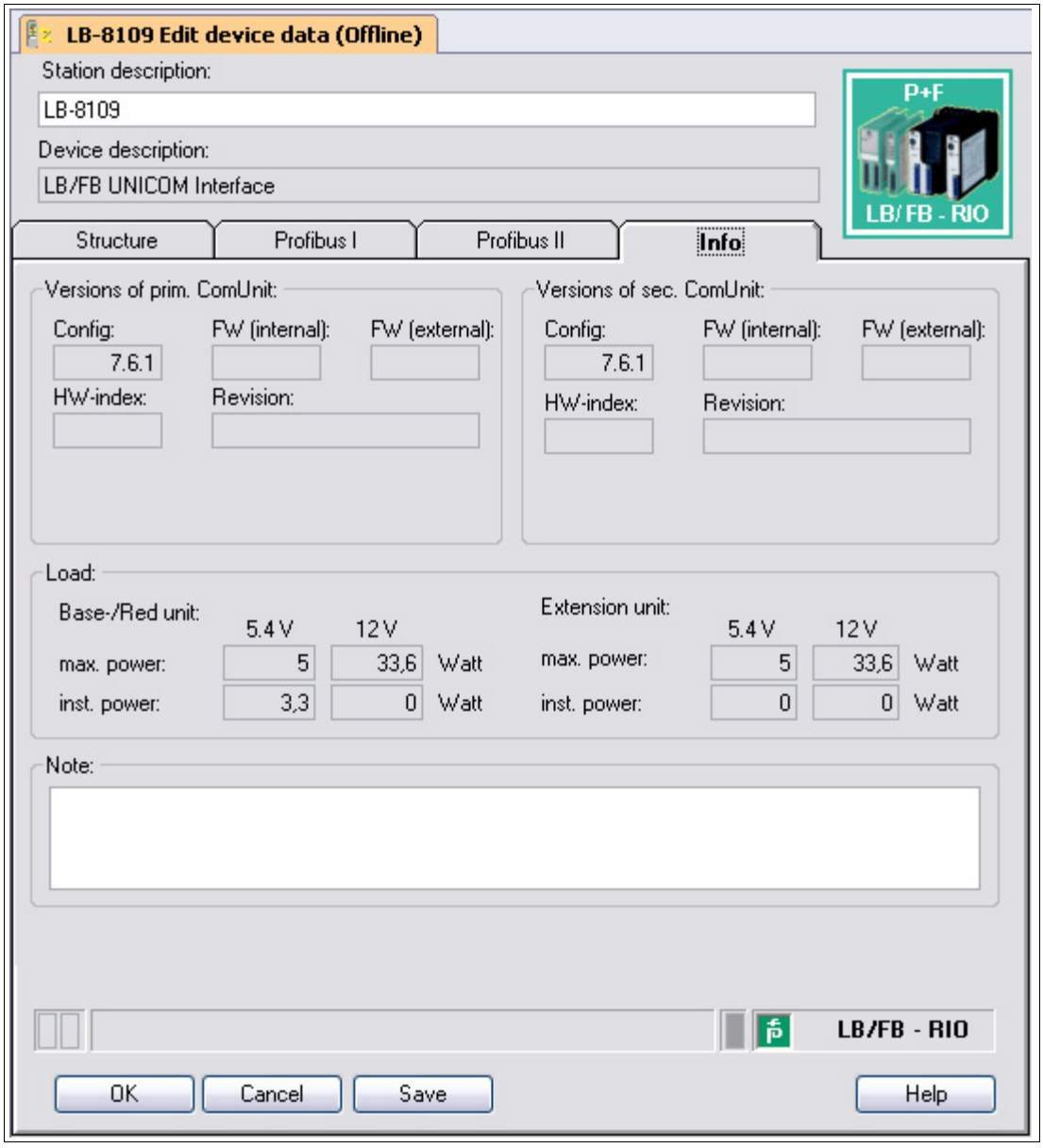

Figure 4.23 Info tab

Field	Explanation
Primary com unit versions	This area contains the following non-editable fields that contain information on the primary com unit. **Config**: DTM version **FW (internal)**: firmware version PIC (cannot be changed) **FW (external)**: firmware version (can be changed by service) **HW index**: com unit hardware version (currently not supported) **Revision counter**: revision status of the parameters
Secondary com unit versions	This area behaves in the same way as the **Primary com unit versions** area. This area can only be viewed if you have enabled the **Redundancy on** check box in the **Structure** tab.

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Field	Explanation
Load	This area contains non-editable fields that contain information about the load. Power rating values appear in the fields after the slots on the backplane are populated with actual I/O modules. During configuration, the Device Type Manager (DTM) identifies any potential overload situations and flags this for the user. The user is then prevented from adding a module to the backplane in the case of overload.
Note	Enter your own notes. The text is saved in the database and not in the com unit.

4.11 Configuring MODBUS Registers

The com unit provides different register areas for the process data. MODBUS telegrams can be used to access these register areas. Two options are available here:

- **Allocated area**

  The process data can be allocated within the **digital output signals**, **digital input signals**, **analog input signals**, and **analog output signals** register areas. In this way, you can optimize the data volume and number of telegrams during data transfer.

- **Slot-based register organization**

  The address of the process value is determined with reference to the slot, e.g., start address + slot number.

Tip

We recommend accessing the process data via the allocated area. The allocation window displays a list of all configured modules with associated address ranges. Manual calculation of the addresses is not required.

4.11.1 Allocating Process Data

As soon as an I/O module is added to the project structure, it is automatically assigned to the first free slot in the relevant register area. It does not matter which slot this I/O module occupies.

There is a separate allocation table for each signal type. Entries relating to I/O modules with input and output signals appear in two allocation tables. For more information about the data volumes and data structure of individual I/O modules, see see chapter 6.

The **Address mode** button allows you to choose how the addresses of the process values should be displayed. Base your selection on the address type used in the master.

- Direct addressing: access via function code and address designation
- MODICON addressing: access using the address designation

Caution!

Failure of process data during allocation

Whenever you allocate process data, the access address of the relevant process value changes. If the master is accessing this process value at that precise moment, modifications to the address cause the relevant process value to fail.

Before allocating process data, make sure that the master is not accessing the process data

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Allocating Process Data

Note!

External system components such as the master can lock the process data of individual I/O modules to prevent it being allocated. Disabled process data in the allocation tables is gray and cannot be moved.

1. Right-click on the entry for the com unit in the project view.
2. Select **Parameter > Parameterization > Modbus Configuration**.

   ↳ The **Modbus Configuration** window opens.

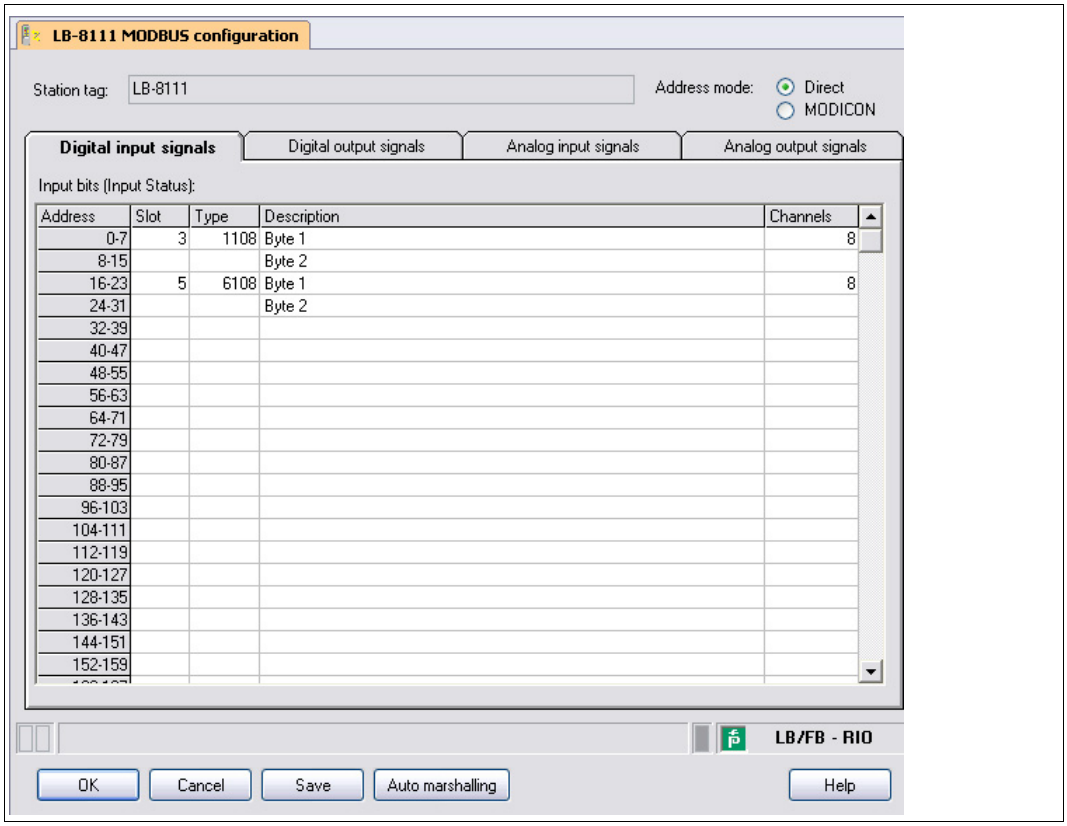

Figure 4.24 **Modbus Configuration** window

3. If there is a connection with the com unit, disconnect this connection. Process data can be allocated offline only.
4. Move the process data of the I/O modules within the tables to the individual tabs using the drag & drop function or select **Auto allocation**. If you select **Auto allocation**, the process data in all four tables is sorted by ascending slot number. Process data accessed by the process master can also be allocated.
5. Click **OK** to save your changes in the project file.
6. To write the allocation information to the com unit, right-click the com unit and select **Store to Device**.

   ↳ A prompt appears in a dialog box asking whether you wish to establish a connection to the device.
7. Click **Yes** to confirm the prompt.

   ↳ The data is then written to the device.

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If there are lots of gaps between the process data in the allocation table and an additional I/O module is added, there may be insufficient continuous memory for the additional I/O module. In such cases, the allocation window is disabled and the allocation cannot be saved. To eliminate this problem, exit the allocation window without saving and remove the additional I/O module. Optimize the allocation and then add the additional I/O module again.

Allocable Digital Process Data

I/O module	Digital input signals	Digital output signals
LB/FB1*01, LB/FB1*02	1 byte	–
LB1007, LB/FB1*08, LB/FB1*09, LB1014, LB1015	2 byte	–
LB/FB2*	1 byte	1 byte
LB/FB6*01	–	1 byte
LB/FB6*05	1 byte	1 byte
LB/FB6*06	2 byte	2 byte
LB/FB6*08	2 byte	2 byte
LB/FB6*1*	1 byte	1 byte

Allocable Analog Process Data

I/O module	Analog input signals	Analog output signals
LB/FB1*03	1 ... 3 words, depending on counter mode	–
LB/FB3*01, LB/FB3*02, LB/FB3*03	1 word	–
LB/FB3*04, LB/FB3*05, LB3*06	4 words	–
LB/FB4*01, LB/FB4*02	–	1 word
LB/FB4*04, LB/FB4*05, LB4106	1 word	4 words
LB/FB5*01, LB/FB5*02, LB/FB5*06	1 word	–
LB/FB5*04, LB/FB5*05	4 words	–
LB/FB7*04	4 words	4 words
LB/FB8*07, LB/FB8*11	1 word	1 word

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4.11.2 Access to MODBUS Registers

The addresses of the components in a remote I/O station must be accessed depending on the requirements of the master. The DTM prepares the required address information for **direct addressing** and for **MODICON addressing**.

The following tables contain the function codes which can be used to activate the different address ranges.

Addressing Overview

Data type	1 bit		16 bit	
	Input bits (discreet inputs)	Output bits (coils)	Input registers	Output registers (holding registers)
Signal type	digital	digital	analog	analog
Function code **read**	02	01	04	03
Function code **single write**		05		06
Function code **multiple write**		15		16
Address range for addressing[1]	0 ... 65535	0 ... 65535	0 ... 65535	0 ... 65535
MODICON addressing reference range[2]	10000 ... 19999	0 ... 9999	30000 ... 39999	40000 ... 49999

[1] Function code required
[2] MODICON addressing does not require a function code.

Table 4.1 Addressing overview

Function code	Meaning
01	Read coils
02	Read discreet inputs
03	Read holding registers
04	Read input register
05	Write single coil
06	Write single register
08	Diagnostics
15	Write multiple coils
16	Write multiple registers

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4.11.3 Assigning an Address to Digital Inputs

Digital inputs (discreet inputs) are activated according to the following table.

In addition to the actual process data, module status information is also stored in the digital input signals area. See chapter 7
The following tables only document access information.

Direct addressing uses function codes. MODICON addressing does not recognize function codes. The tables below describe both direct addressing and MODICON addressing.

To determine the address of a specific component, insert the slot number of the component into the relevant formula. Slots 0 and 49 are reserved for com units. Slot 50 is reserved for power supplies. Slots 1 ... 48 are reserved for I/O modules.

Digital Input Signals: Direct Addressing via Function Code 2 (Read)

Offset	Access/ structure	Description	Formula/access	Slot	Bit no.
0	Bit/byte	Allocated inputs, digital range	See table "Addressing Overview" on page 49	–	–
1024	Bit/byte	Inputs, digital range, 8 bits per slot; Input modules: LB/FB1*01, LB/FB1*02, LB/FB1*08 Output modules (status): LB/FB2*, LB/FB6*05, LB/FB6*06, LB/FB6*08, LB/FB6*1*	Channel 1 ... 4: Offset + (8 * slot) + bit no. - 1 Channel 5 ... 8: Offset + (8 * (slot + 1)) + bit no. - 1	0 ... 50	1 ... 8
2048	Bit/byte	Module status	Offset + (8 * slot) + bit no. - 1	0 ... 50	1 ... 8
5120	Bit/2 bytes	Inputs, digital range, 16 bits per slot, I/O modules LB1007, LB/FB1*09, LB1014, LB1015	Offset + (16 * slot) + bit no. - 1	1 ... 48	1 ... 16

Digital Input Signals: MODICON Addressing

Offset	Access/ structure	Description	Formula/access	Slot	Bit no.
10001	Bit/byte	Allocated inputs, digital range	See table "Addressing Overview" on page 49	–	–
13001	Bit/byte	Inputs, digital range, 8 bits per slot; Input modules: LB/FB1*01, LB/FB1*02, LB/FB1*08 Output modules (status): LB/FB2*, LB/FB6*05, LB/FB6*06, LB/FB6*08, LB/FB6*1*	Channel 1 ... 4: Offset + (8 * slot) + bit no. - 1 Channel 5 ... 8: Offset + (8 * (slot + 1)) + bit no. - 1	0 ... 50	1 ... 8
14001	Bit/byte	Module status	Offset + (8 * slot) + bit no. - 1	0 ... 50	1 ... 8
16001	Bit/2 bytes	Inputs, digital range, 16 bits per slot, I/O modules LB1007, LB/FB1*09, LB1014, LB1015	Offset + (16 * slot) + bit no. - 1	1 ... 48	1 ... 16

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4.11.4 Assigning an Address to Digital Outputs

Digital outputs (coils) are activated according to the following tables.

Direct addressing uses function codes. MODICON addressing does not recognize function codes. The tables below describe both direct addressing and MODICON addressing.

To determine the address of a specific component, insert the slot number of the component into the relevant formula. Slots 0 and 49 are reserved for com units. Slot 50 is reserved for power supplies. Slots 1 ... 48 are reserved for I/O modules.

Digital Output Signals: Direct Addressing via Function Code 1 (Read), 5 (Single Write), 15 (Multiple Write)

Offset	Access/ structure	Description	Formula/access	Slot	Bit no.
0	Bit/byte	Allocated outputs, digital range	See table "Addressing Overview" on page 49	–	–
1024	Bit/byte	Outputs, digital range, 8 bits per slot, I/O modules LB/FB2*, LB/FB6*01, LB/FB6*05, LB/FB6*06, LB/FB6*08, LB/FB6*1*	Channel 1 ... 4: Offset + (8 * slot) + bit no. - 1 Channel 5 ... 8: Offset + (8 * (slot + 1)) + bit no. - 1	1 ... 48	1 ... 8

Digital Output Signals: MODICON Addressing

Offset	Access/ structure	Description	Formula/access	Slot	Bit no.
1	Bit/byte	Allocated outputs, digital range	See table "Addressing Overview" on page 49	–	–
3001	Bit/byte	Outputs, digital range, 8 bits per slot, I/O modules LB/FB2*, LB/FB6*01, LB/FB6*05, LB/FB6*06, LB/FB6*08, LB/FB6*1*	Channel 1 ... 4: Offset + (8 * slot) + bit no. - 1 Channel 5 ... 8: Offset + (8 * (slot + 1)) + bit no. - 1	1 ... 48	1 ... 8

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4.11.5 Assigning an Address to Analog Inputs

Analog inputs (input registers) are activated according to the following tables.

In addition to the process data, status information such as the status register, type register, and redundancy status is also stored in the analog input signals area. See chapter 7
The following tables only document access information.

Direct addressing uses function codes. MODICON addressing does not recognize function codes. The tables below describe both direct addressing and MODICON addressing.

To determine the address of a specific component, insert the slot number of the component into the relevant formula. Slots 0 and 49 are reserved for com units. Slot 50 is reserved for power supplies. Slots 1 ... 48 are reserved for I/O modules.

Analog Input Signals: Direct Addressing via Function Code 4 (Read)

Offset	Access/structure	Description	Formula/access	Slot	Bit no.
0	Word/word	Allocated inputs, analog range	See table "Addressing Overview" on page 49	–	–
256	Word/word	Inputs, analog range, 1 word per slot, input modules: LB/FB1*03[1], LB/FB3*01, LB/FB3*02, LB/FB3*03, LB/FB5*01, LB/FB5*02, LB/FB5*06 Output modules (status): LB/FB4*04, LB/FB4*05, LB4106	Offset + slot	1 ... 48	–
512	Word/word	Inputs, analog range, 2 words per slot, I/O modules LB/FB1*03[1], LB/FB3*04, LB/FB3*05, LB3*06 (channel 1 and 2), LB/FB5*04, LB/FB5*05, LB/FB7*04 (channel 1 and 2)	Offset + (2 * slot)	1 ... 48	–
640	Word/word	Inputs, analog range, 2 words per slot, I/O modules LB3*06 (channel 3 and 4), LB/FB7*04 (channel 3 and 4)	Offset (2 * slot)	1 ... 48	–
768	Word/word	Status Register	Offset + slot	0 ... 50	–
1024	Word/word	Type Register	Offset + slot	1 ... 48	–
1536	Word/byte	Redundancy status: 8 words	–	–	–
1792	Word/byte	Partner redundancy status. 8 words	–	–	–
2048	Word/byte	HART auxiliary variables: 24 bytes per slot (4 auxiliary variables), I/O modules LB/FB3*02, LB/FB3*03, LB/FB4*02	Offset + (12 * slot)	1 ... 48	–

[1] depending on the function type selected: The frequency input and the 12-bit counter input are in the 1-word range (from 256) depending on the configuration and the 32-bit counter input is in the 2-word range (from 512)

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Analog Input Signals: MODICON Addressing

Offset	Access/structure	Description	Formula/access	Slot	Bit no.
30001	Word/word	Allocated inputs, analog range	See table "Addressing Overview" on page 49	–	–
35000	Word/word	Inputs, analog range, 1 word per slot; input modules: LB/FB1*03[2], LB/FB3*01, LB/FB3*02, LB/FB3*03, LB/FB5*01, LB/FB5*02, LB/FB5*06 Output modules (status): LB/FB4*04, LB/FB4*05, LB4106	Offset + slot	1 ... 48	–
35100	Word/word	Inputs, analog range, 2 words per slot, I/O modules LB/FB1*03[2], LB/FB3*04, LB/FB3*05, LB3*06 (channel 1 and 2), LB/FB5*04, LB/FB5*05, LB/FB7*04 (channel 1 and 2)	Offset + (2 * slot)	1 ... 48	–
35200	Word/word	Status Register	Offset + slot	0 ... 50	–
35300	Word/word	Type Register	Offset + slot	1 ... 48	–
35400	Word/word	Inputs, analog range, 2 words per slot, I/O modules LB3*06 (channel 3 and 4), LB/FB7*04 (channel 3 and 4)	Offset + (2 * slot)	1 ... 48	–
35500	Word/byte	Redundancy status: 8 words	–	–	–
35600	Word/byte	Partner redundancy status. 8 words	–	–	–
35700	Word/byte	HART auxiliary variables: 24 bytes per slot (4 auxiliary variables), I/O modules LB/FB3*02, LB/FB3*03, LB/FB4*02	Offset + (12 * slot)	1 ... 48	–

[2] depending on the function type selected: The frequency input and the 12-bit counter input are in the 1-word range (from 35000) depending on the configuration and the 32-bit counter input is in the 2-word range (from 35100)

Note!

HART Auxiliary Variables

HART auxiliary variables from field devices connected to a type LB/FB3*02 or LB/FB4*02 I/O module are stored in the analog input signals area (offset 2048/35700). The first 4 HART auxiliary variables of each slot can be read.

To use the HART auxiliary variables, the HART functionality of the relevant I/O module must be activated (parameters "HART on" = active and "Internal scan on" = active, see chapter 6).

The HART auxiliary variables are updated less frequently than the process data. If the remote I/O station receives a new parameter set, HART communication must be restarted. During the initialization phase, no valid HART auxiliary variables are available. Following initialization, the HART auxiliary variables are read by a HART scan and made available again. The scan generally takes several seconds.

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4.11.6 Assigning an Address to Analog Outputs

Analog outputs (holding registers) are activated according to the following tables.

In addition to the process data, you can access the command register of the com unit in the analog output signals area. See chapter 4.12

Direct addressing uses function codes. MODICON addressing does not recognize function codes. The tables below describe both direct addressing and MODICON addressing.

To determine the address of a specific component, insert the slot number of the component into the relevant formula. Slots 0 and 49 are reserved for com units. Slot 50 is reserved for power supplies. Slots 1 ... 48 are reserved for I/O modules.

Analog Output Signals: Direct Addressing via Function Code 3 (Read), 6 (Single Write), 16 (Multiple Write)

Offset	Access/structure	Description	Formula/access	Slot	Bit no.
0	Word/word	Allocated outputs, analog range	See table "Addressing Overview" on page 49	–	–
256	Word/word	Outputs, analog range, 1 word per slot, I/O modules LB/FB4*01, LB/FB4*02	Offset + slot	1 ... 48	–
512	Word/word	Outputs, analog range, 2 words per slot, I/O modules LB/FB4*04, LB/FB4*05, LB4106 (channel 1 and 2), LB/FB7*04 (channel 1 and 2)	Offset + (2 * slot)	1 ... 48	–
640	Word/word	Outputs, analog range, 2 words per slot, I/O modules LB4106 (channel 3 and 4), LB/FB7*04 (channel 3 and 4)	Offset + (2 * slot)	1 ... 48	–
768	Word/word	Command Register	–	–	–
1024	Word/bit	Allocated inputs digital range, write access is denied	From address 1024, the data is provided according to the sequence in the DTM allocation overview[1]. See chapter 4.11	–	–
1280	Word/bit	Allocated outputs digital range	From address 1280, the data is provided according to the sequence in the DTM allocation overview[1]. See chapter 4.11	–	–
1536	Word/word	Allocated inputs analog range, write access is denied	Offset + DTM address designations see chapter 4.11	–	–

[1] Observe the sequence of the high bytes and low bytes, because access to the bit structure is granted word by word. An address jump of 1 means a jump of 16 bit addresses: bit 0 ... 15 = word 1, bit 16 ... 31 = word 2, etc.

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Analog Output Signals: MODICON Addressing

Offset	Access/structure	Description	Formula/access	Slot	Bit no.
40001	Word/word	Allocated outputs, analog range	See chapter 4.11	–	–
45000	Word/word	Outputs, analog range, 1 word per slot, I/O modules LB/FB4*01, LB/FB4*02	Offset + slot	1 ... 48	–
45100	Word/word	Outputs, analog range, 2 words per slot, I/O modules LB/FB4*04, LB/FB4*05, LB4106 (channel 1 and 2), LB/FB7*04 (channel 1 and 2)	Offset + (2 * slot)	1 ... 48	–
45200	Word/word	Command Register	–	–	–
45300	Word/word	Outputs, analog range, 2 words per slot, I/O modules LB4106 (channel 3 and 4), LB/FB7*04 (channel 3 and 4)	Offset + (2 * slot)	1 ... 48	–
46001	Word/bit	Allocated inputs digital range, write access is denied	From address 46001, the data is provided according to the sequence in the DTM allocation overview[2]. See chapter 4.11	–	–
46101	Word/bit	Allocated outputs digital range	From address 46101, the data is provided according to the sequence in the DTM allocation overview[2]. See chapter 4.11	–	–
16200	Word/word	Allocated inputs analog range, write access is denied	Offset + DTM MODICON address designations see chapter 4.11	–	–

[2] Observe the sequence of the high bytes and low bytes, because access to the bit structure is granted word by word. An address jump of 1 means a jump of 16 bit addresses: bit 0 ... 15 = word 1, bit 16 ... 31 = word 2, etc.

4.12 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 executed only 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 is located at the output address 0 by default. The command register should not be allocated away from this position because it is possible to allocate to output address 0 again using the **auto-allocation** function.

The following commands are supported.

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.

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4.13 Adding or Deleting I/O Modules

Only the com unit has been incorporated into the project structure up to now. I/O modules are to be integrated in this step.

There are two options available for integrating the I/O modules into the PACTware™ project.

- Integrating the I/O modules via the **Add Device** command
- Reading and automatically generating I/O modules via the **Topology Scan** command.

Manually Integrating I/O Modules using the "Add Device" Command

1. Right-click on the com unit entry in the project structure.
2. Select **Add device**.

   ↳ A window opens displaying a list of all the available I/O modules.

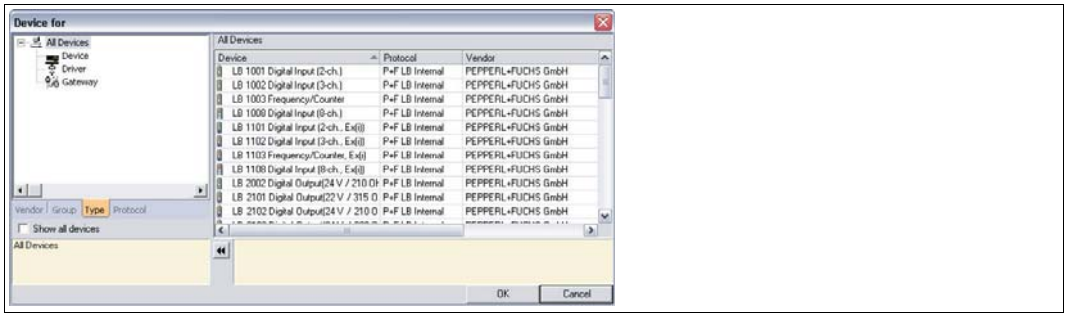

Figure 4.25 Selecting an I/O module

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

   ↳ The **Channel selection** window opens displaying a list of slots.

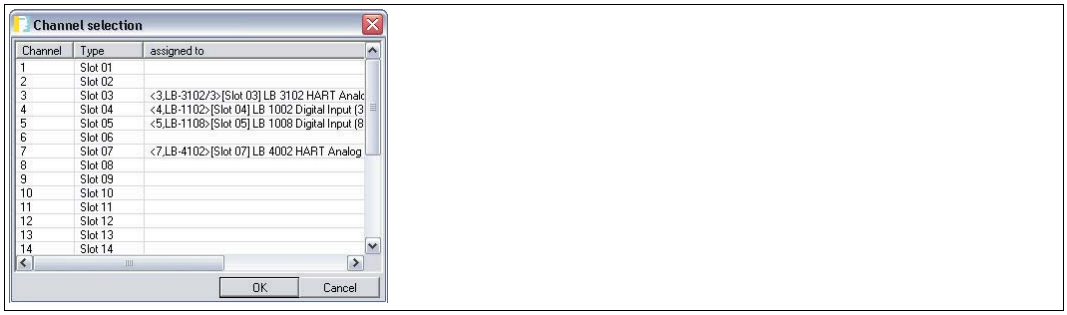

Figure 4.26 Channel selection window

5. Select the slot into which you wish to insert the I/O module. Remember that on redundant remote I/O stations, slots 1 and 2 are reserved for the redundant com unit. Also be aware that dual width I/O modules require 2 slots.

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

   ↳ If you have selected a slot that the selected I/O module can not accept (e.g., slot is already occupied or the subsequent slot for a dual width I/O module is not free), an error message will appear. In this case, repeat the previous step and select a different slot. The I/O module is added and appears under the com unit in the project structure.

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7. If necessary, assign I/O modules to other slots by repeating these steps.

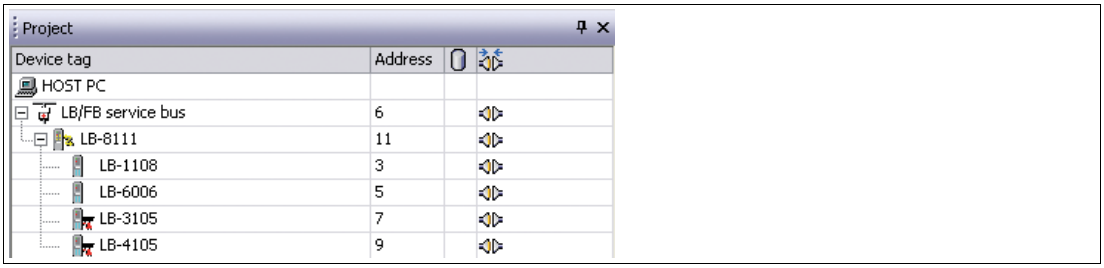

Figure 4.27 Project structure with I/O modules

Integrating I/O Modules Automatically by Scanning the Topology

Before allowing I/O modules to be installed automatically, there must be at least one com unit in the project structure. The **Backplane type**, **Extensions**, and **Power supplies** com unit parameters must already be configured.

1. Right-click on the entry for the required com unit in the project structure.
2. Establish a connection to the com unit. To do this, choose **Connect**.

   ↳ The connection is established. The com unit entry appears bold in the project structure as soon as the connection is established.
3. Right-click on the entry for the com unit in the project structure again.
4. Select **Additional Functions > Topology Scan**.

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

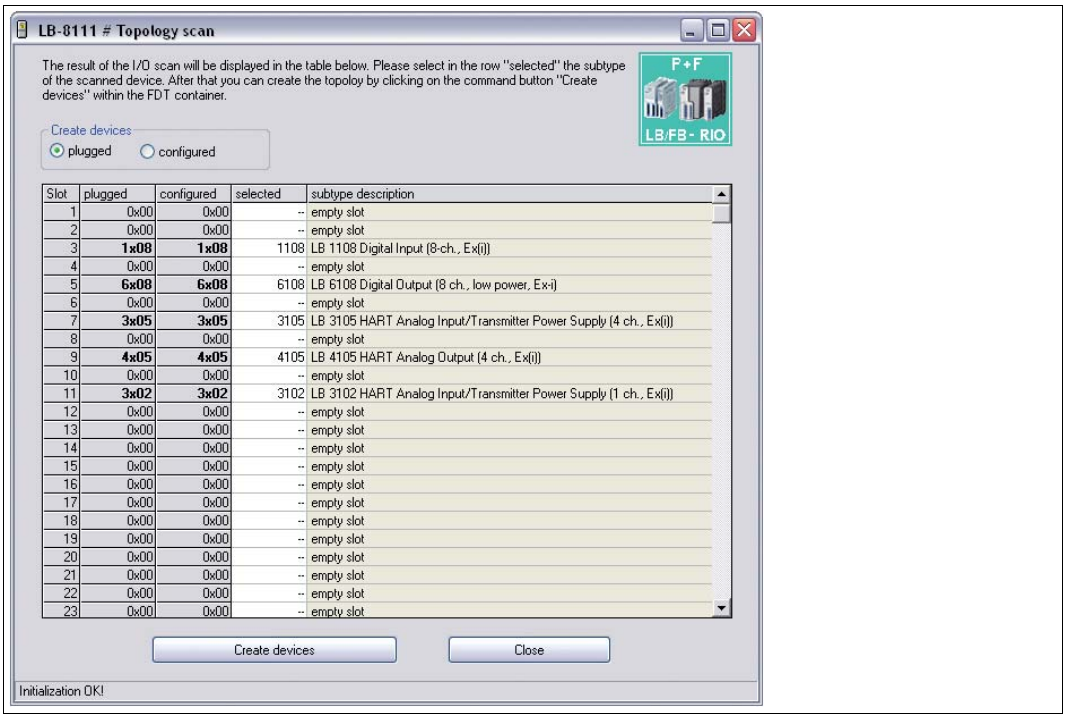

Figure 4.28 **Topology scan** window with a list of located I/O modules

5. The **Connected** column lists the I/O modules as they are actually connected in the backplane.
   The **Configured** column lists the I/O modules as they are currently parameterized in the com unit and project structure.

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6. To integrate the I/O modules in the software in the same way as they are shown in the **Connected** column, choose the **Connected** option. To integrate the I/O modules in the same way as they are shown in the **Configured** column, choose the **Configured** option.
7. The **Selected** column allows the type of module to be specified more precisely or the I/O module to be deselected (- -). To do so, click the cell in the **Selected** and make a selection. The options depending on the type of module in the **Connected** (or **Configured**) column, depend on which of the **Connected** or **Configured** options you selected in the **Create devices** area. The **Variant information** column contains more detailed information about the selected I/O module.
8. To generate the I/O modules as they are shown in the **Selected** column, click on **Create devices**.

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

Deleting I/O Modules

1. Right-click on the entry for the I/O module in the project structure that you wish to delete from the configuration.
2. Select **Remove device**.
3. Click on **Yes** in the dialog box.

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

4.14 Converting I/O Module Type Retroactively

Note!

This feature is available from DTM version 7.5.1 and higher.

If the incorrect module type has been installed for an I/O module, the module type can be converted retroactively. During conversion, the parameters for the old module type are adopted for the new module type. You can convert a module type only if there is another module type with similar functions, e.g., converting LB1108A to LB1008A. The DTM suggests suitable module types for conversion.

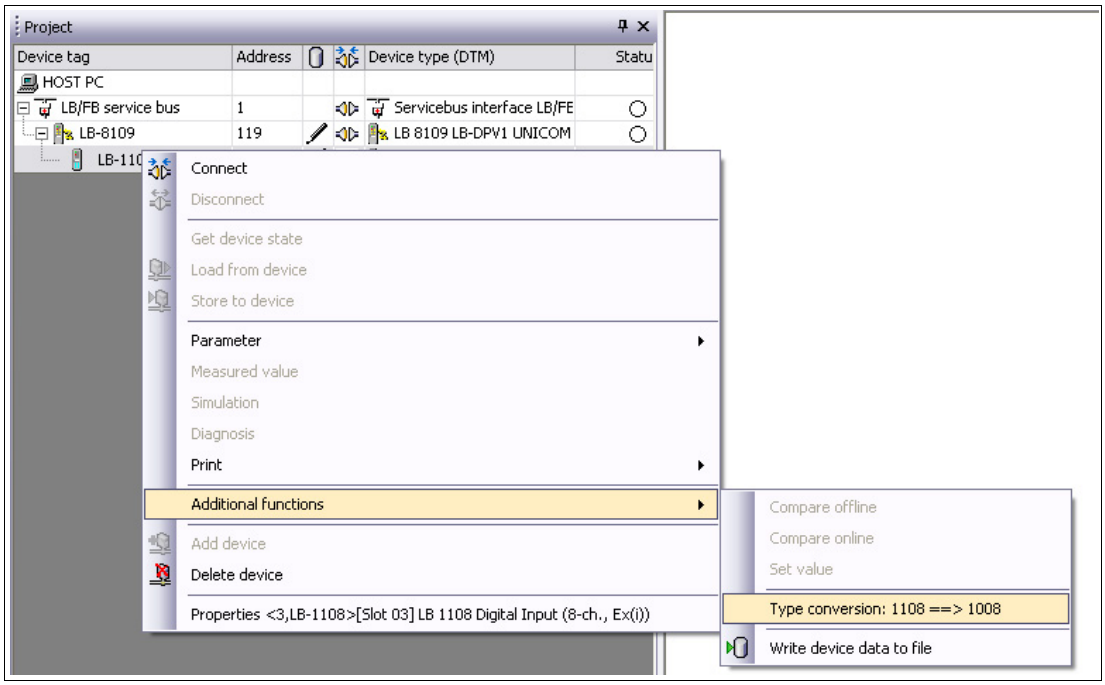

Figure 4.29 Convert module type

Converting I/O Module Type Retroactively

1. Right-click on the I/O module in the project structure that you want to convert.
2. Select **Additional functions** > **Type Conversion X ==> Y** (X = current module type, Y = possible new module type).

   ↳ The module type is converted. The parameters of the old module type are retained.

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5 Basic functions of the DTM LB/FB

5.1 Universal Screen Elements

Unsaved parameter changes are shown in blue in the device data window. As soon as the changes are saved, the values are shown in black.

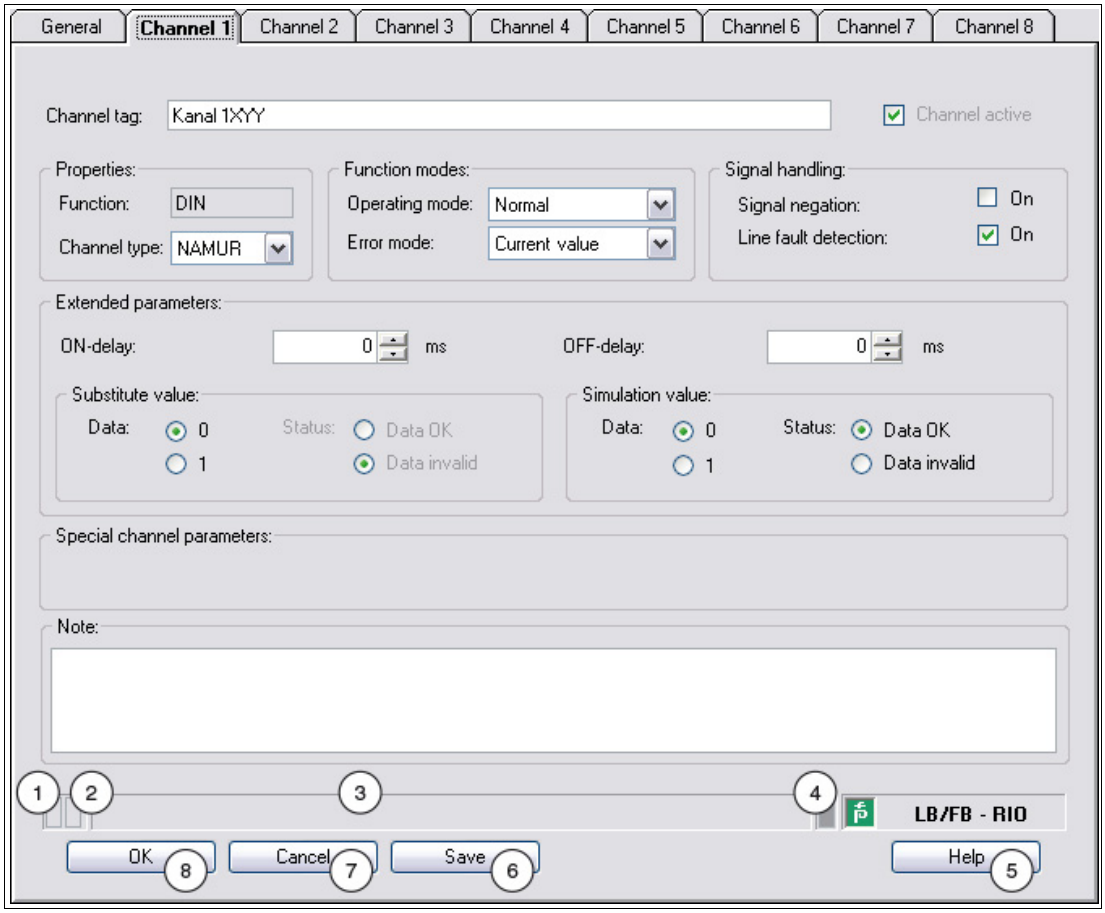

Figure 5.1 DTM status bar and buttons

Field		Explanation
1	Validity of settings	This box in the status bar indicates whether the modified settings are valid. The box is gray if the settings are valid and blue if the settings are invalid.
2	Memory status of settings	Indicates whether settings have been modified and not saved. The field appears blue if settings have not been saved.
3	Text box	Displays text messages relating to certain events.
4	Connection status	Indicates whether there is a connection with the device in question. ■ Yellow = online ■ Gray = offline

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Field		Explanation
5	Help	Displays the Help file.
6	Save	Saves the settings made. The settings are saved in the database or directly on the device depending on the connection status. The configuration window remains open after the settings are saved.
7	Cancel	Closes the configuration window without saving any modifications you may have made.
8	OK	Saves modified settings and closes the configuration window.

5.2 User Administration

Note!

The functions described in this section relate to the DTM, version 7.4 or later.

How you set up different users and their passwords depends on your FDT base application.

In PACTware™, select **Extras > User Administration** to access the user administration options.

The FDT user concept distinguishes between the user roles **Observer**, **Operator**, **Maintenance personnel**, and **Configuration engineer**. The FDT base application already assigns rights and implements restrictions to the different user roles, e.g., relating to downloading or topology modifications.

User roles

User role	Restrictions
Configuration engineer	No restrictions
Maintenance personnel	Can modify all parameters with the exception of the fieldbus addresses. Not authorized to make topology modifications at the system end.
Operator	Can modify all parameters, with the exception of the fieldbus addresses, that have **no** impact on the data structure or data volume. The operator may not modify the following parameters: ■ **Synchronous data** from com units ■ **Measuring method** for I/O modules LB1*03, FB1*03 ■ **Measuring method** for I/O modules LB3*02, FB3*02
Observer	Not authorized to modify any parameters.

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5.3 Editing Device Data

Note!

Before modifying the device data, you should be familiar with the concept of online and offline parameterization.

Opening the "Edit Device Data" Window

1. Right-click on the I/O module in the project structure.
2. Depending on the connection status, select **Parameters > Parameterization > Edit Device Data (Offline)** or **Parameters > Online Parameterization > Edit Device Data (Online)**.

   ↳ The **Edit Device Data** window opens.

The **Edit Device Data** window for the I/O module is divided into several tabs.

The **General** tab contains parameters that affect the whole I/O module, as well as information on the I/O module and available channels. The structure of the **General** tab is the same for all I/O modules.

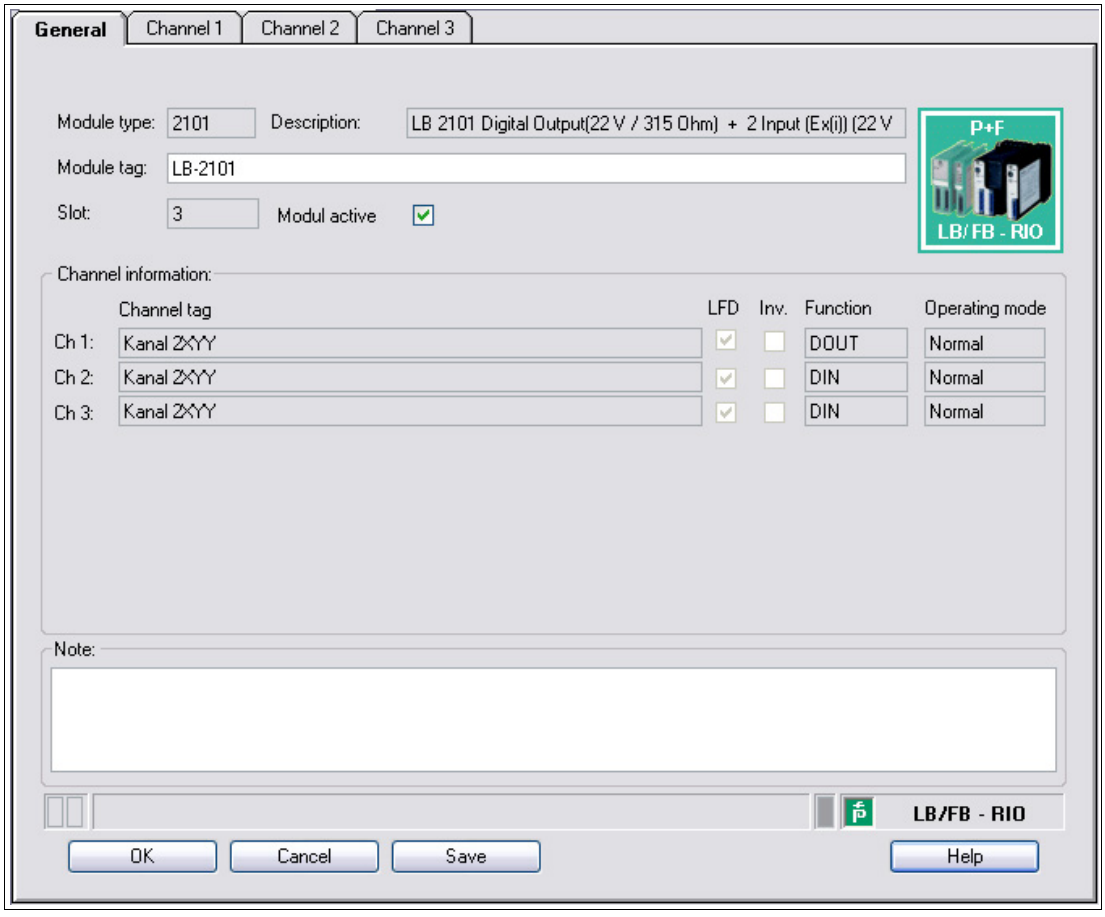

Figure 5.2 **General** tab

Field	Explanation
Module type	This field displays the four-digit type designation for the I/O module. This field can not be edited.
Description	This field displays the description of the I/O module. This field can not be edited.
Module tag	Enter any name for the I/O module. The maximum length is 32 characters.

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Field	Explanation
Slot	This field 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 it from the project structure, and reinsert it in another slot. Note that the layout in the tree structure must match the layout on the backplane.
Module active	Enable or disable this check box to activate or deactivate the I/O module. ■ If you deactivate the I/O module, the module is present in the synchronous data traffic, but does not generate measured values or diagnostic data. In this case, any I/O module can be preconfigured, even if it has not yet been plugged into the backplane. The I/O module can be upgraded in the relevant slot on the backplane at a later date and activated via **Module active**. The I/O module data is then provided immediately without the communication flow changing. ■ If you activate the I/O module, it operates normally and generates measured values and diagnostic data.
Channel tag	The names of the I/O module channels can be found here. You can enter the names on the **Channel X** tab in the **Channel Tag** field of the relevant I/O module. The **Channel Tag** fields cannot be edited on the **General** tab.
LFD	The check box is present only when the I/O module has line fault detection. Here you can see whether line fault detection is enabled for each channel. You can activate/deactivate line fault detection in the **Channel X** tab for the relevant I/O module. The **LFD** check boxes cannot be edited on the **General** tab.
Signal Negation	This check box appears with digital I/O modules only. The check box indicates whether signal negation is active on each channel. You can activate or deactivate signal negation on the **Channel X** tab of the relevant I/O module. The **Signal Negation** check boxes cannot be edited on the **General** tab.
Function	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	This field indicates the operating mode for each channel. You can set the operating mode on the **Channel X** tab for the relevant I/O module. The **Operating Mode** fields cannot be edited on the **General** tab.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, or **Channel 3**. Set channel-specific parameters on the **Channel X** tab.

More detailed, module-specific information about the **Channel X** tabs can be found in chapter Configuring I/O Modules. See chapter 6

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5.4 Operating Mode and Error Mode

Different function modes for each channel of an I/O module can be selected in the **Edit Device Data** window.

- Operating modes
  - Standard
  - Simulation
- Error modes
  - Current value
  - Substitute value
  - Last valid value

5.4.1 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.

In simulation mode, the channel adopts a defined simulation value. Both the operating mode and the simulation value can be set for each channel in the **Edit Device Data** window. Detailed descriptions of the I/O module simulation values can be found in chapter Configuring I/O Modules. See chapter 6

Figure 5.3 Setting the operating mode

Tip

Restoring the Original Configuration

We recommend saving a copy of the current configuration on the hard drive before switching multiple channels to **Simulation** operating mode. That way the channels can be easily switched back to normal mode later.

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 field signals.

Input data is transferred via the fieldbus as preset data (simulation value). You can thus simulate sensor signals during commissioning without modifying the sensor to check that data is communicated correctly to the process control system.

Output data (simulation value) still has to run through the I/O module signal processing first. You can therefore check the function of valves, even if bus communication has not yet been established.

You can check the simulation result using the **Show measured value** function. See chapter 5.6

After finishing commissioning or service work, reset the operating mode to **Normal**.

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5.4.2 Adjusting Error Mode Settings

In the event of a fault, the I/O modules automatically switch over to error mode.

In error mode, the channel concerned can adopt the current value, the last valid value, or a substitute value. The behavior in error mode and the substitute value can both be set for each channel in the **Edit Device Data** window. For details of the substitute values of the individual I/O modules, see see chapter 6.

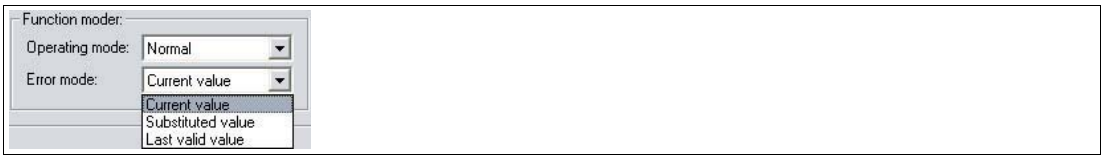

Figure 5.4 Adjusting error mode settings

Error Mode for Outputs

Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit.

If the watchdog is deactivated, the substitute value strategy will be invalid in the event of a bus failure. The watchdog time is set in the com unit.

If a fault state is detected during the startup phase, the outputs are transferred from the power off status to the selected error mode.

- **Current value**
  The current value being transferred by the process control system is output in spite of the **Data invalid** status.
- **Substitute value**
  The substitute value can be changed to any permissible value within the operating range of the I/O module.
- **Last valid value**
  If a new incoming value has the status **Data invalid**, the com unit uses the last valid 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

When there is a lead breakage, a short circuit or a module fault, substitute values are transferred to the process control system in accordance with the substitute values strategy.

- **Current value**
  The current, faulty value with the **Invalid data** status is transferred.
- **Substitute value**
  The substitute value can be modified manually. In DTM version 7 and higher, the substitute value always has the **Invalid data** status.
- **Last valid value**
  The com unit uses the last valid value before the fault occurred to form the input value. This value has the **Invalid data** 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 module status area.

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Responses

The following example shows the data flow from a digital output resulting from different situations and settings.

- In normal mode, the data is transferred directly from the com unit to the output.
- If signal negation has been configured, the signals are inverted beforehand according to their settings.
- If simulation values are output instead of the current bus data, these simulation values are treated in the same way as bus data and are inverted if necessary.
- If the error bit **Invalid data** is set, then either the current values, the substitute values, or the last valid 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.

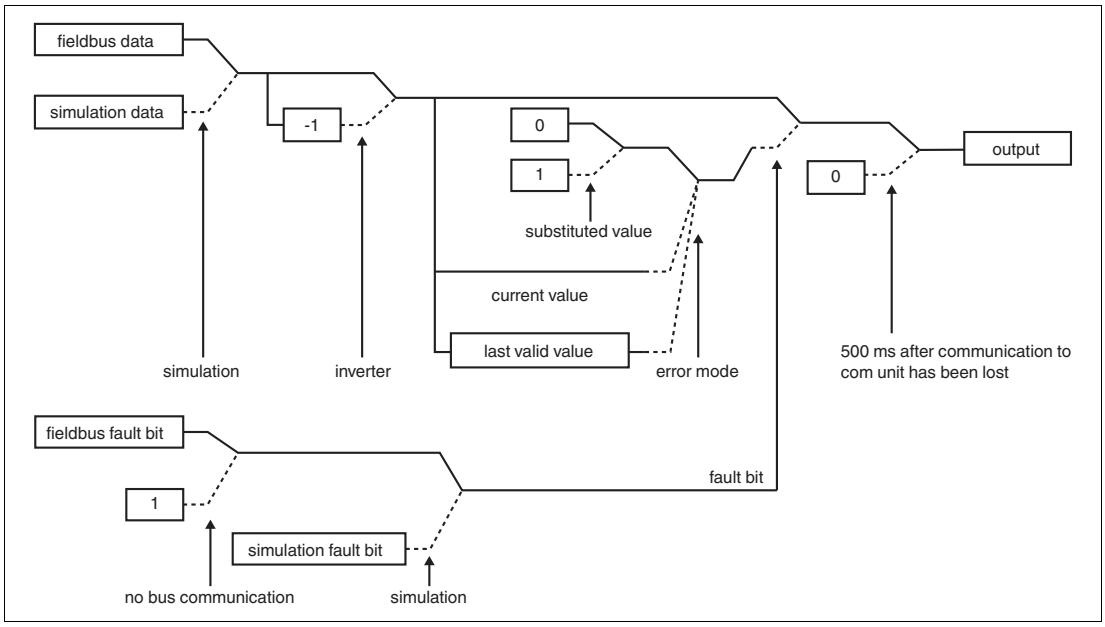

Figure 5.5 Data flow from com unit to a digital output

Solid line for normal position
Dashed line for if-then action
3 options in error mode

Function Table for Digital Output

	Com unit			I/O module					
Status	Data bit	Error bit	Communication with fieldbus	Simulation	Operating mode	Communication with com unit	Signal negation	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
Error bit operation	0	1	Yes	-	Normal	Yes	0	Current value	0
Error bit operation	1	1	Yes	-	Normal	Yes	0	Current value	1

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	Com unit			I/O module					
Status	Data bit	Error bit	Communication with fieldbus	Simulation	Operating mode	Communication with com unit	Signal negation	Error mode	Output
Error bit operation	0	1	Yes	-	Normal	Yes	1	Current value	1
Error bit operation	1	1	Yes	-	Normal	Yes	1	Current value	0
Bus fault	Old	-	No	-	Normal	Yes	-	Current value	Old

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5.5 Scaling the Measuring Range

Normally, analog measured data is transferred in unsigned integers 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. Input signals of 0 mA are accordingly signaled to the process control system by the numerical value 0.

The scaling can also be set to between 4000 ... 20,000 so that correspondence with the 4 mA ... 20 mA signal range is maintained. This setting is suitable for signal ranges of 0 mA ... 20 mA with an extended range.

Note!

On control systems that support the FDT concept, scaling is neither necessary nor appropriate.

The corresponding channel variables that are created by the Device Type Manager (DTM) and can be used in the process control system use the last 12 bits (bits 4 ... 15) of the 16-bit value and specify the validity of the measured value in bit 1.

Scaling the Measuring Range

1. Open the **Edit Device Data** window.
2. Select the **Channel X** tab for the channel for which you wish to scale the measuring range.
3. Enter the desired numeric range in the **Measuring range/scaling** area. Only whole numbers between 0 ... 65535 may be entered.

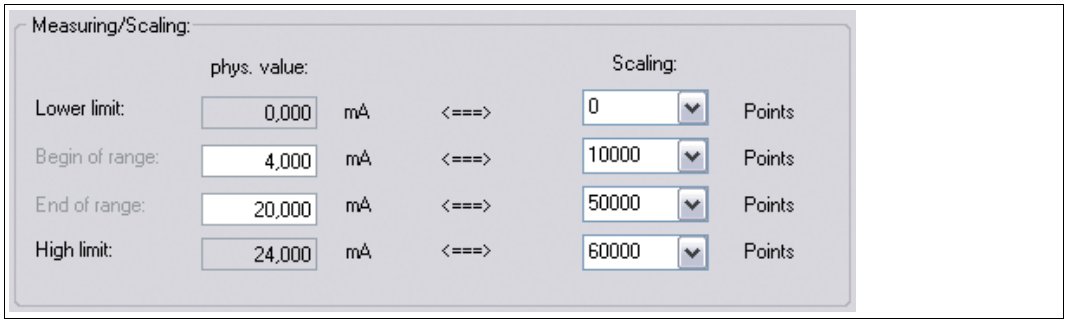

Figure 5.6 Scaling the measuring area

4. Click on **Save** to accept the changes or click on **OK** to accept the changes and close the device data window.

Example!

A process control system operates better within a range between 0 ... 4095 instead of 0 ... 65535. Select the following settings in the process control system to adapt the scaling.

- Start of range: 625
- End of range: 3125
- Scaling factor: 1.3107

Overranges and underranges of the 4 mA ... 20 mA signal can be displayed via the measured value.

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5.6 Show Measured Value

The **Show Measured Value** window is used to display measured values and diagnostics information.

Opening the "Show Measured Value" window

1. Right-click on the entry for the required component in the project structure.
2. Choose **Connect**.

   ↳ The connection is established. The entries appear in bold in the project structure once the connection is established. The connection status is also indicated by an icon.
3. Right-click on the entry for the connected device in the project structure.
4. In the context menu, select **Measured Value > Show Measured Value**. If the command is not available, there is no connection to the device.

   ↳ The **Show Measured Value** window opens.

5.6.1 Measured Value Display for Digital I/O Modules

Depending on the module type (digital input, digital output, relay contact output), the measured value display for digital I/O modules differs in the number of channels displayed.

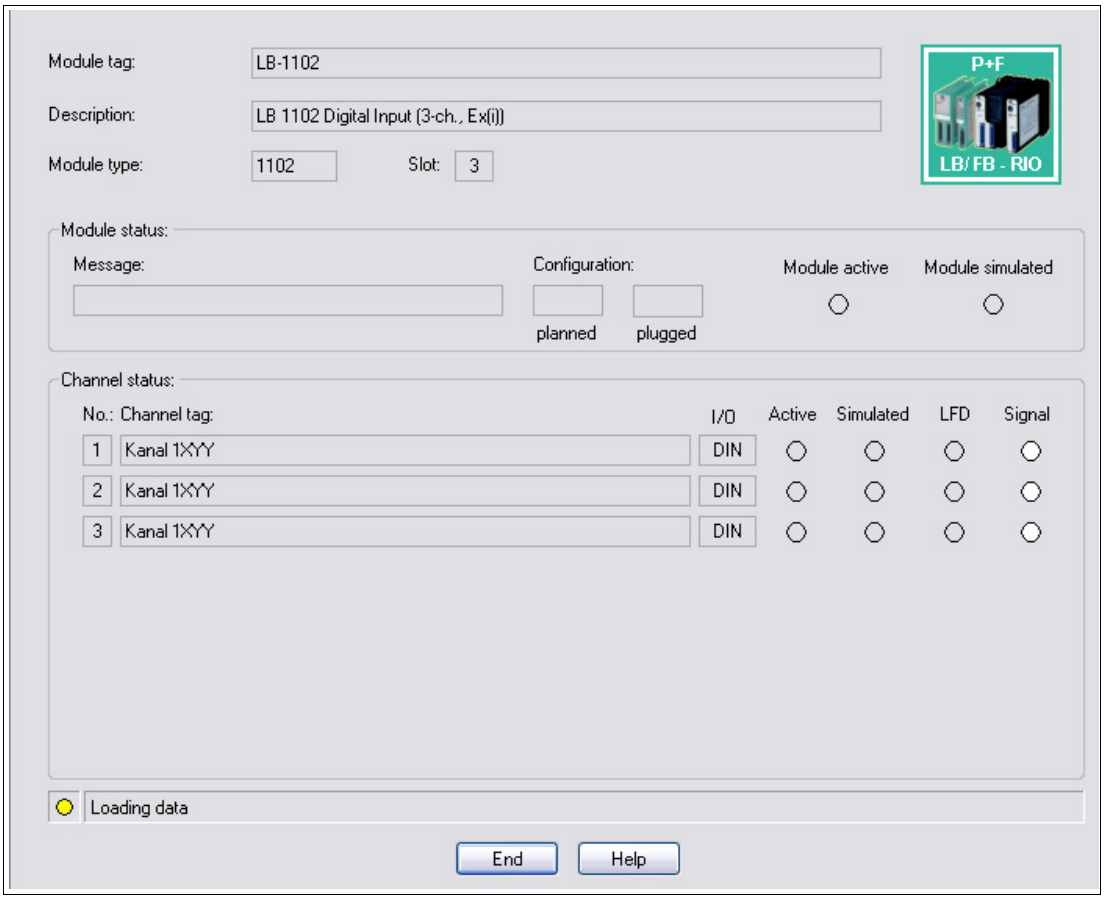

Figure 5.7 **Show Measured Value** window for digital modules

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Field	Explanation
Module tag	This field displays the name of the I/O module. You can edit the name on the **General** tab in the **Edit Device Data** window.
Module description	This field displays the description of the I/O module. This field can not be edited.
Module type	This field displays the four-digit type designation for the I/O module. This field can not be edited.
Slot	This field 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 it from the project structure, and reinsert it in another slot. Note that the layout in the tree structure must match the layout on the backplane.
Module messages	This field displays messages from the I/O module. Error messages are highlighted red.
Configuration	The **Planned** field indicates which I/O module is included in the active com unit configuration. The **Connected** field indicates which I/O module is actually plugged in on the backplane. If the scheduled and actual I/O module types differ, the fields appear red.
Module active	When the display lights up yellow, the I/O module is active. When the display is gray, the I/O module is deactivated. You can activate or deactivate the I/O module on the **General** tab of the **Edit Device Data** window.
Module simulated	When the display lights up yellow, at least one channel of the I/O module is in simulation mode.
Channel tag	This field displays the name of the channel in question. You can specify the name for each channel in the **Channel X** tab of the **Edit Device Data** window. The associated channel number is shown to the left of the field and the channel type to the right. ■ DIN = digital input ■ DOUT = digital output ■ AIN = analog input ■ AOUT = analog output
Active	When the display lights up yellow, the associated channel is active. As soon as an I/O module is active, all channels are also active.
Simulated	When the display lights up yellow, the associated channel is in simulation mode. Simulation mode can be activated or deactivated for each channel in the **Channel X** tab of the **Edit Device Data** window.
LFD	This display only appears if the I/O module has a line fault detection function. If the display lights up red, there is a line fault in the relevant channel. With some I/O modules, a distinction can be made between a lead breakage and a short circuit. In such cases, a B (for lead breakage) or K (for short circuit) is displayed in addition to the **LFD** indicator. Line fault detection can be activated or deactivated for each channel in the **Channel X** tab of the **Edit Device Data** window.
Signal	This display shows the current field signal. If the display lights up yellow, the signal 1 is transferred. If the display lights up gray, the signal 0 is transferred.
Status bar	The status indication flashes yellow in rhythm with the data transfer. If a communication error occurs, the display lights up red. The communication status is displayed as a text message in the text box.

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5.6.2 Measured Value Display for Analog I/O Modules

Depending on the module type (analog input, analog output, frequency input, temperature input, voltage input), the measured value display for analog I/O modules differs in the number of channels displayed.

The **Overview** tab provides an overview of the status and the measured values of all input or output channels of the I/O module.

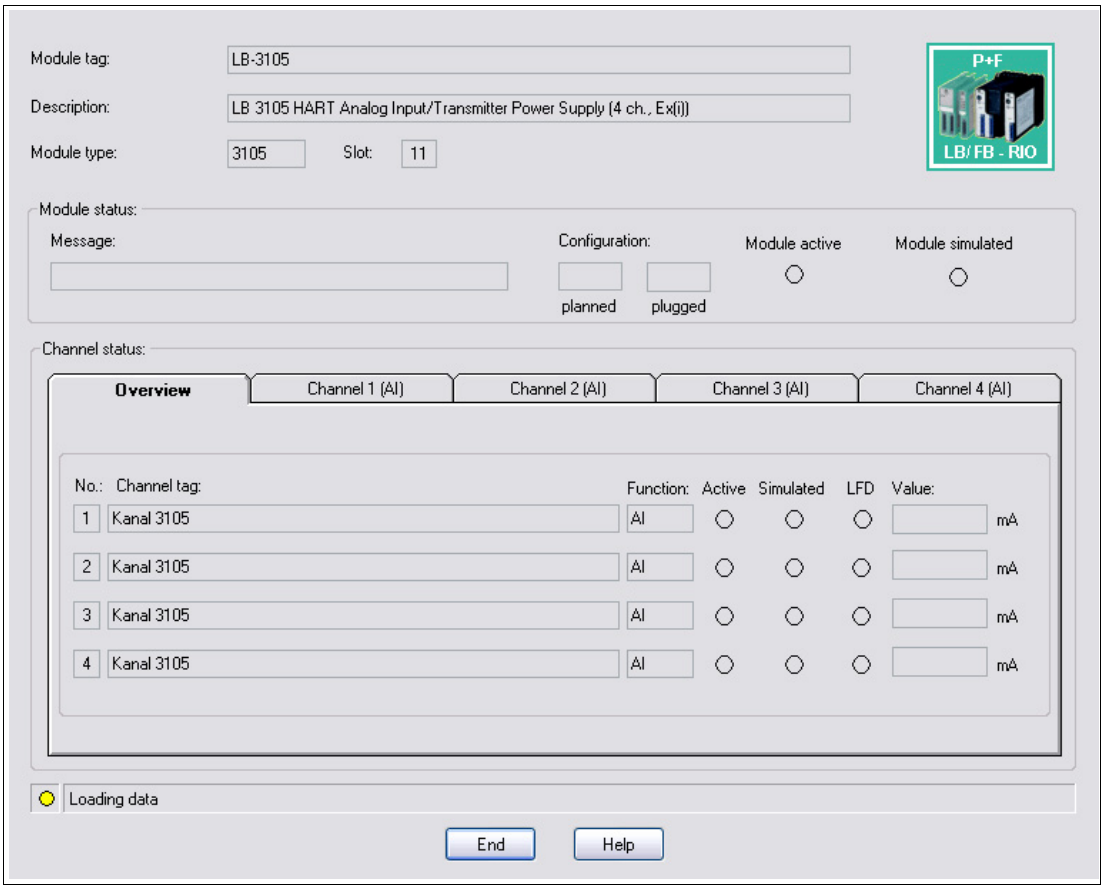

Figure 5.8 **Show Measured Value** window for analog modules

Field	Explanation
Module tag	This field displays the name of the I/O module You can edit the name on the **General** tab in the **Edit Device Data** window.
Module description	This field displays the description of the I/O module. This field can not be edited.
Module type	This field displays the four-digit type designation for the I/O module. This field can not be edited.
Slot	This field 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 it from the project structure, and reinsert it in another slot. Note that the layout in the tree structure must match the layout on the backplane.
Module messages	This field displays messages from the I/O module. Error messages are highlighted red.

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Field	Explanation
Configuration	The **Planned** field indicates which I/O module is included in the active com unit configuration. The **Connected** field indicates which I/O module is actually plugged in on the backplane. If the scheduled and actual I/O module types differ, the fields appear red.
Module active	When the display lights up yellow, the I/O module is active. When the display is gray, the I/O module is deactivated. You can activate or deactivate the I/O module on the **General** tab of the **Edit Device Data** window.
Module simulated	When the display lights up yellow, at least one channel of the I/O module is in simulation mode.
Channel tag	This field displays the name of the channel in question. You can specify the name for each channel in the **Channel X** tab of the **Edit Device Data** window. The associated channel number is shown to the left of the field and the channel type to the right. ■ DIN = digital input ■ DOUT = digital output ■ AIN = analog input ■ AOUT = analog output
Active	When the display lights up yellow, the associated channel is active. As soon as an I/O module is active, all channels are also active.
Simulated	When the display lights up yellow, the associated channel is in simulation mode. Simulation mode can be activated or deactivated for each channel in the **Channel X** tab of the **Edit Device Data** window.
LFD	This display appears only if the I/O module has a line fault detection function. If the display lights up red, there is a line fault in the relevant channel. The line fault is specified in more detail on the **Input/Output X** tabs. Line fault detection can be activated or deactivated for each channel in the **Channel X** tab of the **Edit Device Data** window.
Value	This field displays the current measured value in the relevant unit.
Status bar	The status indication flashes yellow in rhythm with the data transfer. If a communication error occurs, the display lights up red. The communication status appears in the box to the right of the display in the form of a text message.

In addition to the **Overview** tab, the **Channel status** area contains one or more **Input X** and **Output X** tabs where X stands for the channel number, e.g., input 1, input 2.

The **Input X** and **Output X** tabs display the values of each individual input or output channel separately. The measured value is shown in figures on one side and as bars on the other, and the line fault detection status is specified in more detail.

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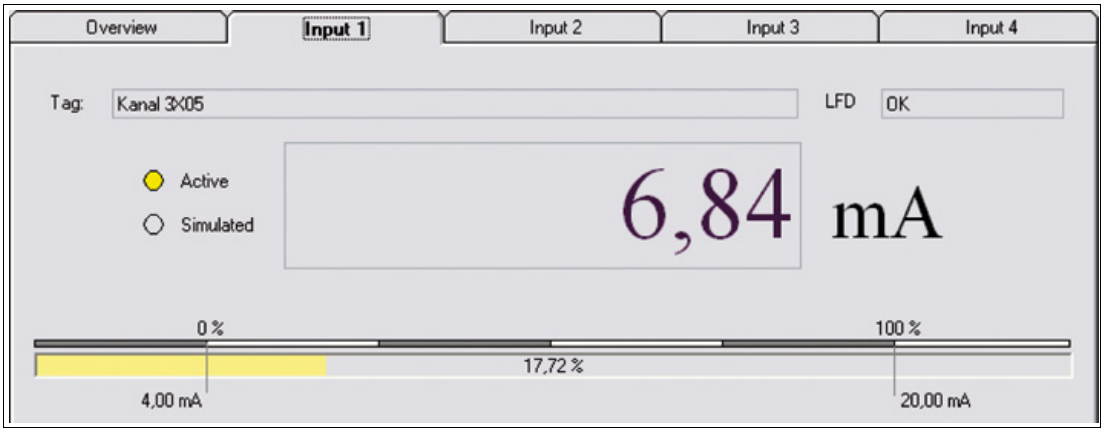

Figure 5.9 **Input 1** tab

5.7 Configuring HART Communication

The following I/O modules are suitable for communication with intelligent field devices using the HART protocol.

- 3x02, 3x03, 3x05, 3x06
- 4x02, 4x05, 4x06
- 7x04

HART field devices can be addressed and operated via the service bus. If you use the com unit LB8111* or FB8211*, HART field devices can also be addressed and operated via MODBUS TCP.

Note!

Note the connection layout of the I/O modules. The connection layout differs depending on whether you are using a 2-wire transmitter, 3-wire transmitter or 4-wire transmitter (externally powered) with the I/O module.

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

Data transfer 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 mA ... 20 mA signals by the I/O modules in frequency shift keying mode. Two types of communication are possible.

- Communication with a handheld connected to the I/O module terminals for hazardous location. The required 250 Ω communication resistance 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. This problem can be identified when the measurement circuit freezes.
- Communication via the PROFIBUS with the com unit using the acyclic DP-V1 services and with the I/O modules without auxiliary equipment. Use a suitable communication 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 be used if the process control system does not provide HART functionality.

The DTM LB/FB contains a HART communication component that, together with a HART DTM (e.g., **generic HART DTM** from the PACTware™ standard setup), allows access to the connected HART devices.

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Configuring HART Communication

Before setting up HART communication, the project file must be open and include a com unit and one or more I/O modules with HART support.

1. Right-click on an I/O module with HART support in the project structure.
2. Select **Add Device**.

   ↳ The **Device for** window opens displaying a list of available DTMs. Device manufacturers usually offer DTMs that are compatible with the relevant device. If you do not have any device-specific DTMs, you can set up the devices using a **generic HART DTM**.

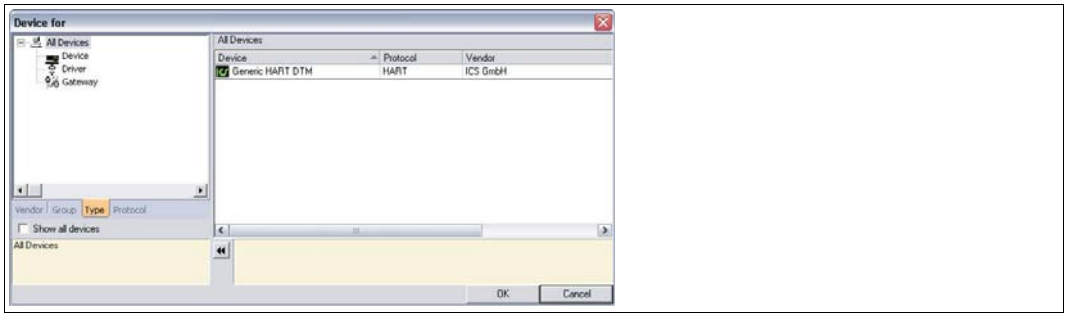

Figure 5.10 **Device for** window

3. Select the required HART DTM in the **Device for** window and then click on **OK**.

   ↳ If you are using a multichannel I/O module, the **Channel Selection** window opens. If you are using a single-channel I/O module, you do not need to select a channel.

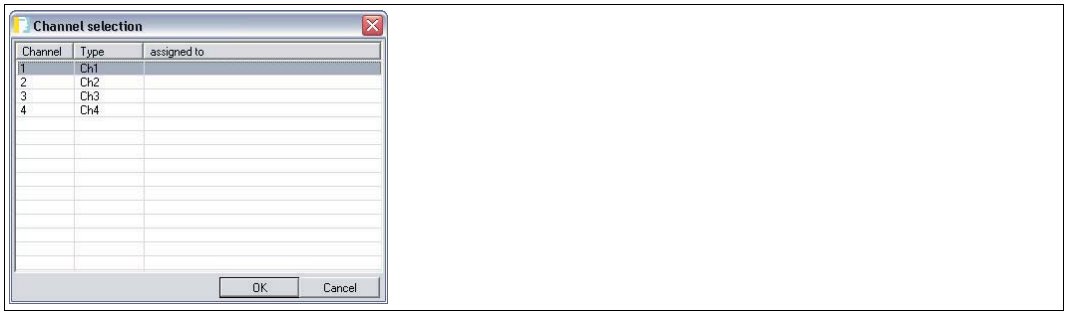

Figure 5.11 **Channel Selection** window

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

   ↳ The HART DTM is added to the project structure under the corresponding I/O module.

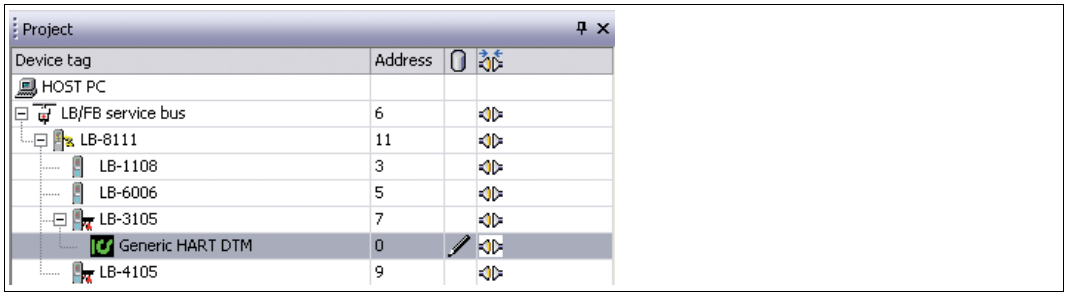

Figure 5.12 Generic HART DTM in the project structure

5. Right-click on the HART DTM.
6. Select **Parameterize > Parameterize** to configure additional settings, or establish a connection with the field device to read the data stored on the field device. Further information about configuring the field devices and field device DTMs can be found in the field device manufacturer's documentation.

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Note!

Com Units with Firmware Version 6 or Higher

Com units with firmware version 6 or higher are equipped with HART cross talk suppression. The cross-talk suppression makes sure that HART channels are signaled as faulty only 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.

Practical Experiences

The following restrictions were found during tests in relation to HART communication.

- HART communication with measuring transmitters is possible in the operating range 4 mA ... 20 mA. Some measuring transmitters go overrange (22 mA) or underrange (< 4 mA) when there is no input signal, e.g., in the event of a lead breakage. In this situation, HART communication with this measuring transmitter is often not possible.
- There are measuring transmitters that work with device-specific HART commands. When device-specific, non-HART compliant commands are executed, the error counter in the I/O module may reach saturation depending on the I/O module firmware and hardware. In this case, perform a reset of the I/O module.
- In rare cases, field devices without HART support such as plunger coil positioners may generate HART-like signals in 20 mA loops. These signals can be produced by random vibrations at the installation location of the field device. The I/O module's error counter can therefore overflow and the I/O module cuts communication with the com unit. In this case, perform a reset of the I/O module.
  You can avoid this problem by using an I/O module without HART support or by deactivating the HART function on the affected channel.

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6 Configuring I/O Modules

The following sections describe the properties and configuration options for the I/O modules.

The sections are always similar in structure.

- Brief description of the relevant I/O module with block diagram
- Information on resolution, measuring time, and cycle time
- Information about data transmission and bit structure within the data telegram
- Information about line fault detection
- Description of adjustment options

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6.1 LB1*01, FB1*01 Digital Input

6.1.1 Description

Versions

- LB1001, digital input, not intrinsically safe
- FB1301, digital input, increased safety terminals
- LB1101, digital input, intrinsically safe
- FB1201, digital input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Suitable sensors: mechanical contacts, NAMUR proximity switches, 2-wire initiators
- Number of channels: 2

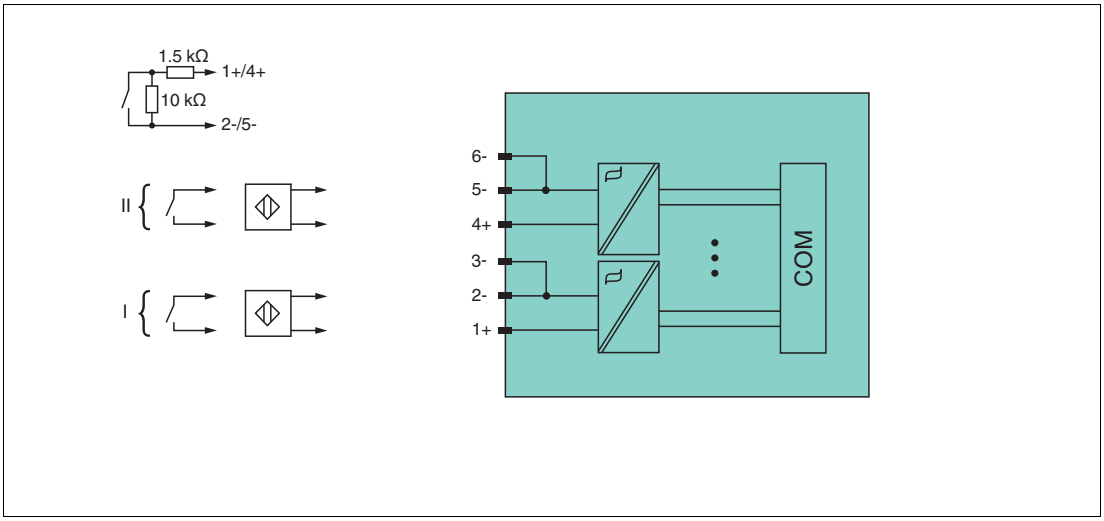

Figure 6.1 Block diagram LB1*01, FB1*01

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

6.1.2 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.

6.1.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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Bit Structure within the Data Telegram

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 ... 7	Empty
Output bytes		Without output bytes

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.1.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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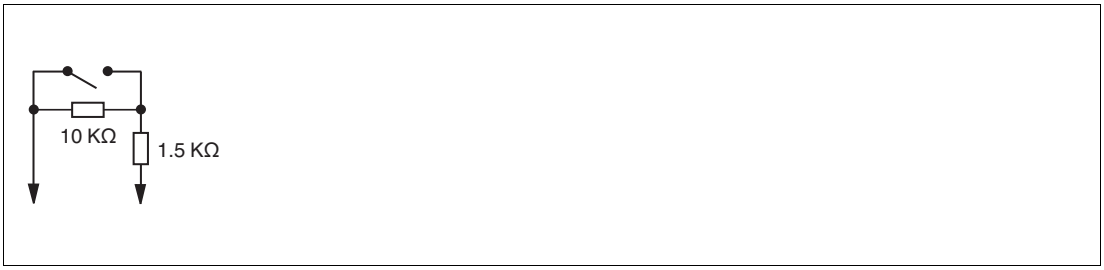

Figure 6.2 Mechanical contact with additional resistor circuit

6.1.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

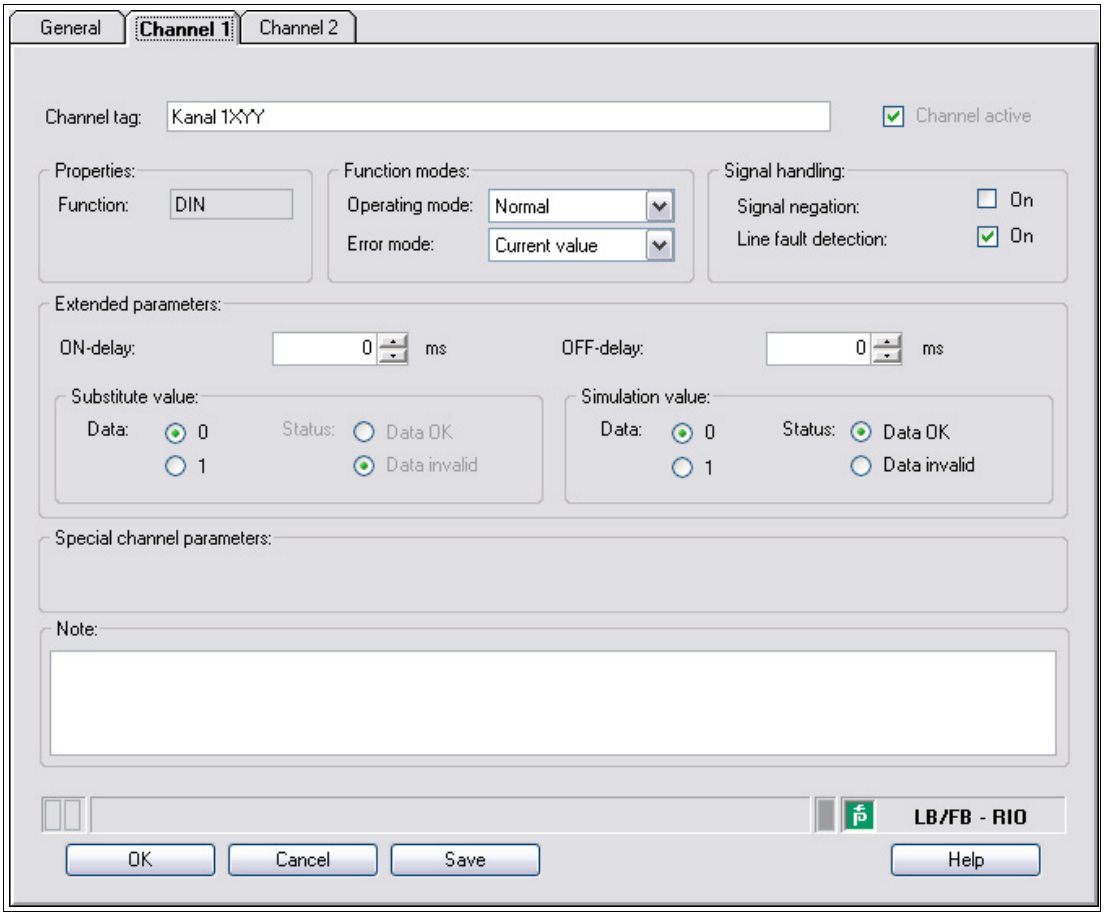

Figure 6.3 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.2 LB1*02, FB1*02 Digital Input

6.2.1 Description

Versions

- LB1002, digital input, not intrinsically safe
- FB1302, digital input, increased safety terminals
- LB1102, digital input, intrinsically safe
- FB1202, digital input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Suitable sensors: mechanical contacts, NAMUR proximity switches, 2-wire initiators
- Number of channels: 3

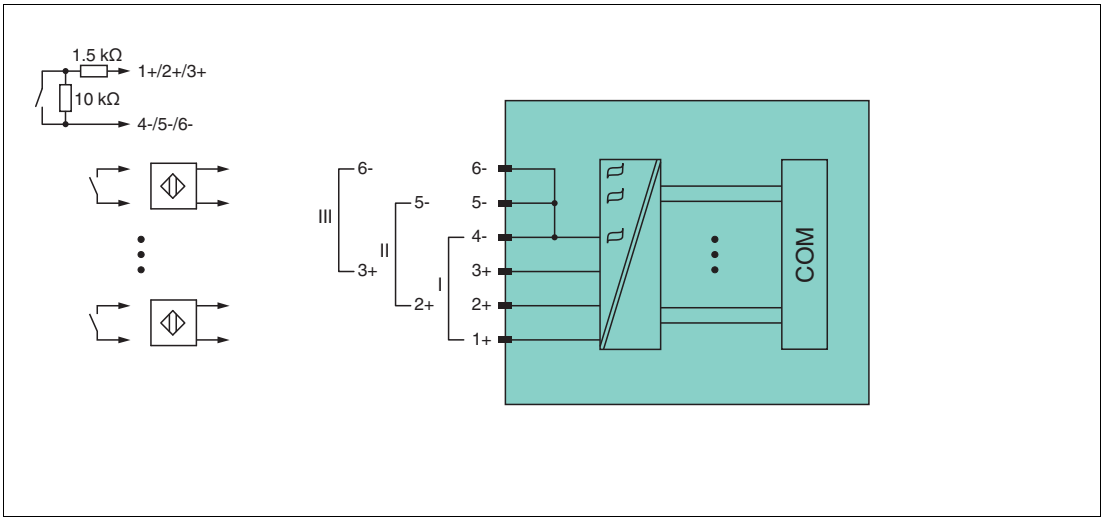

Figure 6.4 Block diagram LB1*02, FB1*02

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

6.2.2 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.

6.2.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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Bit Structure within the Data Telegram

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 ... 7	Empty
Output bytes		Without output bytes

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.2.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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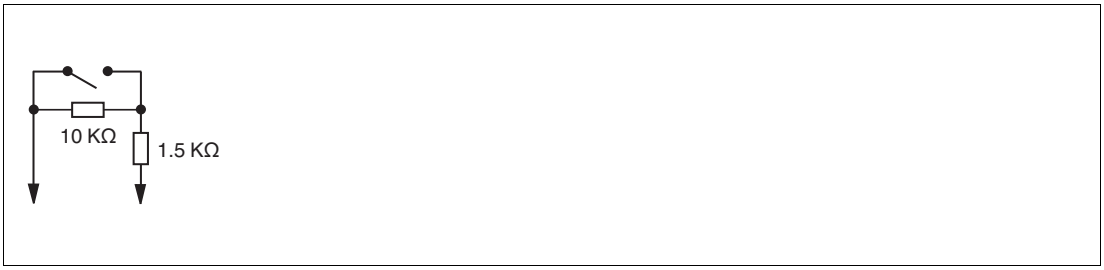

Figure 6.5 Mechanical contact with additional resistor circuit

6.2.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

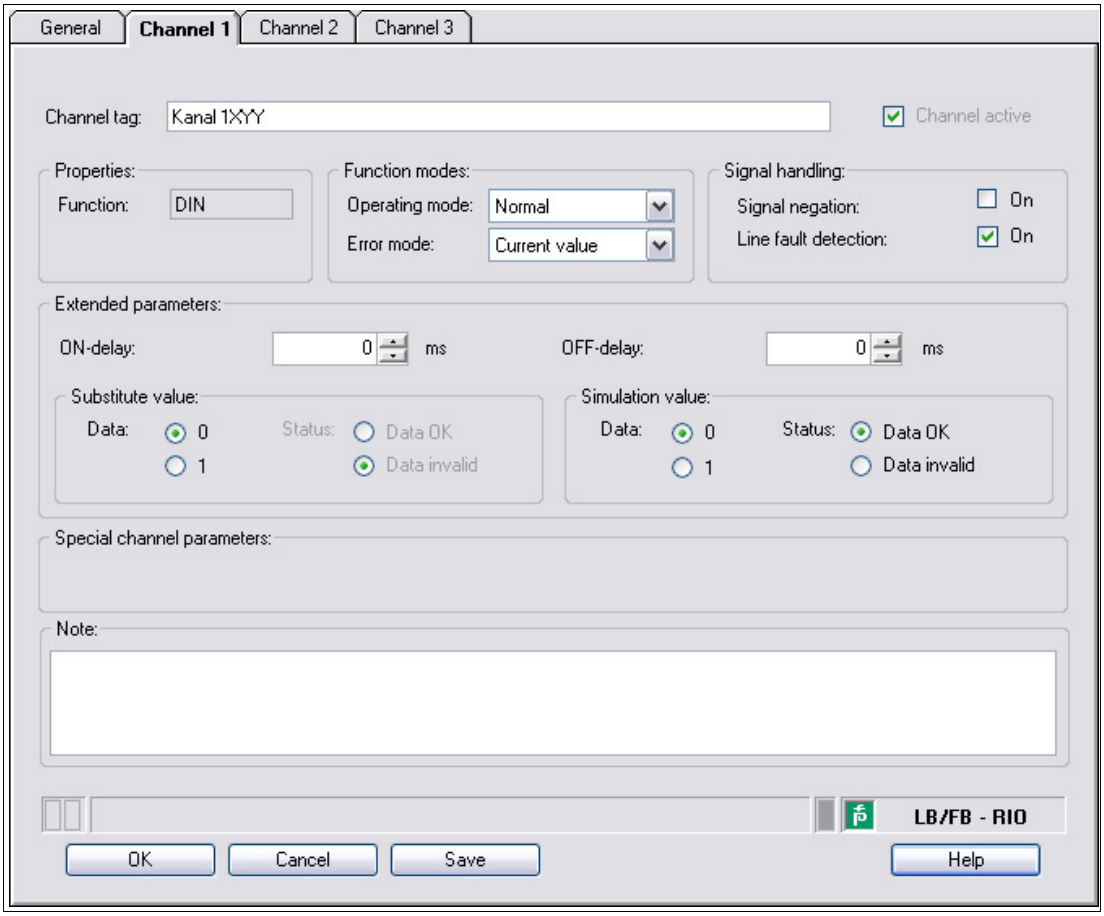

Figure 6.6 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

6.3 LB1*03, FB1*03 Frequency/Counter Input

6.3.1 Description

Versions

- LB1003, frequency/counter input, not intrinsically safe
- FB1303, frequency/counter input, increased safety terminals
- LB1103, frequency/counter input, intrinsically safe
- FB1203, frequency/counter input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Suitable sensors: frequency, counter, direction of rotation, NAMUR proximity switches, 2-wire initiators, mech. contacts
- Number of channels: 1
  - Channel 1 for frequency measurement or pulse counting
  - Additional input for direction of rotation detection, e.g., for rotating machines, or counting direction, e.g., forwards or backwards. The additional input is not a 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.

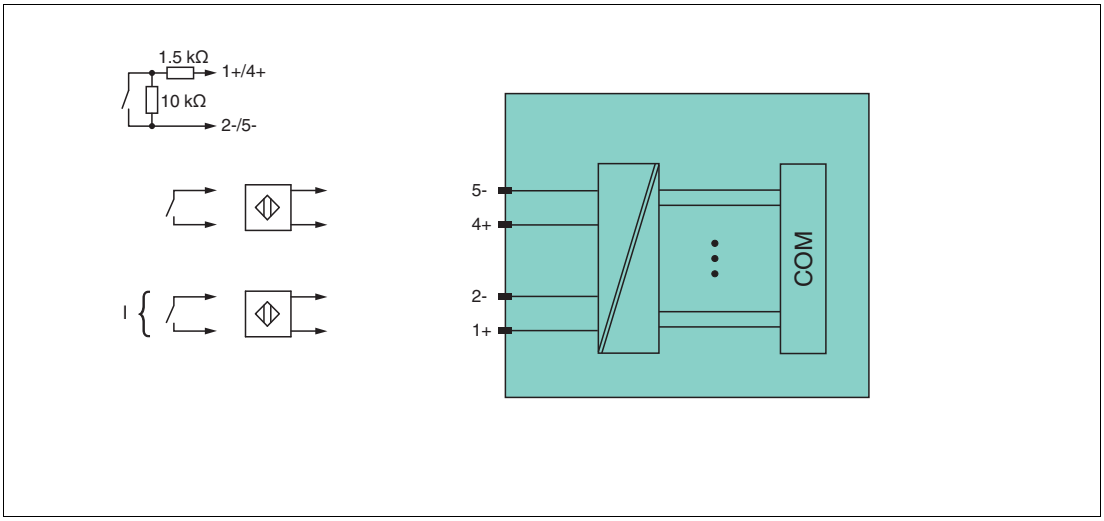

Figure 6.7 Block diagram LB1*03, FB1*03

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

6.3.2 Measuring Time and Cycle Time

The conversion time is approx. 50 ms. The accuracy of the measured value depends on the cycle time of the data traffic on the bus. The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

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6.3.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The I/O modules offer three function types that handle different data volumes.

- Frequency input up to 15 kHz (with or without direction detection) or 12-bit counter input up to 15 kHz (with or without direction detection)
- 32-bit counter input (with or without direction detection)
- Combined 32-bit counter input and frequency input up to 50 Hz (with or without direction detection)

Note!

If you change the function type of the I/O module, it may have an effect on the MODBUS addressing of the signals.

Bit Structure within the Data Telegram: Frequency Input or 12-Bit Counter Input

Byte	Bit	Meaning
Input data word 1	0	Status channel 1
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Empty
	3	Direction detection (0 = forwards, 1 = backwards)
	4 ... 7	Frequency (12 bit) or counter value (12 bit)
	8 ... 15	
Output data		No output data

Bit Structure within the Data Telegram: 32-Bit Counter Input

Byte	Bit	Meaning
Input data word 1 and word 2	0 ... 7	Counter value (32 bit)
	8 ... 15	
	16 ... 23	
	24 ... 31	
Output data		No output data

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Signal Addressing (Input Signals): Frequency Input or 12-Bit Counter Input

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

Signal Addressing (Input Signals): 32-Bit Counter Input

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.3.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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

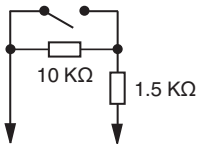

Figure 6.8 Mechanical contact with additional resistor circuit

6.3.5 Function Types

Frequency Input up to 15 kHz

Frequencies up to 15 kHz can be measured using this function type. The result of the frequency measurement is transferred to the com unit as an integer with a degree of accuracy of 0.1 %. New measured results are available in the com unit every 100 ms to 1000 ms (1 Hz) (every 10 seconds at 0.1 Hz) 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 Input

The module operates in the same way as a 12-bit counter input 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 input, the I/O module uses a 4-byte counter in the com unit that records counter values up to 4294967295 (2^{32}).
A counter quotient can be applied to the counter inputs to prevent them from reaching the maximum counter reading (overflow) before the next bus query when the counting frequencies are high. When a counter input and frequency input are combined, the counter quotient is not available.

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Combination of Counter Input and Frequency Input

When a counter input 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. 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 following formula produces a result of less than 400.
`End of range / (1 - start of range / end of range)`
The interrupt control prevents higher values from being processed.

Note!

32-Bit Counter Values

32-bit counter values are stored in the com unit. The counter values are deleted when removing a com unit, in the event of a power failure, when disconnecting the power supply, and in the case of a redundancy switchover.

12-bit counter values are accurate at all times because they are stored in the actual I/O module. The process control system 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 2 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 restrictions in terms of redundancy switchover and disconnection from the power supply.

6.3.6 Direction Detection

The second input is used to determine the direction of rotation from the phase shift between the two incoming pulses.

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 increments the incoming pulses if the direction input is logic `0`.
- The counter decrements the incoming pulses if the 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.

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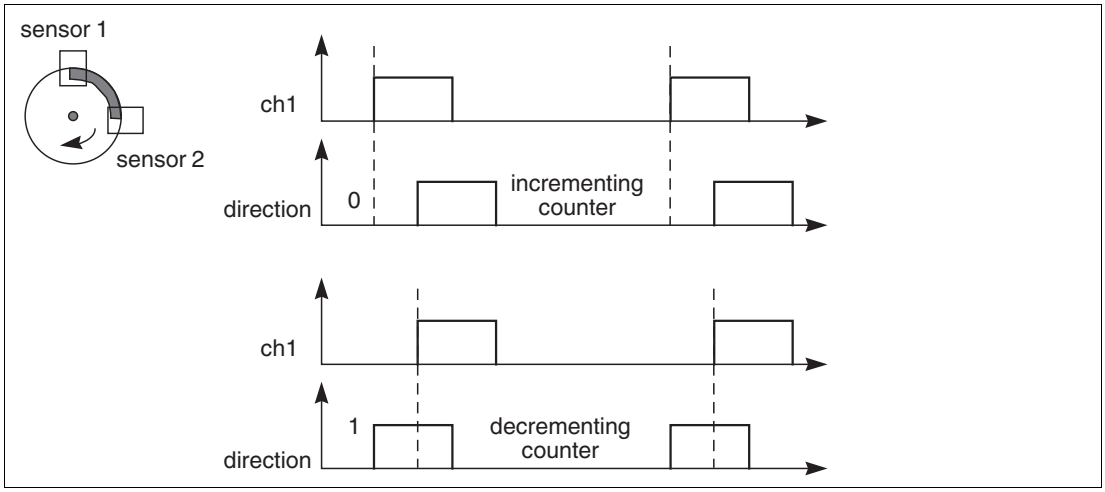

Figure 6.9 Direction detection

6.3.7 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

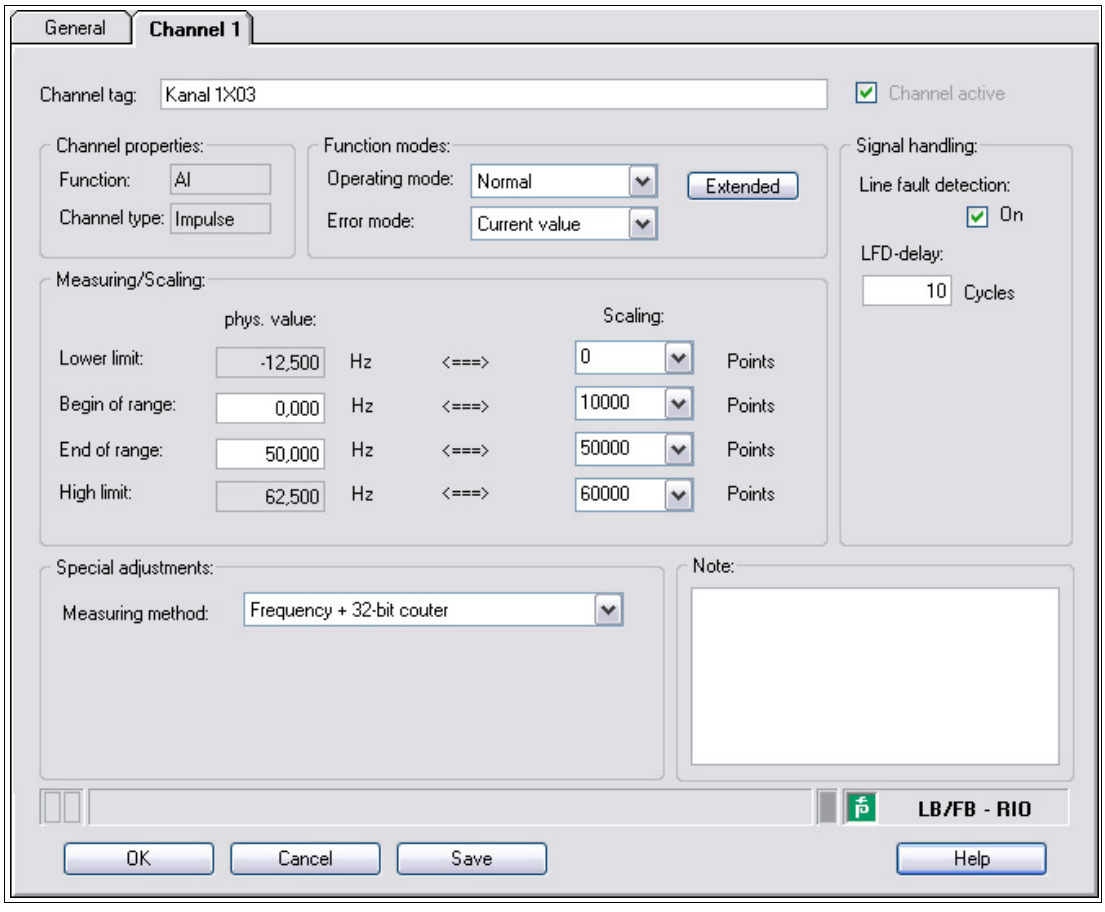

Figure 6.10 **Channel 1** tab

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Note!

Hidden Areas

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

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

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Function	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
LFD delay	This field only appears when **Line fault detection** is enabled. Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This function can be used for suppressing loose contacts, for example.
Measuring range/scaling	This area only appears if you have set a frequency measurement. If you have configured a frequency measurement combined with a 32-bit counter, the maximum input frequency is 50 Hz. The values for the start of range (0%) and end of range (100%) in the **Phys. size** column depend on the sensor and the measuring unit. The values for the lower and upper limits in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value. The **Start of range** indicates the value equal to 0%. The **End of range** indicates the value equal to 100%. The **Upper limit** indicates the largest transferable value.

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Field	Explanation
Measuring method	Select the function type for the I/O module. Modification of the function type is restricted in online mode because the different function types have different data volumes. The following function types are available. The direction detection can be used either to count up or down or as a status indicator for the direction of rotation. ■ Frequency input: Choose between **Frequency** and **Frequency with direction**. ■ Counter input: Choose between **32-bit counter**, **32-bit counter with direction**, **12-bit counter** and **12-bit counter with direction**. ■ Combined frequency input and counter input: The maximum input frequency in this mode is 50 Hz. Select between **Frequency + 32-bit counter** and **Frequency + 32-bit counter with direction**. Frequency measurement is the primary measuring method.
Counter quotient	This field is only visible if you are using the I/O module as a counter. The counter quotient determines how frequently the pulse is counted. For example, if you enter 5, every fifth pulse is counted.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

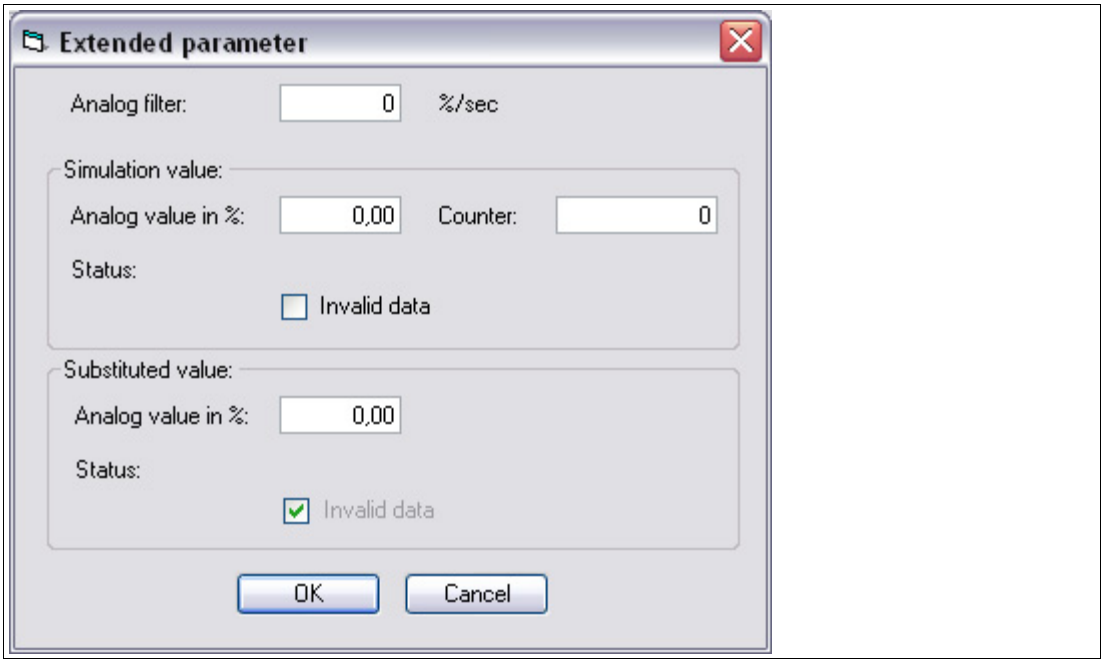

Figure 6.11 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Invalid data (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Invalid data (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.4 LB 1007 Digital Input

6.4.1 Description

Versions

LB1007, digital input, not intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 7
- Suitable sensors: mechanical contacts, NAMUR proximity switches, 2-wire initiators

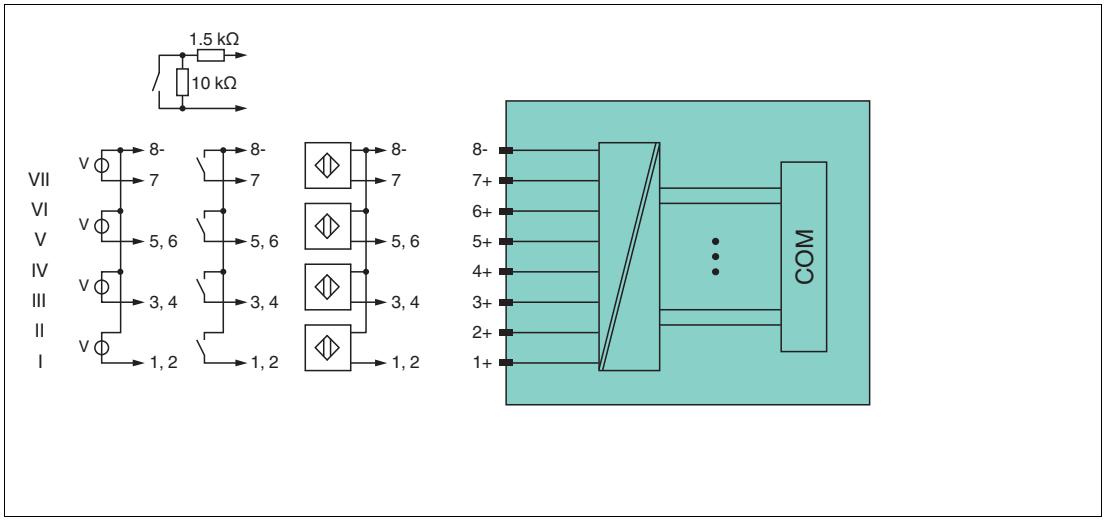

Figure 6.12 Block diagram LB1007

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

6.4.2 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.

6.4.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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Bit Structure within the Data Telegram

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	Status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)
Input byte 2	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 ... 7	Empty
Output bytes		Without output bytes

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**5120** (DA)	Offset + (16 * slot) + bit no. - 1	Function code 2 (read input status)
	16001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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6.4.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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

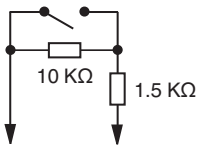

Figure 6.13 Mechanical contact with additional resistor circuit

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6.4.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

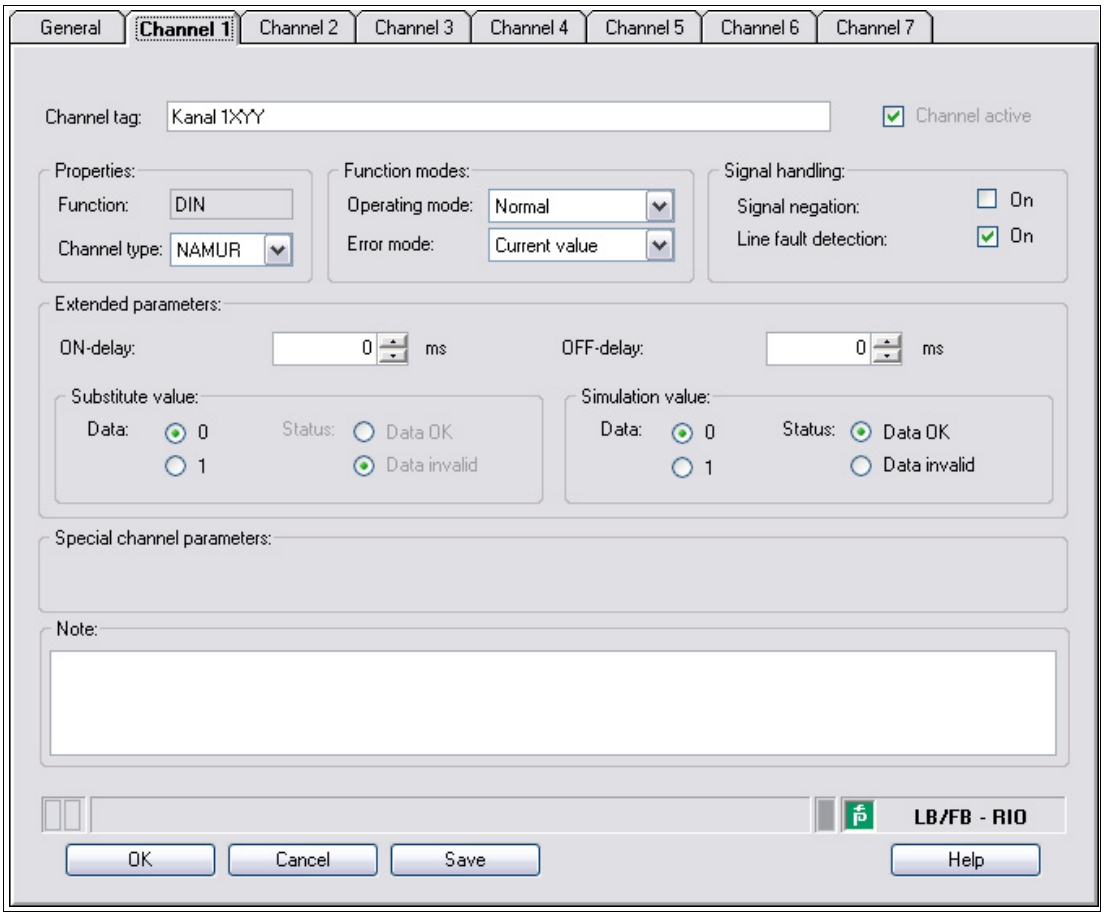

Figure 6.14 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.

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Field	Explanation
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

6.5 LB1*08, FB1*08 Digital Input

6.5.1 Description

Versions

- LB1008, digital input, not intrinsically safe
- FB1308, digital input, increased safety terminals
- LB1108, digital input, intrinsically safe
- FB1208, digital input, intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 8
- Suitable sensors: mechanical contacts, NAMUR proximity switches
  The LB1008 I/O module can read active inputs with 24 V or 5 VDC. This does not apply to I/O modules LB1108, FB1208, and FB1308.

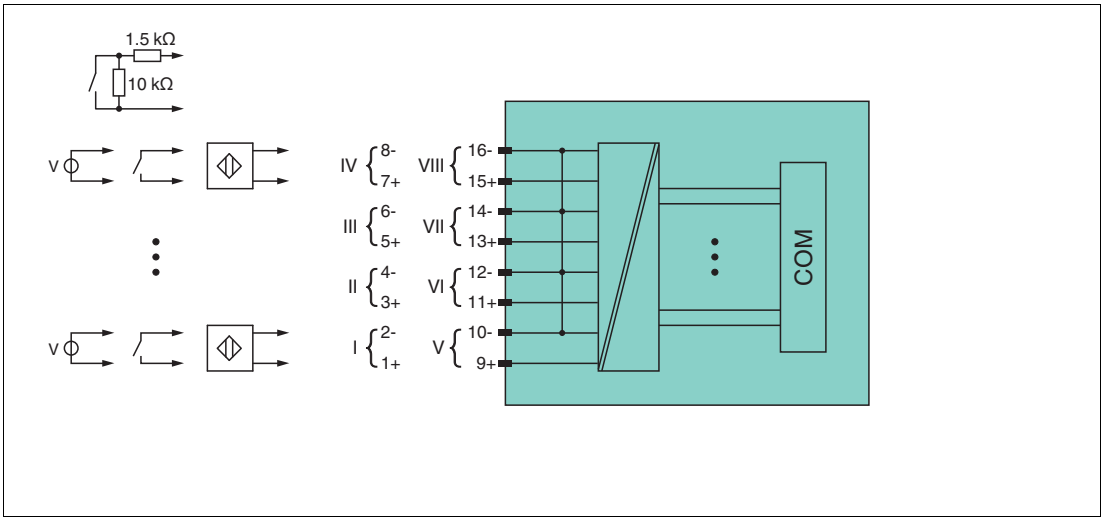

Figure 6.15 Block diagram LB1008

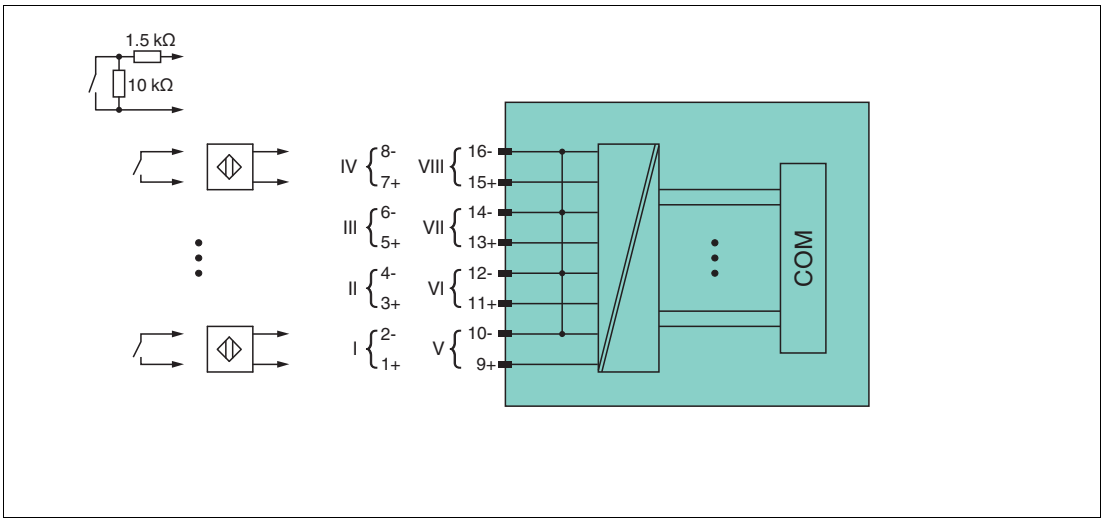

Figure 6.16 Block diagram LB1108, FB1*08

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

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6.5.2 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.

6.5.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Note!

Dual-Width I/O Module

Dual-width I/O modules occupy two 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.

Bit Structure within the Data Telegram

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	Status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)
Input byte 2	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)
Output bytes		Without output bytes

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Byte 1 (channel 1 ... 4): Offset + (8 * slot) + bit no. - 1 Byte 2 (channel 5 ... 8): Offset + (8 * (slot + 1)) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.5.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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

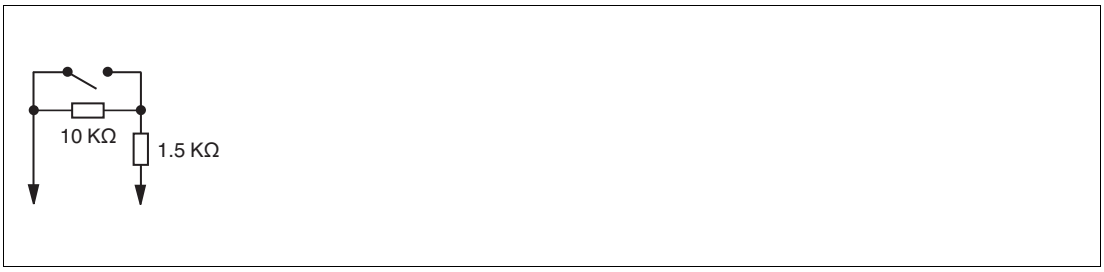

Figure 6.17 Mechanical contact with additional resistor circuit

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6.5.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

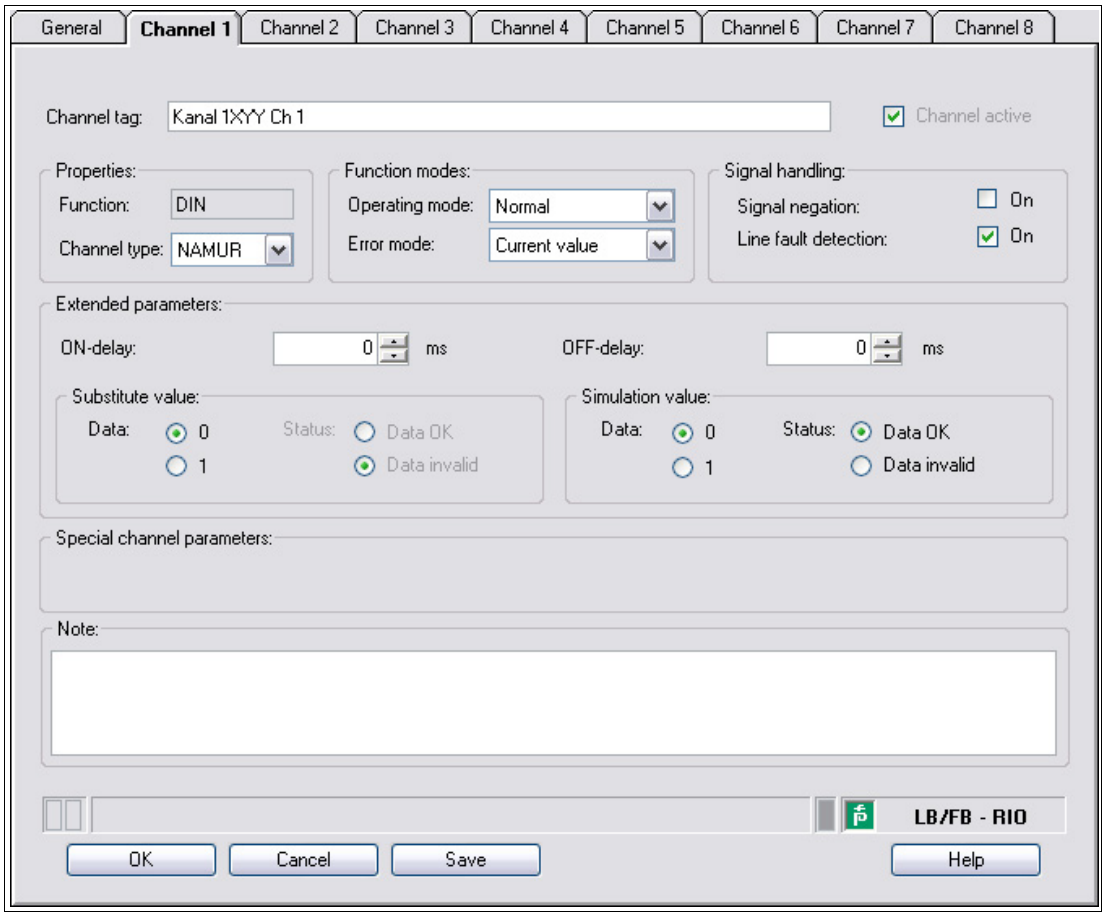

Figure 6.18 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.

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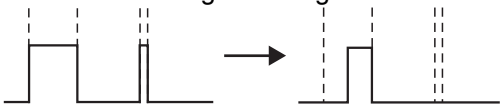
Field	Explanation
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.6 LB1*09, FB1*09 Digital Input

6.6.1 Description

Versions

- LB1009, digital input, not intrinsically safe
- LB1109, digital input, intrinsically safe
- FB1209, digital input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 8
- Suitable sensors: mechanical contacts, NAMUR proximity switches
  The LB1009 I/O module can also read active inputs with 24 V or 5 VDC. This does not apply to I/O modules LB1109, LB1109, and FB1209.

Note!

By default the LB1*09, FB1*09 digital input only supports mechanical contacts and NAMUR proximity switches. Activate the **Support for active input signals (5 V/24 VDC) for 1x09** option in the firmware-dependent com unit settings to be able to process active signals from 2-wire-initiators.

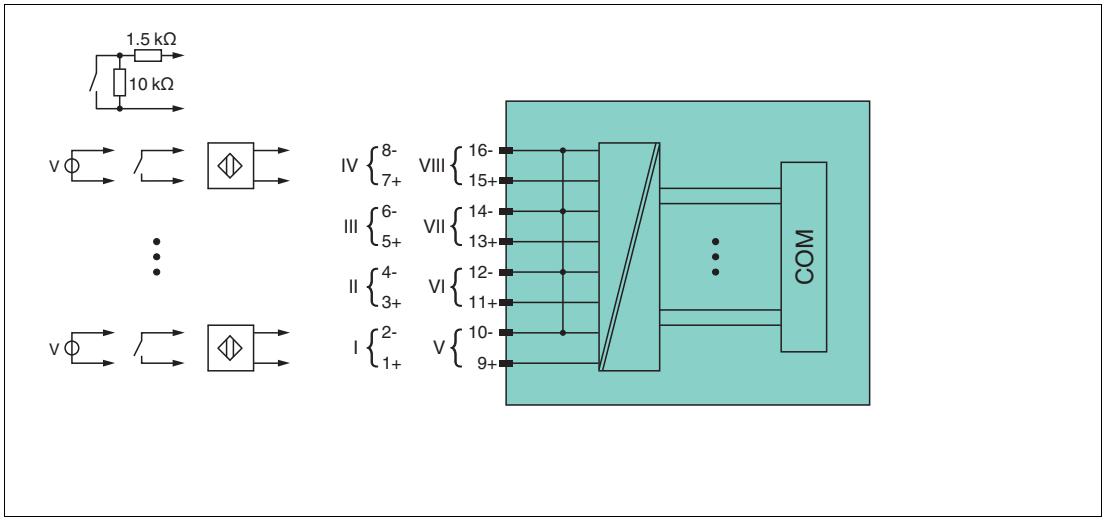

Figure 6.19 Block diagram LB1009

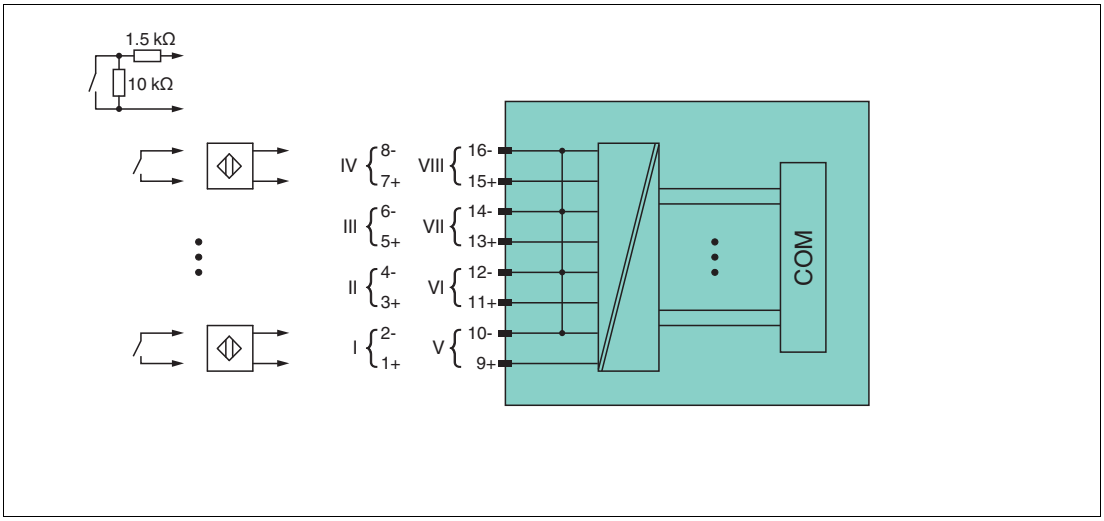

Figure 6.20 Block diagram LB1109, FB1209

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

6.6.2 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.

6.6.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Bit Structure within the Data Telegram

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	Status channel 4
	7	Line fault detection channel 4 (0 = OK, 1 = error)

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Byte	Bit	Meaning
Input byte 2	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)
Output bytes		Without output bytes

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**5120** (DA)	Offset + (16 * slot) + bit no. - 1	Function code 2 (read input status)
	16001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.6.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

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

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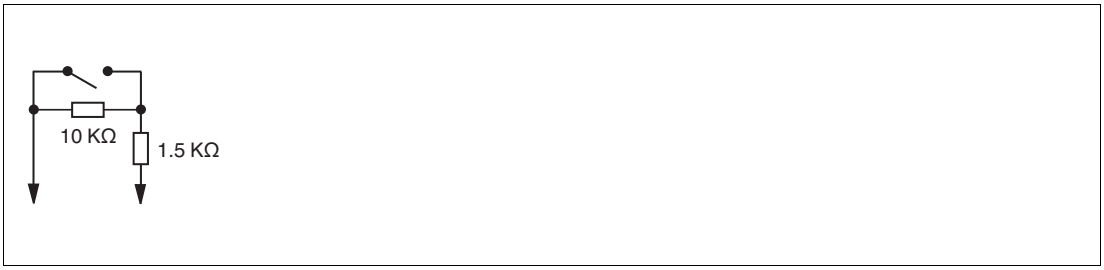

Figure 6.21 Mechanical contact with additional resistor circuit

6.6.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

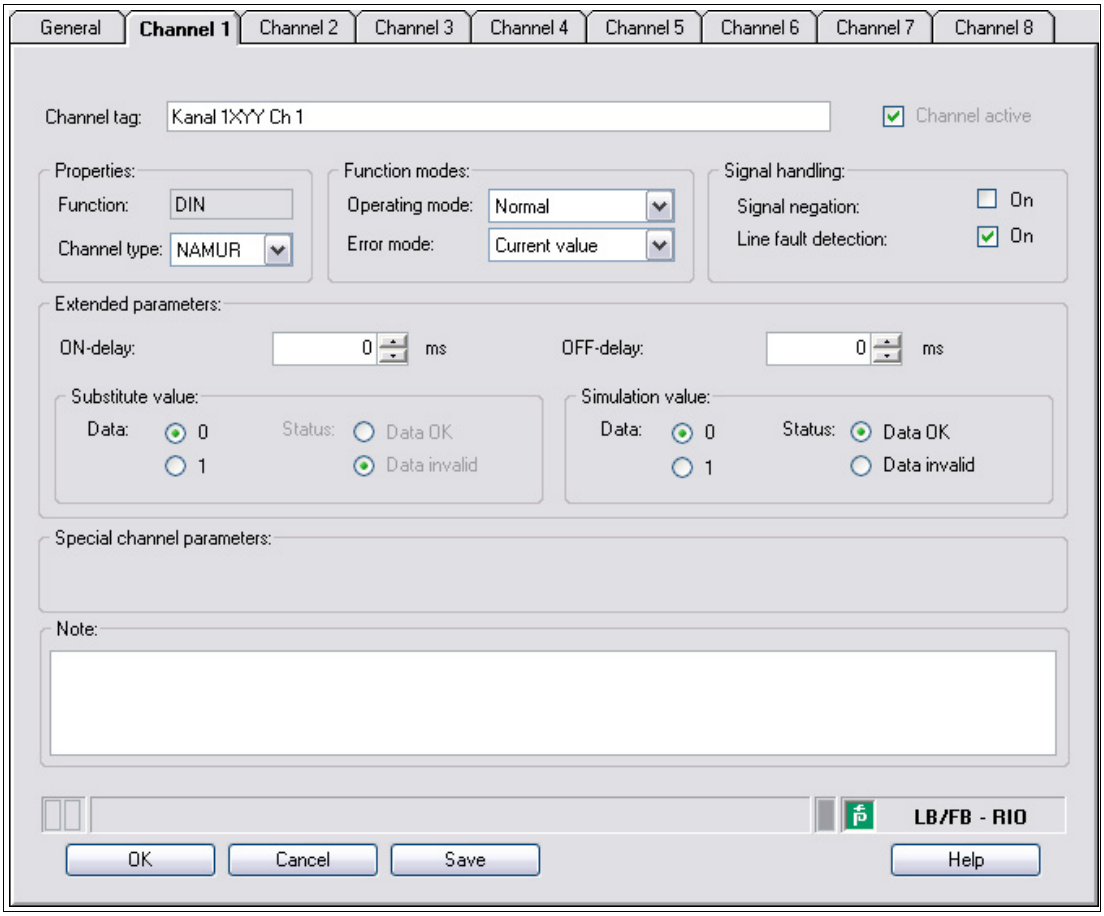

Figure 6.22 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.7 LB1014, LB1015 Digital Input

6.7.1 Description

Versions

- LB1014, digital input, not intrinsically safe
- LB1015, digital input, not intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 15
- Digital signals
  - LB1014: AC 95 V ... 230 V (250 V max.) in phase
  - LB1015: DC 24 V (30 V max.)

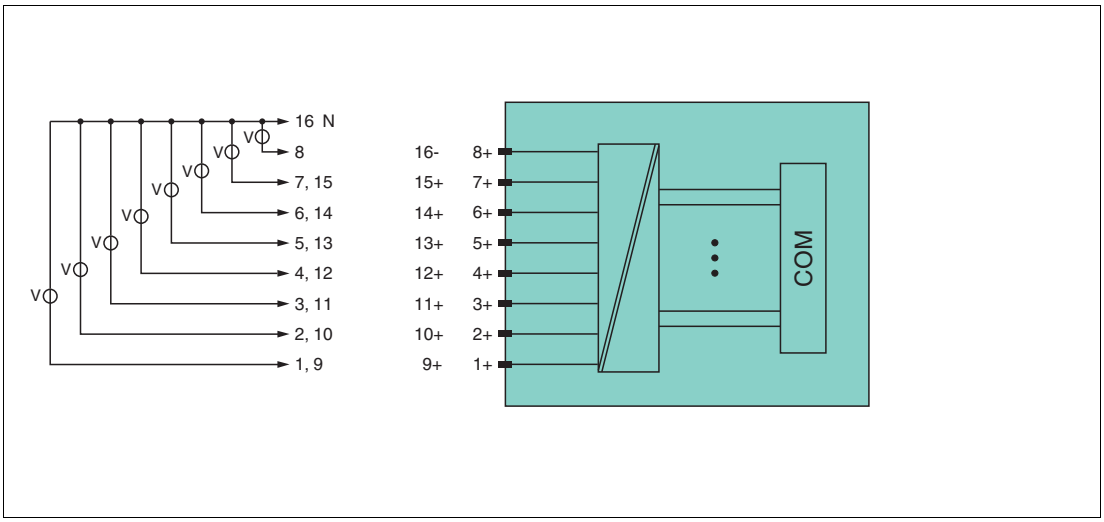

Figure 6.23 Block diagram LB1014, LB1015

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

6.7.2 Measuring Time and Cycle Time

The maximum input frequency of the signals is 50 Hz. Whether 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 500 ms sampling interval).
The signals are transmitted to the Com Unit every 6.5 ms irrespective of the sampling interval of the process control system.

6.7.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input byte 1	0	Status channel 1
	1	Status channel 2
	2	Status channel 3
	3	Status channel 4
	4	Status channel 5
	5	Status channel 6
	6	Status channel 7
	7	Status channel 8
Input byte 2	0	Status channel 9
	1	Status channel 10
	2	Status channel 11
	3	Status channel 12
	4	Status channel 13
	5	Status channel 14
	6	Status channel 15
	7	Collective error channels 1 ... 15
Output bytes		Without output bytes

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**5120** (DA)	Offset + (16 * slot) + bit no. - 1	Function code 2 (read input status)
	16001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.7.4 Line Fault Detection

The "Line fault detection" function is not supported.

6.7.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

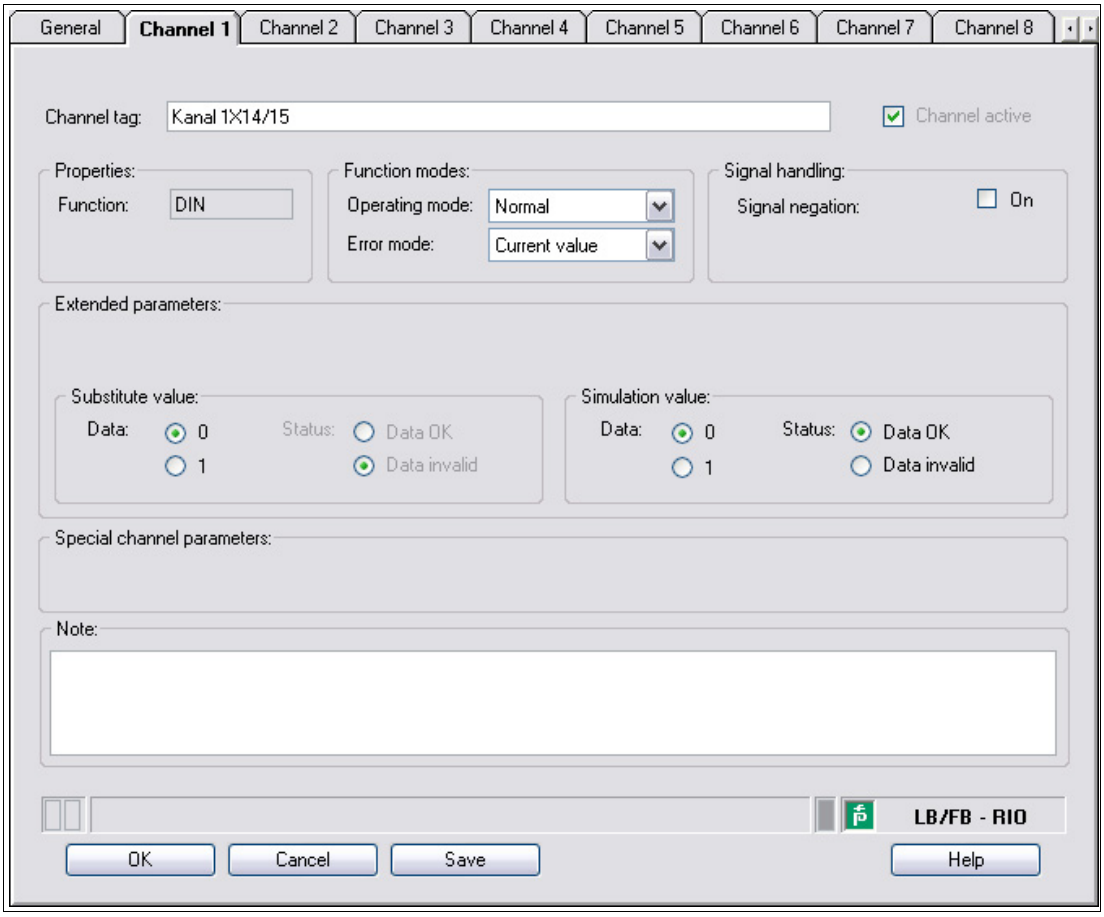

Figure 6.24 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.8 LB2002, LB21*, FB22* Digital Output with Position Feedback

6.8.1 Description

Versions

- LB2002, digital output with position feedback, not intrinsically safe
- LB21*, digital input with position feedback, intrinsically safe
  Versions available with bus-independent shutdown input
- FB22*, digital input with position feedback, intrinsically safe
  Versions available with bus-independent shutdown input

Features

- Occupies 1 slot on the backplane
- Number of channels
  - 1 output channel
    Suitable sensors: solenoid valves, acoustic sensors, and LEDs (without line fault detection)
  - 2 input channels, e.g., for position feedback
    Suitable sensors: mechanical contacts, NAMUR proximity switches, 2-wire initiators

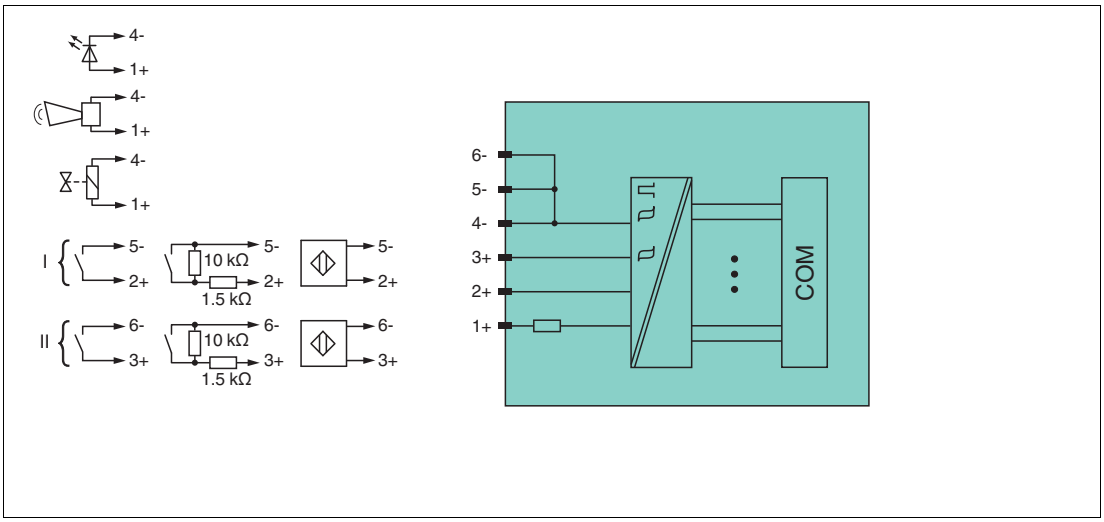

Figure 6.25 Block diagram LB2002, LB21*, FB22* without shutdown input

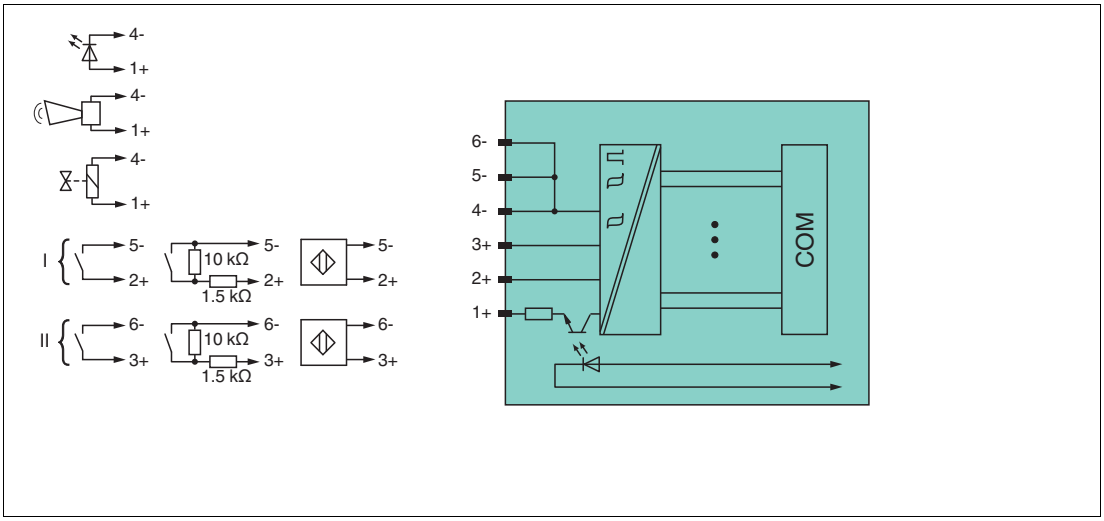

Figure 6.26 Block diagram LB21*, FB22* with shutdown input

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

6.8.2 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.

6.8.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input byte 1	0	Status channel 1 (valve output)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2	Status channel 2 (acknowledgment input 1)
	3	Line fault detection channel 2 (0 = OK, 1 = error)
	4	Status channel 3 (acknowledgment input 2)
	5	Line fault detection channel 3 (0 = OK, 1 = error)
	6 ... 7	Empty
Output byte 1	0	Output value channel 1 (valve output)
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2 ... 7	Empty

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.8.4 Line Fault Detection

With NAMUR proximity switches, the line fault detection can detect a line breakage or short circuit and can be switched off on a channel-by-channel basis.

If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available 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. If the I/O module is being used with indicator lights or acoustic sensors, you can switch off the current pulse for each channel.

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 switched off. In such cases, depending on the valve, a 10 kΩ parallel resistor enables line fault detection for booster valves. If line fault detection is still detected when the valve is off, even with the parallel resistor connected, disable the line fault detection function.

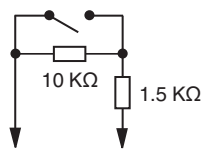

Figure 6.27 Mechanical contact with additional resistor circuit

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6.8.5 Watchdog

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.

6.8.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

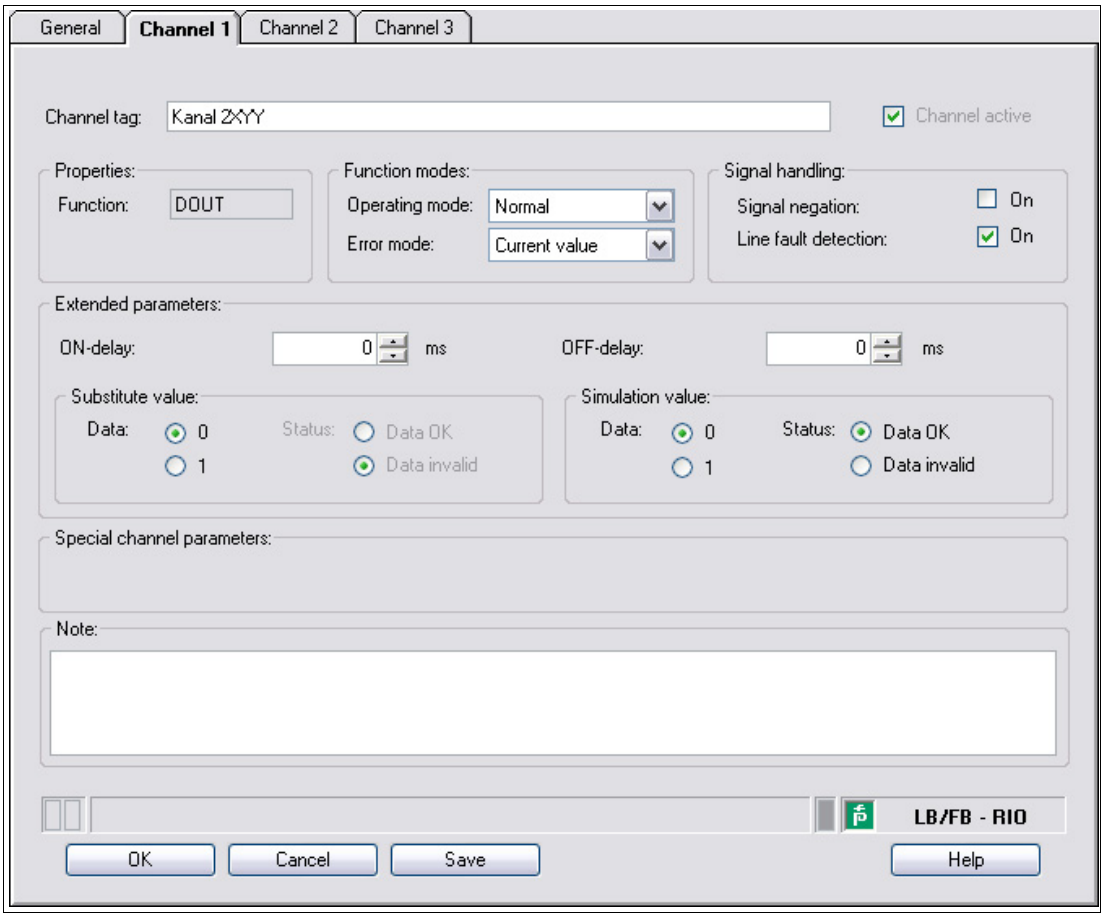

Figure 6.28 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output

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Field	Explanation
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

6.9 LB3101, FB3201 Transmitter Power Supply, Current Input

6.9.1 Description

Versions

- LB3101, transmitter power supply, current input, intrinsically safe
- FB3201, transmitter power supply, current input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Suitable field devices: pressure, differential pressure, filling level, flow rate, and temperature converters, etc.

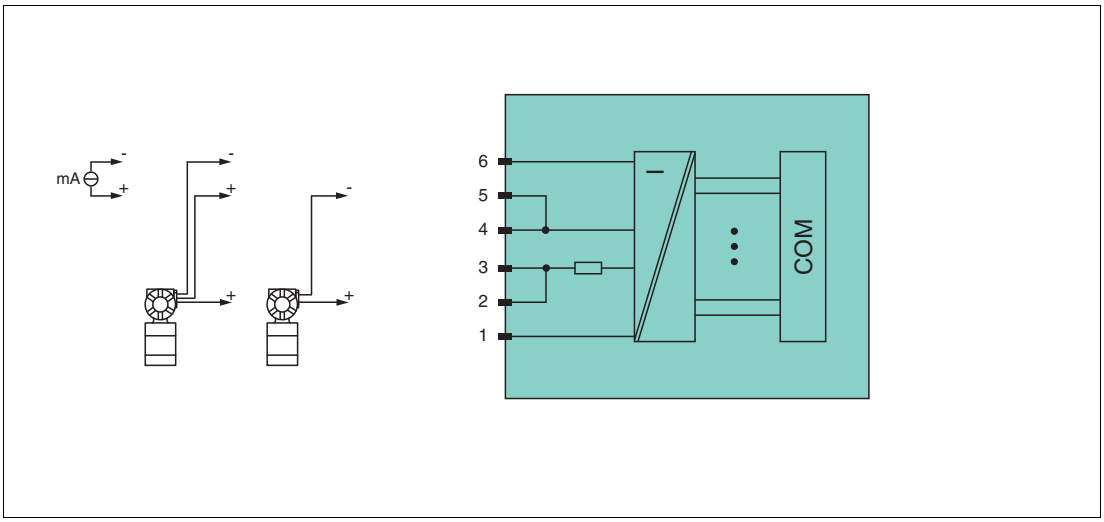

Figure 6.29 Block diagram LB3101, FB3201

2-wire transmitter
Supply circuit: 2/3+, 4/5-

3-wire transmitter
Supply circuit: 2/3+, 6-
Measuring circuit: 4/5+, 6-

4-wire transmitter (powered externally)
Measuring circuit: 4/5+, 6-

Input resistance at terminals 5 and 6: 15 Ω

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

6.9.2 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.

6.9.3 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.

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6.9.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value (12 bit)
	8 ... 15	
Output data		No output data
(*) The live zero monitoring transmits one error bit (= 1) if the current falls below the minimum of 3.6 mA.		

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.9.5 Line Fault Detection

The line fault detection can detect a lead breakage or short circuit and can be switched off on a channel-by-channel basis.

You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g., line breakage < 1 mA and short circuit > 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).

6.9.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

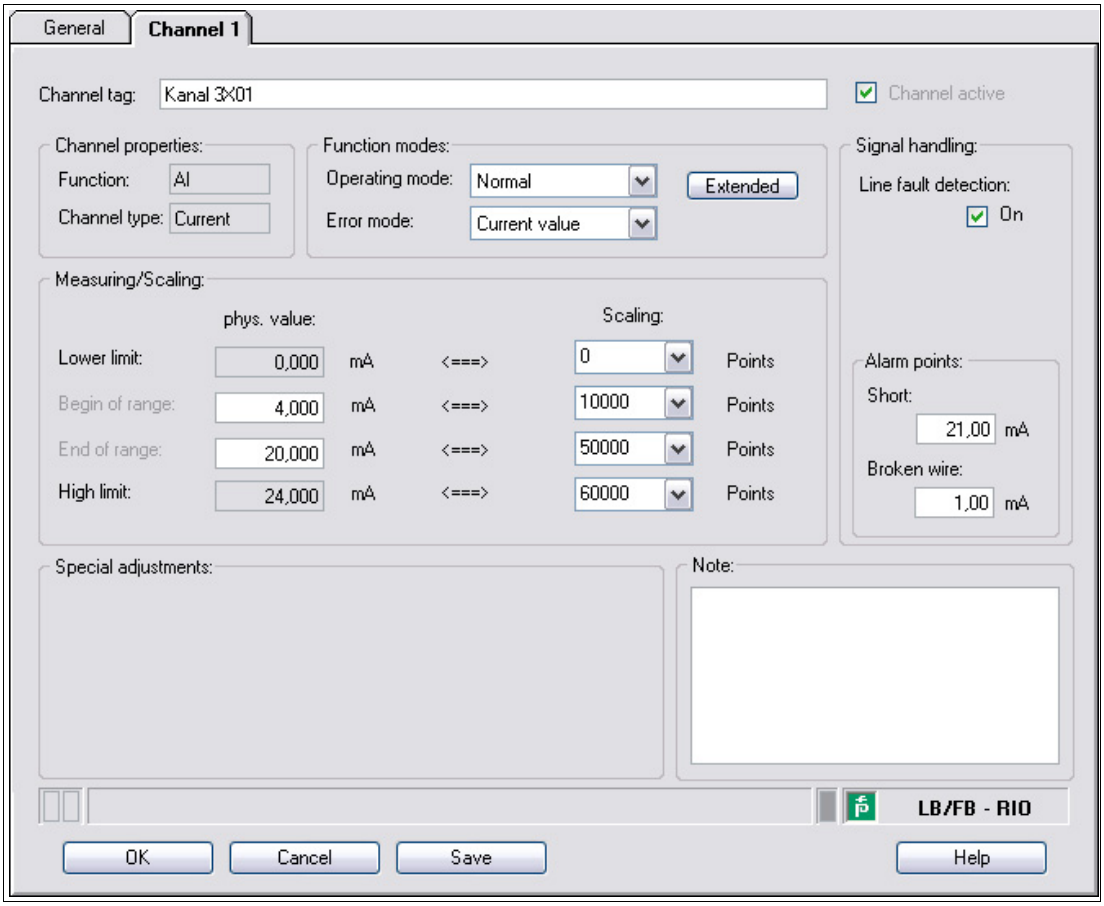

Figure 6.30 **Channel 1** tab

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Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
Short circuit	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.
Lead breakage	Enter the threshold value for the lead breakage detection, e.g., 1 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
Special settings	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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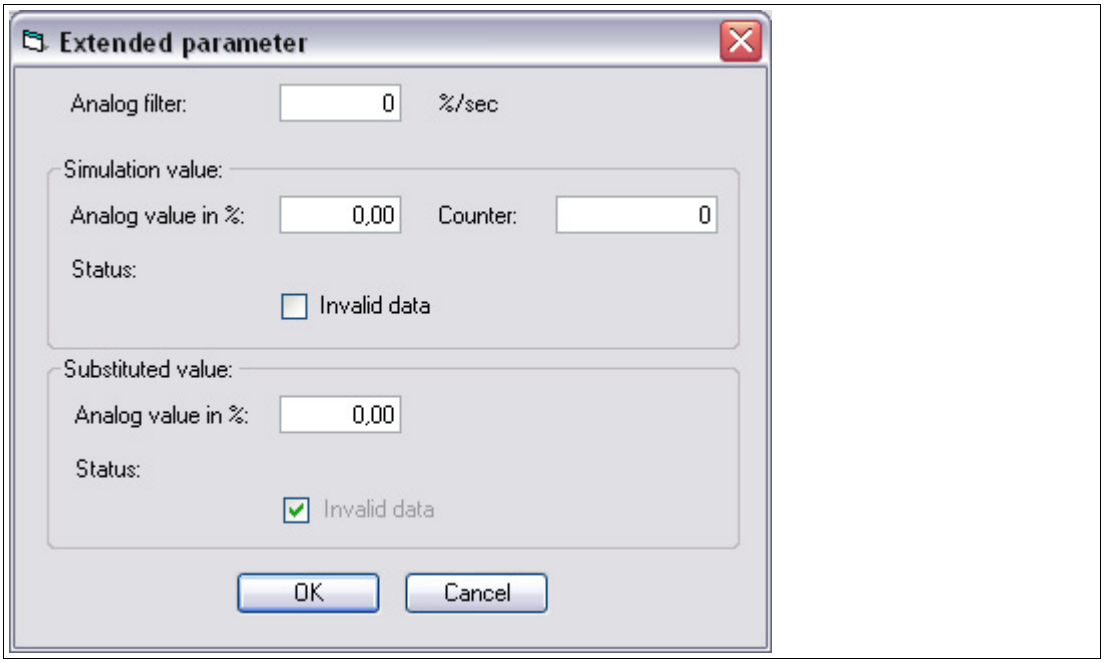

Figure 6.31 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.10 LB3*02, FB3*02, LB3103, FB3203 HART Transmitter Power Supply, current input

6.10.1 Description

Versions

- LB3002, HART transmitter power supply, current input, not intrinsically safe
- FB3302, HART transmitter power supply, current input, increased safety terminals Terminals 3 and 4 are not passed through in this I/O module.
- LB3102, HART transmitter power supply, current input, intrinsically safe
- FB3202, HART transmitter power supply, current input, intrinsically safe
- LB3103, HART transmitter power supply, current input, intrinsically safe
- FB3203, HART transmitter power supply, current input, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Suitable field devices: pressure, differential pressure, filling level, flow rate, and temperature converters, etc.

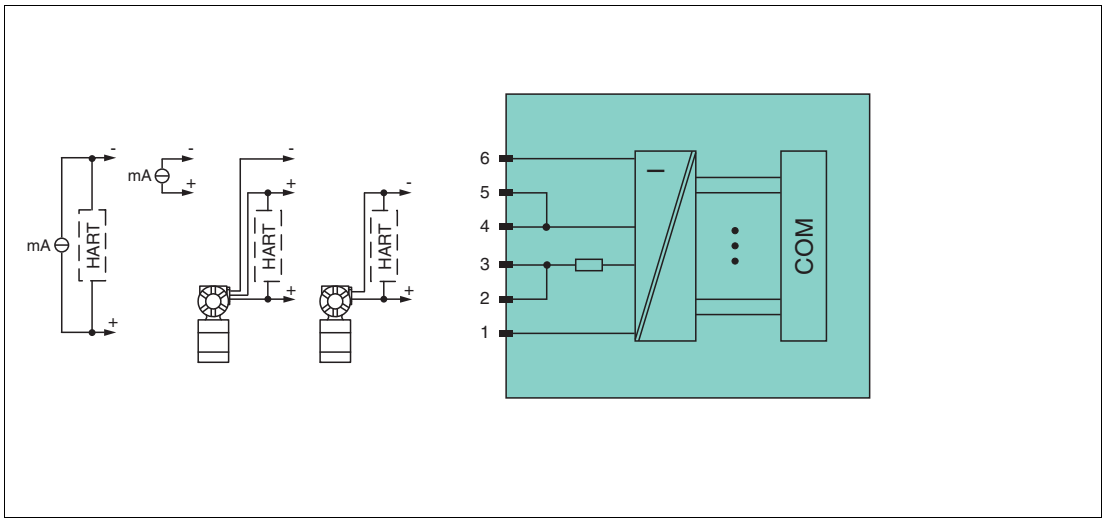

Figure 6.32 Block diagram LB3*02, LB3103, FB3*02, FB3203

2-wire transmitter (HART)
Supply circuit: 2/3+, 4/5-

3-wire transmitter (HART)
Supply circuit: 2/3+, 6-
Measuring circuit: 4/5+, 6-

4-wire transmitter (externally powered)
Measuring circuit: 4/5+, 6-
HART measuring circuit: 1+, 6-

Input resistance at terminals 5 and 6: 15 Ω
Input resistance at terminals 1 and 6 (HART): 236 Ω

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

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6.10.2 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.

6.10.3 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.

6.10.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value (12 bit)
	8 ... 15	
Output data		No output data
(*) The live zero monitoring transmits one error bit (= 1) if the current falls below the minimum of 3.6 mA.		

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
HART auxiliary variables (analog input signals area, slot-based; access: read word by word)	**2048** (DA)	Offset + (12 * slot)	Function code 4 (read input registers)
	35700 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.10.5 Line Fault Detection

The line fault detection can detect a lead breakage or short circuit and can be switched off on a channel-by-channel basis.

You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g., line breakage < 1 mA and short circuit > 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).

6.10.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

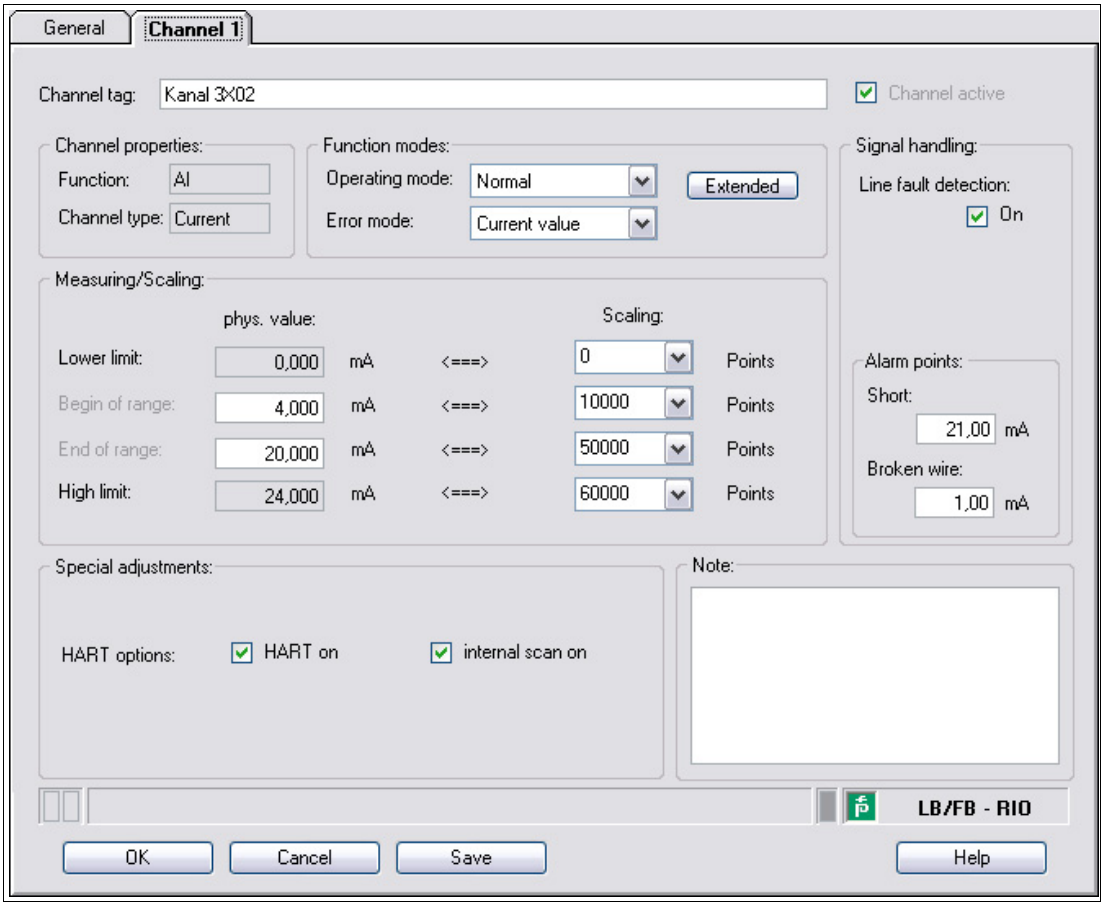

Figure 6.33 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Function	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.

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Field	Explanation
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
Short circuit	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.
Broken wire	Enter the threshold value for the lead breakage detection, e.g., 1 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access. In addition, the internal scan reads out 4 HART auxiliary variables from each HART device (if supported by HART device) and makes them available via special register areas. See chapter 6.10.4 The HART auxiliary variables are updated less frequently than the standard process data. If the remote I/O station receives a new parameter set, HART communication must be restarted. During the initialization phase, no valid HART auxiliary variables are available. Following initialization, the HART auxiliary variables are read by a HART scan and made available again. The scan generally takes several seconds.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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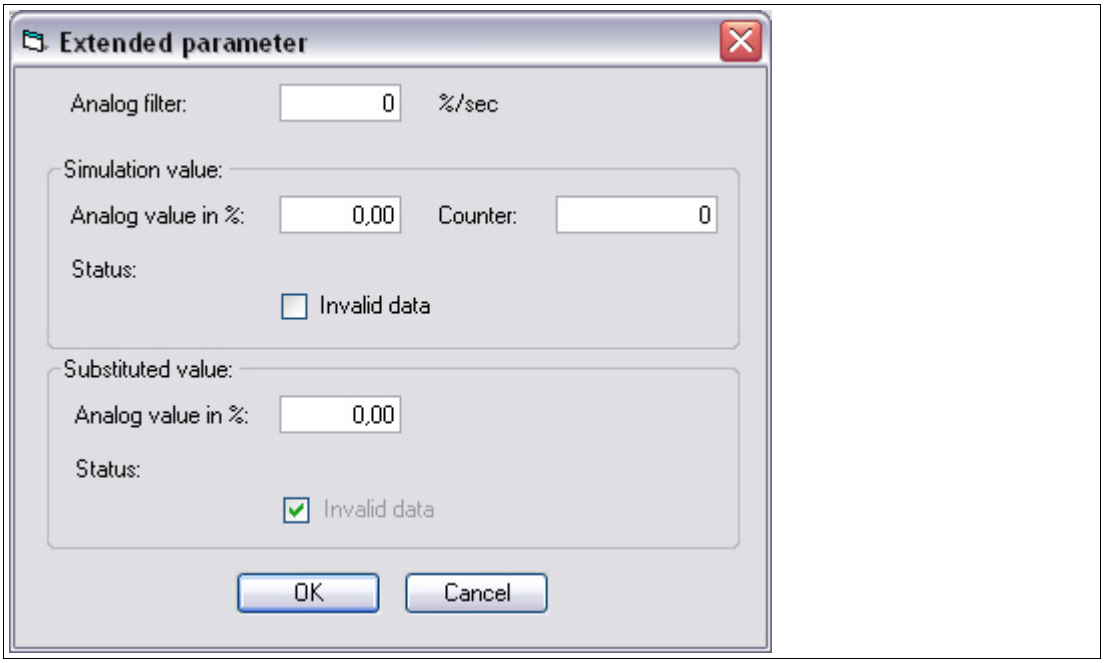

Figure 6.34 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Invalid data (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Invalid data (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.11 LB3104, FB3204 Transmitter Power Supply, Current Input LB3*05, FB3*05 HART Transmitter Power Supply, Current Input

6.11.1 Description

Versions

- LB3104, transmitter power supply, current input, intrinsically safe
- FB3204, transmitter power supply, current input, intrinsically safe
- LB3005, HART transmitter power supply, current input, not intrinsically safe
- FB3305, HART transmitter power supply, current input, increased safety terminals
- LB3105, HART transmitter power supply, current input, intrinsically safe
- FB3205, HART transmitter power supply, current input, intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- Suitable field devices: pressure, differential pressure, filling level, flow rate, and temperature converters, etc.

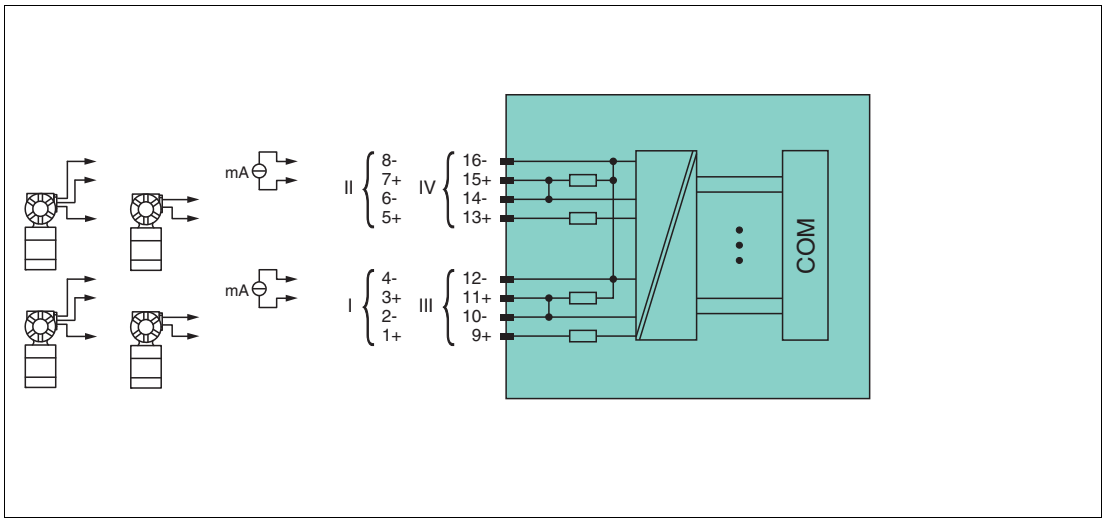

Figure 6.35 Block diagram LB3104, FB3204

2-wire transmitter
Supply circuit: channel I 1+, 2-, channel II 5+, 6-, channel III 9+, 10-, channel IV 13+, 14-

3-wire transmitter
Supply circuit: channel I 1+, 4-, channel II 5+, 8-, channel III 9+, 12-, channel IV 13+, 16-
Measuring circuit: channel I 3+, 4-, channel II 7+, 8-, channel III 11+, 12-, channel IV 15+, 16-

4-wire transmitter (powered externally)
Measuring circuit: channel I 3+, 4-, channel II 7+, 8-, channel III 11+, 12-, channel IV 15+, 16-

Input resistance: 15 Ω (channel I: 3, 4; channel II: 7, 8; channel III: 11, 12; channel IV: 15, 16)

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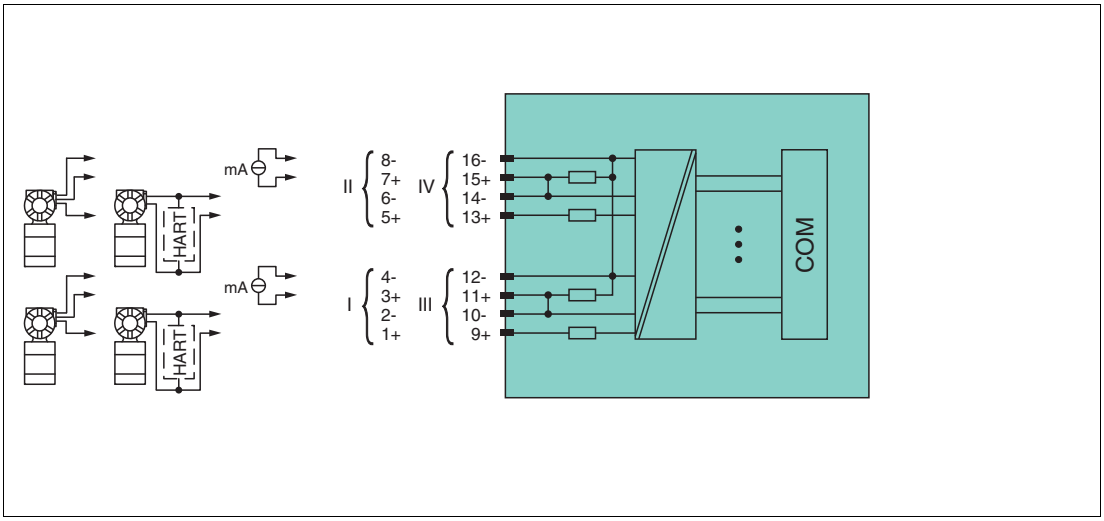

Figure 6.36 Block diagram LB3*05, FB3*05

2-wire transmitter (HART)
Supply circuit: channel I 1+, 2-, channel II 5+, 6-, channel III 9+, 10-, channel IV 13+, 14-

3-wire transmitter
Supply circuit: channel I 1+, 4-, channel II 5+, 8-, channel III 9+, 12-, channel IV 13+, 16-
Measuring circuit: channel I 3+, 4-, channel II 7+, 8-, channel III 11+, 12-, channel IV 15+, 16-

4-wire transmitter (powered externally)
Measuring circuit: channel I 3+, 4-, channel II 7+, 8-, channel III 11+, 12-, channel IV 15+, 16-

Input resistance: 15 Ω (channel I: 3, 4; channel II: 7, 8; channel III: 11, 12; channel IV: 15, 16)

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

6.11.2 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.

6.11.3 Measuring Time and Cycle Time

The conversion time for all 4 channels together is approx. 80 ms. The accuracy of the measured value depends on the cycle time of the data traffic on the bus. 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 for this. In the worst case scenario, the total time is therefore 130 ms.

6.11.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

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A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value channel 1 (12 bit)
	8 ... 15	
Input data word 2 ... 4	0 ... 15	Same structure as input data word 1
Output data		No output data
(*) The live zero monitoring transmits one error bit (= 1) if the current falls below the minimum of 3.6 mA.		

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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6.11.5 Line Fault Detection

The line fault detection can detect a lead breakage or short circuit and can be switched off on a channel-by-channel basis.

You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g., line breakage < 1 mA and short circuit > 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).

6.11.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

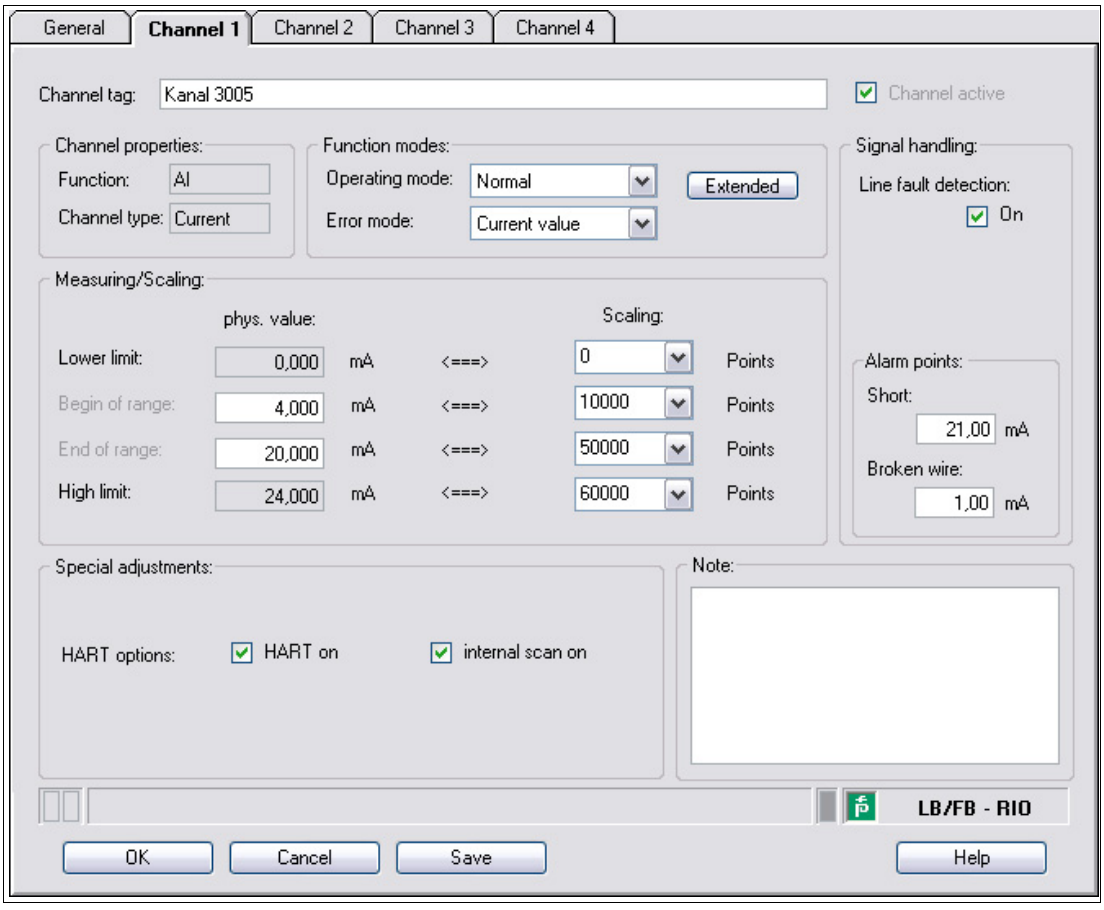

Figure 6.37 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
Short circuit	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.
Lead breakage	Enter the threshold value for the lead breakage detection, e.g., 1 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	This check box is available for the LB3*05 and FB3*05 I/O modules only. Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.

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Field	Explanation
Internal scan on	This check box is available for the LB3*05 and FB3*05 I/O modules only. This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

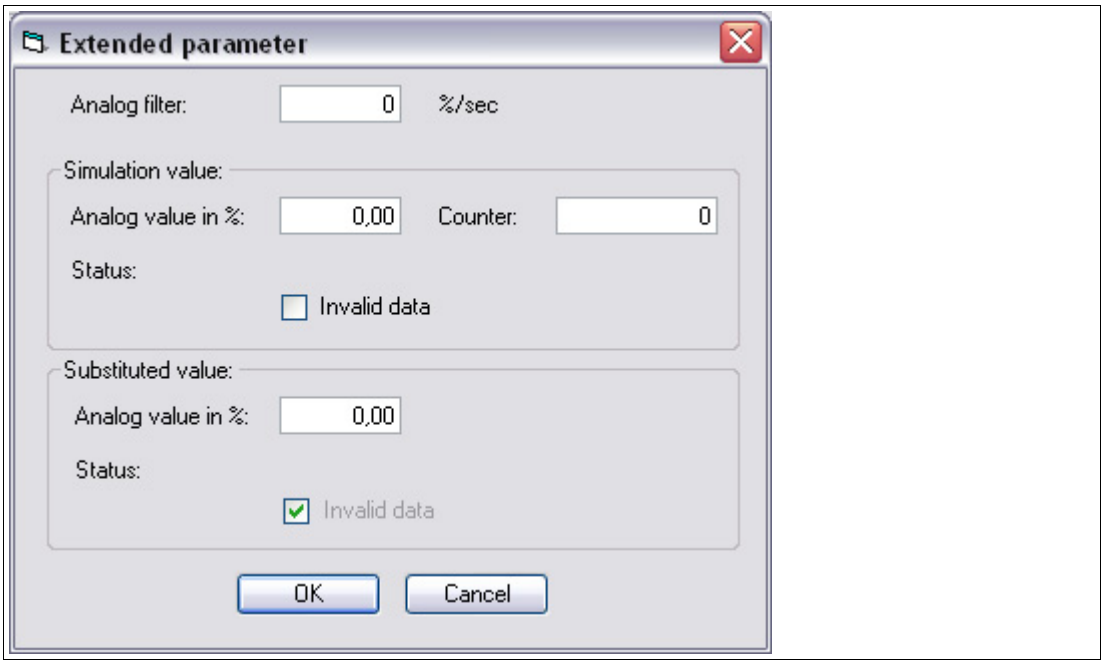

Figure 6.38 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.12 LB3*06 HART transmitter power supply

6.12.1 Description

Versions

- LB3006, HART transmitter power supply, not intrinsically safe
- LB3106, HART transmitter power supply, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 4
- Suitable field devices: pressure, differential pressure, filling level, flow rate, and temperature converters, etc.

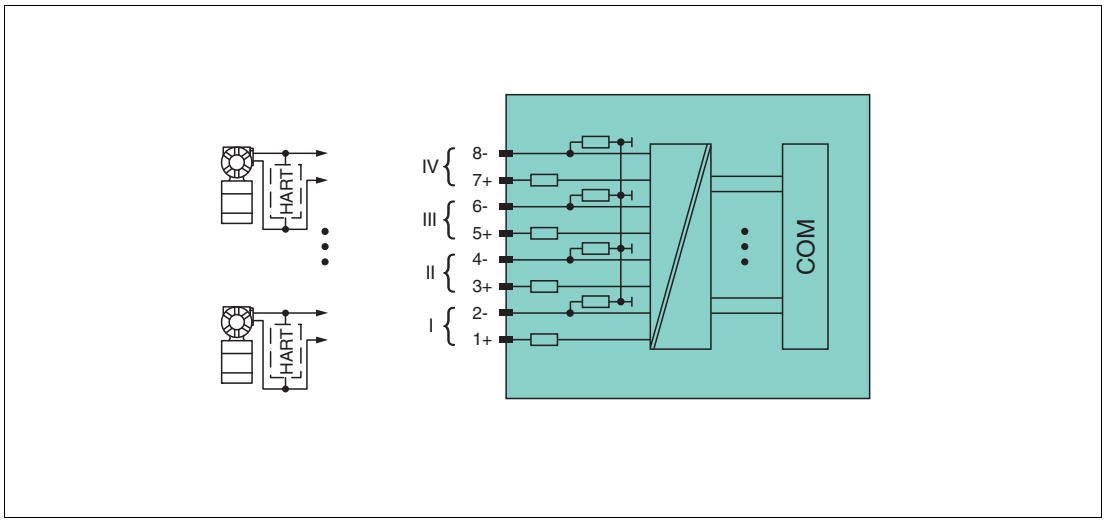

Figure 6.39 Block diagram LB3*06

The connection layout and other technical data can be found on the relevant data sheet.

6.12.2 Measuring Time and Cycle Time

The conversion time for all 4 channels together is approx. 80 ms. The accuracy of the measured value depends on the cycle time of the data traffic on the bus. 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 for this. In the worst case scenario, the total time is therefore 130 ms.

6.12.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

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Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Live zero if current ≤ 3.6 mA (*)
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value channel 1 (12 bit)
	8 ... 15	
Input data word 2 ... 4	0 ... 15	Same structure as input data word 1
Output data		No output data
(*) The live zero monitoring transmits one error bit (= 1) if the current falls below the minimum of 3.6 mA.		

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data channel 1+2 (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Process data channel 3+4 (analog input signals area, slot-based; access: read word by word)	**640** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35400 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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6.12.4 Line Fault Detection

The line fault detection can detect a lead breakage or short circuit and can be switched off on a channel-by-channel basis.

You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g., line breakage < 1 mA and short circuit > 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).

6.12.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

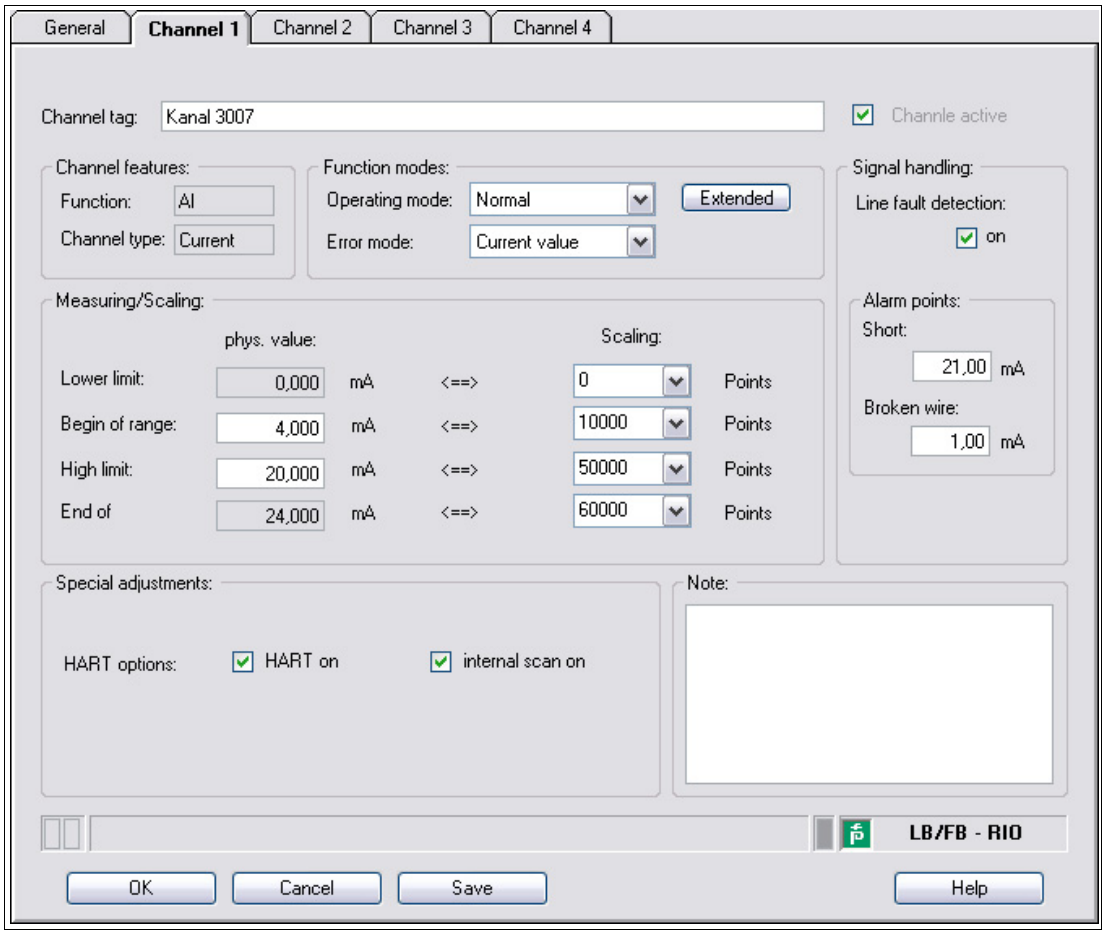

Figure 6.40 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.

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Field	Explanation
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
Short circuit	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.
Lead breakage	Enter the threshold value for the lead breakage detection, e.g., 1 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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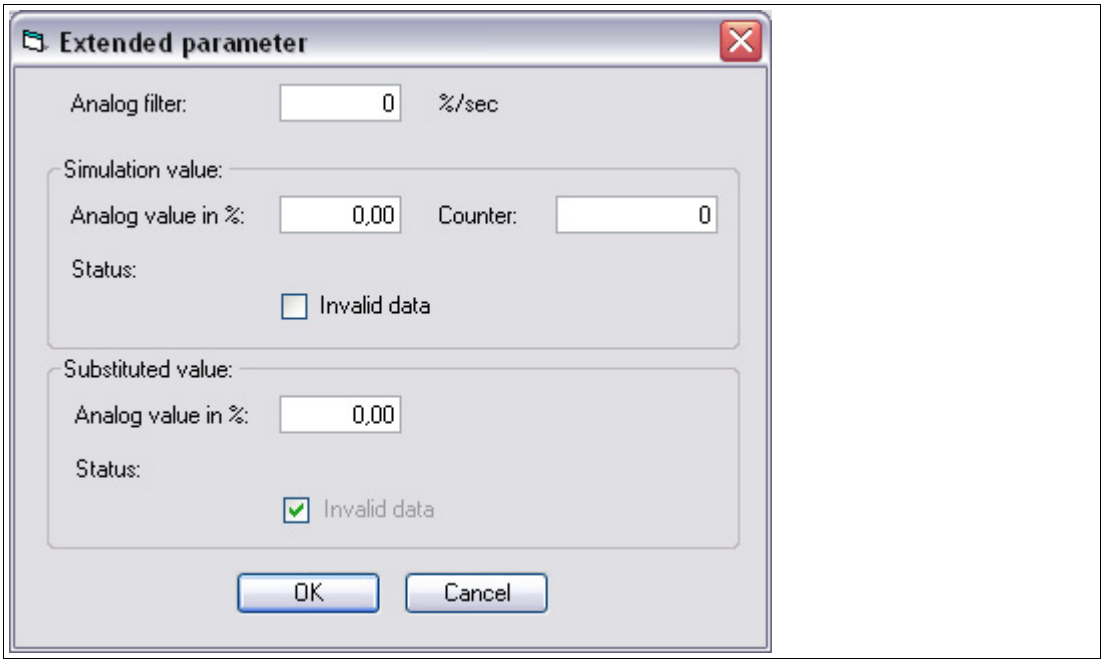

Figure 6.41 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.13 LB4101, FB4*01 Current Output
LB4*02, FB4*02 HART Current Output

6.13.1 Description

Versions

- LB4101, current output, intrinsically safe
- FB4201, current output, intrinsically safe
- LB4002, HART current output, not intrinsically safe
- FB4302, HART current output, increased safety terminals
  Versions with bus-independent shutdown input are available
- LB4102, HART current output, intrinsically safe
  Versions with bus-independent shutdown input are available
- FB4202, HART current output, intrinsically safe
  Versions with bus-independent shutdown input are available.

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Suitable field devices: proportional valves, I/P converters, local indicators

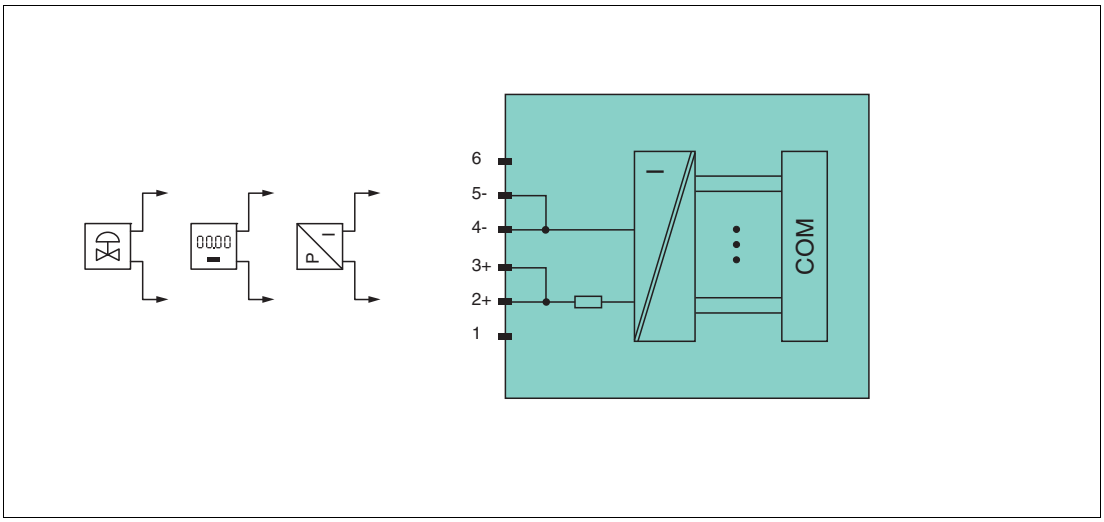

Figure 6.42 Block diagram LB4101, FB4*01

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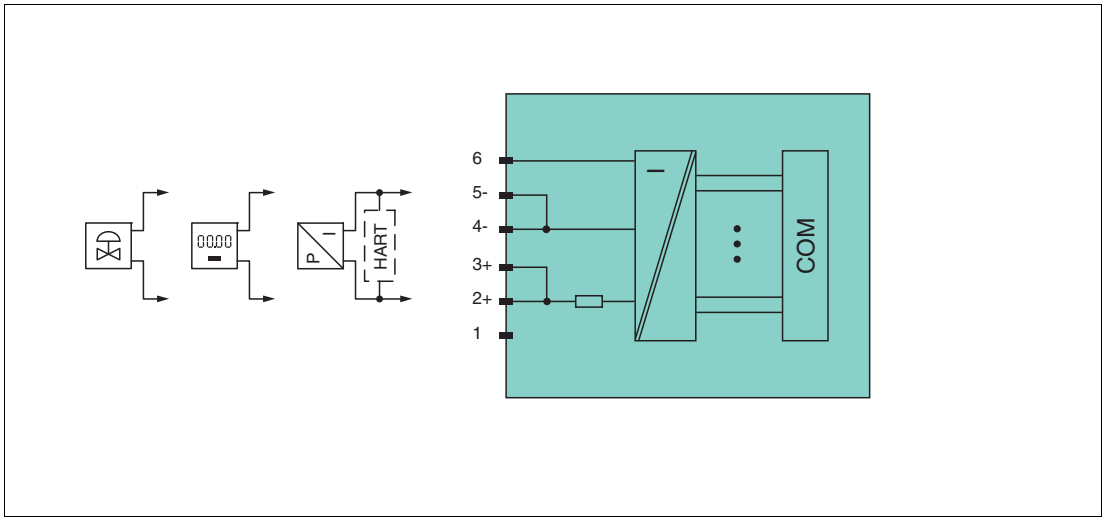

Figure 6.43 Block diagram LB4*02, FB4*02 without shutdown input

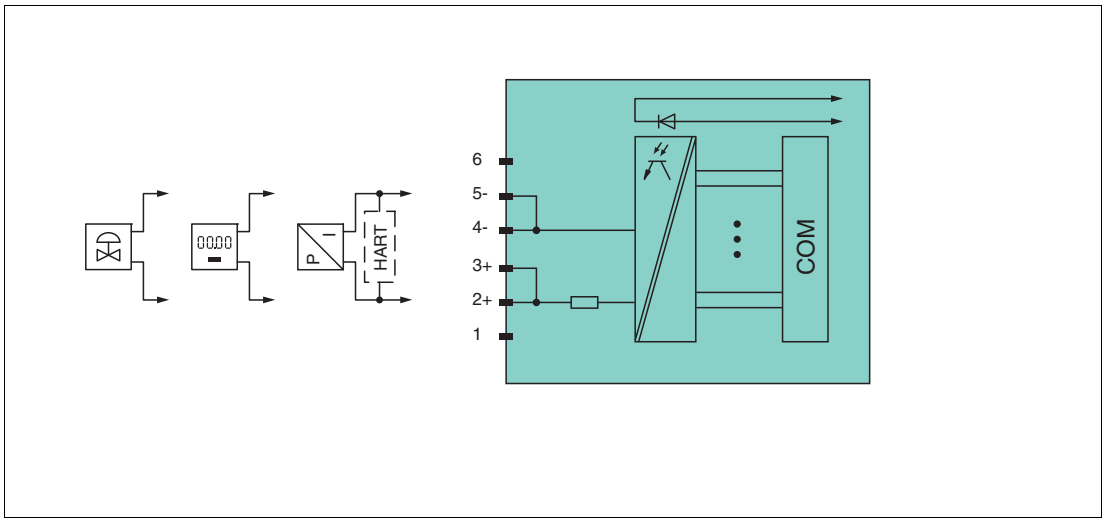

Figure 6.44 Block diagram LB4*02, FB4*02 with shutdown input

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

6.13.2 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 %.

6.13.3 Measuring Time and Cycle Time

The conversion time is approx. 50 ms. The accuracy of the measured value depends on the cycle time of the data traffic on the bus. The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

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6.13.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data		No input data
Output data word 1	0	Empty
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2 ... 3	Empty
	4 ... 7	Process value (12 bit)
	8 ... 15	

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
HART auxiliary variables (analog input signals area, slot-based; access: read word by word) (4x02 only)	**2048** (DA)	Offset + (12 * slot)	Function code 4 (read input registers)
	35700 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog output signals area, allocated; access: read/write word by word)	**0** (DA)	See chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	40001 (MC)		
Process data (analog output signals area, slot-based; access: read/write word by word)	**256** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45000 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.13.5 Line Fault Detection

The line fault detection can detect a line breakage and can be switched off on a channel-by-channel basis.

Line fault detection works on the basis of measuring a minimum current of 1 mA. The current still flows even when the control system specifies 0 mA. The line fault detection function is therefore unsuitable for 0 mA ... 20 mA outputs. When currents < 0.1 mA are detected, a lead breakage is signaled.

6.13.6 Watchdog

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.

6.13.7 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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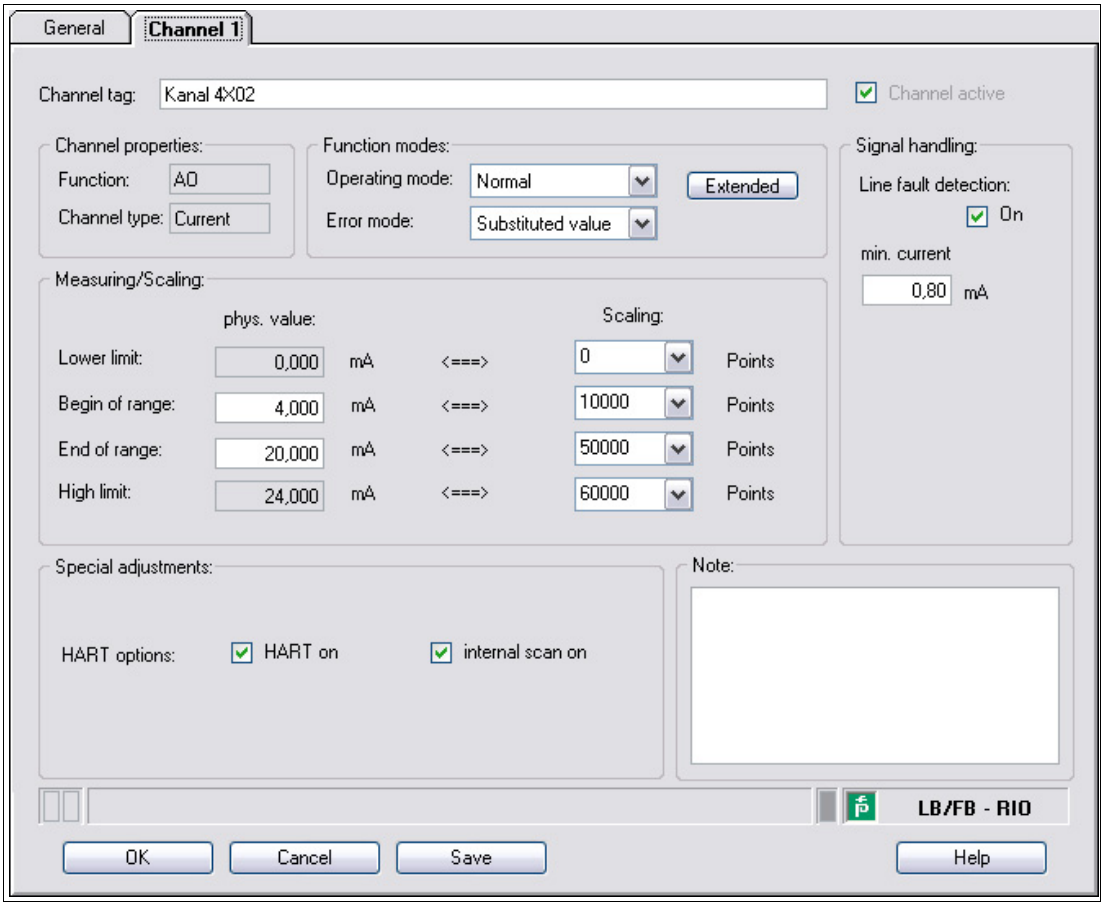

Figure 6.45 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Function	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal using the **Extended** button.

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Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Line fault detection	Enable line fault detection to monitor the connection at the field end. If a lead breakage occurs, the error is reported via the status area for the process value.
Minimum current	Enter the threshold value for lead breakage detection, e.g., 0.8 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	This check box is available for the LB4*02 and FB4*02 I/O modules only. Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box is available for the LB4*02 and FB4*02 I/O modules only. This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access. In addition, the internal scan reads out 4 HART auxiliary variables from each HART device (if supported by HART device) and makes them available via special register areas. See chapter 6.13.4 The HART auxiliary variables are updated less frequently than the standard process data. If the remote I/O station receives a new parameter set, HART communication must be restarted. During the initialization phase, no valid HART auxiliary variables are available. Following initialization, the HART auxiliary variables are read by a HART scan and made available again. The scan generally takes several seconds.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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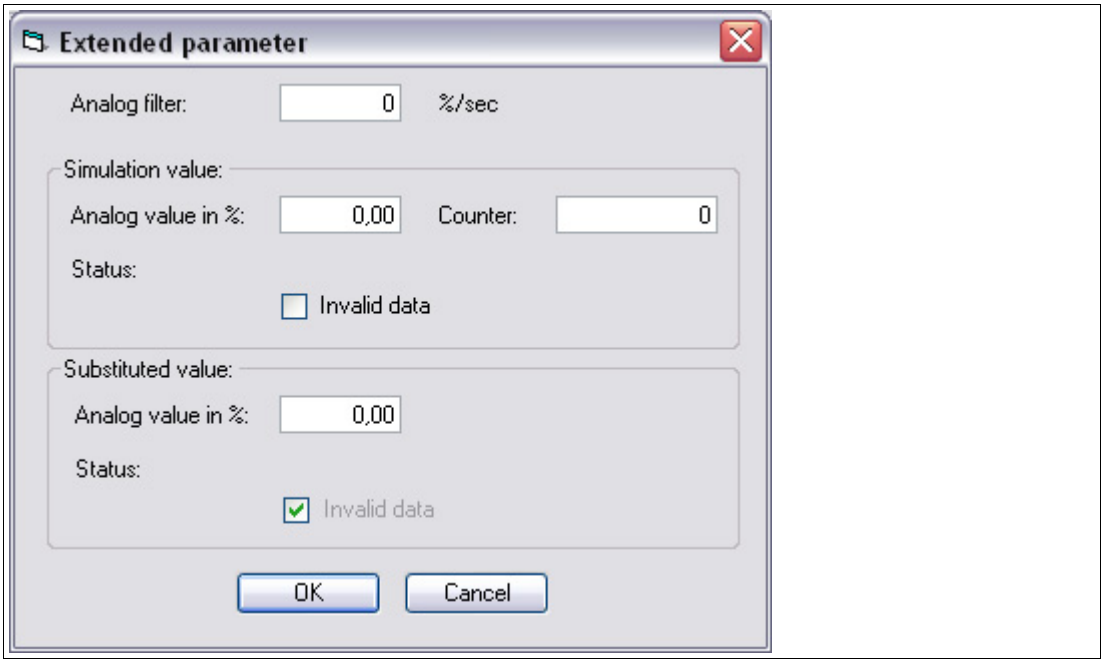

Figure 6.46 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % per second for defining the rate of change of the output value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Invalid data (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid** and the substitute value strategy is initiated.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Invalid data (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

6.13.8 Configuring Strain Gauge Measurement

I/O modules LB4101 and LB5*02 or FB4*01 and FB5202 can be interconnected for strain gauge measurements. Use analog output LB4101 or FB4*01 to create a constant current, and the measuring input for the temperature input LB5*02 or FB5202 to process the millivolt signal for the resulting bridge voltage.

A constant current of 20 mA is sufficient for the bridge voltage for a 350 Ω bridge. A bridge voltage of 7 V is produced. With a bridge sensitivity of 2 mV/V, a voltage of 14 mV results at full load.

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Configuring I/O Modules for Strain Gauge Measurement

Before configuring the I/O modules for strain gauge measurement, the project structure must contain a com unit and the LB4101 and LB5*02 or FB4*01 and FB5202 I/O modules. In addition, communication with the remote I/O station must work.

1. Either set the LB4101 or FB4*01 analog output operating mode to **simulation** and select 20 mA as the simulation value, or set a fixed value of 20 mA via the fieldbus.
2. Set the LB5*02 and FB5202 temperature input to a millivolt measurement **mV**.
3. Deactivate cold junction compensation for LB5*02 and FB5202 temperature input by setting the thermostat temperature for the external cold junction to **0 °C**.

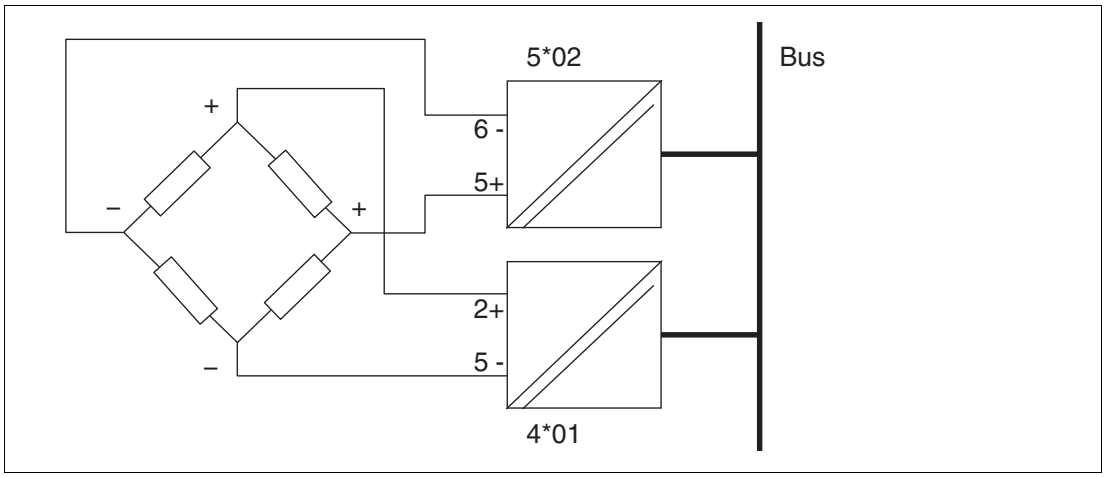

Figure 6.47 Example of a strain gauge bridge

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6.14 LB4104, FB4204 Current Output LB4*05, FB4*05 HART Current Output

6.14.1 Description

Versions

- LB4104, current output, intrinsically safe
- FB4204, current output, intrinsically safe
- LB4005, HART current output, not intrinsically safe
  Versions available with bus-independent shutdown input
- FB4305, HART current output, increased safety terminals
  Versions available with bus-independent shutdown input
- LB4105, HART current output, intrinsically safe
  Versions available with bus-independent shutdown input
- FB4205, HART current output, intrinsically safe
  Versions available with bus-independent shutdown input

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- Suitable field devices: proportional valves, I/P converters, local indicators

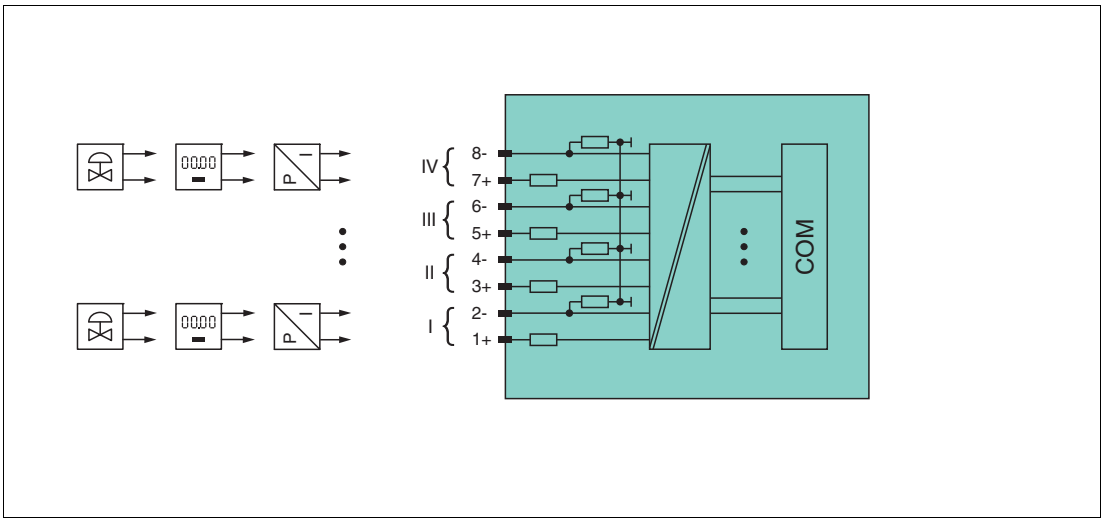

Figure 6.48 Block diagram LB4104, FB4204

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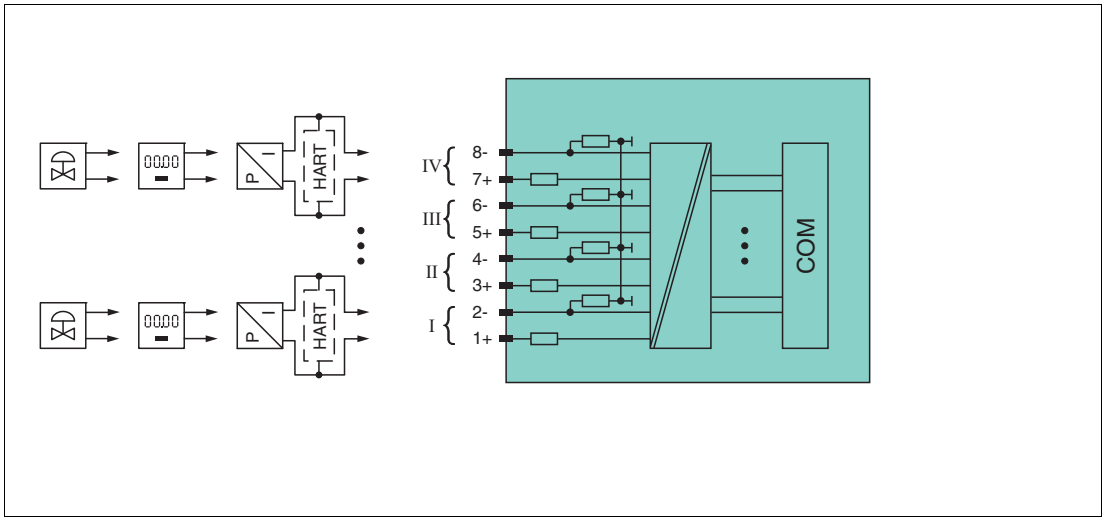

Figure 6.49 Block diagram LB4*05, FB4*05 without shutdown input

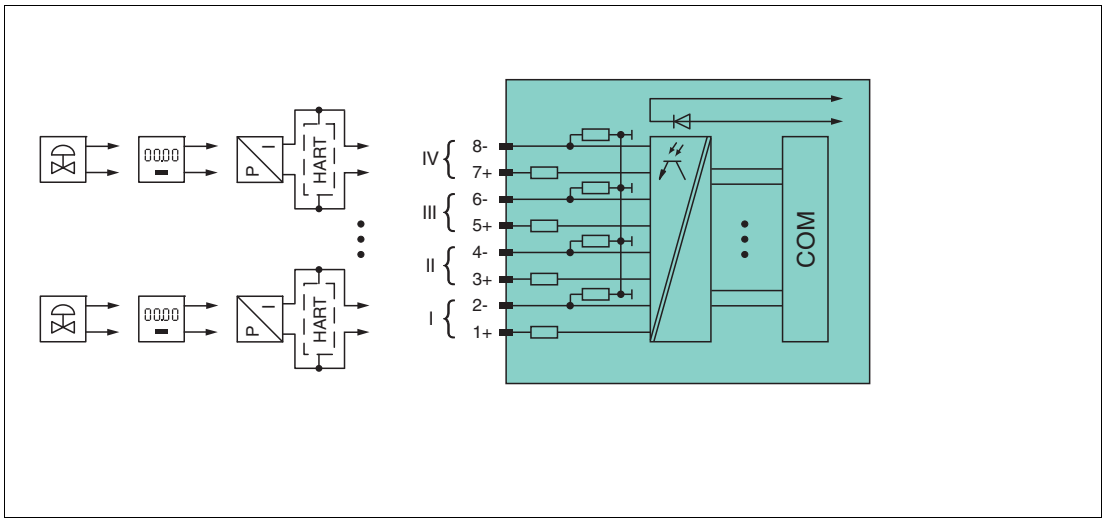

Figure 6.50 Block diagram LB4*05, FB4*05 with shutdown input

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

6.14.2 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 %.

6.14.3 Measuring Time and Cycle Time

The conversion time for all 4 channels together is approx. 60 ms. During HART communication, this time increases to 110 ms. However, the accuracy of the measured value depends on the cycle time of the data traffic on the bus. The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

6.14.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 4	Empty
	5	Line fault detection channel 2 (0 = OK, 1 = error)
	6 ... 8	Empty
	9	Line fault detection channel 3 (0 = OK, 1 = error)
	10 ... 12	Empty
	13	Line fault detection channel 4 (0 = OK, 1 = error)
	14 ... 15	Empty
Output data word 1	0	Empty
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2 ... 3	Empty
	4 ... 7	Process value channel 1 (12 bit)
	8 ... 15	
Output data word 2 ... 4	0 ... 15	Same structure as output data word 1

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog output signals area, allocated; access: read/write word by word)	**0** (DA)	See chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	40001 (MC)		
Process data (analog output signals area, slot-based; access: read/write word by word)	**512** (DA)	Offset + (2 * slot)	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45100 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.14.5 Line Fault Detection

Note!

The LB4*05, FB4*05 I/O module is available with and without line fault detection. The com unit and the operator interface are the same across the various versions, however. Note, therefore, that the line fault detection settings relate to I/O modules with line fault detection only.

The line fault detection can detect a line breakage and can be switched off on a channel-by-channel basis.

Line fault detection works on the basis of measuring a minimum current of 1 mA. The current still flows even when the control system specifies 0 mA. The line fault detection function is therefore unsuitable for 0 mA ... 20 mA outputs. When currents < 0.1 mA are detected, a lead breakage is signaled.

6.14.6 Watchdog

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.

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6.14.7 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

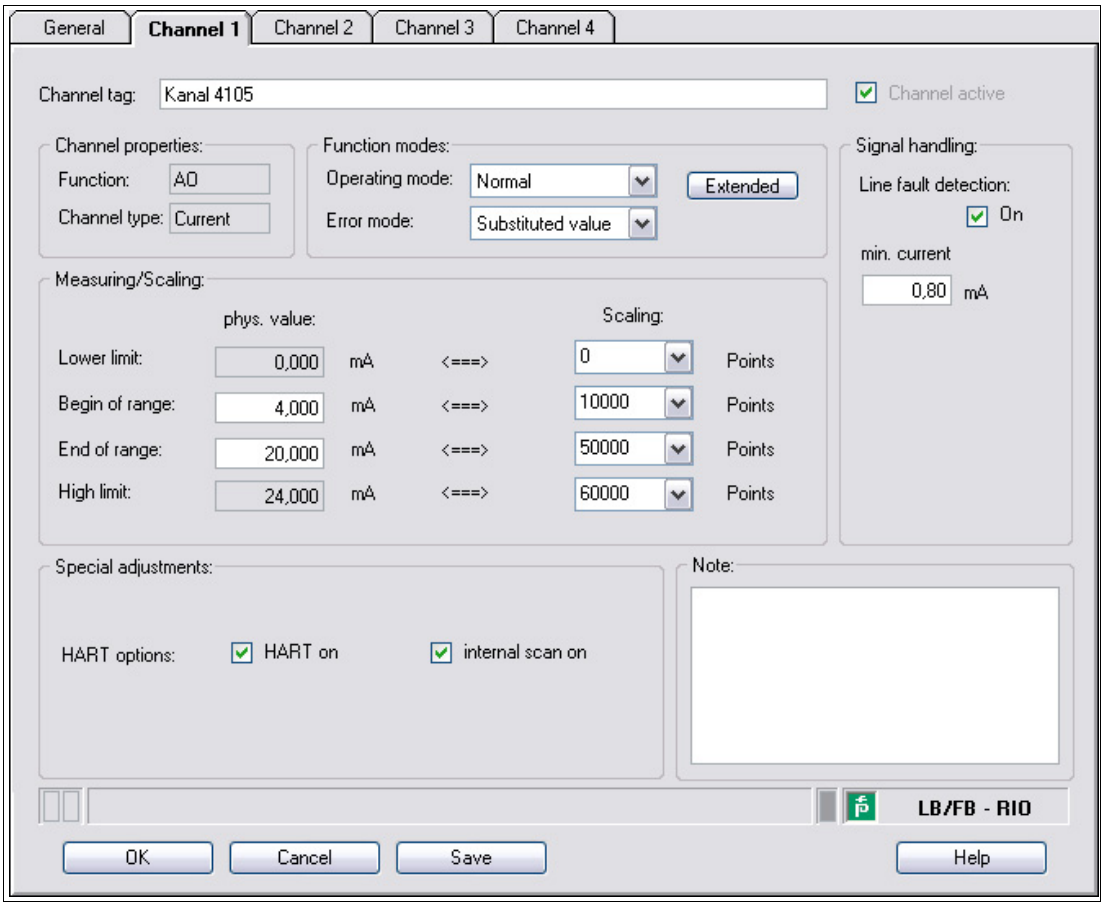

Figure 6.51 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.

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Field	Explanation
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal using the **Extended** button.
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	This check box is available for certain variants of the LB4*05 and FB4*05 I/O modules only. Enable line fault detection to monitor the connection at the field end. If a lead breakage occurs, the error is reported via the status area for the process value.
Minimum current	Enter the threshold value for lead breakage detection, e.g., 0.8 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	This check box is available for the LB4*05 and FB4*05 I/O modules only. Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box is available for the LB4*05 and FB4*05 I/O modules only. This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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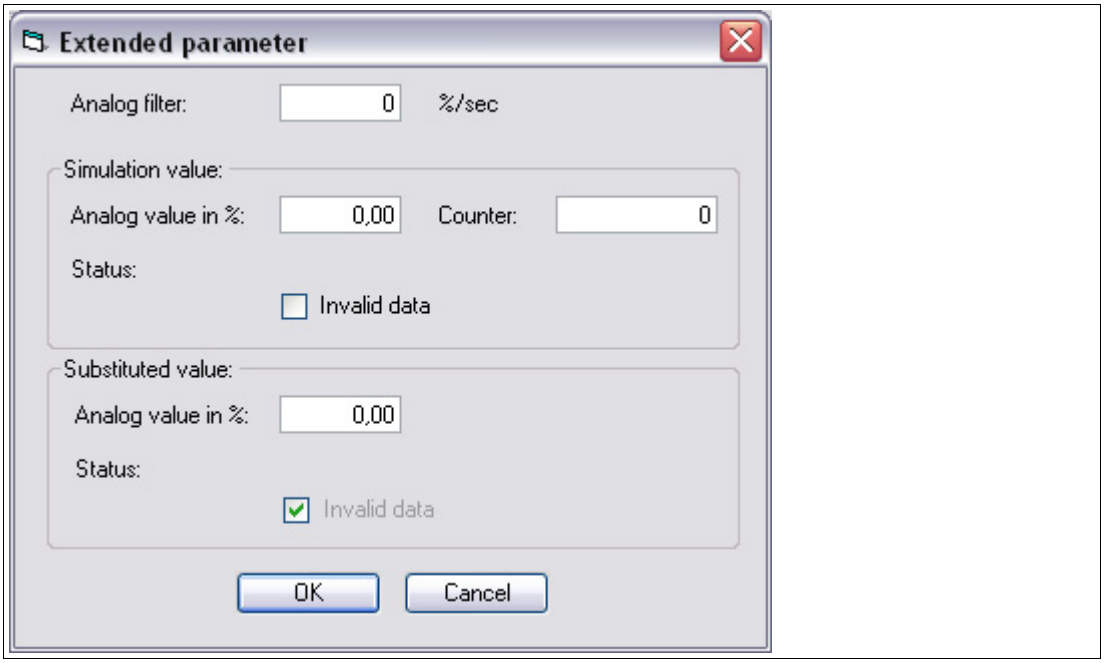

Figure 6.52 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % per second for defining the rate of change of the output value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid** and the substitute value strategy is initiated.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.15 LB4106 HART Current Output

6.15.1 Description

Versions

LB4106, HART current output, intrinsically safe
Versions with bus-independent shutdown input are available.

Features

- Occupies 1 slot on the backplane
- Number of channels: 4
- Suitable field devices: proportional valves, I/P converters, local indicators

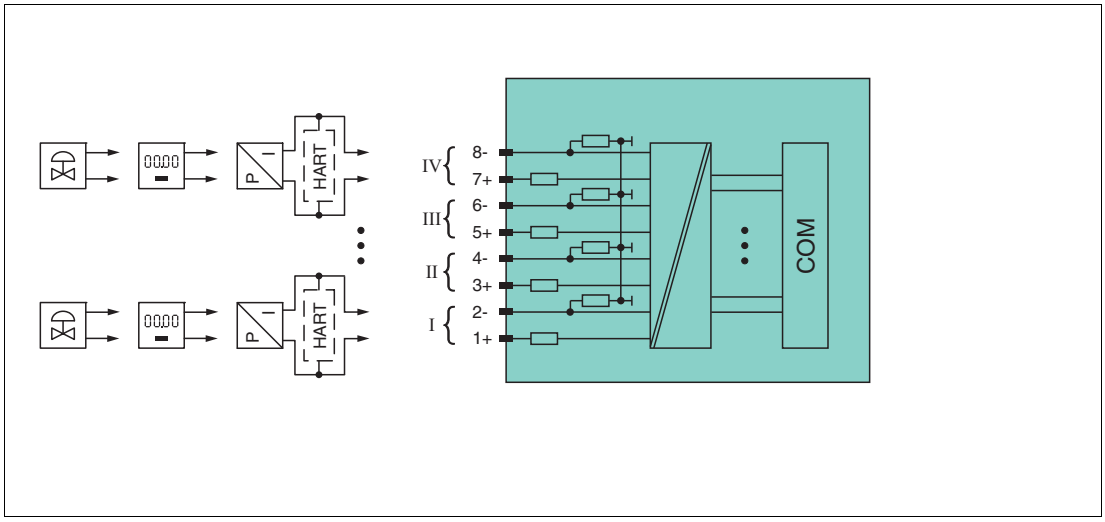

Figure 6.53 Block diagram LB4106 without shutdown input

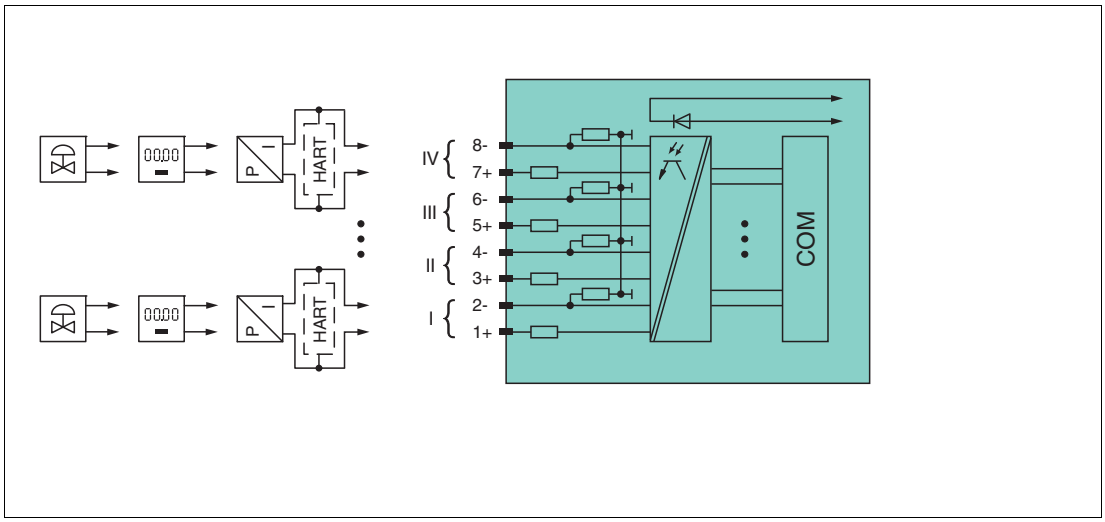

Figure 6.54 Block diagram LB4106 with shutdown input

The connection layout and other technical data can be found on the relevant data sheet.

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6.15.2 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 %.

6.15.3 Measuring Time and Cycle Time

The conversion time for all 4 channels together is approx. 60 ms. During HART communication, this time increases to 110 ms. However, the accuracy of the measured value depends on the cycle time of the data traffic on the bus. The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

6.15.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 4	Empty
	5	Line fault detection channel 2 (0 = OK, 1 = error)
	6 ... 8	Empty
	9	Line fault detection channel 3 (0 = OK, 1 = error)
	10 ... 12	Empty
	13	Line fault detection channel 4 (0 = OK, 1 = error)
	14 ... 15	Empty
Output data word 1	0	Empty
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2 ... 3	Empty
	4 ... 7	Process value channel 1 (12 bit)
	8 ... 15	
Output data word 2 ... 4	0 ... 15	Same structure as output data word 1

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog output signals area, allocated; access: read/write word by word)	**0** (DA)	See chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	40001 (MC)		
Process data channel 1+2 (analog output signals area, slot-based; access: read/write word by word)	**512** (DA)	Offset + (2 * slot)	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45100 (MC)		
Process data channel 3+4 (analog output signals area, slot-based; access: read/write word by word)	**640** (DA)	Offset + (2 * slot)	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.15.5 Line Fault Detection

The line fault detection can detect a line breakage and can be switched off on a channel-by-channel basis.

Line fault detection works on the basis of measuring a minimum current of 1 mA. The current still flows even when the control system specifies 0 mA. The line fault detection function is therefore unsuitable for 0 mA ... 20 mA outputs. When currents < 0.1 mA are detected, a lead breakage is signaled.

6.15.6 Watchdog

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.

6.15.7 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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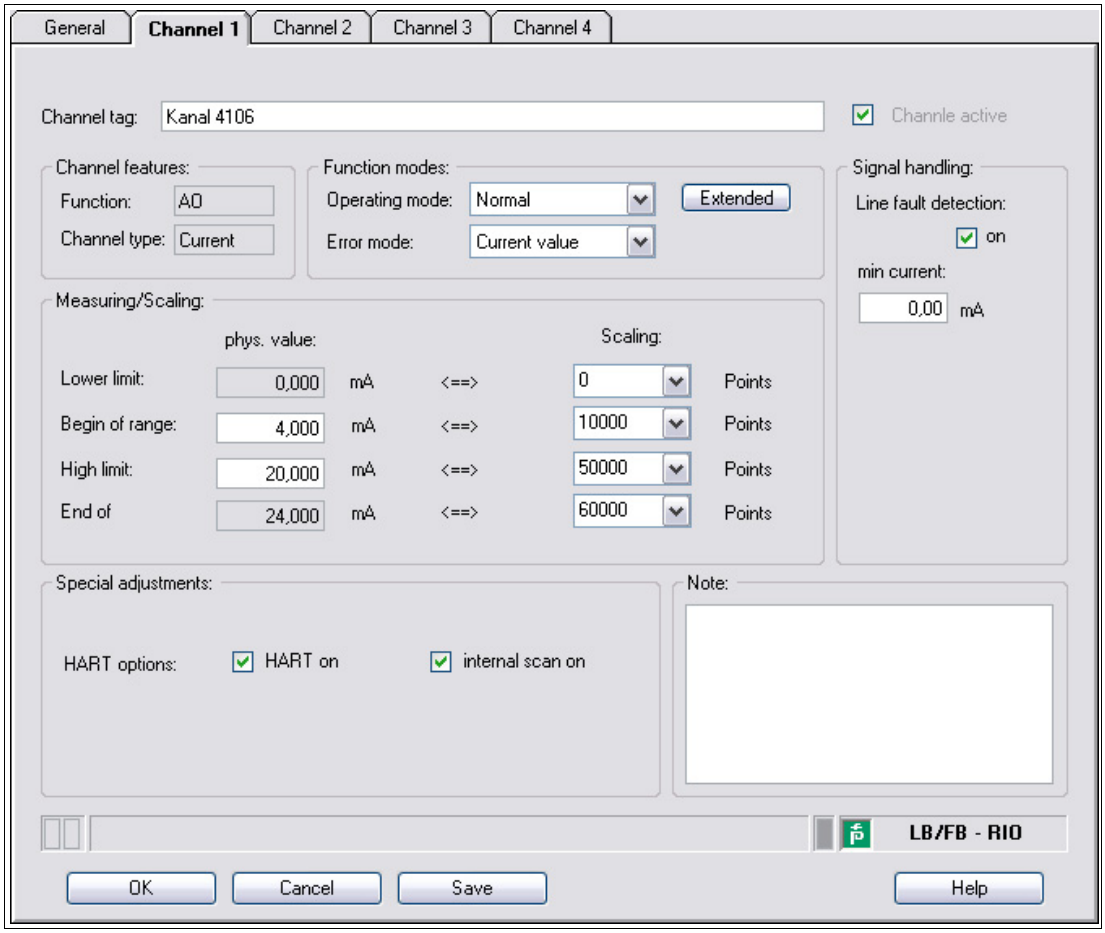

Figure 6.55 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal using the **Extended** button.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	This check box is available for certain variants of the LB4*05 and FB4*05 I/O modules only. Enable line fault detection to monitor the connection at the field end. If a lead breakage occurs, the error is reported via the status area for the process value.
Minimum current	Enter the threshold value for lead breakage detection, e.g., 0.8 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	This check box is available for the LB4*05 and FB4*05 I/O modules only. Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box is available for the LB4*05 and FB4*05 I/O modules only. This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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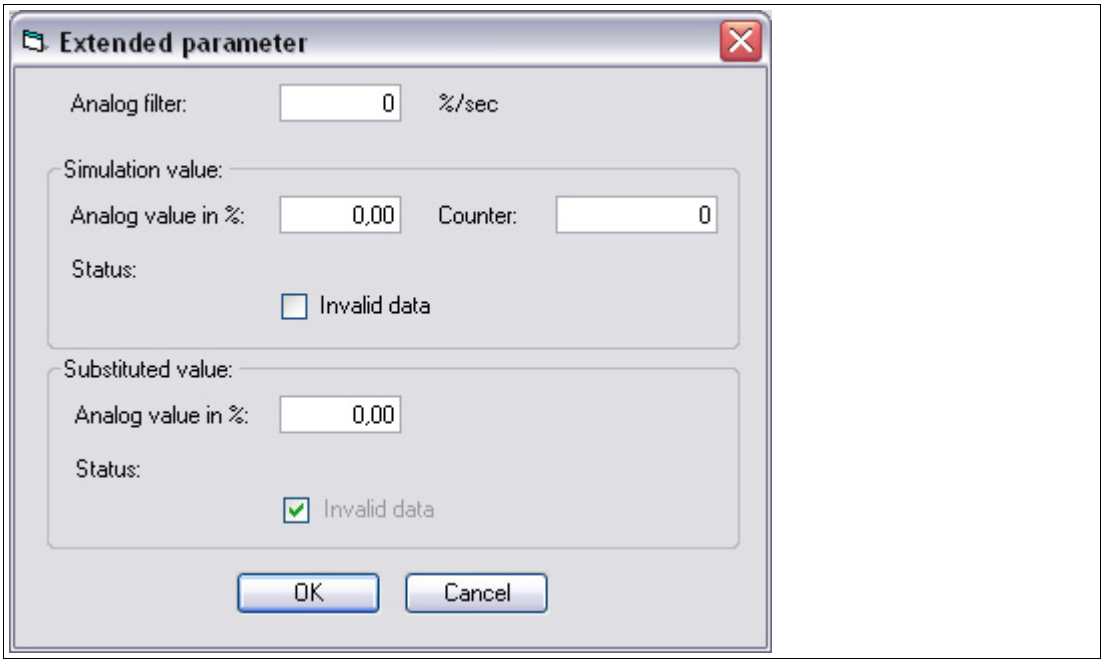

Figure 6.56 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % per second for defining the rate of change of the output value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid** and the substitute value strategy is initiated.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

6.16 LB5*01, FB5201 RTD Converter

6.16.1 Description

Versions

- LB5001, RTD converter, not intrinsically safe
- LB5101, RTD converter, intrinsically safe
- FB5201, RTD converter, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Suitable sensors: 2-, 3- and 4-wire connection, resistance thermometer, slide-wire sensor up to 400 Ω

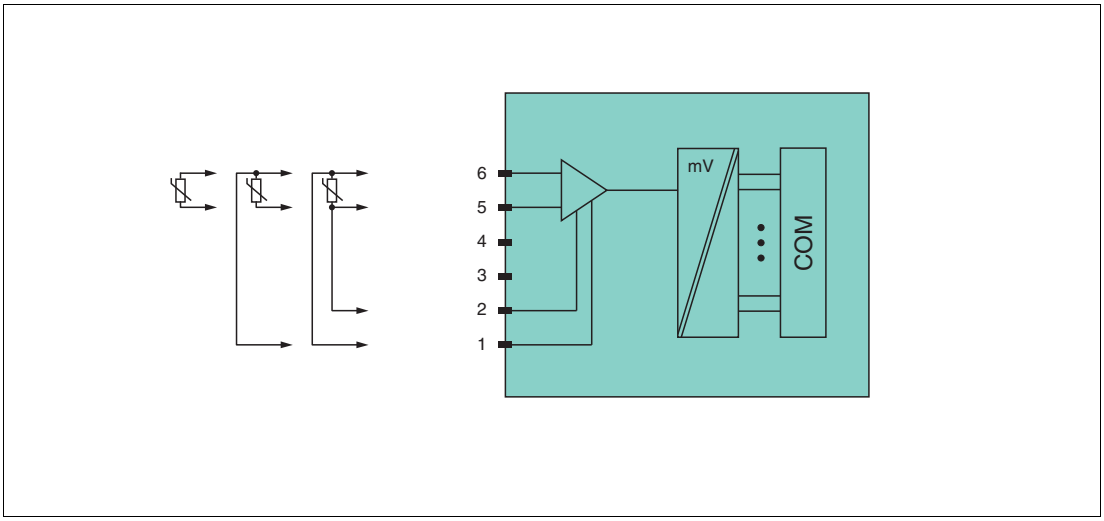

Figure 6.57 Block diagram LB5*01, FB5201

2-wire connection: 5, 6

3-wire connection: 1, 5, 6

4-wire connection: 1, 2, 5, 6

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

6.16.2 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 %.

6.16.3 Measuring Time and Cycle Time

The processing times depend on the preset measurement 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.

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6.16.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value (12 bit)
	8 ... 15	
Output data		No output data

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.16.5 Line Fault Detection

The I/O module has a line fault detection function that can detect lead breakages (resistance > 1 kΩ at Pt100) or short circuits (resistance < 10 Ω at Pt100). Line fault detection can be switched on and off in the Device Type Manager.

When a line fault occurs, the broken wire delay function waits until multiple faultless measuring cycles have been completed before enabling measured values to avoid constant toggling between OK/fault if there is a loose contact.

6.16.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

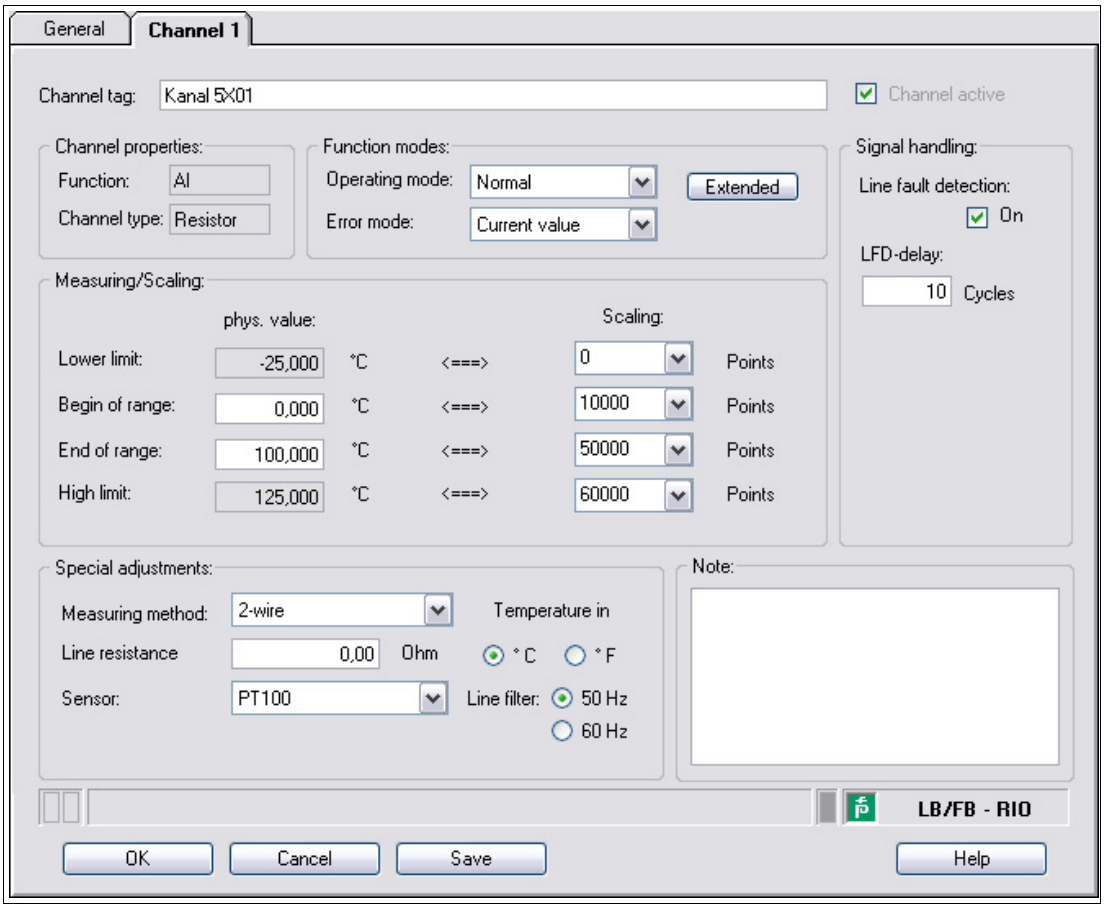

Figure 6.58 **Channel 1** tab

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Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
LFD delay	This field only appears when **Line fault detection** is enabled. Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This function can be used for suppressing loose contacts, for example.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value (e.g., 0 points or underrange). The **Start of range** indicates the value equivalent to 0% (e.g., 10,000 points or start of measuring range). The **End of range** indicates the value equivalent to 100% (e.g., 50,000 points or end of measuring range). The **Upper limit** indicates the largest transferable value (e.g., 60,000 points or overrange).
Measurement method	Set the measuring method used. Choose between a 2-, 3-, and 4-wire configuration. If you choose the 2-wire configuration, enter the line resistance in the **Line resistance** field.
Line resistance	This field is only visible if you have selected a 2-wire configuration from the **measuring methods** in the drop-down list. Enter the resistance value of the spur to compensate for measurement errors.

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Field	Explanation
Sensor	Select the sensor that is connected to the I/O module. Depending on the sensor, the correct linearization is automatically used. ■ Resistance: start of range (min.) at 0 Ω, end of range (max.) at 400 Ω ■ Pt100: start of range (min.) at -200 °C, end of range (max.) at 850 °C
Temperature unit	This option can be edited only if you have selected a Pt or Ni sensor under **Sensor**. Select the temperature unit for the start of range, end of range, and measured value.
Line filter	Select a filter to compensate for system-related interference (50 Hz and 60 Hz).
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

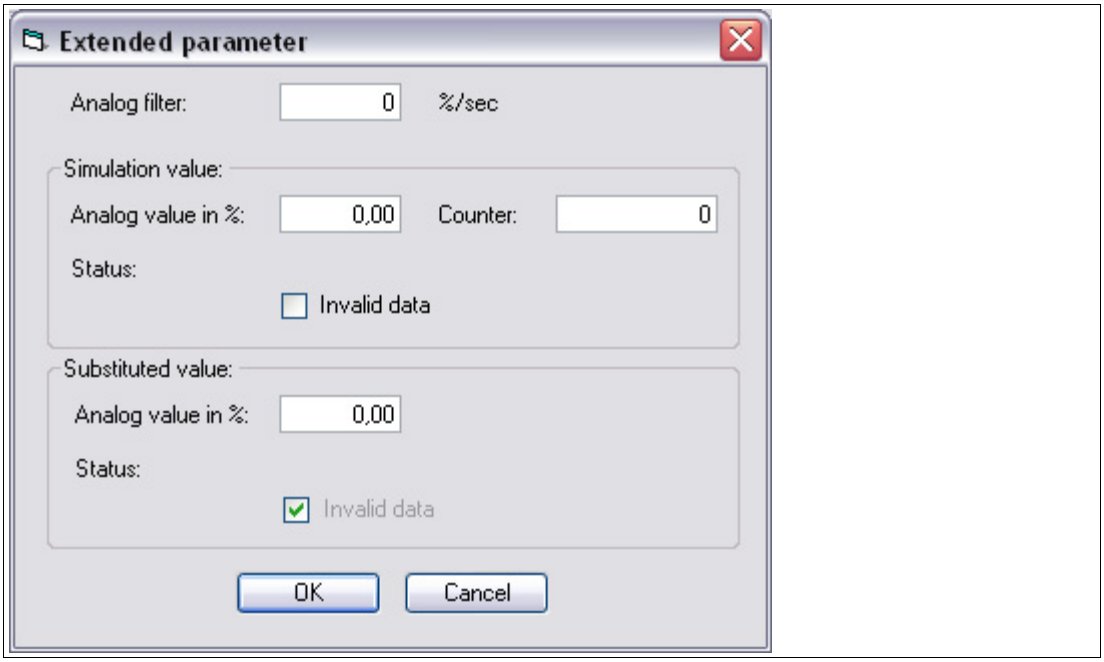

Figure 6.59 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.

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Field	Explanation
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.17 LB5*02, FB5202 Thermocouple Converter

6.17.1 Description

Versions

- LB5002, thermocouple converter, not intrinsically safe
- LB5102, thermocouple converter, intrinsically safe
- FB5202, thermocouple converter, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Suitable sensors: thermocouple types U, B, E, T, K, S, R, L, J, N, pallaplat and mV sensors

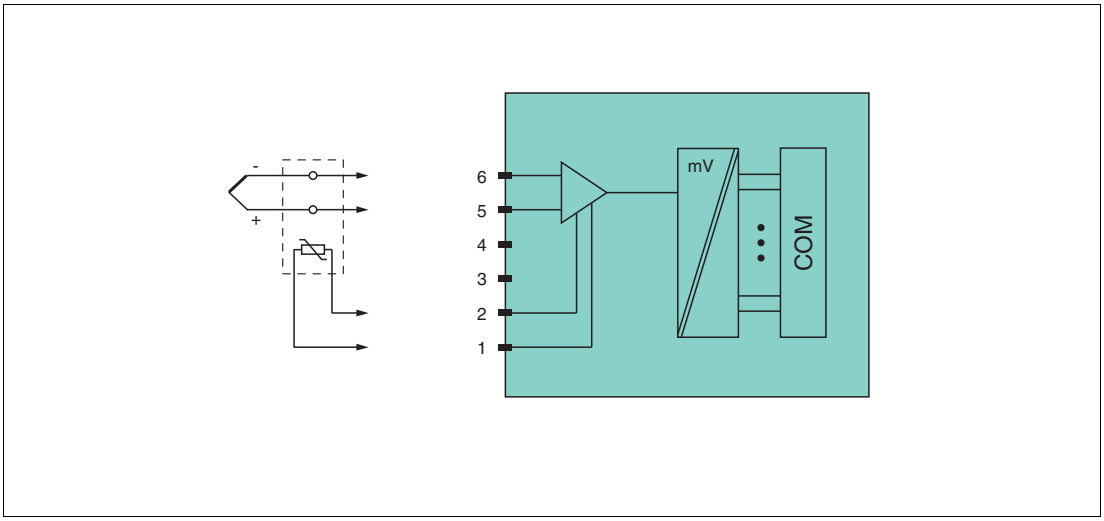

Figure 6.60 Block diagram LB5*02, FB5202

Cold junctions: 1, 2

Thermocouple: 5+, 6-

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

6.17.2 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.

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6.17.3 Measuring Time and Cycle Time

The processing times depend on the preset measurement 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.

6.17.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value (12 bit)
	8 ... 15	
Output data		No output data

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.17.5 Line Fault Detection

The I/O module has a line fault detection function that can detect lead breakages. Line fault detection can be switched on and off via the Device Type Manager.

The broken wire delay function prevents measured values from being enabled after a line fault occurs to avoid constant toggling between OK/fault if there is a loose contact.

- With external cold junction: 0 ms ... 250 ms x 160 ms
- With internal cold junction: 0 ms ... 250 ms x 240 ms

For internal cold junctions, you can set the ratio of temperature compensation measurements to actual thermocouple measurements to provide an optimum measuring time.

6.17.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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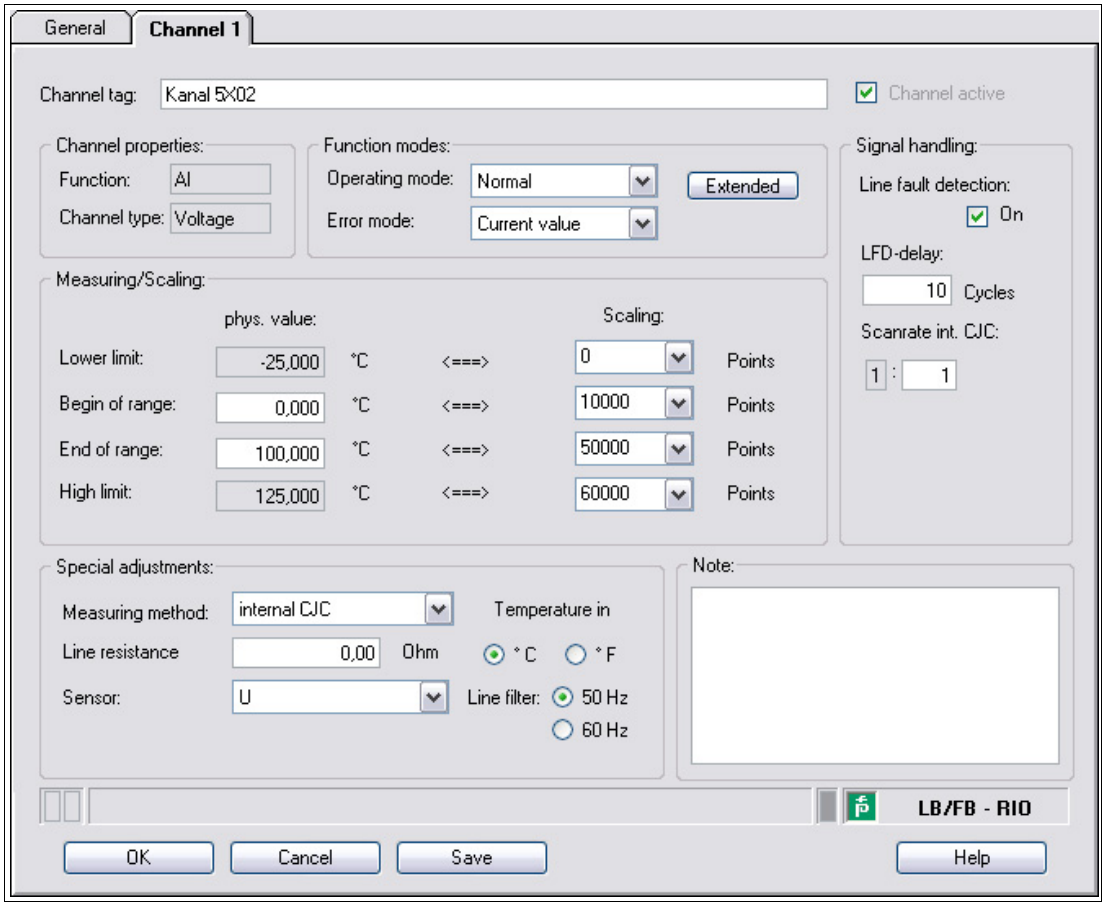

Figure 6.61 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.

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Field	Explanation
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
LFD delay	This field only appears when **Line fault detection** is enabled. Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This function can be used for suppressing loose contacts, for example.
Scan rate internal CJC	This field is only visible if you have selected an external cold junction from the **measuring methods** in the drop-down list. Specify how often the cold junction temperature should be measured in relation to the actual measurement. If you specify the ratio 1:20, for example, the cold junction temperature is measured after every twentieth thermocouple measurement. The setting is effective for the duration of the measuring cycle. The more frequently the cold junction temperature is measured, the longer a measuring cycle lasts.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value (e.g., 0 points or underrange). The **Start of range** indicates the value equivalent to 0% (e.g., 10,000 points or start of measuring range). The **End of range** indicates the value equivalent to 100% (e.g., 50,000 points or end of measuring range). The **Upper limit** indicates the largest transferable value (e.g., 60,000 points or overrange).
Measurement method	Select between an internal and external cold junction.
Line resistance or ext. cold junction	Enter the line resistance of the spur for internal cold junctions and the thermostat temperature for external cold junctions.
Sensor	Select the sensor that is connected to the I/O module. Depending on the sensor, the correct linearization is automatically used. ■ mV: start of range (min.) at -75 mV, end of range (max.) at 75 mV ■ U: start of range (min.) at -200 °C, end of range (max.) at 600 °C ■ B: start of range (min.) at 0 °C, end of range (max.) at 1820 °C ■ E: start of range (min.) at -270 °C, end of range (max.) at 1000 °C ■ T: start of range (min.) at -270 °C, end of range (max.) at 400 °C ■ K: start of range (min.) at -200 °C, end of range (max.) at 1370 °C ■ S: start of range (min.) at 0 °C, end of range (max.) at 1760 °C ■ R: start of range (min.) at -200 °C, end of range (max.) at 900 °C ■ L: start of range (min.) at -50 °C, end of range (max.) at 1760 °C ■ J: start of range (min.) at -210 °C, end of range (max.) at 1200 °C ■ N: start of range (min.) at -210 °C, end of range (max.) at 1200 °C ■ Pallaplat: start of range (min.) at -100 °C, end of range (max.) at 1300 °C

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Field	Explanation
Temperature unit	This option is not visible if you have selected **mV** in the **Sensor** drop-down list. Select the temperature unit for the start of range, end of range, and measured value.
Line filter	Select a filter to compensate for system-related interference (50 Hz and 60 Hz).
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

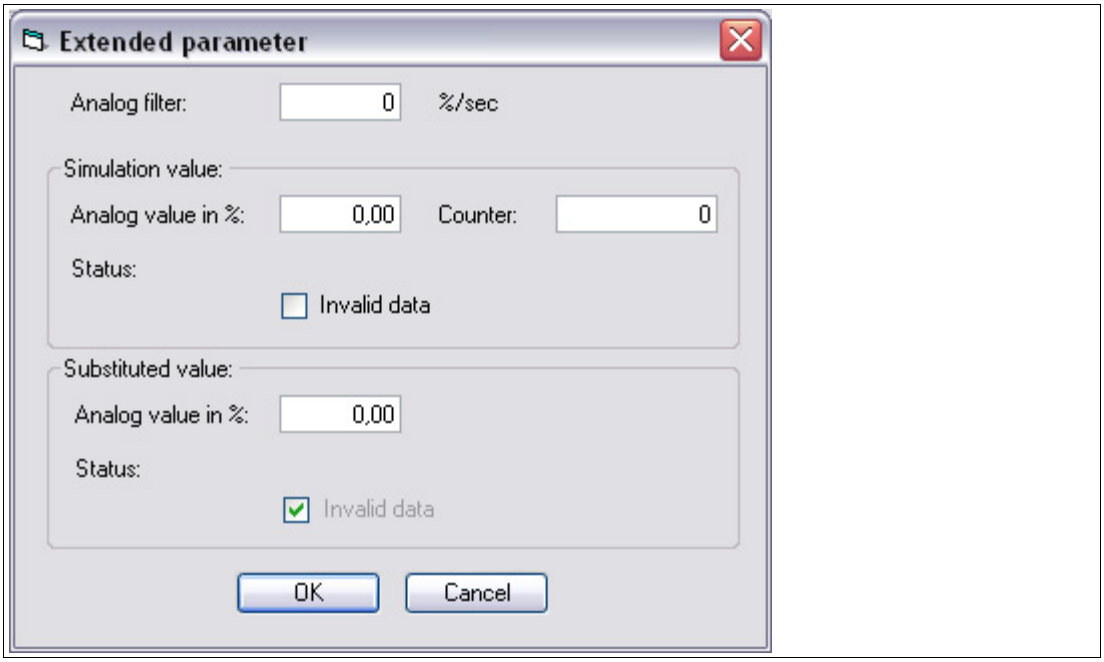

Figure 6.62 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.

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Field	Explanation
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

6.17.7 Configuring Strain Gauge Measurement

I/O modules LB4101 and LB5*02 or FB4*01 and FB5202 can be interconnected for strain gauge measurements. Use analog output LB4101 or FB4*01 to create a constant current, and the measuring input for the temperature input LB5*02 or FB5202 to process the millivolt signal for the resulting bridge voltage.

A constant current of 20 mA is sufficient for the bridge voltage for a 350 Ω bridge. A bridge voltage of 7 V is produced. With a bridge sensitivity of 2 mV/V, a voltage of 14 mV results at full load.

Configuring I/O Modules for Strain Gauge Measurement

Before configuring the I/O modules for strain gauge measurement, the project structure must contain a com unit and the LB4101 and LB5*02 or FB4*01 and FB5202 I/O modules. In addition, communication with the remote I/O station must work.

1. Either set the LB4101 or FB4*01 analog output operating mode to **simulation** and select 20 mA as the simulation value, or set a fixed value of 20 mA via the fieldbus.
2. Set the LB5*02 and FB5202 temperature input to a millivolt measurement **mV**.
3. Deactivate cold junction compensation for LB5*02 and FB5202 temperature input by setting the thermostat temperature for the external cold junction to **0 °C**.

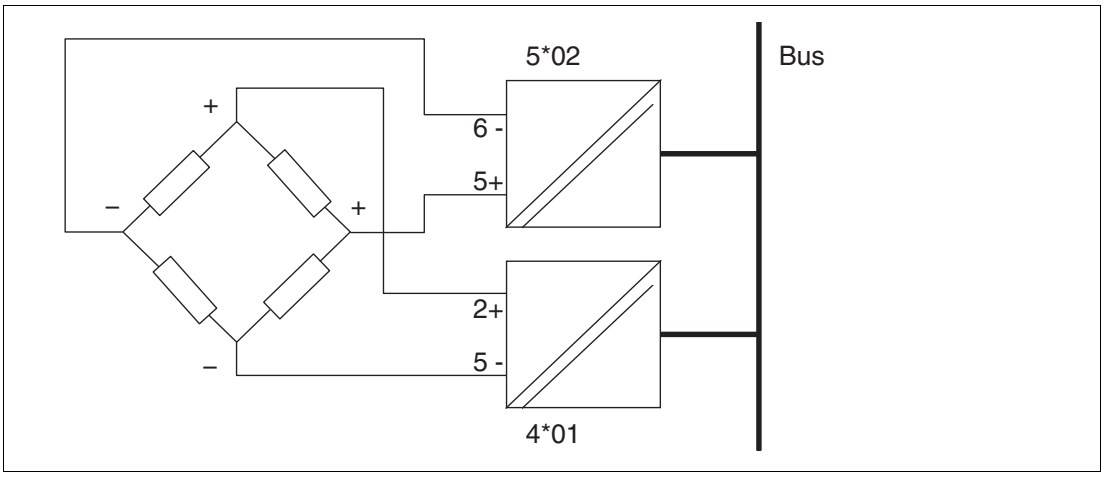

Figure 6.63 Example of a strain gauge bridge

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6.18 LB5*04, FB5204 RTD Converter

6.18.1 Description

Versions

- LB5004, RTD converter, not intrinsically safe
- LB5104, RTD converter, intrinsically safe
- FB5204, RTD converter, intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- Suitable sensors: 2-, 3- and 4-wire connection, resistance thermometer, slide-wire sensor

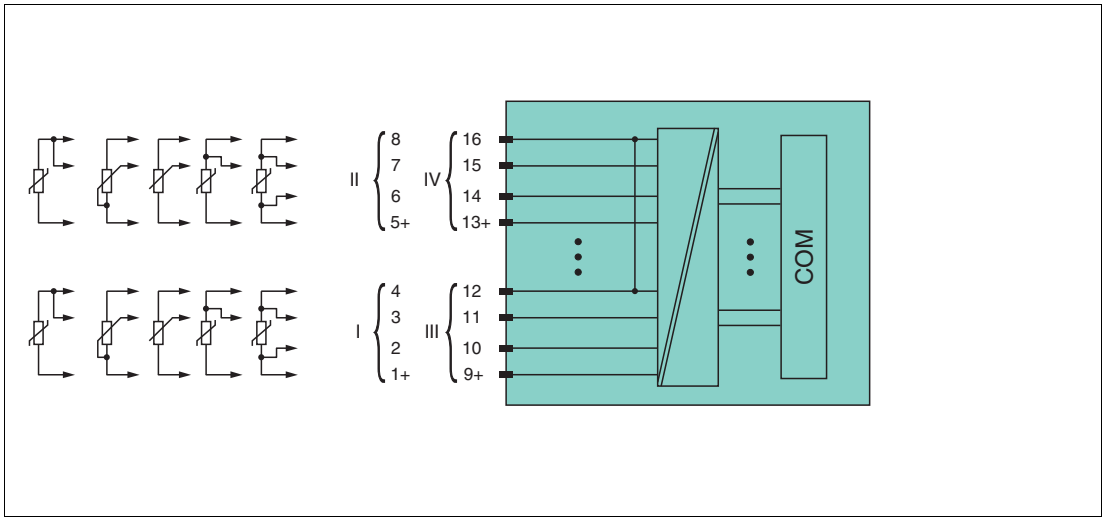

Figure 6.64 Block diagram LB5*04, FB5204

Channel I: resistance/potentiometer input 1 ... 4

Channel II: resistance/potentiometer input 5 ... 8

Channel III: resistance/potentiometer input 9 ... 12

Channel IV: resistance/potentiometer input 13 ... 16

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

6.18.2 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 %.

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6.18.3 Measuring Time and Cycle Time

The processing times depend on the preset measurement 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 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.

6.18.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value channel 1 (12 bit)
	8 ... 15	
Input data word 2 ... 4	0 ... 15	Same structure as input data word 1
Output data		No output data

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.18.5 Line Fault Detection

The I/O module has a line fault detection function that can detect lead breakages (resistance > 1 kΩ at Pt100) or short circuits (resistance < 10 Ω at Pt100). Line fault detection can be switched on and off in the Device Type Manager.

When a line fault occurs, the broken wire delay function waits until multiple faultless measuring cycles have been completed before enabling measured values to avoid constant toggling between OK/fault if there is a loose contact.

6.18.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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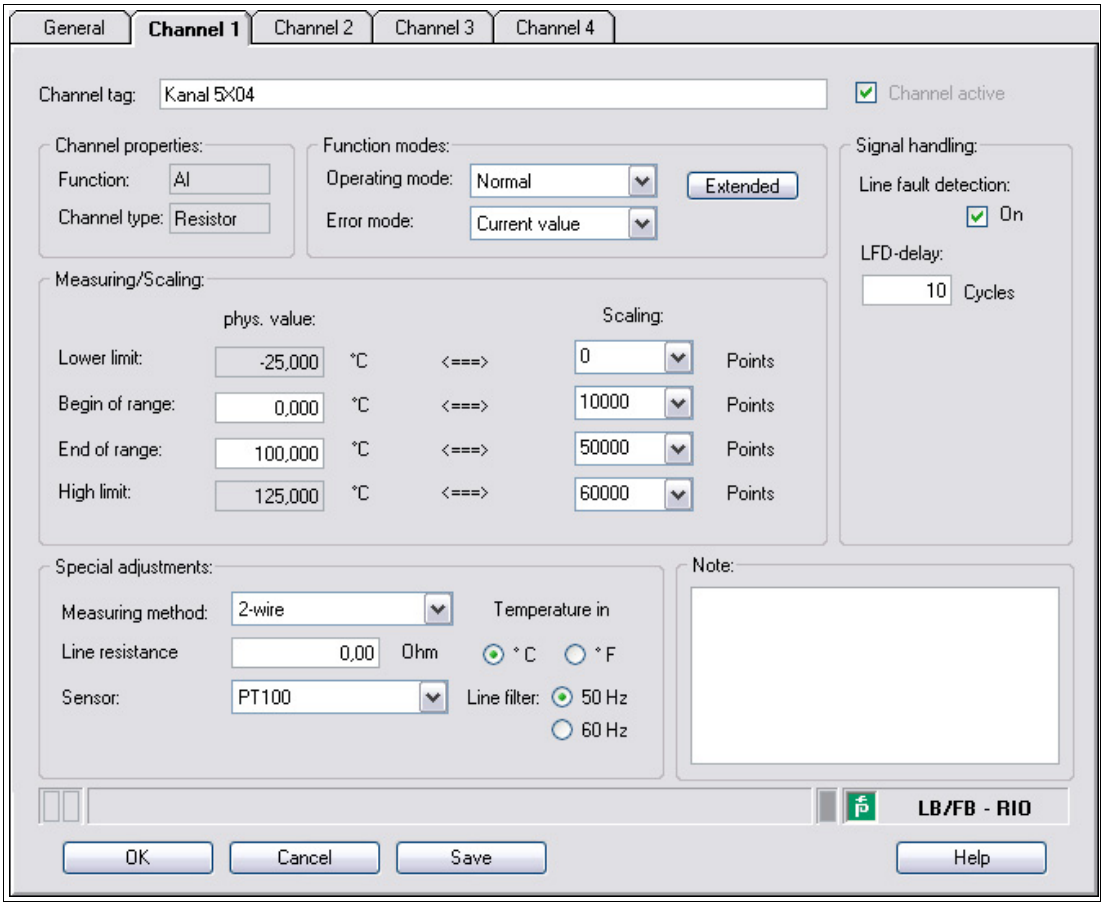

Figure 6.65 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.

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Field	Explanation
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
LFD delay	This field only appears when **Line fault detection** is enabled. Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This function can be used for suppressing loose contacts, for example.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value (e.g., 0 points or underrange). The **Start of range** indicates the value equivalent to 0% (e.g., 10,000 points or start of measuring range). The **End of range** indicates the value equivalent to 100% (e.g., 50,000 points or end of measuring range). The **Upper limit** indicates the largest transferable value (e.g., 60,000 points or overrange).
Measurement method	Set the measuring method used. Choose between a 2-, 3-, and 4-wire configuration. If you choose the 2-wire configuration, enter the line resistance in the **Line resistance** field.
Line resistance	This field is only visible if you have selected a 2-wire configuration from the **measuring methods** in the drop-down list. Enter the resistance value of the spur to compensate for measurement errors.
Sensor	Select the sensor that is connected to the I/O module. Depending on the sensor, the correct linearization is automatically used. ■ Resistance: start of range (min.) at 0 Ω, end of range (max.) at 10000 Ω ■ Pt100, Pt200, Pt500, Pt1000: start of range (min.) at -200 °C, end of range (max.) at 850 °C ■ Ni100, Ni500, Ni1000: start of range (min.) at -70 °C, end of range (max.) at 230 °C
Temperature unit	This option can be edited only if you have selected a Pt or Ni sensor under **Sensor**. Select the temperature unit for the start of range, end of range, and measured value.
Line filter	Select a filter to compensate for system-related interference (50 Hz and 60 Hz).
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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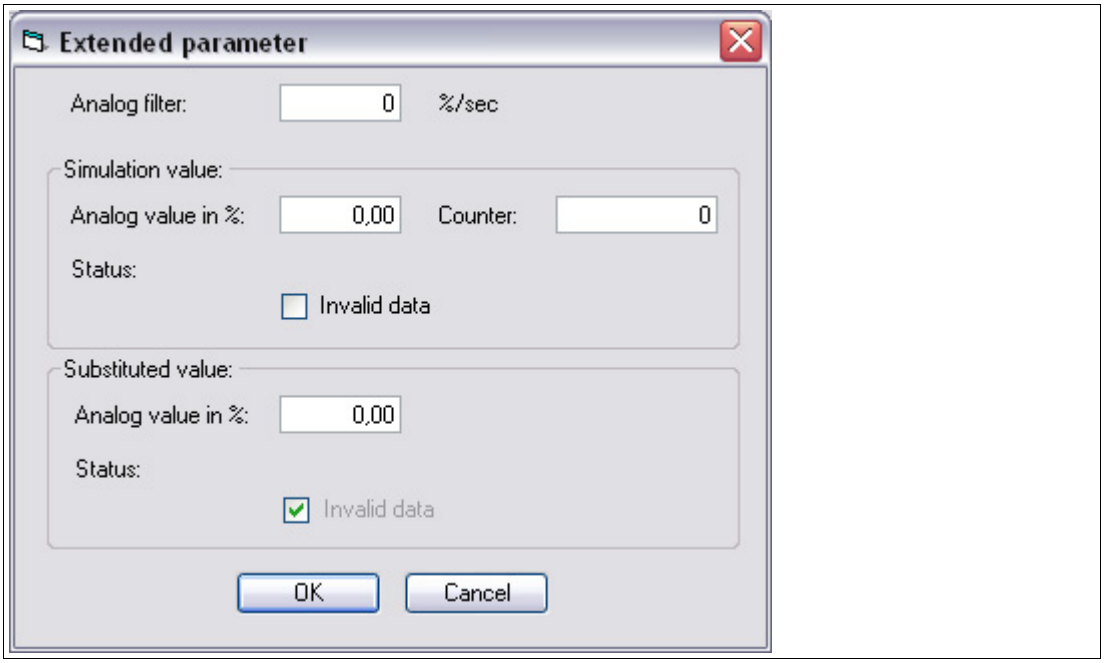

Figure 6.66 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.19 LB5*05, FB5205 Thermocouple Converter

6.19.1 Description

Versions

- LB5005, thermocouple converter, not intrinsically safe
- LB5105, thermocouple converter, intrinsically safe
- FB5205, thermocouple converter, intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- Suitable sensors: thermocouple types U, B, E, T, K, S, R, L, J, N, pallaplat and mV sensors

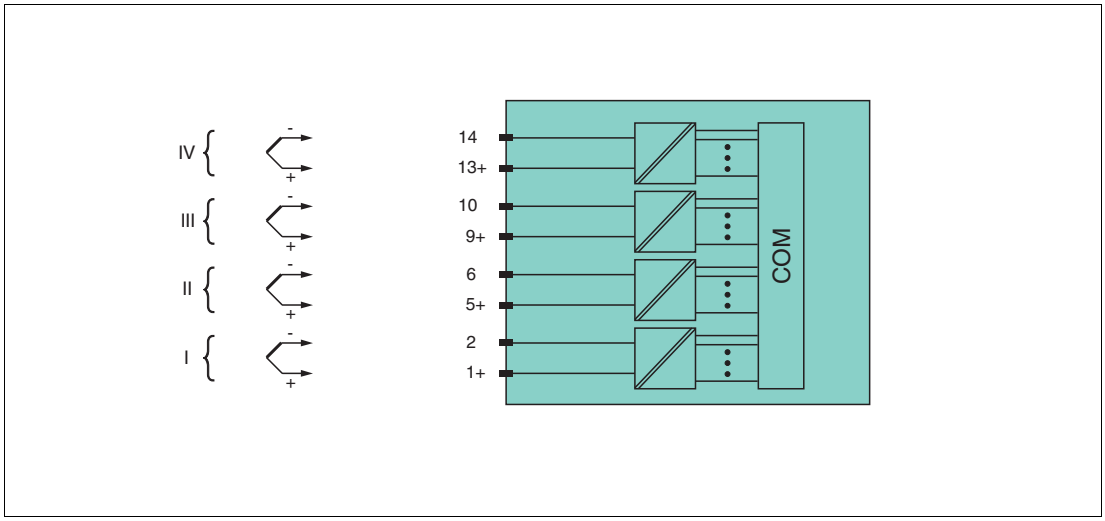

Figure 6.67 Block diagram LB5*05, FB5205

Channel I: 1+, 2-; channel II: 5+, 6-; channel III: 9+, 10-; channel IV: 13+, 14-

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

6.19.2 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.

6.19.3 Measuring Time and Cycle Time

The processing times depend on the preset measurement process.

- 200 ms for all 4 channels without line fault detection (int./ext. cold junction)
- 350 ms for all 4 channels with line fault detection (int./ext. cold 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 conversion time.

A filter is available for smoothing the input signals.

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6.19.4 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.

A data word (=16 bit) is available for each channel for the data transfer. The least significant 4 bits are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0	Empty
	1	Line fault detection channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty
	4 ... 7	Measured value channel 1 (12 bit)
	8 ... 15	
Input data word 2 ... 4	0 ... 15	Same structure as input data word 1
Output data		No output data

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		

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Signal type	Offset	Address identification (formula)	Description
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.19.5 Line Fault Detection

The I/O module has a line fault detection function that can detect lead breakages. Line fault detection can be switched on and off via the Device Type Manager.

The broken wire delay function prevents measured values from being enabled after a line fault occurs to avoid constant toggling between OK/fault if there is a loose contact.

- With external cold junction: 0 ms ... 250 ms x 160 ms
- With internal cold junction: 0 ms ... 250 ms x 240 ms

6.19.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

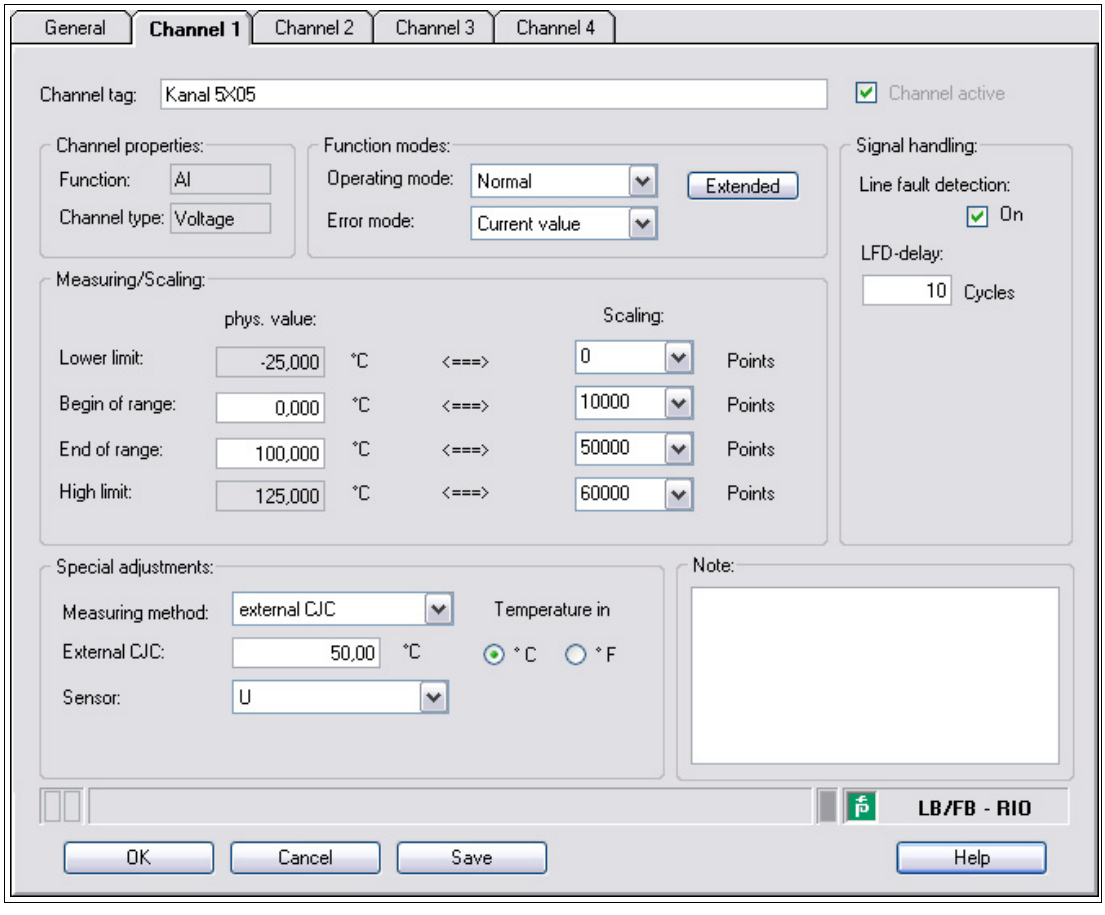

Figure 6.68 **Channel 1** tab

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Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
LFD delay	This field only appears when **Line fault detection** is enabled. Specify the number of measuring cycles during which a measured value must be free of errors before the value is signaled as good. This function can be used for suppressing loose contacts, for example.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value (e.g., 0 points or underrange). The **Start of range** indicates the value equivalent to 0% (e.g., 10,000 points or start of measuring range). The **End of range** indicates the value equivalent to 100% (e.g., 50,000 points or end of measuring range). The **Upper limit** indicates the largest transferable value (e.g., 60,000 points or overrange).
Measurement method	The LB5*05, FB5205 I/O modules have a built-in cold junction. This measures the temperature at the terminals inside the I/O module. Select between an internal and external cold junction.
Ext. cold junction	This field is only visible if you have selected an external cold junction from the **measuring methods** in the drop-down list. Enter the thermostat temperature of an external cold junction.

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Field	Explanation
Sensor	Select the sensor that is connected to the I/O module. Depending on the sensor, the correct linearization is automatically used. ■ mV: start of range (min.) at -70 mV, end of range (max.) at 70 mV ■ U: start of range (min.) at -200 °C, end of range (max.) at 600 °C ■ B: start of range (min.) at 0 °C, end of range (max.) at 1820 °C ■ E: start of range (min.) at -270 °C, end of range (max.) at 1000 °C ■ T: start of range (min.) at -270 °C, end of range (max.) at 400 °C ■ K: start of range (min.) at -200 °C, end of range (max.) at 1370 °C ■ S: start of range (min.) at 0 °C, end of range (max.) at 1760 °C ■ R: start of range (min.) at -200 °C, end of range (max.) at 900 °C ■ L: start of range (min.) at -50 °C, end of range (max.) at 1760 °C ■ J: start of range (min.) at -210 °C, end of range (max.) at 1200 °C ■ N: start of range (min.) at -210 °C, end of range (max.) at 1200 °C ■ Pallaplat: start of range (min.) at -100 °C, end of range (max.) at 1300 °C
Temperature unit	This option is not visible if you have selected **mV** in the **Sensor** drop-down list. Select the temperature unit for the start of range, end of range, and measured value.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

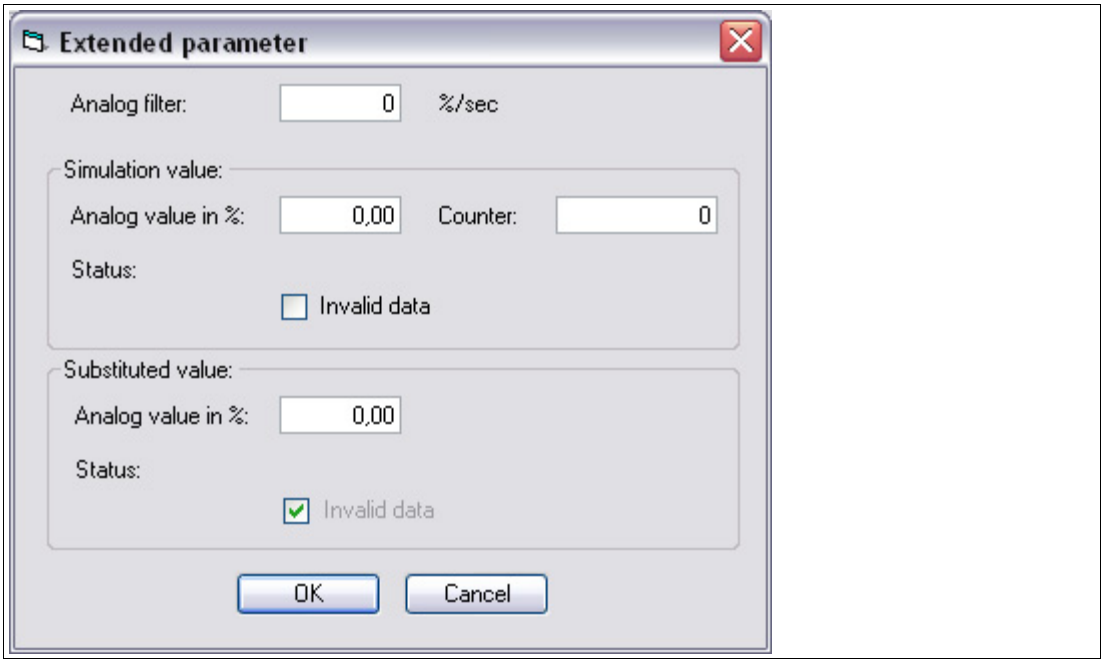

Figure 6.69 **Extended Parameters** window

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Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.20 LB5*06, FB5206 Voltage Converter

6.20.1 Description

Versions

- LB5006, voltage converter, not intrinsically safe
- LB5106, voltage converter, intrinsically safe
- FB5206, voltage converter, intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 1
- Input 0 V ... 10 V

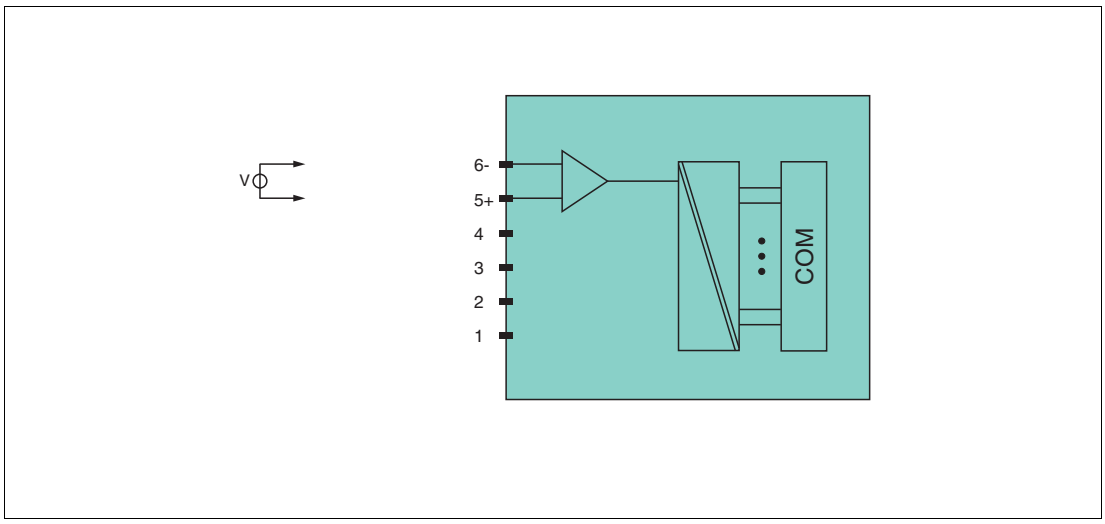

Figure 6.70 Block diagram LB5*06, FB5206

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

6.20.2 Resolution

Voltages within a range of 0 V ... 10 V are detected with a resolution of 16 bits. The actual measuring range is calculated based on this resolution.
For the smallest span of 100 mV (0 ... 100 %) a resolution of 2500 measurement points is obtained, which corresponds to a degree of accuracy of 0.04%.

6.20.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

The process data for each channel is transferred in unsigned integers within a range from 0 ... 65535.
One data word (16 bit) word per channel is available for data transfer. The most significant 12 bits are used.

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Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input data word 1	0 ... 3	Empty
	4 ... 7	Measured value (12 bit)
	8 ... 15	
Output data		No output data

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data (analog input signals area, slot-based; access: read word by word)	**256** (DA)	Offset + slot	Function code 4 (read input registers)
	35000 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.20.4 Line Fault Detection

The "Line fault detection" function is not supported.

6.20.5 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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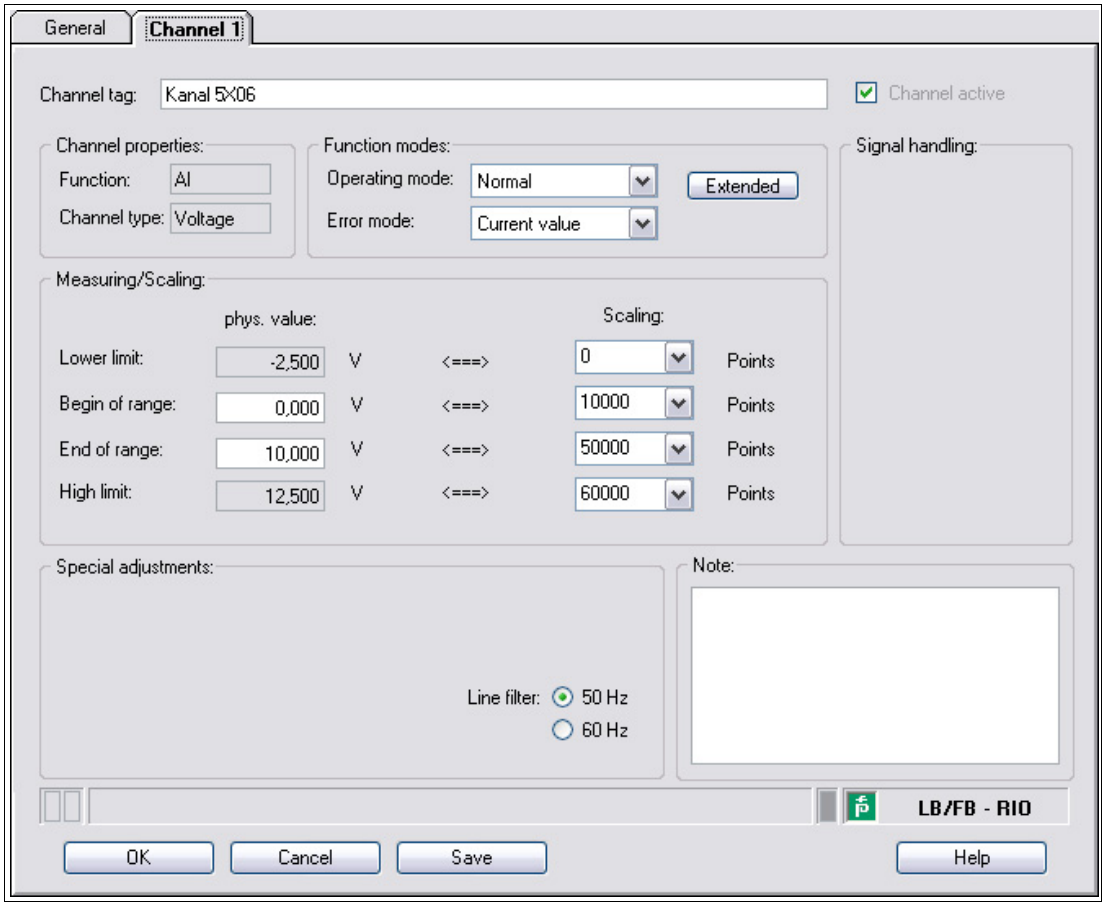

Figure 6.71 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.

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Field	Explanation
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. The **Lower limit** indicates the smallest transferable value (e.g., 0 points or underrange). The **Start of range** indicates the value equivalent to 0% (e.g., 10,000 points or start of measuring range). The **End of range** indicates the value equivalent to 100% (e.g., 50,000 points or end of measuring range). The **Upper limit** indicates the largest transferable value (e.g., 60,000 points or overrange).
Line filter	Select a filter to compensate for system-related interference (50 Hz and 60 Hz).
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

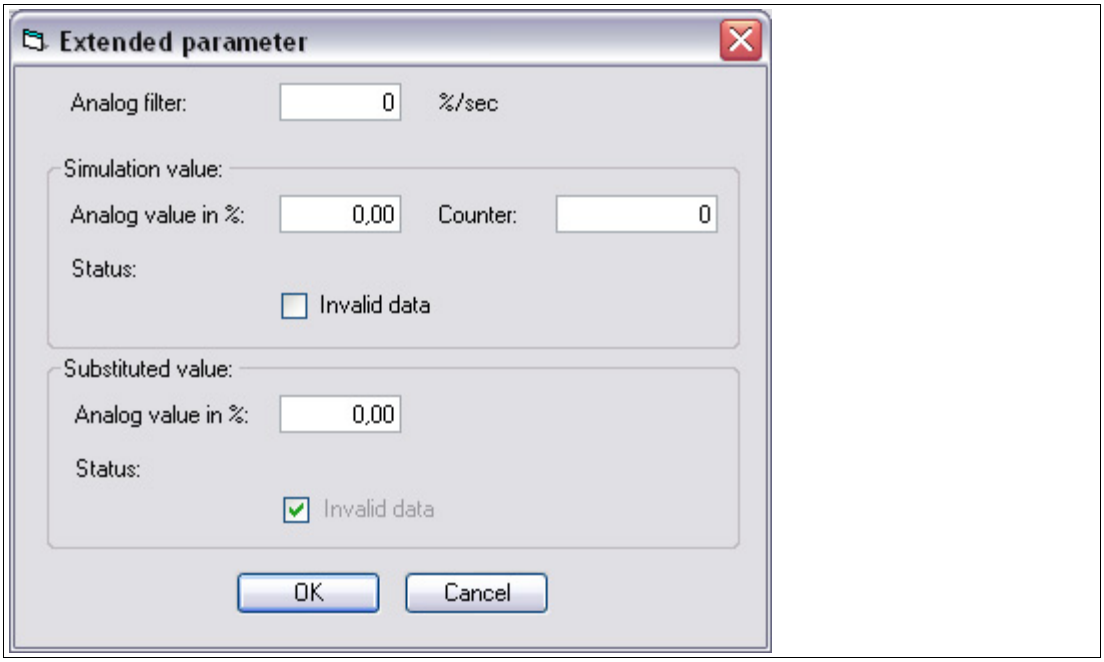

Figure 6.72 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.

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Field	Explanation
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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6.21 LB6101, FB6301 Relay Contact Output

6.21.1 Description

Versions

- LB6101, relay contact output, not intrinsically safe
- FB6301, relay contact output, wire ends for connection to separate increased safety terminal

Features

- Occupies 1 slot on the backplane
- Number of channels: 2
- LB6101
  - Switching voltage: 24 VDC/VAC (30 V max.)/230 VAC, 60 V (UL)
  - Switching current: 1 ADC/AAC resistive load
  - Switching power: 30 VA/30 W/230 VA, 60 W (UL)
- FB6301
  - Switching voltage: 24 VDC/230 VAC
  - Switching current: 1 ADC/AAC resistive load
  - Switching power: 30 W, 230 VA resistive load

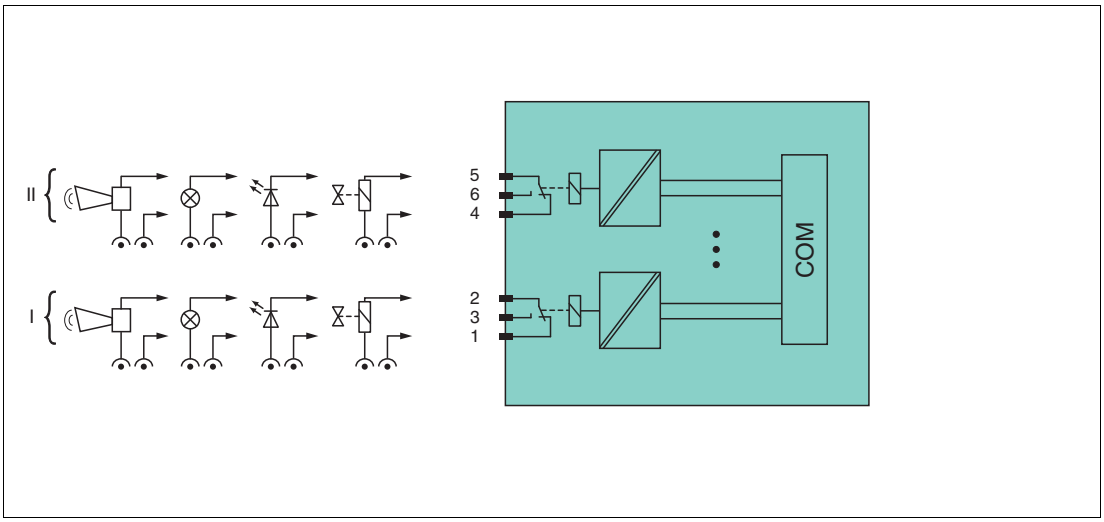

Figure 6.73 Block diagram LB6101, FB6301

LB6101: channel I: 1-2 NC, 3; channel II: 4-5 NC, 6

FB6301: wire ends 1 (white), 2 (brown), 3 (green), 4 (yellow), 5 (gray), 6 (pink), observe color marking or numbering

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

6.21.2 Measuring Time and Cycle Time

The response time of the relay output is 20 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

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6.21.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Bit Structure within the Data Telegram

Byte	Bit	Meaning
Input bytes		Without input bytes
Output byte 1	0	Output channel 1
	1	Output channel 2
	2 ... 7	Empty

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.21.4 Line Fault Detection

The "Line fault detection" function is not supported.

6.21.5 Watchdog

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.

6.21.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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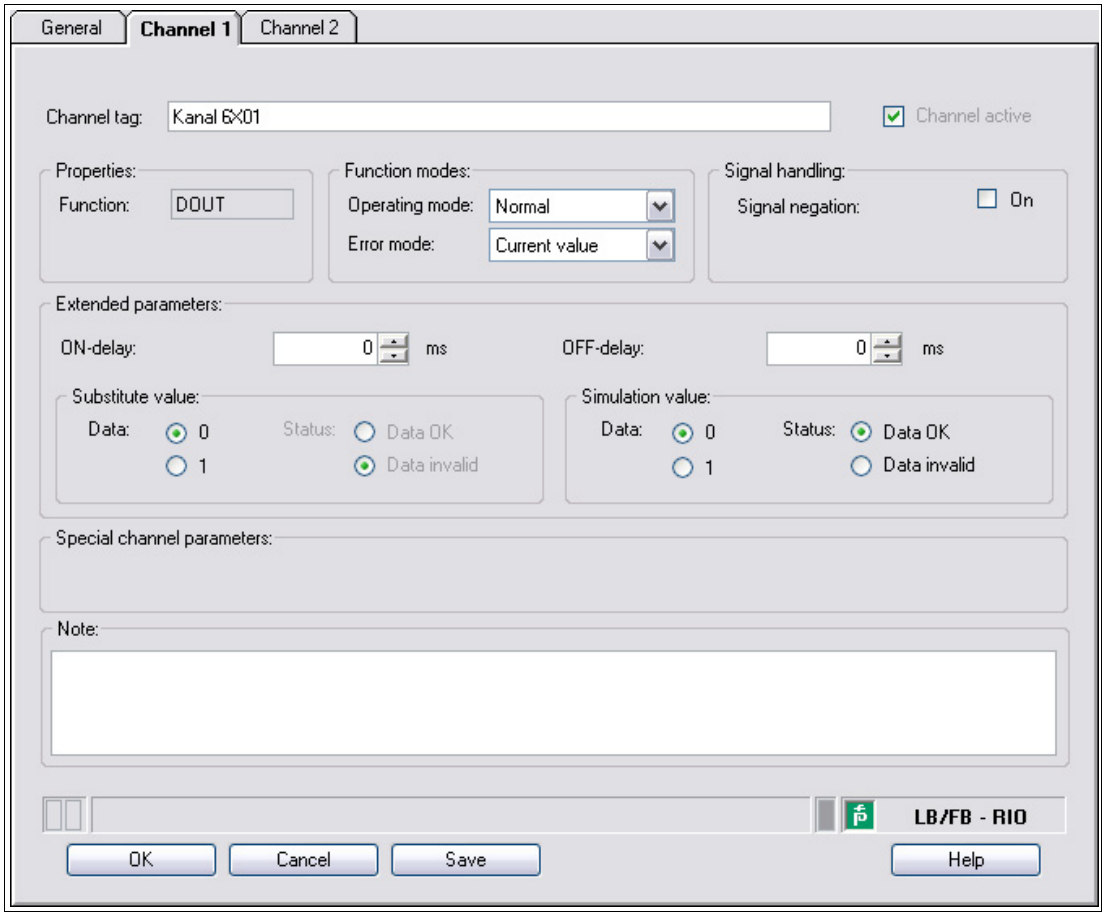

Figure 6.74 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.22 LB6005, FB6305 Relay Contact Output

6.22.1 Description

Versions

- LB6005, relay contact output, not intrinsically safe
- FB6305, relay contact output, wire ends for connection to separate increased safety terminal

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- LB6005
  - Switching voltage: DC: 30 V, AC: 230 V, 60 V (UL)
  - Switching current: 1 ADC/AAC resistive load
  - Switching power: 30 W, AC: 250 VA , 60 W (UL)
- FB6305
  - Switching voltage: DC: 30 V, AC: 230 V
  - Switching current: 1 ADC/AAC resistive load
  - Switching power: 30 W, AC: 250 VA

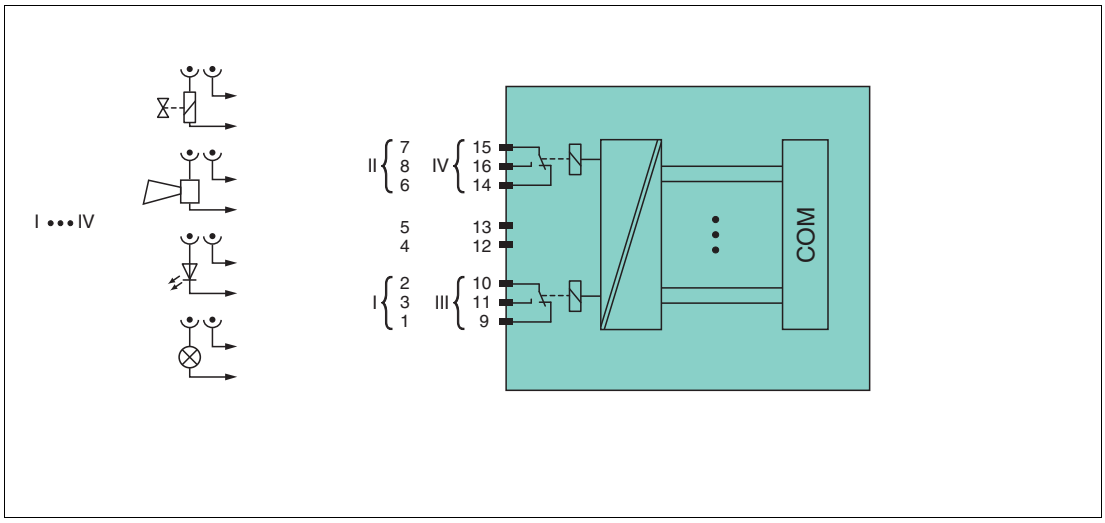

Figure 6.75 Block diagram LB6005, FB6305

LB6005: channel I: 1-2 NC, 3; channel II: 6-7 NC, 8; channel III: 9-10 NC, 11; channel IV: 14-15 NC, 16

FB6305: wire ends 1/9 (white), 2/10 (brown), 3/11 (green), 4/12 (yellow), 5/13 (gray), 6/14 (pink), 7/15 (blue), 8/16 (red), observe color marking or numbering

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

6.22.2 Measuring Time and Cycle Time

The response time of the relay output is 20 ms. This time depends on the cycle time of the data traffic in the Profibus.

The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

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6.22.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Input and Output Data

The I/O module has input and output data.

The output data sets the control outputs and marks the data as valid or invalid. As soon as the **data invalid** error bit is set, the substitute values are used.

The input data allows the master to retrieve the current output status. This is particularly useful when ON delay and OFF delay are activated. The output reaches the required status only after the preset time has elapsed so the master can retrieve the current output status.

Bit Structure within the Data Telegram

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

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.22.4 Line Fault Detection

The "Line fault detection" function is not supported.

6.22.5 Watchdog

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.

6.22.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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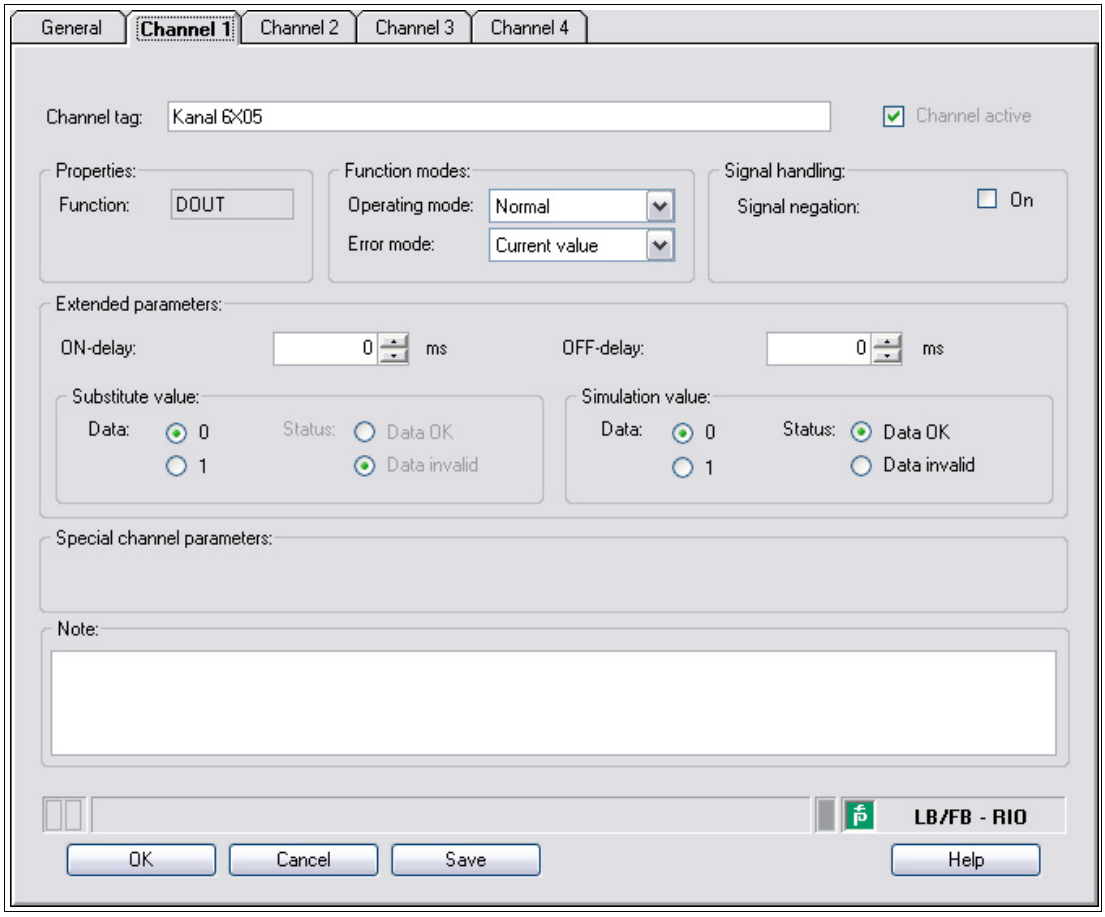

Figure 6.76 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.23 LB6006, FB6306 Relay Contact Output

6.23.1 Description

Versions

- LB6006, relay contact output, not intrinsically safe
- FB6306, relay contact output, increased safety terminals

Features

- Occupies 2 slots on the backplane
- Number of channels: 8
- Switching voltage: 24 VDC/VAC
- Switching current: 1 ADC/AAC resistive load
- Switching power: 30 VA/30 W

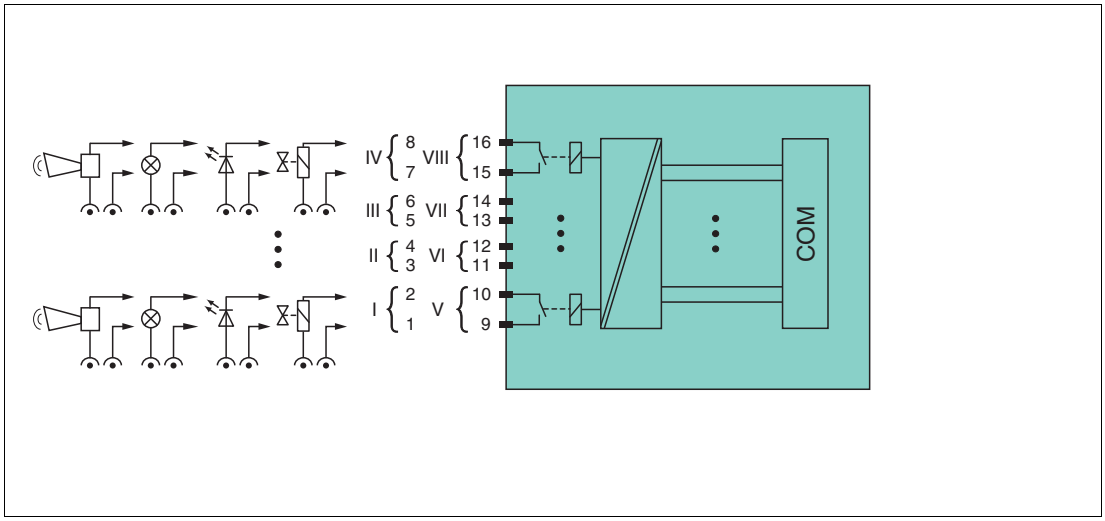

Figure 6.77 Block diagram LB6006, FB6306

Connection: channel I: 1-2 NO; channel II: 3-4 NO; channel III: 5-6 NO; channel IV: 7-8 NO; channel V: 9-10 NO; channel VI: 11-12 NO; channel VII: 13-14 NO; channel VIII: 15-16 NO

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

6.23.2 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.

6.23.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Input and Output Data

The I/O module has input and output data.

The output data sets the control outputs and marks the data as valid or invalid. As soon as the **data invalid** error bit is set, the substitute values are used.

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The input data allows the master to retrieve the current output status. This is particularly useful when ON delay and OFF delay are activated. The output reaches the required status only after the preset time has elapsed so the master can retrieve the current output status.

Bit Structure within the Data Telegram

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
Input byte 2	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
Output byte 1	0	Output value channel 1
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2	Output value channel 2
	3	Invalid identifier channel 2 (0 = OK, 1 = invalid)
	4	Output value channel 3
	5	Invalid identifier channel 3 (0 = OK, 1 = invalid)
	6	Output value channel 4
	7	Invalid identifier channel 4 (0 = OK, 1 = invalid)
Output byte 2	0	Output value channel 5
	1	Invalid identifier channel 5 (0 = OK, 1 = invalid)
	2	Output value channel 6
	3	Invalid identifier channel 6 (0 = OK, 1 = invalid)
	4	Output value channel 7
	5	Invalid identifier channel 7 (0 = OK, 1 = invalid)
	6	Output value channel 8
	7	Invalid identifier channel 8 (0 = OK, 1 = invalid)

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Byte 1 (channel 1 ... 4): Offset + (8 * slot) + bit no. - 1 Byte 2 (channel 5 ... 8): Offset + (8 * (slot + 1)) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Byte 1 (channel 1 ... 4): Offset + (8 * slot) + bit no. - 1 Byte 2 (channel 5 ... 8): Offset + (8 * (slot + 1)) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.23.4 Line Fault Detection

The "Line fault detection" function is not supported.

6.23.5 Watchdog

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.

6.23.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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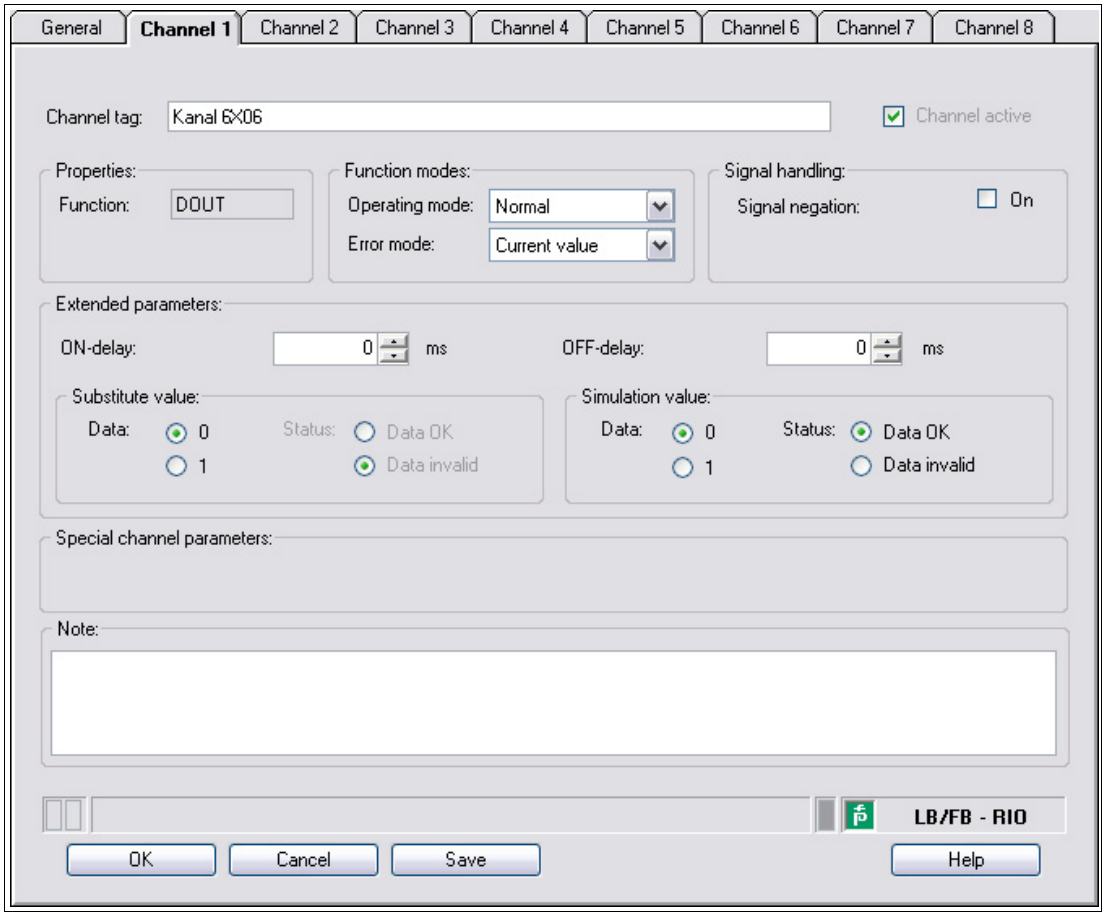

Figure 6.78 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.24 LB6*08, FB6*08 Digital Output

6.24.1 Description

Versions

- LB6008, digital output, not intrinsically safe
  Versions available with bus-independent shutdown input
- FB6308, digital output with shutdown input, increased safety terminals
- LB6108, digital output with shutdown input, intrinsically safe
- FB6208, digital output with shutdown input, intrinsically safe

Features

- Occupies 2 slots on the backplane
- Number of channels: 8
- Switching capacity: 20 VDC/8 mA

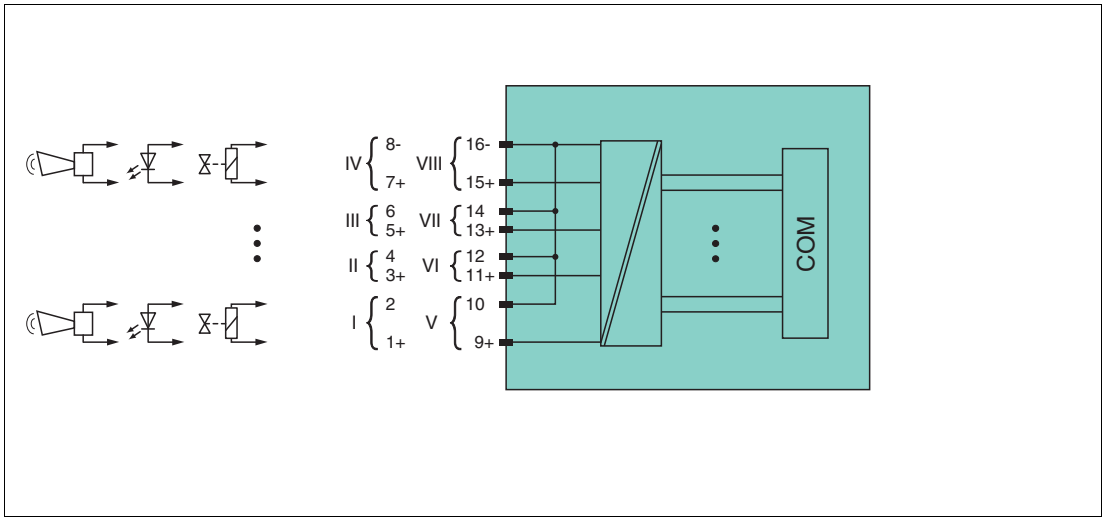

Figure 6.79 Block diagram LB6*08 without shutdown input

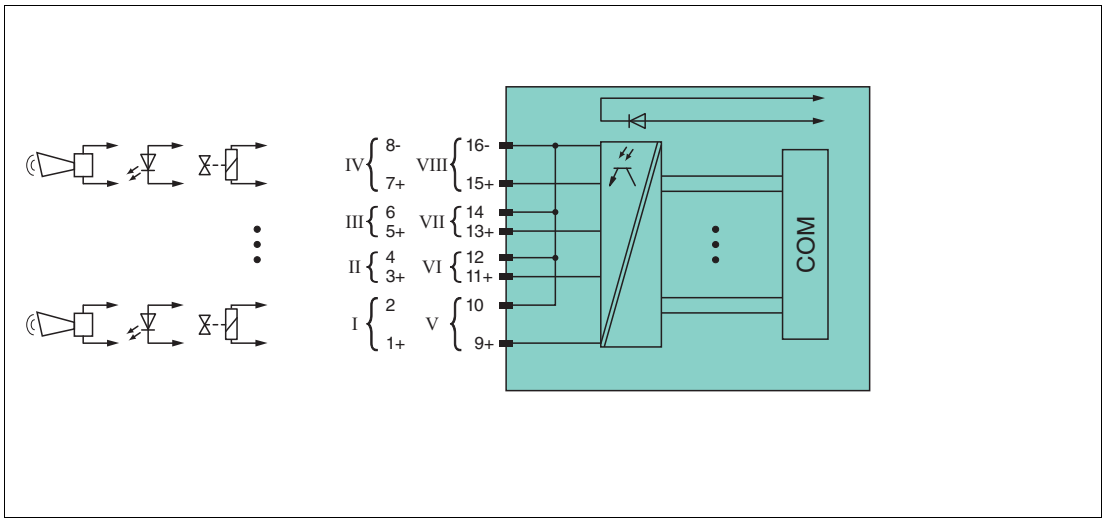

Figure 6.80 Block diagram LB6*08, FB6*08 with shutdown input

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

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6.24.2 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.

6.24.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Input and Output Data

The I/O module has input and output data.

The output data sets the control outputs and marks the data as valid or invalid. As soon as the **data invalid** error bit is set, the substitute values are used.

The input data allows the master to retrieve the current output status. This is particularly useful when ON delay and OFF delay are activated. The output reaches the required status only after the preset time has elapsed so the master can retrieve the current output status.

Bit Structure within the Data Telegram

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)
Input byte 2	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)
Output byte 1	0	Output value channel 1
	1	Invalid identifier channel 1 (0 = OK, 1 = invalid)
	2	Output value channel 2
	3	Invalid identifier channel 2 (0 = OK, 1 = invalid)
	4	Output value channel 3
	5	Invalid identifier channel 3 (0 = OK, 1 = invalid)
	6	Output value channel 4
	7	Invalid identifier channel 4 (0 = OK, 1 = invalid)

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Byte	Bit	Meaning
Output byte 2	0	Output value channel 5
	1	Invalid identifier channel 5 (0 = OK, 1 = invalid)
	2	Output value channel 6
	3	Invalid identifier channel 6 (0 = OK, 1 = invalid)
	4	Output value channel 7
	5	Invalid identifier channel 7 (0 = OK, 1 = invalid)
	6	Output value channel 8
	7	Invalid identifier channel 8 (0 = OK, 1 = invalid)

Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Byte 1 (channel 1 ... 4): Offset + (8 * slot) + bit no. - 1 Byte 2 (channel 5 ... 8): Offset + (8 * (slot + 1)) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

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Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Byte 1 (channel 1 ... 4): Offset + (8 * slot) + bit no. - 1 Byte 2 (channel 5 ... 8): Offset + (8 * (slot + 1)) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.24.4 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.

6.24.5 Watchdog

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.

6.24.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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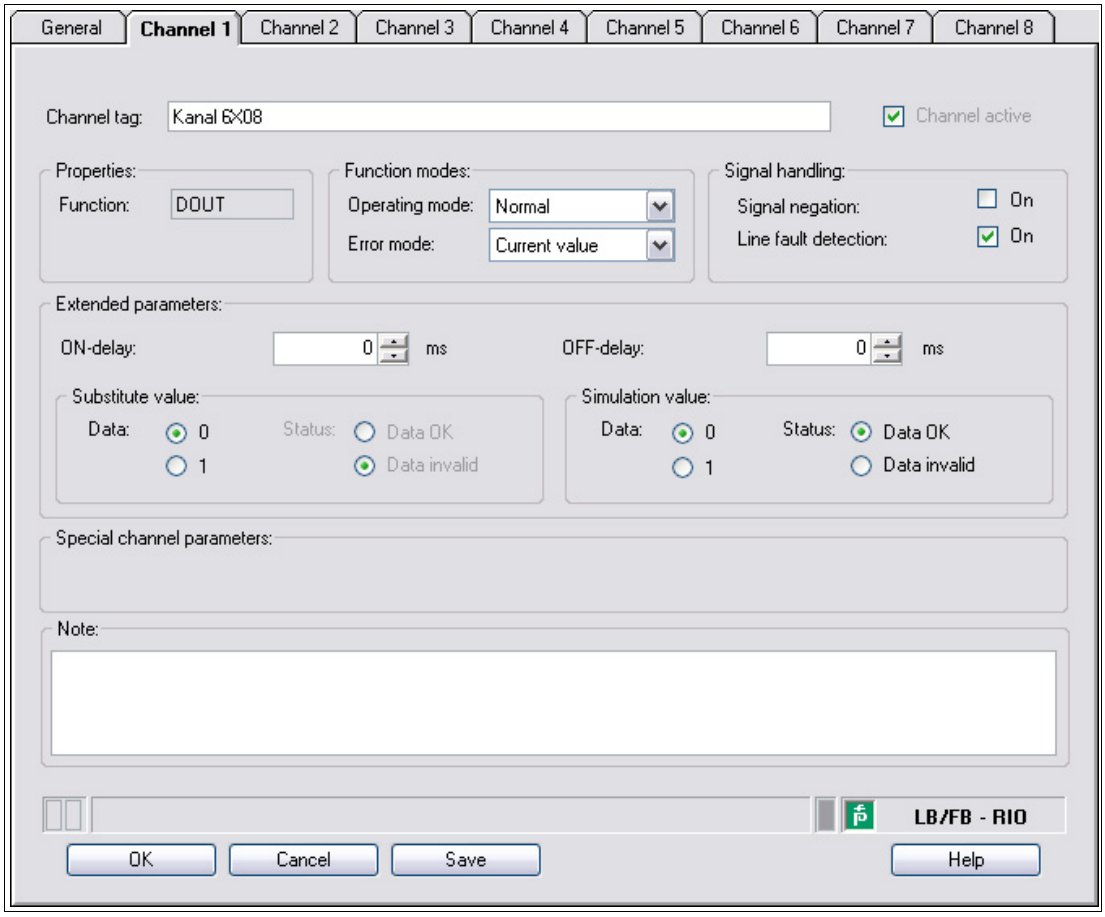

Figure 6.81 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.25 LB6*1*, FB621* Digital Output

6.25.1 Description

Versions

- LB6010, digital output, not intrinsically safe
  Versions available with bus-independent shutdown input
- LB6110 ... LB6115, digital output, intrinsically safe
  Versions available with bus-independent shutdown input
- FB6210 ... FB6215, digital output, intrinsically safe
  Versions available with bus-independent shutdown input

Features

- Occupies 2 slots on the backplane
- Number of channels: 4
- The electrical data of the versions is different.

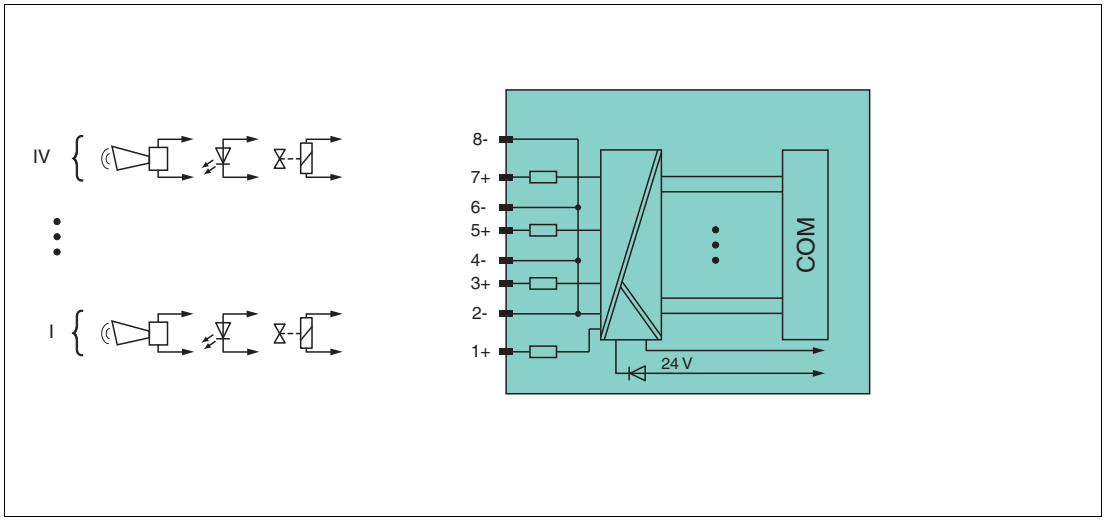
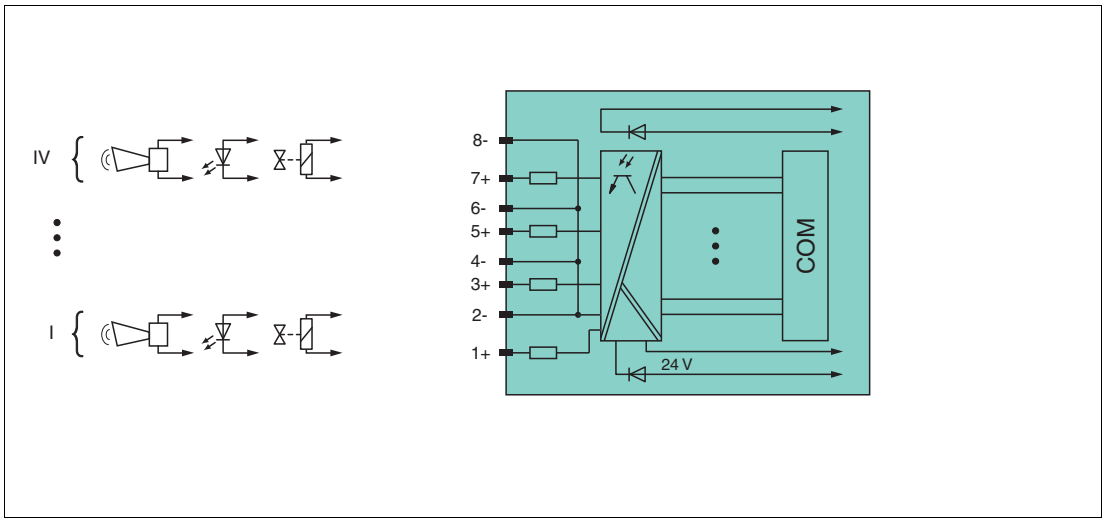


Figure 6.82 Block diagram LB6*1*, FB621* without shutdown input



Block diagram LB6*1*, FB621* with shutdown input

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

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6.25.2 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.

6.25.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

Input and Output Data

The I/O module has input and output data.

The output data sets the control outputs and marks the data as valid or invalid. As soon as the **data invalid** error bit is set, the substitute values are used.

The input data allows the master to retrieve the current output status. This is particularly useful when ON delay and OFF delay are activated. The output reaches the required status only after the preset time has elapsed so the master can retrieve the current output status.

Bit Structure within the Data Telegram

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

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital input signals area, allocated; access: read bit by bit)	**0** (DA)	See chapter 4.11	Function code 2 (read input status)
	10001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1024** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11.	Function code 3 (read holding registers)
	46001 (MC)		
Process data (digital input signals area, slot-based; access: read bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	13001 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (digital output signals area, allocated; access: read/write bit by bit)	**0** (DA)	See chapter 4.11	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	1 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read/write word by word)	**1280** (DA)	From the start address (offset), the digital data is arranged according to the sequence in the allocation overview, see chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	46101 (MC)		
Process data (digital output signals area, slot-based; access: read/write bit by bit)	**1024** (DA)	Offset + (8 * slot) + bit no. - 1	Function code **5** (write single coil) **15** (write multiple coils) **1** (read coils)
	3001 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.25.4 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.

6.25.5 Watchdog

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.

6.25.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

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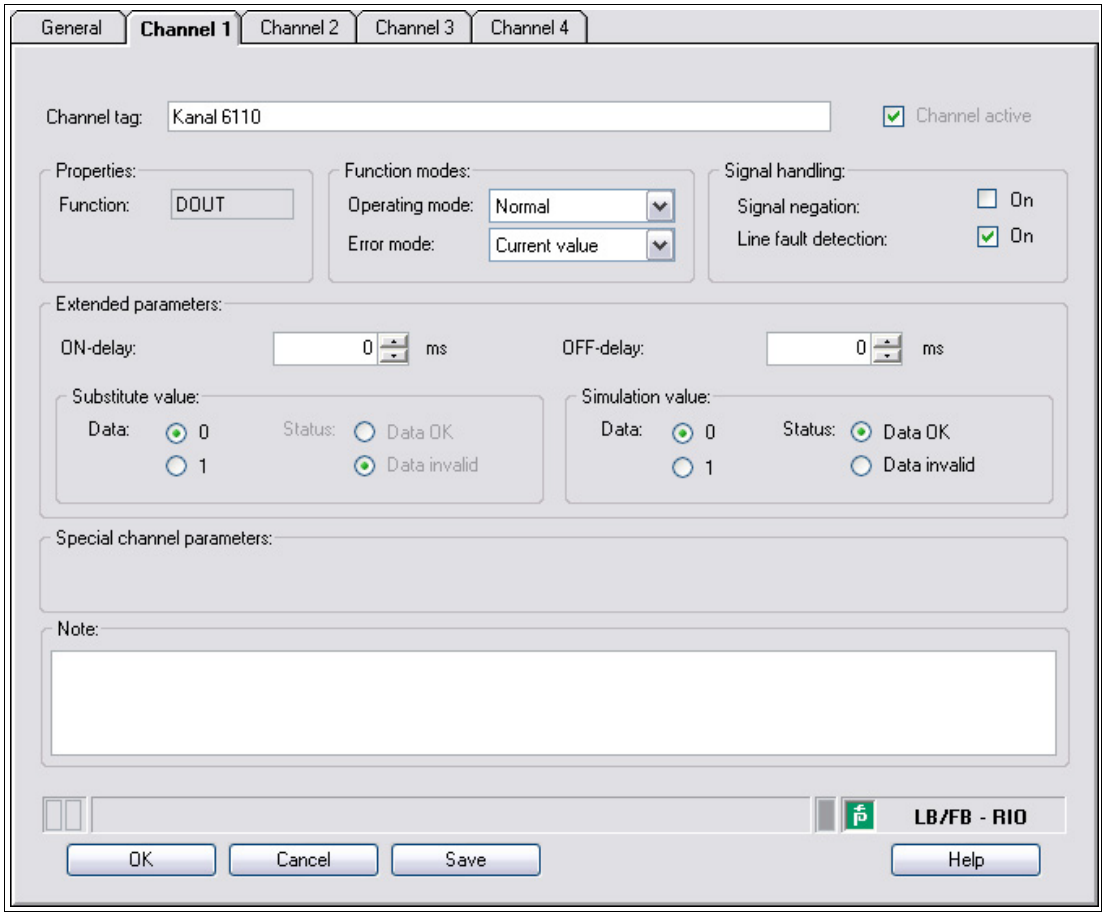

Figure 6.83 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Special channel parameters	-
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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6.26 LB7*04, FB7*04 Universal Input/Output (HART)

6.26.1 Description

Versions

- LB7004, Universal Input/Output (HART), not intrinsically safe
- FB7304, Universal Input/Output (HART), increased safety terminals
- LB7104, Universal Input/Output (HART), intrinsically safe
- FB7204, Universal Input/Output (HART), intrinsically safe

Features

- Occupies 1 slot on the backplane
- Number of channels: 4
- Channels can be set as analog input (HART), analog output (HART), digital input or digital output.
  - Suitable sensors for analog inputs: pressure, differential pressure, filling level, flow rate and temperature converters, etc.
  - Suitable sensors for analog outputs: proportional valves, I/P converters, local indicators
  - Suitable field devices for digital inputs: mech. contacts and optocouplers
  - Suitable field devices for digital outputs: solenoid valves, acoustic sensors, and LEDs (line fault detection can be disabled)

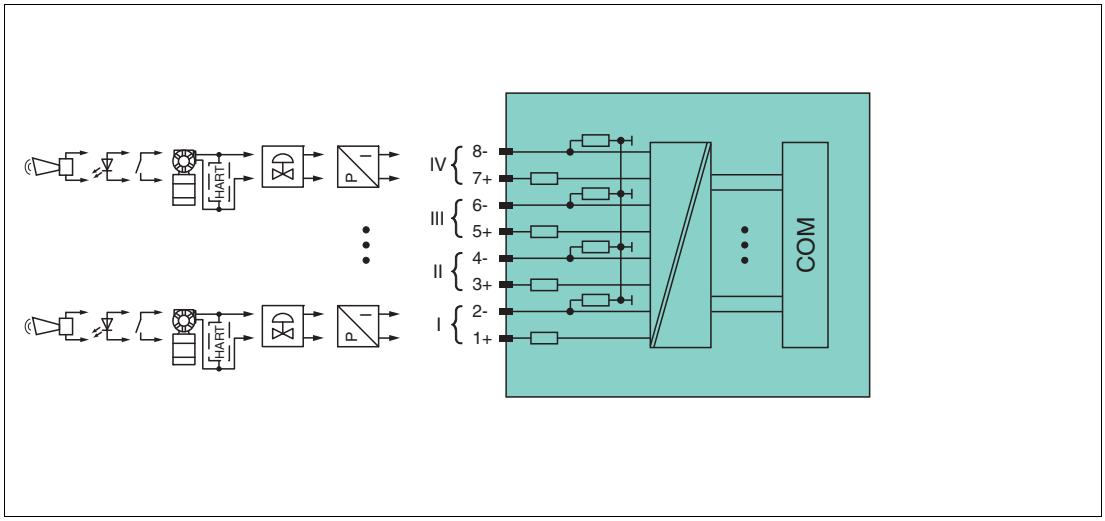

Figure 6.84 Block diagram LB7*04, FB7*04

The connection layout and other technical data can be found on the relevant data sheet.

6.26.2 Measuring Time and Cycle Time

The update rate for all 4 channels together is approx. 100 ms. The accuracy of the measured value depends on the cycle time of the data traffic on the bus. The signals are transmitted to the com unit every 6.5 ms irrespective of the measuring time.

6.26.3 Data Transfer

The master can access the process values and status values using MODBUS telegrams. The signals in the com unit memory can be accessed via allocable or slot-based address ranges. The allocation of signals has been previously described, see chapter 4.11. Slot-based access is displayed in the following tables.

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A data container with 16-bit input data and 16-bit output data is available for the data transfer for each channel. The four data containers can be filled with analog or digital process values in accordance with the selected channel type (AI, AO, DI, DO).

Analog process values are transferred via unsigned integers within the range 0 ... 65535. The 4 bits of the lowest order are of little importance for the accuracy of the measured value and are therefore used for transferring status information. Status information is omitted if the scaling is outside the range of 10000 ... 50000.

Bit Structure within the Data Telegram

		AI channel function	AO channel function	DI channel function	DO channel function
Word	**Bit**	**Meaning**	**Meaning**	**Meaning**	**Meaning**
Input word 1 Channel 1	0	Live zero if current ≤ 3.6 mA (*)	Empty	Measured value channel 1	Mirrored process value channel 1
	1	Status (0 = OK, 1 = error)	Status (0 = OK, 1 = error)	Status (0 = OK, 1 = error)	Status (0 = OK, 1 = error)
	2 ... 3	Empty	Empty	Empty	Empty
	4 ... 15	Measured value channel 1 (12 bit)	Feedback measured value channel 1	Empty	Empty
Input word 2 ... 4 Channel 2 ... 4		Same structure as input word 1 for channel 1			
Output word 1 Channel 1	0	Empty	Empty	Empty	Process value channel 1
	1	Empty	Invalid identifier channel 1 (0 = OK, 1 = error)	Empty	Invalid identifier channel 1 (0 = OK, 1 = error)
	2 ... 3	Empty	Empty	Empty	Empty
	4 ... 15	Empty	Process value channel 1 (12 bit)	Empty	Empty
Output word 2 ... 4 Channel 2 ... 4		Same structure as output word 1 for channel 1			
(*) The live zero monitoring transmits one error bit (= 1) if the current falls below the minimum of 3.6 mA.					

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Signal Addressing (Input Signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog input signals area, allocated; access: read word by word)	**0** (DA)	See chapter 4.11	Function code 4 (read input registers)
	30001 (MC)		
Process data (holding register/"analog output signals" area, allocated; access: read word by word)	**1536** (DA)	Offset + DTM address designations see chapter 4.11	Function code 3 (read holding registers)
	16200 (MC)		
Process data channel 1+2 (analog input signals area, slot-based; access: read word by word)	**512** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35100 (MC)		
Process data channel 3+4 (analog input signals area, slot-based; access: read word by word)	**640** (DA)	Offset + (2 * slot)	Function code 4 (read input registers)
	35400 (MC)		
Module status (high byte, digital input signals area, slot-based; access: read bit by bit)	**2048** (DA)	Offset + (8 * slot) + bit no. - 1	Function code 2 (read input status)
	14001 (MC)		
Module status (analog input signals area, slot-based; access: read word by word)	**768** (DA)	Offset + slot	Function code 4 (read input registers)
	35200 (MC)		
Type register (analog input signals area, slot-based; access: read word by word)	**1024** (DA)	Offset + slot	Function code 4 (read input registers)
	35300 (MC)		
DA = direct addressing, MC = MODICON addressing			

Signal addressing (output signals)

Signal type	Offset	Address identification (formula)	Description
Process data (analog output signals area, allocated; access: read/write word by word)	**0** (DA)	See chapter 4.11	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	40001 (MC)		
Process data channel 1+2 (analog output signals area, slot-based; access: read/write word by word)	**512** (DA)	Offset + (2 * slot)	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45100 (MC)		
Process data channel 3+4 (analog output signals area, slot-based; access: read/write word by word)	**640** (DA)	Offset + (2 * slot)	Function code **6** (write single register) **16** (write multiple registers) **3** (read holding registers)
	45300 (MC)		
DA = direct addressing, MC = MODICON addressing			

6.26.4 Line Fault Detection

Analog Input

For analog inputs the line fault detection can detect line breakages or short circuits. Line fault detection can be switched on and off in the Device Type Manager.

You can preset the switching points at which a lead breakage or a short circuit is signaled, e.g., line breakage < 1 mA and short circuit > 21 mA.

The current circuit has Live Zero monitoring. If the current falls below the minimum of 3.6 mA, an error bit is set (= 1).

Analog output

For analog inputs the line fault detection can detect line breakages. Line fault detection can be switched on and off in the Device Type Manager.

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 mA ... 20 mA outputs When currents < 0.1 mA are detected, a lead breakage is signaled.

Digital Input

For NAMUR proximity switches, the line fault detection can detect line breakages or short circuits. Line fault detection can be switched on and off in the Device Type Manager.

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If you are using mechanical contacts, deactivate line fault detection or connect the mechanical contact at the installation location using an additional resistor circuit. Using the resistor circuit, the electronic circuit can distinguish between a closed switch and a short circuit. The resistor circuit is available as an accessory.

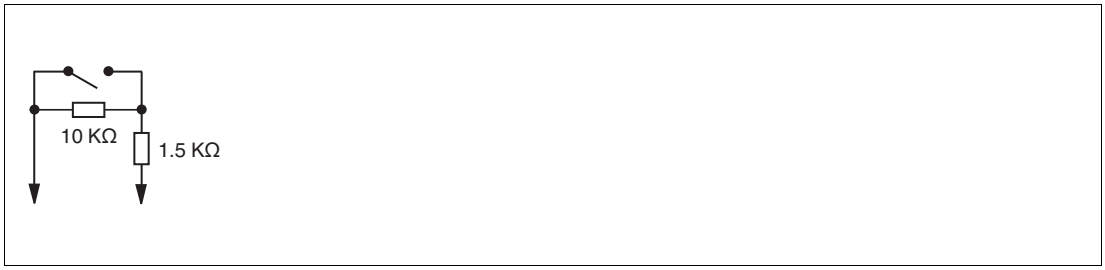

Figure 6.85 Mechanical contact with additional resistor circuit

Digital Output

For digital outputs, the line fault detection can detect line breakages or short circuits. Line fault detection can be switched on and off in the Device Type Manager.

The line fault detection is based on the measurement of a trickle current so low that it does not activate a connected valve.

6.26.5 Watchdog

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.

6.26.6 Editing Device Data

Open the **Edit Device Data** window. The **Edit Device Data** window for the I/O modules is divided into several tabs. The **General** tab contains parameters that affect the whole I/O module.

There are also one or more **Channel X** tabs where X stands for the channel number, e.g., **Channel 1**, **Channel 2**, **Channel 3**. Set channel-specific parameters on these tabs.

The tab adjustment options depend on the channel type selected. The channel type can be configured in the **General** tab. Depending on the channel type selected, the relevant standard input form for AI, AO, DI, or DO is received via the corresponding tab.

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Settings for channel type AI

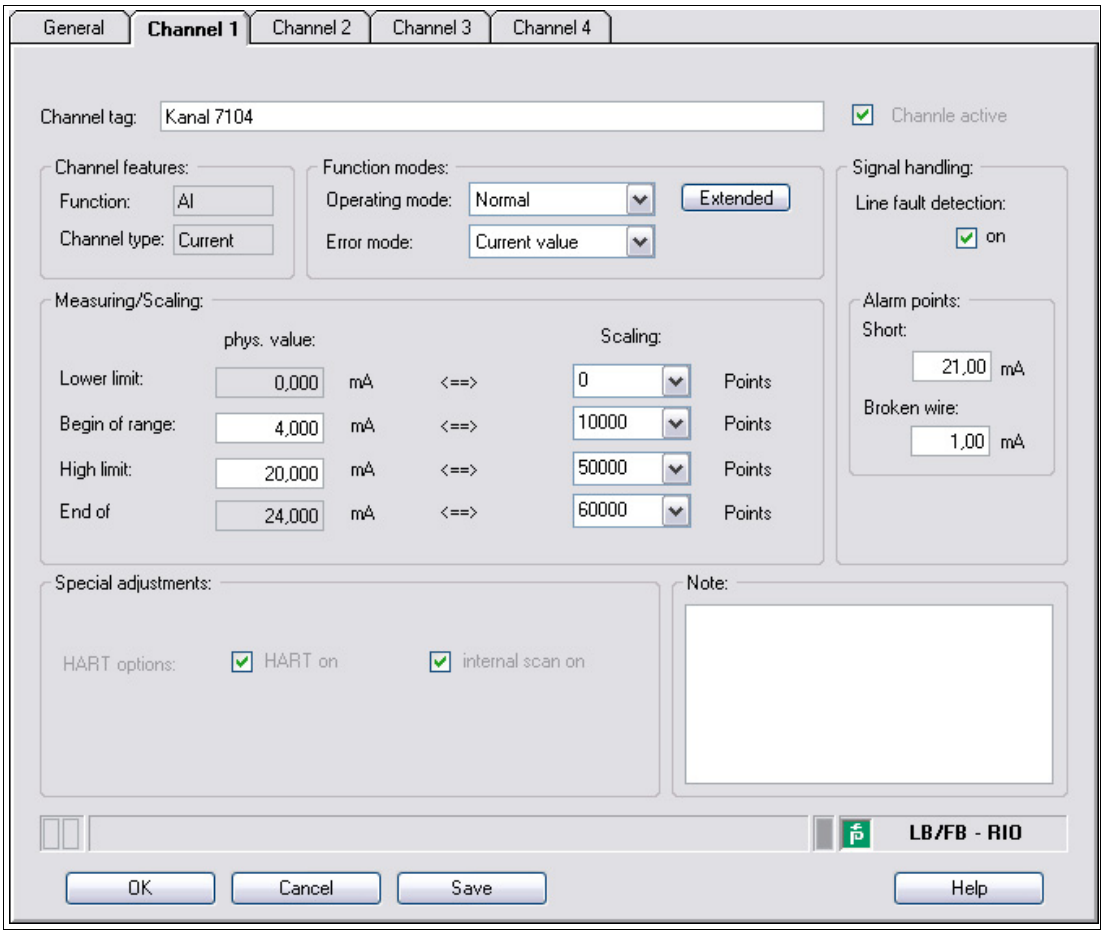

Figure 6.86 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated signal using the **Extended** button.

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Field	Explanation
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the status **Invalid data** in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
Short circuit	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.
Lead breakage	Enter the threshold value for the lead breakage detection, e.g., 1 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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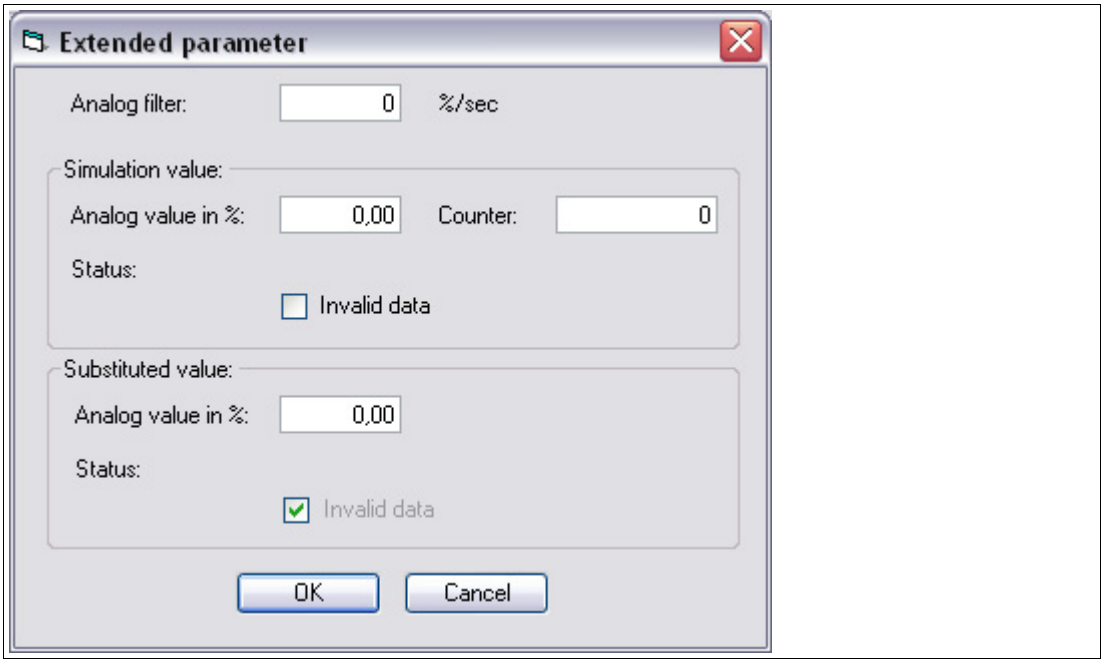

Figure 6.87 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filter for damping the signal can be activated if the input signals fluctuate. Enter a value in % per second for defining the rate of change of the input value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid**.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

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Settings for channel type AO

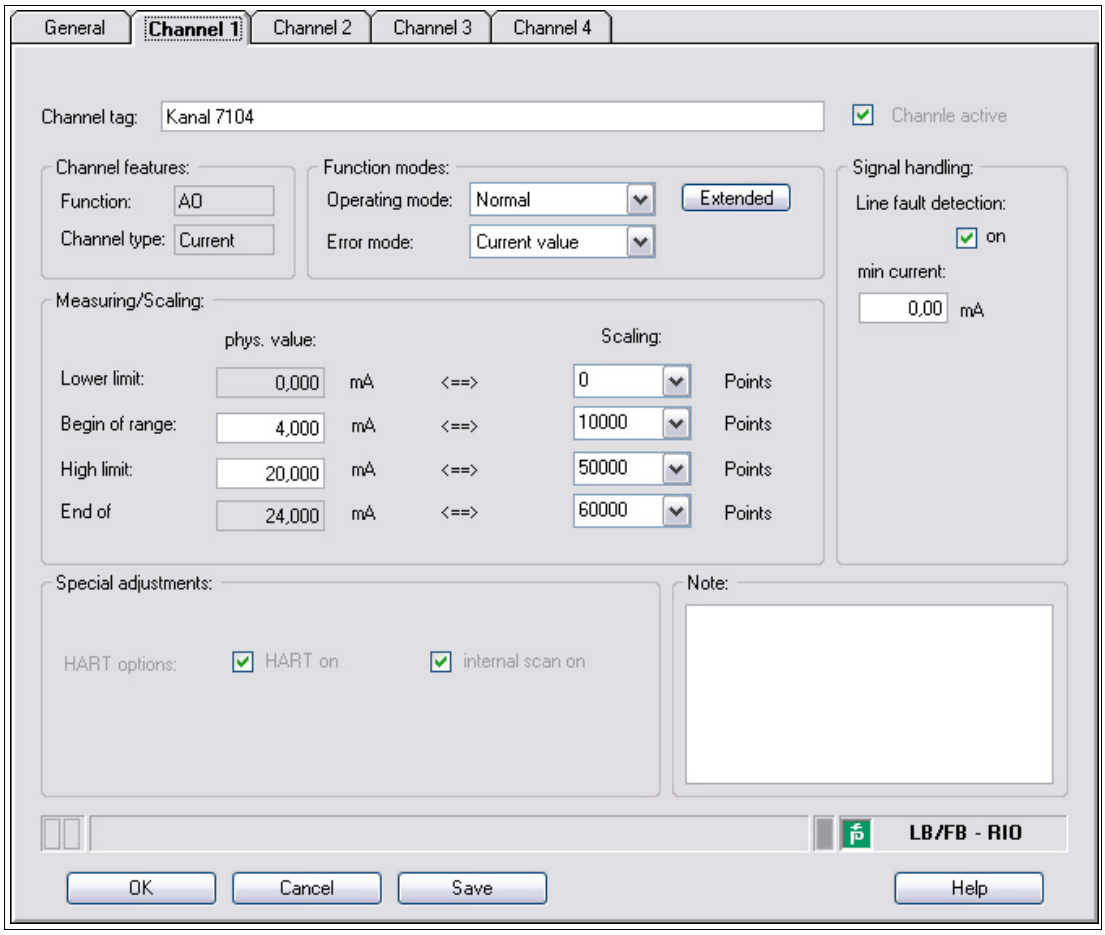

Figure 6.88 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Channel type	Depending on the I/O module, this field shows the signal type, e.g., counter, current, resistance, NAMUR, or 24 V.
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal using the **Extended** button.

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Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can adjust the substitute value using the **Extended** button. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Extended	This button takes you to a window with more channel settings. Here you can adjust the simulation value for the **operating mode** and the substitute value for the **error mode**.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If a lead breakage occurs, the error is reported via the status area for the process value.
Minimum current	Enter the threshold value for lead breakage detection, e.g., 0.8 mA. When the current strength falls below this value, the line fault detection signals a lead breakage.
Measuring range/scaling	Define the scaling for the measured values. The values are calculated in the **Phys. size** column using the values in the **Scaling** column. You can define the scaling yourself. **Lower limit**: indicates the smallest value to be transferred, e.g., 0 points or 0 mA **Start of range**: indicates the value equal to 0 %, e.g., 10,000 points and 4 mA **End of range**: indicates the value equal to 100 %, e.g., 50,000 points or 20 mA **Upper limit**: indicates the largest value to be transferred, e.g., 60,000 points at 24 mA
HART on	Activate or deactivate HART communication to the channel. Deactivate HART communication if no HART-compatible device is connected. This saves time available for communication with other HART devices.
Internal scan on	This check box only appears when HART communication is activated. Activate or deactivate the automatic scanning of IDs, tags, and variables for HART communication. All active HART channels are scanned automatically by default, such that HART data is retrieved and saved for quicker external access.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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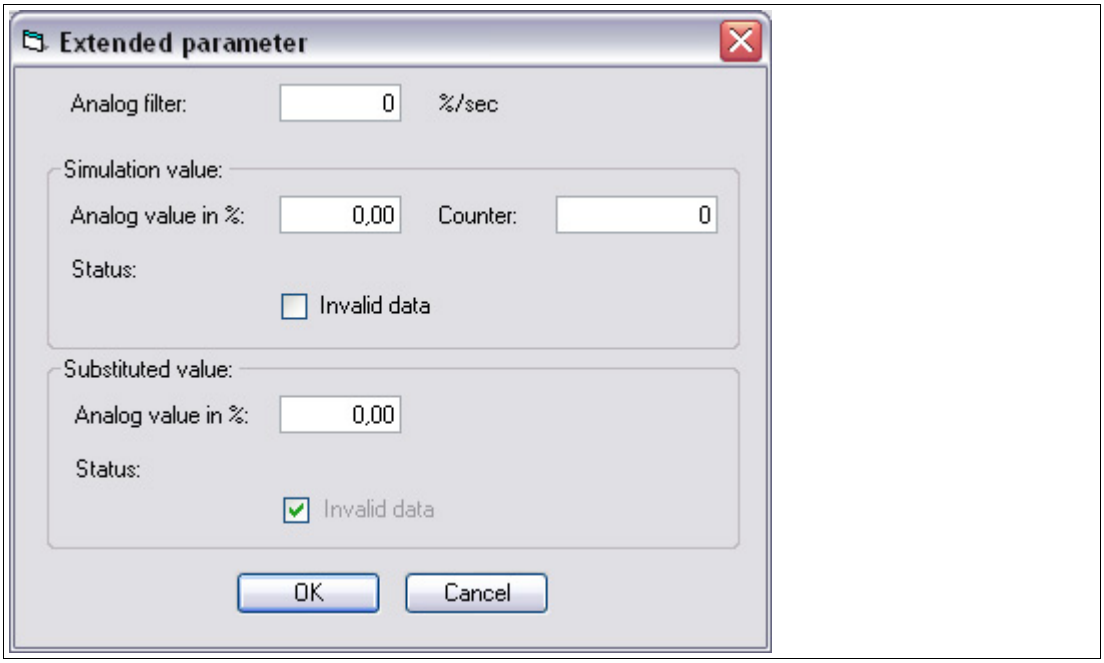

Figure 6.89 **Extended Parameters** window

Field	Explanation
Analog filter	The analog filters for damping the signal are activated if the output signals fluctuate. Enter a value in % per second for defining the rate of change of the output value. The measurement range is used as the reference value. Enter the value `0` here to deactivate the filter.
Analog value as % (simulation value)	The simulation value is transferred if you have selected the **Simulation** operating mode. Enter a simulation value in % relating to the measurement range (-25% ... 125%).
Data invalid (simulation value)	Define the status of the simulation value. If you enable the check box, the simulation value is transferred with the status **Data invalid** and the substitute value strategy is initiated.
Analog value as % (substitute value)	The substitute value is transferred when an error occurs and you have selected the **Substitute value** error mode. Enter a substitute value in % relating to the measurement range (-25% ... 125%).
Data invalid (substitute value)	This field can not be edited. The substitute value is always transferred with the **Invalid data** status.

Settings for channel type DI

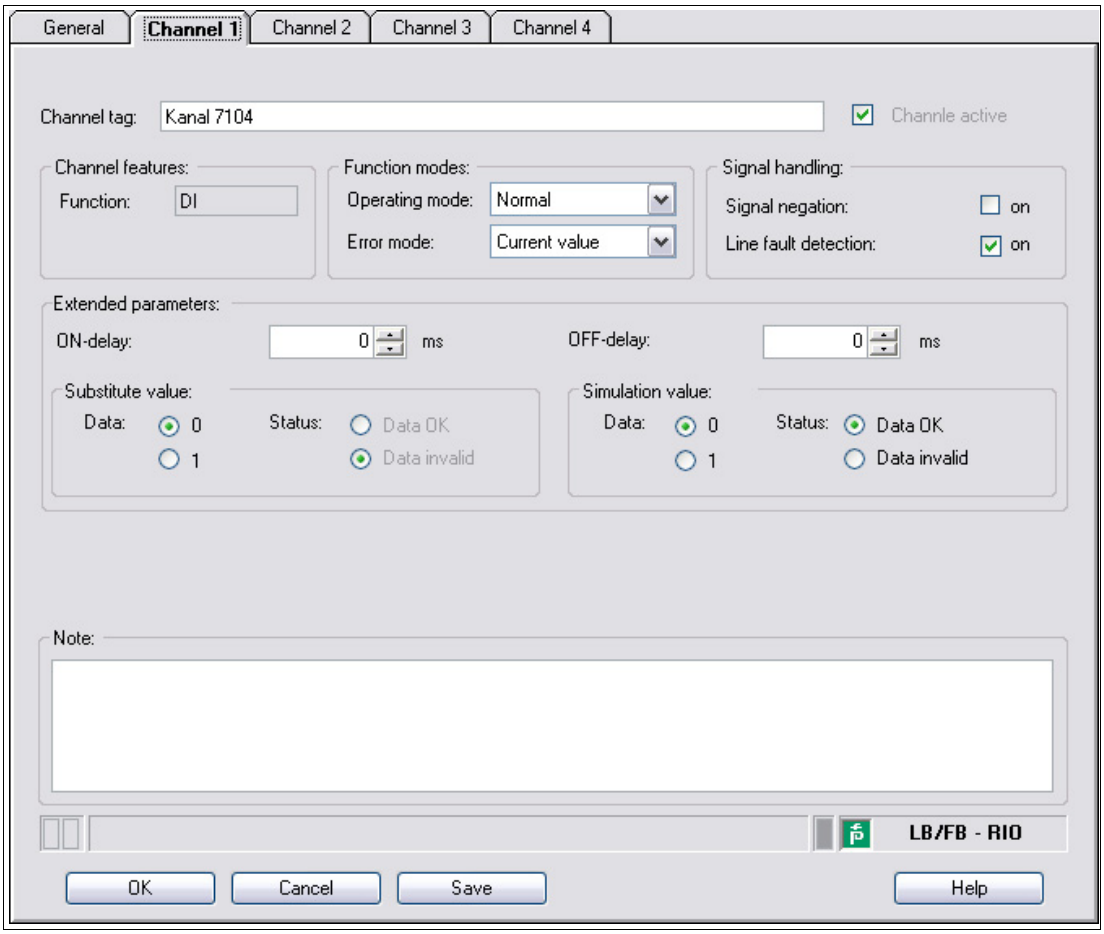

Figure 6.90 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current input signal is transferred to the process control system. An input signal is simulated in simulation mode. You can adjust the simulated input signal in the **Simulation value** area.
Error mode	Define the behavior of the I/O module in the event of an error. Substitute values transferred in the event of an error have the **invalid data** status in DTM version 7 or higher. See chapter 5.4.2 **Current value**: The signal is transferred unchanged from the field in spite of the error. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute Value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.

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Field	Explanation
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value and the substitute value strategy configured under **Error mode** is initiated.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

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Settings for channel type DO

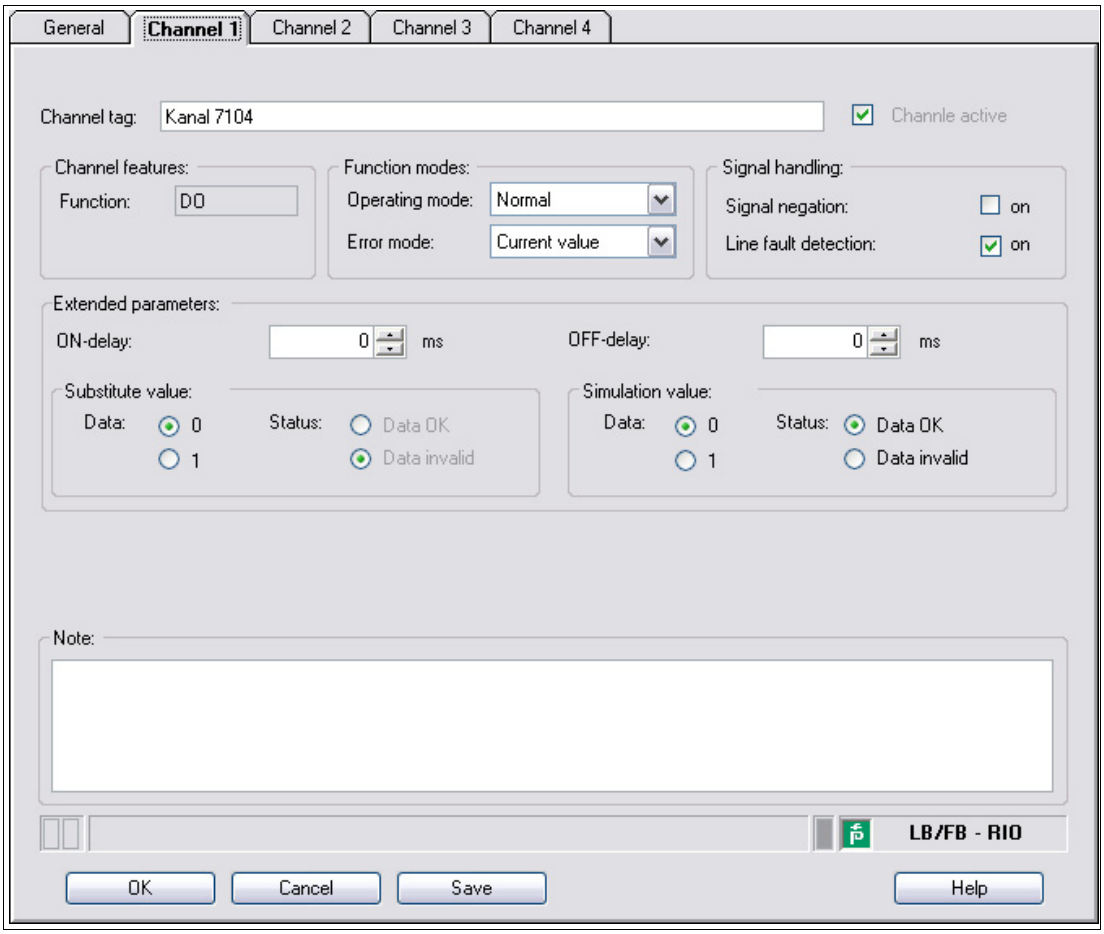

Figure 6.91 **Channel 1** tab

Field	Explanation
Channel tag	Enter a description for the channel. You can enter up to 32 characters.
Channel active	The check box shows whether or not the channel is active. This check box is dependent on the **Module active** check box in the **General** tab and cannot be edited here.
Channel type	This field indicates the channel type for each channel. It cannot be edited. DIN = DI = digital input DOUT = DO = digital output AIN = AI = analog input AOUT = AO = analog output
Operating mode	Choose between **Normal** and **Simulation**. See chapter 5.4.1 In normal operation, the current bus signal is processed and output by the I/O module. A bus signal is simulated in simulation mode. The simulated bus signal is processed and output. You can adjust the simulated bus signal in the **Simulation value** area.

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Field	Explanation
Error mode	Define the I/O module's conduct in the event of an error. Once the watchdog time has expired, e.g., when a bus failure has been detected or when the com unit receives values with the status **Data invalid**, the outputs adopt substitute values in accordance with the substitute value strategy. The substitute value strategy is not activated by line faults in the output circuit. See chapter 5.4.2 **Current value**: The signal from the process control system is transferred unchanged in spite of the error. The signal may also be a simulated signal. **Substitute value**: A substitute value is transferred. You can set the substitute value in the **Substitute value** area. **Last valid value**: The last value that was valid before the fault occurred is transferred.
Signal negation	To invert the signal, activate **Signal negation**. When signal negation is active, a logical `1` may become `0`.
Lead breakage detection	Enable line fault detection to monitor the connection at the field end. If an error occurs (e.g., lead breakage or short circuit), the error is reported via the status area for the process value.
ON delay	You can use the ON delay to filter out short pulses. Enter a value in ms to accelerate a signal change from `0` to `1`. 
OFF delay	You can use the OFF delay to extend short pulses. Enter a value in ms to delay a signal change from `1` to `0`. 
Substitute value	Define a substitute value for when there is a fault. Choose either `0` or `1` as the substitute value. The substitute value is always transferred with the **Invalid data** status.
Simulation value	Define the simulation value and the status of this value. The simulation value is transferred if you activate "Simulation" mode. Choose either `0` or `1` as the simulation value. Choose between the **Data OK** and **Invalid data** status. If you select **Invalid data**, the substitute value strategy is initiated.
Note	You can enter a comment here. The maximum text length is 256 characters. The comment is saved in the database only and not in the I/O module. The comment applies to the entire I/O module and also appears on the other tabs in the window.

7 Diagnostic Functions

Com Unit Diagnostics Functions

The measured value display for the com unit provides you with diagnostics information relating to the remote I/O station as a whole. This chapter describes the structure of the measured value display and shows which diagnostics information is available to it.

Diagnostic functions of PACTware™

In version 4 and above, PACTware™ includes the **Device State Manager**. See chapter 7.6

7.1 Opening the measured value display of the Com Unit

Opening the "Show Measured Value" window

1. Right-click on the entry for the required component in the project structure.
2. Choose **Connect**.

   ↳ The connection is established. The entries appear in bold in the project structure once the connection is established. The connection status is also indicated by an icon.
3. Right-click on the entry for the connected device in the project structure.
4. In the context menu, select **Measured Value > Show Measured Value**. If the command is not available, there is no connection to the device.

   ↳ The **Show Measured Value** window opens.

7.2 Layout of the Measured Values Display

The com unit measured values display is divided into four areas.

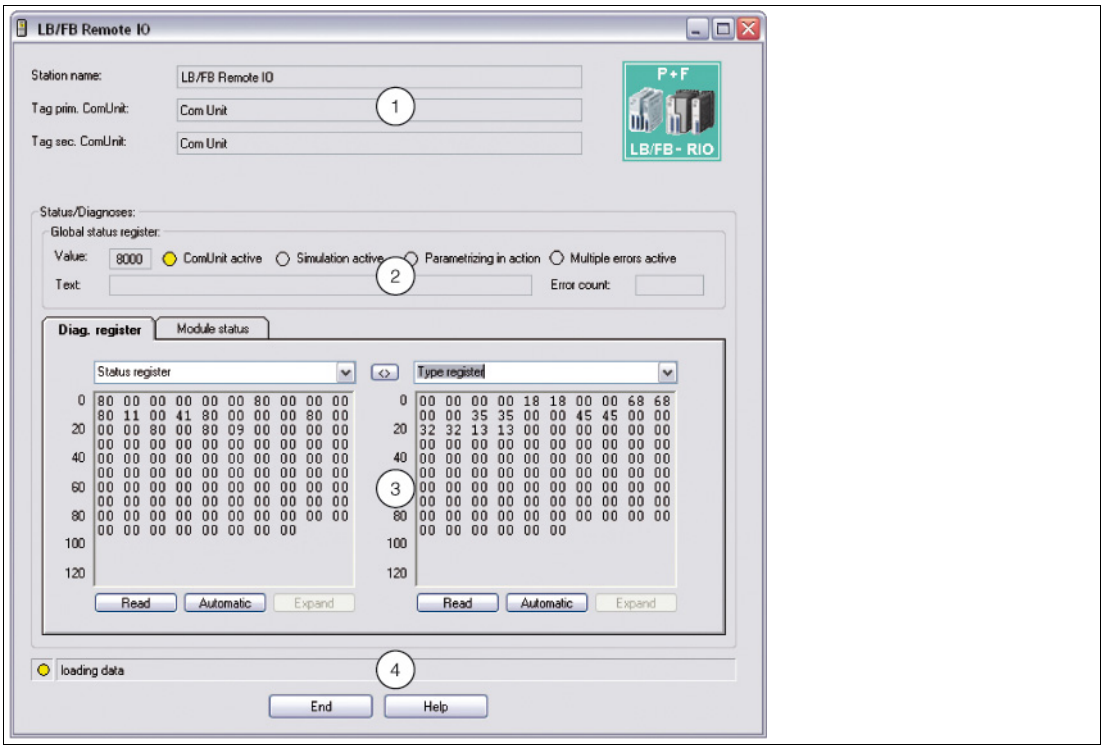

Figure 7.1 **Display Measured Value** window

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Field		Explanation
1	Station name Prim. com unit tag Sec. com unit tag	The fields contain the names of the station and the primary com unit. On redundant systems, the name of the secondary com unit (redundant com unit) is also displayed.
2	Global status register	The global status register contains information about the status of the com unit, the I/O modules, and the power supplies of a station.
3	Tabs	This area contains several tabs. The first **Diagnostics register** tab displays the raw data for the different diagnostic registers. Depending on the com unit type, additional diagnostic information is displayed via additional tabs. The **Module Status** tab is available from DTM version 7.3.
4	Status bar	The status bar provides information about the communication status. The display lights up yellow in the case of read access. The display lights up red if there is a communication error. The communication status is displayed as a text message in the text box. **Data loading**: The read request was successful. The measured value display waits for the requested data. **Wait...**: The read request was unsuccessful because the communication channel is currently in use. **Communication error**: The requested data could not be transfered.

7.3 Global Status Register

The global status register comprises 16 bits (= 1 data word) and contains information about the status of the com unit, I/O modules, and power supplies of a remote I/O station. The global status register is displayed in the **Show Measured Value** window as a raw data value in the **Value** field and as a text message in the **Text** field.

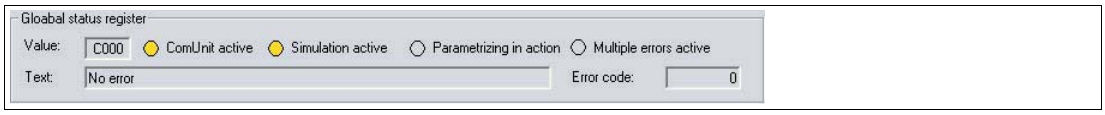

Figure 7.2 Com Unit measured value display, **Global status register** area

7.3.1 Structure of the Global Status Register

The global status register comprises 2 bytes. The meaning of the individual bits is shown in the table below.

Structure of the Global Status Register

Byte	Bit/state		Meaning
2	15	= 0	Com unit is passive
		= 1	Com unit is active
	14	= 0	Operating mode: no simulation
		= 1	Operating mode: a minimum of one I/O module is simulated.
	13	= 0	No fault
		= 1	Fault
	12	= 0	General fault
		= 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	1 fault
		= 1	Multiple faults
	6	= 0	No parameterization/processing
		= 1	Parameterization/processing in progress
	5		Bits 5 ... 0: ■ If a single error occurs (bit 7 = 0), the faulty slot can be determined with reference to these 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 (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 a fault.
	4		
	3		
	2		
	1		
	0		

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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

7.3.2 Example of Global Status Register

There is a power supply fault in the following example. The **Value** field contains the raw data value A784.

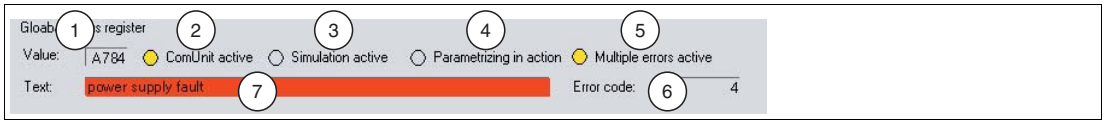

Figure 7.3 Com unit measured value display, **Global status register** area

The value is produced from the 16 bits in the status register. The table below outlines how the raw data value A784 is compiled and on which status displays the value appears.

Example of Global Status Register (Raw Data Value "A784")

A784	Bit/state		Meaning	Image reference
A	15	= 1	Com unit is active Status indicated by **Com unit active** yellow = active gray = passive	2
	14	= 0	Simulation is not active Status indicated by **Simulation active** yellow = min. 1 channel simulated gray = no simulation	3
	13	= 1	Error has occurred Status indicated by **Text** box red background = error gray background = no error	7
	12	= 0	General error no status indicator	

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A784	Bit/state		Meaning	Image reference
7	11	= 0	Bits 11 ... 8 with states 0 1 1 1 produce the error code 7. The error with the highest priority is a power supply fault.	7
	10	= 1		
	9	= 1		
	8	= 1		
8	7	= 1	Multiple errors have occurred Status indicated by **Multiple errors active** yellow = multiple errors gray = no errors or single error	5
	6	= 0	No parameterization/processing Status indicated by **Parameterization in progress** yellow = parameterization in progress gray = no parameterization	4
	5	= 0	There are 4 active errors (multiple errors) Bits 5 ... 0 with the states 0 0 0 1 0 0 produce the number 4.	6
	4	= 0		
4	3	= 0		
	2	= 1		
	1	= 0		
	0	= 0		

7.4 "Diagnostics Register" Tab

Different diagnostic areas in the com unit can be read out and compared with one another using the **Diagnostics Register** tab. Press the **<>** button in the middle of both areas to highlight differences between the diagnostic areas in the left- and right-hand text boxes in color until the data is updated again.

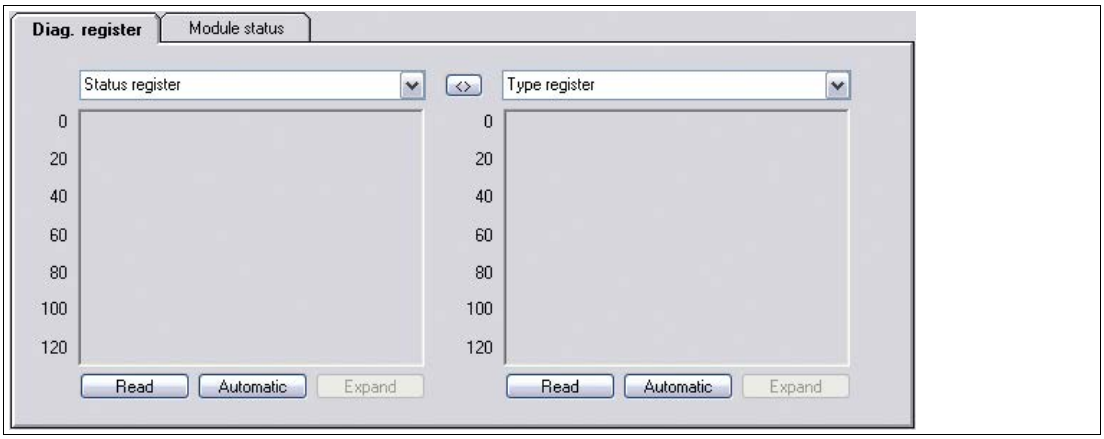

Figure 7.4 **Diagnostics Register** tab

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7.4.1 Redundancy Status

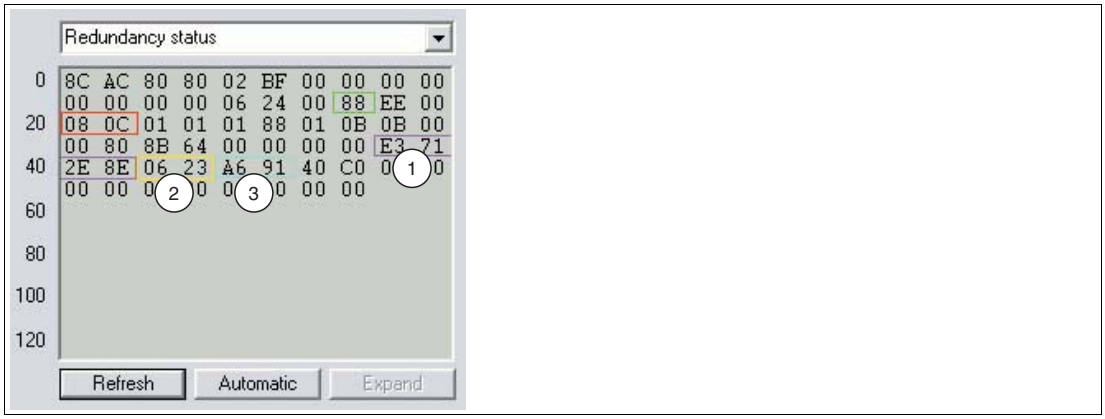

Figure 7.5 Redundancy Status

The structure of the two redundancy status registers **Redundancy status** and **Redundancy status (partner)** is identical. If you select the entry **Redundancy status (partner)** from the drop-down list (only on redundant systems), you access the data record for the redundant com unit via the active com unit. Data is exchanged between the com unit and the redundancy com unit automatically.
Each redundancy status register contains a large amount of information. The most important information is highlighted in the illustration.

1: Checksum Calculation Result

This area contains the result of the checksum calculation for the parameter set of the com unit. With the exception of EasyCom connections, the data records must be identical in both com units in redundant systems. You can compare data records with one another using the **<>** button.

The revision counter value for the parameter set is also included in the checksum calculation. The result is that the checksum changes when the revision version increases and provides confirmation of the transmission of new parameters.

2: Firmware Version

This area contains the com unit firmware version.

3: Global Status Register

This area contains the global status register. See chapter 7.3

7.4.2 Status Register

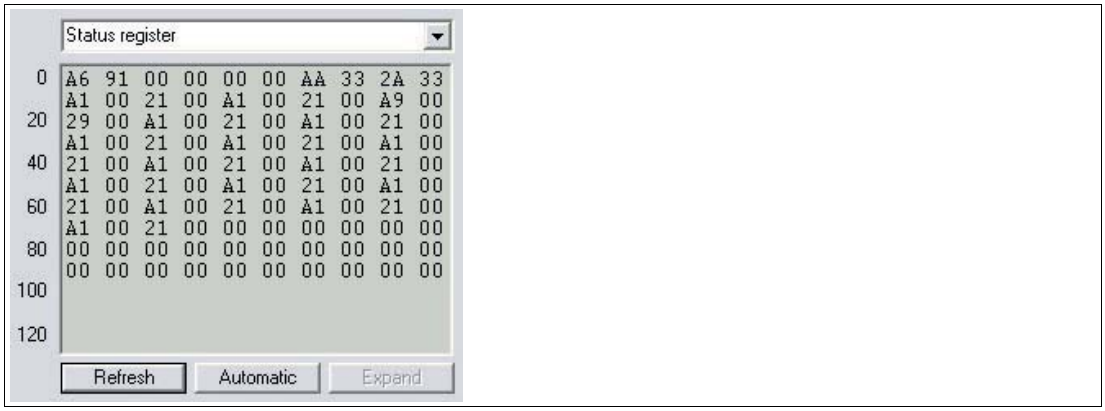

Figure 7.6 Status register

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If you select the **Status register** entry from the drop-down list, the status bytes for the com unit and the I/O modules are displayed.

There are 2 status bytes available for each I/O module slot and for the bus connection (com unit or com unit + redundancy com unit). The first two bytes are allocated to the bus coupling and contain the global status register already described. This is followed by two bytes for each I/O module slot, beginning with slot 1. The meaning of the bytes is displayed in the following tables.

The first of the two status bytes contains module diagnostic information and has the same structure for each slot. The second status byte depends on the module type and contains channel diagnostic information. Since some dual-width I/O modules require two slots, these I/O modules are represented by 4 bytes (2 bytes per slot). In theory, bytes 1 and 3 have the same structure, in which only the first required module slot is assigned the **active** status. Bytes 2 and 4 contain the channel diagnostics information.

Module Status Register

Byte	Bit/state		General meaning	Example of meaning
Byte 1 Example: AA	7	= 1	Module active (0 = inactive, 1 = active)	The I/O module is active (bit 7 = 1) and faulty (bit 5 = 1). There is an internal module error (bit 3 ... 0 = 1 0 1 0 = error code 10_{Hex})
	6	= 0	Simulation active (min. 1 channel) (0 = inactive; 1 = active)	
	5	= 1	Error (0 = no error; 1 = error)	
	4	= 0	Reserved	
	3	= 1	Error code (see table below)	
	2	= 0		
	1	= 1		
	0	= 0		
Byte 2			Channel diagnostics information	

Error codes bit 0 ... 3	Meaning
0	No fault
1	Timeout (module is not inserted in the slot)
2 ... 6	Internal bus error (communication problems between com unit and I/O module(s))
7 ... 8	Reserved
9	Incorrect module type (inserted and configured module types do not match)
10	Internal module error (e.g., lead breakage or short circuit)
11 ... 15	Reserved

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Note!

The following I/O modules have **no** channel diagnostics information. In these I/O modules, byte 2 = 0.

- LB1007
- LB1*09, FB1*09
- LB1014
- LB1015
- LB3*06
- LB4106
- LB7*04, FB7*04

Channel diagnostics information

LB1*01, FB1*01, LB1*02, FB1*02, LB1*08, FB1*08, LB2002, LB21*, FB22*, LB6005, FB6305, LB6006, FB6306, LB6*08, FB6*08, LB6*1*, FB621*

Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Digital data channel 1 (0/1)	Bit 0	Digital data channel 5 (0/1) (*2)
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 5 (0 = valid, 1 = invalid) (*2)
Bit 2	Digital data channel 2 (0/1)	Bit 2	Digital data channel 6 (0/1) (*2)
Bit 3	Status channel 2 (0 = valid, 1 = invalid)	Bit 3	Status channel 6 (0 = valid, 1 = invalid) (*2)
Bit 4	Digital data channel 3 (0/1) (*2)	Bit 4	Digital data channel 7 (0/1) (*2)
Bit 5	Status channel 3 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 7 (0 = valid, 1 = invalid) (*2)
Bit 6	Digital data channel 4 (0/1) (*2)	Bit 6	Digital data channel 8 (0/1) (*2)
Bit 7	Status channel 4 (0 = valid, 1 = invalid) (*2)	Bit 7	Status channel 8 (0 = valid, 1 = invalid) (*2)
(*1) Byte 4 only affects dual-width I/O modules that occupy 2 slots. (*2) This bit may only be reserved depending on the channel number of the I/O module.			

LB6101, FB6301

Byte 2	Meaning
Bit 0	Digital data channel 1 (0/1)
Bit 1	Digital data channel 2 (0/1)
Bit 2 ... 7	Reserved

LB1*03, FB1*03

Byte 2	Meaning
Bit 0	Counter status
Bit 1	Status (0 = valid, 1 = invalid)
Bit 2	Reserved
Bit 3	Direction detection
Bit 4 ... 7	Reserved

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LB3101, FB3201, LB3*02, FB3*02, LB3103, FB3203, LB3104, FB3204, LB3*05, FB3*05

Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Live zero/breakage limit undershot channel 1	Bit 0	Live zero/breakage limit undershot channel 3 (*2)
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Live zero/breakage limit undershot channel 2 (*2)	Bit 4	Live zero/breakage limit undershot channel 4(*2)
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only affects dual-width I/O modules that occupy 2 slots. (*2) This bit may only be reserved depending on the channel number of the I/O module.			

LB4101, FB4*01, LB4*02, FB4*02, LB4104, FB4204, LB4*05, FB4*05

Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Reserved	Bit 0	Reserved
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Reserved	Bit 4	Reserved
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only affects dual-width I/O modules that occupy 2 slots. (*2) This bit may only be reserved depending on the channel number of the I/O module.			

LB5*01, FB5201, LB5*02, FB5202, LB5*04, FB5204, LB5*05, FB5205, LB5*06, FB5206

Byte 2	Meaning	Byte 4(*1)	Meaning
Bit 0	Reserved	Bit 0	Reserved
Bit 1	Status channel 1 (0 = valid, 1 = invalid)	Bit 1	Status channel 3 (0 = valid, 1 = invalid) (*2)
Bit 2 ... 3	Reserved	Bit 2 ... 3	Reserved
Bit 4	Reserved	Bit 4	Reserved
Bit 5	Status channel 2 (0 = valid, 1 = invalid) (*2)	Bit 5	Status channel 4 (0 = valid, 1 = invalid) (*2)
Bit 6 ... 7	Reserved	Bit 6 ... 7	Reserved
(*1) Byte 4 only affects dual-width I/O modules that occupy 2 slots. (*2) This bit may only be reserved depending on the channel number of the I/O module.			

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7.4.3 Type Register

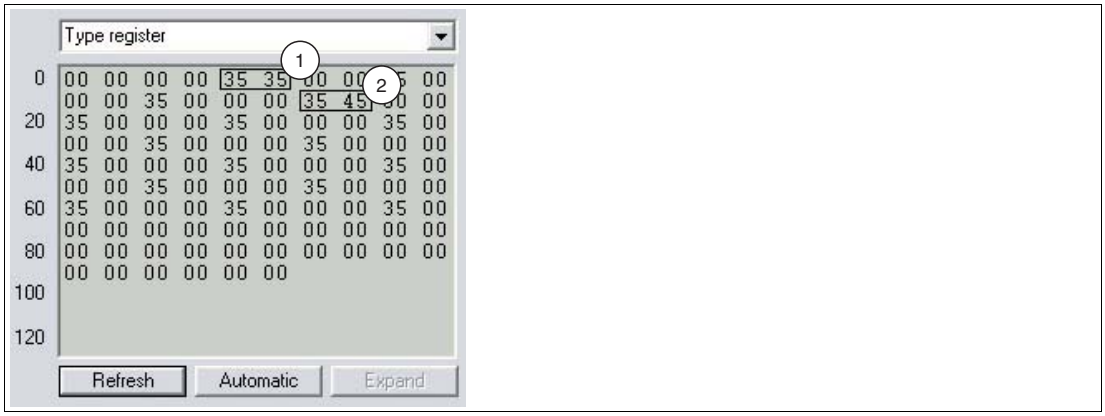

Figure 7.7 Type register

1 Slot 3

2 Slot 9

When you select the **Type register** entry from the drop-down list, an overview of the remote I/O station structure is displayed.

In the type register, two bytes are assigned to each slot. The first byte contains the identifier of the I/O module that is configured in the com unit. The second byte contains the identifier of the module that is actually plugged into the respective slot in the station. Check whether the planned I/O module configuration corresponds with the configuration of the inserted I/O modules by comparing the respective first and second bytes with one another.

The identifier consists of two hexadecimal characters. The first hexadecimal character corresponds to the first decimal number of the I/O module type designation. The second hexadecimal character corresponds to the last two decimal numbers of the I/O module type designation.

Example!

The identifier $2C_{hex}$ corresponds to I/O module LB2*12 or FB2*12. The first character 2_{hex} corresponds to the first number in the type designation **2***12. The second character C_{hex} corresponds to the last two numbers in the type designation 2***12**.

The identifier 35_{hex} corresponds to the I/O module LB3*05 or FB3*05.

In the illustration, you will see two areas marked. The first example shows the identifier 35 35 for slot 3, so the configured I/O module type corresponds with the I/O module that is actually plugged in.

In the second example, 35 45 shows a discrepancy between the configured I/O module (35) and the I/O module plugged in (45). Either replace the I/O module in the remote I/O station or adapt the configuration accordingly to ensure the system functions correctly.

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Identifiers for Module Types

Module type identifiers			
Digital I/O modules		**Analog I/O modules**	
11	LB1*01, FB1*01 digital input	13	LB1*03, FB1*03 frequency/counter input
12	LB1*02, FB1*02 digital input	31	LB3101, FB3201 transmitter power supply, current input
17	LB 1007 digital input	32	LB3*02, FB3*02 HART transmitter power supply, current input
18	LB1*08, FB1*08 digital input	33	LB3103, FB3203 HART transmitter power supply, current input
19	LB1*09, FB1*09 digital input	34	LB3104, FB3204 transmitter power supply, current input
1E	LB1014 digital input	35	LB3*05, FB3*05 HART transmitter power supply, current input
1F	LB1015 digital input	36	LB3*06 HART transmitter power supply
21	LB2*01, FB2*01 digital output with position feedback	41	LB4101, FB4*01 current output
...	...	42	LB4*02, FB4*02 HART current output
2D	LB2*13, FB2*13 digital output with position feedback	44	LB4104, FB4204 current output
61	LB6101, FB6301 relay contact output	45	LB4*05, FB4*05 HART current output
65	LB6005, FB6305 relay contact output	46	LB4106 HART current output
66	LB6006, FB6306 relay contact output	51	LB5*01, FB5201 RTD converter
68	LB6*08, FB6*08 digital output	52	LB5*02, FB5202 thermocouple converter
6A	LB6*10, FB6210 digital output	54	LB5*04, FB5204 RTD converter
...	...	55	LB5*05, FB5205 thermocouple converter
6F	LB6*15, FB6215 digital output	56	LB5*06, FB5206 voltage converter
Special modules			
74	LB7*04, FB7*04 universal input/output (HART)		
00	Empty slot		

7.4.4 Advanced Diagnostics

The **Advanced diagnostics** entry contains status and diagnostic information based on the version.

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7.5 "Module Status" Tab

Note!

The **Module status** tab is available from DTM version 7.3. The status of the power supplies in the **Power Supplies** area is displayed in DTM version 7.5 and higher, and depends on the com unit's firmware version.

The **Module Status** tab provides an overview of the status of the I/O modules and the power supplies in the overall Remote I/O station. Each of the fields in the status/simulation views represents a slot and therefore an I/O module or power supply on the Remote I/O station.

The status of the power supplies is only displayed if the firmware of the com unit has a power supply diagnostic function. The power supplies used must also support this diagnostic function.

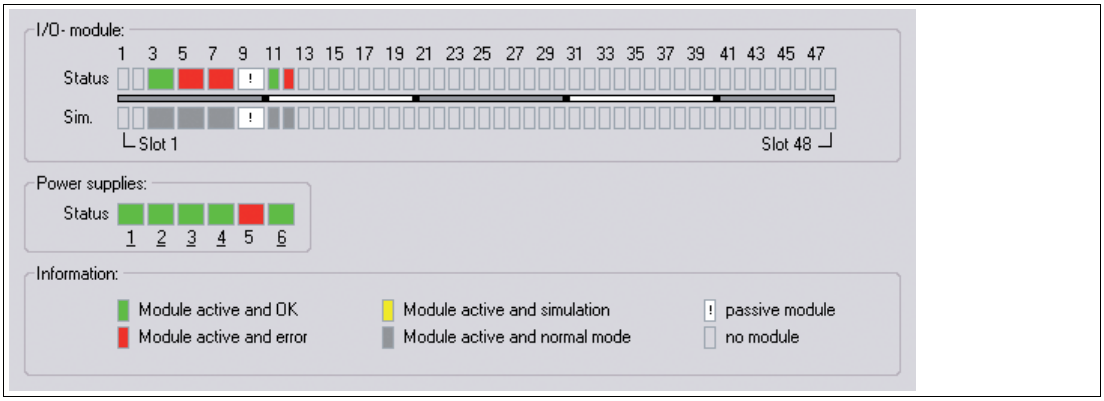

Figure 7.8 **Module status** tab

The status information is explained on the tab. The I/O module types (display of single/dual width module) and corresponding status areas are requested during each update cycle.

The status of the monitored power supplies is displayed in the **Power Supplies** area. An underlined power supply number indicates that a power supply is available at the relevant position. Power supply monitoring can be activated and deactivated in the com unit device data.

Accessing Information About an I/O Module

You have the option of viewing information about a specific I/O module directly on the **Module Status** tab. An active connection to the I/O module may be required, depending on the FDT base application.

1. Right-click on an I/O module in the overview.
2. Access the required information via the context menu.

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7.6 PACTware™ Device State Manager

Version 4 and above of PACTware™ includes the **Device State Manager** and **Device State View**. These add-ins enable a cross-device diagnosis based on the NAMUR recommendation NE 107.

Note!

The **Device State Manager** and **Device State View** add-ins may be deactivated. To activate add-ins, select **Extras** > **Add-ins** in the menu.

Note!

Detailed information on the add-ins described here can be found in the PACTware ™ documentation.

Open the Device State Manager window

1. In the project view, right-click on either **HOST PC**, a CommDTM or a com unit.
2. Select **Device State Manager** from the context menu.

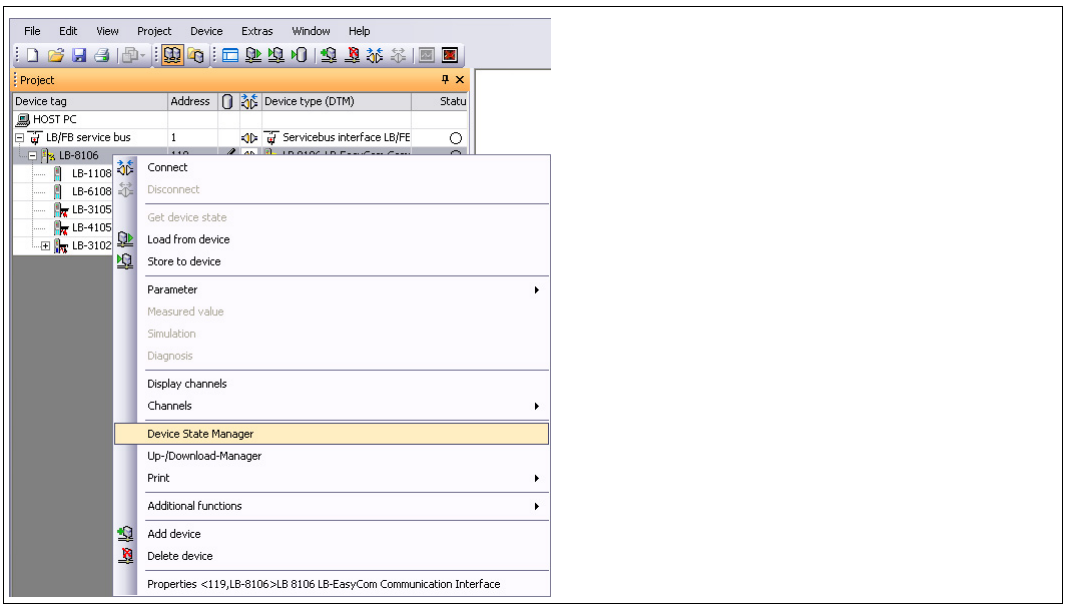

Figure 7.9 Activate Device State Manager

↳ The **Device State Manager** window appears.

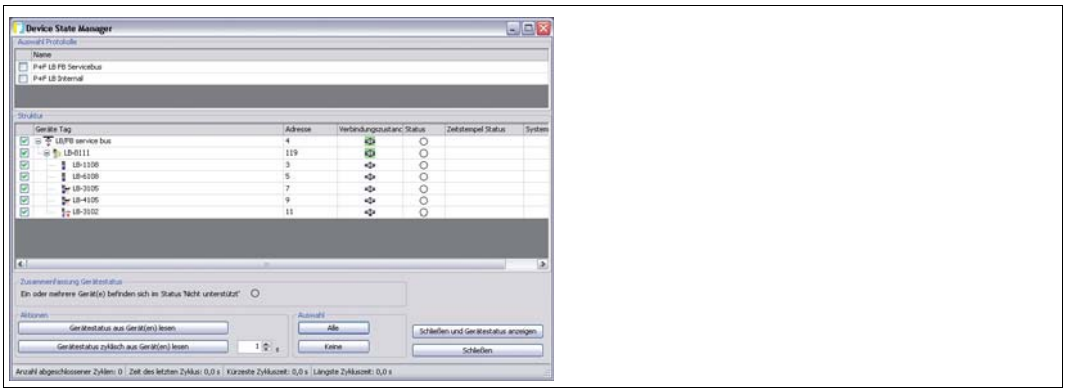

Figure 7.10 Device State Manager window

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3. Select the devices that are to be monitored. Use either the check boxes or the buttons in the **Select** area.
4. To read the device status once or at regular intervals, select one of the buttons in the **Actions** area.

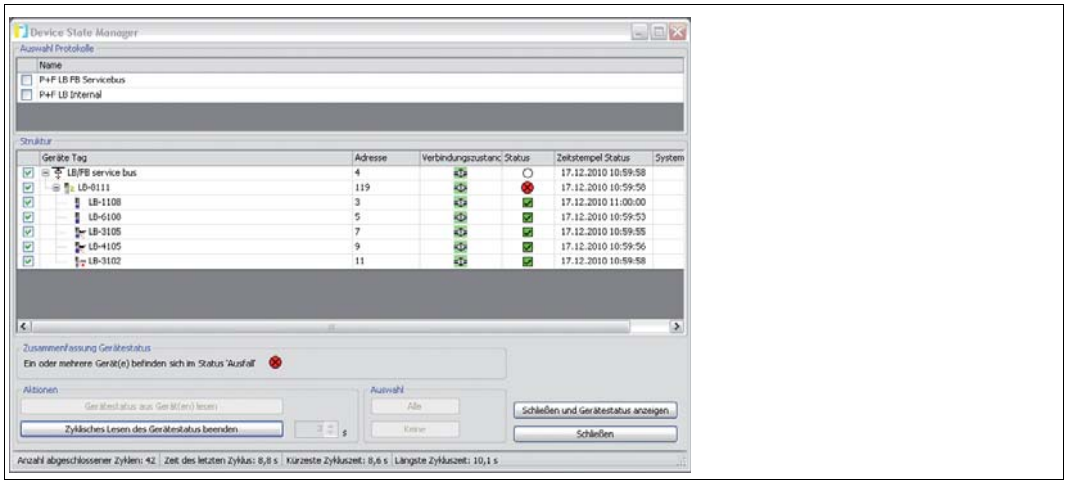

Figure 7.11 Read the device status

↳ A connection to the devices is established and the device status read.

5. Select **Close and Show Device Status**.

↳ The **Device Status** window is displayed. The **Device Status** window contains a list of available status reports. You can filter status reports according to certain criteria and save or delete the list.

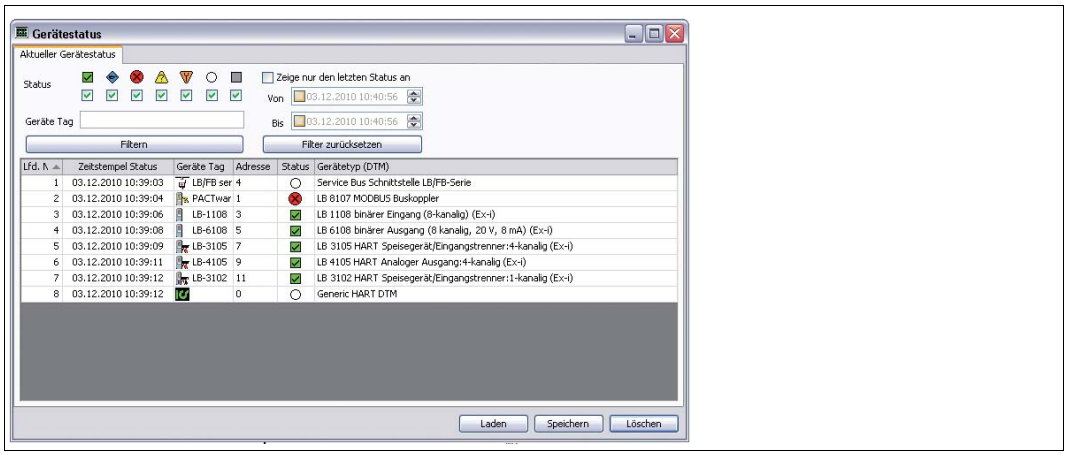

Figure 7.12 Device status window

Note!

Different views for status information

Alternatively, you can open the **Device Status** window via **View** > **Device Status**. The status symbols are displayed in the project view and the system view.

General meaning of the status symbols in accordance with NAMUR recommendation NE107

Symbol	Meaning
	Active diagnostics
	Passive diagnostics
	Failure
	Function check
	Out of specification
	Maintenance required
	Device status not supported

Specific meaning of the status symbols for remote I/O components

Component	Symbol	Possible meanings
I/O module		Error-free
		Diagnostics switched off (passive I/O module)
		Line fault detection (lead breakage or short circuit)
		I/O module missing
		Incorrect I/O module configured
		Simulation active
		–
		–
		Offline
Com unit		Error-free
		–
		Field bus communication: no field bus available (for diagnostics scan via service bus only)
		Memory error: PIC/RAM/FLASH
		CPU/PIC fault
		Parameter or arithmetic error
		Redundancy link not available (LB; fault in internal redundancy link)
		–
		Fieldbus communication: fieldbus available, but no data exchange (with PROFIBUS com units only)
		Command error
		Fault in an I/O module
		Fault in power supply
		Redundancy com unit not available
		Redundancy link not available (LB; fault in external redundancy link, possibly not connected)
		Offline

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8 Troubleshooting

Danger!

Risk of explosion

When work is performed on the remote I/O station in hazardous areas, there is a risk of explosion from spark formation.

Before embarking on any work on the remote I/O station, familiarize yourself with the operating instructions for the components and their certificates of compliance, and read the LB/FB hardware manual.

8.1 Communication Error

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

Error	Action(s)
Remote I/O station cannot be found in the configuration software via the service bus	■ Make sure that no other applications assigned to the selected port are active. This may be the case if you use the HART/SMART software of other manufacturers and this application was not closed before you started the configuration of the remote I/O station. ■ Check that the double-ended cordset 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 communication LEDs on the front of the com unit must flash when data is being exchanged via the service bus.
Communication error on the service bus	■ Check that the cables are connected. ■ In the configuration software, check that the selected address is the same as the remote I/O station address. ■ Check that the terminator has been activated. The service bus must have exactly 2 terminators per segment, one at the start and one at the end. ■ Check that the bus stations are positioned in linear form and without branches. A star-shaped layout is not permitted. ■ Check that the correct interface is preset in the configuration software.
Communication error on the service bus after successfully establishing a connection	■ Check that the service bus is galvanically isolated. ■ If you are using a laptop, operate the laptop using a battery. ■ Use a standard interface converter (RS232 to RS485 converter or USB to RS485 converter) with automatic detection of the baud rate and transmission direction.

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Error	Action(s)
Error when communicating with the process control system	■ Check that the cables are connected. ■ In the configuration software, check that the selected address is the same as the remote I/O station address. ■ Check that the terminator has been activated. The MODBUS must have exactly 2 terminators per segment, one at the beginning and one at the end. ■ Check that the bus stations are positioned in linear form and without branches. A star-shaped layout is not permitted. ■ Check that the correct GSD/GSE file is being used.
A new remote I/O station will not work on a bus if other remote I/O stations are already operating on the bus.	■ Check that the bus terminators are still on the beginning and end of the segment.
The software cannot locate a com unit when establishing the connection	■ Check that the yellow communication LEDs on the com unit are on while the connection is being established. ■ Check that the bus address is within the selected range. If necessary, increase the search range. ■ Check that the com unit is plugged in correctly. ■ Check that the com unit is already present.
Com unit cannot be configured.	■ Check the password. ■ Load the configuration to the PC. Select the menu item **Load from Device.**
Reading out the com unit results in an unexpected configuration	■ The required configuration was not saved in the com unit. Select the menu item **Store to Device** to save the configuration in the com unit.
Data loaded from the remote I/O station is not complete	■ Check that all data was first saved in the remote I/O station.
No HART communication	■ Check that the I/O module in use supports the HART protocol. ■ Ensure that the HART field devices are operating within the permitted operating range of 4 mA ... 20 mA. ■ Check that the correct HART device address was used. ■ Check that the HART software has a DTM for the field device being used. If this is not the case, only basic HART functions will be available.

Fault	Action(s)
FB extension unit not working.	■ Check that the wires on the base unit and extension unit are connected correctly. ■ On redundant systems, check that there is a connection between the extension unit and the redundancy unit.

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8.2 Redundancy Faults

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

Fault	Action(s)
Continuous redundancy switchover	■ Check that the switchover time was set to a long enough time in the com unit. ■ In FB systems, check that there is a front connection between the com units. ■ Check that both com units are configured for redundancy.
No redundancy switchover 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.

8.3 Faults Indicated by LEDs

Fault elimination is supported by a series of LEDs on the com unit, the I/O modules, and the power supply. If the LEDs indicate an error, work through the following checklist and take any relevant action.

Depending on the load, the output circuit may show a lead breakage due to overload. With solenoid valves, this can result in their input resistance being outside the lead breakage detection range. In such cases, connect a high value resistor in parallel to improve the function.

If short-circuit detection is triggered with booster valves, the charging capacitor may be the cause of the error. If this is the case, connecting a small resistor in series may correct this behavior. If necessary, deactivate line fault detection.

LEDs on com units	
Fault	Action(s)
Red LED (2) on com unit is on	Collective error: there is a problem with at least one component (I/O module, power supply, or com unit). ■ Check all slots for I/O modules with red LEDs on. All red LEDs must be turned off, otherwise the com unit will continue to report an error. ■ Make sure that all configured components are plugged in and ready for operation (green LED on). ■ Check the global status register in the com unit measured value display to determine the cause of the collective error message.
Yellow LED (5) on the com unit is flashing without the bus being connected	■ The com unit is ready for operation and working with the I/O modules.
Yellow LED (5) on the com unit is flashing at long intervals	■ The com unit is ready for operation and working with the I/O modules. At least one I/O module is in simulation mode.

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LEDs on com units	
Fault	Action(s)
Fieldbus	
Yellow LEDs (3, 6) on the com unit are showing no activity while communication is being established (LEDs = off)	■ Check that the physical connection between the configuration tool and the remote I/O station was established correctly.
Service bus	
Yellow LEDs (4, 7) on the com unit are flashing while communication is being established via 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 is on	■ 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	No communication between the I/O module and the com unit. ■ Check that the I/O module is plugged into the backplane properly. ■ Make sure that the connector pins are not bent. ■ Plug a different I/O module into this slot. If the new I/O module also does not work (red LED flashing), the fault may lie with the backplane.
Yellow LEDs on I/O modules are on	■ For digital inputs, the yellow LEDs provide various status indicators. ■ For transmitter power supplies, the yellow LED indicates that operation is outside the normal range.
Green LEDs on all I/O modules are off	■ Check that the power supply is connected to the backplane correctly. ■ Check that the power supply is working and is plugged into the backplane properly.

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LEDs on I/O modules and power supplies	
Fault	Action(s)
Green LED on one I/O module is off	■ Check that the I/O module is plugged into the backplane properly. ■ If necessary, replace the I/O module. ■ If the problem persists, 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 VDC voltage must not drop below 20 V including any ripple voltage. ■ The fuse may have blown. FB power supplies do not contain any replaceable fuses and must be replaced with a new FB power supply.

8.4 Signal Fault

Deactivated I/O Modules

Deactivated I/O modules are often used for subsequent extensions. Before deactivating the I/O module, switch off its line fault detection. This prevents the I/O module from triggering an alarm if the com unit launches a query to verify whether an I/O module is installed in that slot.

Fault	Action(s)
No signal change when the parameters are changed	■ Check that the I/O module is in operation. ■ Check that the change in the remote I/O station has been saved. ■ Download the parameterization to determine the current parameterization of the I/O module.
Faulty signal	■ Check if there is a short circuit or lead breakage within the circuit. ■ Check that the field devices and sensors are working properly. ■ If necessary, replace the I/O module. ■ Check the signal path to the I/O module.
All signals for a station are faulty	■ Check that the power supply is working properly. ■ Check the bus connection. ■ Check the bus communication. ■ Use a bus monitor.
Output module switches to substitute values	■ Check the settings for the watchdog on the com unit. The duration for the transition to substitute values must be longer than the duration of a bus cycle.

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Fault	Action(s)
The output module turns off	Communication with the com unit is interrupted. ■ Check that the I/O module is plugged into the backplane properly. ■ If necessary, switch off the status bits for analog outputs.
Input module delivers no measured values sporadically	Communication with the com unit is interrupted. ■ Check that the I/O module is plugged into the backplane properly.
I/O module works fine in a certain slot but not in another	■ Check that the connector is in good order on the faulty slot and that the I/O module pins are not bent. ■ If necessary, do not continue to use the slot.
Measured values occasionally incorrect	■ Check whether the measured value is being distorted by external influences. ■ Check that the shielding is intact.
Signal does not change	■ Check that simulation mode is activated for the channel (not for com units LB8*06 or FB8*06). ■ Check that the substitute value is active, because there is no bus communication. ■ Check if there is a line fault.
I/O module not issuing any diagnostic messages	■ Check that line fault detection is active. If not, activate line fault detection. ■ Check that the expected diagnostic information has been activated in the com unit.
No input/output data	■ Check that the correct I/O module is connected and ready for operation. ■ Check that the analog input/output scaling is compatible with the system requirements. ■ Check that the wiring is in order.
I/O module reported to be faulty	■ Check that the correct I/O module is plugged in. ■ Check that the green LED on the I/O module is lit and that the I/O module is correctly plugged in.
Module fault	■ Check that the green LED on the I/O module is lit. If not, there is no contact with the backplane or the fuse is faulty. If all the I/O modules in a segment have failed, the fault is in the power supply or the backplane. ■ Using the measured values display, check the I/O module diagnostic information.

Fault	Action(s)
6/8 LB modules fail simultaneously (backplanes LB9121, LB9101).	■ Check that the power supply to the segment is working correctly.

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.

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8.5 Faults and their effects

The table below shows what effect different faults will have.

Fault	Diagnostics	Effect
FB power supply failure (redundant)	■ The master receives an error message in the global status register, provided this facility has been preconfigured. ■ The master also receives a redundancy error message.	■ Redundancy switchover from primary to redundant com unit.
FB power supply failure (non-redundant)	■ The master receives 24 error messages in the global and module status register, provided this facility has been preconfigured. ■ The master receives 24 module-specific and channel-specific error messages if module diagnostics have been enabled.	■ 24 I/O modules are lost.

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Fault	Diagnostics	Effect
Power supply failed (redundant remote I/O station)	■ The master receives an error message in the global status register, provided this facility has been preconfigured (only with LB9022 and LB9024 backplanes).	■ Backplanes LB9022, LB9024, and LB9029: With 2 out of 3 redundancy when using 3 LB9006 power supplies, full functionality is retained even in the event of a power supply failure. ■ Backplanes LB9121 and LB9101: When using 2 LB9104 power supplies, 8 I/O modules fail as soon as a power supply fails. However, the com units continue to be supplied by the functioning power supply, so communication is maintained.
Power supply failed (non-redundant remote I/O station)	■ The master receives 8 error messages in the global and module status register, provided this facility has been preconfigured. ■ The master receives 8 module-specific and channel-specific error messages if module diagnostics have been enabled.	■ Backplanes LB9022, LB9024, and LB9029: Only two power supplies are generally used in non-redundant use. This means that in the event of a power supply failure, the whole station may be affected (depending on the number of I/O modules being used). ■ Backplanes LB9121 and LB9101: When using 2 LB9104 power supplies, 8 modules fail as soon as a power supply fails. However, the com unit continues to be supplied by the functioning power supply, so communication is maintained.

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Fault	Diagnostics	Effect
Bus communication failed	■ The master detects the failure.	■ The outputs adopt substitute values provided this facility has been preconfigured.
Com unit or voltage failed	■ The master detects a faulty slave.	■ The outputs have no voltage unless the system is redundant in design.
I/O module failed	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives the **Module error** message if module diagnostics have been activated.	■ No signal change. The inputs adopt substitute values provided this facility has been preconfigured. ■ The output has no voltage. ■ In most cases the green LED is off. There are cases, however, when the green LED is on despite an error.
Incorrect I/O module	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives the **Incorrect module** message if module diagnostics have been activated.	■ No signal change. The inputs adopt substitute values provided this facility has been preconfigured. ■ The output has no voltage. ■ The red LED in the dual width I/O module is flashing.
I/O module missing or has been removed	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives the **Missing module** message if module diagnostics have been activated.	■ The input is frozen. ■ The output has no voltage.

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Fault	Diagnostics	Effect
Module-specific errors		
Line fault in the input module	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives an **Invalid data** error message if module diagnostics have been activated.	■ The red LED is on. ■ No signal change. The inputs adopt substitute values provided this facility has been preconfigured. ■ Temperature inputs only return to normal operation once the error has been corrected and the LFD delay has lapsed.
Range overflow or underflow in I/O modules LB3101, FB3201, LB3*02, FB3*02, LB3103, FB3203, LB3104, FB3204, LB3*05, FB3*05	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives an **Invalid data** error message if module diagnostics have been activated.	■ The yellow LED is on. ■ The signal is limited to the predefined trip values.
Line fault in I/O modules LB2002, LB21*, FB22*, LB4101, FB4*01, LB4*02, FB4*02, LB6*08, FB6*08	■ The master receives an error message in the global and module status register, provided this facility has been preconfigured. ■ The master receives an **Invalid data** error message if module diagnostics have been activated.	■ The red LED is on. ■ The output has no voltage.

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