MOELLER

Hardware and Engineering

LE 4-504-BS1, Master
LE 4-504-BT1, Slave
Network LE for PROFIBUS-DP

Caution!

Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that the device cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.

- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause uncontrolled operation or restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.

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About This Manual

Contents

The network LEs LE 4-504-BS1 and LE 4-504-BT1 form the interface between compact PLC PS 4 and systems with PROFIBUS-DP. They conform to the international standard EN 50 170, vol. 2 Although some of the subjects covered by this manual are closely linked with the PS 4, only features specific to the network LE are covered here.

For further information regarding operation and testing/commissioning of the following PLCs, refer to the respective "Hardware and Engineering" manuals.

PS 4-201-MM1

PS 4-271-MM1

PS 4-341-MM1

Additional documentation

The PROFIBUS configurator is described in detail in the electronic manual AWB-EM 2700-1336 GB. This is a PDF file supplied with the configurator on the Sucosoft S 40 CD-ROM.

For detailed information about the Sucosoft S 40 Topology Configurator, refer to the manual "S 40 User Interface" (AWB 2700-1305 GB).

Symbols

This manual uses symbols which have the following meaning:

▶ Indicates actions to be taken

☞ | Indicates useful tips and additional information.

⚠ | **Attention!**
Warns of the possibility of damage to products, adjacent equipment or data.

⚠ | **Caution!**
Warns of the possibility of serious damage to products, adjacent equipment or data and risk of serious or fatal personal injury.

1 About the local expansion modules

General information

The network LEs LE 4-504-BS1 and LE 4-504-BT1 form the interface between the PS 4 compact PLC and the PROFIBUS-DP field bus. They conform to the international standard EN 50 170, vol. 2.

Purpose of the modules

LE 4-504-BS1

The LE 4-504-BS1 module provides the master function for the PROFIBUS-DP fieldbus. It manages and handles the exchange of data between the user program on the PS 4-300 and the connected slaves. A maximum of 124 slaves can be addressed. Without a repeater, this number is limited to 30.

This module also provides numerous diagnostic functions.

LE 4-504-BT1

The LE 4-504-BT1 module is required for interfacing expandable PS 4 PLCs with the PROFIBUS-DP field bus. It organizes and performs the exchange of data between the user program of an intelligent PS 4 slave controller with the PROFIBUS-DP line master.

Various network masters are available, such as the PS 416-NET-440 card and the LE 4-504-BS1 module from Moeller, as well as other manufacturer's products.

**Hardware and software
requirements**

The table provides an overview of the hardware and
software requirements for using local expansion
modules LE 4-504-BS1 and LE 4-504-BT1 with
compact PLCs.

	LE 4-504-BS1	**LE 4-504-BT1**
Sucosoft S 40	from version 4.0	
PLC	PS 4-341-MM1 with OS, version 2.0 (341_200.0SF)	
	–	PS 4-201-MM1
	–	PS 4-271-MM1
CFG-DP configuration software	from version 1.3	

The device configuration files (*.GSD) are included in
the CFG-DP configuration software.

If other manufacturers' devices are used, the
required files are available from Moeller's service
mailbox and website and from the PROFIBUS User
Organization (PNO):

Analog modem +49 228 6021414

ISDN   +49 228 6021881

http://www.moeller.net/automation

http://www.profibus.com

**Setup of the
LE 4-504-BS1**

Figure 1: LE 4-504-BS1 for PROFIBUS-DP

① Device designation HAEG 18 × 6.5

② LEDs
For detailed information about the function of each
LED, see chapter "Testing/Commissioning/
Diagnostics".

③ Plug-in screw terminal
For connection of the bus cables (see chapter
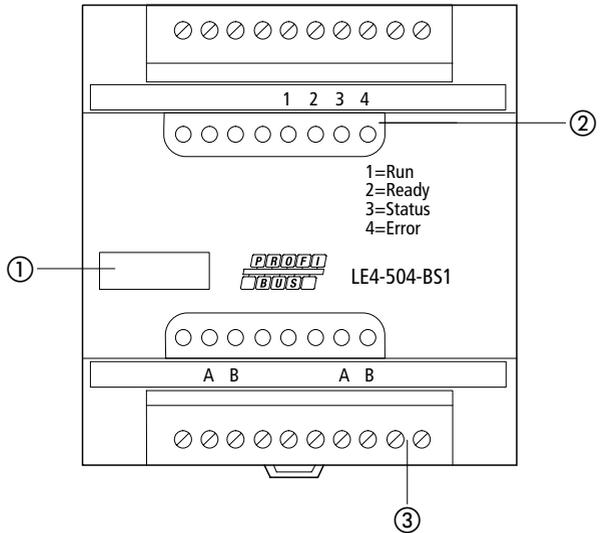"Engineering").

7

Setup of LE 4-504-BT1
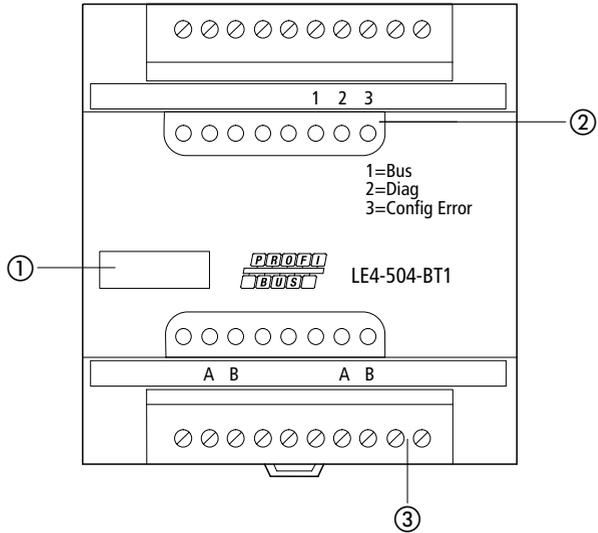
Figure 2: Setup of the LE 4-504-BT1

① Device designation HAEG 18 × 6.5

② LEDs
For detailed information about the function of each
LED, see chapter "Testing/Commissioning/
Diagnostics".

③ Plug-in screw terminal
For connection of the bus cables (see chapter
"Engineering").

2 Engineering

Electromagnetic compatibility (EMC)

The following engineering measures must be observed in order to meet the requirements of the EMC regulations and comply with the following European EMC standards:

EN 50 081-2 (Emission)
EN 50 082-2 (Immunity)

Other engineering instructions are given in the manual "EMC Guidelines for Automation Systems", AWB 27-1287-GB and the EMC manual "Electromagnetic Compatibility of Machines", TB 02-022 GB.

Bus and analog lines

Only screened cables must be used for bus and analog lines (see Page 11).

Attention!
Electromagnetic interference
Interference and line-conducted interference according to ENV 50 140 and ENV 50 141 can corrupt measurement readings by up to 20 %. A faulty connection of the module may produce interference in other components.

Terminating the bus and analog lines

▶ Pull back the screen at the ends of the bus and analog input cables.

▶ Isolate the screen with suitable material such as heat-shrink tubing.
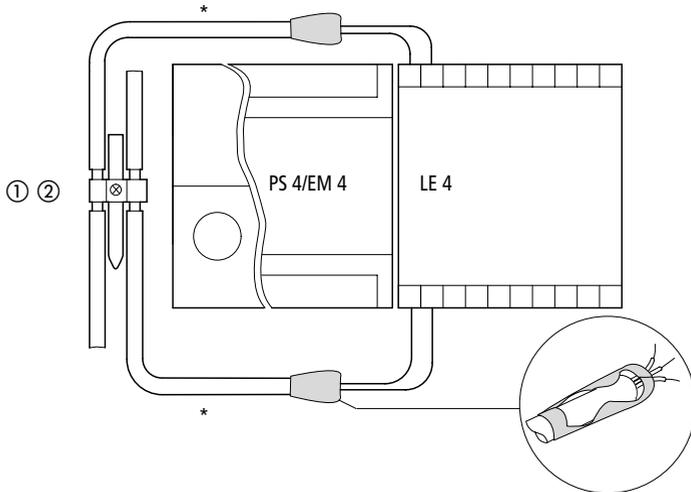
*   Schematic connection
① Installation with top-hat rail on mounting plate
② Mounting on mounting plate

Grounding the bus and analog lines

▶ Strip the cable sheathing near the contact clip.

▶ Place a contact clip around the insulated section of the bus and analog lines or press the stripped section into the snap-on mounting of the terminal clip.

▶ Make a low-impedance connection between the contact clip or terminal clip and the top-hat rail or mounting plate.

▶ Fit the top-hat rail to the mounting plate.

Attention!
Ensure that all connections are corrosion proof and that the paint is removed from the connection point of mounting plates.

▶ Ground the top-hat rail, ensuring a large contact area.

①

FM 4/TS 35
(Weidmüller)

M4

ZB 4-102-KS1

②

KLBü 3-8 SC
(Weidmüller)

ZB 4-102-KS1
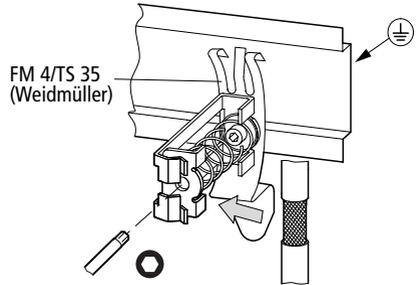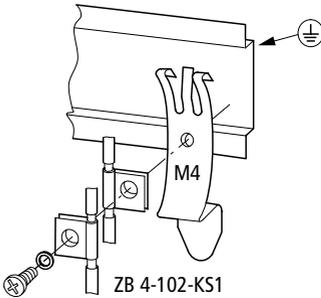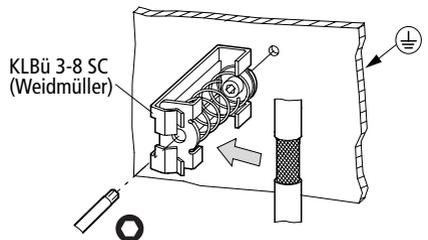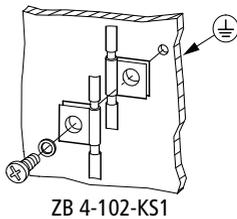
Connections

Legend for Figure 3:

1. Female connector for connection to the PS 4

2. Connection cross-sections:
flexible with ferrule 0.22 to 1.5 mm^2
(AWG 23 to AWG 16) solid 0.22 to 2.5 mm^2 (AWG 23 to AWG 13)

3. Plug-in screw terminal
A (green) = RxD/TxD-N receive/transmit data N
B (red) = RxD/TxD-P receive/transmit data P

4. Plug connector for connecting further LEs

5. Switch for bus terminating resistors S1 and S2

6. PROFIBUS-DP interface; alternative connection for bus lines via 9-pin Sub-D socket with connector ZB-9 4-209-DS3, carry out the following steps:

7. CFG interface (for LE 4-504-BS1 only);
connection for PC with CFG-DP configuration software via PS 416-ZBK-210 cable

8. Terminal strip cover, for use with alternative connection method
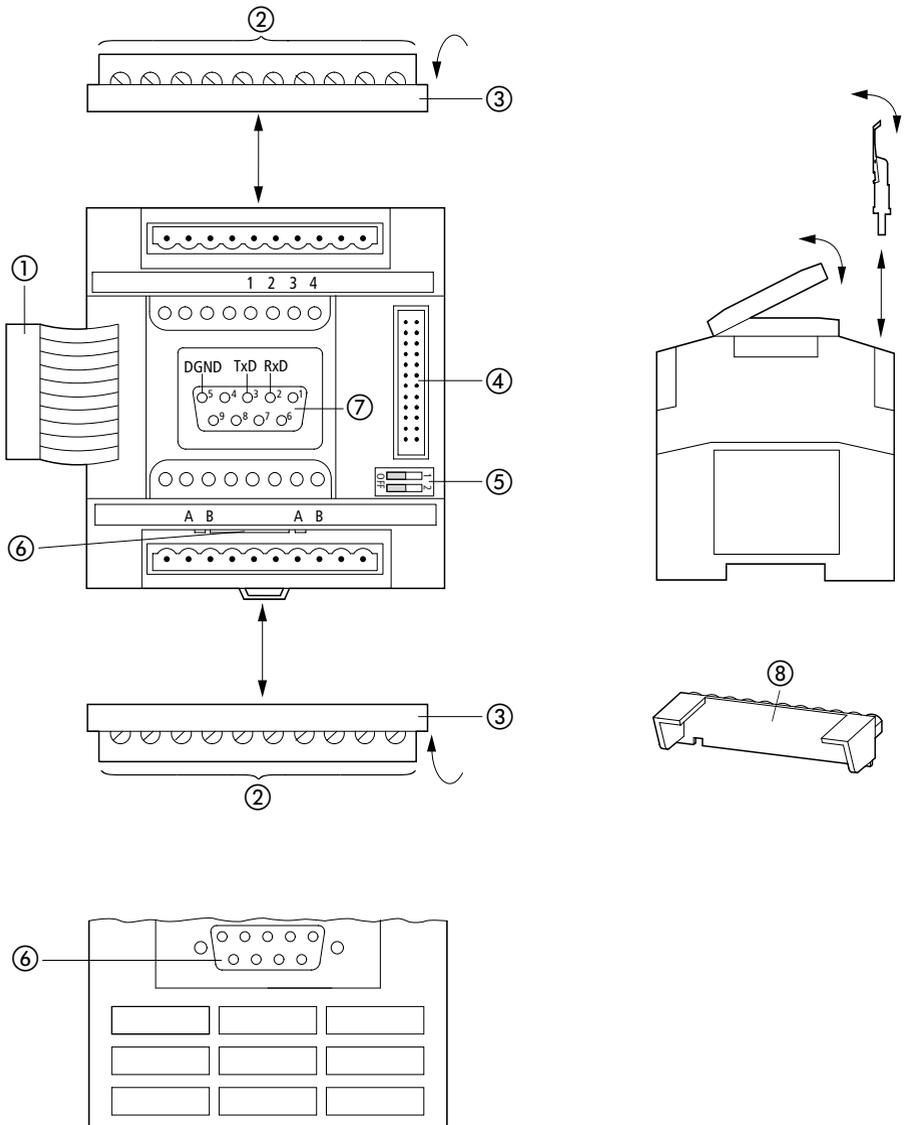
Figure 3: Connection overview

Connecting to the PS 4

The network LEs can be used only in connection with the expandable PS 4 series compact PLCs.

☞ Due to the current consumption of the PROFIBUS-DP LEs, there may be a limit to the expandability with LEs to prevent overloading the PS 4 compact PLC's power supply. The Sucosoft S 40 topology configurator automatically prevents inadmissible configurations.

Table 1: Using the PROFIBUS-DP module

	LE 4-504-BS1 (master)	LE 4-504-BT1 (slave)
PS 4-201-MM1	–	X
PS 4-271-MM1	–	X
PS 4-341-MM1	X (1 module)	X

☞ The PROFIBUS-DP master LE 4-504-BS1 can be used only in conjunction with a PS 4-341-MM1. It must be placed in the first position, immediately adjacent to the PLC.
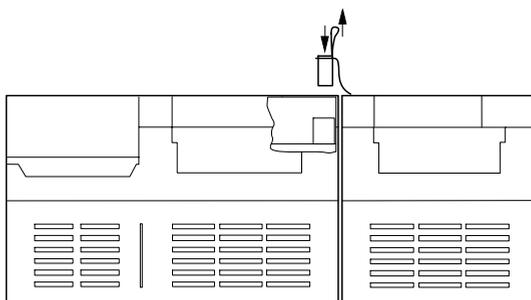
Figure 4: Connecting a locally expandable PS 4

Connection to the PROFIBUS-DP

The network LEs are equipped with an isolated RS 485 interface for connection to PROFIBUS-DP. The connections are made via the lower plug-in screw terminal – labelled A and B – or using the 9-pin Sub-D socket immediately behind the screw terminal.

☞ Use special PROFIBUS-DP plug ZB 4-209-DS3, which contains the circuitry required for interference-free operation up to transfer speeds of 12 Mbit/s. Connector ZB 4-209-DS3 must be ordered separately.

▶ Connect PROFIBUS-DP cable ZB 4-900-KB1 by attaching the green wire to screw terminal A and the red wire to screw terminal B.

▶ Fit a jumper between the two connection points of terminal A and between those of terminal B, so that the screw terminals can be removed without interrupting communications in the bus line.

▶ Establish the connection between screen and top-hat rail using mounting kit ZB 4-102-KS1 and snap-on mounting BT 432. These must be ordered separately.

If the PROFIBUS-DP line is to be connected to the Sub-D socket with connector ZB 4-209-DS3, carry out the following steps:

▶ Release the lower plug-in screw terminal and remove it.

▶ Cover the exposed terminal strip with the supplied cover.

Connection assignment

The PROFIBUS-DP interface is a 9-pin Sub-D female connector. It has the following pin assignment.
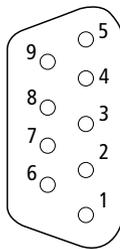
Pin	Designation	Meaning
3	RxD/TxD-P	Transmit/receive data line, positive
5	DGND	Data ground
6	VP	Supply voltage +5 V
8	RxD/TxD-N	Transmit/receive data line, negative

Connecting to the CFG interface

The network LE is connected to a PC with the CFG-DP configuration software via an RS-232C interface (COM). A female Sub-D connector is provided for this purpose on the front of the module. Programming cable PS 416-ZBX-210 can be used to make the connection. If no cable is connected, the front cover must be fitted to the connector during operation.

Connection assignment

The CFG interface is a 9-pin Sub-D female connector. It has the following pin assignment.
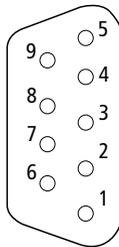
Pin	Designation	Meaning
2	RxD	Receive data
3	TxD	Transmit data
5	DGND	Data ground

Connecting a PC

To configure the module with the CFG-DP configuration software, connect the PC via the pre-assembled PS 416-ZBX-210 cable to the module.

The cable has a length of two metres. If this is not long enough, you can optionally use data connectors PS 416-ZBS-411 and PS 416-ZBS-410 to connect your own cable between the module and the PC's COM interface. The cable must be no longer than 15 m.

☞ Long cables can cause EMC problems in noisy environments.

3 Mounting

Modules LE 4-504-BS1 and LE 4-504-BT1 can be mounted on a top-hat rail or with fixing brackets.

☞ | Before you connect the network LE to the PS 4, the device must be clipped onto the top-hat rail or fitted to the mounting plate.

Mounting on a top-hat rail

▶ Hook the back of the device onto the top edge of the top-hat rail.

▶ Use a screwdriver to slide the spring-loaded clip ① out of the device ②.

▶ Push the device against the top-hat rail ③.

▶ Remove the screwdriver. The spring-loaded clip should snap back into position and hold the device securely.

▶ Check that the device is attached securely.
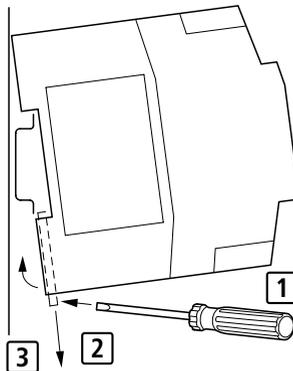
Figure 5: Mounting on top-hat rail

Mounting on fixing brackets

▶ Push the fixing brackets in until they engage ①.

▶ Check that the PLC is seated correctly. The locating pin must be located in the bore ②.

▶ Attach the fixing brackets on the mounting plate ③ with M 4 screws.

LE 4 -...

EM 4 -... / PS 4-...
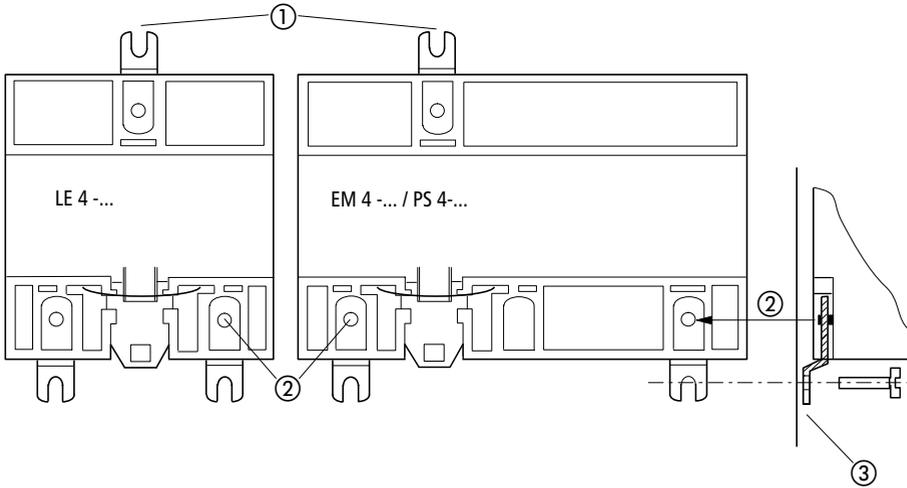
Figure 6: Mounting on fixing brackets

Installing in control cabinet

Observe the following requirements:

▶ Install the locally expandable PS 4 with your local expansion modules horizontally in the control cabinet.

Proceed as follows to prevent electromagnetic interference from impairing the function of the control electronics:

▶ Ensure a spacing between the cable duct ① and the local expansion modules of at least 50 mm (2 inches).

▶ Keep the control ③ and power sections ② apart.
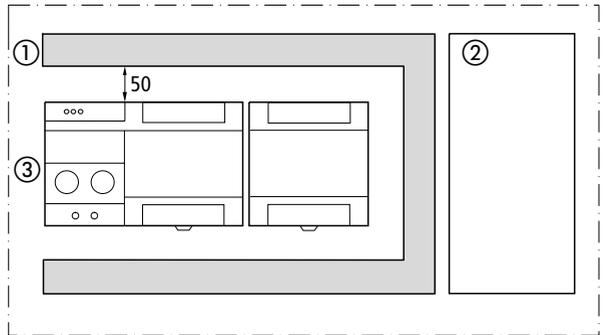
Figure 7: Horizontal arrangement of modules in the control cabinet

4 Hardware Configuration

Setting the bus terminating resistors

The bus terminating resistor prevents interference caused by reflection at the bus cable ends.

They must be switched on if the module is the first or last physical station on a PROFIBUS-DP line.

This can be done in one of two ways:

You can use the network LE's bus terminating resistors.

▶ Open the front panel of the network LE.
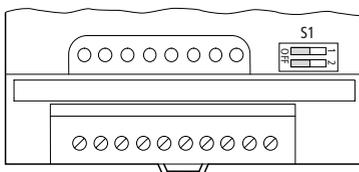
▶ Place DIP switch S1 to its ON position.
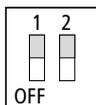
If you are connecting the PROFIBUS-DP line via the 9-pin Sub-D connector and connector ZB 4-209-DS3 with integrated bus terminating resistor:

▶ Set DIP switch S1 on the network LEs to OFF.

▶ Activate the bus terminating resistor on the connector.

5 Software Configuration

Network LEs are always used in conjunction with a locally expandable PS 4 compact PLC. As a rule, the network LE must be integrated into the PS 4 configuration.

CFG files

For configuring PROFIBUS-DP LEs LE 4-504-BS1 and LE 4-504-BT1, you will need the configuration and library files included in version 4.0 or higher of the Sucosoft S 40 software.

You can select the PROFIBUS-DP LEs from the Local Expansion list in the Sucosoft S 40 Topology Configurator.

GSD files

To incorporate the network LEs into PROFIBUS-DP communications, you will need the module master data in the form of the GSD files. These files, which are required for adjusting the communication parameters, can be incorporated into the configuration tools of any PROFIBUS-DP master, e.g. the Sucosoft S 40 CFG-DP software.

The GSD files are included in configurator CFG-DP. They are also available for download from the Moeller website at www.moeller.net (under "Automation User Support") or from the PROFIBUS User Organization (PNO) at www.profibus.com.

Configuring and setting parameters of LE 4-504-BS1

CFG Configurator

With the CFG-DP configuration software, you can configure and define the parameters for the master LE – LE 4-504-BS1 – which manages the PROFIBUS-DP line. The CFG-DP configuration software and its user manual, AWB-EM 2700-1336 GB, are included in the package content.

▶ Start the CFG-DP configurator.

▶ Select ‹File → New›.

▶ Select ‹Insert → Master or click on ⬚ and then the left side of the schematic network line.
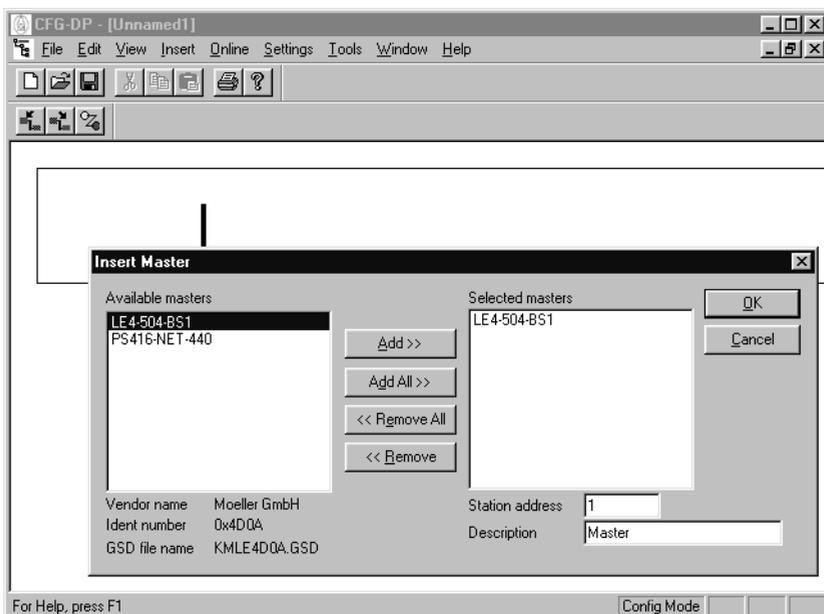
▶ In the left list, double-click on "LE 4-504-BS1"
and, under "Station address", assign a
PROFIBUS-DP address. Optionally, you can also
enter a descriptive name in the "Description"
field.

For each station (master, slave), the PROFIBUS-DP
address can be in the range 1 to 125.

▶ Confirm with "OK".

▶ One by one, select the slave stations in the
PROFIBUS-DP line. Where they are not already
predefined, specify their station address and the
send and receive data.

The LE 4-504-BT1 with "Station address 2" in the
example has 20 send and 20 receive data bytes.

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Attention!
The send and receive data (input and output data) can be stored in various modules. An example of this is the locally expandable EM 4-204-DX1 with its digital inputs. Here, the data can be physically located on different modules. In the example for the LE 4-504-BT1, these data storage areas are physically located on the same module, even though their virtual (software-defined) location is split over two modules. This must always be taken into account with the five-digit address notation when addressing the slave stations within Moeller PLC programs. For further information about addressing in the PLC program, see chapters "Operation" and "Testing/Commissioning/ Diagnostics".

▶ Having set the parameters for and configured all slave stations, save the PROFIBUS-DP configuration.

▶ Using the PS 416-ZBX-210 programming cable, connect your PC's serial port to the CFG interface of the LE 4-504-BS1. The interface is located behind the front cover.

▶ Select ‹Online → Download› to transfer the PROFIBUS-DP configuration to the master module.

For a detailed description of the download procedure, refer to the description of the CFG-DP configurator, which is included as an Acrobat (PDF) file on the Sucosoft S 40 CD-ROM and in the online help for the configurator.

Topology Configurator

The LE 4-504-BS1 master module can be configured
with the Sucosoft S 40 Topology Configurator.

▶ Create a new topology configuration with a
  PS 4-341-MM1.

▶ Select ‹Edit → Local Expansion›.

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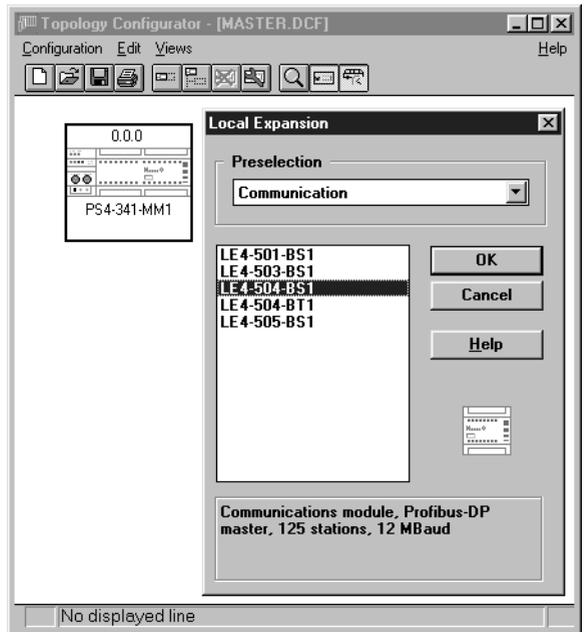
▶ Highlight the master LE in the list and confirm with "OK".
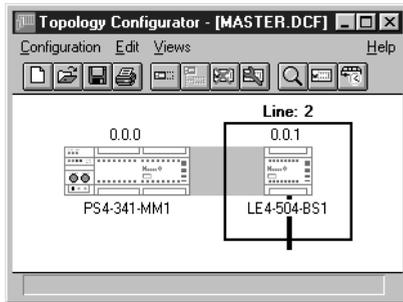
▶ Select ‹Edit → Set Parameters› and, in the dialog that now opens, assign the PROFIBUS-DP address for the LE 4-504-BS1.

▶ In the field "Profibus Configuration Created in CFG-DP", enter the path and name of the file created with the CFG-DP PROFIBUS-DP configurator or select the file with the button next to the field.

The reference to the PROFIBUS-DP configuration file is required for consistency checks by the Sucosoft user program.

☞ If a new or modified PROFIBUS-DP configuration is loaded onto the LE 4-504-BS1 with the CFG-DP, the user program of the PS 4-341-MM1 must be re-compiled with "Generate All" and resent to the PS 4-341-MM1.

▶ Complete and save the local and remote
PS 4-341-MM1 configurations.

**Configuring and setting
LE 4-504-BT1
parameters**

The LE 4-504-BT1 slave module can be configured
with the Sucosoft S 40 Topology Configurator.

▶ Create a new topology configuration with a locally
expandable PS 4-MM1 PLC.

▶ Select ‹Edit → Local Expansion›.
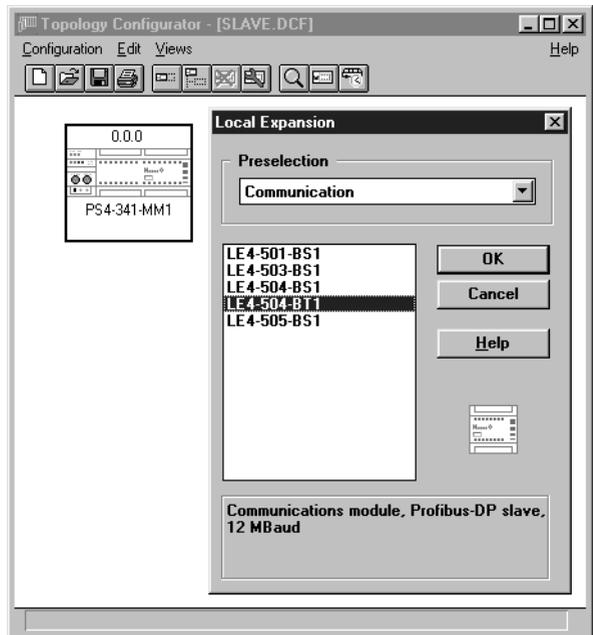
▶ Highlight the slave LE in the list and confirm with
"OK".

▶ Select ‹Edit → Set Parameters›

▶ Enter the slave address, to which the
LE 4-504-BT1 is to be assigned on the
PROFIBUS-DP line.

▶ Using the list boxes, select the number of send and receive data bytes for communication. The data bytes specified here must correspond with the data bytes configured for the respective line master for data exchange with the LE 4-504-BT1 (see example with LE 4-504-BS1 as master, below).
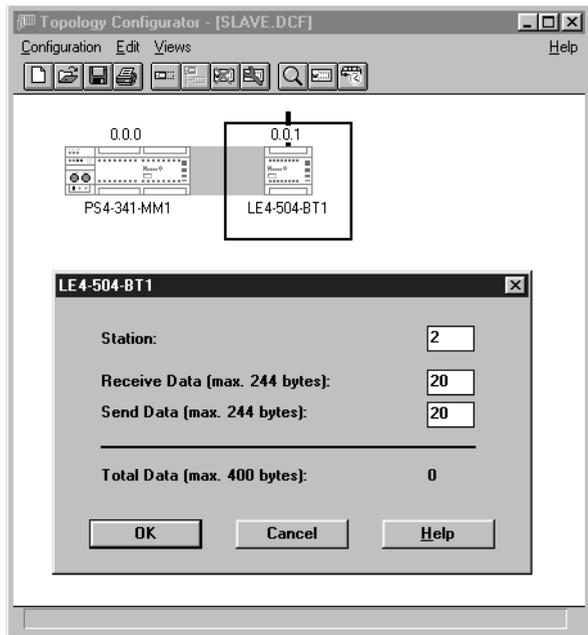
▶ Complete and save the local and remote PLC configurations.

▶ Start the CFG-DP configurator.

▶ With ‹File → Open›, open the configuration into which you want to insert the LE 4-504-BT1 as slave.

▶ Select ‹Insert → Slave› and click the right section of the schematic network line.

▶ In the left list, double-click the entry
"LE 4-504-BT1" and assign a PROFIBUS-DP
address under "Station address" and, optionally,
a representative name under "Description". For
each station (master, slave), the PROFIBUS-DP
address can be in the range 1 to 125.

▶ Confirm with "OK".
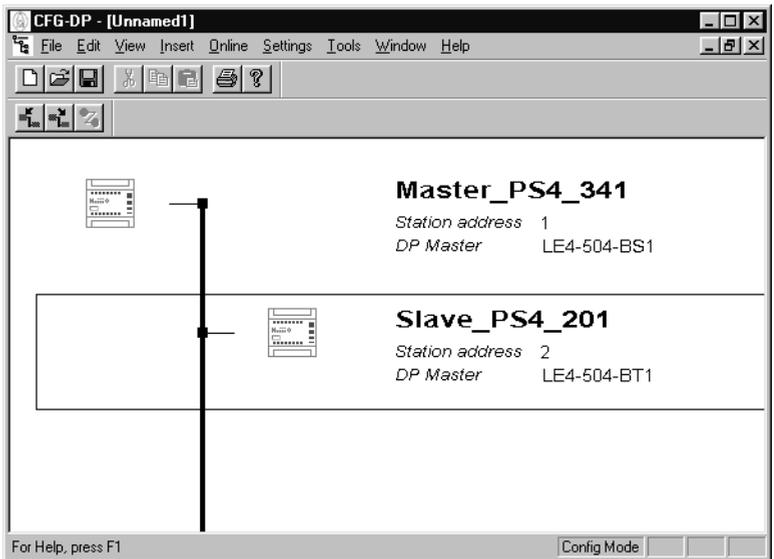
▶ Now specify the send and receive data lengths
for the LE 4-504-BT1.
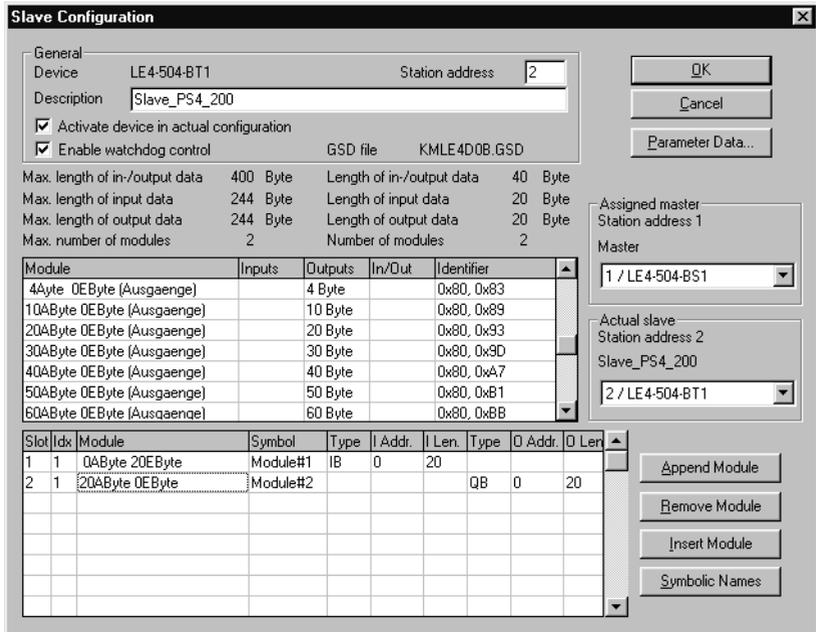
Slave Configuration dialog box

Slot	Idx	Module	Symbol	Type	I Addr.	I Len.	Type	O Addr.	O Len
1	1	0AByte 20EByte	Module#1	IB	0	20			
2	1	20AByte 0EByte	Module#2				QB	0	20

▶ Having set the parameters for and configured all slave stations, save the PROFIBUS-DP configuration.

6 Operation

Addressing the modules

PROFIBUS-DP modules

Moeller's 5-digit notation is used for reading and writing in the PROFIBUS-DP network line. A mirroring procedure is used to access the data. At the beginning of each program cycle, the input values are read from the dual-port RAM of LE 4-504-BS1 and LE 4-504-BT1, and at the end of the program cycle, the output values are written to the dual-port RAM of LE 4-504-BS1 and LE 4-504-BT1.

The I/O data can be accessed in bit, byte, word, or double word format.

The data is assigned to the user program variables when the variables are declared in the user program by Sucosoft S 40.

The address notation corresponds with the notation for Suconet K:

`<Line No.> . <Station No.> . <Module No.> . <Byte/Word/Double Word> . <Bit>`

Operand: I, Q (master); RD, SD (slave)
Data width: X, B, W, D

For addressing slave module LE 4-504-BT1, the first two places of the address – `<Line No.>` and `<Station No.>` are always "0". The third defines the slot in which the module is located (1 or 2).

The master declares the input and output data in packets as separate modules, even if the network station consists of only one physical module. The input and output data is addressed through different module numbers.

A user program may therefore have different numbers for input and output data in the third place of the five-digit address.

Example:
Slave LE 4-504-BT1 is connected to line 1 and has 20 input and 20 output bytes.

The output data from the slave is shown in the lower list box, labelled "Module#2", and will be read by master LE 4-504-BS1 via address operators %IB1.7.1.0 to %IB1.7.1.19.

The slave input data, labelled "Module#1", is supplied by master LE 4-504-BS1 with address operators %QB1.7.0.0 to %QB1.7.0.19.

☞ The address notation requires the listed module number – "Module#x" – to be reduced by "1" each time in the PROFIBUS-DP configurator.

The address notation is documented in detail in manual AWB 2700-1306 GB "Sucosoft S 40: Language Elements for PS 4-150/-200/-300 and PS 416", chapter 2, section "Directly represented variables".

PROFIBUS-DP stations

Master LE 4-504-BS1 manages the PROFIBUS-DP line. The line number is assigned automatically in the Sucosoft S 40 Topology Configurator.

In the Sucosoft S 40 Topology Configurator, enter the slave's station number, which is the same as the "Station address" in the CFG-DP configurator.

Moeller slave devices consisting of several modules (e.g. an EM 4-204-DX1 with local expansion modules), are addressed in the order in which they are connected. The EM 4 would then have the module number 0 and the connected LE 4s module numbers 1 to 6 in ascending order.

Other makes of PROFIBUS-DP station are addressed in accordance with the description in the associated device master data (*.GSD) files. Consult the device's documentation for address details.

☞ To address the input and output values of the PROFIBUS-DP stations, master LE 4-504-BS1 must use address ID %I or %Q, , with a corresponding data width definition (X, B, W or D). There are, for example, no special IDs for analog values (%IAW, %QAW), They are addressed via normal input or output addresses.

Example for LE 4-504-BS1:

```
VAR
    Analog_Input AT %IW2.3.1.0 : INT;
    (* Analog input word 0 of 1st LE of
    3rd station in 2nd line *)
    Limit_Value : INT := 800 ;
END_VAR

LD    Analog_Input
GT    Limit_Value
JMPC  Alarm
.
.
.
Alarm:
```

Example for LE 4-504-BT1:
```
VAR
    Set_Speed AT %SDW0.0.4.0:INT;
    (*Sends an integer value
    to the master's receive data field*)
    Default:INT:=800;
END_VAR

LD    Default
ST    Set_Speed
.
.
.
```

**Function of
LE 4-504-BS1**

After the PLC is powered up, LE 4-BS1 performs a
self-test. Any errors during the self-test are indicated
by the LEDs on the front-panel (see Page 44).

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7 Testing/Commissioning/Diagnostics

Commissioning the LE 4-504-BS1

Commissioning the LE 4-504-BS1 requires the following steps:

▶ With the CFG-DP configurator, transmit the created PROFIBUS-DP line configuration to the LE 4-504-BS1.

☞ | The exact procedure is described in the electronic documentation of the CFG-DP configurator, which is included as a PDF file on the Sucosoft S 40 CD-ROM.

▶ In the Sucosoft S 40 Topology Configurator, create the configuration for the PS 4-341-MM1 to which the LE 4-504-BS1 is connected. When the program code is generated, this configuration is linked with the PLC user program and then sent to the PS 4-341-MM1 with Sucosoft S 40.

☞ | The configuration of LE 4-504-BS1 is only accepted by the PS 4-341-MM1 operating system during the initial cold start of an application.

☞ | For fault correction or for a version update it may be necessary to load new firmware onto the LE 4-504-BS1. New firmware versions are announced in the Sucosoft S 40 Readme file, the mailbox support pages and on the Moeller website. The firmware download procedure is described in the electronic documentation for the CFG-DP configurator, which is included on the Sucosoft S 40 CD-ROM as a PDF file.

If the configuration of the PROFIBUS-DP network
line is modified or if the LE 4-504-BS1 is replaced,
then the configuration must be reloaded to the
PS 4-341-MM1.

During operation, diagnostic data from the
LE 4-504-BS1 and the network slave can be
evaluated either using diagnostic bytes or function
block "PdpStationDiag" in the PS 4-341-MM1 user
program (see function block "PdpStationDiag on
Page 56).

PROFIBUS-DP communication

The start of communications is dependent on the
operational status of the PS 4-341-MM1.

If the LE 4-504-BS1 is correctly entered in the
PS 4-341-MM1 topology configuration, data
communication on the PROFIBUS-DP line starts
when the status of the PS 4-341-MM1 changes from
"ready" to "run".

When an error occurs and the status of the
PS 4-341-MM1 changes from "run" to "ready" or
"not ready", data exchange in the PROFIBUS-DP line
stops, and the "run" LED on the LE 4-504-BS1
flashes at regular intervals.

**Commissioning the
LE 4-504-BT1**

Commissioning the LE 4-504-BT1 consists of the
following steps:

▶ In the Sucosoft S 40 Topology Configurator,
create the configuration for the slave CPU PS 4 to
which the LE 4-504-BT1 is connected.

When the program code is generated, this
configuration is linked with the PLC user program. It
must then be sent to the slave CPU PS 4 with
Sucosoft S 40.

Status indication in the operating phase

The status of the LE 4-504-BS1 and PROFIBUS-DP communications is indicated by four LEDs. The LE 4-504-BT1 has three LEDs for this purpose. They are located on the module's front panel.

☞ During error-free data exchange with all configured stations, all three LEDs of the LE 4-504-BS1 are lit. They are: "run", "ready" and "status".

LED	Colour	Status	Meaning
LE 4-504-BS1			
run	green	on	Communication with at least one station in progress
		cyclic flashing	Ready for communication
		acyclic flashing	Parameterization error
		off	Communication interrupted
ready	yellow	on	LE 4-504-BS1 ready
		cyclic flashing	Firmware must be transmitted or is being transmitted (1 Hz and 2 Hz)
		acyclic flashing	Hardware or firmware fault
		off	Hardware fault
status	yellow	on	LE 4-504-BS1 has the token and is currently active line master
error	red	on	Error during communication transfer
LE 4-504-BT1			
bus	yellow	on	User data exchange with the PROFIBUS-DP master
		flashing	No user data exchange. If the "config-error" LED also flashes, the actual and set configuration do not correspond.
		off	Startup phase
diag	red	on	A hardware fault has occurred in the device. The "config-error" LED is also lit.
		off	Hardware OK
config-error	red	on	Hardware fault in device. The "diag" LED is also lit.
		flashing	Actual configuration deviates from set configuration. The "bus" LED is also lit.
		off	Configuration OK

Overview of diagnostic bytes
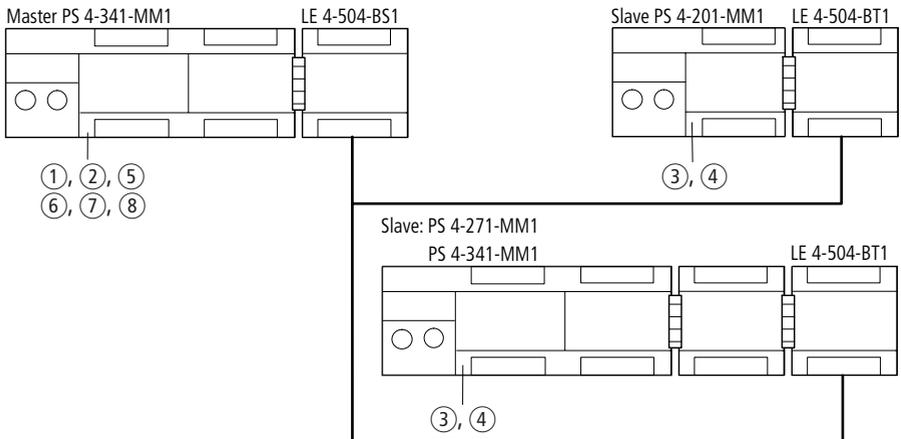
Error messages of master CPU:

① Data synchronization between PS 4-341-MM1 and LE 4-504-BS1

Diagnostic byte from master LE 4-504-BS1:

② Information about master LE 4-504-BS1; group information from slaves

Diagnostic byte from slave LE 4-504-BT1:

③ Byte0: information about status of slave LE 4-504-BT1; read by the slave CPU

④ Byte1: communication status of slave LE 4-504-BT1; read by the slave CPU

⑤ Extended byte1: information about slave CPU; master CPU reads operating status of slave CPU

⑥ Extended byte2: service information about slave CPU (e.g. state of backup battery)

⑦ General byte: indicator for extended diagnostic data from slave; read by the master CPU

Function block "PdpStationDiag":

⑧ Extended diagnostic message from slave; called by the master CPU

Diagnostic bytes indicate errors that have occurred during testing, commissioning or operation. Their physical location is

in master CPU PS 4-341-MM1 (①, ⑧)

in master LE 4-504-BS1 (②)

in slave LE 4-504-BT1 (③, ④, ⑤, ⑥, ⑦)

Diagnostic bytes are called, however, in the PLC's user program. The following bytes are used:

①, ②, ⑤, ⑥, ⑦, ⑧ in the user program of master CPU PS 4-341-MM1

③, ④ in the user program of slave CPU PS 4-201-MM1/-271-MM1/-341-MM1

CPU error messages   ① **Messages from operating system PS 4-341-MM1**

During operation of the PS 4-341-MM1 with the LE 4-504-BT1 module, errors may arise during transfer or cold start of the user program.

☞   If, during the cold start of a user program, an I/O error message appears, check the user program's I/O declarations in PROFIBUS-DP operation against the S 40 configuration and against the PROFIBUS-DP configuration.

The following error codes are possible:

82C0   Error when reading the PROFIBUS-DP
        configuration (message during cold start)

82C2   LE 4-504-BT1 has no PROFIBUS-DP
        configuration (message after transfer)

80FE   Error during parameter configuration of
        LE 4-504-BT1 (message after transfer or
        during cold start; internal error)

82C3   Not enough free memory available for
        PROFIBUS-DP configuration (message
        during cold start)

82C4   No station with the specified address exists
        in the PROFIBUS-DP configuration
        (message after cold start)

82C5   More than 24 modules have been
        configured for one station (message after
        cold start)

82C6   The operating system of the PS 4-341-MM1
        does not know the configuration of the
        PROFIBUS-DP line, because

            the module is not inserted;

            the assignment of line numbers to slot
            numbers in the topology configuration is
            not correct.

Diagnostic byte of master module

② **LE 4-504-BS1**

The LE 4-504-BS1 provides the user program with a diagnostic byte, which is addressed with the type "IS" input operator.

Because the LE 4-504-BS1 can only be connected directly adjacent to the PS 4-341-MM1, the diagnostic byte is declared as follows:

```
VAR
    Status_BS1 AT %ISB0.0.1.0 : BYTE ;
END_VAR
```

The meaning of the bits of the diagnostic byte is as follows:

Bit 0: no/unexpected type; is set when the slot contains no LE or an LE other than LE 4-504-BS1.

Bit 1: Reserved

Bit 2: Reserved

Bit 3: Group information; is set when a configured station does not report on the bus. ("error" LED of LE 4-504-BS1 is lit)

Bit 4: timeout; is set when LE 4-504-BS1 does not respond.

Bit 5: is set when the PLC doe not exchange data with any station in operating status "run".

Bit 6: is set, when the LE 4-504-BS1 does not have a valid configuration.

Bit 7: is set, when the LE 4-504-BS1 has not performed a self-test.

During error-free operation, all bits have the value "0".

Evaluation of the diagnostic byte in the user program must consist of either:

evaluating the individual bits using the special Moeller point notation

```
LD Status_BS1 (* Station on line is not reporting*)
```

or

checking the whole diagnostic byte for errors

```
LD    Status_BS1
NE    0
JMPC  Error
```

Slave module diagnostic bytes

LE 4-504-BT1

The LE 4-504-BT1 provides the user program with two diagnostic bytes, which are addressed with the type "IS" input operator.

If LE 4-504-BT1 is on slot 2 next to the expandable PS 4, the diagnostic bytes for the module are declared as follows:

```
VAR
    Status1_BT1 AT %ISB0.0.2.0 : BYTE ;
    Status2_BT1 AT %ISB0.0.2.1 : BYTE ;
END_VAR
```

③ **BYTE 0**

Bit 0: The module is either missing, defective or of an incorrect type (i.e. the connected module does not correspond with the topology configuration). The signal is cleared automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

Bit 1: If a hardware fault has occurred, replace the faulty module. The signal is cleared automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

Bit 2: If the input/output values are invalid, the module performs an internal parameter configuration shortly after power is restored or the program is transferred. During this time, the values that were read or written are invalid. Permissible values can be read or output as soon as the signal is cleared, which happens automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

Bit 3: In case of a timeout, the communication partner does not respond. This is either due to a faulty module or a fault in the PROFIBUS-DP line. Switch the system off and on again and observe the notes about cable routing in the manuals. which happens automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

④ **BYTE 1**

Bit 2: A configuration error indicates that the local configuration does not match the sent PROFIBUS-DP configuration of the master. Check the configured send and receive data lengths in the Sucosoft S 40 topology configuration and the PROFIBUS-DP configuration of the master. which happens automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

Bit 3: If "SYNC" is active, the station's receive data (the output data for the PROFIBUS-DP master) has been frozen with a "SYNC" command from the master. The message disappears automatically when an "UNSYNC" command is received.

Bit 4: If "FREEZE" is active, the module's send data (the input data for the PROFIBUS-DP master) has been frozen with a "FREEZE" command from the master. The message disappears automatically when an "UNFREEZE" command is received.

☞ For a description of the "PdpFreezeSync" function block, refer to manual AWB 2700-1306 "Language elements for PS 4-150/-200/-300 and PS 416".

Bit 6:   If no PROFIBUS-DP communication is taking place, the master of the PROFIBUS-DP line does not exchange user data with the station. Check:

the master's power supply

that the master is in the correct operating mode for communication

for an interrupted connection

that the PROFIBUS-DP address is correct

that the station has been configured in the PROFIBUS-DP configurator

that the data length in the PROFIBUS-DP configurator corresponds with the locally configured data lengths. If the configuration data is not the same, bit 2 – "config-error" – is set.

The signal is cleared automatically once the fault is rectified. A reset in the diagnostic status of the CPU is not necessary.

Module LE 4-504-BT1 provides extended, station-
specific information to the respective PROFIBUS-DP
master in the line. On PROFIBUS-DP masters
PS 416-NET-440 and LE 4-504-BS1 from Moeller,
this extended information is queried with the help of
function block "PdpStationDiag". For details about
querying extended diagnostic data with other
PROFIBUS-DP masters, refer to the manufacturer's
documentation.

The extended diagnostic information is stored in two
bytes, whose significance is also detailed in the GSD
file:

⑤ **First byte of the extended diagnosis**

Bit 0:   The PLC is in "Not Ready" state. PLC PS 4
         with module LE 4-504-BT1 has a fatal error
         or does not have an operating system
         (PS 4-341-MM1). Load an operating system
         or replace the CPU.

Bit 1:   The PLC is in "Halt" mode. PLC PS 4 has
         stopped.

Bit 2:   If the message "Diag" appears, one or more
         diagnostic messages are pending on PLC
         PS 4. In Sucosoft S 40, call up the diagnostic
         messages with "Test & Commissioning" and
         check the extended information in the
         second byte.

⑥ **Second byte of extended diagnosis
(message bits of host CPU)**

Bit 0:   If the message "DAK" appears, there is an
          error in the local configuration. The topology
          configuration for the PS 4 to which
          LE 4-504-BT1 is connected is not the same
          as the actual configuration. If no module is
          recognized as being connected, then either
          the module has not responded to addressing
          or a module that is not connected has been
          addressed.

Bit 1:   If the message "DDK" appears, there is an
          error in the remote configuration. The
          configuration of one or more network
          stations connected to the PS 4, is not
          correct, i.e. the entered type designation is
          not the same as that of the connected
          device.

Bit 2:   The message "DBM" – Battery Monitor –
          indicates, that the backup battery of the
          PS 4 is exhausted and must be replaced, or
          that no buffer battery is installed.

⑦ **Slave stations – general**

Each slave in the PROFIBUS-DP has a diagnostic
byte that can be addressed with the type "IS" input
operator by the user program of master CPU PS 416
or the network master LE 4-504-BS1. The line
number and station number are determined by the
configuration; the module number is always "0".

Example:

The diagnostic byte of the tenth station on network
line 2 is assigned by the variable declaration.

```
VAR
    Status_Slave AT %ISB 2.10.0.0 : BYTE ;
END_VAR
```

Bits 4 and 6 are required for diagnosis. They can be
declared and evaluated as Boolean variables.

```
VAR
    Bit4_Slave10 AT %IS2.10.0.0.4 : BOOL ;
    Bit6_Slave10 AT %IS2.10.0.0.6 : BOOL ;
END_VAR
```

In the former case, only those bits relevant to the
diagnostic byte must be filtered out before evaluation
(in the example these are bits 4 and 6):

```
LD    2#01010000
AND   Status_Slave
ST    Cleared
```

The meaning of the two relevant bits is as follows:

Bit 4:   Diagnostic bit.
         Extended diagnostic data for the station is
         available. This data can be read in the user
         program with function block
         "PdpStationDiag". This bit is reset to "0"
         after it is evaluated by the function block.

Bit 6:   Communication bit.
         This is set when there is a fault in the data
         exchange with the station, for example when
         the station is not connected or is incorrectly
         configured.

Function block   ⑧ **Extended diagnostic messages from slaves**
"PdpStationDiag"   **Requesting diagnostic data from**
                        PROFIBUS-DP station

```
                            ┌─────────────────────────────────────┐
                            │          PdpStationDiag             │
                            ├─────────────────────────────────────┤
                            │  Diagnostics          Diagnostics   │
ARRAY[1..100] OF BYTE ──────│                                     │
              BOOL ────────▷│ Strobe                    Active    │──── BOOL
             USINT ─────────│ MasterSlot                State1    │──── BYTE
             USINT ─────────│ StationAddress            State2    │──── BYTE
                            │                           State3    │──── BYTE
                            │                    MasterAddress    │──── USINT
                            │                           Ident     │──── UINT
                            │                           Error     │──── UINT
                            └─────────────────────────────────────┘
```
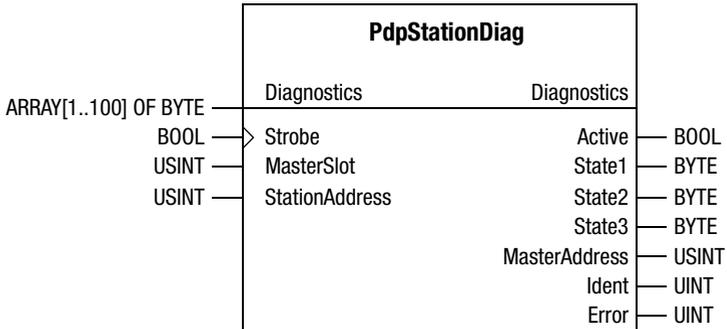
Function block prototype

Meaning of operands

Name	Meaning
Diagnostics	Transfers a field of 100 bytes. The station's extended diagnostic data is stored here
Strobe	Enables the function block; the diagnostic job is initiated
MasterSlot	Specifies the slot number of module LE 4-504-BS1, i.e. "1".
StationAddress	Address of the PROFIBUS-DP slave whose diagnostic data is to be read
Active	Display of job processing status 1: job accepted; 1 to 0: job finished
State 1	Standard diagnostic byte 1 of PROFIBUS-DP
State 2	Standard diagnostic byte 2 of PROFIBUS-DP
State 3	Standard diagnostic byte 3 of PROFIBUS-DP
MasterAddress	Provides address of master module to which addressed slave is assigned
Ident	Provides specific ID of PROFIBUS-DP station
Error	Error messages

Description

☞ Function block "PdpStationDiag" must be
instantiated only once for each LE 4-504-BS1 in
the user program.

Function block "PdpStationDiag" can be used to
scan the standard and extended diagnostic data (if
available) of the PROFIBUS-DP slave. The scan is
performed with a rising edge at input Strobe of the
function block. The address parameters
(StationAddress, MasterAddress, MasterSlot, Ident)
are used to define the slave whose diagnostic data is
to be read.

If output Active is "1", the job was accepted after an
input value validity check. As long as this output
stays "1", the status of input Strobe is ignored. If
output Active changes from "1" to "0" and output
Error is "0", then the job was processed successfully.

If, however, output Error has a value other than "0",
an error has occurred. The error can be identified by
means of the value at output Error.

The value of output Error has the following meaning:

0   No error

1   Defective function block;
     defective function block library

2   Diagnostic data cannot be requested

3   Error when receiving diagnostic data

4   Invalid slot number
     Permissible range: 1 to 19; function block also
     used for PS 416

5   Invalid station number
     Permissible range: 1 to 125

7   No module defined in topology configuration
     for specified slot

8   A module other than LE 4-504-BS1 is
specified for the slot in the topology
configuration.

9   LE 4-504-BS1 is not ready for operation

10   The PROFIBUS-DP configuration does not
contain the specified station

11   No diagnostic data is available for the
specified station.

Parameter "Diagnostics" specifies a 100-element
array of the Byte type. The extended diagnostic data
of the addressed slave is entered here.

If the job is carried out successfully, then
PS 4-504-BS1 always returns 100 bytes, irrespective
of the actual length of the diagnostic data.

☞   Make sure the array you send at input/output
Diagnostics is 100 bytes long!

Extended diagnostics/device-specific										Standard slave diagnostics					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

State 1
State 2
State 3
MasterAddress
Ident
Diagnostics
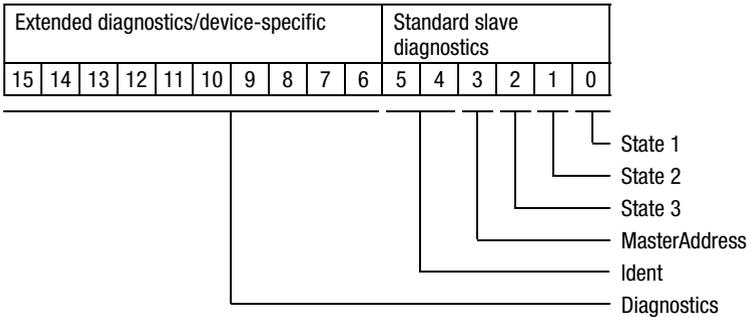
When the job is completed successfully, the function
block returns three diagnostic bytes from the
PROFIBUS-DP

State1

Bit 0: No response from station

Bit 1: Station not ready for data transfer

Bit 2: Station parameters incorrectly configured

Bit 3: Station-specific diagnostic data is available

Bit 4: Station has detected an unknown command.

Bit 5: Implausible response from station

Bit 6: Incorrect configuration (e.g. ID number)

Bit 7: Station parameters were configured by another master

State2

Bit 0: Station parameters not configured

Bit 1: Static diagnosis

Bit 2: Permanently set to 1

Bit 3: Response monitoring active

Bit 4: Freeze command active

Bit 5: Sync command active

Bit 6: Reserved

Bit 7: PROFIBUS-DP configuration does not contain the specified station

State3

Bit 0 to bit 6: reserved

Bit 7: Extended station diagnostic data longer than 100 bytes

**Function block
example**

The example is for a PS 4-341-MM1 with an
LE 4-504-BS1 in slot 1, which manages the
PROFIBUS-DP line with two slave stations:

one CM 4-504-GS1 (gateway)

one EM 4-204-DX1 with local expansion modules

The two slave stations are added and their
parameters set in the PROFIBUS-DP configurator
CFG-DP. For details about operating the CFG-DP
configurator, refer to the electronic manual
AWB-EM 2700-1336 GB (PDF file for Acrobat
Reader), which is included on the Sucosoft S 40
CD-ROM.
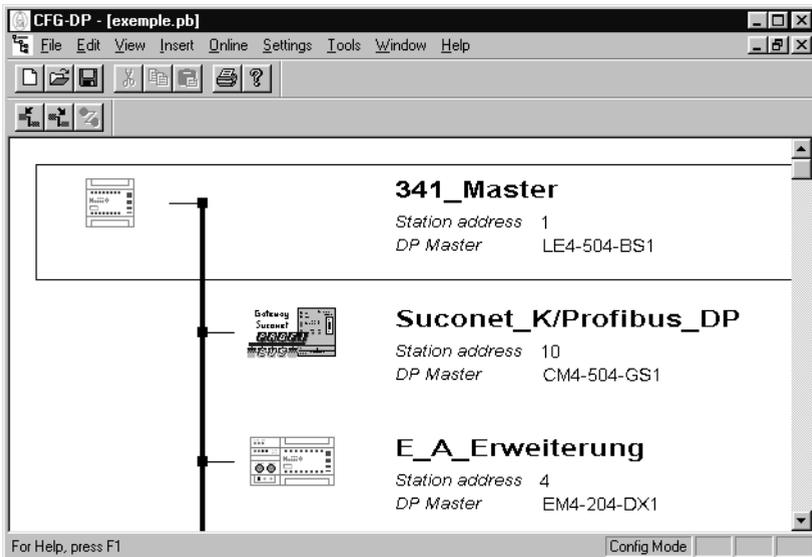
To set the parameters of slave CM 4-504-GS1 with station address 10, 16 bytes will be transferred in each direction in this example.

Slave Configuration		✕

General
Device   CM4-504-GS1   Station address   10

Description   Suconet_K/Profibus_DP

☑ Activate device in actual configuration

☑ Enable watchdog control   GSD file   KMCM4D01.GSD

Max. length of in-/output data	240	Byte	Length of in-/output data	32 Byte
Max. length of input data	120	Byte	Length of input data	16 Byte
Max. length of output data	120	Byte	Length of output data	16 Byte
Max. number of modules	1		Number of modules	1

Buttons: OK, Cancel, Parameter Data...

Assigned master
Station address 1
341_Master
1 / LE4-504-BS1

Actual slave
Station address 10
Suconet_K/Profibus_DP
10 / CM4-504-GS1

Module	Inputs	Outputs	In/Out	Identifier
7AByte 6EByte (K1-Master)	6 Byte	7 Byte		0xC0, 0x86, 0x85
10AByte 10EByte (symetrisch)	10 Byte	10 Byte		0xC0, 0x89, 0x89
16AByte 16EByte (Default: 16B)	16 Byte	16 Byte		0xC0, 0x8F, 0x8F
24AByte 24EByte (symetrisch)	24 Byte	24 Byte		0xC0, 0x97, 0x97
30AByte 30EByte (symetrisch)	30 Byte	30 Byte		0xC0, 0x9D, 0x9D
40AByte 40EByte (symetrisch)	40 Byte	40 Byte		0xC0, 0xA7, 0xA7
50AByte 50EByte (symetrisch)	50 Byte	50 Byte		0xC0, 0xB1, 0xB1

Slot	Idx	Module	Symbol	Type	I Addr.	I Len.	Type	O. Addr.	O Len
1	1	16AByte 16EByte (Default:	Module#1	IB	0	16	QB	0	16

Buttons: Append Module, Remove Module, Insert Module, Symbolic Names

In the example, EM 4-204-DX1 with station address 4 has a total of six local expansions, including an LE 4-206-AA1 analog module in the first position.

Slave Configuration

General
Device   EM4-204-DX1   Station address   4
Description   E_A_Erweiterung

☑ Activate device in actual configuration
☑ Enable watchdog control   GSD file   KM__4D00.GSD

Max. length of in-/output data	42 Byte	Length of in-/output data	22 Byte
Max. length of input data	26 Byte	Length of input data	13 Byte
Max. length of output data	16 Byte	Length of output data	9 Byte
Max. number of modules	7	Number of modules	7

Buttons: OK, Cancel, Parameter Data...

Assigned master
Station address 1
341_Master
1 / LE4-504-BS1

Actual slave
Station address 4
E_A_Erweiterung
4 / EM4-204-DX1

Module	Inputs	Outputs	In/Out	Identifier
EM4-204-DX1 16DE	2 Byte			0x11
LE4-116-DX1 16DE	2 Byte			0x11
LE4-308-HX1 8DE	1 Byte			0x10
LE4-104-XP1 8DA		1 Byte		0x20
LE4-308-XH1 8DA		1 Byte		0x20
LE4-108-XR1 8DA		1 Byte		0x20
LE4-108-XD1 8DA		1 Byte		0x20

Slot	Idx	Module	Symbol	Type	I Addr.	I Len.	Type	O Addr.	O Len
1	1	EM4-204-DX1 16DE	Module#1	IB	16	2			
2	1	LE4-206-AA1 4AEW 2AAW	Module#2	IW	18	4	QW	16	2
3	1	LE4-116-XD1 16DA	Module#3				QB	20	2
4	1	LE4-116-XD1 16DA	Module#4				QB	22	2
5	1	LE4-116-DX1 16DE	Module#5	IB	26	2			
6	1	LE4-308-HX1 8DE	Module#6	IB	28	1			
7	1	LE4-308-XH1 8DA	Module#7				QB	24	1

Buttons: Append Module, Remove Module, Insert Module, Symbolic Names

This configuration is stored and sent to network module LE 4-504-BS1.

The topology configuration is then created in the Sucosoft S 40 Topology Configurator. The procedure for topology configuration is described in manual AWB 2700-1305 GB "Sucosoft S 40, User Interface"
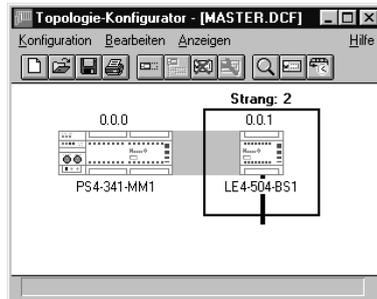
▶ Select ‹Edit → Set Parameters› and, in the dialog that now opens, assign the PROFIBUS-DP address for the LE 4-504-BS1.

▶ In the field "Profibus Configuration Created in CFG-DP", enter the path and name of the file created with the CFG-DP PROFIBUS-DP configurator or select the file with the button next to the field.

The reference to the PROFIBUS-DP configuration file is required for consistency checks by the Sucosoft user program.

☞ | If a new or modified PROFIBUS-DP configuration is loaded onto the LE 4-504-BS1 with the CFG-DP, the user program of the PS 4-341-MM1 must be re-compiled with "Generate All" and resent to the PS 4-341-MM1.

The sample program below uses the topology configuration created with Sucosoft S 40 to generate an executable program for the PS 4-341-MM1, which is then transferred to this PLC.

Beside an error analysis, you should implement the following program sequences when working with the function block.

The functions of the individual program sections are listed below and are indicated by a corresponding comment at the beginning of each section:

Registering all set diagnostic bits

Calling the function block for all registered diagnostic bits

Entering the diagnostic data in a station-specific buffer

Enabling the function block for a restart

Evaluating the diagnostic data

The master card always contains only the last diagnostic message of a station. The diagnostic bit remains set until the diagnostic data is fetched by a function block call.

If diagnostic messages occur frequently and from several stations at the same time, you should assign priority to the function block call. This ensures that all diagnostic data from the most important stations are fetched.

The following example suggests a solution for the function block whenever two stations send a diagnosis at the same time. The solution guarantees that each diagnostic message will be evaluated, even if one of the stations continually sets the diagnostic bit.

Program DP_Diagnostics

```
VAR

(* Status, DP line; master in slot 1*)
   DP_Status_line_1       AT %ISB0.0.1.0:      BYTE;

(* DP---Line 2---Station 4---Module 0---EM4-204-DX1--- *)
(* Status byte, station 4 *)
   Status_EM_4_204_ADR_4  AT %ISB2.4.0.0:      BYTE;

   em4204DX1_Modul0_IB0   AT %IB2.4.0.0 :      BYTE;
   em4204DX1_Modul0_IB1   AT %IB2.4.0.1 :      BYTE;

   le4206AA1_Modul1_IW0   AT %IW2.4.1.0 :      UINT;
   le4206AA1_Modul1_IW2   AT %IW2.4.1.2 :      UINT;
   le4206AA1_Modul1_IW4   AT %IW2.4.1.4 :      UINT;
   le4206AA1_Modul1_IW6   AT %IW2.4.1.6 :      UINT;

   le4206AA1_Modul1_QW0   AT %QW2.4.1.0 :      UINT;
   le4206AA1_Modul1_QW2   AT %QW2.4.1.2 :      UINT;

   le4116XD1_Modul2_QB0   AT %QB2.4.2.0 :      BYTE;
   le4116XD1_Modul2_QB1   AT %QB1.4.2.1 :      BYTE;

   le4116XD1_Modul3_QB0   AT %QB2.4.3.0 :      BYTE;
   le4116XD1_Modul3_QB1   AT %QB2.4.3.1 :      BYTE;

   le4116DX1_Modul4_IB0   AT %IB2.4.4.0 :      BYTE;
   le4116DX1_Modul4_IB1   AT %IB2.4.4.1 :      BYTE;

   le4308HX1_Modul5_IB0   AT %IB2.4.5.0 :      BYTE;

   le4308XH1_Modul6_QB0   AT %QB2.4.6.0 :      BYTE;

(* DP---Line 2------Station 10--- GateWay--CM4-504-GS1--------- *)
(* Status byte, station 10 *)
   Status_GateWay_ADR_10  AT %ISB2.10.0.0:     BYTE;

   cm4504_IB0             AT %IB2.10.0.0 :     BYTE;
   (* max. 16 bytes: 0 - 15 *)
   cm4504_IB15            AT %IB2.10.0.15:     BYTE;

   cm4504_QB0             AT %QB2.10.0.0 :     BYTE;
   (* max. 16 bytes: 0 - 15 *)
   cm4504_QB15            AT %QB2.10.0.15:     BYTE;
```

```
(******************************************************************)
(*      Diagnosis of all line stations  *)
(********************************************************************)

   FB_DP_Diag           :          PDPSTATIONDIAG;
   Strobe               :          BOOL;

   FB_DP_Diag_F_Edge    :          F_TRIG;

   DP_Diag              :          ARRAY[1..100] OF BYTE;
   DP_Address           :          USINT;
   DP_MASTERSLOT        :          USINT;

   GateWay_ADR_10_Diag  :          ARRAY[1..100] OF BYTE;
   Buffer_Adr4          :          ARRAY[1..13] OF BYTE;
   Buffer_Adr10         :          ARRAY[1..6] OF BYTE;

   ADR4_Diag_Flag       :          BOOL;
   ADR10_Diag_Flag      :          BOOL;
   DiagCounter          :          USINT;

   TestDiagBit_ADR4     :          FB_DiagBitCounter;
   TestDiagBit_ADR10    :          FB_DiagBitCounter;

END_VAR

LD    DP_Status_Line_2(* Status byte DP *)
             (* Evaluate DP line status byte*)
(*...*)
                                (* Status byte for DP station      *)
LD    Status_EM_4_204_ADR_4.6    (* Communication bit for station 4 *)
LD    Status_GateWay_ADR_10.6    (* Communication bit for station 10 *)

             (* Evaluate communication bit      *)
(*...*)

(** Begin ****************** Diagnostics Evaluation ******************************)

(*****************************************************************************************)
(*                      Register all set diagnostic bits                            *)
(*****************************************************************************************)

                        (* Diagnostic bit counter Addr.4 *)
CAL TestDiagBit_ADR4(
                  enable :=1,
                  InBit :=Status_EM_4_204_ADR_4.4
                  |
                  :=SetDiagBitCounter)
          (* Diagnostic bit counter Addr.10 *)
```

```
CAL TestDiagBit_ADR10(
                  enable :=1,
                  InBit :=Status_GateWay_ADR_10.4
                  |
                  :=SetDiagBitCounter)
         (* Diagnostic detected then set diagnostic flags *)
   LD     FB_DP_Diag.Active
   EQ     1
   JMPC   _DiagCall        (* Diagnostic request still active *)

   LD     DiagCounter      (* Counter of detected diagnostic events *)
   EQ     0                (* All diagnostics requests have been sent*)
   JMPC   _ADR4            (* Entry of new diagnostic flags possible *)

   JMP    _DiagSelect      (* Continue processing diagnostic flags *)

   _ADR4:                  (* Set diagnostic flag if ADR 4 reports diagnostic*)
   LD     Status_EM_4_204_ADR_4.4
   JMPCN  _ADR10

   LD     DiagCounter
   ADD    1
   ST     DiagCounter      (* Increment diagnostic counter *)

   LD     1
   ST     ADR4_Diag_Flag   (* Set diagnostic flag for addr. 4*)

   _ADR10:                 (* (* Set diagnostic flag if ADR 10 reports diagnostic**)
   LD     Status_GateWay_ADR_10.4
   JMPCN  _ADRx

   LD     DiagCounter
   ADD    1
   ST     DiagCounter

   LD     1
   ST     ADR10_Diag_Flag  (* (* Set diagnostic flag for Addr. 10 **)

   _ADRx:
   (*...*)
```

```
(*******************************************************************************)
(*                    Function block call for all registered diagnostic bits*)
(*******************************************************************************)

_DiagSelect:          (* Process set diagnostic flags *)

  LD      ADR4_Diag_Flag
  JMPC    _prepareDiag_ADR4
  LD      ADR10_Diag_Flag
  JMPC    _prepareDiag_ADR10
  JMP     _DiagCall        (* No diagnostic bit set *)

_prepareDiag_ADR4:    (* Enter parameters for diagnostics function block *)

  LD      Status_EM_4_204_ADR_4.4
  ST      FB_DP_Diag.Strobe
  LD      4
  ST      DP_Address
  LD      1
  ST      DP_MASTERSLOT
  LD      0
  ST      ADR4_Diag_Flag

  JMP     _DiagCounter

_prepareDiag_ADR10:

  LD      Status_GateWay_ADR_10.4
  ST      FB_DP_Diag.Strobe
  LD      10
  ST      DP_Address
  LD      1
  ST      DP_MASTERSLOT
  LD      0
  ST      ADR10_Diag_Flag

  JMP     _DiagCounter

_DiagCounter:(* Decrement diagnostic counter  *)

  LD      DiagCounter
  SUB     1
  ST      DiagCounter
```

```
(********************************************************************************)
(*                          Function block call                         *)
(********************************************************************************)

_DiagCall:

CAL FB_DP_Diag(
          STROBE :=,
          MASTERSLOT :=DP_MASTERSLOT,
          STATIONADDRESS :=DP_Address,
          DIAGNOSE :=DP_Diag
          |
          :=ACTIVE,
          :=STATE1,
          :=STATE2,
          :=STATE3,
          :=MASTERADDRESS,
          :=IDENT,
          :=ERROR)

(* Evaluate falling edge of Active output *)
CAL FB_DP_Diag_F_Edge(
                  CLK :=FB_DP_Diag.Active
                  |
                  :=Q)

  LD      FB_DP_Diag_F_Edge.Q
  JMPCN   _DiagEnd
          (* Falling edge detected *)
  LD      FB_DP_Diag.Error        (* FB error detection *)
  EQ      0
  JMPC    _NoError                (* error-free *)
(*...*)
  JMP     _DiagStrobe0

_NoError:
          (* Enter diagnostic data in station diagnostics buffer *)
  LD      DP_Address
  EQ      4
  JMPC    _DiagData_ADR4

  LD      DP_Address
  EQ      10
  JMPC    _DiagData_ADR10

  JMP     _DiagStrobe0
```

```
(**********************************************************************************)
(*            Enter diagnostic data in station-specific buffer*)
(**********************************************************************************)

_DiagData_ADR4:
          (* Check master address and IdentNo. *)
  LD      FB_DP_Diag.Masteraddress
  LD      FB_DP_Diag.Ident
(*...*)
          (* Enter diagnostic data in buffer *)
  LD      FB_DP_Diag.STATE1
  ST    Buffer_Adr4[1]
  LD      FB_DP_Diag.STATE2
  ST      Buffer_Adr4[2]
  LD      FB_DP_Diag.STATE3
  ST      Buffer_Adr4[3]

  LD      DP_Diag[1]
  ST      Buffer_Adr4[4]
  LD      DP_Diag[2]
  ST      Buffer_Adr4[5]
  LD      DP_Diag[3]
  ST      Buffer_Adr4[6]

  LD      DP_Diag[4]
  ST      Buffer_Adr4[7]
  LD      DP_Diag[5]
  ST      Buffer_Adr4[8]
  LD      DP_Diag[6]
  ST      Buffer_Adr4[9]
  LD      DP_Diag[7]
  ST      Buffer_Adr4[10]
  LD      DP_Diag[8]
  ST      Buffer_Adr4[11]
  LD      DP_Diag[9]
  ST      Buffer_Adr4[12]

  LD      TestDiagBit_ADR4.SetDiagBitCounter
  ST      Buffer_Adr4[13]

  JMP     _DiagStrobe0
```

```
_DiagData_ADR10:
          (* Check master address and IdentNo. *)
  LD      FB_DP_Diag.Masteraddress
  LD    FB_DP_Diag.Ident
(*...*)
          (* Enter diagnostic data in buffer *)
  LD      FB_DP_Diag.STATE1
  ST      Buffer_Adr10[1]
  LD      FB_DP_Diag.STATE2
  ST      Buffer_Adr10[2]
  LD      FB_DP_Diag.STATE3
  ST      Buffer_Adr10[3]

  LD      DP_Diag[1]
  ST      Buffer_Adr10[4]
  LD      DP_Diag[2]
  ST      Buffer_Adr10[5]

  LD      TestDiagBit_ADR10.SetDiagBitCounter
  ST      Buffer_Adr10[6]

  JMP     _DiagStrobe0

(*************************************************************************)
(*                Enable function block for a restart          *)
(*************************************************************************)

_DiagStrobe0:        (* Output Strobe 0 after falling edge *)

CAL FB_DP_Diag(
          STROBE :=0,
          MASTERSLOT :=,
          STATIONADDRESS :=,
          DIAGNOSE :=DP_Diag)

_DiagEnd:

(*************************************************************************)
(*              Evaluate diagnostic data                *)
(*************************************************************************)
(*...*)

(** End ****************** Evaluate diagnostic data ******************************)
```

```
(********************************************************************************)
(*                    I-O Addressing of DP Stations         *)
(********************************************************************************)

LD          16#FF
ST          le4116XD1_Modul2_QB1
(*...*)

_END:
END_PROGRAM

FUNCTION_BLOCK FB_DiagBitCounter
VAR_OUTPUT
    SetDiagBitCounter:BYTE;
END_VAR
VAR_INPUT
    enable    :        BOOL;
    InBit     :        BOOL;
END_VAR
VAR
    Set_Edge  :        R_TRIG;
END_VAR
    LD          enable
    JMPCN       _End

(* Evaluate if bit was set *)
CAL Set_Edge(
        CLK :=InBit
        |
        :=Q)

  LD          Set_Edge.Q
  EQ          1
  JMPC        _SetBit

  JMP         _End

(* Count occurrence of DiagBit *)
_SetBit:

  LD          SetDiagBitCounter
  BYTE_TO_USINT
  ADD         1
  USINT_TO_BYTE
  ST          SetDiagBitCounter

_End:
END_FUNCTION_BLOCK
```

Appendix

Technical Data

Current consumption	max. 0.8 A (LE 4-504-BS1) max. 0.5 A (LE 4-504-BT1)
Ambient temperature	(0 to 55) °C
Storage temperature	(–20 to 70) °C
Isolation voltage	850 V DC
Vibration resistance	1 g/(0...150) Hz
Shock resistance	15 g/11 ms
Degree of protection	IP 20
Weight	300 g
Connection type	Plug-in screw terminal, 9pole Sub-D
Connection cross-sections for screw terminal	flexible with ferrule 0.22 to 1.5 mm^2 (AWG 23 to AWG 16) solid 0.22 to 2.5 mm^2 (AWG 23 to 13)
EMC	see Page 76
Interface	PROFIBUS-DP (EN 50 170, Vol. 2)
Station type	Master (Class 1) (LE 4-504-BS1) LE 4-504-BT1 (slave)
Electrical standard	RS 485
Isolation	Yes
Baud rate detection	automatic

Baud rate [kBit/s]	Cable lengths[m]
9.6	1200
19.2	1200
93.75	1200
187.5	1000
500	400
1500	200
3000	100
6000	100
12000	100

Accessories	
Cable	ZB 4-900-KB1; specifically for PROFIBUS-DP
Connector	ZB 4-209-DS2; special PROFIBUS-DP up to 12 Mbit/s with switchable bus terminating resistors

General EMC specifications for automation equipment

Emission	EN 55 011/22 Class A		

Interference immunity

ESD	EN 61 000-4-2	Contact discharge Air discharge	4 kV 8 kV
RFI	EN 61 000-4-3	AM/PM	10 V/m
Burst	EN 61 000-4-4	Mains/digital I/O Analog I/O, fieldbus	2 kV 1 kV
Surge	EN 61 000-4-5	Digital I/O, asymmetrical Mains DC, asymmetrical Mains DC, symmetrical Mains AC, asymmetrical Mains AC, symmetrical	0.5 kV 1 kV 0.5 kV 2 kV 1 kV
Immunity to line-conducted interference	EN 61 000-4-6	AM	10 V

Dimensions
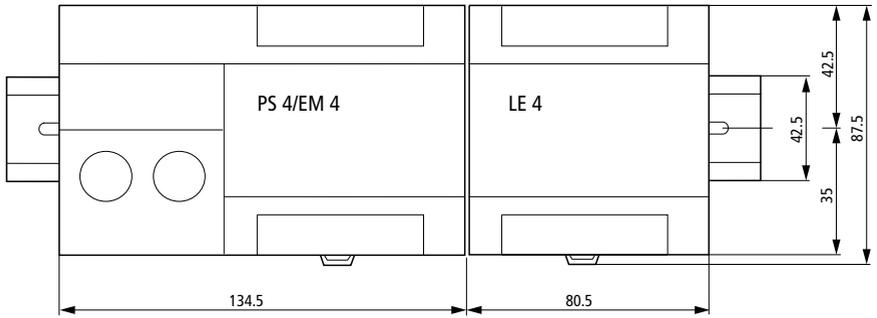
Figure 8: PS 4-200 with LE 4 on top-hat rail
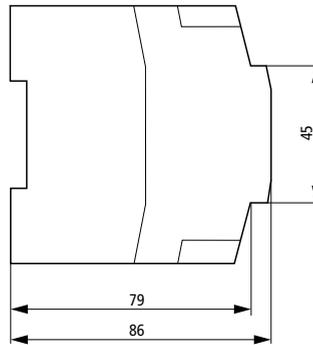
Figure 9: PS 4, LE 4
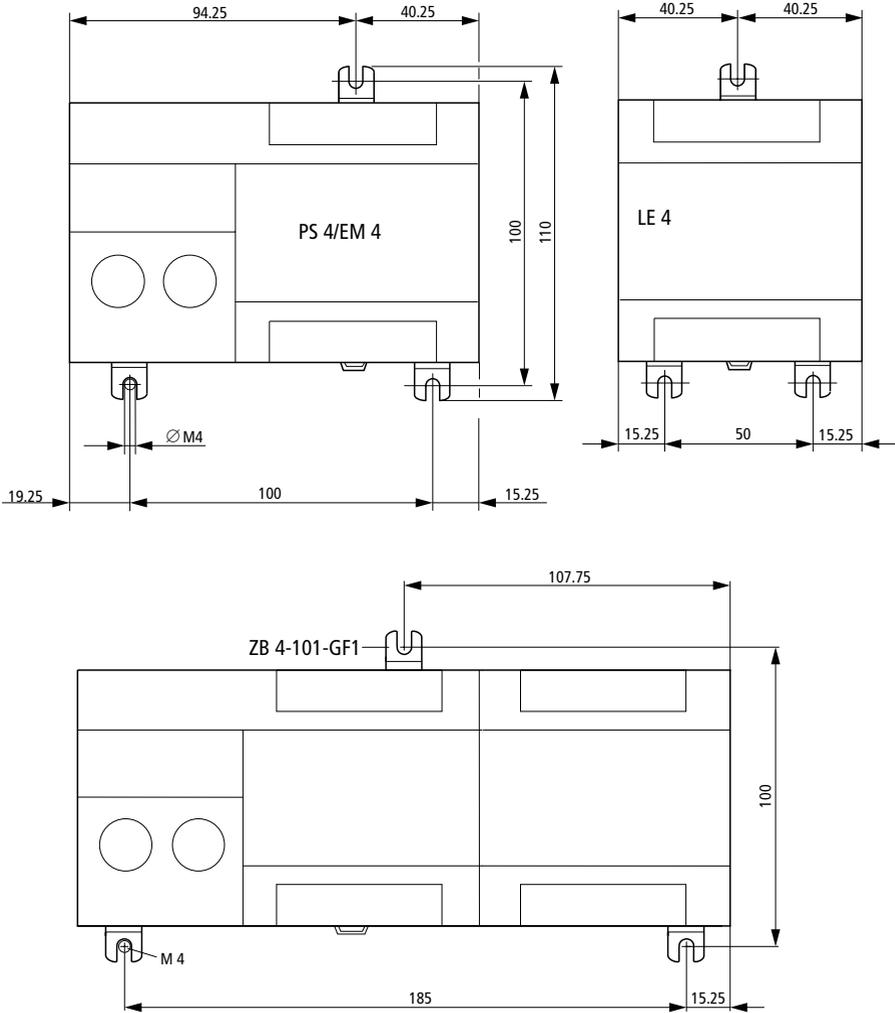
Figure 10: PS 4-200, LE 4 and PS 4-341 with fixing brackets

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