

MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

Siemens

PRODUCT MODEL

6ES7135-0HF01-0XB0

ET 200B Analog Output Block. Relevant section pages: 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 275. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

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Siemens original documentation and product reference

Historical Siemens ET 200B reference. Generic digital-module examples are not TB8 analog wiring. Original K-terminal and coding descriptions differ; reconcile the full circuit and approved design before wiring.

AMIKON PRODUCT SUPPORT

+86-18020776786

INFO@AMIKON.CN

AMIKONG.COM

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SIEMENS

SIMATIC

ET 200B Distributed I/O Station

Manual

EWA 4NEB 812 6089-02c

Edition 04

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Safety Guidelines

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Danger

indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.



Warning

indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.



Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

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The device/system may only be set up and operated in conjunction with this manual.

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

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Note the following:



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Siemens AG
Automation Group
Industrial Automation Systems
P.O. Box 4848, D-90327 Nuremberg

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Preface

Purpose of the Manual

The information contained in this manual will allow you:

- To install, wire and start up the ET 200B distributed I/O station.
- To find module characteristics and technical specifications quickly and easily.

Contents of the Manual

The following explains the structure of the contents of the manual:

What is the ET 200B?	→	Chap. 1
Which control and display elements does the ET 200B have?	→	Chap. 2
How is the ET 200B installed?	→	Chap. 3
How do I configure and parameterize the ET 200B?	→	Chap. 4
Faults?	→	Chap. 5
Technical Specifications?	→	Chap. 6, 7, 8
Which type files do I need?	→	Appendix A
How are configuration and parameterization telegrams structured?	→	Appendix B, C

Scope of the Manual

This manual describes all the ET 200B modules which can be accessed with the **PROFIBUS-DP** bus protocol. These ET 200B modules all have order numbers starting with 6ES7 (see Section F.1).

This manual is valid for operation of the ET 200B with:

- IM 308-B master interface module and COM ET 200 V4.x
- IM 308-C master interface module and COM ET 200 WINDOWS
- S7/M7-DP master with PROFIBUS-DP interface and STEP 7
- other PROFIBUS-DP masters from Siemens and other vendors.

Electronic Manuals

You can also order the documentation for the ET 200B distributed I/O station as an electronic manual on CD-ROM.

Other Requisite Manuals

In addition to this manual, you will also need the manual for the DP master used (see Appendix F.2).

Mechanical and Electrical Installation

3

In the Chapter

This chapter contains information on:

In Section	you will find	on Page
3.1	Installing and Setting the Terminal Block	3-2
3.2	Installing the Electronics Block	3-12
3.3	Dismantling the Terminal Block and Electronics Block	3-14
3.4	Electrical Installation	3-16
3.5	Wiring the Terminal Block	3-22
3.6	Wiring the Bus Interface	3-26

Technical Data

You will find a detailed description of the technical data of the ET 200B modules in Sections 6, 7 and 8.

3.1 Installing and Setting the Terminal Block

Two Methods

You can install the terminal block either

- on a standard sectional rail (35 × 15 mm or 35 × 7.5 mm to DIN EN 50022)
- or
- on smooth surfaces, i.e. direct wall mounting (for dimensions of the mounting holes see Dimensional Drawings in Sections 7 and 8).

Small Electronics Block, Digital

Figure 3-1 shows the clearances required for installation of the 16DI, 16DO, 8DI/8DO, 8DI/8DO HWA, 8RO and 4/8AI, 4AI, 4AO electronics blocks (without shield connecting element):

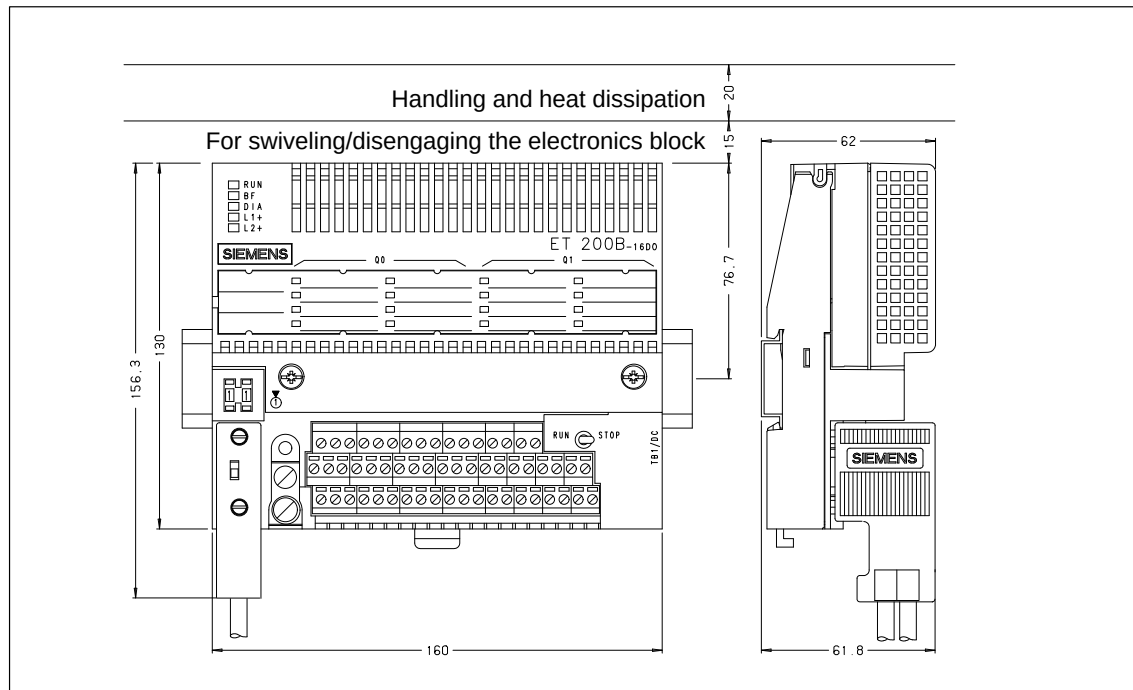


Figure 3-1 Clearances Required for Installation of the 16DI, 16DO, 8DI/8DO, 8DI/8DO HWA, 8RO and 4/8AI, 4AI, 4AO Electronics Blocks (without Shield Connecting Element)

**Small Electronics
Block, Analog**

Figure 3-3 shows the clearances required for installation of the 4/8AI, 4AI, 4AO electronics blocks (with shield connecting element):

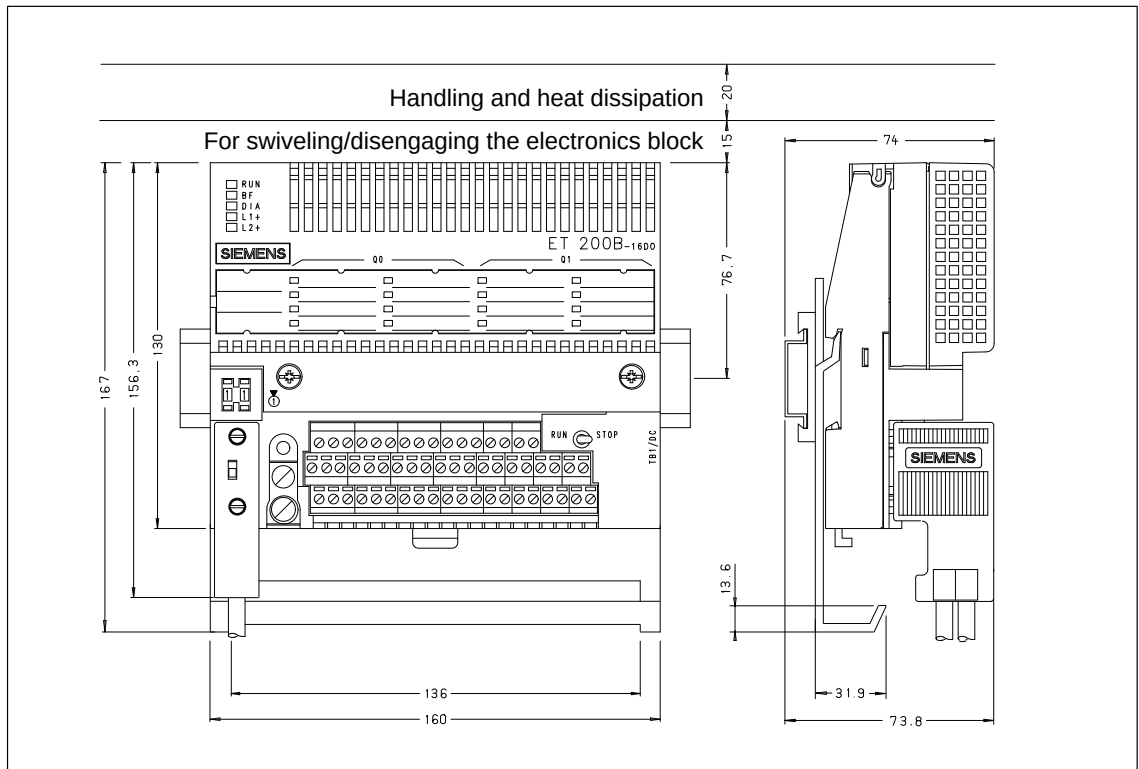


Figure 3-3 Clearances Required for Installation of the 4/8AI, 4AI and 4AO Electronics Blocks (with Shield Connecting Element)

Shield Connecting Element for TB8

In the case of analog value processing, we recommend that the cable shielding of the signal lines be connected directly at terminal block TB8.

For this application, you can hang the TB8 onto a shield connecting element after first mounting the shield connecting element on a standard sectional rail (35×15 or 35×7.5 mm to DIN EN 50022) or a smooth surface.

To secure the shield braiding, install metal terminal elements on the shield connecting element.

You can order the shield connecting element and the terminal elements under the following numbers:

- Shield connecting element → Order No. 6ES7 193-0CD40-7XA0
- Terminal elements (set of two):
 - Single version → Order No. 6ES7 390-5BA00-0AA0
(one shield cable per terminal element with a diameter of 3 to 8 mm to be clamped)
 - Double version → Order No. 6ES7 390-5AB00-0AA0
(two shield cables per terminal element with a diameter of 2 to 6 mm to be clamped)

Note

If you mount the TB8 with shield connecting element on a standard sectional rail, you must install the ET 200B horizontally.

Mounting on a Standard Sectional Rail

To mount the terminal block on a standard sectional rail...

1. Hang the terminal block on the standard sectional rail (1) and
2. Swing it back until the slide on the module snaps into place (2).

Note:

The meanings of the coding switch settings are explained in Table 3-1.

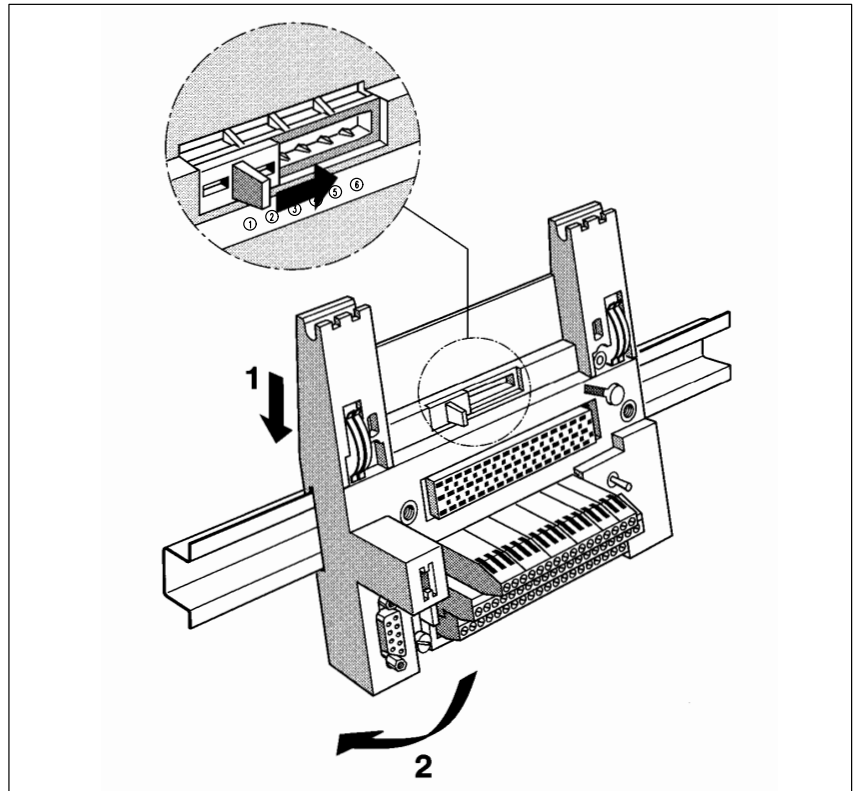


Figure 3-4 Hanging the Terminal Block on the Standard Sectional Rail and Setting the Coding Slide Switch

**Mounting the
Shield Connecting
Element on a Stan-
dard Sectional Rail**

To mount the shield connecting element on a standard sectional rail...

1. Hang the shield connecting element on the standard sectional rail from below (1) and swing it back (2).
2. Secure the shield connecting element on the standard sectional rail by tightening the screws (3).

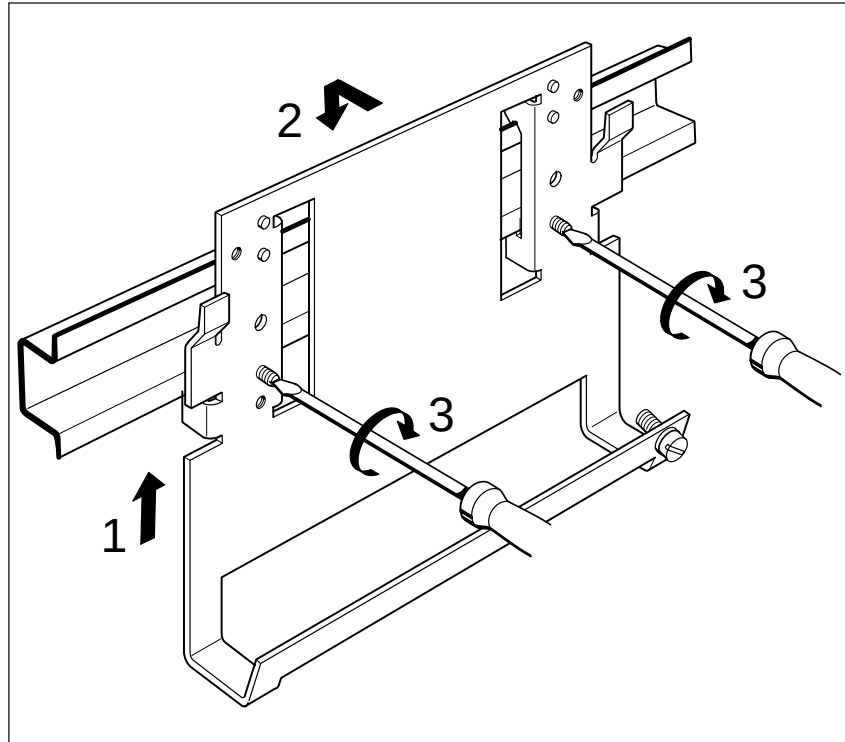


Figure 3-5 Mounting the Shield Connecting Element on the Standard Sectional Rail

Mounting the Terminal Block on the Shield Connecting Element

To mount the terminal block on the shield connecting element ...

1. Engage the terminal block in the brackets of the terminal connecting element (1).
2. Tighten the screws to secure the terminal block to the shield connecting element (2).

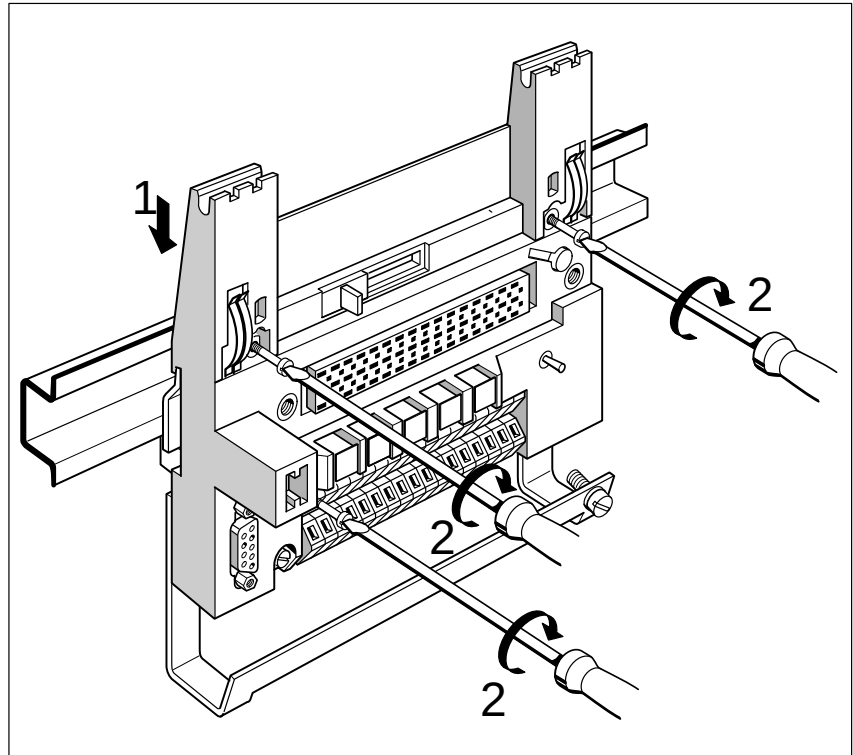


Figure 3-6 Mounting the Terminal Block on the Shield Connecting Element

Setting the Coding Slide Switch

In order to prevent the wrong electronics block being plugged in, the terminal block has a coding slide switch (see Section 2.1, Figure 2-1, 1).

The coding switch can be engaged in 6 settings. Each setting is assigned to a module class of the ET 200B distributed I/O station:

Table 3-1 Assignment of the Electronics Blocks to the Coding Slide Switch

Setting	Module Class
1	24 V digital modules
2	24 V special modules
3	Analog modules
4	Reserved
5	Reserved
6	230 V digital modules

Setting the Station Number

Any station number from 00 to 99 can be set with the aid of a tool such as a screwdriver (see Section 2.1, Figure 2-1, 10):

- Station numbers 3 to 99 are permissible when operating with the IM308-B master interface.
- Station numbers 1 to 99 are permissible when operating with the IM 308-C master interface or with the S7/M7 DP master.

The station number becomes valid only after a STOP/RUN transition of the ET 200B slave station.

Setting the Coding Plug

The coding plus of the TB8 provide the means of setting the defaults for analog value measurement and analog value output for each channel in the case of analog modules (see Section 2-1, Figure 2-2, 7).

The coding plugs enable you to set the input or output circuitry of the TB8 to suit the measured value sensor or load connected and the desired measuring or output method.

The possible settings for the coding plugs are: "A", "B", "C" and "D".

The relationships between the various settings of the coding plugs and the measurement/output method and the measured value sensors and loads are detailed in the sections dealing with the individual electronics blocks (see Sections 8.4 through 8.6). The procedure for changing the settings of the coding plugs is described below.

Changing the Coding Plug Setting

The procedure for changing the setting of a coding plug is as follows:

1. Pull the coding plug above the channel group from its socket in the TB8 (1).

Tip:

It is easiest to reset the coding plugs before installing the electronics block.

2. Turn the coding plug to the appropriate position (2) and reinsert the coding plug in its socket (3).

Correct setting:

The pointer "Δ" beside the letter "A", "B", "C" or "D" must point toward the electronics block.

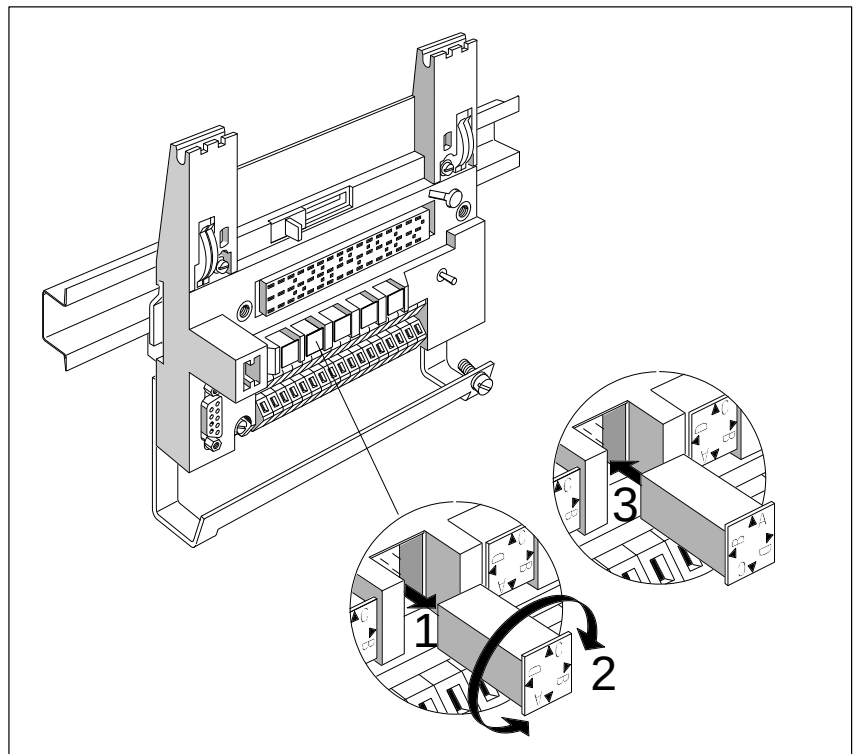


Figure 3-7 Changing the Setting of the Coding Plug

Terminal Block Fuses

The fuse (F1) in the terminal block protects against:

- short-circuit in the sensor supply
- reversed polarity of the voltage supply to the internal logic
- voltage spikes in the voltage supply to the internal logic

If the fuse trips the module's internal logic is deenergized.

Changing the Fuse

Proceed as follows when changing the fuse:

1. Switch the STOP/RUN switch to the "STOP" position.
2. Pull the electronics block off the terminal block.
3. Pry the fuse out of its base using a screwdriver.
4. Insert the new fuse.
5. Reinstall the electronics block on the terminal block.
6. Switch the RUN/STOP switch to "RUN".

Note

The TB6/AC terminal block has no STOP/RUN switch. Make sure that the external power supply is switched off before removing the electronics block and changing the fuse.

Approved Fuses

Install only the fuses listed in Table 3-2. The fuses can be ordered in packs of ten.

Table 3-2 Approved Fuses for Terminal Blocks

Terminal Block	Fuse	Order No. (pack of 10)
TB6/AC	Miniature fuse TR5-T 1.0; 250 V AC	6ES7 193-0DC00-0XA0
TB1/DC	Miniature fuse TR5-T 1.6; 250 V	6ES7 193-0DA00-0XA0
TB1-4/DC	Miniature fuse TR5-T 1.6; 250 V	
TB3/DC	Miniature fuse TR5-T 1.6; 250 V	
TB8-analog	Miniature fuse TR5-T 1.6; 250 V	
TB2/DC	Miniature fuse TR5-T 2.5; 250 V	6ES7 193-0DB00-0XA0
TB2-4/DC	Miniature fuse TR5-T 2.5; 250 V	
TB4/DC	Miniature fuse TR5-T 2.5; 250 V	
TB4M/DC	Miniature fuse TR5-T 2.5; 250 V	

3.2 Installing the Electronics Block

Engaging the Electronics Block on the Terminal Block

After coding the terminal block via the coding slide switch, you can engage the electronics block on the terminal block:



Warning

Avoid electrical destruction of the electronics block.

Always set the STOP/RUN switch of the terminal block to the “STOP” position before engaging the electronics block on the terminal block!

The TB6/DC terminal block has no STOP/RUN switch. Always switch off the external power supply before attempting to engage an electronics block (120/230 V AC) onto the TB6/DC.

1. Engage the electronics block on the terminal block (1).
2. Press the electronics block onto the terminal block (2).
3. Secure the electronics block by tightening the screws (3).

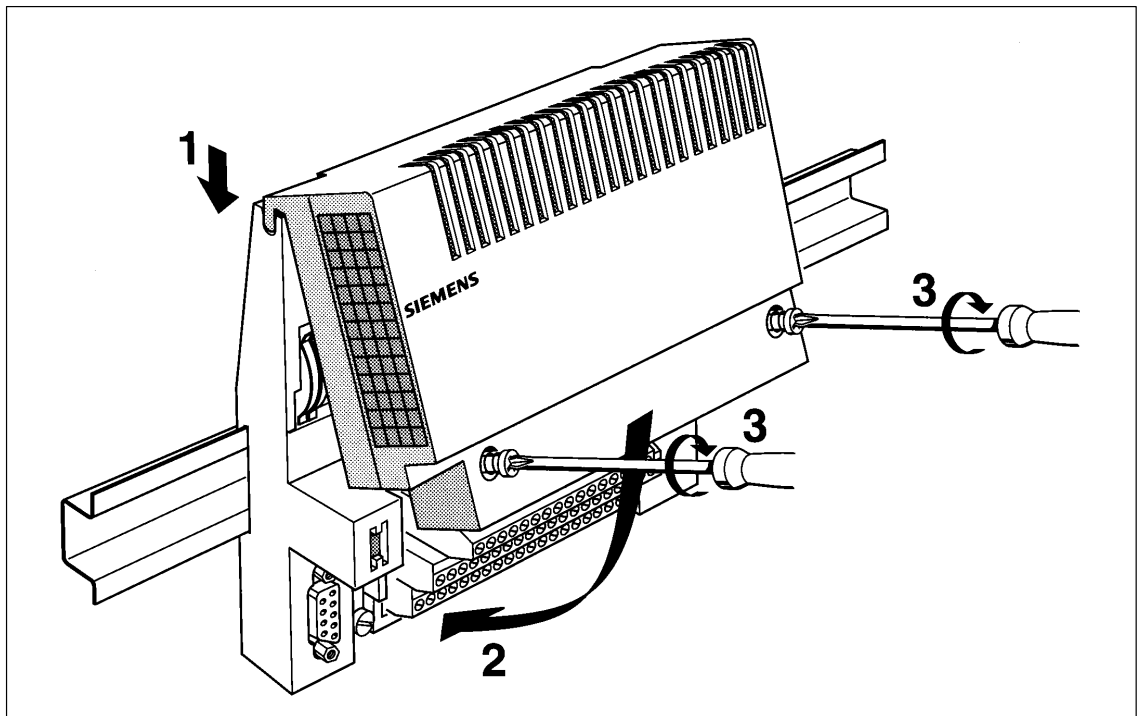


Figure 3-8 Engaging the Electronics Block on the Terminal Block

3.3 Dismantling the Terminal Block and the Electronics Block

Dismantling (from the Standard Sectional Rail)



Proceed according to the following steps:

1. Remove the electronics block in the reverse sequence to that described in Figure 3-8.

Warning

Avoid electrical destruction of the electronics block.

Always set the STOP/RUN switch of the terminal block to the “STOP” position before disengaging the electronics block from the terminal block or installing a replacement electronics block!

The TB6/DC terminal block has no STOP/RUN switch. Always switch off the external power supply before attempting to disengage an electronics block (120/230 V AC) from the TB6/DC or installing a replacement electronics block.

2. Press the slide (1) on the bottom of the terminal block down using a screwdriver and
3. Swing the terminal block out of the standard sectional rail (2).

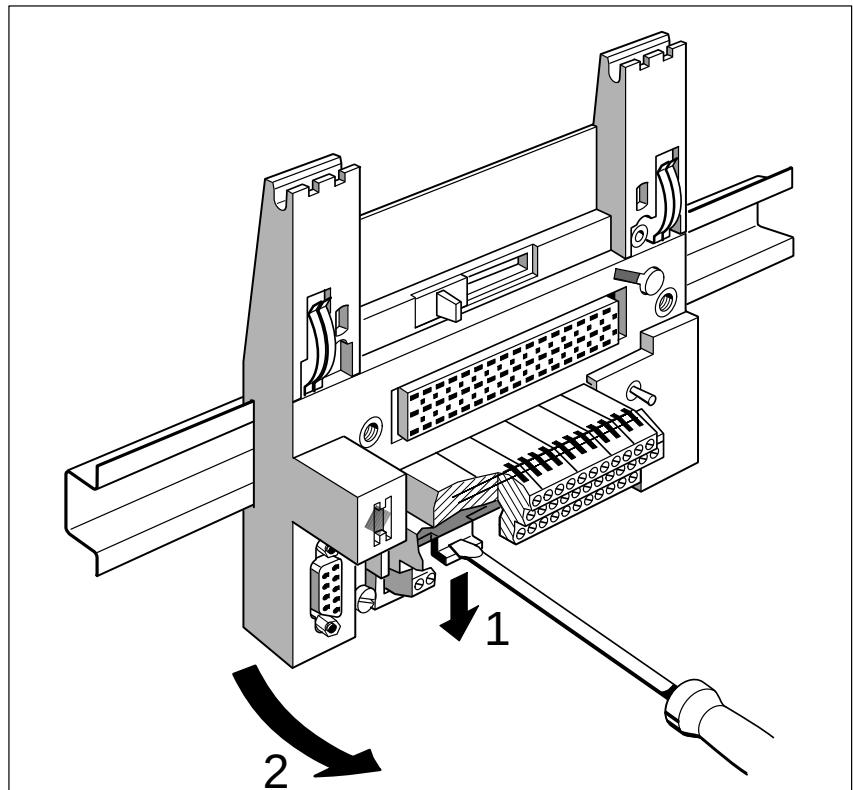


Figure 3-9 Dismantling the ET 200B

**Dismantling
(from the Shield
Connecting Element)**

Proceed according to the following steps:

1. Remove the electronics block in the reverse sequence to that described in Figure 3-8.

Warning

Avoid electrical destruction of the electronics block.

Always set the STOP/RUN switch of the terminal block to the “STOP” position before disengaging the electronics block from the terminal block or installing a replacement electronics block!

The TB6/DC terminal block has no STOP/RUN switch. Always switch off the external power supply before attempting to disengage an electronics block (120/230 V AC) from the TB6/DC or installing a replacement electronics block.

2. Remove the terminal block and the shield connecting element in the reverse sequence to that described in Figures 3-5 and 3-6.

3.4 Electrical Installation

Introduction The ET 200B distributed I/O station allows both **grounded** and **ungrounded** configurations.

Next Sections The following two sections explain the configuration rules and give circuit examples for

In Section	you will find	on Page
3.4.1	Grounded Configuration	3-17
3.4.2	Ungrounded Configuration	3-20

The numbers in the text cross-reference the components shown in the figures.

3.4.1 Grounded Configuration

Definition

In a grounded configuration, the reference potential of the ET 200B logic circuits and the protective ground conductor (PE) are galvanically interconnected.

Rules

You must note the following points for a grounded configuration:

- You must provide a main switch **(1)** in accordance with DIN VDE 0100 for the ET 200B modules, the signal sensors and the actuators.
- If the spur lines are a maximum of 3 m long and are ground-fault-resistant and short-circuit-proof, the supply connection for the ET 200B and the load circuit requires no additional fuse **(2)**.
- Use a Siemens load power supply unit **(3)** in the 6EV1 series (**Catalog ET 1**) for supplying the 24 V DC to the ET 200B.

If you connect another load power supply unit (24 V DC), please note that the voltage must be in the range 20 to 30 V (including ripple). The load power supply unit must generate a functional low voltage with safe electrical isolation in accordance with DIN VDE 0106. In the case of non-stabilized load power supply units, you require a back-up capacitor (rating 200 µF per 1 A load current).

- Provide a detachable connection to the protective ground conductor **(4)** in the secondary circuit of the load power supply unit (M terminal).
- A fuse **(5)** is required for fusing the supply voltage.
- For both grounded and ungrounded configurations, the PE terminal  of the ET 200B must have a low-impedance connection to the protective ground conductor or the cabinet ground (machine parts) **(6)**.
- Use a minimum cross-section of 4 mm² and a maximum of 10 mm² for equipotential bonding and ground connections.
- All machine parts must be grounded.
- The PROFIBUS-DP interface of terminal blocks release 2 and later is ungrounded.

Connecting the Reference Potential of the Logic Circuits to PE

For a grounded configuration, you must also do the following at the digital terminal blocks:

1. Connect the PE terminal to the lower screw.
2. Tighten the upper screw. The upper screw connects the ground potential to PE.

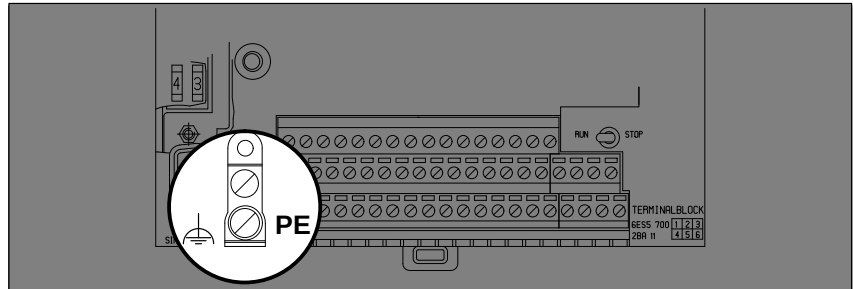


Figure 3-10 Both Screws Tightened in a Grounded Configuration

Electrical Configuration

The following figure shows the grounded configuration for 24 V DC digital modules of the ET 200B:

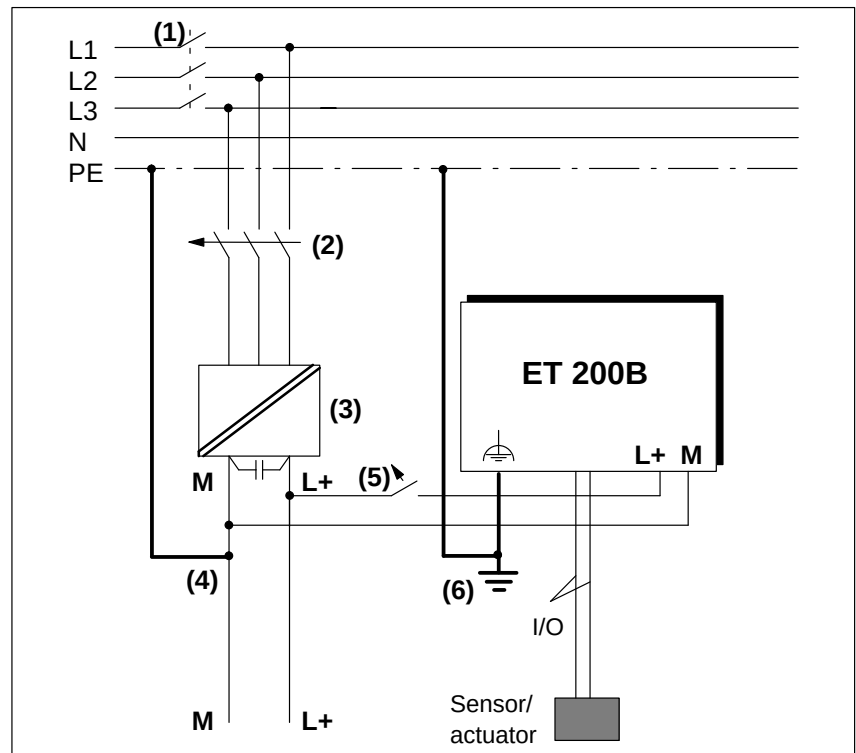


Figure 3-11 Grounded Configuration for 24 V DC Digital Modules of the ET 200B

Electrical Configuration

The following figure shows the grounded configuration for 120/230 V AC digital modules of the ET 200B:

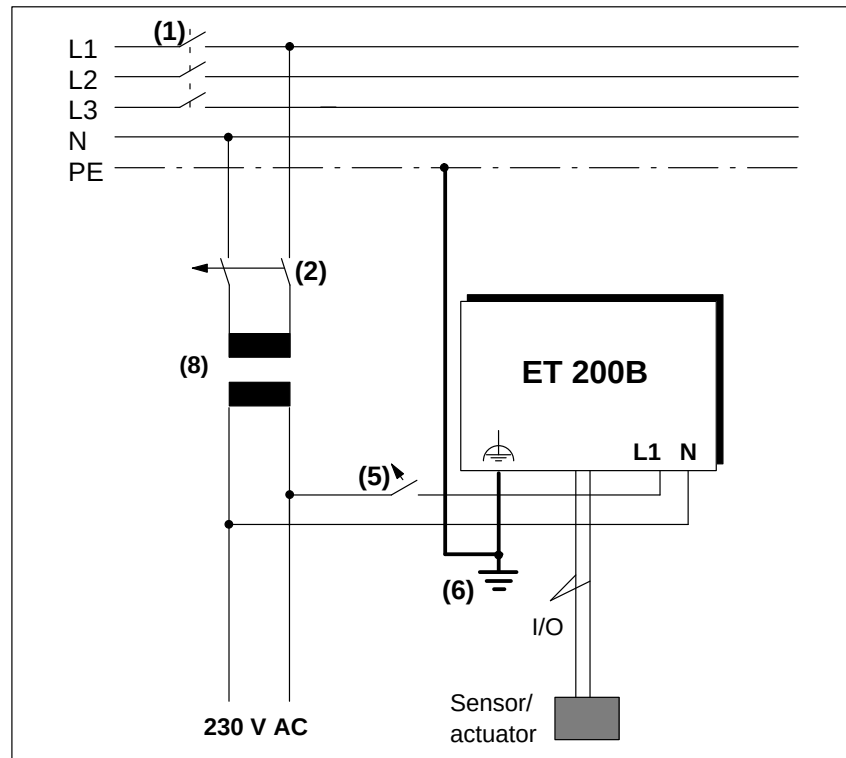


Figure 3-12 Grounded Configuration for 120/230 V AC Digital Modules of the ET 200B

3.4.2 Ungrounded Configuration

Definition

In an ungrounded configuration, there is no galvanic connection between the reference potential of the ET 200B logic circuits and the protective ground conductor (PE).

Rules

You must note the following points for an ungrounded configuration:

- You must provide a main switch (1) in accordance with DIN VDE 0100 for the ET 200B modules, the signal sensors and the actuators.
- If the spur lines are a maximum of 3 m long and are ground-fault-resistant and short-circuit-proof, the supply connection for the ET 200B and the load circuit requires no additional fuse (2).
- Use a Siemens load power supply unit (3) in the 6EV1 series (**Catalog ET 1**) for supplying the 24 V DC to the ET 200B.

If you connect another load power supply unit (24 V DC), please note that the voltage must be in the range 20 to 30 V (including ripple). The load power supply unit must generate a functional low voltage with safe electrical isolation in accordance with DIN VDE 0106. In the case of non-stabilized load power supply units, you require a back-up capacitor (rating 200 µF per 1 A load current).

- A fuse (5) is required for fusing the supply voltage.
- For both grounded and ungrounded configurations, the PE terminal  of the ET 200B must have a low-impedance connection to the protective ground conductor or the cabinet ground (machine parts) (core cross-section of PE min. 4 mm² and max. 10 mm²) (6).
- Provide an insulation monitoring circuit against ground with voltage limitation in accordance with the regulations applying to the system, for example DIN VDE 0160 (7).
- The PROFIBUS-DP interface of terminal blocks release 2 and later is ungrounded.



Warning

The ungrounded configuration can be canceled out by grounded machine parts and grounded electrical equipment.

Example: A grounded sensor or a grounded actuator connects the PE to the reference potential (M terminal) of the controller.

Disconnecting the Reference Potential of the Logic Circuits from PE

For an ungrounded configuration, you must also do the following at the digital terminal blocks:

1. Connect the PE terminal to the lower screw.
2. Remove the upper screw for an ungrounded configuration.

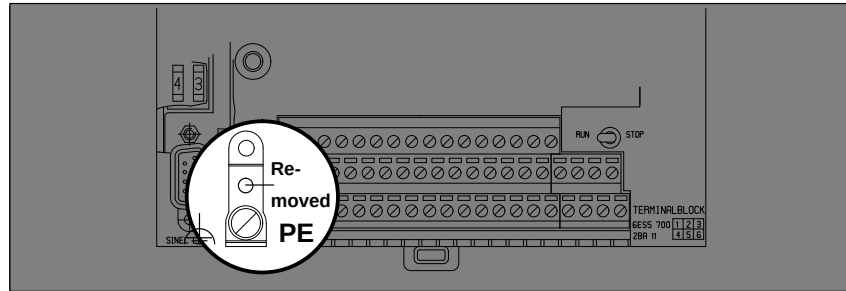


Figure 3-13 Upper Screw Removed in an Ungrounded Configuration

Electrical Configuration

Figure 3-14 shows the ungrounded configuration for 24 V DC digital modules of the ET 200B:

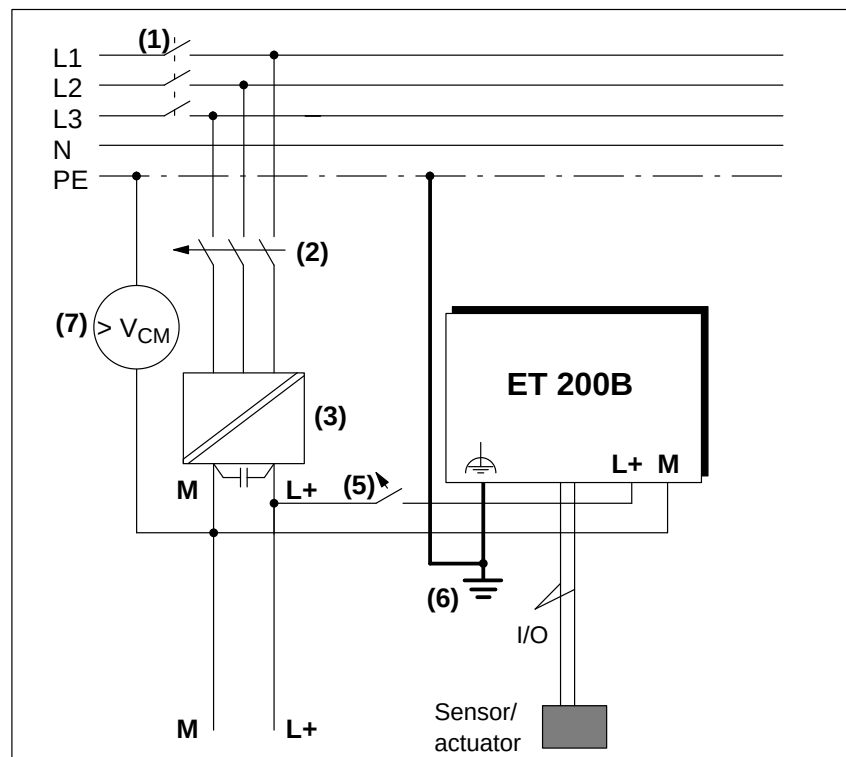


Figure 3-14 Ungrounded Configuration for 24 V DC Digital Modules of the ET 200B

3.5 Wiring the Terminal Block

Introduction

Connect the following to the terminal block:

- Supply voltage for internal logic circuits
- Sensor supply for input channels
- Load voltage supply for output channels
- Sensors/loads

Wiring

The wiring of the terminal block is dependent on the electronics block used. A distinction is made between **floating** and **non-floating** electronics blocks.

Floating Electronics Block

In a floating electronics block

- **either** the circuit for the internal electronics and the load circuit are galvanically isolated from each other:

All 120/230 V AC electronics blocks and floating 24 V DC electronics blocks belong to this category.

- **or** the voltage supply of the internal logic and the analog circuits are galvanically isolated from each other:

All analog electronics blocks belong to this category.

Note

You can use floating electronics blocks regardless of whether the reference potential of the supply voltage for the internal logic circuits is grounded or not.

Non-Floating Electronics Blocks

In non-floating electronics blocks, the internal logic circuits and the load current circuit share a common reference potential (M ground).

Non-floating electronics blocks include: non-floating 24 V DC electronics blocks.

Conductor Cross-sections

The approved conductor cross-sections for all voltage-supply and signal lines are as follows:

Table 3-3 Approved Conductor Cross-sections

Line	Conductor Ferrules	Conductor Cross-section
Supply-voltage and signal lines	with ferrules	max. 1.5 mm ²
	w/o ferrules	max. 2.5 mm ² (min. 0.08 mm ² for TB3, TB4, TB4M, TB8 and min. 0.14 mm ² for TB1, TB1-4, TB2, TB2-4)
Protective earth (PE) to terminal block*	with ferrule	max. 2.5 mm ²

* for TB1-4/DC or TB2-4/DC only

Connections

Some terminal blocks are fitted with screw terminals while others have spring-latch terminals (see Figure 3-15) for securing the cable conductors.

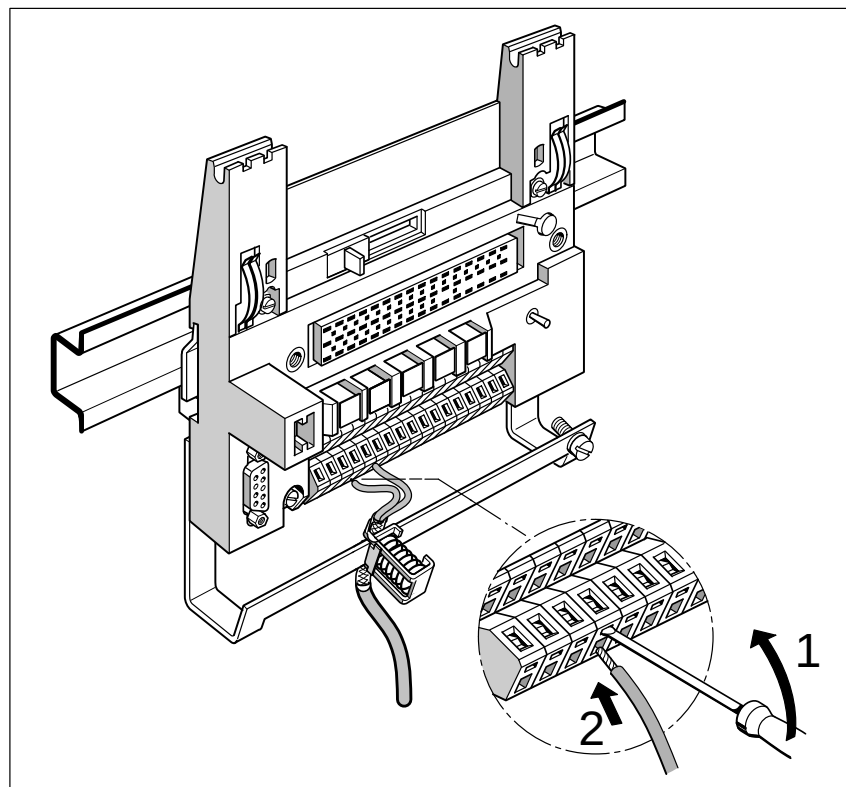


Figure 3-15 Connecting Cables to Spring-Latch Terminals

Pin Assignments

In Chapter 7 “Range of Modules”, you will find the pin assignments of each electronics block. The following table will help you.

Table 3-4 Pin Assignments of the Terminal Blocks

Assignment of ...	For Electronics Block ...	See ...
TB1/DC, TB1-4/DC and TB3/DC	ET 200B-16DI	Table 7-3
	ET 200B-16DO	Table 7-5
	ET 200B-8DI/8DO	Table 7-9
	ET 200B-8DI/8DO HWA	Table 7-10
	ET 200B-8RO	Table 7-8
TB2/DC, TB2-4/DC, TB4/DC and TB4M/DC	ET 200B-16DO/2A	Table 7-6
	ET 200B-32DI, ET 200B-32DI 0.2ms	Table 7-4
	ET 200B-32DO	Table 7-7
	ET 200B-16DI/16DO	Table 7-12
	ET 200B-24DI/8DO, ET 200B-24DI/8DO 0.2ms	Table 7-13
TB6/AC	ET 200B-16DI-AC	Table 7-14
	ET 200B-16DO-AC	Table 7-15
	ET 200B-16RO-AC	Table 7-16
	ET 200B-8DI/8RO-AC	Table 7-17
TB8-analog	ET 200B-4/8AI	Table 8-37
	ET 200B-4AI	Table 8-55
	ET 200B-4AO	Table 8-65

Shielding for Analog Value Processing

For analog value processing, connect the cable shields of the signal lines directly at the TB8 to the shield connecting element (Order No.: 6ES7 193-0CD40-7XA0).

Procedure for Connecting the Shielding

Follow the steps listed below:

1. Engage the TB8 terminal block on the shield connecting element after first mounting the shield connecting element on the standard sectional rail or a smooth surface (wall) (see Section 3.1).
2. Mount the metallic terminal elements (see Section 3.1) on the bottom edge of the shield connecting element (**1** and **2**).
3. Strip the ends of the signal lines.
4. Secure the bare cable ends to the terminal elements (**3** and **4**).
5. Connect the shield connecting element to the protective ground conductor (PE). The cross-section of PE must be a minimum of 4 mm² and a maximum of 10 mm².
6. Connect the shield of the bus cable in such a way that the maximum bend radius when bent once ($10 \times d_O$; d_O = outer diameter of the cable) is not exceeded.

3

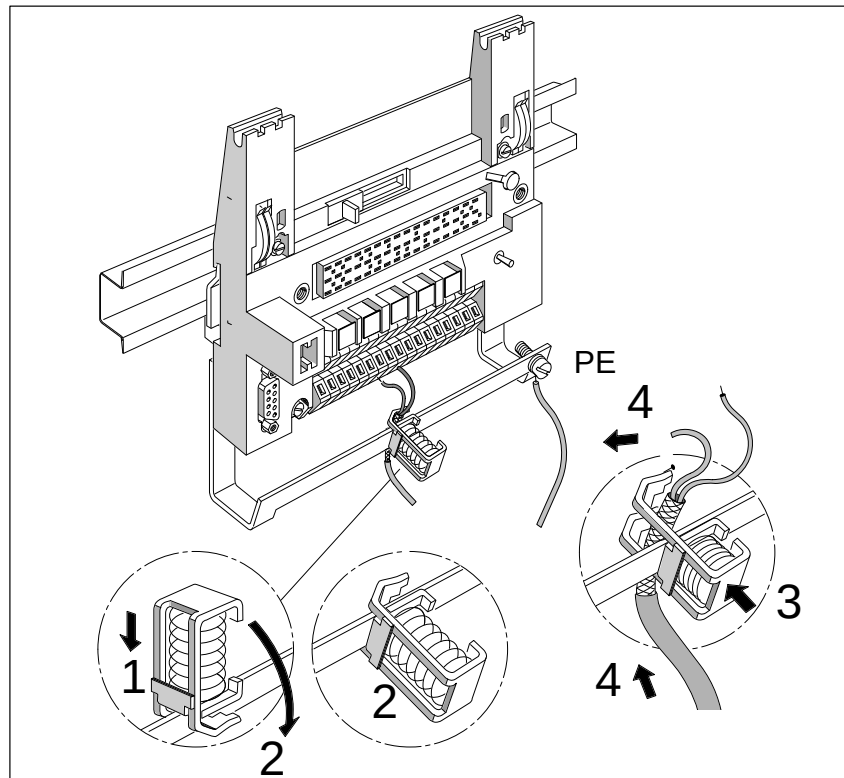


Figure 3-16 Shield Connecting Element on Terminal Block TB8

3.6 Wiring the Bus Interface

Bus Interface The PROFIBUS-DP bus connects to the terminal block by means of a bus connector.

Bus Connector There are a number of bus connectors for ET 200B.

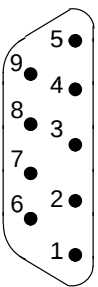
Table 3-5 Bus Connectors

Design		Order Number
max. 12 Mbaud	without programmer socket	6ES7 972-0BA10-0XA0 ¹
	with programmer socket	6ES7 972-0BB10-0XA0 ¹
max. 1.5 Mbaud (without terminating resistor)	without programmer socket	6ES7 972-0BA30-0XA0

¹ When inserted, the installation height for the ET 200B module is not exceeded with this bus connector.

PROFIBUS-DP Interface The pin assignment of the 9-pin PROFIBUS-DP interface of the terminal block is described below.

Table 3-6 Pin Assignment of the PROFIBUS-DP Interface

View ²	Pin No.	Signal Name	Designation
	1	–	–
	2	–	–
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (from station)
	6	P5V2	Supply plus (from station)
	7	–	–
	8	RxD/TxD-N	Data line A
	9	–	–

² Terminal block as viewed from in front

**Connecting the
Bus Cable**

The procedure for connecting the bus cable to the bus connector is described in detail in the following manuals:

- Manual *ET 200 Distributed I/O System*
- Manual *S7-300 Programmable Controller Hardware and Installation*
- Manual *M7-300 Programmable Controller Hardware and Installation*
- Manual *S7-400/M7-400 Programmable Controller Hardware and Installation*

Dimensional Drawings with Bus Connectors

Chapters 7 and 8 contain dimensional drawings of ET 200B modules with bus connectors installed.

8.6 Electronics Block ET 200B-4AO (6ES7 135-0HF01-0XB0)

Characteristics

The ET 200B-4AO electronics block has the following characteristics:

- 4 inputs, floating to the supply voltage of the internal logic
- Output ranges:
 - Voltage output: $\pm 10\text{ V}$, $0 \dots 10\text{ V}$
 - Current output: $\pm 20\text{ mA}$, $0 \dots 20\text{ mA}$, $4 \dots 20\text{ mA}$
- Supply voltage: 24 V DC
- Loads connectable in
 - 4-wire connection
 - 2-wire connection
- Output range selection via COM ET 200 or STEP 7 or directly via parameterization telegram (see Chapter 4)

Dimensional Drawing

See Figure 8-4 for the precise dimensions.

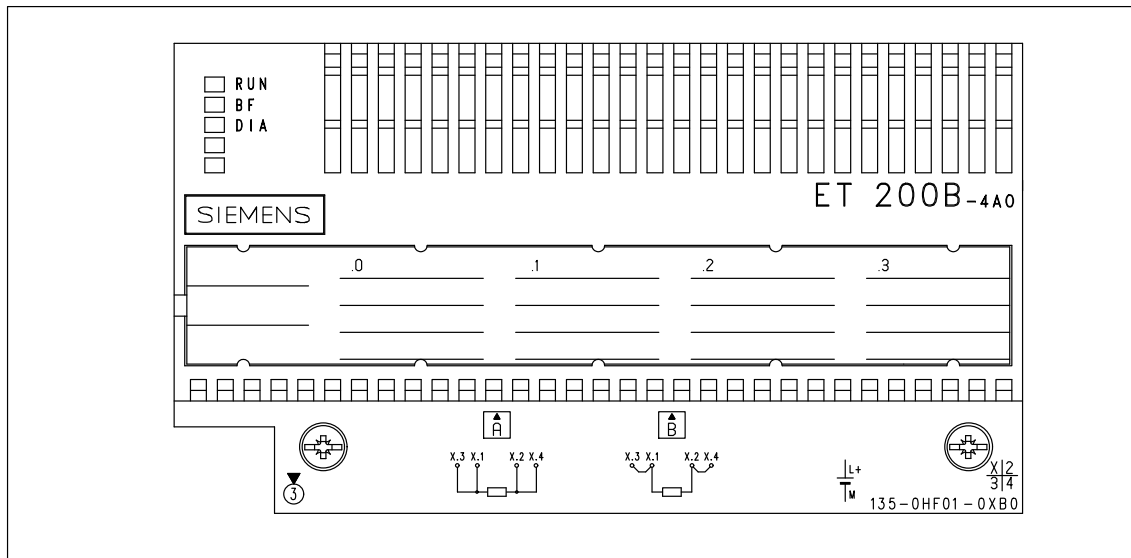


Figure 8-24 Front Elevation: ET 200B-4AO (6ES7 135-0HF01-0XB0)

List of Subsections

The following aspects of the ET 200B-4AO are described below:

In Section	you will find	on Page
8.6.1	Connecting loads	8-78
8.6.2	Configuration options	8-82
8.6.3	Setting the operating mode	8-83
8.6.4	Analog-value representation, operation with SIMATIC S5	8-85
8.6.5	Analog-value representation, operation with SIMATIC S7	8-87
8.6.6	Block diagram, pin assignment and technical data	8-89

8.6.1 Connecting Loads

Possible Connections

There are two methods of connecting loads to the ET 200B-4AO:

- 4-wire connection of loads
- 2-wire connection of loads

On the Following Pages

The following pages contain a connection example for every connection possibility. Please note the following rules.

Rules

Please note the following rules when connecting loads to the ET 200B-4AO:

- The output terminals x.2 (x = 0 to 3) have a fixed connection to analog ground (M_A).
If non-floating loads are connected to a common reference potential, please ensure minimum potential differences. Failure to do so can lead to undesired transient currents across the output module.
- You are recommended to connect floating-ground loads which are floating with reference to each other. In such cases, connect analog ground (M_A) with PE () to enhance noise immunity.
- The connection terminals of unused outputs are left open.
- You must short-circuit terminals “K+” and “K-”. For this purpose, set the coding plug to the “C” position.



Caution

If the supply voltage is below the lower tolerance limit, the output analog values can deviate from the specified values.

Note

Please note the explanation of shielding of analog lines in Sections 3.1 and 3.5.

4-Wire Connection of Loads (Voltage Output)

The voltage on the load is re-adjusted via two high-resistance sensor lines per channel (S+, S– at terminals x.3 and x.4). In this way, voltage drops of up to 3 V per line can be re-adjusted.

Please ensure that the sensor lines are connected directly to the load.

4-wire connection of loads for voltage output is shown below:

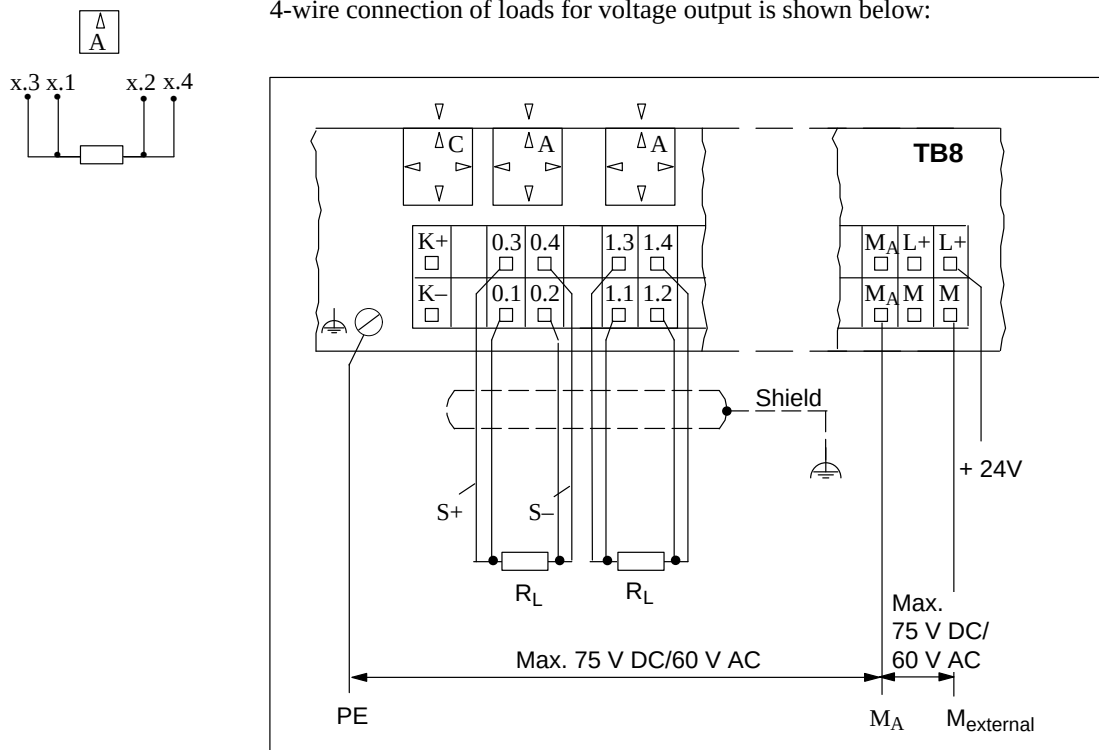
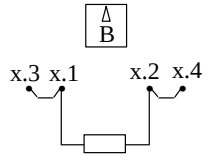


Figure 8-25 4-Wire Connection of Loads for Voltage Output

2-Wire Connection of Loads (Voltage Output)



The sensor lines are not required for 2-wire connection. Two-wire connection is possible for voltage output if the line resistance of the signal lines is negligible compared to the load resistance.

2-wire connection of loads for voltage output is shown below:

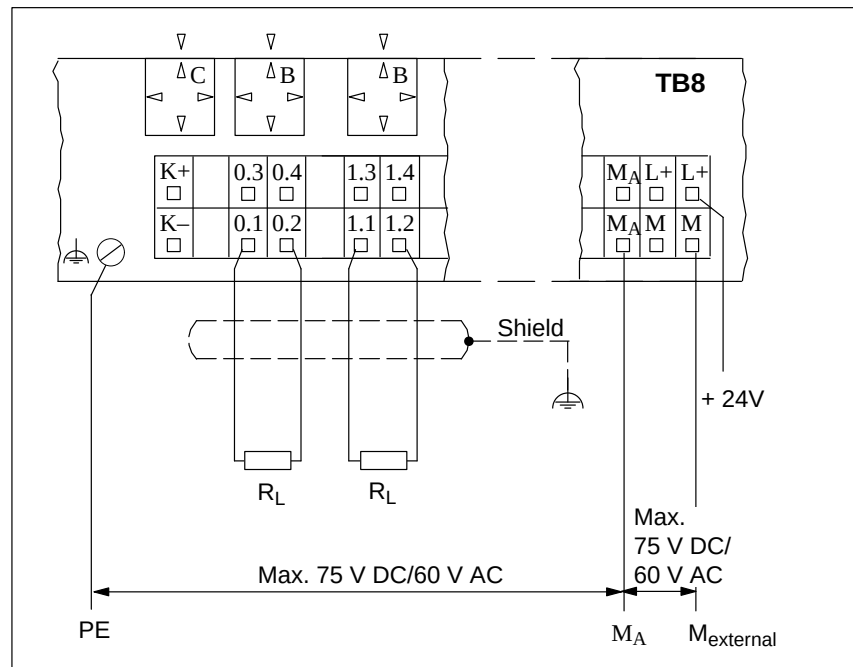
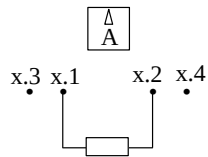


Figure 8-26 2-Wire Connection of Loads for Voltage Output

Two-Wire Connection of Loads (Current Output)



Two-wire connection of loads for current output is shown below:

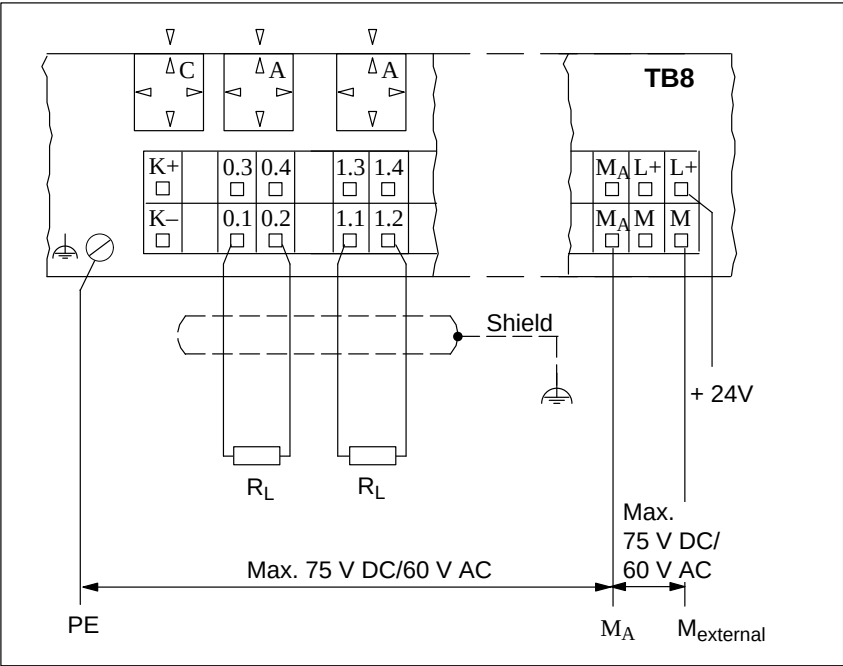


Figure 8-27 2-Wire Connection of Loads for Current Output

8.6.2 Configuration Options

Type File The information in this section applies to the type file **SI8018BE.200**.
The type file contains the possible configurations. The configuration you choose depends on the wiring of the module.

Configuration Table 8-56 shows the possible configurations of the ET 200B-4AO with COM ET 200 Windows or STEP 7.
Table 8-56 lists only the slots for configuring the output areas (slots 4 to 7). Slots 1 to 3 have the default value "004".

Table 8-56 Possible Configurations for the Output Areas of ET 200B-4AO

Config- uration	Terminals used								Length ¹ (in words)	Meaning
	Channel 0		Channel 1		Channel 2		Channel 3			
	0.1/ 0.2	0.3/ 0.4	1.1/ 1.2	1.3/ 1.4	2.1/ 2.2	2.3/ 2.4	3.0/ 3.1	3.3/ 3.4		
4AO	×	o	×	o	×	o	×	o	4	A start address is assigned for the entire module, addresses for 4 are reserved. (= module addressing)
4 x 1AO	×	o	×	o	×	o	×	o	4	A separate start address can be assigned for each channel. (= single-channel addressing)
3 x 1AO	×	o	×	o	×	o			3	
2 x 1AO	×	o	×	o					2	
1 x 1AO	×	o							1	

¹ Length of user data

× = Connection of load

o = Connection of sensor lines for voltage measurement

Diagnostics Diagnostics messages and diagnostics data (slave diagnostics) are returned only for the configured channels.

8.6.3 Setting the Operating Mode

Setting the Operating Mode

You set the operating mode of the ET 200B-4AO electronics block

- by means of the coding plugs on the TB8 terminal block and
- by means of the COM ET 200 or STEP 7 parameterization software.

Coding Plugs

The coding plugs of the TB8 enable you to set the output circuit for analog value output of each individual channel of the ET 200B-4AO.

The possible settings of the coding plugs are: "A", "B", "C" and "D".

For details of the relationships between the settings of the coding plugs and the output mode or load, see Section 8.6.1. Section 3.1 describes how to change the settings of the coding plugs.

Channel

Some parameters of the ET 200B-4AO listed on the following pages apply only to individual channels. Table 8-57 lists the assignment of TB8 terminals to channels.

Table 8-57 Assignment of Terminals to Channels

Channel	Terminals
Channel 0	Terminals 0.1/0.2
Channel 1	Terminals 1.1/1.2
Channel 3	Terminals 2.1/2.2
Channel 4	Terminals 3.1/3.2

Parameters

Table 8-58 shows all the parameters for parameterizing the ET 200B-4AO with COM ET 200 Windows or STEP 7.

You can set these parameters for the ET 200B-4AO if you use the type file **SI8018BE.200**.

Table 8-58 Parameters for ET 200B-4AO (6ES7 135-0HF01-0XB0)

Parameter	Explanation	Explanation
Diagnostics alarm	Diagnostics alarm enable for module	Disable Enable
Diagnostics enable for channel 0	Diagnostics messages enabled separately for each channel	Disable Enable
Diagnostics enable for channel 1		
Diagnostics enable for channel 2		
Diagnostics enable for channel 3		
Output value and range for channel 0	Type and range of output defined separately for each channel	± 10 V 0 ... 10 V ± 20 mA 0 ... 20 mA 4 ... 20 mA
Output value and range for channel 1	For voltage output:	
Output value and range for channel 2	For current output:	
Output value and range for channel 3		
Representation of output values	Sets representation of the analog values for module	SIMATIC S5 SIMATIC S7
Type of dummy value for channel 0	Defines the dummy value output for each channel in the event of communication interruption	Parameterizable Last value
Type of dummy value for channel 1		
Type of dummy value for channel 2		
Type of dummy value for channel 3		
Dummy value for channel 0	Sets dummy value for each channel	0 – 32786 ... 32767
Dummy value for channel 1		
Dummy value for channel 2		
Dummy value for channel 3		

 : Default

8.6.4 Analog Value Representation, Operation with SIMATIC S5

Analog Value Representation, SIMATIC S7

If you operate the ET 200B-4AO with SIMATIC S5, you can utilize the analog value representation of SIMATIC S7. See Section 8.6.5 for the measured-value tables for analog value representation in SIMATIC S7.

Analog Value Representation, SIMATIC S5

Analog values are represented in complements of twos with the ET 200B-4AO.

The table below shows the analog value representation of the ET 200B-4AO:

Table 8-59 Representation of an Analog Output Value as a Bit Pattern (6ES7 135-0HF01-0XB0)

	High Byte								Low Byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Analog value representation	SI	2 ¹⁰	2 ⁹	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰	X	X	X	X

Bits 0 ... 3 and 15 have no significance for the amount of the measured value. See Table 8-60 for a detailed description of these bits.

Supplementary Bits

Bits 0 ... 3 and 15 have the following meaning in the bit pattern of the analog output value:

Table 8-60 Description of the Bits (6ES7 135-0HF01-0XB0)

Bit	Meaning	Signal Status	Meaning of the Signal Status
SI	Sign	0	“+” sign
		1	“−” sign
X	Irrelevant	—	—

Voltage and Current Output Ranges

The table below shows the assignments of analog to digitized output signals for the value ranges: ± 10 V, 0 ... 10 V, ± 20 mA, 0 ... 20 mA, 4 ... 20 mA.

Table 8-61 Analog Output Signals of the ET 200B-4AO (Value Ranges: ± 10 V, 0 ... 10 V, ± 20 mA, 0 ... 20 mA, 4 ... 20 mA; **Complement of Twos**)

Units	Output Value in mV					Digitized Output Value												Range
	0 ... 20 mA	4 ... 20 mA	± 20 mA	0 ... 10 V	± 10 V	15	14	13	12	11	10	9	8	7	6	5	4	
1249		23.52				0	1	0	0	1	1	1	0	0	0	0	1	Over-range
1204	23.52	:	23.52	11.758	11.758	0	1	0	0	1	0	1	1	0	1	0	0	
:	:	:	:	:	:								:					
1025	20.0195	20.016	20.2	10.0098	10.0098	0	1	0	0	0	0	0	0	0	0	0	1	
1024	20.0	20.0	20.0	10.00	10.00	0	1	0	0	0	0	0	0	0	0	0	0	Nominal range
1023	19.98	19.98	19.98	9.99	9.990	0	0	1	1	1	1	1	1	1	1	1	1	
512	10.0	12.0	10.0	5.00	5.000	0	0	1	0	0	0	0	0	0	0	0	0	
256	5.0	8.00	5.0	2.50	2.500	0	0	0	1	0	0	0	0	0	0	0	0	
1	0.0195	4.015	0.02	0.0098	0.0098	0	0	0	0	0	0	0	0	0	0	0	0	
0	0.0	4.0	0.0	0.0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	
-1	0.0	3.984	-0.02	0.0	-0.0098	1	1	1	1	1	1	1	1	1	1	1	1	
-256	0.0	0.0	-05.0	0.0	-2.500	1	1	1	1	0	0	0	0	0	0	0	0	
-512	0.0	0.0	-10.0	0.0	-5.000	1	1	1	0	0	0	0	0	0	0	0	0	
-1024	0.0	0.0	-20.00	0.0	-10.000	1	1	0	0	0	0	0	0	0	0	0	0	
-1025	0.0	0.0	-20.02	0.0	-10.009	1	0	1	1	1	1	1	1	1	1	1	1	Over-range
:	:	:	:	:	:								:					
-1204	0.0	0.0	-23.52	0.0	-11.758	1	0	1	1	0	1	0	0	1	1	0	0	

8.6.5 Analog Value Representation, Operation with SIMATIC S7

Analog Value Representation, SIMATIC S7

Analog values are represented in complements of twos with the ET 200B-4AO for SIMATIC S7.

The table below shows the analog value representation ET 200B-4AO:

Table 8-62 Representation of an Analog Output Value as a Bit Pattern for SIMATIC S7 and ET 200B-4AO

	High Byte								Low Byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Analog value representation	SI	2 ¹⁴	2 ¹³	2 ¹²	2 ¹¹	2 ¹⁰	2 ⁹	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰

Bit 15 has no significance for the amount of the output value. It merely represents the sign.

Voltage Output Ranges

The table below shows the assignments of analog to digitized output signals for the value ranges: ± 10 V, 0 ... 10 V.

Table 8-63 Representation of Digitized Measured Values of the ET 200B-4AO (Output Ranges: 0 to 10 V and ± 10 V)

Output Range 0 to 10 V	Output Range ± 10 V	Units		Range
		Decimal	Hexa- decimal	
0	0	≥ 32512	$\geq 7F00_H$	Overflow
11.7589	11.7589	32511	7EFF _H	Overrange
:	:	:	:	
10.0004	10.0004	27649	6C01 _H	
10.0000	10.0000	27648	6C00 _H	Nominal range
:	:	:	:	
0	0	0	0 _H	
0	:	:	:	
	:	– 6912	E500 _H	
	:	– 6913	E4FF _H	
	:	:	:	Underrange
	– 10.0000	– 27648	9400 _H	
	10.0004	– 27649	93FF _H	
	:	:	:	
	– 11.7593	– 32512	8100 _H	Underrun
	0	≤ -32513	$\leq 80FF_H$	

Current Output Ranges

The table below shows the assignments of analog to digitized output signals for the value ranges: ± 20 mA, 0 ... 20 mA, 4 ... 20 mA.

Table 8-64 Representation of Digitized Measured Values of the ET 200B-4AO (Output Ranges: ± 20 mA, 0 to 20 mA and 4 to 20 mA)

Output Range ± 20 mA	Output Range 0 to 20 mA	Output Range 4 to 20 mA	Units		Range
			Decimal	Hexadecimal	
0	0	0	≥ 32512	$\geq 7F00_H$	Overflow
23.518	23.518	22.81	32511	7EFF _H	Overrange
:	:	:	:	:	
20.0007	20.0007	20.006	27649	6C01 _H	
20.000	20.000	20.000	27648	6C00 _H	Nominal range
0	:	:	:	:	
0	0	4.000	0	0 _H	
:	0	:	:	:	
		0	– 6912	E500 _H	
		0	– 6913	E4FF _H	
– 20.000			:	:	Underrange
			– 27648	9400 _H	
			– 27649	93FF _H	
:			:	:	Underrun
– 23.519			– 32512	8100 _H	
0			≤ -32513	$\leq 80FF_H$	

8.6.6 Block Diagram, Terminal Assignment and Technical Data

Block Diagram Simplified representation of potential for the ET 200B-4AO and TB8:

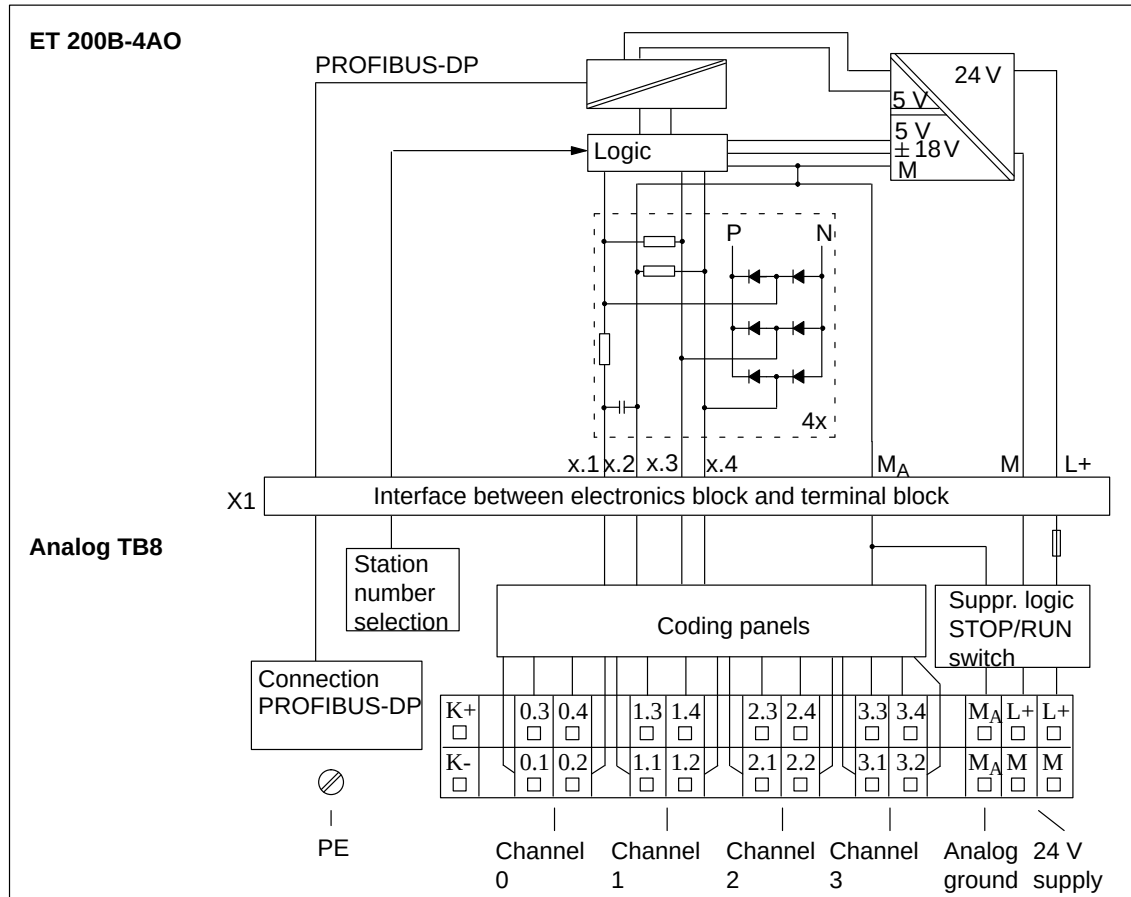


Figure 8-28 Block Diagram: ET 200B-4AO (6ES7 135-0HF01-0XB0) and TB8

Terminal Assignment

The table below contains the terminal assignments of the TB8 for ET 200B-4AO, depending on the circuit type used.

Table 8-65 Terminal Assignment of the TB8 for ET 200B-4AO (6ES7 135-0HF01-0XB0)

Terminal num- bering TB8		
Terminal	4-Wire Connection	2-Wire Connection
K+	Unassigned	
K-	Unassigned	
x.1	Analog output “voltage” (+)	Analog output “current or voltage” (+)
x.2	Analog output “voltage” (–)	Analog output “current or voltage” (–)
x.3	Sensor line (S+)	connected to x.1
x.4	Sensor line (S–)	connected to x.2
MA	Analog ground (MA)	
MA	Analog ground (MA)	
L+	Voltage supply for internal logic	
L+	Voltage supply for internal logic	
M	Voltage supply for internal logic	
M	Voltage supply for internal logic	

x = 0, 1, 2, 3

Note

You must make additional settings for the input circuits of the TB8 via coding plugs. See Figures 8-25 and 8-27 for the necessary settings of the coding plugs.

Technical Data

The technical data of the ET 200B-4AO electronics block are listed in the table below.

Technical specifications		Outputs, continued	
Baud rates*	9.6/19.2/93.75/187.5/500/ 1500/3000/6000/ 12000 kbaud	Data input format	11-bit complement of twos
Bus protocol	PROFIBUS-DP	Overrange	Approx. 17.5 %
Galvanic isolation to SI- NEC L2-DP bus	Yes	Conversion time	Approx. 1 ms
Power losses	Typically 2.4 W	Settling time	
Weight (EB and TB)	Approx. 550 g (19.25 oz.)	• For resistive load	0.1 ms
Dimensions (EB and TB: W x H x D)	160 x 130 x 60 mm (6.24 x 5.07 x 2.34 in.)	• For capacitive load	3.3 ms
Diagnostics functions, alarms		• For inductive load	0.5 ms
Voltage monitoring	Green "RUN" LED	Permissible potential dif- ference	
Bus monitoring SINEC L2-DP	Red "BF" LED	• M _A to PE or M	Max. 75 V DC/60 V AC
Group diagnostics	Red "DIA" LED, parame- terizable	Crosstalk between outputs	40 dB
Diagnostics alarm	Yes, parameterizable	Working error limit (over entire temperature range in relation to output range)	
Supply voltage for outputs and internal logic		• Voltage	± 0.5 %
Supply voltage (L+)		• Current	± 1 %
• Rated value	24 V DC	Basic error limit (working error limit at 25°C (77 °F) in relation to output range)	
• Permissible range	18.5 to 30.2 V	• Voltage	± 0.2 %
• Value for t < 0.5s	35 V	• Current	± 0.3 %
Current consumption from L+		Temperature error (in rela- tion to output range)	± 0.02 %/K
• Logic	Max. 200 mA	Linearity error (in relation to output range)	± 0.05 %
Outputs		Repeatability (in steady- state condition at 25°C (77 °F), in relation to output range)	± 0.05 %
Number of outputs	4	Output ripple (in relation to output range)	± 0.05 %
Galvanic isolation to inter- nal electronic circuits	No	Voltage output	
Galvanic isolation to volt- age supply of internal logic	Yes	• Short-circuit protec- tion	Yes, max. 1 output simul- taneously
Output ranges		• Short-circuit current	Max. 25 mA
• Voltage range	± 10 V, 0 to 10 V	Current output	
• Current ranges	± 20 mA, 0 to 20 mA, 4 to 20 mA	• Idle voltage	Max. 18 V
Connection type	2- or 4-wire connection	Cable length	
Load resistance		• Shielded	Max. 100 m (328 ft.)
• Voltage output	Min. 3.3 kΩ	* In operation with the IM 308-B, the maximum possible baud rate is 1500 kbaud.	
• Load impedance for current output	Max. 300 Ω		
• Capacitive load	Max. 1 μF		
• Inductive load	Max. 1 mH		

Analog Modules

The designations of the type files for the analog ET 200B modules are as follows:

Table A-2 Designations of Type Files for Analog Modules

Station Type (in COM ET 200)		Type File for COM ET 200 V4.x	Type File for COM ET 200 Windows and STEP 7
B-4/8AI	DP	SI801ATE.200	SI801AAE.200
B-4AI	DP	SI8019TE.200	SI8019AE.200
B-4AO	DP	SI8018TE.200	SI8018AE.200
B-4/8AI-2	DP	–	SI801ABE.200
B-4AI-2	DP	–	SI8019BE.200
B-4AO-2	DP	–	SI8018BE.200

SIxxxxBE.200

There are two type-file version for configuring analog modules with COM ET 200 Windows (SIxxxxAE.200 and SIxxxxBE.200).

You can use either version. The SIxxxxBE.200 version supports additional functions for analog modules (alarms, dummy-value output for 4AO) and additional measuring ranges.

The SIxxxxBE.200 version now also supports single-channel addressing.

Installation

The manuals on the software contain notes on installation.

Note

The type files listed in Tables A-1 and A-2 are valid for the modules described in this manual (order numbers are listed in Appendix F), even if the type files contain the order numbers of predecessor modules!