SIEMENS

SIMATIC

ET 200L, ET 200L-SC and ET 200L-SC IM-SC Distributed I/O Device

Manual

EWA 4NEB 780 6009-02c

Edition 04

Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

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.

Qualified Personnel

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.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

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

Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Technical data subject to change.

Siemens Aktiengesellschaft

Order No. 6ES7 130-1AA00-8BA0

Preface

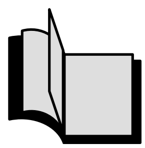
Purpose of the Manual

The information in this manual will enable you to run the ET 200L distributed I/O device and Smart Connect SC in the ET 200 distributed I/O system as a DP slave.

Contents of the Manual

Order number 6ES7 130-1AA00-8AA0 comprises the manual

ET 200L, ET 200L-SC and ET 200L-SC IM-SC
Distributed I/O Device, Release 4



- User information on the ET 200L,
  ET 200L-SC and ET 200L-SC IM-SC
  (SC = Smart Connect)
- Appendices

Applicability of the Manual

This manual is valid for the components of the ET 200L distributed I/O device and Smart Connect SC specified in Appendix A.

It describes the components valid at the time of publication. We reserve the right to attach current product information on new and updated components.

Changes Since the Previous Manual

Changes have been made since the previous version of this manual, order number 6ES7 130-1AA00-8AA0, Release 3, as regards the following:

- ET 200L-SC IM-SC (fine-step modular I/O device)
- ET 200L: AC terminal block and electronics blocks
- ET 200L-SC: High-speed SC analog input modules and counter module

Standards and Certification

The ET 200L and Smart Connect SC meet the requirements and and criteria of IEC 1131, Part 2 and are based on the EN 50170 Volume 2, PROFIBUS standard. They meet the requirements for the CE marking, and have CSA, UL and FM certification.

You will find detailed information on certification and standards in Section 6.1.

Recycling and Disposal

The ET 200L distributed I/O device and Smart Connect SC are environment-friendly products. They are exceptional for the following:

- Development in accordance with the guidelines for environment-friendly products: SN 36350
- Laser inscriptions (i.e. no labels)
- Plastics identification in accordance with DIN 54840
- Fewer materials used due to size reduction; fewer parts due to integration in ASICs

The ET 200L and Smart Connect SC are recyclable due to their low contaminant content.

To recycle and dispose of your old equipment in an environment-friendly manner, contact:

Siemens Aktiengesellschaft
Anlagenbau und Technische Dienstleistungen
ATD TD3 Kreislaufwirtschaft
Postfach 32 40
D-91050 Erlangen

Phone: +49 91 31/7-3 36 98
Fax: +49 91 31/7-2 66 43

The people there will adapt their advice to suit your situation and provide a comprehensive and flexible recycling and disposal system at a fixed price. After disposal you will receive information giving you a breakdown of the relevant material fractions and the associated documents as evidence of the materials involved.

Other Manuals

In addition to this manual, you will require the manual for the relevant DP master.

CD-ROM

The whole of the ET 200 documentation is also available as a collection on CD-ROM.

Aids to Using the Manual

To enable you to access the information you require as quickly as possible, the manual contains the following aids:

- At the beginning of the manual you will find a complete table of contents and lists of all the figures and tables in the manual.
- In the left-hand margin in each chapter you will find headings that provide you with an overview of the contents of the various sections .
- Following the appendices you will find a glossary, which contains definitions of important terms used in the manual.
- At the end of the manual you will find a detailed index, which gives you rapid access to the information you require.

Additional Support

If you have technical questions, please get in touch with your Siemens representative or office. You will find the address in the manuals of the DP masters (e.g. in the appendix entitled “Siemens Worldwide” of the *S7-300 Programmable Controller; Hardware and Installation* manual) in catalogs and in CompuServe (`GO AUTFORUM`). A hotline is available on +49 (911) 895-7000 (fax: 7001).

If you require the type file or device master file, you can download it by modem. Dial +49 (911) 737972.

If you have questions or comments about the manual itself, please fill in the form at the end of the manual and send it to the specified address. Please give us your personal assessment of the manual on the form.

To make things easier for those new to the ET 200 distributed I/O device, we offer the ”KO-ET 200” workshop. If you are interested, please contact your regional training center or the central training center in D-90327 Nuremberg (tel. 0911 895 3154).

Constantly Updated Information

You can get constantly updated information on SIMATIC products:

- On the Internet at http://www.ad.siemens.de/
- On the fax polling no. +49 8765-93 00 50 00

In addition, SIMATIC Customer Support provides you with current information and downloads that can be useful to you when using SIMATIC products:

- On the Internet at http://www.ad.siemens.de/support/html_00/index.shtml
- At the SIMATIC Customer Support mailbox on +49 (911) 895-7100

  To access the mailbox, use a modem of up to V.34 (28.8 kbps) with the following parameter settings: 8, N, 1, ANSI. Alternatively, use ISDN (x.75, 64 kbps).

You can contact SIMATIC Customer Support by phone on +49 (911) 895-7000 and by fax on +49 (911) 895-7002. You can also send queries by e-mail on the Internet or to the above mailbox.

Contents

Figures

Tables

1 Product Overview

In This Chapter

The product overview provides information about

- The role of the ET 200L distributed I/O device and Smart Connect within the ET 200 distributed I/O system.
- The components which make up the ET 200L distributed I/O device.
- The components which make up the Smart Connect SC.
- How the components of the ET 200L and Smart Connect SC can be used together.

Contents of the Chapter

1.1 What Is the ET 200 Distributed I/O System?

What Is the ET 200?

When a system is installed, the input/output modules are normally installed centrally in the programmable logic controller.

If inputs and outputs are made at long distances from the programmable logic controller, there may be long runs of cabling which are not immediately comprehensible, and electromagnetic interference may impair reliability.

In such systems, we recommend you to use the ET 200 distributed I/O system:

- The controller CPU is located centrally.
- The I/O (input/output) system operates locally in a distributed fashion.
- The ET 200 high-performance bus system ensures that the CPU and I/O system communicate with each other without problems owing to its high data transfer rates.

What Does the ET 200 Consist Of?

The ET 200 distributed I/O system consists of active (master) and passive (slave) nodes that are interconnected via the PROFIBUS-DP.

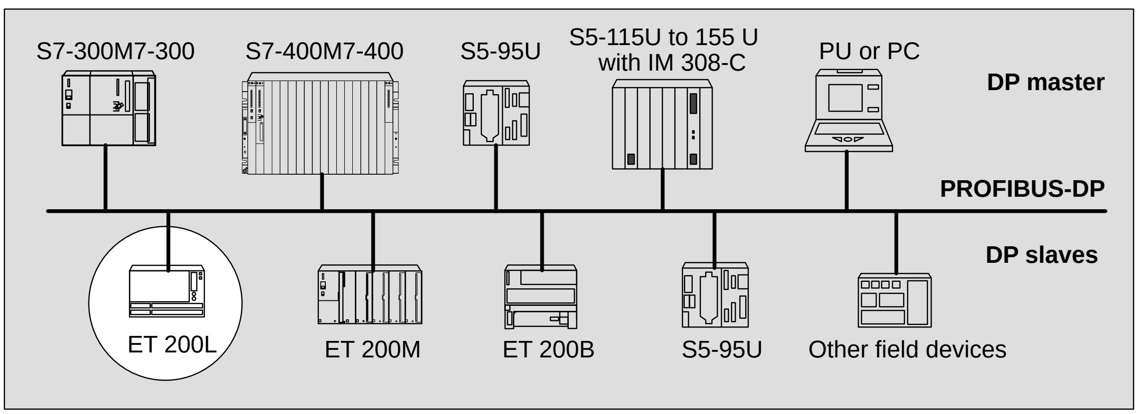


Figure 1-1 A Typical PROFIBUS-DP Installation

PROFIBUS-DP

PROFIBUS-DP (DP means distributed I/O) is an open bus system conforming with EN 50170 Volume 2, PROFIBUS. The PROFIBUS-DP consists of a DP master and DP slaves.

- **DP master**: The link between the controller and the distributed I/O system is the DP master. The DP master exchanges data with the distributed I/O system over the PROFIBUS-DP and monitors the field bus.
- **DP slave**: The I/O devices are connected as DP slaves. DP slaves process data locally from the sensors and signal control elements in such a manner that they can be transferred over the PROFIBUS-DP field bus.

1.2 What Is the ET 200L Distributed I/O Device and Smart Connect?

Definition

The ET 200L distributed I/O device and Smart Connect is a DP slave within the ET 200 distributed I/O system, its degree of protection being IP 20.

Applications

Owing to its compact and flat design, the ET 200L distributed I/O device and Smart Connect is particularly suitable for applications in which space is at a premium. The ET 200L distributed I/O device and Smart Connect has been designed for the low-end to medium performance ranges.

The ET 200L and Smart Connect is available in three versions:

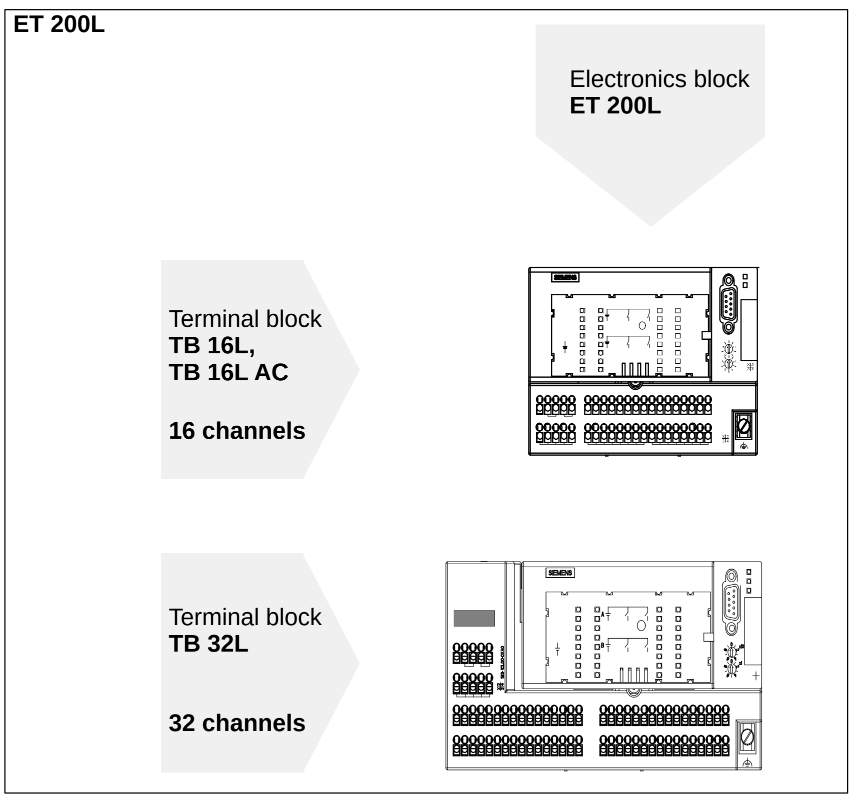
- The ET 200L block I/O device
- The ET 200L-SC modular I/O device
- The ET 200L-SC IM-SC fine-step modular I/O device

ET 200L Block I/O Device

The ET 200L block I/O device is not expandable.

The ET 200L consists of a terminal block for the wiring, to which an electronics block is connected. The electronics block determines the number of input/output channels.

The ET 200L block I/O device is available with 16 or 32 channels.

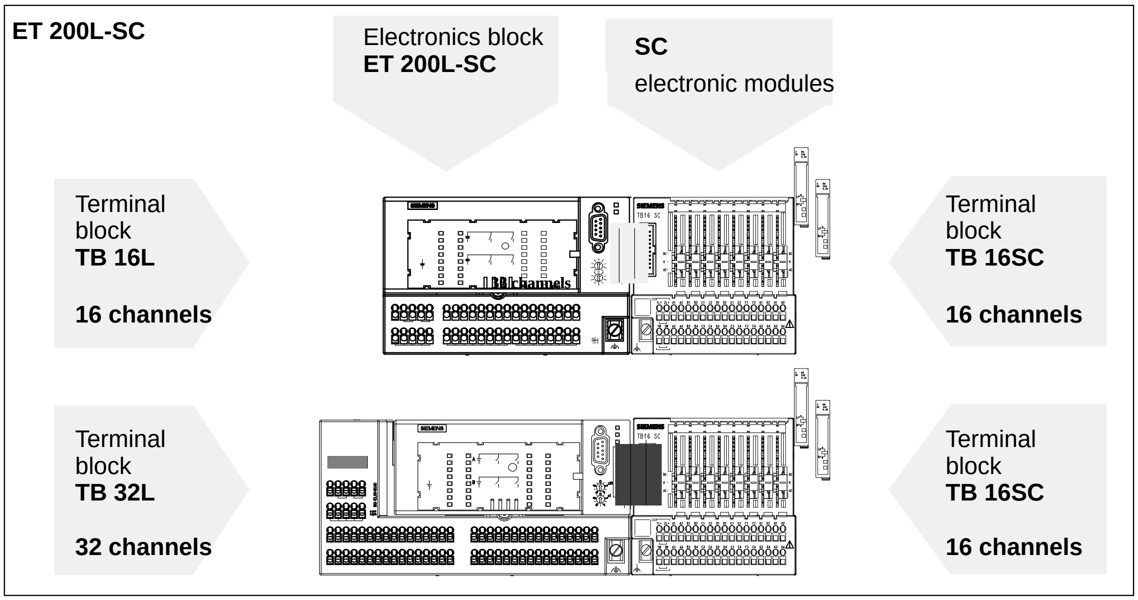


ET 200L-SC Modular I/O Device

The ET 200L-SC modular I/O device can be upgraded with the SIMATIC Smart Connect.

The ET 200L-SC also consists of a terminal block to which an electronics block is connected. The electronics block has an interface for connecting the SIMATIC Smart Connect.

The Smart Connect (SC) consists of a TB 16SC terminal block and up to 8 SC electronic modules. There are one- and two-channel SC electronic modules for digital and analog inputs/outputs or for count functions.



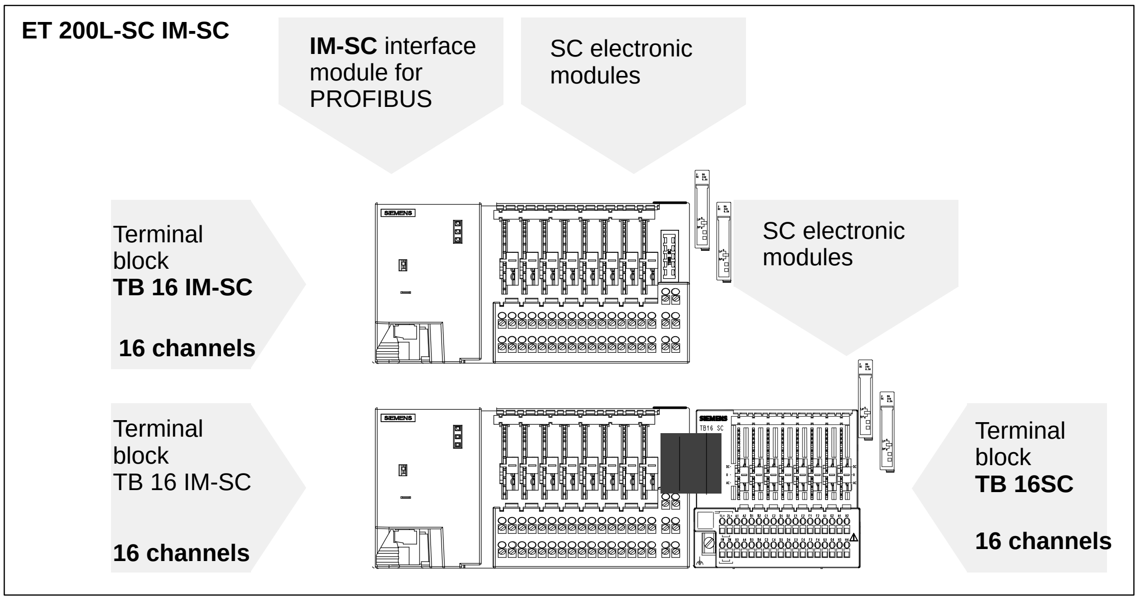
ET 200L-SC IM-SC Fine-Step Modular I/O Device

The ET 200L-SC IM-SC fine-step modular I/O device can be upgraded with the SIMATIC Smart Connect.

The ET 200L-SC IM-SC consists of a TB 16IM-SC terminal block to which you can connect the IM-SC interface module and up to 8 Smart Connect electronic modules.

The IM-SC interface module connects the ET 200L-SC IM-SC to the PROFIBUS-DP.

You can add the TB 16SC to the ET 200L-SC IM-SC, thus allowing you to run an additional 8 SC electronic modules.

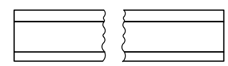
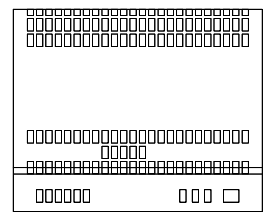
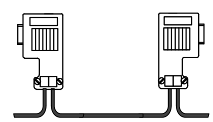


General Components for the ET 200L, ET 200L-SC, ET 200L-SC IM-SC

A range of components are available for setting up the ET 200L, ET 200L-SC or ET 200L-SC IM-SC. You will find the components that you require for all versions of the ET 200L in Table 1-1.

You will find other components in Sections 1.2.1 to 1.2.3.

Table 1-1 General Components for the ET 200L, ET 200L-SC, ET 200L-SC IM-SC

Component	Function	Illustration
Rail (EN 50022, 35 × 15 or 35 × 7.5)	... is the mounting rack for the ET 200L.	
Power supply (PS)	... converts the mains voltage (120/230 VAC) into a 24 V DC operating voltage for supplying the ET 200L. ... is the load current power supply for the 24 V DC load circuits.	
PROFIBUS cables with bus connector	... interconnect the nodes of a PROFIBUS-DP installation.	

Terminal Block

The terminal block (TB) is used for mounting the electronics block (EB). It contains the wiring so that if the electronics block is replaced, leads do not have to be loosened.

The terminal block is characterized by the following:

- It can be pre-wired before the electronics block is mounted.
- Depending on the design, wiring can be connected by means of screw-type or spring terminals.
- It has a two-wire termination and can be upgraded to a three- or four-wire termination by using supplementary terminals.
- It does not contain any active electronic components. The terminal block cannot therefore be destroyed electrically.
- You can insert different electronics blocks.
- There are 16-channel (TB 16L) and 32-channel (TB 32L) terminal blocks.
- The TB 16IM-SC terminal block is used in conjunction with the IM-SC interface module, offers pre-wiring and can be expanded directly by means of a TB 16SC terminal block of the Smart Connect.

Electronics Block

The electronics block contains the logic circuitry and is inserted into the terminal block and screwed. It is characterized by the following:

- It defines the number of input/output channels.
- You do not have to loosen the terminal lead to replace the electronics block; you merely have to remove the bus connector.
- The PROFIBUS-DP is connected via a bus connector to the electronics block.
- You can set PROFIBUS addresses 1 to 99.
- There is galvanic isolation between the PROFIBUS-DP and the internal electronics.
- LEDs are used to display: The voltage supply of the electronics block (ON), bus faults (BF), group errors (SF; not for ET 200L), the status of inputs and outputs
- There is a labeling strip in the electronics block for clear identification of inputs and outputs. You can order the labeling strip separately (refer to Appendix A.1).
- A circuit diagram is displayed on the electronics block. The circuit diagram is located beneath the labeling strip.
- The electronics blocks of the ET 200L-SC can each be be upgraded with a TB 16SC terminal block of the SIMATIC Smart Connect.

Processing Time

The internal processing time is < 1ms.

1.2.1 What Is the ET 200L Block I/O Device?

Features of the ET 200L

Figure 1-2 shows you a view of the ET 200L distributed I/O device. It consists of a terminal block and an electronics block.

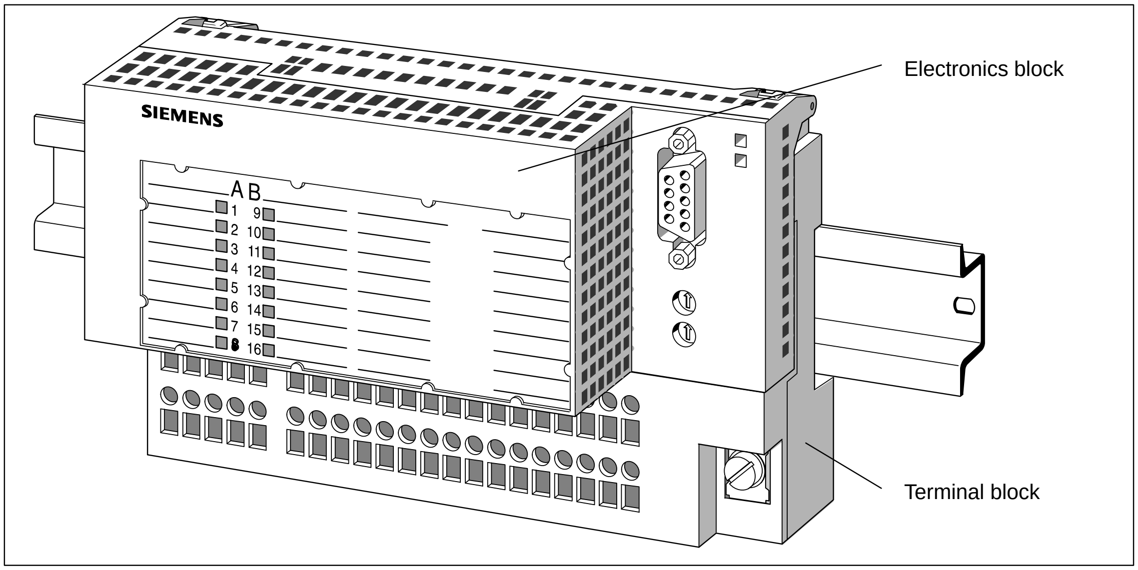


Figure 1-2 View of the ET 200L Distributed I/O Device

ET 200L Modules

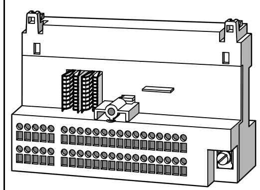
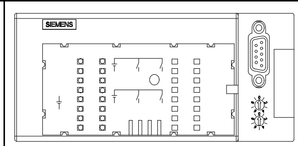
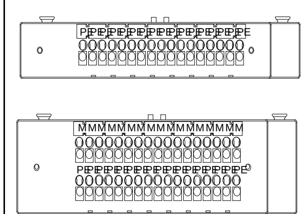
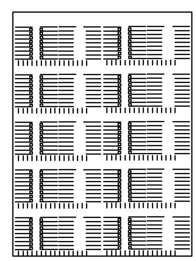
The modules incorporated in the ET 200L include:

- 24 V DC digital input and/or output modules
- AC digital input and/or output modules

ET 200L Components

A whole range of components is available for installing and commissioning the ET 200L. The most important components and their functions are listed in Table 1-2:

Table 1-2 Components of the ET 200L Distributed I/O Device

Component	Function	Illustration
TB 16L, TB 32L, TB 16L AC terminal block	... carries the wiring and accepts the electronics block.	
Electronics block	... is mounted on the terminal block. It defines the function (input or output).	
Supplementary terminals – 1-row – 2-row	... are an extension for actuators and sensors with a 3- or 4-wire termination.	
Labeling sheet	... allows the labeling strips to be labeled automatically or printed using a laser printer.	

Technical Data

You will find the technical data for the terminal blocks in Sections 7.1 to 7.3 and the technical data for the electronics blocks in Chapter 8.

1.2.2 What Is the ET 200L-SC Modular I/O Device?

ET 200L-SC Modules

The modules of the ET 200L-SC can be upgraded with a Smart Connect. The modules of the ET 200L-SC include:

- 24 V DC digital input modules
- 24 V DC digital output modules
- 24 V DC digital input and output modules

Smart Connect SC

The digital and analog electronic modules of the Smart Connect SC add to the digital inputs and outputs of the ET 200L-SC.

Modules of the Smart Connect SC

The Smart Connect SC has the following modules:

- 24 V 0.5A/2A DC digital input/output modules
- 120/230 V AC digital input/output modules
- 230 V AC relay module
- Analog input modules (U, I, TC, RTD)
- Analog output modules (U, I)

Features of the Smart Connect SC

The Smart Connect SC consists of a terminal block and various electronic modules that you can connect to it.

The Smart Connect SC allows you to fine tune the inputs and outputs to your process.

You can connect both analog and digital electronic modules to the terminal block at the same time.

Smart Connect Connecting Cable

You connect the ET 200L to the Smart Connect SC by means of the prefabricated connecting cable. Chapter 3.10 describes how to do this.

Components of the Smart Connect SC

A number of components are available to you for installing and commissioning a Smart Connect. Table 1-3 lists these components and their functions:

Table 1-3 Components of a ET 200L-SC

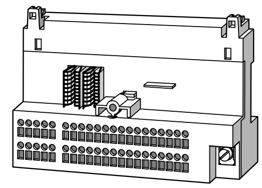
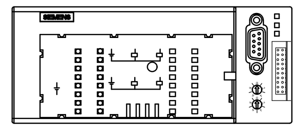
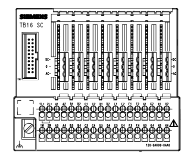
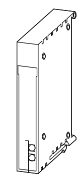
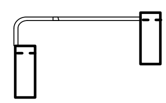
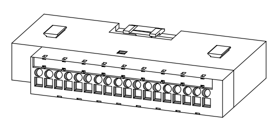
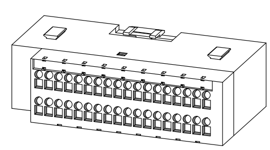
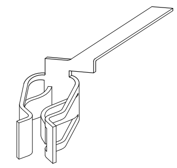
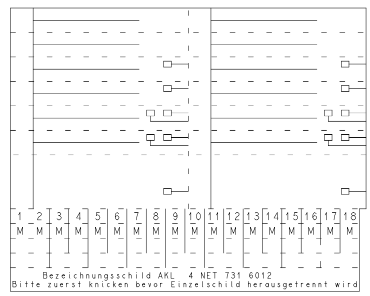
Component	Function	Illustration
TB 16L, TB32L terminal block – With spring terminal – With screw-type terminal	...carries the wiring and accepts the electronics block.	
Electronics block for the SC	...is mounted on the terminal block. It defines the function and has an interface for connecting the Smart Connect.	
TB16 SC terminal block – With spring terminal – With screw-type terminal	...carries the wiring and the SC electronic modules.	
Digital/analog electronic modules	...are connected to the TB 16SC terminal block. Electronic modules define the functions (input/ output...).	
Smart Connect connecting cable (comes with the TB 16SC terminal block)	... connects the TB 16SC to the SC electronic modules.	
Supplementary terminal, single-row – Spring terminal – Screw-type terminal	...is an add-on module for actuators and sensors with 3-conductor connections.	
Supplementary terminal, 2-row – Spring terminal – Screw-type terminal	...is an add-on module for actuators and sensors with 4-conductor connections.	

Table 1-3 Components of a ET 200L-SC, continued

Component	Function	Illustration
Shield terminal	...connects the shielding of analog signal lines with the supplementary terminal.	
Labeling sheet	...allows the labeling strips to be labeled automatically or printed using a laser printer.	

Technical Data

You will find the technical data in the following chapters and sections:

- TB 16L and TB 32L terminal blocks: Sections 7.1 and 7.2
- Electronics blocks for the Smart Connect: Chapter 9
- TB 16SC terminal block: Section 7.4
- SC electronic modules: Chapters 10 and 12

1.2.3 What Is the ET 200L-SC IM-SC Fine-Step Modular I/O Device?

Features of the ET 200L-SC IM-SC

The ET 200L-SC IM-SC consists of the TB 16IM-SC terminal block, to which the IM-SC interface module and up to 8 Smart Connect electronic modules are connected.

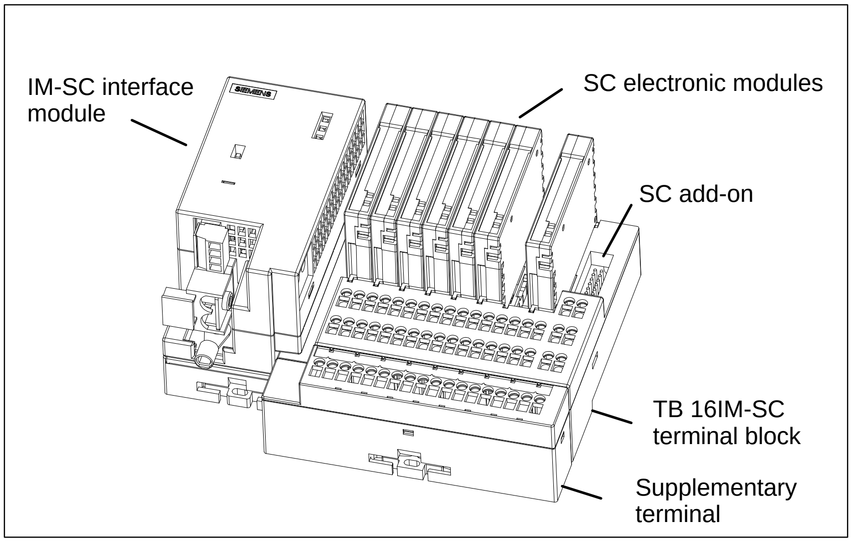


Figure 1-3 ET 200L-SC IM-SC

IM-SC Interface Module

The IM-SC interface module connects the ET 200L-SC IM-SC to the PROFIBUS-DP.

- It is tilted onto the TB 16IM-SC terminal block.
- It has a connector for the PROFIBUS-DP.
- The PROFIBUS addresses 1 to 99 can be set.

Modules of the SC Electronic Modules

You can connect up to 8 SC electronic modules to the TB 16IM-SC terminal block directly. The Smart Connect SC modules include:

- 24 V 0.5A/2A DC digital input/output modules
- 120/230 V AC digital input/output modules
- 230 V AC relay module
- High-speed analog input modules (U, I)
- Analog input modules (U, I, TC, RTD)
- Analog output modules (U, I)
- 40 kHz counter module

Expanding the ET 200L-SC IM-SC

The ET 200L-SC IM-SC can be expanded by means of a TB 16SC terminal block to connect 8 additional SC electronic modules.

High-Speed Analog Input Modules

These modules offer high-speed measured-value acquisition and data transfer. They are particularly well suited to rapid data acquisition for pressure and flow measurements.

The high-speed analog input modules can only be used in the TB 16IM-SC terminal block or in the expanded TB 16SC terminal block.

Components for the ET 200L-SC IM-SC

There are a range of components available for installing and commissioning a Smart Connect. Table 1-4 lists the components and specifies their functions:

Table 1-4 Components of an ET 200L-SC IM-SC

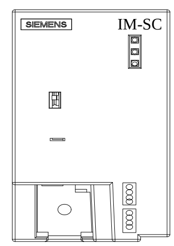
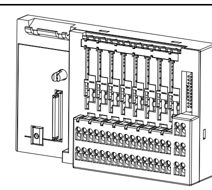
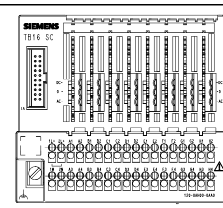
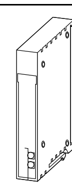
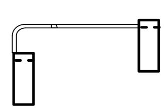
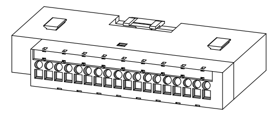
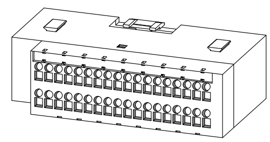
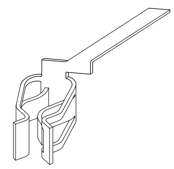
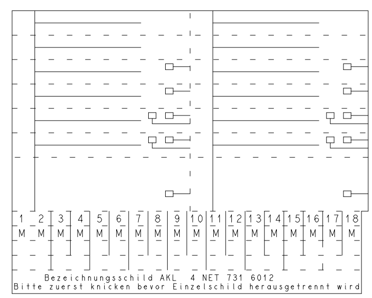
Component	Function	Illustration
IM-SC interface module	... connects the TB 16IM-SC terminal block to the PROFIBUS-DP.	
TB 16IM-SC terminal block – With spring terminal – With screw-type terminal	...carries the wiring, the IM-SC interface module and the SC electronic modules.	
TB 16SC terminal block (with SC connection cable) – With spring terminal – With screw-type terminal	... is added to the TB 16IM-SC and carries the wiring and 8 additional SC electronic modules.	
Digital/analog electronic modules/counter module	...are connected to the TB 16IM-SC and TB 16SC terminal blocks. Electronic modules determine the functions (input/output...).	
Smart Connect connecting cable (comes with the TB 16IM-SC terminal block)	... connects the ET 200L-SC IM-SC to the TB 16SC for connecting 8 additional SC electronic modules.	

Table 1-4 Components of an ET 200L-SC IM-SC

Component	Function	Illustration
Supplementary terminal, single-tier – Spring terminal – Screw-type terminal	...is an extension for actuators and sensors with a 3-wire connection.	
Supplementary terminal, two-tier – Spring terminal – Screw-type terminal	...is an extension for actuators and sensors with a 4-wire connection.	
Shield terminal	...connects the shielding of analog signal lines with the supplementary terminal.	
Labeling sheet	...enables automatic labeling or printing by laser printer.	

Technical Data

You will find the technical data for the ET 200L-SC IM-SC in the following sections and chapters:

- IM-SC interface module: Section 9.1
- TB 16IM-SC terminal block: Section 7.5
- TB 16SC terminal block: Section 7.4
- SC electronic modules: Chapters 10 and 12

  Counter module: Chapter 13

Installation

2

Introduction

The ET 200L distributed I/O device and Smart Connect has been designed for simple installation and wiring. To this end, the label of the ET 200L distributed I/O device and Smart Connect has been made self-explanatory.

In this chapter, you will find additional information on installing and wiring the ET 200L distributed I/O device and Smart Connect.

Procedure

A number of steps are involved in the installation of the ET 200L distributed I/O device and Smart Connect. We suggest you adhere to the following sequence:

Procedure		Section
Installing the ET 200L	1. Install the ET 200L TB 16L/TB 32L terminal block and supplementary terminal	2.1
	2. Install and disassemble the ET 200L electronics block	2.2
	3. Set the ET 200L PROFIBUS address	2.6
Installing the ET 200L-SC and Smart Connect	1. Install the ET 200L TB 16L/TB 32L terminal block and supplementary terminal	2.1
	2. Install and disassemble the ET 200L electronics block	2.2
	3. Install the SC TB 16SC terminal block	2.3
	4. Connect the Smart Connect electronic modules to the TB 16SC terminal block	2.4
	5. Set the ET 200L PROFIBUS address	2.6
	6. Install a supplementary terminal and shield terminal on the TB 16SC terminal block	2.7
Installing the ET 200L-SC IM-SC and Smart Connect	1. Install the ET 200L TB 16IM-SC terminal block	2.3
	2. Connect Smart Connect electronic modules to the TB 16IM-SC terminal block	2.4
	3. Install the SC TB 16SC terminal block	2.3
	4. Connect Smart Connect electronic modules to the TB 16SC terminal block	2.4
	5. Set the ET 200L PROFIBUS address on the IM-SC	2.6
	6. Install a supplementary terminal and shield terminal on the TB 16IM-SC/ TB 16SC terminal block	2.7

Contents of the Chapter

2.1 Installing the ET 200L TB 16L/TB 32L Terminal Block and Supplementary Terminal

Introduction

In this section, we describe how you install the terminal block and the supplementary terminal.

Requirements

Install the terminal block on a rail.

- You install the ET 200L distributed I/O device on a rail conforming with EN 50022 (35×7.5 or 35×15).
- The preferred mounting position is horizontal installation on a vertical wall. All other mounting positions are conceivable.
- You require a free space on a rail of 145 mm (16 channels) or 191 mm (32 channels).
- The minimum installation depth is 82 mm (with an electronics block installed and an MLFB 6ES7 972-0CA30 0XA0 bus connector connected) when using a $35 \times 7{,}5$ mm rail.
- You require a free space of 35 mm above the terminal block. You require a free space of 20 mm below the terminal block(when using the 42 mm single-tier supplementary terminal or the 57 mm two-tier supplementary terminal).

  If you add a TB 16SC to the ET 200L, you need a free space of 40 mm instead of 35 mm above the terminal block.

Installing the Terminal Block

Install the terminal block in the following order:

1. Mount the terminal block on the rail.
2. Tilt the terminal block backwards until you hear both the safety bolts engage.

You can now wire the terminal block (refer to Chapter 3) before you install the electronics block. If you are using supplementary terminals, you must install them before you commence wiring.

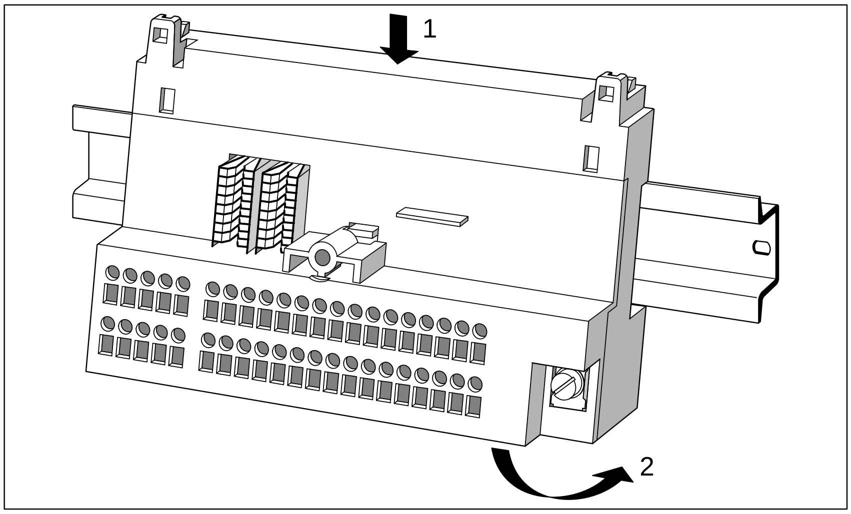


Figure 2-1 Installing the Terminal Block

Installing and Disassembling Supplementary Terminals

Push the supplementary terminals into the existing guideways on the lower side of the terminal block until you hear the safety bolt engage.

To disassemble supplementary terminals, proceed as follows:

1. Pull the safety bolt downwards as far as the stop.
2. Pull out the supplementary terminals forwards from the guideways.

Disassembling the Terminal Block

Remove the terminal block in the following order (refer also to Figure 2-2):

1. Turn off the power supply.
2. Remove the electronics block.
   – Remove the bus connector.
   – Loosen the fixing screw.
   – Tilt the electronics block forwards.
3. Loosen the wiring.
4. If you are using supplementary terminals, you must remove them before disassembling the terminal block (see above).
5. Press the two safety bolts downwards in succession with a screwdriver.
6. Tilt and remove the terminal block from the rail.

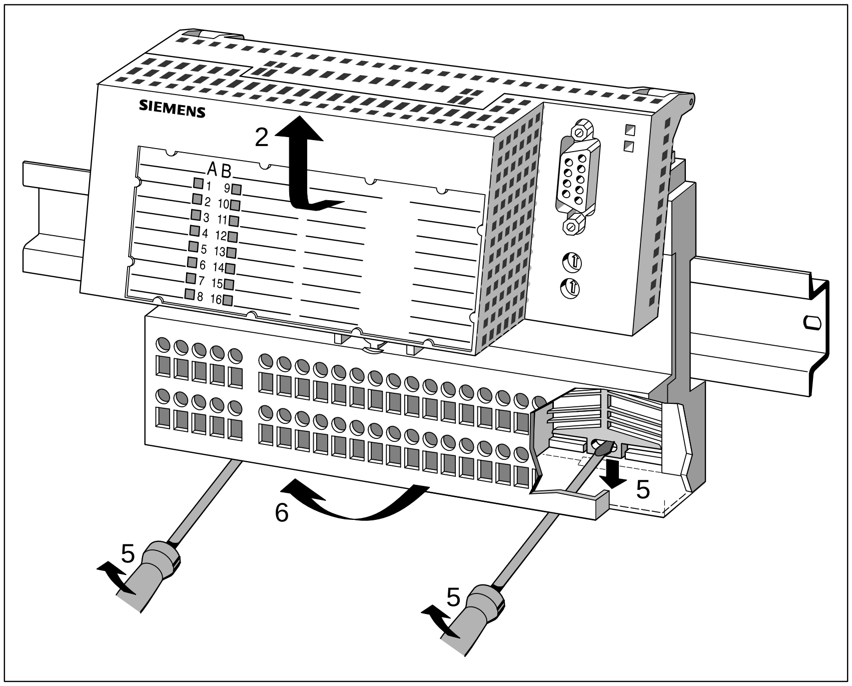


Figure 2-2 Disassembling the Terminal Block

2.2 Installing and Disassembling the ET 200L Electronics Block

Installing the Electronics Block

Attach the electronics block to the terminal block in the following order:

1. Insert the electronics block from above into the guideways on the terminal block.
2. Tilt the electronics block backwards as far as the stop.
3. Secure the electronics block on the terminal block by tightening the screw:

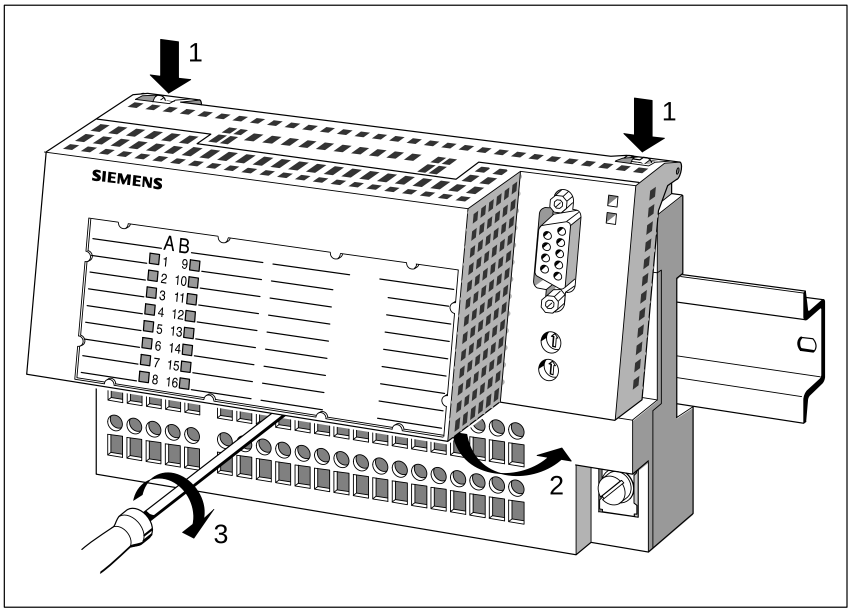


Figure 2-3 Installing the Electronics Block

Disassembling the Electronics Block

To disassemble the electronics block, proceed in the reverse order.

1. Turn off the power supply.
2. Remove the bus connector.
3. Loosen the fixing screw.
4. Tilt the electronics block forwards.

2.3 Installing the TB 16IM-SC/TB 16SC Terminal Block

Installation

The terminal blocks are intended for installation in a cabinet or in an enclosed casing or operating room.

The TB 16SC and TB 16IM-SC terminal blocks can be installed horizontally. Provided temperatures do not exceed 40 °C, other installation locations are also possible.

Installation Dimensions and Clearances

When working out the space requirements of a terminal block, you must maintain adequate clearances to other components.

These minimum clearances are necessary at installation and during operation for the following reasons:

- For installing and removing the terminal block and the electronic modules
- To guarantee the air flow required for cooling during operation
- TB 16IM-SC terminal block: You require a free space of 40 mm above the terminal block and 50 mm under the terminal block (when using the 50 mm single-tier supplementary terminal or the 57 mm two-tier supplementary terminal).
- TB 16SC terminal block: You require a free space of 40 mm above the terminal block and 20 mm under the terminal block (when using the 42 mm single-tier supplementary terminal or the 57 mm two tier supplementary terminal).

Installation Work

If you carry out installation work with AC modules with a 230 V load supply that involves disconnecting the protective conductor from the TB 16SC or TB16 IM-SC, you must first switch off the 230 V load supply.

Installing the Terminal Block

Proceed as follows:

1. Mount the terminal block in such a way that sufficient clearance remains for ventilating the terminal block and installing and ventilating the electronic modules.
2. Screw the rail (35 mm wide) to the cabinet frame or the mounting block (screw size: M5).
3. Position the terminal block on the 35 mm rail from above, and swing it down. The terminal block snaps onto the rail (see Figure 2-4).

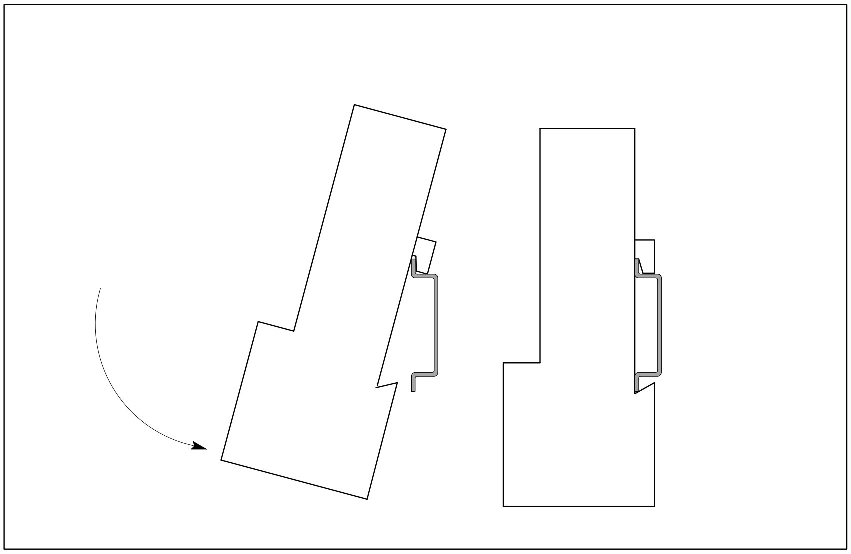


Figure 2-4 Snapping the Terminal Block onto the Rail

Sliding the Labeling Strips into the Terminal Block

Proceed as follows:

1. Note the assignment between the slot and the module on the labeling strip.
2. Slide the labeling strip from the side into the terminal block guide.

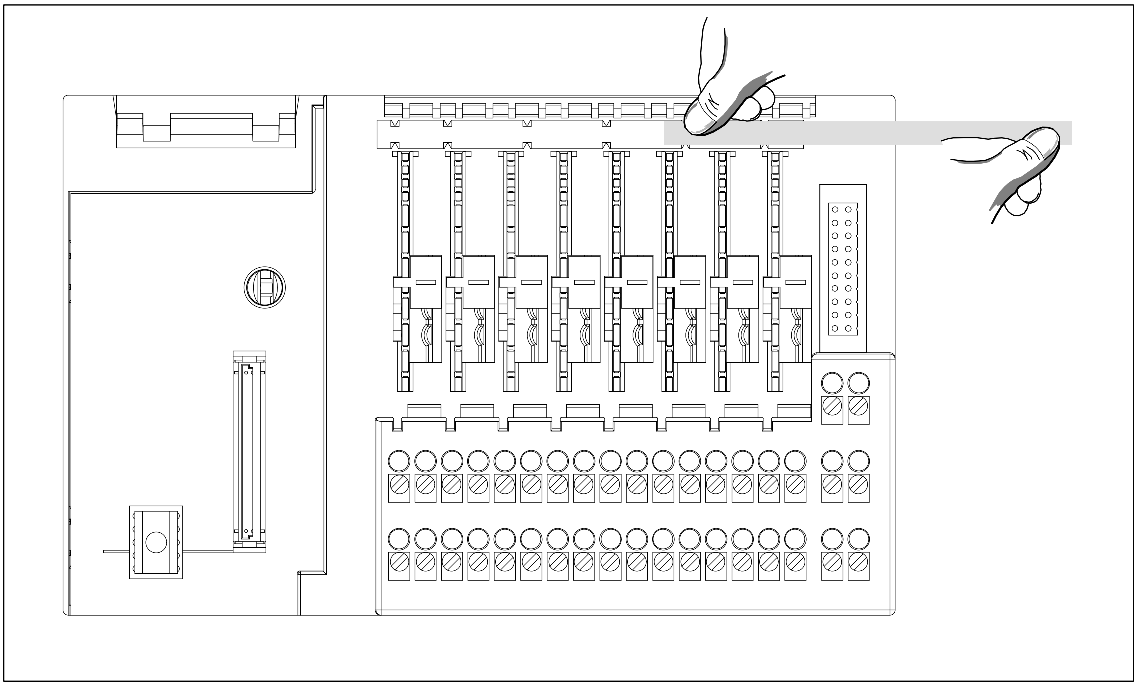


Figure 2-5 Sliding the Labeling Strip into the Terminal Block

Positioning the Coding Slide Switches

You must now position the coding slide switches correctly in accordance with the configuration of your system so that you can install the electronic modules. Each slot has a coding slide switch. The terminal blocks are supplied with coding slide switches at position 0.

Electronic Module	Position of the 1st Coding Slide Switch
DC Modules	
Digital electronic module 2DIDC24V (single width)	DC position (up)
Digital electronic module 2DODC24V0.5A (single width)	DC position (up)
Digital electronic module DODC24V2A (single width)	DC position (up)
Counter module 1COUNT40kHz (single width)	DC position (up)
AC Modules	
Digital electronic module 1DIAC120/230V (single width)	AC position (down)
Digital electronic module 1DOAC120/230V1A (single width)	AC position (down)
Digital electronic module 1DORel.AC230V (single width)	AC position (down)
Analog Electronic Modules	
Analog electronic module 2 AI U, 2 AI HS U (single width)	DC position (up)
Analog electronic module 2 AI I, 2 AI HS I (single width)	DC position (up)
Analog electronic module 2 AI TC (single width)	DC position (up)
Analog electronic module 1 AI RTD (single width)	DC position (up)
Analog electronic module 1 AO U (double width)	DC position (up)
Analog electronic module 1 AO I (double width)	DC position (up)

Warning

There is a risk of injury and damage to property.

Do not attempt to force the coding slide switch.

Forcing the coding slide switch is dangerous and can destroy electronic modules.

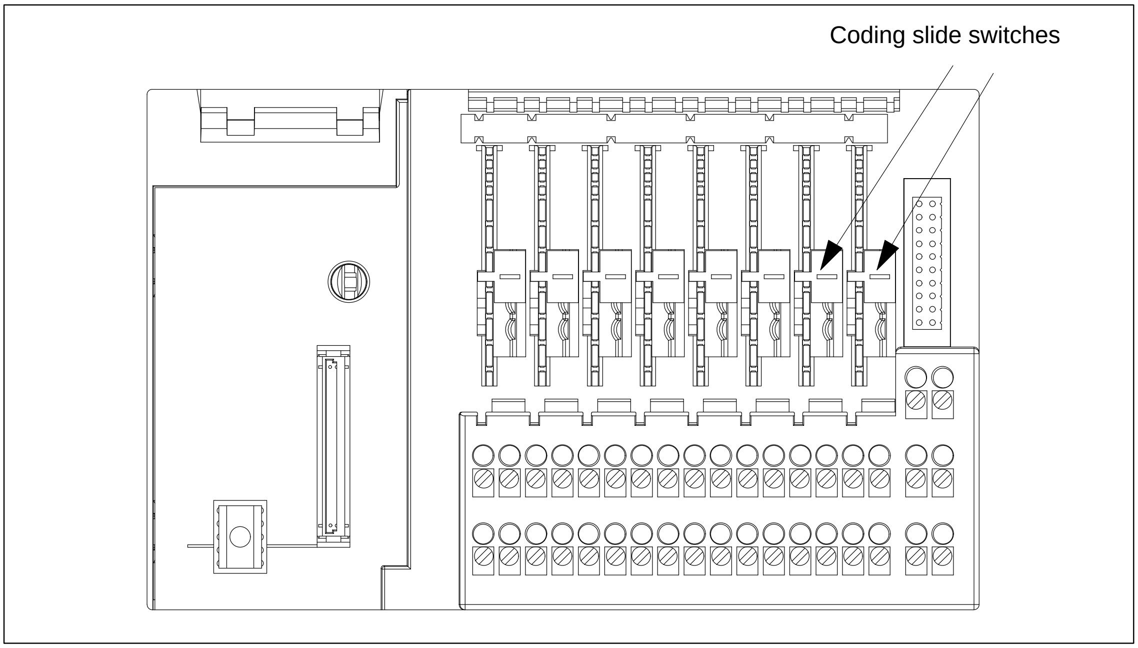


Figure 2-6 Positioning the Coding Slide Switches

1. Select a screwdriver with a blade width of 3.5 mm.
2. Insert the screwdriver into the slot on the coding slide switch (see Figure 2-7).
3. Apply slight pressure to push the coding slide switch into the required position.

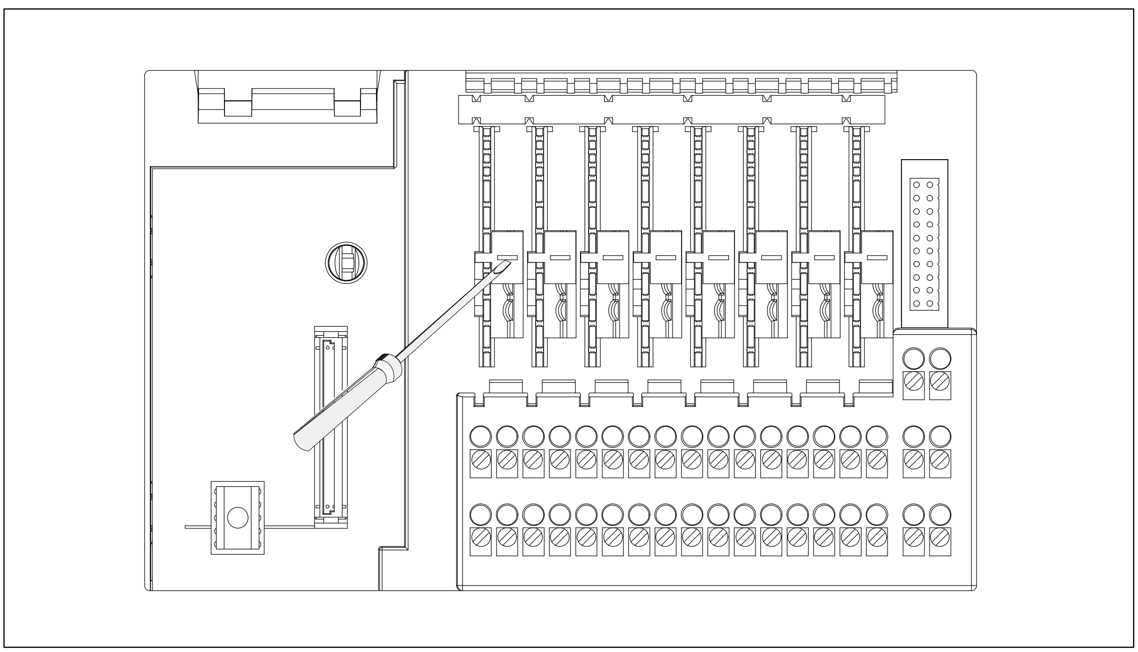


Figure 2-7 Using the Screwdriver

Noting the System Designation

Note your system designations on the enclosed labeling strip for the electronic module.

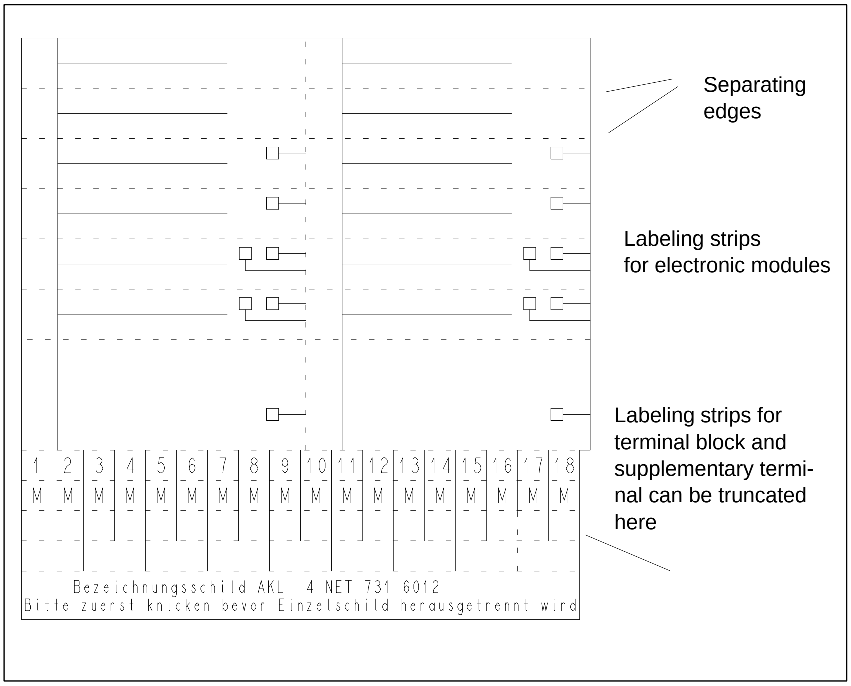


Figure 2-8 Designation Plate with Labeling Strips (Reduced in Size)

2.4 Connecting Smart Connect Electronic Modules to the TB 16IM-SC/TB 16SC Terminal Block

Connection Rules for the Electronic Modules

The following connection rules apply to the SC electronic modules:

- You can connect up to 10 counter modules in an ET 200L-SC IM-SC (with TB 16SC).
- The slot immediately to the **right** of an AC module/relay module must either have an AC module/relay module or be free (see the following example).
- Under certain circumstances the number of plug-in SC electronic modules is limited (see the next page).

Note

If you use the TB 16IM-SC and TB 16SC together, you have a maximum of 16 slots available. This gives you up to 32 digital/analog channels, which can include a maximum of 12 analog channels.

Examples

8 slots (A...H) are available to you on each terminal block.

You Want to Connect the Following Electronic Modules to a Terminal Block	A	B	C	D	E	F	G	H
Only DC modules	DC	DC	DC	DC	DC	DC	DC	DC
Only analog electronic modules	Analog	Analog		Analog	Analog	Analog	Analog	Analog
Only AC modules	AC	AC	AC	AC	AC	AC	Relay	
DC modules **and** AC modules	AC		DC	DC	AC	AC	Relay	
Analog electronic modules **and** AC modules	Analog		Analog	AC	AC	AC	AC	AC
Analog electronic modules, DC modules **and** AC modules	Analog	Analog	Analog	DC	DC	Analog	AC	AC
Analog electronic modules **and** DC modules	Analog	DC	Analog	DC	DC	Analog	DC	Analog

Circuit Schematic

The circuit schematic is shown on the front of every electronic module. Up to two LEDs are located below the circuit schematic. In the operating mode, the circuit schematic is covered by the labeling strip. The LEDs are visible through the transparent part of the labeling strip.

Number of Plug-in Analog SC Electronic Modules

The number of plug-in analog SC electronic modules is limited in the following cases:

– When there is no S7 DP master

– When they are used in an ET 200L-SC IM-SC with a TB 16SC connected

The PROFIBUS-DP standard EN 50 170, Volume 2, restricts the length of the parameterization data to a maximum of 244 bytes. This means that when analog SC electronic modules are used, the number of plug-in SC electronic modules may be limited. You will find a formula below for calculating the maximum number of SC electronic modules permitted in an ET 200L-SC IM-SC:

$$\mathbf{244 \leqq 10 + [(14 + D \times 7)]_1 + [(21 + A \times 9 + K \times 5 + C \times 18)]_2}$$

Key:

D = total number of digital SC electronic modules plugged in

A = total number of analog SC electronic modules plugged in

K = total number of analog channels plugged in

C = total number of SC counter modules plugged in

$[...]_1$ only necessary if digital SC electronic modules are plugged in

$[...]_2$ only necessary if analog SC electronic modules are plugged in

Example 1

ET 200L-SC IM-SC: 15 × 2AE; 1 × 2DE: —> D = 1; A = 15; K = 30

10 + (14 + 1 × 7) + (21 + 15 × 9 + 30 × 5) = 10 + 21 + 306 = 337

The result is greater than 244 so this configuration is not possible.

Example 2

ET 200L-SC IM-SC: 8 × 2AE; 4 × 2DE: —> D = 4; A = 8; K = 16

10 + (14 + 4 × 7) + (21 + 8 × 9 + 16 × 5) = 10 + 42 + 173 = 225

The result is less than 244 so this configuration is not possible.

Example 3

ET 200L-SC IM-SC: 6 × 2AE; 3 × 1COUNT40kHz; 4 × 2DE:
—> D = 4; A = 6; K = 12; C = 3

10 + (14 + 4 × 7) + (21 + 6 × 9 + 12 × 5 + 3 × 18) = 10 + 42 + 189 = 241

The result is less than 244 so this configuration is not possible.

Labeling Strips of the Electronic Modules

Slide the labeling strip down from the top into the electronic module to be plugged in.

Note

You will only achieve full operating safety of the electronic modules if you have inserted the labeling strips on the front of the electronic modules (electrostatic discharge on the front of the module, covering the LEDs).

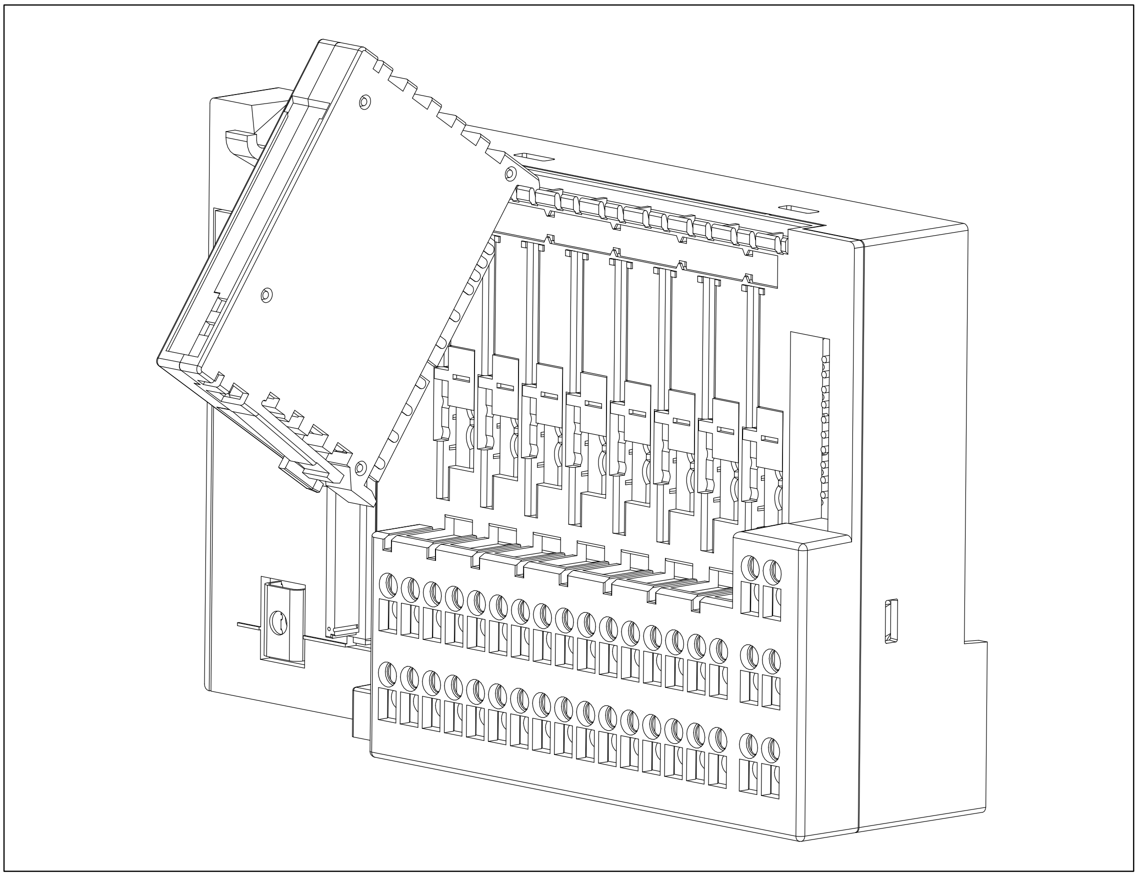


Figure 2-9 Connecting the Electronic Modules to the Terminal Block

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Warning

There is a risk of injury and damage to property.

If you install a combination of AC and DC modules on a terminal block, you must comply with the rules for doing this. If you do not, injury and damage can be caused.

Always position the electronic modules in accordance with the connection rules.

Warning

There is a risk of injury and damage to property.

When using AC modules, you must use a supplementary terminal **(screw-type terminal)**, to which you must connect the protective conductor.

When using AC modules, you must use **screw-type** supplementary terminals.

2.5 Installing the ET 200L IM-SC Interface Module on the TB 16IM-SC Terminal Block

Requirements

Before you install the IM-SC interface module on the TB 16IM-SC terminal block, note the following:

- The screw for fixing the IM-SC interface module is shipped screwed into the terminal block.

  Use a screwdriver to remove the screw.
- When the IM-SC interface module is installed, a cable lug providing a connection to chassis ground is fixed at the same time.

  Secure the ground cable in the cable lug, and establish a connection to chassis ground. See Section 3.7.

Installing the IM-SC Interface Module

Secure the IM-SC interface module by proceeding in the following sequence:

1. Hook the interface module from above into the guides on the terminal block.
2. Tilt the interface backward until the stop.
3. Put the cable lug for chassis ground (with the ground cable) on the screw, and secure the IM-SC interface module on the TB 16IM-SC terminal block by tightening the screw.

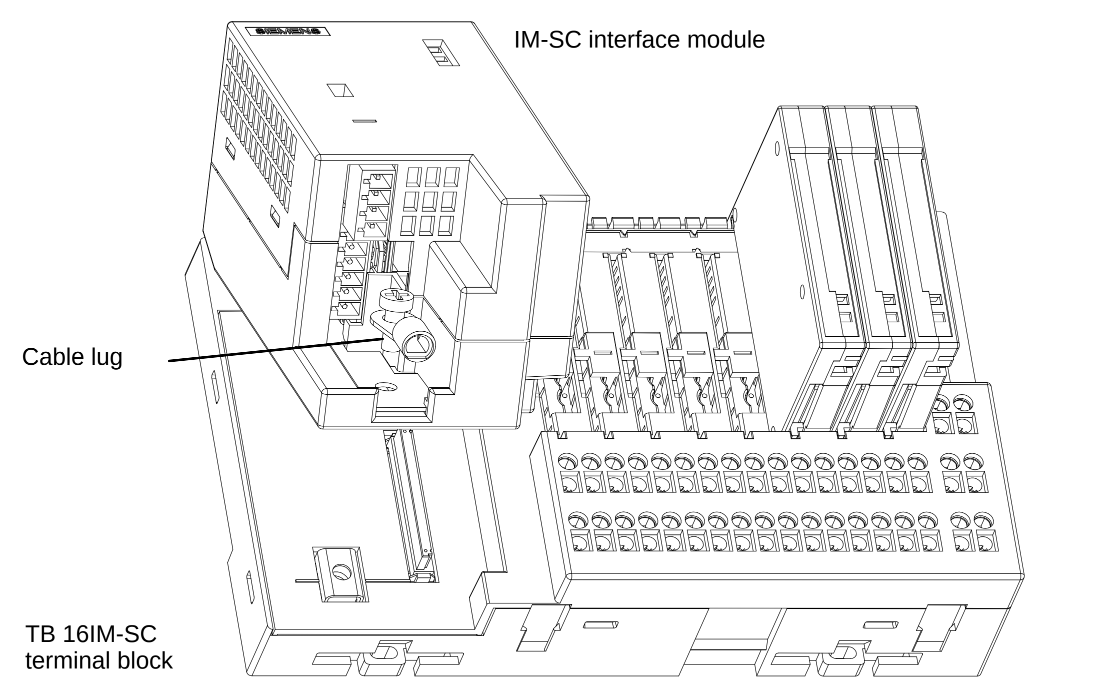


Figure 2-10 Installing the IM-SC Interface Module

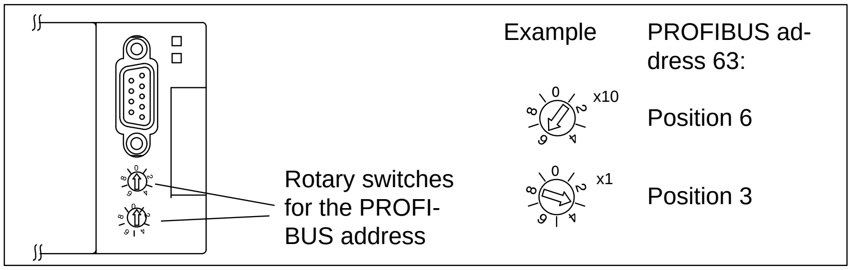
2.6 Setting the ET 200L PROFIBUS Address

Introduction

The PROFIBUS address defines the address of the ET 200L distributed I/O device on the PROFIBUS-DP.

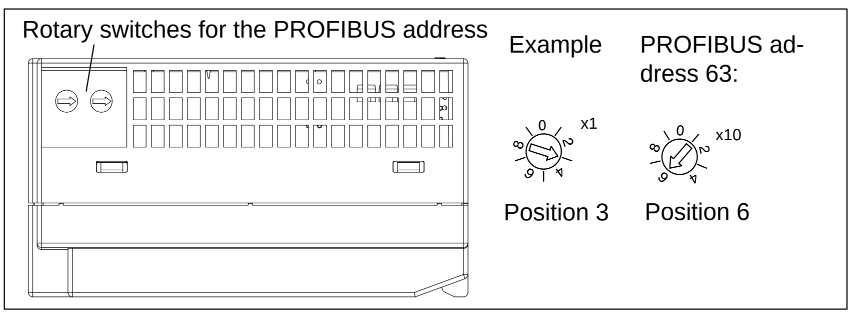
Location of Rotary Switches

The two rotary switches for the PROFIBUS address are located on the electronics block beneath the bus connector.
Tip: You must set the PROFIBUS address before clipping on the bus connector. When clipped on, the bus connector conceals the two rotary switches.



Rotary Switches of the ET 200L-SC IM-SC

The two rotary switches are on the right-hand side of the IM-SC interface module.
Tip: Set the PROFIBUS address before you wire the TB 16IM-SC terminal block or before you mount the IM-SC interface module. The rotary switches are more accessible then.



Modifying the PROFIBUS Address

You modify the PROFIBUS address at the two rotary switches by using a small screwdriver. PROFIBUS addresses 1 to 99 are authorized for the ET 200L distributed I/O device.

PROFIBUS address 0, which is set when the ET 200 distributed I/O system leaves the works, is reserved for a PU or PC. Any change made to the PROFIBUS address takes effect when the supply voltage is turned on.

2.7 Installing a supplementary terminal and shield terminal on the TB 16IM-SC/TB 16SC terminal block

Securing the Supplementary Terminal to the Terminal Block

If you want to connect a single-tier or two-tier supplementary terminal, proceed as follows:

1. Hold the supplementary terminal parallel to the terminal block. Use the right edge as a guide.
2. Insert the mountings (dovetails) into the grooves on the underside of the terminal block.
3. Press the upper side of the supplementary terminal against the underside of the terminal block, and slide the supplementary terminal to the back. The supplementary terminal engages.

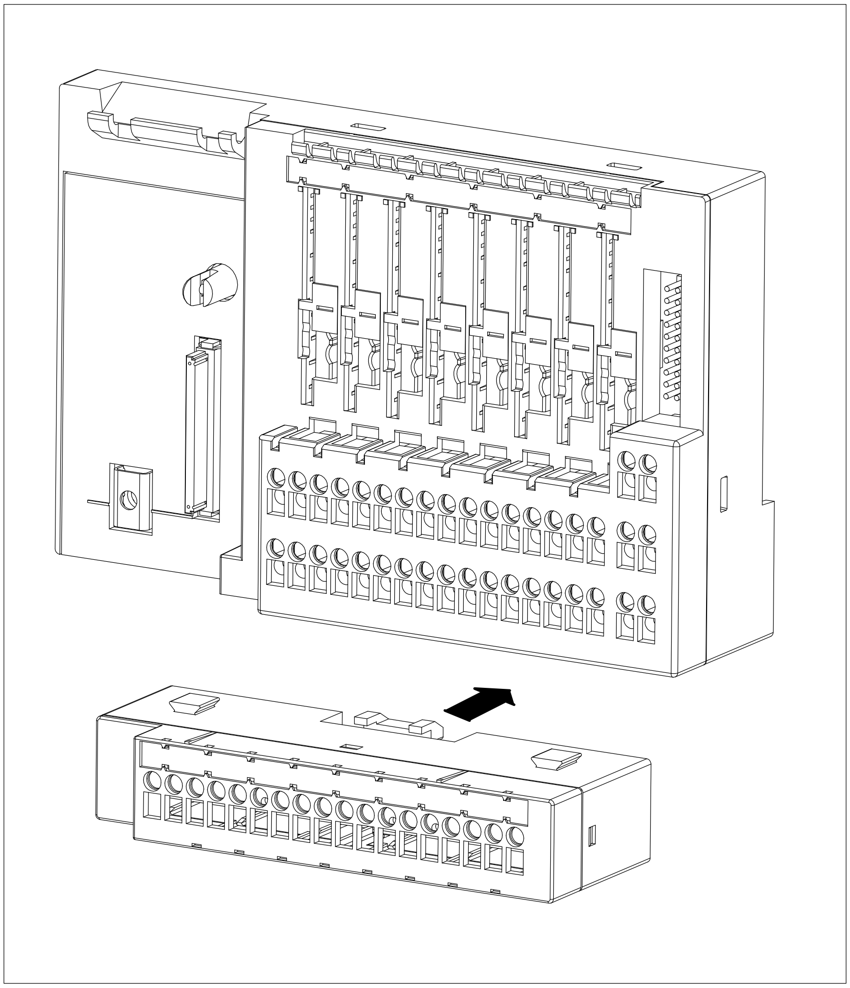


Figure 2-11 Securing a Supplementary Terminal to the Terminal Block

Shielding for Analog Processing

In analog processing, you insert the cables of the signal lines in the shield terminal. To do this, proceed as follows:

1. Clip the TB 16IM-SC/TB 16SC terminal block onto the rail.
2. Connect a 1- or 2-tier supplementary terminal to the TB 16IM-SC/ TB 16SC terminal block.
3. Connect the metallic shield terminal to the 1- or 2-tier supplementary terminal.

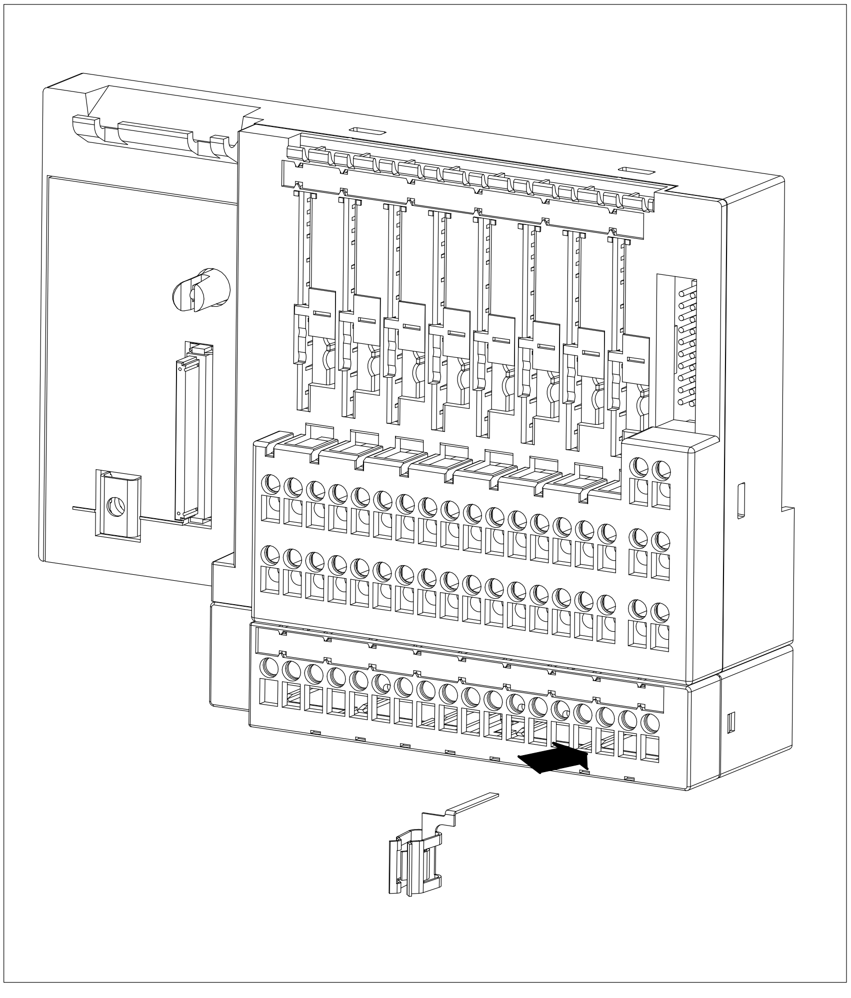


Figure 2-12 Connecting a Shield Terminal to the Supplementary Terminal

4. Secure the shield terminal in the supplementary terminal by tightening the screw of the slot with a screwdriver.
5. If you are using a TB 16IM-SC/TB 16 SC (screw-type terminal):

   Secure the shield terminal in the supplementary terminal by tightening the screw of the slot with a screwdriver.

   If you are using a TB 16IM-SC/TB 16 SC (spring terminal):

   Secure the shield terminal in the supplementary terminal by inserting a screwdriver in the lower opening and the shield terminal in the upper opening until the stop.
6. Strip the insulation to bare the conductors.
7. Secure the bared wire ends in the terminal block, and pull them through the shield terminal.

Wiring 3

Introduction

The ET 200L distributed I/O device and Smart Connect has been designed for simple wiring. To this end, the label of the ET 200L distributed I/O device and Smart Connect has been made self-explanatory.

In this chapter, you will find additional information on wiring the ET 200L distributed I/O device and Smart Connect.

Procedure

The wiring of the ET 200L distributed I/O device and Smart Connect involves several steps. We suggest you adhere to the following sequence:

Procedure		Section
Important information on wiring	1. General rules and regulations	3.1
	2. Configuring the electrical installation	3.2
	3. Wiring rules	3.3
Wiring the ET 200L	1. Wire the ET 200L TB 16L/TB 32L terminal block	3.4
Installing the ET 200L-SC and Smart Connect	1. Wire the ET 200L TB 16L/TB 32L terminal block	3.4
	2. Wire the Smart Connect TB 16SC terminal block	3.5
	3. Install a supplementary terminal for the TB 16SC	3.8
	4. Connect shielded cables to the shield terminal of the supplementary terminals	3.9
	5. Connect the Smart Connect SC to the ET 200L-SC	3.10
Wiring the ET 200L-SC IM-SC and Smart Connect	1. Wire the ET 200L TB 16IM-SC terminal block	3.4
	2. Wire the ET 200L IM-SC interface module	3.7
	3. Wire the Smart Connect TB 16SC terminal block	3.5
	4. Install the supplementary terminal for the TB 16SC/TB 16IM-SC	3.8
	5. Connected shielded cables to the shield terminal of the supplementary terminals	3.9
	6. Connect the Smart Connect SC to the TB 16IM-SC	3.10

Contents of the Chapter

3.1 General Rules and Regulations

Introduction

As a component part of a plant or system, the ET 200L distributed I/O device necessitates observance of special rules and regulations, depending on where it is to be used.

This section provides an overview of the most important rules which you have to observe for integrating the ET 200L distributed I/O device in a plant or system.

Specific Application

Observe the safety and accident prevention regulations – for example, the machine protection guidelines – for specific applications.

EMERGENCY STOP Devices

EMERGENCY STOP devices conforming with IEC 204 (corresponds to DIN VDE 113) must remain effective in all the operating modes of the plant or system.

Plant Start-up After Certain Events

The following table shows the points you have to take into account upon start-up of a plant following certain events.

If ...	Then ...
Start-up follows a voltage drop or failure Start-up of the ET 200L follows an interruption of bus communications	No hazardous operating states may occur. Force an EMERGENCY STOP, if necessary.
Start-up follows unlocking of the EMERGENCY STOP device ET 200L start-up occurs without the DP master addressing the ET 200L	There must not be an uncontrolled or undefined start-up.

Supply Voltage

The following table shows you the items you have to take into account in respect of the supply voltage.

With ...	It Is Essential That ...
A permanently installed plant or system not having an all-pole supply isolating switch	A supply isolating switch or a fuse be present in the building installation
Load current power supplies, power supply modules	The set rated voltage range corresponds to the local supply voltage
All circuits of the ET 200L distributed I/O device	The fluctuation or deviation of the supply voltage from the rated value be within the permitted tolerance (refer to Section 6.6)

24 VDC Supply

The following table shows the points that you have to take into account in respect of the 24 VDC supply.

With ...	Pay Attention to...	
Buildings	Outdoor lightning protection	Take lightning protection precautions – for example, lightning conductors
24 VDC supply lines, signal lines	Indoor lightning protection	
24 VDC supply	Safe (electrical) isolation of extra-low voltage	

Protection Against External Electrical Phenomena

The following table shows you the items you have to take into account in respect of protection against electrical phenomena or faults.

With ...	Pay Attention to:
Any plant or system in which the ET 200L is installed	Is the plant or system connected to a protective conductor for diverting electromagnetic interference?
Connecting leads, signal and bus lines	Are the wiring arrangement and installation correct?
Signal and bus lines	Any break of a line or conductor must not result in undefined states of the plant or system.

3.2 Configuring the Electrical Installation

Introduction

In this section, you will find information on the overall installation of an ET 200L distributed I/O device and Smart Connect on a grounded supply (TN-S system). The specific topics discussed are:

- Circuit-breaking devices, short-circuit and overload protection in accordance with DIN VDE 0100 and DIN VDE 0113
- Load current power supplies and load circuits.

Definition: Grounded Supply

With grounded supplies, the neutral conductor of the system is grounded. A mere ground fault between a live conductor and ground or a grounded section of the plant causes the protective devices to trip.

Components and Protective Measures

Different components and protective measures are specified for erecting a complete plant. The types of component and the degree to which the protective measures are binding depend on the DIN VDE regulation that applies to the installation of your plant. The following table refers to Figure 3-1.

Table 3-1 DIN VDE Regulations for Installation of a Controller

Compare ...	Ref. to Fig. 3-1	DIN VDE 0100	DIN VDE 0113
Circuit-breaking device for PLC, sensors and signal control elements	1	... Part 460: Main switch	... Part 1: Disconnector
Short-circuit and overload-protection: Grouped for sensors and signal control elements	2	... Part 725: Single-pole protection of circuits	... Part 1: • With grounded secondary circuit: **single-pole** protection • In all other cases: **all-pole** protection
Load current power supply for AC load circuits with more than five electromagnetic apparatus	3	Galvanic isolation by means of a transformer is **recommended**	Galvanic isolation by means of a transformer is **essential**

Note

The ET 200L and Smart Connect cannot be operated with an ungrounded supply.

Characteristics of Load Current Power Supplies

The load current power supply feeds input and output circuits (load circuits) as well as sensors and actuators. The following table lists the characteristics of load current power supplies that are required in specific applications.

Characteristic of Load Current Power Supply	Required for ...	Remarks
Safe (electrical) isolation	Modules that have to be supplied with voltages $\leq$ 60 VDC or $\leq$ 25 VAC	Power supply PS 307 and Siemens Series 6EP1 load current power supplies have this characteristic
	24 VDC load circuits	
Output voltage tolerances: 20.4 V to 28.8 V	24 VDC load circuits	If the output tolerances are exceeded, we recommend that you install a back-up capacitor. Rating: 200 µF per 1 A load current (with full-wave rectification).

Rule: Ground Load Circuits

Load circuits should be grounded.

Fault-free operating reliability is ensured by the common reference potential (ground). Install a detachable connection to the protective conductor on the external power supply (terminal L or M) or on the isolation transformer (Figure 3-1, $\boxed{4}$). This measure makes it simpler for you to locate ground faults in the power distribution system.

EMC

You will find notes on EMC-compatible installation and wiring in the manual for the DP master you are using or for the host system.

Take into account the following notes on EMC-compatible installation of the ET 200L distributed I/O device:

- We recommend that you place the cable shield of the PROFIBUS-DP on both sides of a shield bus.
- The chassis ground and the ground terminal are interconnected in the ET 200L distributed I/O device. Connect the ground terminal of the ET 200L distributed I/O device using a copper cable of at least 2.5 mm^2 to the central grounding point in the installation cabinet.
- In the case of the ET 200L-SC, connect the ground terminals of the ET 200L-SC and Smart Connect SC using a short copper cable of at least 2.5 mm^2.

ET 200L in Overall Installation

Figure 3-1 shows the location of the ET 200L in the overall system (load current voltage supply and grounding philosophy) for supply from a TN-S system.

Remark: The arrangement of the power supply connections shown in the figure does not correspond to the actual arrangement but was chosen for the sake of clarity.

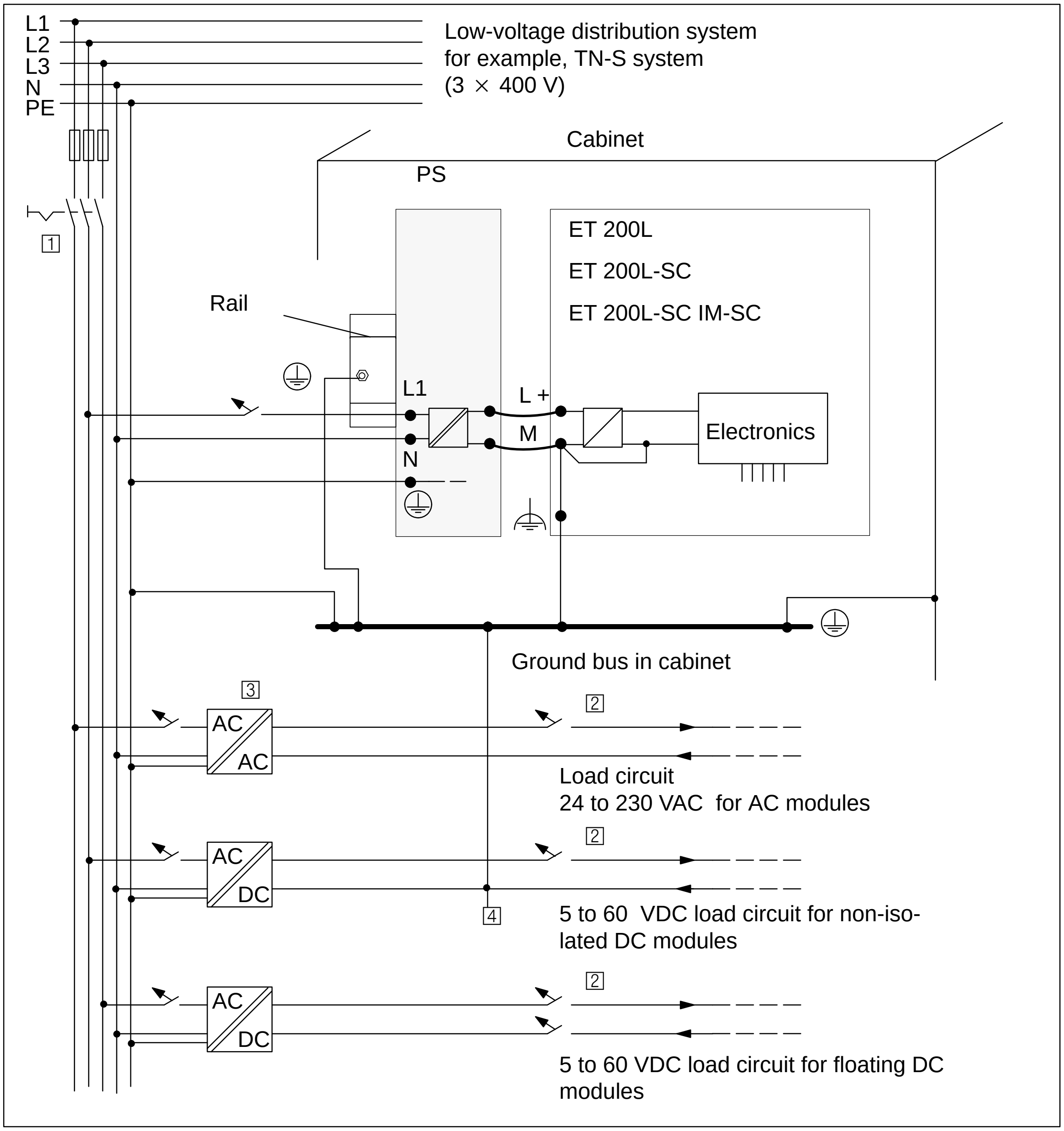


Figure 3-1 Operating the ET 200L from a Grounded Supply

Smart Connect in Overall Installation

Only safely isolated low voltage (DC 24 V) can be used as the power supply. Safe isolation from the mains supply can be achieved in accordance with the requirements in VDE 0100 Part 410 / HD 384-4-41 / IEC 364-4-41 (as functional low voltage with safe isolation) or VDE 0805 / EN 60950 / IEC 950 (as safety extralow voltage with safe isolation SELV) or VDE 0106 Part 101.

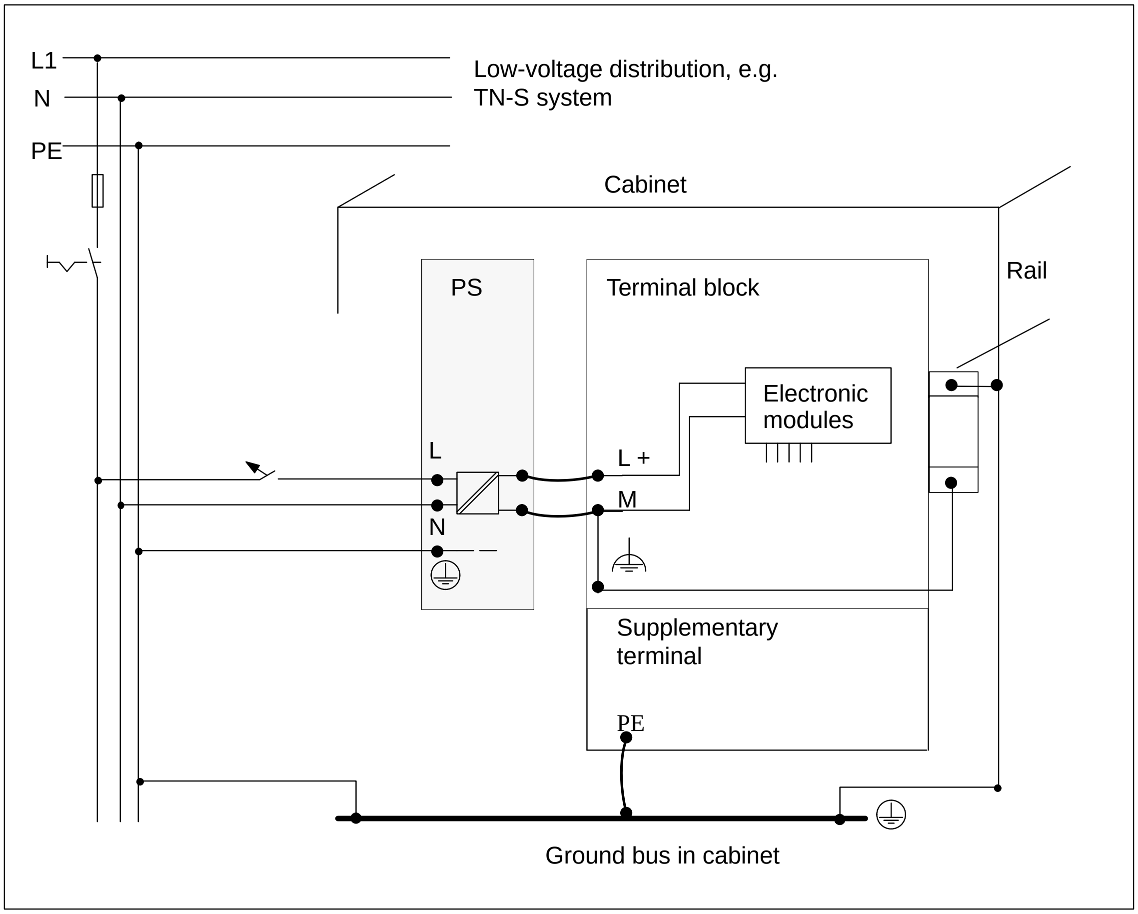


Figure 3-2   Power Supply of the Terminal Block

Special Feature

The 1DIAC120/230V and 1DOAC120/230V1A electronic modules do not require any auxiliary voltage (L+, M).

A supplementary terminal for connecting the protective conductor is required when these electronic modules are used.

3.3 Wiring Rules

Rules for Wiring

The table below shows you what you must observe when wiring the terminal block and the supplementary terminal.

Table 3-2 Pinout of the PROFIBUS-DP Terminal Connection

Rules for ...	Terminal block	
	Spring Terminal	**Screw-Type Terminal**
Suitable cable cross-sections:		
Solid cables	0.14 to 1.5 mm^2 (for PI connection: 2.5 mm^2)	
Flexible cables		
• Without wire end ferrule	0.14 to 1.5 mm^2 (for PI connection: 2.5 mm^2)	
• With wire end ferrule	0.14 to 1.5 mm^2	
Number of cables per connection	1 or combination of 2 cables to a total of 1.5 mm^2 in one wire end ferrule	
Max. diameter of cable insulation	∅ 3.1 mm ∅ 3.8 mm for 2.5 mm^2	
Insulation stripping length of the cables		
• Without insulation collars	7 to 11 mm	
• With insulation collars	7 to 11 mm	
Wire end ferrule in accordance with DIN 46228		
• Without insulation collars	Shape A; up to 12 mm long	Shape A; up to 12 mm long
• With insulation collars		
– 0.25 to 1.0 mm ^{2}	Shape E; up to 12 mm long	Shape E; up to 12 mm long*
– 1.5 mm^2	Shape E; 12 mm long	Shape E; 18 mm long*
Blade width of the screwdriver	3.5 mm (cylindrical design)	
Tightening torque for connecting cables (not applicable to spring terminals)	–	0.4 to 0.7 Nm
Ground connection	up to 6 mm^2 in cable lug for M4 screw	

Terminal Block with Screw-Type Terminal

To wire the terminal block (screw-type terminal), proceed as follows:

1. Strip the insulation of the wires down to 11 mm.
2. Connect the conductors. Begin on the left under the terminal block.
3. Screw the ends of the cables onto the terminal block with a tightening torque of 0.5 Nm. Tighten the screws on the unwired terminals as well.

Terminal Block with Spring Terminal

To wire the terminal block (spring terminal), proceed as follows:

1. Strip the insulation of the wires down to 11 mm.

Remember to:

- Insert the screwdriver in the lower opening.
- Insert the cable in the upper opening until the stop.

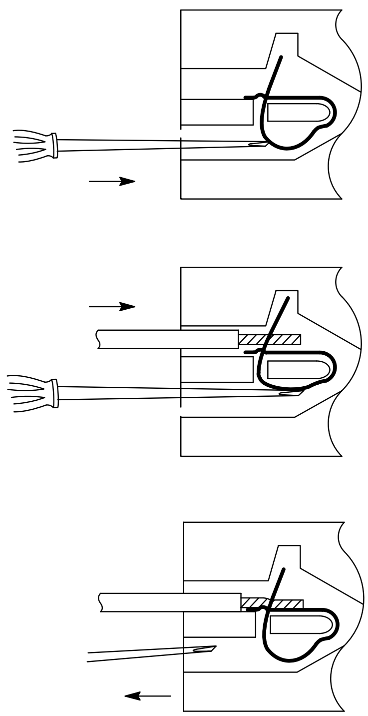


Figure 3-3 How the Spring Terminal Works

4. Release the spring terminal of the first connection using a screwdriver (0.5 x 3.5 mm DIN 5264). Begin at the bottom left of the terminal block.
5. Push the first wire into the released spring terminal and withdraw the screwdriver.
6. Repeat steps 1 to 3 for all other wires.

Warning

There is a risk of injury and damage to property.

Connecting different phases of a three-phase system to a terminal block can cause injury and damage to property.

Connect only one phase to each terminal block.

3.4 Wiring the ET 200L TB 16L/TB 32L Terminal Block

Introduction

When wiring the ET 200L distributed I/O device, we distinguish between the terminal block with its supplementary terminal and the electronics block.

- The terminal block and, if required, the supplementary terminal carry the wiring.
- The electronics block incorporates the PROFIBUS-DP connection.

Wiring the Terminal Block

All terminal connections on the terminal block and supplementary terminals are located on the front and are clearly marked and readily visible from the front. Assignment of terminal connections to input/output channels is simple to perform, without danger of confusion.

Connect the terminal block and the supplementary terminal in accordance with the configuration. Figure 3-4 shows the terminal connections for terminal block TB 16L. Its pinout is described in Chapter 7.

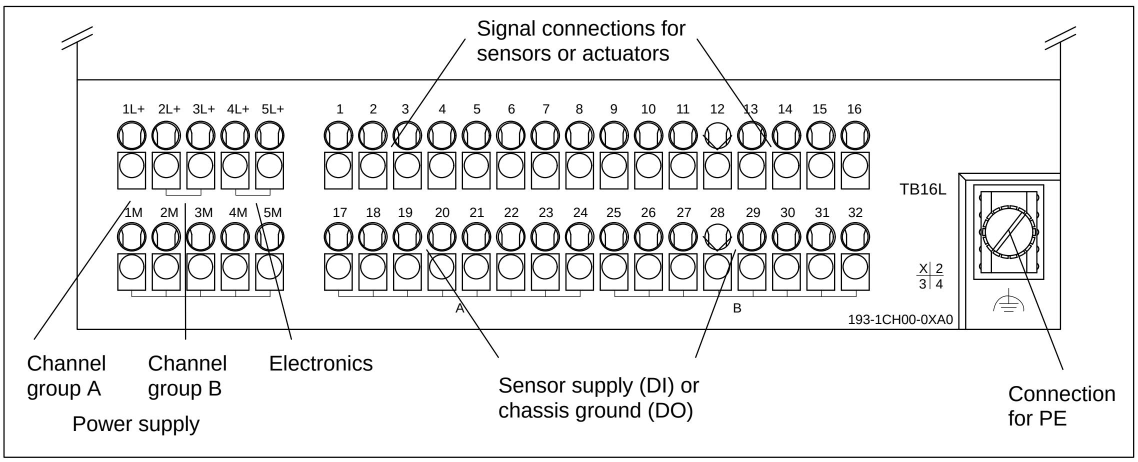


Figure 3-4 Terminal Connections on Terminal Block TB 16L

Connecting the Voltage Supply

There are three different ways to connect the voltage supply to the terminal block.

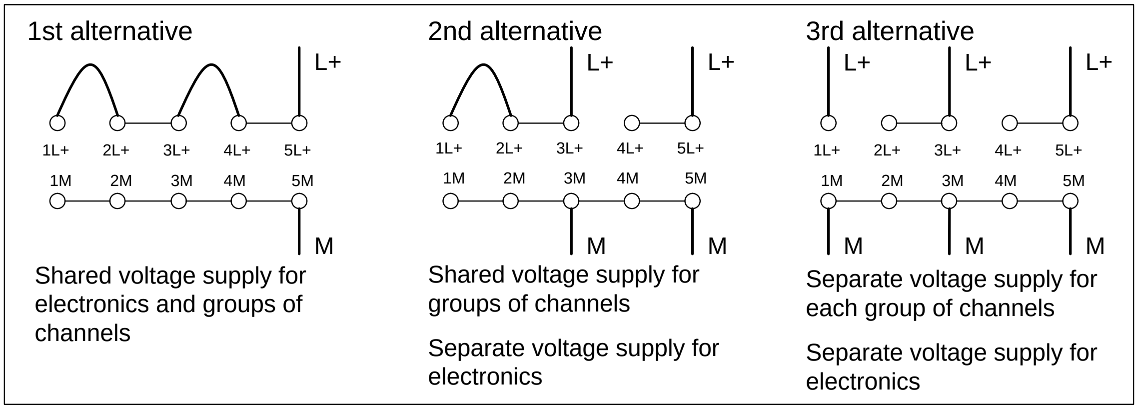


Figure 3-5 Alternative Ways of Connecting the Voltage Supply

Block Diagram

The block diagrams relating to the ET 200L distributed I/O device will be found in Chapter 7.

Label

A labeling strip is located on the front of the electronics block for noting the assignment of inputs and outputs.

Terminal Connection Model

A terminal connection model showing the terminal connection assignment and electrical connections is located beneath the labeling strip on the electronics block (refer to Chapter 8).

Clipping on the Bus Connector

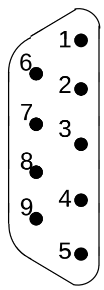
Clip the bus connector on the electronics block.

1. Clip the bus connector on the PROFIBUS-DP terminal connection after setting the PROFIBUS address of the ET 200L distributed I/O device (refer to Section 2.6).
2. Tighten the fastening screws of the bus connector.

PROFIBUS-DP Terminal Connection

The table below describes the pinout of the 9-pin PROFIBUS-DP terminal connection.

Table 3-3 Pinout of the PROFIBUS-DP Terminal Connection

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

1 For connecting an ET 200 handheld or an optical-fiber module

3.5 Wiring the Smart Connect TB 16SC Terminal Block

Introduction

The TB 16SC terminal block and – if required – the supplementary terminal carry the wiring.

Wiring the TB 16SC

The figure below shows the connections of the TB 16SC terminal block:

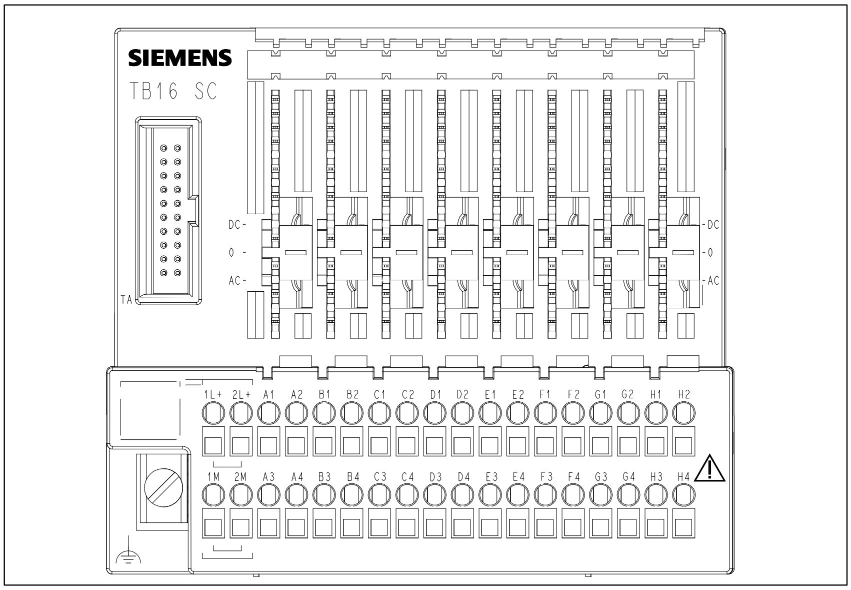


Figure 3-6 Front View of the Terminal Block

Warning

When installing the following electronic modules

- 2DODC24V0.5A (6ES7 122-1BB00-0AA0)
- 2DODC24V2A (6ES7 122-1BB10-0AA0)

check that the polarity of 1L+ and 1M and 2L+ and 2M on the TB 16SC terminal block is correct before you switch on the load voltage.
If the polarity is incorrect, any actuators connected may be activated.

Connecting to Local Ground

The terminal block has one local ground point.

1. You must provide a low resistance connection between the local ground point and the rail. For this purpose, use at least a 4mm^2 conductor with a maximum length of 0.5 m (cable lug rated size 4-6 in accordance with DIN 46237).
2. Provide a low-resistance connection between the rail and foundation ground. Ungrounded installation is not possible.

TB 16SC Terminal Designation

The following table contains an example of the assignment of terminals to slots.

Slot	Terminals
	1L+; 2L+
	1M; 2M
Slot A (on the extreme left)	A1;A2;A3;A4
Slot B	B1;B2;B3;B4
Slot C	C1;C2;C3:C4
Slot D	D1;D2;D3;D4
Slot E	E1;E2;E3;E4
Slot F	F1;F2;F3;F4
Slot G	G1;G2;G3;G4
Slot H	H1;H2;H3;H4

Terminal Assignments

Not all electronic modules use all the terminals assigned to the slot.

Unused terminals must not be wired in order to maintain the clearance and creepage distances.

Warning

There is a risk of injury and damage to property.

Connecting cables to unassigned terminals can cause injury and damage to property.

Do not connect cables to unassigned terminals.

3.6 Wiring the ET 200L TB 16IM-SC Terminal Block

Introduction

The TB 16IM-SC terminal block and – if required – the supplementary terminal carry the wiring. The TB 16IM-SC terminal block also has an interface to the Smart Connect.

Wiring the TB16 IM-SC

The figure below shows the connection of the TB 16IM-SC terminal block:

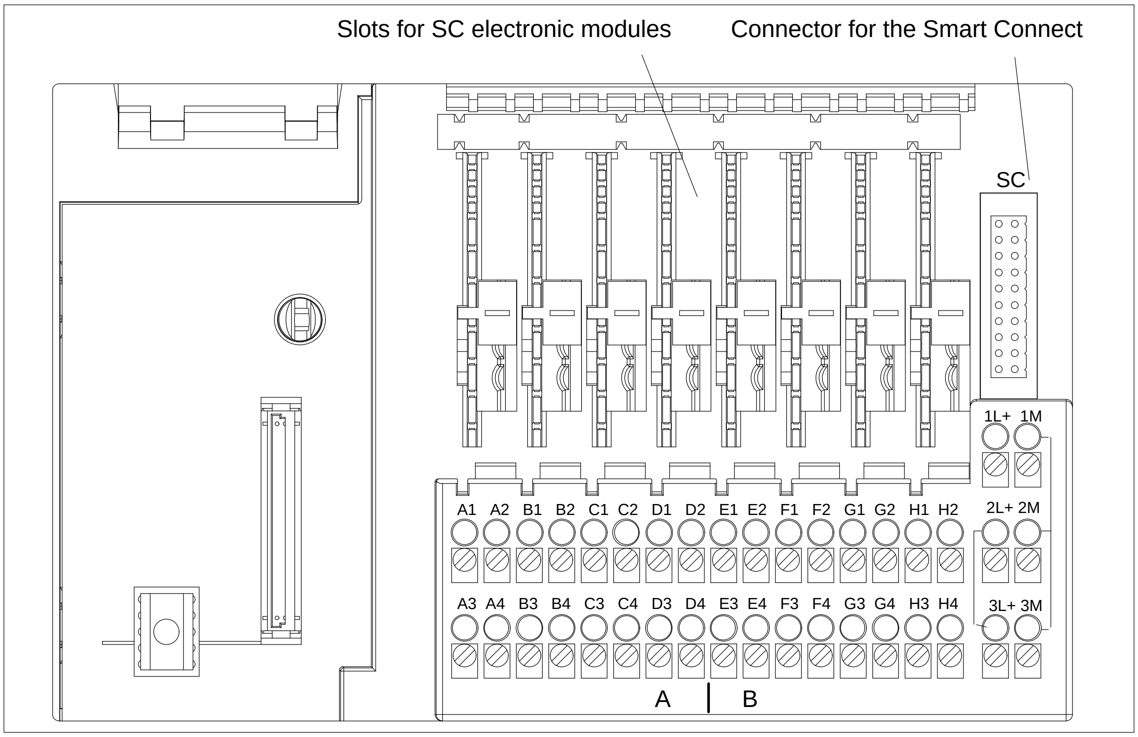


Figure 3-7 Connections of the TB 16IM-SC Terminal Block

Warning

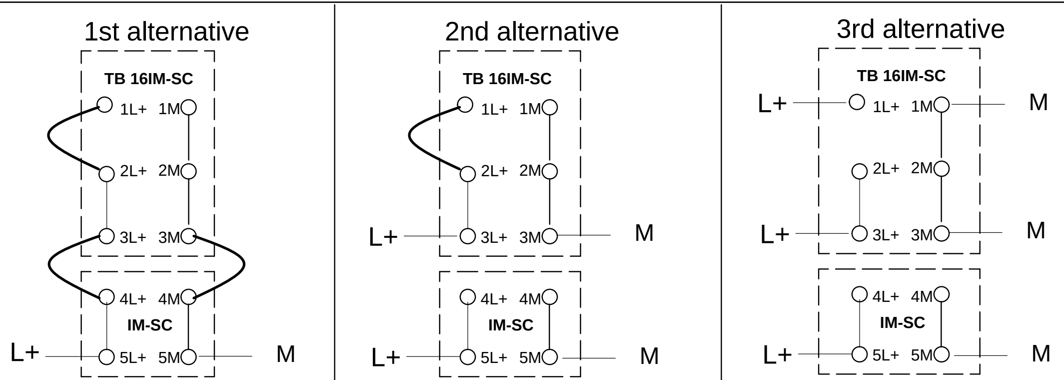
There is a risk of injury and damage to property.

Connecting cables to unassigned terminals can cause injury and damage to property.

Do not connect cables to unassigned terminals.

Connecting the Power Supply

There are two different ways to connect the voltage supply to the terminal block.



1st alternative	2nd alternative	3rd alternative
Shared power supply for the IM-SC and TB 16IM-SC (slots A to H)	Shared power supply for the TB 16IM-SC (slots A to H). Separate power supply for the IM-SC	Separate power supply for the TB 16IM-SC (slots A to D and E to H) Separate power supply for the IM-SC

The bridges between 4L+ and 5L+ and between 4M and 5M are in the screw-type terminal for the power supply (see Table 3-5).

Figure 3-8 Connection Alternatives for the Power Supply

TB 16IM-SC Terminal Designation

Unused terminals must not be wired in order to maintain the clearances and creepage distances.

Terminals	Description	Load Group
1L+, 1M	Power supply slot A to D	–
2L+, 2M; 3L+, 3M	Power supply slot E to H	–
A1;A2;A3;A4	Slot A (extreme left)	A
B1;B2;B3;B4	Slot B	A
C1;C2;C3:C4	Slot C	A
D1;D2;D3;D4	Slot D	A
E1;E2;E3;E4	Slot E	B
F1;F2;F3;F4	Slot F	B
G1;G2;G3;G4	Slot G	B
H1;H2;H3;H4	Slot H	B

3.7 Wiring the ET 200L IM-SC Interface Module

Introduction

The IM-SC connects the TB 16IM-SC terminal block to the PROFIBUS-DP.

Wiring the IM-SC

The figure below shows all the connections of the IM-SC interface module:

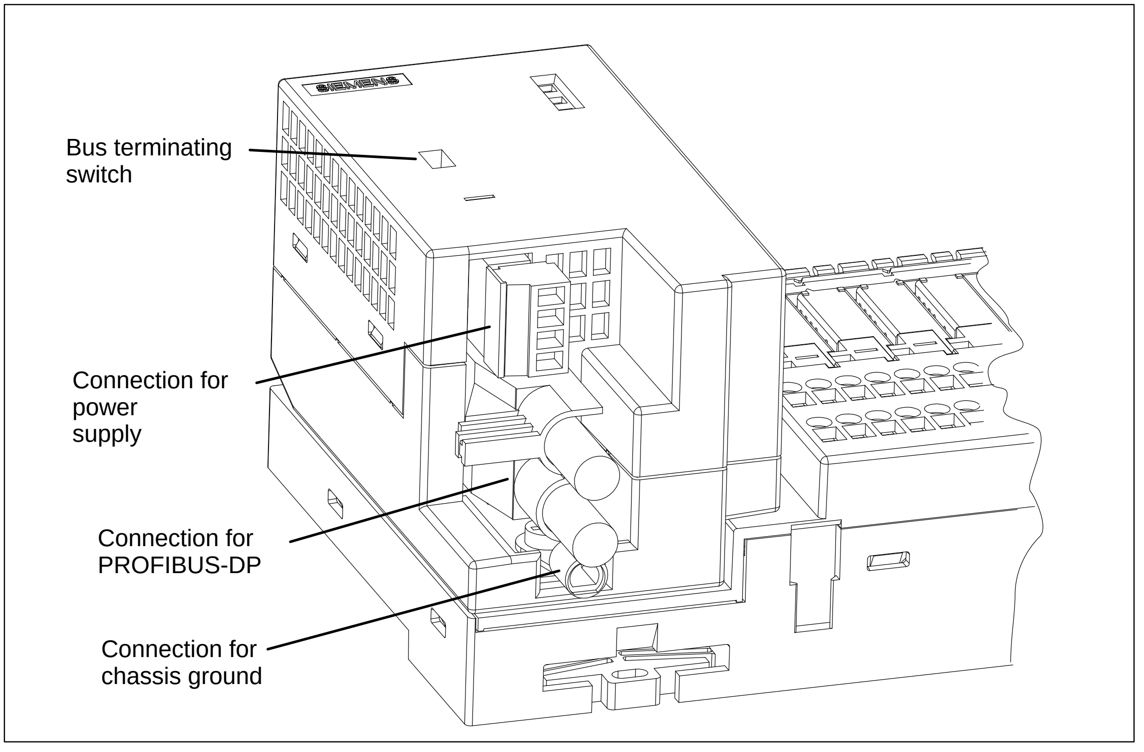


Figure 3-9 Connections of the IM-SC Interface Module

IM-SC Connection to Chassis Ground

The chassis ground connection of the ET 200L-SC IM-SC is on the IM-SC interface module.

1. You must connect the connection point to the rail with low resistance. To do this, use at least a 4mm^2 cable with a maximum length of 0.5 m and a cable lug with a nominal size of 4-6 (in accordance with DIN 46237). Place the cable lug on the screw by means of which you attach the interface module to the terminal block.
2. Connect the rail with low resitance to the foundation ground.

Ungrounded installation is not possible.

Strain Relief Grip

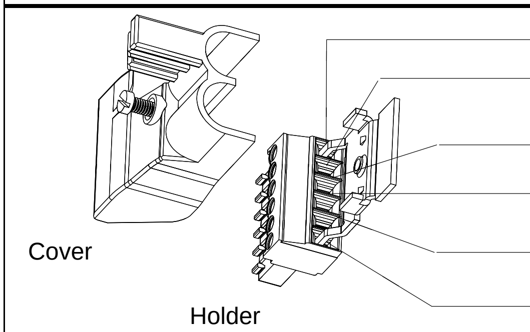
Attach a strain relief grip approximately 20 – 30 cm from the IM-SC for the connecting cables for the power supply and PROFIBUS-DP.

IM-SC PROFIBUS-DP Connection

A plug-in, 6-pin screw-type terminal with a shield support connects the ET 200L-SC IM-SC to the PROFIBUS-DP. You can connect the bus lines and the shield to the screw-type terminal.

The 6-pin screw-type terminal is shipped with the IM-SC interface module.

Table 3-4 Assignment of the PROFIBUS-DP Connection at the IM-SC Interface Module

View	Signal Name	Designation
	Ground	Bus line shield
	A1	Data line A (IN)
	B1	Data line B (IN)
	A2	Data line A (OUT)
	B2	Data line B (OUT)
	Ground	Bus line shield

Wiring the PROFIBUS-DP Connection

The bus lines (see Appendix A) are connected to the plug-in, multipole screw-type terminal.

Note

When you remove the PROFIBUS-DP screw-type terminal, the subsequent DP slaves are disconnected from the PROFIBUS-DP.

---

1. Strip the insulation from the bus line as shown in the figure below.

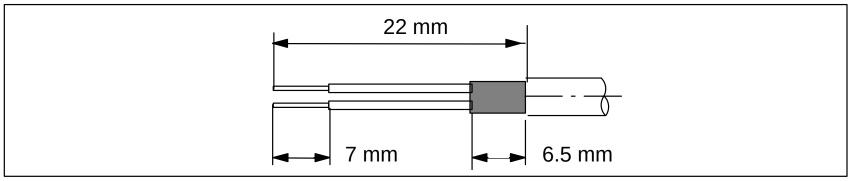


Figure 3-10 Length of Insulation Stripped

2. Connect the bus line to the screw-type terminal, and screw the cover on the holder.

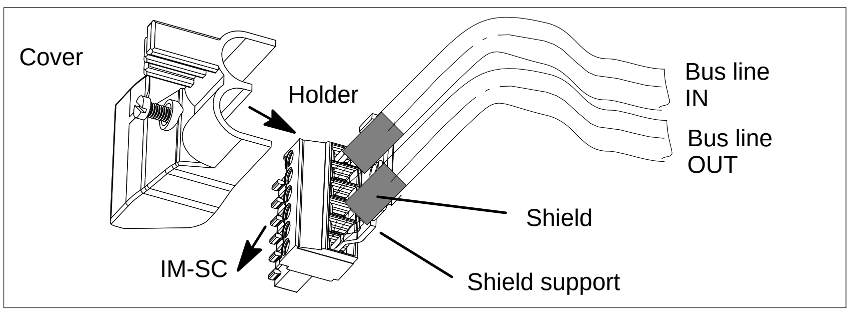


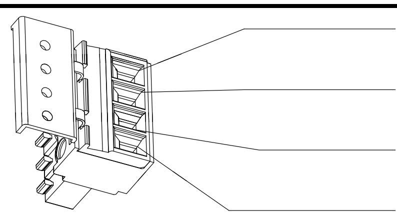
Figure 3-11 Wiring the PROFIBUS-DP Screw-Type Terminal

3. Insert the screw-type terminal in the appropriate socket on the IM-SC interface module.

Power Supply

You connect the power supply for the electronics to the plug-in, 4-pole screw-type terminal. The 4L+, 5L+ and 4M, 5M terminals are linked internally. This enables the power supply to be looped through via the 5L+ and 5M terminals. Insert the screw-type terminal in the appropriate socket on the IM-SC interface module.

Table 3-5 Assignment of the Power Supply

View	Signal Name	Designation
	4L+	DC 24V
	5L+	DC 24V (for looping through)
	4M	Ground
	5M	Ground (for looping through)

Connecting the Power Supply

You connect the 24V DC power supply to the plug- in, 4-pole screw-type terminal.

1. Connect the bus line to the screw-type terminal, and press the cover on the screw-type terminal.

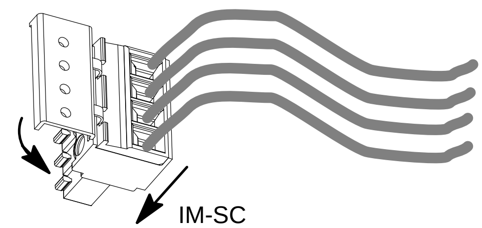
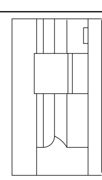


Figure 3-12 Connecting the Power Supply

2. Insert the screw-type terminal in the appropriate socket on the IM-SC interface module.

IM-SC Bus Terminating Resistors

The bus terminating switch allows you to switch bus terminating resistors on or off. The bus terminating switch is located in a recess on the front of the IM-SC interface module.



	ON	The bus terminating resistors are activated. The PROFIBUS-DP terminates at the IM-SC. A data line connected to A_{OUT} and B_{OUT} is separated.
	OFF	The bus terminating resistors are deactivated. You can loop the PROFIBUS-DP through to the IM-SC.

Figure 3-13 Functioning of the Bus Terminating Switch

3.8 Using the Supplementary Terminal for the TB 16SC/TB 16IM-SC

Possible Uses of the Single-Tier Supplementary Terminal

The terminals are electrically connected to each other internally. You can use the single-tier supplementary terminal for different purposes. You must adapt the labeling of the supplementary terminal according to the application.

1. You must use the **screw-type** single-tier supplementary terminal:

   Connection of protective conductors when using AC modules or the relay module for switching circuits that are not safely isolated. The printed label must remain visible.

2. You can use the single-tier supplementary terminal for the following purposes:

- Connecting protective ground for BEROs: For this purpose, you must leave the orginal labeling visible.
- Multiplying M potentials: For this purpose, select either
  - the labeling strip marked M
  - or leave the original labeling visible.
- Multiplying any potentials: For this purpose, you must label the strip yourself.

Possible Uses of the Two-Tier Supplementary Terminal

All the terminals of a tier are electrically connected to each other internally. You can use the two-tier supplementary terminal for different purposes. You must adapt the labeling of the supplementary terminal according to the application.

1. You must use the **screw-type** 2-tier supplementary terminal:

Lower tier

Connection of protective conductors when using AC modules or the relay module for switching circuits that are not safely isolated. The printed label must remain visible.

2. You can use the two-tier supplementary terminal for the following purposes:

Upper tier

- Multiplying M potentials:

  For this purpose, select either:
  - the labeling strip marked M
  - or leave the original labeling visible
- Multiplying the potential of any one potential

  For this purpose, you must label the blank strip yourself.

Lower tier

- Connecting protective ground for BEROs or shield terminals

3.9 Connecting Shielded Lines to the Shield Terminal of the Supplementary Terminals

Application

The shield terminal makes it easy to connect to ground all shielded cables that lead to or from electronic modules of the Smart Connect.

You obtain a connection to ground by installing the shield terminal in the supplementary terminal and connecting it to local ground at low resistance.

Structure of the Shield Terminal

The shield terminal is subdivided by function into a connecting lug and a spring terminal. The connecting lug establishes the electrical contact in the supplementary terminal. The spring terminal contacts the shield of the signal line.

Mounting the Shield Terminal

To secure the shield terminal, proceed as follows:

1. Make as short a connection as possible between 2M on the TB 16SC/TB 16IM-SC terminal block and the tier of the supplementary terminal in which you want to insert the shield terminals.
2. Insert the shield terminal into the desired position in the supplementary terminal.
3. Use a screwdriver with a blade width of 3.5 mm to secure the shield terminal.

Connecting Cables

You can only connect one or two shielded cables to each shield terminal. You connect the cables to the bared cable shield. The bared length of the cable shield must be at least 20 mm. Cables with cross-sections of 4...7 mm are connected securely.

3.10 Connecting the Smart Connect SC to the ET 200L-SC/TB 16IM-SC

Introduction

The electronics blocks of the ET 200L-SC and the ET 200L-SC IM-SC can all be supplemented by means of the Smart Connect:

- ET 200L-SC 16 DI DC 24 V – 6ES7 131-1BH11-0XB0
- ET 200L-SC 32 DI DC 24 V – 6ES7 131-1BL11-0XB0
- ET 200L-SC 16 DO DC 24 V/0.5 A 6ES7 132-1BH11-0XB0
- ET 200L-SC 16 DI/16 DO DC 24 V/0.5 A 6ES7 133-1BL10-0XB0
- ET 200L-SC TB 16IM-SC – 6ES7 120-0AH50-0AA0 (screw-type terminal), 6ES7 120-0BH50-0AA0 (spring terminal)

Connecting the Smart Connect

Enclosed with every TB 16SC terminal block is a 5 cm long Smart Connect cable set with which you can connect the Smart Connect.

1. Insert the sheathed end of the cable set into the Smart Connect interface of the ET 200L-SC or ET 200L-SC IM-SC.
2. One of the connecting cable's connectors has a lug. Insert this connector into the terminal block of the Smart Connect.

Note

All open Smart Connect interfaces must be closed using the accompanying SC cover before operating the ET 200L-SC or ET 200L-SC IM-SC. Only then are the requirements for handling electrostatically sensitive components met.

Removing the Smart Connect

When you remove Smart Connect, do it in the following order:

1. Turn off the power supply on the ET 200L-SC or ET 200L-SC IM-SC and Smart Connect.
2. Detach the cable set from the terminal block of the Smart Connect.
3. Place the SC cover on the Smart Connect interface of the ET 200L-SC or ET 200L-SC IM-SC. Only then are the requirements for handling electrostatically sensitive components met.

Commissioning 4

Contents of the Chapter

4.1 Configuration Software

ET 200L

You configure the ET 200L distributed I/O device and SC using the following configuration software.

- COM ET 200 Windows as of Version 1.0
- COM PROFIBUS as of Version 3.0
- STEP 7 as of Version 2.1

You will find the name of the type file for the various electronics blocks and the contents of the device master file described in Appendix C.

ET 200L-SC

The following applies to the ET 200L-SC:

DP Master	Configuration Software	Type Files	see Section
SIMATIC S7	STEP 7 as of Version 3.0	See Table C-14	• 5.2.1 to 5.2.5
IM 308C	COM ET 200 Windows as of Version 1.0	See Table C-14	• 5.2.6 • C.5
IM 308C	COM ET 200 Windows as of Version 2.1	See Table C-14 Device master files: See Table C-2	• 5.2.1 to 5.2.5
	COM PROFIBUS as of Version 3.0	See Table C-14	• 5.2.1 to 5.2.5
S5-95U with DP master interface	COM ET 200 Windows as of Version 1.0	See Table C-14	• 5.2.6 • C.5
Other master	COM PROFIBUS Version 3.1	Recommendation: See Table C-14 and Device master files: See Table C-2	• 5.2.6 • C.5

ET 200L-SC IM-SC

The following applies to the ET 200L-SC IM-SC:

DP Master	Configuration Software	Type Files	see Section
SIMATIC S7	STEP 7 as of Version V 4.1	See Table C-14	• 5.2.1 to 5.2.5
IM 308-C	COM PROFIBUSas of Version V 3.2	See Table C-14	• 5.2.1 to 5.2.5
S5-95U with DP master interface	COM PROFIBUS as of Version V 3.2	See Table C-14	• 5.2.6 • C.5
Other master	COM PROFIBUS as of Version V 3.2	Recommendation: S. Table C-14 and Device master files: See Table C-2	• 5.2.6 • C.5

4.2 Commissioning the ET 200L and Smart Connect

Commissioning the ET 200L

Commission the ET 200L distributed I/O device as follows:

<table>
<tr><th>Step</th><th>Activity</th><th>Explanation</th></tr>
<tr><td>1</td><td>Install and wire up the ET 200L.</td><td>You will find detailed instructions on installing and wiring in Chapters 2 and 3.</td></tr>
<tr><td>2</td><td>Set the PROFIBUS address of the ET 200L.</td><td rowspan="2">The two rotary switches used to set the PROFIBUS address are concealed by the bus connector (refer to Section 2.6).</td></tr>
<tr><td>3</td><td>Clip the bus connector on the electronics block.</td></tr>
<tr><td>4</td><td>If you are using an ET 200L-SC or ET 200L-SC IM-SC, you can now connect the Smart Connect.</td><td>Use the enclosed Smart Connect cable set for this purpose.</td></tr>
<tr><td>5</td><td>Turn on the power supply for the ET 200L.

Result:
The ET 200L starts up automatically.</td><td>–</td></tr>
<tr><td>6</td><td>If you are using an ET 200L-SC or ET 200L-SC IM-SC, turn on the power supply of the Smart Connect SC and ET 200L-SC.

Result:
The ET 200L-SC or ET 200L-SC IM-SC and Smart Connect SC starts up automatically.</td><td>The power supply of the Smart Connect SC must not be turned on after that of the ET 200L-SC or ET 200L-SC IM-SC.</td></tr>
</table>

Note

Full operational safety of the electronics blocks is not ensured until you have applied the labeling strips to the front of the electronics blocks (electrostatic discharge at the front of the module, LED coverage).

Start-up

The ET 200L distributed I/O device and Smart Connect starts up automatically when the power supply is turned on. A separate switch is not available.

During start-up, both LEDs (ON and BF =**B**us **F**ault) are on.

The ET 200L distributed I/O device ...

- Sets the outputs to ”0”.
- Applies the PROFIBUS address from the two rotary switches.
- Receives the configuration data from the DP master and evaluates the details contained in the configuration data. If the configuration agrees with the installation, the ET 200L distributed I/O device and Smart Connect initiates data exchange, and the BF LED goes off.

ET 200L-SC or ET 200L-SC IM-SC with SC-Modules

The ET 200L-SC or ET 200L-SC IM-SC behaves as follows when analog SC modules are connected:

- SC modules can only be detected at ET 200L-SC or ET 200L-SC IM-SC start-up after power on. If the 24V supply on the SC terminal block is not yet connected at start-up, SC modules are not detected.
- The ET 200L-SC or ET 200L-SC IM-SC starts up when the power supply is switched on.

This behavior can result in the following errors:

- A configured SC module is not detected at start-up. As a result, a diagnostic interrupt occurs with a parameterization error for the SC add-on, and the SF LED on the ET 200L-SC or ET 200L-SC IM-SC comes on.
- ET 200L-SC (as of version 3), ET 200L-SC IM-SC. An SC module or counter module fails during operation. As a result, a diagnostic interrupt occurs with a module error for the SC add-on, and the SF LED on the ET 200L-SC or ET 200L-SC IM-SC comes on.

Data Exchange

After start-up, data exchange is initiated between the DP master and the ET 200L distributed I/O device and Smart Connect.

The data exchange is displayed by the ET 200L distributed I/O device as follows:

- The green operating LED (ON) is on.
- The bus fault LED (BF) is off.
- The inputs and outputs are enabled.
- Conductive inputs and outputs are indicated on the status LEDs by the corresponding LED flashing.

4.3 Replacing SC Electronic Modules

Starting point

The system is running. You want to change the system configuration of the Smart Connect.

You Want to Connect Additional Electronic Modules

The system is in RUN mode. You want to plug in one or more additional electronic modules.

1. Set the CPU to STOP mode.
2. Switch off the load voltage supply to the ET 200L and Smart Connect.
3. Extend the process wiring.
4. Insert the new electronic modules into the terminal block in accordance with the positioning of the coding slide switches.
5. Create a new configuration.
6. Switch on the load voltage supply to the ET 200L and Smart Connect again.
7. Expand your user program.
8. Set the CPU to RUN mode.
9. Check the actual status of the system

Note

Never connect and disconnect the SC electronic modules during operation.

Diagnostics 5

Introduction

The ET 200L distributed I/O device and Smart Connect was designed to make working with and commissioning it as simple as possible. If a failure nevertheless occurs, you can find out what it is by means of LEDs and slave diagnostics.

Contents of the Chapter

5.1 Diagnostics Using the LEDs

Introduction

The ET 200L distributed I/O device features the following diagnostic options:

- LEDs
- Slave diagnostics (refer to Section 5.2)

Status Display

Each input and output of the ET 200L distributed I/O device has a status display. The status display LED lights up when the input or output is active.

ET 200L LED Display

The ET 200L distributed I/O device has two LEDs for displaying statuses.

Table 5-1 Diagnostics Using the LED Display

BF LED (Bus Fault)	ON LED	Meaning	Error Handling
Off	Off	• No voltage is being applied to the ET 200L. • An ET 200L hardware fault has occurred.	• Check the power supply. Switch on the on-off switch for 24 VDC on the power supply module. • Check whether the electronics block is properly secured on the terminal block.
On	On	• ET 200L is in the process of starting up.	–
		• The connection to the DP master has failed. • ET 200L has still not received any configuration data.	• Check the PROFIBUS connection. • Check the DP master. • Check the configuration in the DP master (station type, input/output, PROFIBUS address). • Check which PROFIBUS address has been set.
Off	On	Data exchange	–

LEDs on the ET 200L-SC or ET 200L-SC IM-SC

The ET 200L-SC or ET 200L-SC IM-SC distributed I/O device has three LEDs for indicating its status.

Table 5-2 Diagnostics Using the LEDs of the ET 200L-SC or ET 200L-SC IM-SC

<table>
<tr><th>SF LED (Group Error)</th><th>BF LED (Bus Fault)</th><th>ON LED</th><th>Meaning</th><th>Error Handling</th></tr>
<tr><td>Off</td><td>Off</td><td>Off</td><td>• No voltage is being applied to the ET 200L-SC/ET 200L-SC IM-SC
• An ET 200L-SC/ET 200L-SC IM-SC hardware fault has occurred.</td><td>• Check the power supply. Switch on the on-off switch for 24 V DC on the power supply module.
• Check whether the electronics block is properly secured on the terminal block.</td></tr>
<tr><td>Off</td><td rowspan="3">Off</td><td rowspan="3">On</td><td>• Power supply of the ET200L-SC/ ET 200L-SC IM-SC is on (comes on briefly when the power is switched on)
• Data exchange</td><td>–</td></tr>
<tr><td rowspan="2">On</td><td>• Incorrect assignment of parameters</td><td>• Check whether parameter assignment for the Smart Connect configuration matches the actual Smart Connect configuration.
• Check that the cable to the Smart Connect is properly connected.
• Check the power supply of the TB16 SC.</td></tr>
<tr><td>• SC communication error (see byte 15.1, Table 5-6)</td><td>• Connection to SC module with serial data transfer aborted (analog module, counter)
• 24 V power supply of the SC modules is switched off (analog module, counter)
• Module defective</td></tr>
<tr><td>No meaning</td><td>On</td><td>On</td><td>• Transmission rate is being adjusted (max. 4s).</td><td>• Check the PROFIBUS connection.
• Check the DP master.</td></tr>
</table>

Table 5-2 Diagnostics Using the LEDs of the ET 200L-SC or ET 200L-SC IM-SC

SF LED (Group Error)	BF LED (Bus Fault)	ON LED	Meaning	Error Handling
Off	Flashing	On	• ET 200L-SC/ET 200L-SC IM-SC has still not received any configuration data or has received incorrect data. • Bus protocol incorrect	• Check the configuration in the DP master (station type, input/output, PROFIBUS address). • Check the format of the parameterization frame.
On			• Error in configuration frame.	• Check the configuration in the DP master (station type, input/output, PROFIBUS address). • Check the configuration of the configuration frame.

5.2 Slave Diagnostics

In Section 5.2

You will find the following topics in this section:

Definition

Diagnostics is the detection and localization of errors. The diagnostics structure is laid down in EN 50170 Volume 2, PROFIBUS. ET 200L diagnostics complies with this standard. Slave diagnostics is explained in the section that follows for the ET 200L.

5.2.1 General Remarks on Diagnostics

Diagnostics with an S7/M7 DP Master

If you are operating the ET 200L-SC or ET 200L-SC IM-SC as a DP slave with a **SIMATIC S7/M7** DP master, the modules behave like S7 300 CPU modules.
You read out the diagnosis (data record 0) with SFC 13, ”DPNRM_DG”.

Diagnostics with Another DP Master

If you are operating the ET 200L-SC or ET 200L-SC IM-SC as a DP slave with another DP master for example, with an IM 308-C on a SIMATIC S5 – you will find the slave diagnosis structure in Sections 5.2.2 to 5.2.6.

Diagnostic Interrupt and Process Interrupt

The ET 200L-SC or ET 200L-SC IM-SC supports diagnostic interrupts.

You can evaluate these types of interrupt with an S7/M7 DP master. In the event of an interrupt, interrupt OBs run automatically in the CPU – refer to the programmer’s manual, *System Software for S7-300/S7-400, Program Design*).

If you are operating the ET 200L-SC or ET 200L-SC IM-SC with another DP master, these interrupts are simulated within station diagnostics.

Note

In order to be able to evaluate diagnostic interrupts by means of a station diagnosis with another DP master, you must take the following into account:

- The DP master should be able to store diagnostic messages; this means that diagnostic messages should be stored within the DP master in a ring buffer store. If the DP master cannot store diagnostic messages, only the latest diagnostic message to be received would always be stored, for instance.
- You have to poll regularly in your application the corresponding bits in the station diagnosis. In doing so, you have to take into account the bus run time of the PROFIBUS-DP so that you poll the bits at least once in synchronization with the bus run time, for instance.

Diagnosis upon Erroneous Assignment of Parameters

If the DP master sends an erroneous parameter assignment for the SC extension in the parameterization frame, the ET 200L-SC or ET 200L-SC IM-SC responds with a diagnostic message – in the event of diagnostics being enabled. Owing to an internal processing time, the reply does not immediately follow the parameterization frame, but there is a delay. In the start-up OB, therefore, the diagnosis of the module should be read after a period of approximately 100 ms to determine whether the ET 200L-SC or ET 200L-SC IM-SC is operating properly.

If the ET 200L-SC or ET 200L-SC IM-SC is already exchanging data, all the available SC inputs are supplied as zeros, and all the available SC outputs remain at zero.

5.2.2 Structure of the Slave Diagnosis

Introduction

The diagnostics of the ET 200L/ET 200L-SC/ET 200L-SC IM-SC distributed I/O device comply with EN 50710 Volume 2, PROFIBUS. The slave diagnosis is explained below.

Structure of the Slave Diagnosis

The slave diagnosis comprises 6 bytes for the ET 200L and not more than 17 bytes for the ET 200L-SC/ET 200L-SC IM-SC:

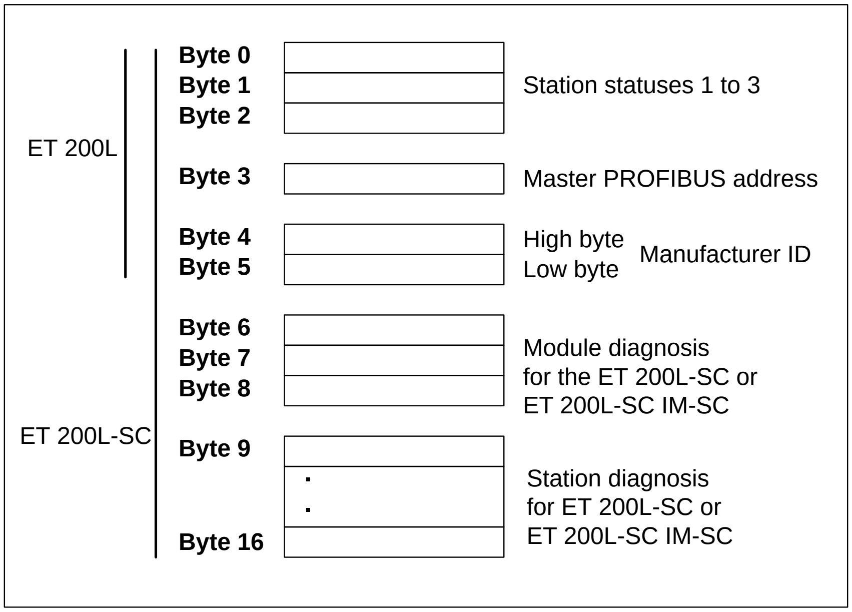


Figure 5-1 Structure of the Slave Diagnosis

Requesting a Slave Diagnosis

You can request a slave diagnosis with the following function blocks:

Table 5-3 Function Blocks for Slave Diagnosis

PLC Family	Number	Name
SIMATIC S5 with IM 308-C	FB 192 192	FB IM308C
SIMATIC S7/M7	SFC 13 13	SFC “DPNRM_DG”
S5-95U with DP master interface	FB 230 230	FB S_DIAG
SIMATIC S5 with CP 5431 DP/FMS	Communication function blocks (see standard FBs) SEND and RECEIVE with job number 209	

5.2.3 Structure of Station Statuses 1 to 3, Master Station Number and Manufacturer Identification

Definition of Station Status

Station statuses 1 to 3 provide an overview of the status of a DP slave (refer to Figure 5-1, bytes 0 to 2).

Structure of Station Status 1

Station status 1 provides information about the DP slave and is structured as follows:

Table 5-4 Structure of Station Status 1 (Byte 0)

Bit	Meaning	Action
0	1: The DP slave cannot be addressed by the DP master.	• Correct PROFIBUS address set on ET 200L? • Bus connector connected? • Voltage at DP slave? • RS 485 repeater set correctly? • Supply voltage ON/ OFF performed on ET 200L?
1	1: The DP slave is not yet ready to exchange data.	• Wait, because the ET 200L is just being powered up.
2	1: The configuration data sent by the DP master to the DP slave do not agree with the installation of the DP slave.	• Correct station type or correct installation of the ET 200L entered in the system configuration software?
3	1: An external diagnosis exists.	• Check the contents of the external diagnosis.
4	1: The requested function is not supported by the DP slave.	• Check the configuration.
5	1: The DP master cannot interpret the reply from the DP slave.	• Check the bus installation.
6	1: The DP slave type does not agree with the software configuration.	• Correct station type entered in the system configuration software?
7	1: Parameters have been assigned to the DP slave by a different DP master from that which currently has access to the DP slave.	• The bit is always 1 if you are in the process of accessing, for example, the ET 200L with the PU or another DP master. The PROFIBUS address of the parameterization master is located in the ”master PROFIBUS address” diagnostic byte.

Structure of Station Status 2

Station status 2 provides additional information about the DP slave and is structured as follows:

Table 5-5 Structure of Station Status 2 (Byte 1)

Bit	Meaning
0	1: Parameters have to be assigned again to the DP slave.
1	1: A diagnostic message has been issued. The DP slave cannot resume operation until the fault has been corrected (static diagnostic message).
2	1: The bit is always set to ”1” if the DP slave having this PROFIBUS address is present.
3	1: Response monitoring has been enabled for this DP slave.
4	1: The DP slave has received the ”FREEZE” control command[1].
5	1: The DP slave has received the ”SYNC” control command[1].
6	1: The bit is always set to ”0”.
7	1: The DP slave is disabled – that is, it has been removed from the processing in progress.

[1] The bit is updated only if another diagnostic message changes too.

Structure of Station Status 3

Station status 3 is reserved and is not relevant in as far as the diagnostics of the ET 200L distributed I/O device are concerned.

Definition of the Master PROFIBUS Address

The Master PROFIBUS Address diagnostic byte stores the PROFIBUS address of the DP master which has assigned parameters to the DP slave (refer to Figure 5-1, byte 3).

Structure of the Master PROFIBUS Address

The master PROFIBUS address comprises one byte with the PROFIBUS address of the DP master that assigned parameters to the DP slave and has read and write access to the DP slave.

Definition of the Manufacturer ID

A code is stored in the manufacturer identification that describes the type of the DP slave (refer to Figure 5-1, bytes 4 and 5).

Structure of the Manufacturer ID

The manufacturer identification of the DP slave comprises two bytes. You will find the manufacturer identifications of the different electronics blocks in Appendix C, Table C-1 and C-4.

5.2.4 Structure of the Module Diagnosis for the ET 200L-SC and ET 200L-SC IM-SC

Module Diagnosis

The module diagnosis for the ET 200L-SC and ET 200L-SC IM-SC (bytes 6 to 8) tells you the slot for which a diagnosis is available.

Structure with the COM/S7 Configuration Software

The structure of the module diagnosis is indicated below. You will find an explanation of the slots in Appendix C.3.

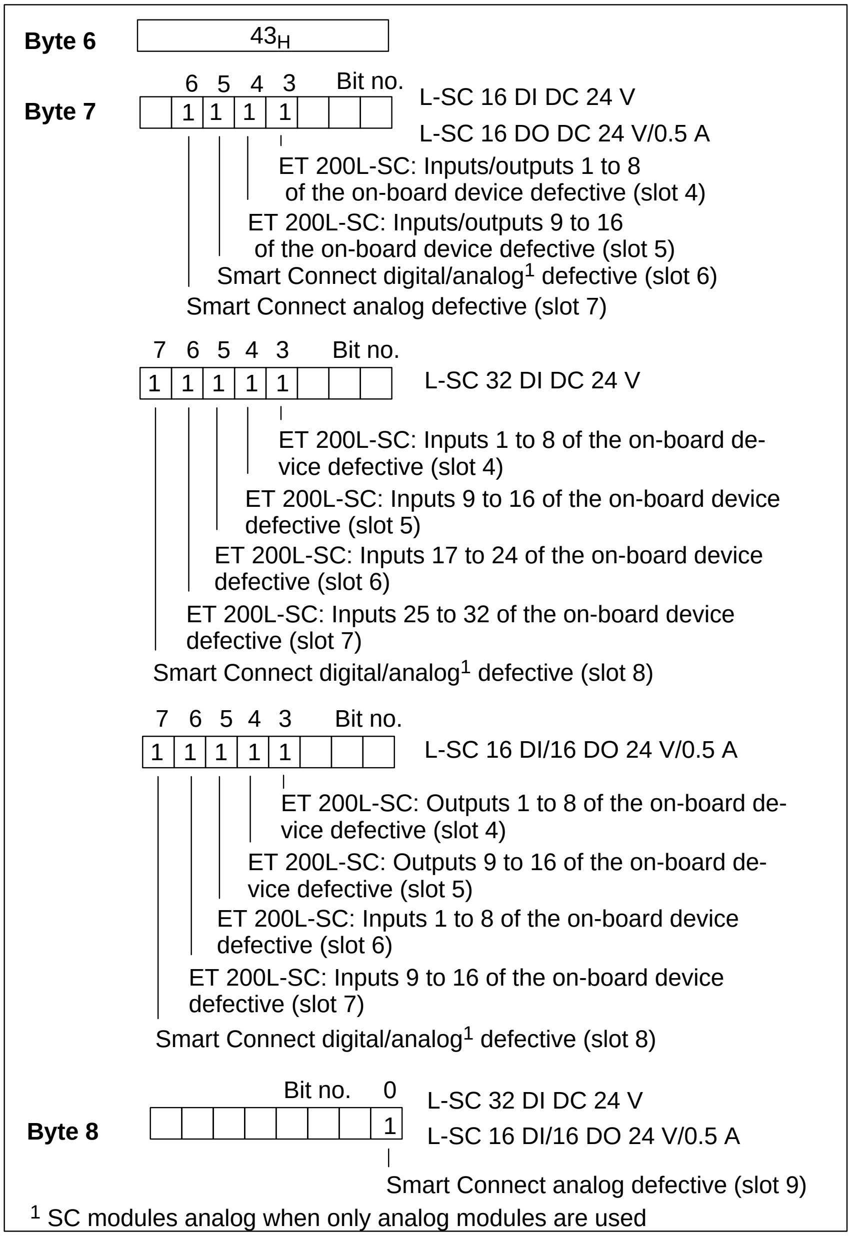


Figure 5-2 Structure of the Module Diagnosis with the COM/S7 Configuration Software for the ET 200L-SC

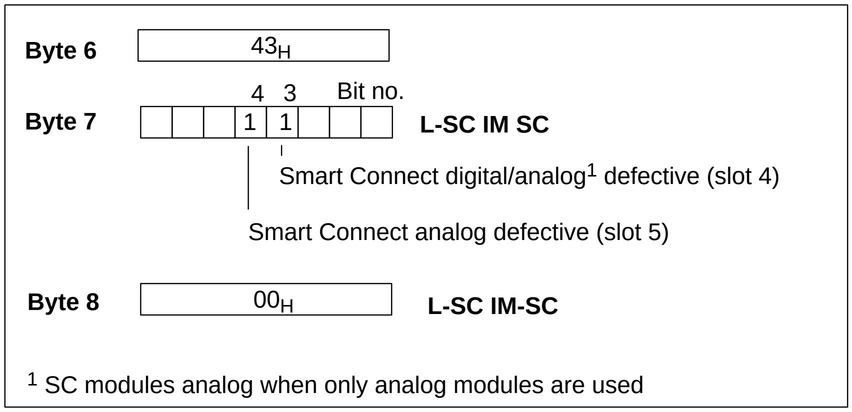


Figure 5-3 Structure of the Module Diagnosis with the COM/S7 Configuration Software for the ET 200L-SC IM-SC

Structure with any Configuration Software

A module diagnosis is structured as follows. You will find an explanation of the slots in Appendix C.3.

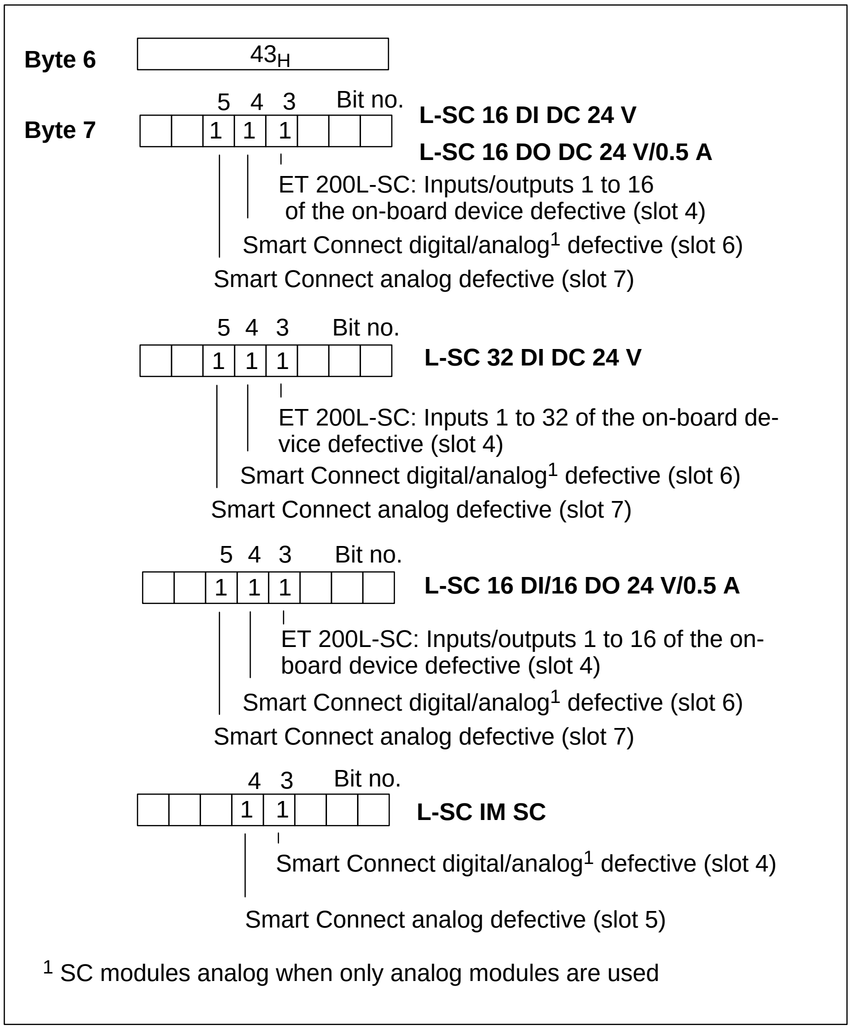


Figure 5-4 Structure of the Module Diagnosis with any Configuration Software for the ET 200L-SC, ET 200L-SC IM-SC

5.2.5 Structure of the Station Diagnosis for the ET 200L-SC and ET 200L-SC IM-SC

Definition

The station diagnosis provides detailed information about a DP slave.

Data record 0, which is typical of the SIMATIC S7, is stored in the station diagnosis (bytes 9 to 16).

The contents of the station diagnosis always refer to the Smart Connect section.

Structure

The station diagnosis contains a maximum of eight bytes. You will find an explanation of the slots in Appendix C.3.

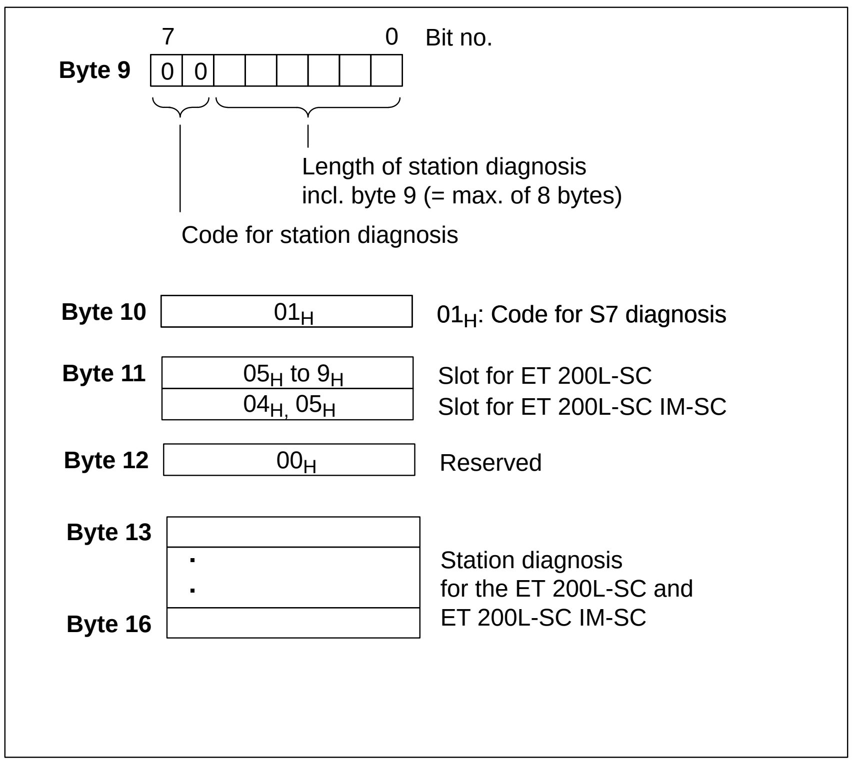


Figure 5-5 Structure of Station Diagnosis

Saving the Diagnosis

Transfer the contents of the station diagnosis to a data block, since the station diagnosis will be updated periodically.

Bytes 13 to 16 for the Diagnostic Interrupt

Table 5-6 shows the structure and contents of bytes 13 to 16 for a diagnostic interrupt.

Table 5-6 Bytes 13 to 16 for the Diagnostic Interrupt

Byte	Bit	Meaning	Error Handling
13	0	Module malfunction	A module malfunction has occurred.
	1	Internal error	An internal error has occurred (see byte 13.6, byte 13.7 and byte 15.0).
	2	External error	An external error has occurred (see byte 15.1).
	2 to 6	Not applicable	---
	7	Wrong parameters in module	Check the ET 200L-SC parameter assignment.
14	0 to 3	Module class: 0010 (special module)	---
	4 to 7	Not applicable	---
15	0	User module wrong or missing	Smart Connect incorrect or missing.
	1	SC communication error (ET 200L-SC, as of version 3)	• Connection to the SC module with serial data transfer aborted (analog module, counter). • Module defective • 24V power supply of the SC modules is switched off (analog module, counter).[1]
15	2 to 7	Not applicable	---
16	0 to 7	Not applicable	---

1 After the 24V power supply is connected, the SC module is included in cyclic data transfer again with the parameters received at start-up. It is reported that the diagnosis has been processed and the problem thus corrected.

5.2.6 Structure of Slave Diagnosis for Default Start-Up of ET 200L-SC and ET 200L-SC IM-SC

Default Start-up

When you execute a default start-up (see AppendixC.5), the following slave diagnosis applies. You will find an explanation of the slots in Appendix C.3.

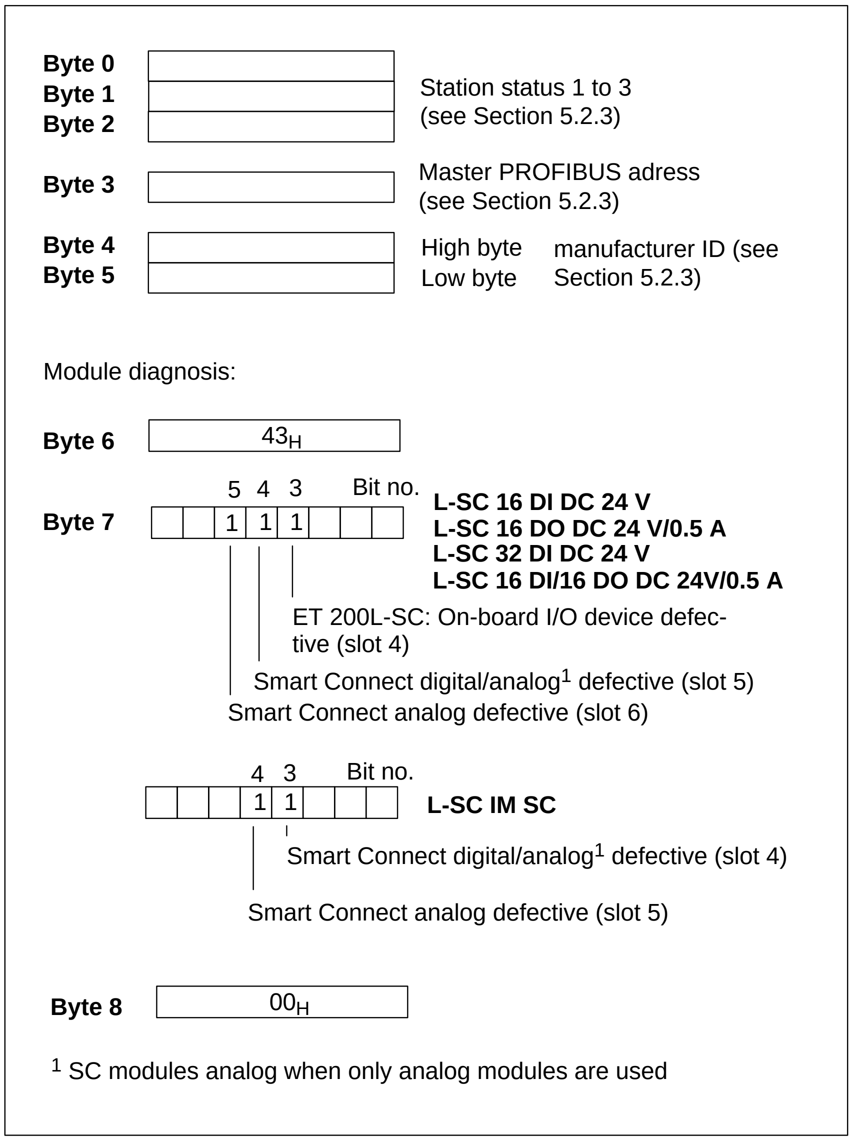


Figure 5-6 Slave Diagnosis for Default Start-up of the ET 200L-SC and ET 200L-SC IM-SC

General Technical Data 6

What Is General Technical Data?

The general technical data consists of the standards and test values with which the ET 200L conforms and which it fulfills, and the test criteria by which the ET 200L distributed I/O device was tested.

Contents of the Chapter

6.1 Standards and Certification

Introduction

This chapter contains information the following for the modules and components of the ET 200L and Smart Connect SC:

- The most important standards complied with by the ET 200L and Smart Connect SC
- The certification of the ET 200L and Smart Connect SC

IEC 1131

The ET 200L distributed I/O device and Smart Connect SC meet the requirements and criteria of IEC 1131, Part 2.

PROFIBUS DP

The ET 200L distributed I/O device and Smart Connect SC meet the requirements and criteria of EN 50 170 Volume 2, PROFIBUS.

CE Marking

Our products fulfill the requirements and safety objectives of the following EC Directives and comply with the harmonized European standards (EN) published for stored-program controllers in the official journals of the European Communities:

- 89/336/EEC Electromagnetic Compatibility Directive
- 73/23/EEC Low Voltage Directive (for electrical equipment)

The EC Declarations of Conformity are available to the relevant authorities at the following address:

Siemens Aktiengesellschaft
Bereich Automatisierungstechnik
A&D AS E 14
Postfach 1963
D-92209 Amberg

PNO

The ET 200L has the following PNO certificates:

Product Name	Order Number	Release	PNO Certificate
ET 200L 16 DI DC 24 V	6ES7 131-1BH00-0XB0	1	Z00179
ET 200L-SC 16 DI DC 24 V	6ES7 131-1BH11-0XB0	1	Z00210
ET 200L 32 DI DC 24 V	6ES7 131-1BL00-0XB0	1	Z00180
ET 200L-SC 32 DI DC 24 V	6ES7 131-1BL11-0XB0	1	Z00212
ET 200L 16 DO DC 24 V/0.5 A	6ES7 132-1BH00-0XB0	1	Z00181
ET 200L-SC 16 DO DC 24 V/0.5A	6ES7 132-1BH11-0XB0	1	Z00211
ET 200L 32 DO DC 24 V/0.5 A	6ES7 132-1BL00-0XB0	1	Z00182
ET 200L 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL00-0XB0	1	Z00183

UL Recognition

UL Recognition Mark
Underwriters Laboratories (UL) to
Standard UL 508, File No. 116536

CSA Certification

CSA Certification Mark
Canadian Standard Association (CSA) to
Standard C22.2 No. 142, File No. LR 48323

FM Approval

Factory Mutual Approval Standard Class Number 3611, Class I, Division 2, Group A, B, C, D.

Warning

There is a risk of injury and damage to property.

In potentially explosive atmospheres, there is a risk of injury to people and damage to property if you disconnect connectors when a ET 200 is in operation.

Always de-energize the ET 200 in potentially explosive atmospheres before disconnecting any connectors.

6.2 Electromagnetic Compatibility

Definition

Electromagnetic compatibility is the ability of an electric device to function satisfactorily in its electromagnetic environment without interfering with this environment.

The ET 200L distributed I/O device also meets the requirements, among others, of the EMC act of the European inner market. A requirement for this is that the ET 200L distributed I/O device meets the specifications and directives concerning electrical installation.

Pulse-Shaped Interference

The following table shows the electromagnetic compatibility of the ET 200L distributed I/O device with regard to pulse-shaped interference.

<table>
<tr><th>Pulse-Shaped Interference</th><th>Tested with</th><th>Corresponds to Severity</th></tr>
<tr><td>Electrostatic discharge
to IEC 801-2 (DIN VDE 0843, Part 2)</td><td>8 kV
4 kV</td><td>3 (air discharge)
2 (contact discharge)</td></tr>
<tr><td>Burst impulses in accordance with
IEC 801-4 (DIN VDE 0843, Part 4)</td><td>2 kV (supply line)
2 kV (signal line)</td><td>3</td></tr>
<tr><td colspan="2">Surge in accordance with IEC 801-5 (DIN VDE 0839, Part 10)
Only with lightning protection elements (refer to DP master manual).</td><td rowspan="3">3</td></tr>
<tr><td>• Assymmetrical connection</td><td>2 kV (supply line)
2 kV (signal line/data line)</td></tr>
<tr><td>• Symmetrical connection</td><td>1 kV (supply line)
1 kV (signal line/data line)</td></tr>
</table>

Sine-Shaped Interference

The following table shows the electromagnetic compatibility of the ET 200L distributed I/O device with regard to sine-shaped interference.

HF Radiation to ENV 50140 (Corresponds to IEC 801-3) Electromagnetic RF Field		RF Coupling to ENV 50141 (Corresponds to IEC 801-6)
Amplitude-Modulated	**Pulse-Modulated**	
80 to 1000 MHz	900 MHz $\pm$5 MHz	0.15 to 80 MHz
10 V/m		10 V_{rms} unmodulated
80 % AM (1 kHz)	50 % ED	80 % AM (1 kHz)
	200 Hz repetition frequency	150 Ω source impedance

Emission of Radio Interference

Emitted interference of electromagnetic fields in accordance with EN 55011: Limit Value Class A, Group 1 (measured at a distance of 30 m).

Frequency	Emitted Interference
From 20 to 230 MHz	< 30 dB (μV/m)Q
From 230 to 1000 MHz	< 37 dB (μV/m)Q

6.3 Shipping and Storage Conditions

Conditions

The ET 200L distributed I/O device surpasses the requirements of IEC 1131, Part 2, with regard to shipping and storage conditions. The following details apply to modules that are shipped and stored in their original packaging.

Type of Condition	Admissible Range
Free fall	≤ 1m
Temperature	From – 40 °C to + 70 °C
Temperature variation	20 K/h
Air pressure	From 1080 to 660 hPa (corresponds to a height of -1000 to 3500 m)
Relative humidity	From 5 to 95 %, without condensation

6.4 Mechanical and Climatic Environmental Conditions

Climatic Environmental Conditions

The following climatic environmental conditions apply:

Environmental Conditions	Operating Ranges	Remarks
Temperature	From 0 to 60 °C From 0 to 40 °C	Horizontal wall mounting All other installation positions
Temperature variation	10 K/h	
Relative humidity	From 15 to 95 %	Without condensation, corresponds to relative humidity (RH) stress rate 2 to IEC 1131-2
Air pressure	From 1080 to 795 hPa	Corresponds to a height of -1000 to 2000 m
Contaminant concentration	SO_2: < 0.5 ppm; rel. humidity < 60 %, no moisture condensation H_2S: < 0.1 ppm; rel. humidity < 60 %, no moisture condensation	Test: 10 ppm; 4 days 1 ppm; 4 days

Mechanical Environmental Conditions

The mechanical environmental conditions are shown in the following table in the form of sinusoidal oscillations.

Frequency Range	Permanent	Occasional
$10 \le f \le 58$ Hz	0.0375 mm amplitude	0.075 mm amplitude
$58 \le f \le 150$ Hz	0.5 g constant acceleration	1 g constant acceleration

Testing Mechanical Environmental Conditions

The following table provides information on the type and extent of tests of mechanical environmental conditions.

Test for ...	Test Standard	Remarks
Oscillations	Oscillation test to IEC 68, Part 2-6 (sine)	Oscillation type: frequency sweeps with a rate of change of 1 octave per minute. 10 Hz $\le f \le$ 58 Hz, const. amplitude 0.075 mm. 58 Hz $\le f \le$ 150 Hz, const. acceleration 1 g. Oscillation time: 10 frequency sweeps per axis in all of the three perpendicular axes.
Shock	Shock test to IEC 68, Part 2-27	Type of shock: half sine Force of shock: 15 g peak value, 11 ms duration Direction of shock: 3 shocks per +/– direction in all of the three perpendicular axes.

6.5 Details of Insulation Testing, Safety Class, and Degree of Protection

Test Voltage

Insulation strength is demonstrated in the routine test with the following test voltage in accordance with IEC 1131, Part 2:

Circuits with a Rated Voltage U_e to Other Circuits or to Ground	Test Voltage
$0\ V < U_e \leq 50\ V$	500 VDC

Safety Class

Safety class II in accordance with IEC 536 (VDE 0106, Part 1) – that is, connection to a protective conductor is not necessary.

Protection Against Foreign Matter and Water

IP 20 degree of protection in accordance with IEC 529 – that is, protection against contact with standard test fingers.

Furthermore, it is protected against foreign matter having a diameter greater than 12.5 mm.

No special protection against water.

6.6 Rated Voltage of the ET 200L Distributed I/O Device

Rated Voltage for Operation

The ET 200L distributed I/O device operates with the rated voltage and corresponding tolerances shown in the following table.

Table 6-1 Rated Voltage of the ET 200L Distributed I/O Device

Rated Voltage	Tolerance Range
24 VDC	20.4 to 28.8 VDC

Bridging Voltage Drops

The ET 200L distributed I/O device bridges voltage drops of the power supply of up to 20 ms long (does not apply to SC electronic modules).

Terminal Blocks and Supplementary Terminals – Technical Data

7

Introduction

The product spectrum of ET 200L and Smart Connect includes various terminal blocks to which you can connect different electronics blocks. This chapter contains the technical data for the terminal blocks and their supplementary terminals.

Contents of the Chapter

7.1 Terminal Block TB 16L – 6ES7 193-1CH00-0XA0, 6ES7 193-1CH10-0XA0

Order Numbers

The TB 16L terminal block is available with two types of connection.

- Connection by means of a screw-type terminal (Order Number 6ES7 193-1CH00-0XA0)
- Connection by means of a spring terminal (Order Number 6ES7 193-1CH10-0XA0)

Plug-In Electronics Blocks

You can connect the following electronics blocks to the TB 16L terminal block:

Chapter	Plug-In Electronics Blocks	Order Number
Chapter 9: ET 200L Electronics Blocks Technical Data	ET 200L 16 DI DC 24 V	6ES7 131-1BH00-0XB0
	ET 200L-SC 16 DI DC 24 V	6ES7 131-1BH11-0XB0
	ET 200L 16 DO DC 24 V/0.5A	6ES7 132-1BH00-0XB0
	ET 200L-SC 16 DO DC 24 V/0.5 A	6ES7 132-1BH11-0XB0

Characteristics

The terminal block bears the stationary wiring.

Dimension Drawing

In Figure 7-1 you can see the dimension drawing of the TB 16L terminal block with the 16 DI 24 V DC electronics block clipped on.

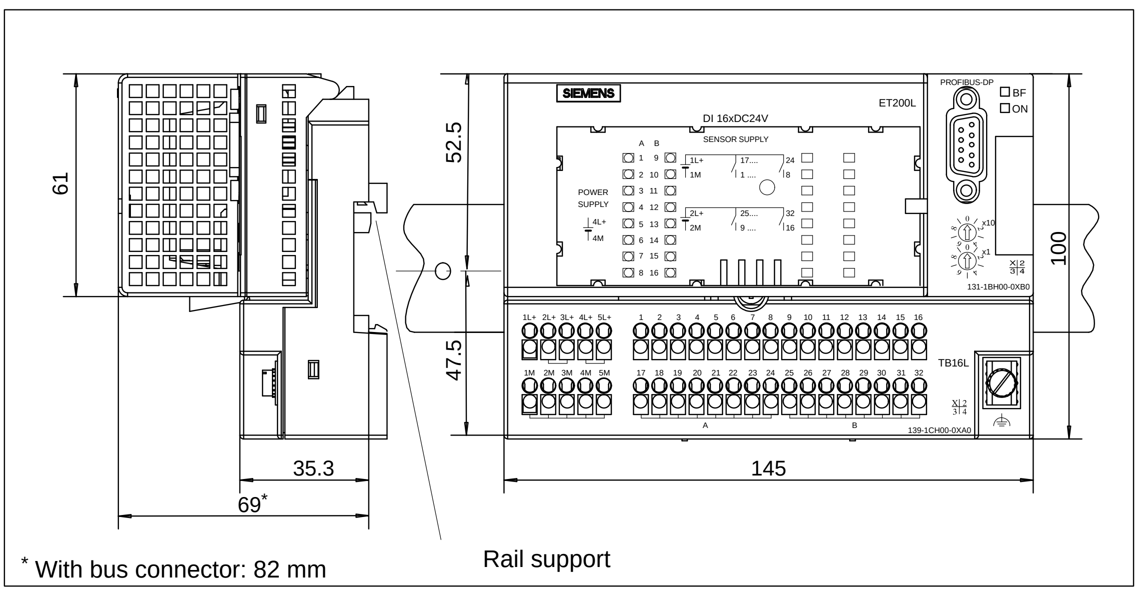


Figure 7-1 The TB 16L Terminal Block with the Electronics Block Clipped On, Dimension Drawing

Pinout

Table 7-1 shows the pinout of the TB 16L terminal block.

Table 7-1 Pinout of the TB 16L Terminal Block

Terminal	Assignment	
	Inputs	**Outputs**
1 to 8	I0: Signals .0 to .7	Q0: Signals .0 to .7
9 to 16	I1: Signals .0 to .7	Q1: Signals .0 to .7
17 to 24	I0: Sensor supply	Q0: Chassis ground (internally jumpered)
25 to 32	I1: Sensor supply	Q1: Chassis ground (internally jumpered)
1L+	Power supply for channel group A (I0 and Q0)	
2L+	Power supply for channel group B (I1 and Q1) internally jumpered	
3L+		
4L+	Power supply for electronics, internally jumpered	
5L+		
1M	Chassis ground connection for channel group A, channel group B, and electronics (all internally jumpered)	
2M		
3M		
4M		
5M		
⏚	PE	

Technical Data

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 100 × 40.5
Height with electronics block from top edge rail (with bus terminator 6ES7 972-0CA30-0XA0)	82 mm
Weight	230 g
Module-Specific Data	
Number of channels	16

7.2 Terminal Block TB 32L – 6ES7 193-1CL00-0XA0, 6ES7 193-1CL10-0XA0

Order Numbers

The TB 32L terminal block is available with two types of connection.

- Connection via screw-type terminal (Order Number 6ES7 193-1CL00-0XA0)
- Connection via spring terminal (Order Number 6ES7 193-1CL10-0XA0)

Plug-In Electronics Blocks

You can connect the following electronics blocks to the TB 32L terminal block:

Chapter	Plug-In Electronics Blocks	Order Number
Chapter 9: ET 200L Electronics Blocks Technical Data	ET 200L 32 DI DC 24 V	6ES7 131-1BL00-0XB0
	ET 200L-SC 32 DI DC 24 V	6ES7 131-1BL11-0XB0
	ET 200L 32 DO DC 24 V/0.5 A	6ES7 132-1BL00-0XB0
	ET 200L 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL00-0XB0
	ET 200L-SC 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL10-0XB0

Characteristics

The terminal block bears the stationary wiring.

Dimension Drawing

In Figure 7-2 you can see the dimension drawing of the TB 32L terminal block with the LSC 32 DI 24 V electronics block clipped on.

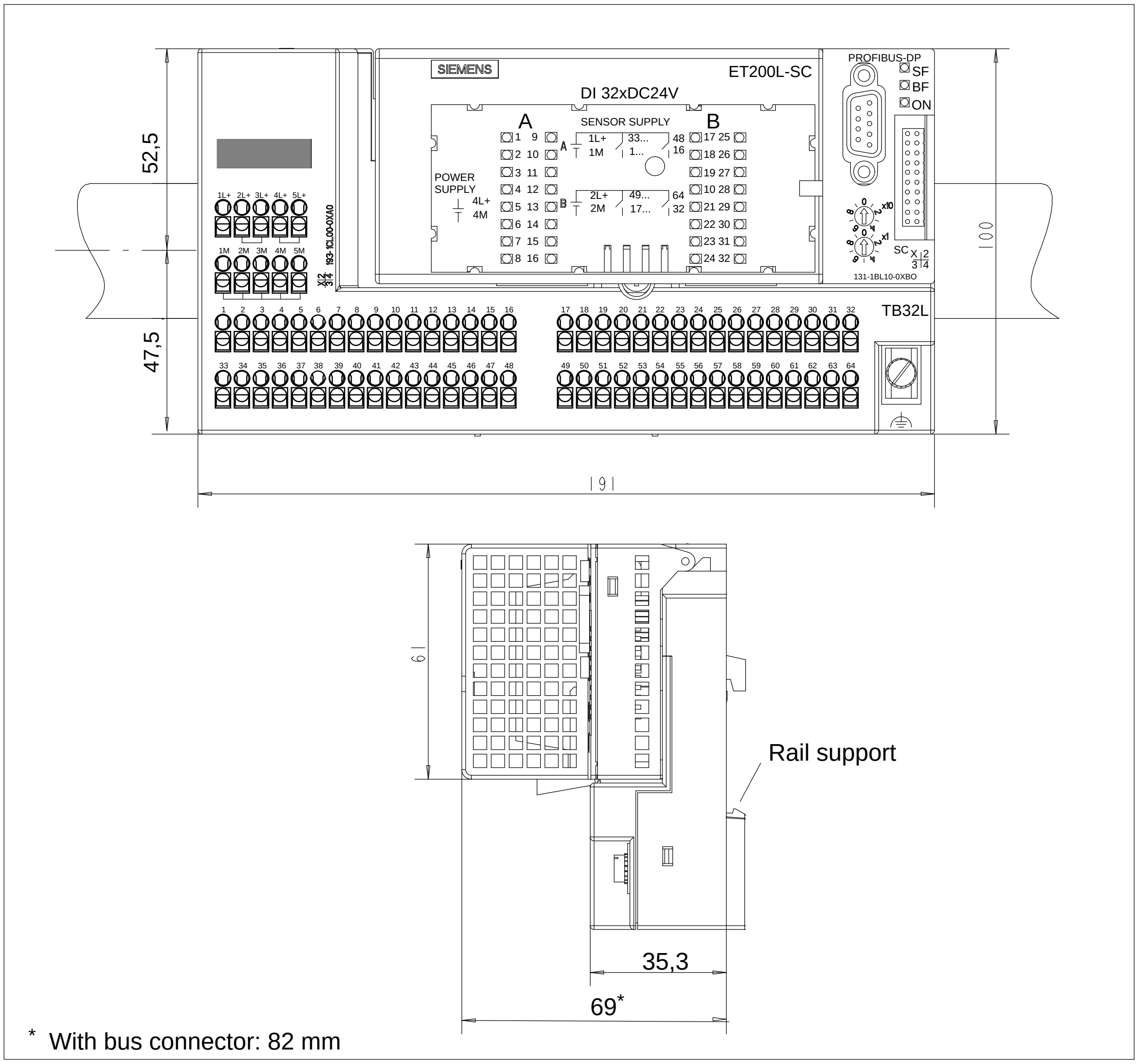


Figure 7-2 The TB 32L Terminal Block with the Electronics Block Clipped On, Dimension Drawing

Pinout

Table 7-2 shows the pinout of the TB 32L terminal block.

Table 7-2 Pinout of the TB 32L Terminal Block

Terminal	Assignment	
	Inputs	Outputs
1 to 8	I0: Signals .0 to .7	Q0: Signals .0 to .7
9 to 16	I1: Signals .0 to .7	Q1: Signals .0 to .7
17 to 24	I2: Signals .0 to .7	Q2: Signals .0 to .7
25 to 32	I3: Signals .0 to .7	Q3: Signals .0 to .7
33 to 40	I0: Sensor supply	Q0: Chassis ground (internally jumpered)
41 to 48	I1: Sensor supply	Q1: Chassis ground (internally jumpered)
49 to 56	I2: Sensor supply	Q2: Chassis ground (internally jumpered)
57 to 64	I3: Sensor supply	Q3: Chassis ground (internally jumpered)
1L+	Power supply for channel group A (I0 and I1 or Q0 and Q1)	
2L+	Power supply for channel group B (I2 and I3 or Q2 and Q3) internally jumpered	
3L+		
4L+	Power supply for electronics, internally jumpered	
5L+		
1M	Chassis ground connection for channel group A, channel group B, and electronics (all internally jumpered)	
2M		
3M		
4M		
5M		
⏚	PE	

Technical Data

Dimensions and Weight	
Dimensions W × H × D (mm)	191 × 100 × 40.5
Height with electronics block from top edge rail (with bus terminator 6ES7 972-0CA30-0XA0)	82 mm
Weight	350 g
Module-Specific Data	
Number of channels	32

7.3 Terminal Block TB 16L AC 6ES7 193-1CH20-0XA0

Characteristics

The TB 16L AC terminal block has the following characteristics:

- Screw-type terminal connection
- The terminal block bears the stationary wiring

Plug-In Electronics Blocks

You can connect the following electronics blocks to the TB 16L AC terminal block:

Chapter	Plug-In Electronics Blocks	Order Number
Chapter 9: ET 200L Electronics Blocks Technical Data	ET 200L 16 DI AC 120 V	6ES7 131-1EH00-0XA0
	ET 200L 16 DO AC 120V/1.0A	6ES7 132-1EH00-0XB0
	ET 200L 16 DO DC 24 V/AC 120V/2.0 A	6ES7 132-1JH00-0XB0
	ET 200L 8 DI/8 DO AC 120V/1.0A	6ES7 133-1EH00-0XB0
	ET 200L 8DI AC 120V/8 DO DC 24V/AC 120V/2.0 A	6ES7 133-1JH00-0XB0

Dimension Drawing

In Figure 7-3 you can see the dimension drawing of the TB 16L AC terminal block with the L 16 DI AC 120 V electronics block clipped on.

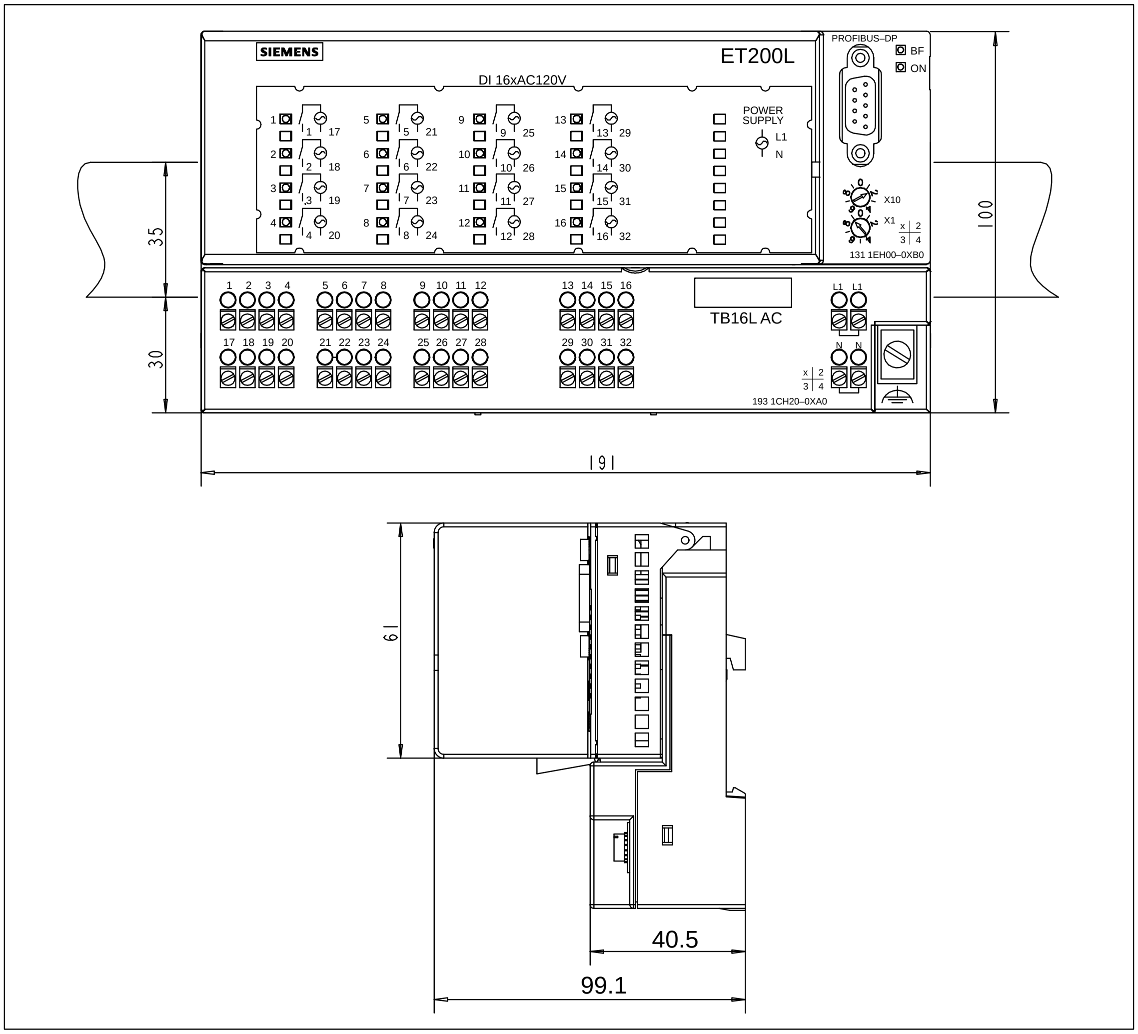


Figure 7-3 The TB 16L AC Terminal Block with the Electronics Block Mounted, Dimension Drawing (mm)

Pinout

Table 7-2 shows the pinout of the TB 16L AC terminal block.

Table 7-3 Pinout of the TB 16L AC Terminal Block

Terminal	Assignment	
	Inputs	**Outputs**
1 to 8	I0: Signals .0 to .7	Q0: Signals .0 to .7
9 to 16	I1: Signals .0 to .7	Q1: Signals .0 to .7
17	I0.0: Sensor neutral	Q0.0: Load voltage
18	I0.1: Sensor neutral	Q0.1: Load voltage
19	I0.2: Sensor neutral	Q0.2: Load voltage
20	I0.3: Sensor neutral	Q0.3: Load voltage
21	I0.4: Sensor neutral	Q0.4: Load voltage
22	I0.5: Sensor neutral	Q0.5: Load voltage
23	I0.6: Sensor neutral	Q0.6: Load voltage
24	I0.7: Sensor neutral	Q0.7: Load voltage
25	I1.0: Sensor neutral	Q1.0: Load voltage
26	I1.1: Sensor neutral	Q1.1: Load voltage
27	I1.2: Sensor neutral	Q1.2: Load voltage
28	I1.3: Sensor neutral	Q1.3: Load voltage
29	I1.4: Sensor neutral	Q1.4: Load voltage
30	I1.5: Sensor neutral	Q1.5: Load voltage
31	I1.6: Sensor neutral	Q0.6: Load voltage
32	I1.7: Sensor neutral	Q1.7: Load voltage
L1	Power supply line for electronics	
N	Power supply neutral for electronics	
⏚	PE	

Technical Data

The following table shows the technical data of the TB 16L AC terminal block.

Dimensions and Weight	
Dimensions W × H × D (mm)	191 × 100 × 40.5
Height with electronics block from top edge rail (with bus terminator)	98.5 mm
Weight	283 g
Module-Specific Data	
Number of channels	16

7.4 Terminal Block TB 16SC

Order Numbers

The TB 16SC terminal block is available with two types of connection:

- Connection by means of a screw-type terminal (Order Number 6ES7 120-0AH01-0AA0)
- Connection by means of a spring terminal (Order Number 6ES7 120-0BH01-0AA0)

Plug-In Electronic Modules

You can connect the following electronic modules to the TB 16 SC terminal block:

Chapter	Plug-In Electronic Modules	Order Number
Chapter 10: Digital SC Electronic Modules Technical Data	2DIDC24V	6ES7 121-1BB00-0AA0
	2DODC24V0.5A	6ES7 122-1BB00-0AA0
	2DODC24V2A	6ES7 122-1BB10-0AA0
	1DIAC120/230V	6ES7 121-1FA00-0AA0
	1DOAC120/230V	6ES7 122-1FA00-0AA0
	1DORel.AC230V	6ES7 122-1HA01-0AA0
	Counter module 1COUNT40kHz *	6ES7 127-1BE00-0AB0
Chapter 12: Analog SC Electronic Modules Technical Data	2 AI U	6ES7 123-1FB00-0AB0
	2 AI HS U *	6ES7 123-1FB50-0AB0
	2 AI I	6ES7 123-1GB00-0AB0 , 6ES7 123-1GB10-0AB0
	2 AI HS I *	6ES7 123-1GB50-0AB0, 6ES7 123-1GB60-0AB0
	2 AI TC	6ES7 123-1JB00-0AB0
	1 AI RTD	6ES7 123-1JA00-0AB0
	1 AO U	6ES7 124-1FA00-0AB0
	1 AO I	6ES7 124-1GA00-0AB0

* Only in conjunction with TB 16IM-SC

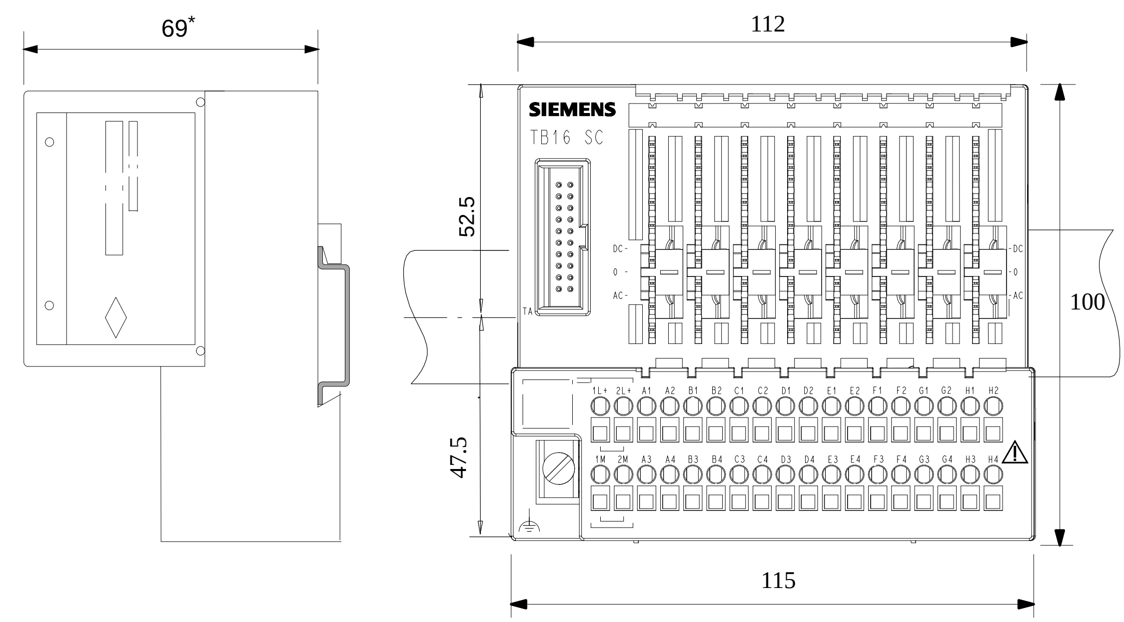
Characteristics

The TB 16SC terminal block has the following characteristics:

- It can be wired before you plug in the electronic modules.
- Depending on the design, the wiring can be connected either via screw-type terminals or via spring terminals.
- You must establish a connection to local ground.
- The TB16 SC enables a 2-wire connection and can be expanded to 3-wire and 4-wire connection using supplementary terminals.
- You can slide a labeling strip into the TB16 SC terminal block for noting the assignments between slot and module.
- The counter module and the high-speed analog SC-electronic modules can only be used in the TB 16SC, when the TB 16SC is connected to a TB 16IM-SC.

Dimension Drawing

Figure 7-4 shows the front elevation of the TB 16SC terminal block.



* With bus connector: 82 mm

Figure 7-4 Front Elevation of the Terminal Block

Caution

The spring terminal will be destroyed if you insert the screwdriver into the opening for the wires.

Only press the screwdriver into the rectangular openings of the terminal block.

Block Diagram

The figure below shows you the block diagram of the TB16 SC terminal block.

The connections 2L+ and 2M are used for looping through the load voltage supply 1L+ and 1M.

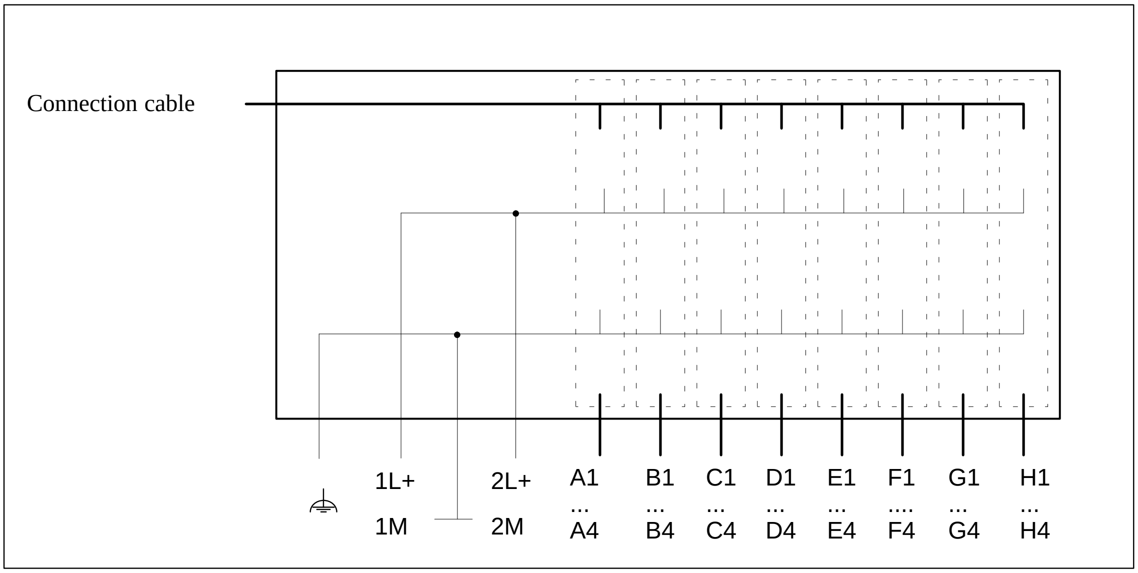


Figure 7-5 Block Diagram of the TB16 SC Terminal Block.

Warning

There is a risk of injury and damage to property.

Connecting different phases of a three-phase system to a terminal block can lead to injury and damage to property.

Connect only one phase to each terminal block.

Technical Data

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 100 × 40.5
Weight	230 g
Module-Specific Data	
Number of slots	8
Current-carrying capacity via 1L+ and 2L+	max. 8A
Current-carrying capacity per slot with parallel supply	max. 1,5 A
Number of times an electronic module can be plugged into a slot of the TB 16 SC	max. 20
Insulation tested (from slot to slot)	DC 4000 V

7.5 Terminal Block TB 16IM-SC

Order Numbers

The TB 16IM-SC terminal block is available with two types of connection.

- Connection by means of a screw-type terminal (Order Number 6ES7 120-0AH50-0AA0)
- Connection by means of a spring terminal (Order Number 6ES7 120-0BH50-0AA0)

Characteristics

The TB 16IM-SC terminal block has the following characteristics:

- It can be wired before you plug in the electronic modules.
- Depending on the design, the wiring can be connected either via screw-type terminals or via spring terminals.
- The TB 16IM-SC enables a 2-wire connection and can be expanded to a 3- and 4-wire connection with the supplementary terminals of the TB 16SC.
- You can slide a labeling strip into the TB 16IM-SC terminal block for noting the assignments between slot and module.
- the TB 16IM-SC can be expanded with the TB 16SC to connect another 8 SC electronics modules.
- two load voltage supplies (load voltage group 1L+: A to D, load voltage group 2L+, 3L+: E to F)

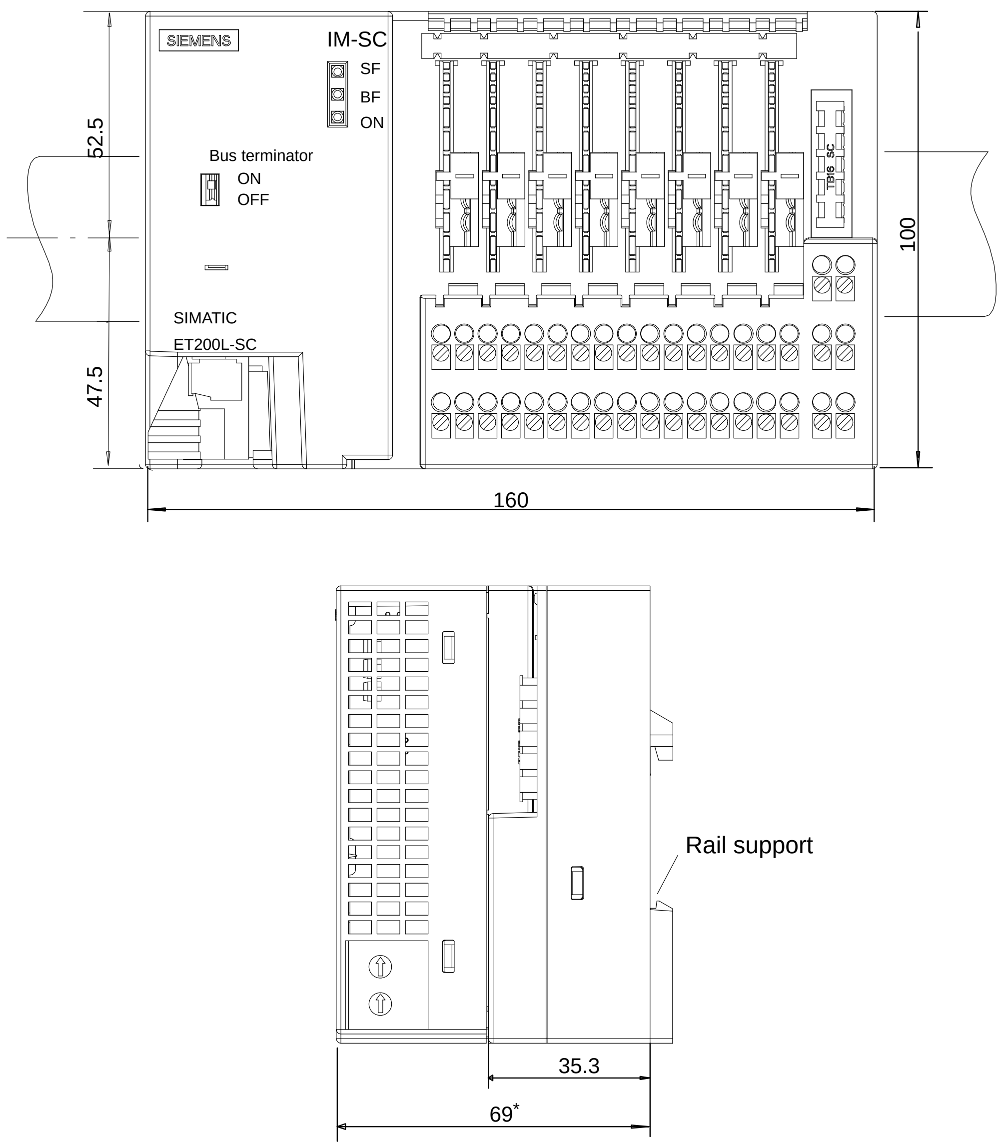
Plug-In Electronic Modules

You can connect the following electronic modules to the TB 16IM-SC terminal block:

Chapter	Plug-In Electronic Modules	Order Number
Chapter 10: Digital SC Electronic Modules Technical Data	2DIDC24V	6ES7 121-1BB00-0AA0
	2DODC24V0.5A	6ES7 122-1BB00-0AA0
	2DODC24V2A	6ES7 122-1BB10-0AA0
	Counter module 1COUNT40kHz	6ES7 127-1BE00-0AB0
	1DIAC120/230V	6ES7 121-1FA00-0AA0
	1DOAC120/230V	6ES7 122-1FA00-0AA0
	1DORel.AC230V	6ES7 122-1HA01-0AA0
Chapter 12: Analog SC Electronic Modules Technical Data	2 AI U	6ES7 123-1FB00-0AB0
	2 AI HS U	6ES7 123-1FB50-0AB0
	2 AI I	6ES7 123-1GB00-0AB0 6ES7 123-1GB10-0AB0
	2 AI HS I	6ES7 123-1GB50-0AB0, 6ES7 123-1GB60-0AB0
	2 AI TC	6ES7 123-1JB00-0AB0
	1 AI RTD	6ES7 123-1JA00-0AB0
	1 AO U	6ES7 124-1FA00-0AB0
	1 AO I	6ES7 124-1GA00-0AB0

Dimension Drawing

Figure 7-6 shows the front elevation of the TB 16IM-SC terminal block.



* With bus connector: 82 mm

Figure 7-6 The TB 16IM-SC Terminal Block with the IM-SC Interface Module Mounted, Dimension Drawing

Caution

The spring terminal will be destroyed if you insert the screwdriver into the opening for the wires.

Only press the screwdriver into the rectangular openings of the terminal block.

Block Diagram

The figure below shows you the block diagram of the TB 16IM-SC terminal block.

The connections 3L+ and 3M are used for looping through the load voltage supply 2L+ and 2M.

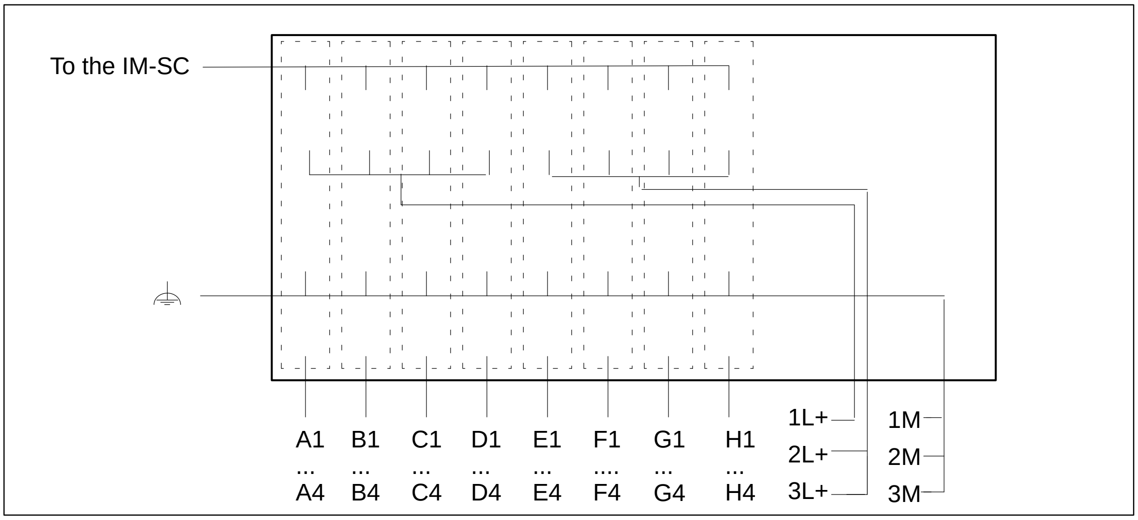


Figure 7-7 Block Diagram of the TB 16IM-SC Terminal Block

Warning

There is a risk of injury and damage to property.

Connecting different phases of a three-phase system to a terminal block can lead to injury and damage to property.

Connect only one phase to each terminal block.

Technical Data

Dimensions and Weight	
Dimensions W × H × D (mm)	160 × 100 × 73.6
Weight	260 g
Module-Specific Data	
Number of slots	8
Current-carrying capacity via 1L+ and 2L+	max. 2 × 8A
Number of times an electronic module can be plugged into a slot of the TB 16IM-SC	max. 8
Isolation tested (from slot to slot)	DC 4000 V

7.6 Supplementary Terminals for the TB 16L and TB 32L

Definition

The supplementary terminals allow you to upgrade the two-wire termination of the ET 200L distributed I/O device to a three- or four-wire termination.

Versions Supplied

Table 7-4 Supplied Versions of the Supplementary Terminals

Channels	Tiers	Fixing	Order Number
16	1	Screw-type terminal	6ES7 193-1FH20-0XA0
		Spring terminal	6ES7 193-1FH50-0XA0
	2	Screw-type terminal	6ES7 193-1FH30-0XA0
		Spring terminal	6ES7 193-1FH60-0XA0
32	1	Screw-type terminal	6ES7 193-1FL20-0XA0
		Spring terminal	6ES7 193-1FL50-0XA0
	2	Screw-type terminal	6ES7 193-1FL30-0XA0
		Spring terminal	6ES7 193-1FL60-0XA0

Characteristics

With the supplementary terminals, every tier is jumpered internally.

Dimension Drawing

Figure 7-8 shows the dimension drawings for the supplementary terminals.

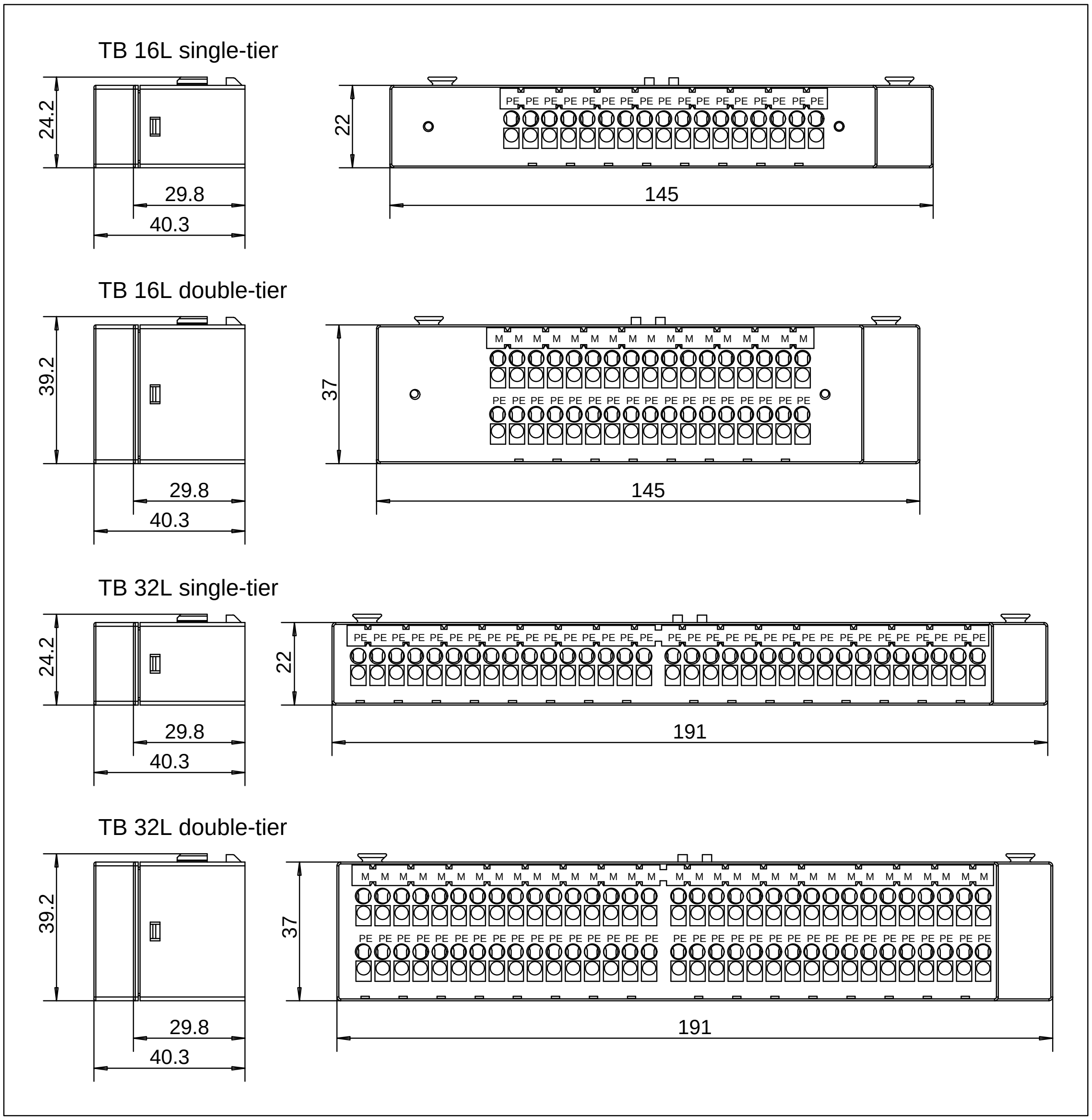


Figure 7-8 TB 16L/TB 32L Supplementary Terminals, Dimension Drawing

7.7 Supplementary Terminals for the TB 16SC and TB 16IM-SC

Definition

The supplementary terminals allow you to upgrade the two-wire termination of the ET 200L-SC IM-SC distributed I/O device and Smart Connect to a three- or four-wire termination.

Versions Supplied

Table 7-5 Supplied Versions of the Supplementary Terminals TB16SC/ TB 16IM-SC

Tiers	Fixing	Order Number
1	Screw-type terminal	6ES7 120-1AH00-0AA0
	Spring terminal	6ES7 120-1BH00-0AA0
2	Screw-type terminal	6ES7 120-2AH00-0AA0
	Spring terminal	6ES7 120-2BH00-0AA0
Shield terminal		6ES7 192-0AA0-0AA0

Characteristics

With the supplementary terminals, every tier is jumpered internally.

Dimension Drawing

Figure 7-8 shows the dimension drawings for the supplementary terminals.

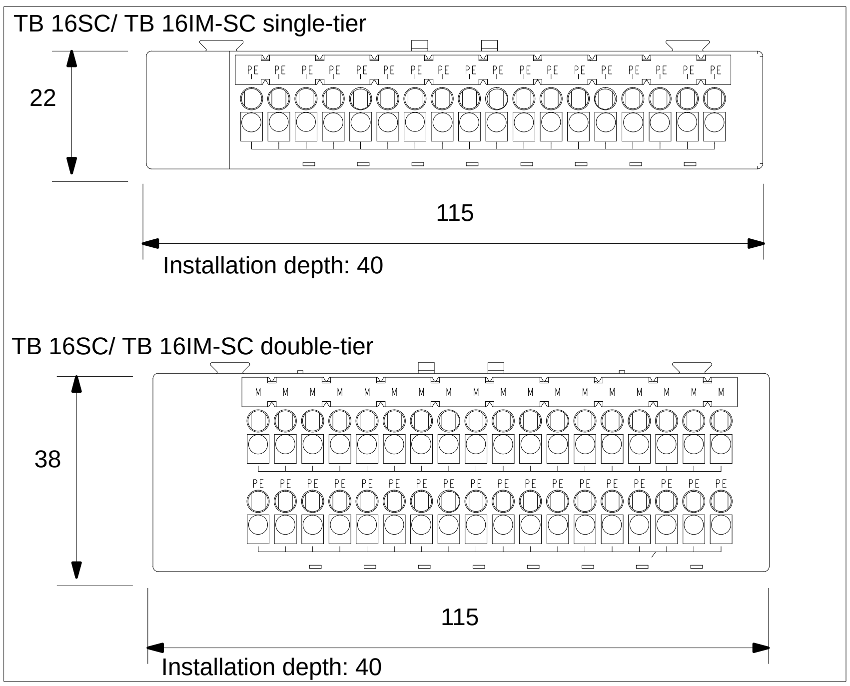


Figure 7-9 TB 16SC/TB 16IM-SC Supplementary Terminals, Dimension Drawing

ET 200L Electronics Blocks – Technical Data

8

Introduction

The components of the ET 200L cannot be upgraded with a Smart Connect. This chapter contains the technical data of the ET 200L electronics blocks.

TB↔EB Assignment

The following table contains the assignment of the ET 200L electronic blocks to the terminal blocks.

Table 8-1 Assignment of the ET 200L Electronic Blocks to the Terminal Blocks

Terminal Block	Electronics Block	Order Number
TB 16L – (6ES7 193-1CH00-0XA0, 6ES7 193-1CH10-0XA0)	ET 200L 16 DI DC 24 V	6ES7 131-1BH00-0XB0
	ET 200L 16 DO DC 24 V/0.5A	6ES7 132-1BH00-0XB0
TB 32L – (6ES7 193-1CL00-0XA0, 6ES7 193-1CL10-0XA0)	ET 200L 32 DI DC 24 V	6ES7 131-1BL00-0XB0
	ET 200L 32 DO DC 24 V/0.5 A	6ES7 132-1BL00-0XB0
	ET 200L 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL00-0XB0
TB 16L AC (6ES7 193-1CH20-0XA0)	ET 200L 16 DI AC 120 V	6ES7 131-1EH00-0XB0
	ET 200L 16 DO AC 120 V/1.0 A	6ES7 132-1EH00-0XB0
	ET 200L 16 DO DC 24 V/AC 120V/2.0 A	6ES7 132-1JH00-0XB0
	ET 200L 8 DI/8DO AC 120 V/1.0 A	6ES7 133-1EH00-0XB0
	ET 200L 8DI AC 120V/8 DO DC 24V/AC 120V/2.0 A	6ES7 133-1JH00-0XB0

Contents of the Chapter

8.1 Electronics Block L 16 DI DC 24 V – 6ES7 131-1BH00-0XB0

Characteristics

The L 16 DI DC 24 V electronics block has the following characteristics:

- 16 inputs in two groups, each of eight inputs
- Rated input voltage of 24 V DC
- Suitable for switches and proximity switches (BEROs)

View

The following figure shows a view of the electronics block.

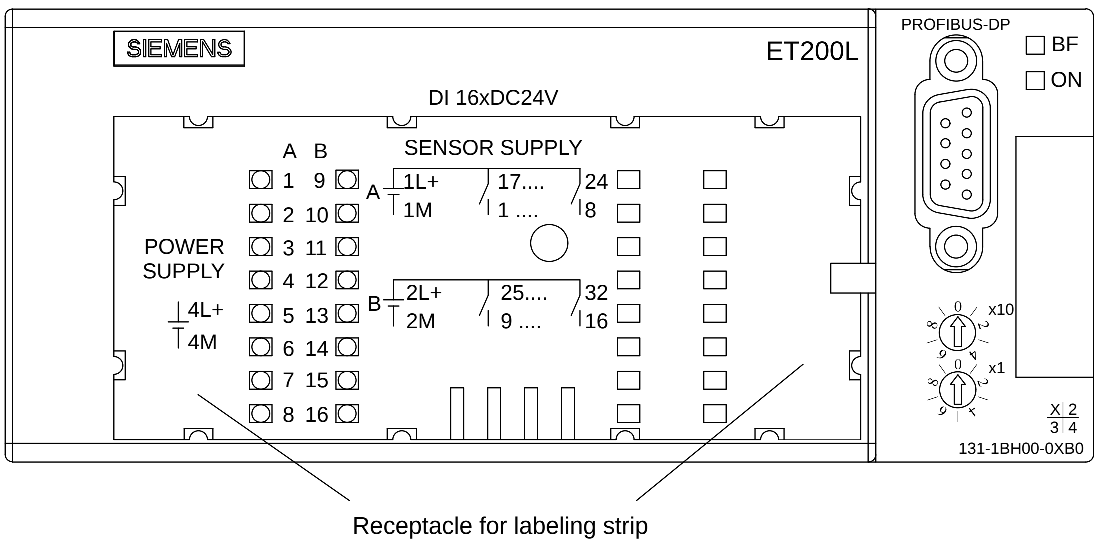


Figure 8-1 View of the L 16 DI DC 24 V Electronics Block

Block Diagram

Figure 8-2 shows the block diagram.

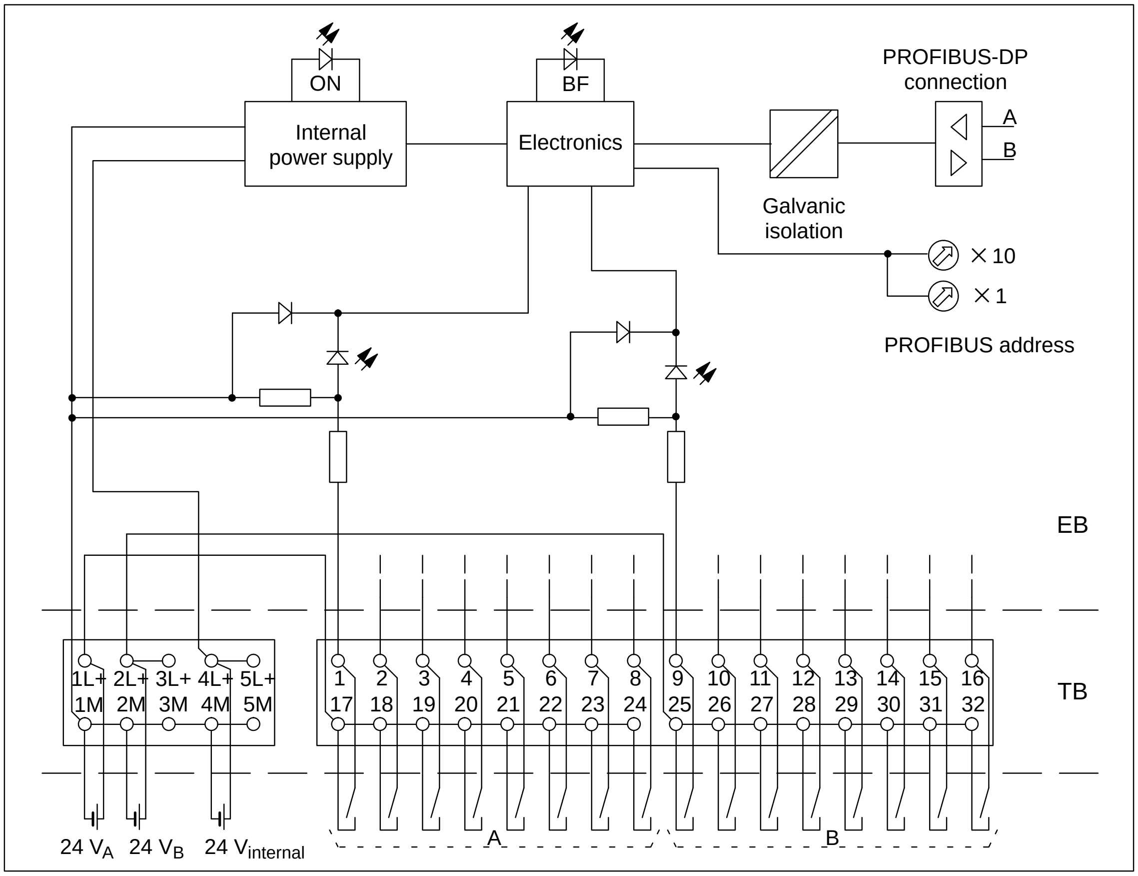


Figure 8-2 Block Diagram of the L 16 DI DC 24 V Electronics Block

Technical Data

The following table shows the technical data of the L 16 DI DC 24 V electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
Number of inputs	16
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0014_H
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 V DC
Maximum number of inputs driven simultaneously	16
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power input	
• From supply voltage L4+/L5+	Max. 70 mA
• From load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 2.2 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	24 V DC
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V
Input delay	
• With ”0” after ”1”	2.0 to 4.5 ms
• With ”1” after ”0”	2.0 to 4.5 ms
Input characteristic	To IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

8.2 Electronics Block L 16 DO DC 24 V/0.5 A – 6ES7 132-1BH00-0XB0

Characteristics

The L 16 DO DC 24 V/0.5 A electronics block has the following characteristics:

- 16 outputs in two groups, each of eight outputs
- Output current of 0.5 A per output
- Rated load voltage of 24 V DC
- Suitable for solenoids, DC contactors, and indicator lights

View

The following figure shows a view of the electronics block.

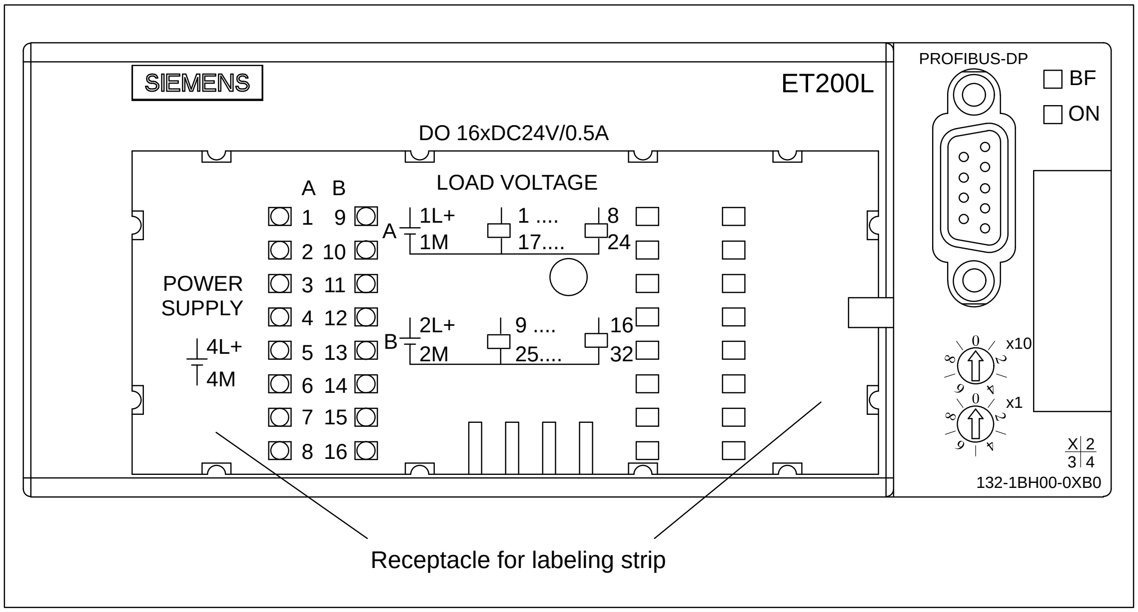


Figure 8-3 View of the L 16 DO DC 24 V/0.5 A Electronics Block

Block Diagram

Figure 8-4 shows the block diagram.

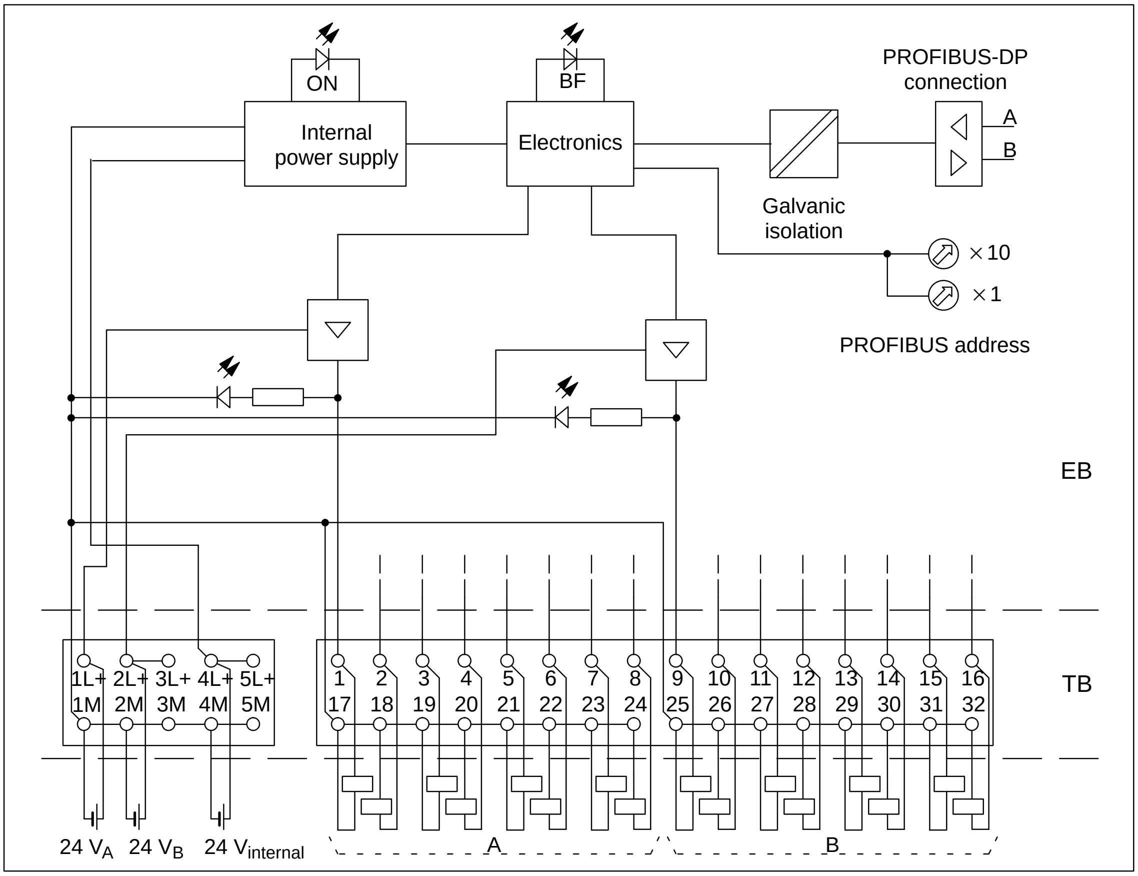


Figure 8-4 Block diagram of the L 16 DO DC 24 V/0.5 A Electronics Block

Technical Data

The following table shows the technical data of the L 16 DO DC 24 V/0.5 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
SYNC compatibility	Yes
Number of outputs	16

Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0016_H

Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 V DC
Aggregate current of outputs (per byte)	
• Horizontal installation	
Up to 30 °C	Max. 4 A
Up to 40 °C	Max. 3 A
Up to 60 °C	Max. 2 A
• All other installation positions	
Up to 40 °C	Max. 2 A
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power input	
• from supply voltage L4+/L5+	Max. 70 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 5 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED

Actuator Selection Data	
Output voltage	
• At signal ”1”	At least L1+ (– 3 V) or L2+/L3+ (3 V)
Output current	
• At signal ”1”	
Rated value	0.5 A
Permissible range	1 mA to 0.5 A
• At signal ”0” (residual current)	Max. 1 mA
Output delay (with resistive load)	
• With ”0” after ”1”	Max. 50 µs
• With ”1” after ”0”	Max. 200 µs
Load resistance range	41 Ω to 28 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 8 Hz
Limitation of voltage induced on circuit interruption	Typically L1+ (– 55 V) or L2+/L3+ (– 55 V)
Short-circuit protection	Yes
• Response threshold	Typically 0.7 A

8.3 Electronics Block L 32 DI DC 24 V 6ES7 131-1BL00-0XB0

Characteristics

The L 32 DI DC 24 V electronics block has the following characteristics:

- 32 inputs in two groups, each of 16 outputs
- Rated input voltage of 24 V DC
- Suitable for switches and proximity switches (BEROs)

View

The following figure shows a view of the electronics block.

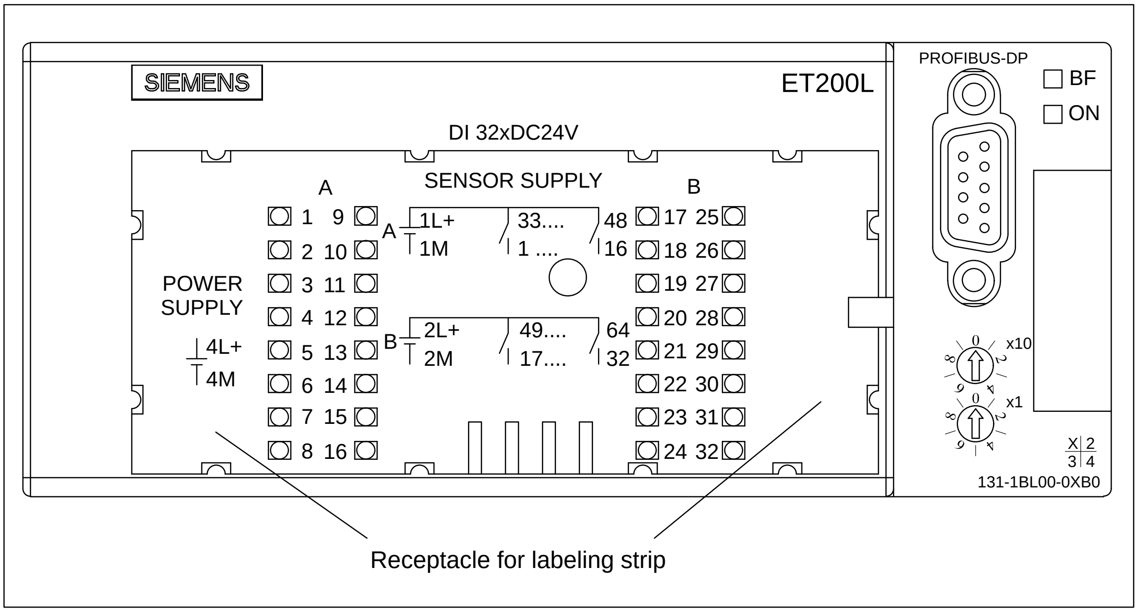


Figure 8-5 View of the L 32 DI DC 24 V Electronics Block

Block Diagram Figure 8-6 shows the block diagram.

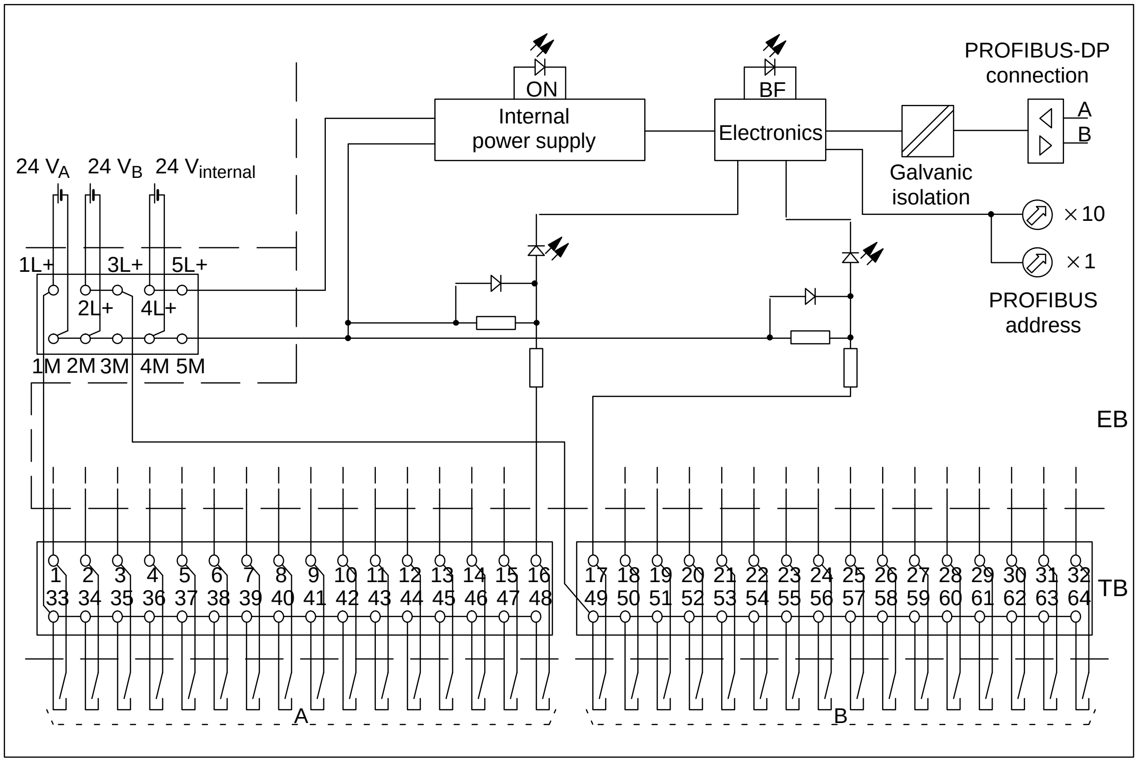


Figure 8-6 Block diagram of the L 32 DI DC 24 V Electronics Block

Technical Data

The following table shows the technical data of the L 32 DI DC 24 V electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 150 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1 500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
Number of inputs	32
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0015_H
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 V DC
Maximum number of inputs driven simultaneously	32
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power input	
• from supply voltage L4+/L5+	Max. 70 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 100 mA per load group
Power loss of module	Typically 3.2 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	24 V DC
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V
Input delay	
• With ”0” after ”1”	2.0 to 4.5 ms
• With ”1” after ”0”	2.0 to 4.5 ms
Input characteristic	To IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

8.4 Electronics Block L 32 DO DC 24 V/0.5 A – 6ES7 132-1BL00-0XB0

Characteristics

The L 32 DO DC 24 V/0.5 A electronics block has the following characteristics:

- 32 outputs in two groups, each of 16 outputs
- Output current of 0.5 A per output
- Rated load voltage of 24 V DC
- Suitable for solenoids, DC contactors, and indicator lights

View

The following figure shows a view of the electronics block.

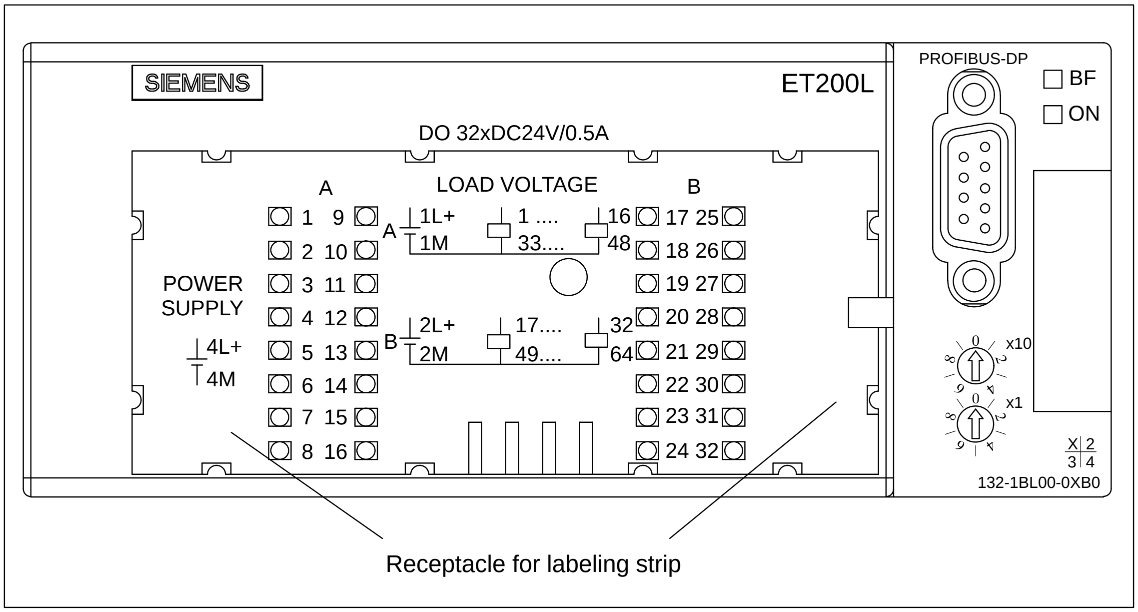


Figure 8-7 View of the L 32 DO Electronics Block DC 24 V/0.5 A

Block Diagram

Figure 8-8 shows the block diagram.

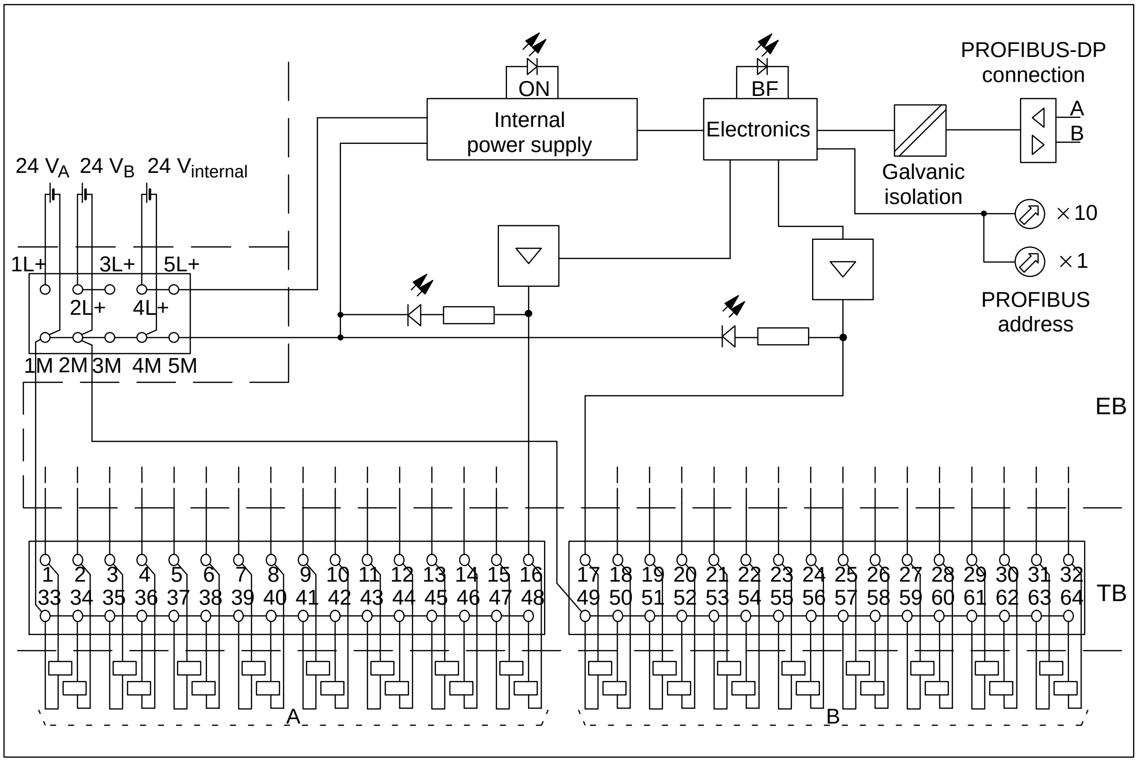


Figure 8-8 Block Diagram of the L 32 DO DC 24 V/0.5 A Electronics Block

Technical data

The following table shows the technical data of the L 32 DO DC 24 V/0.5 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 150 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
SYNC compatibility	Yes
Number of outputs	32
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0011_H

Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure with-stand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 V DC
Aggregate current of outputs (per byte)	
• Horizontal installation	
Up to 30 °C	Max. 4 A
Up to 40 °C	Max. 3 A
Up to 60 °C	Max. 2 A
• All other installation positions	
Up to 40 °C	Max. 2 A

Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power input	
• from supply voltage L4+/L5+	Max. 70 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 100 mA per load group
Power loss of module	Typically 7 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED

Actuator Selection Data	
Output voltage	
• At signal ”1”	At least L1+ (– 3 V) or L2+/L3+ (3 V)
Output current	
• At signal ”1”	
Rated value	0.5 A
Permissible range	1 mA to 0.5 A
• At signal ”0” (residual current)	Max. 1 mA
Output delay (with resistive load)	
• With ”0” after ”1”	Max. 50 µs
• With ”1” after ”0”	Max. 200 µs
Load resistance range	41 Ω to 28 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 8 Hz
Limitation of voltage induced on circuit interruption	Typically L1+ (– 55 V) or L2+/L3+ (55 V)
Short-circuit protection	Yes
• Response threshold	Typically 0.7 A

8.5 Electronics Block L 16 DI/16 DO DC 24 V/0.5 A – 6ES7 133-1BL00-0XB0

Characteristics

The L 16 DI/16 DO DC 24 V/0.5 A electronics block has the following characteristics:

- 16 inputs in a single group of 16 inputs
  - Rated input voltage of 24 V DC
  - Suitable for switches and proximity switches (BEROs)
- 16 outputs in a single group of 16 outputs
  - Output current of 0.5 A
  - Rated load voltage of 24 V DC
  - Suitable for solenoids, DC contactors, and indicator lights

View

The following figure shows a view of the electronics block.

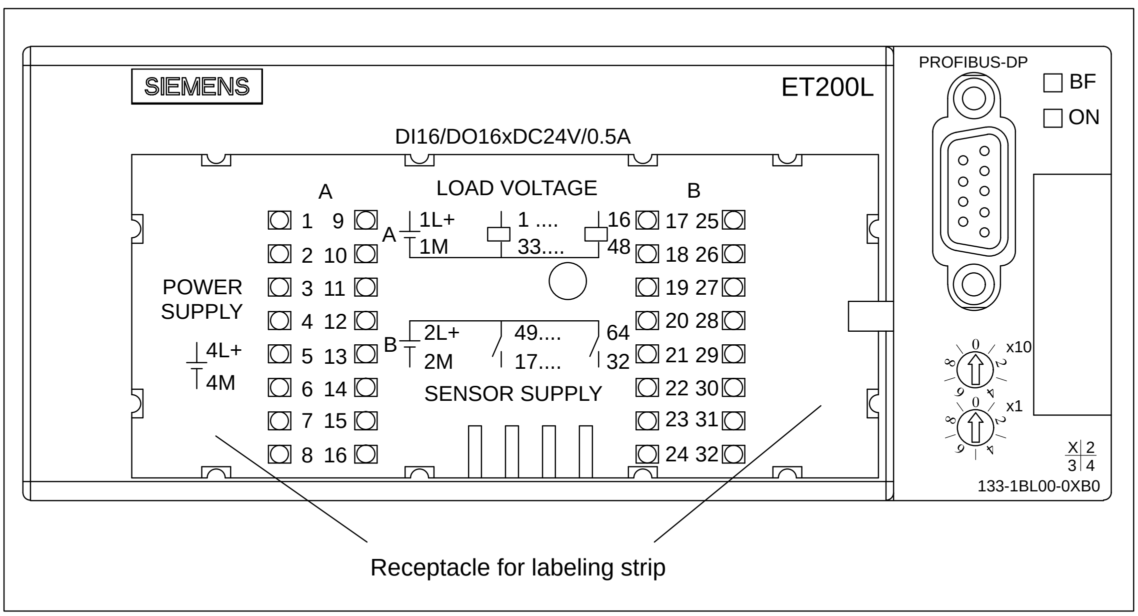


Figure 8-9 View of the L 16 DI/16 DO DC 24 V/0.5 A Electronics Block

Block Diagram Figure 8-10 shows the block diagram.

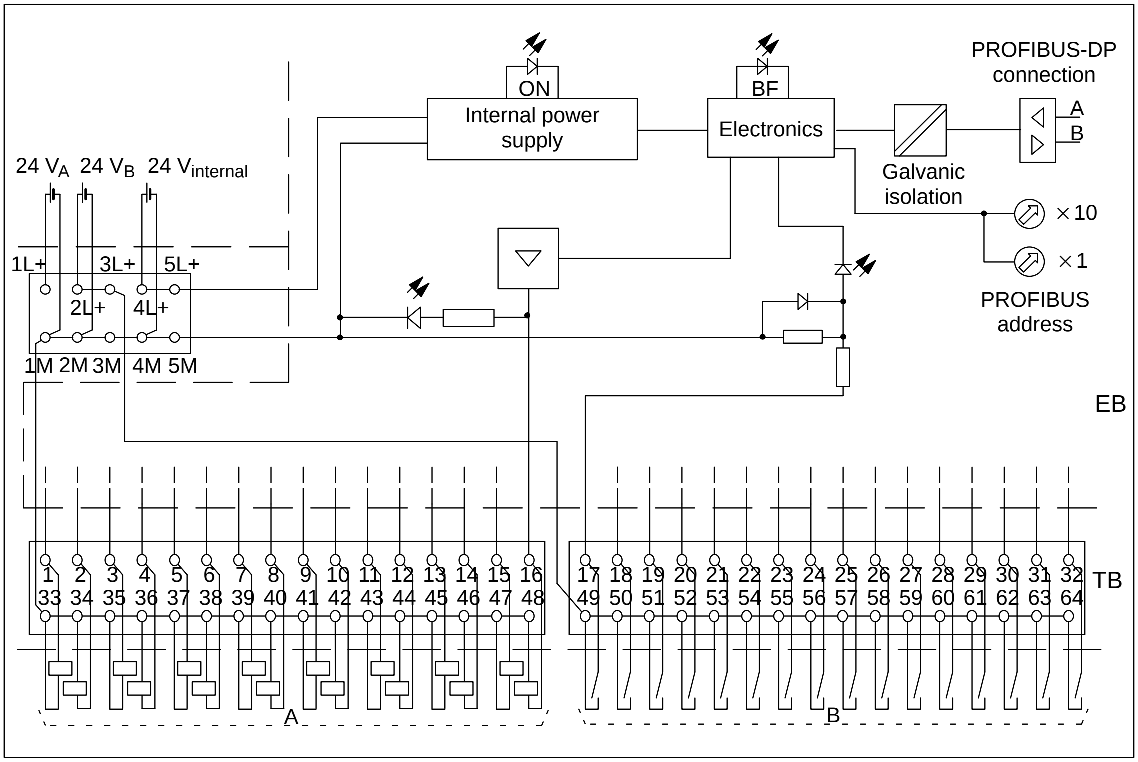


Figure 8-10 Block Diagram of the L 16 DI/16 DO DC 24 V/0.5 A Electronics Block

Technical Data The following table shows the technical data of the L 16 DI/16 DO DC 24 V/0.5 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of inputs	16
Number of outputs	16

Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0017_H
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 V DC
Maximum number of inputs driven simultaneously	16

Aggregate current of outputs (per byte)	
• Horizontal installation	
Up to 30 °C	Max. 4 A
Up to 40 °C	Max. 3 A
Up to 60 °C	Max. 2 A
• All other installation positions	
Up to 40 °C	Max. 2 A
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power input	
• from supply voltage L4+/L5+	Max. 70 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	24 V DC
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V
Input delay	
• With ”0” after ”1”	2.0 to 4.5 ms
• With ”1” after ”0”	2.0 to 4.5 ms
Input characteristic	To IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA
Actuator Selection Data	
Output voltage	
• At signal ”1”	At least L1+ (– 3 V) or L2+/L3+ (3 V)
Output current	
• At signal ”1”	
Rated value	0.5 A
Permissible range	1 mA to 0.5 A
• At signal ”0” (residual current)	Max. 1 mA
Output delay (with resistive load)	
• With ”0” after ”1”	Max. 50 µs
• With ”1” after ”0”	Max. 200 µs
Load resistance range	41 Ω to 28 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 8 Hz
Limitation of voltage induced on circuit interruption	Typically L1+ (– 55 V) or L2+/L3+ (– 55 V)
Short-circuit protection	Yes
• Response threshold	Typically 0.7 A

8.6 Electronics Block L 16 DI AC 120 V – 6ES7 131-1EH00-0XB0

Characteristics

The L 16 DI AC 120 V electronics block has the following characteristics:

- 16 inputs, fully isolated
- Rated input voltage of 120 VAC
- Suitable for switches and proximity switches compatible with IEC Type 2 currents

View

Figure 8-11 shows a view of the L 16 DI AC 120V electronics block.

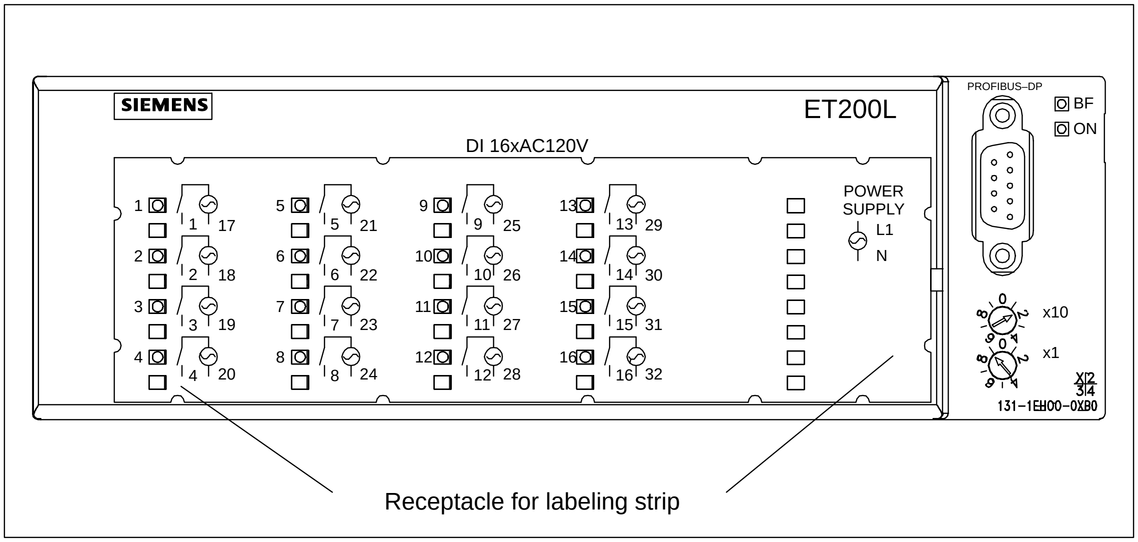


Figure 8-11 View of the L 16 DI AC 120 V Electronics Block

Block Diagram

Figure 8-12 shows the block diagram of the L 16 DI AC 120 V electronics block.

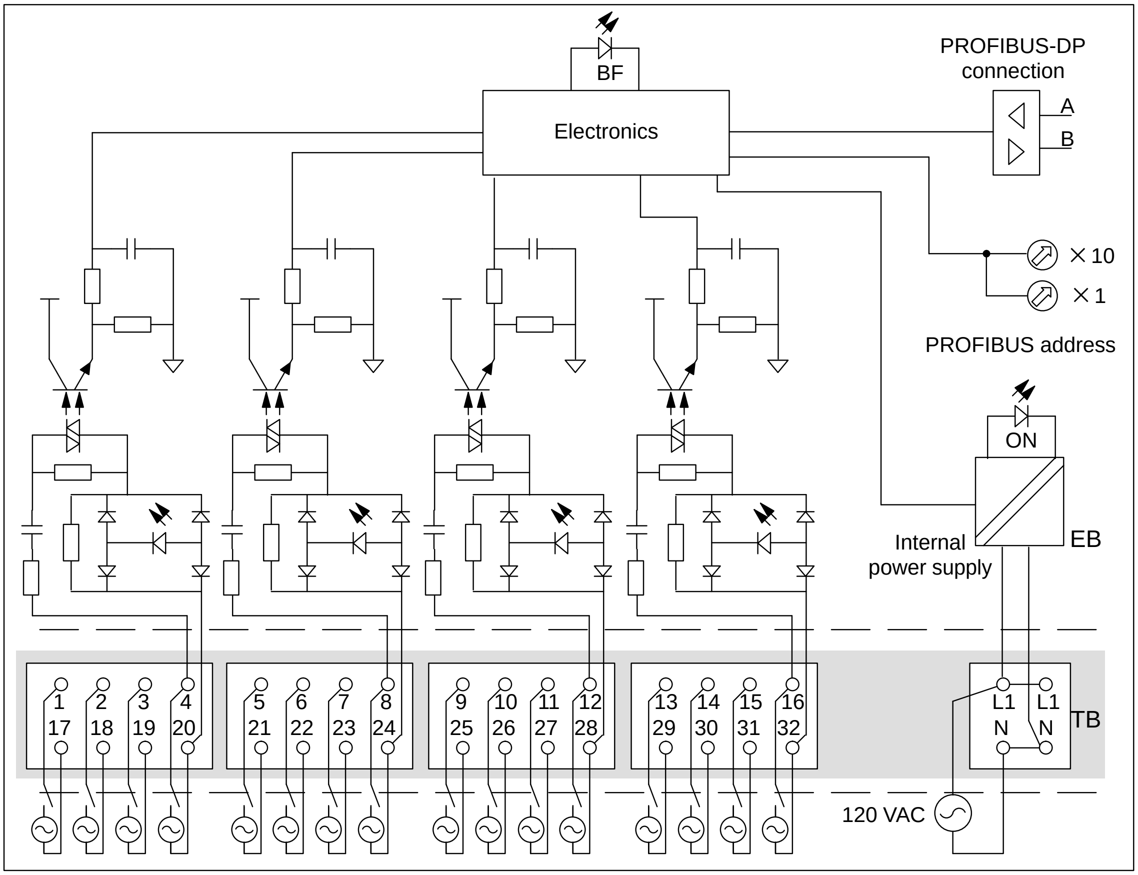


Figure 8-12 Block Diagram of the L 16 DI AC 120 V Electronic Block

Technical Data

The following table shows the technical data of the L 16 DI AC 120 V electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	191 × 61 × 85.5
Weight	Approx. 341 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500, 1500, 3000, and 6000 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
Number of inputs	16
I/O Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	$002A_H$
Voltages, Currents, Potentials	
Supply voltage L1	
• Rated value	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
• Power failure withstand time	At least 20 ms
Maximum number of inputs driven simultaneously	16
Optical isolation	
• Between channels	Yes
• Between L1 and PROFIBUS-DP	Yes
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	1500 VAC
Power input	
• from supply voltage L1	Max. 90 mA
Power loss of module	Typically 5.4 W

Status, Alarms, Diagnostics	
Status display	Green LED per channel
Alarms	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red “BF” LED
• Monitoring of electronics power supply	Green “ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	120 VAC
• With signal 1	74 to 132 VAC
• With signal 0	0 to 20 VAC
Input current	
• With signal 1	9 to 27 mA
• With signal 0	0 to 4 mA
Input delay	
• From 0 to 1	2 to 14 ms
• From 1 to 0	6 to 25 ms
Input characteristic	To IEC 1131-2 Type 2
Connection of 2-wire BEROs	Possible

8.7 Electronics Block L 16 DO AC 120 V/1.0 A – 6ES7 132-1EH00-0XB0

Characteristics

The L 16 DO AC 120 V/1.0 A electronics block has the following characteristics:

- 16 outputs, fully isolated
- Output current of 1.0 A
- Rated load voltage of 120 VAC
- Suitable for solenoids, AC contactors, and indicator lights

View

Figure 8-13 shows a view of the L 16 DO AC 120 V/1.0 A electronics block.

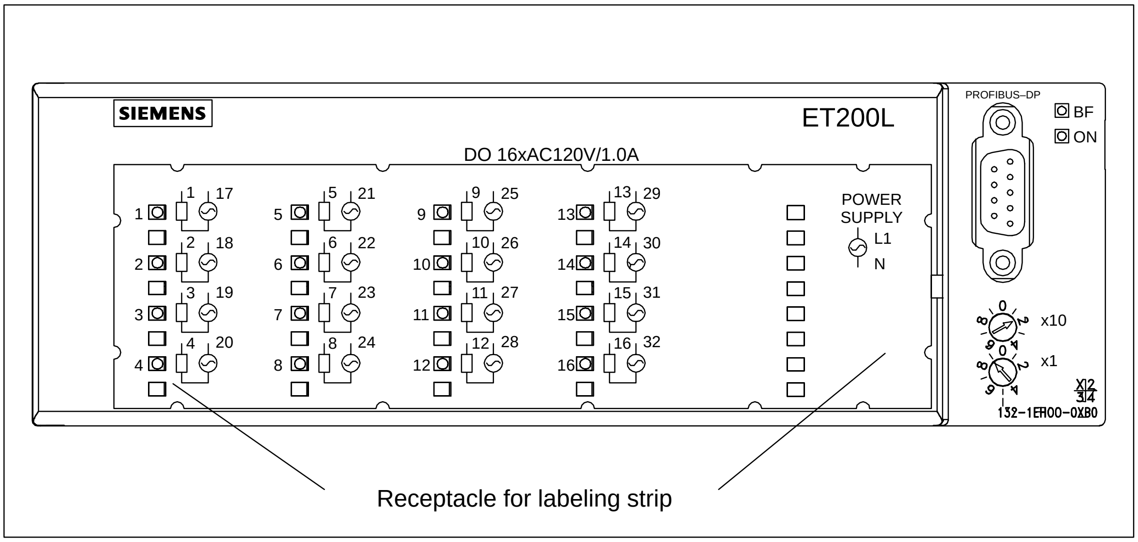


Figure 8-13 View of the L 16 DO AC 120 V/1.0 A Electronics Block

Block Diagram

Figure 8-14 shows the block diagram of the L 16 DO AC 120 V/1.0 A electronics block.

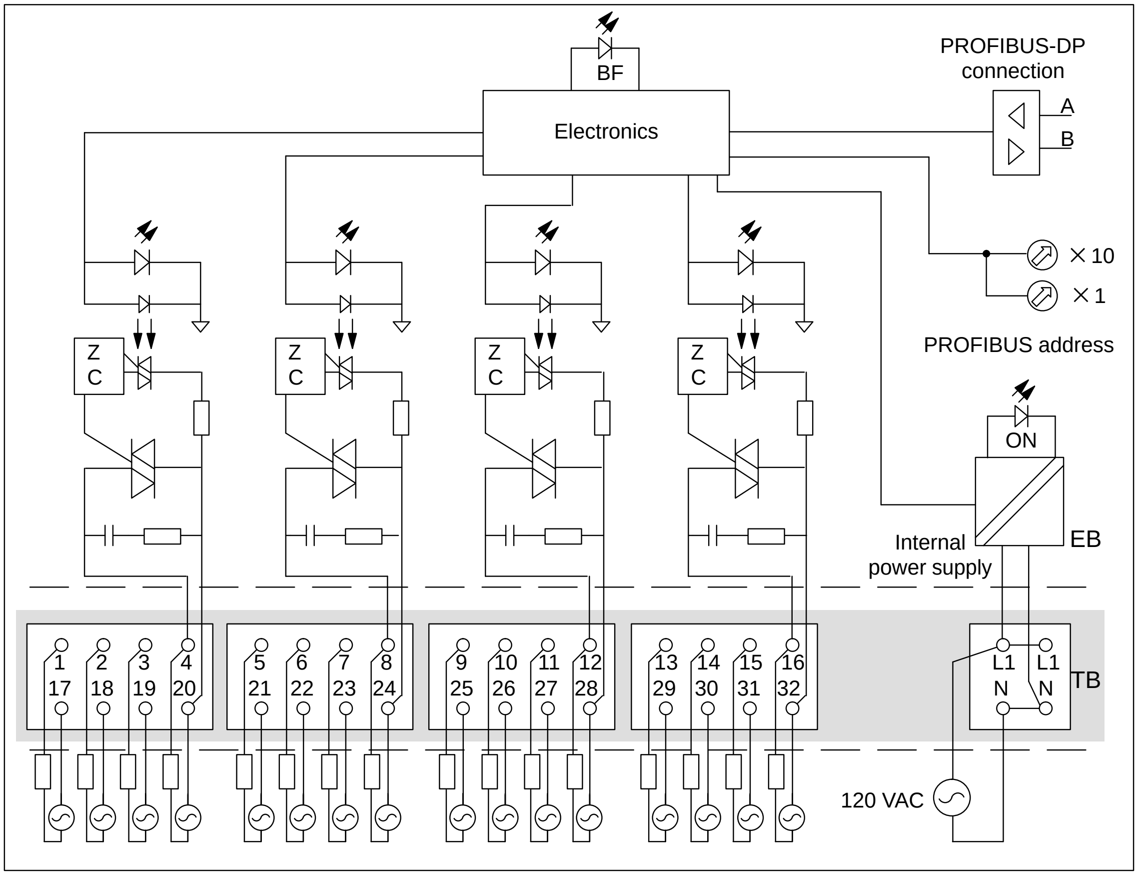


Figure 8-14 Block Diagram of the L 16 DO AC 120 V/1.0 A Electronics Block

Technical data

The following table shows the technical data of the L 16 DO AC 120 V/1.0 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	191 × 61 × 85.5
Weight	Approx. 294 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500, 1500, 3000, and 6000 kBaud
Bus protocol	PROFIBUS-DP
SYNC compatibility	Yes
Number of outputs	16
I/O Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0028_H
Voltages, Currents, Potentials	
Supply voltage L1	
• Rated voltage	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
• Power failure withstand time	At least 20 ms
Aggregate current of outputs (per point)	
• Horizontal installation	
up to 40°C	Max. 1 A
up to 60°C	Max. 0.4 A
• All other installation positions	
up to 40°C	Max. 0.4 A
Optical isolation	
• Between channels	Yes
• Between L1 and PROFIBUS-DP	Yes
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	1500 VAC
Power input	
• from supply voltage L	Max. 170 mA
Power loss of module	Typically 18.9 W

Status, Alarms, Diagnostics	
Status display	Green LED per channel
Alarms	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red “BF” LED
• Monitoring of electronics power supply	Green “ON” LED
Actuator Selection Data	
Load voltage L	
• Rated voltage	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
Output voltage	
• With signal 1	At least L (– 1.5V)
Output current	
• With signal 1	
Rated value	1.0 A Pilot Duty
Permissible range	0.1 to 1.0 A
• With signal 0 (residual current)	Max. 2.6 mA
Zero cross inhibit voltage	Max. 60 V
Output delay (with resistive load)	Max. 20 ms
Size of motor starter	
• Up to 40°C	Max. size 4 acc. to NEMA
• Up to 60°C	Max. size 3 acc. to NEMA
Lamp load	Max. 50 W
Parallel connection of two outputs	
• For redundant control of load	Possible
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 10 Hz
• Inductive load	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Short-circuit protection	No

8.8 Electronics Block L 16 RO DC 24 V/AC 120 V/2.0 A – 6ES7 132-1JH00-0XB0

Characteristics

The L 16 RO DC 24 V/AC 120 V/2.0 A electronics block has the following characteristics:

- 16 relay outputs, fully isolated
- Output current of 2.0 A
- Rated load voltage of 24 V DC or 120 VAC
- Suitable for solenoids, contactors, and indicator lights
- Adjacent outputs of 24 V DC and 120 VAC are permitted

View

Figure 8-15 shows a view of the L 16 RO DC 24 V/AC 120 V/2.0 A electronics block.

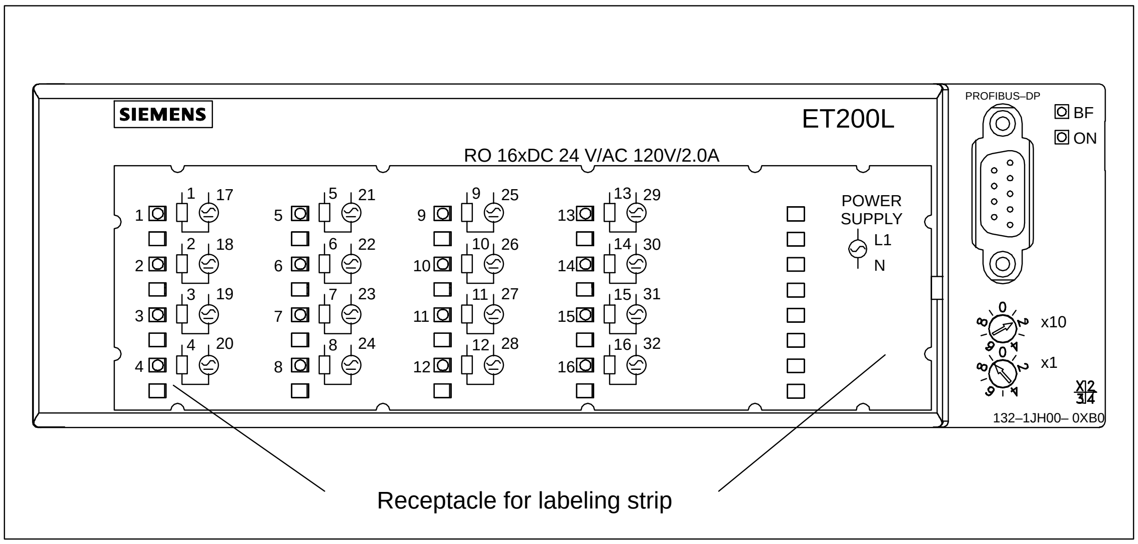


Figure 8-15 View of the L 16 RO DC 24 V/AC 120V/2.0 A Electronics Block

Block Diagram

Figure 8-16 shows the block diagram of the L 16 RO DC 24 V/AC 120 V/2.0 A electronics block.

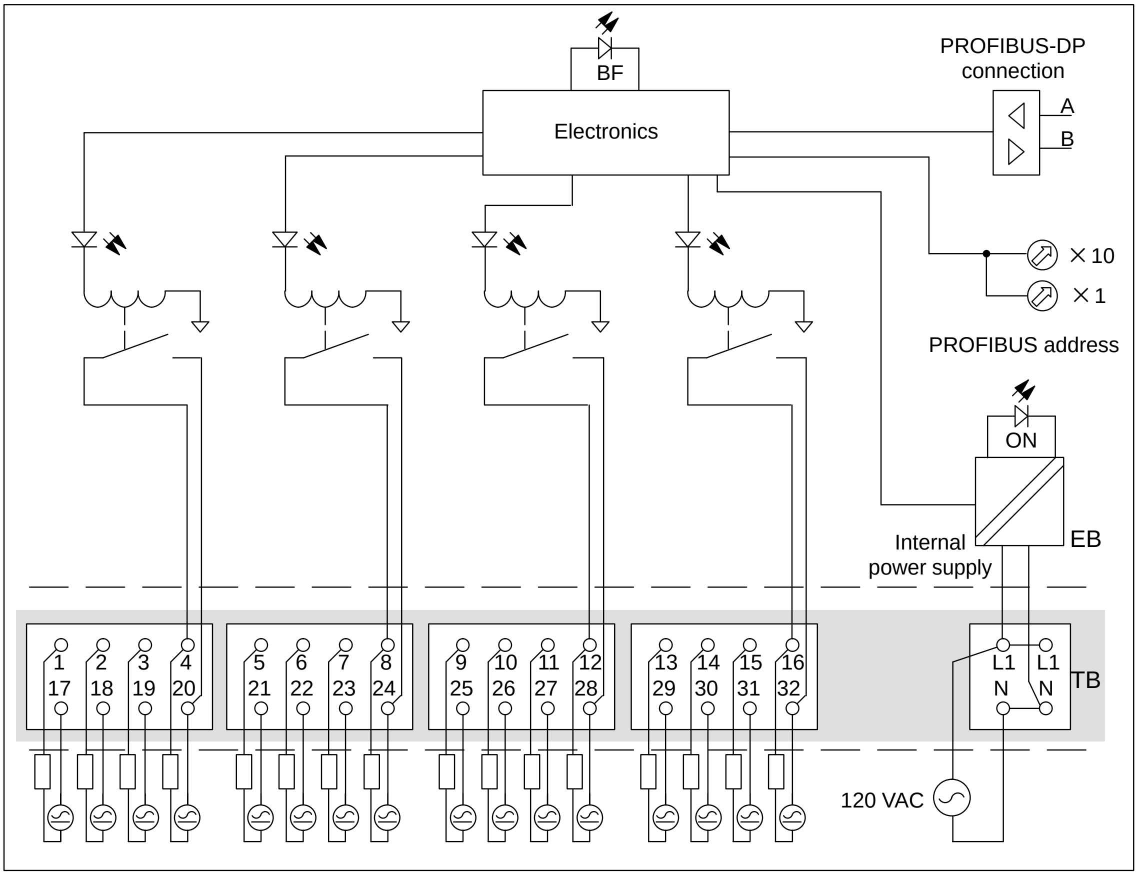


Figure 8-16 Block Diagram of the L 16 RO DC 24 V/AC 120 V/2.0 A Electronics Block

Technical data

The following table shows the technical data of the L 16 RO DC 24 V/AC 120 V/2.0 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	191 × 61 × 85.5
Weight	Approx. 302 g

Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500, 1500, 3000, and 6000 kBaud
Bus protocol	PROFIBUS-DP
SYNC compatibility	Yes
Number of outputs	16
I/O Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0026_H

Voltages, Currents, Potentials	
Supply voltage L1	
• Rated voltage	120 VAC
• Permissible range	85 to 132 VAC
• Frequency	47 to 63 Hz
• Power failure withstand time	At least 20 ms
Aggregate current of outputs (per byte)	
• Horizontal installation	
up to 40°C	Max. 2 A
up to 60°C	Max. 1 A
• All other installation positions	
up to 40°C	Max. 1 A
Optical isolation	
• Between channels	Yes
• Between L1 and PROFIBUS-DP	Yes
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	1500 VAC
Power input	
• from supply voltage L	Max. 220 mA
Power loss of module	Typically 25.6 W

Status, Alarms, Diagnostics	
Status display	Green LED per channel
Alarms	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red “BF” LED
• Monitoring of electronics power supply	Green “ON” LED

Actuator Selection Data	
Load voltage L	
• Rated voltage	24 V DC or 120 VAC
• Permissible DC range	4.5 to 30 V DC
• Permissible AC range	6 to 132 VAC
• AC Frequency	47 to 63 Hz
Output voltage	
• With signal 1	At least L (– 1.0V)
Output current	
• With signal 1	
Rated value	2.0 A Pilot Duty
Permissible range	10 mA to 2.0 A
• With signal 0 (residual current)	none
Output delay (with resistive load)	Max. 10 ms
Size of motor starter	
• Up to 40°C	NEMA Size 5
• Up to 60°C	NEMA Size 4
Lamp load	Max. 50 W
Parallel connection of two outputs	
• For redundant control of load	Possible
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 10 Hz
• Inductive load	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Short-circuit protection	No

Table 8-2 Service Life of the Contacts

Resistive Load	Voltage	Switching Cycles (Typical)
• Resistive load		
0.5 A	30 V DC or 250 V AC	800.000
1.0 A	30 V DC or 250 V AC	550.000
2.0 A	30 V DC or 250 V AC	300.000
• Inductive load (L/R = 7 ms; power factor = 0.4)		
0.5 A	30 V DC or 250 V AC	500.000
1.0 A	30 V DC or 250 V AC	300.000
2.0 A	30 V DC or 250 V AC	100.000
• Mechanical		20.000.000

8.9 Electronics Block L 8 DI/8 DO AC 120 V/1.0 A – 6ES7 133-1EH00-0XB0

Characteristics

The L 8 DI/8 DO AC 120 V/1.0 A electronics block has the following characteristics:

- 8 inputs, fully isolated
  - Rated input voltage of 120 VAC
  - Suitable for switches and proximity switches, compatible with IEC Type 2 currents
- 8 outputs, fully isolated
  - Output current of 1.0 A
  - Rated load voltage of 120 VAC
  - Suitable for solenoids, AC contactors, and indicator lights

View

Figure 8-17 shows a view of the L 8 DI/8 DO AC 120 V/1.0 A electronics block.

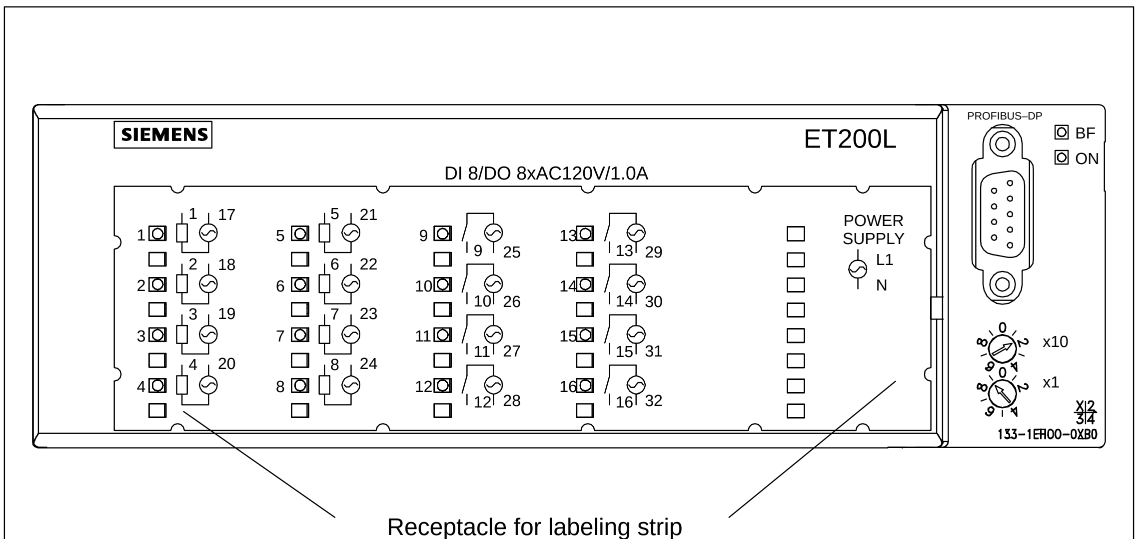


Figure 8-17 View of the L 8 DI/8 DO AC 120 V/1.0 A Electronics Block

Block Diagram

Figure 8-18 shows the block diagram of the L 8 DI/8 DO AC 120 V/1.0 A electronics block.

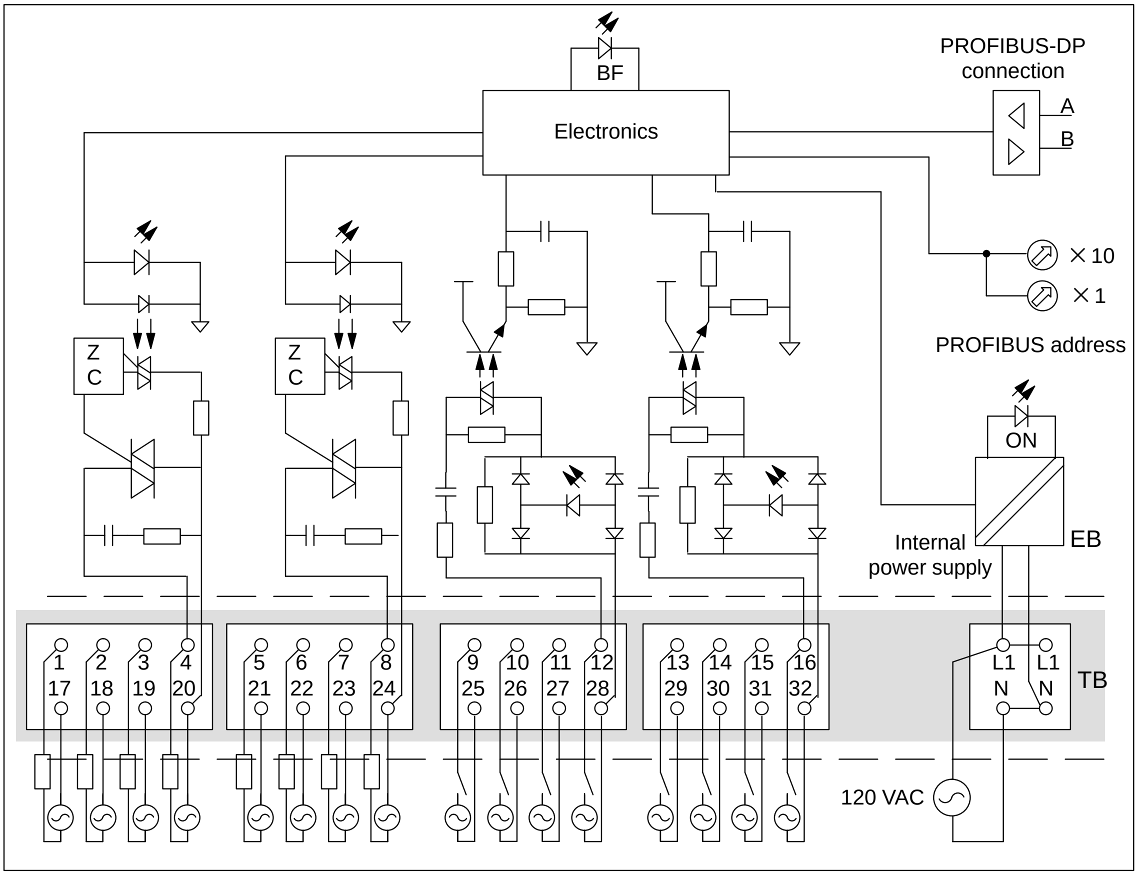


Figure 8-18 Block Diagram of the L 8 DI/8 DO AC 120 V/1.0 A Electronics Block

Technical data

The following table shows the technical data of the L 8 DI/8 DO AC 120 V/1.0 A electronics block.

Dimensions and Weight	
Dimensions WxHxD (mm)	145 × 61 × 85 .5
Weight	Approx. 318 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500, 1500, 3000, and 6000kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of inputs	8
Number of outputs	8
I/O Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0029_H

Voltages, Currents, Potentials	
Supply voltage L1	
• Rated voltage	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
• Power failure withstand time	At least 20 ms
Aggregate current of outputs (per byte)	
• Horizontal installation	
up to 40° C	Max. 1 A
up to 60° C	Max. 0.4 A
• All other installation positions	
up to 40° C	Max. 0.4 A
Optical isolation	
• Between channels	Yes
• Between L1 and PROFIBUS-DP	Yes
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	1500 VAC
Power input	
• from supply voltage L	Max. 130 mA
Power loss of module	Typically 12.2 W
Status, Alarms, Diagnostics	
Status display	Green LED per channel
Alarms	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red “BF” LED
• Monitoring of electronics power supply	Green “ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	120 VAC
• With signal 1	74 to 132 VAC
• With signal 0	0 to 20 VAC
Input current	
• With signal 1	9 to 27 mA
• With signal 0	0 to 4 mA
Input delay	
• From 0 to 1	2 to 14 ms
• From 1 to 7	6 to 25 ms
Input characteristic	To IEC 1131-2 Type 2
Connection of 2-wire BEROs	Possible
Actuator Selection Data	
Load voltage L	
• Rated voltage	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
Output voltage	
• With signal 1	At least L (– 1.5V)
Output current	
• With signal 1	
Rated value	1.0 A Pilot Duty
Permissible range	0.1 to 1.0 A
• With signal 0 (residual current)	Max. 2.6 mA
Zero cross inhibit voltage	Max. 60 V
Output delay (with resistive load)	Max. 20 ms
Size of motor starter	
• Up to 40°C	Max. size 4 acc. to NEMA
• Up to 60°C	Max. size 3 acc. to NEMA
Lamp load	Max. 50 W
Parallel connection of two outputs	
• For redundant control of load	Possible
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 10 Hz
• Inductive load	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Short-circuit protection	No

8.10 Electronics Block L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0 A – 6ES7 133-1JH00-0XB0

Characteristics

The L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0 A electronics block has the following characteristics:

- 8 inputs, fully isolated
  - Rated input voltage of 120 VAC
  - Suitable for switches and proximity switches, compatible with IEC Type 2 currents
- 8 relay outputs, fully isolated
  - Output current of 2.0 A
  - Rated load voltage of 24 V DC or 120 VAC
  - Suitable for solenoids, contactors, and indicator lights
  - Adjacent outputs of 24 V DC and 120 VAC are permitted

View

Figure 8-19 shows a view of the
L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0 A electronics block.

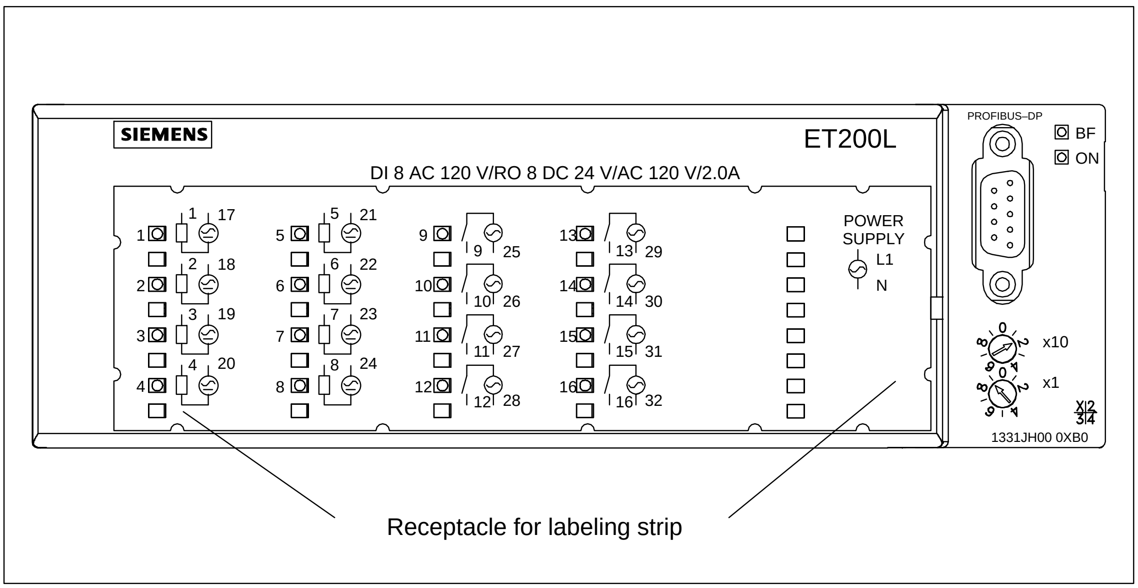


Figure 8-19 View of the L 8DI AC 120 V/8 RO DC 24 V/AC 2.0A Electronics Block

Block Diagram

Figure 8-20 shows the block diagram of the L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0 A electronics block.

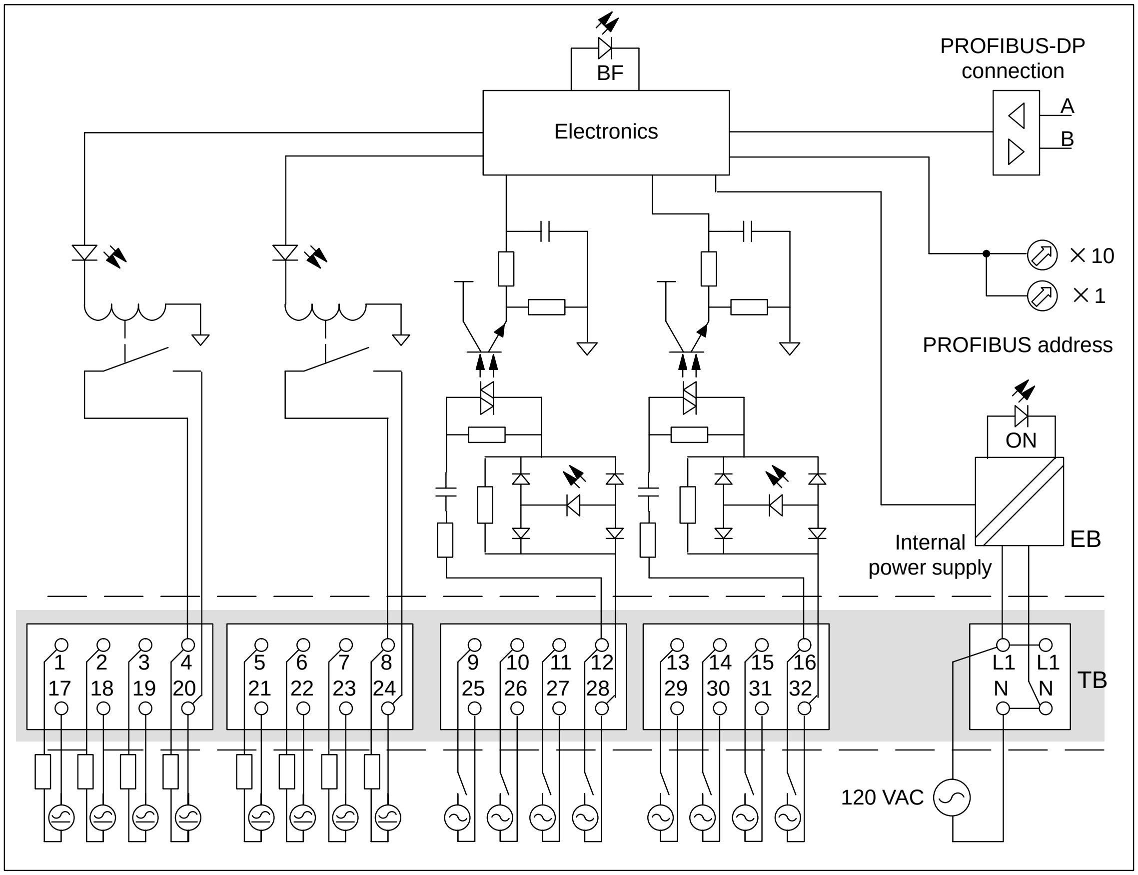


Figure 8-20 Block Diagram of the L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0A Electronics Block

Technical data

The following table shows the technical data of the L 8 DI AC 120 V/8 RO DC 24 V/AC 120 V/2.0A electronics block.

Dimensions and Weight	
Dimensions WxHxD (mm)	145 × 61 × 85.5
Weight	Approx. 322 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500, 1500, 3000, and 6000kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of inputs	8

Number of outputs	8
I/O Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	0027_H

Voltages, Currents, Potentials	
Supply voltage L1	
• Rated voltage	120 VAC
• Permissible range	74 to 132 VAC
• Frequency	47 to 63 Hz
• Power failure withstand time	At least 20 ms
Aggregate current of outputs (per point)	
• Horizontal installation	
up to 40° C	Max. 2 A
up to 60° C	Max. 1 A
• All other installation positions	
up to 40° C	Max. 1A
Optical isolation	
• Between channels	Yes
• Between L1 and PROFIBUSDB	Yes
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	1500 VAC
Power input	
• from supply voltage L	Max. 160 mA
Power loss of module	Typically 15.1 W
Status, Alarms, Diagnostics	
Status display	Green LED per channel
Alarms	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red “BF” LED
• Monitoring of electronics power supply	Green “ON” LED
Sensor Selection Data	
Input voltage	
• Rated value	120 VAC
• With signal 1	74 to 132 VAC
• With signal 0	0 to 20 VAC
Input current	
• With signal 1	9 to 27 mA
• With signal 0	0 to 4 mA

Input delay	
• From 0 to 1	2 to 14 ms
• From 1 to 7	6 to 25 ms
Input characteristic	To IEC 1131-2 Type 2
Connection of 2-wire BEROs	Possible
Actuator Selection Data	
Load voltage L	
• Rated voltage	24 V DC or 120 VAC
• Permissible DC range	4.5 to 30 V DC
• Permissible AC range	6 to 132 VAC
• AC Frequency	47 to 63 Hz
Output voltage	
• With signal 1	At least L (– 1.0V)
Output current	
• With signal 1	
Rated value	2.0 A Pilot Duty
Permissible range	10 mA to 2.0 A
• With signal 0 (residual current)	none
Output delay (with resistive load)	Max. 10 ms
Size of motor starter	
• Up to 40°C	NEMA Size 5
• Up to 60°C	NEMA Size 4
Lamp load	Max. 50 W
Parallel connection of two outputs	
• For redundant control of load	Possible
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 10 Hz
• Inductive load	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Short-circuit protection	No

Table 8-3 Service Life of the Contacts

Resistive Load	Voltage	Switching Cycles (Typical)
• Resistive load		
0.5 A	30 V DC or 250 V AC	800.000
1.0 A	30 V DC or 250 V AC	550.000
2.0 A	30 V DC or 250 V AC	300.000
• Inductive load (L/R = 7 ms; power factor = 0.4)		
0.5 A	30 V DC or 250 V AC	500.000
1.0 A	30 V DC or 250 V AC	300.000
2.0 A	30 V DC or 250 V AC	100.000
• Mechanical		20.000.000

ET 200L-SC Electronics Blocks – Technical Data

9

Introduction

The components of the ET 200L-SC can be upgraded with a Smart Connect. This chapter contains the technical data of the ET 200L-SC electronics blocks and the IM-SC interface module.

TB↔EB Assignment

The following table assigns the interface module/electronics blocks to the terminal blocks.

Table 9-1 Assignment of the Interface Module/ET 200L-SC Electronics Blocks to the Terminal Blocks

Terminal Block	Interface Module/Electronics Block	Order Number
TB 16IM-SC (6ES7 120-0AH50-0AA0, 6ES7 120-0BH50-0AA0)	IM-SC interface module	6ES7 138-1XL00-0XB0
TB 16L – (6ES7 193-1CH00-0XA0, 6ES7 193-1CH10-0XA0)	ET 200L-SC 16 DI DC 24 V	6ES7 131-1BH11-0XB0
	ET 200L-SC 16 DO DC 24 V/0.5 A	6ES7 132-1BH11-0XB0
TB 32L – (6ES7 193-1CL00-0XA0, 6ES7 193-1CL10-0XA0)	ET 200L-SC 32 DI DC 24 V	6ES7 131-1BL11-0XB0
	ET 200L-SC 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL10-0XB0

Contents of the Chapter

9.1 Interface Module IM-SC

Order Number

6ES7 138-1XL00-0XB0

Characteristics

The IM-SC interface module has the following characteristics:

- It connects the TB 16IM-SC terminal block with the PROFIBUS-DP.
- It is swiveled onto the TB 16IM-SC terminal block.
- The PROFIBUS-DP can be connected and disconnected at the IM-SC interface module by means of the bus terminating switsch. In this way, a data line connected at A2 and B2 can be disconnected or looped through.
- When the PROFIBUS-DP screw-type terminal is removed, subsequent DP slaves are disconnected from the PROFIBUS-DP.
- When the connector for the power supply is removed, the IM-SC is switsched off. Subsequently connected slaves are not affected.

View

The following figure shows a view of the IM-SC interface module:

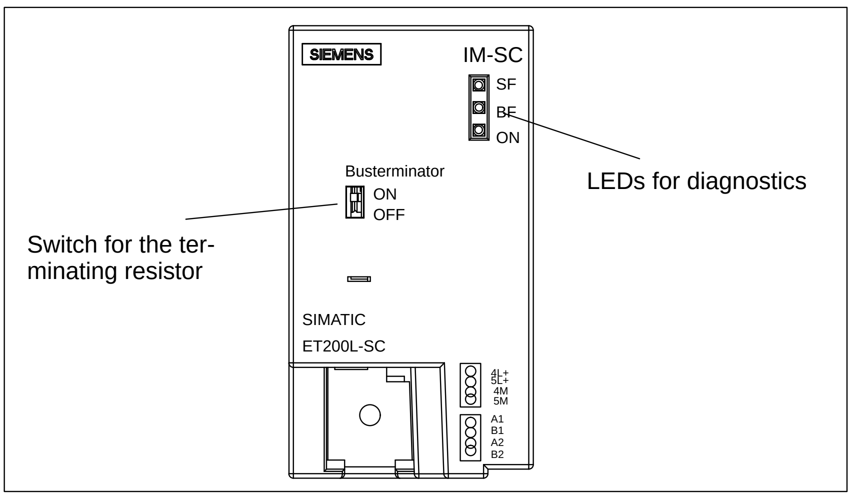


Figure 9-1 IM-SC Interface Module

Block Diagram

Figure 9-2 shows the block diagram.

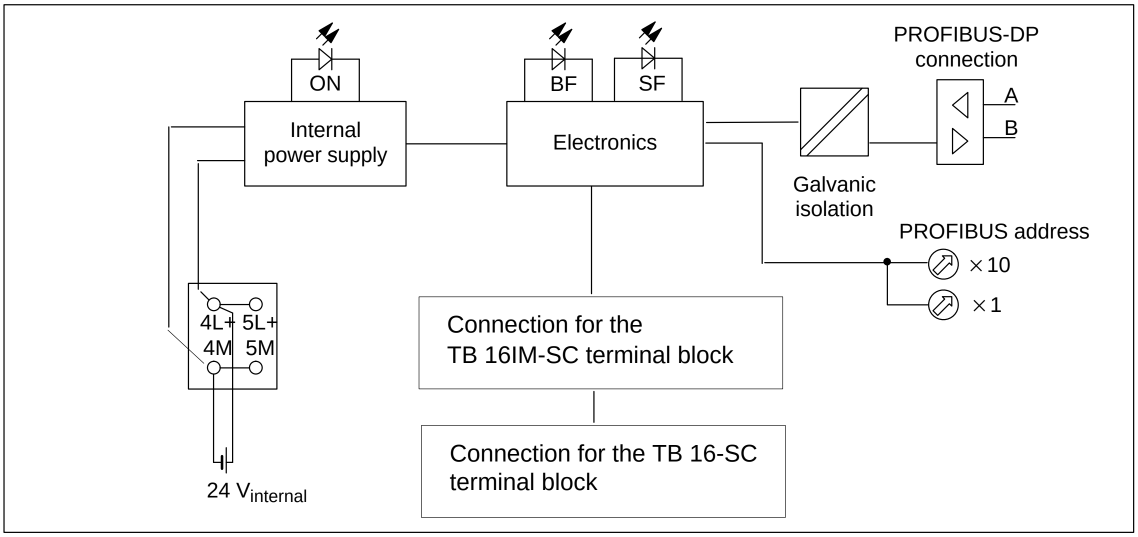


Figure 9-2 Block Diagram of the IM-SC Interface Module

Technical Data

The following table shows the technical data of the IM-SC interface module:

Dimensions and Weight	
Dimensions B × H × T (mm)	54 × 100 × 55
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of inputs	Max. 32
Number of outputs	Max. 32
Manufacturer ID	$802B_H$

Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Maximum number of inputs/outputs driven simultaneously	32
Galvanic isolation	
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 V DC
Power loss of module	Typically 1.4 W
Status, Interrupts, Diagnostics	
Interrupts	None
Diagnostic function	Yes
• Group error	Red ”SF” LED
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED

9.2 Electronics Block L-SC 16 DI DC 24 V – 6ES7 131-1BH11-0XB0

Characteristics

The upgraded L-SC 16 DI DC 24 V electronics block has the following characteristics:

- 16 inputs in two groups, each of 8 inputs
- Rated input voltage of 24 VDC
- Suitable for switches and proximity switches (BEROs)
- Connection of a TB 16SC

View

The following figure shows a view of the electronics block.

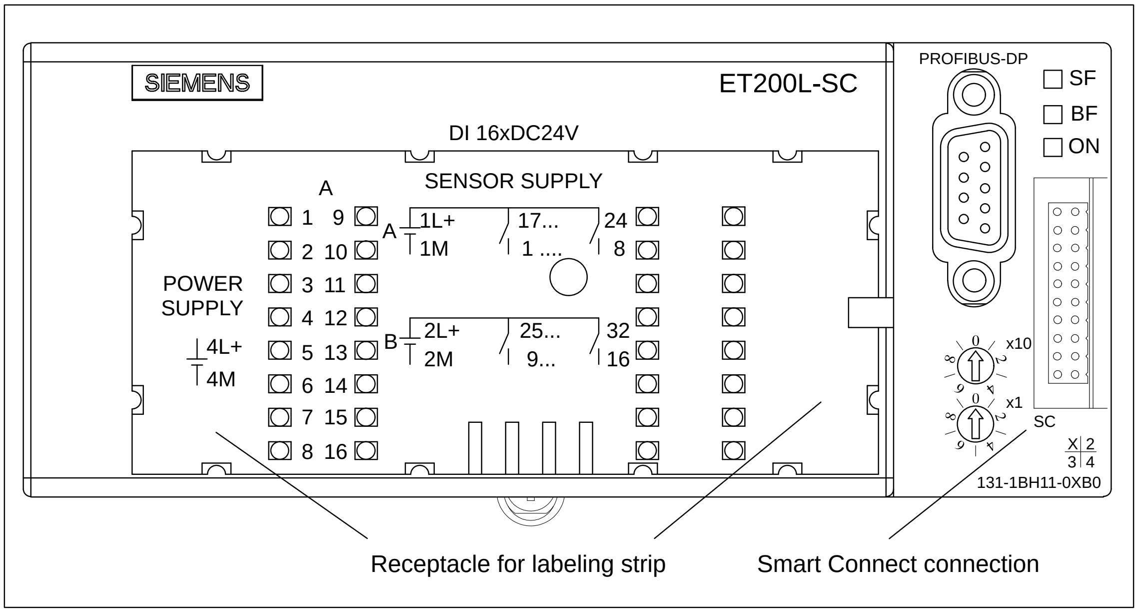


Figure 9-3 View of the L-SC 16 DI DC 24 V Electronics Block

Block Diagram Figure 9-4 shows the block diagram.

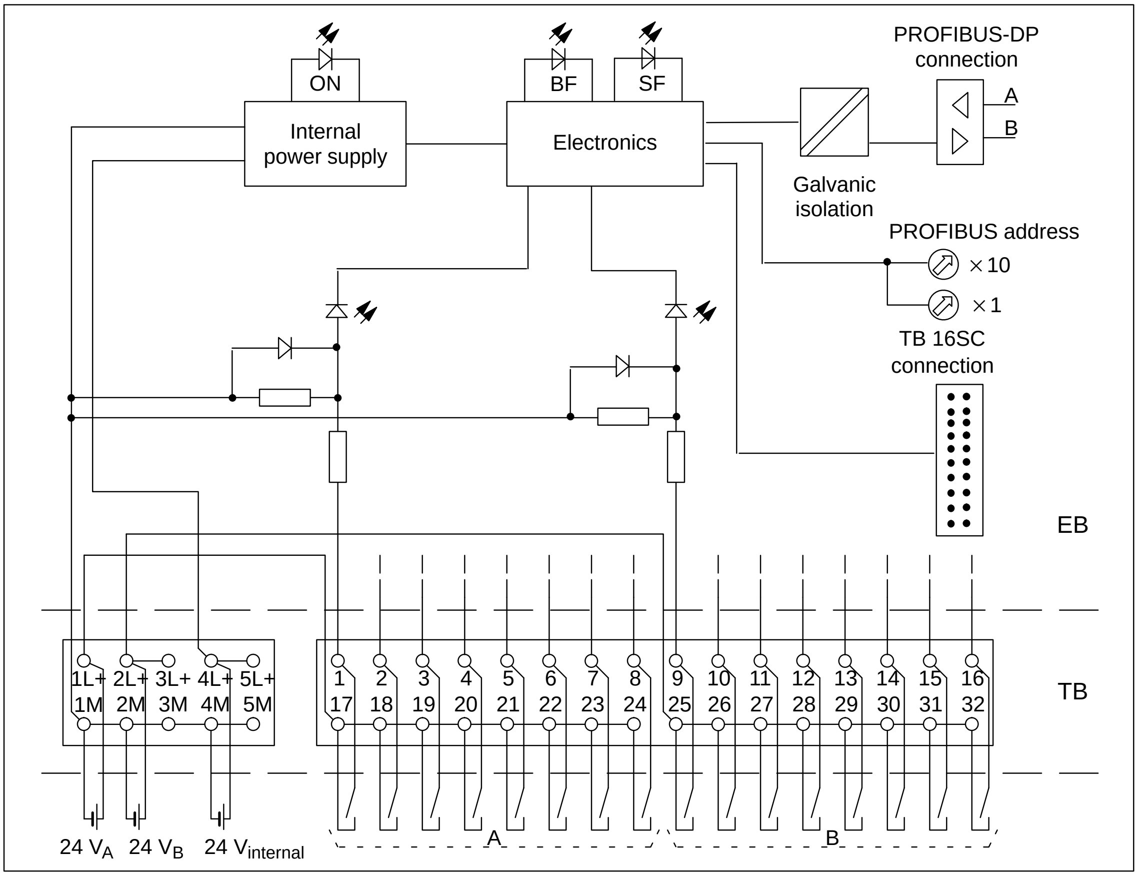


Figure 9-4 Block Diagram of the L-SC 16 DI DC 24 V Electronics Block

Technical Data

The following table shows the technical data of the L-SC 16 DI DC 24 V electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1 500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility for SC outputs	Yes
Number of inputs	16
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	8027 $_H$
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 VDC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 VDC
Maximum number of inputs driven simultaneously	16
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 VDC
Power input	
• from supply voltage L4+/L5+	Max. 180 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 4.0 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED
• Group error	Red ”GE” LED
Sensor Selection Data	
Input voltage	
• Rated value	24 VDC
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V
Input delay	
• With ”0” after ”1”	2.0 to 4.5 ms
• With ”1” after ”0”	2.0 to 4.5 ms
Input characteristic	To IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

9.3 Electronics Block L-SC 16 DO DC 24 V/0.5 A – 6ES7 132-1BH11-0XB0

Characteristics

The upgraded L 16 DO DC 24 V/0.5 A electronics block has the following characteristics:

- 16 outputs in two groups, each of eight outputs
- Output current of 0.5 A
- Rated load voltage of 24 VDC
- Suitable for solenoids, DC contactors, and indicator lights
- TB 16SC connection

View

The following figure shows a view of the electronics block.

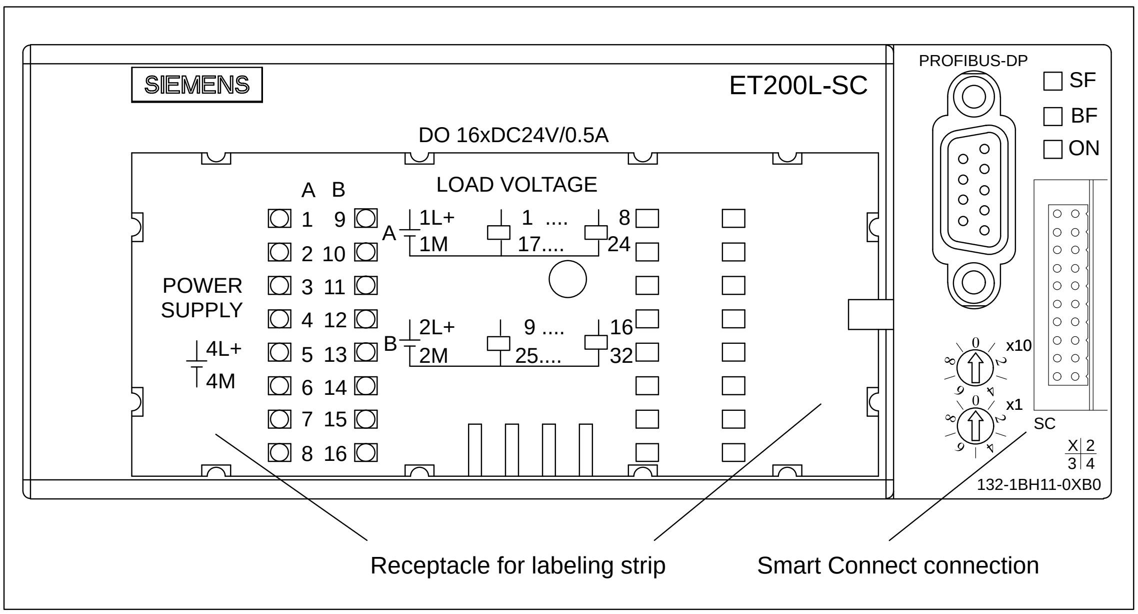


Figure 9-5 View of the L-SC 16 DO DC 24 V/0.5 A Electronics Block

Block Diagram

Figure 9-6 shows the block diagram.

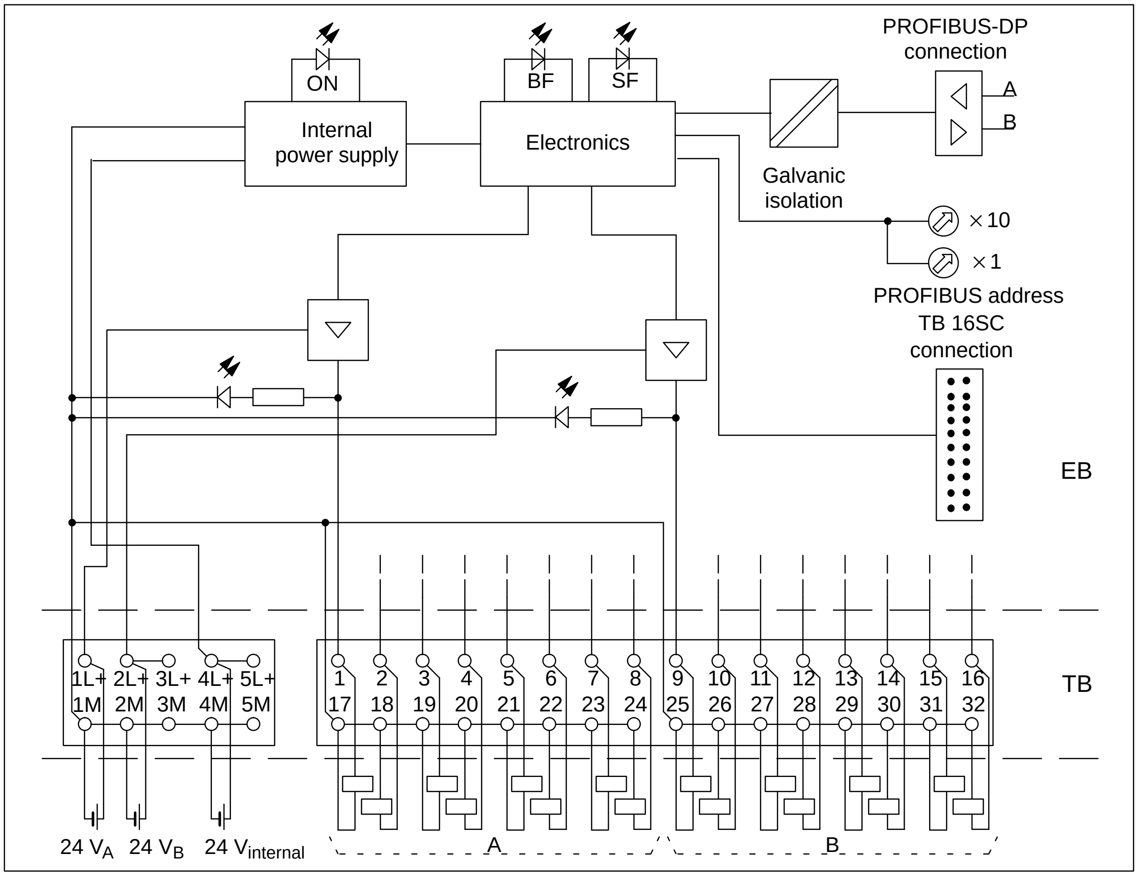


Figure 9-6 Block diagram of the L-SC 16 DO DC 24 V/0.5 A Electronics Block

Technical Data

The following table shows the technical data of the L-SC 16 DO DC 24 V/0.5 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
SYNC compatibility	Yes
FREEZE compatibility for SC inputs	Yes
Number of outputs	16

Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	8028_H

Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 VDC
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 VDC
Aggregate current of outputs (per byte)	
• Horizontal installation	
Up to 30 °C	Max. 4 A
Up to 40 °C	Max. 3 A
Up to 60 °C	Max. 2 A
• All other installation positions	
Up to 40 °C	Max. 2 A
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 VDC
Power input	
• from supply voltage L4+/L5+	Max. 180 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 4.0 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of electronics power supply	Green ”ON” LED
• Group error	Red ”SF” LED

Actuator Selection Data	
Output voltage	
• At signal ”1”	At least L1+ (– 3 V) or L2+/L3+ (3 V)
Output current	
• At signal ”1”	
Rated value	0.5 A
Permissible range	1 mA to 0.5 A
• At signal ”0” (residual current)	Max. 1 mA
Output delay (with resistive load)	
• With ”0” after ”1”	Max. 50 µs
• With ”1” after ”0”	Max. 200 µs
Load resistance range	41 Ω to 28 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 8 Hz
Limitation of voltage induced on circuit interruption	Typically L1+ (– 55 V) or L2+/L3+ (– 55 V)
Short-circuit protection	Yes
• Response threshold	Typically 0.7 A

9.4 Electronics Block L-SC 32 DI DC 24 V – 6ES7 131-1BL11-0XB0

Characteristics

The upgraded L-SC 32 DI DC 24 V electronics block has the following characteristics:

- 32 inputs in two groups, each of 16 outputs
- Rated input voltage of 24 VDC
- Suitable for switches, and proximity switches (BEROs)
- TB 16SC connection

View

The following figure shows a view of the electronics block.

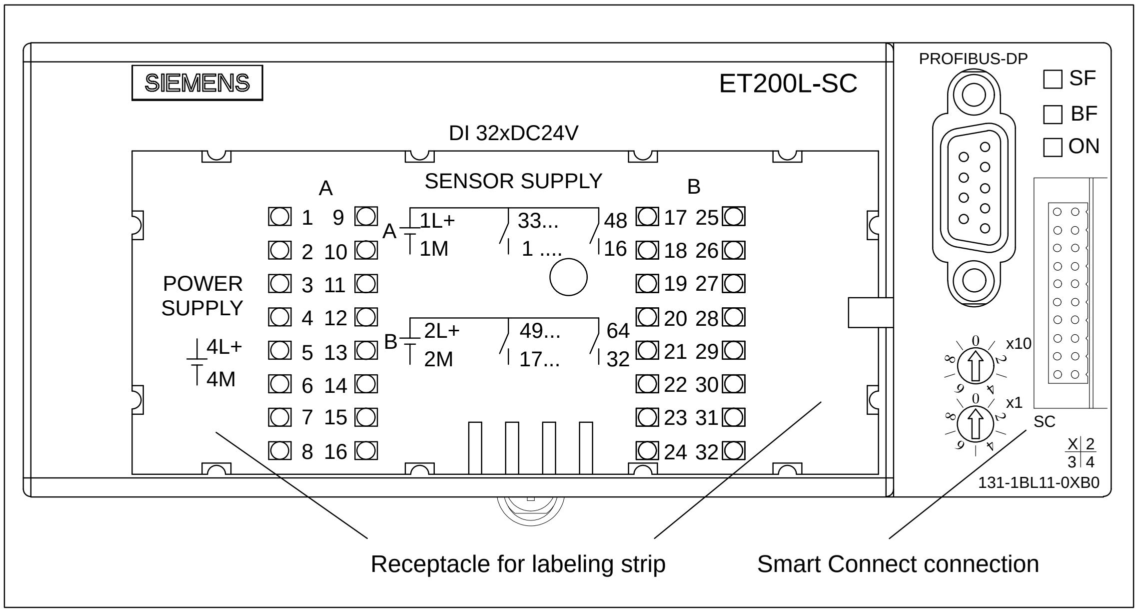


Figure 9-7 View of the L-SC 32 DI DC 24 V Electronics Block

Block Diagram Figure 9-8 shows the block diagram.

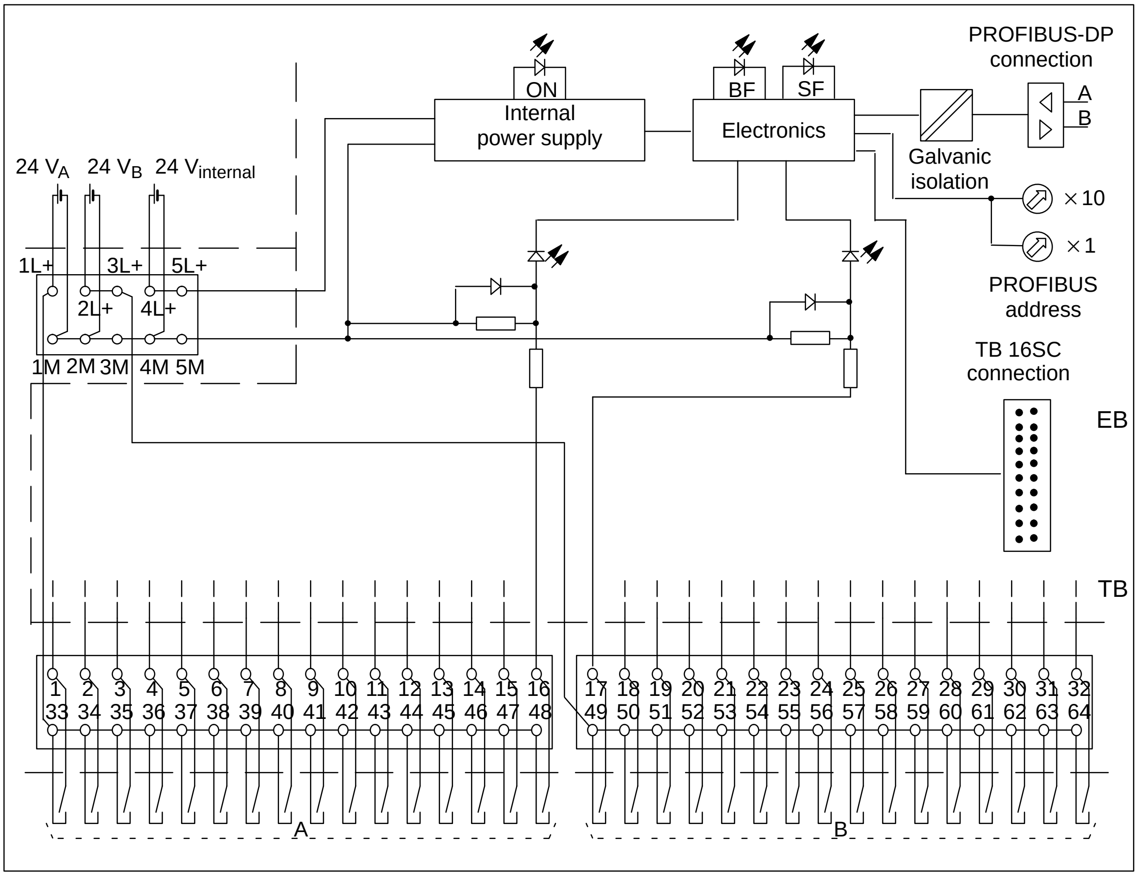


Figure 9-8 Block diagram of the L-SC 32 DI DC 24 V Electronics Block

Technical Data

The following table shows the technical data of the L-SC 32 DI DC 24 V electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 150 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility for SC outputs	Yes
Number of inputs	32
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	8029_H
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	24 VDC
• Reverse polarity protection	Yes
• Power failure with-stand time	At least 20 ms
Rated load voltage (1L+, 2L+ and 3L+)	24 VDC
Maximum number of in-puts driven simultaneously	32
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Insulation tested with	500 VDC
Power input	
• from supply voltage L4+/L5+	Max. 180 mA
• from load voltage L1+ and L2+/L3+ (without load)	Max. 100 mA per load group
Power loss of module	Typically 4.8 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red ”BF” LED
• Monitoring of elec-tronics power supply	Green ”ON” LED
• Group error	Red ”GE” LED
Sensor Selection Data	
Input voltage	
• Rated value	24 VDC
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V
Input delay	
• With ”0” after ”1”	2.0 to 4.5 ms
• With ”1” after ”0”	2.0 to 4.5 ms
Input characteristic	To IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-cir-cuit current	Max. 1.5 mA

9.5 Electronics Block L-SC 16 DI/16 DO DC 24 V/0.5 A – 6ES7 133-1BL10-0XB0

Characteristics

The L-SC 16 DI/16 DO DC 24 V/0.5 A electronics block has the following characteristics:

- 16 inputs in a single group of 16 inputs
  - Rated input voltage of DC 24 V
  - Suitable for switches and proximity switches (BEROs)
- 16 outputs in a single group of 16 outputs
  - Output current of 0.5 A
  - Rated load voltage of DC 24 V
  - Suitable for solenoids, DC contactors, and indicator lights
- TB 16SC connection

View

The following figure shows a view of the electronics block.

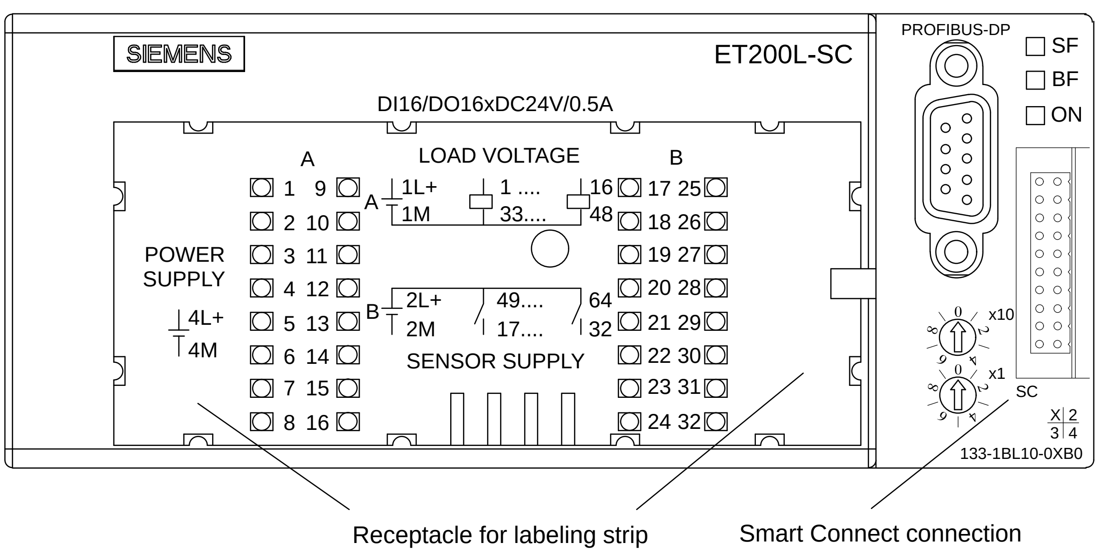


Figure 9-9 View of the L-SC 16 DI/16 DO DC 24 V/0.5 A Electronics Block

Block Diagram

Figure 8-10 shows the block diagram.

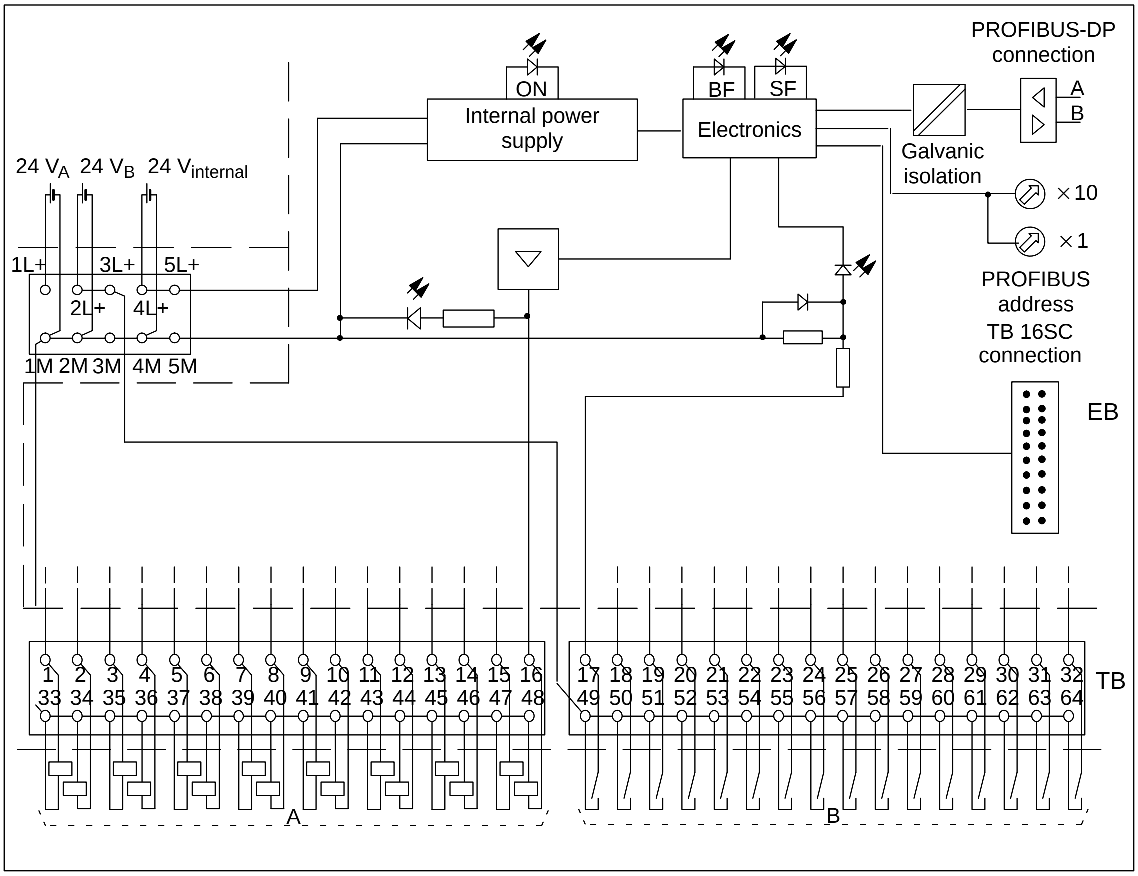


Figure 9-10 Block Diagram of the L-SC 16 DI/16 DO DC 24 V/0.5 A Electronics Block

Technical Data

The following data shows the technical data of the L-SC 16 DI/16 DO DC 24 V/0.5 A electronics block.

Dimensions and Weight	
Dimensions W × H × D (mm)	145 × 60 × 60.5
Weight	Approx. 130 g
Module-Specific Data	
Baud rate	9.6; 19.2; 93.75; 187.5; 500 and 1500 kBaud
Bus protocol	PROFIBUS-DP
FREEZE compatibility for SC outputs	Yes
SYNC compatibility for SC outputs	Yes
Number of inputs	16
Number of outputs	16
Cable length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
Manufacturer ID	$802C_H$
Voltages, Currents, Potentials	
Rated supply voltage for electronics (4L+, 5L+)	DC 24 V
• Reverse polarity protection	Yes
• Power failure withstand time	At least 20 ms

Rated load voltage (1L+, 2L+ and 3L+)	DC 24 V
Number of inputs driven simultaneously	16
Aggregate current of outputs (per byte)	
• Horizontal installation	
Up to 30 °C	Max. 4 A
Up to 40 °C	Max. 3 A
Up to 60 °C	Max. 2 A
• All other installation positions	
Up to 40 °C	Max. 2 A
Galvanic isolation	
• Between channels	No
• Between channels and PROFIBUS-DP	Yes
Isolation tested with	DC 500 V
Power input	
• From supply voltage L4+/L5+	Max. 180 mA
• From load voltage L1+ and L2+/L3+ (without load)	Max. 50 mA per load group
Power loss of module	Typically 5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic function	Yes
• Bus monitoring PROFIBUS-DP	Red LED ”BF”
• Monitoring of electronics power supply	Green LED ”ON”
• Group error	Red LED ”SF”
Actuator Selection Data	
Input voltage	
• Rated value	DC 24 V
• At signal ”1”	13 to 30 V
• At signal ”0”	-30 to 5 V
Input current	
• At signal ”1”	Typically 5 mA at 24 V

Input delay	
• At ”0” after ”1”	2,0 to 4.5 ms
• At ”1” after ”0”	2.0 to 4.5 ms
Input Characteristic	to IEC 1131-2 Type 1
Connection of 2-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA
Actuator Selection Data	
Output voltage	
• At signal ”1”	At least L1+ (– 3 V) or L2+/L3+ (– 3 V)
Output current	
• At signal ”1”	
Rated value	0.5 A
Permissible range	1 mA to 0.5 A
• At signal ”0” (residual current)	Max. 1 mA
Output delay (with resistive load)	
• At ”0” after ”1”	Max. 50 µs
• At ”1” after ”0”	Max. 200 µs
Load resistance range	41 Ω to 28 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 8 Hz
Limitation of voltage induced on circuit interruption	Typically L1+ (– 55 V) or L2+/L3+ (– 55 V)
Short-circuit protection	
• Response threshold	Typically 0.7 A

SC Digital Electronic Modules – Technical Data

10

Contents of Chapter

Order Numbers

Product Name	Order Number
Digital Electronic Module 2DIDC24V	6ES7 121-1BB00-0AA0
Digital Electronic Module 2DODC24V0.5A	6ES7 122-1BB00-0AA0
Digital Electronic Module 2DODC24V2A	6ES7 122-1BB10-0AA0
Digital Electronic Module 1DIAC120/230V	6ES7 121-1FA00-0AA0
Digital Electronic Module 1DOAC120/230V1A	6ES7 122-1FA00-0AA0
Digital Electronic Module 1DORel.AC230V	6ES7 122-1HA01-0AA0

10.1 Digital Electronic Module 2DIDC24V

Order Number 6ES7 121-1BB00-0AA0

Front Elevation/ Side Elevation

The figure below shows you the front elevation and the side elevation of the input module.

The circuit schematic is shown on the front of the input module. The two LEDs are located below the circuit schematic. In the operating state, the circuit schematic is covered by the labeling strip. The LEDs are visible through the transparent part of the labeling strip.

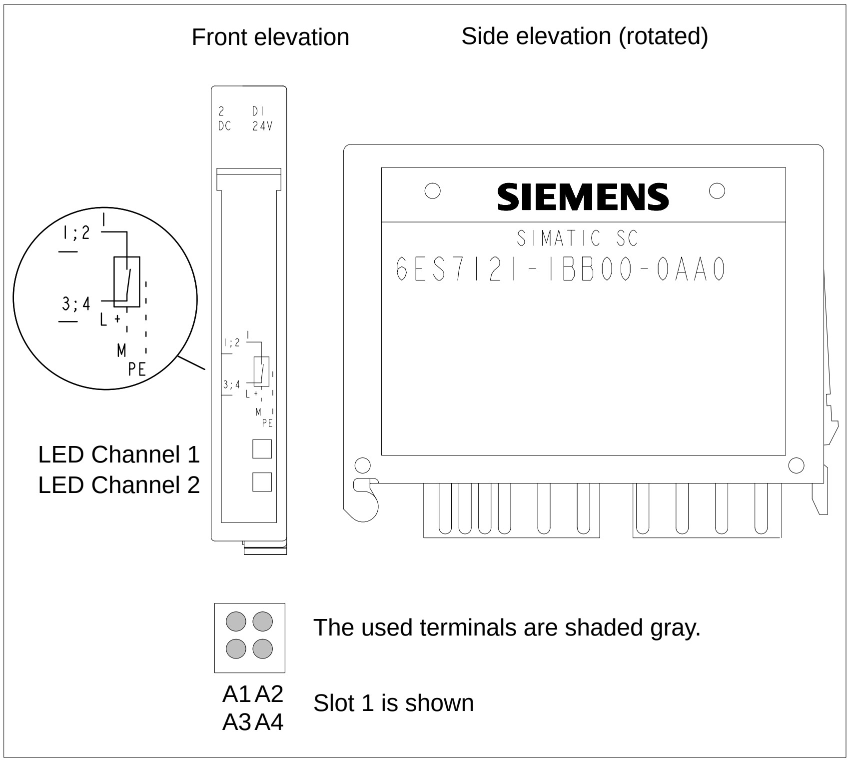


Figure 10-1 Front and Side Elevations of the 2DIDC24V Digital Electronic Module

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Note

The status LEDs of the input module indicate the system status.

Block Diagram

Figure 10-2 shows the block diagram of the 2DIDC24V digital electronic module.

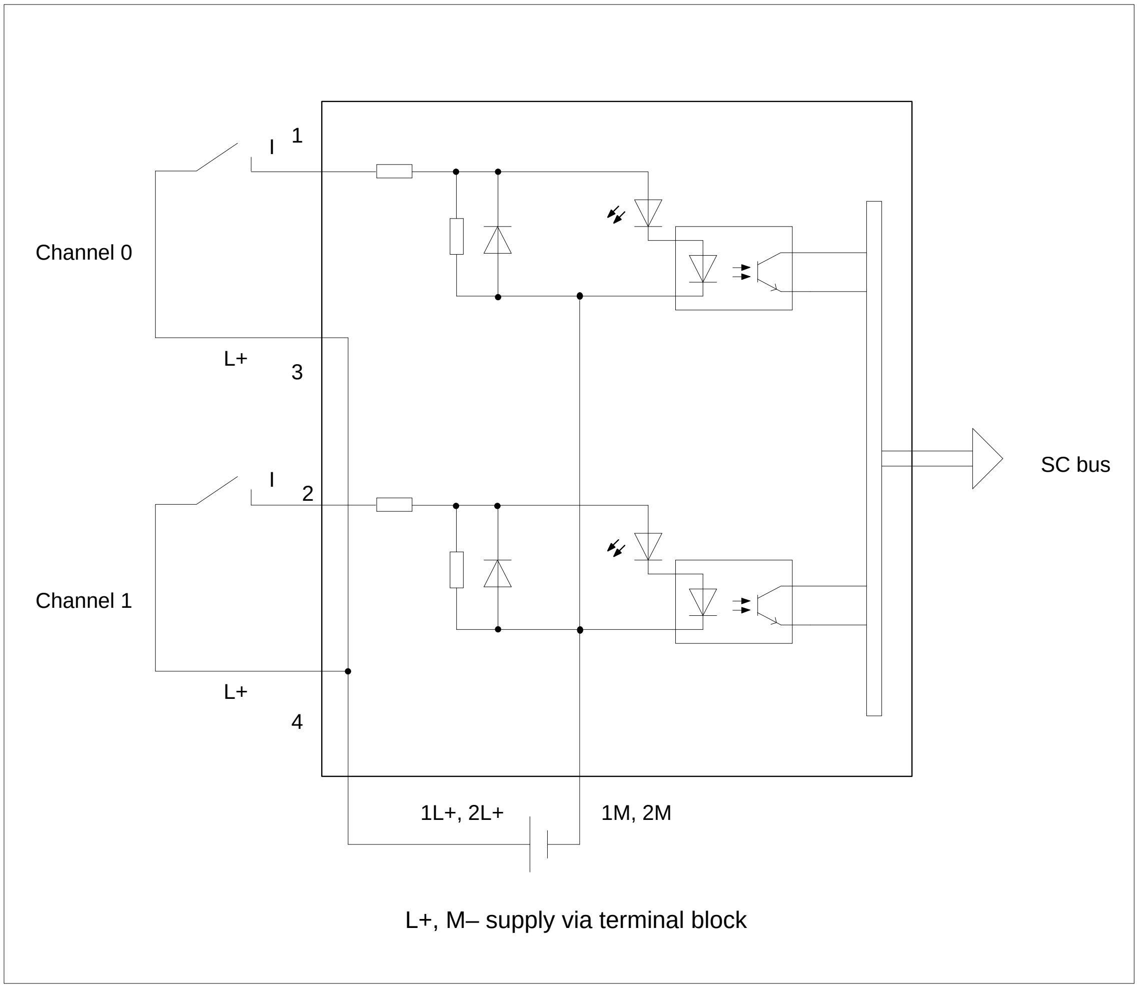

Figure 10-2 Block Diagram of the 2DIDC24V Digital Electronic Module

Technical Data The technical data of the 2DIDC24V digital electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 15 g
Module-Specifc Data	
Number of inputs	2
Cable length	
• Unshieded	max. 600 m
• Shielded	max. 1000 m
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Current, Potentials	
Rated load voltage L+	DC 24 V
Number of simultaneously controllable imputs	2
Galvanic isolation	
• Between channels and SC bus	no
• Between different channels	no
Permissible potential difference	
• Between different circuits	DC 75 V/AC 60 V

Power input	
• From load voltage L+	–
Power loss of the module	typ. 0.4 W
Status, Interrupts, Diagnostics	
Status indication	green LED per channel
Interrupts	none
Diagnostic functions	none
Sensor Selection Data	
Input voltage	
• Rated value	DC 24 V
• At signal ”1”	13 ... 30 V
• At signal ”0”	-3 ... 5 V
Input current	
• At signal ”1”	typ. 7 mA
Input delay	
• At ”0” to ”1”	1.2...4.8 ms
• At ”1” to ”0”	1.2...4.8 ms
• Input characteristic to	IEC 1131, Type 1
Connection of 2-wire BEROs	possible
• Permissible closed-circuit current	max 1.5 mA

10.2 Digital Electronic Module 2DODC24V0.5A

Order Number

6ES7 122-1BB00-0AA0

Front Elevation/ Side Elevation

The figure below shows you the front elevation and the side elevation of the output module.

The circuit schematic is shown on the front of the output module. The two LEDs are located below the circuit schematic. In the operating state, the circuit schematic is covered by the labeling strip. The LEDs are visible through the transparent part of the labeling strip.

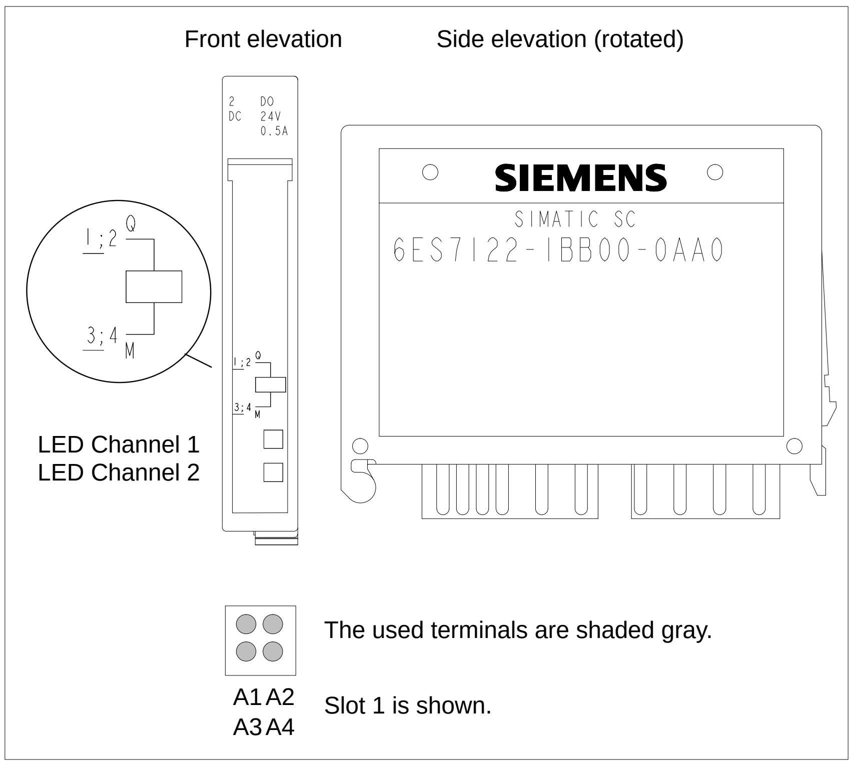

Figure 10-3 Front and Side Elevations of the 2DODC24V0.5A Digital Electronic Module

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Note

The status LEDs of the output module indicate the system status.

Special Features

When L+ is connected by means of a mechanical contact, a disturbing pulse appears at the output with an exponentially increasing width from 8 μs at rated current to 20 μs at 10 mA load current. (The time specifications are based on a threshold of 10 V.)

Block Diagram

Figure 10-4 shows the block diagram of the 2DODC24V0.5A digital electronic module.

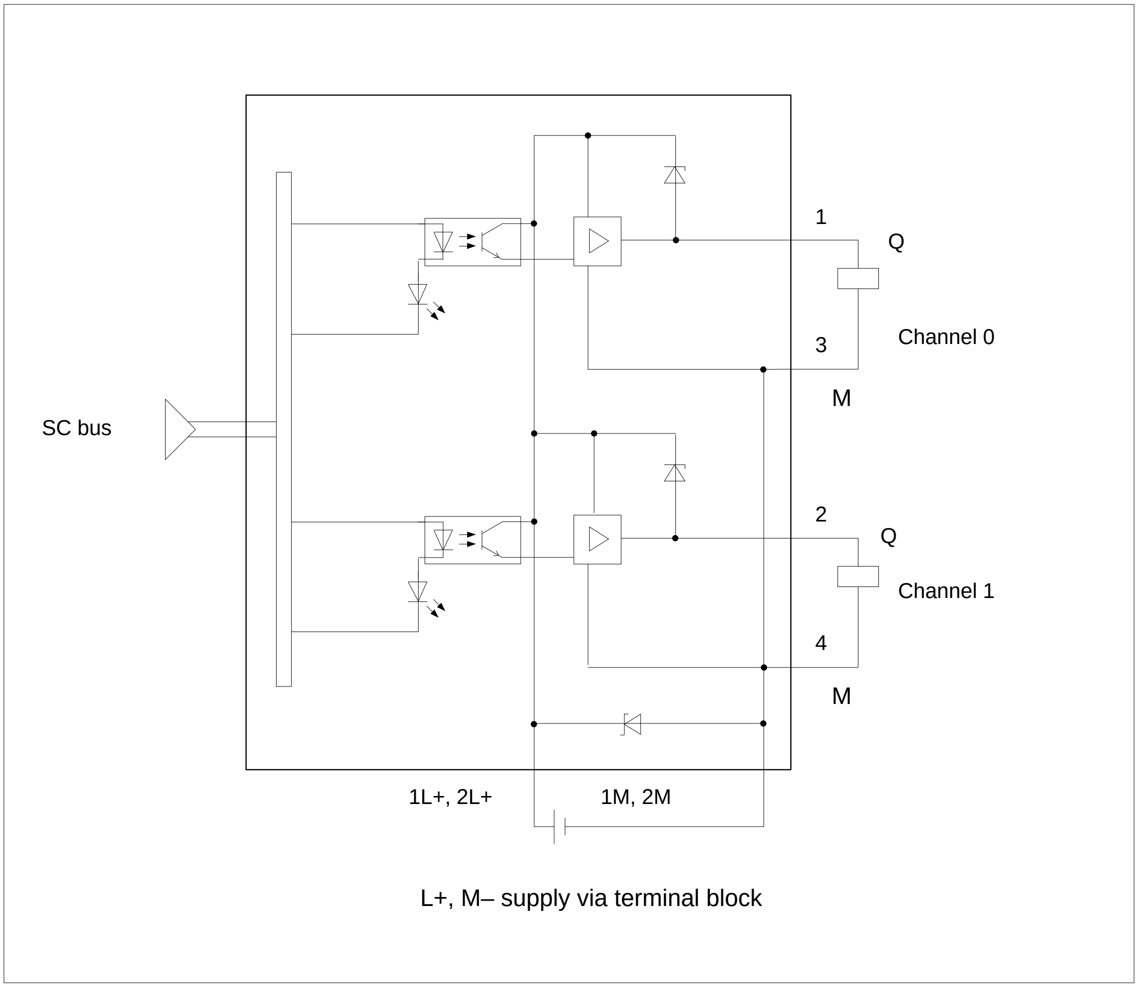

Figure 10-4 Block Diagram of the 2DODC24V0.5A Digital Electronic Module

Technical Data

The technical data of the 2DODC24V0.5A digital electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 15 g
Module-Specific Data	
Number of outputs	2
Cable length	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated load voltage L+	DC 24 V
Total current of the outputs (per module)	
• to 40°C	1 A
• to 60°C	0.8 A
Galvanic isolation	
• Between channels and SC bus	no
• Between the different channels	no
Permissible potential difference	
• Between different circuits	DC 75 V/AC 60 V
Power input	
– From load voltage L+ (without load)	3 mA
Power loss of the module	typ. 0.4 W
Status, Interrupts, Diagnostics	
Status indication	green LED per channel
Interrupts	none
Diagnostic functions	none

Actuator Selection Data	
Output voltage	
• At signal ”1”	min. L+ (-0.5 V)
Output current	
• At signal ”1” Rated value Permissible range	 0.5 A 5 mA ... 0.6 A
• At signal ”0” (residual current)	max. 0.3 mA
Output delay (with resistive load)	
• At ”0” to ”1”	max. 200 μs
• At ”1” to ”0”	max. 1.3 ms
Load resistance range	48 Ω to 4.8 kΩ
Lamp load	max. 2.5 W
Parallel switching of 2 outputs	
• For redundant control of a load	not possible
• For performance enhancement	possible
Controlling a digital input	possible
Switching frequency	
• With resistive load	max. 100 Hz
• With inductive load in accordance with IEC 947-5-1, DC 13	max.2 Hz at 0.3 A max.0.5 Hz at 0.5 A
• With lamp load	max. 1 Hz
Inductive switch-off voltage limited (internally) to	typ. L+ (48 V)
Short-circuit protection of the output	yes, electronically [1]
• Response threshold	typ. 0.7...1.8 A

[1] After a short-circuit, switch-on under full load cannot be guaranteed. Countermeasures are:

- Change the signal at the output, or
- Interrupt the load voltage of the module, or
- Temporarily disconnect the load from the output.

10.3 Digital Electronic Module 2DODC24V2A

Order Number 6ES7 122-1BB10-0AA0

Front Elevation/ Side Elevation

The following figure shows you the front elevation and the side elevation of the output module.

The circuit schematic is shown on the front of the input module. The two LEDs are located below the circuit schematic. In the operating state, the circuit schematic is covered by the labeling strip. The LEDs are visible through the transparent part of the labeling strip.

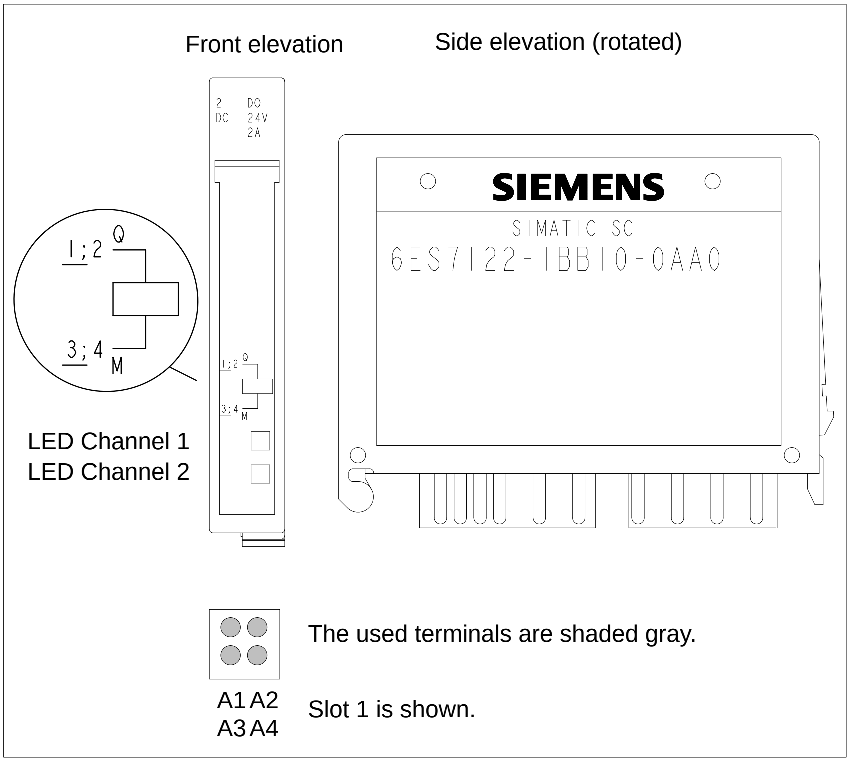

Figure 10-5 Front and Side Elevations of the 2DODC24V2A Digital Electronic Module

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Note

The status LEDs of the output module indicate the system status.

Special Features

When L+ is connected by means of a mechanical contact, a disturbing pulse appears at the output with an exponentially increasing width from 5 μs at rated current to 100 μs at 10 mA load current. (The time specifications are based on a threshold of 10 V.)

Block Diagram

Figure 10-6 shows the block diagram of the 2DODC24V2A digital electronic module.

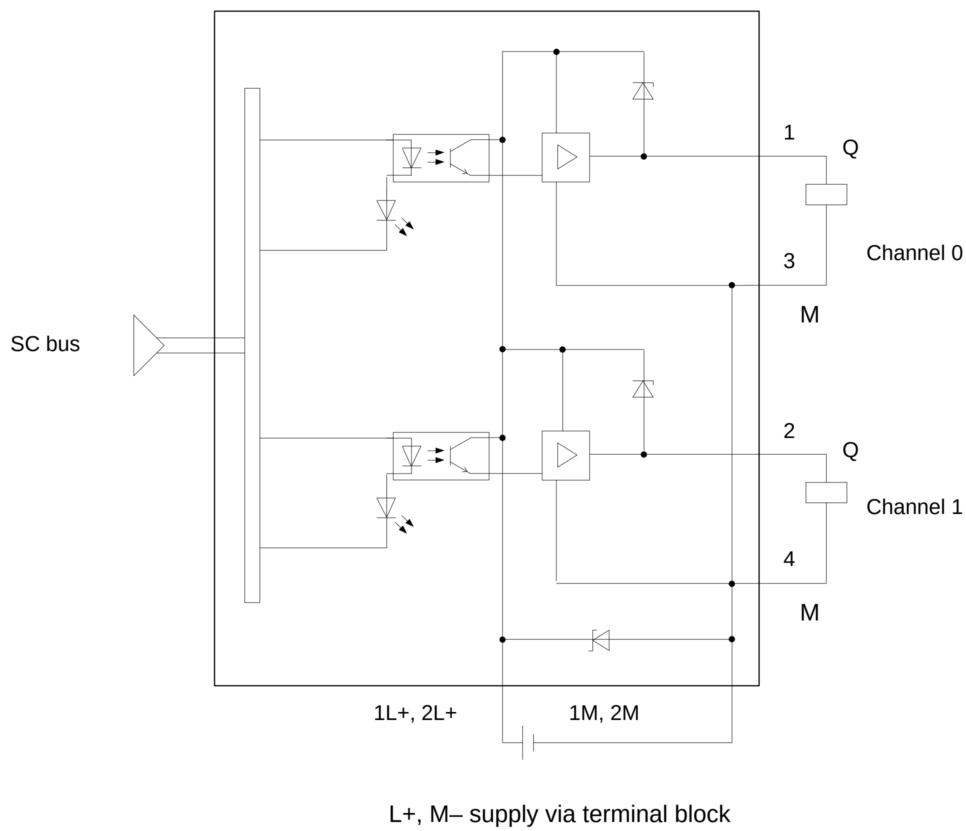

Figure 10-6 Block Diagram of the 2DODC24V2A Digital Electronic Module

Technical Data

The technical data of the 2DODC24V2A digital electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 15 g
Module-Specific Data	
Number of outputs	2
Cable length	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Current, Potentials	
Rated load voltage L+	DC 24 V
Total current of the outputs (per module)	
• to 40°C	max. 3 A
• to 60°C	max. 2 A
Galvanic isolation	
• Between channels and SC bus	no
• Between the different channels	no
Permissible potential difference	
• Between different circuits	DC 75 V/AC 60 V
Power input	
• From load voltage L+ (without load)	6 mA
Power loss of the module	typ. 0.9 W
Status, Interrupts, Diagnostics	
Status indication	green LED per channel
Interrupts	none
Diagnostics function	none

Actuator Selection Data	
Output voltage	
• At signal ”1”	min. L+ (-0.5 V)
Output current	
• At signal ”1” Rated value Permissible range	 2 A
– For 0 to 40°C	5 mA to 2.4 A
– For 40 to 60°C	5 mA to 1.8 A
• At signal ”0” (residual current)	max. 0.6 mA
Output delay (with resistive load)	
• At ”0” to ”1”	max. 200 µs
• At ”1” to ”0”	max. 1.3 ms
Lamp load	max. 10 W
Load resistance range	12 Ω to 4.8 kΩ
Parallel switching of 2 outputs	
• For performance enhancement	possible
• For redundant control of a load	not possible
Controlling a digital input	possible
Switching frequency	
• With resistive load	max. 100 Hz
• With inductive load in accordance with IEC 947-5-1, DC 13	max. 0.2 Hz at 1 A max. 0.1 Hz at 2 A
• With lamp load	max. 1 Hz
Inductive switch-off voltage limited (internally) to	typ. L+ (48 V)
Short-circuit protection of the output	Yes, electronically
• Response threshold	typ. 2.8...7.2 A

[1] After a short-circuit, switch-on under full load cannot be guaranteed. Countermeasures are:

- Change the signal at the output, or
- Interrupt the load voltage of the module, or
- Temporarily disconnect the load from the output.

10.4 Digital Electronic Module 1DIAC120/230V

Order Number

6ES7 121-1FA00-0AA0

Front Elevation/ Side Elevation

The figure below shows you the front elevation and the side elevation of the digital electronic module.

The circuit schematic is shown on the front of the digital electronic module. The LED is located below the circuit schematic. In the operating state, the circuit schematic is covered by the labeling strip. The LED is visible through the transparent part of the labeling strip.

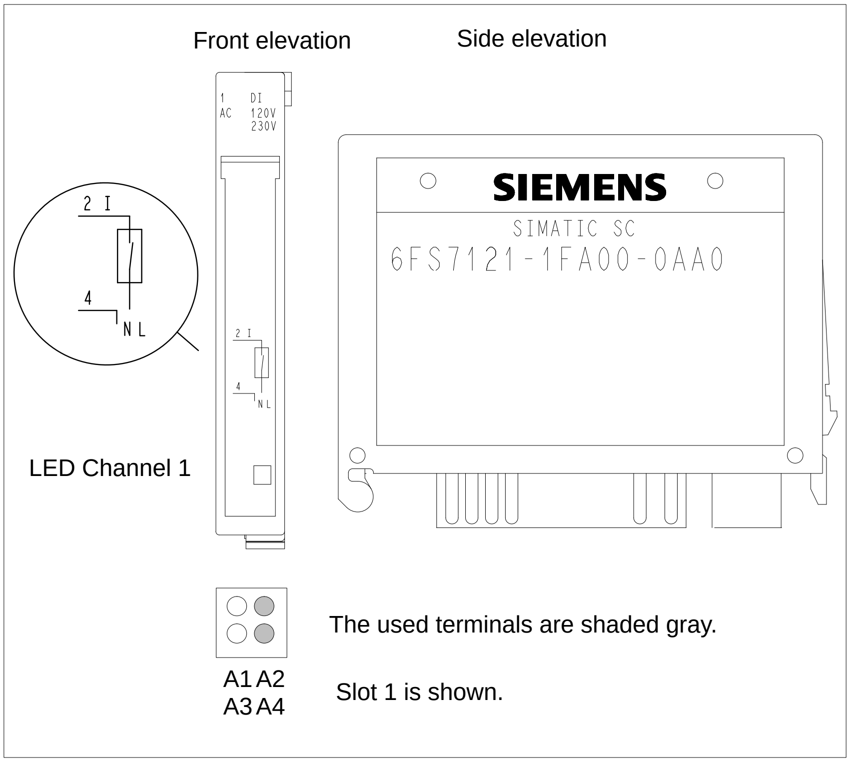

Figure 10-7 Front and Side Elevations of the 1DIAC120/230V Digital Electronic Module

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Note

The status LED of the input module indicates the system status.

Block Diagram

Figure 10-8 shows the block diagram of the 1DIAC120/230V digital electronic module.

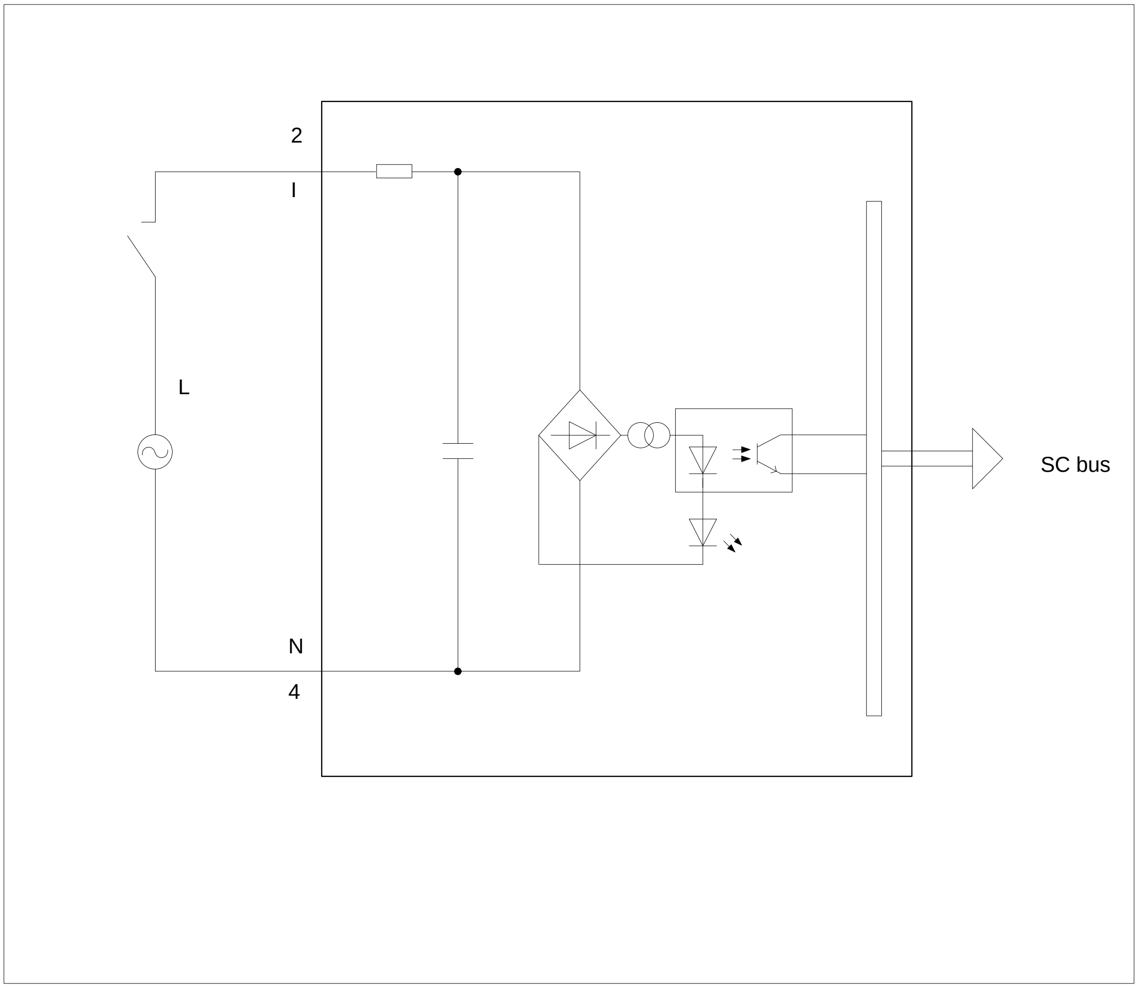


Figure 10-8 Block diagram of the 1DIAC120/230V Digital Electronic Module

Special Feature

The 1DIAC120/230V electronic module does not require a supply voltage (L+, M).

Technical Data The technical data of the 1DIAC120/230V electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 15 g
Module Specific Data	
Number of Inputs	1
Cable Length	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Galvanic isolation	
• Between channels and SC bus	yes
Permissible potential difference	
• Between ground and input	AC 240 V
Isolation tested with	DC 2500 V
Power loss of the module	typ. 0.6 W
Status, Interrupts, Diagnostics	
Status indication	green LED
Interrupts	none
Diagnostic functions	none

Sensor Selection Data	
Input voltage	
• Rated value	AC 120/230 V
• At signal ”1”	AC 74 ... 264 V DC 75 ... 264 V
• At signal ”0”	AC 0 ... 40 V DC 0 ... 40 V
• Frequency range	47...63 Hz
Input current	
• At signal ”1”	typ. 3.,7 mA*
• At signal ”0”	typ. 2.2 mA*
Input delay	
• At ”0” to ”1”	max. 30 ms
• At ”1” to ”0”	max. 30 ms
Input characteristic	in accordance with IEC 1131, Type 1*
Connection of 2-wire BEROS	possible
• Permissible closed-circuit current	max. 1.5 mA

* With parallel switching of 2 electronic modules, IEC 1131-2/Type 2 is complied with at AC 120 V.

10.5 Digital Electronic Module 1DOAC120/230V1A

Order Number

6ES7 122-1FA00-0AA0

Front Elevation/ Side Elevation

The figure below shows you the front elevation and the side elevation of the 1DOAC120/230V1A

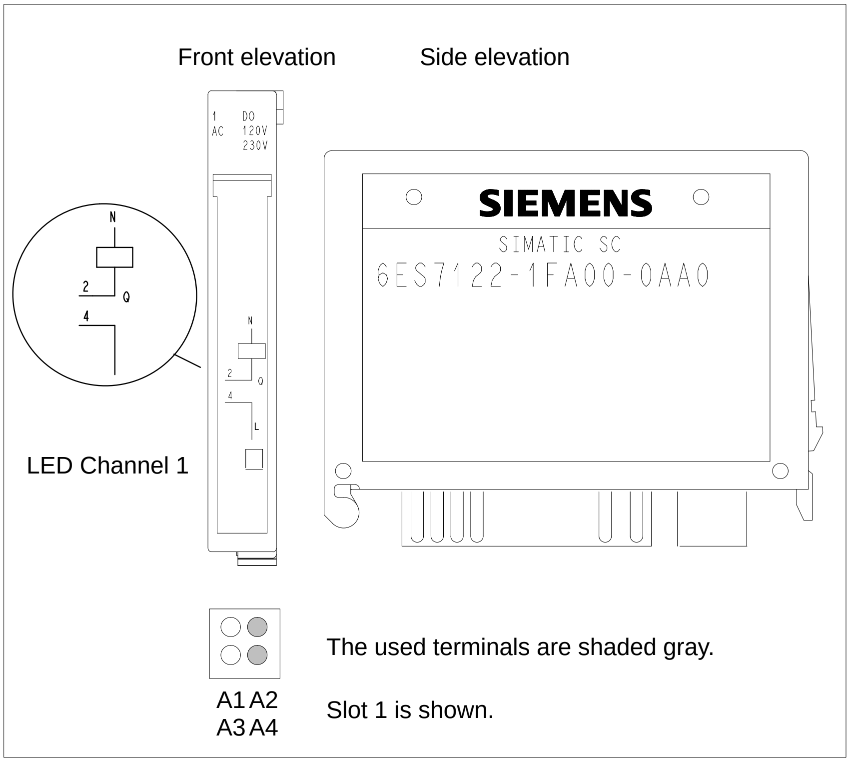


Figure 10-9 Front and Side Elevations of the 1DOAC120/230V1A Digital Electronic Module

Special Feature

The 1DOAC120/230V1A electronic module does not require a supply voltage (L+, M).

Block Diagram

Figure 10-10 shows the block diagram of the 1DOAC120/230V1A digital electronic module.

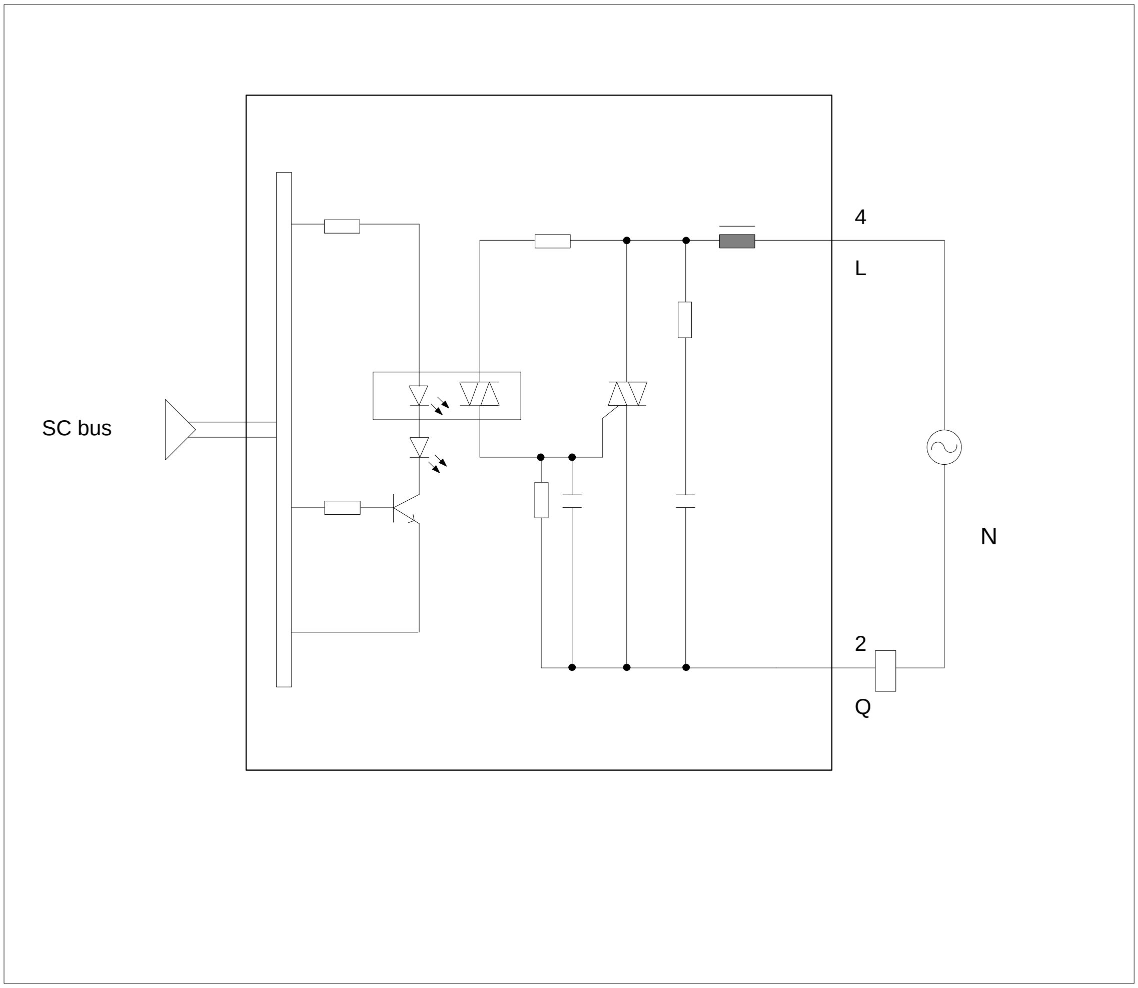


Figure 10-10 Block Diagram of the 1DOAC120/230V1A Digital Electronic Module

Technical Data The technical data of the 1DOAC120/230V1A electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 15 g
Module-Specific Data	
Number of outputs	1
Cable length	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	AC 120/230 V
• Permissible frequency range	47...63 Hz
Galvanic isolation	
• Between channels and SC bus	yes
Permissible potential difference	
• Between ground and the output	AC 240 V
Isolation tested with	DC 2500 V
Power loss of the module	typ. 0.7 W
Status, Interrupts, Diagnostics	
Status indication	green LED
Interrupts	none
Diagnostic functions	none
Actuator Selection Data	
Output voltage	
• At signal ”1”	min. L (1 V)
Output current	
• At signal ”1”	
– Rated value	1 A
– Permissible range for 0^0 C to 40^0 C	40 mA ... 1.1 A
– Permissible range for 40^0 C to 60^0 C	40 mA ... 0.6 A
– Permissible surge current	max. 10 A (for 2 half-waves)
• At signal ”0”(residual current)	max. 3 mA
Output delay (with resistive load)	
• At ”0” to ”1”	max. 20 ms
• At ”1” to ”0”	max. 20 ms
Zero crossing	with zero crossing switch
Size of the motor starter	max. size 8
Lamp load	
• At AC 230 V	max. 100 W
• At AC 120 V	max. 50 W
Parallel switching of 2 outputs	
• For redundant control of a load	possible
• For performance enhancement	not possible
Controlling a digital input	only possible with additional load
Switching frequency	
• With resistive load	max. 50 Hz
• With inductive load in accordance with IEC 947-5-1, AC 15	max. 10 Hz
• With lamp load	max. 1 Hz
Short-circuit protection of the output	no

10.6 Digital Electronic Module 1DORel.AC230V, DC 24 V to 120 V

Order Number

6ES7 122-1HA00-0AA0

Front Elevation/ Side Elevation

The figure below shows you the front elevation and the side elevation of the 1DORel.AC230V digital electronic module.

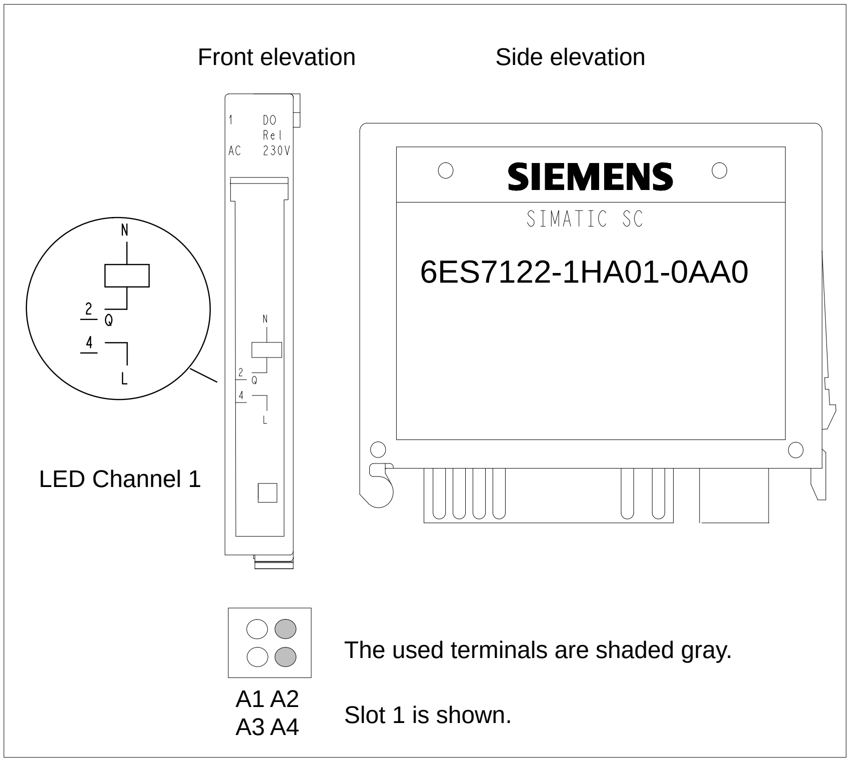


Figure 10-11 Front and Side Elevations of the 1DORel.AC230V Digital Electronic Module

Block Diagram

Figure 10-12 shows you the block diagram of the 1DORel.AC230V digital electronic module.

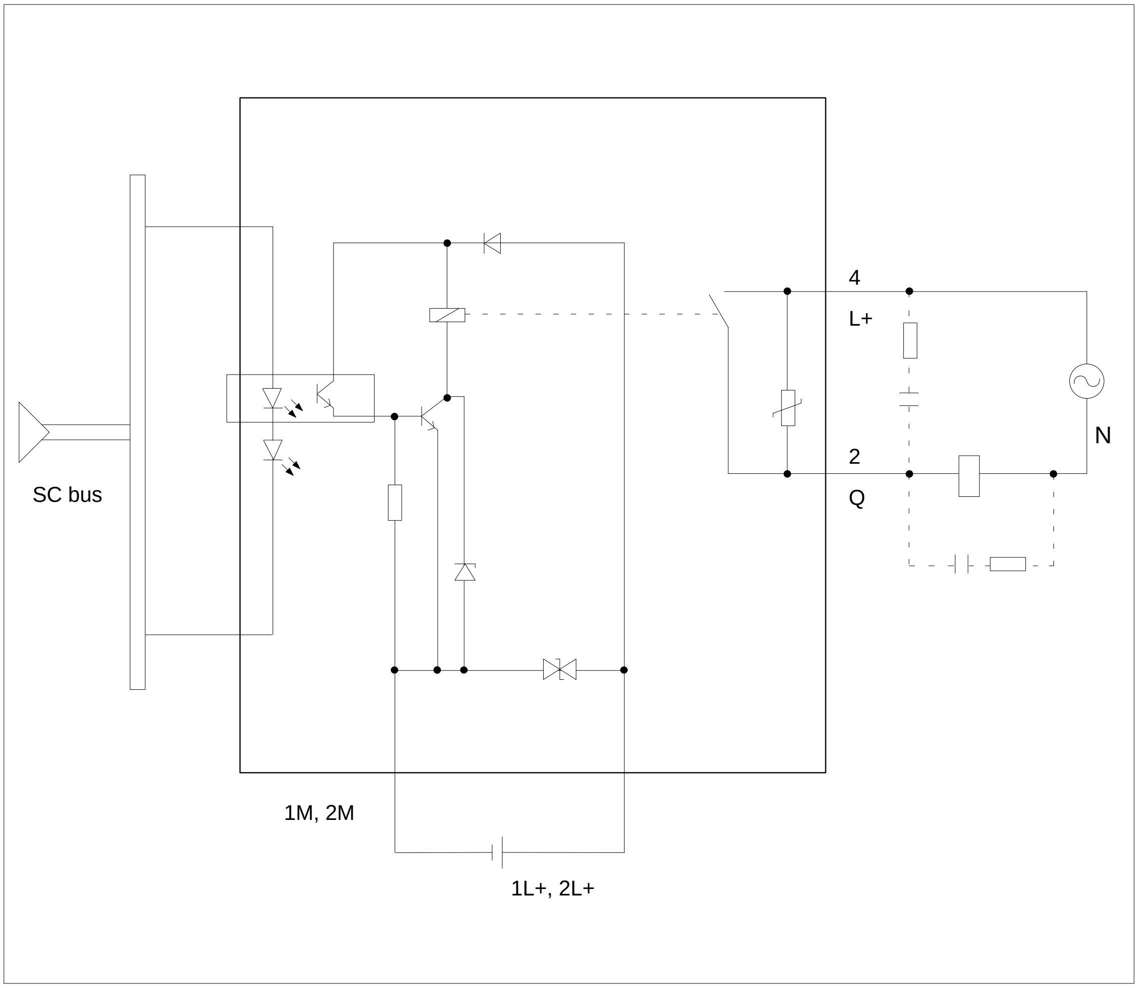


Figure 10-12 Block Diagram of the 1DORel.AC230V Digital Electronic Module

Technical Data

The technical data of the 1DORel.AC230V digital electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 30 g
Module-Specific Data	
Number of outputs	1
Contact type	1 x A
Cable length	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated supply voltage of relay L+	DC 24 V
• Reverse polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	yes
• Between channel and supply voltage of the relay	yes
Permissible potential difference	
• Between ground and supply voltage of the relay	DC 75 V, AC 60 V
• Between ground or supply voltage of the relay and the output	AC 240 V
Isolation tested with	
• Between ground and supply voltage of the relay	AC 1500 V
• Between ground or supply voltage of the relay and the output	DC 2500 V
Power input	
• From supply voltage L+	max. 15 mA
Power loss of the module	typ. 0.7 W
Status, Interrupts, Diagnostics	
Status indication	green LED
Interrupts	none
Diagnostic functions	none

Actuator Selection Data	
Continuous thermal current	max. 5 A
Minimum load current	1 mA
Switching capacity and lifetime of the contacts	see Table 10-1
• For resistive load	see Table 10-1
• For inductive load in accordance with IEC 947-5-1 DC13/AC15	see Table 10-1
Lamp load	see Table 10-1
Internal contact connection	Varistor rated voltage 275 V
Parallel switching of 2 outputs	
• For redundant control of a load	possible
• For performance enhancement	not possible
Controlling a digital input	possible
Switching frequency	
• Mechanical	max. 10 Hz
• With resistive load	max. 1 Hz
• With inductive load in accordance with IEC 947-5-1 DC13/AC15	max. 1 Hz max. 0.1 Hz
• With lamp load	max. 0.1 Hz

Table 10-1 Switching capacity and lifetime of the contacts

With Resistive Load		
Voltage	Current	Number of Operations (Typ.)
DC 24 V	5.0 A	0.1 million
DC 24 V	1.0 A	0.5 million
DC 24 V	0.5 A	1.5 million
DC 60 V	0.5 A	1.0 million
DC 120 V	0.2 A	1.0 million
AC 48 V	5.0 A	0.3 million
AC 60 V	5.0 A	0.2 million
AC 120 V	5.0 A	0.1 million
AC 120 V	1.0 A	1.0 million
AC 120 V	0.5 A	2.5 million
AC 230 V	5.0 A	0.2 million
AC 230 V	1.0 A	0.5 million
AC 230 V	0.5 A	1.5 million
For Inductive Load in Accordance with IEC 947-5-1 DC13/AC15 and Lamp Load		
Voltage	Current	Number of Operations (Typ.)
DC 24 V	1.0 A	0.1 million
DC 24 V	0.5 A	0.5 million
DC 60 V	0.5 A	0.5 million
DC 120 V	0.2 A	0.1 million
AC 48 V	2.0 A	1.0 million
AC 60 V	2.0 A	1.0 million
AC 120 V	2.0 A	0.5 million
AC 120 V	1.0 A	0.7 million
AC 120 V	0.7 A	1.0 million
AC 120 V	0.5 A	2.0 million
AC 230 V	2.0 A	0.2 million
AC 230 V	1.0 A	0.5 million
AC 230 V	0.5 A	1.0 million

The lifetime is longer with an external suppression circuit.

SC Analog Electronic Modules – Parameters

11

Contents of the Chapter

11.1 Parameters of the Analog Input Modules

This section contains an overview of the parameters of the analog input modules.

The modules use a subset of the parameters and value ranges listed below, depending on their functionality.

Tool for Parameterization

You will find the tools for parameterization described in Section 4.1.

Parameters

In the following table, you will find all the parameters used by analog modules.

Parameter
The following settings are possible for each channel:
Measurement range deactivated (yes/no)
Voltage measurement range
± 80 mV 1 ... 5 V ± 10 V
Current measurement range for 4-wire measuring transducer
0 ... 20 mA 4 ... 20 mA ± 20 mA
Current measurement range for 2-wire measuring transducer
4 ... 20 mA
Resistance measurement range, 4-conductor connection
600 Ω
Thermal resistance with linearization, 4-conductor connection
Pt 100 climatic range Pt 100 standard range Ni 100 standard range
Thermocouples with linearization
Type R Type J Type K

Parameter
Interference frequency suppression
50 Hz interference suppression 60 Hz interference suppression
Smoothing
None Weak smoothing Medium smoothing Strong smoothing
Reference junction
None Dynamic reference temperature at Pt100 module on A Dynamic reference temperature
Format (analog value representation)
S5 format S7 format

11.2 Notes on the Parameters of the Analog Input Modules

Measurement Type/Measurement Range

Each module is intended for a specific measurement type. You can select a measurement range for each channel.

Measurement Type	Measurement Ranges	Notes
Deactivated		Use this parameter if you have not connected a sensor to this channel and you want to shorten the module cycle time.
Voltage measurement range	± 80 mV ... ± 10 V	
Current, 4-wire measuring transducer	± 20 mA; 4...20 mA	
Current, 2-wire measuring transducer	4...20 mA	The 2-wire measuring transducers must be operated via an external voltage source at +24 V.
Resistance measurement range, 4-conductor connection	0 ... 600 Ω	The 4-conductor connection gives the maximum possible accuracy. The conductor resistances are in principle fully compensated.
Resistance thermometer with linearization 4-conductor connection	Platinum and nickel resistance thermometer	Temperature characteristics of various resistance thermometers (dynamic reference temperature) are stored in the module's ROM. The converted analog value is shown in units of 0.1 (0.5)* ºC in the standard temperature range and 0.01 (0.05)*ºC in the climatic temperature range.
Thermocouples with linearization	Type R (PtRh-Pt) Type J (Fe-CuNi) Type K (NiCr-Ni)	Temperature characteristics of various thermocouples are stored in the module's ROM. The converted analog value is shown in units of 0.1 (1)*ºCt. * The values in brackets refer to S5 format.

Reference Junction

If you have connected a thermocouple, the following options are available to you for specifying the reference junction:

Reference Junction	Notes
None	The module records only the temperature difference between the measurement point and the free ends of the thermocouple.
Dynamic reference temperature module on A	Connect a platinum resistance thermometer to the resistance measurement module on slot A in order to record the reference junction in the climatic temperature range. Any thermocouple types on the remaining slots can then use this reference temperature. ET 200L-SC and Smart Connect: The reference temperature refers to slot A on the TB16SC and applies to all other SC modules. ET 200L-SC IM-SC and Smart Connect: The reference temperature refers to slot A on the TB 16IM-SC and applies to all other SC modules. Slot A of the TB16 SC cannot generate a reference temperature.
Dynamic reference temperature[1]	Select this option if the temperature at your reference junction is constant or the temperature at the reference junction is recorded by another module. You can specify the temperature in the reference temperature parameter and adjust it dynamically in RUN mode.

1 In the case of the ET 200L-SC, the dynamic reference temperature is only possible with S7 masters.

Reference Temperature

Here you can enter the reference junction temperature in the climatic temperature range for recording temperatures using thermocouples (in S7 number format: 0.01°C and in S5 number format: 0.05°C).

You can update this parameter using your application program.
You can, for instance, record the reference junction temperature via another module.

In the case of the ET 200L-SC or ET 200L-SC IM-SC, entering the reference temperature is only possible with S7 masters.

Interference Frequency Suppression

The frequency of your AC power supply can interfere with the measured value particularly in the case of low voltage ranges and thermocouples. Enter the mains frequency of your system.

Smoothing

The various measured values are smoothed by digital filtering. You can choose between no, weak, medium and strong smoothing for each module. The stronger the smoothing, the greater the time constant of the filter.

Format

The analog input module supplies its information in S5 or S7 number format, depending the parameterization.

11.3 Default Parameters of the Analog Input Modules

Default Parameters

If you have not set the parameters of the relevant module using the specified software (Chapter 4), the default settings apply to all input channels after a restart. Specifically, this means:

Table 11-1 Default Parameters of the Analog Input Modules

Parameters		Default Value
Measurement type		Each module is intended for a specific measurement type.
		Measurement Range
Module type	for voltage input	± 10 V
Module type	for current input	4 ... 20 mA
Module type	for resistance input	Pt 100 standard
Module type	for thermocouple input	Thermocouple type K
Interference frequency suppression		50 Hz
Smoothing		None
Reference junction		None
Reference temperature value		0000H
Format		S7 format

11.4 Behavior of the Analog Input Modules

Introduction

This section describes:

- The dependency of analog input values on the load power supply of the analog modules and the operating states of the CPU
- The behavior of the analog modules depending on the position of the analog values in each value range
- The effect of faults on the analog modules

Extreme Range of the Analog Signals

The behavior of the analog input modules depends on which part of the value range the input values are in.

Table 11-2 Effect of the Operating Mode of the CPU and the Supply Voltage L+ on the Analog Input Values

Operating Mode of the CPU		Supply Voltage L+ at the Analog Module	Input Value of the Analog Module	
			S7 Number Format	**S5 Number Format**
POWER ON	RUN	L+ applied	Process value	Process value
			$7FFF_H$ until the conclusion of the 1st conversion after the parameterization of the module.	$7FFF_H$ until the conclusion of the 1st conversion after the parameterization of the module.
		L+ not applied	$7FFF_H$	$7FFF_H$
POWER ON	STOP	L+ applied	Process value	Process value
			$7FFF_H$ until the conclusion of the 1st conversion after the parameterization of the module.	$7FFF_H$ until the conclusion of the 1st conversion after the parameterization of the module.
		L+ not applied	$7FFF_H$	$7FFF_H$
POWER OFF	–	L+ applied	–	–
		L+ not applied	–	–

11.5 Conversion and Cycle Times of the Analog Input Channels

In this section, you will find the definitions and interrelationships of the conversion time and cycle time for analog input modules.

Conversion time

The conversion time consists of the basic conversion time and additional processing times of the module. The basic conversion time depends directly on the conversion process (integrated process, successive approximation) of the analog input channel. In integrating conversion processes, the integration time is included directly with the conversion time. The integration time is dependent on the interface frequency suppression.

Cycle Time in a Module

Analog/digital conversion and transfer of the digitized measured values to the SC bus are sequential. In other words, the analog input channels are converted one after the other. The cycle time (i.e. the time until another analog input value is converted) is the sum of the conversion times of the activated analog input channels of an analog input module (see Chapter 12). You should activate unused analog input channels to reduce the cycle time.

Cycle Time to the System

The transfer of the digitized measured values to the system depends on the interface used and the degree of expansion of the Smart Connect.

If you are using an ET 200L-SC with analog SC modules, you must allow the following times for the transmission of the digitized measured values:

- 12 ms for each analog module
- An additional 10 ms for each 2 AI TC SC module for which you have set the reference temperature transfer parameter (dynamically or from the dynamic reference temperature module on slot A)

The total cycle time thus depends on the cycle time in the SC modules (see Chapter 12) plus the cycle times to the system, as described above.

11.6 Connecting Thermocouples

Thermocouples are used to measure temperature.There are various types of thermocouple, which differ with regard to their temperature range and output voltage, depending on the material of their wires.

Structure of Thermocouples

A thermocouple assembly consists of:

- The thermocouple itself (sensor)
- The required built-in and connected components.

The thermocouple itself consists of two wires made of different metals or metal alloys, the ends of which are soldered or welded together. Thermocouples are categorized into different types (e.g. R, J, K) according to the combination of materials used. The measurement principle is the same for all thermocouple types.

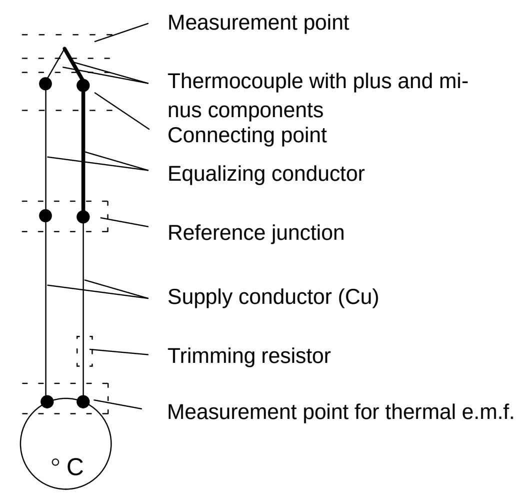


Figure 11-1 Structure of Thermocouples

How Thermocouples Work

If the measurement point is subjected to a different temperature to the free end of the thermocouple, a potential difference develops between the free ends, which is referred to as the thermal e.m.f.

The thermal e.m.f. depends on the difference between the temperature of the measurement point and the temperature at the free ends of the reference junction, as well as the combination of materials used in the thermocouple. A thermocouple always measures a temperature difference, so to determine the temperature of a measurement point the free ends at a reference junction must be kept at a known temperature.

Compensation of the Reference Junction Temperature

You have various options for measuring the reference junction temperature in order to obtain an absolute temperature value from the temperature difference between the reference junction and the measurement point.

Table 11-3 Compensation of the Reference Junction Temperature

Option	Notes	Reference Junction Parameters
No compensation	When you only want to measure the temperature difference between the measurement point and the reference junction.	None
Use of a compensating box in the supply conductors of a single thermocouple	You have already measured and compensated the reference junction temperature using a compensating box looped into the supply conductors of a single thermocouple. No further processing on the part of the module is required.	None
Use of a resistance thermometer to measure the reference junction temperature (recommended method)	You can measure the reference temperature using a resistance thermometer (platinum), and have the module calculate it for any thermocouple of this terminal block.	Dynamic reference temperature module on A
Constant reference junction temperature (thermostat, ice bath)	If the reference junction temperature is constant and known, you can specify this value in the dynamic parameters.	Dynamic reference temperature
Distribution of thermocouples with the same reference junction across several modules	Use a resistance measurement module with a connected dynamic reference temperature module, which measures the reference junction temperature, and set the parameters of the reference junctions of the thermocouples as described above (dynamic reference temperature module on A). Read the climatic temperature into the CPU, and pass the value via SFC55 to the other module.	Dynamic reference temperature

Connecting Thermocouples

Connect the thermocouple to the inputs of the modules either directly or via equalizing conductors. Each channel, independently of the other channel, can use any thermocouple type supported by the analog input module.

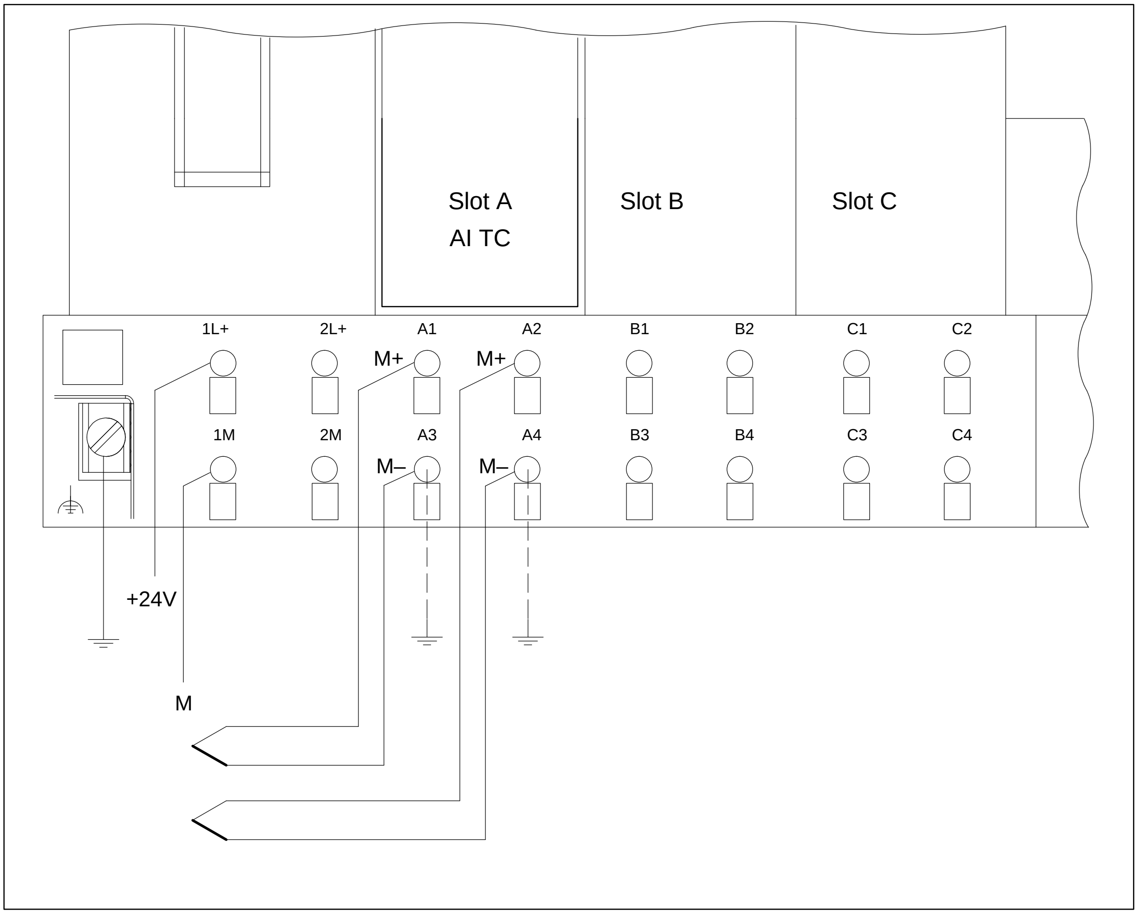


Figure 11-2 Connecting Insulated Thermocouples Without Compensation, With Internal Compensation, or Use of the Reference Temperature (Example TB 16SC)

Non-Insulated Thermocouples

If you use non-insulated thermocouples, you must be careful to comply with the permitted common-mode voltage.

Extension to a Reference Junction

The thermocouples can be extended from their connecting point via equalizing conductors to a point with as constant a temperature as possible (reference junction).

The equalizing conductors are made of the same material as the wires of the thermocouple. The supply conductors are of copper. In this case, internal compensation must not be set. Ensure that the polarity of the connection is correct, since otherwise serious measurement errors occur.

Equalizing Circuit

The effect of temperature fluctuations on the reference junction can be compensated for by an equalizing circuit (e.g. by means of a compensating box for a reference junction outside the terminal block or by means of internal compensation for a reference junction in the terminal block). In this case, the equalizing conductors must lead to the terminal block.

Use of a Compensating Box

The effect of temperature on the reference junction of a thermocouple (e.g. terminal box) can be equalized by means of a compensating box.

The compensating box contains a bridge circuit, which is compensated for a specified reference junction temperature (compensating temperature). The connections for the ends of the equalizing conductor of the thermocouple form the reference junction.

If the actual reference temperature differs from the compensating temperature, the temperature-dependent bridge resistance changes. The result is a positive or negative compensation voltage, which is added to the thermal e.m.f.

To compensate the analog input modules, compensating boxes with the **reference junction temperature of 0 °C** must be used.

Note:

- The compensating box must be supplied potential-free.
- The power supply unit must have sufficient interference filtering (e.g. by means of a grounded shielding winding).

Compensation by Measurement of the Reference Junction Temperature

If all thermocouples connected to the inputs of the analog modules of a terminal block have the same reference junction, compensate them as follows:

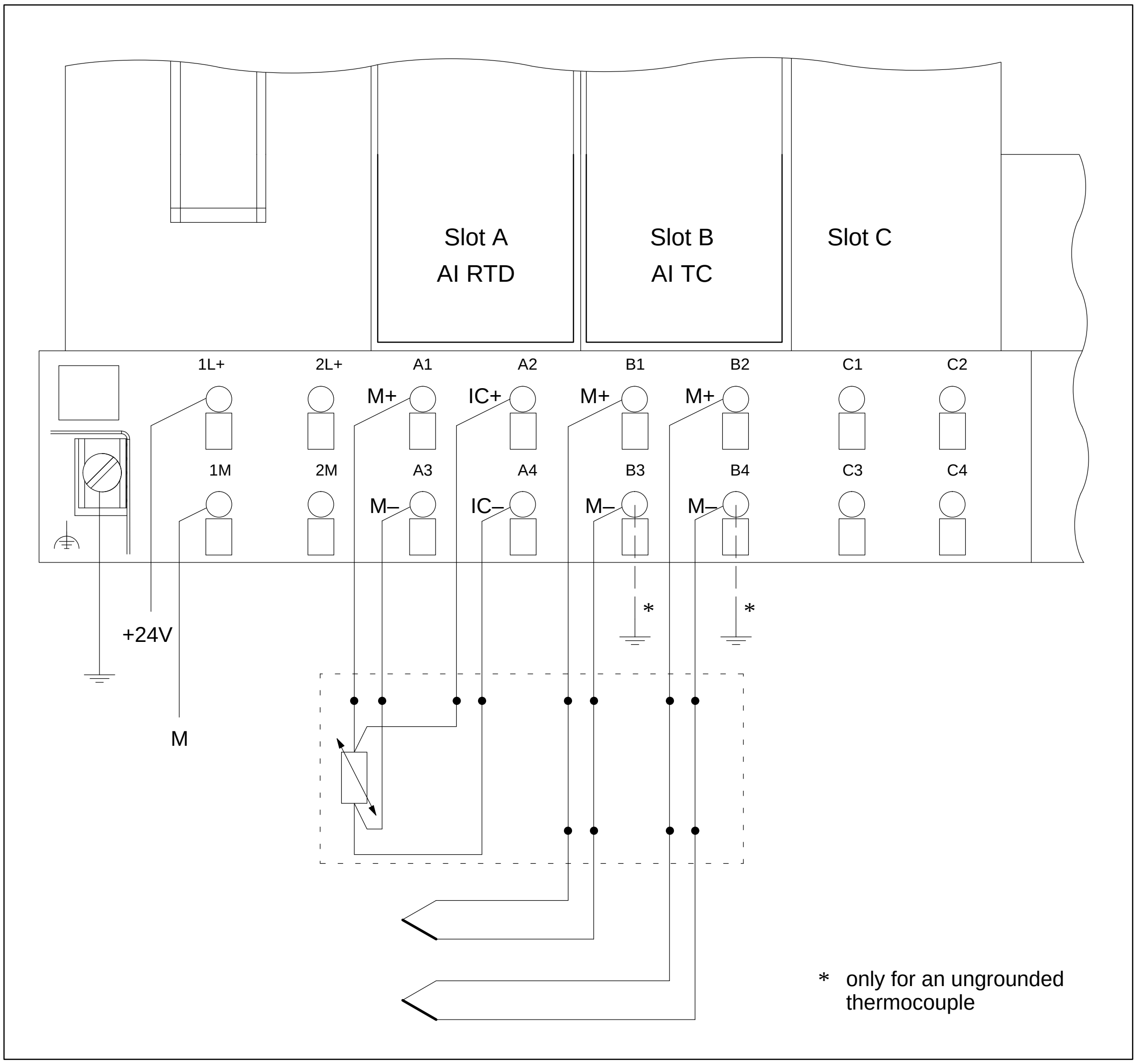


Figure 11-3 Connecting Insulated Thermocouples of the Same Type with External Compensation, via a Resistance Thermometer Connected to the Resistance Measurement Module, to Slot A of the Terminal Block (Example TB 16SC)

Connect the resistance thermometer to the module on slot A. Note the parameterization of the reference junction for each thermocouple channel.

Abbreviations

In Figures 11-2 and 11-3, the abbreviations have the following meanings:

IC +:	Constant current line (positive)
IC–:	Constant current line (negative)
M +:	Measurement line (positive)
M–:	Measurement line (negative)

11.7 Connecting Non-Isolated Voltage Sensors

Voltage Sensors

Figure 11-4 shows how to connect voltage sensors to an analog input module.

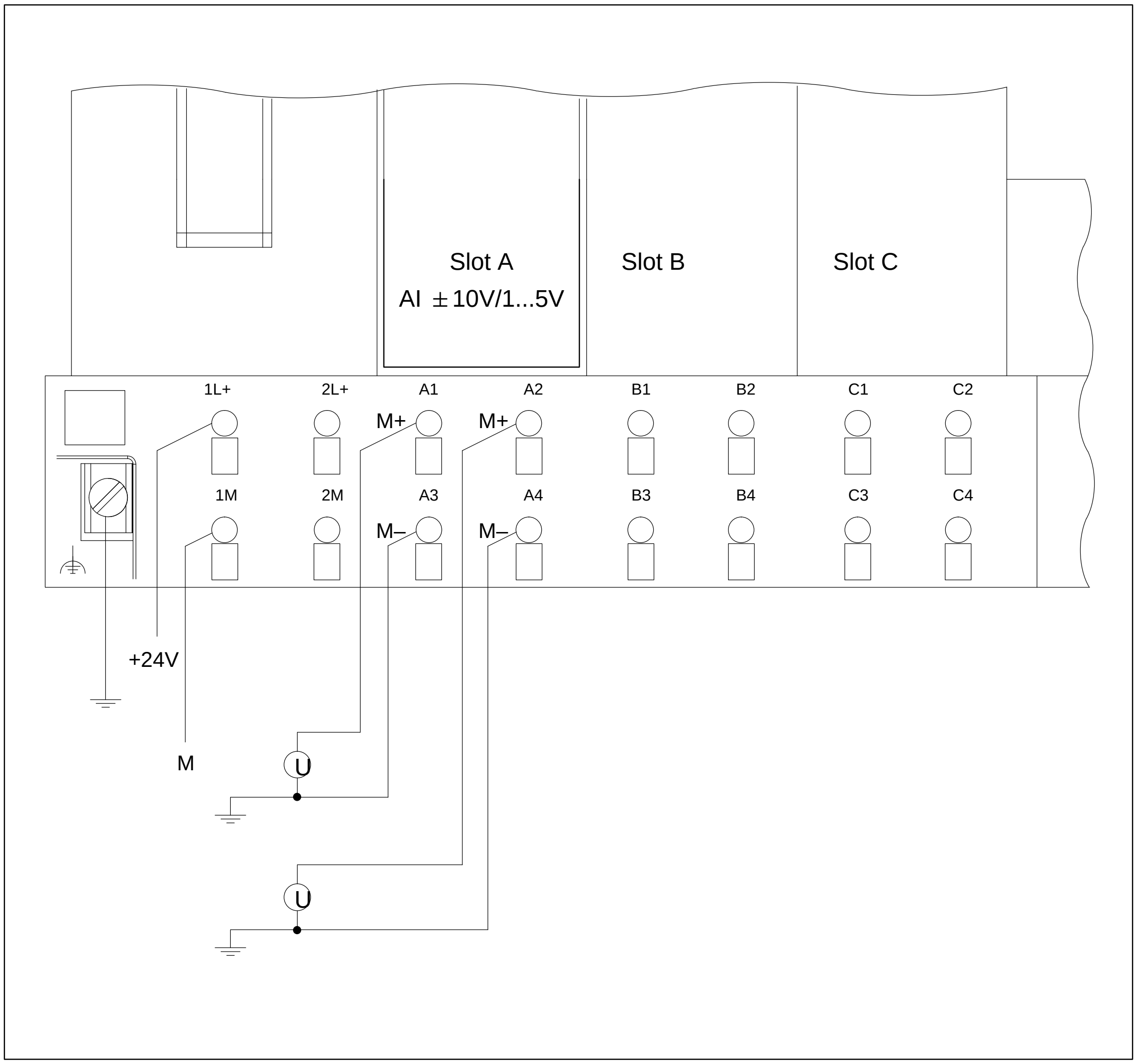


Figure 11-4 Connecting Voltage Sensors (Example TB 16SC)

4-wire measuring transducers with voltage output are connected like voltage sensors.

11.8 Connecting Current Sensors

Supply Voltage of the Sensors

You can only connect 4-wire measuring transducers or 2-wire measuring transducers with external supply voltage to the modules.

Connecting 4-Wire Measuring Transducers

Figure 11-5 shows you how to connect current sensors as 4-wire measuring transducers to analog input modules.

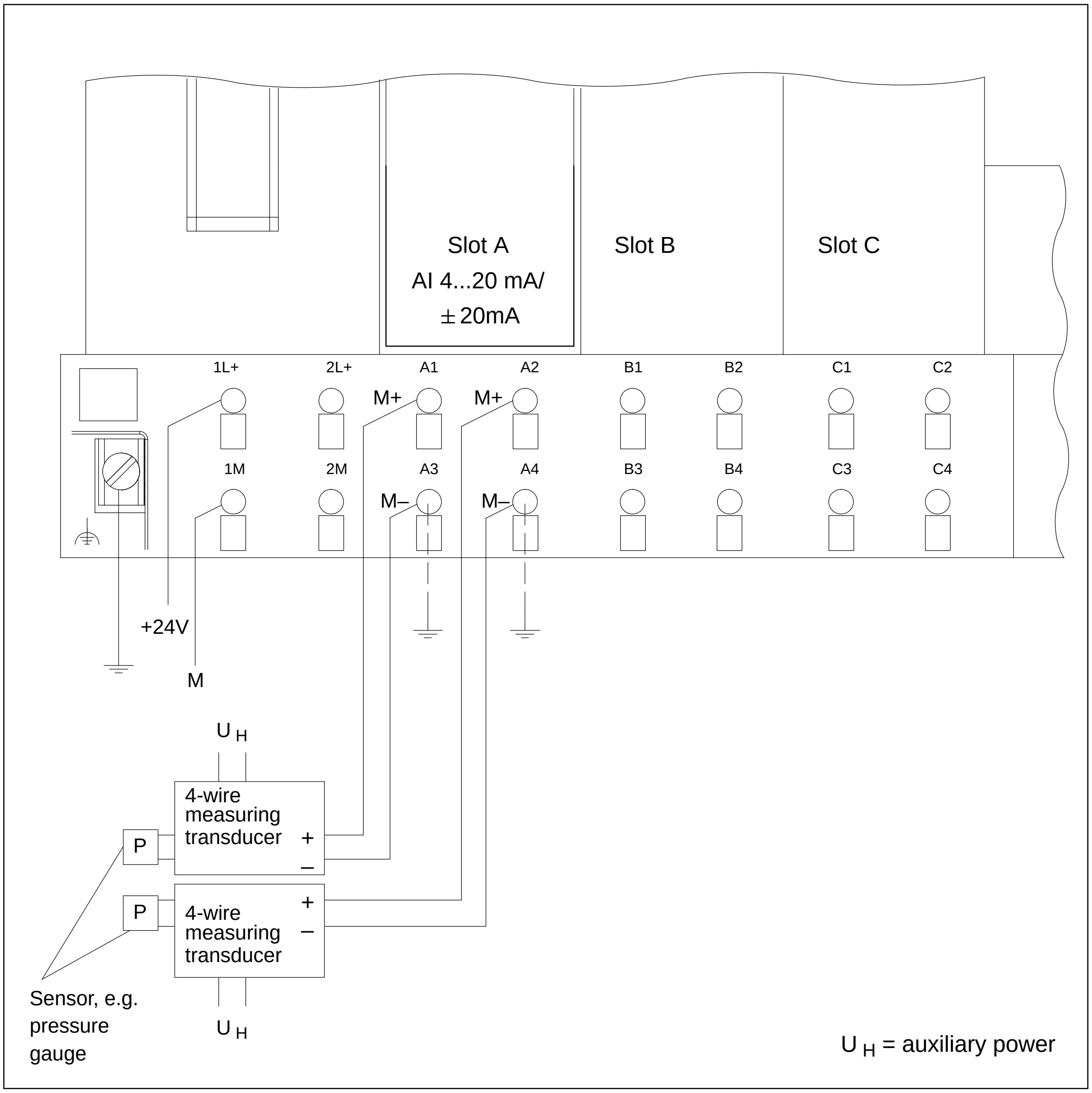


Figure 11-5 Connecting 4-Wire Measuring Transducers (Example TB 16SC)

Connecting 2-Wire Measuring Transducers

Figure 11-6 shows you how to connect 2-wire measuring transducers with an external power supply to current input modules.

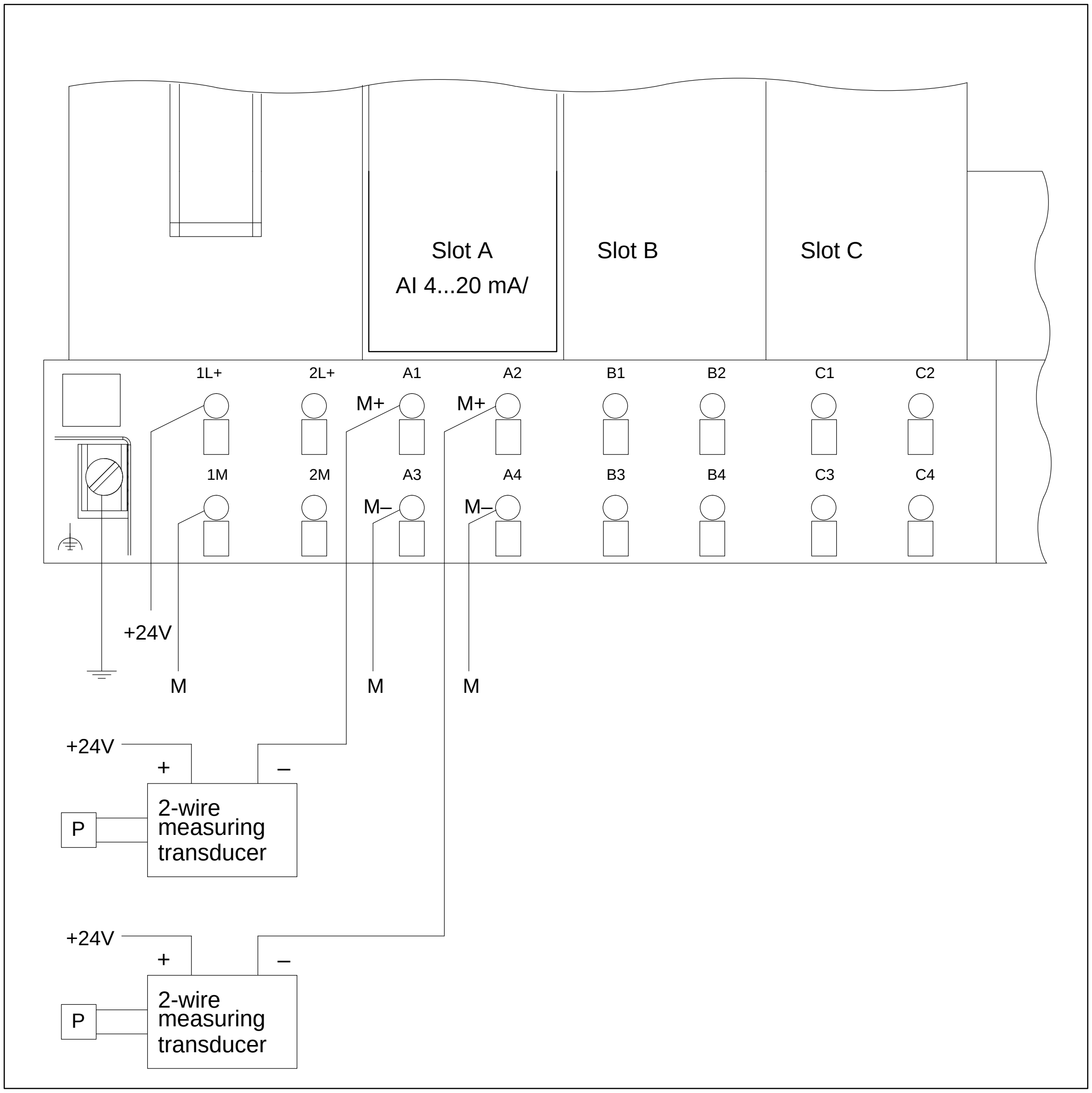


Figure 11-6 Connecting 2-wire measuring transducers (Example TB 16SC)

11.9 Connecting resistance thermometers and resistors

The resistance thermometers and resistors are measured by means of a 4-conductor system. A constant current is fed via terminals IC + and IC – to the resistance thermometers and resistors. The resulting voltage at the resistance thermometer and resistor is measured via terminals M + and M –. Very precise measurement results are thus obtained at the 4-conductor connection.

4-Conductor Connection

Figure 11-7 shows how to implement the 4-conductor connection for resistance thermometers/resistors.

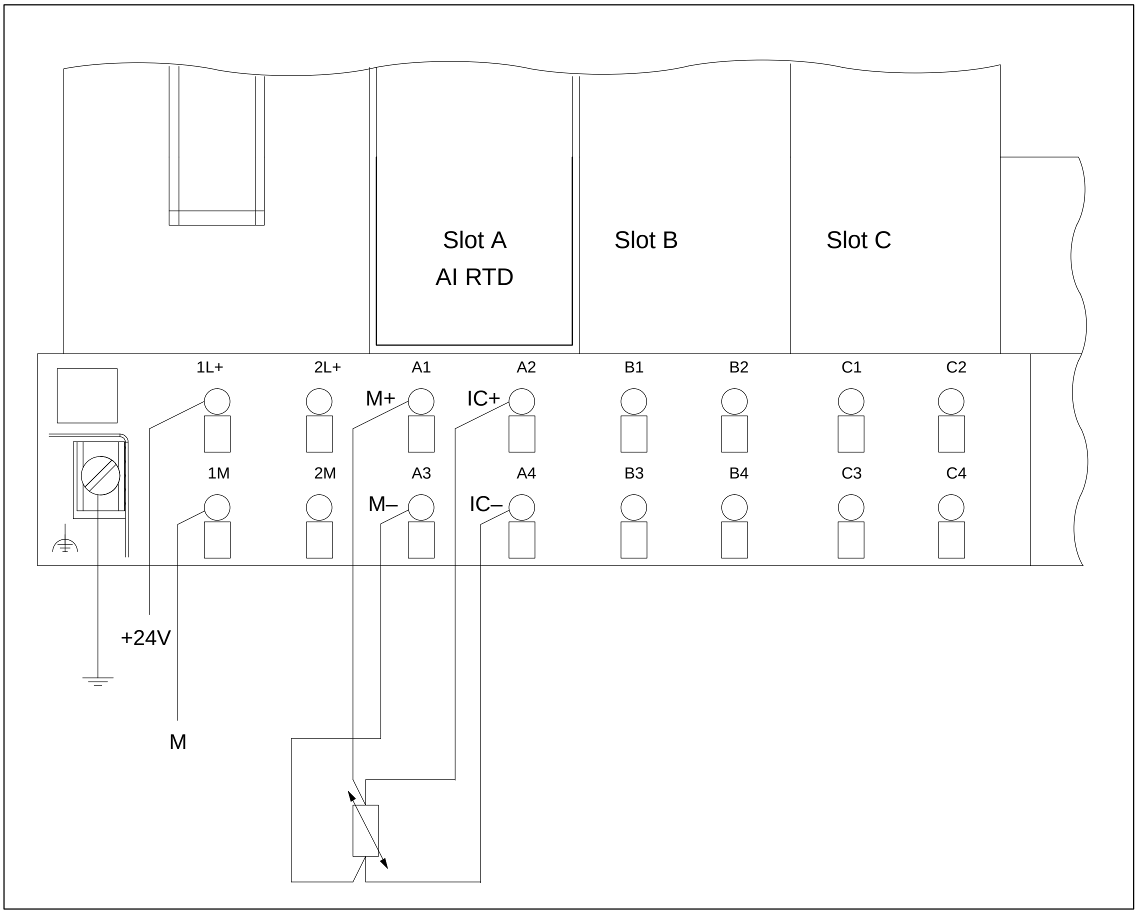


Figure 11-7 4-Conductor Connection for Resistance Thermometers and Resistors (Example TB 16SC)

11.10 Floating Measuring Sensors

Floating Measuring Sensors

In the case of floating measuring sensors, potential differences can occur between the individual measuring sensors and in comparison to M. These potential differences can also be caused by malfunctions or the spatial distribution of the measuring sensors. Ensure that U_{CM} does not exceed the permitted value (e.g. by using an equalizing conductor).

11.11 Wiring Unused Inputs of Analog Input Modules

To avoid malfunctions, you should deactivate unused channels of analog input modules using the configuration tool and wire as follows:

- In the case of analog input modules for voltage, current and thermocouples:

  Insert a bridge between M+ and M–, and connect it to the ground (M) of the terminal block.

- In the case of analog input modules for resistance thermometers:

  Insert a bridge between M+ and M–, and connect it to the ground (M) of the terminal block. IC+ and IC– remain unwired.

- In the case of the 2 AI HS I analog input module (6ES7 123-1GB50-0AB0):

  Leave the inputs of the unused channel unwired.

11.12 Parameters of the Analog Output Modules

This section contains an overview of the parameters of the analog output modules.

The modules use a subset of the parameters and value ranges listed below, depending on their functionality.

Tool for Parameterization

The parameterization tools are described in Chapter 4.

Parameters of the Analog Output Modules

The table 11-4 shows which parameters are used by the analog output modules.

Table 11-4 Parameters of the Analog Output Modules

Parameters
The following settings are possible:
Measurement range deactivated (yes/no)
Voltage range
1 ... 5 V ± 10 V
Current range
0 ... 20 mA 4 ... 20 mA

11.13 Notes on the Parameters of the Analog Output Modules

Output Type/Output Range

You specify the output type by selecting the corresponding module type. For each module type, you have the option of entering an output range of the parameters or value ranges listed below.

Table 11-5 Output Types/Output Ranges of the Analog Output Modules

Output Type	Output Range	Notes
Voltage	1 ... 5 V ± 10 V	Wire the S+ and S– sense inputs of the modules directly to the load to be driven in order to compensate for line effects.
Current	0 ... 20 mA 4 ... 20 mA	

11.14 Default Parameters of the Analog Output Modules

Default Parameters

If you have not set the parameters of the corresponding module using the specified software (Chapter 4), the default settings apply to all output channels after a restart. Specifically, this means:

Table 11-6 Default Parameters of the Analog Output Modules

Parameter		Default Value
Output type		Each module is intended for a specific output type.
		Output Range
Module type	for voltage	± 10 V
Module type	for current	4 ... 20 mA

11.15 Behavior of the Analog Output Modules

Introduction

This section describes the following:

- The effect of the load power supply of the analog modules and the operating modes of the CPU on the analog output values
- The behavior of the analog modules depending on the position of the analog values in the relevant value range
- The effect of errors on the analog modules

Table 11-7 Effect of the Operating Mode of the CPU and the Supply Voltage L+ on the Analog Output Values

<table>
<tr><th rowspan="2" colspan="2">Operating Mode of the CPU</th><th rowspan="2">Supply Voltage L+ at the Analog Module</th><th colspan="2">Output Value of the Analog Output Module</th></tr>
<tr><th>S7 Number Format</th><th>S5 Number Format</th></tr>
<tr><td rowspan="3">POWER ON</td><td rowspan="3">RUN</td><td rowspan="2">L+applied</td><td>CPU values</td><td>CPU values</td></tr>
<tr><td>By the conclusion of the 1st conversion ...
• after power on, a signal of 0 mA or 0 V is output.
• after parameterization, a signal of 0 mA or 0 V is output.</td><td>By the conclusion of the 1st conversion ...
• after power on, a signal of 0 mA or 0 V is output.
• after parameterization, a signal of 0 mA or 0 V is output.</td></tr>
<tr><td>L+ not applied</td><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
<tr><td rowspan="3">POWER ON</td><td rowspan="3">STOP</td><td rowspan="2">L+ applied</td><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
<tr><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
<tr><td>L+ not applied</td><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
<tr><td rowspan="2">POWER OFF</td><td rowspan="2">–</td><td>L+applied</td><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
<tr><td>L+ not applied</td><td>0 mA / 0 V</td><td>0 mA / 0 V</td></tr>
</table>

11.16 Conversion, Cycle, Settling and Response Times of the Analog Output Modules

In this section, you will find the definition and interrelationships of the relevant times for the analog output modules.

Conversion Time

The conversion time of the analog output modules includes transferring the digitized output values from internal memory after a message ends, and digital/analog conversion.

Cycle Time in a Module

The analog output modules are single-channel, so the internal cycle time corresponds to the conversion time described above.

Cycle Time of the System

The data in the analog modules is transmitted sequentially by means of the appropriate interface. The cycle time (i.e. the time that elapses before an analog module is addressed again) depends on the interface used and the number of parameterized analog modules.

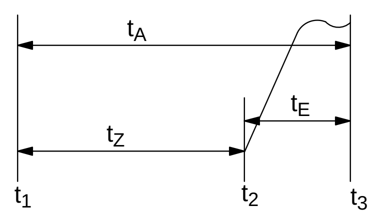
Analog Output Module Settling Time

The settling time (t_2 to t_3), which is the time from when the converted value is applied to when the specified value is obtained at the analog output, depends on the load. Distinctions must be drawn between ohmic, capacitive and inductive load.

Response Time

The response time (t_1 to t_3), which is the time from when the digital output values apply in the internal memory of the appropriate interface to when the specified value is reached at the analog output, is, in the worst case, the sum of the cycle time and the settling time. The worst case is when the analog channel is converted just before transfer of a new output value to the interface, and is only transferred again after transfer and conversion of the other channels (cycle time).

Figure 11-8 shows the response time of the analog output channels.



t_A = response time

t_Z = cycle time, which corresponds to n × transfer time +1 × conversion time

(n = activated modules)

t_E = settling time

t_1 = new digitized output value applies

t_2 = output value accepted and converted

t_3= specified output value

Figure 11-8 Response Time of the Analog Output Channels

11.17 Connecting Loads/Actuators to Analog Outputs

In the figures below, the abbreviations have the following meanings:

QI+:	Output current
QV+:	Output voltage
S +:	Sensor line (positive)
S –:	Sensor line (negative)
QV–/QI–:	Return line for load (ground connection)
R_L:	Load resistance

The figures below show you how to connect loads and actuators to the current or voltage outputs of the analog output modules.

Connecting Loads to a Current Output

Figure 11-9 shows an example of the wiring on an electronic module.

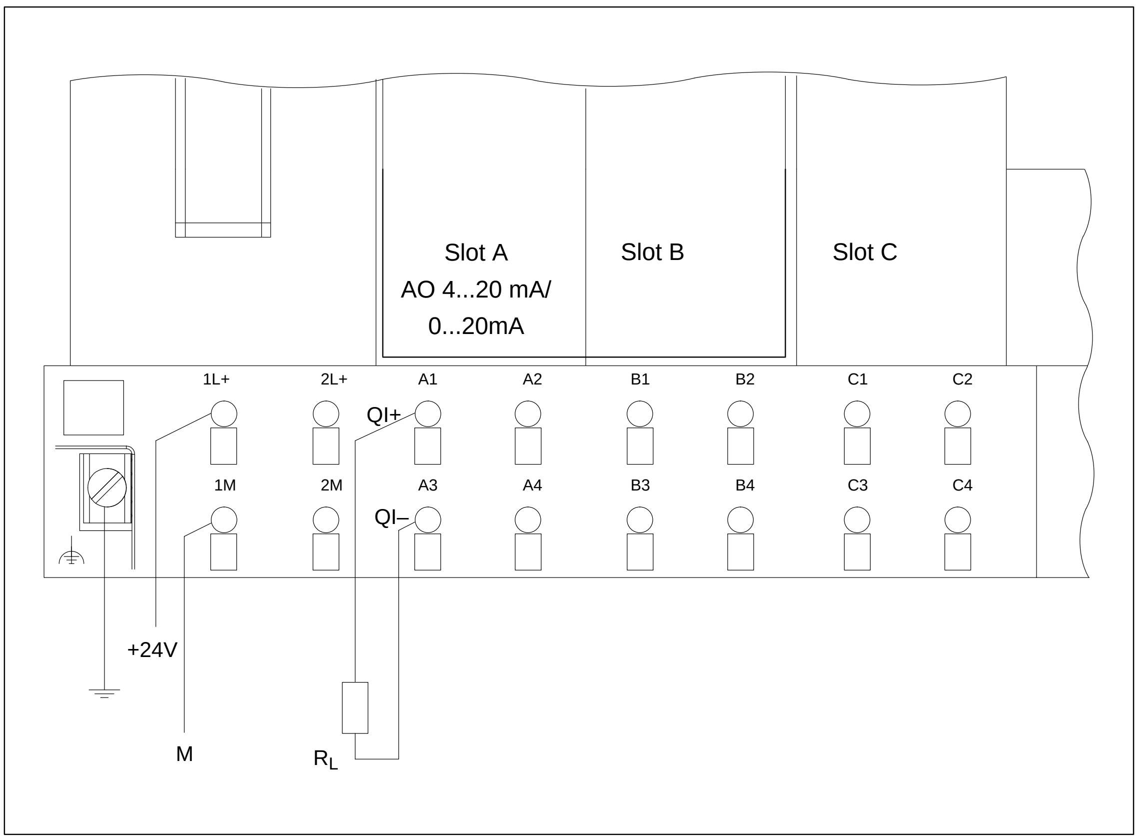


Figure 11-9 Connecting Loads/Actuators to a Current Output (Example TB 16SC)

Connecting Loads to a Voltage Output

If you connect the load to the voltage output via a 4-wire circuit, high accuracy is obtained.

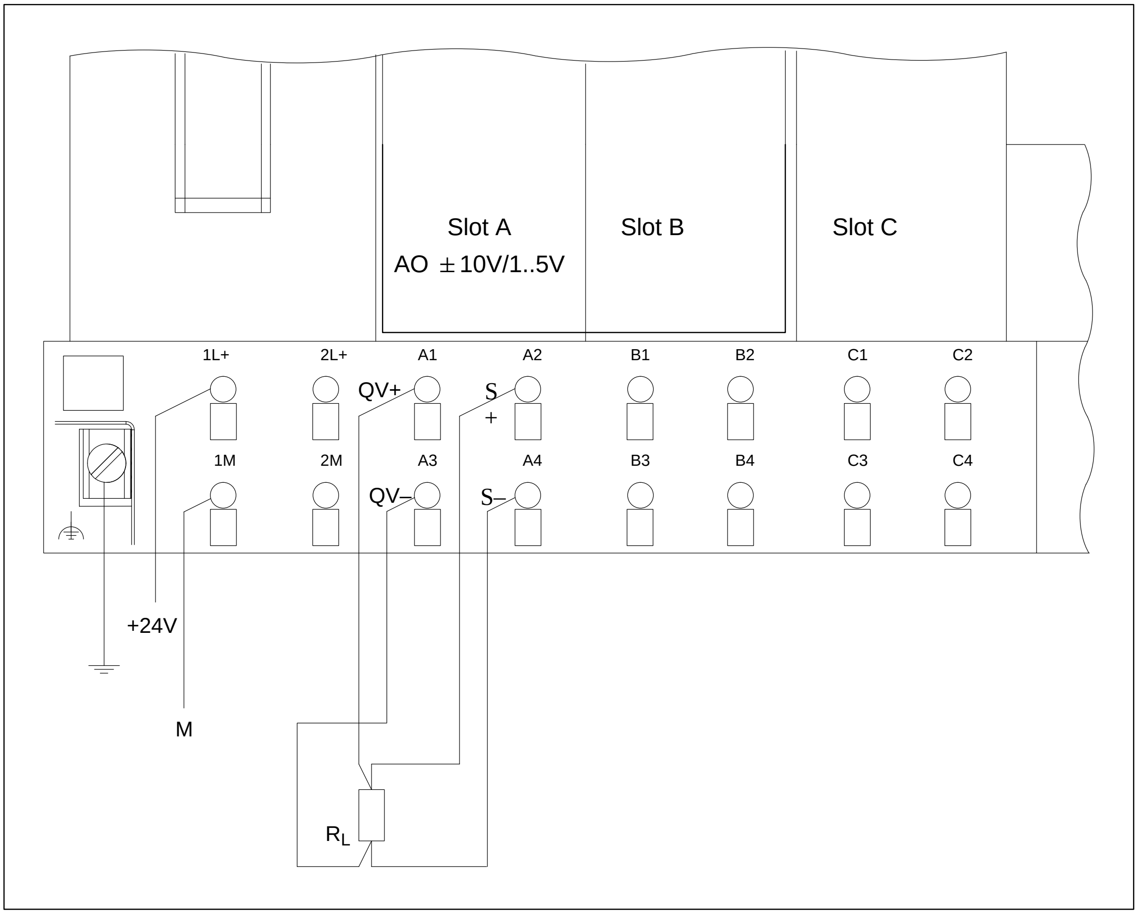


Figure 11-10 Connecting Loads/Actuators to a Voltage Output via a 4-Wire Circuit (Example TB 16SC)

The sensor lines (S +, S –) must be connected directly to the load. The voltage is thus measured and adjusted directly on the load.

You can also use only QV+ and QV– by bridging QV+ with S+ and QV– with S– on the terminal block. This entails a loss of accuracy. In this case, the line resistances are not compensated.

S + and S – must not remain unwired.

11.18 Wiring Unused Analog Output Modules

To avoid faults, you must wire unused channels of analog output modules as follows:

- In the case of analog output modules for voltage:

  Insert a bridge between QV+ and S+ and between QV– and S– .

- In the case of analog output modules for current:

  No wiring is required.

11.19 Analog Value Representation in S7 Number Format

In this section, the analog values are shown in S7 number format for all measurement ranges or output ranges that you can use with the SC analog modules.

All modules use the same analog value representation, but their resolution varies.

Analog Value Representation with 16-Bit Resolution

The digitized analog value is the same for input and output values with the same rated range.

Analog values are represented as fixed-point numbers in two's complement form. The assignment is as follows:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value of bits	2^{15}	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}

Resolution Less Than 16 Bits

If the resolution of an analog module is less than 16 bits, the analog value is stored on the module with left justification. "0" is written to the unused low-value positions.

Example

In the following example, you see how "0" is written to the unused positions when the resolution is low.

Bit pattern of a 14-bit and a 12-bit analog value

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
14-bit analog value	0	1	0	0	0	1	1	0	0	1	1	1	1	1	**0**	**0**
12-bit analog value	0	1	0	0	0	1	1	0	0	1	1	1	**0**	**0**	**0**	**0**

11.20 Analog Measurement Ranges for Input Channels in S7 Number Format

Input Ranges

The input ranges contained in Tables 11-8 to 11-10 are defined in two's complement representation:

Table 11-8 Bipolar Input Ranges

Units	Measured Value in %	Data Word																Range
		2^{15}	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}	
32767	> 117.589	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Overrange
27649	100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
– 1	– 0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
– 27648	– 100.000	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
– 27649	100.004	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	Underrange
– 32512	– 117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
– 32768	< – 117.593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

Table 11-9 Unipolar Input Ranges

Units	Measured Value in %	Data Word																Range
		2^{15}	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}	
32767	> 117.589	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Overrange
27649	100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Rated range
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
– 1	– 0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Underrange
– 4864	– 17.593	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	
– 32768	< – 17.593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

Table 11-10 Life-Zero Input Ranges

Units	Measured Value in %	Data Word																Range
		2^{15}	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}	
32767	> 117.589	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Overrange
27649	100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Rated range
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
– 1	– 0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Underrange
– 4864	– 17.593	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	
32767	< – 17.593	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Open circuit

11.21 Analog Value Representation for Analog Input Modules in S7 Number Format

The tables in this section contain the measurement representations for the individual measurement ranges of the analog input modules. The table values apply to all modules with the corresponding measurement ranges.

How to Read the Measurement Tables

The following tables contain the digitized analog values for the various measurement ranges.

Since the binary representation of the analog values is always the same, the following tables contain only the measurement ranges against the units.

For the corresponding binary representation of the measured values, see the tables in Section 11.20.

Voltage Measurement Range +10 V and +80 mV

Measured Value in %	System		Voltage Measurement Range		
	Dec.	**Hex.**	**± 10 V**	**± 80 mV**	
> 117.589 %	32767	7FFF	> 11.759V		Overflow
117.589 %	32511	7EFF	11.759 V	94.1 mV	Overrange
	27649	6C01			
100.000 %	27648	6C00	10 V	80 mV	Rated range
0.003617 %	1	1	361.7 µV	2.89 µV	
0 %	0	0	0 V	0 V	
– 0.003617 %	– 1	FFFF	–361.7 µV	– 2.89 µV	
– 100.000 %	– 27648	9400	– 10 V	– 80 mV	
	– 27649	93FF			Underrange
– 117.593 %	– 32512	8100	-11.759 V	-94.1 mV	
< 117.593 %	–32768	8000	< -11.759V	< -94.1mV	Underflow

Voltage Measurement Range 1...5 V

Measured Value in %	System		Voltage Measurement Range	
	Dec.	**Hex.**	**1 ... 5 V**	
> 117.589 %	32767	7FFF	> 5.704 V	Overflow
117.589 %	32511	7EFF	5.704 V	Overrange
	27649	6C01		
100.000 %	27648	6C00	5 V	Rated range
0.003617 %	1	1	1 V + 144.7 μV	
0 %	0	0	1 V	
	– 1	FFFF		Underrange
–17.593 %	– 4864	ED00	0.296 V	
< –17.593 %	32767	7FFF	< 0.296 V	Open circuit

Current Measurement Range ± 20 mA

Measured Value in %	System		Current Measurement Range	
	Dec.	**Hex.**	**± 20 mA**	
> 117.589 %	32767	7FFF	> 23.52 mA	Overflow
117.589 %	32511	7EFF	23.52 mA	Overrange
	27649	6C01		
100.000 %	27648	6C00	20 mA	Rated range
0.003617 %	1	1	723.4 nA	
0 %	0	0	0 mA	
– 0.003617 %	– 1	FFFF	– 723.4 nA	
– 100.000 %	– 27648	9400	– 20 mA	
	– 27649	93FF		Underrange
– 117.593 %	– 32512	8100	– 23.52 mA	
< –117.593 %	– 32768	8000	< – 23.52 mA	Underflow

Current Measurement Range 4... 20 mA

Measured Value in %	System		Current Measurement Range	
	Dec.	**Hex.**	**4 ... 20 mA**	
> 117.589 %	32767	7FFF	> 22.81 mA	Overflow
117.589 %	32511	7EFF	22.81 mA	Overrange
	27649	6C01		
100.000 %	27648	6C00	20 mA	Rated range
0.003617 %	1	1	4 mA + 578.7 nA	
0 %	0	0	4 mA	
	– 1	FFFF		Underrange
– 17.593 %	– 4864	ED00	1.185 mA	
< – 17.593 %	32767	7FFF	< 1.185 mA	Open circuit

Resistance-Type Sensor 0...600 Ω

Measured Value in %	System		Resistance-Type Sensor	
	Dec.	**Hex.**	**600 Ω**	
> 117.589 %	32767	7FFF	> 705.53 Ω	Overflow
117.589 %	32511	7EFF	705.53 Ω	Overrange
	27649	6C01		
100.000 %	27648	6C00	600 Ω	Rated range
0.003617 %	1	1	21.70 mΩ	
0 %	0	0	0 Ω	
	– 1	FFFF	*	Underrange
– 17.593 %	– 4864	ED00	*	
< – 17.593 %	– 32768	8000	*	Underflow

*Polarity reversal of IC+, IC

Analog Value Representation for Temperature Sensors

The following two tables show the analog value representation for temperature sensors of various types in various temperature ranges.

System		Temperature Range for Thermoresistors			
		Climatic (1 Digit = 0.01 ºC)	**Standard (1 Digit = 0.1 ºC)**		
Dec.	**Hex.**	Pt100	Pt100	Ni100	
32767	7FFF				Overflow
		*155 ºC	*1000 ºC	*295 ºC	Overrange
		130 ºC	850 ºC	250 ºC	Rated range
1000		10 ºC	100 ºC	100 ºC	
1	1	0.01 ºC	0.1 ºC	0.1 ºC	
0	0	0.00 ºC	0.0 ºC	0.0 ºC	
–1	FFFF	– 0.01 ºC	– 0.1 ºC	– 0.1 ºC	
		– 120 ºC	– 200 ºC	– 60 ºC	
					Underrange
		*– 145 ºC	*–243 ºC	*– 105 ºC	
–32768	8000				Underflow

* Overrange and underrange: In the overrange and underrange, the gradient of the characteristic curve as it leaves the linearized rated range is retained.

System		**Temperature Range for Thermocouples**			
		Standard (1 Digit = 0.1 ºC)			
Dec.	**Hex.**	Type R	Type J	Type K	
32767	7FFF				Overflow
		*2019 ºC	*1450 ºC	*1622 ºC	Overrange
		1769 ºC	1200 ºC	1372 ºC	Rated range
	10000	1000 ºC	1000 ºC	1000 ºC	
1	1	0.1 ºC	0.1 ºC	0.1 ºC	
0	0	0.0 ºC	0.0 ºC	0.0 ºC	
– 1	FFFF	– 0.1 ºC	–0.1 ºC	– 0.1 ºC	
		– 50 ºC	– 210 ºC	– 270 ºC	
					Underrange
		*– 170 ºC	*– 330 ºC	*– 390 ºC	
– 32768	8000				Underflow

* Overrange and underrange: In the overrange and underrange, the gradient of the characteristic curve as it leaves the linearized rated range is retained.

11.22 Analog Output Ranges for Output Channels in S7 Number Format

Output Ranges The output ranges shown in the following tables are defined for the analog output modules.

Table 11-11 Bipolar Output Ranges

Units	Data Word																Output Value in %	Range
	2^{15}	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}		
≥ 32512	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	0 %	Overflow
32511	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	117.589	Overrange
27649	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	100.004	
27648	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	100.000	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.003617	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	Rated range
– 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	– 0.003617	
– 27648	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	– 100.000	
– 27649	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	100.004	Underrange
– 32512	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	– 117.593	
≤ 32513	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x	0 %	Underflow

Table 11-12 Unipolar Output Ranges

Units	Data Word																Output Value in %	Range
	2^{15}	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}		
≥ 32512	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	0 %	Overflow
32511	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	117.589	Overrange
27649	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	100.004	
27648	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	100.000	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.003617	Rated range
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
– 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.000	Restricted to rated range lower limit, 0 V or 0
– 32512	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
≤ 32513	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x	0 %	Underflow

Table 11-13 Life-Zero Output Ranges

Units	Data Word																Output Value in %	Range
	2^{15}	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}		
≥ 32512	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	0 %	Overflow
32511	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	117.589	Overrange
27649	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	100.004	
27648	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	100.000	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.003617	Rated range
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
– 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	– 0.003617	Underrange
– 6912	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	– 25.000	
– 6913	1	1	1	0	0	1	0	0	1	1	1	1	1	1	1	1	– 25.000	Restricted to overrange lower limit, 0 V or 0 mA
– 32512	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
≤ – 32513	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x	– 25 %	Underflow

11.23 Analog Value Representation for Output Modules in S7 Number Format

The tables in this section contain the measurement representations for the individual measurement ranges of the analog output modules. The table values apply to all modules with the corresponding measurement ranges.

How to Read the Measurement Tables

The following tables contain the digitized analog values for the various measurement ranges.

Since the binary representation of the analog values is always the same, the following tables contain only the measurement ranges against the units.

Voltage Range ±10 V

Measured Value in %	System		Voltage Range	
	Dec.	**Hex.**	**± 10 V**	
118.5149 %	32767	7FFF	0.00 V	Overflow, no voltage and no current
117.593 %	32512	7F00	0.00 V	
117.589 %	32511	7EFF	11.76 V	Overrange
	27649	6C01		
100 %	27648	6C00	10 V	Rated range
0.003617 %	1	1	361.7 µV	
0 %	0	0	0 V	
– 0.003617 %	– 1	FFFF	– 361.7 µV	
– 100 %	– 27648	9400	– 10 V	
	– 27649	93FF		Underrange
117.593 %	– 32512	8100	– 11.76 V	
–117.596%	– 32513	80FF	0.00 V	Underflow, no voltage and no current
– 118.519 %	– 32768	8000	0.00 V	

Voltage Range 1...5 V

Measured Value in %	System		Voltage Range	
	Dec.	**Hex.**	**1 ... 5 V**	
118.5149 %	32767	7FFF	0.00 V	Overflow, no voltage and no current
117.593 %	32512	7F00	0.00 V	
117.589 %	32511	7EFF	5.70 V	Overrange
	27649	6C01		
100 %	27648	6C00	5 V	Rated range
0.003617 %	1	1	1V+144.7µV	
0 %	0	0	1 V	
	– 1	FFFF	1V-144.7µV	Underrange
– 25 %	– 6912	E500	0 V	
	– 6913	E4FF	0.00 V	Impossible; output value restricted to 0 V
117.593 %	– 32512	8100	0.00 V	
- 117.596 %	– 32513	80FF	0.00 V	Underflow, no voltage and no current
– 118.519 %	– 32768	8000	0.00 V	

Current range 0...20 mA and 4...20 mA

System			Current range		
	Dec.	**Hex.**	**0 ... 20 mA**	**4 ... 20 mA**	
118.5149 %	32767	7FFF	0.00 mA	0.00 mA	Overflow, no voltage and no current
117.593 %	32512	7F00			
117.589 %	32511	7EFF	23.52 mA	22.81 mA	Overrange
	27649	6C01			
100 %	27648	6C00	20 mA	20 mA	Rated range
0.003617 %	1	1	723.4 nA	4mA+578.7 nA	
0 %	0	0	0 mA	4 mA	
	– 1	FFFF	0 mA	4mA-578.7 nA	Underrange
– 25 %	– 6912	E500	0 mA	0 mA	
	– 6913	E4FF	0 mA	0 mA	Impossible; output value restricted to 0 mA
– 117.593 %	– 32512	8100	0 mA	0 mA	
- 117.596 %	– 32513	80FF	0 mA	0 mA	Underflow, no voltage and no current
– 118.519 %	– 32768	8000	0 mA	0 mA	

11.24 Analog Value Representation in S5 Number Format

In this section, the differences between the analog value representation in S5 number format and S7 number format are explained.

The measurement and output ranges are always represented with left justification, with the exception of temperature ranges. Temperature ranges (PT100, Ni100, thermocouples) refer to bit 3, with right justification.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	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	x	F	Ü

Bits Ü, F and x are reserved for diagnostic functions:

Bit	Meaning
Bit 2^0 = Ü	Overflow bit
Bit 2^1 = F	Fault (open circuit)
Bit 2^2 = x	Not used

The individual measurement ranges are represented as follows:

Measurement Ranges for Analog Electronic Modules

Table 11-14 Representation of the Measurement Ranges for Analog Inputs

Measurement range	Representation in S5 Number Format	Representation in S7 Number Format
± 80 mV ± 10 V ± 20 mA	– 2048...+2048	–27648...+27648
1...5 V; 4...20 mA	512...+2560	0...+27648
PT100 Standard –100...+850 °C – 200...+850 °C	0.5 °C/digit –200...+1700	**0.1 °C/digit** – 2000...+8500
PT100 climatic – 120...+130 °C	**0.05 °C/digit** – 2400...+2600	**0.01 °C/digit** –12000...+13000
Ni100 standard – 60...+250 °C	**0.5 °C/digit** – 120...+500	**0.1 °C/digit** –600...+2500
Resistor 0...600 Ω	 0...+2048	 0...+27648
Thermocouple type J – 210...+1200 °C –200...+1200 °C	**1 °C/digit** –200...+1200 °C	**0.1 °C/digit** – 2100...+12000
Thermocouple type K – 270...+1372 °C –100...+1369 °C	**1 °C/digit** –100...+1369 °C	**0.1 °C/digit** – 2700...+13720

Table 11-14 Representation of the Measurement Ranges for Analog Inputs

Measurement range	Representation in S5 Number Format	Representation in S7 Number Format
Thermocouple type R – 50...+1769 ºC	**1 ºC/digit** – 50...+1769	**0.1 ºC/digit** –500...+17690

Table 11-15 Representation of the Measurement Rangesfor Analog Outputs

Output Range	Representation in S5 Number Format	Representation in S7 Number Format
± 10 V	–1024...+1024	– 27648...+27648
1...5 V 0...20 mA 4...20 mA	0...1024	0...+27648

- Overrange 117.59% (as S7)

- Overflow value Greatest overrange value +1
- Underflow value Greatest underrange value –1

  In both cases, the 0 (overflow) bit is set for inputs.

11.25 Analog Measurement Ranges for Input Channels in S5 Number Format

Input Ranges

The input ranges contained in Tables 11-16 to 11-18 are defined in two's complement representation:

Table 11-16 Bipolar Input Ranges

Units	Measured Value in %	Data Word 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	x	F	Ü	Range
2409	> 117.578	0	1	0	0	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
2408	117.578	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
2049	100.05	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
2048	100.000	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0.0488	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
– 1	– 0.0488	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	
– 2048	– 100.000	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
– 2049	– 100.05	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	Underrange
– 2408	– 117.578	1	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	
– 2409	< – 117.578	1	0	1	1	0	1	0	0	1	0	1	1	1	0	0	1	Underflow

Table 11-17 Unipolar Input Ranges

Units	Measured Value in %	Data Word 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	*	F	Ü	Range
2409	> 117.578	0	1	0	0	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
2408	117.578	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
2049	100.05	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
2048	100.000	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0.0488	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Rated range
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
– 1	– 0.0488	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	Overrange
– 360	– 17.593	1	1	1	1	0	1	0	0	1	1	0	0	0	0	0	0	
– 361	< – 17.593	1	0	0	1	0	1	0	0	1	0	1	1	1	0	0	1	Underflow

Table 11-18 Life-Zero Input Ranges

Units	Measured Value in %	Data Word																Range
		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	x	F	Ü	
2921	117.578	0	1	0	1	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
2920	117.578	0	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
2561	100.05	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
2560	100.000	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
513	0.0488	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
512	0.000	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
511	0.0488	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	Underrange
151	– 17.593	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	
4095	≤ –17.593	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	Open circuit

11.26 Analog Value Representation for Analog Input Modules in S5 Number Format

The tables in this section contain the measurement representations for the individual measurement ranges of the analog input modules. The table values apply to all modules with the corresponding measurement ranges.

How to Read the Measurement Tables

The following tables contain the digitized analog values for the various measurement ranges.

Since the binary representation of the analog values is always the same, the following tables contain only the measurement ranges against the units.

Voltage Measurement Range ± 10 V and ± 80 mV

Measured Value in %	System	Voltage Measurement Range		
	Dec.	**± 10 V**	**± 80 mV**	
> 117.589 %	2409	> 11.769 V	≥ 94.1 mV	Overflow
117.589 %	2408	11.758 V	94.06 mV	Overrange
	2049			
100.000 %	2048	10 V	80 mV	Rated range
0.0488 %	1	4.9 mV	39 µV	
0 %	0	0 V	0 V	
–0.0488 %	– 1	–4.9 mV	–39 µV	
– 100.000 %	– 2048	– 10 V	– 80 mV	
	– 2049			Underrange
– 117.593 %	– 2408	– 11.759 V	– 94.06 mV	
< – 117.593 %	– 2409	< 11.759 V	≤ – 94.1 mV	Underflow

Voltage Measurement Range 1...5 V

Measured Value in %	System	Voltage Measurement Range	
	Dec.	**1 ... 5 V**	
> 117.589 %	2921	≥ 5.704 V	Overflow
117.589 %	2920	5.704 V	Overrange
100.05 %	2561		
100.000 %	2560	5 V	Rated range
0.0488 %	513	1 V + 1.95 mV	
0	512	1 V	
– 0.0488 %	511		Underrange
– 17.593 %	151	0.296 V	
< – 17.593 %	4095	< 0.296 V	Open circuit

Current Measurement Range ± 20 mA

Measured Value in %	System	Current Measurement Range	
	Dec.	**± 20 mA**	
> 117.589 %	2409	> 23.52 mA	Overflow
117.589 %	2408	23.52 mA	Overrange
	2049		
100.000 %	2048	20 mA	Rated range
0.0488 %	1	9.766 µA	
0 %	0	0 mA	
–0.0488 %	– 1	–9.766 µA	
– 100.000 %	– 2048	– 20 mA	
	– 2049		Underrange
– 117.593 %	– 2408	– 23.52 mA	
< – 117.593 %	– 2409	< – 23.52 mA	Underflow

Current Measurement Range 4...20 mA

Measured Value in %	System	Current Measurement Range	
	Dec.	**4 ... 20 mA**	
> 117.589 %	2921	> 22.81 mA	Overflow
117.589 %	2920	22.81 mA	Overrange
	2561		
100.000 %	2560	20 mA	Rated range
0.0488 %	513	4 mA + 7.813 µA	
0 %	512	4 mA	
– 0.0488 %	511		Underrange
– 17.593 %	151	1,185 mA	
< – 17.593 %	4095	< 1,185 mA	Open circuit

Resistance-Type Sensor 600 Ω

Measured Value in %	System	Resistance-Type Sensor	
	Dec.	**600 Ω**	
> 117.589 %	2409	> 705.53 Ω	Overflow
117.578 %	2408	705.53 Ω	Overrange
	2049		
100.000 %	2048	600 Ω	Rated range
0.0488 %	1	0.293 Ω	
0 %	0	0 Ω	
	-1	*	Underrange
– 17.593 %	-360	*	
< – 17.593 %	-361	*	Underflow

* Polarity reversal of constant current IC+, IC-

Analog Value Representation for Temperature Sensors

The following two tables show the analog value representation for temperature sensors of various types in various temperature ranges.

... for Resistance Thermometers

System	Temperature Range			
	Climatic (1 Digit = 0.05 ºC)	**Standard (1 Digit = 0.5 ºC)**		
Dec.	Pt100	Pt100	Ni100	
3101	> 155 ºC			Overflow
2001		> 1000 ºC		
591			> 295 ºC	Overflow
	*155 ºC	*1000 ºC	*295 ºC	Overrange
	130 ºC	850 ºC	250 ºC	Rated range
200	10 ºC	100 ºC	100 ºC	
1	0.05 ºC	0.5 ºC	0.5 ºC	
0	0.00 ºC	0.0 ºC	0.0 ºC	
	– 120 ºC	100 ºC	60 ºC	
				Underrange
	*– 145 ºC	*– 243 ºC	*– 105ºC	
211			< – 105 ºC	Underflow
487		< – 243 ºC		
2901	< – 145 ºC			

* Overrange and underrange: In the overrange and underrange, the gradient of the characteristic curve as it leaves the linearized rated range is retained.

System	Temperature Range			
	Standard (1 Digit = 1 ºC)			
Dec.	Type R	Type J	Type K	
2020	> 2019 ºC			Overflow
1623			> 1622 ºC	
1451		> 1450 ºC		
	*2019 ºC	1450 ºC	1622 ºC	Overrange
	1769 ºC	1200 ºC	1372 ºC	Rated range
	1000 ºC	1000 ºC	1000 ºC	
1	1 ºC	1 ºC	1 ºC	
0	0.0 ºC	0.0 ºC	0.0 ºC	
– 1	– 1 ºC	– 1 ºC	– 1 ºC	
	– 50 ºC	– 210 ºC	– 270 ºC	
				Underrange
	*– 170 ºC	– 330 ºC	– 390 ºC	
– 171	< – 170 ºC			Underflow
– 331		< – 330 ºC		
– 390			< – 390 ºC	

* Overrange and underrange: In the overrange and underrange, the gradient of the characteristic curve as it leaves the linearized rated range is retained.

11.27 Analog Output Ranges for Output Channels in S5 Number Format

Output Ranges The output ranges shown in the following tables are defined for the analog output modules.

Table 11-19 Bipolar Output Ranges

Units	Data Word															Output Value in %	Range
	2^{11}	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		
≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	0 %	Overflow
1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	117.578	Overrange
1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	100.097	
1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	100.000	Rated range
1	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	0.097	
0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	0.000	
– 1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	0.097	
– 1024	1	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	100.000	
– 1025	1	0	1	1	1	1	1	1	1	1	1	1	x	x	x	x	100.097	Underrange
– 1204	1	0	1	1	0	1	0	0	1	1	0	0	x	x	x	x	– 117.578	
≤ 1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	0 %	Underflow

x=irrelevant

Table 11-20 Unipolar Output Ranges

Units	Data Word															Output Value in %	Range
	2^{11}	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		
≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	0 %	Overflow
1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	117.578	Overrange
1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	≥ 100.097	
1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	100.000	Rated range
1	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	0.0971	
0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	0.000	
– 1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	0.000	Restricted to rated range lower limit, 0 V or 0 mA
– 1204	1	0	1	1	0	1	0	0	1	1	0	0	x	x	x	x		
≤ – 1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	0 %	Underflow

x = irrelev

Table 11-21 Life-Zero Output Ranges

Units	**Data Word**																**Output Value in %**	**Range**
	2^{11}	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		
≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	0 %	Overflow
1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	117.578	Overrange
1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	100.097	
1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	100.000	
1	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	0.097	Rated range
0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	0.000	
– 1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	0.097	Underrange
– 256	1	1	1	1	0	0	0	0	0	0	0	0	x	x	x	x	– 25.000	
– 257	1	1	1	0	1	1	1	1	1	1	1	1	x	x	x	x	– 25.000	Restricted to overrange lower limit, 0 V or 0 mA
– 1204	1	0	1	1	0	1	0	0	1	1	0	0	x	x	x	x		
≤ –1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	– 25 %	Underflow

x=irrelevant

11.28 Analog Value Representation for Output Modules in S5 Number Format

The tables in this section contain the measurement representations for the individual measurement ranges of the analog output modules. The table values apply to all modules with the corresponding measurement ranges.

How to Read the Measurement Tables

The following tables contain the digitized analog values for the various measurement ranges.

Since the binary representation of the analog values is always the same, the following tables contain only the measurement ranges against the units.

Analog Value Representation

The following tables show the analog value representation for output channels in various voltage ranges.

Voltage Range ± 10 V

System		Voltage Range	
	Dec.	**± 10 V**	
> 117.578 %	>1204	0.00 V	Overflow, no voltage and no current
117.578 %	1204	11.76 V	Overrange
	1025		
100 %	1024	10 V	Rated range
0.097 %	1	9.76 mV	
0 %	0	0 V	
–0.097 %	– 1	– 9.76 mV	
– 100 %	– 1024	– 10 V	
	– 1025		Underrange
– 117.578 %	– 1204	– 11.76 V	
>–117.578 %	>–1204	0.00 V	Underflow, no voltage and no current

Voltage Range 1...5 V

System		Voltage Range	
	Dec.	**1 ... 5 V**	
> 117.578 %	1205	0 V	Overflow, no voltage and no current
117.578 %	1204	5.70 V	Overrange
	1025		
100 %	1024	5 V	Rated range
0.0976 %	1	1V + 3.9 mV	
0 %	0	1 V	
	– 1	1 V – 3.9 mV	Underrange
– 25 %	– 256	*0 V	
	- 257	0 V	Impossible; output value restricted to 0 V
<–117.578 %	<–1205	0 V	

Current range 0...20 mA and 4...20 mA

System		Current Measurement Range		
	Dec.	**0 ... 20 mA**	**4 ... 20 mA**	
>117.578 %	>1204	0.00 mA	0.00 mA	Overflow, no voltage and no current
117.578 %	1204	23.52 mA	22.81 mA	Overrange
	1025			
100 %	1024	20 mA	20 mA	Rated range
0.0976 %	1	19.5 µA	4mA+15.6 µA	
0 %	0	0 mA	4 mA	
–0.0976 %	– 1	0 mA		Underrange
– 25 %	– 256	0 mA	0 mA	
	– 257	0 mA	0 mA	Impossible; output value restricted to 0 mA
– 117.578 %	–1204	0 mA	0 mA	
<– 117.578%	<–1205	0.00 mA	0.00 mA	Underflow, no voltage and no current

SC Analog Electronic Modules – Technical Data

12

Contents of the Chapter

Order Numbers

Product Name	Order Number
Analog Electronic Module 2 AI U	6ES7 123-1FB00-0AB0
High-Speed Analog Electronic Module 2 AI HS U	6ES7 123-1FB50-0AB0
Analog Electronic Module 2 AI I	6ES7 123-1GB00-0AB0 6ES7 123-1GB10-0AB0
HighSpeed Analog Electronic Module 2 AI HS I (0/4–20 mA, 4-Wire Measuring Transducer)	6ES7 123-1GB60-0AB0
HighSpeed Analog Electronic Module 2 AI HS I (4–20 mA, 2-Wire Measuring Transducer)	6ES7 123-1GB50-0AB0
Analog Electronic Module 2 AI TC	6ES7 123-1JB00-0AB0
Analog Electronic Module 1 AI RTD	6ES7 123-1JA00-0AB0
Analog Electronic Module 1 AO U	6ES7 124-1FA00-0AB0
Analog Electronic Module 1 AO I	6ES7 124-1GA00-0AB0

12.1 Analog Electronic Module 2 AI U

Order Number

6ES7 123-1FB00-0AB0

Characteristics

The 2 AI U analog electronic module is an analog input module with the following characteristics:

- 2 inputs for voltage measurement
- Input ranges ± 10 V and 1...5 V
- 13/12-bit resolution
- Input range selection
- Isolated from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the input module.

The block diagram is shown on the front of the input module. In the operating state, the block diagram is covered by the labeling strip.

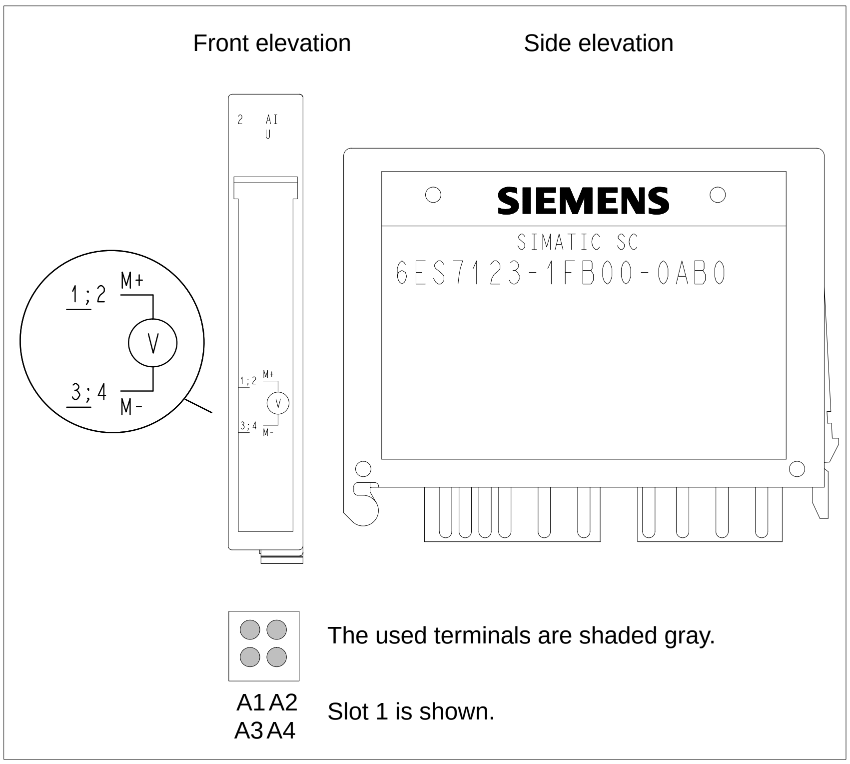


Figure 12-1 Front and Side Elevations of the 2 AI U Analog Electronic Module

Block Diagram

Figure 12-2 shows the block diagram of the 2 AI U analog electronic module.

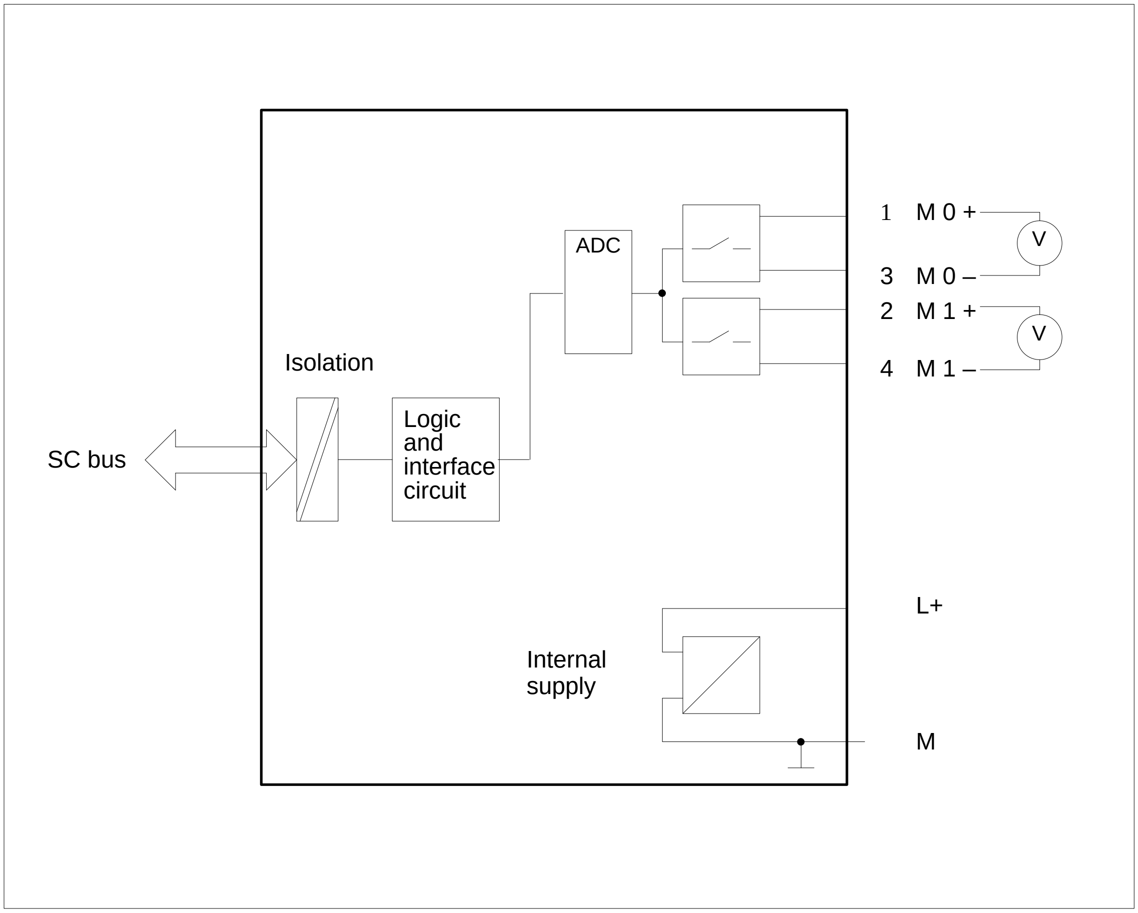


Figure 12-2 Block Diagram of the 2 AI U Analog Electronic Module

Parameters The 2 AI U electronic module uses the following parameters:

Table 12-1 Static Parameters of the 2 AI U Electronic Module

Parameters	Value Range	Default Parameters	Scope
Measurement type	deactivated Voltage	 Voltage	Channel
Measurement range (voltage)	± 10 V 1 ... 5 V	± 10 V	Channel
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz	Module
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters If you have not set the parameters of the 2 AI U electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-1).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\,y_{n-1}}{k}$$

y_n = value passed to the system in the current cycle n

Jump Response

Figure 12-3 shows the jump response for various smoothing factors, depending on the number of module cycles.

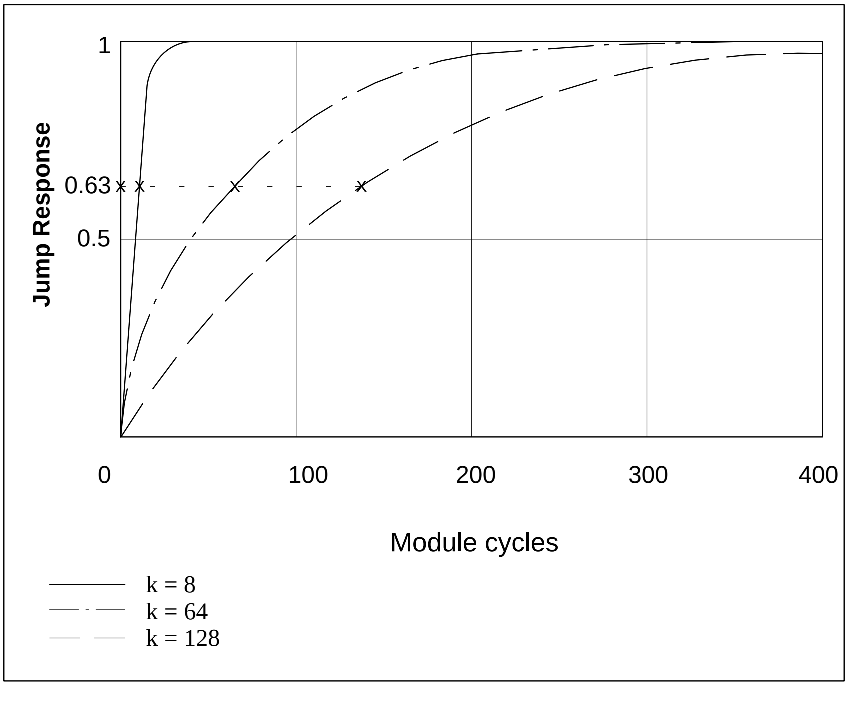


Figure 12-3 Jump response

Technical Data

The technical data of the 2 AI U electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>90 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.7%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation		
Measurement principle	integrative	
Integration and conversion time/ resolution per channel		
• Parameterized	yes	
• Integration time in ms	60	50
• Conversion time in ms	65	55
• Resolution (incl. overrange/ representation in two's complement)		
– S7 format/S5 format		
± 10 V/13 bits		
1...5 V/12 bits		
• Interference voltage suppression for interference frequency f1 in Hz	50	60

Sensor Selection Data	
Input ranges (rated values)/input resistance	± 10 V/100kΩ 1...5 V/100kΩ
Permitted input voltage For voltage input (destruction limit)	max.20 V permanent; 75 V for max. 1 s (pulse duty factor 1:20)
Connection of sensors	
• For voltage measurement	possible
Characteristic curve linearization	no
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering

Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.2 High-Speed Analog Electronic Module 2 AI HS U

Order Number

6ES7 123-1FB50-0AB0

Characteristics

The 2 AI HS U high-speed analog electronic module is an analog input module with the following characteristics:

- 2 inputs for voltage measurement
- Input ranges ± 10 V
- 12-bit resolution
- Isolated from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the two-channel input module.

The circuit shematic is shown on the front elevation of the input module. In its operative state the circuit schematic is covered by the labeling strip.

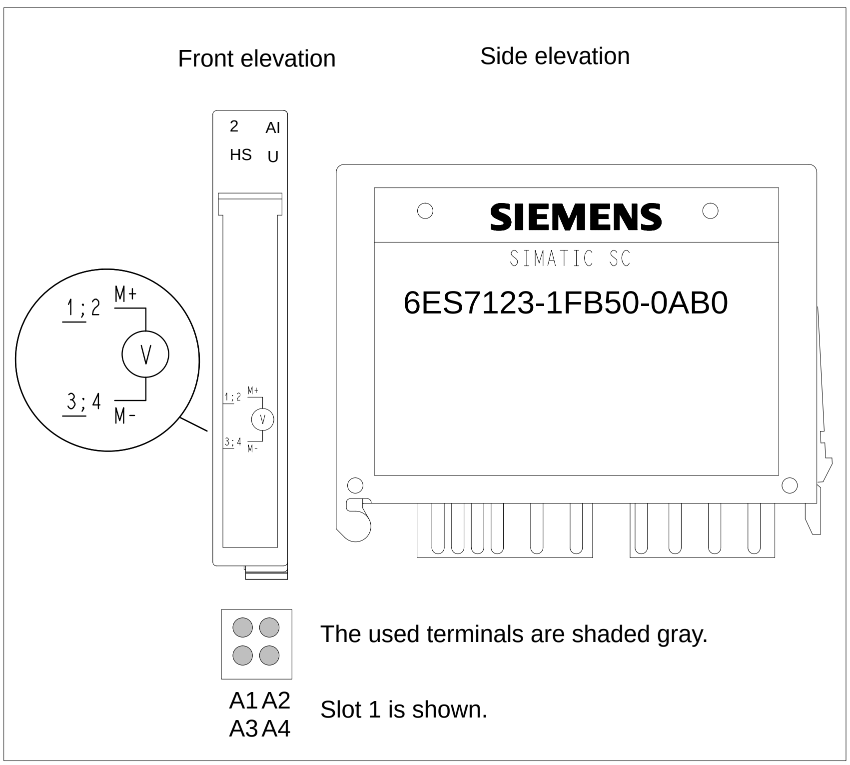


Figure 12-4 Front and Side Elevations of the 2 AI HS U High Speed Analog Electronic Module

Block Diagram

Figure 12-5 shows the block diagram of the 2 AI HS U high speed analog electronic module.

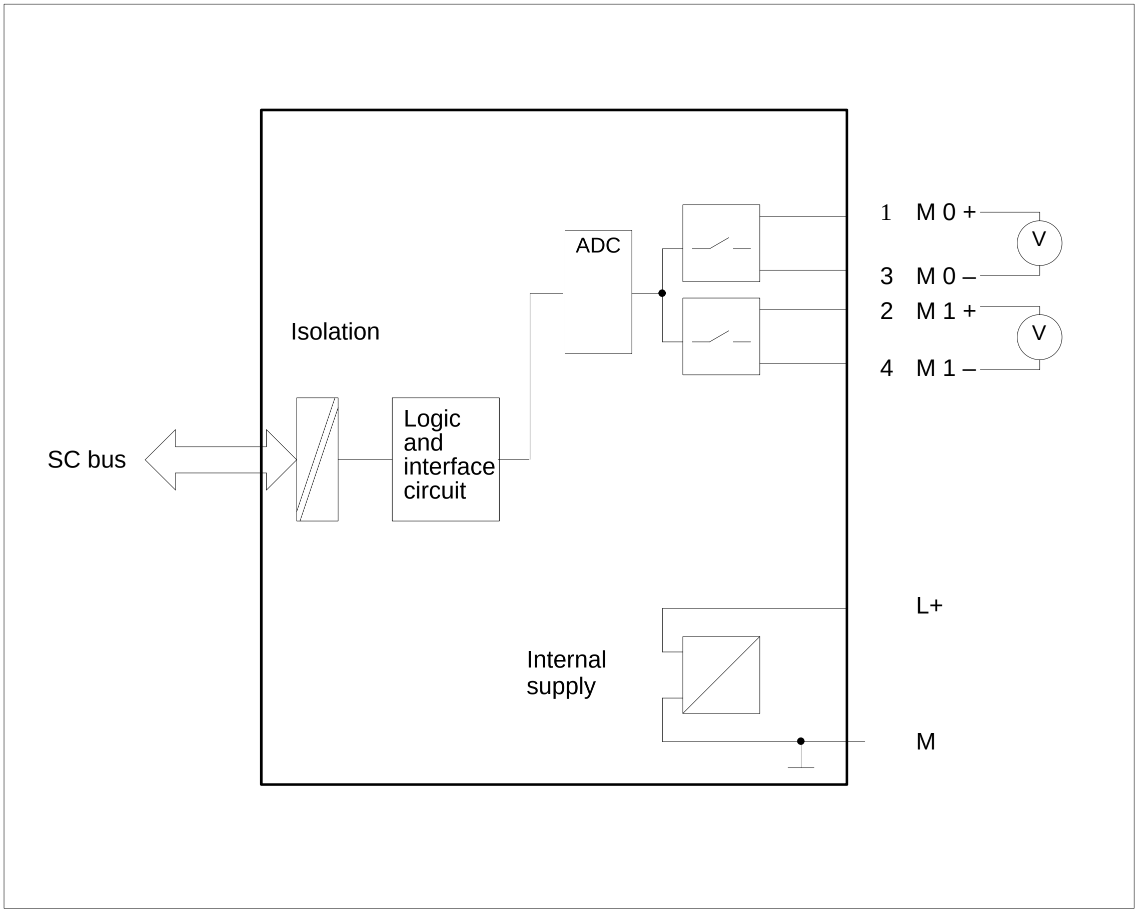


Figure 12-5 Block Diagram of the 2 AI HS U High-Speed Analog Electronic Module

Parameters

The 2 AI HS U electronic module uses the following parameters:

Table 12-2 Static Parameters of the 2 AI HS U HighSpeed Electronic Module

Parameters	Value Range	Default Parameters	Scope
Measurement type	Deactivated Voltage	 Voltage	Channel
Measurement range (voltage)	± 10 V	± 10 V	Channel
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters

If you have not set the parameters of the 2 AI HS U electronic module using the specified software (Chapter 4), the default settings of all parameters apply to both input channels after a restart (see Table 12-2).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\, y_{n-1}}{k}$$

y_n = value passed to the system in the current cycle n

Jump Response

Figure 12-3 shows the jump response for various smoothing factors, depending on the number of module cycles.

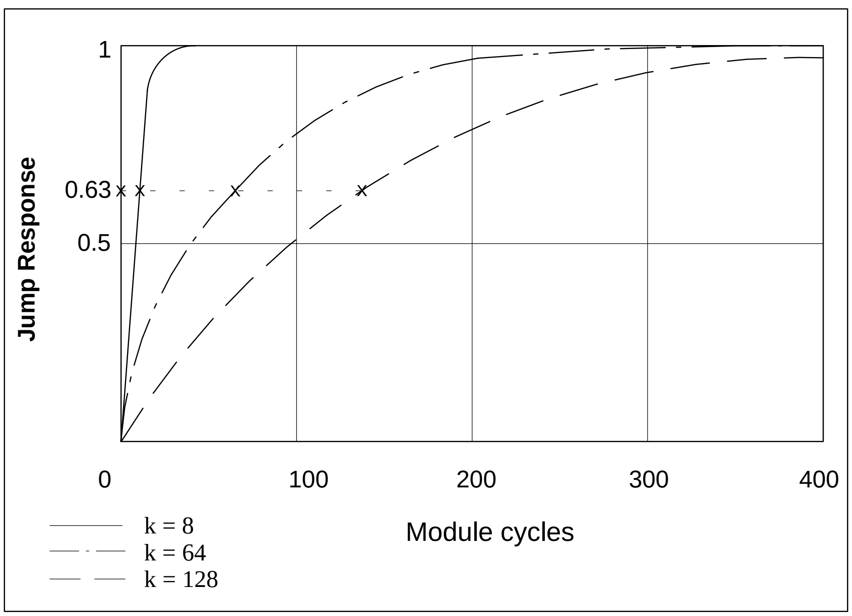


Figure 12-6 Jump response

Technical Data

The technical data of the 2 AI HS U high speed electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16IM-SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>50 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB (with smoothing factor k = 128)
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.7%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation	
Measurement principle	instantaneous value encoding
Conversion time/resolution per channel	
• Parameterized	no
• Time constant of the input filter in µs	300 ± 20 %
• Conversion time in ms	2
• Resolution (incl. overrange/ representation in two's complement)	
– S7 format/S5 format	
± 10 V/12 bits incl. sign	

Sensor Selection Data	
Input ranges (rated values)/input resistance	± 10 V/approx. 100kΩ
Permitted input voltage For voltage input (destruction limit)	max.20 V permanent; 75 V for max. 1 s (pulse duty factor 1:20)
Connection of sensors	
• For voltage measurement	possible
Characteristic curve linearization	no
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.3 Analog Electronic Module 2 AI I (...123-1GB00...)

Order Number

6ES7 123-1GB00-0AB0

Characteristics

The 2 AI I analog electronic module is an analog input module with the following characteristics:

- 2 inputs for current measurement
- Input ranges ± 20 mA and 4...20 mA
- 13/12-bit resolution
- Input range selection
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the two-channel input module.

The circuit shematic is shown on the front elevation of the input module. In its operative state the circuit schematic is covered by the labeling strip.

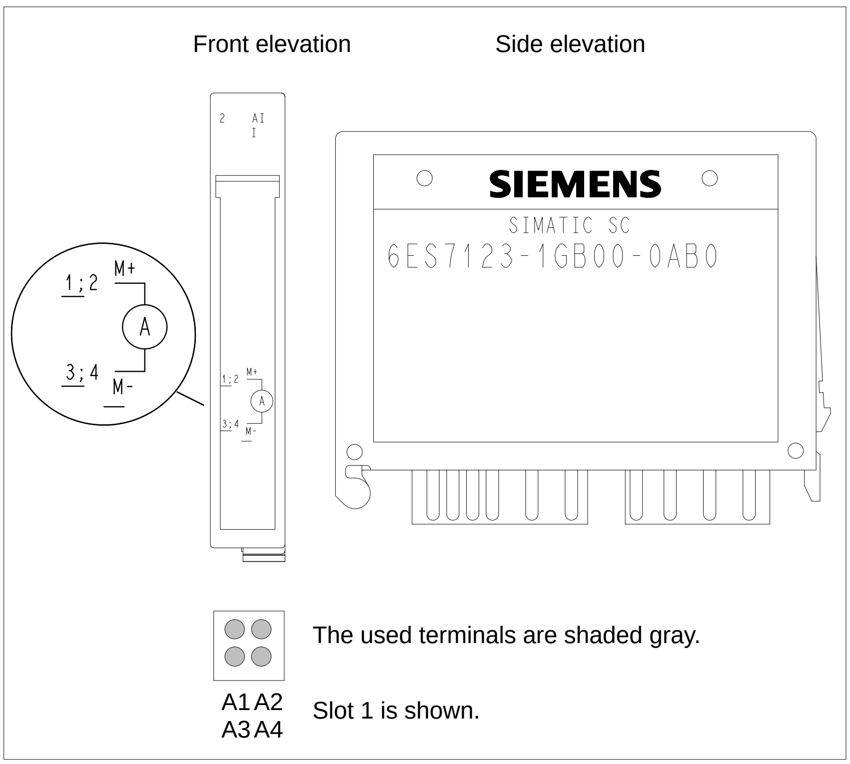


Figure 12-7 Front and Side Elevations of the 2 AI I Analog Electronic Module

Block Diagram

Figure 12-8 shows the block diagram of the 2 AI I analog electronic module.

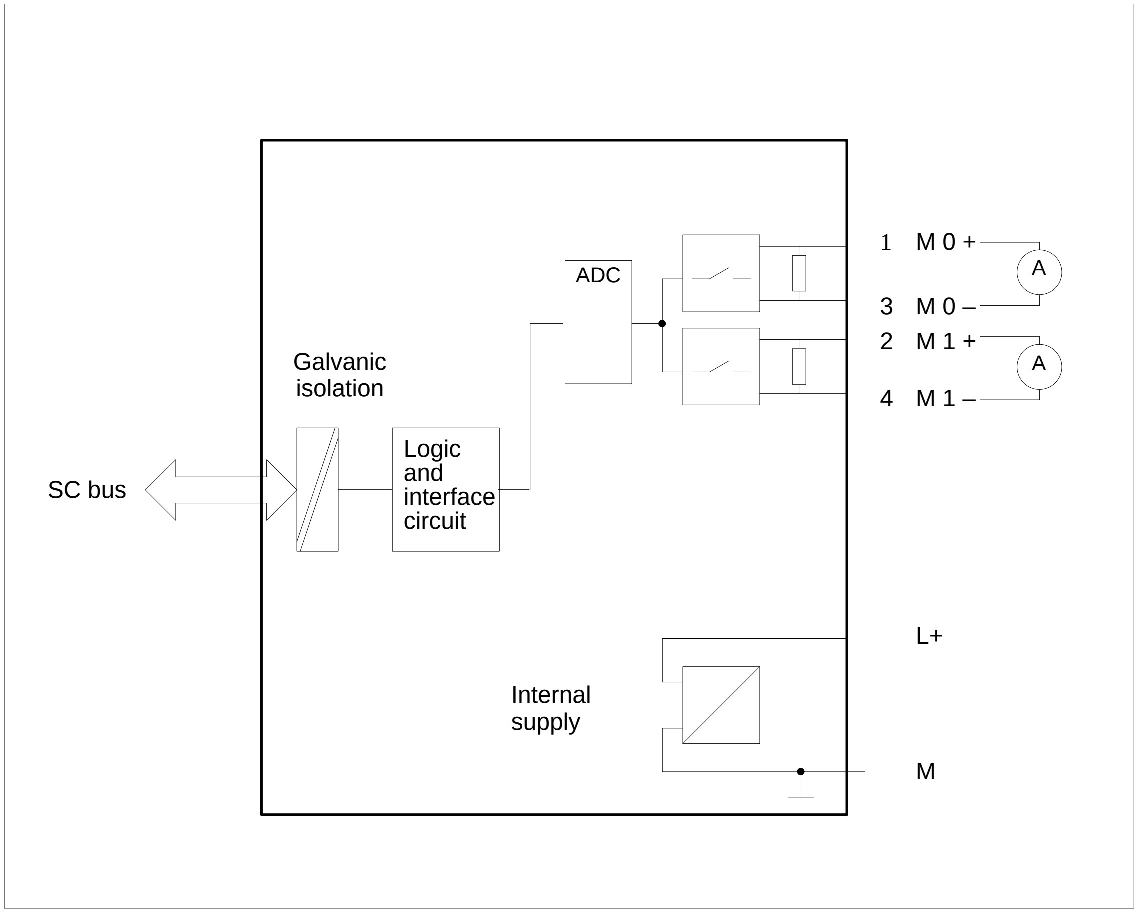


Figure 12-8 Block Diagram of the 2 AI I Analog Electronic Module

Parameters

The 2 AI I electronic module uses the following parameters:

Table 12-3 Static Parameters of the 2 AI I Electronic Module

Parameter	Value Range	Default Parameters	Scope
Measurement type	Deactivated Current (4-wire measuring transducer)	Current (4-wire measuring transducer)	Channel
Measurement range (4-wire measuring transducer)	4...20 mA ± 20 mA	4...20 mA	Channel
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz	Module
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters

If you have not set the parameters of the 2 AI I electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-3).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\, y_{n-1}}{k}$$

y_n = value passed to system in cycle n

Jump Response

Figure 12-9 shows the jump response for various smoothing factors, depending on the number of module cycles.

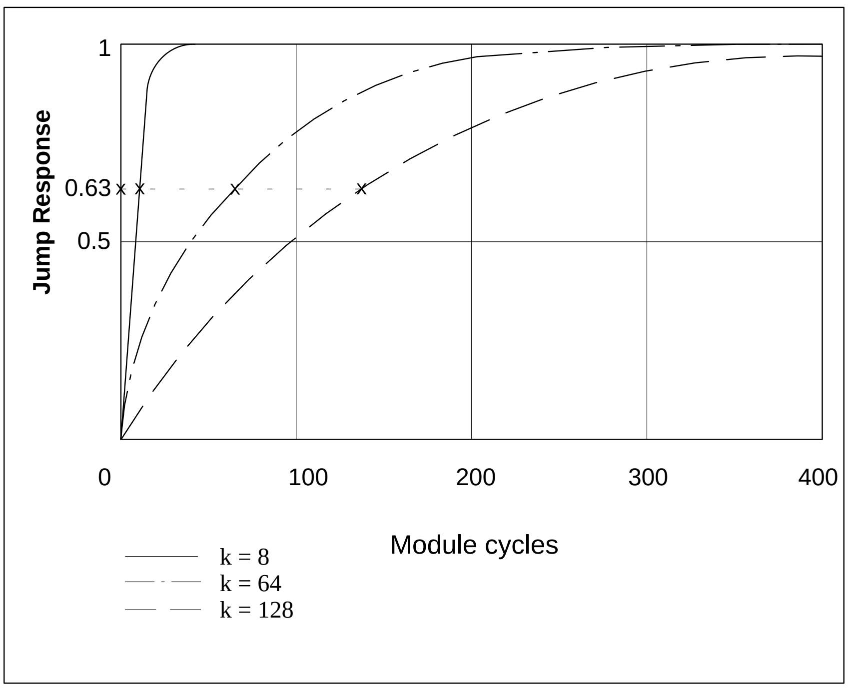


Figure 12-9 Jump Response

Technical Data The technical data of the 2 AI I electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>90 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.8%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation		
Measurement principle	integrative	
Integration and conversion time/ resolution per channel		
• Parameterized	yes	
• Integration time in ms	50	60
• Conversion time in ms	55	65
• Resolution (incl. overrange/ representation in two's complement)		
– ± 20 mA	13 bits	
– 4...20 mA	12 bits	

Sensor Selection Data	
Input ranges (rated values)/input resistance	± 20 mA/50 Ω 4...20 mA/50 Ω
Permissible input current For current input (destruction limit)	40 mA, permanent
Connection of sensors	
• For voltage measurement	
– As 2-wire measuring transducer	possible; with external measuring transducer feed
– As 4-wire measuring transducer	possible
Characteristic curve linearization	no
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.4 Analog Electronic Module 2 AI I (...123-1GB10-...)

Order Number

6ES7 123-1GB10-0AB0

Characteristics

The 2 AI I analog electronic module is an analog input module with the following characteristics:

- 2 inputs for current measurement
- Input ranges ± 20 mA and 4...20 mA
- 13/12-bit resolution
- Basic error ± 0.1 %; operating error ± 0.3 %
- Input range selection
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the two-channel input module.

The circuit shematic is shown on the front elevation of the input module. In its operative state the circuit schematic is covered by the labeling strip.

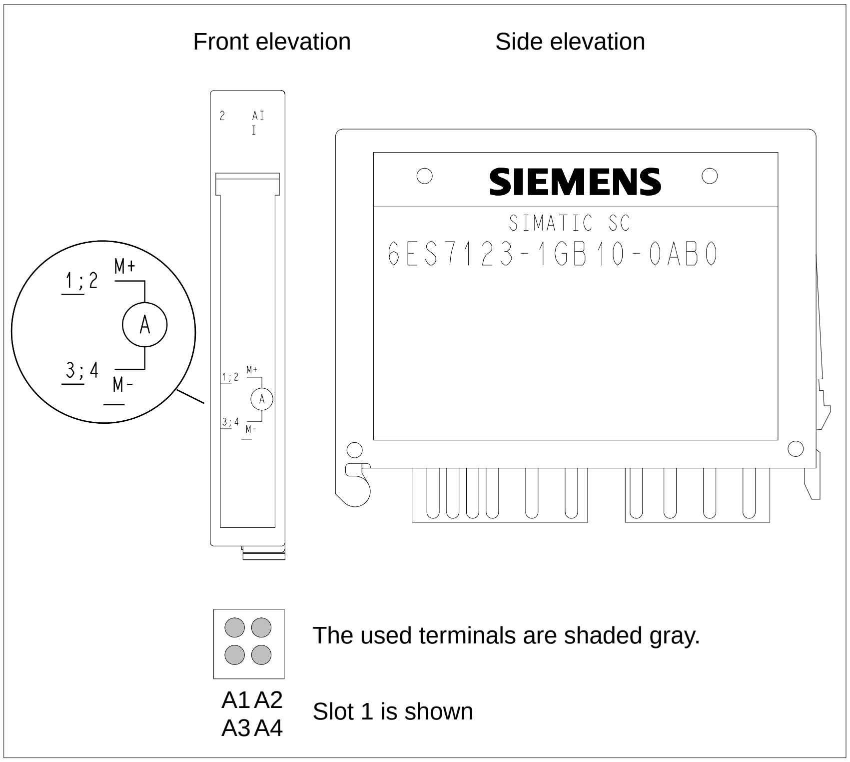


Figure 12-10 Front and Side Elevations of the 2 AI I Analog Electronic Module

Block Diagram

Figure 12-8 shows the block diagram of the 2 AI I analog electronic module.

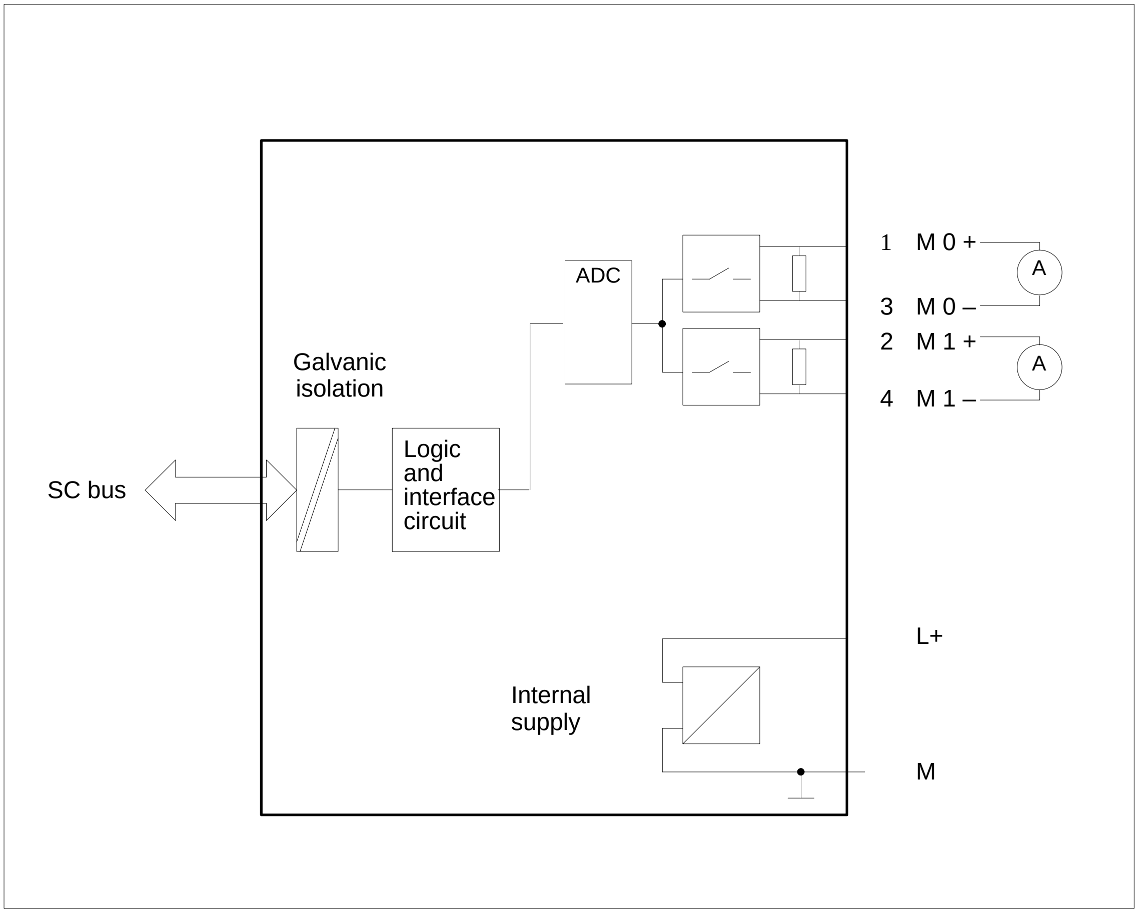


Figure 12-11 Block Diagram of the 2 AI I Analog Electronic Module

Parameters

The 2 AI I electronic module uses the following parameters:

Table 12-4 Static Parameters of the 2 AI I Electronic Module

Parameter	Value Range	Default Parameters	Scope
Measurement type	Deactivated Current (4-wire measuring transducer)	Current (4-wire measuring transducer)	Channel
Measurement range (4-wire measuring transducer)	4...20 mA ± 20 mA	4...20 mA	Channel
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz	Module
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters

If you have not set the parameters of the 2 AI I electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-3).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\,y_{n-1}}{k}$$

y_n = *value passed to system in cycle n*

Jump Response

Figure 12-9 shows the jump response for various smoothing factors, depending on the number of module cycles.

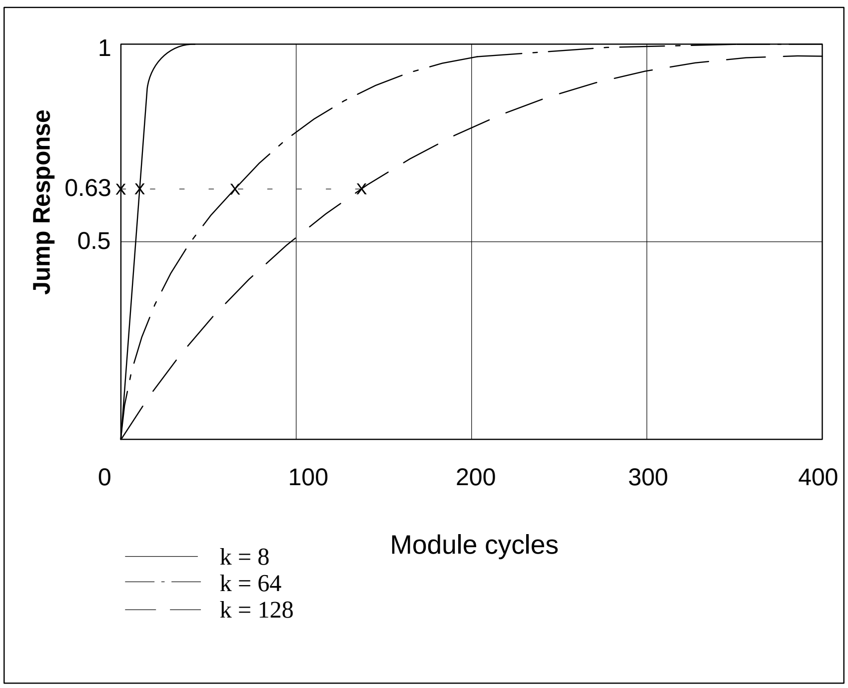


Figure 12-12 Jump Response

Technical Data The technical data of the 2 AI I electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>90 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 0.3%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.1%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.06%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation		
Measurement principle	integrative	
Integration and conversion time/ resolution per channel		
• Parameterized	yes	
• Integration time in ms	50	60
• Conversion time in ms	55	65
• Resolution (incl. overrange/ representation in two's complement)		
– ± 20 mA	13 bits	
– 4...20 mA	12 bits	

Sensor Selection Data	
Input ranges (rated values)/input resistance	± 20 mA/50 Ω 4...20 mA/50 Ω
Permissible input current For current input (destruction limit)	40 mA, permanent
Connection of sensors	
• For voltage measurement	
– As 2-wire measuring transducer	possible; with external measuring transducer feed
– As 4-wire measuring transducer	possible
Characteristic curve linearization	no
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.5 High-Speed Analog Electronic Module 2 AI HS I (0/4-20 mA, 4-Wire Measuring Transducer)

Order Number

6ES7 123-1GB60-0AB0

Characteristics

The 2 AI HS I high-speed analog electronic module is an analog input module with the following characteristics:

- 2 inputs for current measurement
- Input ranges 0/4...20 mA
- 12 bit resolution
- Input range selection
- Isolation from the SC bus
- Permissible common-mode voltage AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the two-channel input module.

The circuit shematic is shown on the front elevation of the input module. In its operative state the circuit schematic is covered by the labeling strip.

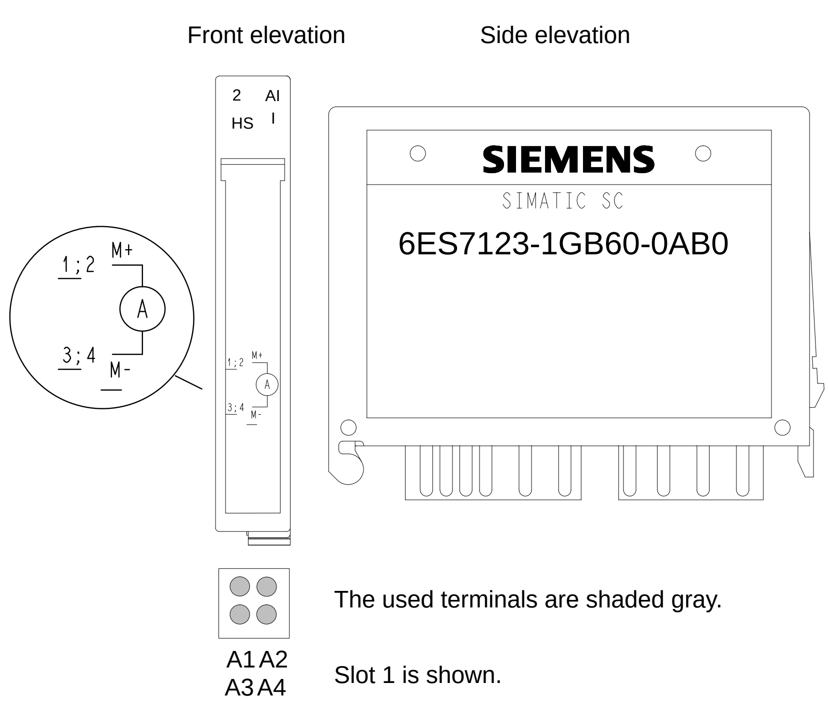


Figure 12-13 Front and Side Elevations of the 2 AI HS I High-Speed Analog Electronic Module (0/4–20mA, 4-Wire Measuring Transducer)

Block Diagram

Figure 12-14 shows the block diagram of the 2 AI HS I high-speed analog electronic module (0/4–20mA, 4-wire measuring transducer).

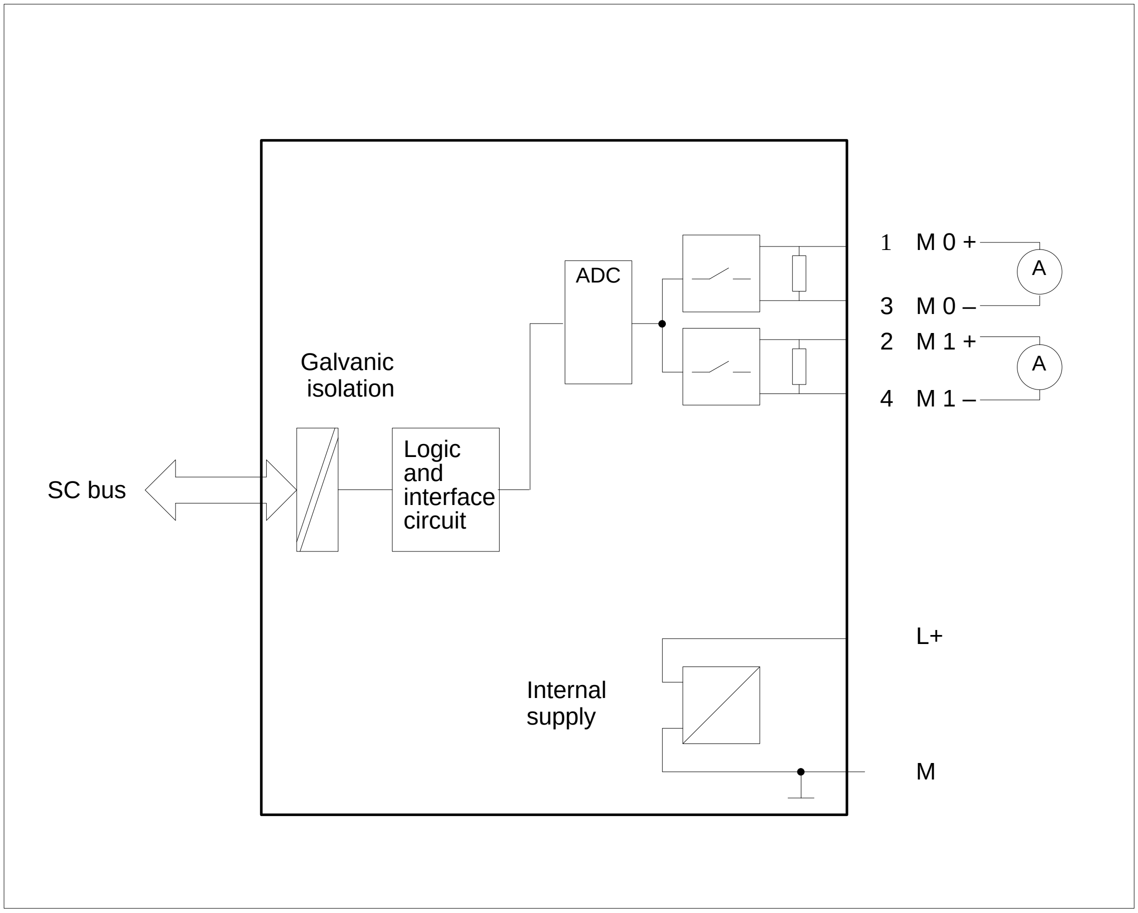


Figure 12-14 Block Diagram of the 2 AI HS I High-Speed Analog Electronic Module (0/4–20mA, 4-Wire Measuring Transducer)

Note

The current limitation applies to both measuring transducers of the 2 AI HS I analog electronic module.

If a short circuit occurs at one measuring transducer and thus activates current limitation, the second measuring transducer does not indicate a valid value.

Parameters

The 2 AI HS I electronic module uses the following parameters:

Table 12-5 Static Parameters of the 2 AI HS I Electronic Module

Parameter	Value Range	Default Parameters	Scope
Measurement type	Deactivated Current (4-wire measuring transducer)	Current (4-wire measuring transducer)	Channel
Measurement range (4-wire measuring transducer)	4...20 mA ± 20 mA	4...20 mA	Channel
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters

If you have not set the parameters of the 2 AI HS I electronic module using the specified software (see Chapter 4), the default settings of all parameters apply to both input channels after a restart (see Table 12-3).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\, y_{n-1}}{k}$$

y_n = value passed to system in current cycle n

Jump Response

Figure 12-9 shows the jump response for various smoothing factors, depending on the number of module cycles.

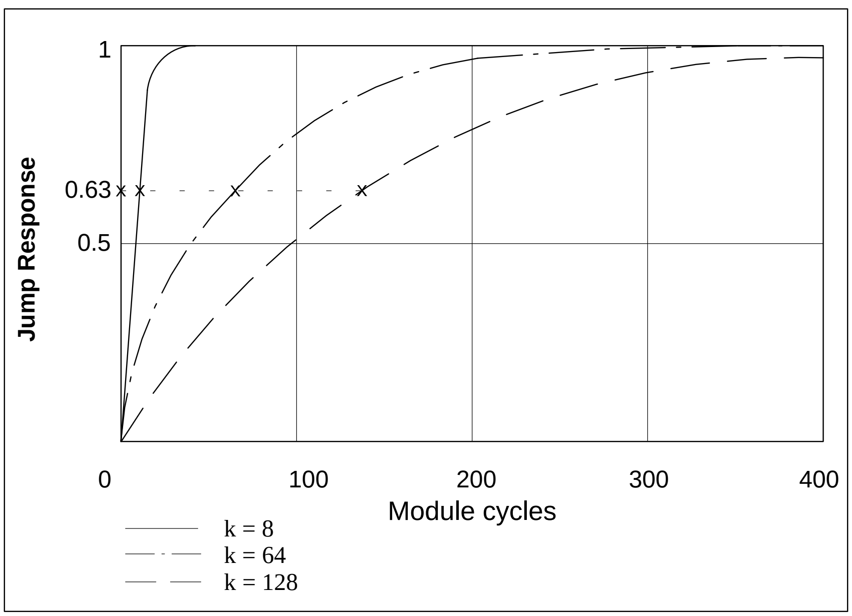


Figure 12-15   Jump Response

Technical Data The technical data of the 2 AI HS I electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16IM-SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>50 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB (with smoothing factor k = 128)
Crosstalk between inputs	
• at 50 Hz/60 Hz	> 50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.7%
Temperature error (relative to rated input)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation	
Measurement principle	Instantaneous value encoding
Conversion time/resolution per channel	
• Parameterized	no
• Time constant of the input filter	typ. 1 ms
• Conversion time in ms	1
• Resolution (incl. overrange/ representation in two's complement)	
– ± 20 mA	12 bits incl. sign
– 4...20 mA	11 bits

Sensor Selection Data		
Input ranges (rated values)/input resistance		± 20 mA/approx. 50 Ω 4...20 mA/approx. 50 Ω
Permitted input current For current input (destruction limit)		35 mA, permanent; 150mA for max. 1s; (pulse duty factor 1:20)
Connection of sensors		
• For current measurement		
– As 4-wire measuring transducer		possible
Characteristic curve linearization		no
Temperature compensation		no
Smoothing of measured values		yes; set by parameters in 4 steps by digital filtering
	Step	Time constant
	None	1x cycle time
	Weak	8x cycle time
	Medium	64x cycle time
	Strong	128x cycle time

12.6 High-Speed Analog Electronic Module 2 AI HS I (4–20 mA, 2-Wire Measuring Transducer)

Order Number

6ES7 123-1GB50-0AB0

Characteristics

The 2 AI HS I high-speed analog electronic module is an analog input module with the following characteristics:

- 2 inputs for current measurement
- Input ranges 4...20 mA
- 12 bit resolution
- Short circuit-proof supply of the measuring transducers
- Isolation from the SC bus
- Common-mode voltage irrelevant

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the two-channel input module.

The circuit shematic is shown on the front elevation of the input module. In its operative state the circuit schematic is covered by the labeling strip.

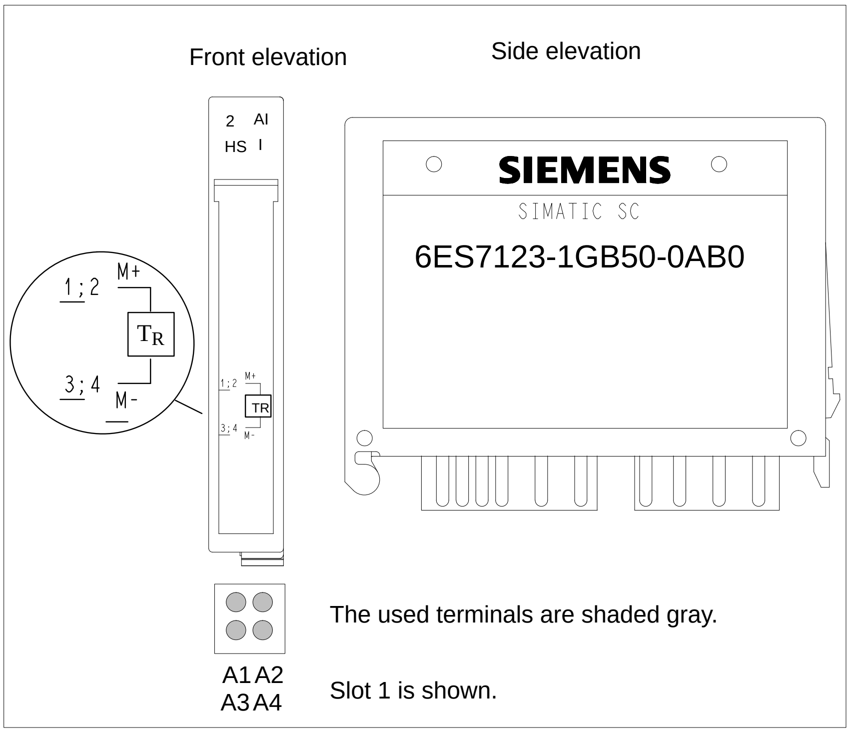


Figure 12-16 Front and Side Elevations of the 2 AI HS I High-Speed Analog Electronic Module (4–20mA, 2-Wire Measuring Transducer)

Block Diagram

Figure 12-17 shows the block diagram of the 2 AI HS I high-speed analog electronic module (4–20mA, 2-wire measuring transducer).

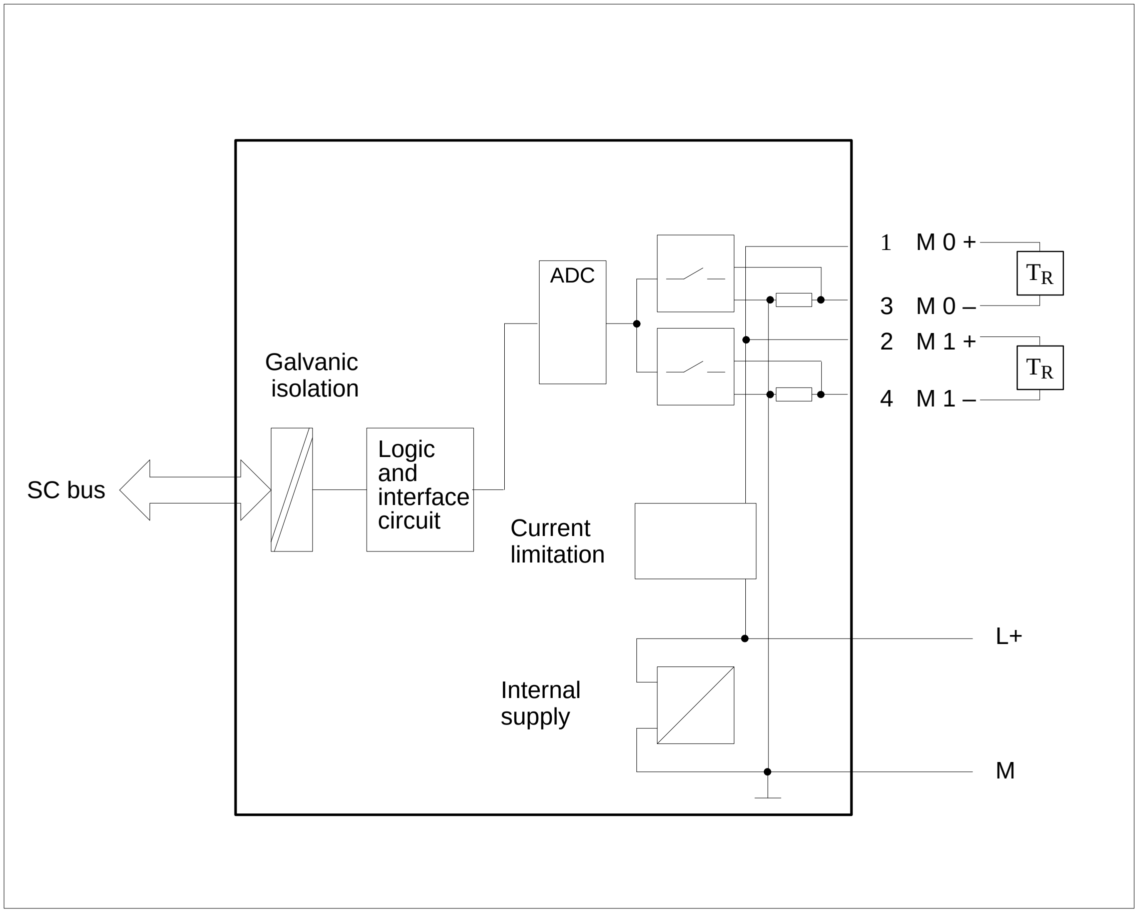


Figure 12-17 Block Diagram of the 2 AI HS I High-Speed Analog Electronic Module (4–20mA, 2-Wire Measuring Transducer)

Parameters

The 2 AI HS I high-speed electronic module (4–20mA, 2-wire measuring transducer) uses the following parameters:

Table 12-6 Static Parameters of the 2 AI HS I Electronic Module (4–20mA, 2-Wire Measuring Transducer)

Parameter	Value Range	Default Parameters	Scope
Measurement type	Deactivated Current (2-wire measuring transducer)	 Current (2-wire measuring transducer)	Channel
Measurement range (4-wire measuring transducer)	4...20 mA	4...20 mA	Channel
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Defaultparameter

If you have not set the parameters of the 2 AI HS I high-speed electronic module (4–20mA, 2-wire measuring transducer) using the specified software (see Chapter 4), the default settings for all parameters apply to both input channels after a restart (see Table 12-6).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\,y_{n-1}}{k}$$

y_n = value passed to the system in the current cycle n

Jump Response

Figure 12-18 shows the jump response for various smoothing factors, depending on the number of module cycles.

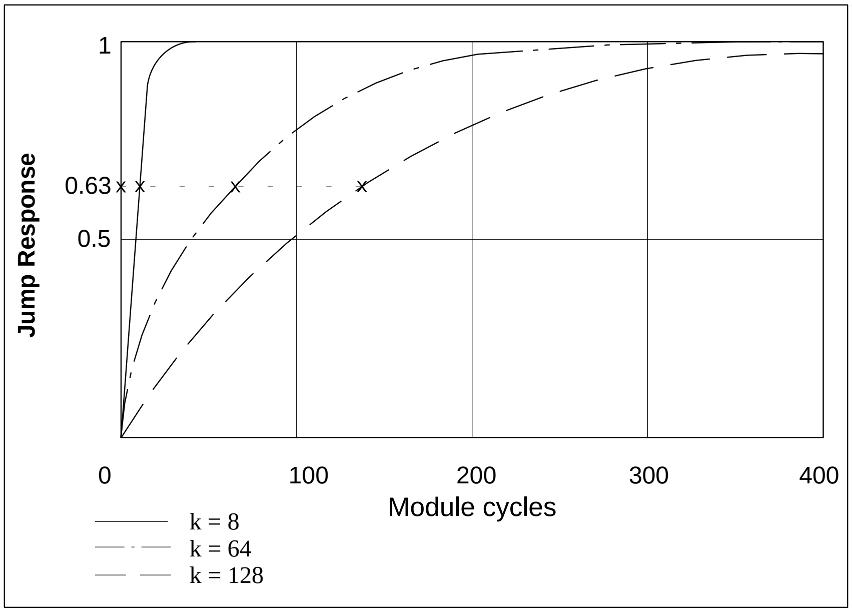


Figure 12-18   Jump response

Technical Data

The technical data of the 2 AI HS I high-speed electronic module (4–20mA, 2-wire measuring transducer) is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16IM-SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W
Sustained short-circuit current from M0+/ M1+ against M	to 100mA

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>50 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB (with smoothing factor k = 128)
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1,0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.7%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation	
Measurement principle	instantaneous value encoding
Conversion time/resolution per channel	
• Parameterized	no
• Time constant of the input filter	typ. 1 ms
• Conversion time in ms	1
• Resolution (incl. overrange/ representation in two's complement)	
– 4...20 mA	12 bits

Sensor Selection Data	
Input ranges (rated values)/input resistance	4...20 mA/approx. 50 Ω
Permitted input current For current input (destruction limit)	35 mA, permanent; 150mA for max. 1s; (pulse duty factor 1:20)
Connection of sensors	
• For current measurement	
– As 2-wire measuring transducer	possible
– Load of the 2-wire measuring transducer	up to 750 Ω
Characteristic curve linearization	no
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.7 Analog Electronic Module 2 AI TC

Order Number

6ES7 123-1JB00-0AB0

Characteristics

The 2 AI TC analog electronic module is an analog input module with the following characteristics:

- 2 inputs for thermocouples or voltage measurement
- Input ranges for thermocouples of type R, J or K or voltage measurement ± 80 mV
- 0.1°C/digit or 14-bit resolution
- Input range selection
- Linearization of sensor characteristic curves
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the input module.

The block diagram is shown on the front of the input module. In the operating state, the block diagram is covered by the labeling strip.

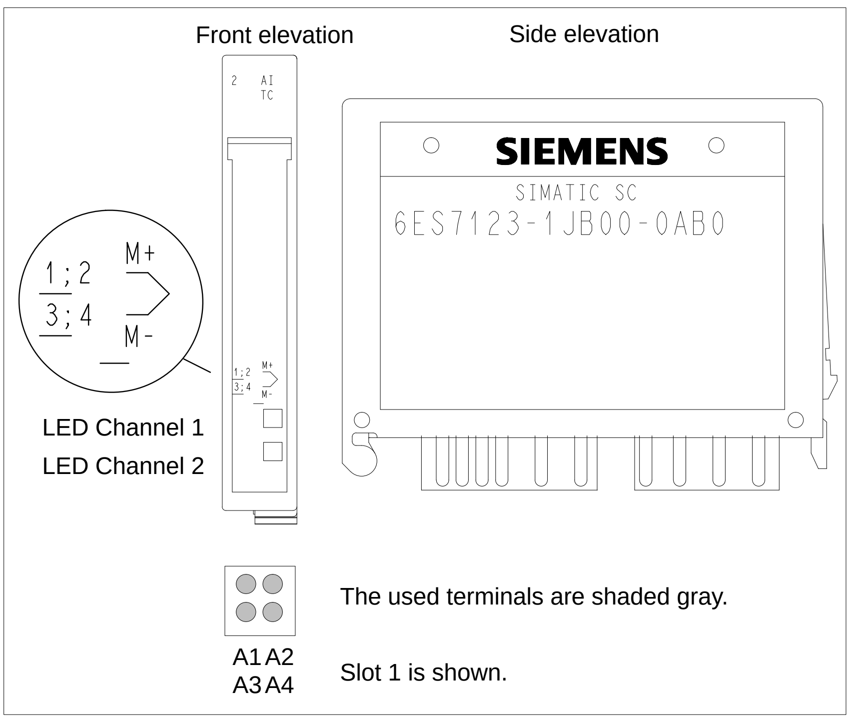


Figure 12-19 Front and Side Elevations of the 2 AI TC Analog Electronic Module

Block Diagram

Figure 12-20 shows the block diagram of the 2 AI TC analog electronic module

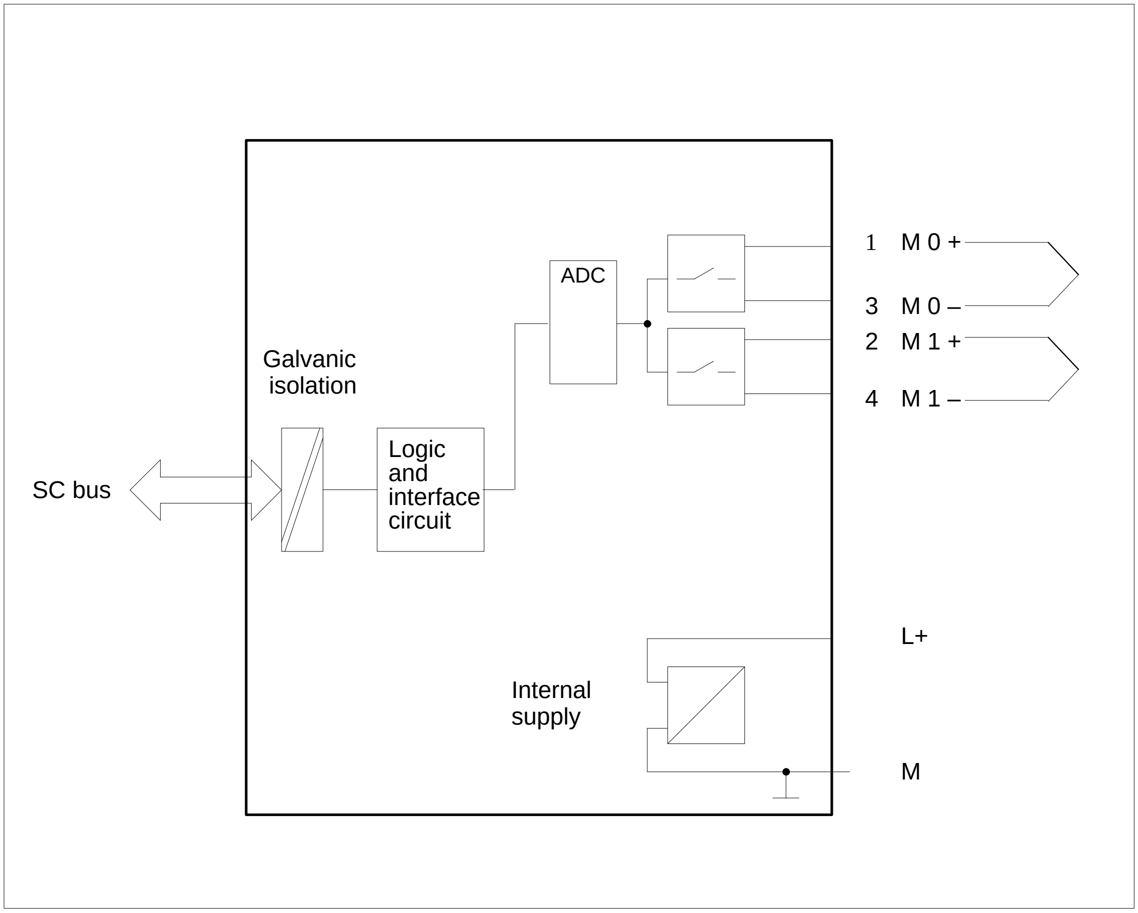


Figure 12-20 Block Diagram of the 2 AI TC Analog Electronic Module

Parameters The 2 AI TC electronic module uses the following parameters:

Table 12-7 Static Parameters of the 2 AI TC Electronic Module

Parameter	Value Range	Default Parameters	Wirkungsbereich
Measurement type	Deactivated Voltage	 Voltage	Channel
Measurement range (voltage)	± 80 mV	± 80 mV	Channel
Thermocouple with linearization	Type R Type J Type K	Type K	Channel
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz	Module
Smoothing	None Weak Medium Strong	None	Channel
Reference junction	None Dynamic reference temperature on the AI RTD electronic module at slot A Dynamic reference temperature		Module
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Module

Table 12-8 Dynamic Parameters of the 2 AI TC Electronic Module

Parameter	SIMATIC S7 Value Range	SIMATIC S5 Value Range
Reference temperature in 0.01 °C	In 0.01°C – 14500... + 15500	In 0.05°C – 2900... + 3100*

*The following applies to the SIMATIC S5 value range:

Bit	15	14					8	7	6	5	4	3	2	1	0
	Reference temperature												0	0	0

Default Parameters If you have not set the parameters of the 2 AI TC electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-7).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\, y_{n-1}}{k}$$

y_n = value passed to system in cycle n

Jump Response

Figure 12-21 shows the jump response for various smoothing factors, depending on the number of module cycles.

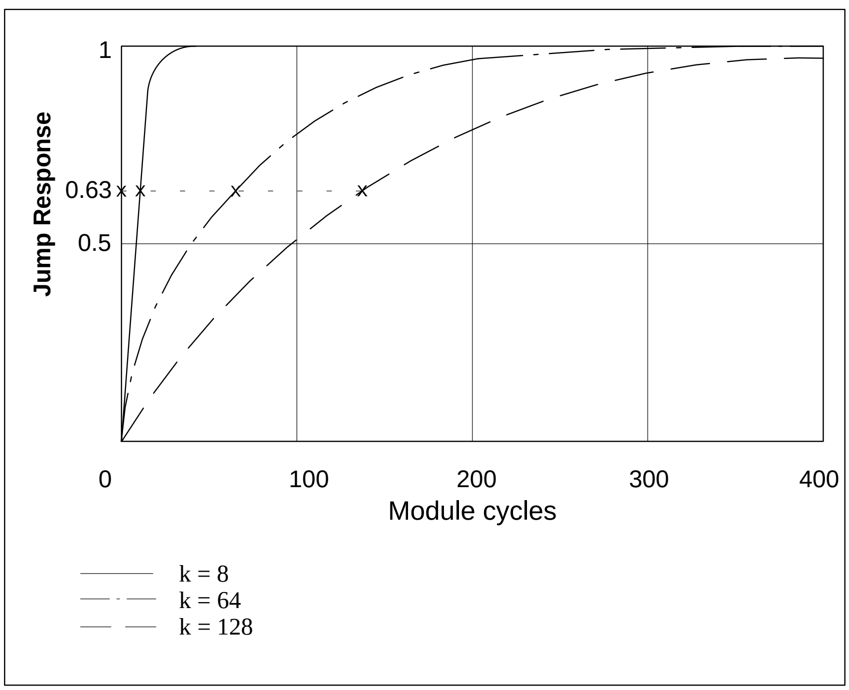


Figure 12-21 Jump Response

Technical Data The technical data of the 2 AI TC electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Number of inputs	2
Line length	
• Shielded	max. 50 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between channels	no
Permissible potential difference	
• Between inputs and ground (V_{CM})	DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error	
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)	
• Common-mode interference	>90 dB
• Series-mode interference (peak value of interference < rated value of input range)	>70 dB
Crosstalk between inputs	
• at 50 Hz/60 Hz	>50 dB
Operational limit (in entire temperature range, relative to rated input range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated input range)	± 0.8%
Temperature error (relative to rated input range)	± 0.01%/K
Linearity error (relative to rated input range)	± 0.05%
Repeatability in settled state at 25°C, (relative to rated input range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
Diagnostic functions	
• Fault display on module	no
• Readable diagnostic function	no

Analog value formation		
Measurement principle	integrative	
Integration and conversion time/resolution per channel		
• Parameterized	yes	
• Integration time in ms	50	60
• Conversion time in ms	55	65
Resolution (incl. overrange/representation in two's complement)		
	S7 format	
±80mV	14 bit	
Type J	0.1°C/digit	
Type K	0.1°C/digit	
Type R	0.1°C/digit	
	S5 format	
±80mV	13 bit	
Type J	1°C/digit	
Type K	1°C/digit	
Type R	1°C/digit	
• Interference voltage suppression for interference frequency f1 in Hz	50	60

Sensor Selection Data	
Input ranges (rated values)/input resistance	± 80 mV/>1MΩ Type J/1200°C/>1MΩ Type K/1372°C/> 1 MΩ Type R/1769°C/> 1 MΩ
Permitted input voltage for voltage input (destruction limit)	max.10 V permanent; 25 V for max. 1 s (pulse duty factor 1:20)
Connection of sensors	
• For voltage measurement	possible
Characteristic curve linearization	yes; parameterized Type J, K, R to IEC 584
Temperature compensation	yes; parameterized
• Internal temperature compensation	not possible
• External temperature compensation by means of a compensating box looped into the measuring circuit	possible; one compensating box per channel
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.8 Analog Electronic Module 1 AI RTD

Order Number

6ES7 123-1JA00-0AB0

Characteristics

The 1 AI RTD analog electronic module is an analog input module with the following characteristics:

- 1 input for a resistance thermometer or resistance measurement
- 0.01°C/digit or 14-bit resolution
- Input ranges for the Pt100 climatic range, Pt100 standard range, Ni100 standard range or 0... 600 Ω
- Input range selection
- Linearization of sensor characteristic curves
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the input module.

The block diagram is shown on the front of the input module. In the operating state, the block diagram is covered by the labeling strip.

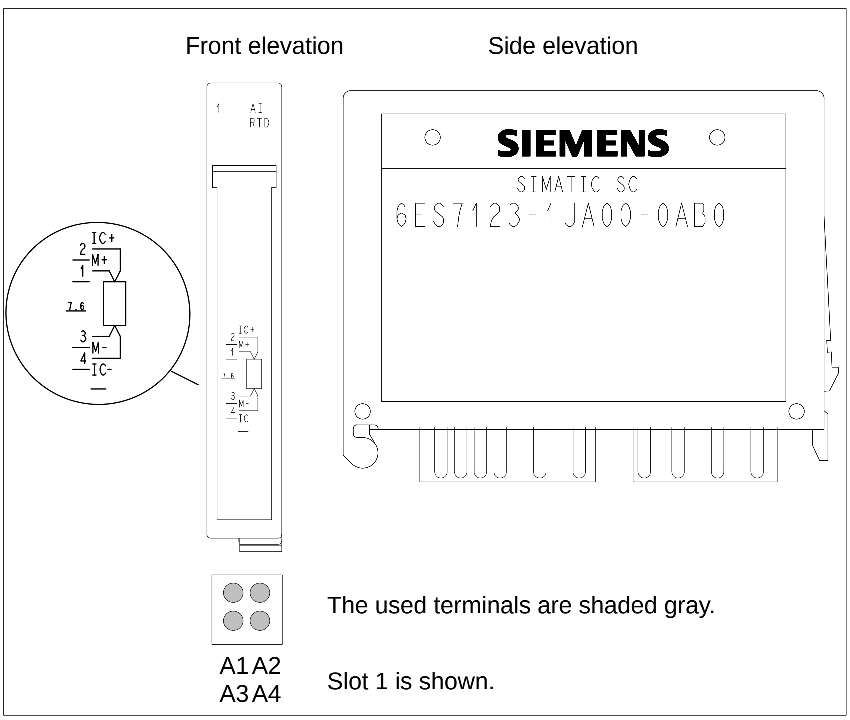


Figure 12-22 Front and Side Elevations of the 1 AI RTD Analog Electronic Module

Block Diagram

Figure 12-23 shows the block diagram of the 1 AI RTD analog electronic module

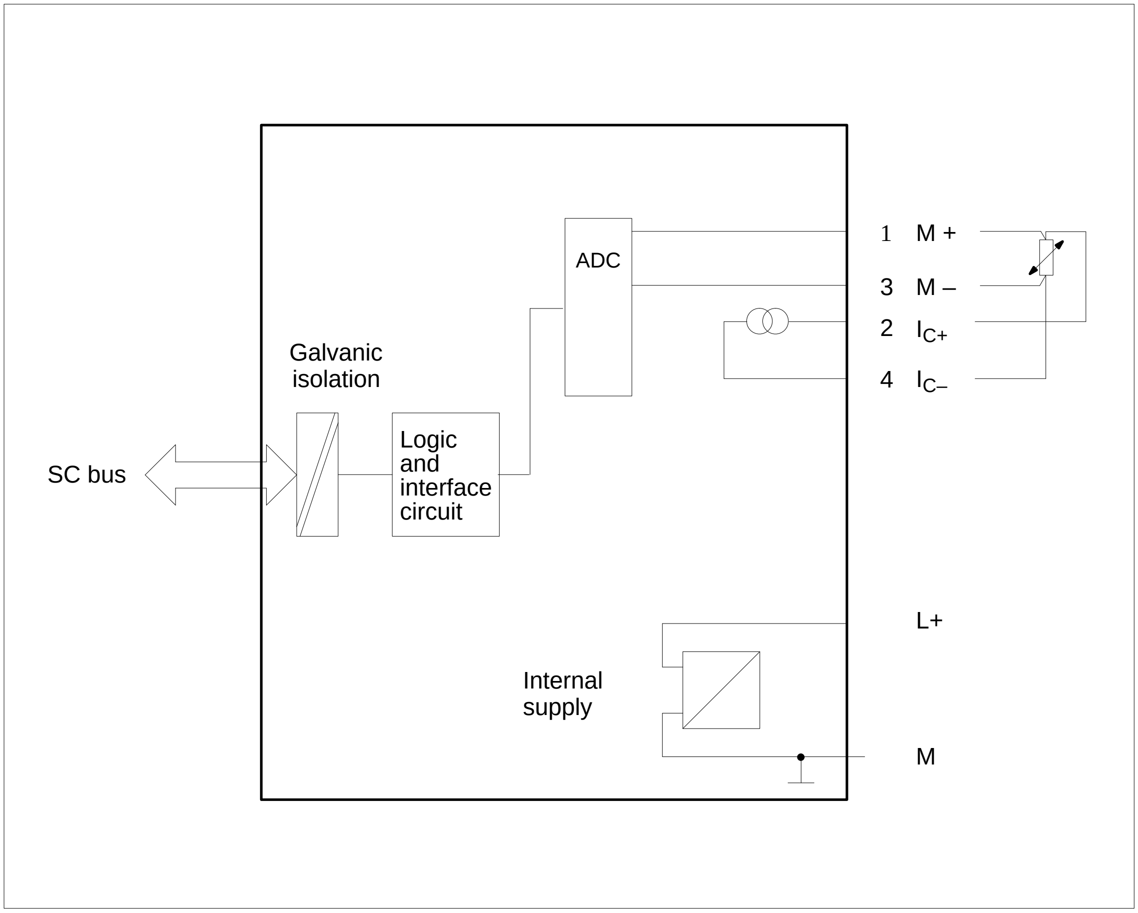


Figure 12-23 Block Diagram of the 1 AI RTD Analog Electronic Module

Parameters The 1 AI RTD electronic module uses the following parameters:

Table 12-9 Static Parameters of the 2 AI RTD Electronic Module

Parameter	Value Range	Default Parameters	Scope
Measurement type	Deactivated Resistance 0...600 Ω Temperature measurement with thermal resistance	Resistance 0...600 Ω	Channel
Measurement range • Resistance measurement with 4-conductor connection • Temperature measurement with thermal resistance	Resistance 0...600 Ω Pt100 climatic range Pt100 standard range Ni100 standard range	Pt100 standard range	Channel
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz	Channel
Smoothing	None Weak Medium Strong	None	Channel
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7	Channel

Default Parameters If you have not set the parameters of the 1 AI RTD electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-9).

Time Response of the Digital First-Order Low-Pass Filter

The smoothing is adjustable in 4 steps. Smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter.

Smoothing factor: k:

None	1
Weak	8
Medium	64
Strong	128

Calculation of the Time Response

You can calculate the time response for any jump of the input value x and the smoothing factor k by using the following formula:

$$y_n := \frac{x_n + (k-1)\, y_{n-1}}{k}$$

y_n = value passed to system in cycle n

Jump Response

Figure 12-24 shows the jump response for various smoothing factors, depending on the number of module cycles.

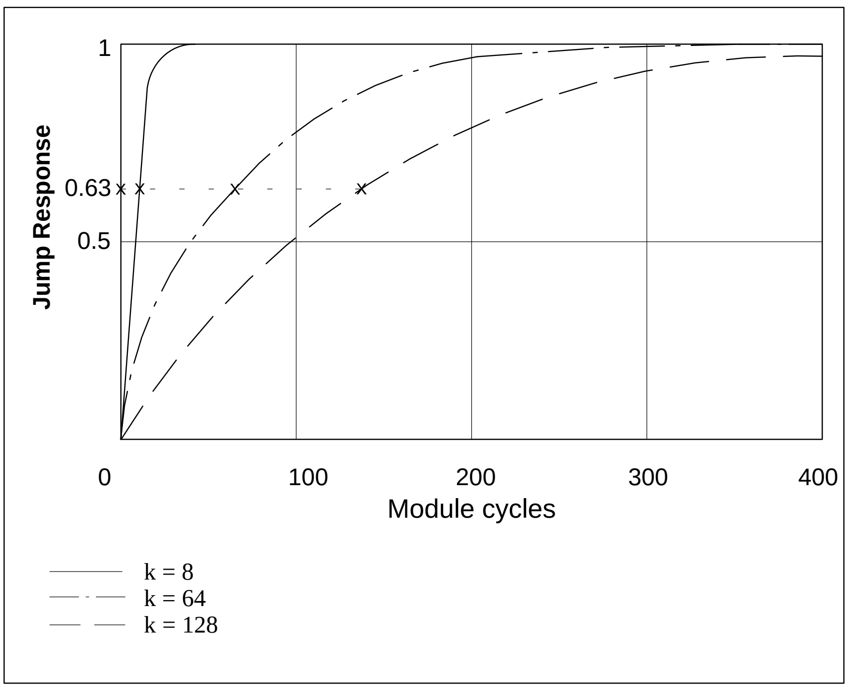


Figure 12-24 Jump Response

Technical Data The technical data of the 1 AI RTD electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	approx. 20 g
Module-Specific Data	
Baud rate of the SC bus	9.6 KBaud
Number of inputs	1
Line length	
• Shielded	max. 50 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channels and SC bus	no
• Between channels and power supply of electronics	no
• Between measurement and current channels	no
Permissible potential difference	
• Between input and ground (V_{CM})	DC 2 V/AC 2 V_{SS}
Constant current for resistance sensor	approx. 1.5 mA
Power input	
• From supply voltage L+	max. 30 mA
Power loss of the module	typ. 0.6 W

Interference Suppression, Limits of Error		
Interference voltage suppression for f=n x (f1 ± 1%) (f1=interference frequency; n=1,2...)		
• Common-mode interference		>90 dB
• Series-mode interference (peak value of interference < rated value of input range)		>70 dB
Crosstalk between inputs		
• at 50 Hz/60 Hz		>50 dB
Operational limit (in entire temperature range, relative to rated input range)		
	0...600Ω	± 1.0%
	Pt100 (climatic)	4 °C
	Pt100 (standard)	8 °C
	Ni100 (standard)	4 °C
Basic error limit (operational limit at 25°C, relative to rated input range)		
	0...600Ω	0.7 %
	Pt100 (climatic)	1 °C
	Pt100 (standard)	4 °C
	Ni100 (standard)	2 °C
Temperature error (relative to rated input range)		± 0.03%/K
Linearity error (relative to rated input range)		± 0.05%
after a restart (see Table in settled state at 25°C, (relative to rated input range)		± 0.1%
Statuses, Interrupts, Diagnostics		
Interrupts		none
Diagnostic functions		
• Fault display on module		no
• Readable diagnostic function		no

Analog value formation		
Measurement principle	integrative	
Integration and conversion time/ resolution per channel		
• Parameterized	yes	
• Integration time in ms	50	60
• Conversion time in ms	110	130
• Cycle time in ms	110	130
Resolution (incl. overrange/representation in two's complement)		
	S7 format	
0...600 Ω		14 bits
Pt100 climatic		0.1°C/digit
Pt100 standard		0.1°C/digit
Ni100 standard		0.1°C/digit
	S5 format	
0...600 Ω		13 bits
Pt100 climatic		0.05°C/digit
Pt100 standard		0.5°C/digit
Ni100 standard		0.5°C/digit
• Interference voltage suppression for interference frequency f1 in Hz	50	60

Sensor Selection Data	
Input ranges (rated values)/input resistance	0...600 Ω / >1 MΩ
	Pt100 (climatic; -120...+130 °C) / >1 MΩ
	Pt100 (standard; -200...+850 °C) / >1 MΩ
	Ni100 (standard; -60...+250 °C) / >1 MΩ
Permitted input voltage for resistance measurement input and constant current inputs/outputs (destruction limit)	max.10 V permanent; 25 V for max. 1 s (pulse duty factor 1:20)
Connection of sensors	
• For resistance measurement with	
– 4-conductor connection	yes; with compensation of the line resistances
Characteristic curve linearization	yes; parameterized
– For Pt100 to DIN IEC 751	
– For Ni100 to DIN 43760	
Temperature compensation	no
Smoothing of measured values	yes; set by parameters in 4 steps by digital filtering
Step	Time constant
None	1x cycle time
Weak	8x cycle time
Medium	64x cycle time
Strong	128x cycle time

12.9 Analog Electronic Module 1 AO U

Order Number

6ES7 124-1FA00-0AB0

Characteristics

The 1 AO U analog electronic module is an analog output module with the following characteristics:

- 1 voltage output
- Output ranges ± 10 V and 1...5 V
- 12/11-bit resolution
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the output module.

The block diagram is shown on the front of the output module. In the operating state, the block diagram is covered by the labeling strip.

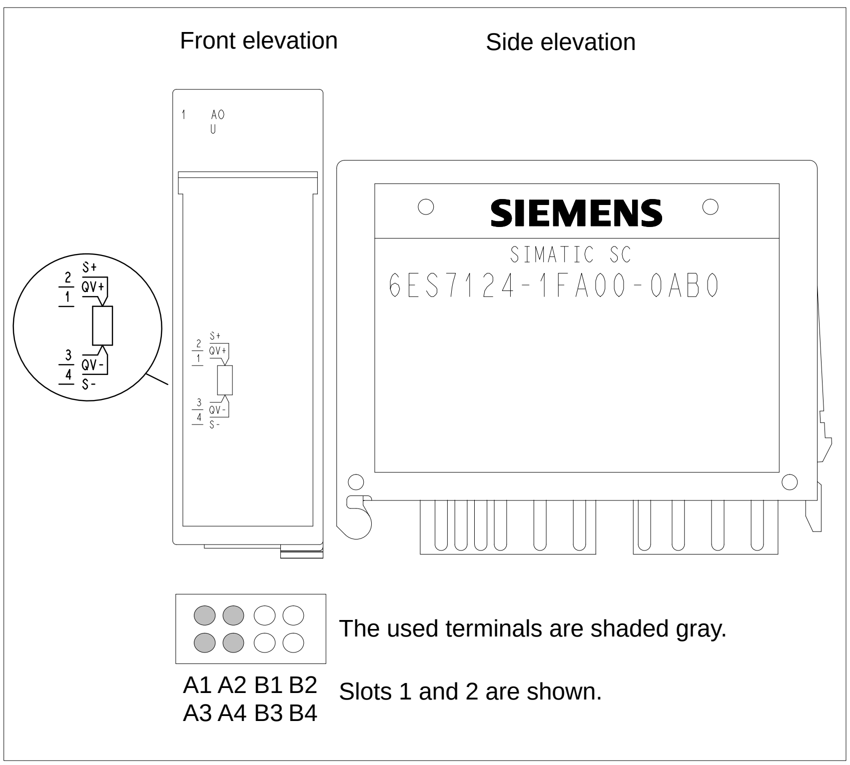


Figure 12-25 Front and Side Elevations of the 1 AO U Analog Electronic Module

Block Diagram

Figure 12-26 shows the block diagram of the 1 AO U analog electronic module

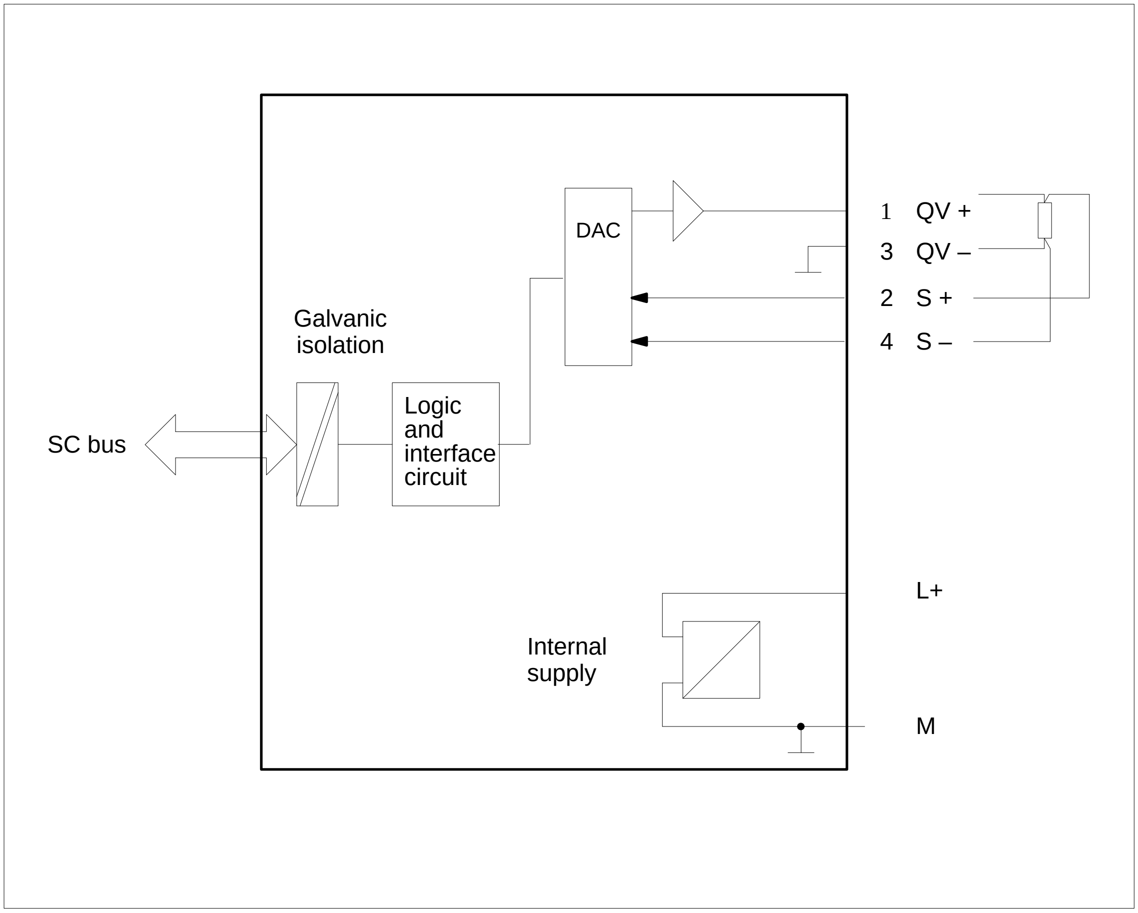


Figure 12-26 Block Diagram of the 1 AO U Analog Electronic Module

Parameters The 1 AO U electronic module uses the following parameters:

Table 12-10 Static Parameters of the 1 AO U Electronic Module

Parameter	Value Range	Default Parameters
Measurement type	Deactivated Voltage	 Voltage
Output range (voltage)	± 10 V 1 ... 5 V	± 10 V
Interference frequency suppression	50 Hz (integration time 60 ms) 60 Hz (integration time 50 ms)	50 Hz
Smoothing	None Weak Medium Strong	None
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7

Default Parameters If you have not set the parameters of the 1 AO U electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-10).

Technical Data The technical data of the 1 AO U analog electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	20 × 64 × 51
Weight	approx. 25 g
Module-Specific Data	
Number of outputs	1
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between output channel and SC bus	no
• Between output channel and current supply of electronics	no
Permissible potential difference	
• Between S- and QV- (V_{CM})	max. DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 50 mA
Power loss of the module	max. 1 W
Analog value formation	
• Resolution (incl. overrange)	
S7 format /	S5 format
± 10 V	12 bits
1...5 V	11 bits
Conversion time	max. 5 ms
Settling time	
• For resistive load	0.1 ms
• For capacitive load	3.3 ms
Substitute values applicable	no

Interference Suppression, Limits of Error	
• Common-mode interference	
V_{CM} < 2 V_{SS} AC (50Hz)	>30 dB
Operational limit (in entire temperature range, relative to rated output range)	± 0.9%
Basic error limit (operational limit at 25°C, relative to rated output range)	± 0.6%
Temperature error (relative to rated output range)	± 0.01%/K
Linearity error (relative to rated output range)	± 0.06%
Repeatability in settled state at 25°C (relative to rated output range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
• Diagnostic interrupt	none
Actuator Selection Data	
Output range (rated values)	± 10 V 1...5 V
Load resistance (in rated range of the output)	min. 1kΩ
• Short circuit protection	yes
• Short circuit current	approx. 30 mA
• Capacitive load	max. 1 μF
Destruction limit against externally applied voltages/currents	
• Voltage at outputs against ground; QV-	max. 15 V permanent; 75 V for max. 1 s (pulse duty factor 1:20)
• Current	max. DC 50 mA
Connection of the actuators	
– 2-conductor connection	possible
– 4-conductor connection (measuring lead)	possible

12.10 Analog Electronic Module 1 AO I

Order Number

6ES7 124-1GA00-0AB0

Characteristics

The 1 AO I analog electronic module is an analog output module with the following characteristics:

- 1 current output
- Output ranges 0..20 mA and 4...20 mA
- 12-bit resolution
- Output range selection
- Isolation from the SC bus
- Permissible common-mode voltage of AC 2 V_{SS}

Front Elevation/ Side Elevation

The figure below shows the front elevation and the side elevation of the output module.

The block diagram is shown on the front of the output module. In the operating state, the block diagram is covered by the labeling strip.

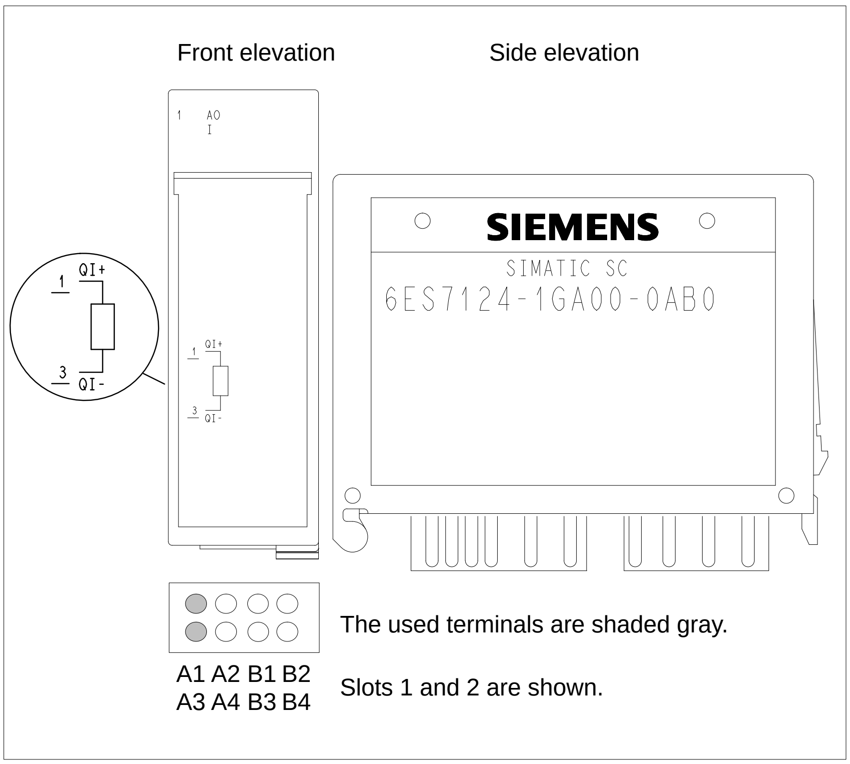


Figure 12-27 Front and Side Elevations of the 1 AO I Analog Electronic Module

Block Diagram

Figure 12-28 shows the block diagram of the 1 AO I analog electronic module.

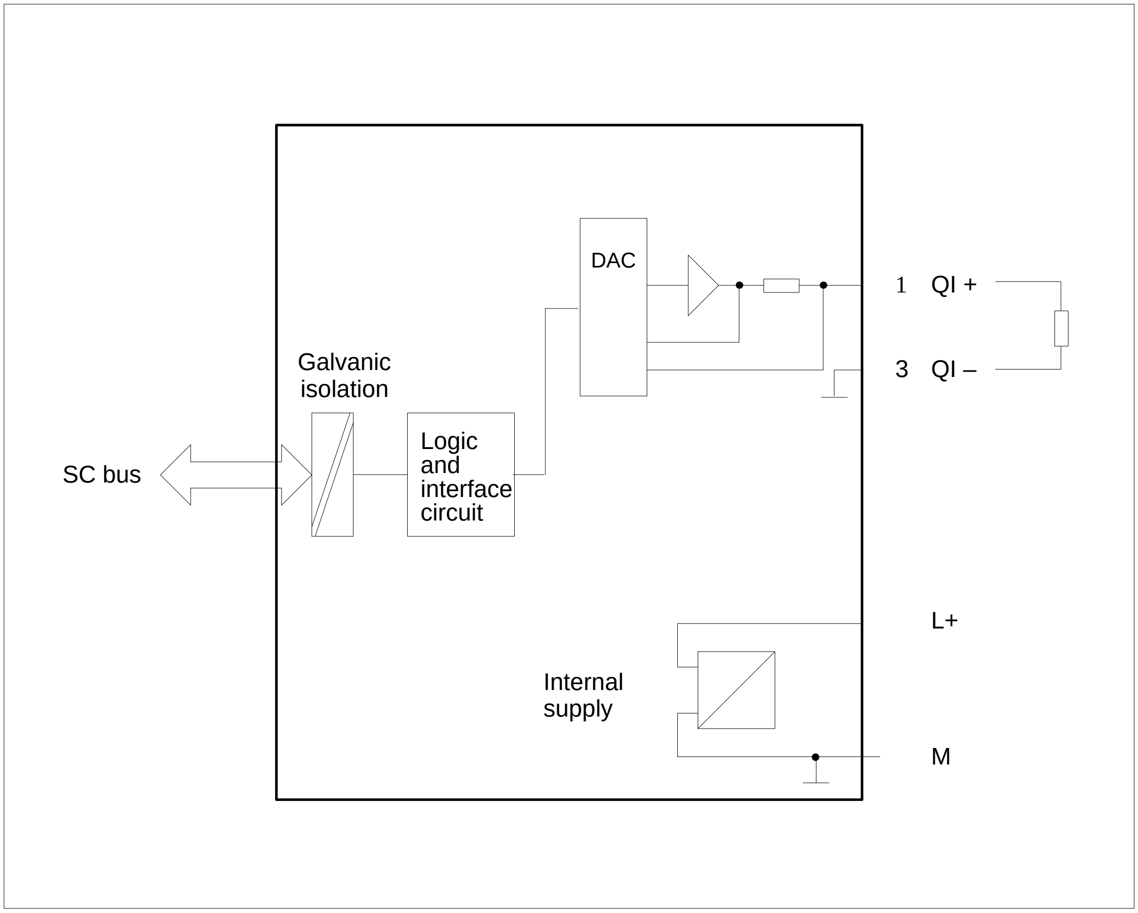


Figure 12-28 Block Diagram of the 1 AO I Analog Electronic Module

Parameters

The 1 AO I electronic module uses the following static parameters, which are stored in data record 0:

Table 12-11 Static Parameters of the 1 AO I Electronic Module

Parameter	Value Range	Default Parameters
Measurement type	Deactivated Current	 Current
Output range (current)	0 ... 20 mA 4 ... 20 mA	4 ... 20 mA
Format	SIMATIC S7 SIMATIC S5	SIMATIC S7

Default Parameters

If you have not set the parameters of the 1 AO I electronic module using the specified software (see Chapter 4), the default settings apply to both input channels after a restart (see Table 12-11).

Technical Data The technical data of the 1 AO I analog electronic module is listed below.

Dimensions and Weight	
Dimensions W × H × D (mm)	20 × 64 × 51
Weight	approx. 25 g
Module-Specific Data	
Number of outputs	1
Line length	
• Shielded	max. 200 m
Protection of the electronic module against surge stress to IEC801-5	external protective device in the power supply and signal lines required
Number of times the electronic module can be plugged into a TB 16 SC	max. 20
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L+	DC 24 V
• Reversed polarity protection	yes
Galvanic isolation	
• Between channel and SC bus	no
• Between output channel and voltage supply of electronics	no
Permissible potential difference	
• Between reference point of load and QV- (V_{CM})	max. DC 2 V/ AC 2 V_{SS}
Power input	
• From supply voltage L+	max. 50 mA
Power loss of the module	max. 1 W
Analog value formation	
• Resolution (incl. overrange)	
S7 format /	S5 format
0...20 mA	12 bits
4...20 mA	12 bits
Conversion time	max. 5 ms
Settling time	
• For resistive load	0.1 ms
• For inductive load	0.5 ms
Substitute values applicable	no

Interference Suppression, Limits of Error	
• Common-mode interference	
$V_{CM} < V_{SS}$ AC (50Hz)	>30 dB
Operational limit (in entire temperature range, relative to rated output range)	± 1.0%
Basic error limit (operational limit at 25°C, relative to rated output range)	± 0.7%
Temperature error (relative to rated output range)	± 0.01%/K
Linearity error (relative to rated output range)	± 0.06%
Repeatability in settled state at 25°C (relative to rated output range)	± 0.1%
Statuses, Interrupts, Diagnostics	
Interrupts	none
• Diagnostic interrupt	none
Actuator Selection Data	
Output ranges (rated values)	0...20 mA; 4...20 mA
Load resistance (in rated range of the output)	
• at common-mode voltage of 2 V	max. 500Ω
• at common-mode voltage of 0 V	max. 600Ω
• Idling-proof	yes
• Open-circuit voltage	approx. 16 V
• Inductive load	max. 1mH
Destruction limit against externally applied voltages/currents	
• Voltage at outputs against ground	max. 15 V permanent; 75 V for max. 1 s (pulse duty factor 1:20)
• Current	max. DC 50 mA
Connection of the actuators	
– 2-conductor connection	possible

The 1COUNT40kHz Counter Module 13

Contents of the Chapter

Order Numbers

Product Name	Order Number
Counter module 1COUNT40kHz	6ES7 127-1BE00-0AB0

Characteristics

The 1COUNT40kHz counter module is a counter for use in the ET 200L-SC IM-SC. The module incorporates a counter that can work in the following range:

Counting Range	Lower count limit	Upper count limit
16 bits (unipolar)	0	+65535

The maximum input frequency of the count signals is 40 kHz.

You can use the 1COUNT40kHz counter module for the following types of counting:

- Continuous counting
- Single-pass counting
- Periodic counting

What Signals Can the 1COUNT40kHz Count?

The 1COUNT40kHz counter module can count signals generated by the following pulse initiators: 24-V pulse initiator

- with direction indicator (e.g. light barrier or proximity switch)
- without a direction indicator (e.g. light barrier or proximity switch)

13.1 Front and Side Elevations

Front/Side Elevation

The figure below shows you the front and side elevations of the 1COUNT40kHz counter module.

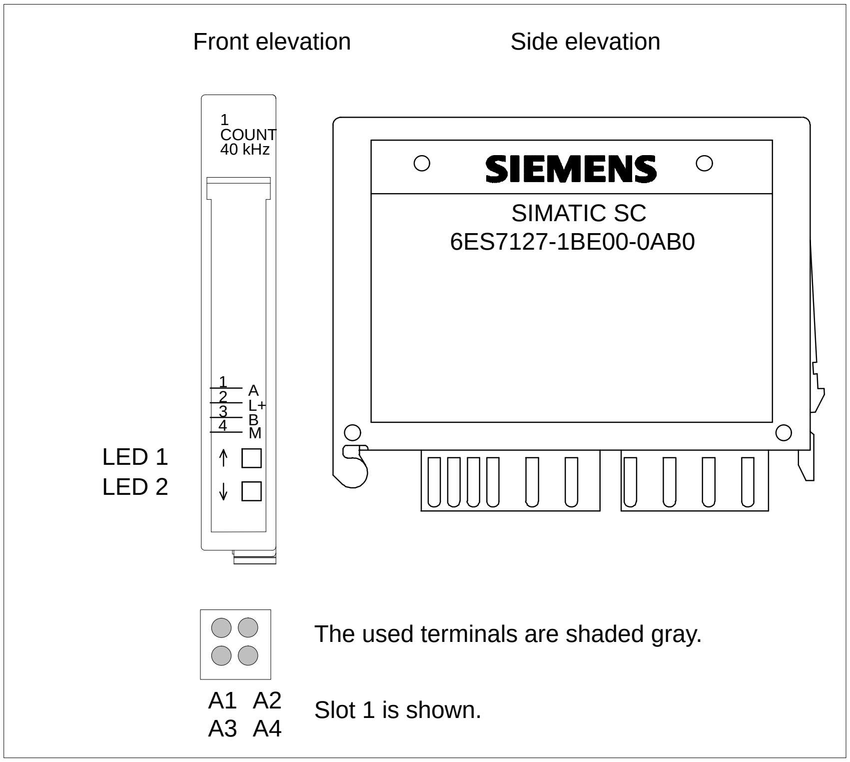


Figure 13-1 Front and Side Elevations of the 1COUNT40kHz Counter Module

Status LEDs

The 1COUNT40kHz counter module has two LEDs, which indicate the status of the 1COUNT40kHz counter module.

Table 13-1 lists the LED displays, giving their display, colour and function.

Table 13-1 Displays, Colour and Functions of the LEDs

Display	Color	Function
↑	Green	This LED comes on when the counter is counting upward (door open and status of the direction input B = 0 signal)
↓	Green	This LED comes on when the counter is counting downward (gate open and status of the direction input B = 1 signal)

13.2 Block Diagram

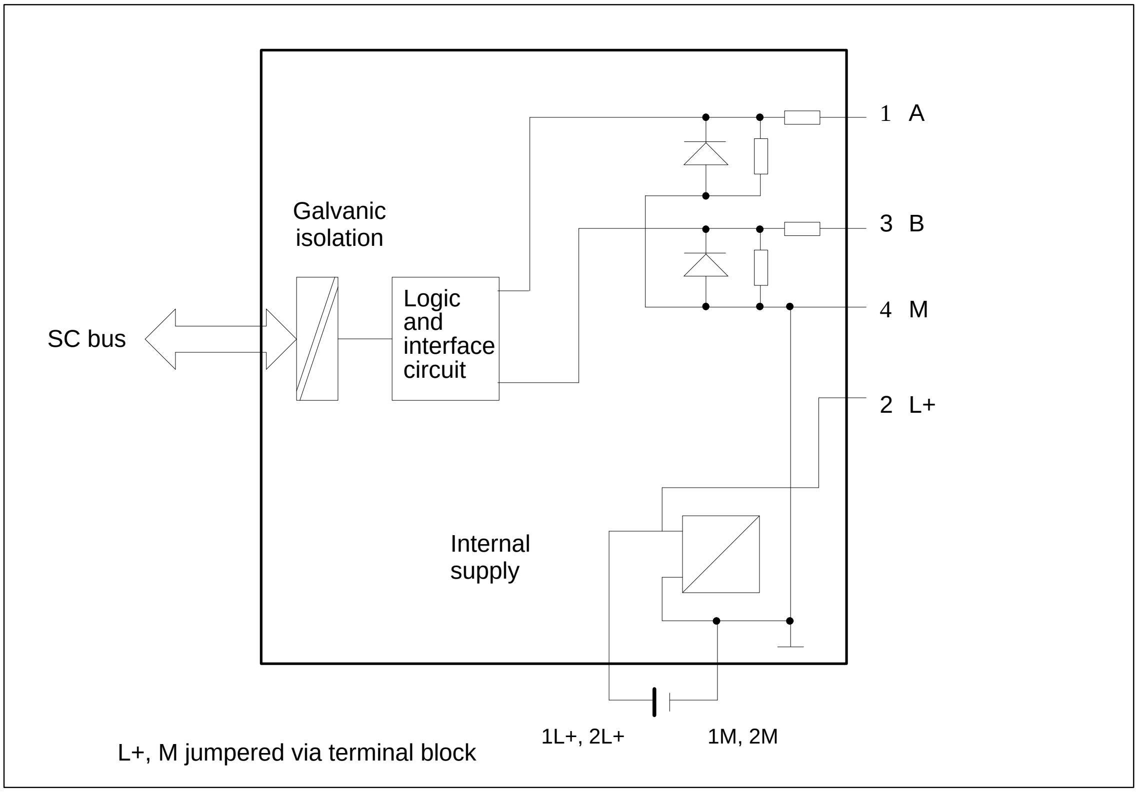


Figure 13-2 Block Diagram of the 1COUNT40kHz Counter Module

Abbreviations Used

1A	=	count input
3B	=	direction input
4M	=	load voltage brought out (neg. potential)
2L+	=	load voltage brought out (pos. potential)

13.3 Functions of the Counter Module

Contents of the Section

Continuous Counting

The counter begins at the lower count limit.

If the counter reaches the upper limit when counting upward and there is then another count pulse, the counter jumps to the lower limit and starts to count the count pulses again, thus counting continuously.

If the counter reaches the lower count limit when counting downward and there is then another count pulse, the counter jumps to the upper count limit and starts to count downward from there.

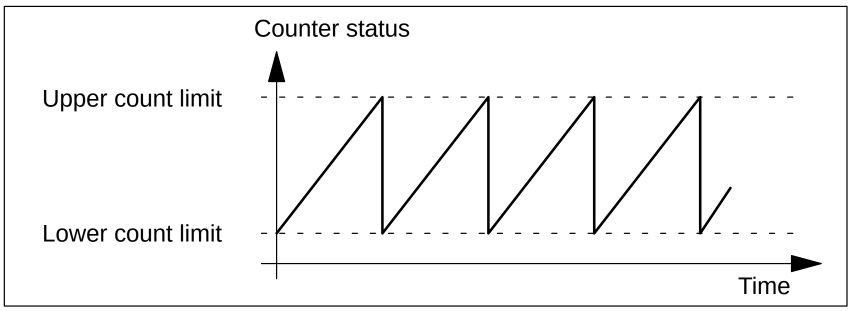


Figure 13-3 Continuous Upward Counting

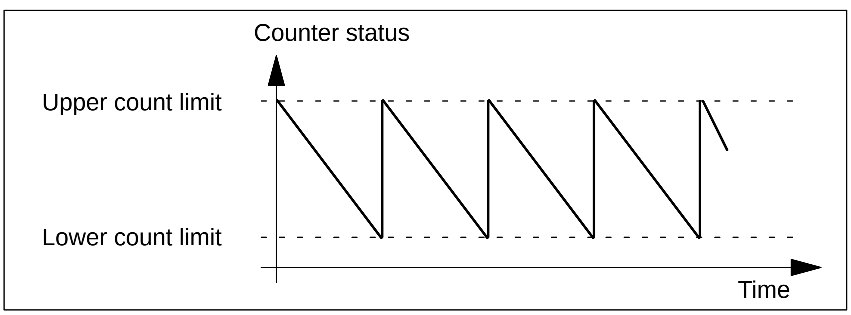


Figure 13-4 Continuous Downward Counting

Single-Pass Counting

The counter begins at the loaded value.

In single-pass counting, the counter starts at the loaded value. If the counter reaches the upper count limit when counting upward and there is then another count pulse, the counter jumps to the lower count limit and stays there even when there are additional count pulses.

If the counter reaches the lower count limit when counting downward and there is then another count pulse, it jumps to the upper count limit and stays there even when there are additional count pulses.

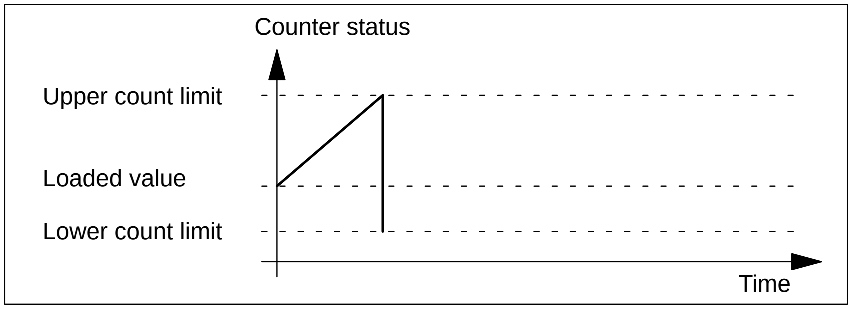


Figure 13-5 Single-Pass Upward Counting

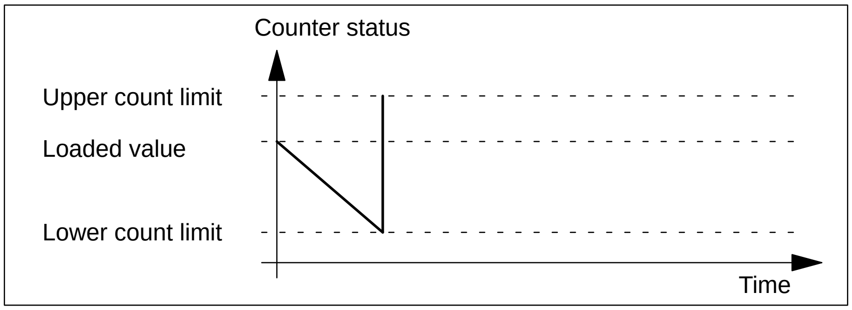


Figure 13-6 Single-Pass Downward Counting

Repeated Single-Pass Counting with Door Function

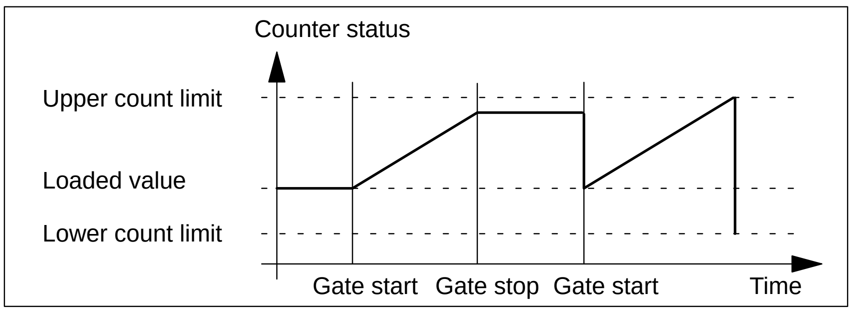


Figure 13-7 Single-Pass Counting with Loaded Value and Gate Function

Periodic Counting

The counter begins at the loaded value.

In periodic counting, the counter starts at the loaded value. If the counter reaches the upper value when counting upward and there is then another count pulse, the counter jumps to the loaded value and starts to count the count pulses again.

If the counter reaches the lower count limit when counting downward and there is then another count pulse, the counter jumps to the loaded value and continues to count downward from there.

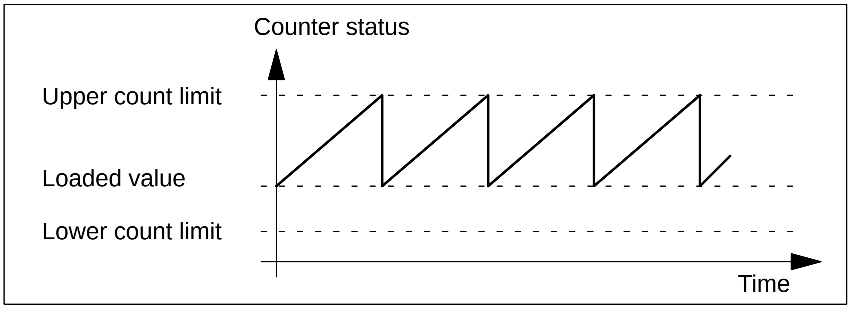


Figure 13-8 Periodic Upward Counting

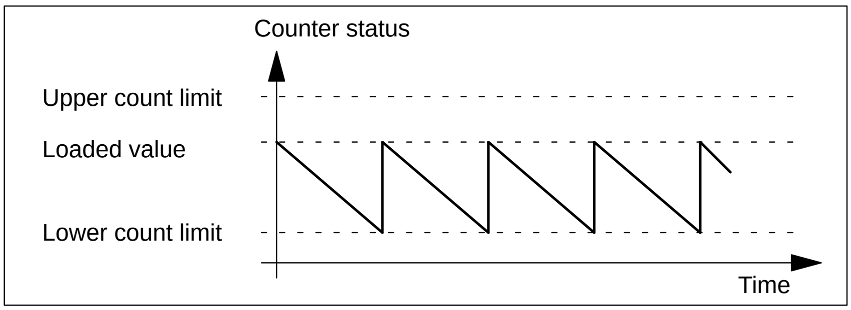


Figure 13-9 Periodic Downward Counting

13.3.1 24V Pulse Initiator With/Without Direction Indicator

The pulse initiator – a proximity switch (BERO) or light barrier, for example – supplies only one count signal, which must be connected to terminal A on the terminal block.

You can also connect a signal for direction identification to terminal B of the terminal block. If you do not connect a direction signal, the counter counts upward.

Note the parameterization of the count direction.

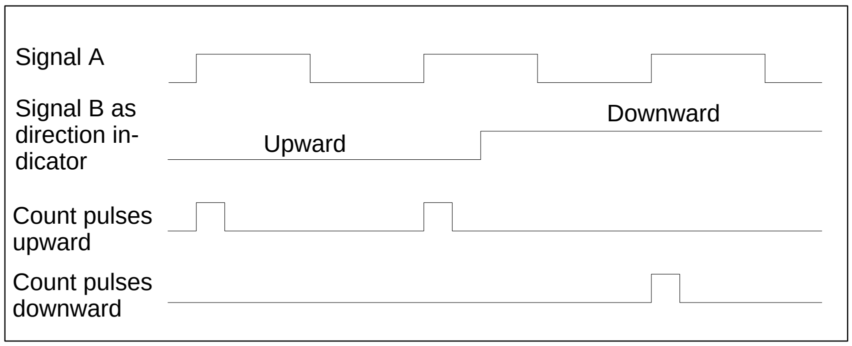


Figure 13-10 Signals of a 24V Pulse Initiator with Direction Indicator

13.3.2 Gate Functions

Counting with Gate Functions

Many applications require counting to start or stop as of a defined time, dependent on other events. In the case of the counter module, this starting and stopping of counting is effected by means of a gate function. If the gate is opened, count pulses can get through to the counter. If the gate is closed, count pulses can no longer get through to the counter and counting stops.

Gate Function

The counter module has a gate function. This is controlled by the user program in the CPU. The transmission times must be taken into account here.

Example

When the gate signal is set, the gate is opened and the count pulses are counted. When the gate signal is taken away, the gate is closed and the count pulses are no longer registered by the counter. The count remains constant.

Figure 13-11 shows the opening and closing of a gate and the counting of the pulses.

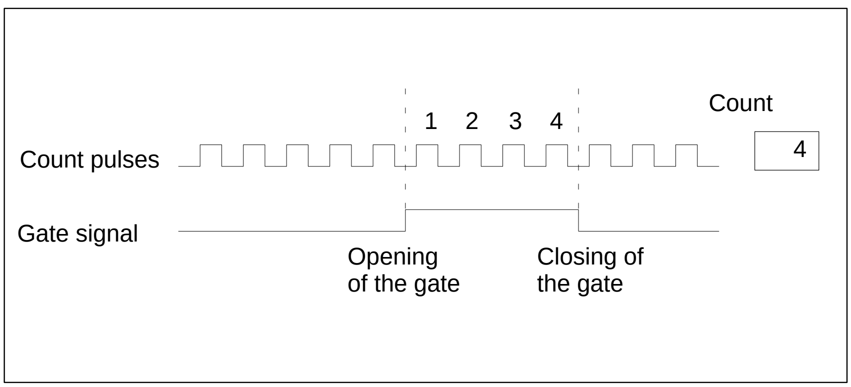


Figure 13-11 Opening and Closing of a Gate

Terminating Counting with the Gate Stop Function

You can terminate counting by setting the ”gate” bit to ”0”.

13.3.3 Digital Output

Introduction

You can store a comparison value on the 1COUNT40kHz counter module. This is assigned to the digital output. The output is activated depending on the count and the comparison value. This section describes the various ways of setting the responses of the output.

The digital output of the counter module is only available as a status bit. To operate a digital output, you must read in this status bit, which is in the input range, and output it to a digital output.

Comparison Value

You transfer the comparison value to the 1COUNT40kHz counter module. Counting is not affected by this.

The comparison value must lie within the count range of the counter module. The comparison value is interpreted in accordance with the selected count mode. If you specify a comparison value of $FFFF_H$, for example, in 16-bit mode the number is interpreted as 65535.

Enabling the Output

The output cannot be activated unless you first enable it by setting the appropriate bit (see also Section 13.6, Subdivision of the Data Areas).

Default Setting

By default, the output is switched off.

Pulse Duration

The pulse duration can be set for the purpose of adaptation to the actuators being used. The pulse duration specifies how long the output is to be set. The pulse duration can be set between 0 and 3 s in steps of 100 ms.

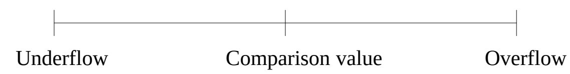
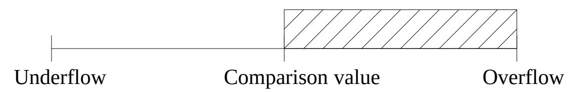
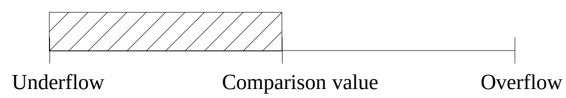
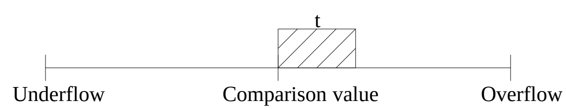
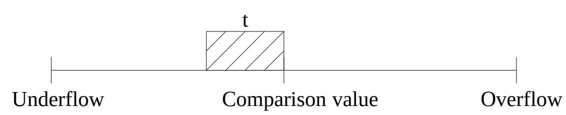
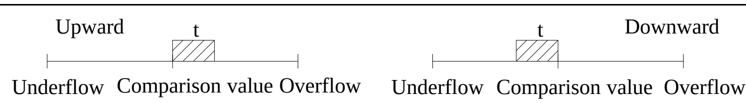
Digital Output: Logic

If you set the digital output: logic parameter to inverted, in its active state the digital output has a 0 in its status bit.

This does not take effect until the parameter values are received.

Behavior of the Output

You can set one of 6 possible responses for the output when the comparison value is reached. The alternatives are shown in the table below.

Behavior of the Output	
Output disabled	
	The output remains deactivated and is not affected by the events comparison value, zero-crossing, overflow or underflow.
Active from comparison value to overflow *	
	The output is activated when the counter is in the range between the comparison value n and overflow. When the counter is set to a value between comparison value and overflow, the output is activated.
Active from comparison value to underflow *	
	The output is activated when the counter is in the range between the comparison value n and underflow. When the counter is set to a value between comparison value and underflow, the output is activated.
Active at comparison value counting upward *	
	The output is activated for the length of the pulse duration when the comparison value is reached counting upward.
Active at comparison value counting downward *	
	The output is activated for the length of the pulse duration when the comparison value is reached counting downward.
Active at comparison value counting upward/downward	
	The output is activated for the length of the pulse duration when the comparison value is reached regardless of the direction of counting.

* Note the conditions overleaf

 = output active

t = pulse duration

Conditions

When you parameterize the behavior of the digital outputs, you must comply with the following:

If..	Then...
...you want to parameterize the output as active from the comparison value to overflow or underflow	...you must ensure that the time between these events is greater than the transmission time. Otherwise, the control pulses are lost at the output. If the count reaches the comparison value again while the output is still active, no new pulse is released. Another pulse cannot be released until the output is no longer active.

Hysteresis

Hysteresis is only significant in upward/downward count mode.

Hysteresis, which can be set from 0 to 255 allows you to prevent the switching output from changing with the direction signal around the comparison value or the pulse duration from being restarted.

If the counter counter reaches the comparison value for the first time after entry, the output is activated.

Here are five examples:

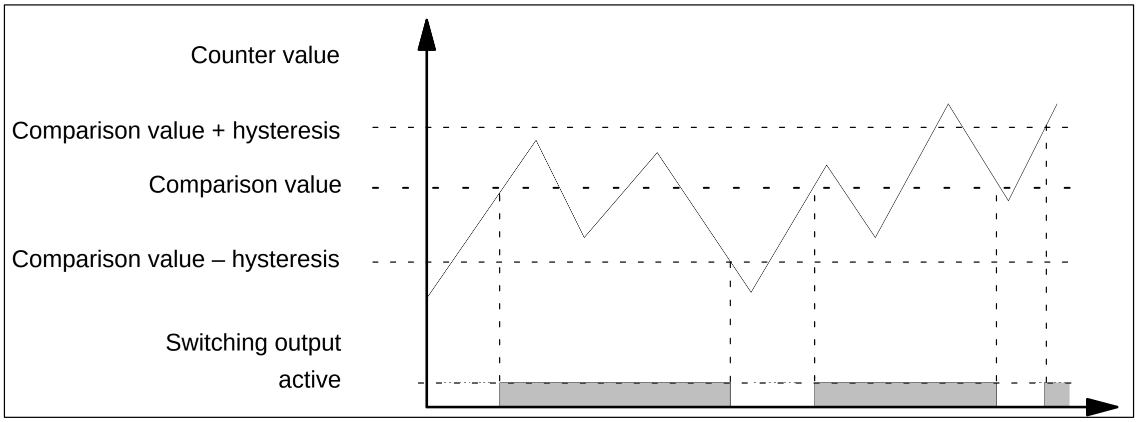


Figure 13-12 Example 1: The Output Is Set to Be Active from the Comparison Value to Overflow

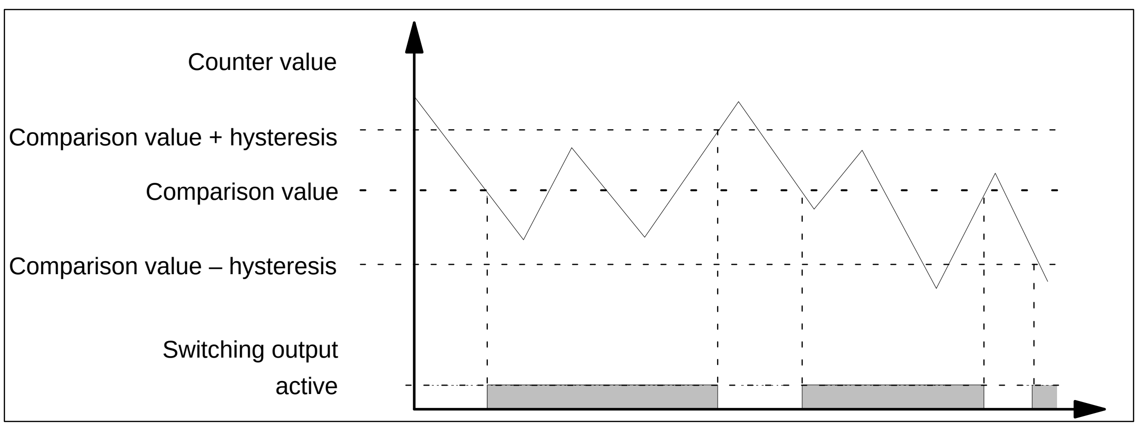


Figure 13-13 Example 2: The Output Is Set to Be Active from the Comparison Value to Underflow

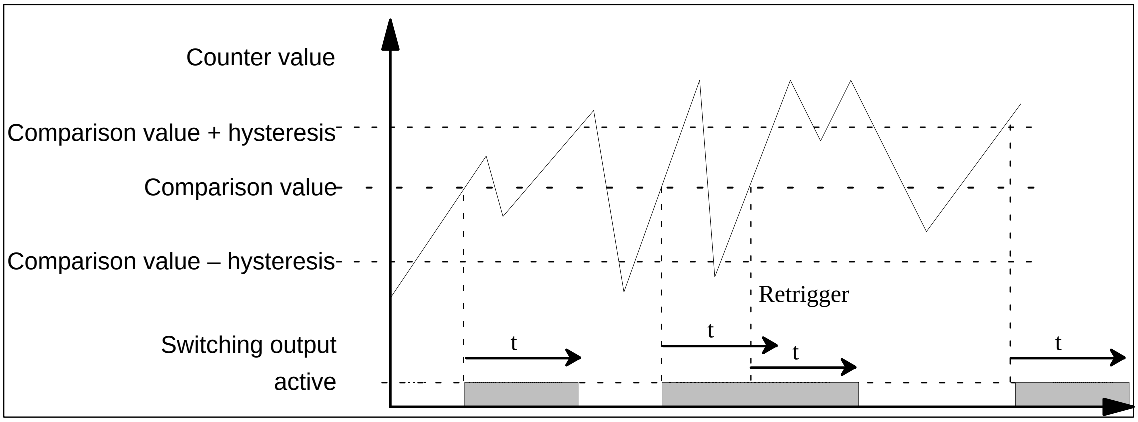


Figure 13-14 Example 3: The Output Is Set to Be Active for the "Pulse Duration on Reaching the Comparison Value Counting Upward"

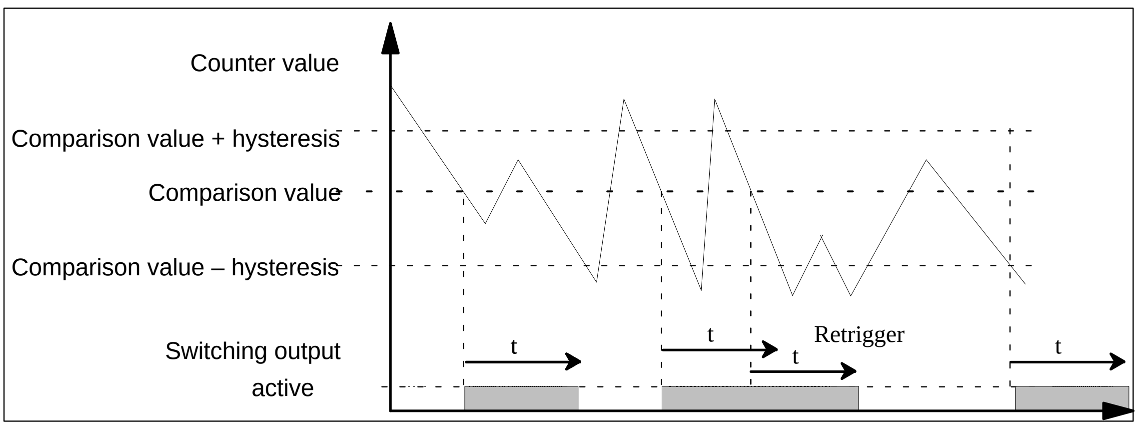


Figure 13-15 Example 4: The Output Is Set to Be Active for the "Pulse Duration on Reaching the Comparison Value Counting Downward"

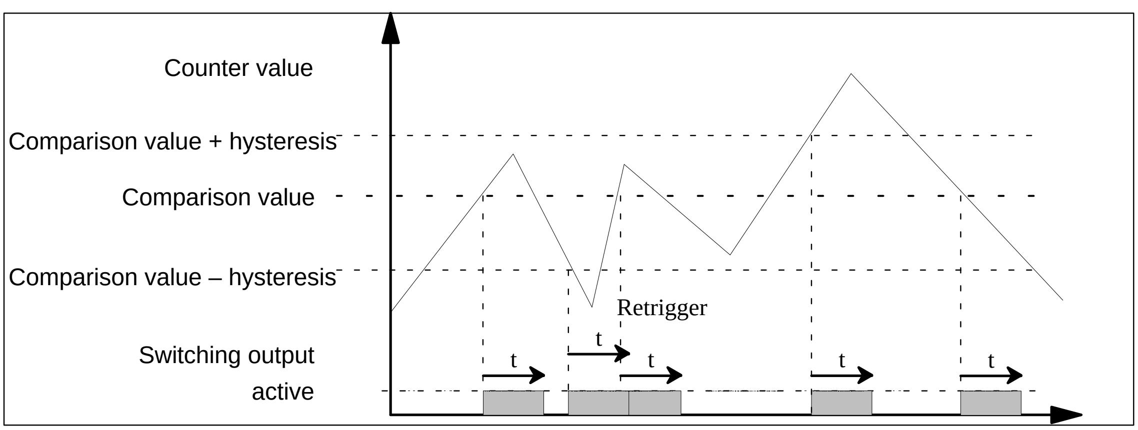


Figure 13-16 Example 5: The Output Is Set to Be Active for the "Pulse Duration on Reaching the Comparison Value Counting Upward/Downward"

13.4 Wiring the Counter and Putting the Counter into Operation

Contents of the Chapter

13.4.1 Wiring the Counter

You wire the 1COUNT40kHz counter module as shown in the following figure:

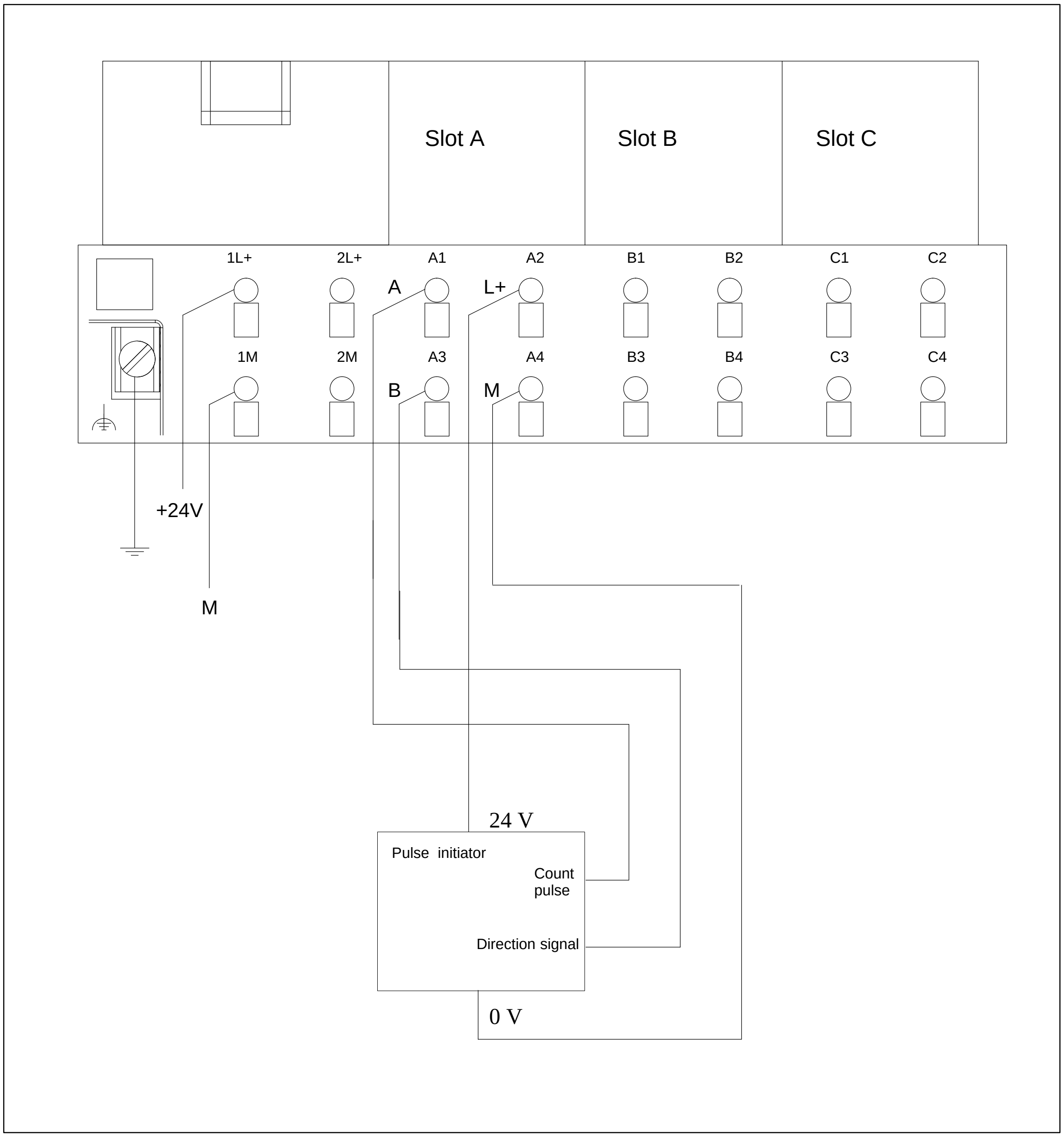


Figure 13-17 Connecting a Pulse Initiator with a Direction Signal (Example TB 16SC)

Note

You can run up to 10 counter modules in the ET 200L-SC IM-SC.

13.4.2 Putting the Counter into Operation

Characteristics

After the power is switched on and before any data is transmitted, the state of the module is as follows:

- The count is at zero.
- The continuous counting mode is set.
- Status messages are updated.
- The gate is closed.
- The module is waiting for parameters.

13.5 Parameters of the Counter Module

Parameter

In the table below you will find a list of the parameters, their value ranges and default values:

Table 13-2 Parameter List

Parameter	Value Range	Default Values
Count limit: lower	0 ... 65535	0
Count limit: upper	0 ... 65535	65535
Mode	Continuous Single-pass Periodic	Continuous
Count mode	Upward Upward/downward	Upward
Enable comparison value	Disable Enable	Disable
Digital output: activated on	Disable Comparison value to overflow Comparison value to underflow Reaching the comparison value for the pulse duration counting upward Reaching the comparison value for the pulse duration counting downward Reaching the comparison value for the pulse duration counting upward or downward	Disable
Digital output: logic	Not inverted Inverted	Not inverted
Digital output: pulse duration	0 ... 3000 ms in steps of 100 ms	0
Hysteresis	0 ... 255 count pulses	0

Count Mode

You can choose between the following count directions:

- Upward
- Upward/downward

In the upward count mode the direction input is ignored.

Comparison Values

You can store a comparison value in the counter module. An output of the counter module is assigned to this value. If the count reaches the comparison value, the output can be set in order to trigger direct control operations in the process.

Comparison Value Enabling

If the comparison value is disabled, the count is not compared with the comparison value and the output is thus not activated.

Default Parameters

If no other values are supplied from data records, the counter module works with the default parameters.

Peculiarities

If the DP line fails or the CPU goes into STOP mode (see Section 13.6, Subdivision of the Data Areas: Note), the counter module continues to count provided the gate was open.

When a connection to the DP station is re-established or the CPU goes into RUN mode, and provided the lower and upper count limit parameters have not been changed, you can read the current count.

13.6 Subdivision of the Data Areas

Control Data

Control data is transferred from the CPU to the counter module cyclically. Control data amounting to more than 1 byte is stored as follows:

n	high byte
n + 1	low byte

You can use the control data to change the functioning of the counter module. The following table indicates which function can be affected by which address/addresses.

Output Range

Module output address + 0	Loaded value
Module output address + 2	Comparison value
Module output address + 4	Bits: | | 0 | 0 | 0 | | | | | Gate 0: Stop 1: Start Output 0: Disable 1: Enable Loaded value job 0: Do not accept 1: Accept Comparison value 0: Do not accept 1: Accept Valid control commands 0: Not valid 1: Valid
Module output address + 5	00_H

Note

You generally have to set bit 7 (valid control commands) to 1 in the user program. As a result, when there are changes to the operating status of the CPU or in the event of the DP strang failing or being switched off, you can recognize this and continue to count, provided the gate was open.

Input range

Module input address + 0	Count
Module input address + 2	Comparison value
Module input address + 4	Counter running 0: Disabled 1: Running Count direction 0: Upward 1: Downward Output 0: Inactive 1: Active Gate input 0: Stopped 1: Started Loaded value acknowledgment 0: Not accepted 1: Accepted Comparison value acknowledgment 0: Not accepted 1: Accepted Loaded value error 0: No loaded value error 1: Value outside range Comparison value error 0: No comparison value error 1: Value outside range
Module input address + 5	␣ 0 0 0 0 0 0 0 Valid data 0: Invalid data 1: Valid data

13.7 Application Examples

Example 1

The following example shows how to count upward in a single pass, with gate function, without output.

Conditions: The input and output address of the counter module have been parameterized as 0.

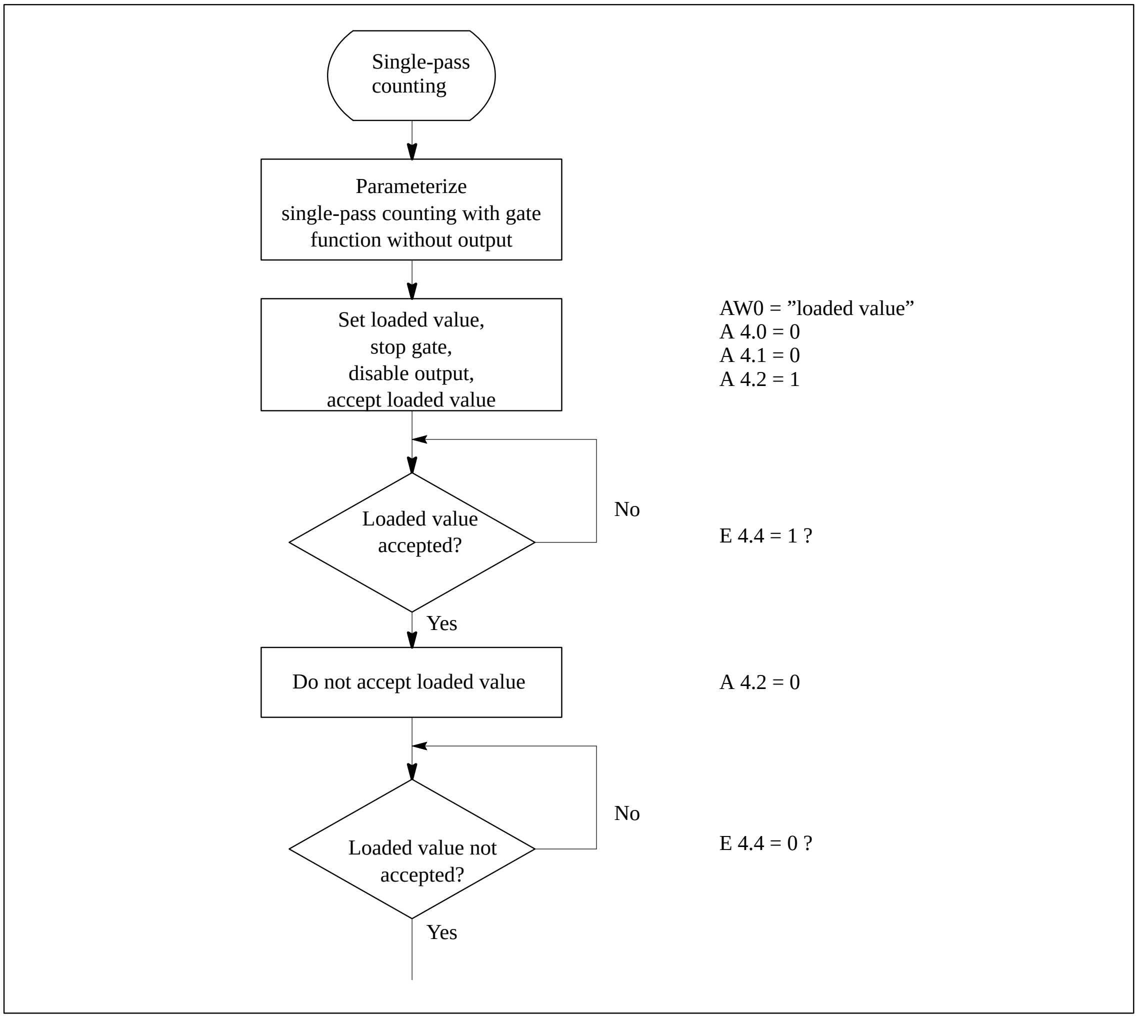


Figure 13-18 Example 1

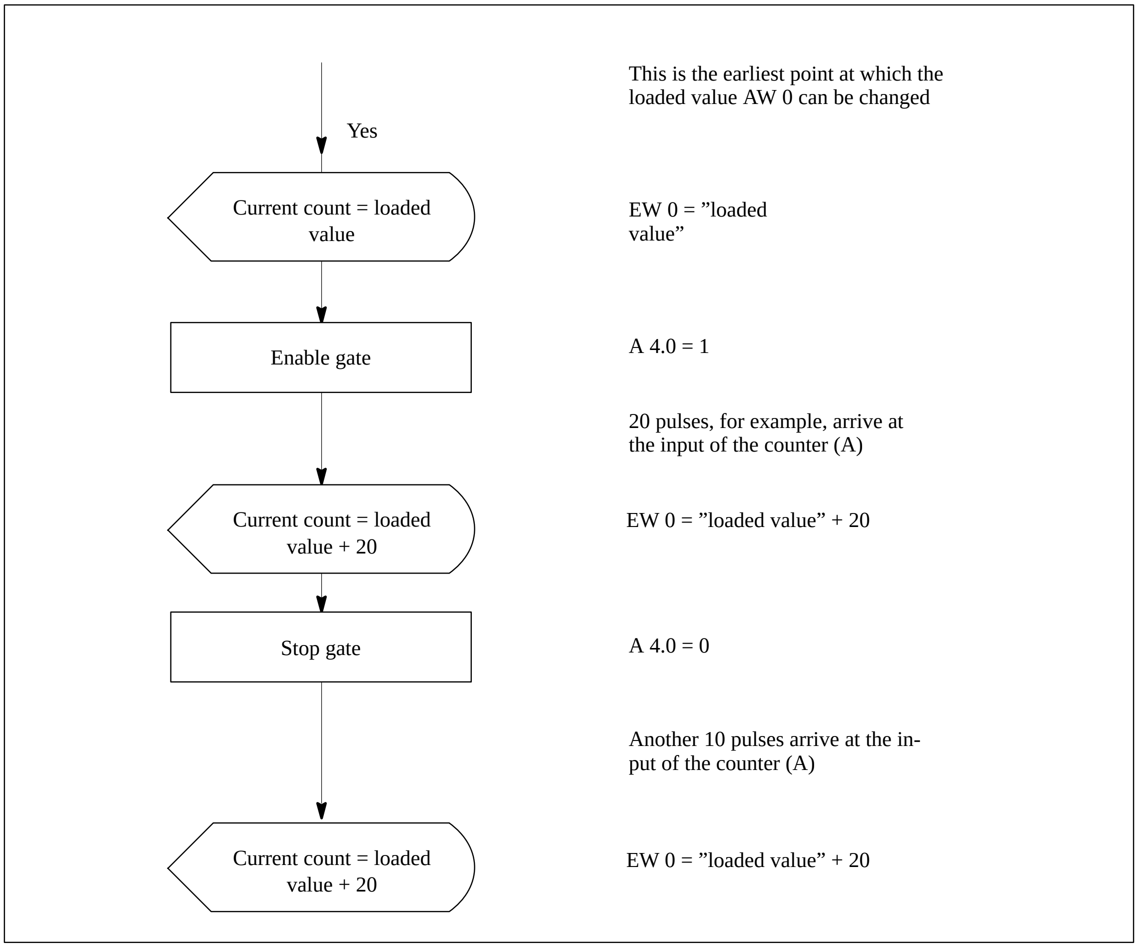


Figure 13-19 Example 1, Continued

Example 2

The following example shows how to count upward periodically, with gate function, output at comparison value.

Conditions: The input and output address of the counter module have been parameterized as 0.

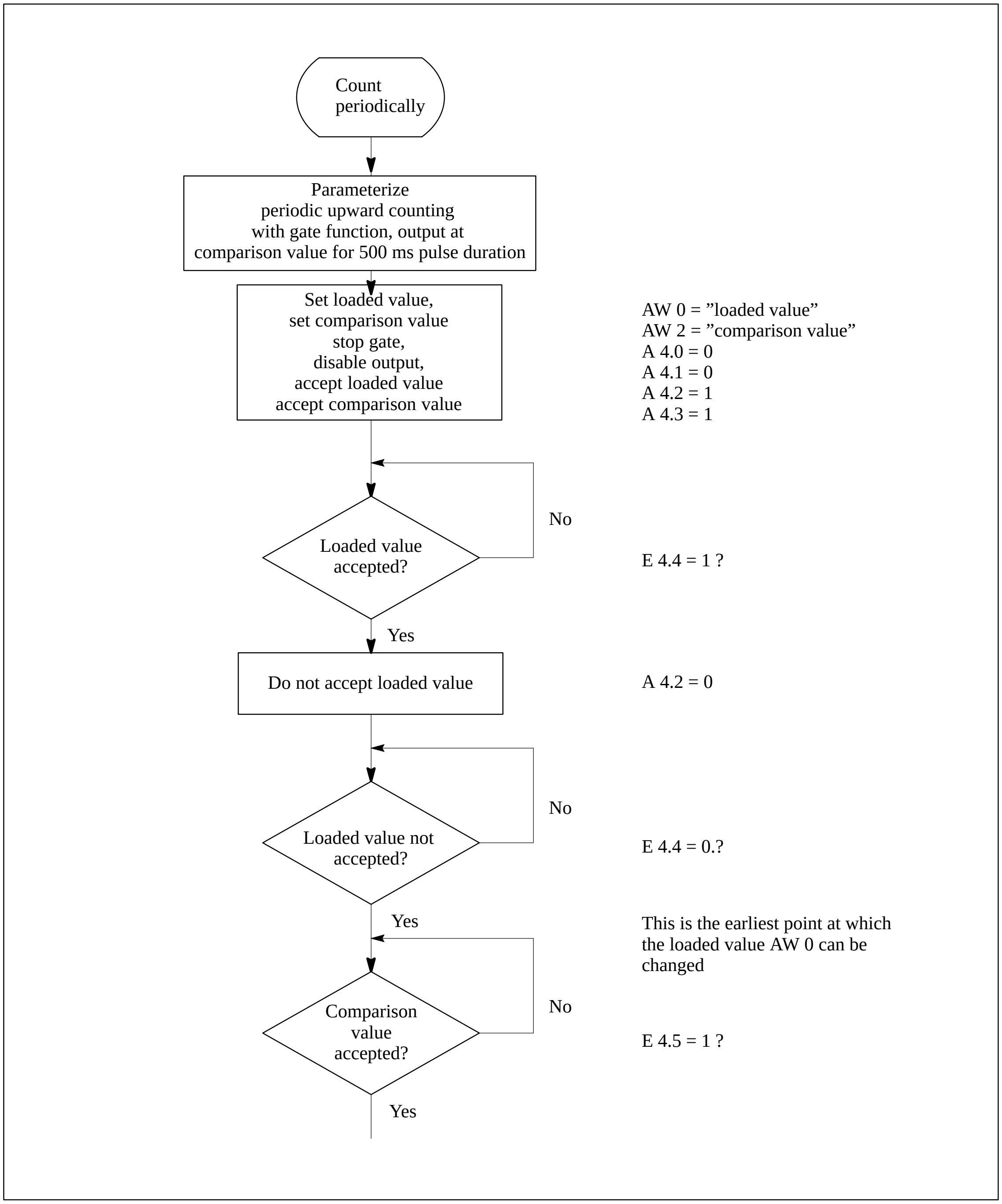


Figure 13-20 Example 2

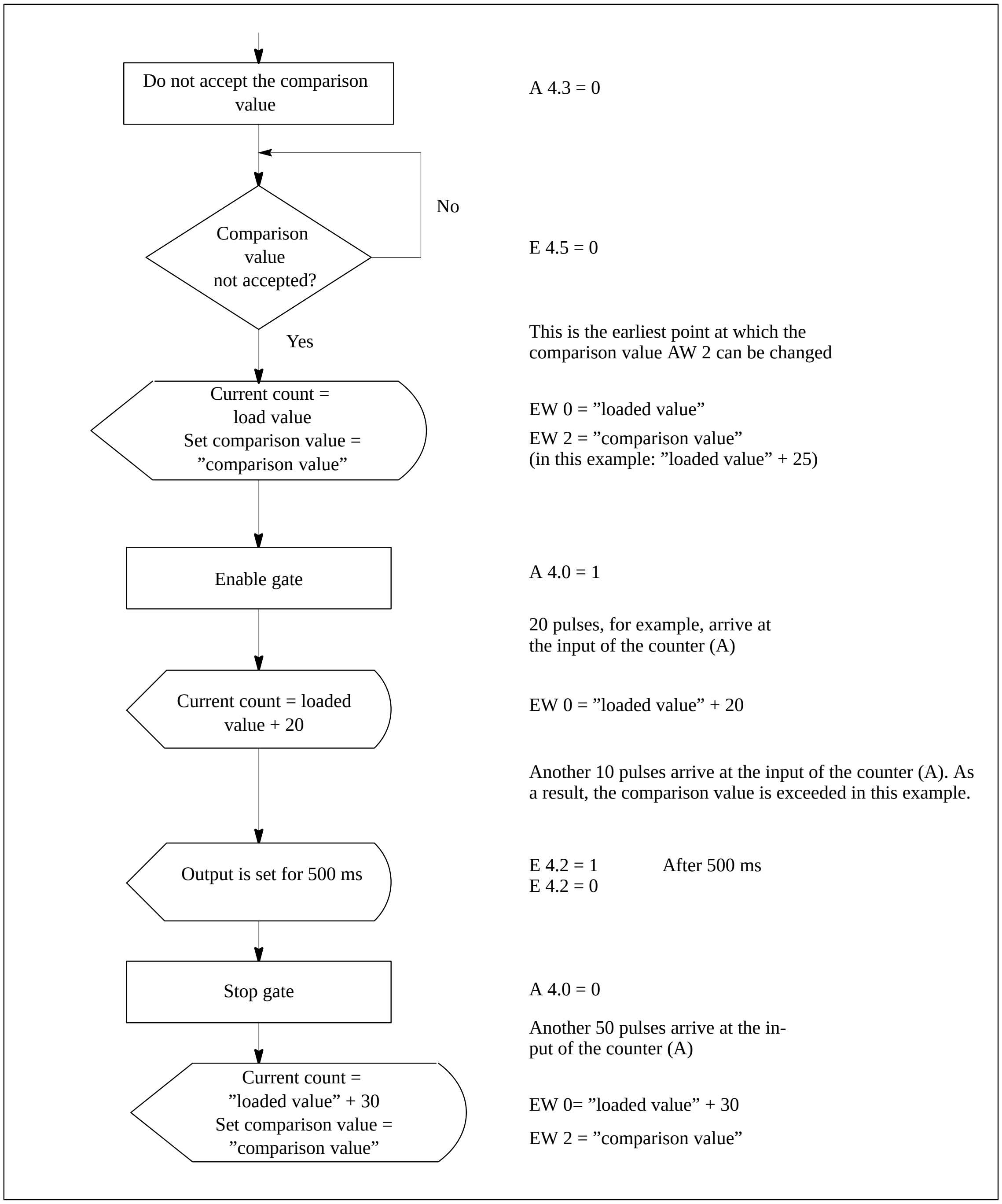


Figure 13-21 Example 2, Continued

13.8 Technical data

Dimensions and Weight	
Dimensions W × H × D (mm)	10 × 64 × 51
Weight	Approx. 15 g
Module-Specific Data	
Number of counters	1
Cable length	
• Shielded	Max. 100 m
Voltages, Currents, Potentials	
Rated load voltage L+	DC 24 V
• Reverse polarity protection	Yes
Galvanic isolation	
• Between channels and SC bus	No
• Between the inputs	No
Permissible potential difference	
• Between different circuits	DC 75 V/ AC 60 V
Power input	
• From load voltage L+	Approx. 20 mA
Power loss of the module	Max. 0.5 W

Statuses, Interrupts, Diagnostics	
Status display	1 green LED each for – Counting upward – Counting downward
Interrupts	None
Diagnostic functions	None
Data on the Count Signals	
24 V input signals	
• Rated value	DC 24 V
• For signal ”1”(high level)	11 ... 30 V
• For signal ”0” (low level)	–3 ... 5 V
Input current	
• At signal ”1”(high level)	Typ. 6 mA
Minimum pulse width (max. input frequency)	≥ 12.5 µs (40 kHz)
• Input characteristic curve to	IEC 1131, Type 1
Connection to 2-wire BEROs	Possible
• Permissible closed–circuit current	Max. 1.5 mA

Order Numbers

A

Introduction

Should you require additional components for the ET 200L distributed I/O device or should you wish to upgrade the PROFIBUS, you will find the order numbers here for the corresponding components.

We have divided the components into:

- ET 200L components
- Smart Connect SC components
- Accessories for the PROFIBUS with a note on the manuals for the different PROFIBUS-DP masters and system configuration software

Contents of the Appendix

A.1 Order Numbers for ET 200L Components

Introduction

You will find here the order numbers for ET 200L components.

Terminal Blocks

Table A-1 Terminal Block Order Numbers

Description	Order Number
Terminal block TB 16L, screw-type terminal	6ES7 193-1CH00-0XA0
Terminal block TB 16L, spring terminal	6ES7 193-1CH10-0XA0
Terminal block TB 32L, screw-type terminal	6ES7 193-1CL00-0XA0
Terminal block TB 32L, spring terminal	6ES7 193-1CL10-0XA0
Terminal block TB 16L AC, screw-type terminal	6ES7 193-1CH20-0XA0
Terminal block TB 16SC, spring terminal	6ES7 193-1CH10-0XA0
Terminal block TB 16SC, spring terminal	6ES7 193-1CL10-0XA0
Terminal block TB 16IM-SC, screw-type terminal	6ES7 120-0AH50-0AA0
Terminal block TB 16IM-SC, spring terminal	6ES7 120-0BH50-0AA0

Electronics Blocks

Table A-2 Electronics Block Order Numbers

Description	Order Number
Interface module IM-SC	6ES7 138-1XL00-0XB0
L 16 DI DC 24 V	6ES7 131-1BH00-0XB0
L-SC 16 DI DC 24 V	6ES7 131-1BH11-0XB0
L 16 DI AC 120 V	6ES7 131-1EH00-0XB0
L 32 DI DC 24 V	6ES7 131-1BL00-0XB0
L-SC 32 DI DC 24 V	6ES7 131-1BL11-0XB0
L 16 DO DC 24 V/0.5 A	6ES7 132-1BH00-0XB0
L-SC 16 DO DC 24 V/0.5 A	6ES7 132-1BH11-0XB0
L DO AC 120 V/1.0 A	6ES7 132-1EH00-0XB0
L 16 DO DC 24 V/AC 120V/2.0 A	6ES7 132-1JH00-0XB0
L 32 DO DC 24 V/0.5 A	6ES7 132-1BL00-0XB0
L 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL00-0XB0
L-SC 16 DI/16 DO DC 24 V/0.5 A	6ES7 133-1BL10-0XB0
L-8 DI/8 DO AC 120 V/1.0 A	6ES7 133-1EH00-0XB0
L 8DI AC 120V/8 DO DC 24V/AC 120V/2.0 A	6ES7 133-1JH00-0XB0

Supplementary Terminal

Table A-3 Supplementary Terminal Order Numbers

Description	Order Number
Single-tier, 16 channels, screw-type terminal	6ES7 193-1FH20-0XA0
Two-tier, 16 channels, screw-type terminal	6ES7 193-1FH30-0XA0
Single-tier, 16 channels, spring terminal	6ES7 193-1FH50-0XA0
Two-tier, 16 channels, spring terminal	6ES7 193-1FH60-0XA0
Single-tier, 32 channels, screw-type terminal	6ES7 193-1FL20-0XA0
Two-tier, 32 channels, screw-type terminal	6ES7 193-1FL30-0XA0
Single-tier, 32 channels, spring terminal	6ES7 193-1FL50-0XA0
Two-tier, 32 channels, spring terminal	6ES7 193-1FL60-0XA0

Labeling Strips

You obtain additional labeling strips by quoting the following order number:

- DIN A4 with 10 strips, 16 channels: 6ES7 193-1BH00-0XA0
- DIN A4 with 10 strips, 32 channels: 6ES7 193-1BL00-0XA0

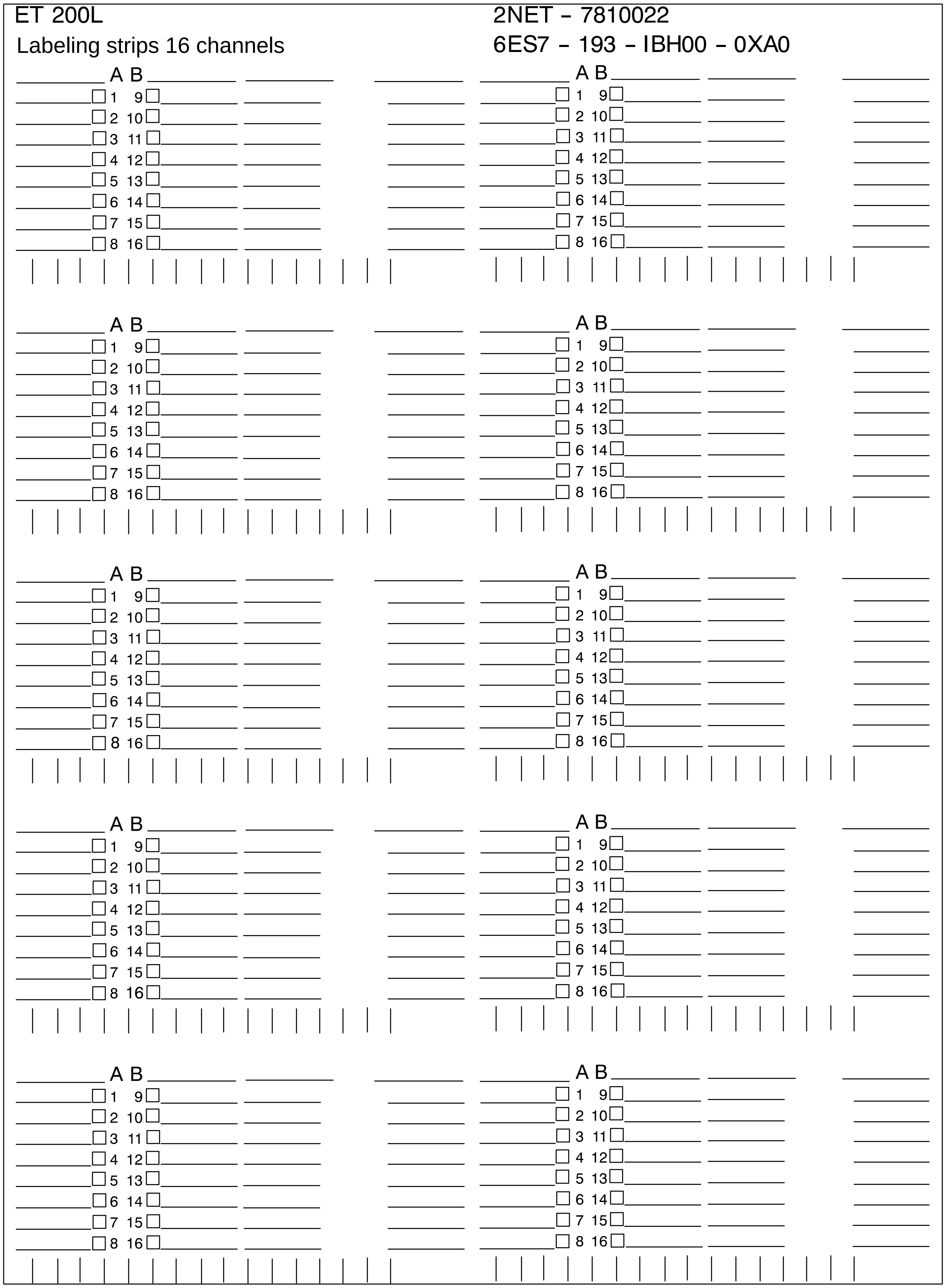


Figure A-1 Labeling Strips 6ES7 193-1BH00-0XA0

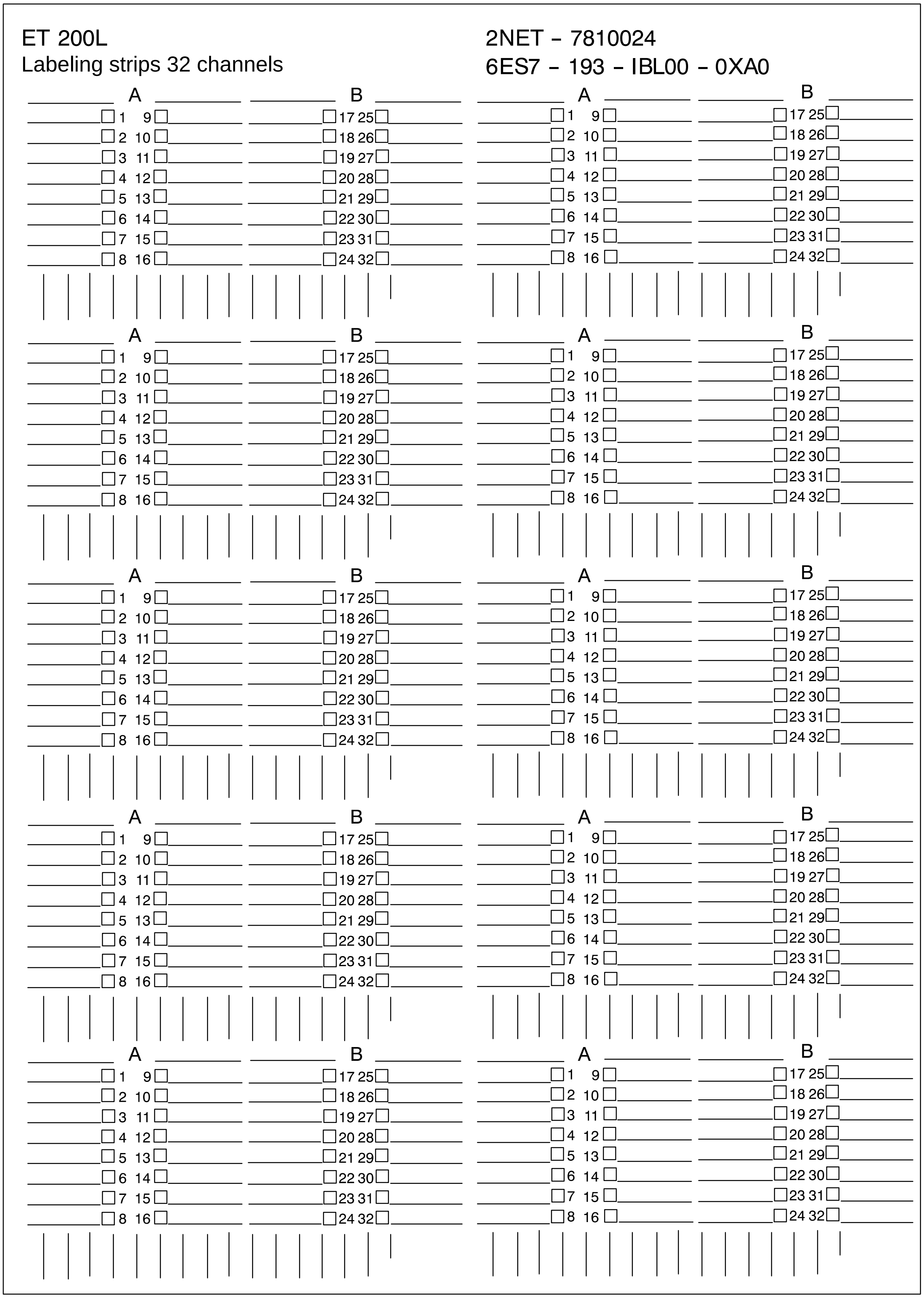


Figure A-2 Labeling Strips 6ES7 193-1BL00-0XA0

A.2 Order Numbers for Smart Connect SC Components

Introduction

You will find here the order numbers for Smart Connect SC components.

Terminal Block and Terminals

Table A-4 Terminal Block and Terminal Order Numbers

Description	Order Number
Terminal block TB16 SC (screw-type terminal)	6ES7 120-0AH01-0AA0
Terminal block TB16 SC (spring terminal)	6ES7 120-0BH01-0AA0
Supplementary terminal, single-tier (screw-type terminal)	6ES7 120-1AH00-0AA0
Supplementary terminal, single-tier (spring terminal)	6ES7 120-1BH00-0AA0
Supplementary terminal, double-tier (screw-type terminal)	6ES7 120-2AH00-0AA0
Supplementary terminal, double-tier (spring terminal)	6ES7 120-2BH00-0AA0
Shield terminal	6ES7 192-0AA00-0AA0

Digital SC Electronic Modules

Table A-5 Digital SC Electronic Module Order Numbers

Description	Order Number
Digital electronic module 2DIDC24V	6ES7 121-1BB00-0AA0
Digital electronic module 2DODC24V0.5A	6ES7 122-1BB00-0AA0
Digital electronic module 2DODC24V2A	6ES7 122-1BB10-0AA0
Digital electronic module 1DIAC120/230V	6ES7 121-1FA00-0AA0
Digital electronic module 1DOAC120/230V1A	6ES7 122-1FA00-0AA0
Digital electronic module 1DORel.AC230V	6ES7 122-1HA01-0AA0

Analog SC Electronic Modules

Table A-6 Analog SC Electronic Module Order Numbers

Description	Order Number
Analog electronic module 2 AI U	6ES7 123-1FB00-0AB0
High-speed analog electronic module 2 AI HS U	6ES7 123-1FB50-0AB0
Analog electronic module 2 AI I	6ES7 123-1GB00-0AB0
Analog electronic module 2 AI I	6ES7 123-1GB10-0AB0
High-speed analog electronic module 2 AI HS I (0/4–20 mA, 4-wire measuring transducer)	6ES7 123-1GB60-0AB0
High-speed analog electronic module 2 AI HS I (4–20 mA, 2-wire measuring transducer)	6ES7 123-1GB50-0AB0
Analog electronic module 2 AI TC	6ES7 123-1JB00-0AB0
Analog electronic module 1 AI RTD	6ES7 123-1JA00-0AB0
Analog electronic module 1 AO U	6ES7 124-1FA00-0AB0
Analog electronic module 1 AO I	6ES7 124-1GA00-0AB0

Function Modules

Table A-7 Function Modules

Description	Order Number
Counter module 1COUNT40kHz	6ES7 127-1BE00-0AB0

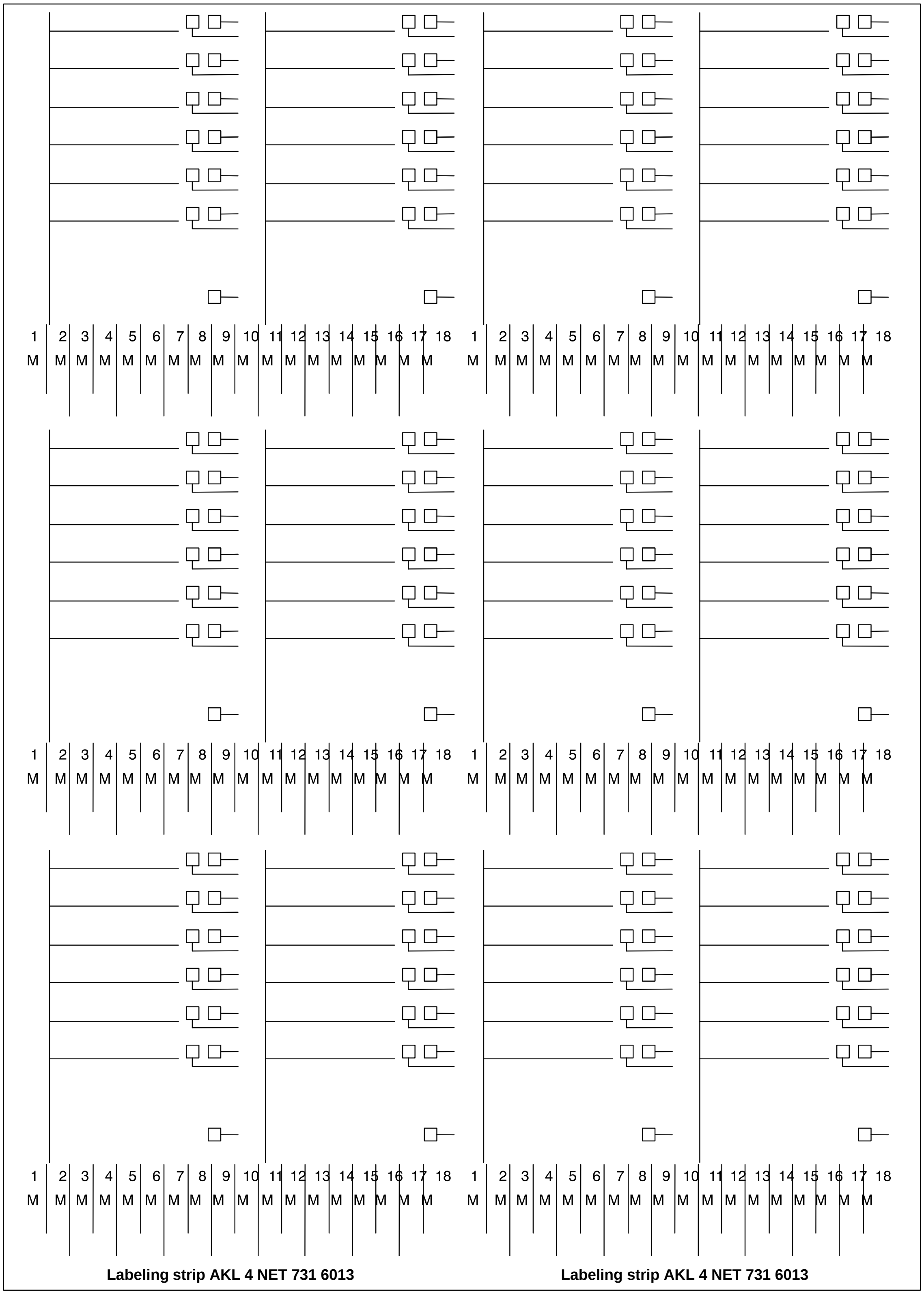


Figure A-3 Labeling Strips for Smart Connect

A.3 Order Numbers for PROFIBUS Accessories

Introduction

In this section, we have listed the order numbers for PROFIBUS accessories which you require for the ET 200L.

Further, you will find notes on the different manuals you will require, depending on the PROFIBUS-DP master being used.

Network Components for the ET 200

Table A-8 lists all the network components for the ET 200L distributed I/O device which you may require in conjunction with the ET 200L.

Table A-8 Accessories for the ET 200 Distributed I/O Device

Accessories	Order Number
RS 485 repeater, PROFIBUS -DP, IP 20	6ES7 972-0AA00-0XA0
PROFIBUS bus terminator (12 MBaud) (not for interface module IM-SC)	
• Anthracite (without programming port)	6ES7 972-0BA10-0XA0
• Anthracite (with programming port)	6ES7 972-0BB10-0XA0
PROFIBUS bus terminator (1.5 MBaud)	6ES7 972-0CA30-0XA0
Bus cable (not for interface module IM-SC)	
• Normal	6XV1 830-0AH10
• Drum cable	6XV1 830-3BH10
• Direct-buried cable	6XV1 830-3AH10
Repeater adapter	6GK1 510-1AA00
Optical link modules for glass fiber-optic cables	6GK1 502-3AB00 6GK1 502-4AB00
PROFIBUS drop cable	6ES7 901-4BD00-0XA0

Manuals for STEP 7 and SIMATIC S7

You require one of the manuals listed in Table A-9 to program and commission the ET 200L with STEP 7.

Table A-9 Manuals for STEP 7 and SIMATIC S7

Manual	Contents
S7-300 Programmable Controller Hardware and Installation	Includes • Description of the PROFIBUS-DP interface of CPU 315-2 DP • Installing a PROFIBUS-DP network • Bus connector and RS 485 repeater
M7-300 Programmable Controller Hardware and Installation	Includes • Description of the PROFIBUS-DP interface in M7-300 • Installing a PROFIBUS-DP network • Bus connector and RS 485 repeater
S7-400, M7-400 Programmable Controllers Hardware and Installation	Includes • Description of the PROFIBUS-DP interface in S7-400 and M7-400 • Installing a PROFIBUS-DP network • Bus connector and RS 485 repeater
System software for S7-300 and S7-400 Program Design Programming manual	Includes Description of addressing and diagnostics on SIMATIC S7
System software for S7-300 and S7-400 System and Standard Functions Reference manual	Description of the SFCs in STEP 7

Manual for ET 200 on SIMATIC S5

You require one of the manuals listed in Table A-9 to program and commission the ET 200L with COM ET 200.

Table A-10 Manuals for ET 200 on SIMATIC S5

Manual	Order Number	Contents
ET 200 distributed I/O device	6ES5 998-3ES.1	• Description of master interface IM 308-B for S5-115U/H, S5-135U, and S5-155U/H • Handling COM ET 200 V 4.x
ET 200 distributed I/O device	6ES5 998-3ES.2	• Description of master interface IM 308-C for S5-115U/H, S5-135U and S5-155U/H • Description of the S5-95U with PROFIBUS-DP master interface • Handling COM ET 200 Windows • Handling FB IM308C

Type and Device Master Files

B

Type File

All the properties of a DP slave are stored in a type file.

You can integrate the type file of the ET 200L (Table C-1) in COM ET 200 as of Version 4.0, COM ET 200 Windows and STEP 7.

The type files for the ET 200L-SC (Table C-4) can be integrated in COM ET 200 Windows as of Version 2.1.

The type files for a default start-up of the ET 200L-SC with a standard, non-Siemens DP master are described in Table C-14. You can integrate the type files of the default start-up in COM ET 200 Windows as of Version 1.0.

If you need the type file, you can get it using a modem by calling +49 (911) 737972 or from the SINEC library in AUTFORUM in CompuServe (`GO AUTFORUM`).

Device Master File

All slave-specific characteristics are stored in a device master file (GSD file). The structure of the device master file is laid down in EN 50 170 Volume 2, PROFIBUS.

If you need the device master file, you can get it using a modem by calling +49 (911) 737972 or from the SINEC library in AUTFORUM in CompuServe (`GO AUTFORUM`).

Configuration Software

The following table shows the version of the configuration software as of which the ET 200L, ET 200L-SC and ET 200L-SC IM-SC are integrated.

Table B-1 Version der Projektier-Software

Order Number of the Module (6ES7 ... 0XB0)	COM ET 200 Windows as of Version	COM PROFIBUS as of Version	STEP 7 as of Version
131-1BH00	2.1	3.0	3.0
131-1BL00	2.1	3.0	3.0
132-1BH00	2.1	3.0	3.0
132-1BL00	2.1	3.0	3.0
133-1BL00	2.1	3.0	3.0
131-1EH00	–	3.0	3.1
132-1EH00	–	3.0	3.1
133-1EH00	–	3.0	3.1
131-1BH10	2.1	3.0	3.0
131-1BH11	–	3.0	3.0
131-1BL10	2.1	3.0	3.0
131-1BL11	–	3.0	3.0
132-1BH10	2.1	3.0	3.0
132-1BH11	–	3.0	3.0
133-1BL10	–	3.0	3.0
138-1XL00	–	3.2	4.1

Most Important Characteristics

If you do not have the device master file in front of you, the most important characteristics of the ET 200L distributed I/O device are listed here in tabular form.

Table B-2 Data for PROFIBUS-DP

Characteristic	DP Keyword in Accordance with EN 50 170 Volume 2, PROFIBUS	ET 200L	ET 200L-SC or ET 200L-SC IM-SC
Manufacturer ID	Ident_Number	See Table C-1	See Table C-4
Supports FMS	FMS_supp	No	No
Supports 9.6 kbps	9.6_supp	Yes	Yes
Supports 19.2 kbps	19.2_supp	Yes	Yes
Supports 93.75 kbps	93.75_supp	Yes	Yes
Supports 187.5 kbps	187.5_supp	Yes	Yes
Supports 500 kbps	500_supp	Yes	Yes
Supports 1.5 Mbps	1.5M_supp	Yes	Yes
Supports 3 Mbps	3M_supp	No*	No
Supports 6 Mbps	6M_supp	No*	No
Supports the FREEZE control command	Freeze_Mode_supp	Yes	Yes
Supports SYNC control command	Sync_Mode_supp	Yes	Yes
Supports automatic baud rate recognition	Auto_Baud_supp	Yes	Yes
PROFIBUS address modifiable using software	Set_Slave_Add_supp	No	No
User-specific parameterization data (default)	User_Prm_Data	Yes	Yes
Length of the user-specific data	User_Prm_Data_Len	5 bytes $5 \times 00_H$	Variable
Modular device	Modular_Station	0	1
Maximum number of modules	Max_Module	0	8 (ET 200L-SC) 16 (ET 200L-SC IM-SC)
Maximum number of inputs	Max_Input_Len	See Table B-3 and B-4	
Maximum number of outputs	Max_Output_Len		
Maximum number of inputs and outputs together	Max_Data_Len		
Central display of manufacturer-specific status and error messages	Unit_Diag_Bit	Not used	Not used
Assignment of values to texts in device-specific diagnostic field	Unit_Diag_Area	Not used	Used
Identification of all modules of a modular DP slave	Module, End_Module	No	No
Assignment of manufacturer-specific error types to texts in channel-specific diagnostic field	Channel_Diag	No	No

* Exception: AC terminal blocks of the ET 200L

Inputs and Outputs with the ET 200L

Table B-3 indicates the maximum number of inputs and outputs of the different ET 200L electronics blocks:

Table B-3 Maximum Number of Inputs and Outputs with the ET 200L

Electronics Block	Maximum Number of		
	Inputs (Bytes)	Outputs (Bytes)	Inputs and Outputs Together (Bytes)
L 16 DI DC 24 V	2	0	2
L 32 DI DC 24 V	4	0	4
L 16 DO DC 24 V/0.5 A	0	2	2
L 32 DO DC 24 V/0.5 A	0	4	4
L 16 DI/16 DO DC 24 V/0.5 A	2	2	4

Inputs and Outputs with the ET 200L-SC or ET 200L-SC IM-SC

Table B-4 indicates the maximum number of inputs and outputs of the different ET 200L-SC electronics blocks.

Table B-4 Maximum Number of Inputs and Outputs with the ET 200L-SC or ET 200L-SC IM-SC

Electronics Block	Maximum Number of Digital[1]			Maximum Number of Analog[2]		
	Inputs (Bytes)	Outputs (Bytes)	Inputs and Outputs Together (Bytes)	Inputs (Bytes)	Outputs (Bytes)	Inputs and Outputs Together (Bytes)
	Type File with SI802XA?.200[3,4]			Type File with SI802XB?.200[3,4]		
L-SC 16 DI DC 24 V	10	8	18	34	32	66
L-SC 32 DI DC 24 V	12	8	20	36	32	68
L-SC 16 DO DC 24 V/0,5 A	8	10	18	32	34	66
L-SC 16 DI/16 DO DC 24 V/0,5 A	–	–	–	34	34	68
L-SC IM-SC	64	64	128	–	–	–

1 Only digital input and output modules are connected to the ET 200L-SC.
2 Analog and digital input and output modules are connected to the ET 200L-SC; you can use digital or analog or digital and analog modules on the Smart Connect.
3 “X” = 7, 8, 9 or C
4 “?” stands for a language abbreviation; D = German

Configuration Frame and Parameterization Frame for the ET 200L

C

Using STEP 7 as of V 3.2 or COM PROFIBUS as of V 3.0

If you configure and parameterize the ET 200L using STEP 7 or using COM PROFIBUS as of V 3.0 (or COM ET 200 Windows as of Version 2.1), you can call on an on-line help system for assistance with your entries.

You need **only** the information in Section C.5. If you want to run your ET 200L-SC or ET 200L-SC IM-SC without parameterization, you will find the default configuration for a default start-up in Section C.5.

Using Any Configuration Software

If you enter the configuration of the ET 200L-SC or ET 200L-SC IM-SC using a configuration frame and a parameterization frame, you will find the information you require in Section C.3/C.4.

Default Start-Up

If you run your ET 200L-SC or ET 200L-SC IM-SC without parameterization (e.g. with S5-95U), you will find the default configuration for a default start-up in Section C.5.

Note

When creating the configuration and parameterization frames, you must use the predefined identifiers. If you use the wrong identifiers, the ET 200L-SC or ET 200L-SC IM-SC cannot work properly.

The ET 200L-SC or ET 200L-SC IM-SC does not check all the contents of the configuration and parameterization frames for plausibility.

Contents of the Chapter

C.1 Identifiers for the ET 200L

DP Identifier

The various electronic blocks are distinguished by means of the DP identifier within PROFIBUS-DP. Table C-1 lists the DP identifiers for the ET 200L distributed I/O device.

Table C-1 DP Identifiers for the ET 200L

Electronics Block ET 200L	Order Number 6ES7 ... -0XB0	Name of Type File ... .200	Manufac-turer ID	DP Identifier		Con-sis-tency	Address Length (Bytes)	Ad-dress Area
				Slot 0	Slot 1			
L 16 DI DC 24 V	131-1BH00	SI0014AX[1]	0014_H	000	017	Byte	2	Digital
L 32 DI DC 24 V	131-1BL00	SI0015AX[1]	0015_H	000	019	Byte	4	Digital
L 16 DO DC 24 V/0.5 A	132-1BH00	SI0016AX[1]	0016_H	033	000	Byte	2	Digital
L 32 DO DC 24 V/0.5 A	132-1BL00	SI0011AX[1]	0011_H	035	000	Byte	4	Digital
L 16 DI/16 DO DC 24 V/0.5 A	133-1BL00	SI0017AX[1]	0017_H	033	017	Byte	2×2[2]	Digital
L 16 DI AC 120 V	131-1EH00	SI002AAX[1]	$002A_H$	000	017	Byte	2	Digital
L 16 DO AC 120 V/ 1.0A	132-1EH00	SI0028AX[1]	0028_H	033	000	Byte	2	Digital
L 8 DI/DO AC 120 V/1.0 A	133-1EH00	SI0029AX[1]	0029_H	032	016	Byte	2	Digital

1 “X” stands for a language-independent version
2 Two bytes each for the input and output ranges

C.2 Types of ET 200L-SC or ET 200L-SC IM-SC Start-Up

ET 200L-SC or ET 200L-SC IM-SC

In the case of the ET 200L-SC or ET 200L-SC IM-SC you can carry out a normal start-up (with configuration) or a default start-up (with a default configuration). The table below indicates how the different electronics blocks are displayed in the configuration software and which type/device master files are valid.

Table C-2 Types of ET 200L-SC of ET 200L-SC IM-SC Start-Up

Display in the Configuration Software	Type File Name	Order Number in the Configuration Software 6ES7...0XB0	Device Master File Name[3]	Start-Up Type
L-SC 16DI DP	SI8027A?.200[1]	131-1BH10	-	Normal (SC digital only)
L-SC 16DI /a DP	SI8027B?.200[1]	131-1BH11	SIEM8027.GSG	Normal (SC analog and digital)
L-SC 16DI/def. DP	SI8027ZX.200[2]	131-1BH10	-	Default (SC digital only)
L-SC 32DI DP	SI8029A?.200[1]	131-1BL10	-	Normal (SC digital only)
L-SC 32DI /a DP	SI8029B?.200[1]	131-1BL11	SIEM8029.GSG	Normal (SC analog and digital)
L-SC 32DI/def. DP	SI8029ZX.200[2]	131-1BL10	-	Default (SC digital only)
L-SC 16DO DP	SI8028A?.200[1]	132-1BH10	-	Normal (SC digital only)
L-SC 16DO /a DP	SI8028B?.200[1]	132-1BH11	SIEM8028.GSG	Normal (SC analog and digital)
L-SC 16DO/def. DP	SI8028ZX.200[2]	132-1BH10	-	Default (SC digital only)
L-SC 16DI/DO /a DP	SI802CB?.200[1]	133-1BL10	SIEM802C.GSG	Normal (SC analog and digital)
L-SC 16DI/DO/d. DP	SI802CZX.200[2]	133-1BL10	-	Default (SC digital only)
L-SC IM-SC DP	SI802BA?.200[1]	138-1XL00	SIEM802B.GSG	Normal (SC analog and digital)
L-SC IM-SC/def. DP	SI802BZX.200[2]	138-1XL00	-	Default (SC digital only)

1 ”?” stands for a language-dependent abbreviation; D = German
2 “X” stands for a language-independent version
3 The extension “.GSG” stands for German, “.GSE” for English, “.GSF” for French, and so on.

Note

You can also use the SI80__B?.200 type files to configure the existing (only digitally upgradable) ET 200L-SC (131-1BH10, 131-1BL10 and 132-1BH10). You can of course then only use digital SC modules.

C.3 Configuration Frame for the ET 200L-SC

Introduction

If a configuration frame is sent to the ET 200L-SC (or ET 200L-SC IM-SC) that deviates from the default configuration, a parameterization frame must be sent to the ET 200L-SC (or ET 200L-SC IM-SC) as well.

In this case, the ET 200L-SC (or ET 200L-SC IM-SC) always expects a complete parameterization frame for all the slots in use.

If you have not connected any SC electronic modules in the ET 200L-SC or ET 200L-SC IM-SC, the module only starts up when there is no configuration available for the Smart Connect part (see Section C.3.3 for an example).

Structure of the Configuration Frame

The structure of the configuration frame depends on the address distribution of the Smart Connect electronic modules used.

The ET 200L-SC or ET 200L-SC IM-SC can work with various configuration frames. The configuration frame that can be read from the ET 200L-SC or ET 200L-SC IM-SC is described below. Possible changes to the frame are also described.

Note

SC function modules, such as the counter module, behave in the same way as analog SC modules.

Table C-3 Structure of the Configuration Frame

Configuration		Slot	Identifiers (Hexadecimal) in Bytes				
			0	1	2	3	4
Virtual slot		1	04	00	00	AD	C4
		2	04	00	00	9B	40
		3	04	00	00	8F	C0
ET 200L-SC (electronics block)		4 to 5 or 7*	See Table C-4				
Smart Connect (SC)	SC digital modules	6 or 8*	See Table C-5 and Table C-6				
	SC analog modules, if only analog modules are used	6 or 8*					
	SC analog modules, if analog and digital modules are used	7 or 9*					

Table C-3 Structure of the Configuration Frame, continued

Configuration		Slot	Identifiers (Hexadecimal) in Bytes				
			0	1	2	3	4
ET 200L-SC IM-SC Smart Connect (SC)	SC digital modules	4	See Table C-7 and Table C-8				
	SC analog modules, if only analog modules are used	4					
	SC analog modules, if analog and digital modules are used	5					

* The slot depends on the type of the ET 200L-SC electronics block; 8 bits of an electronic block occupy one slot

Slot Assignment

The slot assignment depends on the Smart Connect Modules used:

- Slot 6 or 8:
  - For digital modules
  - For analog modules when only analog modules are connected to the Smart Connect
- Slot 7 or 9:
  - For analog modules when analog and digital modules are connected to the Smart Connect

Contents of the Section

In the following section you will find all the information you need on the structure of the parameterization frame.

C.3.1 Identifiers for the ET 200L-SC

Identifiers for the ET 200L-SC

The identifiers for configuration depend on the electronics block used. Table C-4 contains all the DP identifiers for the ET 200L-SC.

Table C-4 Identifiers for the ET 200L-SC

Electronics Block ET 200L-SC	Order Number 6ES7 ... -0XB0	Manufacturer ID	Slot	DP Identifiers (Hexadecimal) in Bytes					Consistency	Address Length (Bytes)[1]	Address Area[2]
				0	1	2	3	4			
L-SC 16 DI DC 24 V	131-0BH11	8027_H	4	43	00	00	9F	41	Byte	66	Digital
			5	43	00	00	9F	41			
L-SC 32 DI DC 24 V	131-1BL11	8029_H	4	43	00	00	9F	41	Byte	68	Digital
			5	43	00	00	9F	41			
			6	43	00	00	9F	41			
			7	43	00	00	9F	41			
L-SC 16 DO DC 24 V/0.5 A	132-1BH11	8028_H	4	83	00	00	AF	48	Byte	66	Digital
			5	83	00	00	AF	48			
L-SC 16 DI/ 16 DO DC 24 V	133-1BL10	$802C_H$	4	83	00	00	AF	48	Byte	68	Digital
			5	83	00	00	AF	48			
			6	43	00	00	9F	41			
			7	43	00	00	9F	41			

1 Total address length of the ET 200L-SC

2 The address area “Digital” and consistency “Byte” apply only to the electronic blocks. If you use analog modules on the Smart Connect, the address area is “Analog” and the consistency “Word”.

Identifiers for the Smart Connect with Digital Modules

Table C-5 Identifiers for the Smart Connect with Digital ET 200L-SC Modules

Smart Connect	Input Byte	Output Byte	Identifiers (Hexadecimal)				
			0	1	2	3	4
DI SC (SC configuration with SC input modules)	1	---	43	00	00	42	45
	2	---	43	01	00	42	45
	3 to 8*	---	43	02 to 07	00	42	45
DO SC (SC configuration with SC output modules)	---	1	83	00	00	42	45
	---	2	83	01	00	42	45
	---	3 to 8*	83	02 to 07	00	42	45
DI/DO SC (SC configuration with SC input and output modules)	1	1	C2	00	00	42	45
	1	2	C2	00	01	42	45
	2	1	C2	01	00	42	45
	2	2	C2	01	01	42	45
	3 to 8*	3 to 8*	C2	02 to 07	02 to 07	42	45

Identifiers for the Smart Connect with Analog Modules

Table C-6 Identifiers for the Smart Connect with Analog ET 200L-SC Modules

Smart Connect	Input Word	Output Word	Identifiers (Hexadecimal)				
			0	1	2	3	4
DI SC (SC configuration with SC input modules)	1	---	43	40	00	42	45
	2	---	43	41	00	42	45
	3 to 16	---	43	42 to 4F	00	42	45
DO SC (SC configuration with SC output modules)	---	1	83	40	00	42	45
	---	2	83	41	00	42	45
	---	3 to 16	83	42 to 4F	00	42	45
DI/DO SC (SC configuration with SC input and output modules)	1	1	C2	40	40	42	45
	1	2	C2	40	41	42	45
	2	1	C2	41	40	42	45
	2	2	C2	41	41	42	45
	3 to 16	3 to 16	C2	42 to 4F	42 to 4F	42	45

Note

The byte size in the DP identifiers “1” and “2” becomes the word size when the Smart Connect is analog. The word size begins with the value 40_H (for 1 word) and ends at $4F_H$ (16 words).

If only input modules or only output modules are connected to the Smart Connect, the byte and word size is in the DP identifier “1”.

If input and output modules are connected to the Smart Connect, the byte and word size of the outputs is in the DP identifier “1” and the byte and word size of the inputs is in the DP identifier “2”.

For the Smart Connect with digital and analog modules, the total length of the input and output range is a maximum of 32 bytes in each case.

C.3.2 Identifiers for the ET 200L-SC IM-SC

Identifiers for the Smart Connect with Digital Modules

Table C-7 Identifiers for the Smart Connect with Digital ET 200L-SC IM-SC Modules

Smart Connect	Input Byte	Output Byte	Identifiers (Hexadecimal)				
			0	1	2	3	4
DI SC (SC structure with SC input modules)	1	---	43	00	00	42	4A
	2	---	43	01	00	42	4A
	3 to 16	---	43	02 to 0F	00	42	4A
DO SC (SC structure with SC output modules)	---	1	83	00	00	42	4A
	---	2	83	01	00	42	4A
	---	3 to 16	83	02 to 0F	00	42	4A
DI/DO SC (SC structure with SC input and output modules)	1	1	C2	00	00	42	4A
	1	2	C2	00	01	42	4A
	2	1	C2	01	00	42	4A
	2	2	C2	01	01	42	4A
	3 to 16	3 to 16	C2	02 to 0F	02 to 0F	42	4A

Identifiers for the Smart Connect with Analog Modules

Table C-8 Identifiers for the Smart Connect with ET 200L-SC IM-SC Analog Modules

Smart Connect	Input Word	Output Word	Identifiers (Hexadecimal)				
			0	1	2	3	4
AI SC (SC structure with SC input modules)	1	---	43	40	00	42	4A
	2	---	43	41	00	42	4A
	3 to 32	---	43	42 to 5F	00	42	4A
AO SC (SC structure with SC output modules)	---	1	83	40	00	42	4A
	---	2	83	41	00	42	4A
	---	3 to 32	83	42 to 5F	00	42	4A
AI/AO SC (SC structure with SC input and output modules)	1	1	C2	40	40	42	4A
	1	2	C2	40	41	42	4A
	2	1	C2	41	40	42	4A
	2	2	C2	41	41	42	4A
	3 to 32	3 to 32	C2	42 to 5F	42 to 5F	42	4A

Note

The byte size in the DP identifiers “1” and “2” becomes the word size when the Smart Connect is analog. The word size begins with the value 40_H (for 1 word) and ends at $5F_H$ (32 words).

If only input modules or only output modules are connected to the Smart Connect, the byte and word size is in the DP identifier “1”.

If input and output modules are connected to the Smart Connect, the byte and word size of the outputs is in the DP identifier “1” and the byte and word size of the inputs is in the DP identifier “2”.

For the Smart Connect with digital and analog modules, the total length of the input and output range is a maximum of 64 bytes in each case.

C.3.3 Configuration Frame Example

1st Example

The following example describes the structure of a configuration frame of an ET 200L-SC 16 DO DC 24V/0.5A with:

- 2 bytes DO
- A Smart Connect with 2 electronic modules (SC): 2DI and 2DO

The configuration frame thus consists of the 25 bytes described below:

Configuration Frame for Example 1

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
83-01-00-AF-48	4	2 bytes DO
C2-00-00-42-45	5	Smart Connect with electronic modules (SC): 2DI, 2DO. The inputs and outputs of the 2DI/2DO are distributed over 1 input and 1 output byte.

2nd Example

The following example describes the structure of a configuration frame of an ET 200L-SC 16 DI/16 DO DC 24V/0.5A with:

- 2 bytes DI, 2 bytes DO
- A Smart Connect with 4 digital electronic modules: 2 × 2DI and 2 × 2DO and with 3 analog electronic modules: 1 × 2AI, 1 × 1AI and 1 × 1AO

The configuration frame thus consists of the following 30 bytes:

Configuration Frame for Example 2

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
C2-01-01-AF-48	4	2 bytes DO / 2 bytes DI
C2-01-01-42-45	5	SC with digital electronic modules: 2 × 2DI and 2 × 2DO. The inputs and outputs of the 2 × 2DI/2 × 2DO are distributed over 2 input and 2 output bytes.
C2-40-42-42-45	6	SC with analog electronic modules: 1 × 2AI, 1 × 1AI and 1 × 1AO. The inputs and outputs are distributed over 3 input words and 1 output word.

3rd Example

The following example describes the structure of a configuration frame of an ET 200L-SC 32 DI DC 24V with:

- 4 bytes DI
- No Smart Connect

The configuration frame thus consists of the 20 bytes described below:

Configuration Frame for Example 3

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-AF-C0	3	
43-03-00-9F-41	4	4 bytes DI

Note

- You must always transfer the complete configuration frame to the ET 200L-SC.
- If you have not inserted a Smart Connect module, a configuration frame is not sent for the SC section (slots 5 and 6).

4th Example

The following example describes the structure of a configuration frame of an ET 200L-SC IM-SC with:

- A Smart Connect with 7 digital electronic modules: 4 × 2DI and 3 × 2DO and with 6 analog electronic modules: 1 × 2AI, 2 × 1AI and 3 × 1AO

The configuration frame thus consists of the 25 bytes described below:

Configuration Frame for Example 4

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
C2-04-03-42-4A	4	SC with digital electronic modules: 4 × 2DI and 3 × 2DO. The inputs and outputs are distributed over 4 input and 5 output bytes.
C2-48-44-42-4A	5	SC with analog electronic modules: 1 × 2AI, 2 × 1AI and 3 × 1AO. The inputs and outputs are distributed over 5 input and 9 output words.

5th Example

The following example describes the structure of a configuration frame of an ET 200L-SC IM-SC with:

- A Smart Connect with 3 digital electronic modules: 2 × 2DI and 1 × 2DO and with 2 analog electronic modules: 1 × 2AI and 1 × 1AI and with one counter module (3 words I and O)

The configuration frame thus consists of the following 25 bytes:

Configuration Frame for Example 5

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-AF-C0	3	
C2-00-01-42-4A	4	SC with digital electronic modules: 2 × 2DI and 1 × 2DO. The inputs and outputs are distributed over 2 input and 1 output byte.
C2-42-45-42-4A	5	SC with analog electronic modules: 1 × 2AI, 1 × 1AI and 1 × 1COUNT40kHz. The inputs and outputs are distributed over 6 input nad 3 output words.

C.4 Parameterization Frame for the ET 200L-SC or ET 200L-SC IM-SC

ET 200L-SC Parameterization Frame

All the parameterizable values of the ET 200-SC are stored in the parameterization frame. The maximum length of the parameterization frame is 185 bytes.

The maximum length is required for the following Smart Connect module combination:

- 8 × 2AI

ET 200L-SC IM-SC Parameterization Frame

The structure of the ET 200L-SC IM-SC parameterization frame is identical to that of the ET 200L-SC. In the case of the ET 200L-SC IM-SC you can parameterize up to 16 SC modules. You must not exceed the maximum length of the parameterization frame, which is 244 bytes (see Section 2.4).

Structure of the Parameterization Frame

The following figure shows the basic structure of the parameterization frame of the ET 200L-SC or ET 200L-SC IM-SC:

Standard section (7 bytes)	See Figure C-2
Parameters for the status (3 bytes)	See Figure C-3
Parameters for the ET 200L-SC (21 to 185 bytes) Parameters for the ET 200L-SC IM-SC (21 to 244 bytes)	See Section C.4.2

Figure C-1 Structure of the Parameterization Frame of the ET 200L-SC and ET 200L-SC IM-SC

Contents of the Section

This section contains all the information you require on the structure of the parameterization frame.

C.4.1 Standard Section and Parameters for the Status

Overview

The standard section is identical for all ET 200L modules. The parameters for the status have an identical structure for all ET 200L-SC and ET 200L-SC IM-SC modules.

Standard Section

The first 7 bytes of the parameterization frame are standardized in accordance with EN 50170 Volume 2, PROFIBUS and contain the following, for example:

Byte 0	88_H	Station status
Byte 1	01_H	Watchdog factor 1
Byte 2	06_H	Watchdog factor 2
Byte 3	$0B_H$	Response delay T_{RDY}
Byte 4	80_H	Manufacturer ID, high-byte
Byte 5	27_H	Manufacturer ID, low-byte
Byte 6	00_H	Group ID

Figure C-2 Standard Section of the Parameterization Frame

ET 200L: Parameters for Status

The next 5 bytes contain the status bytes for the ET 200L. The default assignment for these 5 bytes is: 00_H 00_H 00_H 00_H 00_H.

ET 200L-SC and ET 200L-SC IM-SC: Parameters for Status

The next 3 bytes are the status bytes. The default assignment for these 3 bytes is: 40_H 20_H 00_H. The meaning of the parameters is given in Figure C-3:

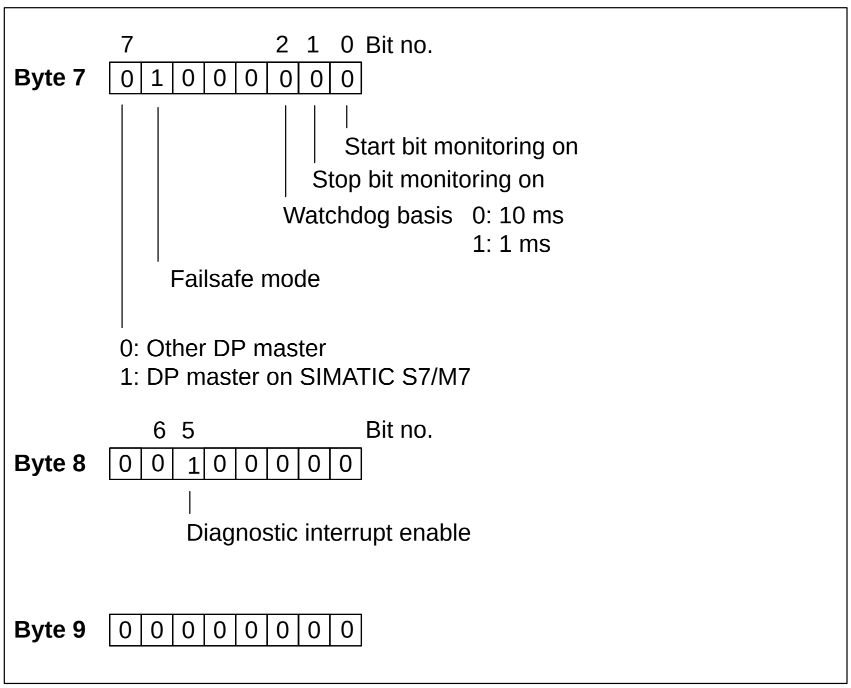


Figure C-3 Parameters for the Status

C.4.2 Parameters for the Smart Connect Section

Overview

The parameters for the Smart Connect section are stored in various data records. Table 5-4 shows the composition of the records.

Configuration ET 200L-SC

The data records for the ET 200L-SC are arranged in the following order:

Table C-9 Data Records for the ET 200L-SC

Parameter Record	Slot			Length	Meaning
	Digital SC Modules Only	Analog SC Modules Only	Digital and Analog SC Modules		
DS0 SC digital	5		5	7 bytes	Diagnostic interrupt for the digital Smart Connect modules
DS128 SC digital	5		5	7 bytes + 7 bytes per SC module	Configuration data for the digital Smart Connect modules
DS0 SC analog		5	6	7 bytes	Diagnostic interrupt for the analog Smart Connect modules
DS128 SC analog		5	6	7 bytes + 7 bytes per SC module	Configuration data for the analog Smart Connect modules
DS130 SC analog		5	6	7 bytes + 2 bytes per SC module + 5 bytes per channel	Parameters for the analog Smart Connect modules

Configuration ET 200L-SC IM-SC

The data records for the ET 200L-SC IM-SC are arranged in the following order:

Table C-10 Data Records for the ET 200L-SC IM-SC

Parameter Record	Slot			Length	Meaning
	Digital SC Modules Only	Analog SC Modules Only	Digital and Analog SC Modules		
DS0 SC digital	4		4	7 bytes	Diagnostic interrupt for the digital Smart Connect modules
DS128 SC digital	4		4	7 bytes + 7 bytes per SC module	Configuration data for the digital Smart Connect modules
DS0 SC analog		4	5	7 bytes	Diagnostic interrupt for the analog Smart Connect modules
DS128 SC analog		4	5	7 bytes + 7 bytes per SC module	Configuration data for the analog Smart Connect modules
DS130 SC analog		4	5	7 bytes + 2 bytes per analog SC module + 5 bytes per channel + 11 bytes per counter module	Parameters for the analog Smart Connect modules Parameters for the counter module

Note

You must always transfer the complete parameterization frame for the configuration of the ET 200L-SC or ET 200L-SC IM-SC.

The information in records DS128 and DS130 for the analog Smart Connect modules must correspond.

C.4.3 Data Record 0

Data Record 0

Record 0 consists of 7 bytes (byte 0 to byte 6) and is generated separately for digital and analog Smart Connect modules. Record 0 has the same content for both modules.

The following figure describes the structure of DS0 for the ET 200L-SC:

Byte 0	07_H	Block length
Byte 1	$5F_H$	S7 constant
Byte 2	$04_H/05_H/06_H$	Slot

- **ET 200L-SC**: For analog modules when analog and digital modules are connected to the SC
- **ET 200L-SC IM-SC**: For analog modules when analog modules and digital modules are connected to the SC
- **ET 200L-SC IM-SC**: For digital modules and for analog modules when only analog modules are connected to the SC
- **ET 200L-SC**: For digital modules and analog modules when only analog modules are connected to the SC

Byte 3	00_H	Record number
Byte 4	02_H	Record length

Byte 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

0: Diagnostics enabling blocked
1: Diagnostics enabling

Byte 6	00_H	Not applicable

Figure C-4 Structure of Data Record 0

C.4.4 Data Record 128

Overview

Data record 128 consists of a header with a length of 7 bytes and an additional 7 bytes per Smart Connect module. These are described below.

Data Record 128, Header

Figure C-5 describes the header of data record 128.

Byte 0	Variable	Block length: 7 bytes + 7 bytes / SC mod.
Byte 1	$5F_H$	S7 constant
Byte 2	04_H/05_H/06_H	Slot

ET 200L-SC: For analog modules when analog and digital modules are connected to the SC

ET 200L-SC IM-SC: For analog modules when analog and digital modules are connected to the SC
ET 200L-SC IM-SC: For digital modules and for analog modules when only analog modules are connected to the SC

ET 200L-SC: For digital modules and analog modules when only analog modules are connected to the SC

Byte 3	80_H	Data record number
Byte 4	Variable	Data record length: 7 bytes / SC mod. +2
Byte 5	00_H	Version identifier
Byte 6	50_H	Additional identifier/device type assignment

Figure C-5 Structure of the Header of Data Record 128

Data Record 128, Contents

Figure C-6 describes the contents of data record 128. These bytes are repeated for each Smart Connect electronic module that is connected.

Byte 7, 14 to 56 — 01_H to 08_H — Channel module address of the Smart Connect electronic module

Byte 8, 15 to 57 — Channel module-specific identifier of the Smart Connect electronic module

- 01_H: 2DIDC24V or 1DIAC120/230V
- 02_H: 2DODC24V0.5A; 2DODC24V2A; 1DOAC120/230V1A or 1DORel.AC230V
- $C5_H$: AI RTD; 2AI U; 2AI I or 2AI TC
- $D5_H$: Fast 2AI U or 2AI I
- $E6_H$: 1AO U or 1AO I (double module width)
- $D9_H$: 1COUNT40kHz

Byte 9, 16 to 58 — 00_H to $1F_H$ or $3F_H$/ FF_H — Byte offset, input range of the SC section (see Table C-5)

- No input
- Byte offset 31 (ET 200L-SC) or 63 (ET 200L-SC IM-SC)
- Byte offset 0

Byte 10, 17 to 59 — bits 7 6 5 4 3 2 1 0 (bits 5 and 4 = 0)

- Bit offsets 0 to 7: Determine the position within the byte in the input range (not applicable if the byte offset is FF_H)
- Number of channels of the Smart Connect electronic module: 0 - single-channel; 1 - two-channel; 2 - three-channel
- Length requirements of channels 00 - 1 bit; 10 - 2 bytes

Byte 11, 18 to 60 — 00_H to $1F_H$ or $3F_H$/ FF_H — Byte offset, input range of the SC section (see Table C-5)

- No input
- Byte offset 31 (ET 200L-SC) bzw. 63 (ET 200L-SC IM-SC)
- Byte offset 0

Byte 12, 19 to 61 — bits 7 6 5 4 3 2 1 0 (bits 5 and 4 = 0)

- Bit offsets 0 to 7: Determine the position within the bytes in the input range (not applicable if the byte offset is FF_H)
- Number of channels of the Smart Connect electronic module: 0 - single-channel; 1 - two-channel; 2 - three-channel
- Length requirements of channels 00 - 1 bit; 10 - 2 bytes

Byte 13, 20 to 62 — 00_H — Channel-module specific parameters

Figure C-6 Structure of Data Record 128, Bytes 7 to 62

C.4.5 Data Record 130

Overview

Data record 130 consists of a header with a length of 7 bytes, an additional 2 bytes per SC module and 5 bytes per channel. They are described below.

Data Record 130, Header

Figure C-7 describes the header of data record 130.

Byte 0	Variable	Block length: 7 bytes + 2 bytes per SC module + 5 bytes per channel
Byte 1	$5F_H$	S7 constant
Byte 2	$04_H/05_H/06_H$	Slot

ET 200L-SC: For analog modules when analog and digital modules are connected to the SC

ET 200L-SC IM-SC: For analog modules when analog and digital modules are connected to the SC
ET 200L-SC IM-SC: For digital modules and for analog modules when only analog modules are connected to the SC

ET 200L-SC: For digital modules and analog modules when only analog modules are connected to the SC

Byte 3	82_H	Data record number
Byte 4	Variable	Data record length: 2 bytes + 2 bytes per SC module + 5 bytes per channel
Byte 5	00_H	Version identifier
Byte 6	50_H	Additional identifier/device type assignment

Figure C-7 Structure of the Header of Data Record 128

Data Record 130, Contents

Figures C-8 and C-9 describe the contents of data record 130. A distinction is drawn between single- and two-channel modules.

Data Record 130, Single-Channel

You will find the contents of data record 130 for single-channel modules in the following figure.

Byte 7	07_H	Total block length for a module
Byte 8	01_H to 08_H	Module address
Byte 9	05_H	Block length for a channel
Byte 10	00_H	Channel address
Byte 11		
Byte 12		Channel-specific parameters
Byte 13	00_H	

Figure C-8 Structure of Data Record 130 for Single-Channel Modules

Data Record 130, Two-Channel

You will find the contents of data record 130 for two-channel modules in the following figure.

Byte 7	$0C_H$	Total block length for a channel module
Byte 8	01_H to 08_H	Channel module address
Byte 9	05_H	Block length for a channel
Byte 10	00_H	Channel address
Byte 11		
Byte 12		Channel-specific parameters
Byte 13	00_H	
Byte 14	05_H	Block length for a channel
Byte 15	01_H	Channel address
Byte 16		
Byte 17		Channel-specific parameters
Byte 18	00_H	

Figure C-9 Structure of Data Record 130 for Two-Channel Modules

Channel-Specific Parameters

The channel-specific parameters comprise 3 bytes. The third byte (byte 13 or byte 18) is reserved and preset with the value 00_H.

The remaining two bytes of the channel-specific parameters are assigned differently depending on the Smart Connect module. The assignment depends on whether the module is an input or output module.

Data Record 130, 1COUNT40kHz

The contents of the data record for the 1COUNT40kHz counter module are shown in the following figure:

Byte 7	$0B_H$	Total block length for a module
Byte 8	01_H to 08_H	Channel module address
Byte 9	09_H	Block length for a channel
Byte 10	00_H	Channel address
Byte 11		Channel-specific parameters
Byte 12		
Byte 13		
Byte 14		
Byte 15		
Byte 16		
Byte 17		

Figure C-10 Structure of Data Record 130 for the 1COUNT40kHz Counter Module

AI Module – Byte 11 or Byte 16

The purpose of bytes 11 and 16 of data record 130 for analog input modules is indicated in Table C-11.

Table C-11 AI Parameters in Byte 11 and 16 of DS130

Smart Connect Module	Measurement Type	Measurement Range	Bit[1]	
			7 ... 4	3 ... 0
–	Deactivated		0000	0000
2AI U	Voltage measurement	1 ... 5 V	0001	0111
		+/– 10 V		1001
2AI I	Current measurement, 4-wire connection	0 ... 20 mA	0010	0010
		4 ... 20 mA		0011
		+/– 20 mA		0100
	Current measurement, 2-wire connection	4 ... 20 mA	0011	0011
1AI RTD	Resistance measurement, 4-wire connection	0 ... 600 Ω	0100	0110
	Thermal resistance measurement with linearization and 4-wire connection	Pt100 Kl (climatic range)	1000	0000
		Pt100		0010
		NI100		1011
2AI TC	Voltage measurement	+/– 80 mV	0001	0001
	Temperature measurement with thermocouple	Type R	1011	0011
		Type J		0101
		Type K		1000

1 No other values or combinations are permissible

AI Module – Byte 12 or Byte 17

The purpose of bytes 12 and 17 of data record 130 for analog input modules is indicated in Figure C-11.

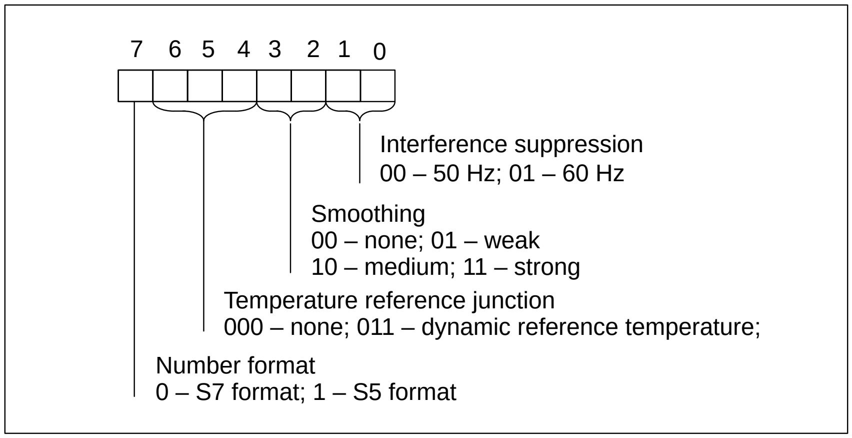


Figure C-11 AI Parameters in Byte 12 or 17 of DS130

AI Module – Byte 13 or Byte 18

The third byte (byte 13 or byte 18) of the channel-specific parameters is always assigned the value 00_H for input modules.

AO Module – Byte 11 or Byte 16

The purpose of bits 0 to 5 in bytes 11 and 16 of data record 130 for analog output modules is indicated in Table C-12.

Bit 6 is always assigned the value “0”.

Bit 7 specifies the number format:

- Bit 7 = “0”: S7 format
- Bit 7 = “1”: S5 format

Table C-12 AO Parameters in Byte 11 or 16 of DS130

Smart Connect Module	Output	Measurement Range	Bit[1]	
			5, 4	3 ... 0
–	Deactivated		00	0000
1AO U	Voltage output	1 ... 5 V	01	0111
		+/– 10 V		1001
1AO I	Current output	0 ... 20 mA	10	0010
		4 ... 20 mA		0011

1 No other values or combinations are permissible

AO Module – Bytes 12 and 13 or Bytes 17 and 18

The second and third bytes (bytes 12 and 13 or bytes 17 and 18) of the channel-specific parameters are always assigned the value 00_H for output modules.

Counter Module – Bytes 11 to 17

The purpose of bytes 11 to 17 of data record 130 for the 1COUNT40kHz counter module indicated in Figure C-12.

Byte 11	Lower count limit (high byte)	Lower count limit
Byte 12	Lower count limit (low byte)	
Byte 13	Upper count limit (high byte)	Upper count limit
Byte 14	Upper count limit(low byte)	

Byte 15

7 6 5 4 3 2 1 0 Bit no.

Mode
- 00: Continuous
- 01: Single-pass
- 10: Periodic

Count mode
- 0: Upward
- 1: Upward/downward

Comparison value enabling
- 0: Disable
- 1: Enable

Digital output: activate at
- 000: Dispable
- 001: Comparison value to overflow
- 010: Comparison value to underflow
- 011: Comparison value reached as pulse counting upward
- 100: Comparison value reached as pulse counting downward
- 101: Comparison value reached as pulse counting upward or downward

Digital output: logic
- 0: Not inverted
- 1: Inverted

Byte 16	Pulse duration [0 to 30]	Pulse duration in steps of 100 ms
Byte 17	Hysteresis [0 to 255]	Activate hysteresis of count pulses at output

Figure C-12 1COUNT40kHz Counter Module – Purpose of Bytes 11 to 17 of Data Record 130

C.4.6 Parameterization Frame Example

Example

The example below describes the parameterization of an ET 200L-SC IM-SC.

The Smart Connect contains the following electronic modules:

- 2DIDC24V (slot A)
- 2DODC24V0.5A (slot B)
- 2AI U (slot C)
- 1AO I (slot D)
- 1COUNT40kHz (slot F)

Table C-13 below shows the contents of the associated parameterization frame:

Table C-13 ET 200L-SC IM-SC Example

Byte	Value	Meaning	
0 to 6	See Figure C-2	Standard section	
7	40_H	Status byte 0	Status bytes
8	20_H	Status byte 1; diagnostic interrupt enable: 21_H	
9	00_H	Status byte 2	
10	07_H	Block length	Data record 0 (digital)
11	$5F_H$	S7 constant	
12	04_H	Slot	
13	00_H	Data record number	
14	02_H	Data record length	
15	00_H	Diagnostics enable: 0	
16	00_H	Not applicable	
17	15_H	Block length	Data record 128 (digital)
18	$5F_H$	S7 constant	
19	04_H	Slot	
20	80_H	Data record number	
21	10_H	Data record length	
22	00_H	Version identifier	
23	50_H	Additional identifier/device type assignment	

Table C-13 ET 200L-SC IM-SC Example, continued

Byte	Value	Meaning		
24	01_H	Channel module address: slot A	Smart Connect 2DIDC24V on slot A	Data record 128 (digital)
25	01_H	Channel module-specific identifier: 01_H		
26	00_H	Byte offset, input range: 0		
27	$0A_H$	Bit offset: 2; number of channels: 1 (two-channel); input range		
28	FF_H	Byte offset, output range: no output		
29	FF_H	Bit offset: 0; number of channels: 0; output range		
30	00_H	Channel module-specific parameters		
31	02_H	Channel module address: slot B	Smart Connect 2DODC24V0.5A on slot B	
32	02_H	Channel module-specific identifier: 02_H		
33	FF_H	Byte offset, input range: no input		
34	FF_H	Bit offset: 0; number of channels: 0 ; input range		
35	00_H	Byte offset, output range: 0		
36	$0C_H$	Bit offset: 4; number of channels 1 (two- channel); output range		
37	00_H	Channel module-specific parameters		
38	07_H	Block length		Data record 0 (analog)
39	$5F_H$	S7 constant		
40	05_H	Slot		
41	00_H	Data record number		
42	02_H	Data record length		
43	00_H	Diagnostics enable: 0 (as DS0 digital)		
44	00_H	Not applicable		
45	$1C_H$	Block length		Data record 128 (analog)
46	17_H	S7 constant		
47	05_H	Slot		
48	80_H	Data record number		
49	17_H	Data record length		
50	00_H	Version identifier		
51	50_H	Additional identifier/device type assignment		
52	03_H	Channel module address: slot C	Smart Connect 2AI U +/– 10 V in slot C	
53	$C5_H$	Channel module-specific identifier: $C5_H$		
54	00_H	Byte offset input range 0		
55	88_H	Bit offset: 0; channel number: 1 (two-channel); channel length: 2 bytes		
56	FF_H	Byte offset output range: no output		
57	FF_H	Bit offset: 0; channel number: 0; output range		
58	00_H	Channel module-specific parameters		

Table C-13 ET 200L-SC IM-SC Example, continued

Byte	Value	Meaning		
59	04_H	Channel module address: slot D	Smart Connect 1AO I 0 ... 20 mA in slot D	Data record 128 (analog)
60	$E6_H$	Channel module-specific identifier: $E6_H$		
61	FF_H	Byte offset input range: no input		
62	FF_H	Bit offset: 0; channel number: 0; input range		
63	00_H	Byte offset output range: 0		
64	80_H	Bit offset: 0; channel number: 0 (single-channel); length of the output channel: 2 bytes		
65	00_H	Channel module-specific parameter		
66	06_H	Channel module address: slot F	Smart Connect 1COUNT40kHz counter module in slot F	Data record 128 (analog)
67	$D9_H$	Channel module-specific identifier: $D9_H$		
68	04_H	Byte offset input range: 4		
69	98_H	Bit offset: 0; channel number: 2 (three-channel); input channel length: 2 bytes		
70	02_H	Byte offset output range: 2		
71	98_H	Bit offset: 0; channel number: 2 (three-channel); length of the output channels: 2 bytes		
72	00_H	Channel module-specific parameters		
73	25_H	Block length		Data record 130 (analog)
74	$5F_H$	S7 constant		
75	05_H	Slot		
76	82_H	Data record number		
77	$1F_H$	Data record length		
78	00_H	Version identifier		
79	50_H	Additional identifier/device type assignment		

Table C-13 ET 200L-SC IM-SC Example, continued

Byte	Value	Meaning		
80	$0C_H$	Block length for channel module	Smart Connect 2AI U +/– 10 V in slot C	Data record 130 (analog)
81	03_H	Channel module address: slot C		
82	05_H	Block length for channel		
83	00_H	Channel address: 0 (one)		
84	19_H	Voltage input: +/– 10 V		
85	80_H	S5 format; interference frequency suppression: 50 Hz; no smoothing		
86	00_H	Not relevant		
87	05_H	Block length for channel		
88	01_H	Channel address: 1 (two)		
89	19_H	Voltage input: +/– 10 V		
90	80_H	S5 format; interference frequency suppression: 50 Hz; no smoothing		
91	00_H	Not relevant		
92	07_H	Block length for channel module	Smart Connect 1AO I 0 ... 20 mA in slot D	
93	04_H	Channel module address: slot D		
94	05_H	Block length for channel		
95	00_H	Channel address: 0 (one)		
96	$A3_H$	Power output: 0 ... 20 mA, S5 format		
97	00_H	Not relevant		
98	00_H	Not relvant		
99	$0B_H$	Block length for channel module	Smart Connect 1COUNT40kHz in slot F	
100	06_H	Channel module address: slot F		
101	09_H	Block length for channel		
102	00_H	Channel address: 0 (one)		
103	00_H	Lower count limit: 11		
104	$0B_H$			
105	08_H	Upper count limit: 2222		
106	AE_H			
107	38_H	Mode: continuous; count mode: upward; comparison value enabling: enable; activate digital output at: comparison value counting upward as pulse; digital output logic: 0;		
108	07_H	Digital output pulse duration: 700 ms		
109	14_H	Hysteresis: 20 pulses		

C.5 Default Start-up

Introduction

The ET 200L-SC or ET 200L-SC IM-SC can carry out a default start-up. When it does this, the ET 200L-SC or ET 200L-SC IM-SC works with a default configuration.

The ET 200L-SC or ET 200L-SC IM-SC also runs with the digital default configuration when there are no SC modules connected.

The default configuration frame corresponds to the message of the ET 200L-SC or ET 200L-SC IM-SC when you read the configuration.

Warning

If an SC module fails, in a default start-up the addresses are read in such a way that the failed SC is not included.

A device master file provides security here. You can create this with COM PROFIBUS.

Contents of the Section

This section contains all the information you require on the default start-up.

C.5.1 Default Start-up with Digital Smart Connect Modules

Type Files

A number of type files are available for the default start-up. You can obtain these via modem (dial +49 (911) 737972) or in CompuServe in AUTFORUM (`GO AUTFORUM`) in the SINEC library.

Table C-14 Type Files for the ET 200L-SC Default Start-up with Digital SC Modules

Electronics Block ET 200L-SC	Name of the Type File
L-SC 16 DI DC 24 V	SI8027ZX.200
L-SC 32 DI DC 24 V	SI8029ZX.200
L-SC 16 DO DC 24 V/0.5 A	SI8028ZX.200
L-SC 16 DI/16 DO DC 24 V/0.5 A	SI802CZX.200
L-SC IM-SC	SI802BZX.200

Configuration Frame

The following configuration frames are required for the default start-up of the ET 200L-SC or ET 200L-SC IM-SC with digital Smart Connect modules:

Note

When an ET 200L-SC or ET 200L-SC IM-SC receives a default configuration frame with 2/4 bytes DI and DO, the module still starts up when there are no SC modules connected.

L-SC 16 DI

Configuration frame for the ET 200L-SC 16 DI DC 24 V:

Configuration Frame	Slots	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
43-01-00-9F-42	4	2 bytes DI
C2-01-01-42-45	5	Smart Connect with electronic modules (SC): 2 input and 2 output bytes

L-SC 32 DI

Configuration frame for the ET 200L-SC 32 DI DC 24 V:

Configuration Frame	Slots	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
43-03-00-9F-43	4	4 bytes DI
C2-01-01-42-45	5	Smart Connect with electronic modules (SC): 2 input and 2 output bytes

L-SC 16 DO

Configuration frame for the ET 200L-SC 16 DO DC 24 V/0.5 A

Configuration Frame	Slots	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
83-01-00-AF-50	4	2 bytes DO
C2-01-01-42-45	5	Smart Connect with electronic modules (SC): 2 input and 2 output bytes

L-SC 16 DI/16 DO

Configuration frame for the ET 200L-SC 16 DI/16 DO DC 24 V/ 0.5 A:

Configuration Frame	Slots	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
C2-01-01-BF-D2	4	2 bytes DO/2 bytes DI
C2-01-01-42-45	5	Smart Connect with electronic modules (SC): 2 input and 2 output bytes

L-SC IM-SC

Configuration frame for the ET 200L-SC IM-SC:

Configuration Frame	Slots	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
C2-01-01-42-4A	4	4 input and 4 output bytes

Parameterization Frame

The ET 200L-SC requires the following parameterization frame for the default start-up:

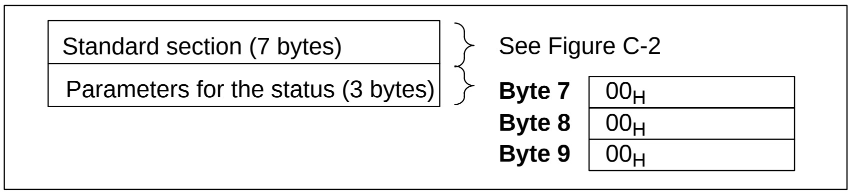


Figure C-13 Structure of the Parameterization Frame

Note

- A diagnostic interrupt enable is not possible in byte 1 (BIT 5).
- If you use a DP master for the default start-up that sends only the standard section of the parameterization frame, the start-up is carried out without status bytes (bytes 7 to 9).

Default Setting for Digital Smart Connect Modules

For the default setting of the ET 200L-SC, 2 bytes each are set in the process image for the digital Smart Connect modules for the input and output of the Smart Connect electronic modules.

	Slot															
SC modules	A		B		C		D		E		F		G		H	
Input bytes	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Output bytes	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
	Byte 0								Byte 1							

Figure C-14 Default Setting for Digital SC Modules with the ET 200L-SC

Default Setting for the ET 200L-SC IM-SC

For the default setting of the ET 200L-SC IM-SC, 4 bytes each are set in the process image for the digital Smart Connect modules for the input and output of the Smart Connect electronics modules.

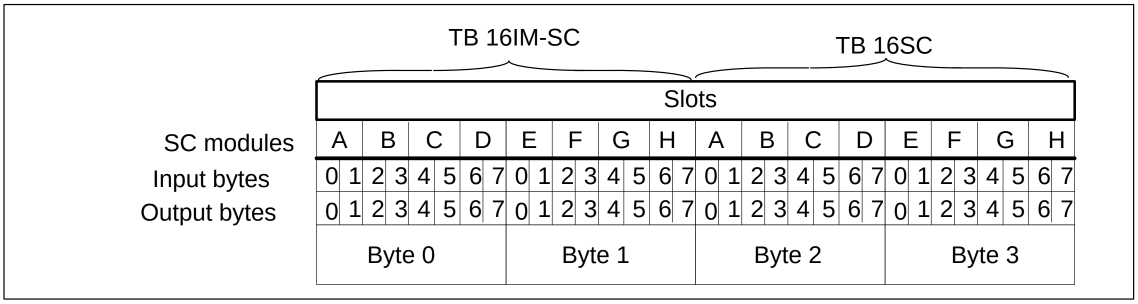
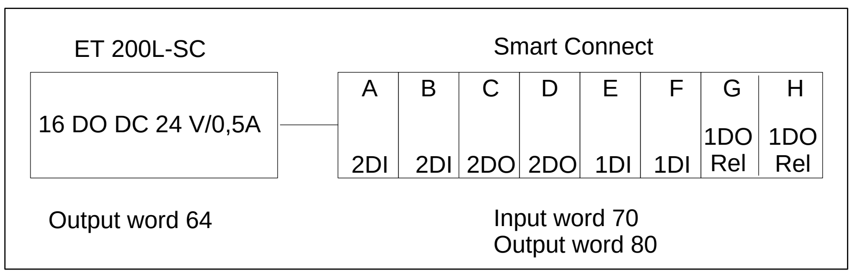


Figure C-15 Default Setting for Digital SC Modules with the ET 200L-SC IM-SC

Example

A default start-up is carried out with the following configuration:

- ET 200L-SC 16 DO DC 24 V/0.5A and Smart Connect:



Solution of the Example

Address assignment for the ET 200L-SC and Smart Connect

- ET 200L-SC 16 DO DC 24 V/0.5 A
  - On-board I/O device outputs 1 to 8: output byte 64.0 to 64.7
  - On-board I/O device outputs 9 to 16: output byte 65.0 to 65.7
- Smart Connect:

Slot	SC Module	Address	
A	2DIDC24V	Input	70.0 and 70.1
B	2DIDC24V	Input	70.2 and 70.3
C	2DODC24V0.5A	Output	80.4 and 80.5
D	2DODC24V0.5A	Output	80.6 and 80.7
E	1DIAC120/230V	Input	71.0
F	1DIAC120/230V	Input	71.2
G	1DORel.AC230V	Output	81.4
H	1DORel.AC230V	Output	81.6

C.5.2 Default Start-Up with Analog Smart Connect Modules

Type Files

There are no type files for the default start-up of the ET 200L-SC or ET 200L-SC IM-SC with analog Smart Connect modules. This is because there is such a wide range of configuration options.

Note

In the default start-up, the analog Smart Connect modules use the default parameters stored in each module (see Chapter 12).

Configuration Frame

For the default start-up of the ET 200L-SC or ET 200L-SC IM-SC with analog Smart Connect modules, an addition must be made to the configuration frame of the ET 200L-SC with digital Smart Connect modules. Use the configuration frame extension shown in Tables C-15 and C-16, and append it to the configuration frame of the ET 200L-SC or ET 200L-SC IM-SC with digital Smart Connect modules.

In addition to analog Smart Connect modules, at least one digital Smart Connect module must be plugged in.

Table C-15 ET 200L-SC: Configuration Frame Extension for Analog Smart Connect Modules

Configuration Frame Extension for the ET 200L-SC	Slot	Meaning
43-(40 to 4E)-00-42-45	6	Smart Connect with analog input modules; 1 to 8 modules with 1 to 16 channels, depending on the configuration
83-(40 to 43)-00-42-45	6	Smart Connect with analog output modules; 1 to 4 modules with 1 to 4 channels, depending on the configuration
C2-(40 to 43)-(40 to 4E)-42-45	6	Smart Connect with analog output and input modules; 1 to 4 output modules with 1 to 4 channels and 1 to 8 modules with 1 to 16 channels, depending on the configuration

Table C-16 ET 200L-SC IM-SC: Configuration Frame Extension for Analog Smart Connect Modules

Configuration Frame Extension for the ET 200L-SC IM-SC	Slot	Meaning
43-(40 to 5D)-00-42-4A	5	Smart Connect with analog input modules; 1 to 16 modules with 1 to 32 channels, depending on the configuration
83-(40 to 48)-00-42-4A	5	Smart Connect with analog output modules; 1 to 8 modules with 1 to 8 channels, depending on the configuration
C2-(40 to 48)-(40 to 5D)-42-4A	5	Smart Connect with analog output and input modules; 1 to 8 output modules with 1 to 8 channels and 1 to 16 input modules with 1 to 32 channels

Parameterization Frame

For the default start-up, the ET 200L-SC requires the following parameterization frame. The analog Smart Connect modules work with their default parameters:

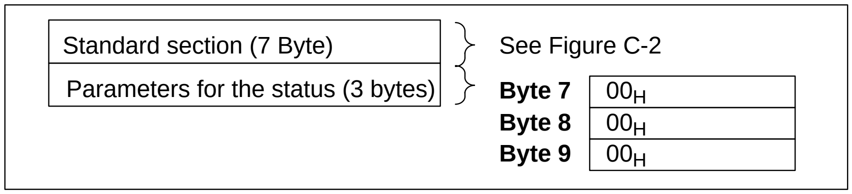


Figure C-16 Structure of the Parameterization Frame

Note

- A diagnostic interrupt enable is not possible in byte 1 (BIT 5).
- If you use a DP master for the default start-up that sends only the standard section of the parameterization frame, the start-up is carried out without status bytes (bytes 7 to 9).

Default Setting for Analog Smart Connect Modules

For the default setting of the ET 200L-SC, 2 bytes each are set in the process image for the digital Smart Connect modules for the input and output channel of the Smart Connect electronic modules.

The identified analog channels are incorporated **seamlessly** in the slot sequence in the process image. Figure C-17 shows the assignment of the bytes in the process image to the individual channels.

Note

Unidentified analog channels are not inserted in the process image(because, for example, the SC analog module has been removed or is defective). As a result, the 3rd analog channel occupies bytes 2 and 3, for example.

The device master file gives you security about correct addressing. You can create this file with COM PROFIBUS.

ET 200L-SC,
ET 200L-SC IM-SC:

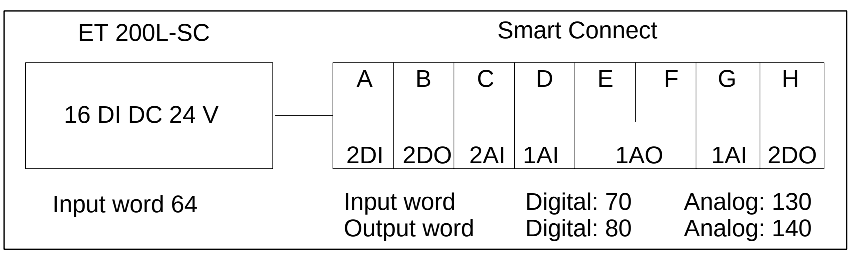
Inputs	1st AI chan.		2nd AI chan.		3rd AI chan.		...
Outputs	1st AO chan.		2nd AO chan		3rd AO chan		...
Byte	0	1	2	3	4	5	...

Figure C-17 Default Setting for Analog Smart Connect Modules

Example

A default start-up is carried out with the following configuration:

- ET 200L-SC 16 DI DC 24 V and Smart Connect:



Configuration Frame of the Example

Configuration frame for the ET 200L-SC 16 DI DC 24 V:

Configuration Frame	Slot	Meaning
04-00-00-AD-C4	1	Virtual slots
04-00-00-9B-40	2	
04-00-00-8F-C0	3	
43-01-00-9F-42	4	2 bytes DI
C2-01-01-42-45	5	Smart Connect with digital electronic modules (SC): 2 input and 2 output bytes
C2-40-44-42-45	6	Smart Connect with analog electronic modules (SC): 1 input and 5 output words

Solution of the Example

Address assignment for the ET 200L-SC and Smart Connect

- ET 200L-SC 16 DI DC 24 V
  - On-board I/O device outputs 1 to 8: input byte 64.0 to 64.7
  - On-board I/O device outputs 9 to 16: input byte 65.0 to 65.7
- Smart Connect:

Slot	SC Module	Address
A	2DIDC24V	Input 70.0 and 70.1
B	2DODC24V/0.5A	Output 80.2 and 80.3
C	2AI U +/– 10V	Input word 130 and 132
D	2AI RTD	Input word 134
E	1AO I4 ... 20 mA (double module width)	Output word 140
F		
G	2AI I4 ... 20 mA	Input word 136 and 138
H	2DODC24V/2A	Output word 81.6 and 81.7

Guidelines for Handling Electrostatically Sensitive Devices (ESD)

D

Summary of Sections

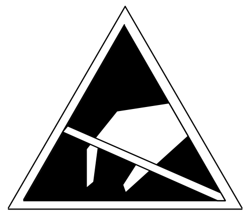
D.1 What is ESD?

Definition

All electronic modules are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are very sensitive to overvoltages and thus to any electrostatic discharge.

These **E**lectrostatically **S**ensitive **D**evices are commonly referred to by the abbreviation **ESD**.

Electrostatically sensitive devices are labeled with the following symbol:



Caution

Electrostatically sensitive devices are subject to voltages that are far below the voltage values that can still be perceived by human beings. These voltages are present if you touch a component or the electrical connections of a module without previously being electrostatically discharged. In most cases, the damage caused by an overvoltage is not immediately noticeable and results in total damage only after a prolonged period of operation.

D.2 Electrostatic Charging of Persons

Charging

Every person with a non-conductive connection to the electrical potential of its surroundings can be electrostatically charged.

Figure D-1 shows you the maximum values for electrostatic voltages which can build up on a person coming into contact with the materials indicated in the figure. These values are in conformity with the specifications of IEC 801-2.

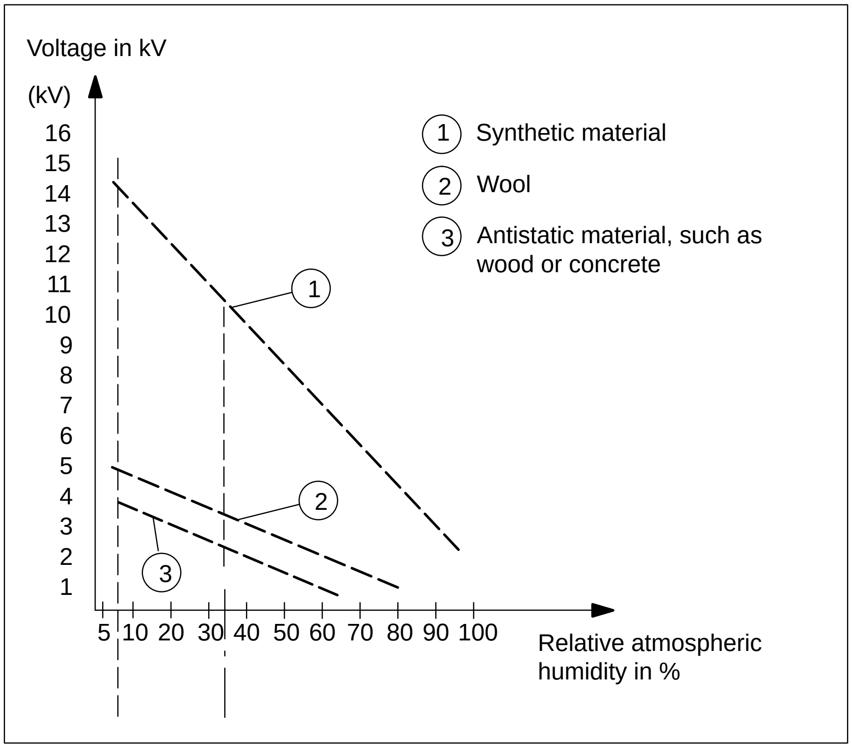


Figure D-1 Electrostatic Voltages which can Build up on a Person

D.3 General Protective Measures Against Electrostatic Discharge Damage

Ensure Sufficient Grounding

Make sure the personnel, working surfaces and packaging are sufficiently grounded when handling electrostatically sensitive devices.You can thus avoid electrostatic charging.

Avoid Direct Contact

You should touch electrostatically sensitive devices only if it is unavoidable (for example, during maintenance work). Hold modules without touching the pins of components or printed conductors. In this way, the discharged energy cannot affect the sensitive devices.

If you have to carry out measurements on a module, you must discharge your body before you start the measurement by touching grounded metallic parts. Use grounded measuring devices only.

Glossary

A

Aggregate current The aggregate of the currents of all the output channels of a digital output module.

B

Baud rate The baud rate is the speed at which data is transmitted. It specifies the number of bits transmitted per second (baud rate = bit rate).

Baud rates of 9.6 kbps to 1.5 Mbps are possible with the ET 200L.

Bus The common transmission path to which all nodes are connected. It has two defined ends.

In the case of the ET 200, the bus is a two-wire cable or a fiber-optic cable.

Bus connector The physical link between the bus nodes and the bus cable.

In the case of the ET 200, there is a bus connector with and without connections for the programming unit and with IP 20 and IP 65 degrees of protection.

C

Chassis ground The chassis ground is the totality of all the interconnected inactive parts of a piece of equipment that cannot carry hazardous contact voltage even in the event of a fault.

Configuration This refers to the configuration of individual modules in a distributed I/O system.

Consistent data

Data that belongs together by content is referred to as consistent data.

The data must not be corrupted by being read at different times.

D

Default setting

The default setting is a basic setting that applies unless another value is set (i.e. parameterized).

Device master file

All the properties of a DP slave are stored in a device master file. The format of the device master file is stored in the EN 50170 Volume 2, PROFIBUS standard.

Distributed I/O devices

These are input/output units that are installed in a distributed configuration at some distance from the CPU rather than in the central rack. For example:

- ET 200L
- ET 200B
- ET 200M
- Other DP slaves manufactured by Siemens or another company

The distributed I/O devices are connected to the DP master via the PROFIBUS-DP bus.

Diagnostics

Diagnostics is the detection, localization, categorization, indication and analysis of errors, faults, malfunctions and messages.

Diagnostics provides monitoring functions that run automatically while a plant is operating. This enhances the availability of a plant by reducing setup and stoppage times.

DP master

A → master whose behavior complies with EN 50170 Volume 2, PROFIBUS is referred to as a DP master.

DP slave

A → slave that runs on the PROFIBUS using the PROFIBUS-DP protocol and whose behavior complies with EN 50170 Volume 2, PROFIBUS is referred to as a DP slave.

DP standard

The DP standard is the bus protocol of the ET 200 distributed I/O system. It complies with EN 50170 Volume 2, PROFIBUS.

E

Electromagnetic compatibility

Electromagnetic compatibility is the capacity of electrical equipment to work correctly in a specified environment without negatively affecting the functioning of other equipment in the vicinity.

Equipotential bonding

An electrical connection (equipotential bonding conductor) that brings the bodies of electrical apparatus and extraneous conductive bodies to the same or approximately the same potential to prevent interfering or hazardous voltages between these bodies.

ET 200

The ET 200 distributed I/O system with the PROFIBUS-DP protocol is a bus for connecting distributed I/O devices to a CPU or an adequate DP master. A feature of ET 200 are its short response times, since only a small volume of data (bytes) is transmitted.

ET 200 complies with the PROFIBUS standard, EN 50170 Volume 2, PROFIBUS.

ET 200 operates on the master/slave principle. The IM 308-C master interface module or the CPU 315-2 DP can be DP masters, for example.

The distributed I/O devices ET 200B, ET 200C, ET 200M, ET 200L or ET 200U can be DP slaves, as can other DP slaves made by Siemens or other manufacturers.

F

Floating

In the case of input/output modules, the reference potentials of control and load circuits are isolated (e.g. by means of an optocoupler, a relay contact or a transformer). Input/output circuits can be connected to common potential.

FREEZE

This is a control command of the DP master to a group of DP slaves.

When a DP slave receives the FREEZE control command, it freezes the current status of the **inputs** and transfers them at intervals to the DP master.

The DP slave freezes the status of the **inputs** again after each subsequent FREEZE control command.

The input data is not transmitted from the DP slave to the DP master at intervals again until the DP master sends the UNFREEZE control command.

Function grounding

Grounding with the sole purpose of ensuring that the electrical equipment functions properly. By means of function grounding, interference voltages that would otherwise result in inadmissible interference to the equipment are short-circuited.

G

Ground

The conductive earth whose electrical potential can be set to zero at any point.

Around grounding electrodes, the earth may have a potential other than zero. The term ”reference ground” is frequently used in this connection.

Grounding

Grounding means to connect an electrically conductive part to the grounding electrode by means of a grounding system.

I

IP 20

DIN 40050 degree of protection: Protection against finger contact and against solid foreign matter more than 12 mm in diameter.

L

Load power supply unit

A power supply unit for the ET 200L distributed I/O device and the process devices connected to it.

M

Master

When it is in possession of the token, a master can send data to other nodes and request data from other nodes (synonymous with active node).

The CPU 315-2 DP and the IM 308-C can be → DP masters, for example.

N

Node

A device that can send, receive or amplify data via the bus (e.g. a DP master, DP slave, RS 485 repeater or active star coupler).

Non-isolated

In the case of non-isolated input/output modules, the reference potentials of control and load circuits are electrically connected.

P

Parameterization

Parameterization is the passing of slave parameters from the DP master to the DP slave.

Parameters, dynamic

In contrast to static parameters, the dynamic parameters of modules can be changed during operation by calling an SFC in the application program (e.g. limit values of an analog signal input module).

Parameters, static

In contrast to dynamic parameters, the static parameters of modules cannot be changed by means of the application program; they can only by changed by means of STEP 7 (not in RUN mode). An example is the input delay of a digital signal input module.

Programmable logic controller

A programmable logic controller consists of at least one CPU, a number of input and output modules, and operating and monitoring equipment.

PROFIBUS

PROcess FIeld BUS, the German process and field bus standard defined in the PROFIBUS standard (EN 50170 Volume 2, PROFIBUS). It specifies functional, electrical and mechanical characteristics for a bit-serial field bus system.

PROFIBUS is available with the following protocols: DP (= distributed I/O), FMS (= Fieldbus Message Specification), PA (= Process Automation) or TF (= Technological Functions).

PROFIBUS address

Each bus node must have a PROFIBUS address (station number) so that it can be identified uniquely on the PROFIBUS.

PC/PG or the ET 200-Handheld have the PROFIBUS address ”0”.

The PROFIBUS addresses 1 to 99 are permissible for the ET 200L distributed I/O device.

PROFIBUS-DP

A draft standard (EN 50170 Volume 2, PROFIBUS) on which the ET 200 distributed I/O system is based.

R

Reference potential

The potential on the basis of which the voltages of the circuits involved can be observed and/or measured.

S

Slave

A slave cannot exchange data with a → master unless requested by the latter to do so.

Examples of slaves are all DP slaves, such as ET 200B, ET 200L and ET 200M.

Smart Connect SC

The Smart Connect SC enables the fine adjustment of input and output channels to the process. The ET 200L-SC can be upgraded by means of a Smart Connect.

SYNC

SYNC is a control command of the DP master to a group of DP slaves.

By means of the SYNC control command, the DP master causes the DP slave to freeze the statuses of the **outputs** at their current value. In the subsequent frames, the DP slave saves the output data, but the statuses of the outputs remain unchanged.

After each SYNC control command, the DP slave sets the outputs it has saved as output data.

The outputs are not periodically updated again until the DP master sends the UNSYNC control command.

T

Type file

A file required by the configuration software (e.g. COM ET 200 Windows) for configuring a DP slave. The type file contains definitions of the slave-specific properties, such as the number of inputs and outputs, the number of diagnostic bytes, and SYNC capability.

U

Ungrounded

Not having a conductive connection to → ground.

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