Rexroth Bosch Group

Rexroth Inline SERCOS Bus Coupler

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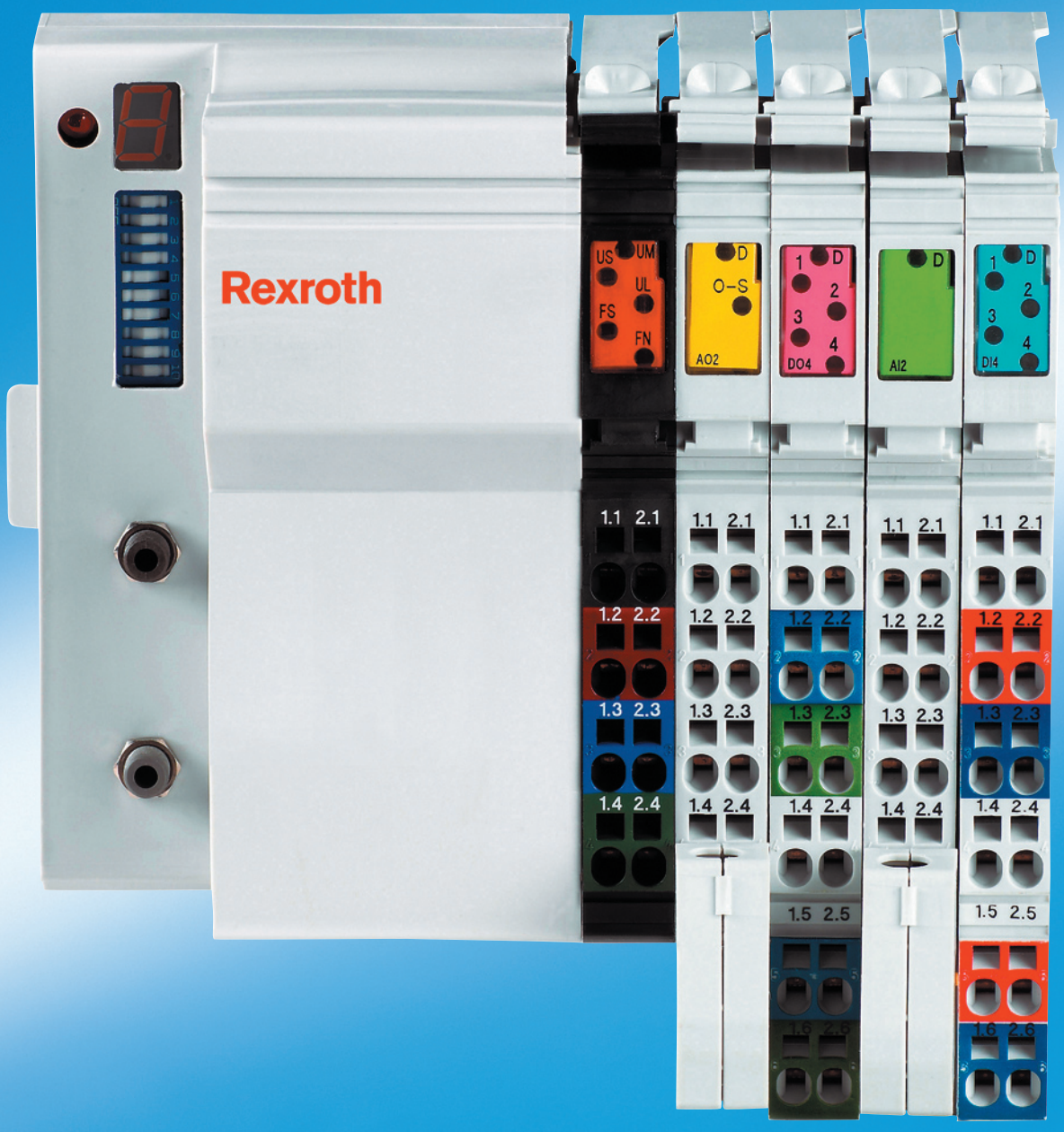
Edition 02

Application Manual



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Contents

1 General Information

1.1 Purpose of this Documentation

This documentation contains technical data and general instructions on commissioning and mounting of the bus coupler R-IL SE BK. Additionally, this documentation contains detailed information on the use of SERCOS communication functions and parameters.

Related Documentation

For additional information on the various modules, please refer to the appropriate functional descriptions.

In Chapter 10 you will find the ordering information.

1.2 SERCOS interface

IEC 61491

The SERCOS interface is an international standard specified in IEC 61491 and has been a success on the market as a digital drive interface for more than 10 years. In its quality and capacity, the SERCOS interface is the leading standard worldwide. In addition to the drive engineering components, typical system configurations also contain inputs and outputs (I/O), which are assigned to a logic control and have, up to now, been wired directly or coupled via a field bus.

I/O via SERCOS interface

Owing to the increasing integration of motion and logic controls, it is reasonable from a technical point of view to connect inputs and outputs via the SERCOS interface as well. Since an additional bus system for I/O is not applicable any longer (e.g. PROFIBUS DP), the economic efficiency of this solution is also very attractive.

Noise Immunity and Efficiency

The SERCOS interface ows its noise immunity to the fiber optic transmission technology. Despite this expensive solution, there are price advantages as compared with RS485 bus systems, since electrical isolation is not necessary and cables and connectors are significantly cheaper. With its transfer rate of 16 Mbps and its extremely high protocol efficiency, the SERCOS interface is comparable with a 100-Mbps Ethernet interface, as regards the data processing capacity.

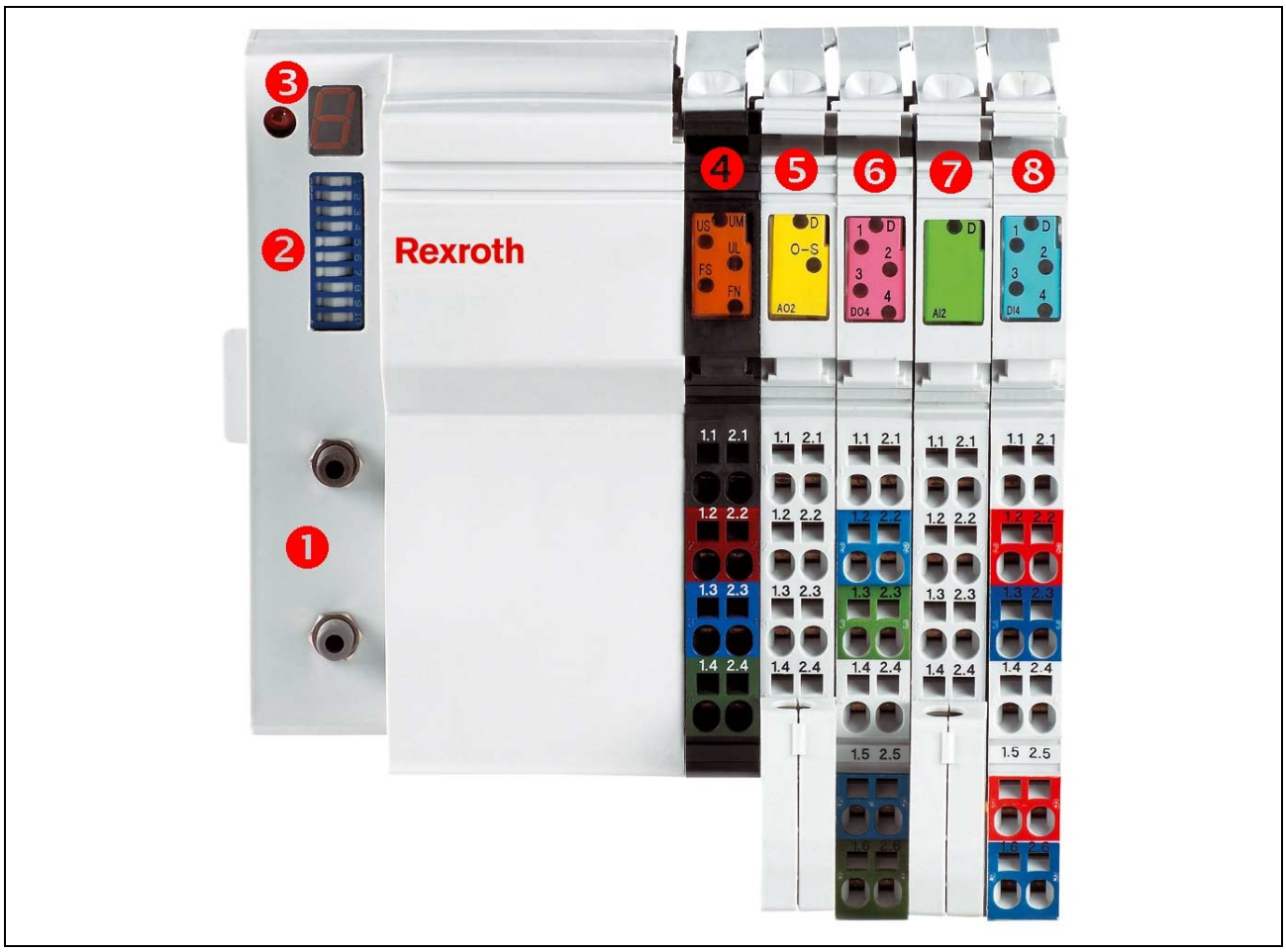
Rexroth Inline System

The SERCOS bus coupler for the Rexroth Inline system provides a universal and extremely flexible I/O system in the SERCOS ring feeder. Digital, analog and technology modules can be combined. When the system is running up, the configuration is determined automatically. In other words, the system facilitates quick commissioning of the controls. By means of input modules, the disk-design system provides separate circuits for different output modules.

Diagnosis and Error Localization

Each module is provided with indicator LEDs for error diagnosis. The diagnostic function is also available via the SERCOS interface. Moreover, the SERCOS devices provide status word, error word and error message. In drive controllers, the messages are even contained in several languages. Since the SERCOS specification has been extended for I/O devices, high-modular I/O are taken into particular consideration, thus permitting precise localization of the error.

1.3 SERCOS Bus Coupler



1:	FO connection	5:	Analog output module
2:	Address DIP switch	6:	Digital output module
3:	Diagnostic display	7:	Analog input module
4:	Power terminal	8:	Digital input module

Fig. 1-1: SERCOS bus coupler R-IL SE BK

The SERCOS bus coupler R-IL SE BK (in short: bus coupler) constitutes the link between the SERCOS interface (in short: SERCOS) and the Rexroth Inline installation system.

The bus coupler permits connection of Inline modules to an existing SERCOS ring feeder, thus providing all benefits of the installation system built by these modules even at the SERCOS interface.

The features of the bus coupler are as follows:

- A maximum of 40 Inline modules can be connected to the SERCOS interface by simply latching them to each other via the bus coupler.
- The number of data is limited to a maximum of 32 bytes of input data and 32 bytes of output data.
- The bus coupler can be used with a baud rate of 2, 4, 8, or 16 Mbps.
- The working voltage is 24 V DC; the range of operating temperature is 5 °C to 55 °C.
- Diagnosis is implemented locally via the indicator elements both on the bus coupler and the Inline modules.

2 Important Directions for Use

2.1 Appropriate Use

Introduction

Bosch Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Bosch Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of Use and Application

The SERCOS bus coupler R-IL SE BK for the Bosch Rexroth Inline system provides an I/O system in the SERCOS ring. Rexroth Inline modules can be connected to an existing SERCOS ring by means of the bus coupler.

Additional sensors and actuators are connected to the Inline modules.

Note: The SERCOS bus coupler may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

The SERCOS bus coupler may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

Class A devices might be used in residential, business and commercial areas as well as in small-sized enterprises with the following note:

Note: This is a Class A device. In a residential area, this device may cause radio interferences. In such a case, the user may be required to introduce suitable countermeasures at his own cost.

2.2 Inappropriate Use

Using the SERCOS bus coupler outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "inappropriate use".

The SERCOS bus coupler may not be used, if

- it is subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Bosch Rexroth has not specifically released it for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

3 Safety Instructions for Electric Drives and Controls

3.1 Introduction

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

Do not attempt to install or start up this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment, contact your local Bosch Rexroth representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the equipment is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the equipment.

WARNING

Improper use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

3.2 Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

Warning symbol with signal word	Degree of hazard seriousness according to ANSI
 **DANGER**	Death or severe bodily harm will occur.
 **WARNING**	Death or severe bodily harm may occur.
 **CAUTION**	Bodily harm or material damage may occur.

Fig. 3-1: Hazard classification (according to ANSI Z535)

3.3 Hazards by Improper Use

DANGER

High voltage and high discharge current! Danger to life or severe bodily harm by electric shock!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

WARNING

High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

CAUTION

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

CAUTION

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock or incorrect handling of pressurized systems!

CAUTION

Risk of injury due to incorrect handling of batteries!

3.4 General Information

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Only persons who are trained and qualified for the use and operation of the equipment may work on this equipment or within its proximity.
  - The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and equipment on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Use only safety features and applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded.
  The following areas of use and application, for example, include safety features and applications: construction cranes, elevators used for people or freight, devices and vehicles to transport people, medical applications, refinery plants, transport of hazardous goods, nuclear applications, applications in which electrical devices with vital functions can be electromagnetically disturbed, mining, food processing, control of protection equipment (also in a machine).
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

- Operation is only permitted if the national EMC regulations for the application are met.
  The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.

3.5 Protection Against Contact with Electrical Parts

Note: This section refers to equipment and drive components with voltages above 50 Volts.

Touching live parts with voltages of 50 Volts and more with bare hands or conductive tools or touching ungrounded housings can be dangerous and cause electric shock. In order to operate electrical equipment, certain parts must unavoidably have dangerous voltages applied to them.

DANGER

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

⇒ Follow general construction and safety regulations when working on high voltage installations.

⇒ Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.

⇒ Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.

⇒ The following should be observed with electrical drive and filter components:

⇒ Wait thirty (30) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

⇒ A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

⇒ Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.

To be observed with electrical drive and filter components:

DANGER

High electrical voltage on the housing!
High leakage current! Danger to life, danger of injury by electric shock!

⇒ Connect the electrical equipment, the housings of all electrical units and motors permanently with the safety conductor at the ground points before power is switched on. Look at the connection diagram. This is even necessary for brief tests.

⇒ Connect the safety conductor of the electrical equipment always permanently and firmly to the supply mains. Leakage current exceeds 3.5 mA in normal operation.

⇒ Use a copper conductor with at least 10 mm² cross section over its entire course for this safety conductor connection!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. Otherwise, high voltages can occur on the housing that lead to electric shock.

3.6 Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 0 and 50 Volts on Rexroth products are protective low voltages designed in accordance with international standards on electrical safety.

WARNING

High electrical voltage due to wrong connections! Danger to life, bodily harm by electric shock!

⇒ Only connect equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) to all terminals and clamps with voltages of 0 to 50 Volts.

⇒ Only electrical circuits may be connected which are safely isolated against high voltage circuits. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.

3.7 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

⇒ Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.

⇒ Pay attention to unintended machine motion or other malfunction in any mode of operation.

⇒ Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:

- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers

⇒ Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.

⇒ Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the machine if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.

⇒ Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.

⇒ Secure vertical axes against falling or dropping after switching off the motor power by, for example:
- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

⇒ Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such equipment cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated near current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with heart pacemakers, hearing aids and metal implants are not permitted to enter the following areas:
- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

⇒ If it is necessary for a person with a heart pacemaker to enter such an area, then a doctor must be consulted prior to doing so. Heart pacemakers that are already implanted or will be implanted in the future, have a considerable variation in their electrical noise immunity. Therefore there are no rules with general validity.

⇒ Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise, health hazards will occur.

3.9 Protection Against Contact with Hot Parts

CAUTION

Housing surfaces could be extremely hot! Danger of injury! Danger of burns!

⇒ Do not touch housing surfaces near sources of heat! Danger of burns!

⇒ After switching the equipment off, wait at least ten (10) minutes to allow it to cool down before touching it.

⇒ Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors. Danger of burns!

3.10 Protection During Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

CAUTION

Risk of injury by incorrect handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general installation and safety instructions with regard to handling and mounting.

⇒ Use appropriate mounting and transport equipment.

⇒ Take precautions to avoid pinching and crushing.

⇒ Use only appropriate tools. If specified by the product documentation, special tools must be used.

⇒ Use lifting devices and tools correctly and safely.

⇒ For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never stand under suspended loads.

⇒ Clean up liquids from the floor immediately to prevent slipping.

3.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or material damage.

CAUTION

Risk of injury by incorrect handling!

⇒ Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and cauterization).

⇒ Never charge non-chargeable batteries (danger of leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the equipment.

Note: Be aware of environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other waste. Observe the legal requirements in the country of installation.

3.12 Protection Against Pressurized Systems

Certain motors and drive controllers, corresponding to the information in the respective Project Planning Manual, must be provided with pressurized media, such as compressed air, hydraulic oil, cooling fluid and cooling lubricant supplied by external systems. Incorrect handling of the supply and connections of pressurized systems can lead to injuries or accidents. In these cases, improper handling of external supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

Danger of injury by incorrect handling of pressurized systems !

⇒ Do not attempt to disassemble, to open or to cut a pressurized system (danger of explosion).

⇒ Observe the operation instructions of the respective manufacturer.

⇒ Before disassembling pressurized systems, release pressure and drain off the fluid or gas.

⇒ Use suitable protective clothing (for example safety glasses, safety shoes and safety gloves)

⇒ Remove any fluid that has leaked out onto the floor immediately.

Note: Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.

Notes

4 Structure of the Inline Terminals

4.1 Principal Structure of the Terminals of the Low Signal Level

Independently of its function and its overall width, an Inline module of the low signal level consists of the electronic socket (in short: socket) and the plug-in connector (in short: connector).

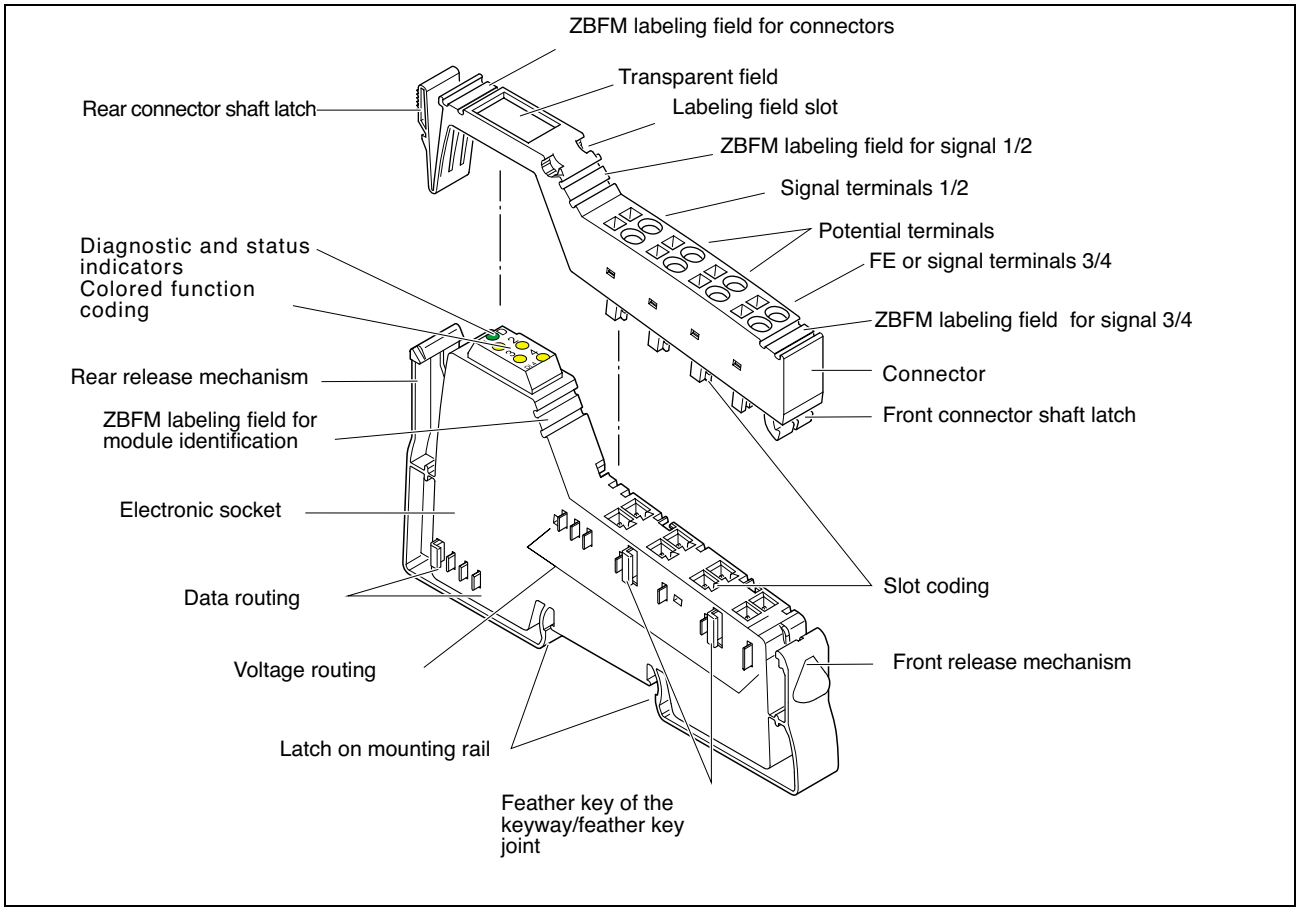


Fig. 4-1: Principal structure of an Inline module

The most important components of those shown in Fig. 4-1: Principal structure of an Inline module are described in Chapters "Electronic Socket" on page 4-2 and "Connector" on page 4-2.

ZBFM: Zack marker strips, flat (also refer to Chapter "Identification of Function and Labeling" on page 4-5).

4.2 Electronic Socket

All of the electronic parts of the Inline module as well as the voltage and data jumpers are accommodated in the electronic socket.

Overall Widths

By default, the electronic sockets for terminals of the low signal level are available in terminal widths of 8 terminal points (8-slot connector) and 2 terminal points (2-slot connector). Any other dimensions are combinations of these two basic terminal widths (also refer to Chapter "Housing Dimensions of the Modules of the Low Signal Level" on page 4-8).

4.3 Connector

The connection of the peripheral equipment or the supply voltages is provided in the form of a connector, that can be disconnected from the electronic socket.

Advantages

This pluggable connection has the following advantages:

- Easy replacement of electronic module parts for servicing. The wiring does not have to be removed.
- For different requirements, different connectors can be fitted on an electronic socket.

Connector Width

Irrespective of the width of the electronic socket, the connectors have a width of two terminal points. Accordingly, you must fit 1 connector on a 2-slot socket, 2 connectors on a 4-slot socket and 4 connectors on an 8-slot socket.

Connector Types

The following connector types are available:

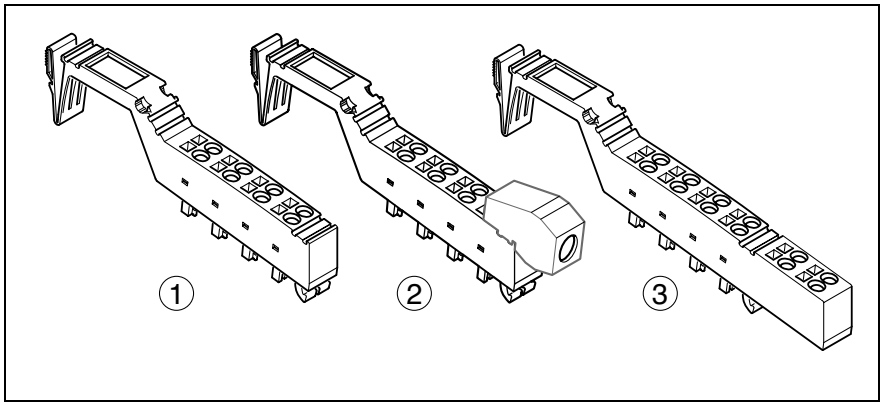


Fig. 4-2: Rexroth Inline connector types

Connector Identification

All connectors are available with colored print. If connectors are provided with colored print, the terminal points are color-coded according to their functions.

The signals of the terminal points are coded by the following colors:

1 Standard connector

The gray standard connector is used for connecting two signals as 4-wire connection (e.g. digital input/output signals). The black standard connector is used for supply terminals. Its neighboring contacts are internally jumpered (see Fig. 4-4).

2 Shield connector

This gray connector is used for signals connected via shielded lines (e.g. analog input/output signals). The FE and/or shielding connection is not provided through terminal points but through a shield clip.

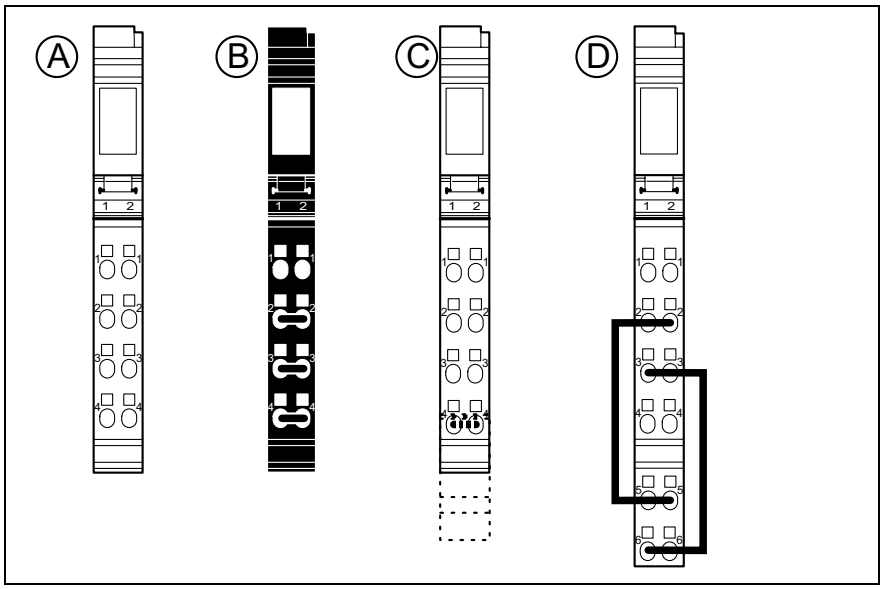
3 Extended double-signal connector

This gray connector is used for connecting four signals as 3-wire connection (e.g. digital input/output signals).

Color	Signal at the terminal point
Red	+
Blue	-
Green	Functional earth ground

Fig. 4-3: Color-coding of the terminal points

Interior Design of the Connectors



L: A Gray connector for peripheral connection
B Black connector for supply terminals
C Gray shield connector for analog terminals
D Large gray connector for peripheral connection

Fig. 4-4: Interior design of the connectors

Connectors with integrated jumpering of terminal points are shown in Fig. 4-4.

The shield connector is jumpered by the shield connection. All other connectors are jumpered by a connection of the terminal points.

Note: To avoid malfunctions, only latch the connector onto the terminal it is intended for. The particular functional description (refer to Chapter 10.2 "Ordering Information on the Documentation") specifies the connector to be used. The black connector may not be latched onto a module that is intended for a double-signal connector. Any reversal would lead to a short-circuit between the two signal terminal points (1.4–2.4).

Important: Place only black connectors on supply terminals! The terminal point jumpering ensures that the potential is transmitted (if this feature is provided) via the jumpering in the connector and not via the module board.

Connector Coding

It is possible to prevent the mismatching of connectors by coding socket and connector.

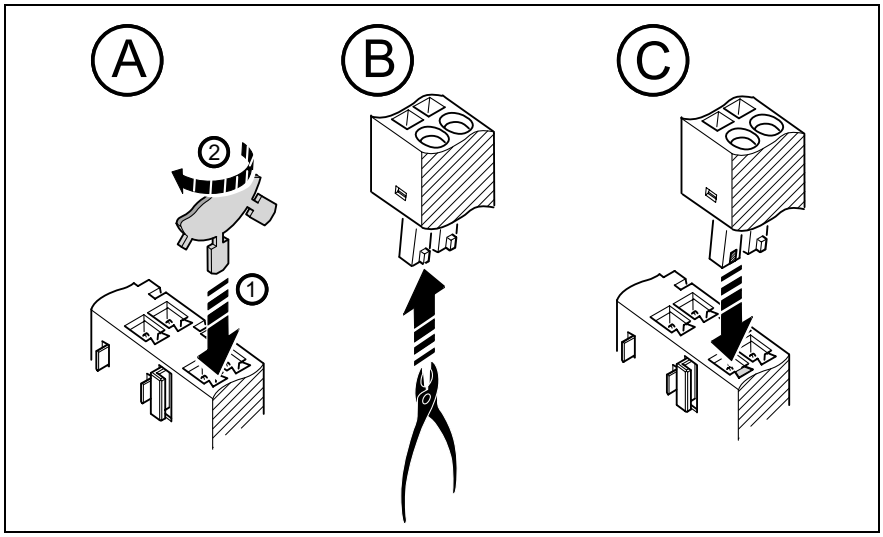


Fig. 4-5: Connector coding

- For this purpose, put a coding profile into the coding keyway in the socket (1) and pull it off the small plate (2) by rotation (Fig. 4-5, / A).
- Use a side-cutting pliers to cut the respective coding tab off the connector (Fig. 4-5 / B).

Now, only socket and connector of the same coding fit together (Fig. 4-5 / C).

4.4 Identification of Function and Labeling

Identification of Function

For visual identification of their function, the modules are color-coded (1 in Fig. 4-6).

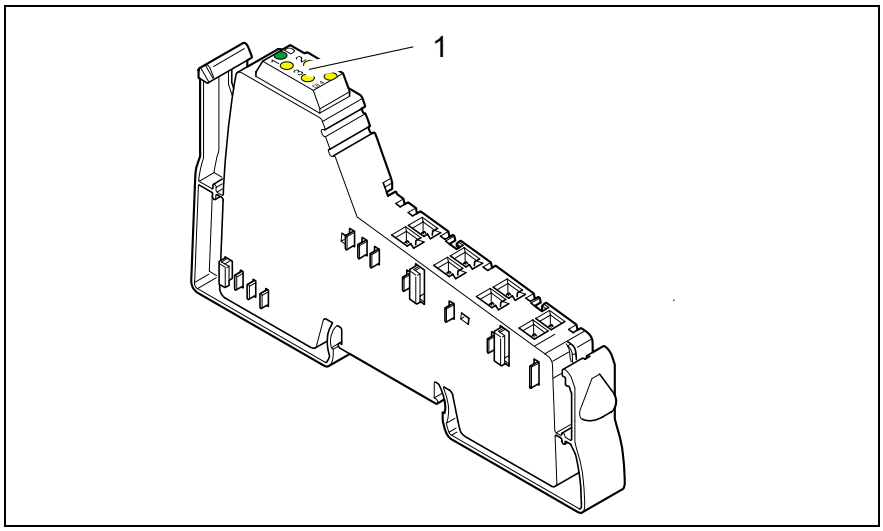


Fig. 4-6: Identification of function

The various functions are identified by the following colors:

Color	Module function
Light-blue	Digital input, 24 V range
Pink	Digital output, 24 V range
Blue	Digital input, 120/230 V range
Red	Digital output, 120 /230 V range
Green	Analog input
Yellow	Analog output
Orange	Field bus coupler, function modules *)
Black	Power terminal / segment terminal

Fig. 4-7: Color coding of the modules:

*) For a complete list of approved function modules, please refer to Section 10.2 "Ordering Information of the Inline Modules".

Connector Identification

The color coding of the terminal points is described above (on this page).

Labeling/Numbering of Terminal Points

Numbering of the terminal points is illustrated by means of an 8-slot module.

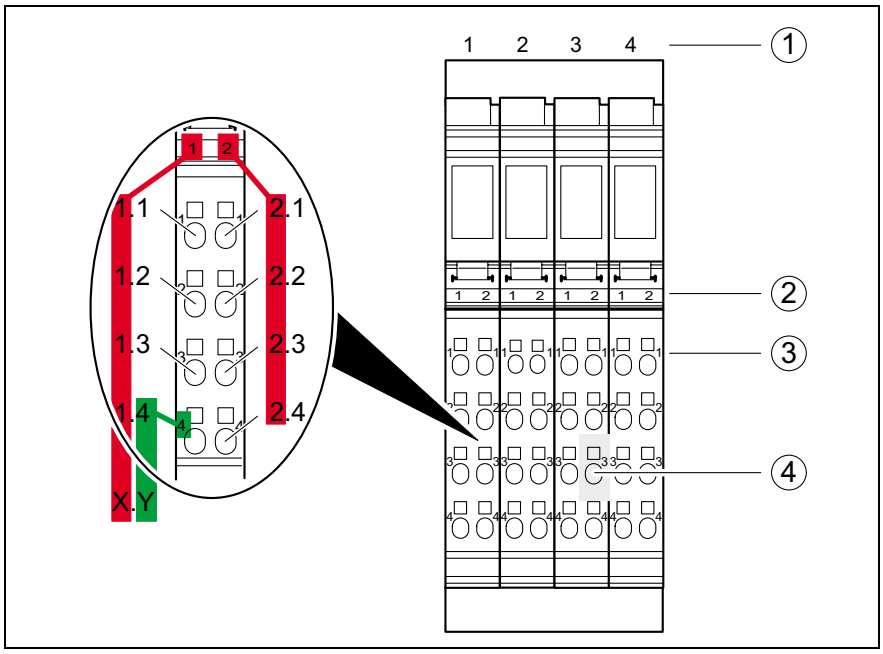


Fig. 4-8: Numbering of terminal points

Slot/Connector

The slots (connectors) on a socket are numbered consecutively (1 in Fig. 4-8). These numbers are **not** specified on the module.

Terminal Point

On each connector, the terminal points are identified by X, Y.

X is the number of the terminal point row on the connector and is indicated on the top of the respective terminal point row (2 in Fig. 4-8).

Y is the number of the terminal point in a row and is indicated directly at the terminal point (3 in Fig. 4-8).

Thus, the position of the slot and terminal point can be exactly determined. For instance, the gray connection (4 in Fig. 4-8) is numbered as follows:

slot 3, terminal point 2.3.

Additional Labeling

In addition to the above labeling of the modules, you can label the slots, terminal points and connections with zack marker strips (ZBFMs) and labeling fields.

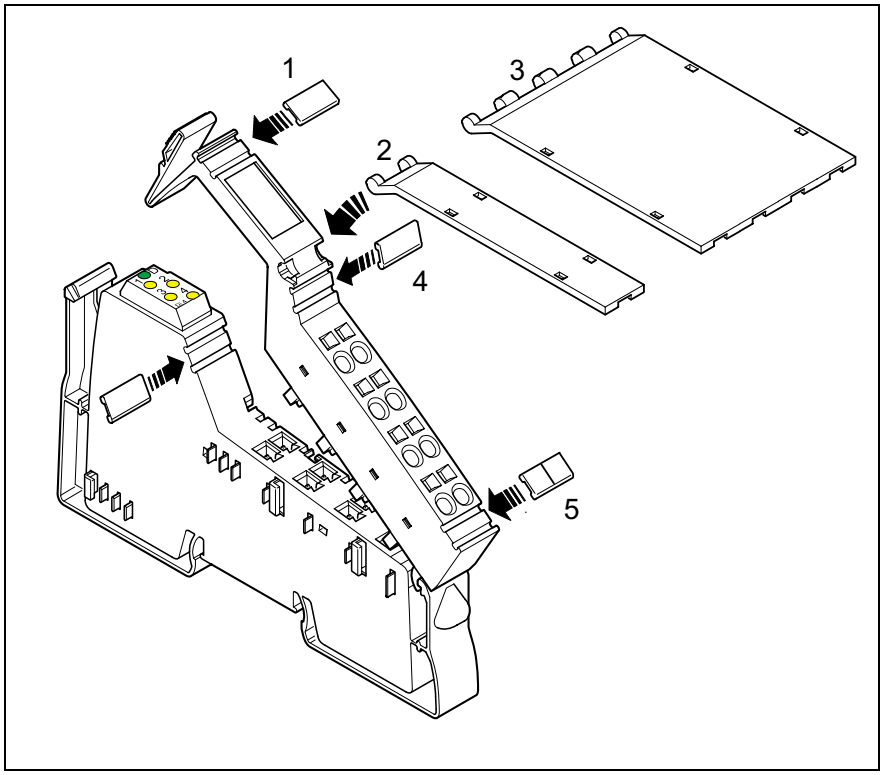


Fig. 4-9: Labeling of modules

There are various possibilities for labeling slots and terminal points:

1 You can label each connector individually with zack marker strips.

2 / 3 As an option, you can use a large labeling field. This labeling field is available in two widths, either as labeling field covering only one connector (2) or as labeling field covering four connectors (3). Thus, you can label each channel individually with continuous text. In the upper connector head, there is a keyway to attach the labeling field to the connector(s). The labeling field can be moved up and down. A small catch at both end positions allows the labeling field to keep its position.

4 / 5 You can label each signal with zack marker strips. With double-signal connectors, the upper keyway (4) is provided for labeling the signals 1/2, and the bottom keyway (5) for the signals 3/4.

6 The electronic socket provides the possibility of labeling each slot individually with zack marker strips. If the connector is latched onto the socket, this labeling is hidden.

You can clearly assign connector and slot by using the labeling field at the connector and on the electronic socket.

4.5 Housing Dimensions of the Modules of the Low Signal Level

Today, small I/O stations are often used in 80 mm standard control boxes. The Inline modules have been designed for use in this type of control box.

The housing dimensions of a module are defined by the dimensions of the electronic socket and the connector.

The electronic sockets of the modules of the low signal level are available in three overall widths (12.2 mm; 24.4 mm; and 48.8 mm).

One, two or four connectors of a width of 12.2 mm are fitted on these sockets.

With connector, each module has a depth of 71.5 mm.

The height of the module depends on the connector used. The connectors are available in three versions (see Fig. 4-13).

2-Slot Housing

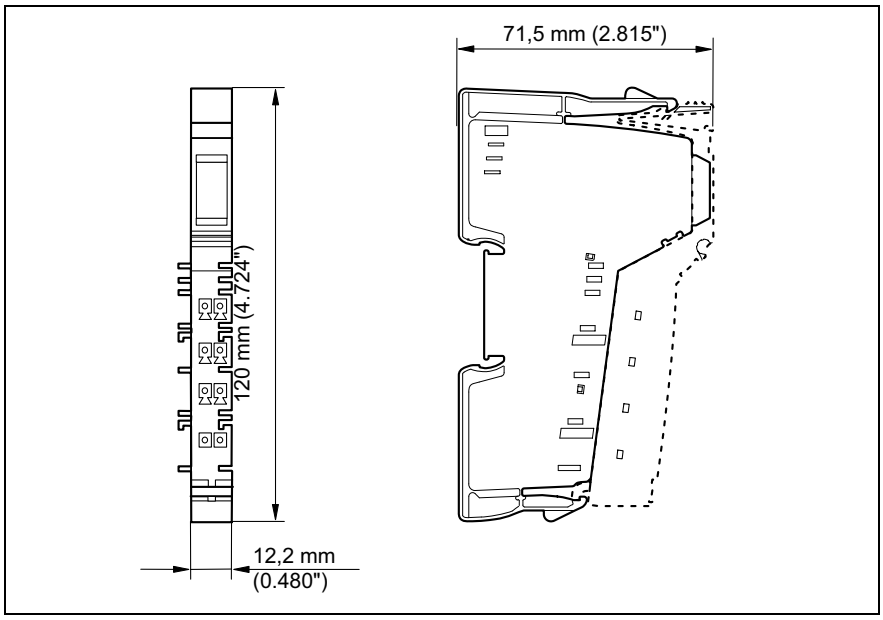


Fig. 4-10: Dimensions of the electronic sockets (2-slot housing)

4-Slot Housing

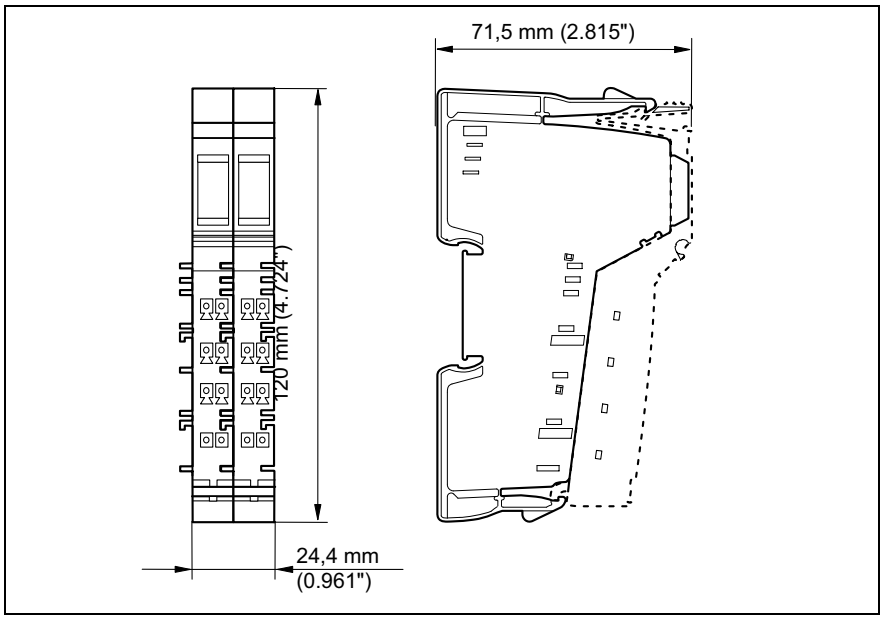


Fig. 4-11: Dimensions of the electronic sockets (4-slot housing)

8-Slot Housing

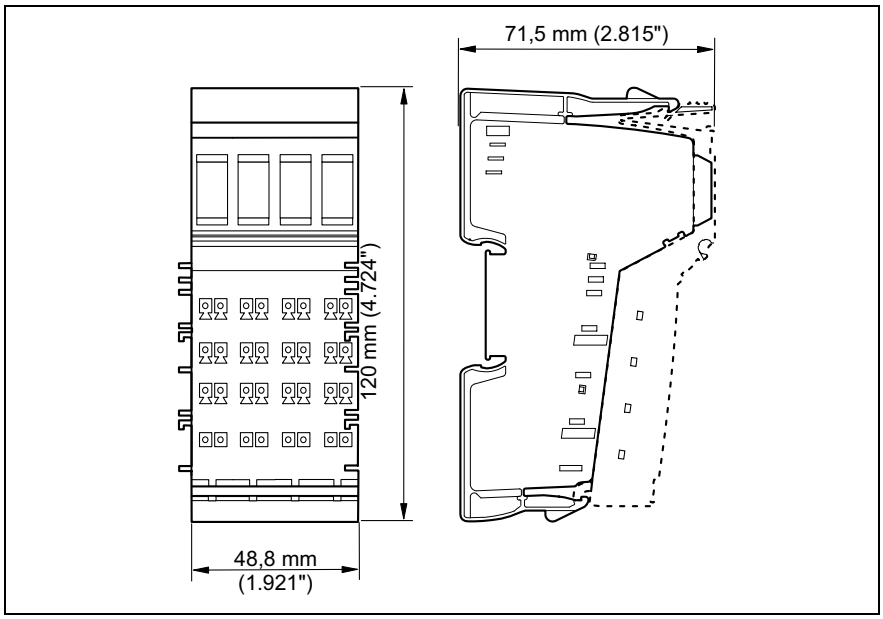
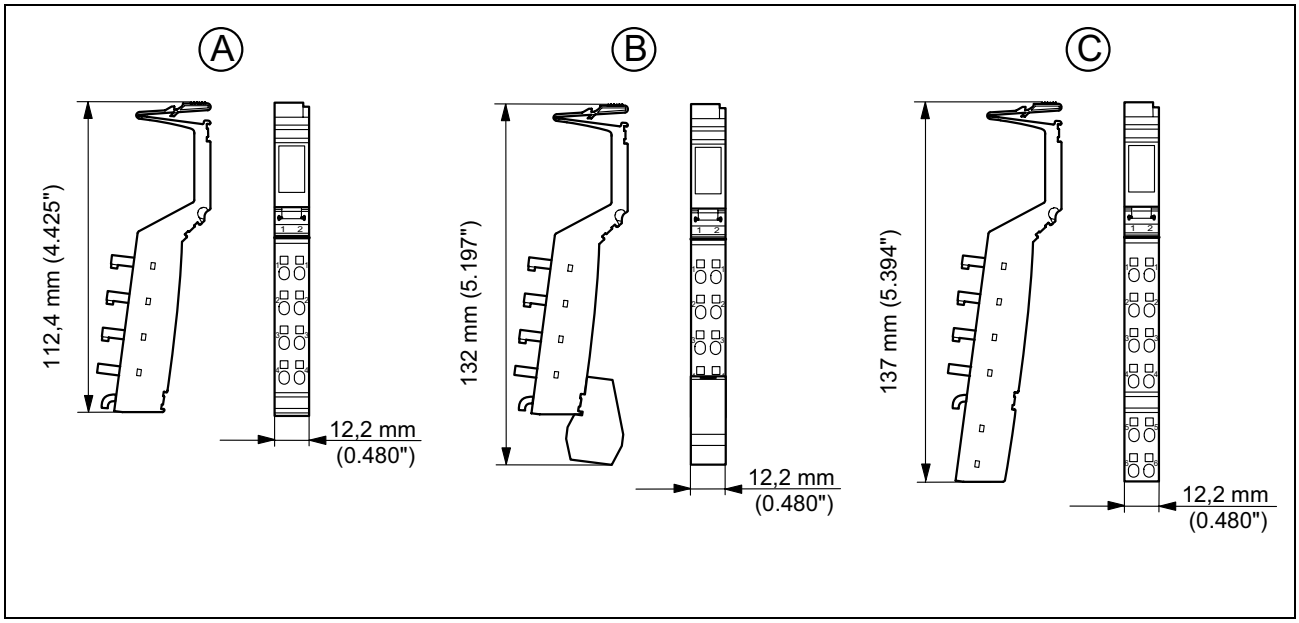


Fig. 4-12: Dimensions of the electronic sockets (8-slot housing)

Connectors



L: A Standard connector
B Shield connector
C Extended double-signal connector

Fig. 4-13: Connector dimensions

The connector depth is irrelevant as it has no effect on the overall module depth.

4.6 Voltage and Data Routing

An essential feature of the Rexroth Inline product family and the SERCOS bus coupler is the internal voltage routing system. The electrical connection between the individual station devices is established automatically when the station is set up. When the individual station devices are latched to each other, a conductor rail is set up for the respective electric circuit. Mechanically, this contact is realized by the blade and spring contacts of the neighboring modules latching into each other.

Using a special segment circuit, the user does not have to establish the additional external potential transmission to the neighboring modules.

In one station, two independent electric circuits have been realized: the logic circuit and the peripheral circuit.

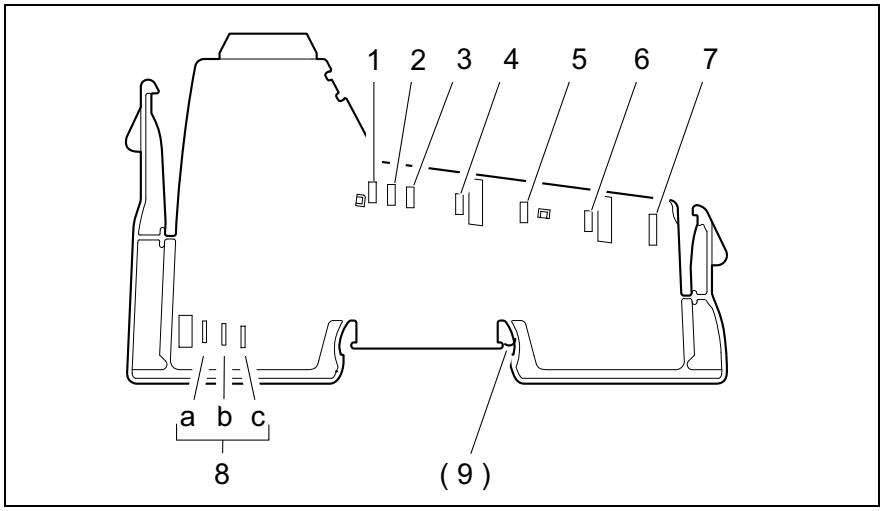


Fig. 4-14: Voltage and data routing

No.	Function		Meaning
1	7.5 V	U_{L+}	Supply voltage for module electronics
2	24 V	U_{ANA}	Peripheral supply voltage for analog modules
3	GND	U_{L-}	Ground of the logic supply voltage and the peripheral supply voltage for analog modules
4	24 V	U_S	Supply voltage for the segment circuit (if necessary protected against overload) This routing block does not exist on the 120 V and 230 V levels.
5	24 V	U_M	Supply of the main circuit (if necessary protected against overload)
6	GND	GND	Ground of the segment and main voltage supply (neutral conductor)
7	FE	FE	Functional earth ground
(9)	(FE spring)		FE contact to the mounting rail (in case of the SERCOS bus coupler as well as the power and segment terminals)

Abb. 4-15: Voltage jumpers (see Fig. 4-14)

Important: **The GND voltage jumper carries the total current of the main and the segment circuit. It may not exceed the maximum current carrying capacity of the voltage jumpers of 8 A. If, during project planning, the limit of 8 A is reached at one of the U_S, U_M and GND voltage jumpers, a new power terminal must be used!**

Note: The FE voltage jumper must be connected to a ground terminal at the coupler via terminal point 1.4 or 2.4 (see Fig. 4-8). In addition, it must be connected to the grounded mounting rail at each supply terminal via the FE spring and routed through all modules.

No.	Function	Meaning
8a	DI1	Local bus signal (Data In)
8b	DO1	Local bus signal (Data Out)
8c	DCLK	Clock signal, local bus

Fig. 4-16: Data jumpers (see Fig. 4-14)

4.7 Electric Circuits and Power Supply Voltages within an Inline Station

There are several electric circuits within an Inline station. These circuits are set up automatically when the modules are latched to each other. The voltages of the different electric circuits are supplied to the connected modules via the voltage jumpers.

Note: Please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation") for further information about the electric circuit to which the peripheral circuit of a specific module has to be connected.

Current Carrying Capacity of the Jumper Contacts

The maximum current carrying capacity of the lateral jumper contacts must be observed for each electric circuit. The current carrying capacities for all voltage jumpers are specified in the sections below.

The arrangement of the voltage jumpers is illustrated in Chapter "Voltage and Data Routing" on page 4-11.

Connection of the supply voltages is described in Chapter ”Connecting Power Supply Voltages” on page 6-13.

For voltage connection, please observe the instructions and notes in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

SERCOS Bus Coupler Supply

The main voltage U_M, the logic voltage U_{LS} and the segment voltage U_S **must** be connected to the SERCOS bus coupler. The voltages for the logic circuit U_L and the supply of the modules for analog signals U_{ANA} are generated internally from the logic voltage. The segment voltage supplies the sensors and/or actuators (see Fig. 4-17).

Please also refer to Chapter 5.1 "SERCOS Bus Coupler".

Logic Circuit

The logic circuit with the ínternal logic voltage U_L starts at the coupler and is routed through all modules of a station; it cannot be re-supplied via an additional supply terminal.

Function Logic voltage is supplied from the logic circuit to all modules of the station.

Voltage The voltage in this circuit is 7.5 V.

U_L Generation The internal logic voltage U_L is generated from the voltage U_{LS} (24 V) of the coupler.

Current Carrying Capacity The maximum current carrying capacity of U_L is 2 A.

The logic voltage is not galvanically isolated from the 24 V input voltage of the coupler.

Analog Circuit

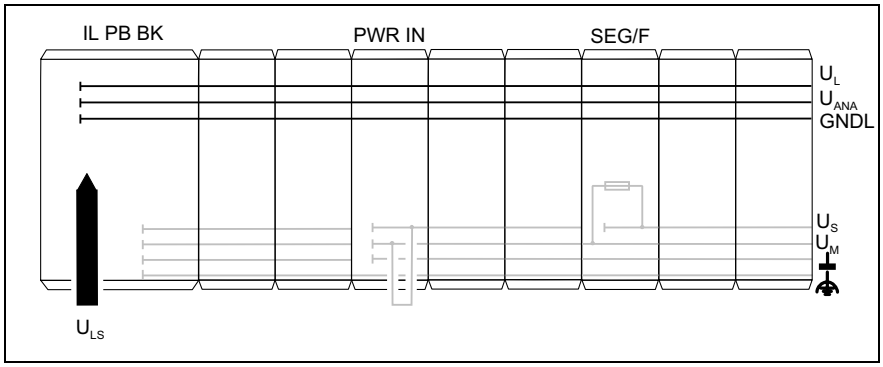
The analog circuit with the supply voltage for analog modules (also called analog voltage herein) U_{ANA} is supplied from the SERCOS bus coupler and is routed through all modules of an Inline station.

Function The peripheral equipment of the modules for analog signals is supplied from the analog circuit.

Voltage The voltage in this circuit is 24 V.

Generation The analog voltage U_{ANA} is generated from the logic voltage U_{LS} of the bus coupler.

Current Carrying Capacity The maximum current carrying capacity of U_{ANA} is 0.5 A.



IL SE BK SERCOS bus coupler
PWR IN Power terminal
SEG/F Segment terminal with fuse

Fig. 4-17: Logic and analog circuits

Main Electric Circuit

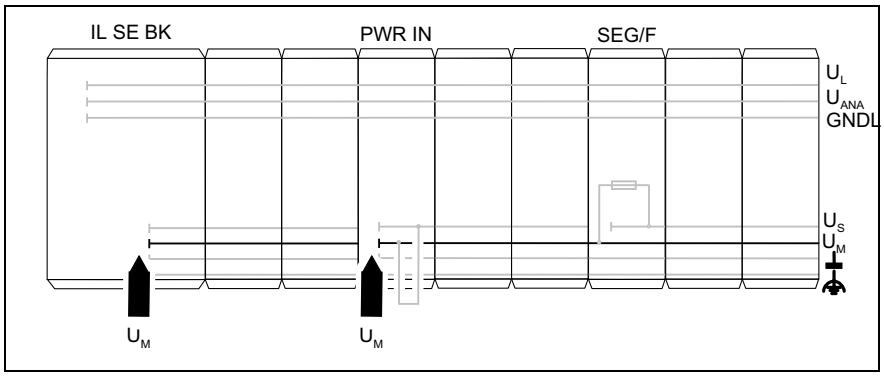
The main circuit with the main voltage U_M starts at the coupler or at a power terminal and is supplied through all following modules up to the next power terminal. At the next power terminal, a new circuit is started; its potential is isolated from the previous one.
One and more power terminals can be set within one station.

Function

Several independent segments can be created within the main circuit. The main circuit provides the main voltage for these segments. For instance, a separate supply system for the actuators can be set up.

Current Carrying Capacity

The maximum current carrying capacity is 8 A (total current with the segment circuit). If the limit for the voltage jumpers U_M and U_S has been reached (total current of U_S and U_M), a new power terminal **must** be used.



IL SE BK	SERCOS bus coupler
PWR IN	Power terminal
SEG/F	Segment terminal with fuse

Fig. 4-18: Main electric circuit

Generation of U_M

In the simplest case, the main voltage U_M can be fed in at the coupler.

The main voltage U_M can also be fed in via a power terminal. A power terminal **must** be used in the following cases:

1 An electrical isolation is to be set up.

2 The maximum current carrying capacity of a voltage jumper (U_M, U_S or GND, total current of U_S and U_M) has been reached.

Electric Segment Circuit

The segment circuit or auxiliary circuit with the segment voltage U_S starts at the coupler or a supply terminal (power terminal or segment terminal) and is routed through all following modules up to the next supply terminal.

Function

You can use several segment terminals within a main circuit and thereby segment the latter. The reference to ground is the same as that of the main circuit. Thus, you can realize within the station differently fused electric circuits without any external cross wiring.

Voltage

The voltage in this circuit must not exceed 24 V DC.

Current Carrying Capacity

The maximum current carrying capacity is 8 A (total current with the main circuit). If the limit for a voltage jumper U_M has been reached (total current of U_S and U_M), a new power terminal must be used.

Generation of U_S

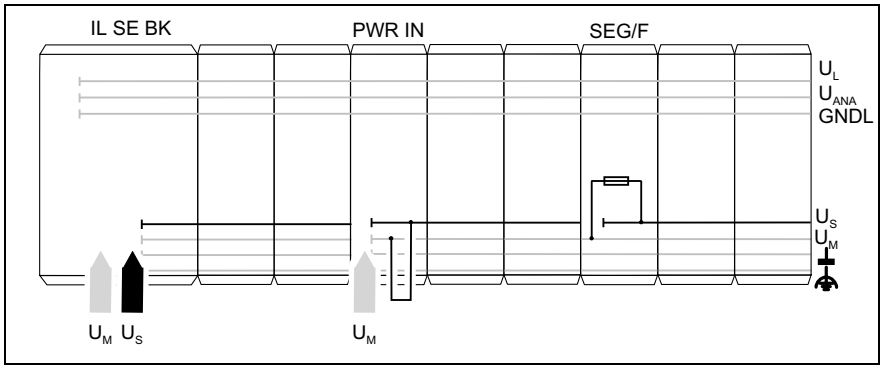
The segment voltage U_S can be provided in various ways:

1 You can feed the segment voltage at the coupler or at a power terminal.

2 You can tap the segment voltage from the main voltage, either at the coupler or at a power terminal using a jumper or a switch.

3 You can use a segment terminal with fuse. In this terminal, the segment voltage is automatically tapped from the main voltage.

Note: At the 120 V and 230 V voltage levels, it is not possible to set up segments. In this case, only the main circuit is used. Special power terminals must be used.



IL SE BK	SERCOS bus coupler
PWR IN	Power terminal
SEG/F	Segment terminal with fuse

Fig. 4-19: Electric segment circuit

4.8 Potential Design

The SERCOS bus coupler and the Inline system are provided with a defined potential and grounding design.

This prevents any undesired feedback of peripheral equipment to the logic section, suppresses the flow of any undesired equalizing currents, and increases the noise immunity.

Electrical Isolation: SERCOS

Owing to the FO technology, the SERCOS interface is galvanically isolated from the bus coupler logic.

When latched on, the functional earth ground spring is in contact with the mounting rail; it is provided to discharge interferences and must not be used as protective earth. To ensure safe discharge of the interferences, even if the mounting rail is dirty, the functional earth ground must be connected directly to terminal point 1.4 or 2.4. This also adequately grounds the Inline station up to the first segment terminal.

Electrical Isolation: Peripheral Equipment

The bus coupler is not provided with electrical isolation for the logic supply of the Inline modules. U_M (24 V), U_L (7.5 V) and U_{ANA} (24 V) are not galvanically isolated.

The main voltage U_M and the peripheral voltage U_S can be supplied separately, but have the same reference to ground. That means that only these two voltages can be fused separately. If you wish to galvanically isolate the U_M / U_S and U_{LS} voltage from each other, you have to fit a separate power terminal. Only then it is ensured, that the galvanic isolation in the input and output modules is not jumpered by a joint reference to ground.

Option 1

Feeding the main voltage of the field bus coupler U_M, the logic voltage U_{LS} and the peripheral supply voltage U_S from **two** voltage supply systems:

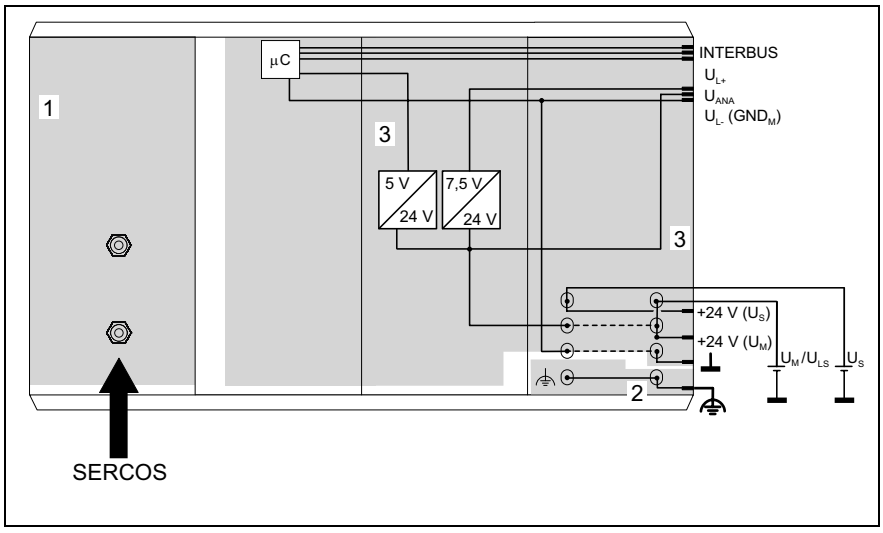


Fig. 4-20: Electrical isolation in the bus coupler (two supply voltages)

Potential sections:

1. SERCOS interface section
2. Section of functional earth ground (FE) of bus coupler and entire station
3. Section of main voltage U_M, logic voltage U_{LS} and peripheral voltage U_S

Note: Electrical isolation can be achieved by supplying the U_M and U_S voltages via a separate power terminal with its own voltage supply (see Fig. 4-19) and not via the power terminal integrated in the bus coupler.

Note: The feeder connector R-IB SCN-PWR IN-CP links connector 1.2 (U_{LS}) to 2.2 (U_M), connector 1.3 (LGND) to 2.3 (PGND) and connector 1.4 (FE) to 2.4 (FE) (see dashed line in Fig. 4-20).

As a result, the supply voltage of the logic section (U_{LS}) is directly tapped from the main voltage (U_M) and does not have to be fed-in separately.

Option 2 Feeding the main voltage of the field bus coupler U_M, the logic voltage U_{LS} and the peripheral supply voltage U_S from **one** voltage supply system:

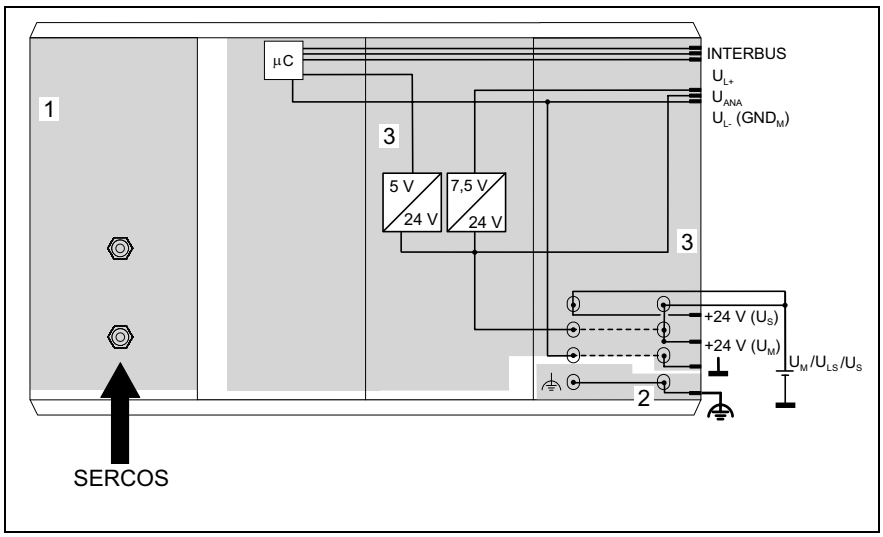


Fig. 4-21: Electrical isolation in the bus coupler (one supply voltage)

Potential sections:

1. SERCOS interface section
2. Section of functional earth ground (FE) of bus coupler and entire station
3. Section of main voltage U_M, logic voltage U_{LS} and peripheral voltage U_S

Note: The feeder connector R-IB SCN-PWR IN-CP links connector 1.2 (U_{LS}) to 2.2 (U_M), connector 1.3 (LGND) to 2.3 (PGND) and connector 1.4 (FE) to 2.4 (FE) (see dashed line in Fig. 4-21).

As a result, the supply voltage of the logic section (U_{LS}) is directly tapped from the main voltage (U_M) and does not have to be fed-in separately.

Electrical Isolation: Digital Module

Isolation of the peripheral circuit of a digital module for supplying the logic is ensured, only if a separate R-IB IL 24 PWR IN feeder terminal is fitted and the voltages for both the feeder terminal and the bus coupler are provided from separate power supply units. In this case, the supplying 24 V power supply units on the low voltage side must not be connected to each other.

The power terminal interrupts all voltage jumpers of the previous terminal and implements a new setup of the voltage jumpers for the main circuit U_M, the segment circuit U_S and the reference potential of the supply voltage GND.

This principle is shown in Fig. 4-22 by the example of a section of an Inline station.

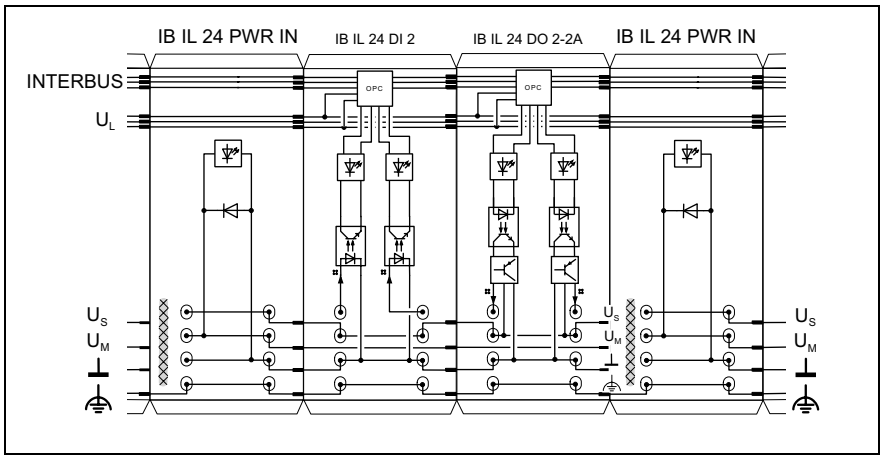


Fig. 4-22: Example: Interruption / setup of the voltage jumpers through the power terminal

The cross-hatched areas XXXXX mark the points where the voltage jumpers are interrupted.

Electrical Isolation: Analog Module

The peripheral circuit (measuring amplifier) of an analog module is supplied potential-free from the 24 V supply voltage U_{ANA}. The power supply unit with galvanic isolation is an integral part of the analog module. As is the case in each module, the voltage U_{ANA} is looped through here as well, thus being available for the following module again.

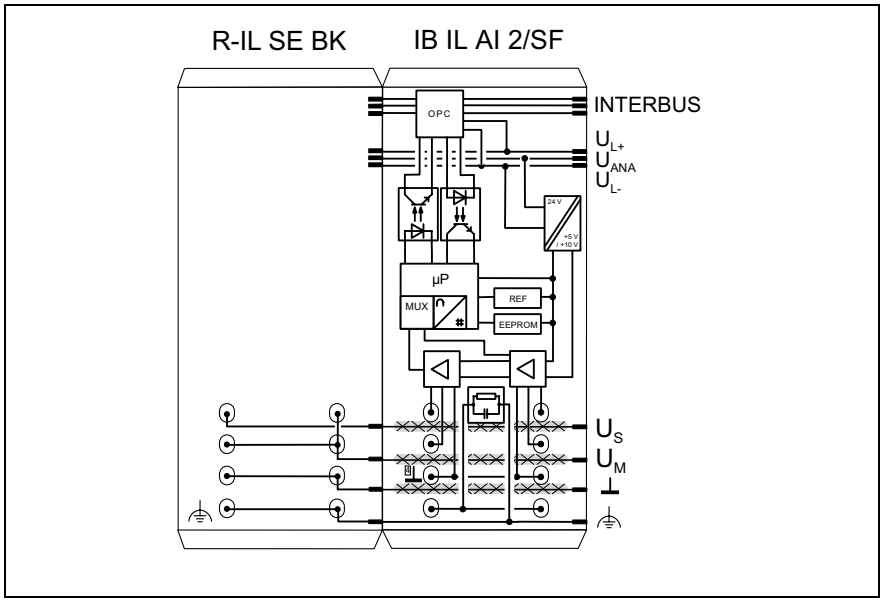


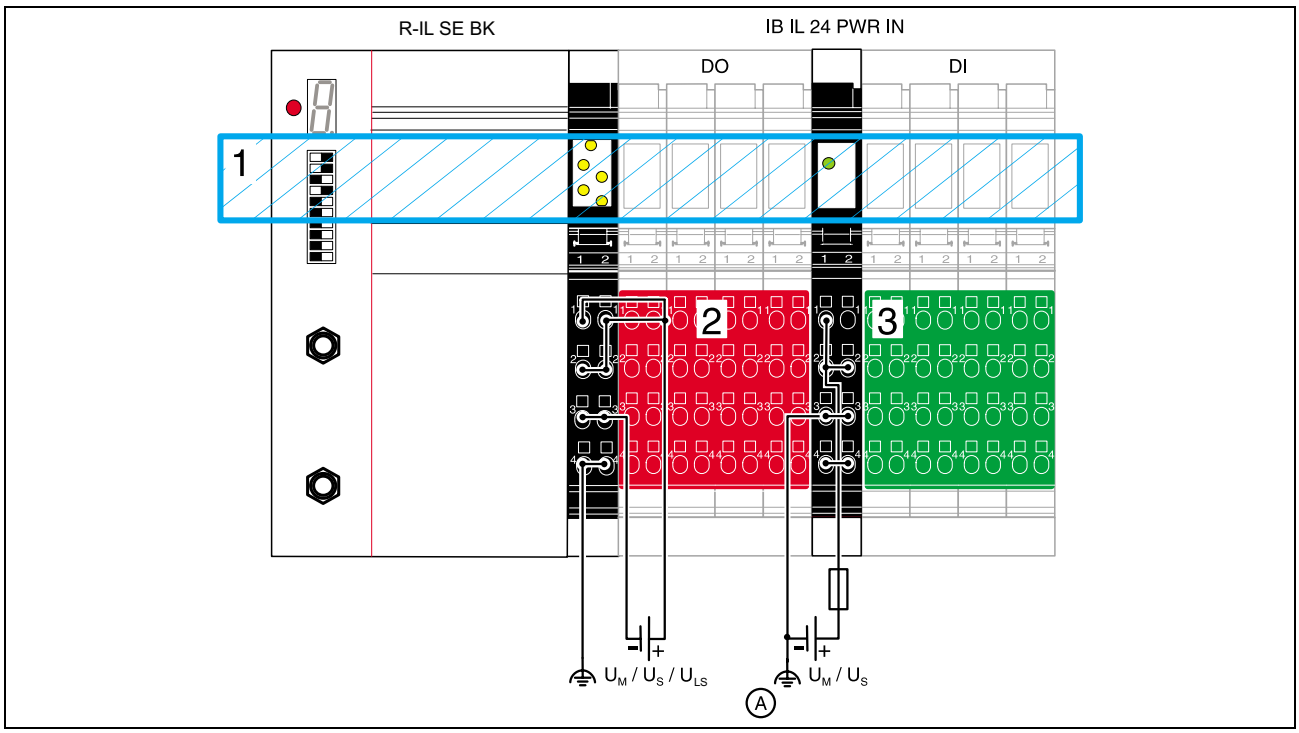
Fig. 4-23: Electrical isolation between SERCOS bus coupler and analog module

The cross-hatched voltage jumpers XXXXX are not used in the analog module. Hence, the 24 V supply of the coupler (U_M) or the power terminal is galvanically isolated from the peripheral circuit (measuring amplifier) of the analog module. The peripheral circuit of the analog module is supplied from the analog circuit U_{ANA}.

Electrical Isolation: Miscellaneous

Additional electrical isolations depend on how the supply voltages are provided. For instance, electrical isolations can be set up by feeding in a new 24 V supply by means of a power terminal. In this case, the supplying 24 V power supply units on the low voltage side must not be connected to each other.

Fig. 4-24 shows a possible electrical isolation by means of a power terminal. A connection between the ground of a supply voltage (U_S or U_M) and the functional earth ground may be established only at one point in the station (point A). Connection of several grounds to the functional earth ground cancels the electrical isolation.



Electrically isolated areas within one station:

1 Bus logic of the station
2 Peripherals (outputs)
3 Peripherals (inputs)

Fig. 4-24: Setup of electrical isolations

4.9 Diagnostic and Status Indicators

Indicators on the SERCOS Bus Coupler

For quick error diagnosis on site, all modules are equipped with diagnostic and status LEDs. In addition, the bus coupler is equipped with a 7-segment display. Please refer to Chapter 9. What to Do in Case of Failures?"

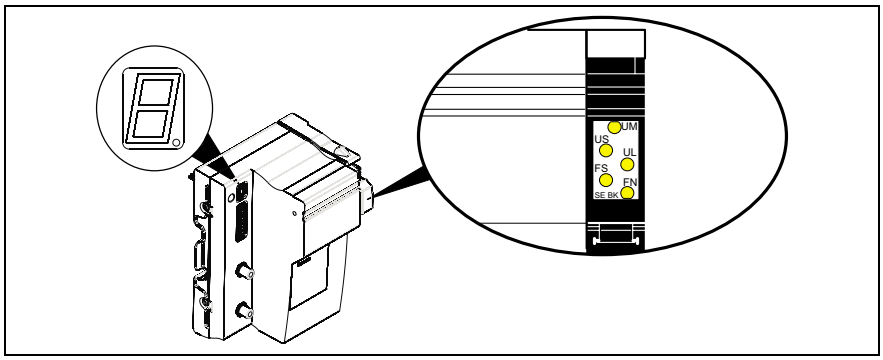


Fig. 4-25: Indicators on the SERCOS bus coupler

Indicators on the Supply Terminals

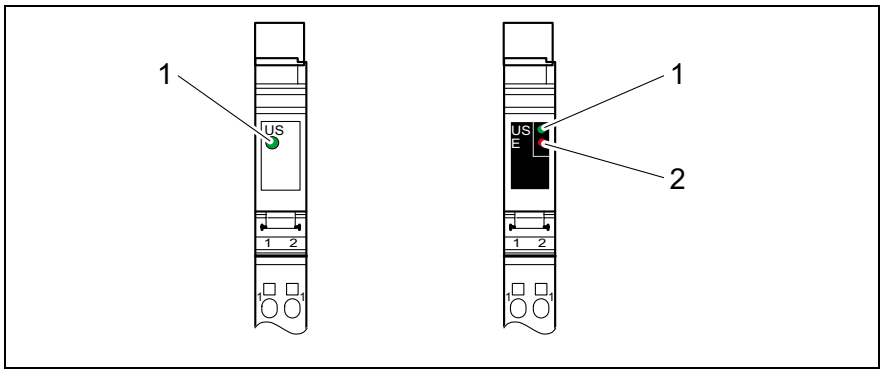


Fig. 4-26: Possible indicators on supply terminals (here: segment terminal without and with fuse)

Indicators on the Input/Output Modules

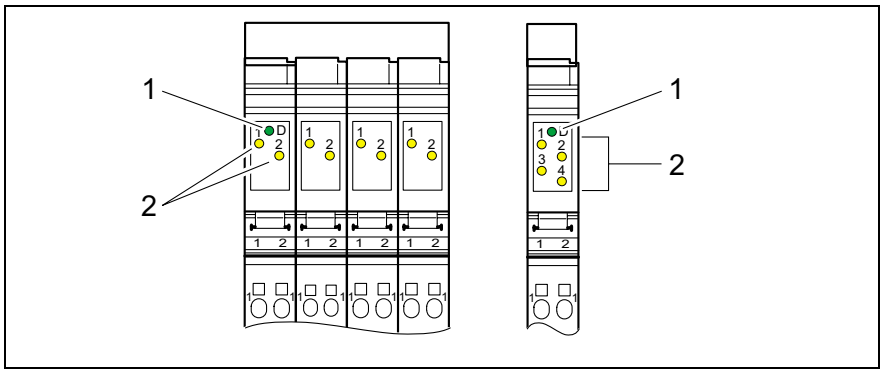
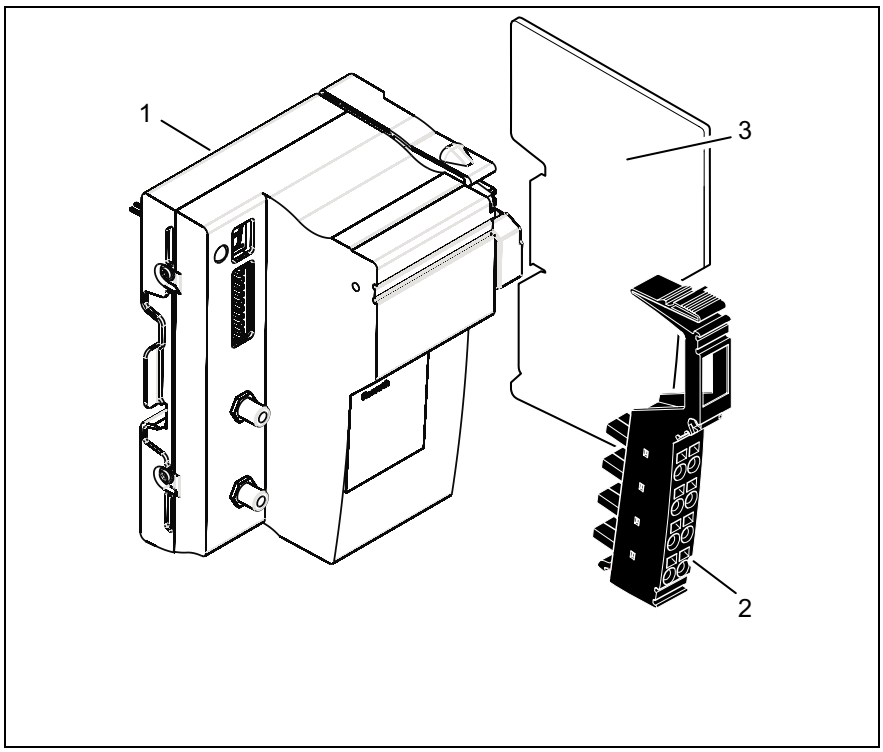


Fig. 4-27: Indicators on the input/output modules

Notes

5 SERCOS Bus Coupler and Approved Inline Modules

5.1 SERCOS Bus Coupler



1: SERCOS bus coupler
2: Feeder connector
3: End plate

Fig. 5-1: SERCOS bus coupler R-IL SE BK

Scope of Delivery

On delivery, the SERCOS bus coupler R-IL SE BK includes the following components:

Number	Order no.	Component
1	1070 922 879	End plate I-L ATP GY 7035
2	1070 922 852	End clamp
1	In preparation	Product insert

Fig. 5-2: Standard scope of delivery

Accessories

The following component can be ordered as an additional accessory part:

Order no.	Component
R911 289328	Power supply connector: R-IB IL SCN-PWR IN-CP Packaging unit: 10 pieces

Fig. 5-3: Accessories

Note: The feeder connector R-IB SCN-PWR IN-CP is the only one permitted for connecting the operating voltage (refer to Chapter 10.2 "Ordering Information on Connectors and Accessories"). This power supply connector is **not** included in the scope of delivery.

Bus Coupler

The SERCOS bus coupler constitutes the link between the SERCOS interface and the Inline modules.

The bus coupler automatically assumes the task of configuring the connected modules and of exchanging the data with **one** SERCOS master. In addition, it assumes the task of supplying the connected Inline modules with power.

End Plate

The mechanical end plate **must** be attached to the last Inline station.

DANGER

The end plate terminates the Inline station. It is mandatory to attach it after the last module of the station. The end plate does not have any electrical function. It is intended to protect the station from ESD pulses and the user from dangerous contact voltages (in case of 120/230 V supply).

Data Transfer

Data is transferred by noise-free FO transmission technology.

System Limits

The maximum number of modules that can be connected to a SERCOS bus coupler is determined by the following system key data:

- A maximum of 40 Inline modules can be connected by simply latching them to each other.
- The number of data is limited to a maximum of 32 bytes of input data and 32 bytes of output data.
- In the logic section, the field bus coupler is able to supply a maximum current of 2 A at 7.5 V DC (U_L).
- To analog modules, the field bus coupler is able to supply a maximum current of 0.5 A at 24 V DC (U_{ANA}).
- The maximum current carrying capacity of the voltage jumpers is 8 A (total current $U_S + U_M$).

Note: For information on the various circuits in a bus coupler station, please refer to Chapter 4.7 "Electric Circuits and Power Supply Voltages Within an Inline Station".

Note: When planning an Inline station project, observe the current consumption of each device at the individual voltage jumpers! This current consumption is specified in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation") and in Fig. 7-1 on page 7-2.

Important: Keep to system key data!

The potential number of devices that can be connected depends on the specific setup of the station in question. Be absolutely sure to keep to the system key data mentioned above!

Functions

The bus coupler constitutes the head of an Inline station. It couples the Inline modules to the SERCOS interface.

Note: Function modules which are not operated via the process data channel **cannot** be operated with the bus coupler.

From the fed-in supply voltage U_{LS}, the field bus coupler creates the logic voltage U_L for the connected devices. In addition, it provides the supply voltage for the connected analog modules U_{ANA}.

For information on the various circuits in a bus coupler station, please refer to Chapter 4.7 "Electric Circuits and Power Supply Voltages within an Inline Station".

The field bus coupler is the starting point of voltage and data routing of the Inline station (also refer to Chapter 4.6 "Voltage and Data Routing").

Housing

The bus coupler is accommodated in a special Inline housing. Connector and socket can be disconnected (refer to Chapter 4.3).

End clamp / CLIPFIX

Attach end clamps to either side of the Inline station. These end clamps ensure that the station is securely mounted to the mounting rail and are also provided as lateral termination elements. The end clamp is included in the scope of delivery of the bus coupler.

Connectors

The SERCOS bus coupler provides FO female connectors and terminal points for connecting the following lines:

- FO input for receiving data
- FO output for transferring data
- Main voltage U_M
- Segment voltage U_S
- Supply voltage U_{LS}, used to generate the internal logic voltage U_L and supply voltage for the analog terminals U_{ANA}.
- Functional earth ground (FE)

For detailed information on the circuits, please refer to Chapter "Voltage and Data Routing" on page 4-11 and to Chapter "Electric Circuits and Power Supply Voltages Within an Inline Station" on page 4-12.

When connecting the lines, please observe the instructions in Chapter "Mounting and Dismounting Modules and Connecting Lines" on page 6-1 as well as those in Chapter "Installing and Connecting an Inline Station" on page 7-9.

Connection Method

Connect lines with a connection cross-section of 0.2 mm^2 to 1.5 mm^2 to the tension spring connector.

Indicators

The diagnostic and status indicators of the bus coupler and the Inline station provide information on the status and on whether the supply voltages are applied or not (refer to Chapter "Diagnostic and Status Indicators" on page 4-21).

Coupling to the Functional Earth Ground (FE)

In the bus coupler, U_M, U_S and GND are capacitively coupled to the functional earth ground FE.

Ground Connection

The ground connection is established, when the bus coupler is latched onto the grounded mounting rail via the FE spring.

Prescribed Additional Ground

The bus coupler must be additionally grounded via the FE connector to ensure reliable grounding of the station, even if the FE springs are dirty or damaged. To achieve this, connect the terminal points for the FE connector to an additional ground connection (refer to Chapter "Grounding an Inline Station" on page 6-6).

Electrical Isolation

For information on the various potential sections of the SERCOS bus coupler, please refer to Chapter 4.8 "Potential Design".

5.2 Supply Terminals

The power terminal and the segment terminal are provided to supply the station with peripheral voltage. Both these terminals are also termed supply terminals. The segment terminal is a supplement to the power terminal. It permits the setup of new segments within the Inline station.

Note: **Protect the power supply! Protect the power supply with an external fuse.**

WARNING

Do not replace the terminals when the station is live!

⇒ De-energize the entire station before removing a terminal from the station! Connect the voltage only after you have set up the entire station.

Note: Since U_S and U_M are connected in parallel, the entire station can be supplied from one power supply. In this case, supply terminals are not mandatory.

Power Terminal

The peripheral voltages U_M and U_S are supplied to the voltage jumpers in the station via a power terminal. Several power terminals can be fitted within one station. In this way, the electrical isolations between different electric circuits within one and the same station are implemented without additional wiring.

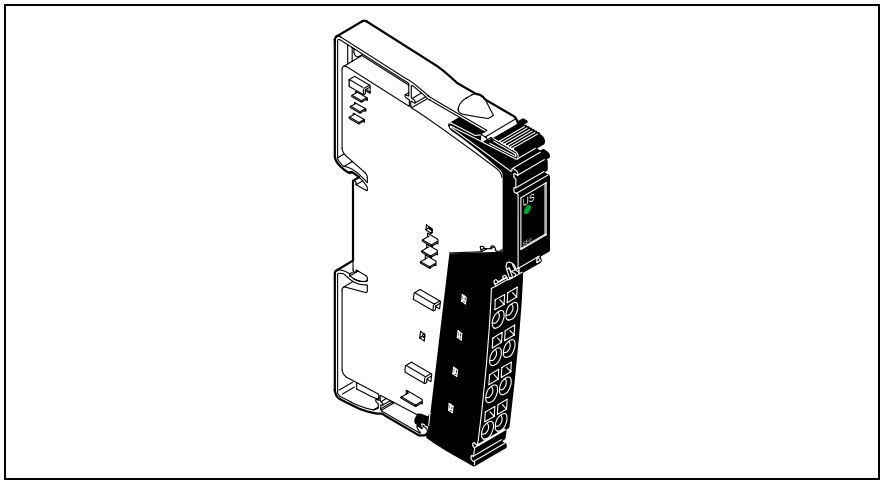


Fig. 5-4: Example of a power terminal: R-IB IL 24 PWR IN

Power Terminal Without Fuse

If power terminals without fuse are used, the main circuit is not protected via an internal fusible cutout. The 24 V supply voltage must be provided with an external fuse.

Note: The segment circuit is not protected by a power terminal. It can only be protected by a segment terminal with fuse.

Note: The SERCOS bus coupler is already provided with an integrated power terminal, which can be used to supply the entire station (depending on the setup of the station and the particular requirements for the application).

Housing (Low Signal Level)

The power terminal of the low signal level is accommodated in a 2-slot housing. Connector and socket can be disconnected.

Connectors

The power terminal is provided with terminal points for feeding the supply voltage for the main circuit U_M and the segment circuit U_S.

Note: For detailed information on the circuits, please refer to Chapter "Voltage and Data Routing" on page 4-11 and to Chapter "Electric Circuits and Power Supply Voltages Within an Inline Station" on page 4-12.

Connection Method (Low Signal Level)

Connect lines with a connection cross-section of 0.2 mm^2 to 1.5 mm^2 to the tension spring connector.

Indicators

The diagnostic indicator U_M provides information on whether the supply voltage in the main circuit U_M is applied to the output side (refer to Section "Indicators on the Supply Terminals" in Chapter "Diagnostic and Status Indicators" on page 4-21).

If the terminal concerned is one with a fuse, the E indicator also indicates the state of the fuse in the main circuit (refer to Section "Indicators on the Supply Terminals" in Chapter "Diagnostic and Status Indicators" on page 4-21.

Ground Connection

The ground connection is established, when the terminal is latched onto the grounded mounting rail via the FE springs on the bottom side of the terminal. These springs are connected to the voltage jumper FE and to the terminal points for an FE connector (also refer to Section "Prescribed Additional Ground Connection" on page 6-6).

When being latched to the preceding module, the power terminal is also connected to the FE voltage jumper of the station.

Voltage Ranges

Modules of the low signal level are provided for various voltage ranges. Depending on the power terminal, operation is possible with a voltage of 24 V DC, 120 V AC, or 230 V AC.

WARNING

Set up different voltage ranges by means of separate power terminals!

⇒ If you intend to use different voltage ranges within one station, you must use a separate power terminal for each range.

Voltage jumpers U_M /U_S

The power terminal interrupts all voltage jumpers of the previous terminal and implements a new setup of the voltage jumpers for the main circuit U_M, the segment circuit U_S and the reference potential of the supply voltage GND.

This principle is shown schematically in Fig. 5-5 by the example of a section of an Inline station.

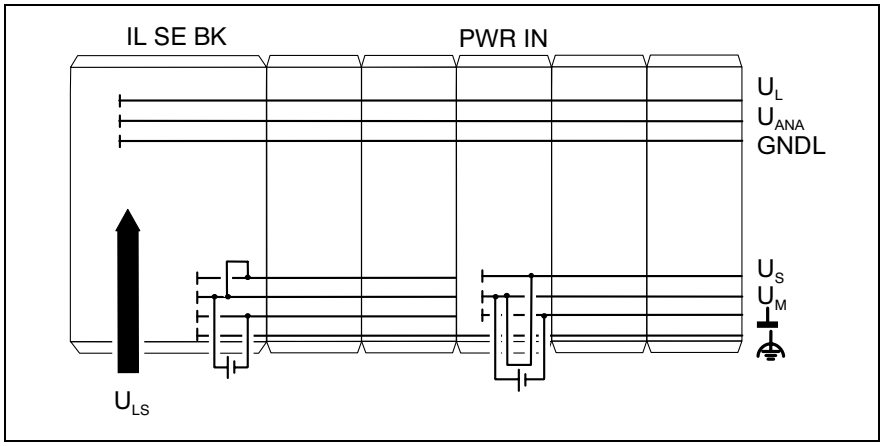


Fig. 5-5: Example: Interruption / setup of the voltage jumpers through the power terminal

Note: For detailed information on the circuits, please refer to Chapter "Voltage and Data Routing" on page 4-11. For detailed information on the supply voltages, please refer to Chapter "Electric Circuits and Power Supply Voltages Within an Inline Station" on page 4-12.

Segment Terminal

Segment terminals can only be used in the 24 V range.

Only segment terminals with fuse are available.

The segment terminals with fuse connects the voltage jumper for the main circuit U_M within the station and the segment or auxiliary current jumper U_S. Within the main circuit, the segment terminal permits setting up a new partial circuit (segment circuit), which allows power outputs, digital actuators and digital sensors to be supplied separately.

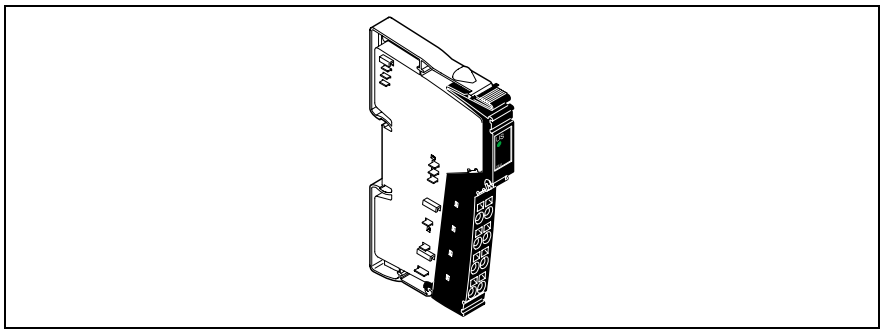


Fig. 5-6: Example of a segment terminal: R-IB IL 24 SEG/F

Segment Terminal With Fuse

Segment terminals with fuse protect the segment circuit U_S via an internal fusible cutout.

Housing

The segment terminal is shown in Fig. 5-6.

If segment terminals with fuse are used, the electronic socket contains a fuse lever (see page 6-3). Connector and socket can be disconnected.

Note: For detailed information on the circuits, please refer to Chapter "Voltage and Data Routing" on page 4-11. For detailed information on the supply voltages, please refer to Chapter "Electric Circuits and Power Supply Voltages Within an Inline Station" on page 4-12.

Indicators

The diagnostic indicator U_S provides information on whether the supply voltage in the segment circuit U_S is applied to the output side (refer to Section "Indicators on the Supply Terminals" in Chapter "Diagnostic and Status Indicators" on page 4-21).

The E indicator additionally indicates the state of the fuse in the segment circuit (see Fig. 4-26).

Coupling to the Functional Earth Ground (FE)

In the terminal, U_S and GND are capacitively coupled to the functional earth ground (FE).

Ground Connection

The ground connection is established, when the terminal is latched onto the grounded mounting rail via the FE springs on the bottom side of the terminal. These springs are connected to the voltage jumper FE and to the terminal points for an FE connector (also refer to Section "Prescribed Additional Ground Connection" on page 6-6).

When being latched to the preceding module, the segment terminal is also connected to the FE voltage jumper of the station.

No Electrical Isolation

A segment terminal does not establish an electrical isolation between two peripheral voltage ranges. This requires a power terminal.

Segment terminals are available only for the 24 V DC voltage range.

U_M

The voltage jumper for the main circuit U_M is not interrupted in the segment terminal. From this voltage jumper, the potential for the segment circuit U_S is tapped from the segment terminal.

U_S

The segment terminal interrupts the segment circuit U_S in the voltage jumper of the previous module.

This principle is shown schematically in Fig. 5-7 by the example of a section of a station.

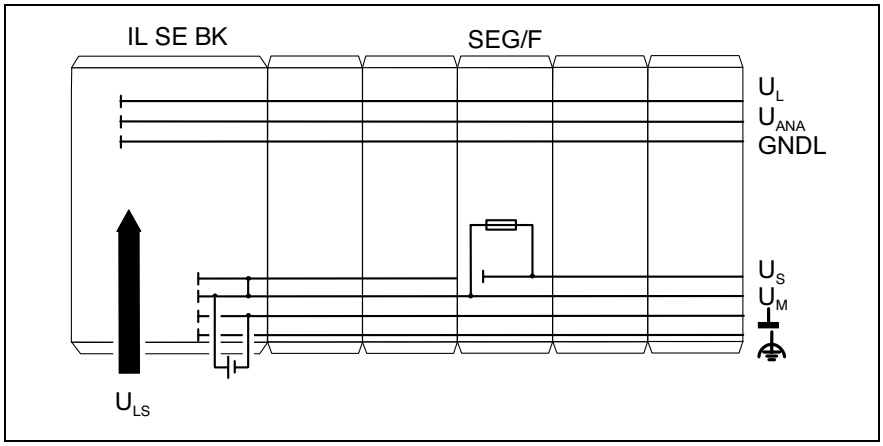


Fig. 5-7: Example: Interruption / setup of the voltage jumper through the segment terminal

5.3 Input/Output Modules

General Information on Modules for Analog and Digital Signals

On the low signal level, input and output modules are available for analog and digital signals. These modules are available in various sizes. Using these modules, you can set up the station according to your requirements.

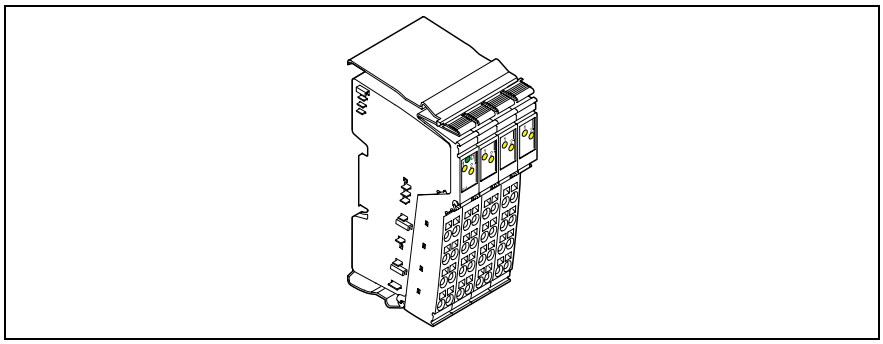


Abb. 5-8: Example of a digital input module: R-IB IL 24 DI 8

Housing Depending on the overall width of the socket and the design of the connector, the following input/output modules are available:

Connectors Depending on their design, the input/output modules are provided with terminal points for the connection of 2-wire, 3-wire and 4-wire sensors and actuators.

Connection Method Connect lines with a connection cross-section of 0.2 mm^2 to 1.5 mm^2 to the tension spring connector.

Fusing The system is protected against overload centrally in the power terminal with fuse. If this is not the case, this protection must be provided by the user.

Connectors	Maximum connection method	Housing width		
		2 slots	4 slots	8 slots
Standard connector	4-wire connection	2 x DI 2 x DO		8 x DI 8 x DO
Standard connector, AC	Alternating contact	1 x DO (relay type)		4 x DO (relay type)
Standard connector, not printed	3-wire connection	2 x EDI		
Standard connector, not printed	1-wire connection	2 x EDI		32 x DI 32 x DO
Shield connector	For connection method, refer to module-specific data sheets.	2 x AI 2 x AI TEMP 2 x AO U/BP	1 x AO SF	
Extended double-signal connector	3-wire connection	4 x DI 4 x DO		16 x DI 16 x DO

DI/DO: Digital input / output
AI/AO: Digital input / output

Fig. 5-9: Input/output modules

Note: Select the value of the upstream fuse, so that it will not exceed the maximum load current (total of all I/O modules to be considered). The maximum permissible load current of an I/O module is specified in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Connectors Depending on their design, the input/output modules are provided with terminal points for the connection of 2-wire, 3-wire and 4-wire sensors and actuators.

Indicators The diagnostic and status indicators of the modules provide information on the bus and the status of the inputs and outputs (refer to Chapter "Indicators on the Input/Output Modules" on page 4-24).

The LEDs are located in the logic section of the modules. As a consequence, the outputs are not activated in case of a failure of the segment voltage U_S, although the status LEDs of the output are emitting light.

Coupling to the Functional Earth Ground (FE) There is no coupling to the functional earth ground (FE) in the module.

Ground Connection The ground connection is established via the FE voltage jumper on latching to the preceding module.

Additional Ground Connection An additional ground connection via these modules is not necessary.

No Electrical Isolation These modules do not set up an electrical isolation. This requires a power terminal.

Voltage Ranges Modules of the low signal level are provided for various voltage ranges. Depending on the power terminal, operation is possible with a voltage of 24 V DC, 120 V AC, or 230 V AC.

DANGER

Set up different voltage ranges by means of a separate power terminal!

⇒ If you intend to set up different voltage ranges within one station, you must use a separate power terminal for each range.

Specific Information on Modules for Analog Signals

Shielding The connectors of the analog modules are provided with a special shield connector to shield the lines. The shield must be applied to the source on one side, i.e. to the module itself in case of an AO module and to the sensor in case of an AI module.

Note: Analog sensors must always be connected with twisted and shielded cable pairs!

6 Mounting and Dismounting Modules and Connecting Lines

6.1 Mounting Regulations

Correct mounting is described in the "Installation Instructions for the Electrician" which are supplied with the bus coupler.

CAUTION

Do not replace modules or connectors with the station being live!

⇒ De-energize the entire station before you remove a module from the station or before you install a module in the station! Connect the voltage only after you have set up the entire station. Any non-observance of this requirement may cause destruction of the module.

6.2 Mounting and Dismounting Inline Modules

You can set up an Inline station by end-to-end mounting the individual components. No tool is required. On connecting these modules in series, the potential and bus signal connection (voltage and data routing) between the individual components of the station is established automatically.

Mounting the components in vertical direction to the mounting rail ensures easy installation and removal even in confined spaces.

Once the station has been set up, individual modules can be replaced subsequently by being pulled out or plugged in without any additional tools.

Mounting Rail

All Inline modules are mounted on a 35 mm standard mounting rail.

End Clamp / CLIPFIX

Attach end clamps to either side of the Inline station. These end clamps ensure that the Inline station is securely mounted to the mounting rail and are also provided as lateral termination elements. These termination elements are included in the scope of delivery of the bus coupler.

Note: When dismounting the modules, the left-hand end clamp of the bus coupler must be removed before the latter can be latched off.

End plate

The mechanical termination of a SERCOS bus coupler station **must** be the end plate. The end plate does not have any electrical function. It is intended to protect the station from ESD pulses and the user from dangerous contact voltages. The end plate is supplied with the bus coupler and does not have to be ordered separately.

Mounting

Proceed as follows to latch on a module (Fig. 6-1):

- First latch on the electronic sockets, which are required to set up the station, perpendicularly to the mounting rail (Fig. A).

Note: Ensure that **all** feather keys and keyways of neighboring modules are interlocked (Fig. B).

The keyway/feather key joint connects neighboring modules to each other and ensures, that the voltage jumper is set up securely.

- Then fit the connectors onto the pertinent sockets.

First fit the front connector shaft latch in the front release mechanism (Fig. C).

Then press the connector towards the socket until it clicks into place in the rear release mechanism (Fig. D).

Note: The keyways provided in the electronic socket are not continued in the connector. An electronic socket can only be latched on, if there is no connector to the left of it. If necessary, the latter must be removed.

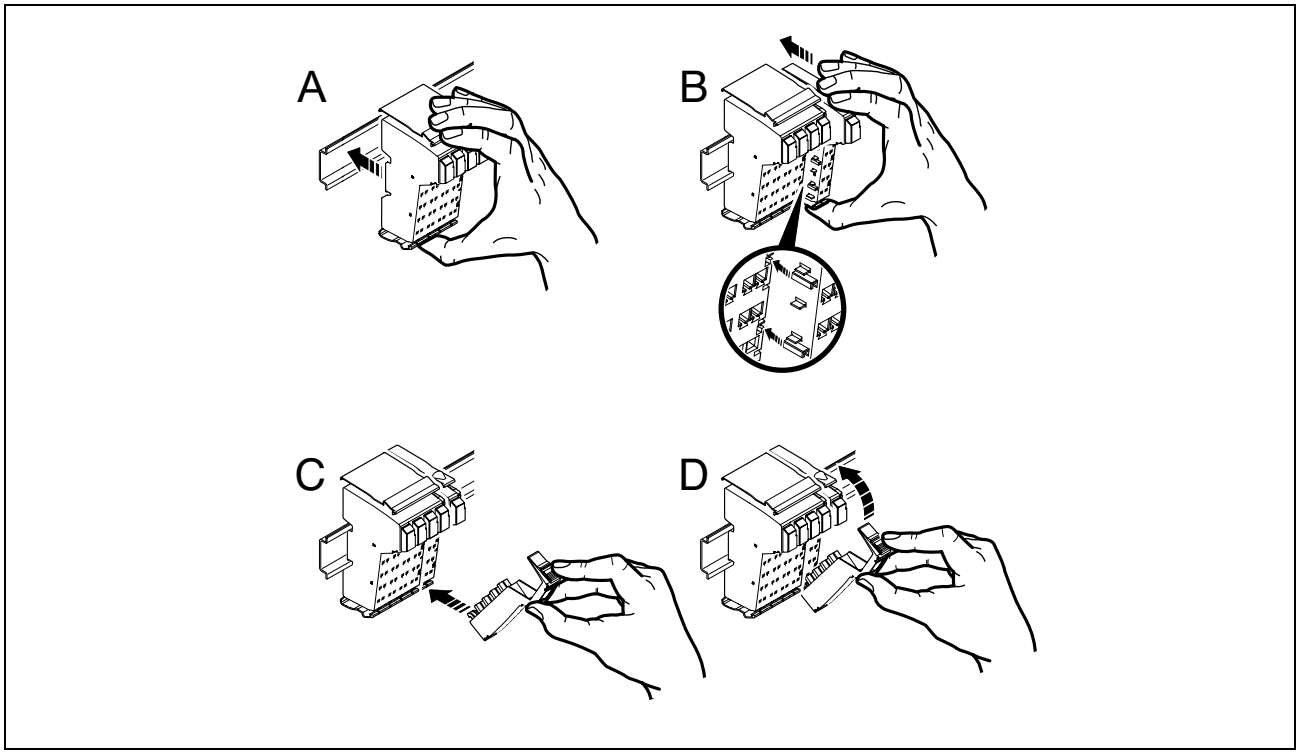


Fig. 6-1: Latching on a module

Dismounting

Proceed as follows to remove a module (Fig. 6-2):

- Remove the labeling field, if present (A1 in Fig. A).

Note: If any of the modules is provided with more connectors than one, all these connectors must be removed from the module. The sections below describe the removal of a 2-slot module.

Pry out the connector of the module to be removed by pressing on the rear connector shaft latch (A2 in Fig. A).

- Remove the connector (Fig. B).
- Remove the adjacent connectors of the neighboring modules (Fig. C). This ensures that the feathers of the voltage jumpers and the keyway/feather key joint are prevented from damage. Moreover, the module can be accessed more easily.
- Actuate the release mechanism (D1 in Fig. D) and remove the electronic socket perpendicularly to the mounting rail (D2 in Fig. D). If you have failed to loosen the connector of the neighboring module to the left, this connector now comes loose to protect the feathers of the voltage jumper and the keyway/feather key joint.

Note: When dismounting the modules, the left-hand end clamp of the field bus coupler must be removed before the latter can be latched off.

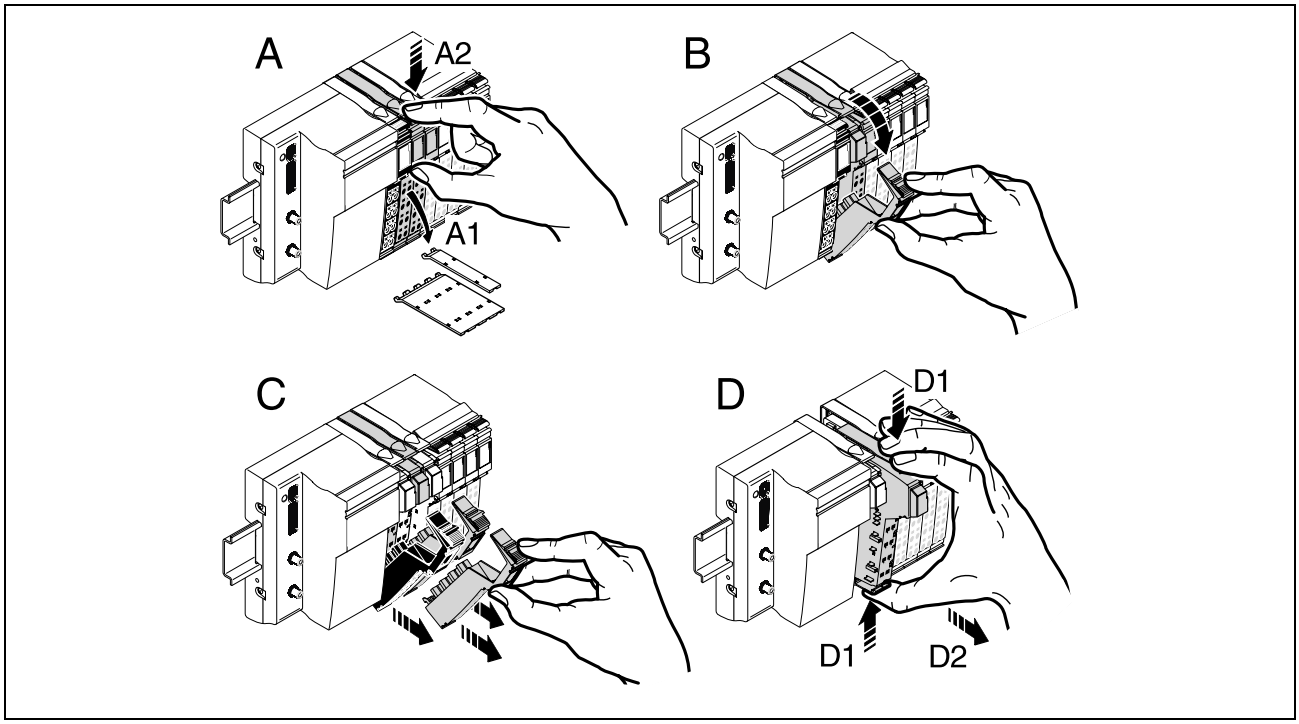


Fig. 6-2: Removing a module

Replacing a Module

If you intend to replace a module within the Inline station, proceed as described above to remove it. Do not latch on the adjacent connector of the neighboring module to the left yet.

Insert the socket of the new module. Refit all connectors.

Fuse Replacement

If segment terminals with fuse are used, the connected voltage and the state of the fuse are monitored and indicated by diagnostic indicators (refer to Section “Indicators on the Supply Terminals” in Chapter "Diagnostic and Status Indicators" on page 4-21).

Note: A missing fuse must be installed; a defective fuse must be replaced.

When replacing the fuse, please observe the following instructions on the safety of your health and the protection of your station!

1. Always use the screwdriver with care to prevent yourself and any other person from being injured.
2. Pry out the fuse at the metal contact. Do not pry the fuse out at the glass body to prevent the latter from being broken.
3. Pry out the fuse carefully on one side and then remove it by hand. Take care not to drop the fuse into your station.

Proceed as follows to replace the fuse (also see the illustrations in Fig. 6-3):

- Swing up the fuse lever (A).
- Put a screwdriver behind a metal contact of the fuse (B).
- Carefully pry out the metal contact of the fuse (C).
- Remove the fuse by hand (D).
- Latch in the new fuse (E).
- Press the fuse lever down again until it clicks into place (F).

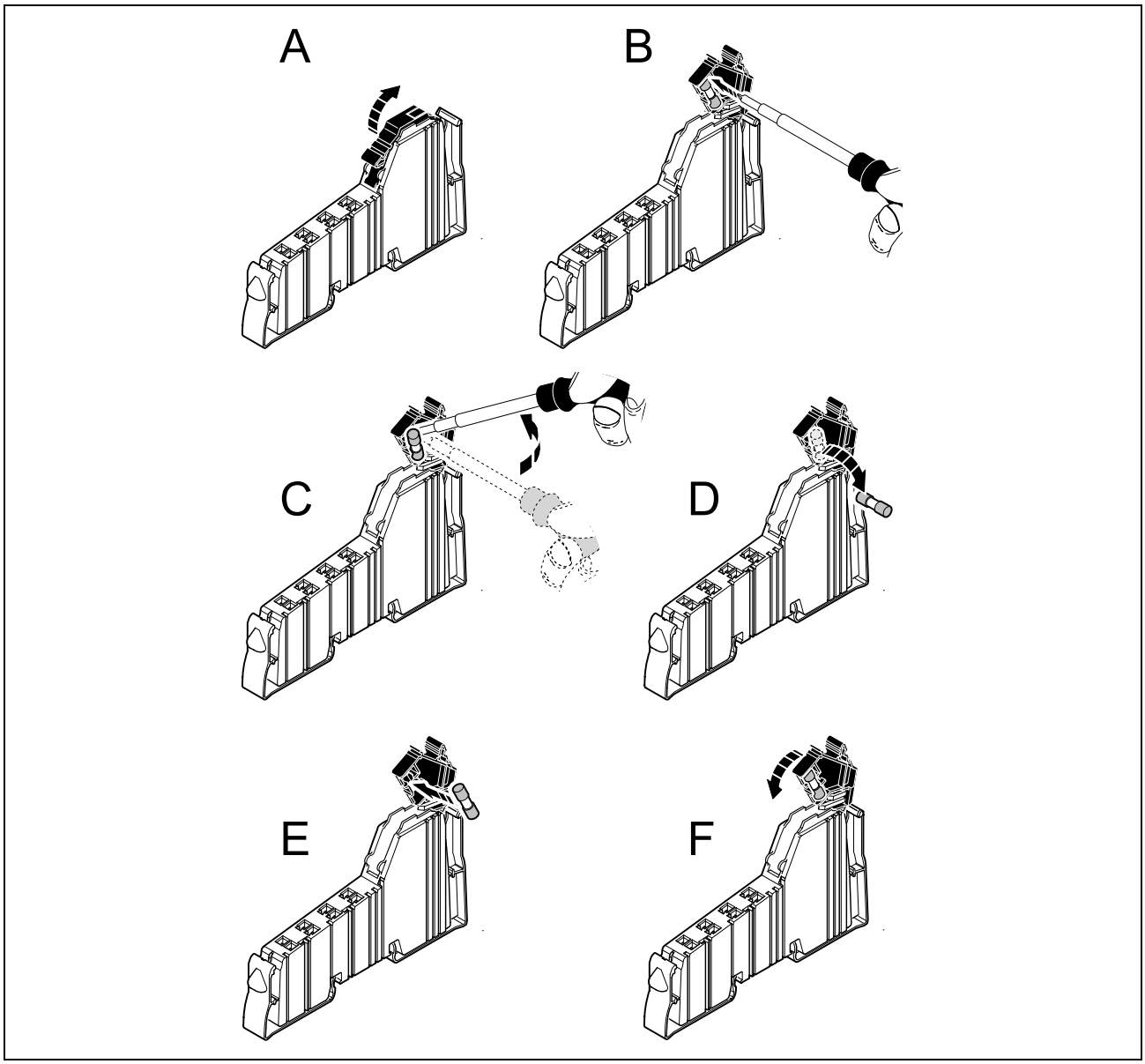


Fig. 6-3: Fuse replacement

6.3 Grounding an Inline Station

All devices of an Inline station must be grounded to keep possible interferences away from the station and to discharge them to the ground. Grounding must be implemented by means of a conductor with a cross-section of at least 1.5 mm^2.

SERCOS Bus Coupler, Supply Terminals

FE springs (metal clips) establishing an electric connection to the mounting rail are provided on the bottom side of the electronic socket of the SERCOS bus coupler and the power and segment terminals. Connect the mounting rail to the protective ground by using ground terminals. This also grounds the modules mentioned.

Prescribed Additional Ground Connection

As prescribed by Rexroth, the field bus coupler must be additionally grounded via the FE terminal point, see Fig. 6-4, in order to ensure a reliable ground connection, even if the mounting rail is dirty or the metal clip is damaged.

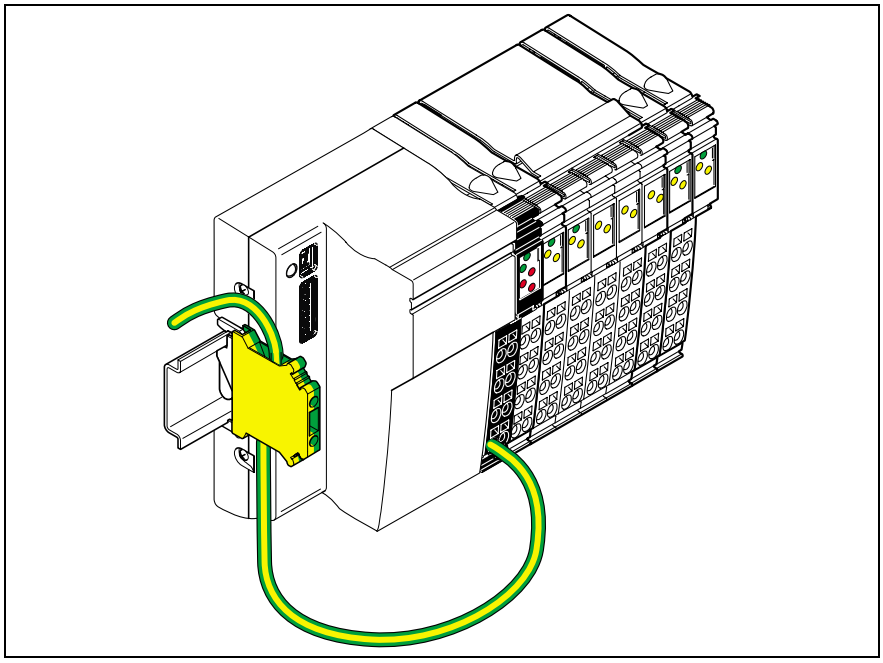


Fig. 6-4: Additional ground connection of the SERCOS bus coupler

FE Voltage Jumper

Starting at the SERCOS bus coupler, the FE voltage jumper (functional earth ground) is routed through the entire Inline station. Ground the mounting rail. When latched on, the FE voltage jumper is connected to the grounded mounting rail. If the station is equipped with supply terminals, the FE voltage jumper is connected to the grounded mounting rail in these modules as well.

The FE functional earth ground is only intended to discharge disturbances. It is not provided as a protection against electric shock for persons.

Low Signal Level

The further Inline modules of the low signal level are grounded automatically via the FE voltage jumper when the modules are latched to each other.

Power Level

The FE voltage jumper is also routed through the power modules.

6.4 Shielding an Inline Station

The shielding is intended to reduce any effects of interferences on the system.

In the Inline station, the connection lines of modules for analog signals are shielded.

Observe the following when shielding:

- Fit the shield over an area as large as possible under the clip in the shield connector.
- Ensure proper contact between the connector and the module.
- Avoid damaging or squeezing of cores. Avoid stripping the lines too much.
- Connect the cores properly.

Shielding the Line

Shielding in Case of Analog Sensors and Actuators

- Always connect analog sensors and actuators using shielded and twisted cable pairs.
- Connect the shield system via the shield connector.

Connection of the shield to the shield connector is described on page 6-11, "Connecting Shielded Lines Via the Shield Connector".

Depending on the analog input and output modules, there are several ways of grounding the shield. The length of the cables must also be taken into consideration.

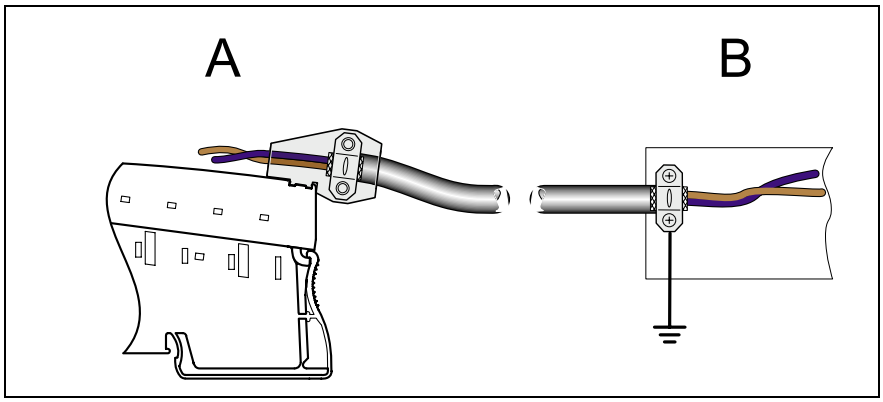
Module type	Connection to the module	Cable length	Connection to the sensor/actuator
Analog input module R-IB IL AI 2/SF	Ground connections are connected to FE via an RC element inside the module.	< 10 m	–
		> 10 m	Apply the sensor directly to the PE.
Analog output module IB R-IL AO...	Directly on FE using a shield clip.	< 10 m	–
		> 10 m	Decouple the actuator with RC element and apply it to the PE.

Fig. 6-5: Overview: Shield connection of analog sensors and actuators

Connecting the Analog Input Module R-IB IL 24 AI 2/SF

- Connect the shield system via the shield connector (see page 6-11, "Connecting Shielded Lines Via the Shield Connector").
- Connect the shield system at the sensor to the FE potential over an area as large as possible.

The ground connection in the module is connected to FE via an RC element inside the module.



A: Module side
B: Sensor side

Fig. 6-6: Connection of analog sensors in case of signal lines > 10 m

Note: If you intend to use both channels of the module R-IB IL AI 2/SF, you may connect the shield system in several ways, depending on the line cross-section.

1 To connect the two sensors, you should use a multi-core line; connect the shield via the shield connector, as described above.

2 To connect the two sensors, you should use a thin line; connect the shield system for both lines via the shield connector.

Connecting the Analog Output Module R-IB IL AO ...

Note:

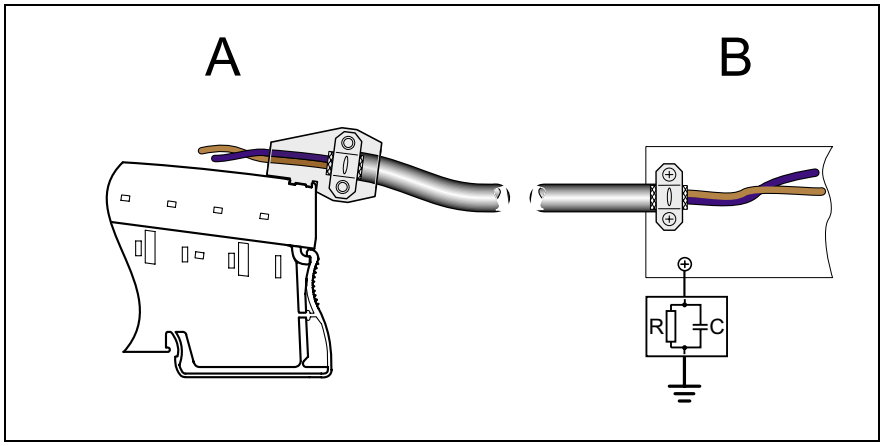
- Connect the shield system via the shield connector (see page 6-11, "Connecting Shielded Lines Via the Shield Connector").
- Connect the shield system to the FE potential over an area as large as possible.

Note: Development of ground loops!

⇒ The shielding system may be connected directly to the ground potential at one point only.

- If lines are more than 10 meters in length, they should always be decoupled by means of an RC element (on the actuator side).

The typical value of the capacitor C should range from 1 nF to 15 nF. The value of the resistor R should be at least 10 MΩ.



A: Module side
B: Actuator side

Fig. 6-7: Connection of actuators, in case of signal lines > 10 m

6.5 Connecting Lines

Both shielded and unshielded lines are used in a station application.

Connect the lines for peripheral equipment and supply voltages via tension spring connection points. This allows you to connect signals up to 250 V AC/DC and 5 A with a connection cross-section ranging from 0.2 mm^2 to 1.5 mm^2 (AWG 24-16).

Connecting Unshielded Lines

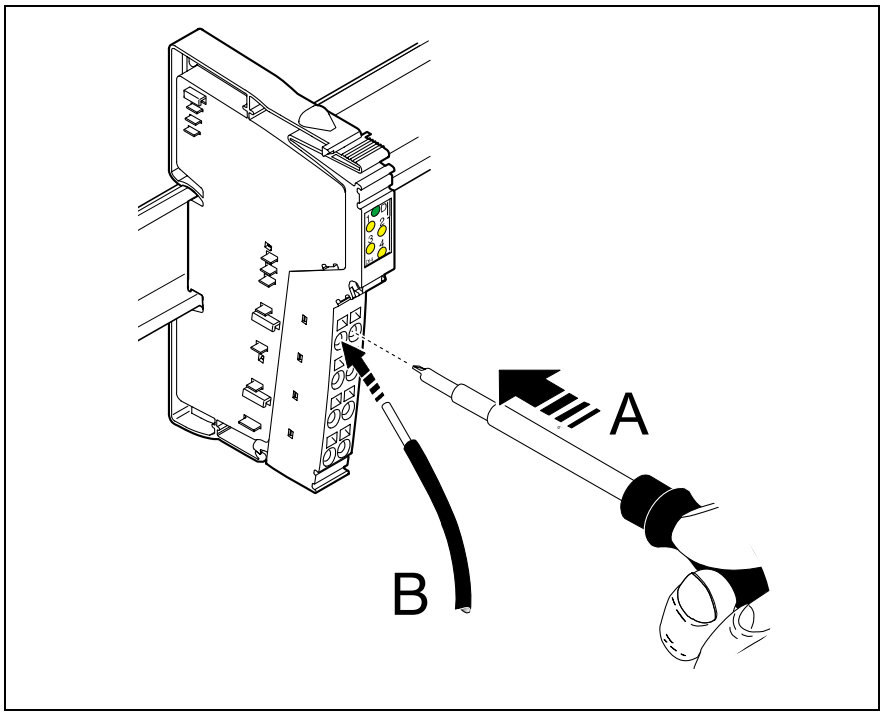


Fig. 6-8: Connecting unshielded lines

Wire the connectors as required according to your application.

Note: For connector assignment, please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Wire the connectors as required according to your application.

- Strip the line to a length of 8 mm. The field bus coupler or Inline wiring is not provided with connector sleeves. However, connector sleeves may be used, if desired. In this case, the connector sleeves must be properly crimped.
- Put a screwdriver into the actuation slot of the appropriate terminal point (Fig. 6-8, A) as far as necessary to be able to insert the core into the opening of the spring. Insert the core (Fig. 6-8, B). Pull the screwdriver out of the opening. This fixes the core. After completed installation, the cores and terminal points should be labeled (also refer to Chapter "Diagnostic and Status Indicators" on page 4-21).

Connecting Shielded Lines Via the Shield Connector

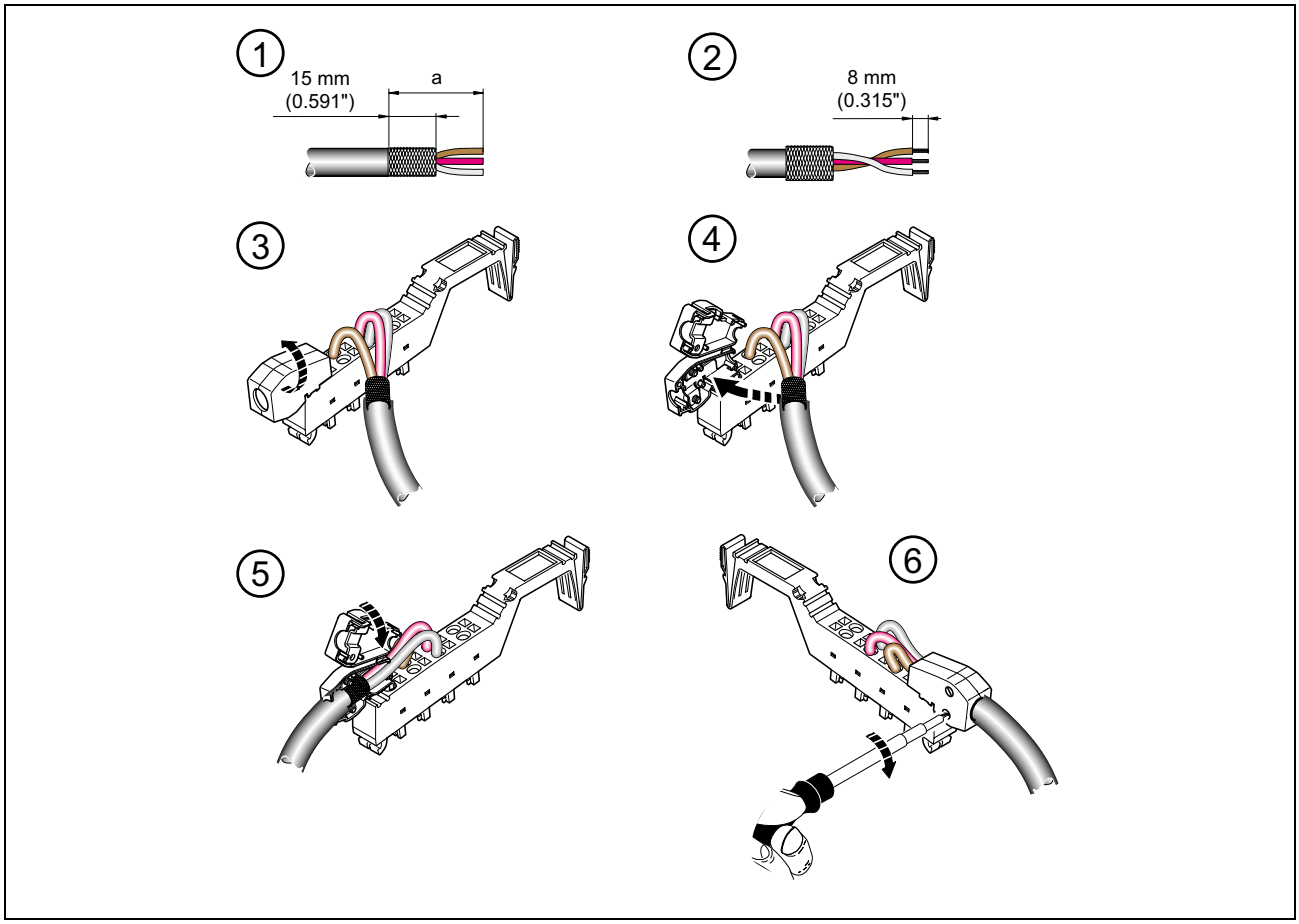


Fig. 6-9: Connecting the shield to the shield connector

Below, connection of a shielded line is described by example of an “analog line”.

Proceed as follows:

Stripping the Lines

- Strip the outer sheath of the line to the desired length (a) (1).

  The desired length (a) depends on the position where you connect the cores and on whether you intend to place the cores between the connection point and shield connection in a generous or a tight arrangement.
- Shorten the braid to 15 mm (1).
- Place the braid around the outer sheath (2).
- Remove the protective foil.
- Strip the lines for 8 mm (2).

Note: The Rexroth Inline wiring is not provided with connector sleeves. However, connector sleeves may be used, if desired. In this case, the connector sleeves must be properly crimped.

Wiring the Connectors

- Put a screwdriver into the actuation slot of the appropriate terminal point as far as necessary to be able to insert the core into the opening of the spring.
- Insert the core. Pull the screwdriver out of the opening. This fixes the core.

Connecting the Shield

For connector assignment, please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

- Open the shield connector (3).
- Check the orientation of the shield clip in the shield connector.
- Place the line including surrounding braid in the shield connector (4).
- Close the shield connector (5).
- Tighten the screws on the shield connector using a screwdriver (6).

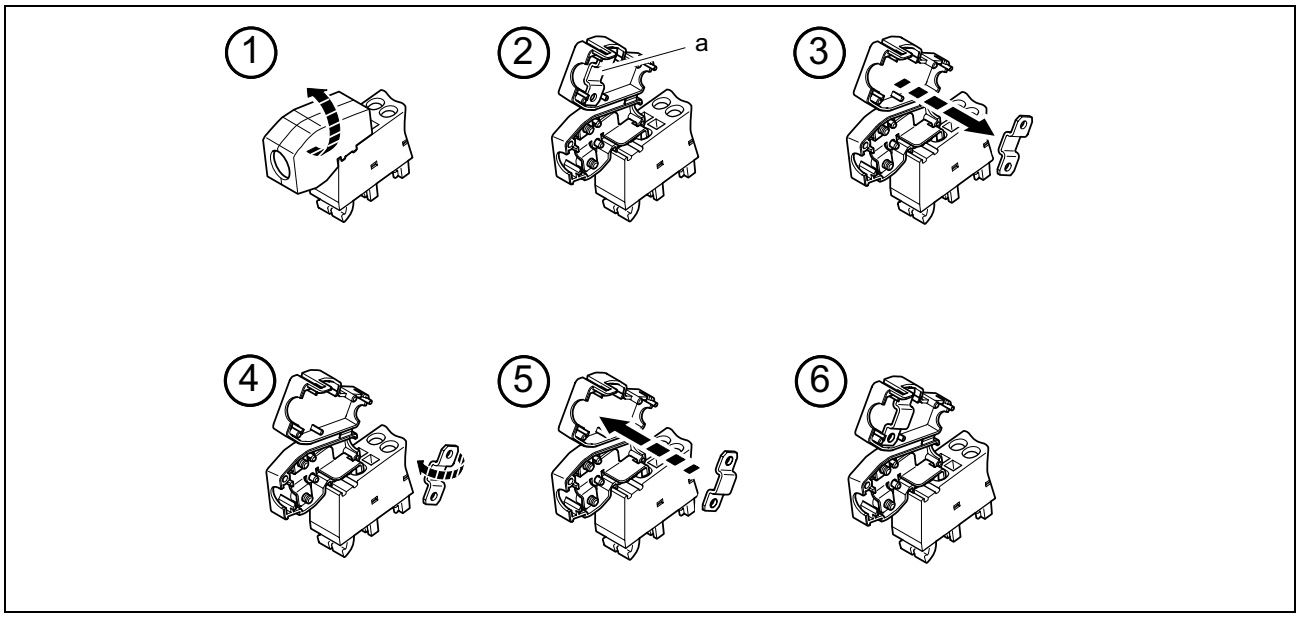


Fig. 6-10: Orientation of the shield clip

Shield Clip

The shield clip (a in Fig. 6-10, 2) in the shield connector can be used according to the line cross-section. If thicker lines are used, the camber of the clip must be directed away from the line (Fig. 6-10, 2). If thinner lines are used, the camber of the clip must be directed towards the line (Fig. 6-10, 6).

If you have to change the orientation of the shield clip, proceed as described below and shown in Fig. 6-10:

- Open the housing of the shield connector (1).
- On delivery, the shield connector is intended for the connection of thicker lines (2).
- Remove the clip (3), turn the clip according to the cross-section of the line used (4), and fit the clip (5).
- Figure 6 illustrates the clip, if a thin line is used.

6.6 Connecting Power Supply Voltages

When using a station, you must provide the supply voltage for the SERCOS bus coupler, for the logic of the modules, for the sensors and for the actuators.

Connect the power supply voltages via unshielded lines as described on page 6-10.

For information on the pin assignments for connection of the supply voltages, please refer to Fig. 7-12 or the functional description (refer to Chapter 10.2 "Ordering Information on the Documentation") for the SERCOS bus coupler, power terminals, and segment terminals.

CAUTION

Do not replace the terminals when the station is live!

⇒ De-energize the entire station before you remove a module from the station or before you install a module in the station!

Connect the voltage only after you have set up the entire station.

Infeed at the SERCOS Bus Coupler

In the simplest case, all necessary 24 V supply voltages are fed in at the bus coupler. From there, the entire station will then be supplied with voltage (also refer to "Connecting the SERCOS Bus Coupler" on page 7-12).

In this case, the following supply voltages must be fed in or made available:

U_M 24 V infeed into the main circuit

The main voltage U_M supplies all devices connected to the main circuit.

U_S 24-V infeed in the segment circuit

The segment voltage U_S can be fed in separately at the bus coupler or tapped from the main circuit. To tap the voltage U_S from the main circuit U_M, a jumper can be fitted or an activated segment circuit be established by means of a switch.

The voltage U_S supplies all devices connected to the segment circuit.

U_{LS} 24-V infeed into the logic circuit

Owing to the jumper from the feeder connector to U_M, the logic voltage U_{LS} is tapped automatically from the main circuit. It supplies the bus coupler, the internal logic voltage U_L (7.5 V) and the analog voltage U_{ANA} (24 V).

Functional Spring

When latched on, the functional earth ground spring is in contact with the mounting rail; it is provided to discharge interferences and must not be used as protective earth. To ensure safe discharge of the interferences, even if the mounting rail is dirty, the functional earth ground must be connected directly to terminal point 1.4 or 2.4. This also adequately grounds the Inline station up to the first segment terminal.

Please also refer to Chapter 4.8 "Potential Design".

Electrical Isolation: Peripheral Equipment

The bus coupler is not provided with electrical isolation for the logic supply of the I/O modules. U_M (24 V), U_S (24 V), U_{LS} (24 V), U_L (7.5 V) and U_{ANA} (24 V) are not isolated galvanically.

The main voltage U_M and the peripheral voltage U_S can be supplied separately, but have the same reference to ground. That means that only these two voltages can be fused separately. If you wish to galvanically isolate the U_M / U_S and U_{LS} voltage from each other, you have to fit a separate power terminal. Only then it is ensured, that the galvanic isolation in the input and output modules is not jumpered by a joint reference to ground.

Please also refer to Chapter 4.8 "Potential Design".

Infeed at Power Terminals

In addition to feeding the supply voltages for the peripheral equipment in at the bus coupler, it is also possible to feed or provide the voltage via a power terminal.

Note: Please also refer to Chapter 5.2 "Supply Terminals".

U_M 24 V infeed into the main circuit

The main voltage is fed in at the power terminal.

U_S 24 V infeed in the segment circuit

The segment voltage can be fed in at the power terminal or generated from the main voltage. To tap the voltage U_S from the main circuit U_M, a jumper can be fitted or an activated segment circuit be established by means of a switch.

Electrical isolation

A new potential range can be established via the power terminal.

Voltage Ranges

Using power terminals, you can also set up partial stations with different voltage ranges. Depending on the power terminal, operation is possible with a voltage of 24 V DC, 120 V AC, or 230 V AC.

WARNING

Set up different voltage ranges by means of separate power terminals!

⇒ If you intend to use different voltage ranges within one station, you **must** use a separate power terminal for each range.

DANGER

Dangerous contact voltage! Any failure to observe this warning may be detrimental to your health and may even cause dangerous injuries.

⇒ If you remove the power terminal, the metal contacts are freely accessible.

⇒ It must be assumed that 120 V or 230 V power terminals cause dangerous contact voltage. Be **absolutely** sure to de-energize the station **before removing** a terminal!

Providing the Segment Voltage at Power Terminals

It is not possible to feed in voltage at the segment terminal.

Within the main circuit, the segment terminal permits setting up a new partial circuit (segment circuit), which allows power outputs, digital actuators and digital sensors to be supplied separately.

The segment voltage can be tapped from the main circuit via a jumper. Using a switch, you can control the segment circuit from outside.

Using a segment terminal with fuse, you can set up a protected segment circuit without any additional wiring.

Power Supply Voltage Requirements

WARNING

Use power supply units ensuring safe isolation!

⇒ Only use power supply units ensuring safe isolation between the primary and secondary circuits according to EN 50178.

Note: For further power supply voltage requirements, please refer to Chapter 10.1 "Technical Data" in this manual.

6.7 Connecting the FO Conductor Cable

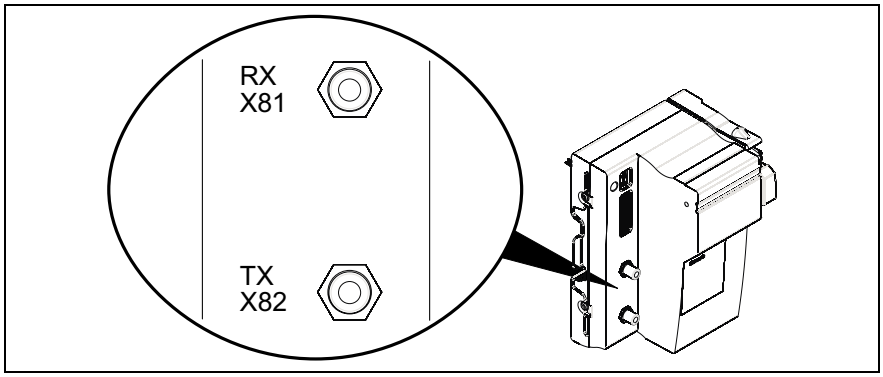


Fig. 6-11: FO connectors of the SERCOS bus coupler

Because of the ring structure, the transmitter of the preceding device must be connected to the receiver of the following device.

Connect the fiber optic conductor (FO) running to the receiver of the next device to the transmitter X82 (TX). The FO conductor coming from the preceding device must be connected to the receiver X81 (RX). The light signal is amplified in the interface module and exits the transmitter (X82), provided that the supply voltage of the bus coupler is activated.

If the transmitter feeds a signal via an FO conductor cable, red light is emitted from the former. This allows you to verify, whether a device is transmitting or not.

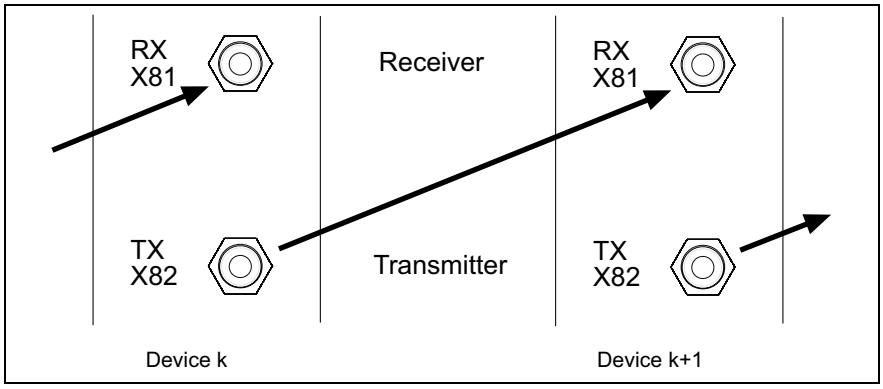


Fig. 6-12: Principal connection of the FO conductors

For further information on the connection of FO conductor cables, please refer to Chapter 7.2 "Selecting the FO Conductor Cable".

6.8 Connecting Sensors and Actuators

Sensors and actuators must be connected using the connectors. The type of connector which can be used for the respective module is specified in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

The connection of shielded and unshielded lines is described in Chapter 6.5.

Sensor and Actuator Connection Methods

The digital I/O modules of the Inline product family usually permit 2-wire, 3-wire or 4-wire connection of sensors and actuators.

Owing to the connector types, the following connection methods can be used at a connector:

- 2 sensors or actuators with 2-wire, 3-wire or 4-wire connection
- 4 sensors or actuators with 2-wire or 3-wire connection
- 2 sensors or actuators with 2-wire or 3-wire connection with shield (for analog sensors or actuators)

When connecting analog devices, please observe the appropriate functional descriptions (refer to Chapter 10.2 "Ordering Information on the Documentation"), since the connection method for analog devices is different from the connection method for digital devices.

Typical Connector Pin Assignments with Digital Input and Output Modules

Below, the modules of the 24 V range serve as an example of the possible connection methods. The specifications must be adapted accordingly for the 120 V and 230 V ranges. A connection example is specified for each module in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Connection	Symbol in the figure	2-wire	3 wire	4 wire
Sensor signal IN	IN	X	X	X
Sensor supply U_S / U_M	U_S (+24 V)	X	X	X
Ground	GND	_	X	X
Grounding/shielding FE	FE ( )	_	_	X

X: assigned
–: not assigned

Fig. 6-13: Overview of the connections assigned with digital input modules

Connection	Symbol in the figure	2-wire	3-wire	4-wire
Actuator signal OUT	OUT	X	X	X
Actuator supply U_S	U_S (+24 V)	_	_	X
Ground	GND	X	X	X
Grounding/shielding FE	FE ( )	_	X	X

X: assigned
–: not assigned

Fig. 6-14: Overview of the connections assigned with digital input modules

Connecting Sensors and Actuators According to the Various Connection Methods

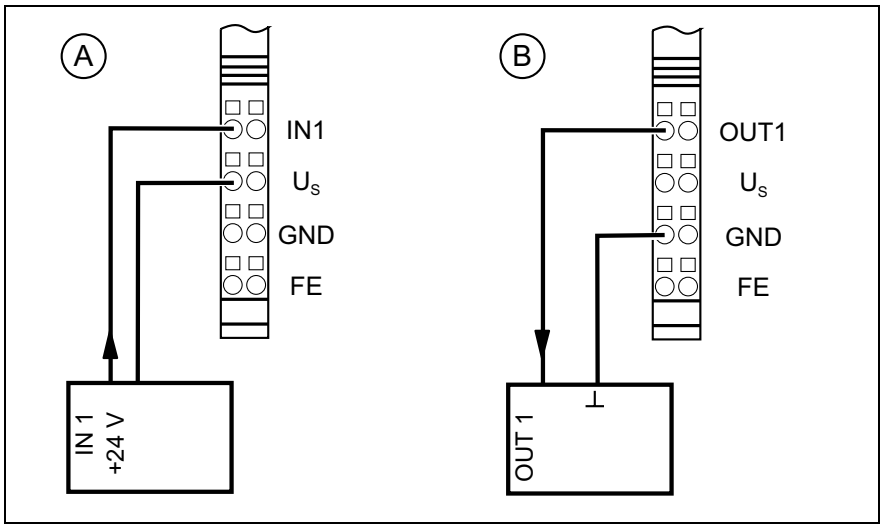


Fig. 6-15: 2-wire connection with digital devices

Sensor Fig. 6-15, A shows the connection of a 2-wire sensor. The sensor signal is supplied to terminal point IN1. The sensor is supplied by the voltage U_S.

Actuator Fig. 6-15, B shows the connection of an actuator. The actuator is supplied with voltage from the output OUT1. The load is directly connected across the output.

Note: The maximum current carrying capacity of the output must not be exceeded (see the functional description of the particular module): Chapter 10.2 "Ordering Information on the Documentation").

3-Wire Connection

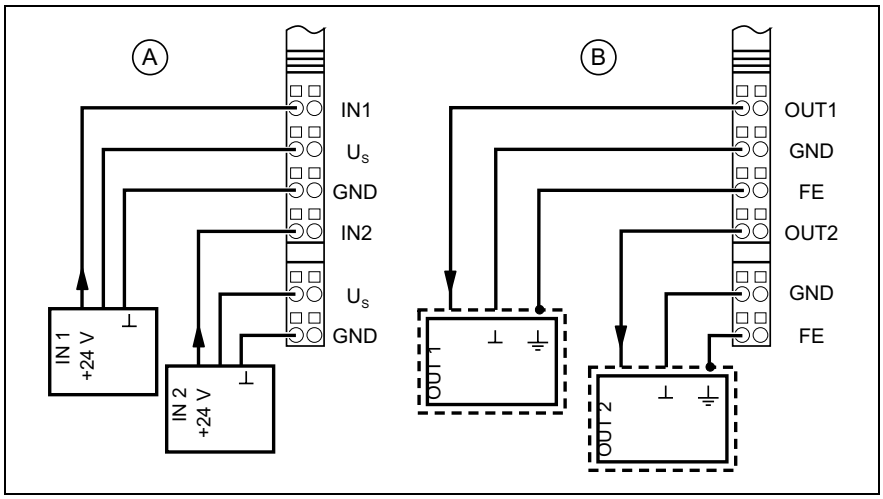


Fig. 6-16: 3-wire connection with digital devices

Sensor Fig. 6-16 , A shows the connection of a 3-wire sensor. The sensor signal is supplied to terminal point IN1 (IN2). The sensor is supplied via terminal points U_S and GND.

Actuator Fig. 6-16, B shows the connection of an actuator. The actuator is supplied from the output OUT1 (OUT2). The load is directly connected across the output.

Note: The maximum current carrying capacity of the output must not be exceeded (see the functional description of the particular module): Chapter 10.2 "Ordering Information on the Documentation").

4-Wire Connection

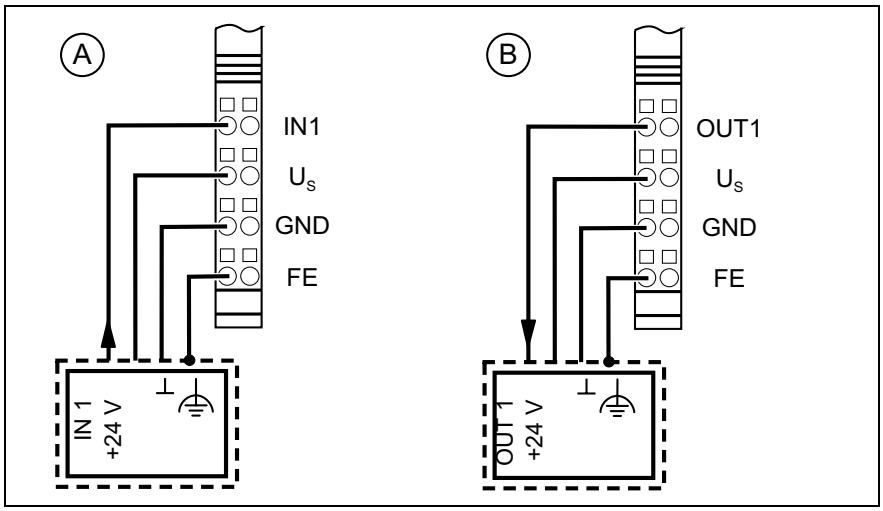


Fig. 6-17: 4-wire connection with digital devices

Sensor Fig. 6-17, A shows the connection of a 4-wire sensor. The sensor signal is supplied to terminal point IN1. The sensor is supplied via terminal points U_S and GND. The sensor is grounded via the FE terminal point.

Actuator Fig. 6-17, B shows the connection of an actuator. If the supply voltage U_S is provided, actuators requiring their own 24 V supply voltage can also be connected directly to the terminal.

Note: The maximum current carrying capacity of the output must not be exceeded (see the functional description of the particular module): Chapter 10.2 "Ordering Information on the Documentation").

Notes

7 From Project Planning to Commissioning

7.1 General Information

This chapter describes the various steps required to set up a properly functioning Inline station.

These steps are in detail:

- Project planning
- Installation and connection
- Configuration and commissioning

7.2 Planning an Inline Station Project

Planning of an Inline station project comprises five steps:

- Describing and defining the task
- Selecting the modules required
- Taking the system limits into consideration
- Selecting the power supply voltages
- Selecting the FO conductor cable

Describing and Defining the Task

Start with describing your task. The task may, for instance, be the following:

It is planned to expand a production line in a printing company. The present automation system has been implemented in SERCOS technology and is to be used in the future as well. However, all extensions are to be implemented with Inline modules. Define the number and type of input and output signals.

Selecting the Modules Required

Select the appropriate Inline modules for the input/output signals present in your project. You cannot operate all Inline modules on the SERCOS bus coupler.

Fig. 7-1 contains a list of all presently permitted Inline devices of the SERCOS bus coupler together with their most important features and part numbers. The abbreviations in the "Error message" column are explained in Fig. 7-3.

Note: Each station must be protected by an end plate and an end clamp, which are included in the scope of delivery of the bus coupler, one each at the beginning and at the end of the station (also see the corresponding notes in the “Installation Instructions for the Electrician".

Note: If you intend to set up different electrically isolated sections within one station, you must fit additional power terminals, which are supplied from separate voltages.

Part description	Part no.	ID code dec/hex	Length dec/hex	IN addr.	OUT addr.	PCP	Reg. length	Error message	Current consumption	
									U_L	U_{ANA}
Digital inputs										
R-IB IL 24 DI 2	R911289286	190 / BE	194 / C2	2 bits	–	–	2 bits	–	35 mA	–
R-IB IL 24 DI 4	R911289287	190 / BE	65 / 41	4 bits	–	–	4 bits	–	40 mA	–
R-IB IL 24 DI 8	R911289288	190 / BE	129 / 81	1 byte	–	–	1 byte	–	50 mA	–
R-IB IL 24 DI 16	R911289290	190 / BE	01 / 01	2 bytes	–	–	2 bytes	–	60 mA	–
R-IB IL 24 DI 32	R911297188	190 / BE	02 / 02	4 bytes	–	–	4 bytes	–	90 mA	–
R-IB IL 24 EDI 2-DES	R911289292	190 / BE	65 / 41	4 bits	–	–	4 bits	K, Ü	31 mA	–
Digital outputs										
R-IB IL 24 DO 2-2A	R911289294	189 / BD	194 / C2	–	2 bits	–	2 bits	K, Ü	35 mA	–
R-IB IL 24 DO 4	R911289295	189 / BD	65 / 41	–	4 bits	–	4 bits	K, Ü	44 mA	–
R-IB IL 24 DO 8	R911289297	189 / BD	129 / 81	–	1 bytes	–	1 bytes	K, Ü	60 mA	–
R-IB IL 24 DO 8-2A	R911289298	189 / BD	129 / 81	–	1 byte	–	1 byte	K, Ü	60 mA	–
R-IB IL 24 DO 16	R911289299	189 / BD	01 / 01	–	2 bytes	–	2 bytes	K, Ü	90 mA	–
R-IB IL 24 DO 32/HD	R911297191	189 / BD	02 / 02	–	4 bytes	–	4 bytes	K, Ü	140 mA	–
R-IB IL 24/230 DOR 1W	R911289301	189 / BD	194 / C2	–	2 bits	–	2 bits	–	60 mA	–
R-IB IL 24/230 DOR 4W	R911289302	189 / BD	65 / 41	–	4 bits	–	4 bits	–	187 mA	–
Analog inputs										
R-IB IL AI 2/SF	R911289306	127 / 7F	02 / 02	4 bytes	4 bytes	–	4 bytes	L, P	45 mA	12 mA
R-IB IL TEMP 2 RTD	R911289305	127 / 7F	02 / 02	4 bytes	4 bytes	–	4 bytes	D	43 mA	11 mA
Analog outputs										
R-IB IL AO 1/SF	R911289303	125 / 7D	01 / 01	–	2 bytes	–	2 bytes	L	40 mA	65 mA
R-IB IL AO 2/U/BP	R911289381	91 / 5B	02 / 02	4 bytes	4 bytes	–	4 bytes	L	40 mA	35 mA
Function modules										
R-IB IL CNT	R911289315	191 / BF	02 / 02	4 bytes	4 bytes	–	4 bytes	K, A	50 mA	–
R-IB IL TEMPCON RTD	In preparation	191 / BF	02 / 02	4 bytes	4 bytes	–	4 bytes	K	150 mA	20 mA

									Current consumption	
Supply terminals										
R-IB IL 24 PWR IN	R911289312	–	–	–	–	–	–	–	–	–
R-IB IL 24 SEG/F	R911289313	–	–	–	–	–	–	–	–	–

Fig. 7-1: Permissible Inline devices

Abbreviation	Meaning
K	Signals a short-circuit or an overload of an output and/or an initiator supply voltage
A	Signals a failure of the main or the segment voltage
P	Signals an overload of an output
Ü	Signals a failure of the internal supply voltage
D	Signals a wire break during TC operation
L	Signals that the logic voltage U_L has failed or has been fallen below the required value
T	Temperature warning of a protocol chip
H	Hardware fault

Fig. 7-2: Explanation of error messages for Rexroth Inline devices

Taking the System Limits into Consideration

The maximum number of devices, which can be connected to a SERCOS field bus coupler is defined by the system key data specified in Chapter 6-13.

Calculate the total current consumption of all connected modules of U_L and U_{ANA}. The total of these currents must not exceed the maximum current of 2 A for U_L and 0.5 A for U_{ANA}. The current consumption of the modules is specified in Fig. 7-1. Also check the current carrying capacity of the voltage jumpers.

Check the number of modules (max. 40) and the total of input and output data (max. 32 bytes of input data and max. 32 bytes of output data).

Assignment of Inputs and Outputs within the Bus Coupler

The bus coupler creates an assignment list where a specific position in the process image is assigned to the inputs and outputs. The following features form the basis of the fitting instructions described below.

- The maximum number of Inline modules that can be fitted is 40.
- The number of data is limited to a maximum of 32 bytes of input data and 32 bytes of output data.
- The data is subdivided in two successive groups each containing only outputs and inputs.
- In each group, the I/O data is assigned in the process image, starting at slot 1.
- 15 SERCOS I/O channels each are used for I/O data. For further information please refer to Section 8.9.
- Analog and digital modules cannot be arranged jointly in one channel. They are assigned to separate channels.
- Modules with a data width of 16 bits, 2 bytes or 4 bytes are arranged in "word-aligned" manner, i.e. at even addresses in the process image.
- Modules with a data width of 8 bits are arranged in "byte-aligned" manner, i.e. at even and uneven addresses in the process image.
- Modules with a data width of 2 or 4 bits are arranged at the next unused position of the current byte. Several successive 2-bit or 4-bit modules are compressed in one byte. If it is not possible to assign a 4-bit module completely within one byte, then this module is assigned to the next byte. There may be gaps in the image as a result. The figure below shows an unfavorable module arrangement. After a 4-bit module has been inserted, there is a gap in byte 0, and the new module is assigned to byte 1.

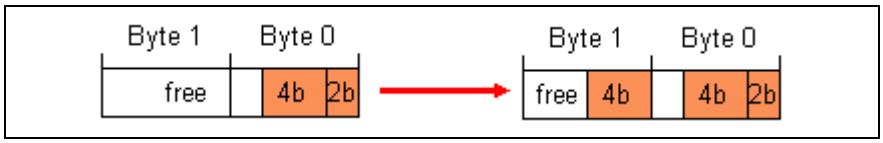


Fig. 7-3: Address gap caused by an unfavorable module arrangement

Fitting Instructions

The arrangement of modules is defined by the features mentioned above. The fitting instructions permit optimum utilization of the 15 input and 15 output channels that are available:

Module arrangement, starting at slot 1:

1. Analog outputs
2. Digital outputs
3. Analog inputs
4. Digital inputs

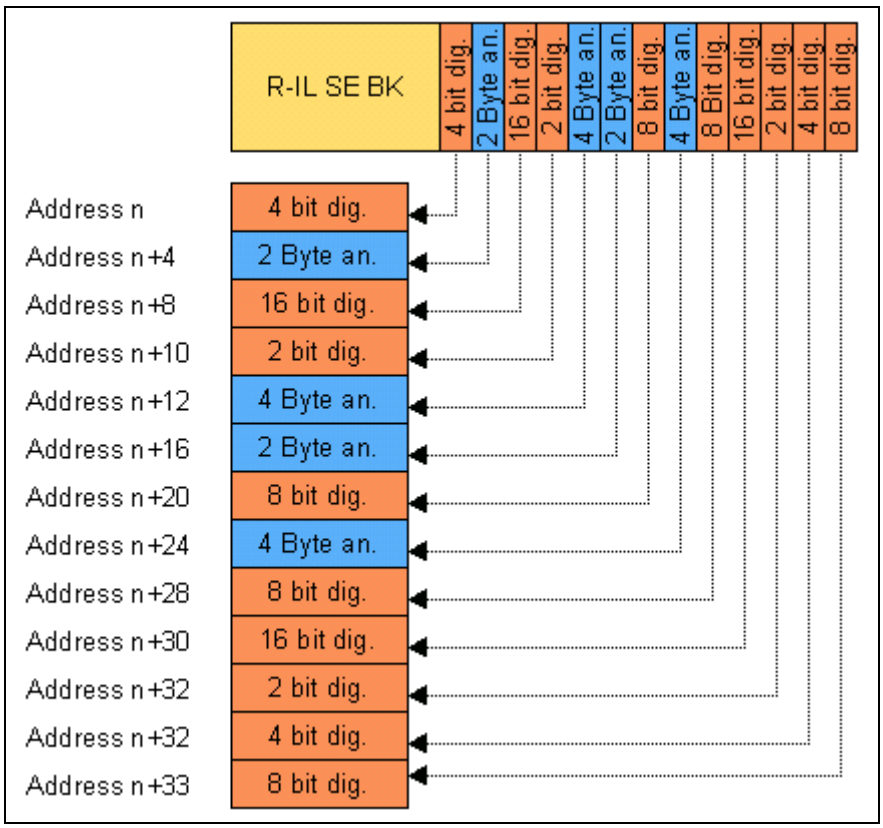
In each of the four groups mentioned, the disks with the greatest data width should be the first to be fitted, all through to the disks with the smallest data width.

Note: An unfavorable module arrangement might cause considerable redundancies in the channel assignment.

Examples

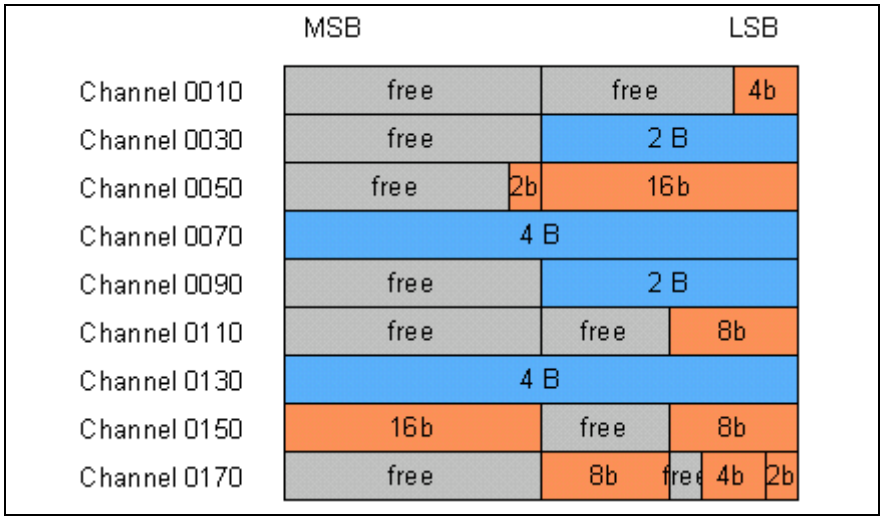
The example below (Fig. 7-4) shows an unfavorable module arrangement. Fig. 7-5 shows the associated I/O channel assignment. This example is followed by an example showing the optimum arrangement of fitting the modules according to the fitting instructions, Fig. 7-6 and Fig. 7-7.

The examples show the input modules only, but can also be used for the outputs.



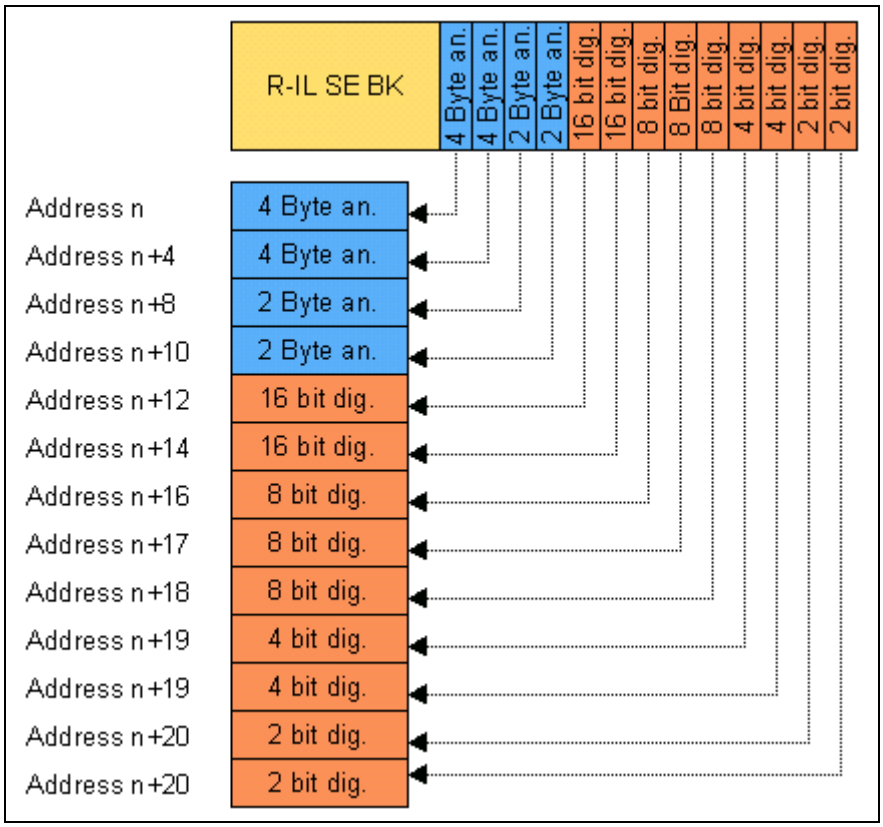
Address: PLC address

Fig. 7-4: Unfavorable module arrangement



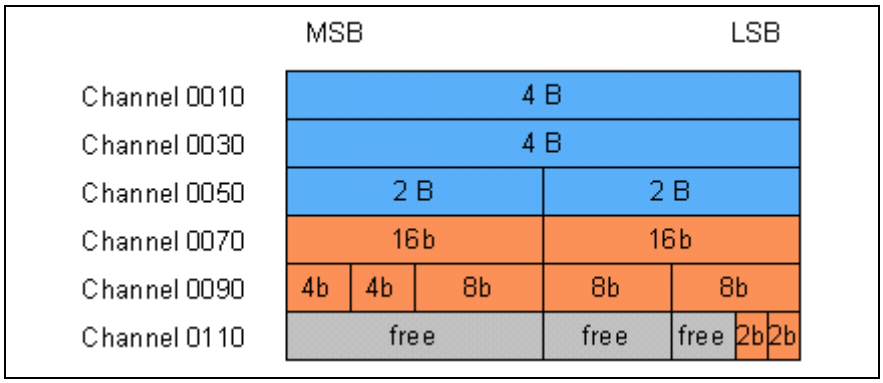
B: bytes
b: bits

Fig. 7-5: Channel assignment, unfavorable module arrangement



Address: PLC address

Fig. 7-6: Optimized module arrangement



B: bytes
b: bits

Fig. 7-7: Channel assignment, optimized module arrangement

Current Calculation

In addition to the fitting instructions for channel assignment, the current consumption of the particular components fitted must also be considered. Since the voltage at each power terminal is fed in the voltage jumpers U_M and U_S separately, the section under consideration for determining the current consumption must always be the section (main circuit) between the bus coupler and the power terminal or between the power terminal and the next power terminal.

If you do not use any power terminal, the entire station constitutes the main circuit.

Arrange the modules with the highest current consumption first in a main circuit. This has the advantage that the high supply current does not flow through the entire main circuit.

Note: The current consumption of the modules is specified in Fig. 7-1.

If a high current flows through the voltage jumpers U_M and U_S, the voltage jumpers will heat up, thus increasing the internal module temperature.

Note: For a change in the current carrying capacity or the possible output currents (what is called "derating"), please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Selecting the Power Supply Voltages

Note: For information on the various circuits within an Inline station, please refer to Chapter 4.7 "Electric Circuits and Power Supply Voltages Within an Inline Station".

Note: For more information on connection of the bus coupler supply, please refer to Chapter 6.6 "Connecting Power Supply Voltages".

The appropriate power supply voltages must always be selected depending on the particular system concerned. The 24 V DC power supply voltages should, however, always meet the following criteria:

Nominal value:	24 V DC
Tolerances:	-15 % / +20 % (according to EN 61 13 1-2)
Ripple factor:	± 5 %
Permissible range:	19.2 V to 30 V (ripple factor included)

Electrical Isolation

If you intend to set up electrical isolations between logic and peripheral equipment, you must provide the infeed of the bus coupler supply voltage U_{LS} and the peripheral supply voltages U_M and U_S from separate power supply units. To achieve this, U_M and U_S must be supplied via an additional power terminal.

If you intend to set up different electrically isolated sections within one Inline station, you must fit additional power terminals which are supplied separately.

Note: For information on the setup of electrically isolated ranges, please refer to Chapter 4.8 "Potential Design".

Selecting the FO Conductor Cable

Select one of the following FO conductor cables according to your case of application:

Standard polymer fiber cable for permanent interior placement:	PSM-LWL-KDHEAVY-980/1000
Heavy polymer fiber cable for permanent interior placement:	PSM-LWL-RUGGED-980/1000
Highly flexible polymer fiber cable for interior areas:	PSM-LWL-RUGGED-FLEX-980/1000

Fig. 7-8: Polymer fiber cables

Note: For information on connection of the FO conductor cable, please refer to Chapter 6.7 "Connecting the FO Conductor Cable". For information on adjustment of the transmitter capacity, refer to Chapter 7.4 "Configuration and Commissioning of the SERCOS Bus Coupler".

7.3 Installing and Connecting an Inline Station

Safety Instructions and Warnings

CAUTION

Do not set up the station when it is live!

⇒ Before setting up an Inline station or inserting a module in a station, ensure that you have de-energized the entire station! Connect the voltage only after you have set up the entire station.

Placing the Modules for Analog Signals

If a high current flows through the voltage jumpers U_M and U_S, the voltage jumpers will heat up, thus increasing the internal module temperature. Follow the note below to keep the current flowing through the voltage jumpers of the analog modules as low as possible:

Note: **Set up a separate main circuit for all analog modules!**

If this is impossible in your concrete case and you have to set up analog modules in a main circuit together with other modules, place the analog modules behind all other terminals at the end of the main circuit.

CAUTION

Ground the bus coupler via the FE pins of the connector. In addition, the bus coupler is automatically grounded when being latched onto a grounded mounting rail.

⇒ In case of prewired modules, please check the electronic sockets, the connectors, and the connection lines for proper seating.

Note: For more information on connection of the Inline modules as well as of the sensors and actuators, please refer to Chapter 6.2 "Mounting and Dismounting Inline Modules" or to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Setting Up an Inline Station

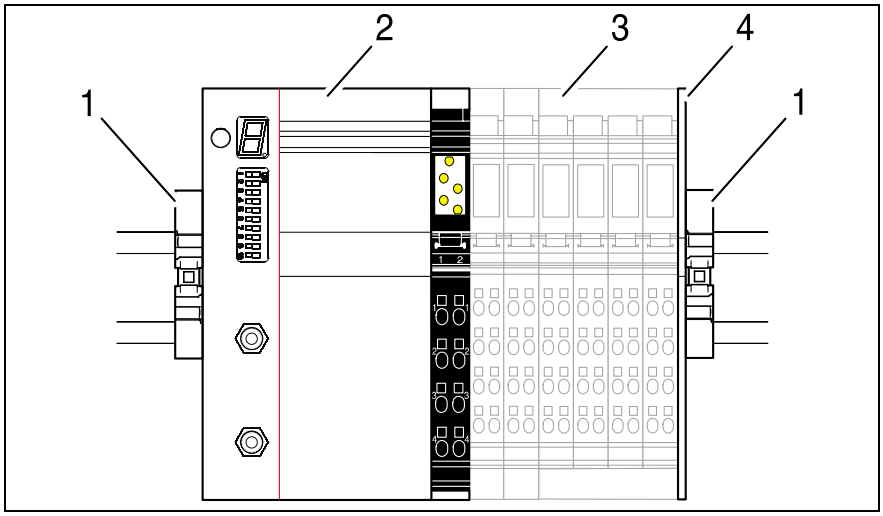


Fig. 7-9: Setup of a Rexroth Inline station

In order to ensure reliable operation, an Inline station with SERCOS bus coupler **must** be composed of the following elements:

- (1) End clamp (included in the scope of delivery of the bus coupler)
- (2) SERCOS bus coupler
- (3) Modules according to your application
- (4) End plate (included in the scope of delivery of the bus coupler)

Latching on the Electric Socket

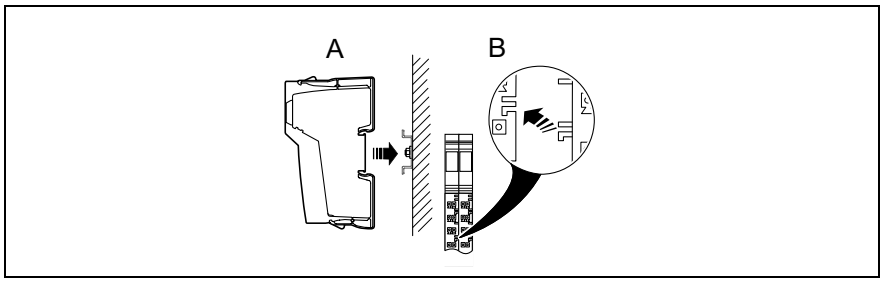


Fig. 7-10: Latching on the electric socket

Latch the electronic socket onto the rail (A).

Note: Ensure that the feather keys and keyways of neighboring modules are safely interlocked (Fig. B).

Fitting the Connector

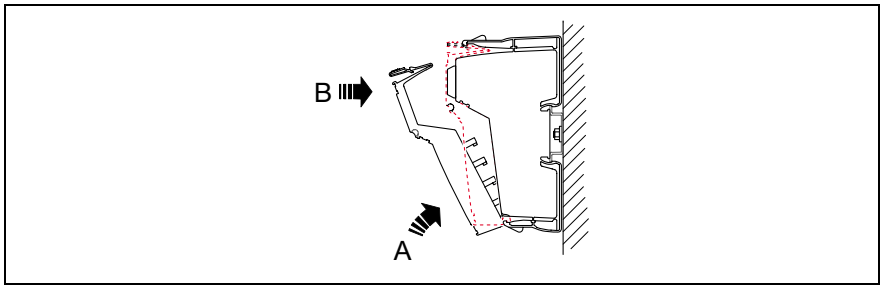


Fig. 7-11: Fitting the connector

Fit the connector in the order (A, B) specified.

Removing the Connector

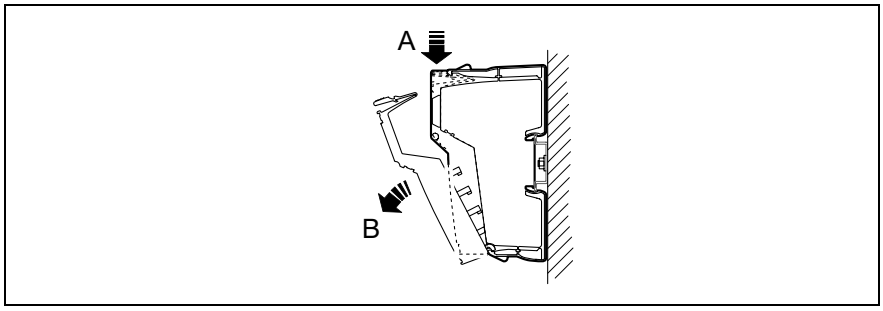


Fig. 7-12: Removing the connector

Remove the labeling field, if present.

Pry out the connector by pressing on the rear shaft latch (A) and remove it (B).

Removing the Electronic Socket

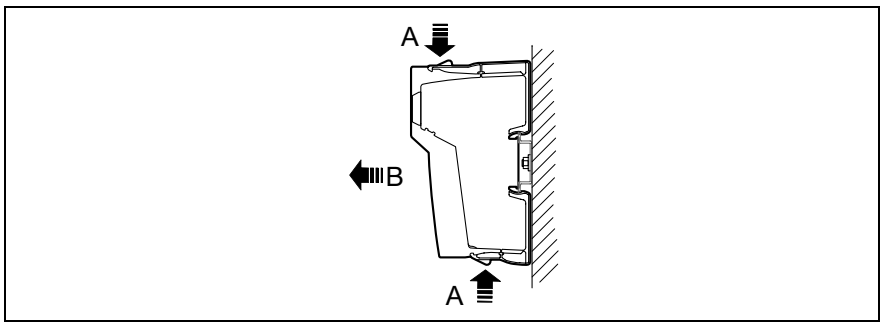


Fig. 7-13: Removing the electronic socket

Before removing the electronic socket, remove the connector of the coupler and the end clamp to the left of the coupler.

Press on the forward and the rear release mechanisms (A) to loosen the socket. Remove the socket perpendicularly to the rail (B).

Connecting the SERCOS Bus Coupler

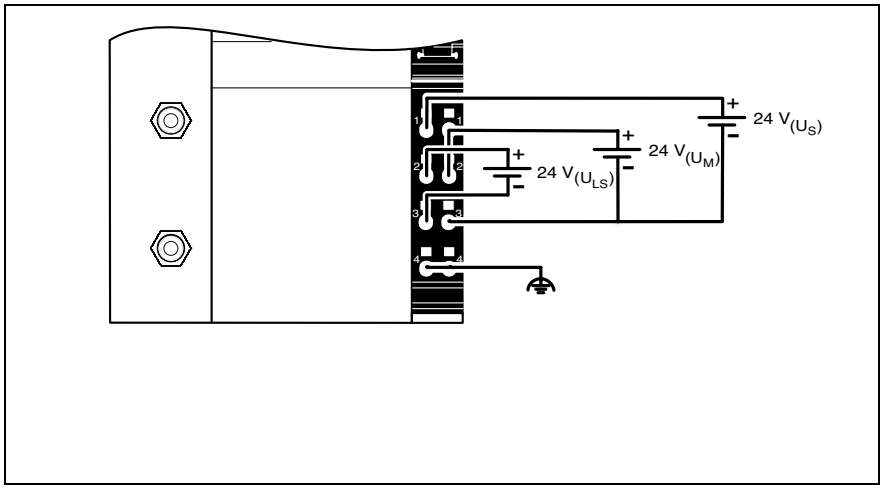


Fig. 7-14: Connection diagram of the SERCOS bus coupler

Connect the bus coupler as shown in Fig. 7-14. For terminal assignment of the bus coupler, please refer to Fig. 7-15 and to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Note: The feeder connector R-IB SCN-PWR IN-CP links connector 1.2 (U_{LS}) to 2.2 (U_M), connector 1.3 (LGND) to 2.3 (PGND) and connector 1.4 (FE) to 2.4 (FE).

As a result, the supply voltage of the logic section (U_{LS}) is directly tapped from the main voltage (U_M) and does not have to be fed-in separately.

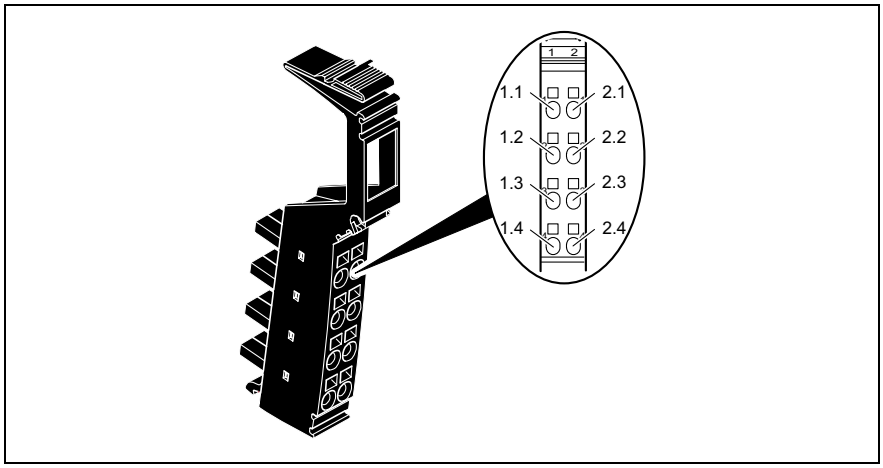


Fig. 7-15: SERCOS bus coupler terminals

Terminal	Signal
1.1	+ 24 V DC segment voltage (U_S)
1.2	+ 24 V DC logic voltage (U_{LS})
1.3	LGND (ground logic voltage)
1.4 and 2.4	FE (functional earth ground)
2.1 and 2.2	+ 24 V DC main voltage (U_M)
2.3	PGND (ground main and segment voltages)

Fig. 7-16: Assignment of the terminal points of the field bus coupler

The analog voltage U_{ANA}, which is generated from the main voltage, may be loaded only with a current of 0.5 A. However, the logic voltage U_L, which is also generated from the main voltage, may be loaded with a current of 2.0 A.

Note: Please observe the instructions and notes in the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Clamping the Lines

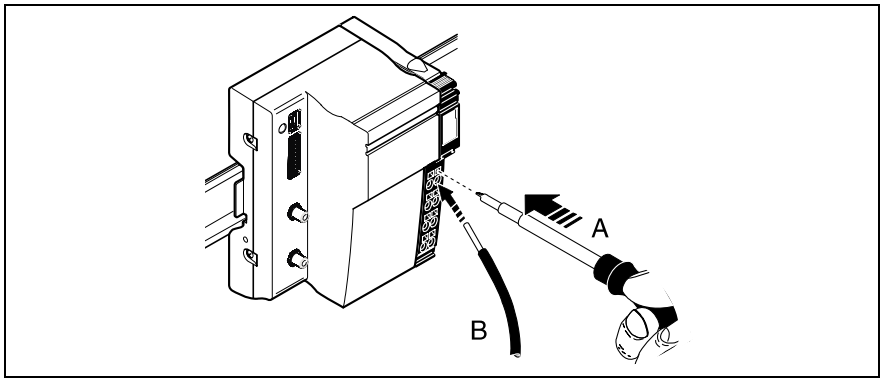


Fig. 7-17: Clamping the lines

1. Loosen the spring by pressing on it with a screwdriver (A).
2. Insert the line (stripped by 8 mm) into the terminal point (B).
3. Fix the line by removing the screwdriver.

Establishing the Additional Ground Connection

Refer to Chapter 6.3 "Grounding an Inline Station".

Connecting Inline Modules

As a final step, connect all Inline modules.

Note: For more information on connection of the I/O modules as well as of the sensors and actuators, please refer to Chapter 6 "Mounting and Dismounting Inline Modules and Connecting Lines" or to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

7.4 Configuration and Commissioning of the SERCOS Bus Coupler

Configuration

Configure the hardware of the bus coupler by means of the 10-fold DIP switch.

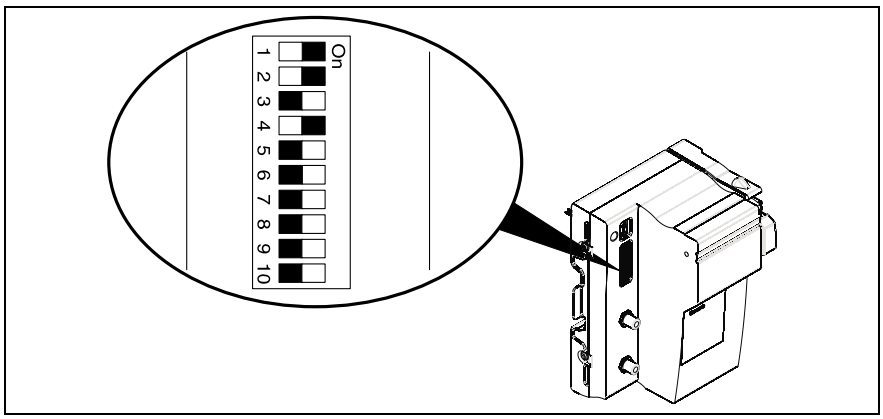


Fig. 7-18: DIP switch of the SERCOS bus coupler

The DIP switch allows setting of the station address (see Fig. 7-19) and of the further behavior of the SERCOS bus coupler (see Fig. 7-20).

Setting the Station Address

The station address of the bus coupler is set by means of the DIP switch. The valid address range is 1 to 127. Address 0 is not permitted.

	SW2	SW3	SW4	SW5	SW6	SW7	SW8
ON	64	32	16	8	4	2	1
OFF	0	0	0	0	0	0	0

Fig. 7-19: Setting the station address

The station address is independent of the order in which the stations are connected to each other via the FO conductor.

Setting the Transmitter Capacity

The transmitter capacity can be adjusted to the cable length. The following DIP switches can be used to set four different emissivities.

FO conductor length	SW 9	SW 10
Glass fiber	ON	ON
> 30 m	ON	OFF
15-30 m	OFF	ON
< 15 m	OFF	OFF

Fig. 7-20: Setting the transmitter capacity

The distortion LED "F-OPTIC ERR" lights up if the capacity of the signal received is too high or too low or if no edges are on the signal received.

Note: By adjusting the transmitter capacity of the preceding ring device, set the signal level, such that it is in the permissible range and the distortion LED turns dark.

Transmission Rate

The SERCOS bus coupler can be operated with 2, 4, 8, or 16 Mbauds. While the initialization phase is in progress, it automatically detects the baud rate of the master.

Note: A change in the baud rate of the master does not require a reset of the bus coupler.

Notes

8 SERCOS Communication

8.1 Definitions

Parameters

Communication with the SERCOS bus coupler takes place, with a few exceptions, by means of parameters. They are used for

- Setting the configuration
- Parameterizing the I/O channels
- Activating commands
- Cyclic or demand-actuated transmission of input and output values.

All identy numbers in the I/O device are listed in parameter **S-0-0017, IDN list of all operation data**.

Data Status

Each parameter is provided with a data status, which can also be read. It serves the following purposes:

- Identifying the validity/invalidity of the parameter
- Containing the command acknowledgement, if the parameter acts as a command (see "Commands" on page 8-3)

Data Block Structure

There are different data block elements available for each parameter, that can be read or written via a non-cyclical interface from a higher-level control unit and/or a parameterization interface.

Element no.:	Designation:	Notes:
1	Identity number	Identification of the parameter
2	Name	Can be changed by the language selection
3	Attribute	Contains data length, type and decimal places
4	Unit	Can be changed by the language selection
5	Minimum input value	Contains the minimum input value of the operating data
6	Maximum input value	Contains the maximum input value of the operating data
7	Operating data	Parameter value 2 or 4 bytes

Fig. 8-1: Data block structure

Note: The write access of the operating data depends on the communication phase.

Write access is only possible for the operating data, all other elements are read-only. The operating data can be write-protected either permanently or temporarily.

Possible Error Messages while Reading and Writing the Operating Data

Error:	Cause:
0x7004, data not changeable	Basically, the operating data is write-protected
0x7005, data currently write-protected	In this communication phase the operating data cannot be written to
0x7006, data smaller than min. value	The operating data has been written smaller than the corresponding minimum input value
0x7007, data larger than maximum value	The operating data has been written larger than the corresponding maximum input value
0x7008, date not correct	The written value could not be accepted as written, because internal tests lead to a negative result.

Fig. 8-2: Error messages while reading/writing the operating data

Operating Modes

The SERCOS bus coupler only recognizes operating modes without regulation.

A positive edge at bit 15 of the master control word sets the output information to valid.

The device shows "**b**" in the H1 display.

Error

Depending on the parameter settings many checks are executed. If a status is recognized, which does no longer permit regular operation, an error message is generated.

Error Reaction

If an error status is recognized in the SERCOS bus coupler, the processing of an error reaction is started automatically. The 7-segment display H1 flashes while indicating **F/x / x/x**. If an Inline error occurs, an information is generated via the diagnostic long word P-0-1110. (see section: Diagnostic Long Word P-0-1110 on page 8-8).

Clearing Errors

Errors must be cleared externally.

Note:

Errors are not cleared automatically, but must be externally cleared by activating command **S-0-0099, Reset class 1 diagnostic** . If the error status is still present, the error will be immediately recognized again.

To reactivate the I/O device a "1" on the bit 15 master control word is necessary.

Commands

Commands are used to control complex functions in the device. Hence, e. g. function "Communication phase 4 transition check" is defined as command.

Note: Each command that was started must be cleared again.

A higher-level control can start, interrupt or clear a command.

Each command has a parameter, with which the command can be controlled.

During the execution of the command the diagnosis **Cxxx** – x represents the number of the command – appears in the 7-segment display H1.

I/O Basis

When addressing I/O-specific identity numbers, there are four identity number differing functionally. Each of this sections has its own basic address:

- General I/O section with **I/O BASIS**
- I/O data channel with **DATA BASIS**
- I/O command channel with **COMMAND BASIS**
- I/O module channel with **MODULE BASIS**

I/O BASIS, **DATA BASIS, COMMAND BASIS and MODULE BASIS** include an identity number in the operating data, that represents the basic address and must be used to calculate the identity number of a function or a date.

The only identity number included in the absolutely addressed section of the SERCOS interface is the identity number of the **I/O BASIS** (IDN S-0-0291). Therefore, it is the key to all I/O-specific identity numbers, also to the identity numbers of **DATA BASIS, COMMAND BASIS and MODULE BASIS**.

The following addresses at the SERCOS bus coupler cannot be moved; they are fixed to:

- I/O BASIS S-1-0000
- DATA BASIS S-2-0000
- COMMAND BASIS S-3-0000
- MODULE BASIS S-4-0000

Command Values, Actual Values

Command values	Output data and output variables of the I/O device to the peripheral equipment
Actual values	Input data and measured values of the I/O device

Fig. 8-3: Command and actual values

8.2 Diagnostic Configurations

Identification of the Current Operating Status

The indicated errors, warnings and commands show the current operating status of the device. Furthermore, it is indicated, in which phase the device currently is.

The current operating status can be determined from

- the 1-digit seven-segment-display (H1 display)
- the diagnostic parameter **S-0-0095, Diagnostic Message**
- the parameter **S-0-0390, Diagnostic Message Number**
- the parameter **P-0-0009, SERCOS ERROR Number**.

The current diagnostic message with the highest priority is always shown on the H1 display in diagnostic parameter **S-0-0095, Diagnostic Message** and parameter **S-0-0390, Diagnostic Message Number**. Parameter **P-0-0009, SERCOS ERROR Number** contains only one value unequal to 0, if an error is present. For an overview of all diagnostic messages see Fig. 9.9.

Structure of a Diagnostic Message

Each operating status is identified by a diagnostic message consisting of a **Diagnostic Message Number** and a **Diagnostic Text**. For example, the diagnostic message for error "Class 1 Inline error" is represented as follows:

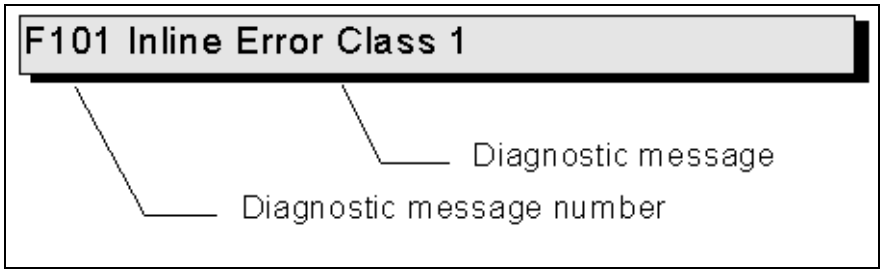


Fig. 8-4: Structure of a diagnostic message containing a diagnostic message number and a diagnostic text

In the H1 display alternates "F“, “1", "0“, “1". In parameter **S-0-0390, Diagnostic Message Number** the diagnostic message number appears in hexadecimal format. In this example this would be (0x)F101. In parameter **S-0-0095, Diagnostic Message** the diagnostic message number and the diagnostic text appear as text string ("F101“," Class 1 Inline error").

H1 Display

See chapter 9.3: 7-segment display "H1" on the SERCOS bus coupler.

Diagnostic Messages in Plain Text

The diagnostic message in plain text contains the diagnostic message number followed by the diagnostic text, e. g. "Class 1 Inline error". The diagnostic message can be read with parameter **S-0-0095, Diagnostic Message**. Thus, the device status can be directly indicated on an user interface.

The required language of the diagnostic message in plain text can be changed by means of the language selection.

Diagnostic Message Number

The diagnostic message number only contains the number, but not the diagnostic text. It can be read with parameter **S-0-0390, Diagnostic Message Number** and is a language-independent possibility to determine and display the device status on an user interface.

SERCOS Error Number

The error number only contains the SERCOS error number, but not the diagnostic text. It can be read with parameter **P-0-0009, SERCOS Error Number** and is a language-independent possibility to determine and display an error status on an user interface. This parameter only contains one value unequal to "0", if an error is present in the device.

The SERCOS error number is generated from the lowest 3 digits of the diagnostic number. For example, error "F101, Class 1 Inline error", with the diagnostic message number "(0x)F101" would produce SERCOS error number "101".

Collective Messages

There are parameters, that are used as collective messages for the display of operating states. These parameters are:

- **IDN. I/O BASIS+00005, I/O class 1 diagnostic**
- **IDN. I/O BASIS+00006, I/O class 2 diagnostic**
- **IDN. I/O BASIS+00007, I/O class 3 diagnostic**

Note: I/O class 3 diagnostic may not be used by the SERCOS bus coupler. Therefore, it is not supported.

IDN. I/O BASIS+00005, I/O Class 1 Diagnostic

In parameter **IDN. I/O BASIS+00005, I/O class 1 diagnostic** bits are provided for different errors. A bit is set in this parameter in the event of an error. Simultaneously, the bit "Device locked, error in status class 1" is set in the **I/O status word**.

All bits in status class 1 are deleted upon the execution of command **S-0-0099, Reset class 1 diagnostic**.

The following bits are supported in I/O class 1 diagnostic.

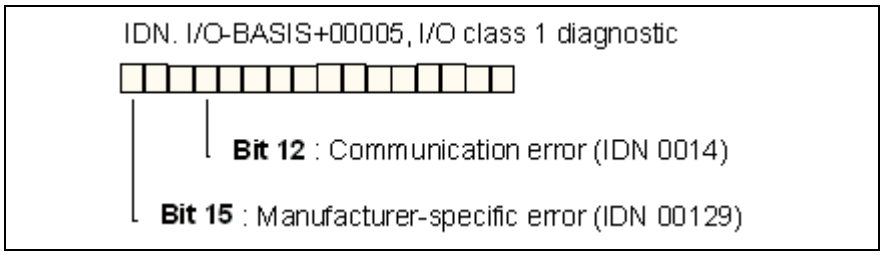


Fig. 8-5: IDN. I/O BASIS+00005, I/O class 1 diagnostic

Manufacturer-Specific Error S-0-0129

Structure of parameter S-0-0129:

Parameter	Bit	Description
S-0-0129		I/O class 1 diagnostic
	24-31	Error class (hexadecimal), only error class 1 or 2 are possible
	8-23	Slot number (hexadecimal), 0x001C = slot 28, start counting with slot 1. Slot number can only be indicated for error class 1 – error number 1.
	0-7	Error number (hexadecimal)

Fig. 8-6: Manufacturer-specific error S-0-0129

Error number and error class are identical to the errors listed in Fig. 9-6.

IDN. I/O BASIS+00006, I/O Class 2 Diagnostic

This parameter provides single bits for the different warnings. A bit is set in this parameter in the event of a warning error. Simultaneously, the bit "Change bit, I/O Status Class 2" is set in the **I/O status word**. By reading **IDN. I/O BASIS+00006, I/O class 2 diagnostic** this change bit is deleted. Via parameter **IDN I/O BASIS+00008, Mask I/O class 2 diagnostic** warnings can be masked in terms of their effect on the change bit.

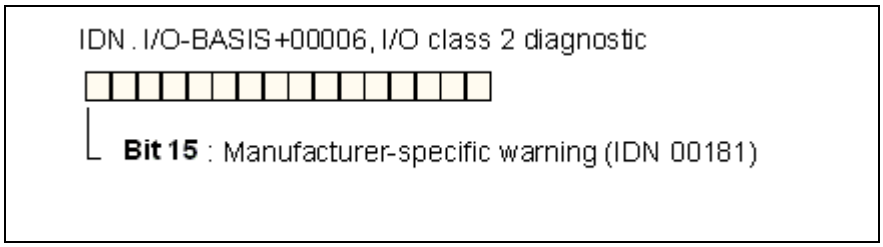


Fig. 8-7: IDN. I/O BASIS+00006, I/O class 2 diagnostic

Manufacturer-Specific Warning S-0-0181

Structure of parameter S-0-0181:

Parameter	Bit	Description
S-0-0181		Manufacturer Cass 2 Diagnostics
	24-31	Error class (hexadecimal), only error class 3 is possible
	8-23	Slot number (hexadecimal), example: 0x001C = slot 28, start counting with slot 1.
	0-7	Error number (hexadecimal)

Fig. 8-8: Manufacturer-specific warning S-0-0181

Error number and error class are identical to the errors listed in Fig. 9-6.

Diagnostic Long Word P-0-1110

The SERCOS bus coupler provides a long word with input information. This long word is used to display error and status information. If the long word is transmitted cyclically, the control unit can react very fast to the error messages.

Parameter	Bit	Description
P-0-1110		Diagnostic channel
	31	0: Input information valid 1: The input as well as the output information is invalid. If an error is detected, the SERCOS bus coupler sets the bit to “1”. In bit 0-7 the error number and in bit 8-15 the slot number (if possible) is indicated.
	24	0: No local bus error 1: Transmission error on the local bus (standstill of the local bus)
	16-18	Error class (octal)
	8-15	Slot number (hexadecimal), 0x1C = slot 28, start counting with slot 1. Slot number can only be indicated for error class 1 – error number 1 and error class 3 – error number 1.
	0-7	Error number (hexadecimal)

Fig. 8-9: Diagnostic long word P-0-1110

Error number and error class are identical to the errors listed in Fig. 9-6.

Local Bus Error and Local Bus Warning

The SERCOS bus coupler recognizes local bus errors and warnings, see Fig. 9-6.

The local bus errors are indicated via manufacturer-specific errors in I/O Status Class 1 and are described with parameter S-0-0129, see "Collective Messages" on page 8-6. With parameter S-0-0095 (Diagnostic Message) the error is provided in text mode. The diagnostic message number appears in S-0-0390 and the SERCOS error number in P-0-0009.

Diagnostic No.	Error text	
F101	Class 1 Inline error	Class1
F102	Class 2 Inline error	Class2

Fig. 8-10: Local bus error

The local bus warning is indicated via a manufacturer-specific warning in I/O Status Class 2 and is described with parameter S-0-0181, see "Collective Messages" on page 8-6. With parameter S-0-0095 (Diagnostic Message) the error is provided in text mode. The diagnostic message number appears in S-0-0390 and the SERCOS error number in P-0-0009.

Diagnostic No.	Error text	
E411	Error in the connected periphery equipment	Class 3

Fig. 8-11: Local bus warnings

8.3 Parameterization Mode – Operating Mode

Note: The communication phases and thus the parameterization and operating mode is specified by the SERCOS master.

After switching on the I/O device it does not automatically reach the operating mode, but has to be switched into this mode by different actions of the SERCOS master. This switching of the device into the operating mode is closely connected to establish the readiness of the SERCOS interface ring.

The procedure comprises several steps and is controlled by the master by presetting communication phases 0 to 4 and by activating/deactivating the commands **S-0-0127, C100 Communication phase 3 transition check** and **S-0-0128, C200 Communication phase 4 transition check**.

If the device reaches phase 4 without errors, "**b**" will appear on the H1 display. The corresponding diagnostic message is: **A107 without regulation**.

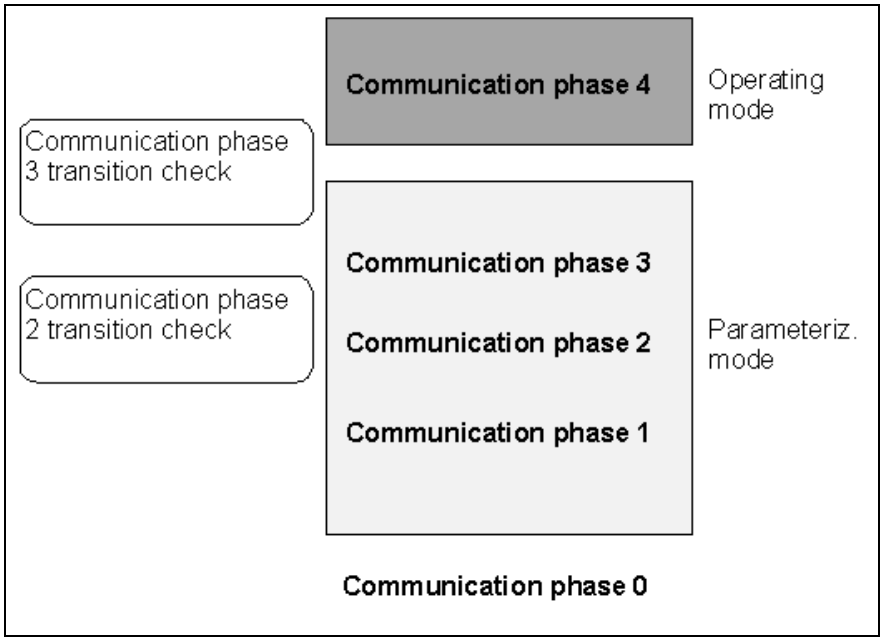


Fig. 8-12: Communication phases

Communication between the SERCOS master and the device is not possible during phase 0 . The parameterization mode is active during communication phase 2 and 3.

Transition Check Commands

Transition check commands must be activated in order to switch from communication phase 2 to 3 and from 3 to 4. This includes a series of checks and parameter calculations.

S-0-0127, C100 Communication Phase 3 Transition Check

If this command is activated, the following checks are carried out:

Checking the Telegram Configuration

Especially in the case of configured telegrams. The SERCOS cyclic telegram is checked for valid parameters configured in the MDT or AT data blocks and to ensure, that the maximum length of the configured data blocks is not exceeded.

The following command errors may occur:

C101 Error Telegram Type (only telegram type "7", configured telegram, allowed)
C104 Config. IDN for MDT not configurable

C105 Configured length > max. length for MDT

C106 Config. IDN for AT not configurable

C107 Configured length > max. length for AT

Checking the Timing Parameters

Checking the timing parameters for the SERCOS communication in phases 3 and 4 for plausibility and compliance with the requirements.

The following command errors may occur:

C108 Time slot parameter > SERCOS cycle time

C109 Beginning address of data record in MDT even (S-0-0009)

C110 Length of MDT odd (S-0-0010)

C111 Beginning address in MDT (S-0-0009) + record length - 1 > length of MDT (S-0-0010)

C112 TNcyc (S-0-0001) or TScyc (S-0-0002) error

C113 Relation TNcyc (S-0-0001) to TScyc (S-0-0002) error

C114 T4 > TScyc (S-0-0002) - T4min (S-0-0005)

C115 T2 too small

S-0-0128, C2 Communication Phase 4 Transition Check

If this command is activated, the following checks are carried out:

Check of extreme values and bit combination check of all parameters. All parameters are checked for compliance with their extreme values or permissible bit combinations. If an error occurs during this process, then command error

C202 Parameter limit error

is generated. The identity numbers of the faulty parameters are listed in **S-0-0022, IDN list of invalid op. data for comm. ph. 3** and must be corrected.

8.4 Master Communication via SERCOS interface

Cyclic Data Transmission via SERCOS interface

To synchronize the **devices** in a ring, the **master synchronization telegram** (MST) is sent at the beginning of every SERCOS cycle. The MST contains only the preset communication phase information from the master.

Once during each SERCOS cycle time, a **Master Data Telegram** (MDT) is sent from the control to every device. The MDT contains the master control word, sections of the service channel and a configurable data block. Mostly, this data block contains command and limit values. The contents of this data block can be configured by the telegram settings.

The master data telegram is received by all devices in the ring at the same time.

In addition, once during each SERCOS cycle time, an **AT telegram** is sent from every device to the control. The AT telegram contains the I/O status word, sections of the service channel and a configurable data block. Mostly, this data block contains input information and status values.

Master Control Word

The master control word is part of the master data telegram. It contains all important control information for the device, such as

- **Outputs ON**
- **Real-time control bit 1 and 2**
- **Control information for the service channel**

The master control word is structured as follows:

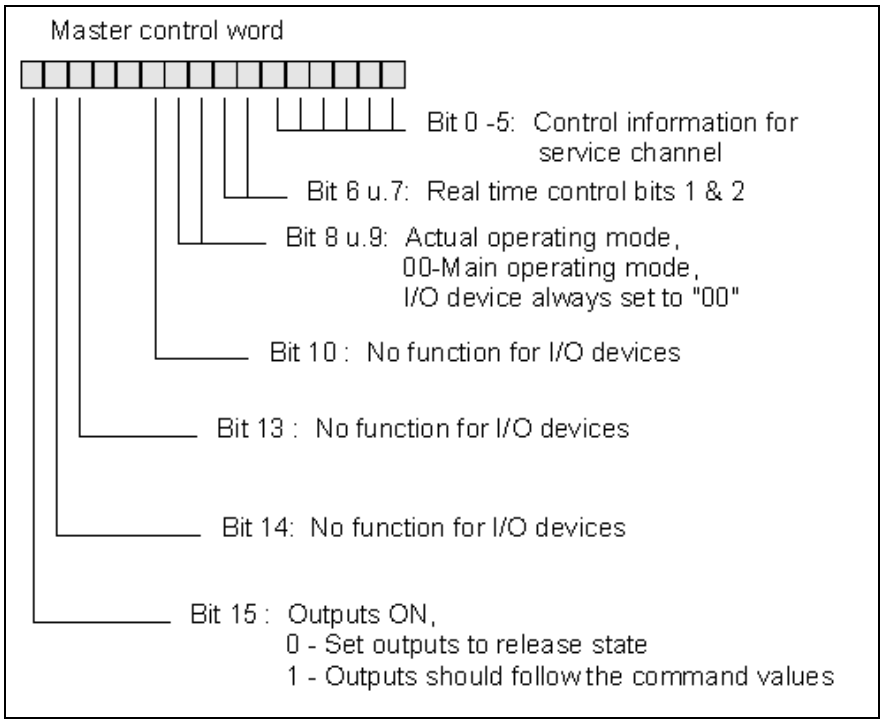


Fig. 8-13: Structure of the master control word

The master control word can be displayed by using parameter **S-0-0134, Master control word**.

Enable Output Information

The outputs are activated via a 1-level at bit 15 in the master control word of the master data telegram. To set the output to active, the following condition must be fulfilled:

- SERCOS interface ready for operation (communication phase 4), no error.

In this status, the SERCOS bus coupler indicates "**b**" at the 7-sgement display. Using parameter **S-0-0095, Diagnostic Message** the diagnosis is: **A107, without regulation**.

Drive Status Word (I/O Status Word)

The I/O status word is part of the AT telegram. It contains all important control information of the device, such as

- **Readiness for use of the I/O device**
- **Device error**
- **Change bits of status class 2 and 3**
- **Real time status bits 1 and 2**
- **Status information for service channel**

The I/O status word is structured as follows:

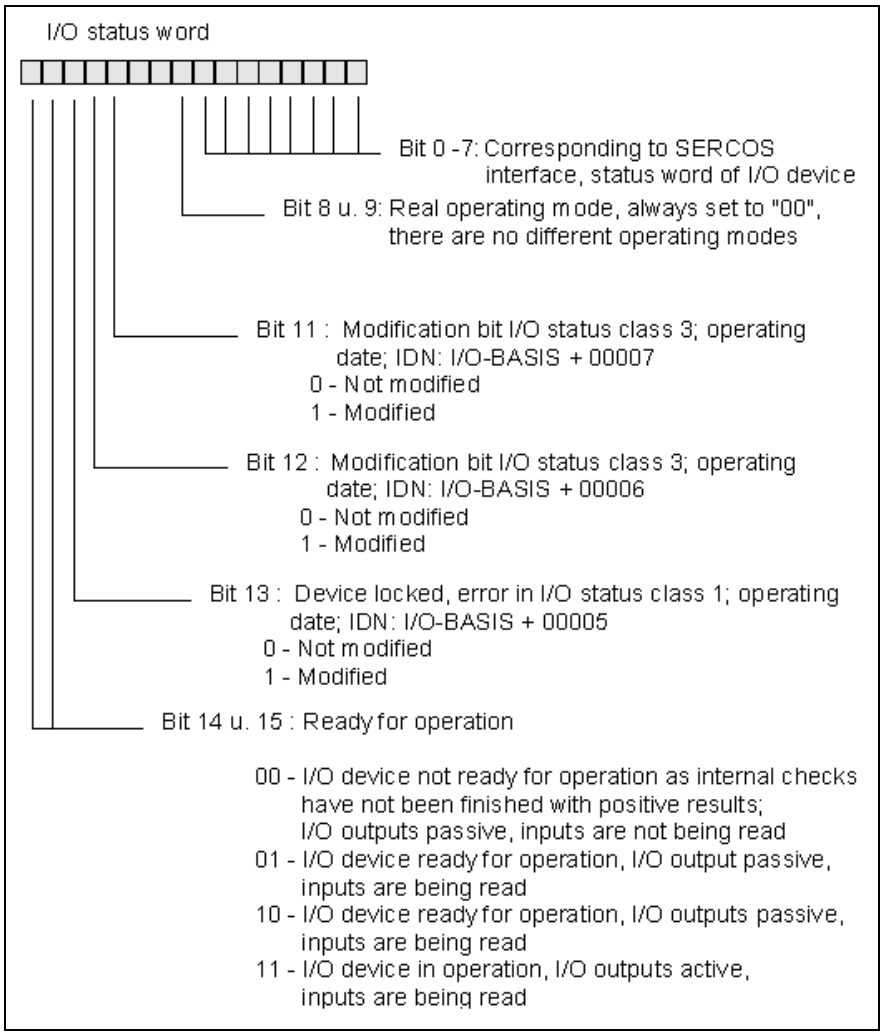


Fig. 8-14: Structure of the I/O status word

The I/O status word is transferred with parameters **S-0-0135, I/O status word (Drive status word)** via the service channel to the control.

Real-Time Control and Status Bits

The master control and I/O status word each contain 2 configurable real-time bits. The configuration of this binary signals occurs via the following parameters

- **S-0-0301, Allocation of Real-Time Control Bit 1**
- **S-0-0303, Allocation of Real-Time Control Bit 2**
- **S-0-0305, Allocation of Real-Time Status Bit 1**
- **S-0-0307, Allocation of Real-Time Status Bit 2**

These parameters indicate of which parameter bit 0 (LSB) is mapped to the corresponding real-time status bit and therefore is sent cyclically to the master, or to which parameters the real-time control bits are mapped.

Transmission of Non-Cyclical Data via SERCOS interface

Non-cyclical data are parameters, that are not transmitted cyclically, but via the service channel.

The transmission via the service channel is done in sections in the MDT and AT and may last several SERCOS cycles for each transmitted element.

The service channel is used for

- **parameterization**

and

- **diagnosis.**

Language Selection

The SERCOS bus coupler supports two languages, which can be set with **S-0-0265**:

0 corresponds to German

1 corresponds to English

8.5 SERCOS Telegram Configuration

To operate the device properly, the settings of the telegram transmit and receive times, their lengths and contents have to be transmitted from the SERCOS master to the device.

Configuration of the Telegram Send and Receive Times

The requirements to calculate the time-slot parameters (telegram send and receive times) are stored in the device in the following parameters:

- **S-0-0003, Minimum AT Transmit Starting Time (T1min)**
- **S-0-0004, Transmit/Receive Transition Time (TATMT)**
- **S-0-0005, Minimum Feedback Acquisition Time (T4min)**
- **S-0-0088, Receive to Receive Recovery Time (TMTSY)**
- **S-0-0090, Command Value Transmit Time (TMTSG)**

From the information received from all devices the SERCOS master calculates the time slot parameters for the operation of the interface starting with communication phase 3. These values are transmitted to the device in communication phase 2 via the following parameters:

- **S-0-0002, SERCOS Cycle Time (Tscyc)**
- **S-0-0006, AT Transmission Starting Time (T1)**
- **S-0-0007, Feedback Acquisition Starting Time (T4)**
- **S-0-0008, Command Valid Time (T3)**
- **S-0-0009, Beginning Address in MDT (Master Data Telegram)**
- **S-0-0010, Length of MDT (Master Data Telegram)**
- **S-0-0089, MTD Transmit Starting TimeT2**

The device checks these settings while processing command **S-0-0127, C100 Communication phase 3 transition check**. Error messages see "S-0-0127, C100 Communication Phase 3 Transition Check" on page 8-10.

Configuration of Telegram Contents

The telegram contents are specified by the following parameters:

- **S-0-0015, Telegram Type Parameter must be telegram type "7", configured telegram.**
- **S-0-0016, Custom Amplifier Telegram Configuration List**
- **S-0-0024, Config List of MDT (Master Data Telegram)**

However, the device-side requirements for type and number of the configurable data must be in the set range. The device provides these requirements by the following parameters:

- **S-0-0185, Length of the config. data record in the AT**
- **S-0-0186, Length of the config. data record in the MDT**
- **S-0-0187, List of Configurable Data in the AT**
- **S-0-0188, List of Configurable Data in the MDT**

The device checks these settings while processing command **S-0-0127, C100 Communication phase 3 transition check**. Error messages see "S-0-0127, C100 Communication Phase 3 Transition Check" on page 8-10.

8.6 Multiplex Channel

The PLC cycle time is often much higher than the SERCOS cycle time. Therefore, it is not necessary to exchange the I/O information several times per PLC cycle. The SERCOS cycle time depends on the number of I/O information. To load the SERCOS drive ring with additional I/O information could cause an increasing SERCOS cycle time. Therefore, SERCOS interface allows to transmit data via multiplex channel. For the data transmission two multiplex data channels are available. The data capacity of the container is 4 bytes. If only one word is to transmit, this word has to be used in the low word of the long word.
To set the multiplex channels

- **S-0-0360/S-0-0361 MDT data container A/B**
- **S-0-0364/S-0-0365 AT-data container A/B**
- **S-0-0368/ S-0-0369 Addressing data container A/B**
- **S-0-0370 Configuration list MDT-data container**
- **S-0-0371 Configuration list AT-data container**

are necessary.

The SERCOS master indicates via the index (addressing to configuration list MDT), which data are included in data container A/B. Furthermore, the master shows via the index (addressing to configuration list AT), which data is expected in the data container A/B of the AT telegram.

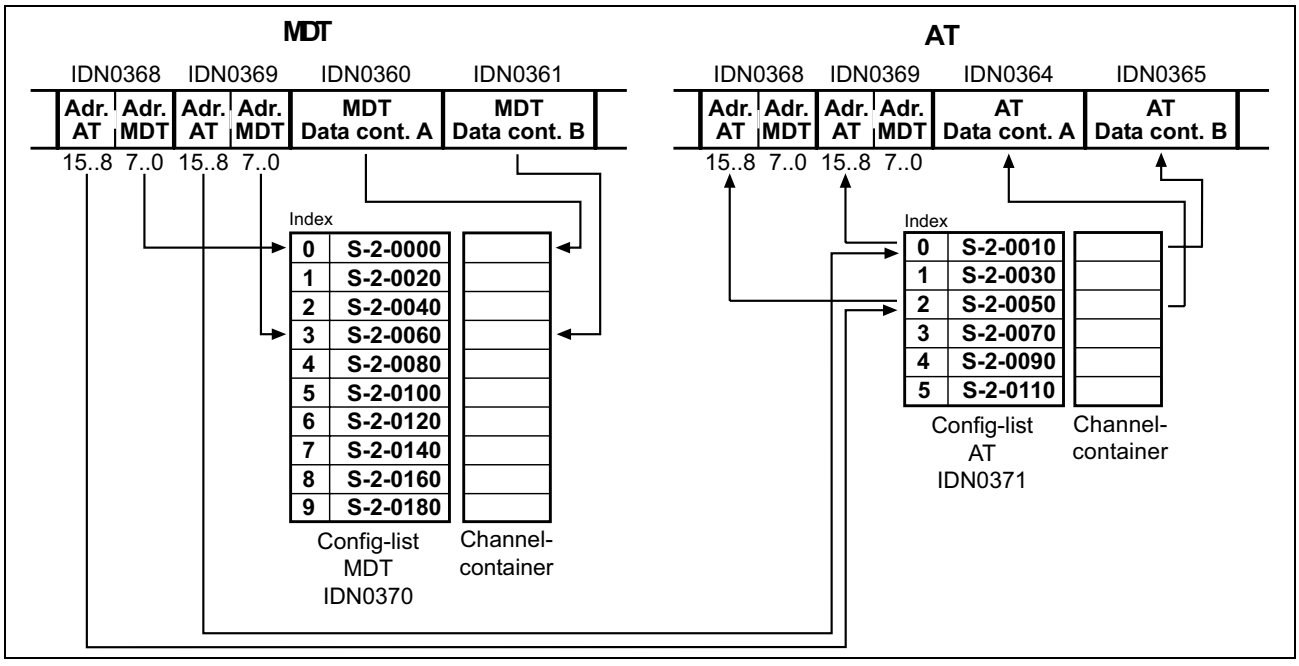


Fig. 8-15: Example to represent the multiplex operation

Initialization of the Multiplex Channel

The initialization of the multiplex channel takes place in SERCOS phase 2 as described in the following example:

Set IDN	Data	Comment
S-0-0370		Configuration list MDT data container
	40	Length of the list (in bytes)
S-2-0000		Output channel 0
S-2-0020		Output channel 1
S-2-0040		Output channel 2
S-2-0060		Output channel 3
S-2-0080		Output channel 4
S-2-0100		Output channel 5
S-2-0120		Output channel 6
S-2-0140		Output channel 7
S-2-0160		Output channel 8
S-2-0180		Output channel 9
S-0-0024		Configuration list MDT
	12	Length of the list (in bytes)
	0368	Addressing data container A
	0369	Addressing data container B
	0360	MDT data container A
	0361	MDT data container B
S-0-0371		Configuration list AT data container
	24	Length of the list (in bytes)
S-2-0010		Input channel 0
S-2-0030		Input channel 1
S-2-0050		Input channel 2
S-2-0070		Input channel 3
S-2-0090		Input channel 4
S-2-0110		Input channel 5
S-0-0016		Configuration list AT (drive telegram)
	12	Length of the list (in bytes)
	0368	Addressing data container A
	0369	Addressing data container B
	0364	AT data container A
	0365	AT data container B

Fig. 8-16: Example to initialize the multiplex channel

Warnings of the Multiplex Channel

Warning	Cause
E408	MDT addr. in S-0-0368/ S-0-0369 is greater than the number of the configured IDNs in S-0-0370
E409	AT addr. in S-0-0368/ S-0-0369 is greater than the number of the configured IDNs in S-0-0371

Fig. 8-17: Multiplex channel warnings

8.7 SERCOS Interface Error

If conditions are detected in the I/O device, that prevent the proper operation of the interface or if incorrect inputs are recognized during the initialization phase, the I/O device reacts by resetting to communication phase 0. This means that no more AT telegrams will be send, the I/O device automatically executes an error reaction and waits for the reinitialization of the SERCOS ring by the master.

Possible errors could be:

- **F401 Twice MST error**
- **F402 Twice MDT error**
- **F403 SERCOS – phase > 4**
- **F404 Error during Phase Progression**
- **F405 Error during Phase Regression**
- **F406 Phase Switching without Ready Signal**

Diagnosis of the Interface Status

Parameter **S-0-0014, Interface Status** is used to diagnose existing interface errors as well as the current communication phase.

Error Count for Telegram Interrupts

The I/O device monitors every received master synchronization and master data telegram for compliance with

- **the correct receive time,**
- **the agreed telegram length and**
- **the correct CRC checksum.**

A telegram interrupt is registered by incrementing an error counter. For this purpose, the parameters **S-0-0028, MST Error Count** and **S-0-0029, MDT Error Count** are used.

These parameters are deleted by switching the communication phase from 2 to 3 (S-0-0028) or 3 to 4 (S-0-0029).

8.8 Data Exchange SERCOS interface -> Inline Modules

The data exchange between MDT or AT and the Inline modules follows the scheme illustrated below. The seize of the SERCOS channels can be either 2 or 4 bytes. If several Inline modules are used, please consider Chapter 7 "From Project Planning to Commissioning", especially section "Fitting instructions".

Legend: “W“ Word
“b“ Bit

Digital Modules

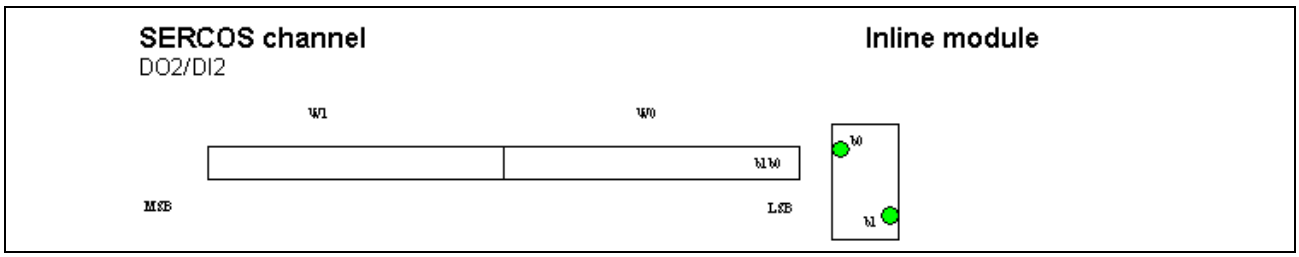


Fig. 8-18: Module DO2/DI2

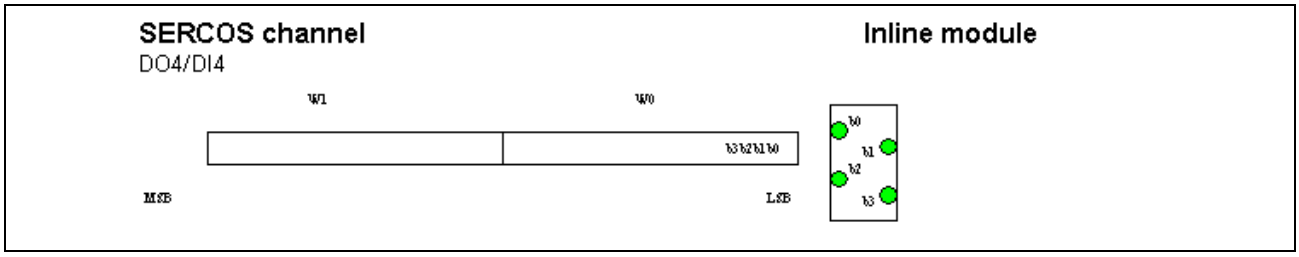


Fig. 8-19: Module DO4/DI4

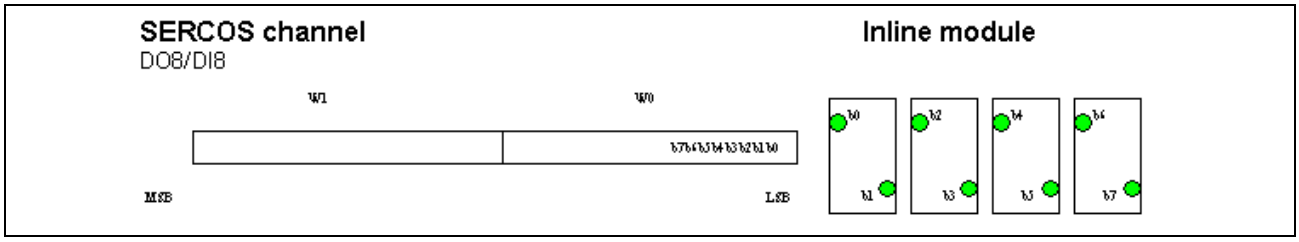


Fig. 8-20: Module DO8/DI8

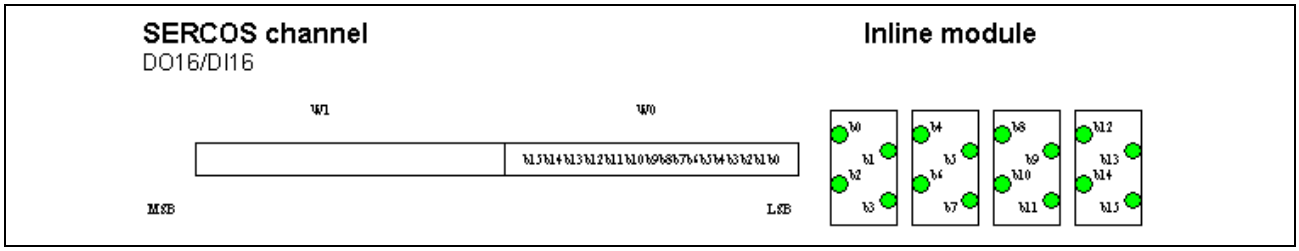


Fig. 8-21: Module DO16/DI16

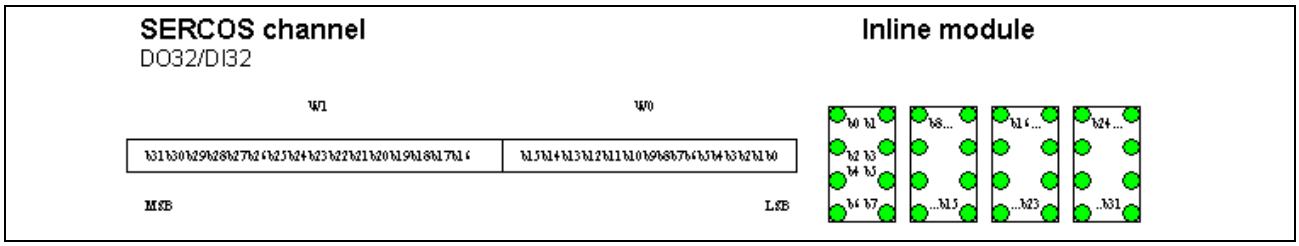


Fig. 8-22: Module DO32/DI32

Analog and Function Modules

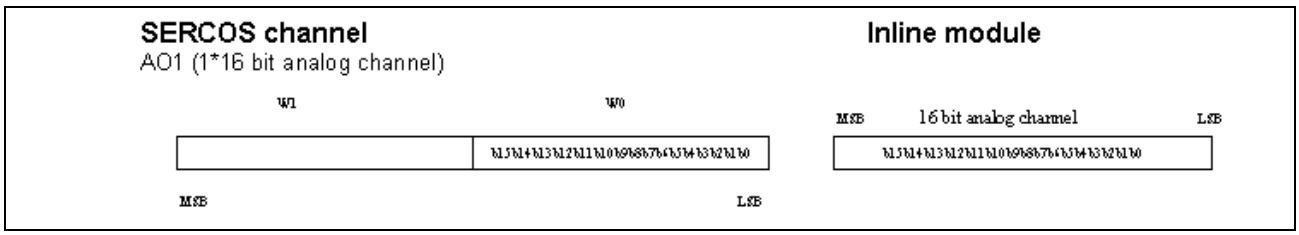


Fig. 8-23: Module AO1

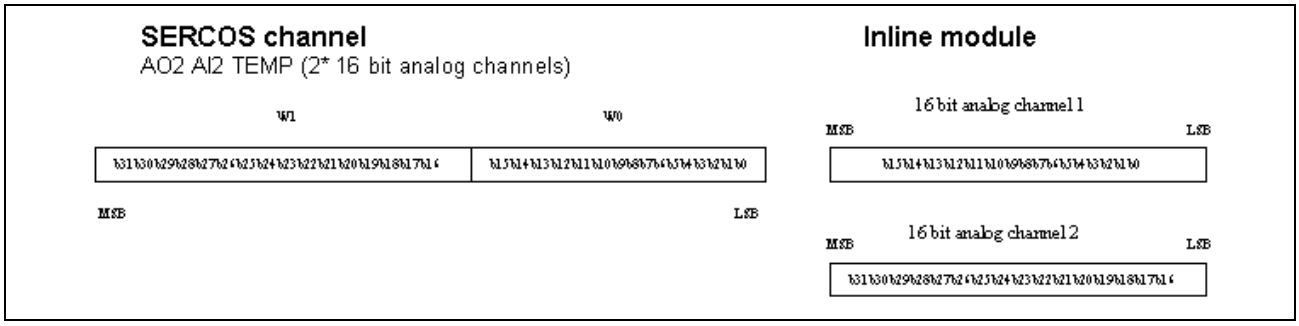


Fig. 8-24: Module AO2/AI2/TEMP2RTD

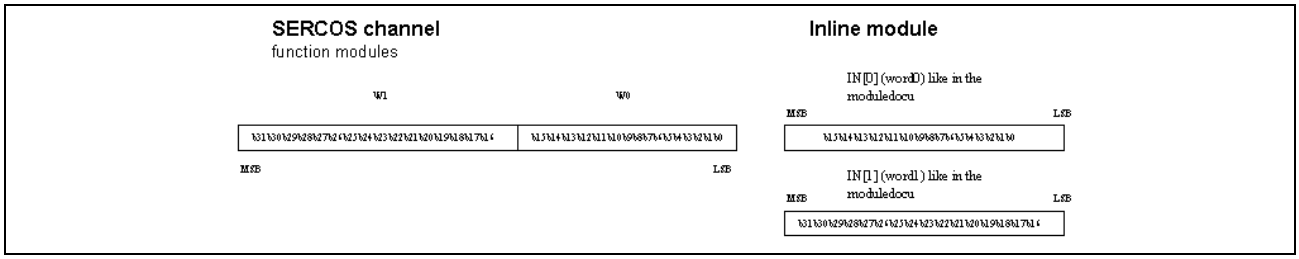


Fig. 8-25: Function modules

8.9 Identity Number of the I/O Data Channels

The identity number for the I/O data channels is permanently assigned to the Inline I/O, see "Assignment of Inputs and Outputs Within the Bus Coupler" on page 7-4. The command and actual values are cyclically transmitted via the data channels. Each I/O data channel consists of 10 successive identity numbers (see SERCOS interface Standard: I/O extensions).

Channels	Output data channels	Input data channels
1	S-2-0000	S-2-0010
2	S-2-0020	S-2-0030
3	S-2-0040	S-2-0050
4	S-2-0060	S-2-0070
5	S-2-0080	S-2-0090
6	S-2-0100	S-2-0110
7	S-2-0120	S-2-0130
8	S-2-0140	S-2-0150
9	S-2-0160	S-2-0170
10	S-2-0180	S-2-0190
11	S-2-0200	S-2-0210
12	S-2-0220	S-2-0230
13	S-2-0240	S-2-0250
14	S-2-0260	S-2-0270
15	S-2-0280	S-2-0290

Fig. 8-26: SERCOS data channels

8.10 Module Channels

To be able to retrieve the configuration of the SERCOS bus coupler, module channels are supported. Module basis is **IDN S-4-0000** which is stored in **IDN I/OBasis+18**. **IDN I/OBasis+19** contains an IDN list of the module names. A list of the module types is generated in **IDN I/OBasis+20**.

Number	Contents	Notes
M+9	Not assigned	
M+8	Not assigned	
M+7	Reserved	
M+6	Reserved	
M+5	Not assigned	
M+4	Bit offset	2 bytes, variable (entries correspond to M+3). Bit offset of the signal channel within the corresponding channel container.
M+3	IDN list of the channel containers	2 bytes, variable (entries correspond to the signal channels) For input/output modules the number of IDNs doubles (list elements). At first, all inputs and then all outputs are entered.
M+2	Module identity list	2 bytes, variable (existing IDN of the module)
M+1	Module type	2 bytes, signal direction (Bit14): 0 - input 1 - output Type (bit13-12): 00 – module not available 01 – digital 10 – analog 11 – other Signals (bit11-8): number of the logic signal channels (coded) Input length (7-4): in bit (coded) Output length (3-0): in bit (coded) Coding: 0: 0 1: 1 2: 2 3: 4 4: 8 5: 16 6: 24 7: 32 8: 48 9: 64 10: 96 11: 128 15: other
Module basis	Module name	Name see Fig. 8-28

Fig. 8-27: Structure of the module channels

Assignment of the Inline Modules -> Module Channels

The first module besides the SERCOS bus coupler is module 1. The parameters S-4-0000 to S-4-0009 are assigned to this module. Module 2: Parameters S-4-0010 to S-4-0019, module 3: Parameters S-4-0020 to S-4-0029, etc., see also section 8.11, SERCOS Inline Parameters.

Module Names

Inline modules	Module name
Digital inputs	
R-IB IL 24 DI 2	DI 2
R-IB IL 24 DI 4	DI 4
R-IB IL 24 DI 8	DI 8
R-IB IL 24 DI 16	DI 16
R-IB IL 24 DI 32	DI 32
R-IB IL 24 EDI 2-DES	DI 4
Digital outputs	
R-IB IL 24 DO 2-2A	DO 2
R-IB IL 24 DO 4	DO 4
R-IB IL 24 DO 8	DO 8
R-IB IL 24 DO 8-2A	DO 8
R-IB IL 24 DO 16	DO 16
R-IB IL 24 DO 32/HD	DO 32
R-IB IL 24/230 DOR 1W	DO 2
R-IB IL 24/230 DOR 4W	DO 4
Analog inputs	
R-IB IL AI 2/SF	AI 2 4B/4B
R-IB IL TEMP 2 RTD	AI 2 4B/4B
Analog outputs	
R-IB IL AO 1/SF	AO 1 2B
R-IB IL AO 2/U/BP	AO 2 4B/4B
Function modules	
R-IB IL CNT	FM 4B/4B
R-IB IL TEMPCON RTD	FM 4B/4B

Fig. 8-28: Module names

8.11 SERCOS Inline Parameters

SERCOS Basis Parameters

S-0-0001	NC Cycle Time (TNcyc)
S-0-0002	SERCOS Cycle Time (Tscyc)
S-0-0003	Minimum AT Transmit Starting Time (T1min)
S-0-0004	Transmit/Receive Transition Time (TATMT)
S-0-0005	Minimum Feedback Acquisition Time (T4min)
S-0-0006	AT Transmission Starting Time (T1)
S-0-0007	Feedback Acquisition Starting Time (T4)
S-0-0008	Command Valid Time (T3)
S-0-0009	Beginning Address in MDT (Master Data Telegram)
S-0-0010	Length of MDT (Master Data Telegram)
S-0-0014	Interface Status
S-0-0015	Telegram Type Parameter
S-0-0016	Custom Amplifier Telegram Configuration List
S-0-0017	IDN list of all operation data
S-0-0018	IDN list of all operation data for CP2
S-0-0019	IDN list of all operation data for CP3
S-0-0021	IDN list of invalid operation data for CP2
S-0-0022	IDN list of invalid operation data for CP3
S-0-0024	Config. List of MDT (Master Data Telegram)
S-0-0025	IDN list of all procedure commands
S-0-0028	MST Error Count
S-0-0029	MDT Error Count
S-0-0030	Manufacturer Version
S-0-0088	Receive to Receive Recovery Time (TMTSY)
S-0-0089	MTD Transmit Starting Time (T2)
S-0-0090	Command Value Transmit Time (TMTSG)
S-0-0095	Diagnostic Message
S-0-0096	Slave arrangement (SLKN)
S-0-0099	Reset class 1 diagnostic
S-0-0127	C1 Communication phase 3 transition check
S-0-0128	C2 Communication phase 4 transition check
S-0-0129	Manufacturer Status Class 1
S-0-0134	Master control word
S-0-0135	I/O status word (drive status word)
S-0-0142	Application type
S-0-0143	SYSTEM interface version
S-0-0181	Manufacturer Class 2 Diagnostics
S-0-0182	Manufacturer Class 3 Diagnostics

S-0-0185	Length of the config. data record in the AT
S-0-0186	Length of the config. data record in the MDT
S-0-0187	List of Configurable Data in the AT
S-0-0188	List of Configurable Data in the MDT
S-0-0192	IDN list of backup operation data
S-0-0265	Language Selection
S-0-0267	Password
S-0-0290	Type of participant
S-0-0291	I/O Basis
S-0-0301	Allocation of Real-Time Control Bit 1
S-0-0303	Allocation of Real-Time Control Bit 2
S-0-0305	Allocation of Real-Time Status Bit 1
S-0-0307	Allocation of Real-Time Status Bit 2
S-0-0360	MDT data container A
S-0-0361	MDT data container B
S-0-0364	AT data container A
S-0-0365	AT data container B
S-0-0368	Addressing data container A
S-0-0369	Addressing data container B
S-0-0370	Configuration list MDT data container
S-0-0371	Configuration list AT data container
S-0-0390	Diagnostic Message Number

Fig. 8-29: SERCOS basis parameters

I/O Basis Parameters

S-1-0000	DATA Basis
S-1-0001	Max. number of I/O channels
S-1-0002	Occupation I/O data channels
S-1-0003	COMMAND Basis
S-1-0004	Max. number of I/O command channels
S-1-0005	I/O class 1 diagnostic
S-1-0006	I/O class 2 diagnostic
S-1-0007	I/O class 3 diagnostic
S-1-0008	Mask I/O class 2 diagnostic
S-1-0009	Mask I/O class 3 diagnostic
S-1-0010	Wire break
S-1-0011	Wire break origin
S-1-0012	Short circuit
S-1-0013	Origin of short circuit
S-1-0014	Out of range
S-1-0015	Origin of range error
S-1-0016	Error communication interface
S-1-0017	Origin of communication error
S-1-0018	Module basis
S-1-0019	Module list
S-1-0020	Module type list

Fig. 8-30: I/O basis parameters

Data Channels

S-2-0000	Channel container	Output channel 0
S-2-0001	Channel type	
S-2-0002	Ident list	
S-2-0003	Parameter 0	
S-2-0004	Parameter 1	
S-2-0010	Channel container	Input channel 0
S-2-0011	Channel type	
S-2-0012	Ident list	
S-2-0013	Parameter 0	
S-2-0014	Parameter 1	
S-2-0020 ... S-2-0024	Channel container ... Parameter 1	Output channel 1
S-2-0030 ... S-2-0034	Channel container ... Parameter 1	Input channel 1
S-2-0040 ... S-2-0044	Channel container ... Parameter 1	Output channel 2
S-2-0050 ... S-2-0054	Channel container ... Parameter 1	Input channel 2
S-2-0060 ... S-2-0064	Channel container ... Parameter 1	Output channel 3
S-2-0070 ... S-2-0074	Channel container ... Parameter 1	Input channel 3
S-2-0080 ... S-2-0084	Channel container ... Parameter 1	Output channel 4
S-2-0090 ... S-2-0094	Channel container ... Parameter 1	Input channel 4
S-2-0100 ... S-2-0104	Channel container ... Parameter 1	Output channel 5
S-2-0110 ... S-2-0114	Channel container ... Parameter 1	Input channel 5
S-2-0120 ... S-2-0124	Channel container ... Parameter 1	Output channel 6
S-2-0130 ... S-2-0134	Channel container ... Parameter 1	Input channel 6
S-2-0140 ... S-2-0144	Channel container ... Parameter 1	Output channel 7
S-2-0150 ... S-2-0154	Channel container ... Parameter 1	Input channel 7

S-2-0160 ... S-2-0164	Channel container ... Parameter 1	Output channel 8
S-2-0170 ... S-2-0174	Channel container ... Parameter 1	Input channel 8
S-2-0180 ... S-2-0184	Channel container ... Parameter 1	Output channel 9
S-2-0190 ... S-2-0194	Channel container ... Parameter 1	Input channel 9
S-2-0200 ... S-2-0204	Channel container ... Parameter 1	Output channel 10
S-2-0210 ... S-2-0214	Channel container ... Parameter 1	Input channel 10
S-2-0220 ... S-2-0224	Channel container ... Parameter 1	Output channel 11
S-2-0230 ... S-2-0234	Channel container ... Parameter 1	Input channel 11
S-2-0240 ... S-2-0244	Channel container ... Parameter 1	Output channel 12
S-2-0250 ... S-2-0254	Channel container ... Parameter 1	Input channel 12
S-2-0260 ... S-2-0264	Channel container ... Parameter 1	Output channel 13
S-2-0270 ... S-2-0274	Channel container ... Parameter 1	Input channel 13
S-2-0280 ... S-2-0284	Channel container ... Parameter 1	Output channel 14
S-2-0290 ... S-2-0294	Channel container ... Parameter 1	Input channel 14

Fig. 8-31: Data channels

Module Channels

S-4-0000	Module name	Module 1
S-4-0001	Module type	
S-4-0002	Ident list	
S-4-0003	Ident list of channel containers	
S-4-0004	Bit offset	
S-4-0010 ... S-4-0014	Module name ... Bit offset	Module 2
S-4-0020 ... S-4-0024	Module name ... Bit offset	Module 3
S-4-0030 ... S-4-0034	Module name ... Bit offset	Module 4
S-4-0040 ... S-4-0044	Module name ... Bit offset	Module 5
S-4-0050 ... S-4-0054	Module name ... Bit offset	Module 6
S-4-0060 ... S-4-0064	Module name ... Bit offset	Module 7
S-4-0070 ... S-4-0074	Module name ... Bit offset	Module 8
S-4-0080 ... S-4-0084	Module name ... Bit offset	Module 9
S-4-0090 ... S-4-0094	Module name ... Bit offset	Module 10
S-4-0100 ... S-4-0104	Module name ... Bit offset	Module 11
S-4-0110 ... S-4-0114	Module name ... Bit offset	Module 12
S-4-0120 ... S-4-0124	Module name ... Bit offset	Module 13
S-4-0130 ... S-4-0134	Module name ... Bit offset	Module 14
S-4-0140 ... S-4-0144	Module name ... Bit offset	Module 15
S-4-0150 ... S-4-0154	Module name ... Bit offset	Module 16
S-4-0160 ... S-4-0164	Module name ... Bit offset	Module 17

S-4-0170 ... S-4-0174	Module name ... Bit offset	Module 18
S-4-0180 ... S-4-0184	Module name ... Bit offset	Module 19
S-4-0190 ... S-4-0194	Module name ... Bit offset	Module 20
S-4-0200 ... S-4-0204	Module name ... Bit offset	Module 21
S-4-0021 ... S-4-0214	Module name ... Bit offset	Module 22
S-4-0220 ... S-4-0224	Module name ... Bit offset	Module 23
S-4-0230 ... S-4-0234	Module name ... Bit offset	Module 24
S-4-0240 ... S-4-0244	Module name ... Bit offset	Module 25
S-4-0250 ... S-4-0254	Module name ... Bit offset	Module 26
S-4-0260 ... S-4-0264	Module name ... Bit offset	Module 27
S-4-0270 ... S-4-0274	Module name ... Bit offset	Module 28
S-4-0280 ... S-4-0284	Module name ... Bit offset	Module 29
S-4-0290 ... S-4-0294	Module name ... Bit offset	Module 30
S-4-0300 ... S-4-0304	Module name ... Bit offset	Module 31
S-4-0310 ... S-4-0314	Module name ... Bit offset	Module 32
S-4-0320 ... S-4-0324	Module name ... Bit offset	Module 33
S-4-0330 ... S-4-0334	Module name ... Bit offset	Module 34
S-4-0340 ... S-4-0344	Module name ... Bit offset	Module 35
S-4-0350 ... S-4-0354	Module name ... Bit offset	Module 36

S-4-0360 ... S-4-0364	Module name ... Bit offset	Module 37
S-4-0370 ... S-4-0374	Module name ... Bit offset	Module 38
S-4-0380 ... S-4-0384	Module name ... Bit offset	Module 39
S-4-0390 ... S-4-0394	Module name ... Bit offset	Module 40

Fig. 8-32: Module channels

Manufacturer-Specific Parameters

P-0-0009	SERCOS error number	
P-0-1110	Channel container diagnostic channel	Diagnostic channel
P-0-1111	Channel type Diagnostic channel	
P-0-1112	Ident list of diagnostic channels	
P-0-1113	Parameter 0	
P-0-1114	Parameter 1	

Fig. 8-33: Manufacturer-specific parameters

8.12 Example

The SERCOS bus coupler is equipped with the following modules:

- R-IB IL AO 2/U/BP
- R-IB IL 24 DO 32/HD
- R-IB IL 24 DO 16
- R-IB IL 24 DO 8
- R-IB IL 24 DO 2-2A
- R-IB IL AI 2/SF
- R-IB IL 24 DI 32/HD
- R-IB IL 24 DI 8
- R-IB IL 24 DI 4

Excerpt from the parameter list:

Parameters	Description	Value
S-1-0001	Max. number of I/O channels	8
S-1-0002	Occupation I/O data channels	S-2-0000, S-2-0010, S-2-0020, S-2-0040, S-2-0060, S-2-0030, S-2-0050, S-2-0070
S-1-0019	Module list	S-4-0000, S-4-0010, S-4-0020, S-4-0030, S-4-0040, S-4-0050, S-4-0060, S-4-0070, S-4-0080
S-1-0020	Module type list	0110 0010 0101 0101 0101 0111 0000 0001 0101 0101 0000 0001 0101 0100 0000 0001 0101 0010 0000 0001 0010 0010 0101 0101 0001 0111 0001 0000 0001 0100 0001 0000 0001 0011 0001 0000
S-2-0000	Channel container 4 bytes	Output data AO 2
S-2-0001	Channel type	Analog outputs
S-2-0002	IDN list	S-2-0003; S-2-0004
S-2-0003	Assignment inputs	0x0
S-2-0004	Assignment outputs	0xFFFF.FFFF
S-2-0010	Channel container 4 bytes	Input data AO 2
S-2-0011	Channel type	Analog inputs
S-2-0012	IDN list	S-2-0013; S-2-0014
S-2-0013	Assignment inputs	0xFFFF.FFFF
S-2-0014	Assignment outputs	0x0
S-2-0020	Channel container 4 bytes	Output data DO32
S-2-0021	Channel type	Digital outputs
S-2-0022	IDN list	S-2-0023; S-2-0024
S-2-0023	Assignment inputs	0x0
S-2-0024	Assignment outputs	0xFFFF.FFFF

S-2-0030	Channel container 4 bytes	Input data AI2
S-2-0031	Channel type	Analog inputs
S-2-0032	IDN list	S-2-0033; S-2-0034
S-2-0033	Assignment inputs	0xFFFF.FFFF
S-2-0034	Assignment outputs	0x0
S-2-0040	Channel container 4 bytes	Output data DO16/8/2
S-2-0041	Channel type	Digital outputs
S-2-0042	IDN list	S-2-0043; S-2-0044
S-2-0043	Assignment inputs	0x0
S-2-0044	Assignment outputs	0x03FF.FFFF
S-2-0050	Channel container 4 bytes	Input data DI32
S-2-0051	Channel type	Digital inputs
S-2-0052	IDN list	S-2-0053; S-2-0054
S-2-0053	Assignment inputs	0xFFFF.FFFF
S-2-0054	Assignment outputs	0x0
S-2-0060	Channel container 4 bytes	Output data AI2
S-2-0061	Channel type	Analog outputs
S-2-0062	IDN list	S-2-0063; S-2-0064
S-2-0063	Assignment inputs	0x0
S-2-0064	Assignment outputs	0x0FFF.FFFF
S-2-0070	Channel container 2 bytes	Input data DI8/4
S-2-0071	Channel type	Digital inputs
S-2-0072	IDN list	S-2-0073; S-2-0074
S-2-0073	Assignment inputs	0x0FFF
S-2-0074	Assignment outputs	0x0

Fig. 8-34: Example

Notes

9 What to Do in Case of Failures?

9.1 General Information

Failures or errors can occur both on commissioning of the Inline station and during operation of the SERCOS interface. Basically, there are two methods of troubleshooting. On the one hand, failures and errors can be detected using the on-site diagnosis by means of the LEDs and the 7-segment display of the SERCOS bus coupler and the LEDs of the Inline modules. On the other hand, the bus coupler also transfers all failures as SERCOS diagnostic parameters to the SERCOS master, so that the SERCOS master can also diagnose errors in the station and initiate remedy measures via the software. For detailed information on SERCOS diagnostic parameters please refer to Chapter "SERCOS Communication".

The diagnostic and status indicators of the modules and the 7-segment display of the bus coupler can be used for quick failure and error diagnosis.

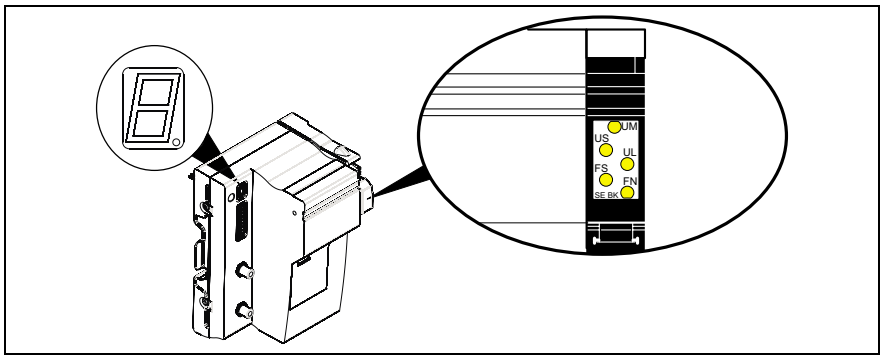


Fig. 9-1: Diagnostic indicators on the SERCOS bus coupler

Diagnostic Indicators

The red and green diagnostic indicators provide information on the failure type and location.

The bus coupler operates properly when the DIAG LED does not indicate a failure, when the UM, US and UL LEDs emit green light, and when the F-OPTIC-ERR, FS and FN LEDs are dark.

Status Indicators

The status indicators of the Inline modules (yellow LED) show the status of the associated input/output and/or the connected unit.

The sections below describe the diagnostic and status indicators and the resulting error analysis for the SERCOS bus coupler and the Inline modules.

7-Segment Display

The 7-segment display H1 of the bus coupler indicates operating states and diagnostic messages. By means of this display, the current operating state can be seen quickly without having to use a communication interface.

9.2 LED Indicators on the SERCOS Bus Coupler

Diagnostic and Status Indicators

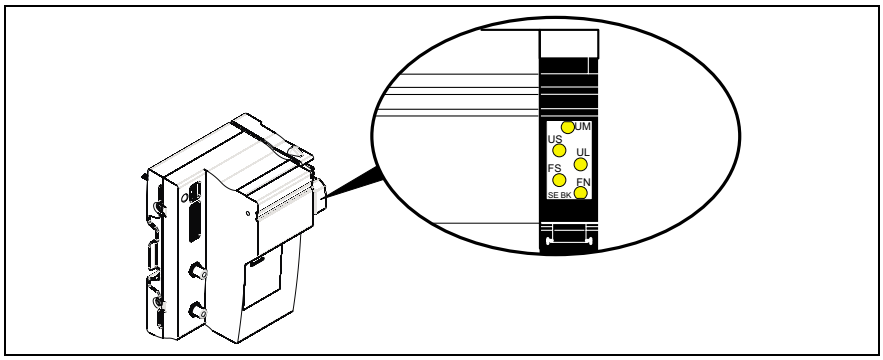


Fig. 9-2: Indicators on the SERCOS bus coupler

The SERCOS bus coupler detects module failures. These failures are indicated by the LEDs of the bus coupler. Fig. 9-4 describes the various LED indicators. The symbols used have the following meaning:

Symbol	Meaning
●	LED on
○	LED off
⊙	LED flashing

Fig. 9-3: LED combinations

LED	Color	Meaning	Status	Description of LED states
UM	Green	U_{Main}	●	24 V supply U_M of main circuit is present.
			○	Main circuit supply U_M is not present.
US	Green	$U_{Segment}$	●	24 V supply U_S of segment circuit is present.
			○	Segment circuit supply U_S is not present.
UL	Green	$U_{LogicSupply}$	●	24 V supply U_{LS} of logic is present.
			○	Logic supply U_{LS} is not present.
FS	Red	Failure Select	●	If FS emits red light, then FN indicates the **failure class,** see Fig. 9-6
			○	If FS does not emit light, then FN indicates the **failure number,** see Fig. 9-6
FN	Red	Failure Number	⊙	Flashing pulses for failure number or failure class, see Fig. 9-6
			○	No failure

Fig. 9-4: Diagnostic LEDs of the SERCOS bus coupler

Failure Causes and Remedies

Each combination of LEDs on the bus coupler indicates a specific failure, thus assisting in identifying and eliminating this failure.

No.	UM	US	UL	FS	FN	Failure	Remedy
1)	●	●	●	○	○	No failure	-
2)	○	●	●	○	○	Power supply voltage U_M missing	Check power supply voltage U_M.
3)	●	○	●	○	○	Power supply voltage U_S missing	Check power supply voltage U_S.
4)	●	●	○	○	○	Power supply voltage U_{LS} missing	Check power supply voltage U_{LS}.
5)	○	○	○	○	○	All power supply voltages are missing.	Check power supply voltages U_M, U_S and U_{LS}.
6)	●	●	●	●	⊙	The number of flashing pulses at FN indicates the failure class.	See Fig. 9-6, "Class" column.
7)	●	●	●	○	⊙	The number of flashing pulses at FN indicates the failure number.	See Fig. 9-6, "No." column.

Fig. 9-5: Possible LED combinations

Note: As a matter of principle, it is not permitted to make changes in configuration during operation! The Inline station must always be de-energized beforehand!

Failure Cause and Remedy with Failure Class and Failure Number

The **FS** and **FN** LEDs on the power terminal of the SERCOS bus coupler can be used to determine the failure class and the failure number.

- FS on: the number of flashing pulses at FN indicates the failure class.
- FS off: the number of flashing pulses at FN indicates the failure number.

Example The FS LED is lit, while the FN LED flashes once. Then the FS LED turns dark, and the FN LED flashes twice. This indicates that the failure is caused by too great a number of fitted modules (more than 40).

The table below shows the flashing pulse code.

Class	No.	Meaning	Failure cause and remedy
1		**Configuration error**	
	1	One of the Inline modules is not enabled for operation on the bus coupler (unknown module).	Determine the exact error location by means of the 7-segment display DIAG. After activation of the supply voltage, the slot number of the unknown module is shown briefly. Example: Display "3" = the third module of the bus coupler is not permitted. Remove the module from the station.
	2	The number of fitted Inline modules exceeds 40.	Check whether there are more than 40 Inline modules in the station and reduce the number of modules.
	3	The total of process data for inputs exceeds 32 bytes.	Reduce the number of modules with input data.
	4	The total of process data for outputs exceeds 32 bytes.	Reduce the number of modules with output data.
	5	The number of SERCOS output channels exceeds 15.	Take note of the fitting instructions for Inline modules (see Chapter 7).
	6	The number of SERCOS input channels exceeds 15.	Take note of the fitting instructions for Inline modules (see Chapter 7).
	7	The length code of one of the Inline modules is not supported.	Check whether the fitted modules are enabled for the SERCOS bus coupler. Remove the module from the station.
	8	No module connected.	No Inline modules are connected to the bus coupler. Add modules to the bus coupler.
2		**Transmission error on the local bus**	
	1	An error has occurred in the data transmission between the Inline modules.	Identify the exact error location on site by means of the diagnostic indicators of the modules. Check the connections between the devices indicated.
3		**Warning: Periphery error**	
	1	A failure has occurred in the connected peripheral equipment, e.g. short-circuit or overload at the actuator.	The error location is identified by the diagnostic indicator of the modules. Consult the functional description of the particular Inline module (see Chapter 10.2 "Ordering Information on the Documentation") to find out which error may initiate this error message. Remove the peripheral error.

Fig. 9-6: Identifying the error cause and remedy

9.3 7-Segment Display "H1" on the SERCOS Bus Coupler

The current operating status of the bus coupler is indicated by error messages, warnings and commands, if any are present. The display also shows whether the device is in the ready status or in the parameterization mode.

The 1-digit 7-segment display shows a multi-digit message by indicating the digits one after the other. Example: "Twice MST error" is indicated by the H1 display showing "F", "4", "0", "1" one after the other. This is followed by a brief pause (display off). Then the message is displayed again. Fig. 9-9 shows a list of all possible messages.

Communication phases

The following communication phases (initialization) are activated after the bus coupler has been turned on and are shown on the H1 display:

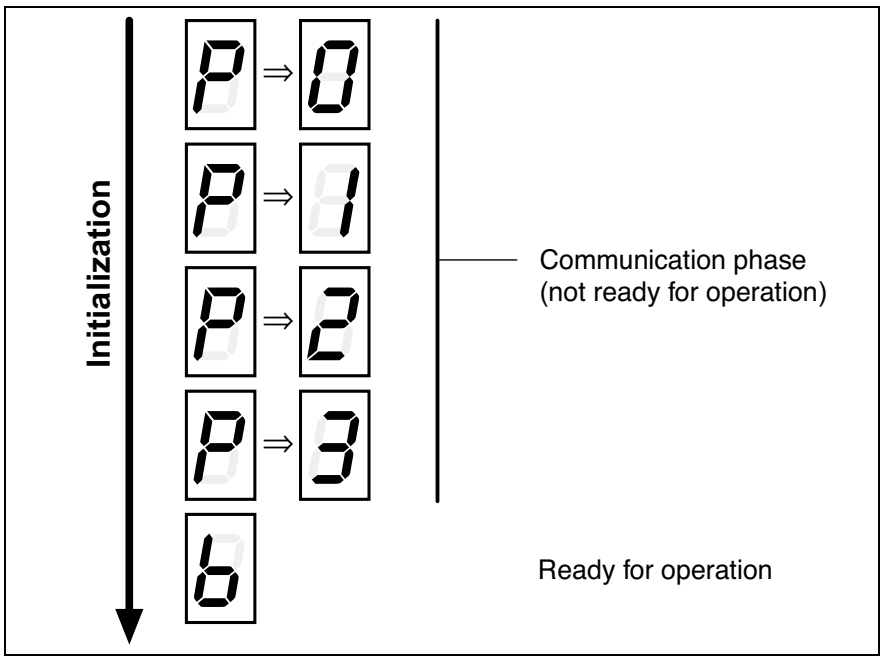


Fig. 9-7: Communication phases of the SERCOS bus coupler

Display	Meaning
P0	Communication phase 0
P1	Communication phase 1
P2	Communication phase 2
P3	Communication phase 3
b	Ready for operation

Fig. 9-8: Communication phases

For detailed information on SERCOS communication phases please refer to Chapter 8 "SERCOS Communication".

Diagnostic Messages

The H1 display may show the following diagnostic messages:

Display	Meaning
C100	Communication phase 3 transition check
C101	Error telegram type
C104	Config. IDN for MDT not configurable
C105	Configured length > max. length for MDT
C106	Config. IDN for AT not configurable
C107	Configured length > max. length for AT
C108	Time slot parameter > SERCOS cycle time
C109	Beginning address of data record in MDT even (S-0-0009)
C110	Length of MDT odd (S-0-0010)
C111	Beginning address in MDT (S-0-0009) + record length - 1 > length of MDT (S-0-0010)
C112	TNcyc (S-0-0001) or TScyc (S-0-0002) error
C113	Relation TNcyc (S-0-0001) to TScyc (S-0-0002) error
C114	T4 > TScyc (S-0-0002) - T4min (S-0-0005)
C115	T2 too small
C200	Communication phase 4 transition check
C202	Parameter limit error (-> S-0-0022)
C500	Reset class 1 diagnostic; error reset
F101	Class 1 Inline error
F102	Class 2 Inline error
F401	Twice MST error
F402	Twice MDT error
F403	SERCOS phase > 4
F404	Error during Phase Progression
F405	Error during Phase Regression
F406	Phase Switching without Ready Signal
E408	Multiplex channel error MDT
E409	Multiplex channel error AT
E410	Device no scan or device no. = 0
E411	E411 periphery error

Fig. 9-9: Diagnostic messages on the H1 display

For information on how to map the diagnostic messages to the SERCOS parameters, please refer to Chapter 8 "SERCOS Communication".

Diagnostic Message Priority

Several errors may be displayed at the same time. Errors with the lowest priority are shown first; an example is shown in Fig. 9-10.

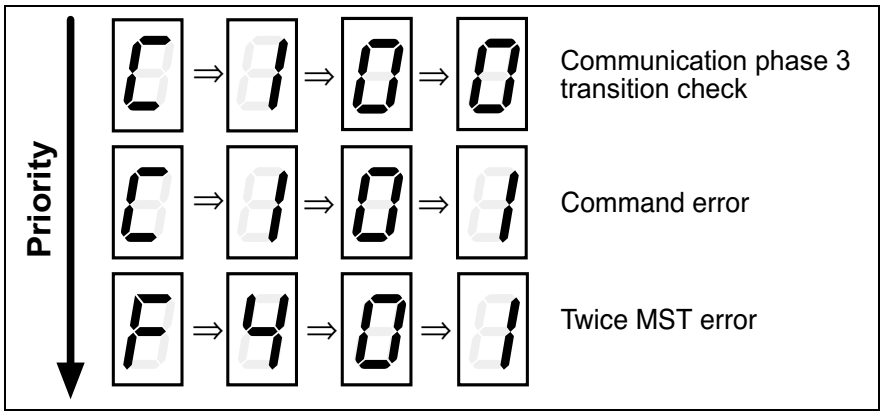


Fig. 9-10: Priority-depending diagnosis generation

9.4 Distortion LED (F-OPTIC ERR)

The distortion LED lights up, if the capacity of the signal received is too high or too low, or if no edges are on the signal received.

Note: By adjusting the transmitter capacity of the preceding ring device, set the signal level, such that it is in the permissible range and the distortion LED turns dark.

9.5 Indicators on the Inline Modules

For quick error diagnosis on site, all modules are equipped with diagnostic and status LEDs.

Diagnosis

The diagnostic indicators (red/green) provide information on the failure type and location. A module operates faultlessly, when all of its green LEDs are lit.

After correction of the failure, the indicators immediately show the current status.

Status

The status indicators (yellow) show the status of the associated input/output and/or the connected unit.

Note: Please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation") for further information about the diagnostic and status indicators provided on a specific module.

Indicators on Supply Terminals

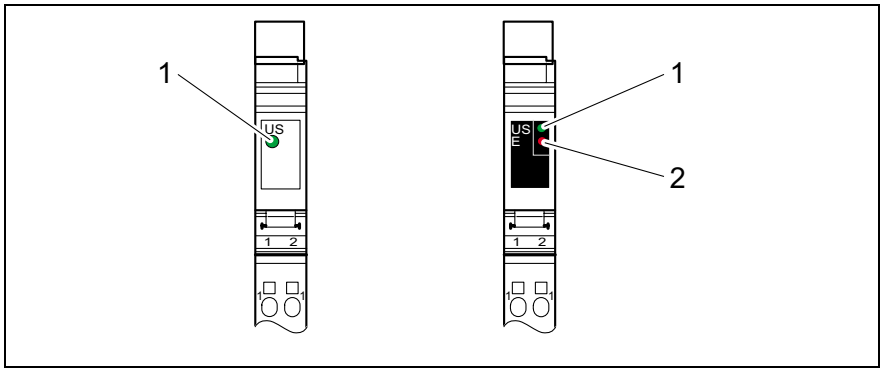


Fig. 9-11: Possible indicators on supply terminals (here: segment terminal without and with fuse)

Diagnosis The following states are indicated by the supply terminals:

LED	Color	Status	Description of LED states
UM (1)	Green	On	24 V supply of the main circuit is present.
		Off	Main circuit supply is not present.

Fig. 9-12: Diagnostic LED of the power terminal

LED	Color	Status	Description of LED states
US (1)	Green	On	24 V supply of the segment circuit is present.
		Off	Segment circuit supply is not present.

Fig. 9-13: Diagnostic LED of the segment terminal

LED	Color	Status	Description of LED states
E (2)	Red	On	No fuse, or tripped fuse
		Off	Fuse okay

Fig. 9-14: Additional LED for supply terminals with fuse

Note: In modules with fuse, the green LED indicates that the main or segment voltage is available **upstream** of the fuse. That means that, with the green LED being lit, the voltage is applied upstream of the fuse. If the red LED is lit as well, the voltage is not applied to the output side! Either there is no fuse, or the fuse is defective.

Indicators on the Input/Output Modules

Electrically, all LEDs of the input/output modules are in the logic section.

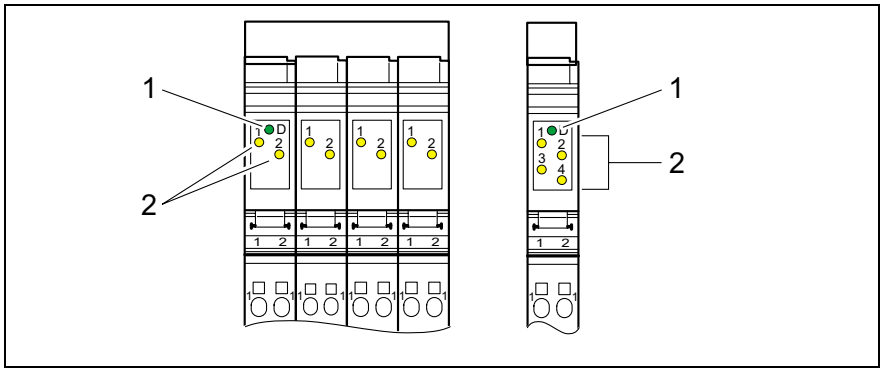


Fig. 9-15: Indicators on the input/output modules

Diagnosis The following states are indicated by the input/output modules:

LED	Color	Status	Description of LED states
D (1)	Green	On	Local bus active
		Flashing: 0.5 Hz (slow)	Logic voltage available, local bus not active
		2 Hz (medium)	Logic voltage available, local bus active, periphery error pending
		4 Hz (fast)	Logic voltage available; module upstream of the flashing module failed; or module itself is defective. Modules downstream of the flashing module are not included in the configuration scope.
		Off	Logic voltage not available, local bus not active

Fig. 9-16: Diagnostic LED of input/output modules

Status The state of the input or output is indicated by the corresponding yellow LED.

LED	Color	Status	Description of LED states
1, 2, 3, 4 (2)	Yellow	On	The assigned input/output is set.
		Off	The assigned input/output is not set.

Fig. 9-17: Status LEDs of input/output terminals

Assignment of Status LED to Input/Output

The following figure shows the general principle of assignment of a status LED to its input or output.

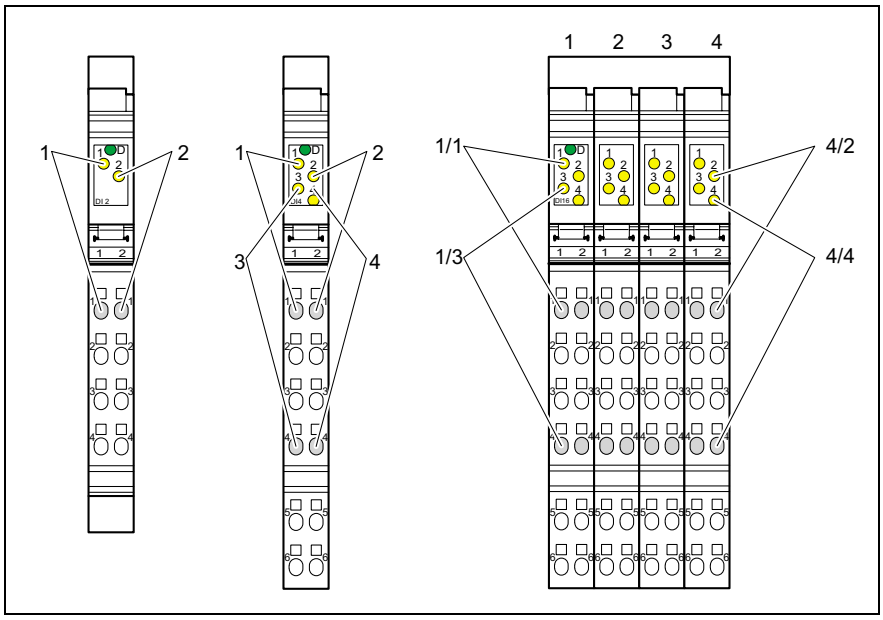


Fig. 9-18: Assignment of status LED to input/output

In a 8-slot module, the LEDs of a slot belong to the terminal points of this slot. Each slot can be treated like a 2-slot module.

In a 2-slot module with 4 inputs or outputs (center illustration in Fig. 9-18), the following LEDs belong to the following terminal points:

LED 1 Terminal point 1.1

LED 2 Terminal point 2.1

LED 3 Terminal point 1.4

LED 4 Terminal point 2.4

In Fig. 9-18 and Fig. 9-19, 4/2 on the 8-slot module indicates LED 2 at slot 4. It belongs to input 14 at terminal point 4/2.1 (slot 4 / terminal point 2.1).

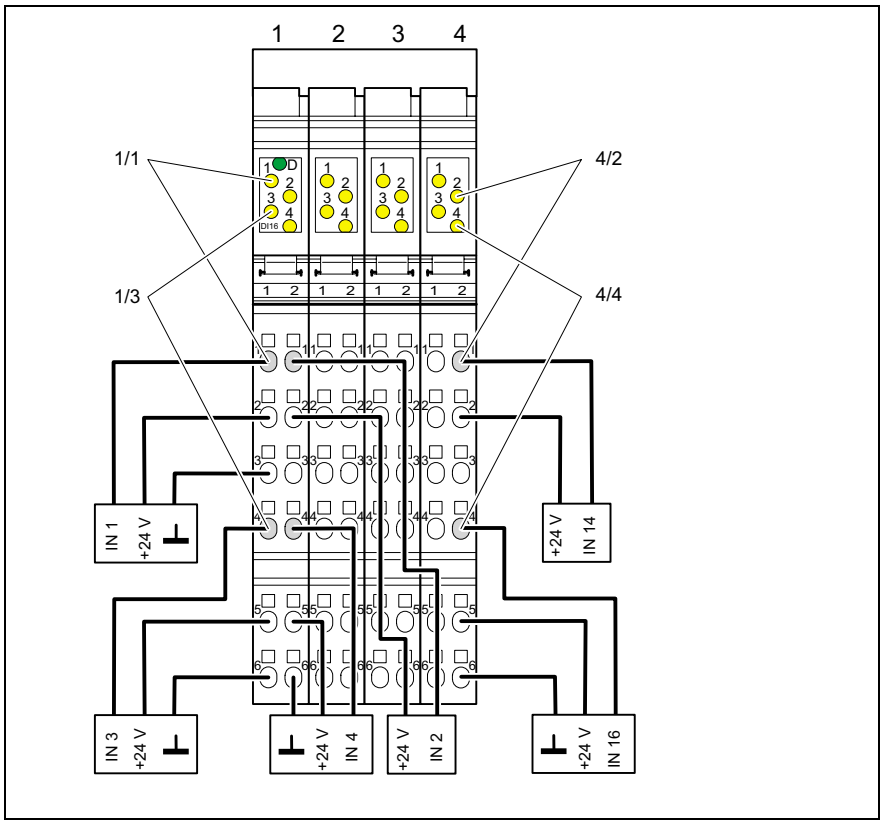


Fig. 9-19: Assignment of the status LED to input/output by the example of a R-IB IL 24 DI 16 module

Note: For the assignment of a specific module, please refer to the functional description of that module (refer to Chapter 10.2 "Ordering Information on the Documentation").

Failure Localization

The Rexroth Inline diagnostic and status indicators permit unique failure localization. A failure is indicated in the station. Furthermore, the device in which the failure occurred is signaled to the control and can be read there.

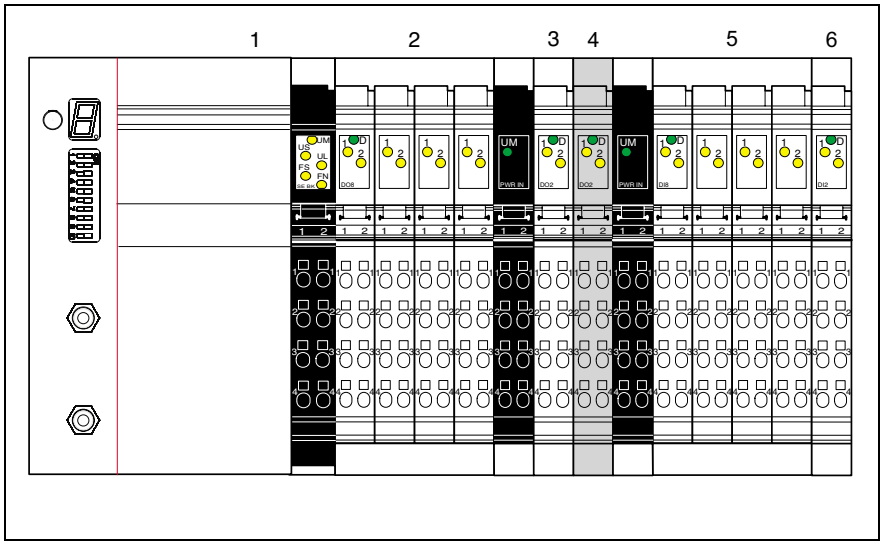


Fig. 9-20: Example of a station for failure localization

Modules used in the sample station:

1	R-IL SE BK	4	R-IB IL 24 DO 2-2A
2	R-IB IL 24 DO 8	5	R-IB IL 24 DI 8
3	R-IB IL 24 DO 2-2A	6	R-IB IL 24 DI 2

The R-IB IL 24 PWR IN power terminals are not numbered, since they are no bus devices and are, therefore, not provided with error diagnostic indicators either.

If there are no failures, the green LEDs on the bus coupler and the modules emit steady light (Fig. 9-21, A).

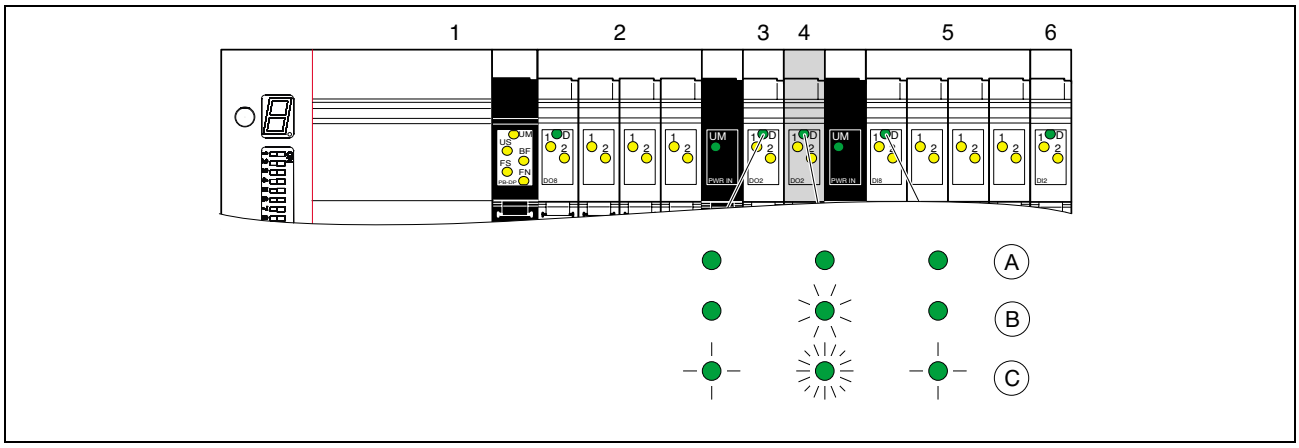


Fig. 9-21: Station with diagnostic indicators

Fig. 9-21 shows a station with possible failure states. The periphery errors at module 4 and the bus errors between module 3 and module 5 as well as the behavior of the diagnostic indicators of the neighboring modules are observed.

A No failure

B Periphery error, see Fig. 9-21.

C Bus error, see Fig. 9-21.

LED on or flashing at a rate of 0.5 Hz / 2 Hz / 4 Hz

(on / slow / medium / fast)

Error:	Short-circuit at module 4 (R-IB IL 24 DO 2).
Effect:	
Control:	Error message to the control (periphery error).
Bus coupler:	Indicators remain as they are.
Module 4:	The green LED D flashes at a rate of 2 Hz.
Other modules:	Remain as they are.

Fig. 9-22: Periphery error

Error:	The incoming bus downstream of module 3 and upstream of module 5 is interrupted.
Effect:	
Control:	Error location identifiable by the control.
Bus coupler:	Red FN LED is flashing.
Module 4:	The green LED D flashes at a rate of 4 Hz (bus error).
Other modules:	The green D LEDs of all other modules are flashing at a rate of 0.5 Hz.

9.6 Indicators on Other Inline Modules

For diagnostic and status indicators on other Inline modules (e.g. function modules or power modules), please refer to the appropriate functional description (refer to Chapter 10.2 "Ordering Information on the Documentation").

Notes

10 Technical Data and Ordering Information

10.1 Technical Data

General Data

Part designation	R-IL SE BK
Part number	R911296696
Housing dimensions	91 mm x 120 mm x 71.5 mm (W x H x D) (1.921 x 4.724 x 2.815 in.)
Weight	200 g (without connectors)
Degree of protection	IP20 according to IEC 60529
Protection class	Class 3 according to VDE 61131-2 Class 1 according to EN 50178

Fig. 10-1: General data

System Data

Number of devices per station	No more than 40
Total of all I/O data per station	No more than 32 bytes of input data and 32 bytes of output data
Maximum current of the field bus coupler for supply of the logic of the I/O modules	2.0 A at U_L
Maximum additional current for supply of the analog modules	0.5 A at U_{ANA}

Fig. 10-2: System data

Interfaces

SERCOS interface	
FO conductor cable; refer to Section "Selecting the FO Conductor Cable" in Chapter 7.	

Fig. 10-3: Interfaces

Main Infeed U_M and 24 V Segment Infeed U_s

Connection method	Tension spring terminals
Recommended cable lengths	No more than 30 m; cable running across free areas not permitted
Continuation	Via voltage jumpers
Nominal value	24 V DC
Tolerances	-15 % / +20 % (according to EN 61 13 1-2)
Ripple factor	± 5 %
Permissible range	19.2 V to 30 V (ripple factor included)
Current carrying capacity	No more than 8 A
Safety measures	
Over-voltage	Yes
Polarity reversal	Yes

Fig. 10-4: Main infeed U_M and segment infeed U_S

CAUTION!

Protect the 24 V range with an external fuse!

⇒ This 24 V range must be provided with an external fuse. The power supply unit must be able to deliver the quadruple nominal current of the external fusible cutout, to ensure that the fuse reliably trips in the event of a failure.

24 V Logic Infeed U_{LS}

Connection method	Tension spring terminals
Recommended cable lengths	No more than 30 m; cable running across free areas not permitted
Continuation	Via voltage jumpers
Nominal value	24 V DC
Tolerances	-15 % / +20 % (according to EN 61 13 1-2)
Ripple factor	± 5 %
Permissible range	19.2 V to 30 V (ripple factor included)
Typical current consumption at nominal voltage	0.11 A DC (in idle mode, i. e. no Inline devices connected)
Maximum current consumption at nominal voltage	1.5 A DC, consisting of: 1.0 A DC for logic supply 0.5 A DC for analog power supply
Safety measures	**Only for infeed at bus coupler**
Over-voltage	Yes
Polarity reversal	Yes

Fig. 10-5: 24 V segment infeed U_s

CAUTION!

Protect the 24 V range with an external fuse!

⇒ This 24 V range must be provided with an external fuse. The power supply unit must be able to deliver the quadruple nominal current of the external fusible cutout, to ensure that the fuse reliably trips in the event of a failure.

Ambient Conditions according to EN 61131-2

	In operation	Storage/Transport
Max. ambient temperature (surrounding air temperature)	+5 ... +55 °C, 50°C max. average temperature over 24 hours	-25 °C to +70 °C
Relative humidity	10 % to 95 % according to DIN EN 61131-2, non-condensing.	5 % to 95 % according to DIN EN 61131-2, non-condensing.
Air pressure	Up to 2,700 m above MSL according to DIN 60204	Up to 3,000 m above MSL according to DIN 60204
Mechanical strength	Max. vibration: Frequency range: 5...150 Hz Excursion: 3.5 mm for 5...9 Hz Acceleration: 1 g for 9..150 Hz According to EN 60068-2-6	Max. shock: 15 g according to EN 60 068-2-27, no disturbance of the function

Fig. 10-6: Ambient conditions

Note: The ambient air must be free from acids, alkaline solutions, corrosive agents, salts, metal vapors, and other electrically conductive contaminants in high concentrations.

The ambient air must be free from dust. Housings and installation compartments must at least comply with degree of protection IP 54 according to DIN VDE 0470-1.

DANGER

Danger of destruction by overheating

⇒ Ensure an ambient temperature of less than 55 °C.

Compliance with EC Guideline 89/336/EEC (EMC Guideline)

Electrostatic discharge (ESD)	EN 61000-6-2/ EN 61000-4-2	Criterion B 4 kV contact discharge 8 kV air discharge
High-frequency electromagnetic fields	EN 61000-6-2/ EN 61000-4-3	Criterion A Field strength: 10 V/m
Bursts	EN 61000-6-2/ EN 61000-4-4	2 kV with DC supply
Surges	EN 61000-6-2/ EN 61000-4-5	Criterion A DC supply lines: 0.5 kV/0.5 kV (symmetric/asymmetric)
Conducted disturbances	EN 61000-6-2 EN 61000-4-6	Criterion A Test voltage 10 V
Electromagnetic interfering radiation	EN 55011	Class A

Fig. 10-7: Compliance with EMC guideline 89/336/EEC

UL/CSA Certification

The SERCOS bus coupler is certified according to:

- **UL508** (Industrial Control Equipment) and
- **C22.2 No. 14-M95** (CSA)

Compatibility Test

All Rexroth components are developed and tested according to the latest state-of-the-art.

As it is impossible to follow the continuing development of all materials (e.g. lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For that reason, test new lubricants, cleaning agents, etc. for compatibility with our housings / our housing materials before using the particular material concerned.

10.2 Ordering Information

Ordering Information on the Permissible Inline Modules

Description	Designation	Part no.
SERCOS bus coupler		
SERCOS bus coupler (with end plate and end clamp)	R-IL SE BK	R911296696
Supply terminals		
Power terminal without fuse	R-IB IL 24 PWR IN	R911289312
Segment terminal with fuse	R-IB IL 24 SEG/F	R911289313
Digital inputs		
Module with 2 digital inputs	R-IB IL 24 DI 2	R911289286
Module with 4 digital inputs	R-IB IL 24 DI 4	R911289287
Module with 8 digital inputs	R-IB IL 24 DI 8	R911289288
Module with 16 digital inputs	R-IB IL 24 DI 16	R911289290
Module with 32 digital inputs	R-IB IL 24 DI 32/HD	R911297188
Module with inputs	R-IB IL 24 EDI 2-DES	R911289292
Digital outputs		
Module with 2 digital outputs	R-IB IL 24 DO 2-2A	R911289294
Module with 4 digital outputs	R-IB IL 24 DO 4	R911289295
Module with 8 digital outputs	R-R-IB IL 24 DO 8	R911289297
Module with 8 digital outputs	R-R-IB IL 24 DO 8-2A	R911289298
Module with 16 digital outputs	R-IB IL 24 DO 16	R911289299
Module with 32 digital outputs	R-IB IL 24 DO 32/HD	R911297191
Module with a digital changeover contact relay output, max. contact voltage 230 V AC	R-IB IL 24/230 DOR/1W	R911289301
Module with a digital changeover contact relay output, max. contact voltage 230 V AC	R-IB IL 24/230 DOR/4W	R911289302
Analog inputs		
Module with 2 analog current or voltage inputs	R-IB IL AI 2/SF	R911289306
Module for connection of 2 analog temperature measuring resistors	R-IB IL TEMP 2 RTD	R911289305
Analog outputs		
Module with analog current or voltage output	R-IB IL AO 1/SF	R911289303
Module with 2 analog voltage outputs	R-IB IL AO 2U/BP	R911289381
Function modules		
Module with counter input	R-IB IL CNT	R911289315

Fig. 10-8: Ordering information on the permissible Inline modules

Ordering Information on Connectors and Accessories

Description	Designation	Part no.
Connector set for R-IB IL AO1/SF and R-IB IL CNT	R-IB IL AO/CNT-PLSET	R911289339
Connector for Inline modules, 2 signals with 4-wire connection, printed	R-IB IL SCN-8-CP	R911289323
Connector for Inline modules, for signals with shielded lines, e.g. analog signals, with shield terminal clip	R-IB IL SCN-6 SHIELD	R911289331
Connector for Inline modules, for signals with shielded lines, e.g. analog signals, with 2 shield terminal clips	R-IB IL SCN-6 SHIELD-TWIN	R911289332
Connector for Inline input modules, 4 signals with 3-wire connection, printed	R-IB IL SCN-12-ICP	R911289326
Connector for Inline output modules, 4 signals with 3-wire connection	R-IB IL SCN-12-OCP	R911289327
Feeder connector for Inline modules and SERCOS bus coupler; neighboring terminal points internally jumpered	R-IB IL SCN-PWR IN-CP	R911289328
Connector for Inline modules, dark-gray for relay terminal, not printed	R-IB IL SCN-8-AC-REL	R911289337
Labeling field, latching in, 2-slot width, 10 pieces	R-IB IL FIELD 2	R911289341
Labeling field, latching in, 8-slot width, 10 pieces	R-IB IL FIELD 8	R911289342

Fig. 10-9: Ordering information on connectors

Ordering Information on the Documentation

Title	Designation	Part no.
Funktionsbeschreibung der digitalen Input/Output Module für die Produktfamilie Inline (German)	DOK-CONTRL-R-IL*DIO	R911289588
Functional Description of Digital Input/Output Modules for the Inline Product Family (English)	DOK-CONTRL-R-IL*DIO	R911289589
Funktionsbeschreibung der analogen Input/Output Module für die Produktfamilie Inline (German)	DOK-CONTRL-R-IL*AIO	R911289590
Functional Description of Analog Input/Output Modules for the Inline Product Family (English)	DOK-CONTRL-R-IL*AIO	R911289591
Projektierung und Installation des Funktions-Moduls CNT (COUNTER – TIMER) Produktfamilie Inline (German)	DOK-CONTRL-R-IL*CNT	R911289592
Projecting and Installing the CNT Function Module (COUNTER – TIMER) Inline Product Family (English)	DOK-CONTRL-R-IL*CNT	R911289593

Fig. 10-10: Ordering information on the documentation

11 Glossary, Abbreviations and Symbols

Glossary

1-wire connection

Connection method for I/O modules with one connector per I/O channel. This wire transmits the signal. The I/O module and the sensor or actuator must have a common potential.

2-wire connection

Connection method for I/O modules with two connectors per I/O channel. One of the wires transmits the signal, the other one the common potential.

3-wire connection

Connection method for I/O modules with three connectors per I/O channel. One of the wires transmits the signal, a second one the common ground potential and the third an additional common potential (shield in case of the output, 24 V in case of the input).

4-wire connection

Connection method for I/O modules with four connectors per I/O channel. One of the wires transmits the signal, another one the common potential, and the third and forth wires are provided for connecting the shield and the ground.

Actuator

An actuator is a device capable of changing the behavior of a process, thus causing a change in the process variables. Actuators may be lamps, relays, etc.

Bus coupler

→ SERCOS bus coupler

Connector

The connector is latched onto the electronic socket of the Rexroth Inline module. For instance, the connector can be used to connect the power supply or the peripheral equipment.

Connector coding

In a → Rexroth Inline station, the connectors can be protected against being latched on incorrectly by means of the coding profiles of connector and socket.

Data jumper

Contact to → data routing

Data routing

Within a → Rexroth Inline station, the data signal is transferred via a connection which is established automatically when the Rexroth Inline modules are latched on.

Diagnostic LEDs

The diagnostic LEDs provide information on the state of the Rexroth Inline station, such as location and type of the failures or errors that might have occurred.

Electrical isolation

The electrical isolation isolates circuits of an electrical device galvanically.

Electric segment circuit

The segment circuit or auxiliary circuit supplies the modules of the → Rexroth Inline station with the segment voltage (U_S). The segment circuit starts at the → SERCOS bus coupler or at a → supply terminal (→ power terminal or → segment terminal) and is routed through all modules to the next supply terminal. It is provided for setting up separate electric circuits within one Rexroth Inline station.

End clamp

In a Rexroth Inline station, the end clamps are fitted to the left of the → SERCOS bus coupler and behind the last module and are attached to a mounting rail to prevent the modules from slipping.

End plate

The mechanical end plate constitutes the termination of a → Rexroth Inline station. The end plate does not have any electrical function. It is intended to protect the station from ESD pulses and the user from dangerous contact voltages. The end plate is supplied with the → SERCOS bus coupler and does not have to be ordered separately.

FE

→ Functional earth ground

Functional earth ground

A current path of low impedance between electric circuits and ground, which is not intended as a safety measure but, for instance, to improve the interference immunity.

Function module

A function module is a module with special functions (e.g. module with counter input (counter terminal)).

Inline

→ Rexroth Inline

Inline station

→ Rexroth Inline station

Input/output modules

Connection contact of a circuit or a device, to which a signal can be applied with the purpose to process, amplify, or store this signal or to link it to other signals.

Local bus

The local bus connects the → Rexroth Inline modules as local bus users to each other and to the → SERCOS bus coupler.

Logic circuit

Logic voltage is supplied from the logic circuit to all connected modules (U_L +, U_L -). This circuit starts at the → SERCOS bus coupler and is routed through all modules of a → Rexroth Inline station.

Main circuit

→ Main electric circuit

Main electric circuit

The main electric circuit supplies the modules of the → Rexroth Inline station with the main voltage (U_M, main circuit). The main electric circuit starts at the → SERCOS bus coupler or at a → power terminal and is routed to the next power terminal.

Module

Name of the terminals (disks) of the flexible automation kit → Rexroth Inline.

Peripheral connector

→ Connector

Peripheral equipment connector

→ Connector

Power supply

All of the components used to generate and transfer the supply voltage.

Power terminal

The power terminal is a → supply terminal. A power terminal is used to feed the main voltage into the → voltage jumper within the station. In addition to the main voltage, the segment voltage can be supplied or tapped from the main voltage.
Several power terminals can be fitted within one station. In this way, the electric isolation between various electric circuits is established and sections with different voltages are set up within the station (e.g. 24 V DC and 230 V AC).

Reset

Process where a system is reset to a defined basic state.

Rexroth Inline

Rexroth Inline is the flexible automation kit from Rexroth. The terminals (disks) of the Rexroth Inline product family constitute a modular automation system which is integrated in the SERCOS interface system. The Rexroth Inline automation terminals can be used to set up functional units by tool-free end-to-end mounting, with the functional units corresponding to the particular automation tasks. Rexroth Inline can be used both in the central switch cabinet and in the decentralized switchbox.

Rexroth Inline station

A Rexroth Inline station consists of the → SERCOS bus coupler, the Rexroth Inline modules, → supply terminals and the → end plate.

Segment circuit

→ Electric segment circuit

Segment terminal

The segment terminal is a → supply terminal, allowing the setup of a partial circuit (→ segment circuit).

Sensor

A sensor is a device acquiring the physical quantities of a process. The sensor determines the process variables. Sensors may be switches, detectors, buttons, etc.

SERCOS bus coupler

The SERCOS bus coupler from Rexroth constitutes the link between the SERCOS interface and the → Rexroth Inline installation system. Digital, analog and technology modules can be combined. The bus coupler and each module are provided with indicator LEDs for fault localization.

Serial data transmission

Serial data transmission is a method where the bits are transmitted via a line one after the other.

Station

→ Rexroth Inline station

Supply terminal

In a → Rexroth Inline station, supply terminals are → power terminals and → segment terminals.

Voltage jumper

Contact to → voltage routing

Voltage routing

Within a → Rexroth Inline station, the potentials are transferred via a connection which is established automatically when the modules are latched on.

Abbreviations and Symbols

Explanation of Abbreviations

FE 

Functional earth ground

Noiseless ground

This ground is noiseless and is used to ground cable shields and to suppress noise and interfering voltages.

The functional earth ground is a current path of low impedance between electric circuits and ground, which is not intended as a safety measure but, for instance, to improve the interference immunity (EN 61131).

This ground connection must be isolated from parts with a dangerous voltage by double and reinforced insulation (EN 60950).

GND 

0 V (ground); housing (chassis)

In this manual, the term ground relates to common voltage return lines. The ground is galvanically isolated from FE and PE. This isolation is cancelled if a jumper is fitted between ground and FE or PE.

Ground 

Ground, general symbol

PE 

Protective earth ground

This ground connection is used to ground devices. It is also provided as a protection against electric shock for persons.

The protective earth ground is a current path of low impedance which, in case of an error, reduces the user's risk (EN 61131).

U_M

Main supply voltage (peripheral supply in the main circuit)

The voltage U_M supplies all users connected to the main circuit.

All digital initiators (sensors) with their own short-circuit protection as well as those initiators which do not have to be protected are supplied from the main circuit.

The voltage U_M is fed in at the SERCOS bus coupler or at a power terminal, from where it is supplied to the next power terminal via the voltage jumpers.

U_S

Segment supply voltage (peripheral supply in the segment circuit)

The voltage U_S supplies all users connected to the segment circuit.

Digital sensors without their own short-circuit protection and all digital actuators are supplied from the segment circuit.

The voltage U_S is fed in via the SERCOS field bus coupler or is generated from the main supply voltage U_M at the bus coupler, the power terminal or the segment terminal.

U_{ANA}

Peripheral supply for analog terminals

The voltage U_{ANA} supplies all modules for analog signals.

It is generated at the SERCOS bus coupler and supplied through the Rexroth Inline station via the voltage jumpers.

U_L

Logic supply

The voltage U_L supplies all users with logic voltage (supply of the module electronics).

It is generated in the SERCOS bus coupler and supplied through the Rexroth Inline station via the voltage jumpers.

Representations in Block Diagrams

U_{L+}

Voltage jumper for the logic voltage

U_{L-}

Voltage jumper for the ground of the logic voltage

U_{ANA}

Voltage jumper for the supply voltage for analog modules

U_S

Voltage jumper for the segment voltage + 24 V

U_M

Voltage jumper for the main voltage + 24 V

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14 Service & Support

14.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

Our service helpdesk at our headquarters in Lohr am Main, Germany can assist you in all kinds of inquiries. Contact us

- telefonisch - by phone: **+49 (0) 9352 40 50 60**
  über Service Call Entry Center Mo-Fr 07:00-18:00
  - via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- per Fax - by fax: **+49 (0) 9352 40 49 41**
- per e-Mail - by e-mail: **service.svc@boschrexroth.de**

14.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26

oder - or **+49 (0) 172 660 04 06**

14.3 Internet

Unter **www.boschrexroth.com** finden Sie ergänzende Hinweise zu Service, Reparatur und Training sowie die **aktuellen** Adressen *) unserer auf den folgenden Seiten aufgeführten Vertriebs- und Servicebüros.

Verkaufsniederlassungen
Niederlassungen mit Kundendienst

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit unserem für Sie nächstgelegenen Ansprechpartner auf.

*) Die Angaben in der vorliegenden Dokumentation können seit Drucklegung überholt sein.

At **www.boschrexroth.com** you may find additional notes about service, repairs and training in the Internet, as well as the **actual** addresses *) of our sales- and service facilities figuring on the following pages.

sales agencies
offices providing service

Please contact our sales / service office in your area first.

*) Data in the present documentation may have become obsolete since printing.

14.4 Vor der Kontaktaufnahme... - Before contacting us...

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tel.-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

14.5 Kundenbetreuungsstellen - Sales & Service Facilities

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