

# DeviceNet Systems of the Rexroth Fieldline Product Range

R911317949  
Edition 01

## Application Description



**Title** DeviceNet systems of the Rexroth Fieldline product range

**Type of Documentation** Application Description

**Document Typecode:** DOK-CONTRL-FLSDNSYS-PRO-AW01-EN-P

**Internal File Reference** 7492\_en\_00, 120-0401-B339-01/EN

**Purpose of Documentation** This documentation describes the Fieldline-Stand-Alone (FLS) product group for DeviceNet systems.

**Record of Revisions**

Document Designation of Previous Editions	Release Date	Notes
120-0401-B339-01/EN	01/11	First edition

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**Published by** Bosch Rexroth AG  
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**Note** This document is printed on non-chlorine bleached paper.

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# 1 Fieldline on DeviceNet

## 1.1 The Fieldline Product Range

The input and output devices in the Fieldline product range are designed for distributed automation tasks in harsh environmental conditions. The devices meet the requirements for IP65/IP67 protection. They enable the direct connection of sensors and actuators in an environment close to the station.

The Fieldline product range includes the Fieldline Stand Alone (FLS) product group.

Fieldline Stand Alone devices cannot be extended and have a directly integrated fieldbus connection and I/O level. They are used for distribution in the field when only a few digital I/O points are required.

Fieldline Modular offers a user-friendly and powerful alternative for more complex I/O functions or when many cables are bundled together.

A Fieldline Modular station consists of a bus coupler (gateway) and up to 16 local bus I/O devices.

## 1.2 Documentation for Fieldline Devices

The documentation for Fieldline devices is modular, providing you with the optimum information for your specific bus system.



This application description describes only the DeviceNet-specific features of the devices.

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The following documentation is also required:

### **Installation of Devices in the Rexroth Fieldline Product Range DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P (MNR R911317026)**

This application description describes the devices for all bus systems. These include:

- The device properties, which are the same for all bus systems
- Mounting
- The power supply concept and connection

### **Device-specific data sheet**

The data sheet describes the specific properties of a device. These include:

- Function description
- Local diagnostic and status indicators
- Connector pin assignment and connection example
- Programming data and technical data

Fieldline on DeviceNet

## 1.3 DeviceNet

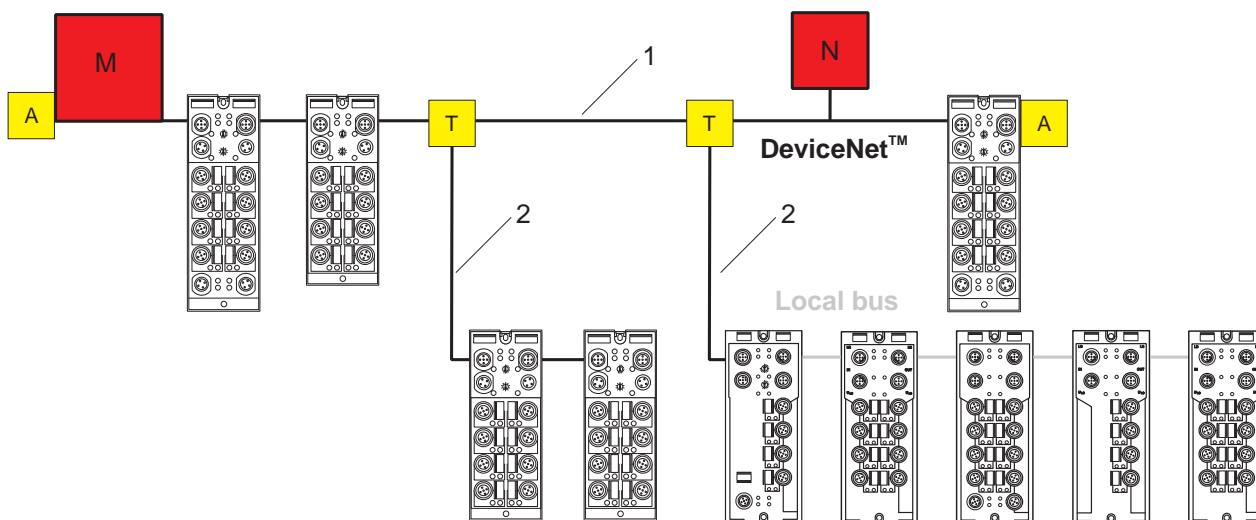
DeviceNet was developed as an open fieldbus standard based on the CAN protocol. As an organization that provides support for all DeviceNet users, the ODVA (Open Device Vendor Association) is responsible for specifying and maintaining the DeviceNet standard (<http://www.odva.org>).

### 1.3.1 Structure of DeviceNet

DeviceNet has a linear structure. This structure comprises a trunk line with branch lines, which lead to connected devices. The communications power is supplied and signals are transmitted via the same lines.

A termination resistor is required at both ends of the main line. Drops, made of trunk or drop cable, may be as long as 6 m, and each drop can support one or more nodes.

The total length of main lines and branch lines in the network depends on the line type and/or the baud rate (see Fig.1-3 on page 4). For further details on cable lengths in the network in relation to the current supply, please refer to the DeviceNet specification.



7492A006

Fig.1-1 Typical structure of a DeviceNet system

M	Master
N	Power supply unit
A	Termination resistor
T	Branch (tap)
1	Main line (DeviceNet, trunk line)
2	Branch line (secondary line, drop line)

Topology	Linear, active bus connection at both ends (termination resistor); branch lines are permitted
Number of devices in the DeviceNet system	64
Maximum expansion	Depends on the transmission speed (see <a href="#">Fig.1-3 on page 4</a> )
Transmission speed	125 kbps, 250 kbps, and 500 kbps (see <a href="#">Fig.1-3 on page 4</a> )

Fig.1-2 Basic network specifications

<b>Trunk line</b>	If there are no branches in the network, the main line is used to connect devices. If branches are present, device taps are connected via the trunk line.
<b>Branch line (secondary line, drop line)</b>	A branch line is used to connect branches to the trunk line. They are connected using a network tap.
<b>Termination resistor</b>	<p>DeviceNet requires a termination resistor to be installed at each end of the trunk line. It must have a metal film resistance of 121 ohms, with a tolerance of 1%, and a maximum power dissipation of at least 0.25 W.</p> <p>The termination resistor is either screwed onto the BUS OUT connection or, if T-pieces are used, screwed onto the open connection of the T-piece.</p> <p>The Fieldline devices do not have a resistor of this type. The ordering data can be found in the device-specific data sheet.</p>

### 1.3.2 Address

In the network, each device is identified by its address (device ID). Any address between 0 and 63 is permitted. In a network, an address can only be assigned once.

The device address is set using the rotary encoding switches (see [Chapter "Setting the Device ID \(MAC ID\)" on page 22](#)).

### 1.3.3 Baud Rate

Fieldline devices for have an automatic baud rate detection function, which means that there is no need to set the baud rate. After power up, the Fieldline device detects the baud rate and stores it as long as the supply voltage is present.



If you modify the baud rate of the master, you must disconnect and re-connect the supply voltage for the Fieldline device so that the device detects the modified baud rate.



Only one baud rate can be used at a time in a DeviceNet system.

Fieldline on DeviceNet

### 1.3.4 Bus Lines

The bus lines for the DeviceNet system are stipulated in the DeviceNet specification. According to this specification, the maximum expansion of a DeviceNet system depends on the baud rate.

Baud Rate	Length of the Trunk Line		Length of the Branch Line	
	Thick	Thin	Maximum	Accumulated
125 kbaud	500	100	6	156
250 kbaud	250	100	6	78
500 kbaud	100	100	6	39

Fig. 1-3 Baud rate and line lengths



As Fieldline devices have an M12 connection, only the thin cable can be used.

The length of the trunk line is the maximum distance between any two devices or termination resistors.

The accumulated length of the branch lines is the sum of all the branch lines.

	Thick	Thin
Outside diameter	12.2 mm	6.9 mm
Usage	Trunk lines (secondary lines)	Secondary lines (trunk lines)

Fig. 1-4 Outside diameter and use of the lines

## 2 Important Directions for Use

### 2.1 Appropriate Use

#### 2.1.1 Introduction

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.



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.

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Before using 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.

Important Directions for Use

## 2.1.2 Areas of Use and Application

The system of Rexroth is



The Rexroth system 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.

---

Typical applications of the Rexroth system are:

- Handling and assembly systems,
- Packaging and foodstuff machines,
- Printing and paper processing machines and
- Machine tools.

The Rexroth system 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.

In residential areas as well as in business and commercial areas Class A devices may be used with the following 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 Rexroth system 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 Rexroth system may not be used if

- they are 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 them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

## 3 Safety Instructions for Electric Drives and Controls

### 3.1 Safety Instructions - General Information

#### 3.1.1 Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

If the device is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the device in the official language of the user's country.



**Improper use of these devices, 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!**

Observe the safety instructions!

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#### 3.1.2 How to Employ the Safety Instructions

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

- 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 commissioning 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 device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the product, 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 devices 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.

## Safety Instructions for Electric Drives and Controls

- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
- 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.
- Commissioning 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.
- 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 section on EMC in the respective documentation (Project Planning Manuals of components and system).  
The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connection and installation conditions are specified in the product documentation and must be followed at all times.

*National regulations which the user must take into account*

- European countries: according to European EN standards
- United States of America (USA):
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  - regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  - International Organization for Standardization (ISO)
  - International Electrotechnical Commission (IEC)

### 3.1.3 Warning Symbols and Degrees of Hazard Seriousness

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




Warning symbol	Signal word	Degree of hazard seriousness acc. to ANSI Z 535.4-2002
	Danger	Death or severe bodily harm will occur.
	Warning	Death or severe bodily harm may occur.
	Caution	Minor or moderate bodily harm or material damage may occur.

Fig. 3-1

Hazard classification (according to ANSI Z 535)

Safety Instructions for Electric Drives and Controls

### 3.1.4 Hazards by Improper Use



**DANGER**

**High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!**

Observe the safety instructions!



**DANGER**

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

Observe the safety instructions!



**WARNING**

**High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!**

Observe the safety instructions!



**WARNING**

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

Observe the safety instructions!



**CAUTION**

**Hot surfaces on device housing! Danger of injury! Danger of burns!**

Observe the safety instructions!



**CAUTION**

**Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting or improper handling of pressurized lines!**

Observe the safety instructions!



**CAUTION**

**Risk of injury by improper handling of batteries!**

Observe the safety instructions!

## 3.2 Instructions with Regard to Specific Dangers

### 3.2.1 Protection Against Contact with Electrical Parts and Housings



This section concerns devices and drive components with voltages of more than **50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the units conduct dangerous voltage.



#### High electrical voltage! Danger to life, electric shock and severe bodily injury!

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on electrical power installations.
- Before switching on the device, the equipment grounding conductor must have been permanently connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- For electrical drive and filter components, observe the following:  
Wait **30 minutes** after switching off power to **allow capacitors to discharge** before beginning to work. Measure the electrical 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 device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.



For electrical drive and filter components with voltages of **more than 50 volts**, observe the following additional safety instructions.

**DANGER****High housing voltage and high leakage current! Risk of death or bodily injury by electric shock!**

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the devices must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 mm<sup>2</sup> for this equipment grounding connection!
- Before commissioning, also in trial runs, always attach the equipment grounding conductor or connect to the ground wire. Otherwise, high voltages may occur at the housing causing electric

### 3.2.2 Protection Against Electric Shock by Protective Extra-Low Voltage

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

All connections and terminals with voltages between 5 and 50 volts at Rexroth products are PELV systems<sup>1</sup>. It is therefore allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections and terminals.

**WARNING****High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!**

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g. the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV<sup>1</sup>.

### 3.2.3 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of 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

These errors 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 harm and/or 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.

1) "Protective Extra-Low Voltage"



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

- For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.  
They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

### **To avoid accidents, bodily harm and/or material damage**

- 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.
  - Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before commissioning. Do not operate the device if the emergency stop switch is not working.
  - Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
  - Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
  - Additionally 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 or
    - ensuring sufficient equilibration of the vertical axes.
  - The standard equipment motor brake or an external brake controlled 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 devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial commissioning. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.
-

### 3.2.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those 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 and metal implants are not permitted to enter following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of present or future implanted heart pacemakers differs greatly so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

### 3.2.5 Protection Against Contact with Hot Parts



**CAUTION**

Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to the operating conditions, temperatures can be **higher than 60 °C, 140 °F** during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes!** Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

### 3.2.6 Protection During Handling and Mounting

In unfavorable conditions, handling and mounting certain parts and components in an improper way can cause injuries.



---

**Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!**

- Observe the general construction and safety regulations on handling and mounting.
  - Use suitable devices for mounting and transport.
  - Avoid jamming and bruising by appropriate measures.
  - Always use suitable tools. Use special tools if specified.
  - Use lifting equipment and tools in the correct manner.
  - If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
  - Do not stand under hanging loads.
  - Immediately clean up any spilled liquids because of the danger of skidding.
- 

### 3.2.7 Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or material damage.



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**Risk of injury by improper handling!**

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
  - Do not recharge the batteries as this may cause leakage or explosion.
  - Do not throw batteries into open flames.
  - Do not dismantle batteries.
  - When replacing the battery/batteries do not damage electrical parts installed in the devices.
  - Only use the battery types specified by the manufacturer.
- 



Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.

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Safety Instructions for Electric Drives and Controls

### 3.2.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricating agents. Improper handling of the connected supply systems, supply lines or connections can cause injuries or material damage.



**CAUTION**

---

#### **Risk of injury by improper handling of pressurized lines!**

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
  - Observe the respective manufacturer's operating instructions.
  - Before dismounting lines, relieve pressure and empty medium.
  - Use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
  - Immediately clean up any spilled liquids from the floor.
- 



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Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separately from other waste. Observe the local regulations in the country of assembly.

---

Connecting the Voltage Supply and Bus Lines, and Setting the Address

## 4 Connecting the Voltage Supply and Bus Lines, and Setting the Address

### 4.1 Power supply $U_L$



For additional information on the voltage supplies, please refer to the DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P Fieldline application description.

#### DeviceNet devices

For DeviceNet, the voltage  $U_L$  is always transferred via the bus cable and supplied at the BUS IN connection via V+/V- and then forwarded via BUS OUT. The supply of the voltage  $U_L$  via the  $U_{LS}$  connection is used exclusively for test purposes for FLS.

Advantage: If the voltage  $U_L$ , which is supplied via the bus cable, is no longer sufficient, the communications power is taken from the additional supply.

However, this additional supply is not an extra power source. It is not available at the BUS OUT connection. If other devices also require this additional voltage, it must be forwarded via the  $U_{LS}$  OUT connection.



CAUTION

The current carrying capacity of the M12 connectors is 4 A per contact. Ensure that this value is not exceeded. Please note that the connection for the outgoing supply voltage is not monitored for overload. If the permissible current carrying capacity is exceeded, this may lead to connector damage.

### 4.2 Connection Options for the Bus



In the following, a cable that conforms to the fieldbus specification must be used to connect.

Use shielded M12 connectors to connect the bus. The thread of the M12 connector and, if required, pin 1 are used to connect the shielding to functional earth ground.

Bosch Rexroth recommends the use of pre-assembled bus cables (see [Chapter "Ordering Information" on page 37](#)).



If you assemble the cables yourself, please follow the instructions provided in the DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P Fieldline application description and the device-specific data sheet.

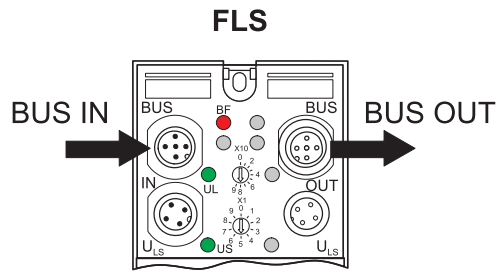
For DeviceNet there are two ways of connecting the bus:

1. Connect the incoming DeviceNet to the BUS IN socket and the outgoing DeviceNet to the BUS OUT socket.
2. Connect DeviceNet via a T-piece.

Both connection options can be used without restriction.

Connecting the Voltage Supply and Bus Lines, and Setting the Address

**BUS IN/BUS OUT**



7492A002

Fig.4-1 Bus connection via BUS IN/BUS OUT

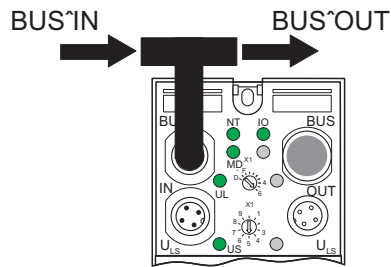
Accessories: Two M12 connectors.

Advantage: No additional accessories required.

Disadvantages: When the bus is running, no devices can be removed or added without physical interruption.

**T-piece** If a T-piece is used to connect the bus, this must be connected at the **BUS IN** connection.

To ensure IP65/IP67 protection, cover the unused BUS OUT connection with a protective cap.



6853 3

Fig.4-2 Bus connection via T-piece

Accessories: Two M12 connectors, one T-piece, one protective cap

Advantage: When the bus is running, devices can be removed or added without physical interruption. To do this, the master and the control program must support the removal and addition of devices.

Disadvantage: Additional accessories required.

Connecting the Voltage Supply and Bus Lines, and Setting the Address

## 4.3 Connecting the Bus and Termination Resistor

For a Fieldline stand-alone device that is followed by another device, the incoming and outgoing bus must be connected. For the last device of a trunk line, only the incoming bus is connected. A termination resistor is placed in the connection for the outgoing bus.

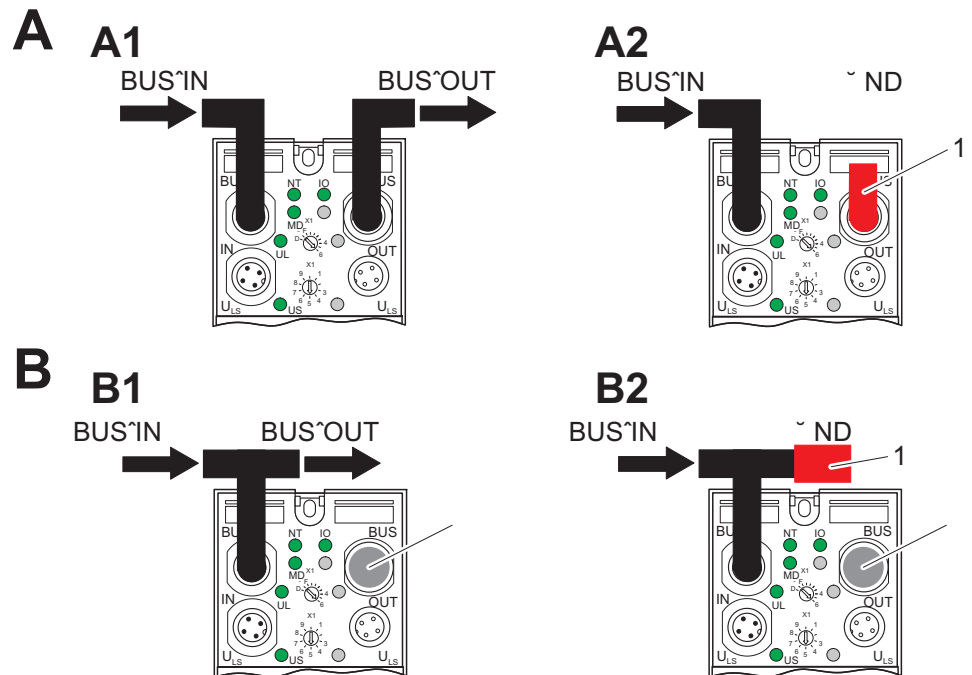


Fig.4-3 Options for connecting the bus and termination resistor

6853 9

- A** Connection via BUS IN/BUS OUT
- A1** Incoming and outgoing bus
- A2** Incoming bus and termination resistor
- B** Connection via T-piece
- B1** Incoming and outgoing bus
- B2** Incoming bus and termination resistor
- 1** Termination resistor
- 2** Cover for unused connection

Connecting the Voltage Supply and Bus Lines, and Setting the Address

## 4.4 Connecting the Bus

Connect the bus via BUS IN/BUS OUT or via a T-piece (see [Chapter "Connection Options for the Bus" on page 17](#)).

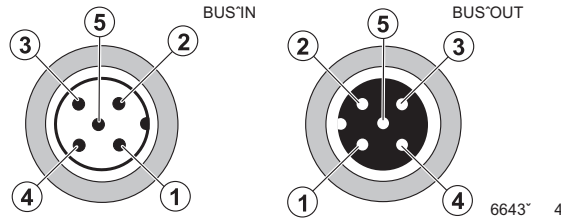


Fig. 4-4 DeviceNet pin assignment

Pin	IN	OUT	Remark
1	CAN_SHLD	CAN_SHLD	Shield (optional)
2	V+	V+	Communications power
3	V-	V-	Reference potential GND
4	CAN_High	CAN_High	With reference to GND
5	CAN_Low	CAN_Low	With reference to GND



The thread and, if required, pin 1 are used for shielding.

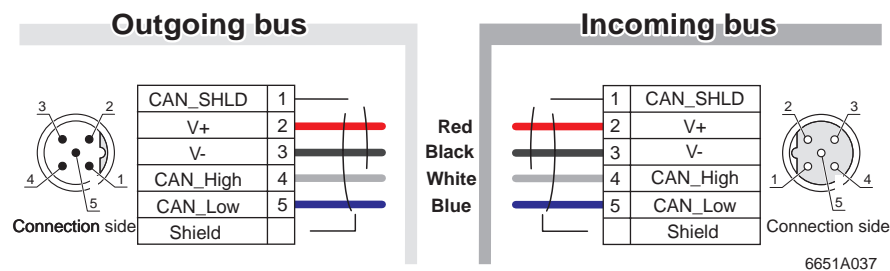


Fig. 4-5 Connector pin assignment of the M12 connector

DeviceNet cables available on the market have 2 twisted wire pairs, which are protected by a braided shield and foil.

### Encoding of the connections

For DeviceNet devices, the connections for the bus and the connections for the supply voltage are A-encoded. Mechanical protection against incorrect connection is therefore not provided. If the connections are mixed up, the internal wiring protects the device against damage, however it cannot be guaranteed that the device will function correctly.

The connections for the local bus are B-encoded.

Connecting the Voltage Supply and Bus Lines, and Setting the Address

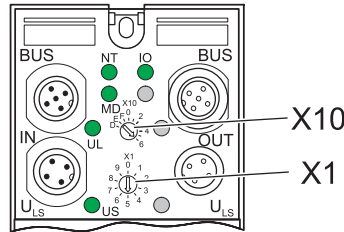
## 4.5 Setting the Address and Transmission Speed

The Fieldline devices for DeviceNet have an automatic baud rate detection function. However, if there is no communication between the bus and the device, the transmission speed (baud rate) can also be set manually using the rotary encoding switches.

The address of a device (device ID) is also set using the rotary encoding switches.

The X10 rotary encoding switch is used to specify the tens and the X1 switch is used to specify the units of the device ID.

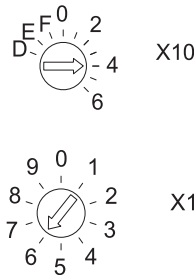
FLS



7492a011

Fig.4-6 Rotary encoding switches

**Example:** Setting address 46:  
FLS



7942A005

Fig.4-7 Address 46



Adjust the rotary encoding switches using a suitable screwdriver (blade width 3.5 mm). Use of an unsuitable tool may damage the rotary encoding switches.

Connecting the Voltage Supply and Bus Lines, and Setting the Address

### 4.5.1 Setting the Device ID (MAC ID)



**Set the device ID (MAC ID = Media Access Control Identifier) immediately after installation and before connecting the supply voltages.**



**The device ID is set in the range from 0 to 63 using the two rotary encoding switches. Device ID 63 is assigned to all values outside this value range.**

The device ID set is read upon system startup and accepted in the device settings.



Changing the switch positions during operation has no effect on the address settings. A new address value is only applied on device power up. Dynamic address changing via is not supported.

### 4.5.2 Setting the Baud Rate Manually



The baud rate is set automatically. If there is no communication between the bus and the device, you must set the baud rate manually. The baud rate is stored in the non-volatile memory of the device and read upon system startup. If the baud rate is changed manually during operation, the change only takes effect upon the next system initialization (carried out by the fieldbus master or by switching the device off and on again).

**FLS** To set the baud rate, proceed as follows:

- Set the X10 rotary encoding switch to position "D".
- Wait for five seconds.
- The "IO" LED starts to flash red and green. The "MD" LED goes out.
- If the switch positions are not changed within the five seconds, the value of the X1 rotary encoding switch is directly latched in a buffer.
- Select the desired setting using the X1 rotary encoding switch:

0:	125 kbaud
1:	250 kbaud
2:	500 kbaud
≥3:	Autobaud detection; data transmission speed is automatically determined
- Wait for five seconds.
- The "MD" LED starts to flash green: The value has been recognized as valid and has been latched.

## Connecting the Voltage Supply and Bus Lines, and Setting the Address



When autobaud detection is active, the "IO" LED flashes red and green at different rates.

---

- Set the X10 rotary encoding switch to position "E".
  - Wait for five seconds.
  - The "MD" LED lights up green and thus indicates the valid latching of data in the non-volatile memory.
  - The baud rate is programmed.
  - Set the X10 rotary encoding switch to position "F".
  - Wait for five seconds.
  - The "IO" and "MD" LEDs indicate the same states as before setting the baud rate.
  - Programming is complete.
- 



The stored parameterization will only take effect upon a system restart.

---

Programming can be stopped at any time by setting the X10 rotary encoding switch to position "F".

The programming mode is automatically exited after ten minutes if the rotary encoding switch positions are not changed in this time. In this case the device will not store any data.



**CAUTION**

**Set the original device ID again.**

---



The order of settings for the X10 rotary encoding switch during programming can be remembered easily as follows: "D" like "Do", "E" like "Enter", "F" like "Finished".

---

Connecting the Voltage Supply and Bus Lines, and Setting the Address

## 5 Configuration and Startup

### 5.1 Configuring the DeviceNet System

To configure your system, proceed as follows:

- Describe and define the task
  - Specify the device range for the I/O devices
  - Specify the type and number of input and output signals
- Select the devices required
  - Specify the devices to be installed according to the input and output signals
- Considering the system limits
  - Take into account the basic network specifications (see [Fig.1-2 on page 3](#))
- Select the power supply
  - Please refer to the information on the power supply in the DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P application description.
  - The selection of suitable power supplies always depends on the individual system. The following criteria should always be met for the 24 V DC voltage supply:
    - Nominal value: 24 V DC
    - Tolerance: -15%/+20% (according to EN 61131-2)
    - Ripple:  $\pm 5\%$
    - Permissible range: 19.2 V to 30 V (ripple included)  
11 V to 30 V  
(communications power V+, V-)
- Select DeviceNet cables



For interference-free transmission, Bosch Rexroth recommends that you use shielded pre-assembled cables and shielded configurable connectors.

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- Select the type of connections for the cables to the devices (BUS IN/BUS OUT or T-pieces, see [Chapter "Connecting the Bus" on page 20](#))

## 5.2 Installation



CAUTION

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**Disconnect the power supply before installing the devices.**

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- Installing devices  
See DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P application description
- Connecting the bus  
See [Chapter "Connecting the Bus" on page 20](#)
- Installing mains termination resistors  
See [Chapter "Connecting the Bus and Termination Resistor" on page 19](#).
- Setting the address  
See [Chapter "Setting the Device ID \(MAC ID\)" on page 22](#).
- Connecting the supply voltage  
See [Chapter "Power supply UL" on page 17](#) and  
DOK-CONTRL-FLSYSINS\*\*\*-AW..-EN-P application description.

## 5.3 Configuration and startup

DeviceNet can be configured, for example, using a suitable configuration software. Please refer to the relevant documentation for this software for the configuration and startup of Fieldline devices.

### 5.3.1 Requirements for Configuration and Startup

- DeviceNet network is installed
- Termination resistors are specified
- DeviceNet addresses are set on the devices

### 5.3.2 EDS File

The characteristic communication features of a DeviceNet device are defined in the form of an electronic data sheet (ESD). The EDS file for the Fieldline devices can be downloaded from the Internet at [www.boschrexroth.com](http://www.boschrexroth.com).

The EDS file is the software interface between the DeviceNet device and a software package for DeviceNet configuration software.

### 5.3.3 Checking the Address

In the dialog box that appears in the configuration software, check the DeviceNet address of the device, and, if necessary, modify it according to the application.

## 5.4 General information



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The general requirements of DeviceNet also apply to Fieldline devices. Please refer to the DeviceNet specification for these requirements, as they are not listed in this application description.

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<b>Address (Device ID; MAC ID)</b>	Fieldline devices in DeviceNet must use predefined master/slave connections to exchange data. Therefore, the MAC address must be set for every Fieldline device before startup using the rotary encoding switches (MAC ID = Media Access Control Identifier) (see <a href="#">Chapter "Setting the Address and Transmission Speed" on page 21</a> ).
<b>Baud Rate</b>	The baud rate can be set automatically or manually (see <a href="#">Chapter "Setting the Address and Transmission Speed" on page 21</a> ).
<b>Data objects</b>	The individual data objects are embedded in the object structure of the fieldbus software. This is also where the standard I/O objects are mapped and read.
<b>Device classes</b>	In addition to the device classes specified by DeviceNet, which must be followed, device-specific classes have been implemented for Fieldline devices.

## Configuration and Startup

## 6 Messages, Services, and Classes

### 6.1 DeviceNet Messages

Fieldline devices do not support UCMM connections or the "Offline Connection Set".

### 6.2 DeviceNet Services

Fieldline devices support the following services:

Service code	Name
05 <sub>hex</sub>	Reset
0E <sub>hex</sub>	Get_Attribute_Single
10 <sub>hex</sub>	Set_Attribute_Single

Fig.6-1 DeviceNet services

### 6.3 DeviceNet Classes

With DeviceNet, protocol processing is object-oriented. Each network node is represented as a group of objects. The key terms used in this section are explained below:

- Class** A class describes the properties of an object. These properties are the services, attributes, and I/O data used in the class.
- Instance** When an instance is generated from a class, an object of this class then exists. The services in this class can therefore be used.
- Attribute** Attributes are used to configure classes and instances. Examples of attributes include configuration parameters, I/O data, and information data.
- Service** Services for specific objects can be requested via explicit messaging connections. There are elementary services such as reading and writing attributes as well as object-specific services, which can be defined by the user.
- Object** There are two types of object. Communication objects manage the exchange of messages and application objects contain product-specific properties.

#### Fieldline Devices Support the Following Standard Classes:

Service code	Name
1	Identity Object
2	Message Router
3	DeviceNet Object
4	Assembly Object
5	Connection Object

Fig.6-2 DeviceNet standard classes

The attributes implemented for the individual classes are briefly described below. For more detailed information, please refer to the ODVA DeviceNet specification (<http://www.odva.org>).

Messages, Services, and Classes

### 6.3.1 Attributes of the Identity Object Class (01<sub>dec</sub>, 0x01<sub>hex</sub>)

Attribute	R/W	Attribute Name	Type	Short Description
1	R	Vendor	BYTE	Manufacturer ID 0x011F (287 <sub>dec</sub> )
2	R	Product type	BYTE	Device type (7 = General Purpose Discrete I/O)
3	R	Product code	BYTE	Product code
4	R	Revision (Major, Minor)	CHAR ARRAY	Byte 0      Main revision Byte 1      Subrevision
5	R	Status	WORD	Bits 0 to 3    Reserved Bit 4           UL Bit 5           P24V Bit 6           VINI Bit 7           US Bit 8           Diag1 Bit 9           Unknown device type Bit 10          Error handling active Bit 11          Not configured or unknown I/O Bits 12 to 15   Reserved
6	R	Serial number	DWORD	Serial number of the device
7	R	Name (length, name)	CHAR ARRAY	Byte 0      20 <sub>hex</sub> (name length) Bytes 1 to 32   Device name, as configured at the factory.

Fig.6-3 Attributes of the Identity Object class

R/W   Read/write      Read and write access

R      Read only        Read access only

### 6.3.2 Attributes of the DeviceNet Object Class (3<sub>dec</sub>, 0x03<sub>hex</sub>)

Attribute	R/W	Attribute Name	Type	Short Description
1	R	MACID	BYTE	The device address is set using rotary encoding switches.
2	R	Baud Rate	BYTE	The baud rate is set using rotary encoding switches.
3	R/W	BusOff Interrupt	BOOL	BOI action: 0              Chip remains in the "OFF" state 1              CAN interface is reset
4	R/W	Bus Off Counter	BYTE	During write access this counter is always set to "0", regardless of the value being written.
5	R	ChoiceByte Master NodeAddr	BYTE ARRAY	Byte 0      ChoiceByte Byte 1      Master NodeAddr

Fig.6-4 Attributes of the DeviceNet Class

R/W   Read/write      Read and write access

R      Read only        Read access only

### 6.3.3 Attributes of the Connection Object Class (05<sub>dec</sub>, 0x05<sub>hex</sub>)

The Connection Object class describes the individual connection types.  
Fig.6-5 has been taken from the ODVA specification for DeviceNet.

Attribute	Requirement	Attribute Name	Type	Short description (According to ODVA)	Short description (German)
1	Required	State	USINT	State of the object	Objektstatus
2	Required	instance_type	USINT	Indicates either I/O or messaging connection	Zeigt entweder Peripherie- oder Datentransferanschluss an
3	Required	transportClass_trigger	BYTE	Defines behavior of the connection	Definiert das Verhalten der Verbindung
4	Required	produced_connection_id	UINT	Placed in CAN identifier field when data transmitted via connection	Im CAN Identifier Field platziert, sobald über den Anschluss Daten übertragen werden
5	Required	consumed_connection_id	UINT	CAN identifier field value that indicates message to be received	Wert des CAN Identifier Fields, der den Empfang einer Meldung ermöglicht
6	Required	initial_comm_characteristics	BYTE	Defines the message group(s) across which productions and consumptions associated with this connection occur	Definiert die Meldungsgruppe(n), über die Sendung und Empfang in Verbindung mit diesem Anschluss erfolgen
7	Required	produced_connection_size	UINT	Maximum number of bytes transmitted via this connection	Maximale Anzahl der über diesen Anschluss übertragenen Bytes
8	Required	consumed_connection_size	UINT	Maximum number of bytes received via this connection	Maximale Anzahl der über diesen Anschluss empfangenen Bytes
9	Required	expected_packet_rate	UINT	Defines timing associated with this connection	Definiert Timing in Verbindung mit diesem Anschluss
10, 11	N/A	N/A	N/A	Not used. These attribute IDs are obsolete and are no longer defined for a Connection Object	Nicht belegt. Diese Attribut-IDs sind veraltet und sind nicht mehr für ein Anschlussobjekt definiert
12	Required	watchdog_timeout_action	USINT	Defines how to handle inactivity/watchdog timeouts	Definiert den Umgang mit Inaktivität/ Watchdog Timeouts
13	Required	produced_connection_path_length	UINT	Number of bytes in the produced_connection_path attribute	Anzahl der Bytes im Attribut „produced_connection_path“
14	Required	produced_connection_path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this Connection Object.	Gibt die Anwendungsobjekte an, deren Daten von diesem Anschlussobjekt erstellt werden sollen

## Messages, Services, and Classes

Attribute	Requirement	Attribute Name	Type	Short description (According to ODVA)	Short description (German)
15	Required	consumed_connection_path_length	UINT	Number of bytes in the consumed_connection_path attribute	Anzahl der Bytes im Attribut „consumed_connection_path“
16	Required	consumed_connection_path	Array of USINT	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object	Gibt die Anwendungsobjekte an, die die von diesem Anschlussobjekt konsumierte Daten erhalten sollen
17	Conditional	production_inhibit_time	UINT	Defines minimum time between new data production. This attribute is required for I/O client connections.	Definiert die kürzeste Zeitspanne bis zur erneuten Datenerzeugung. Dieses Attribut wird für Peripherie-Client-Verbindungen benötigt.

*Fig.6-5 Attributes of the Connection Object class*

Instance 1 of the object describes explicit messaging connections.

Instance 2 of the object describes poll connections.

Instance 3 of the object describes strobe connections.

Instance 4 of the object describes COS/CYCLIC connections.

The devices do not support other connection types.

## 6.4 Individually Implemented Classes

The **8** (Discrete Input Object) and **9** (Discrete Output Object) object classes are implemented, which describe inputs and outputs. The instance of the object corresponds to the appropriate I/O channel (1 to 8 for the DI 8 or DO 8 device; 1 to 4 for the DIO 4/4 device).

A user-specific class **100** is also implemented with the following attributes:

- Output port (attribute 101, 1 byte contains all 8 bits)
- Rotary encoding switch (attribute 102, 1 byte)
- Diagnostic port (attribute 103, contains the value of the diagnostic port, port 6)

### 6.4.1 Class 8 Discrete Input Point (08<sub>dec</sub>, 0x08<sub>hex</sub>)

Each instance of this class describes an input channel of the device.

For **DIO devices** this class contains input channel values in instances 1 to 4. In instances 5 to 8, the class contains the latest state of the output channels (the value, which is output after taking into consideration any error handling).

For **DI devices**, the class contains the read values and any input channel values modified after error handling.

For **DO devices**, any output values modified after error handling are read back.

Maximum number of instances = 8 (number of device channels).

Attribute	Data Type	Meaning
3	BOOL	Value of the input channel or output channel, after taking into consideration any error handling (ON = 1; OFF = 0)
4	BOOL	Status: Error status of the channel (0 = No error, 1 = error)
5	BOOL	Fault state: 1: No specific value in the event of an error; maintain value 0: In the event of an error, a specific value (substitute value) is taken from attribute 6.
6	BOOL	Fault value: Value, which is used in the event of an error if the fault state (attribute 5) equals 1.

Fig.6-6 Class 8 attributes

Messages, Services, and Classes

## 6.4.2 Class 9 Discrete Output Point (09<sub>dec</sub>, 0x09<sub>hex</sub>)

Every instance of this class describes an output channel of the device.

This class is not available for **DI devices**.

For **DO devices**, the class contains the state of the output channel.

For **DIO devices**, only the instances 1 to the maximum number of channels are used to control the output channels. It is possible to access the higher instances, but this has no effect.

Maximum number of instances = number of device channels

Attribute	Data Type	Meaning
3	BOOL	Value of the output channel (ON = 1; OFF = 0)  This value can be written and the outputs are set. During read access the output value is read back.
4	BOOL	Error status of the channel (0 = No error, 1 = Error or alarm)
5	BOOL	Fault state:  1: No specific value in the event of an error; maintain value  0: In the event of an error, a specific value (substitute value) is taken from attribute 6.
6	BOOL	Fault value: Value, which is used in the event of an error if the fault state (attribute 5) equals 1 (substitute value).

Fig.6-7 Class 9 attributes

## 6.4.3 User-Specific Class 100

Class 100 only has one instance.

Attribute	Data Type	Meaning
100	BYTE	Reserved
101	BYTE	Group byte: Outputs 0 to 7
102	BYTE	Hexadecimal value of the two rotary encoding switches (as mapped in the memory):  Bits 0 to 3: MSB (upper part of the value to be set)  Bits 4 to 7: LSB (lower part of the address value to be read)
103	BYTE	Diagnostic data for service
104	BYTE	Device encoding read for service

Fig.6-8 Class 100 attributes

## 6.5 Terms

- Vendor ID** The vendor IDs (manufacturer IDs) are specified and managed by the ODVA. The Bosch Rexroth vendor ID for DeviceNet is 0x011F (287dec).
- Product Type; Device Type** The list of device types is managed by the ODVA. The device type is used to determine the appropriate device profile, which the device uses.
- Product ID; Product Code** The product code is specified by the manufacturer and defines a certain product within a device type; thus a product code usually applies to one or more order numbers. Products must have different product codes if they, for example, differ in terms of their configuration or functions. On the other hand, products that have a different vendor ID may have the same product code.
- Revision** The revision attribute consists of a major revision and a minor revision. It indicates the release status of the relevant device. The major and minor revisions are usually specified in the form of major.minor. Minor revisions must be specified in three digits (if required, with leading zeros). A maximum of 7 bits is available for the major revision.  
Example: 010A<sub>hex</sub>: Major Revision = 1; Minor Revision = 10; the revision is 1.010.
- The major revision should be increased if a significant change is made to the device function. A major revision is essential for modifications, which affect the device configuration options available to the user (and thus the EDS file).
- The minor revision is used to indicate modifications, which do not affect the configuration options available to the user (error removal, labeling, individual hardware components, etc.).

### Data Types

Type	Data Type Meaning
UINT	Unsigned integer (16 bits)
USINT	Unsigned short integer (8 bits)
ARRAY	Array of ...
BYTE	8 bits
WORD	16 bits
DWORD	32 bits

Fig.6-9 Meaning of data types

Messages, Services, and Classes

## 7 Appendix

### 7.1 Ordering Information



The ordering data of all Fieldline devices and the accessories can be found at [www.boschrexroth.com](http://www.boschrexroth.com).

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These include:

- Fieldline devices
- Bus cables
- Shielded bus connectors
- Unshielded connectors
- Other accessories



The documentation for Fieldline devices is available on the Internet at [www.boschrexroth.com](http://www.boschrexroth.com).

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## Appendix

## 8 Disposal and Environmental Protection

### 8.1 Disposal

#### 8.1.1 Products

Our products can be returned to us free of charge for disposal. However, it is a pre-condition that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Bürgermeister-Dr.-Nebel-Straße 2

D-97816 Lohr am Main

#### 8.1.2 Packaging Materials

The packaging materials consist of cardboard, wood and polystyrene. These materials can be easily recycled in any municipal recycling system. For ecological reasons, please refrain from returning the empty packages to us.

### 8.2 Environmental Protection

#### 8.2.1 No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Accordingly, our products will normally not have any negative effect on the environment.

#### 8.2.2 Materials Contained in the Products

##### Electronic devices

Electronic devices mainly contain:

- steel
- aluminium
- copper
- synthetic materials
- electronic components and modules

##### Motors

Motors mainly contain:

- steel
- aluminium
- copper
- brass
- magnetic materials
- electronic components and modules

Disposal and Environmental Protection

### 8.2.3 Recycling

Due to their high content of metal most of the product components can be recycled. In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Metals contained in electric and electronic modules can also be recycled by means of special separation processes. The synthetic materials remaining after these processes can be thermally recycled.

If the products contain batteries or rechargeable batteries, these batteries are to be removed and disposed before they are recycled.

## 9 Service & Support

### 9.1 Helpdesk

Our service helpdesk at our headquarters in Lohr, Germany, will assist you with all kinds of enquiries.

Contact us:

- By phone through the Service Call Entry Center,  
Mo - Fr 7:00 am - 6:00 pm CET  
+49 (0) 9352 40 50 60
- By Fax  
+49 (0) 9352 40 49 41
- By email: [service.svc@boschrexroth.de](mailto:service.svc@boschrexroth.de)

### 9.2 Service Hotline

Out of helpdesk hours please contact our German service department directly:

+49 (0) 171 333 88 26

or

+49 (0) 172 660 04 06

Hotline numbers for other countries can be found in the addresses of each region (see below).

### 9.3 Internet

Additional notes regarding service, maintenance and training, as well as the current addresses of our sales and service offices can be found on

<http://www.boschrexroth.com>

Outwith Germany please contact our sales/service office in your area first.

### 9.4 Helpful Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone / fax numbers and e-mail address so we can contact you in case of questions

Service & Support

Notes

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