Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth Inline Bus Coupler for PROFIBUS-DP
R-IL PB BK DP/V1-PAC

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1 Important Directions for Use

1.1 Appropriate Use

1.1.1 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.

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

1.1.2 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.

1.2 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!

2 Safety Instructions for Electric Drives and Controls

2.1 Safety Instructions - General Information

2.1.1 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.

WARNING

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!

2.1.2 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)

2.1.3 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. 2-1 Hazard classification (according to ANSI Z 535)

2.1.4 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!

2.2 Instructions with Regard to Specific Dangers

2.2.1 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.

DANGER

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^2 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

Safety Instructions for Electric Drives and Controls

2.2.2 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[1]. 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[1].

2.2.3 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"

DANGER

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.

2.2.4 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.

2.2.5 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.

2.2.6 Protection During Handling and Mounting

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

CAUTION

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.

2.2.7 Battery Safety

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

CAUTION

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.

2.2.8 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.

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.

3 The PROFIBUS DP/V1 Bus Coupler

3.1 The PROFIBUS System

PROFIBUS is a serial bus system that transmits data between control systems and spatially distributed I/O terminals, to which sensors and actuators are connected.

PROFIBUS has a star/tree structure. In the PROFIBUS topology the single devices can be differentiated by means of their addressing. The communication profiles determine how the devices transmit their data serially via the bus.

In addition to PROFIBUS-**FMS** (**F**ieldbus **M**essage **S**pecification) and PROFIBUS-**PA** (**P**rocess **A**utomation), PROFIBUS-**DP** (**D**istributed **P**eripherals) is the most frequently used communication profile. PROFIBUS-DP is normally a single master system, i.e., a master controls all devices of a PROFIBUS DP system. PROFIBUS DP is designed for easy transmission of input and output data and specifically tailored for communication between automation systems and distributed I/O devices.

3.2 Properties of the PROFIBUS DP/V1 Bus Coupler

Different versions

This section describes the PROFIBUS-DP/V1 bus coupler, which is a further development of the PROFIBUS DP bus coupler.

The PROFIBUS DP/V1 bus coupler has been extended to include dynamic configuration in firmware B or later.

The R-IL PB BK DP/V1 and R-IL PB BK DP/V1 only differ in the scope of supply. Their function and technical data are identical. Die Artikelvarianten R-IL PB BK DP/V1 und R-IL PB BK DP/V1-PAC unterscheiden sich ausschließlich durch den Lieferumfang. Funktion und technische Daten sind identisch. The product designation R-IL PB BK DP/V1-PAC will be used in the following.

Features

The key features of the PROFIBUS DP/V1 bus coupler are listed below:

- DP/V1 for Class 1 and Class 2 masters
- Acyclic communication with, e.g., V.24 (RS-232) modules also in the process data channel (*)
- I/O terminal parameterization
- Failsafe values
- Various diagnostic formats
- Acknowledgment of I/O errors from the user program (*)
- Adaptation of the high byte/low byte format in 16 and 32-channel input and output terminals to the control system format (*)
- Dynamic configuration

DIP switch 8

DIP switch 8 is particularly important. By default upon delivery, it is in the "OFF" position. This means that the device can directly replace the previous version although it also offers a few new functions, see above (*). However, these functions can only be used on the new devices. When configuring the device, use the "RX0105BA.gsd" GSD and the "R-IL PB BK DP/V1 (DIP 8 = OFF)" device entry in the hardware list.

For the GSD file of the PROFIBUS DP/V1 bus coupler, please visit www.boschrexroth.com.

In the "ON" position, the device offers all the above functions and has a new PROFIBUS ID number.

It should therefore be configured and parameterized using the "RX0106CC.gsd" GSD and the device entry "R-IL PB BK DP/V (DIP8 = ON)" in the hardware list. The stop behavior, which was specified by this switch on the old device, is set in the parameterization.

PROFIBUS	R-IL PB BK DI8 DO4/EF-PAC	R-IL PB BK DI8 DO4-PAC	R-IL PB BK DP/V1-PAC	
			DP/V0 Mode	DP/V1 Mode
Can be replaced with R-IL PB BK	No	No	Yes	No
Support of DP/V0 (cyclic communication)	Process data, 488 bytes, maximum	Process data, 488 bytes, maximum	Process data, 184 bytes, maximum	Process data, 176 bytes, maximum
Number of PCP devices	16, maximum	16, maximum	8, maximum	8, maximum
PDU size	64 bytes	64 bytes	64 bytes	64 bytes
Amount of parameter data	237 bytes	237 bytes	168 bytes	168 bytes
Amount of process data				
IN and OUT	488 bytes, maximum	488 bytes, maximum	184 bytes, maximum	176 bytes, maximum
IN	244 bytes, maximum	244 bytes, maximum	184 bytes, maximum	176 bytes, maximum
OUT	244 bytes, maximum	244 bytes, maximum	184 bytes, maximum	176 bytes, maximum
PCP module operation	Yes	Yes	Yes	Yes
Supports DP/V1 read and write (acyclic communication), Class 1 and Class 2 master	Yes	Yes	No	Yes
Communication with PCP modules via "normal" process data (DP/V0)	Yes	Yes	Yes	Yes
Parameterization of several I/Os via dialog boxes in the configuration tool	Yes	Yes	No	Yes
Specification of failsafe values using the configuration tool	Yes	Yes	No	Yes
Byte rotation for R-IB IL 24 DI 16 and R-IB IL 24 DO 16 for adaptation to the control system format	Yes	Yes	Yes	Yes
Byte rotation for the R-IB IL 24 DI 32 and R-IB IL 24 DO 32	Yes	Yes	Yes	Yes *
Operation in the event of terminal failure on the local bus	Yes	Yes	No	No
Acknowledgment of bus stop, either automatically or via the application program	Yes	Yes	Yes	Yes
Acknowledgment of I/O errors, either automatically or via the application program	Yes	Yes	Yes	Yes

PROFIBUS	R-IL PB BK DI8 DO4/EF-PAC	R-IL PB BK DI8 DO4-PAC	R-IL PB BK DP/V1-PAC	
			DP/V0 Mode	DP/V1 Mode
Channel-specific diagnostics	Yes	Yes	Yes	Yes
Diagnostics in identification format	Yes	Yes	No	Yes
Diagnostics as status PDU	Yes	Yes	No	Yes
Stop behavior can be set via DIP switch	No	No	No	No
Stop behavior can be set via parameter telegram	Yes	Yes	Yes	Yes
Invoke ID transmission	Yes	Yes	Yes	Yes *
Dynamic configuration (reserving I/Os in the PLC for easy expandability)	Yes	Yes	No	Yes *
Freely assignable station ID (2 bytes) for improved identification in the network	No	No	No	Yes *
Specification of failsafe values via the configuration tool	Yes	Yes	No	Yes
Failsafe values even without connection to the PLC	No	No	No	Yes *
Configuration can be stored (additional verification using the latest valid configuration)	No	No	No	Yes *
I & M function	Yes	Yes	No	No
Support of PROFISafe	Yes	No	No	No

Fig.3-1 Overview of firmware functions

Firmware B or later

The PROFIBUS DP/V1 Bus Coupler

The PROFIBUS DP/V1 bus coupler is the link between PROFIBUS DP and the Inline installation system. Inline terminals as well as Fieldline Modular M8 modules can be connected to an existing PROFIBUS DP using the PROFIBUS DP/V1 bus coupler. In this way, all the advantages of the installation system can also be used on .

The intelligent wiring method used in Inline terminals enables the stations to be constructed easily and quickly. There is no need for time-consuming wiring of power supplies. It is only necessary for the power supply units integrated in the PROFIBUS DP/V1 bus coupler to be supplied with 24 V DC on the input side. They generate the operating voltage required for the PROFIBUS DP/V1 bus coupler and the connected I/O terminals.

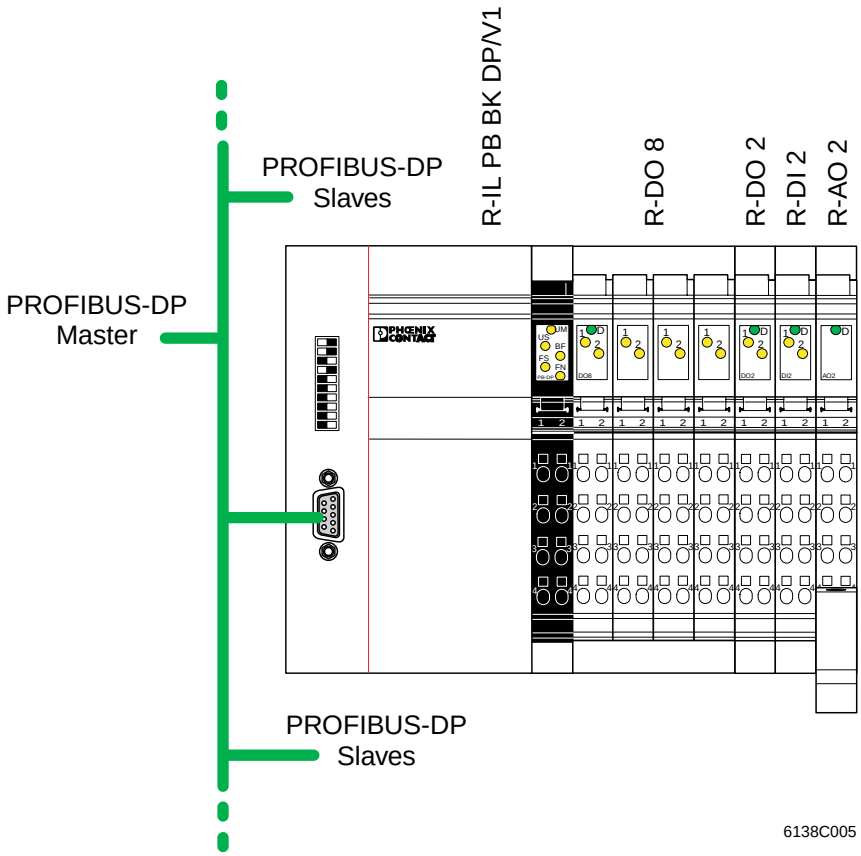


Fig.3-2 Typical PROFIBUS DP/V1 bus coupler station

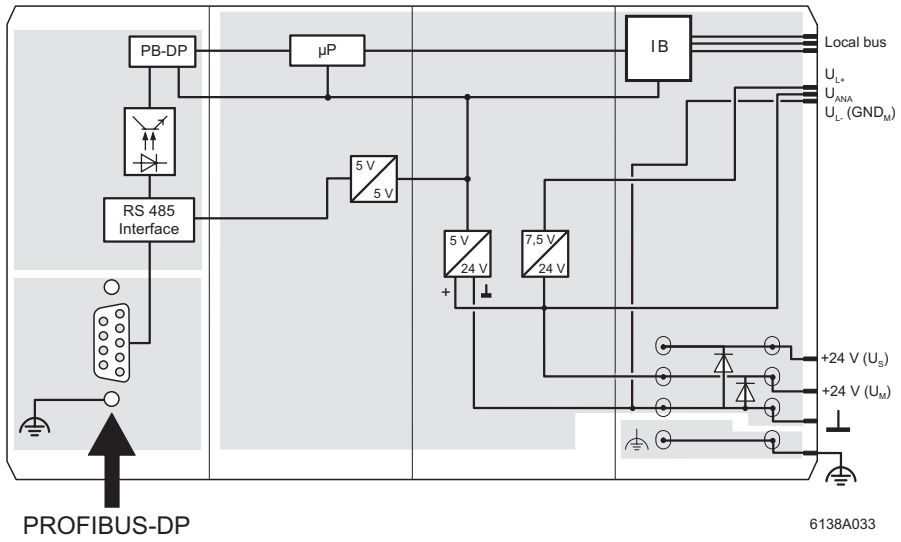


Fig.3-3 Basic circuit diagram of the PROFIBUS DP/V1 bus coupler

Key:

PB-DP	Protocol chip		Electrically isolated area
µP	Microprocessor	RS 485 Interface	RS-485 interface
IB	Protocol chip		Power supply unit with electrical isolation
	Optocoupler		

The PROFIBUS DP/V1 Bus Coupler

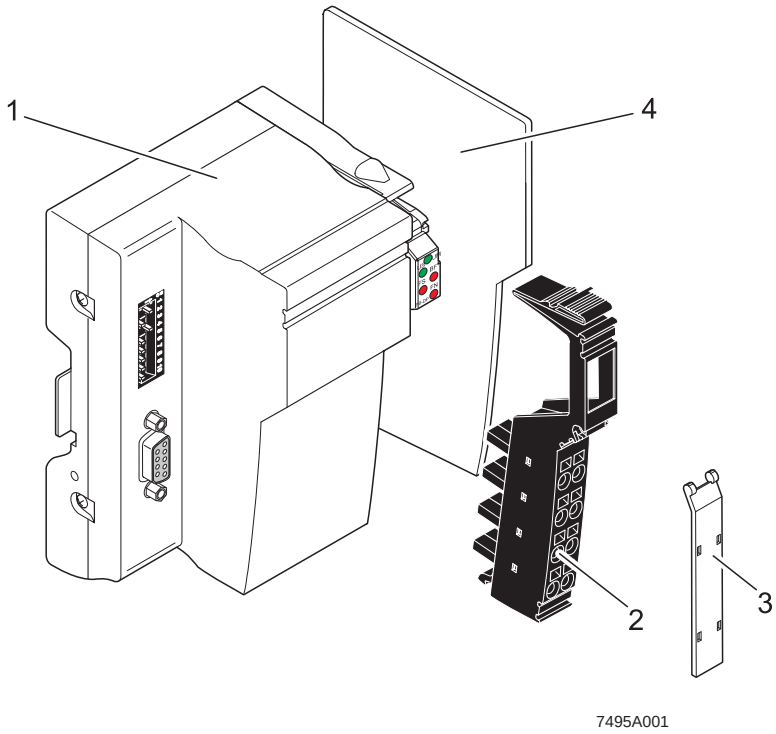


Fig.3-4 The PROFIBUS DP/V1 bus coupler R-IL PB BK DP/V1-PAC

Scope of supply

- PROFIBUS DP/V1 bus coupler (1)
- Power connector (2)
- Labeling field (3)
- End plate (4)

PROFIBUS DP/V1 bus coupler

The PROFIBUS DP/V1 bus coupler configures the station and manages data exchange with a PROFIBUS master. It also provides the current supply for the connected Inline terminals.

End plate

The end plate is supplied as standard with the PROFIBUS DP/V1 bus coupler.

CAUTION

The end plate terminates an Inline station and must be placed after the last terminal of a station. It has no electrical function. It protects the station against ESD pulses and the user against dangerous contact voltages (with 120 V AC/230 V supply).

GSD file

The characteristic communication features of a PROFIBUS DP device are defined in the form of an electronic device data sheet (GSD, device database file).

For the GSD file of the PROFIBUS DP/V1 bus coupler, please visit www.boschrexroth.com.

Data transmission

The PROFIBUS DP/V1 bus coupler is suitable for the connection of copper cables. In order to implement data transmission through fiber optics, additional interface converters must be used.

Potential and data routing

The various potentials and the data signals are distributed within a Rexroth Inline station via a connection that is automatically established when the terminals are properly installed on the DIN rail.

Number of devices

The maximum number of devices that can be connected to a PROFIBUS DP/V1 bus coupler is determined by the following system specifications:

- Up to 63 devices can be connected to a Bus coupler.

DIP switch 8 can be used to change the operating mode.
"DIP switch 8 = ON" corresponds to R-IL PB BK-DP/V1 mode
"DIP switch 8 = OFF" corresponds to R-IL PB BK mode

- In "DIP switch 8 = ON" mode, the sum of all input and output data is 176 bytes per station, plus 168 bytes of parameter data. In "DIP switch 8 = OFF" mode, the sum of the process data is 184 bytes.
- The Bus coupler can supply a maximum current of 2 A at 7.5 V DC (U_L) in the logic area.
- The Bus coupler can supply a maximum current of 0.5 A at 24 V DC (U_{ANA}) to analog modules.
- The maximum current carrying capacity of the potential jumpers is 8 A (total current U_S + U_M, GND).

Operation in "DIP switch 8 = ON" mode (R-IL PB BK-DP/V1 mode) is supported even if the master does not support DP/V1.

Diagnostics

Diagnostics are provided locally by LEDs on the bus coupler, and on the Inline terminals and Fieldline Modular M8 modules. Diagnostic information is also sent to the PROFIBUS master via PROFIBUS DP.

For additional information about the individual circuits within a Rexroth Inline station, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

Observe the current consumption of each device at the individual potential jumpers when configuring a station. This data can be found in the terminal-specific data sheets.

CAUTION

Observe the basic system specifications

The permissible number of devices that can be connected depends on the specific station structure. Always observe the basic system specifications given above.

The PROFIBUS DP/V1 Bus Coupler

Functions

The PROFIBUS DP/V1 bus coupler forms the head of a Rexroth Inline station. It couples Inline terminals and Fielline Modular M8 modules to PROFIBUS DP.

The Bus coupler generates the communications power U_L for the connected devices from the main voltage U_M. It also provides the supply voltage for the connected analog terminals U_{ANA}.

The potential and data routing of the Rexroth Inline station begins at the Bus coupler. Notes on the individual circuits in a bus coupler station can be found in the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

Housing

The PROFIBUS DP/V1 bus coupler is housed in a special Inline housing. The connector and the base can be separated.

For additional information about housing, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

End clamps

Mount end clamps on both sides of the station. The end clamps ensure that the station is correctly mounted. End clamps secure the Inline station on both sides and keep it from moving from side to side on the DIN rail.

Connections

A 9-pos. D-SUB female connector and terminal points for connecting the following cables are available on the PROFIBUS DP/V1 bus coupler:

- PROFIBUS cable for transmitting data to the PROFIBUS system
- Bus coupler supply U_M, which generates the communications power U_L and the supply for the analog modules U_{ANA}
- Supply of the I/O supply for the segment circuit U_S
- Functional earth (FE)

Connection method

Connect cables with diameters of 0.2 mm^2 through 1.5 mm^2 (AWG 24 - 16) to the spring-clamp connection.

Indicators

The diagnostic and status indicators on the PROFIBUS DP/V1 bus coupler and the Rexroth Inline station indicate the station state, the state of the Bus coupler itself, and whether the supply voltages are present.

Interfacing to functional earth ground (FE)

The shield of the PROFIBUS cable is connected with the left FE spring on the bottom side of the PROFIBUS DP/V1 bus coupler and is therefore connected to the DIN rail.

In addition, there is a capacitive connection of U_M, U_S and GND to functional earth ground (FE) in the bus coupler.

Grounding

The PROFIBUS DP/V1 bus coupler is grounded when it is snapped onto the grounded DIN rail via the two FE springs, see also "Connecting Grounding" on page 28.

Required additional grounding

In addition, ground the PROFIBUS DP/V1 bus coupler through the FE connection to ensure reliable grounding of the station even if the FE springs are dirty or damaged. Connect the terminal points for the FE connection with an additional ground.

Electrical isolation

For additional information about the various potential areas of the PROFIBUS DP/V1 bus coupler, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

4 From Configuration to Startup

4.1 Configuring an Inline Station

Configuring an Inline station involves five individual steps:

- Describing and defining the task
- Selecting the required Inline terminals
- Considering the system limits
- Selecting the power supplies
- Selecting the PROFIBUS cable

4.1.1 Describing and Defining the Task

First of all describe your task. For example, itcould be as follows:

A production line is to be extended in a brewery. PROFIBUS technology has been used in the previous automation system and should be used in the new system. However, all extensions should be made using Inline terminals. Specify the number and type of input and output signals.

4.1.2 Selecting the Required Inline Terminals

Select the appropriate Inline terminals for the input and output signals in your project. Not all terminals, which can be operated, are currently implemented in the PROFIBUS DP/V1 bus coupler firmware or listed in the GSD file.

In general, INTERBUS remote bus branch lines are not permitted.

An end plate, which is supplied as standard with the bus coupler, must be placed at the end of the station. The end plate has no electrical function. It protects the station against ESD pulses and the user against dangerous contact voltages. Each station must be secured by an end clamp at the start and the end of the station (see also the corresponding notes in the "Installation Instructions for the Electrical Engineer" supplied with the bus coupler).

If you wish to set up various electrically isolated areas within a station, you must use additional power terminals that are supplied from separate power supplies.

4.1.3 Considering System Restrictions

The maximum number of devices that can be connected to a PROFIBUS DP/V1 bus coupler is determined by the basic system specifications. These specifications can be found in Chapter "Number of devices" on page 19.

Observe the current consumption of each device at the individual potential jumpers when configuring a Rexroth Inline station. This data can be found in the terminal-specific data sheets.

4.1.4 Selecting the Power Supplies

Information on the individual circuits in an Inline station can be found in Chapter "Circuits and Provision of Supply Voltages" on page 30.

The selection of suitable power supplies always depends on the individual system. 24 V DC power supplies should, however, always meet the following criteria:

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

A selection of suitable power supplies can be found at www.boschrexroth.com.

4.1.5 Selecting the PROFIBUS Cable

For interference-free transmission Bosch Rexroth recommends a 2-wire, twisted pair and shielded cable, specified as cable type A in EN 50 170 Part 8-2. Cable type B, which is also described, should no longer be used as it is out of date.

Installing the PROFIBUS cable

When installing the PROFIBUS cable, note the following:

- Do not install signal and bus cables parallel to power cables or in bundles with power cables.
- Install PROFIBUS cables and cables with direct voltages > 60 V and alternating voltages > 25 V in separate bundles or cable ducts.
- Always install signal cables and equipotential bonding together in one channel, along the shortest route.
- Avoid extending the PROFIBUS cables with connectors.
- Do not install PROFIBUS cables in bundles with telephone lines and cables leading to potentially explosive areas.
- As a rule, avoid branch lines.

4.2 Installing and Connecting a PROFIBUS DP/V1 Bus Coupler Station

4.2.1 Safety Instructions

When using Inline terminals in the SELV area:

CAUTION

Disregarding this warning may result in malfunction

Do not replace terminals while power is connected.

Before removing a terminal from or inserting a terminal in the station, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

4.2.2 Installation Notes

With prewired terminals, check that the electronics base, the connector, and the connection cables are securely locked in place.

For information about installing and wiring terminals, sensors, and actuators, please refer to the terminal-specific data sheets and the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description (see "Ordering Data for Documentation" on page 96).

4.2.3 Structure of an Inline Station with a PROFIBUS DP/V1 Bus Coupler

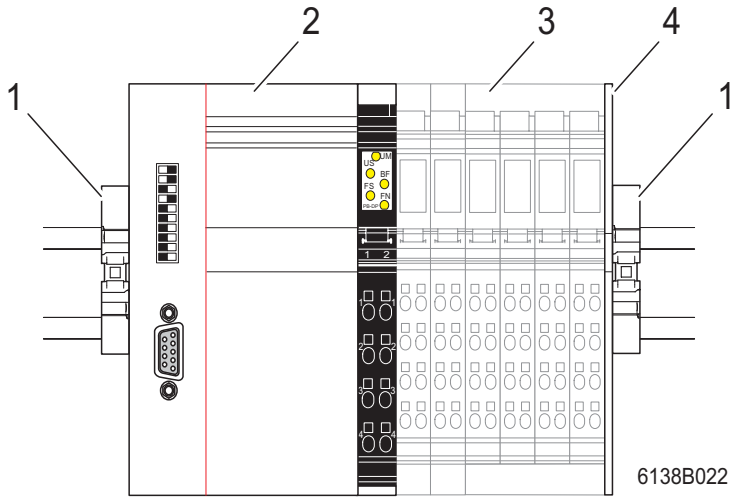


Fig.4-1 Structure of a PROFIBUS DP/V1 bus coupler station

To ensure reliable operation, a PROFIBUS DP/V1 bus coupler station must be constructed from the following elements:

- (1) End clamp
- (2) PROFIBUS DP/V1 bus coupler
- (3) Terminals appropriate to the application
- (4) End plate (supplied as standard with the bus coupler)

For additional information about installation and removal, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

4.2.4 General Tips and Notes on Setting Up the PROFIBUS DP/V1 Bus Coupler Station

Sequence of the Inline terminals

The sequence of the terminals within a station should depend on the current consumption of the I/O from the potential jumpers U_M and U_S.

Please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description for information on the order of the Inline terminals.

Safe grounding

To ensure reliable grounding of the station, ground the bus coupler via the FE connection.

Connect the terminal points for the FE connection with a grounded PE terminal (see also Fig.4-9 on page 28).

4.2.5 Connecting the PROFIBUS DP/V1 Bus Coupler

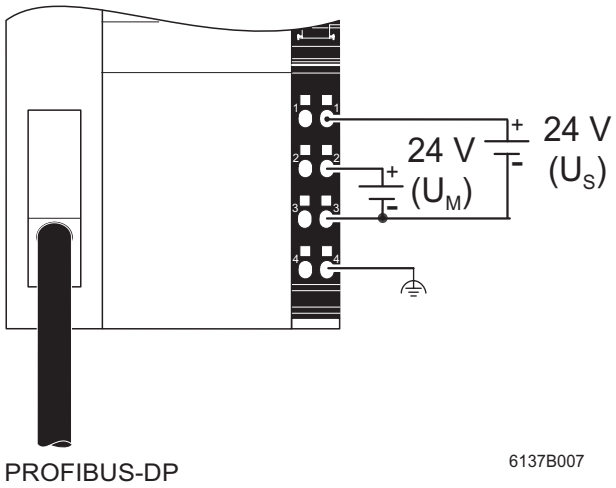


Fig.4-2 Circuit diagram for the PROFIBUS DP/V1 bus coupler

Connect the supply voltages to the bus coupler according to Fig.4-2. For the terminal point assignment for the bus coupler, please refer to Fig.4-3 and Fig.4-4.

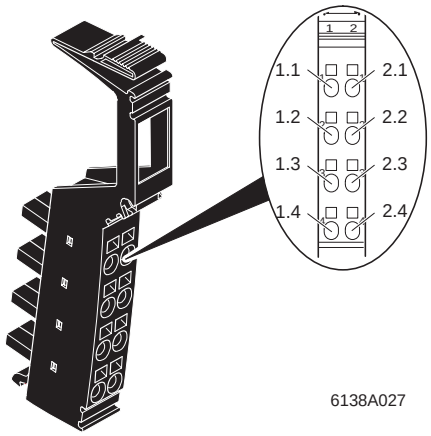


Fig.4-3 PROFIBUS DP/V1 bus coupler terminals

Terminal points	Remark
1.1, 2.1	Segment supply U_S (+24 V DC)
1.2, 2.2	Main supply, bus coupler supply, communications power and interface supply U_M (+24 V DC)
1.3, 2.3	Reference potential GND
1.4, 2.4	Functional earth (FE)

Fig.4-4 Assignment of the bus coupler terminal points

The analog voltage U_{ANA}, which is generated from the main voltage, can carry a current of 0.5 A. The communications power U_L, which is also generated from the main voltage, can carry a current of 2.0 A.

4.2.6 Securing Cables

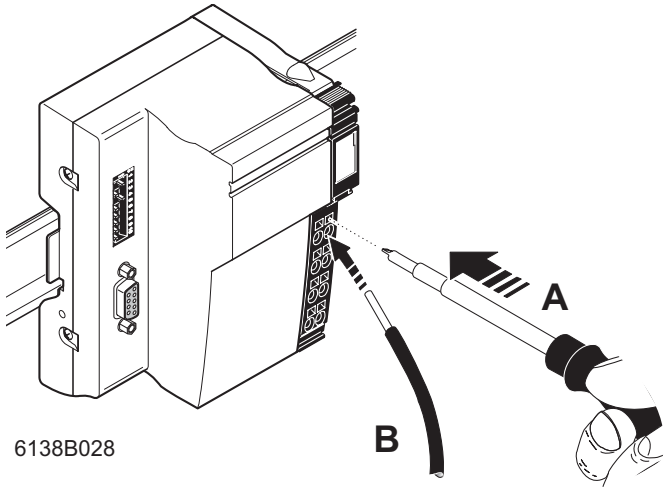


Fig.4-5 Securing cables

- Release the spring by pressing with the screwdriver. (A)
- Insert the cable stripped to 8 mm in the terminal point (B).
- Remove the screwdriver to secure the wire.

4.2.7 Connecting PROFIBUS

When connecting the cables, the following parameters should be maintained:

Parameter	Cable type A
Wave impedance in Ω	135 to 165 (at a frequency of 3 MHz to 20 MHz)
Effective capacitance (pF/m)	≤ 30
Loop resistance (Ω/km)	≤ 110
Conductor diameter (mm)	> 0.64 *)
Conductor cross section (mm^2)	> 0.34 *)

Fig.4-6 PROFIBUS cable parameters

*) Observe the permissible conductor cross-sections of the PROFIBUS connector used.

Switch on the termination resistors on the last device in the PROFIBUS connector.

For higher baud rates (> 1.5 Mbaud) use connectors with integrated series inductance.

Install the cable shield in the PROFIBUS connector. Use a connector with shield connection when installing the sensors.

When mounting the bus coupler in the cabinet, connect the cable shield of the connected PROFIBUS cable with a shield bus directly behind the cable gland via cable clamps. Use an appropriate shield connection clamp for this.

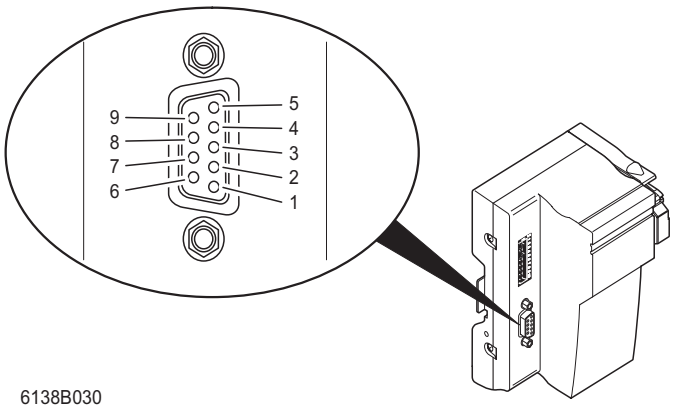


Fig.4-7 Pin assignment of the 9-pos. D-SUB female connector

Connect PROFIBUS to the module via a 9-pos. D-SUB connector according to the PROFIBUS standard.

Pin	Assignment
1	Reserved
2	Reserved
3	RxD/TxD-P (receive/transmit data +), cable B
4	CNTR-P (control signal for repeater), direction control
5	DGND (reference potential to 5 V)
6	VP (supply voltage +5 V for termination resistors)
7	Reserved
8	RxD/TxD-N (receive/transmit data –), cable A
9	Reserved

Fig.4-8 PROFIBUS interface:
Pin assignment of the 9-pos. D-SUB female connector

4.2.8 Connecting Grounding

Bosch Rexroth also recommends securing the bus coupler on the DIN rail with an end clamp over the left-hand housing latch and grounding it via the FE power connector connections (e.g., using the universal ground terminal block, see also Fig.4-9) to ensure reliable grounding even if the DIN rail is dirty or the metal clip damaged.

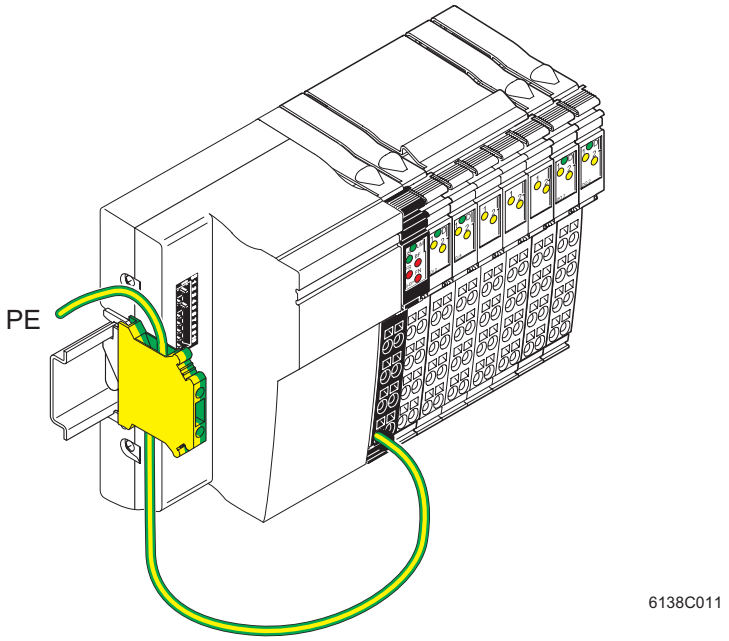


Fig.4-9 Additional grounding of the PROFIBUS DP/V1 bus coupler

For additional information on the grounding concept of a Rexroth Inline station, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

4.3 Supply at the PROFIBUS DP/V1 bus coupler

The supply voltage U_M and the segment voltage U_S **must** be connected to the PROFIBUS DP/V1 bus coupler. The voltages for the logic circuit U_L and the supply of the terminals for analog signals U_{ANA} are internally generated from the main voltage. The segment voltage is used to supply the sensors and actuators.

In the simplest case, the required 24 V supply voltages can be supplied at the bus coupler. The entire station is supplied with power from the bus coupler (see Chapter "Installing and Connecting a PROFIBUS DP/V1 Bus Coupler Station" on page 23). In this case you must provide the following supply voltages:

U_M **24 V main circuit supply**

The main voltage U_M supplies all of the devices connected to the main circuit. It also supplies the bus coupler, communications power U_L, and analog voltage U_{ANA}.

U_S **24 V segment circuit supply**

The segment voltage U_S can be supplied separately to the bus coupler or tapped from the main circuit. Install a jumper or create a segment circuit using a switch to tap the voltage U_S from the main circuit U_M.

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

Electrical isolation: PROFIBUS DP

The PROFIBUS interface is electrically isolated from the bus coupler logic. The PROFIBUS cable shield is directly connected with the functional earth spring (FE spring), which can be found on the left directly under the D-SUB female connector on the bottom of the . This spring is not connected to the second FE spring in the module, which can be found on the lower right, directly under the terminal points. The right spring is directly connected with both terminal points of the power connector. When the two FE springs have been snapped on, they have contact with the DIN rail and are used to discharge interference, rather than serve as a protective earth ground. To ensure effective interference discharge, even for dirty DIN rails, connect functional earth ground directly to terminal points 1.4 or 2.4. This also grounds the PROFIBUS DP bus coupler station sufficiently up to the first segment terminal.

To avoid the flow of compensating currents, which may affect data transmission quality, connect a suitably sized equipotential bonding cable parallel to the PROFIBUS cable.

Electrical isolation: I/O

The bus coupler does not have electrical isolation for the I/O terminal communications power. U_M (24 V), U_L (7.5 V) and U_{ANA} (24 V) are not electrically isolated.

It is only possible to isolate both voltages separately using isolated power options for the main voltage U_M and the I/O voltage U_S on the bus coupler, as both voltages have the same ground reference. To electrically isolate both voltages, a separate power terminal must be used. Only then can it be ensured that the electrical isolation in the input and output terminals cannot be jumpered by a common ground reference.

4.4 Electrical Potential and Data Routing

4.4.1 Circuits and Provision of Supply Voltages

There are several circuits within a Rexroth Inline station. These are automatically created when the terminals are properly installed. The voltages of the different circuits are supplied to the connected terminals via potential jumpers.

An example of the circuits within a station is provided on the next page.

Load capacity of the jumper contacts

Observe the maximum current carrying capacity of the jumper contacts on the side for each circuit.

The connection of the supply voltages is described in Chapter "Selecting the Power Supplies" on page 22.

Please observe the notes on current carrying capacity and voltage connection in the terminal-specific data sheets.

For additional information about the provision of the supply voltage, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

4.4.2 Example of a Circuit Diagram

Fig.4-10 shows a typical circuit diagram. Its segments are described below.

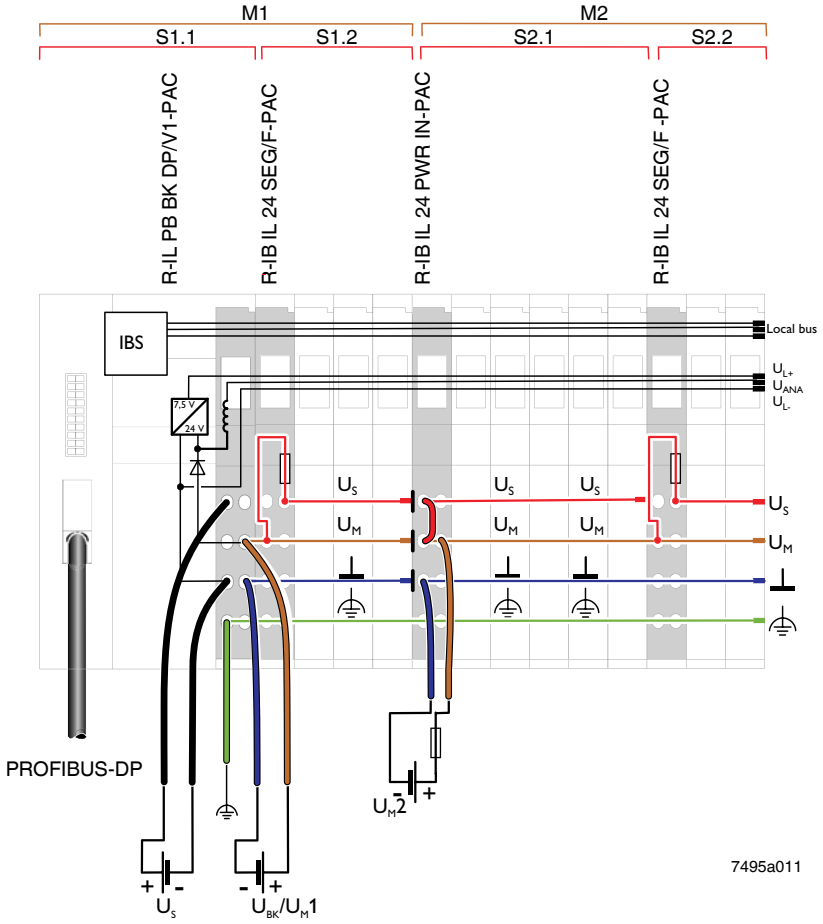


Fig.4-10 Circuit diagram for the PROFIBUS DP/V1 bus coupler

Mx Main circuit (e.g., M1, M2)

Sx,y Segment circuit y in main circuit x (e.g., S2.1, S2.2)

BK PROFIBUS DP bus coupler

U_{BK} Bus coupler supply (supply for bus coupler, generates U_{ANA} and U_L)

U_M Main supply (I/O supply in the main circuit)

U_S Segment supply (I/O supply in the segment circuit)

U_{ANA} I/O supply for analog terminals

U_L Communications power

Main circuit M1 The supply voltage for the bus coupler and the main and segment voltage are supplied in the PROFIBUS DP/V1 bus coupler.

Segment S1.1 The communications power U_L and the supply voltage of the analog terminals U_{ANA} are generated from the PROFIBUS DP/V1 bus coupler supply and led through the entire station.

No terminals are used in segment S1.1.

Segment S1.2 In a segment terminal with fuse, the segment voltage U_S for segment S1.2 is automatically tapped from the main power U_M1. This segment circuit is protected by the internal fuse.

This segment terminal has been specifically used to create a protected segment circuit without the need for additional external fuse protection. If this is not necessary, the terminal does not have to be used. In this case, the connection between U_M and U_S on the bus coupler must be established using a jumper (as shown on the R-IB IL 24 PWR IN-PAC terminal) or a switch (as shown on the R-IB IL 24 SEG-PAC terminal).

Main circuit M2/ segment S2.1 The supply voltage for the following terminals should be supplied separately. A new power terminal (e.g., R-IB IL 24 PRW IN-PAC) is used, which provides the supply voltage U_M2.

Using a jumper, the segment voltage U_S for segment S2.1 is tapped from the main voltage U_M2 at this terminal.

Segment S2.2 See Segment S1.2.

Examples of errors and their effects:

In this example structure,a short circuit in segment S1.2 would not affect the terminals in other segments. The fuse in segment terminal means that only segment S1.2 is switched off.

4.5 Connecting Inline Terminals

Finally, connect all Inline terminals.

For information about the I/O terminals, sensors, and actuators, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description and the terminal-specific data sheets.

4.6 Diagnostics on the PROFIBUS DP/V1 Bus Coupler

Diagnostics is provided locally by LEDs on the bus coupler, as well as on the Inline terminals and FLM branch terminals. Diagnostic information is also sent to the PROFIBUS master via PROFIBUS DP.

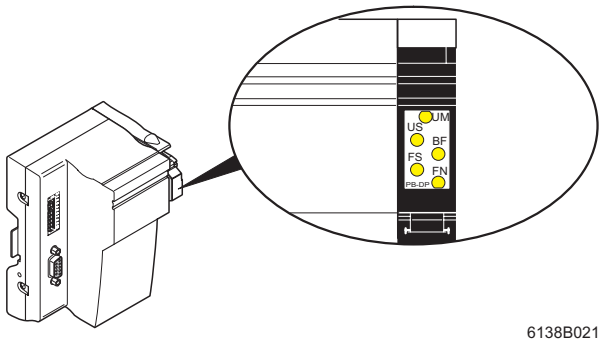


Fig.4-11 LEDs on the PROFIBUS DP/V1 bus coupler

The following states can be read on the PROFIBUS DP/V1 bus coupler:

LED	Color	Meaning	Status	Description of the LED states
UM	Green	**U**Main	ON	24 V main circuit supply present.
			OFF	Main circuit supply not present
US	Green	**U**Segment	ON	24 V segment circuit supply present
			OFF	Segment circuit supply not present
BF	Red	**B**us **F**ault	ON	No communication on PROFIBUS
			OFF	No error
FS	Red	**F**ail **S**afe	Flashing	PLC in STOP state. Failsafe values are output.
			ON	If FS is on, FN indicates the error type.
			OFF	If FS is not on, FN indicates the error number.
FN	Red	**F**ailure **N**umber	Flashing	The number of flashing pulses indicates the error type or the error number, depending on whether FS is on or not.

Fig.4-12 Diagnostic LEDs on the PROFIBUS DP/V1 bus coupler

More detailed information on the various error codes can be found in Chapter "Error Description" on page 97.

4.7 Configuration and Startup of the Inline Station on PROFIBUS

4.7.1 Hardware Configuration

Configure the hardware on the PROFIBUS DP/V1 bus coupler using the 10-pos. DIP switch.

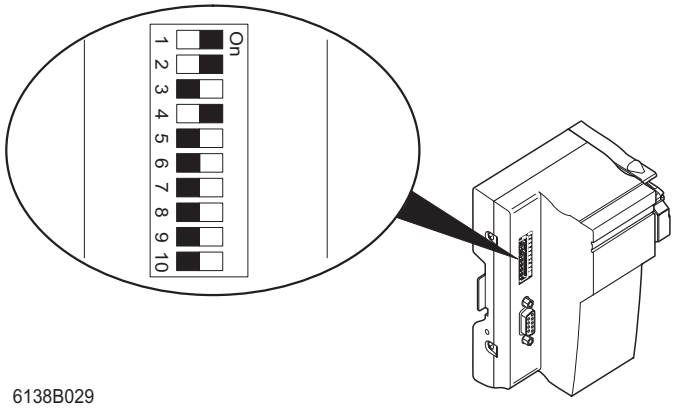


Fig.4-13 DIP switches of the PROFIBUS DP/V1 bus coupler

The PROFIBUS address and other PROFIBUS DP/V1 bus coupler settings can be set using the 10-pos. DIP switch. Fig.4-14

DIP switch	Meaning
1 to 7	PROFIBUS address in binary format (= 0 to 127 in decimal format) Switch 1 defines the least significant bit (2^0), Switch 7 defines the most significant bit (2^6).
8	Operating modes of the Inline station: ON = New mode with DP/V1 support, failsafe values, and parameterization. OFF = Compatible mode (to R-IL PB BK).
9 to 10	Reserved, both switches **must** be in the OFF position

Fig.4-14 DIP switch settings on the bus coupler

4.7.2 Mains Termination Resistors

Since PROFIBUS is a serial bus system in a star/tree structure, the individual branches must be terminated with a termination resistor. The PROFIBUS DP/V1 bus coupler does not have a resistor of this type. For additional information, please refer to your PROFIBUS documents. Bosch Rexroth recommends using a PROFIBUS connector with a connectable termination resistor. See product catalog at www.boschrexroth.com.

4.7.3 Configuration and Startup with Rexroth IndraWorks

You can configure the station after the hardware is installed.

Requirements

- PROFIBUS network is installed
- Termination resistors are specified
- PROFIBUS addresses on the device are set
- Baud rate is specified

Configuration and startup of the station and the remaining system is done with the Rexroth IndraWorks software.

For detailed information on the user interface and operation of IndraWorks, please refer to the "Rexroth IndraWorks Engineering; Operating and Programming Instructions" documentation or the online help.

4.7.4 Selecting Parameters

In this case, parameterization refers to setting the options on an I/O terminal and specifying failsafe values. For example, for an analog input terminal, this involves setting the measuring range: 0 mA to 20 mA or 4 mA to 20 mA. For an analog output terminal, this may involve setting a failsafe value of, e.g., 3 V or "Hold". In addition to the parameters that can be set for I/O terminals, the bus coupler itself also has different setting options.

I/O terminal parameterization is a wide-ranging subject. It ranges from setting the measuring range and the filter depth for analog inputs through selecting temperature sensors to failsafe values for digital and analog outputs.

Function terminals, such as counter and absolute encoder terminals, also have a wide range of different settings, which can be individually adjusted to meet application requirements. For this reason it is also possible to carry out parameterization from the application, e.g., using function blocks.

Typically, parameterization is carried out by the C1 master on slave startup. It can also be carried out by acyclic services.

The format of the parameter telegram is as follows (see also "Format of the Parameter Telegram" on page 102):

Bytes 1 to 7	DP standard
Bytes 8 to 10	DP/V1 standard
Byte 11	Bus coupler parameter byte

Fig.4-15 Format of the parameter telegram

Byte 1	Parameter byte/failsafe value/configuration value/PCP
Byte 2 onwards	Configuration block
	Failsafe value
	PCP block

Fig.4-16 Format of the I/O terminal

Usually, you need only import the GSD file and update the device directory. When a terminal that can be parameterized is selected, the Rexroth IndraWorks user interface displays a dialog box, in which all the relevant parameters can be selected easily. The parameter telegram is then created in the background.

Select the "Parameter Assignment" tab. A module-specific dialog box is opened:

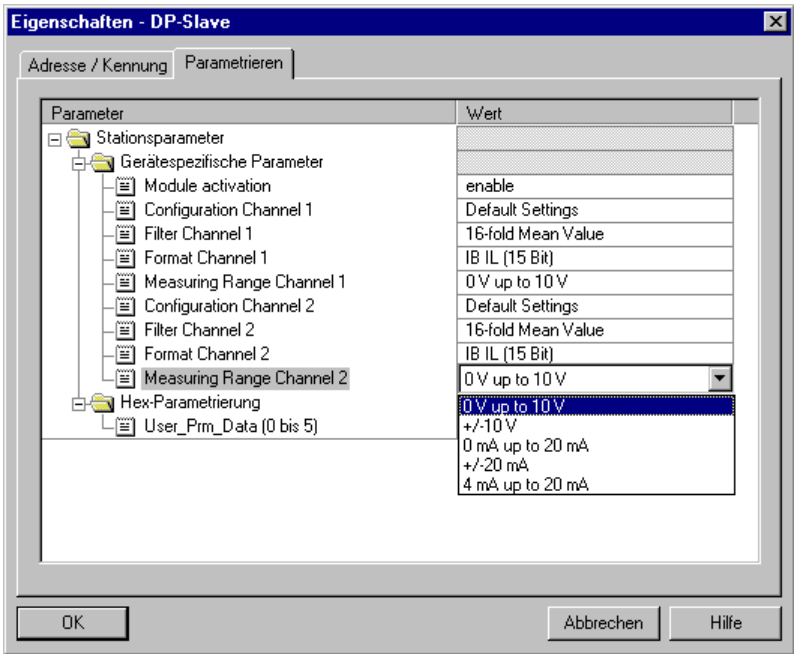


Fig.4-17 Selection using a dialog box for the R-IB IL AI 2/SF

In some tools it is possible to directly specify the hexadecimal encoding of the parameters. In this case, you can work with the detailed description of the parameter telegram (see "Format of the Parameter Telegram" on page 102) and with the GSD file.

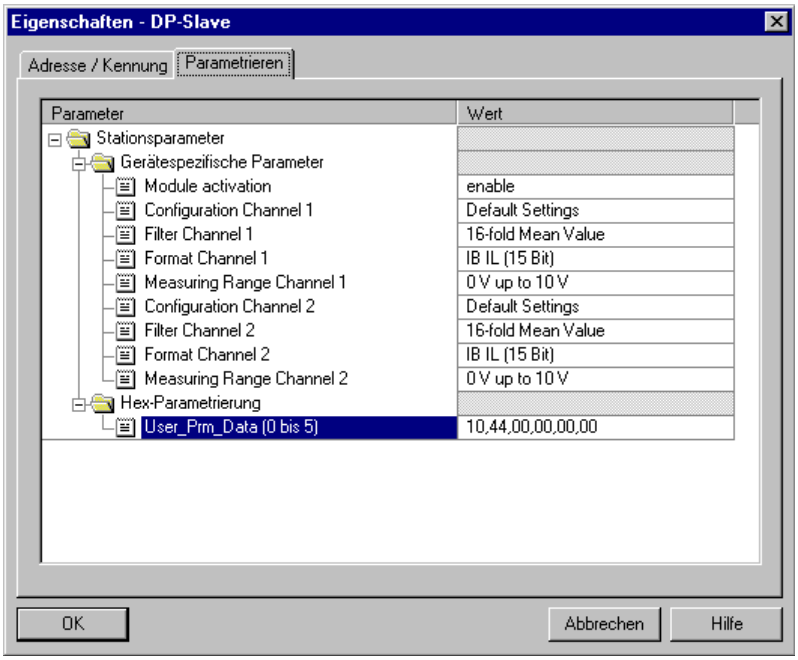


Fig.4-18 Selection in hexadecimal format for the R-IB IL AI 2/SF

The bus coupler also offers the option of setting various parameters.

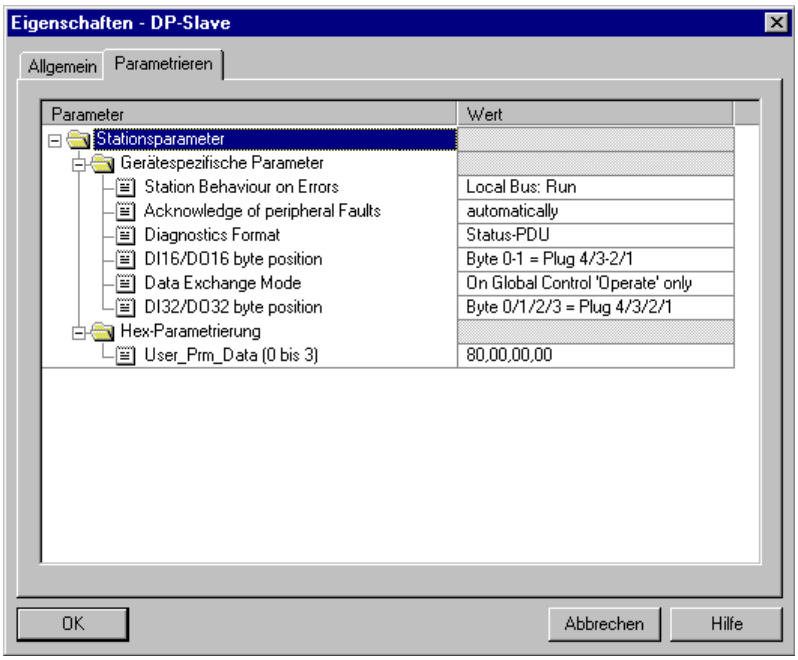


Fig.4-19 Parameters on the bus coupler

4.7.5 Failsafe Values

General Information on Failsafe Values

Failsafe values

Failsafe values are output values, which are used as output data in the event of a communication error (activation of response monitoring) or a PLC stop. Different values may be appropriate, depending on the application. It is therefore possible to select:

(1) Hold last value

(2) Output 0

(3) Use specified value

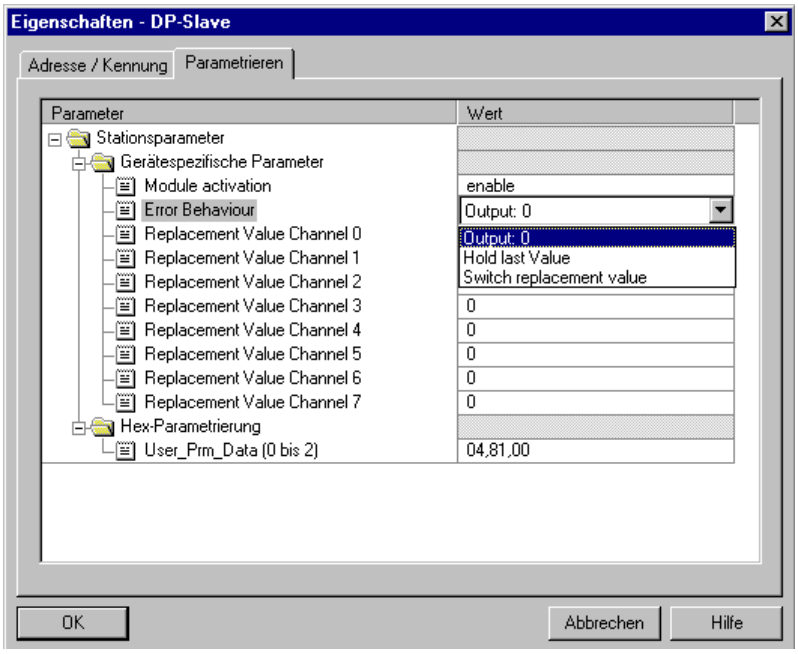


Fig.4-20 Setting the output behavior of a terminal

If option (3) "Use specified value" is selected, then the substitute value, which can be freely selected from within the data area, is used. For a digital output, 0 or 1 can be selected. For an analog terminal, a value between -32768 and 32767 (bipolar) or 0 and 32512 (unipolar) can be selected. Depending on the terminal and the set data area, this value is converted into a current or voltage value.

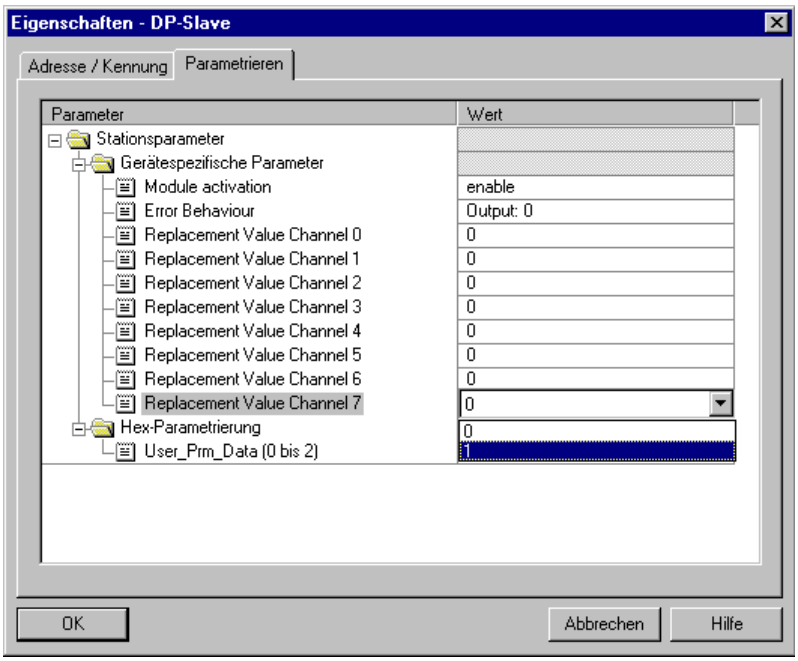


Fig.4-21 Selecting substitute values, 8-channel digital output terminal

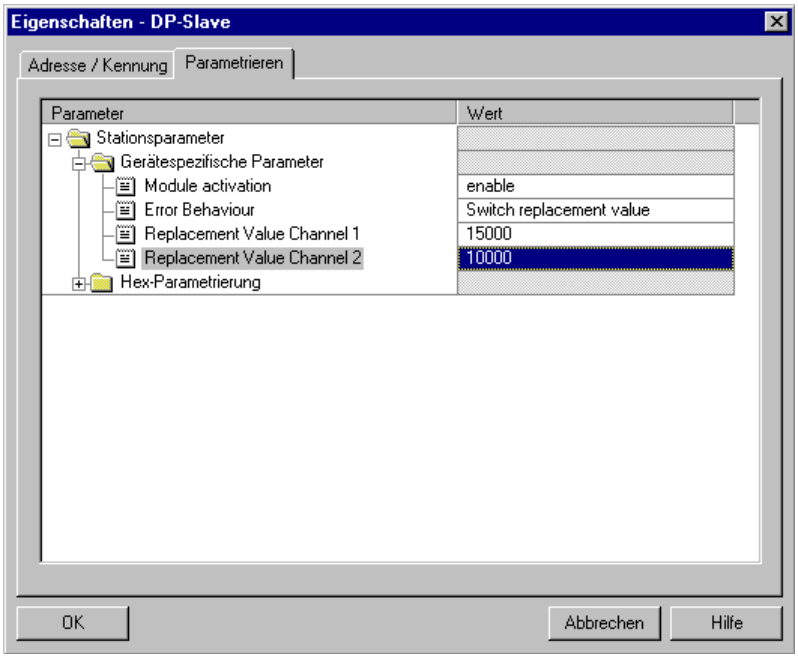


Fig.4-22 Selecting substitute values, 2-channel analog output terminal

The description of the module format in the GSD file is not limited by adding failsafe and parameter values. In other words, parameter data is added to the previous configuration data. These data types are independent of one another.

Activation of Failsafe Values

Failsafe values become valid if:

1. There is no communication with the PLC (response monitoring)
2. The control system is stopped
3. There is no process data traffic after power up, even though the parameter telegram has already been received

(1) means that there is no connection to the PLC. An example of this is a broken cable. If the response monitoring time has elapsed and no telegrams have been received, the substitute value is output if response monitoring is active.

In case (2), the control system managing the process data has stopped. No process data is exchanged. As soon as the control system indicates that it has stopped, the substitute value is used. The various control systems indicate their status at intervals using a broadcast.

Finally, it is also possible that the PLC is running but the device has not been activated yet (3). In this case, the station receives parameter and configuration telegrams. However, it cannot be guaranteed that the status of the control system (RUN/STOP) is known or that directly valid data telegrams are being sent. Therefore the failsafe values, which were already transmitted in the parameter telegram, are output.

If data exchange is enabled without global command "Operate", the CPU stop, which is sent via a broadcast in the same way as "Operate", is ignored, see also Chapter 4.7.10 on page 50. The last data output by the CPU is used. In this case, the failsafe values are only activated, if response monitoring has been enabled on the slave.

The BF LED flashes when the failsafe values are transmitted. This indicates locally that the output data is being controlled by the local slave.

Behavior on PLC Stop in DP/V1 Mode

PLC stop in DP/V1 mode

On a PLC stop in the new mode (DIP switch 8 = ON), cycles are still run in the local bus. The parameterized failsafe values are output on the output terminals. If a terminal has not been parameterized, the value 0 (for digital outputs) or "Hold" (for analog outputs) is used. The BF LED flashes when the failsafe values are transmitted. This indicates locally that the output data is being determined by the failsafe values.

Since the local bus continues to operate, DP/V1 commands can still be transmitted and processed via the C2 master. This increases the station availability.

4.7.6 Diagnostics

For detailed error codes, please refer to "Error Description" on page 97.

Selecting the diagnostic format

The diagnostic format can be set as a parameter on the bus coupler. You can select either "Status-PDU" (Display as Status PDU) or "Identifier related" (ID-Specific Diagnostics).

It is also possible to select the diagnostics for the previous version of the R-IL PB BK, which means that you can reuse operations, which were applied to the previous diagnostics.

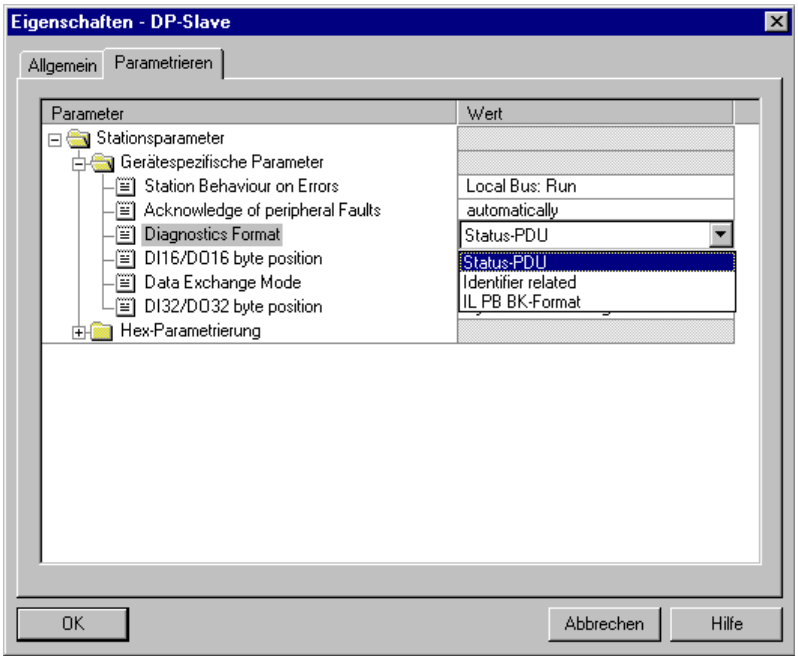


Fig.4-23 Selecting the diagnostic format

For reasons of compatibility, in R-IL PB BK mode (DIP 8 = OFF) only the usual diagnostic format of the R-IL PB BK is supported.

For a description of the diagnostics for byte 0 to byte 5, which applies to all PROFIBUS devices, please refer to Chapter "PROFIBUS Standard Diagnostics" on page 91.

Additional information for station diagnostics starts at byte 6.

Status PDU Block

Byte No.	Value	Description
Byte 0 to 5		PROFIBUS standard diagnostics
Byte 6	09_{hex}	DP/V1 status PDU header
Byte 7	81_{hex}	DP/V1 status PDU type - Status PDU
Byte 8	Device No.	DP/V1 status PDU slot
Byte 9	0 to 2	DP/V1 status PDU specifier
Byte 10	0 to 6	DP/V1 status PDU user: Error type*
Byte 11	0 to 12	DP/V1 status PDU user: Error No.*
Byte 12	0 to 255	DP/V1 status PDU user: ID Code (local bus)
Byte 13	0 to 255	DP/V1 status PDU user: Length Code (local bus)
Byte 14	41_{hex}	DP/V1 status PDU user: Software Version
* See Chapter "Error Description" on page 97		

Fig.4-24 Status PDU block

Specifier
0 : No change
1 : Error present
2 : Error no longer present

Error type
0 : No error
1 : PROFIBUS parameter error (Set_Prm)
2 : PROFIBUS configuration error (Chk_Cfg)
3 : Configuration error on the local bus
4 : Local bus error within the station
5 : Terminal error
6 : Parameter error on the local bus

Error number
0 to 12 : Depends on the error type (see "Error Description" on page 97).

An I/O error on terminal 2 (R-IB IL 24 DO 8-PAC) is displayed in status PDU format as follows:

Fig.4-25 I/O error on terminal 2 in status PDU format

ID-specific (terminal) diagnostics

Byte No.	Value	Description
Byte 0 to 5		PROFIBUS standard diagnostics
Byte 6	49_{hex}	Header
Byte 7	0 to 255	Terminals 1 to 8
Byte 8	0 to 255	Terminals 9 to 16
Byte 9	0 to 255	Terminals 17 to 24
Byte 10	0 to 255	Terminals 25 to 32
Byte 11	0 to 255	Terminals 33 to 40
Byte 12	0 to 255	Terminals 41 to 48
Byte 13	0 to 255	Terminals 49 to 56
Byte 14	0 to 255	Terminals 57 to 64

Fig.4-26 ID-specific (terminal) diagnostics

Bytes 2 to 9:

A bit is reserved for each terminal. If the bit is set, there is an error at the terminal.

Byte 0 Bit 0 : Terminal 1

Byte 0 Bit 1 : Terminal 2

- : -

Byte 0 Bit 7 : Terminal 8

Byte 1 Bit 0 : Terminal 9

Etc.

The error message in "ID-specific diagnostic format" is:

Fig.4-27 Peripheral fault on terminal 2 in "ID-specific diagnostic format"

Device-specific diagnostics

Byte	Meaning	Explanation
0 to 5		PROFIBUS standard diagnostics
6	$0A_{hex}$ header byte	Number of device-specific diagnostic bytes
7	00_{hex} diagnostics type	Diagnostics version
8	Firmware revision	This contains the firmware version in ASCII code. Example: 45_{hex} corresponds to revision "E".
9	Error type (for meaning see Chapter "Error Description" on page 97)	The error type is explained in the error table, see Chapter "Error Description" on page 97.
10	Error number (for meaning see Chapter "Error Description" on page 97)	The error number is explained in the error table, see Chapter "Error Description" on page 97.
11	Device number of the Inline terminal or the FLM module at the error location	This byte contains the logical number of the Inline terminal or the FLM module in which an I/O error has occurred (e.g., a short circuit at an output). In the event of data transmission errors, it indicates, together with byte 12, a faulty path between two terminals/modules. Passive devices such as power terminals without diagnostics or FLM branch modules are not counted.
12	Device number of the Inline terminal or FLM module at the error location	This byte contains the logical number of the Inline terminal or the FLM module in which an I/O error has occurred (e.g., a short circuit at an output). In the event of data transmission errors, it indicates, together with byte 11, a faulty path between two terminals/modules. Passive devices such as power terminals without diagnostics or FLM branch terminals are not counted.
13	Inline ID code	The ID code of the Inline terminal is used for identification and is marked on the housing and printed in the terminal data sheet.
14	Inline length code	The length code is used for identification and for automatic setting of the data width. This is also printed in the terminal data sheet.
15	Reserved	

Fig.4-28 Device-specific diagnostics (R-IL PB BK format)

Using usual R-IL PB BK diagnostics, the error is indicated as follows:

Fig.4-29 *I/O error on terminal 2 in manufacturer-specific format (known from R-IL PB BK)*

4.7.7 Acknowledging I/O Errors

I/O errors are errors that are triggered by some I/O terminals in the event of specific error states. Some errors have to be acknowledged, while others do not.

Errors that do not have to be acknowledged

Errors that do not have to be acknowledged include, for example, an output short circuit on an R-IB IL 24 DO 16. These errors are reset automatically when the error cause is removed.

Errors that have to be acknowledged

The error must be acknowledged either automatically or manually on the bus coupler. This setting is made during parameterization of the bus coupler:

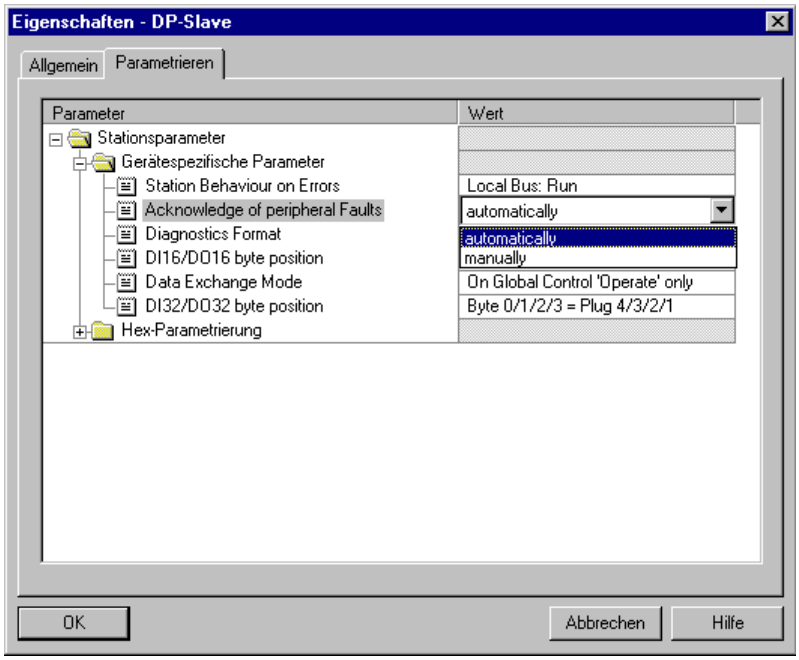


Fig.4-30 Setting for acknowledging I/O errors

Manual acknowledgment

An error can be acknowledged manually via DP/V1 (C1 and C2 master) or standard DP. The system writes to the bus coupler (slot 0), index 0004, subindex 00 (= 02_{hex}). Bit 1 (= 02_{hex}) should be set for the acknowledgment. The data length is exactly 1 byte (see Chapter "Acyclic Communication (DP/V1 and PCP)" on page 51).

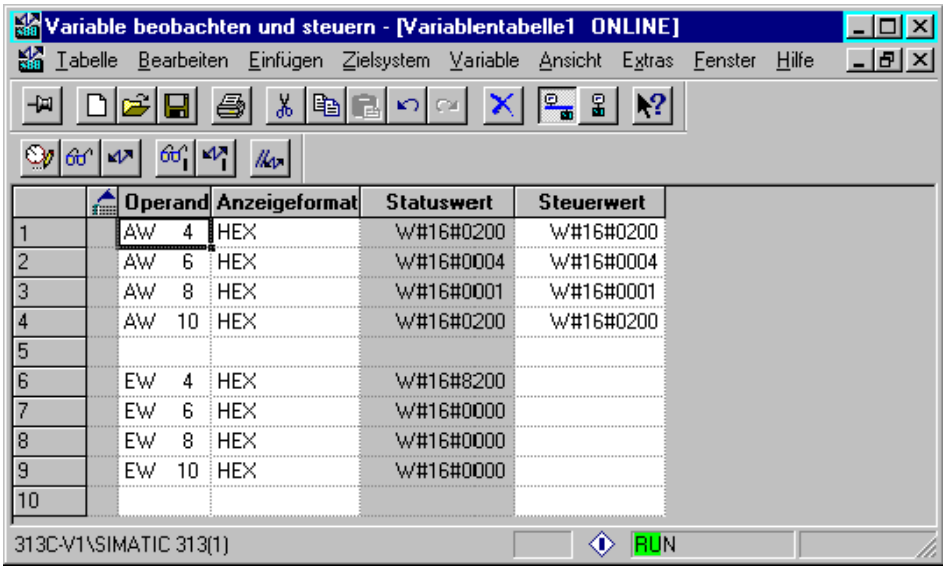


Fig.4-31 Manual acknowledgment of I/O errors in standard DP

The following telegram should be sent via DP/V1 (for C1 and C2 masters) for an acknowledgment:

Master	Data contents	Remark
C1 master	5F 00 04 01 02	
C2 master	5F 00 04 01 02	Do not forget "Initiate"

Fig.4-32 Telegram for the acknowledgment of I/O errors

4.7.8 Byte Rotation for R-IB IL 24 DI 16/R-IB IL 24 DO 16 Terminals

In order to adapt 16-channel digital terminals to the data format of the control system, the byte position of channels 1 - 8 and 9 - 16 can be rotated.

By default, channels 9 - 16 (slots 3, 4) are on byte n and channels 1 - 8 (slots 1, 2) are on byte n+1.

If bit 4 is set in the control byte (parameter telegram, byte 11, see Chapter "Format of the Parameter Telegram" on page 102), then the format is rotated. Channels 1 - 8 (slots 1, 2) are then on byte n and channels 9 - 16 (slots 3, 4) are on byte n+1.

(Byte.bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Assignment	Slot	4				3				2				1			
	Terminal point (signal)	8.4	7.4	8.1	7.1	6.4	5.4	6.1	5.1	4.4	3.4	4.1	3.1	2.4	1.4	2.1	1.1

Fig.4-33 Default (bit 4 = 0)

(Byte.bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Assignment	Slot	2				1				4				3			
	Terminal point (signal)	4.4	3.4	4.1	3.1	2.4	1.4	2.1	1.1	8.4	7.4	8.1	7.1	6.4	5.4	6.1	5.1

Fig.4-34 Rotated (bit 4 = 1)

4.7.9 Byte Rotation for R-IB IL 24 DI 32/R-IB IL 24 DO 32 Terminals

In order to adapt 32-channel digital terminals to the data format of the control system, the byte position of channel groups 1 - 8, 9 - 16, 17 - 24, and 25 - 32 can be rotated.

By default, channels 1 - 8 (slot 1) are on byte n+3 and channels 9 - 16 (slot 2) are on byte n+2, channels 17 - 24 (slot 3) are on byte n+1, and channels 25 - 32 (slot 4) are on byte n.

If bit 6 is set in the control byte (parameter telegram, byte 11, see Chapter "Format of the Parameter Telegram" on page 102), then the format is rotated. Channels 1 - 8 (slot 1) are then on byte n and channels 9 - 16 (slot 2) are on byte n+1, channels 17 - 24 (slot 3) are on byte n+2, and channels 25 - 32 (slot 4) are on byte n+3.

Byte	0					1					2					3				
Bit	7	6	...	1	0	7	6	...	1	0	7	6	...	1	0	7	6	...	1	0
Slot	4					3					2					1				
Terminal point	8.4	7.4	...	8.1	7.1	6.4	5.4	...	6.1	5.1	4.4	3.4	...	4.1	3.1	2.4	1.4	...	2.1	1.1

Fig.4-35 Default (bit 6 = 0)

Byte	0					1					2					3				
Bit	7	6	...	1	0	7	6	...	1	0	7	6	...	1	0	7	6	...	1	0
Slot	1					2					3					4				
Terminal point	2.4	1.4	...	2.1	1.1	4.4	3.4	...	4.1	3.1	6.4	5.4	...	6.1	5.1	8.4	7.4	...	8.1	7.1

Fig.4-36 Default (bit 6 = 1)

4.7.10 Data Exchange and Global Command "Operate"

Broadcast messages

PROFIBUS supports broadcast messages, which the PLC can use to display its status. Some control systems indicate their status to other devices in the network using these broadcast messages. The R-IL PB BK DP/V1 bus coupler uses this message to determine whether process data values or failsafe values should be output.

Usually, when the R-IL PB BK DP/V1 bus coupler receives a parameter telegram it first starts with the failsafe values until it receives the broadcast message and then either maintains the failsafe values or switches to process data mode, depending on the PLC status.

Data exchange without broadcast "Operate"

However, it is also possible that PLCs do not indicate their status. In this case, the option of "data exchange without broadcast "Operate" can be used. In the parameter telegram it is possible to specify that the device should not wait for the control system broadcast. In other words, process data is exchanged immediately after parameterization and configuration when the first data telegram is received.

In the event of a control system stop, this is indicated by the PROFIBUS master and the system switches immediately to the failsafe values.

The evaluation of the broadcast can be set in bit 5 of the control byte for the bus coupler (see "Format of the Parameter Telegram" on page 102).

4.8 Response Monitoring

Response monitoring

The response monitoring function, also referred to as the watchdog, checks that telegrams are received within a specified maximum time period. If no valid telegram is received in this period, the monitoring mechanism is triggered and failsafe settings are activated on the slave. These settings affect output terminals in particular, and a failsafe value is output as a substitute value.

This also means that there is no longer any communication with the master (e.g., cable interrupt). If communication between the master and slave is restored, a normal slave startup must be completed, i.e., with parameterization and configuration telegrams. This ensures that the local configuration matches the configuration stored on the PLC.

Options are available for activating/deactivating response monitoring, and for setting the time when response monitoring is activated. Values from 0 (no monitoring) to 650 s can be set in increments of at least 10 ms. Many configuration tools make these settings automatically to save work for the user. Finally, the cycle time should also be taken into account when setting the monitoring time. This depends on the entire network.

In IndraWorks, these settings are done for each bus coupler under the "DP Parameter" register. Here you can activate or deactivate the "Monitoring Control" and specify a value in ms for the response monitoring.

5 Acyclic Communication (DP/V1 and PCP)

DP/V1 DP/V1 extends the cyclic data exchange function according to IEC 61158 to include acyclic services.

PCP PCP is used in the local bus to exchange data acyclically. This is usually the parameterization data of complex terminals (e.g., R-IB IL RS 232-PAC) or variable length data.

DP/V1 is a PROFIBUS mechanism, which corresponds to PCP. The PROFIBUS coupler prepares the data records, which are sent via DP/V1 from the Class 1 or Class 2 master, for the PCP mechanism in the local bus. PCP data from the local bus is then converted from the R-IL PB BK DP/V1 into DP/V1 telegrams.

Before programming the application, check whether your control system or configuration tool supports DP/V1. If not, you can use the functions offered by the cyclic process data channel (DP/V0), see Chapter "Communication via Process Data (C1 Master in DP/V0 Mode)" on page 65.

The following distinctions must be observed regarding communication:

5.1 Acyclic Communication Via the Class 1 Master (C1 Master)

C1 master The C1 master carries out parameterization during slave startup and is also the master for cyclic data traffic. It may also be necessary to operate a V.24 (RS-232) interface acyclically from this C1 master or to read a parameter from the device as an option.

Corresponding read and write access rights are therefore defined for the C1 master. As it already has a connection to the slave during cyclic data traffic, the C1 master does not have to establish an explicit connection (using "Initiate"), but can communicate with the slave directly via "Read" and "Write".

5.2 Acyclic Communication Via the Class 2 Master (C2 Master)

C2 master For communication in the C2 master, the data fields are identical to those of C1 communication, and it is only the SAPs (Service Access Points) which are different. The additional effort required is the use of "Initiate" and "Abort" to establish and release the connection via SAP49 and 50. If DP/V1 devices are already in use, the routines for connection management can be adapted easily.

The C2 master can be implemented in various forms, e.g., in the form of a display device or operator interface. In a display device, the data is retrieved from the slave on request if, for example, a specific parameter is to be read. Access to the operator interface is usually acyclic.

Only one active DP/V1 communication is permitted at any time. It is possible to connect a total of up to eight PCP-compatible terminals to the PROFIBUS DP/V1 bus coupler.

5.3 PCP Communication Basics

PCP (Peripherals Communication Protocol) controls the transmission of parameter data in the local bus. Special PCP services are available for this purpose.

Application example

To explain the basics of PCP communication, the following concrete PCP application is used as an example:

A frequency inverter (FI), together with other field devices, is connected to a PLC via a bus interface. The device versions are standardized according to the Drives profile.

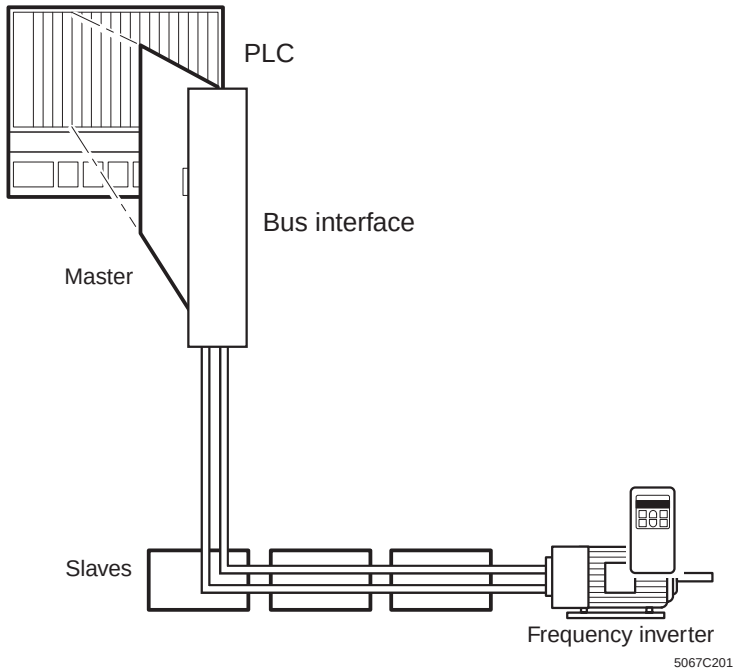


Fig.5-1 Application example

Device parameters

Device parameters are data from intelligent field devices (PCP devices), which is required for the startup phase of machines and systems. Once it has been entered, this data only has to be modified upon a change in the parameterization or in the event of an error. The parameters are preconfigured and can be taken from the device documentation provided by the manufacturer.

Parameters of a frequency inverter

As an electrical variable frequency drive, a key feature of a frequency inverter is that changes can be made to process variables (e.g., speed, position, and torque) using analog or digital signals. Additional information is required to optimize the adaptation of the variable frequency drive and motor to the process. As well as setpoint information, the frequency inverter also requires information about the motor type point, the minimum and maximum permissible speed of the system, the maximum speed variation during acceleration and deceleration, starting ramp, starting current, etc.

These types of additional information are device-specific parameters, which can be modified via the parameter data channel.

The parameter values for all PCP devices are the subject of communication via the parameter data channel. To enable the individual parameters to be distinguished during communication, each parameter has a number, the index.

Object dictionary (OD)

The index is listed together with the description of the parameter properties in a standardized list, the object dictionary (OD). Each PCP device, which exchanges information via the parameter data channel, has its own object dictionary.

Index

The index is the address of the communication object. It is required to identify the object.

	Object description (OD)		
Index	**Type**	**Object**	**Name**
...	...	...	...
60 $4A_{hex}$	Ramp	Record	Speed quick stop
60 $4B_{hex}$	Integer16	Array	Setpoint factor
...	...	...	...

Fig.5-2 Object description (example)

Object description

The object description includes all the properties of the object, such as data type, object type, name, etc.

Object types

There are various different object types:

Simple variable

- Simple variable type objects.
  Examples include measured values, the time or status of a device.

Array

- Array type objects, i.e.,several "simple variable" objects of the same type, which are grouped to form one object. Each element can be accessed individually.
  An example of an array is a range of the same type of measured values.

Record

- Record type objects, i.e., several "simple variable" objects of different types, which are grouped to form one object. As for the array type, each element of a record can be accessed individually. An example of a record is the group of data in a test report, which contains not only the actual measured value, but also additional information, e.g., the time of the measurement.

Program invocation

- Program invocation type objects, i.e., program sequences that can be run.

5.4 Acyclic Communication in DP/V1 Mode

5.4.1 The Communication Mechanism

Whenever data is accessed, a distinction must be made between accessing data from terminals in the local bus and data from the bus coupler:

Data type	Access to local bus terminal	Access to bus coupler	Slot	Index/ dec
Terminal parameters	x			2
Control byte (byte 4 of the bus coupler)		x	0	3
Local bus stop acknowledgment		x	0	4
Peripheral fault acknowledgment		x	0	4
Overview of PCP terminals and status		x	0	5
Deactivation of terminals		x	0	6
Activation status of terminals		x	0	7
Station ID		x	0	8
Terminal parameters (power up)	x		1 to 63	9
Set active configuration as power up configuration		x	0	10
Delete saved configuration		x	0	11
PCP data with Invoke ID	x		1 to 63	47
PCP data	x		1 to 63	48

Fig.5-3 Assignment of data

When accessing the bus coupler, use the usual DP/V1 format. Read and write access can be completed in 1(2) steps.

The PCP data from I/O terminals is usually addressed via 16-bit object indices. DP/V1 only has fields for 8-bit indices. Additional parameters have therefore been added to the data block for use when accessing the local bus, as for PROFIDrive. A sequence involving 2 (4) steps is used, which follows the PROFIDrive profile:

Read:

1. a) Send the request as Write (Read) to slot x
   b) Poll the response to Write (Read) - usually performed automatically by the master
2. a) Send a Read to slot x
   b) Poll the response to Read - usually performed automatically by the master

Write:

1. a) Send the request as Write (Write) to slot x
   b) Poll the response to Write (Write) - usually performed automatically by the master
2. a) Send a Read to slot x
   b) Poll the response to Read - usually performed automatically by the master

Note that when communicating with objects on local bus terminals, the response should be fetched using Read. Otherwise on the next communication attempt, the DP/V1 error code DF 80 B5 00 will indicate that the terminal is busy. In this case, this means that the terminal is waiting because it has not yet had a response from the last communication.

Communication is carried out via DP/V1 index 47 and 48, and the object index and assigned subindex of the I/O terminal are transmitted as part of the data field.

Request and Response

The section below provides additional information about the format of write and read access (Request and Response).

The format for all types of access (Request and Response, Read and Write) in DP/V1 is:

<DP/V1 Header> <Data (PCP / DP/V1)>

The format of the DP/V1 header is always:

<DP/V1 service> <Slot> <DP/V1 index> <DP/V1 length>

The <Data (PCP / DP/V1)> is optional depending on the service and has the following structure:

Access	Service	Data
Write objects (bus coupler)	Request	Object data
	Response	None
Read objects (bus coupler)	Request	None
	Response	Object data
Write objects (I/O terminals)	Write Request (Write)	Write PCP/Index high/Index low/Subindex/Length of PCP data/x bytes of PCP object data
	Write Response (Write)	None
	Read Request (Write)	None
	Read Response (Write)	PCP acknowledgment
Read objects (I/O terminals)	Write Request (Read)	Read PCP/Index high/Index low/Subindex
	Write Response (Read)	None
	Read Request (Read)	None
	Read Response (Read)	PCP acknowledgment
Write objects with Invoke ID	Write Request (Write)	Invoke ID/Write PCP/Reserved/Reserved/Reserved/Reserved/Index high/Index low/Reserved/Subindex/Reserved/Length of PCP data/x bytes of PCP object data
	Write Response (Write)	None
	Read Request (Write)	None
	Read Response (Write)	Invoke ID (mirrored)/Write PCP/Reserved/Reserved
Read objects with invoke ID	Write Request (Read)	Invoke ID/Read PCP/Reserved/Reserved/Reserved/Reserved/Index high/Index low/Reserved/Subindex
	Write Response (Read)	None
	Read Request (Read)	None
	Read Response (Read)	Invoke ID (mirrored)/Read PCP/Reserved/Reserved/Reserved/Length of PCP data/x bytes of PCP object data

Fig.5-4 Structure of the data depending on the service

In the event of a faulty response, the format is as follows:

- For a DP/V1 error:
  <DP/V1 Service> <Error Decode> <Error Code 1> <Error Code 2>
- For an I/O module error:
  <DP/V1 Service> <Slot> <DP/V1 Index> <DP/V1 Length> <Error Data (PCP / DP/V1>

The meaning of the individual parameters is as follows:

- <DP/V1 Service>:
In the request there is a distinction between DP/V1 Read ($5E_{hex}$) and DP/V1 Write ($5F_{hex}$); in the error response there is a distinction between DE_{hex} (Read Error) and DF_{hex} (Write Error)

- <Slot>:
The slot of the terminal to be addressed in the station. The bus coupler is addressed using Slot = 0, the first I/O terminal using Slot = 1, the second using Slot = 2, etc. The slot provides a reference to a specific terminal, e.g., also for the terminal parameters.

- <DP/V1 Index>:
The index to be used for accessing local bus communication objects is index 48_{dec} (= 30_{hex}). Indices 2 to 5 should be used for all other services. Index 47_{dec} is reserved for future use and should therefore not be assigned.

- <DP/V1 Length>:
For write access, the length of the subsequent data is specified here, and for read access, the length of the expected data is specified. On a response, this parameter contains the actual length of the DP/V1 data.

-<Error Data (PCP / DP/V1)>:
Contains the error codes from the PCP access to the local bus (see "Error Codes for DP/V1 and VC1 Communication" on page 108).

- <Error Decode>:
80_{hex} indicates an error in DP/V1

- <Error Code 1> and <Error Code 2>:
Error codes from DP/V1 access (see "Error Codes for DP/V1 and VC1 Communication" on page 108).

- <Write PCP / Read PCP>:
This specifies whether the following object index should be written or read. Read PCP = 01_{hex}; write PCP = 02_{hex}.

- <Object Data>
This is only the contents of an object. The length and scope of the data has already been described by <DP/V1 Length>.

- <Index High and Index Low>
This specifies the object index of the addressed PCP object in two bytes. For example, for index $5FE0_{hex}$ the value $5F_{hex}$ should be entered for Index high and the value $E0_{hex}$ should be entered for Index low.

- <Subindex>
When working with a PCP object, the subindex can be used to select a specific element from an array or record.

- <PCP Data Length>
This value specifies how many bytes of PCP object data (object contents) follow.

- <PCP Object Data>
This is the actual contents of a PCP object.

- <PCP Acknowledgment>
The structure of a PCP acknowledgment is as follows:

- <Message Code> <Result> <PCP Data Length> <PCP Object Data> or
- <Message Code> <Result><PCP Error Code>

- <Invoke-ID> The invoke ID is one byte in length and is used for channel selection on some terminals.

The message code is 81_{hex} (PCP Read) or 82_{hex} (PCP Write). The result has the function of a status byte (0 means "OK", 44_{hex} means "general error"). "PCP Length Data" and "PCP Object Data" only contain specific values on a Read Response (Read). "PCP Data Length" specifies how many bytes of PCP object data (object contents) follow. The "PCP Object Data" contains the actual contents of a PCP object. In the event of an error, the status byte is directly followed by the PCP error code, see Chapter "Error Codes for DP/V1 and VC1 Communication" on page 108.

When accessing PCP, note that the first byte in the DP/V1 data block uses PCP Read (= 01_{hex}) and PCP Write (= 02_{hex}) to indicate whether the PCP object should be read or written.

5.4.2 Examples

The section below provides a few examples to aid understanding (all values in hex). These examples indicate how objects on the bus coupler and the I/O terminals can be read and written.

The station structure is as follows:

- R-IL PB BK DP/V1
- R-IB IL 24 DO 8
- R-IB IL 24 DI 8
- R-IB IL RS 232
- R-IB IL AI 2/SF
- R-IB IL AO 1/SF

In order to understand the examples, knowledge of the object dictionary is also required. The object dictionary of the R-IB IL RS 232 has the following structure:

Index	Data type	A	L	Meaning	Object name	Rights
$5FC1_{hex}$	Var of Unsigned 8	1	1	Module start indicator	START-IND	rd/wr
$5FE0_{hex}$	String Var of Octed String	1	58	Transmit/receive V.24 (RS-232) data	V24-DATA	rd/wr
$5FFF_{hex}$	Array of Unsigned 8	20	1	Terminal configuration	INIT-Table	rd/wr

Fig.5-5 Object dictionary of the R-IB IL RS 232

A:	Number of elements	rd:	Read access permitted
L:	Length of an element in bytes	wr:	Write access permitted

Due to preassignment with default values and the array structure, index $5FFF_{hex}$, which contains details of the protocol, is a good example:

Writing the INIT-TABLE object with a write service configures the terminal.

Object	INIT-TABLE	
Access	Read, Write	
Data type	Array of Unsigned 8	20 x 1 byte
Index	$5FFF_{hex}$	
Subindex	00_{hex} Write all elements 01_{hex} Protocol 02_{hex} Baud rate 03_{hex} Data width 04_{hex} Reserved 05_{hex} Reserved 06_{hex} Error Pattern 07_{hex} First delimiter 08_{hex} Second delimiter 09_{hex} 3964R priority $0A_{hex}$ Output type $0B_{hex}$ DTR control system $0C_{hex}$ Rotation switch $0D_{hex}$ XON pattern $0E_{hex}$ XOFF pattern $0F_{hex}$ Reserved : : 14_{hex} Reserved	
Length (bytes)	14_{hex} Subindex 00_{hex} 01_{hex} Subindex 01_{hex} to 14_{hex}	
Data	R-IB IL RS 232 terminal configuration	

Fig.5-6 Object description

A default value has already been assigned to the individual elements:

Element		Meaning	Default setting		Data type
dec	hex		Code	Meaning	
1	1	Protocol	00_{hex}	Transparent	Unsigned 8
2	2	Baud rate	07_{hex}	9600 baud	Unsigned 8
3	3	Data width	02_{hex}	8 data bits, even parity, 1 stop bit	Unsigned 8
4	4	Reserved	00_{hex}		Unsigned 8
5	5	Reserved	00_{hex}		Unsigned 8
6	6	Error pattern	24_{hex}	($)	Unsigned 8
7	7	First delimiter	$0D_{hex}$	Carriage return (CR)	Unsigned 8
8	8	Second delimiter	$0A_{hex}$	Line feed (LF)	Unsigned 8
9	9	3964R priority	00_{hex}	Low	Unsigned 8
10	A	Output type	00_{hex}	RS-485	Unsigned 8
11	B	DTR control system	00_{hex}	Automatic	Unsigned 8
12	C	Rotation switch	00_{hex}	No rotation	Unsigned 8
13	D	XON pattern	11_{hex}		Unsigned 8
14	E	XOFF pattern	13_{hex}		Unsigned 8
15-20	F-14	Reserved	00_{hex}		Unsigned 8

Fig.5-7 INIT-TABLE object elements

The PROFIBUS DP/V1 bus coupler also has objects (see "Object Dictionary for the PROFIBUS DP/V1 Bus Coupler" on page 104).

Slot	Index	Service	Remark
0	3	Write	Control byte (diagnostic format, manual I/O error acknowledgment, etc.)
0	4	Write	Acknowledgment of local bus event 1: Local bus stop acknowledgment 2: Peripheral fault acknowledgment
0	5	Read	Overview of PCP modules and status
1 to 63	2	Write	Terminal parameters
1 to 63	48	Read/Write	PCP data

Fig.5-8 Assignment of object indices to an R-IL PB BK DP/V1 station

These objects (INIT-TABLE of the R-IB IL RS 232 and bus coupler objects) can be used to indicate how an intelligent slave can be accessed via different masters.

Example 1: Reading the Connected Local PCP Devices and Their Status (Slot 0, Index 5 on the Bus Coupler)

Data	Data structure
5E 00 05 20	Read/Slot/Index/Maximum length

Fig.5-9 Read Request (Master -> Slave)

Data	Data structure
5E 00 05 03 03 01 00	Read/Slot/Index/Actual length/3 bytes of object data

Fig.5-10 Read Request (Slave -> Master)

The data shows that there is a PCP device on slot 3, and its connection status is OK, see Chapter "Object Dictionary for the PROFIBUS DP/V1 Bus Coupler" on page 104. Byte 3 of the object data is reserved.

Example 2: Reading Object 5FFF, Subindex 2 of an IB IL RS 232 on Slot, Access to I/O Terminal

Data	Data structure
5F 03 30 04 01 5f ff 02	Write/Slot/Index/Length/Read PCP/Index high/Index low/Subindex

Fig.5-11 Write Request (Master -> Slave)

Data	Data structure
5F 03 30 04	Write/Slot/Index/Length

Fig.5-12 Write Response (Slave -> Master)

Data	Data structure
5E 03 30 28	Read/Slot/Index/Maximum length

Fig.5-13 Read Request (Master -> Slave)

Data	Data structure
5E 03 30 04 81 00 01 07	Read/Slot/Index/Actual length/4 bytes of object data

Fig.5-14 Read Response (Slave -> Master)

This example illustrates how the typical PROFIDrive profile write and read sequence provides the requested value when a value is read. In this case, the Write Response does not contain any data. It simply indicates that a Write Request was received at the R-IL PB BK DP/V1.

81_{hex} means that PCP read has been executed. The status is 00_{hex}, which indicates that there were no errors. 01_{hex} indicates the length of the subsequent data and 07_{hex} is the value stored under 5FFF, subindex 2, see "INIT-TABLE object elements" on page 60.

Example 3: Manual Acknowledgment of Peripheral Faults (Writing to the Bus Coupler, Slot 0, Index 4)

Data	Data structure
5F 00 04 01 02	Write/Slot/Index/Length/1 byte of data

Fig.5-15 Write Request (Master -> Slave)

Data	Data structure
5F 00 04 01	Write/Slot/Index/Length

Fig.5-16 Write Response (Slave -> Master)

In this case, the data block is only important in the request. The response indicates that the command has been received. As can be seen in Chapter "Object Dictionary for the PROFIBUS DP/V1 Bus Coupler" on page 104, I/O errors should be acknowledged using bit 1 (02_{hex}) at index 4, slot 0.

Example 4: Writing to Object 5FFF, Subindex 0 of an R-IB IL RS 232 on Slot 3

Data	Data structure
5F 03 30 19 02 5F FF 00 14 00 06 02 00 00 24 0D 0A 00 00 00 00 11 13 00 00 00 00 00 00	Write/Slot/Index/Total Data Length/Write PCP/Index high/ Index low/Subindex/Length of PCP Data/20 bytes of object data

Fig.5-17 Write Request (Master -> Slave)

Data	Data structure
5F 03 30 19	Write/Slot/Index/Length

Fig.5-18 Write Response (Slave -> Master)

Data	Data structure
5E 03 30 28	Read/Slot/Index/Maximum length

Fig.5-19 Read Request (Master -> Slave)

Data	Data structure
5E 03 30 02 82 00	Read/Slot/Index/Actual length/2 bytes of data (PCP acknowledgment)

Fig.5-20 Read Response (Slave -> Master)

This example shows how subindex 00_{hex} can be used to write to all the subindices of a PCP object on an I/O terminal in a single step. In the Write Request data block, 14_{hex} indicates the length of the subsequent data. This is followed by the data, which is transmitted in this order according to the structure of the object.

The Read Response is simple. The data block receives 82_{hex} to confirm that the PCP data has been written. 00_{hex} again indicates the OK status.

A maximum of 58 bytes of PCP data may be transmitted per command.

Example 5: Error: Reading a Non-Existent Object on an I/O Terminal with PCP Functions (Access to 5C00, Subindex 0 on an R-IB IL RS 232, Slot 3)

Data	Data structure
5F 03 30 04 01 5C 00 00	Write/Slot/Index/Length/Read PCP/Index high/Index low/Subindex

Fig.5-21 Write Request (Master -> Slave)

Data	Data structure
5F 03 30 04	Write/Slot/Index/Length

Fig.5-22 Write Response (Slave -> Master)

Data	Data structure
5E 03 30 28	Read/Slot/Index/Maximum length

Fig.5-23 Read Request (Master -> Slave)

Data	Data structure
5E 03 30 06 81 44 06 07 00 00	Read/Slot/Index/Actual length/6 bytes of object data

Fig.5-24 Read Response (Slave -> Master)

The Write Request here has a similar structure to Example 2, see page 61. However, instead of index 5FFF and subindex 2, index 5C00 and subindex 00 are requested in this case.

This shows that the Write Response (as is usual for PROFIDrive and also in Example 2) is simply being used to indicate that the command has been received. Processing on the local bus only starts afterwards. 81_{hex} indicates the execution of the command, and 44_{hex} already indicates a basic error.

On closer examination, it is clear that PCP Read cannot be processed because the object does not exist, see Chapter "Error Codes for DP/V1 and VC1 Communication" on page 108. This is indicated by the error code 06_{hex} and 07_{hex} within the object data of the Read Response. The 2 bytes at the end provide additional information about the error, but are not used in this case. As the command was executed without errors on DP/V1, the error is indicated as an error in the lower-level local bus rather than a DP/V1 error. In these cases, refer to the I/O terminal data sheet and the general error description for PCP. 44_{hex} as the response status always indicates an I/O terminal error.

Example 6:
Error: Reading an Object on an I/O Terminal Without PCP Functions (Access to 5FF0, Subindex 0 on an R-IB IL DO 8, Slot 2)

Data	Data structure
5F 02 30 04 01 5f ff 00	Write/Slot/Index/Length/Read PCP/Index high/Index low/Subindex

Fig.5-25 Write Request (Master -> Slave)

Data	Data structure
DF 80 D2 00	Write error/Error decode/Error code 1/Error code 2

Fig.5-26 Write Response (Slave -> Master)

Data	Data structure
5E 02 30 28	Read/Slot/Index/Maximum length

Fig.5-27 Read Request (Master -> Slave)

Data	Data structure
DE 80 D4 00	Read error/Error decode/Error code 1/Error code 2

Fig.5-28 Read Response (Slave -> Master)

In this case, DF_{hex} in the Write Response already indicates that the service cannot be executed. The service cannot be sent to the I/O terminal, so the error code is indicated immediately. For these types of error, the DP/V1 error codes are helpful, see Appendix "Error Codes for DP/V1 and VC1 Communication" on page 108.

In this example, 80_{hex} means that the error is a DP/V1 error. D2 00 indicates that the terminal does not have PCP. In this instance, the process should be aborted immediately after the write action. However, if the system tries to read the result on slot 2, D4 00 is output ("Incorrect service", see Chapter "Error Codes for DP/V1 and VC1 Communication" on page 108). This indicates that this command is not expected at present. There is no read data available at the slot.

If you use I/O terminals, which do not establish the PCP connection immediately following power up, error code $D1_{hex}$ may be displayed when PCP communication is attempted for the first time. This code indicates that there is (still) no PCP connection. At the same time, an attempt is made to establish this connection with the terminal so that the problem will not re-occur the next time a communication attempt is made.

In the event of doubt, index 5 can be used to request the PCP communication status and even establish communication if all PCP devices do not yet have a connection. To do this, write 01_{hex} to slot 0, index 5.

This example also shows:
Function code DE_{hex} (Read error) or function code DF_{hex} (Write error) in connection with error code 80_{hex}. These cases indicate errors at DP/V1 level. There are also more general DP/V1 error codes, which can be found in EN 50170, PROFIBUS Guideline 2.082.

5.5 Communication via Process Data (C1 Master in DP/V0 Mode)

DP/V1 communication is relatively new. However, the life of control systems and plants is so long that expansions and modifications are often made. In many cases, the control system is not DP/V1-compatible, but is expected to operate complex devices.

Acyclic services

Consequently, it is possible to operate acyclic services within the process data. This means that even a control system that does not support DP/V1 can control complex interfaces such as R-IB IL RS 232.

For additional information about PCP communication, please refer to "PCP Communication Basics" on page 52 and "Acyclic Communication in DP/V1 Mode" on page 54.

5.5.1 Mechanism for Transmission in the Process Data

VC1 module

Transmission is via a virtual C1 module (VC1 module). A C1 module should be selected in the hardware configurator in the same way as "normal" I/O terminals and therefore specified in the configuration and parameter telegram.

The VC1 module is only a virtual device because the process data can be used to transmit communication data (PCP) and is not linked to a specific module. During active process data exchange, it is possible to assign the VC1 module sequentially to different terminals with communication objects and to exchange parameter data parallel to the process data.

Process data width

The process data width occupied by the VC1 module in the process data channel can be selected from 4 to 16 words in increments of 2 words. This means that communication objects can be used even if resources are limited. If there are sufficient free resources, a data width of up to 16 words can be used, providing the same ease of operation as for DP/V1 communication.

The VC1 module (listed in the GSD as "PD-PCP x words") may only be configured once in the first position after the bus coupler. It is not linked to any hardware, so a terminal is not actually inserted.

As the data width of the VC1 module is between 4 and 16 words, but the user data can be up to 58 bytes (29 words) per communication, it may be necessary to split the data and transmit it in several steps.

This leads to:

- Start fragment
- Continue fragment
- End fragment
- Error or abort fragment

Each fragment contains a service byte, which is used for the precise assignment of the fragment.

Start fragment:

Byte 1: Service
Byte 2: Module number
Byte 3: Index high
Byte 4: Index low
Byte 5: Subindex
Byte 6: Length, if required
Byte 7: Data block, if required
...
Byte n: Data block, if required

Byte 1							
7	6	5	4	3	2	1	0
Request/ Response	0	0	Frag- menta- tion	Action			

Fig.5-29 Byte 1 - Service in start fragment:

Bit 7: **Request/Response**
0 = Request
1 = Response
Bits 6 to 5: **Fragment Type**
00 = Start fragment
Bit 4 **Fragmentation**
0 = Not fragmented
1 = Fragmented
Bits 3 to 0: **Action**

00_{hex}	No action (clear)
01_{hex}	Read PCP (I/O terminal)
02_{hex}	Write PCP (I/O terminal)
03_{hex}	Read (bus coupler)
04_{hex}	Write (bus coupler)
05_{hex}	Read PDU length (displayed in bytes)
06_{hex}	Read PCP with Invoke ID (I/O terminal)
07_{hex}	Write PCP with Invoke ID (I/O terminal)
08_{hex} to $0F_{hex}$	Reserved

In the start fragment, enter the Invoke ID for actions 6 and 7 (read/write with the Invoke ID) after the terminal number. Bytes 3 to n are then entered at byte 4 and onwards.

Please note that actions 01_{hex} and 02_{hex}, and 06_{hex} and 07_{hex} refer to PCP, i.e., these commands can be used to access PCP terminals. Actions 03_{hex} and 04_{hex} are used to read or write objects on the bus coupler (object indices 2 to 5). Please also refer to the Table "Assignment of data" on page 54.

Continue fragment:

Byte 1: Service

Byte 2: Data block, if required

...

Byte n: Data block, if required

Fig.5-30 Byte 1 - Service in continue fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ Response	0	1	Fragment number (01_{hex}-$1F_{hex}$)				

Bit 7: **Request/Response**

0 = Request

1 = Response

Bits 6 to 5: **Fragment Type**

01 = Continue fragment

Bits 4 to 0: **Counter**

01_{hex} to $0F_{hex}$ Fragment number. If more fragments are required, continue with 0 after $1F_{hex}$.

End fragment:

Byte 1: Service

Byte 2: Data block, if required

...

Byte n: Data block, if required

Fig.5-31 Byte 1 - Service in end fragment:

Byte 1							
7	6	5	4	3	2	1	0
Request/ Response	1	0	Reserved				

Bit 7: **Request/Response**

0 = Request

1 = Response

Bits 6 to 5: **Fragment Type**

10 = Last fragment (end fragment)

Bits 4 to 0: **Reserved**

Abort/error fragment:

Byte 1: Service
Byte 2: Error code, if required
...
Byte n: Error code, if required

Byte 1							
7	6	5	4	3	2	1	0
Request/ Response	1	1	Reserved				

Fig.5-32 Byte 1 - Service in abort/error fragment

Bit 7: **Request/Response**
0 = Request
1 = Response
Bits 6 to 5: **Fragment Type**
11 = Abort/error fragment
Bits 4 to 0: **Reserved**

Communication can be reset using 60_{hex} so that all buffers involved in the communication are set to their initial status.

When a service is complete, this should be acknowledged (clear) using service 00 (the other bytes of the VC1 module are then "don't care"). A handshake is implemented, which indicates to the PROFIBUS DP/V1 bus coupler that the result has been received by the master. The VC1 module can then receive the next service.

A Response is sent after every Request. This Response indicates that the Request has been received and shows its current status:

Response structure:

Byte 1:	Service (response bit is set)
Byte 2:	Status, if required
Byte 3:	Length, only for first read response
...	
Byte n:	Data block, if required

The status is indicated when local PCP transmission is complete and in the event of an error. In the event of an error, the data block can provide details. An error has occurred if the value of the status byte does not equal 00_{hex}.

00_{hex}	No error
44_{hex}	PCP module error
Other errors	See error table "Error Codes for DP/V1 and VC1 Communication" on page 108

For VC1, the parameters have the following meaning:

- <Module number>

The bus coupler counts as module 0, the first configured terminal as 1, the second as 2, etc. Please note that only devices with diagnostics should be configured and are "active" devices in the station.

- <Index high and Index low>

This specifies the object index of the addressed object in two bytes. This also applies for objects on the bus coupler. For example, for index $5FE0_{hex}$ the value 5_{Fhex} should be entered for Index high and the value $E0_{hex}$ should be entered for Index low. For Index 4_{hex} on the bus coupler, 00_{hex} is Index high and 04_{hex} is Index low.

- <Subindex>

When working with a PCP object, the subindex can be used to select a specific element from an array or record. The bus coupler has no arrays or records, so subindex 0 should be specified.

- <Length>

This value specifies how many bytes of object data (object contents) follow. Depending on the terminal, this may be bus coupler object data or I/O terminal object data.

- <Data block>

This is only the contents of an object. The length and scope of the data has already been described by the <Length> parameter.

- <Invoke ID>

The Invoke ID is one byte in length and is used for channel selection on some terminals.

To aid understanding, the same examples are used in the following section as for DP/V1 services. This means that the description of the examples for DP/V1 communication is valid again here, see Chapter "Examples" on page 58. "Error codes for DP/V1 and VC1 communication" on page 108

5.5.2 Examples for VC1 Services

Example 1: Reading the Connected Local PCP Devices and Their Status (Slot 0, Index 5 on the Bus Coupler)

Data (4 words VC1)	Data structure
03 00 00 05 00 l 00 00 00	Read/Slot/Index high/Index low/Subindex l 3 bytes unused

Fig.5-33 Read Request (Master -> Slave)

Data (4 words VC1)	Data structure
83 00 03 03 01 00 l 00 00	Read Response/Status/Actual length/3 bytes of object data l 2 bytes unused

Fig.5-34 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear

Fig.5-35 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-36 Clear Response (Slave -> Master)

Example 2: Reading Object 5FFF, Subindex 2 of an R-IB IL RS 232 on Slot 3

Data (4 words VC1)	Data structure
01 03 5F FF 02 I 00 00 00	Read PCP/Slot/Index high/Index low/Subindex I 3 bytes unused

Fig.5-37 Read Request (Master -> Slave)

Data (4 words VC1)	Data structure
81 00 01 07 I 00 00 00 00	Read Response/Status/Actual length/1 byte of object data I 4 bytes unused

Fig.5-38 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear

Fig.5-39 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-40 Clear Response (Slave -> Master)

Example 3: Manual Acknowledgment of Peripheral Faults (Writing to the Bus Coupler, Slot 0, Index 4)

Data (4 words VC1)	Data structure
04 00 00 04 00 01 02 I 00	Write/Slot/Index high/Index low/Subindex I Length/Data I 1 byte unused

Fig.5-41 Write Request (Master -> Slave)

Data (4 words VC1)	Data structure
84 00 I 00 00 00 00 00 00	Write Response/Status I 6 bytes unused

Fig.5-42 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear

Fig.5-43 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-44 Clear Response (Slave -> Master)

Example 4: Writing to Object 5FFF, Subindex 0 of an R-IB IL RS 232 on Slot 3

Data (4 words VC1)	Data structure
12 03 5F FF 00 14 00 06	Write PCP/Slot/Index high/Index low/Subindex/Length/2 bytes of data

Fig.5-45 Write Request (Master -> Slave) - Start fragment

Data (4 words VC1)	Data structure
12 I 00 00 00 00 00 00 00	Write Response/7 bytes unused

Fig.5-46 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
21 02 00 00 24 0D 0A 00	Write/7 bytes of data

Fig.5-47 Write Request (Master -> Slave) - 1st continue fragment

Data (4 words VC1)	Data structure
21 I 00 00 00 00 00 00 00	Write Response I 7 bytes unused

Fig.5-48 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
22 00 00 00 11 13 00 00	Write/7 bytes of data

Fig.5-49 Write Request (Master -> Slave) - 2nd continue fragment

Data (4 words VC1)	Data structure
22 I 00 00 00 00 00 00 00	Write Response I 7 bytes unused

Fig.5-50 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
40 00 00 00 00 I 00 00 00	Write/4 bytes of data I 3 bytes unused

Fig.5-51 Write Request (Master -> Slave) - End fragment

Data (4 words VC1)	Data structure
82 00 I 00 00 00 00 00 00	Write Response/Status I 6 bytes unused

Fig.5-52 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear

Fig.5-53 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-54 Clear Response (Slave -> Master)

In this case, Write Response with service 82_{hex} is the acknowledgment of Write Request with 12_{hex} in the start fragment.

Example 5 - Error: Reading a Non-Existent Object on an I/O Terminal With PCP Functions (Access to 5C00, Subindex 0 on an R-IB IL RS 232, Slot 3)

Data (4 words VC1)	Data structure
01 03 5C 00 00 I 00 00 00	Read PCP/Slot/Index high/Index low/Subindex I 3 bytes unused

Fig.5-55 Read Request (Master -> Slave)

Data (4 words VC1)	Data structure
81 44 06 07 00 00 I 00 00	Read Response/Status/4 bytes of error code I 4 bytes unused

Fig.5-56 Write Response (Slave -> Master)

Data (4 words VC1)	Data structure
60 xx xx xx xx xx xx xx	Abort

Fig.5-57 Abort Request (Master -> Slave)

Data (4 words VC1)	Data structure
E0 00 00 00 00 00 00 00	Abort Response

Fig.5-58 Abort Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear Response

Fig.5-59 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-60 Clear Response (Slave -> Master)

44_{hex} in the Read Response of the start fragment indicates an error. 06_{hex} and 07_{hex} in this case is the error code, which according to the PCP description indicates that the addressed index does not exist, see also "Error Codes for PCP Communication" on page 109.

Communication can be reset using 60_{hex} so that all buffers involved in the communication are set to their initial status.

Example 6 - Error: Reading an Object on an I/O Terminal Without PCP Functions (Access to 5FF0, Subindex 0 on an R-IB IL 24 DO 8, Slot 2)

Data (4 words VC1)	Data structure
01 02 5F F0 00 I 00 00 00	Read PCP/Slot/Index high/Index low/Subindex I 3 bytes unused

Fig.5-61 Read Request (Master -> Slave)

Data (4 words VC1)	Data structure
81 D2 00 I 00 00 00 00 00	Read Response/Status or 2 bytes of error code I 5 bytes unused

Fig.5-62 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
60 xx xx xx xx xx xx	Abort

Fig.5-63 Abort Request (Master -> Slave)

Data (4 words VC1)	Data structure
E0 00 00 00 00 00 00	Abort Response

Fig.5-64 Abort Response (Slave -> Master)

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx	Clear

Fig.5-65 Clear Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00	Clear Response

Fig.5-66 Clear Response (Slave -> Master)

$D2_{hex}$ in the Read Response indicates an error. An error has occurred if the second byte of the response (status byte) does not equal 0, see also "Error Codes for PCP Communication" on page 109

Communication can be reset using 60_{hex} so that all buffers involved in the communication are set to their initial status.

Example 7 - Fragmented Read on R-IB IL RS 232, Slot 3, Object 5FFF, Subindex 0 (Additional Example)

Data (4 words VC1)	Data structure
01 03 5F FF 00 I 00 00 00	Read PCP/Slot/Index high/Index low/Subindex I 3 bytes unused

Fig.5-67 Read Request (Master -> Slave) - Start fragment

Data (4 words VC1)	Data structure
91 00 14 00 07 02 00 00	Read Response/Status/Actual length/5 bytes of object data

Fig.5-68 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
91 xx xx xx xx xx xx xx	Read/7 bytes unused

Fig.5-69 Read Request (Master -> Slave) - Start fragment acknowledgment

Data (4 words VC1)	Data structure
A1 24 0D 0A 00 00 00 00	Read Response/7 bytes of object data

Fig.5-70 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
A1 xx xx xx xx xx xx xx	Read/7 bytes unused

Fig.5-71 Read Request (Master -> Slave) - Acknowledgment of 1st continue fragment

Data (4 words VC1)	Data structure
A2 11 13 00 00 00 00 00	Read Response/7 bytes of object data

Fig.5-72 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
A2 xx xx xx xx xx xx xx	Read/7 bytes unused

Fig.5-73 Read Request (Master -> Slave) - Acknowledgment of 2nd continue fragment

Data (4 words VC1)	Data structure
C0 00 I 00 00 00 00 00 00	Read/1 byte of object data I 6 bytes unused

Fig.5-74 Read Response (Slave -> Master)

Data (4 words VC1)	Data structure
C0 xx xx xx xx xx xx x	Read/7 bytes unused

Fig.5-75 Read Request (Master -> Slave)- End fragment acknowledgment

Data (4 words VC1)	Data structure
00 xx xx xx xx xx xx xx	Clear

Fig.5-76 Read Request (Master -> Slave)

Data (4 words VC1)	Data structure
00 00 00 00 00 00 00 00	Clear Response

Fig.5-77 Read Response (Slave -> Master)

Acyclic Communication (DP/V1 and PCP)

6 Dynamic Configuration

Dynamic configuration is the specification and configuration of a maximum configuration. Any subgroup of this maximum configuration can be operated.

In addition to dynamic configuration, empty spaces can be reserved for future expansions.

6.1 Empty Spaces

It can be helpful to reserve empty spaces for a station, which may be used at different configuration levels. You can configure the maximum configuration level and thus also reserve memory in the PLC. However, optional terminals must not be connected. They can be deactivated in the configuration.

If the station is subsequently expanded to include previously deactivated terminals, the new terminals can be connected and activated in the hardware configurator.

Configuration under IndraWorks is carried out in the same way as for other modular slaves. The configuration can be created from the hardware catalog using drag & drop.

Open the "Properties" dialog box by double-clicking on a terminal.

The "DP Parameter" tab can be used to specify whether a terminal should be active or inactive.

Please note that adjustments to the configuration and actual structure are also carried out for inactive terminals. A message is displayed if deactivated terminals are connected.

Following activation/deactivation, the configuration can be saved, translated, and downloaded as usual.

Depending on the terminal type, failsafe values (DO and AO) to be output in the event of an error can also be set at this point, for example. Furthermore, inputs (AI) can be parameterized. This is also carried out via the dialog under the "DP Parameter" tab.

6.2 Dynamic Configuration

In dynamic configuration, a maximum configuration is specified during configuration. The addresses are thus reserved in the PLC. Any subgroup of this maximum configuration can be operated. The advantage is that several stations with the same device number but different configurations can be used in the field, although only one such station can ever be active on PROFIBUS.

Three indices are used on the R-IL PB BK DP/V1:

Index 6: Activation/deactivation of terminals and slots

Access: Read and write

Index 6 is stored retentively.

Dynamic Configuration

Structure: Length of 8 bytes

Byte 1								Byte 2								Bytes 3 ... 7	Byte 8							
8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9	...	x	63	62	61	60	59	58	57

Bit = 1: Terminal and slot inactive

Bit = 0: Terminal and slot active

Index 7: Read back active/inactive terminals and slots

Access: Read

Index 7 indicates which terminals are active/inactive. Deactivation via the parameter telegram (reservation of empty spaces) is also indicated here.

Structure: Length of 8 bytes

Byte 1								Byte 2								Bytes 3 ... 7	Byte 8							
8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9	...	x	63	62	61	60	59	58	57

Bit = 1: Terminal and slot inactive

Bit = 0: Terminal and slot active

Empty spaces configured in the parameter telegram are logically ORed with inactivation via index 6.

Index 8: Read/Write ID

Access: Read and write

Structure: Length of 2 bytes

Each R-IL PB BK DP/V1 can be assigned an individual ID. This ID is stored retentively and can be used to identify a station if it was disconnected from the power supply. This means that several stations can be operated alternately under the same station address in PROFIBUS. The ID can also be read cyclically in the process data.

6.3 Startup

DIP switch position 8 = ON is recommended for new projects, as this tallies with the default parameterization options.

6.3.1 Planning Configuration

It can be assumed that there is a maximum configuration. All terminals are activated by default.

Access to the indices described on page 79 can be enabled via PROFIBUS DP/V1 or even via DP/V0. This means that the indices can also be addressed via normal process data. This example only describes access via process data.

To access indices 6 to 8 via process data, configure the "PD-PCP x words" terminal (x = 4, 6, .., 16) as the first terminal in the station. The data width and address can be selected according to the options in the CPU.

The "Module-ID" module is used to read the individually definable ID of the PROFIBUS DP/V1 bus coupler (index 8).

It does not have to be configured. However, if it is configured, it must be placed directly after "PD-PCP x words", i.e., in the second position or the first position if no "PD-PCP x words" module was configured.

Configure the remaining terminals as usual, once you have proceeded as described in "Specifying the Active Configuration" on page 83.

6.3.2 Options for Specifying the Active Configuration

In the following example, the 16-channel digital terminals and the 1-channel analog output terminal should not be part of the station, i.e., these terminals are part of the maximum configuration, but should be deactivated at this station. An entirely different subgroup of the maximum configuration could thus be active at another station. This means that stations with different subgroups can be docked on PROFIBUS and run with their individual configurations.

There are three options for startup:

1 Via DP/V1

This option is very user-friendly but should not be considered further as the master used in this example is a PROFIBUS master without DP/V1 capability.

2 Via DP/V0 with maximum configuration and configured empty spaces

Empty spaces remain free. The active configuration can be modified via DP/V0 and the deactivation can then be undone from the configuration. Proceed as follows:

- Deactivate DI16, DO16, and AO1 in the hardware configuration and download the hardware configuration.
- You can switch to cyclic data exchange and the configuration connected to the station can be set retentively via index 6.
- Reactivate the terminals that were deactivated in the hardware configurator (translate and download hardware configurator).

In addition to the parameter telegram, index 6 is taken into consideration for all subsequent startups.

3 Via DP/V0 with minimum configuration

Only the terminal for accessing indices 6 to 8 via the process data channel is configured initially. In fact, any structure can be connected. Configuration settings can be made subsequently.

- In the hardware configuration select only the "PD-PCP x words" module and download it. The actual connected structure is of no importance here (at least one terminal must be connected).
- Switch to cyclic data exchange and retentively set the configuration connected to the station via index 6.
- Enter configuration settings in the hardware configurator.

The third option is particularly suitable for startup. All the hardware can be plugged in together. You only need to transmit the hardware configuration once on startup if "PD-PCP x words" is the only module configured. Briefly switch to RUN state and transmit the data for index 6 and 8. The terminal can be clearly identified later by assigning an ID to index 8.

The configuration for the maximum configuration can then be completed.

The following describes the individual steps for startup via DP/V0 with minimum configuration.

6.3.3 Specifying the Active Configuration

1 Specify the address on the station using DIP switches 1 to 7 and select the operating mode using DIP switch 8 = ON.

Connect the terminals, which represent the subgroup of the maximum configuration. In the hardware configurator, configure only the "PD-PCP x words" module (recommendation: x > = 8).

The address can be freely defined in the PLC memory within the framework of the options provided by the PLC.

2 Specify the active configuration.

In the example, terminals 3 (R-IB IL 24 DO 16), 4 (R-IB IL 24 DI 16), and 6 (R-IB IL 24 AO 1) should be deactivated. According to the description of index 6, the value is
2C 00 00 00 00 00 00 00.

Data (8 words VC1)	Data structure
04 00 00 06 00 08 2C 00 00 00 00 00 00 00 I 00 00	Write/Slot/Index high/Index low/Subindex/Length/Data I 2 bytes unused

Fig.6-1 Write Request (Master -> Slave)

Data (8 words VC1)	Data structure
84 00 I 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Write Response/Status I 14 bytes unused

Fig.6-2 Write Response (Master -> Slave)

Data (8 words VC1)	Data structure
00 xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	Clear

Fig.6-3 Clear Request (Master -> Slave)

Data (8 words VC1)	Data structure
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Clear Response

Fig.6-4 Clear Response (Master -> Slave)

You have thus specified which slots should be active and which should be inactive.

3 Specify an ID.

2 bytes are available for an ID. This corresponds to 65536 options for identifying the terminal retentively. If terminals with the same address are connected alternately, this makes it easy to identify terminals after power up.

The ID is stored on index 8.

Example ID: 2633

Data (8 words VC1)	Data structure
04 00 00 08 00 02 26 33 I 00 00 00 00 00 00 00 00	Write/Slot/Index high/Index low/Subindex/Length/Data I 8 bytes unused

Fig.6-5 Write Request (Master -> Slave)

Data (8 words VC1)	Data structure
84 00 I 00 00 00 00 00 00 00 00 00 00 00 00 00	Write Response/Status I 14 bytes unused

Fig.6-6 Write Response (Master -> Slave)

Data (8 words VC1)	Data structure
00 xx xx xx xx xx xx xx xx xx xx xx xx xx xx	Clear

Fig.6-7 Clear Request (Master -> Slave)

Data (8 words VC1)	Data structure
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Clear Response

Fig.6-8 Clear Response (Master -> Slave)

4 Create the entire configuration.

In this step, the hardware configuration is completed and downloaded.

The R-IB IL 24 DO 16, R-IB IL 24 DI 16, and R-IB IL 24 AO1 terminals are deactivated and must not be connected.

The "PD-PCP x words" module does not have to be configured for normal operation. It is only required if you wish to access indexes.

The station ID (module ID) on index 8 can also be read in the normal process data.

If you wish to use the "PD-PCP x words" and "Module-ID" modules, you must configure them first. The "PD-PCP x words" module has priority over the "Module ID" module.

6.4 Modifying the Station Structure

Two options are available if you wish to modify the station structure.

1 Proceed according to the steps described in 6.3.
2 Use the "PD-PCP x words" module in the old configuration to activate/deactivate terminals:

- Step 2 on page 83 to specify a new subgroup
- Step 3 on page 84 to specify a new ID
- Subsequent modification of the station

Dynamic Configuration

7 What To Do in the Event of an Error

Basics

Errors can occur during startup of the Inline station as well as when PROFIBUS is in operation. There are basically two ways of detecting errors. One way errors can be detected is by using local diagnostics with the help of the LEDs on the PROFIBUS DP/V1 bus coupler and the Inline terminals, and Fieldline Modular M8 modules. Alternatively, all types of errors are sent from the PROFIBUS DP/V1 bus coupler to the PROFIBUS master via the PROFIBUS diagnostic telegram so that errors in the station can also be diagnosed and rectified using software.

Optional: PROFIBUS DP master simulator

In addition to the basic diagnostic options, special startup software can be used for pre-function testing of the Inline station with the PROFIBUS DP/V1 bus coupler.

7.1 Local Diagnostics

The diagnostic and status indicators of the terminal enable quick local error diagnostics. They are clearly visible on the front of the terminal.

Diagnostics

The diagnostic indicators are red and green LEDs. They indicate the type and location of the error.

A terminal is operating correctly if all of its green LEDs are on.

Once an error has been removed, the indicators immediately display the current status.

Status

The status indicators (yellow) display the status of the relevant inputs/outputs or the connected device.

The diagnostic and status indicators and the resulting error analysis for the PROFIBUS DP/V1 bus coupler are described in the following sections.

For information on the diagnostic and status indicators and on error diagnostics for Inline terminals, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P application description.

7.1.1 LED Diagnostic and Status Indicators on the PROFIBUS DP/V1 Bus Coupler

For additional information about diagnostic and status indicators, please refer to Chapter "Diagnostics on the PROFIBUS DP/V1 Bus Coupler" on page 33.

7.1.2 Error Causes and Remedies on the PROFIBUS DP/V1 Bus Coupler

Each LED combination on the PROFIBUS DP/V1 bus coupler indicates a specific error, which can be localized and removed.

The various LED combinations are described in Fig.7-2. The symbols used have the following meanings:

Symbol	Meaning
○	LED off
⊙	LED flashing
●	LED on

Fig.7-1 LED symbols

No.	UM	US	BF	FS	FN	Error	Remedy
1	?	?	?	?	?	Voltage supply U_M and U_S not present	Check voltage supply U_M and U_S
2	?	I	?	?	?	Voltage supply U_M not present	Check voltage supply U_M
3	I	?	?	?	?	Voltage supply U_S not present	Check voltage supply U_S
4	I	I	?	?	?	No error, everything OK	
5	I	I	I	?	?	No communication on PROFIBUS	- Correct PROFIBUS address on the Bus coupler - Correct PROFIBUS master settings - Remove PROFIBUS cable fault
6	I	I	?	I	§	Number of flashing pulses at FN indicates the type of error	See 7.1.3
7	I	I	?	?	§	Number of flashing pulses on FN indicates the error number	See 7.1.3
8	I	I	§	?	?	Failsafe values are being output	Switch master to RUN state, check communication with master Set "Data exchange mode" parameter on the bus coupler to "Data exchange without operate"

Fig.7-2 Possible LED combinations

CAUTION

Never make any changes to the configuration during operation. Always switch off the Inline station first.

7.1.3 Determining the Error Cause and Remedy

The error type and the error number can be determined using the **FS** and **FN** LEDs on the PROFIBUS DP/V1 bus coupler.

- FS on: The number of flashing pulses at FN indicates the error type.
- FS off: The number of flashing pulses at FN indicates the error number.

More detailed information on the various error codes can be found in Chapter "Error Description" on page 97.

Example The FS LED is on and the FN LED flashes once. According to Fig.9-3 the Inline terminal is not enabled for operation on the bus coupler.

Locating an Error

Inline terminal LED diagnostic and status indicators enable clear error localization. An error is displayed at the station. In addition, the device on which the error has occurred is indicated to the control system can be displayed with IndraWorks.

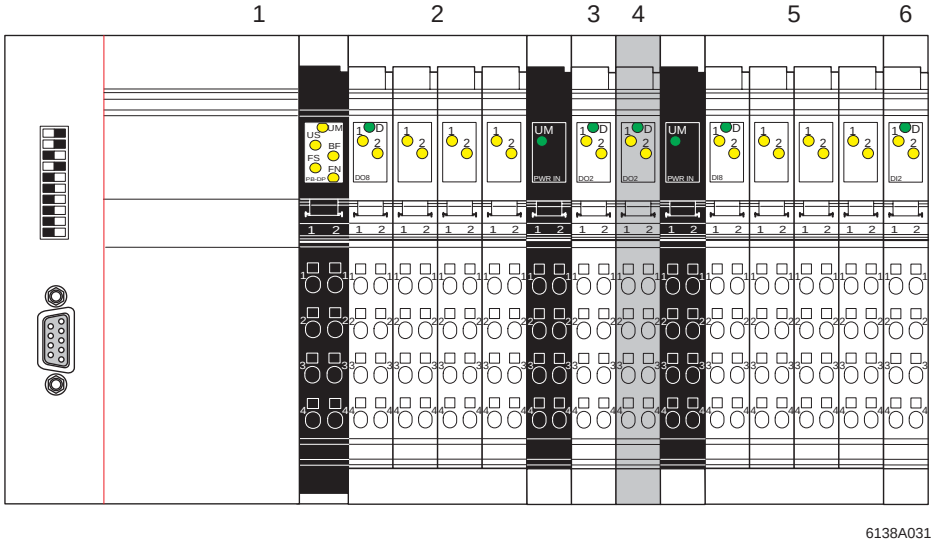


Fig.7-3 Example station for error localization

Terminals Used in the Example Station:

1	R-IL PB BK DP/V1	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

Fig.7-4 Terminals of the example station

The R-IB IL 24 PWR IN power terminals are not numbered because they are not bus devices (they do not contain protocol chips) and therefore do not have indicators for error diagnostics.

When the system is operating correctly, the green LEDs on the Bus coupler and the other terminals remain lit (Fig.7-5, A).

What To Do in the Event of an Error

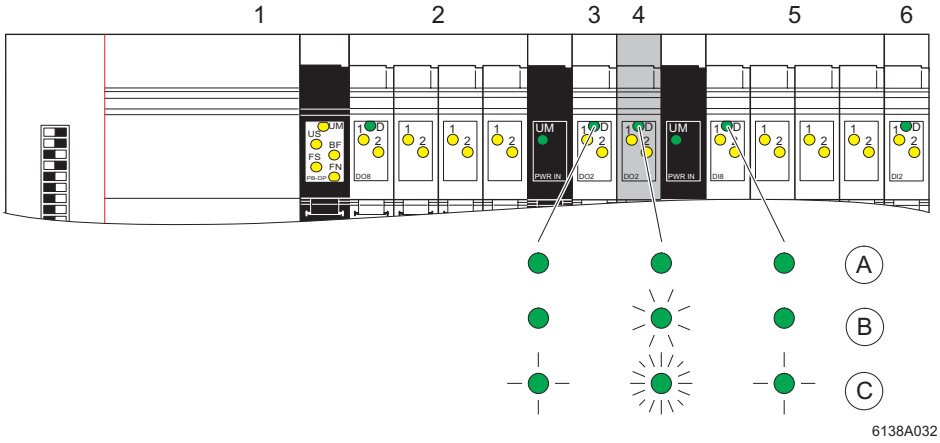
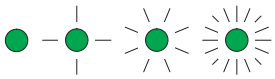


Fig.7-5 Station with diagnostic indicators

Fig.7-5 shows a station with possible error states. It indicates an I/O error on terminal 4 and a bus error between terminal 3 and terminal 4, and shows the behavior of the diagnostic indicators on the adjacent terminals.

A	No error
B	Peripheral fault (I/O error), see Fig.7-6
C	Bus error, see Fig.7-7
	LED on or flashing at 0.5 Hz/2 Hz/4 Hz (on/slow/medium/fast)

Error:	Short circuit on terminal 4 (R-IB IL 24 DO 2)
Effect:	
Controller:	Error message to the controller (peripheral fault)
Bus coupler:	FS and FN flash
Terminal 4:	Green D LED flashes at 2 Hz
Other terminals:	Remain unchanged

Fig.7-6 Peripheral fault

Error:	Incoming bus after terminal 3 and before terminal 4 has been interrupted
Effect:	
Controller:	Error can be located by the controller
Bus coupler:	FS and FN flash
Terminal 4:	Green D LED flashes at 4 Hz (bus error)
Other terminals:	Green D LEDs on all other terminals flash at 0.5Hz

Fig.7-7 Bus error

In firmware Version A (41_{hex}) or later, a peripheral fault triggered by the R-IB IL 24 EDI 2-DES input terminal is acknowledged by reading the station diagnostics. The error can also be acknowledged from the application.

7.2 Diagnostics on the PROFIBUS Master

The error information sent in the diagnostic telegram from the PROFIBUS DP/V1 bus coupler to the PROFIBUS master are then displayed in the IndraWorks user interface (Diagnostics -> Fieldbus Diagnostics). Both "standard diagnostics" and "device-specific diagnostics" are available. The meaning of the individual bytes is provided in Fig.7-8 and Fig.7-9 (below).

7.2.1 PROFIBUS Standard Diagnostics

Byte	Meaning (DIP8 = OFF)	Meaning (DIP8 = ON)
0	Station status 1	Station status 1
1	Station status 2	Station status 2
2	Station status 3	Station status 3
3	PROFIBUS master address	PROFIBUS master address
4	05_{hex} manufacturer ID high byte	06_{hex} manufacturer ID high byte
5	BA_{hex} manufacturer ID low byte	CC_{hex} manufacturer ID low byte

Fig.7-8 PROFIBUS standard diagnostics

Detailed Explanation for Station Status 1 to 3

Station status 1 to 3 indicates the state of a DP slave.

Bit	Value	Meaning, Cause	Remedy
0	1	The DP slave is not addressed by the DP master.	Is the correct PROFIBUS address set on the DP slave? Is the bus connector connected? Is there voltage to the DP slave? Is the RS-485 repeater set correctly? Has the DP slave been reset?
1	1	The DP slave is not ready for data exchange.	Wait, because the DP slave is starting up.
2	1	The configuration data sent from the DP master to the DP slave does not correspond to the configuration of the DP slave.	Has the correct station type or the correct DP slave configuration been entered in the configuration software?
3	1	External diagnostics are present (group diagnostic indicator).	Evaluate diagnostics. Once all errors have been removed, bit 3 is reset. The bit is reset when a new diagnostic message is present in the bytes of the above diagnostics.
4	1	The required function is not supported by the DP slave.	Check configuration.

Fig.7-9 Structure of station status 1 (byte 0)

Bit	Value	Meaning, Cause	Remedy
5	1	The DP master cannot interpret the response of the DP slave.	Check bus configuration.
6	1	The DP slave type does not match the software configuration.	Is the correct station type specified in the configuration software?
7	1	The DP slave has been parameterized by another DP master (not by the DP master that currently has access to the DP slave).	The bit always has the value 1 if, for example, you access the DP slave with the programming device or another DP master. The PROFIBUS address of the DP master that parameterized the DP slave is located in the diagnostic byte "master PROFIBUS address".

Fig.7-9 Structure of station status 1 (byte 0)

Bit	Value	Meaning
0	1	The DP slave must be reparameterized.
1	1	A diagnostic message has been generated. The DP slave will not operate until the error has been removed (static diagnostic message).
2	1	The bit always has the value 1.
3	1	Response monitoring is activated for this DP slave.
4	1	The DP slave has received the "FREEZE" control command. This bit is only updated if you change another diagnostic message as well.
5	1	The DP slave has received the "SYNC" control command.
6	0	The bit always has the value 0.
7	1	The DP slave is deactivated, i.e.,removed from the current process.

Fig.7-10 Structure of station status 2 (byte 1)

Bit	Value	Meaning
0 to 6	0	These bits always have the value 0.
7	1	There are more diagnostic messages than the DP slave can save.

Fig.7-11 Structure of station status 3 (byte 2)

7.2.2 PROFIBUS - Device-Specific Diagnostics

For additional information on device-specific diagnostics, please refer to Chapter "Diagnostics" on page 41.

8 Technical Data and Ordering Data

Technical data for the Inline terminals, FLM and AS-i modules, as well as Fieldline Modular M8 modules can be found in the module-specific data sheets.
The technical data does not claim to be complete.
Technical modifications reserved.

8.1 Technical Data

General data	
Housing dimensions (width x height x depth)	90 mm x 120 mm x 72 mm (with Inline connector)
Weight	210 g (without Inline connector), 240 g (with Inline connector)
Ambient temperature (operation)	-25°C ... +55°C
Ambient temperature (storage/transport)	-25°C ... +85°C
Permissible humidity (operation/storage/transport)	10% ... 95%, according to DIN EN 61131-2
Permissible air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Class of protection	Class III, IEC 61140

System data	
Number of devices per station	63, maximum
Total amount of I/O data per station	184 bytes, maximum in compatible mode 176 bytes, maximum in DP/V1 mode
Maximum PROFIBUS DP/V1 bus coupler current for supplying the logic of I/O terminals	2 A at U_L
Maximum additional current for supplying the analog terminals	0.5 A at U_{ANA}

Interfaces
PROFIBUS
Copper cable (RS-485), connected via D-SUB shield connector; electrically isolated supply; shielding directly connected to functional earth ground.

Main supply U_M	
Connection method	Spring-cage terminal blocks
Recommended cable lengths	30 m, maximum; do not route cable through outdoor areas
Continuation	Through potential routing
Nominal value:	24 V DC
Tolerance	-15% / + 20% (according to EN 61 13 1-2)
Ripple	± 5%
Permissible range	19.2 V to 30 V (ripple included)

Technical Data and Ordering Data

Main supply U_M	
Typical current consumption of the R-IL PB BK DP/V1 without Inline devices at nominal voltage	0.11 A DC (no-load operation, i.e., incoming PROFIBUS plugged in, no Inline devices connected)
Maximum current consumption of the R-IL PB BK DP/V1 without Inline devices at nominal voltage	0.15 A DC (no-load operation, i.e., incoming PROFIBUS plugged in, no Inline devices connected)
Maximum current consumption at nominal voltage	1.25 A DC, consisting of: 0.75 A DC for communications power 0.5 A DC for analog voltage supply
Current carrying capacity (including the supply of Inline devices)	8 A, maximum
Protective measures (for bus coupler supply only)	
Surge voltage	Yes
Polarity reversal	Yes

CAUTION

Provide an external fuse for the 24 V area.

This 24 V area must be externally protected. The power supply unit must be able to supply four times the nominal current of the external fuse, to ensure that it trips in the event of an error.

24 V segment supply U_S	
Connection method	Spring-cage terminal blocks
Recommended cable lengths	30 m, maximum; do not route cable through outdoor areas
Continuation	Through potential routing
Nominal value:	24 V DC
Tolerance	-15% / + 20% (according to EN 61 13 1-2)
Ripple	± 5%
Permissible range	19.2 V DC to 30 V DC (ripple included)
Current carrying capacity	8 A, maximum
Protective measures	
Surge voltage	Yes
Polarity reversal	Yes

CAUTION

Provide an external fuse for the 24 V area.

This 24 V area must be externally protected. The power supply unit must be able to supply four times the nominal current of the external fuse, to ensure that it trips in the event of an error.

Mechanical requirements	
Vibration test sinusoidal vibrations according to IEC 60068-2-6; EN 60068-2-6	5g load, 2 hours for each direction (24 V DC, 120 V AC, 230 V AC areas) 2g load, 2 hours for each direction (400 V AC area)
Shock test according to IEC 60068-2-27; EN 60068-2-27	25g load for 11 ms, half sinusoidal wave, three shocks in each space direction and orientation
Broadband noise according to IEC 60068-2-64; EN 60068-2-64	0.78g load, 2.5 hours in each direction
Insertion/withdrawal cycles	
Terminal block	10 cycles
Connector	10 cycles

Conformance with EMC directive 2004/108/EC		
Noise immunity test according to EN 61000-6-2		
Electrostatic discharge (ESD)	EN 61000-4-2/ IEC 61000-4-2	Criterion B 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	Criterion A All interfaces 1 kV Criterion B All interfaces 2 kV
Surge voltage	EN 61000-4-5/ IEC 61000-4-5	Criterion B Supply lines AC: 2.0 kV/4.0 kV (symmetrical/asymmetrical) DC supply lines: 0.5 kV/0.5 kV (symmetrical/asymmetrical) Signal lines: 1.0 kV/2.0 kV (symmetrical/asymmetrical)
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V
Noise emission test according to EN 61000-6-4		
Noise emission of housing	EN 55011	Class A

Approvals

For the latest approvals, please visit www.boschrexroth.com.

Technical Data and Ordering Data

8.2 Ordering Data

8.2.1 Ordering Data for the Bus Coupler

Description	Type	MNR	Pcs. / Pkt.
Rexroth Inline bus coupler for PROFIBUS-DP, complete with accessories (end plate, connector and labeling field)	R-IL PB BK DP/V1-PAC	R911170971	1

8.2.2 Ordering Data for Accessories

Ordering Data for Inline Terminals and Associated Connectors

For ordering data for Inline terminals and associated connectors, please refer to the online product catalog at www.boschrexroth.com.

8.2.3 Ordering Data for Documentation

Description	Type	MNR	Pcs. / Pkt.
"Automation Terminals of the Rexroth Inline Product Range" application description	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317021	1
"Configuring and Installing the Rexroth Inline Product Range" application description	DOK-CONTRL-IL-SYSPRO***-AW..-EN-P	R911317023	1

9 Technical Appendix

9.1 Error Description

Type	No.	Error cause	Error remedy
1		**Parameter error on PROFIBUS (SET_PRM telegram)**	
	1	An invalid terminal number was used.	Check whether the terminal can be parameterized.
	2	A parameter block is not complete.	The number of terminals does not correspond to the number of parameter blocks.
	3	The data length of the parameter block is too short.	Check the number of parameters.
	4	The data length of the parameter block is too long.	Check the number of parameters.
	5	The internal block for configuration, safety value, and PCP is too small	Check the structure of the parameters for the terminals.
	6	The header byte for the module parameter is incorrect.	Check the first byte of the module parameters.
	7	PCP initialization for a terminal without PCP functions.	Check the configuration.
	8	Too many data blocks for the terminal.	The number of terminals does not correspond to the number of parameter blocks.
	9	Incomplete data block in a deactivated terminal.	Check the number of parameters.

Fig.9-1 Determining the error cause and remedy (parameter error on PROFIBUS)

Type	No.	Error cause	Error remedy
2		**Configuration error on PROFIBUS (CHK_CFG telegram)**	
	1	Not all Inline terminals that are available in the station have been configured.	Add these terminals to the configuration.
	2	More Inline terminals have been configured than are available in the station.	Remove the extra terminals from your configuration or add the missing terminals to the station.
	3	The first byte of the special identification format for the Inline terminal is faulty.	Determine the exact error location using the device-specific diagnostics in your control system.
	4	Not enough bytes of the special identification format for the last Inline terminal have been configured.	Check the identification format.
	5	The sum of the configured process data for inputs and outputs of the station is greater than 184 bytes (DIP8 = OFF) or 176 bytes (DIP8 = ON).	Combine several Inline terminals in the configuration, so that the process data is compressed (resulting in fewer empty bits).
	6	The ID code in the configuration does not correspond to the Inline terminal.	Determine the exact error location using the device-specific diagnostics in your control system. Check the configuration in the hardware configurator.
	7	The length code of the configured Inline terminal does not correspond to the length code of the terminal in the station.	Determine the exact error location using the device-specific diagnostics in your control system. Check the configuration in the hardware configurator.
	8	The amount of manufacturer-specific data of the special identification format for the Inline terminal is incorrect. The amount is 2, 3 or a multiple of 2.	Determine the exact error location using the device-specific diagnostics in your control system.
	9	Not enough OUT process data has been configured within the identification format for the Inline terminal.	Determine the exact error location using the device-specific diagnostics in your control system.
	10	Not enough IN process data has been configured within the identification format for the Inline terminal.	Determine the exact error location using the device-specific diagnostics in your control system.
	11	More than 244 bytes are required for PROFIBUS configuration.	
	12	An internal list is too short.	
	13	Not enough output bytes have been configured for deactivated terminals.	Determine the exact error location using the device-specific diagnostics in your control system.
	14	Not enough input bytes have been configured for deactivated terminals.	Determine the exact error location using the device-specific diagnostics in your control system.

Fig.9-2 Determining the error cause and remedy (configuration error on PROFIBUS)

Type	No.	Error cause	Error remedy
3		**Configuration error in the station**	
	1	The Inline terminal is not enabled for operation on the Bus coupler.	Determine the exact error location using the device-specific diagnostics in your control system.
	2	The length code of the Inline terminal corresponds to a length of 0 bytes.	Determine the exact error location using the device-specific diagnostics in your control system. Check the terminal and, if necessary, remove it from your configuration.
	3	The length code of the Inline terminal corresponds to a length of more than 32 bytes.	Determine the exact error location using the device-specific diagnostics in your control system.
	4	The station contains a module that is not enabled for operation on the bus coupler.	A used module is not enabled for operation on the Bus coupler. Determine the exact error location using the device-specific diagnostics in your control system. Remove the module from the station.
	5	The sum of the process data in the local bus is greater than 250 bytes.	Check the amount of process data and reduce the number of terminals in the station.
	6	There are more than 64 Inline terminals and FLM branch terminals connected.	Check whether more than 64 Inline terminals and FLM branch terminals are available in the station.
	7	The sum of the process data for the inputs and outputs on PROFIBUS is greater than 176 bytes. (184 bytes in DP/V0 mode)	Remove terminals from the station.
	8	More than eight PCP slaves are connected.	Reduce the number of PCP terminals in the station.

Fig.9-3 Determining the error cause and remedy (configuration error in the station)

Type	No.	Error cause	Error remedy
4		**Local bus error within the station**	
	1	An error has occurred in the local bus signal (data IN).	Determine the exact error location locally using the LEDs or the device-specific diagnostics in your control system. Check the connection between the indicated devices.
	2	An error has occurred in the local bus signal (data OUT).	Determine the exact error location locally using the LEDs or the device-specific diagnostics in your control system. Check the connection between the indicated devices.
	3	An error has occurred during data transmission between the Inline terminals. It was not possible to locate the error.	Check the configuration of the station.
	4	The Inline terminal is not ready.	Determine the exact error location using the device-specific diagnostics in your control system. Check the indicated device.
	5	The replaced Inline terminal does not correspond to the length code or ID code.	Remove the terminal from the station. Determine the exact error location using the device-specific diagnostics in your control system.
	6	Another Inline terminal has been added.	Check the configuration of the station. If the configuration is correct, switch off the current supply for a short period, so that the new configuration is accepted.

Fig.9-4 Determining the error cause and remedy (local bus error within the station)

Type	No.	Error cause	Error remedy
5		**Terminal error**	
	1	An error has occurred in your I/O circuit (e.g., short circuit or overload at the actuator).	The station and the PROFIBUS terminal where the I/O error has occurred can be located using the Inline address and the device number. The error location can also be determined using the flashing LED of the Inline terminal, or using the device-specific diagnostics in your control system. Use the terminal data sheet to determine which error triggers this error message. Remove the error from your I/O devices.
	2	Terminal not ready.	Determine the exact error location using the device-specific diagnostics in your control system. Check the indicated device.

Fig.9-5 Determining the error cause and remedy (terminal error)

Type	No.	Error cause
6		**Parameter error on the local bus**
	1	General parameter error ("Initiate")

Fig.9-6 Determining the error cause and remedy (parameter error on the local bus)

Type	No.	Error cause
7		**Error accessing the memory**
	1	Memory not available
	2	Checksum error
	3	Read error
	4	Write error
	5	Initialization
	6	Saved structure differs from the actual structure

Fig.9-7 Error accessing the memory

Technical Appendix

9.2 Format of the Parameter Telegram

This section provides a detailed description of the format of the parameters for the bus coupler and the input and output terminals. This may be useful when setting parameters using acyclic services or if there is no user interface for the simple selection of parameters. One possible application is changing the parameters of failsafe values during operation.

Bytes 1 to 7	DP standard		
Bytes 8 to 10	DP/V1 standard		
Byte 11	Control byte		
	Bit 7	0	Reserved
	Bit 6	0	Do not rotate DI 32 and DO 32 data
		1	Rotate DI 16 and DO 16 data
	Bit 5	0	DXCH only for Global Control OPERATE
		1	DXCH without Global Control OPERATE
	Bit 4	0	Do not rotate DI32 and DO32 data
		1	Rotate DI 16 and DO 16 data
	Bit 3 to bit 2	00	Status PDU
		01	ID-specific terminal diagnostics
		10	Old diagnostics
	Bit 1	0	Automatic error acknowledgment
		1	Must be acknowledged via the acyclic channel
	Bit 0	0	No stop on error
		1	Stop on error

Fig.9-8 Parameters for the bus coupler

Parameterization in data exchange mode is not permitted for the configuration data (measuring range, sensor type, etc.).

The data for the configuration and the failsafe value can be found in the terminal-specific data sheets.

Byte 1	Bit 7 to bit 6	00 Start block ID for device
	Bit 5 to bit 4	Configuration
		00 No configuration (e.g., for DO terminals, no configuration value block)
		01 Permanent configuration
		10 Temporary configuration
	Bit 3 to bit 2	Failsafe value
		00 No failsafe value (e.g., for DI terminals, no failsafe value block)
		01 Zero is output
		10 Hold value
		11 Apply value from data field
	Bit 1	PCP
		0 No PCP block
		1 PCP block
	Bit 0	0 Terminal activated
		1 Terminal deactivated

Fig.9-9 Parameters for the terminals, byte 1

Byte 2	Bit 7 to bit 6	01 Configuration block ID
	Bit 5 to bit 0	Length of the data block
Byte 3 to n		n data bytes

Fig.9-10 Parameters for the terminals

Byte x	Bit 7 to bit 6	10 ID for failsafe value block
	Bit 5 to bit 0	Length of the data block
Byte x to y		n data bytes

Fig.9-11 Parameters for the terminals

Byte x	Bit 7 to bit 6	11 ID for PCP block
	Bit 5 to bit 0	Length of the data block (including index/subindex)
Byte x+1		Index high byte
Byte x+2		Index low byte
Byte x+3		Subindex
Byte x+4 to y		n data bytes

Fig.9-12 Parameters for the terminals

Technical Appendix

9.3 Object Dictionary for the PROFIBUS DP/V1 Bus Coupler

The R-IL PB BK DP/V1 bus coupler includes the following objects:

Slot	Index	Service	Remark
1 to 63	2	Write	Terminal parameters
0	3	Write	Control byte (diagnostic format, manual I/O error acknowledgment, etc.)
0	4	Write	Acknowledgment of local bus event 1: Local bus stop acknowledgment 2: Peripheral fault acknowledgment
0	5	Read/Write	Overview of PCP modules and status
0	6	Read/Write	Activate/deactivate modules
0	7	Read/Write	Activation status of modules
0	8	Read/Write	Station ID
1 to 63	9	Read/Write	Terminal parameters (power up)
0	10	Write	Set active configuration as power up configuration
0	11	Write	Delete saved configuration
0 to 63	47_{dec}	Read/Write	PCP communication with Invoke ID
1 to 63	48_{dec}	Read/Write	PCP communication

Fig.9-13 Objects on the bus coupler

The structure of the objects is as follows:

Index 2: Terminal Parameters

Index 2 can be used on some terminals to change parameters during operation, e.g., to adjust a measuring range.

Please note that changing parameters during operation is not permitted for all terminals.

As described in Table "Parameters for the terminals" on page 103, failsafe and configuration values can be specified here for each I/O terminal. Slot "1 to 63" should be selected to create a reference to the I/O terminal. In the end it is the bus coupler, which makes the connection to the master and therefore index 2 is the parameter that refers to the I/O terminals, which is stored on the bus coupler.

Index 3: Control Byte

The parameter telegram provides a user-specific byte for the bus coupler, which can be used to select the diagnostic format. In addition to transmission in the parameter telegram (byte 11, see "Parameters for the bus coupler" on page 102) it is also possible to specify the byte under index 3 and therefore to change the parameters during operation.

Bit 0	0	No stop on error (local bus)
	1	Stop on error (local bus)
Bit 1	0	Automatic error acknowledgment (e.g., on I/O errors)
	1	Manual acknowledgment required
Bit 3 to bit 2	00	Status PDU format
	01	ID-specific diagnostics
	10	Manufacturer-specific diagnostics (R-IL PB BK format)

Fig.9-14 Index 3: Control Byte

Bit 4	0	DI 16 and DO 16 format byte 1/byte
	1	DI 16 and DO 16 format byte 1/byte
Bit 5	0	Data exchange with broadcast "Operate"
	1	Data exchange without broadcast "Operate"
Bit 6	0	DI 32 and DO 32 format slot 1/2/3/4 - byte 3/2/1/0
	1	DI 32 and DO 32 format slot 1/2/3/4 - byte 3/2/1/0
Bit 7	Reserved	

Fig.9-14 Index 3: Control Byte

As already described in the introduction, the behavior in the event of a local bus error is set via the parameter telegram. Please note that "Stop on error (local bus)" indicates that the local bus switches to the STOP state after 10 consecutive faulty data cycles. In the case of "No stop on error (local bus)", an attempt is made continuously to keep the local bus operating and to automatically restart the local bus following error removal. The set behavior only takes effect in the event of errors in the local bus.

For an explanation of the other parameters, please refer to Chapter 4.7.6.

Index 4: Acknowledgment of Local Bus Event

By default, peripheral faults are acknowledged automatically and the local bus remains in the RUN state whenever possible.

Depending on the application, automatic acknowledgment may not be permitted and special measures may be required. In this case it is possible to respond to bus events manually via index 4. This applies for an error on a terminal (I/O error that has to be acknowledged), and also after a serious error, which prevented further data communication.

Bit 0	Acknowledgment of local bus stop
Bit 1	Peripheral fault acknowledgment
Bit 7 to bit 2	Reserved

Fig.9-15 Index 4: Acknowledgment of Local Bus Event

Index 5: Overview of PCP Terminals and Status

3 bytes are provided for each connected PCP terminal.

Byte 1	Position in the station (slot)
Byte 2	Status of PCP connection
	$0x00_{hex}$: No connection
	$0x01_{hex}$: Connection OK
	$0xFF_{hex}$: Error on connection establishment
Byte 3	Reserved

Fig.9-16 Index 5: Overview of PCP Terminals and Status

Index 5 can be used to request the PCP communication status and even establish communication if all PCP devices do not yet have a connection. To do this, write 01_{hex} to slot 0, index 5.

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Index 6: Activation/Deactivation of Terminals and Slots

Slots can be deactivated via index 6. This setting is stored retentively. During power up, index 6 is adjusted to the configuration and parameterization stored on the PLC. The deactivated terminals are logically ORed. However, this means that some slots will be configured although no terminals are connected to them.

Make sure that no terminals are inserted in "deactivated" slots. Otherwise a configuration error will be displayed.

Byte 1								Byte 2								Bytes 3 to 7	Byte 8						
8	7	6	5	4	3	2	1	16	15	14	13	12	11	20	9	...	x	63	62	60	59	58	57

Fig.9-17 Index 6: Activation/Deactivation of Terminals and Slots

Bit = 1: Terminal and slot inactive

Bit = 0: Terminal and slot active

Index 7: Activation Status of Terminals and Slots

Index 7 can be used to read back which slots have been deactivated. The status is obtained from the parameterization during hardware configuration and index 6 by ORing.

Byte 1								Byte 2								Bytes 3 to 7	Byte 8						
8	7	6	5	4	3	2	1	16	15	14	13	12	11	20	9	...	x	63	62	60	59	58	57

Fig.9-18 Index 7: Activation status of terminals and slots

Bit = 1: Terminal and slot inactive

Bit = 0: Terminal and slot active

Index 8: Read/Write ID

Each R-IL PB BK DP/V1 can be assigned an individual ID. This ID is stored retentively. It can be used to identify a station if it was disconnected from the power supply. This means that several stations can be operated alternately under the same station address in PROFIBUS. The ID can also be read cyclically in the process data.

Structure: Length of 2 bytes

Index 9: Terminal Parameters (Power Up)

Terminal parameters can be stored here if there is a longer period of time between powering up the station and establishing a connection to the PLC, in which failsafe values are to be output, for example. The parameterization from the hardware configurator is then enabled with the PLC parameter telegram.

The format corresponds to the parameters described on page 102.

Index 10: Set Active Configuration as Power Up Configuration

The active configuration is set as the reference configuration. Before the PLC configuration telegram is evaluated, a check is carried out during power up to determine whether the active configuration corresponds to the last configuration used. If it does not correspond, the station is not started. An error is indicated. This is particularly important in conjunction with index 9 (e.g., for retentively stored failsafe values).

Index 11: Delete Saved Configuration

All data that has not been stored retentively can be deleted (write 01_{hex}). The device is thus returned to its default state.

Index 47: PCP Data with Invoke ID

Index 47 is a parameter on the bus coupler. It is used to establish the connection between the master and I/O terminal for DP/V1/PCP communication. It is used when the Invoke ID is to be transmitted.

Index 48: PCP Data

Index 48 is a parameter on the bus coupler. It is used to establish the connection between the master and I/O terminal for DP/V1/PCP communication. The slot number (1 to 63) is required.

Technical Appendix

9.4 Error Codes for DP/V1 and VC1 Communication

Always observe the individual representations in your working environment.

DP/V1 error:

Function code (response) = DE_{hex} (Read error) or DF_{hex} (Write error)

Error decode = 80_{hex} (DP/V1 communication)

Status 44_{hex} indicates an error (for DP/V1 on byte 2 of the data block; for VC1 on byte 2 in the response)

Error_Code_1	Error_Code_2	Error Meaning
$A0_{hex}$	0	Terminal object cannot be read.
$A1_{hex}$	0	Terminal object cannot be written.
$B0_{hex}$	0	Incorrect terminal index
$B1_{hex}$	0	PB PDU length is too short.
$B2_{hex}$	0	Incorrect slot
$B5_{hex}$	0	Terminal is busy.
$B7_{hex}$	0	Error writing to index 47 or 48
$D1_{hex}$	0	No PCP connection
$D2_{hex}$	0	Module has no PCP.
$D3_{hex}$	0	Module timeout
$D4_{hex}$	0	Incorrect service
$D5_{hex}$	0	VC1 sequence incorrect
$D6_{hex}$	0	VC1 length incorrect
Fx_{hex}		Error writing terminal parameters
$F1_{hex}$	0	An invalid terminal number was used.
$F2_{hex}$	0	The parameter block is not complete.
$F3_{hex}$	0	The data length of the parameter block is too short.
$F4_{hex}$	0	The data length of the parameter block is too long
$F5_{hex}$	0	The internal block for configuration, failsafe value, and PCP is too small
$F6_{hex}$	0	The header byte for the terminal parameter block is incorrect.
$F7_{hex}$	0	PCP initialization for a terminal without PCP functions
$F8_{hex}$	0	Too many data blocks for the terminal

Fig.9-19 Error codes for DP/V1 and VC1 communication

9.5 Error Codes for PCP Communication

Meaning	A start or stop command was sent twice.
Cause	This error only occurs on a start or stop service: As the start or stop has already been executed, the service cannot be executed again.
Remedy	No action required.

Fig.9-20 *$05_{hex}/01_{hex}$ (State Conflict)*

Meaning	Access to the object failed due to a hardware fault.
Cause	For example, I/O voltage not present.
Remedy	Remove the hardware fault.

Fig.9-21 *$06_{hex}/02_{hex}$ (Hardware Fault)*

Meaning	The object has limited access rights.
Cause	It may be a read-only object or it may be password-protected.
Remedy	Check the access rights in the object description.

Fig.9-22 *$06_{hex}/03_{hex}$ (Object Access Denied)*

Meaning	A service parameter was specified with an impermissible value.
Cause	For example, an incorrect length specification or subindex that is not permitted.
Remedy	Check the parameters in the object description and send the service again with the corrected values.

Fig.9-23 *$06_{hex}/05_{hex}$ (Object Attribute Inconsistent)*

Communication Error Messages

Meaning	The service used cannot be applied to this object.
Cause	For example, a program sequence can be started or stopped, but not read.
Remedy	Check the object description to find out which services are supported for this object.

Fig.9-24 *$06_{hex}/06_{hex}$ (Object Access Unsupported)*

Meaning	The object does not exist.
Cause	The "Index" parameter probably contains an invalid value.
Remedy	Check the object index in the object description and send the service again.

Fig.9-25 *$06_{hex}/07_{hex}$ (Object Non Existent)*

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Other Error Messages

Meaning	Device-specific error message; no communication error.
Cause	-
Remedy	Refer to your device description.

Fig.9-26 *$08_{hex}/00_{hex}$ (Application Error)*

Meaning	Device-specific error message
Cause	-
Remedy	Refer to your device description.

Fig.9-27 *$09_{hex}/xx_{hex}$ (Firmware Error)*

Depending on the I/O terminal, other specific error codes may also be used. These codes are listed in the relevant data sheet/user manual.

10 Disposal and Environmental Protection

10.1 Disposal

10.1.1 Products

Our products can be returned to us free of charge for disposal. However, it is a precondition 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

10.1.2 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.

10.2 Environmental Protection

10.2.1 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.

10.2.2 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

10.2.3 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.

11 Service & Support

11.1 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

11.2 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).

11.3 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.

11.4 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

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Notes

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