I/O Terminal

Installation Manual

Revision 1.1, June 2011

AKT-PRB-000-000 PROFIBUS Coupler

Keep all manuals as a product component during the life span of the product.
Pass all manuals to future users / owners of the product.

KOLLMORGEN®

Because Motion Matters™

Record of Document Revisions

Revision	Remarks
1.0	Preliminary edition
1.1	Added dimensions to technical data table and mechanical drawing to Appendix B. For more information, see “Technical Data” page 8 and “Appendix B” page 76.

IMPORTANT NOTICE

Disclaimer

The information in this manual was accurate and reliable at the time of its release. However, Kollmorgen. reserves the right to change the specifications of the product described in this manual without notice at any time.

This document contains proprietary and confidential information of Kollmorgen. The contents of the document may not be disclosed to third parties, translated, copied or duplicated in any form, in whole or in part, without the express written permission of Kollmorgen.

Registered Trademarks

Kollmorgen is a registered trademark of Danaher Corp.

June 2011

Appendix B

1 SAFETY PRECAUTIONS

This chapter provides safety information for the I/O terminal.

1.1 Safety Rules

The appropriate staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

1.2 State at Delivery

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify any liability from Kollmorgen.

1.3 Personnel Qualification

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

1.4 Description of Notes and Warnings

The following notes and warnings are used in this manual. They are intended to alert the reader to the associated safety instructions.

Danger — This note is intended to highlight risks for the life or health of personnel.

Warning — This note is intended to highlight risks for equipment, materials or the environment.

Note — Indicates information that contributes to better understanding.

2 OVERVIEW

This section provides an overview of the PROFIBUS Coupler.

Note: For information about configuring the PROFIBUS Coupler, see the Kollmorgen Automation Suite™ IDE software and online help system.

2.1 PROFIBUS Coupler (AKT-PRB-000-000)

The Bus Coupler connects the PROFIBUS system to the electronic terminal blocks, which can be extended in modular fashion. One unit consists of the Bus Coupler, any number of up to 64 terminals and one end terminal. Up to 64 digital input/output terminals can be connected.

The Bus Coupler recognizes the connected terminals and automatically generates the affiliations of the inputs/outputs to the bytes of the process image. The first input/output signal is inserted in the first bit of one byte (LSB), beginning from the left. The Bus Coupler inserts further signals in this byte. Inputs and outputs are clearly separated. The Bus Coupler automatically begins a further byte if the number of inputs or outputs exceeds 8 bits.

The Bus Coupler supports the operation of all Bus Terminals. As far as the user is concerned, handling of the analog inputs/outputs is not different to other series. The information is available in the process image of the controller for processing in the form of a byte array.

The Bus Terminals can be controlled by the control system. Via function blocks (FBs), the programmable logic controller (PLC) or the handles configuration of the complete periphery during the start up phase. If required, the controller can upload the de-centrally created configuration data in order to centrally manage and store this data. Therefore, new adjustments are not necessary in the event of replacement of a Bus Terminal. The controller automatically sets the required setting on power up.

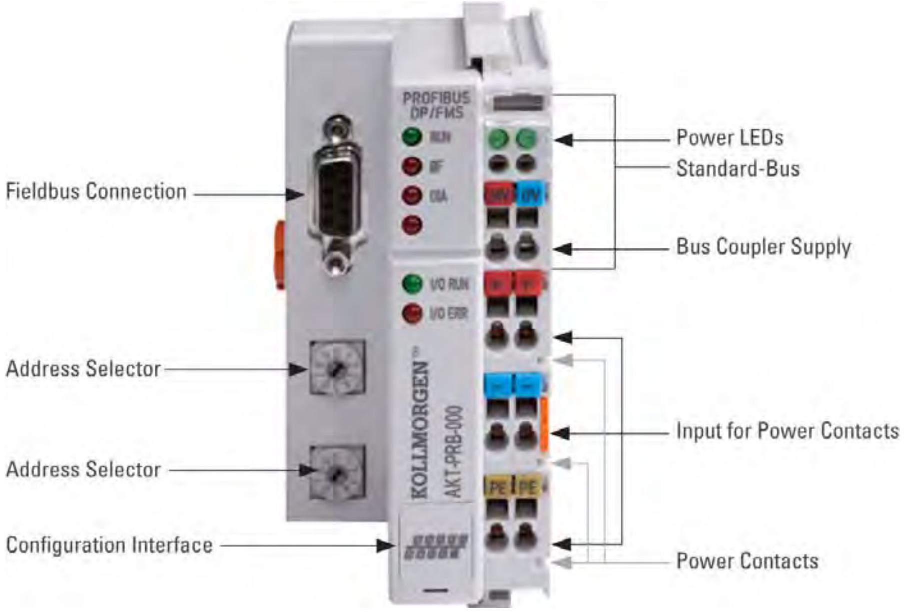


Figure 2.1 PROFIBUS Coupler (Front View)

2.1.1 Technical Data

This section provides the technical details for the ETHERCAT Coupler.

Parameters	(AKT-PRB-000-000)
Number of Bus Terminals	64
Digital peripheral signals	512 inputs/outputs
Analog peripheral signals	128 inputs/outputs
Configuration possibility	IDE software or controller
Maximum number of bytes	64 bytes (DP and FMS operation) 128 bytes (DP operation only)
Baud rate (automatic detection)	Up to max. 12 MBaud
Bus connection	1 x D-sub plug, 9-pin with shielding
Power supply	24 V_{DC} (-15 % /+20 %)
Input current	70 mA + (total Standard-Bus current)/4, max. 500 mA
Starting current	2.5 x continuous current
Standard-Bus current up to	1750 mA (BK3x00)
Power contact voltage (Up)	Maximum 24 V_{DC}
Power contact current load (Up)	Maximum 10 A
Recommended fuse (Up)	Maximum 10 A
Electrical isolation	Power contact / supply / fieldbus
Dielectric strength	500 V_{rms} (power contact / supply / fieldbus)
Dimensions (H × W)	100 × 51 mm
Weight	~150 g
Permissible ambient temperature (operation)	0 °C … +55 °C
Permissible ambient temperature (storage)	-25 °C … +85 °C
Permissible relative humidity	95 % (no condensation)
Vibration / shock resistance	According to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance Burst / ESD	According to EN 61000-6-2 (EN 50082) / EN 61000-6-4 (EN 50081)
Protection class	IP 20
Installation position	Variable

2.2 System Overview

This section provides a system overview for the PROFIBUS Coupler.

2.2.1 Bus Terminal System

Up to 64 Bus Terminals each having 2 I/O Channels for each Signal Form

The Bus Terminal system is the universal interface between a fieldbus system and the sensor / actuator level. A unit consists of a Bus Coupler as the head station, and up to 64 electronic series terminals, the last one being an end terminal. For each technical signal form, terminals are available each having two I/O channels, and these can be mixed in any order. All the terminal types have the same mechanical construction, so that difficulties of planning and design are minimized. The height and depth match the dimensions of compact terminal boxes.

Decentralized Wiring of Each I/O Level

Fieldbus technology allows more compact forms of controller to be used. The I/O level does not have to be brought to the controller. The sensors and actuators can be wired de-centrally, using minimum cable lengths. The controller can be installed at any location within the plant.

Programmable Automation Controllers (PAC)

The use of a PAC as the controller means that the operating and observing element can be implemented in the controller’s hardware. The controller can therefore be located at an operating panel, in a control room, or at some similar place. The Bus Terminals form the decentralized input/output level of the controller in the control cabinet and the subsidiary terminal boxes. The power sector of the plant is also controlled over the bus system in addition to the sensor/actuator level. The Bus Terminal replaces the conventional series terminal as the wiring level in the control cabinet. The control cabinet can have smaller dimensions.

Bus Couplers for all Usual Bus Systems

The Bus Terminal system unites the advantages of a bus system with the possibilities of the compact series terminal. Bus Terminals can be driven within all the usual bus systems, thus reducing the controller parts count. The Bus Terminals then behave like conventional connections for that bus system. All the performance features of the particular bus system are supported.

Assembly on Standardized C Mounting Rails

The easy, space-saving, assembly on a standardized C-rail, and the direct wiring of actuators and sensors, without cross-connections between the terminals, standardizes the installation. The consistent labeling scheme also contributes.

The small physical size and the great flexibility of the Bus Terminal system allow it to be used wherever a series terminal is also used. Every type of connection, such as analog, digital, serial or the direct connection of sensors can be implemented.

Modularity

The modular assembly of the terminal strip with Bus Terminals of various functions limits the number of unused channels to a maximum of one per function. The presence of two channels in one terminal is the optimum compromise of unused channels and the cost of each channel. The possibility of electrical isolation through potential feed terminals also helps to keep the number of unused channels low.

Display of the Channel State

The integrated LEDs show the state of the channel at a location close to the sensors and actuators.

Standard-Bus

The Standard-Bus is the data path within a terminal strip. The Standard--Bus is led through from the Bus Coupler through all the terminals via six contacts on the terminals’ side walls. The end terminal terminates the Standard-Bus. The user does not have to learn anything about the function of the Standard-Bus or about the internal workings of the terminals and the Bus Coupler. Many software tools that can be supplied make project planning, configuration and operation easy.

Potential Feed Terminals for Isolated Groups

The operating voltage is passed on to following terminals via three power contacts. You can divide the terminal strip into arbitrary isolated groups by means of potential feed terminals. The potential feed terminals play no part in the control of the terminals, and can be inserted at any locations within the terminal strip.

Up to 64 terminals can be used within one terminal strip. This count does include potential feed terminals, but not the end terminal.

Bus Couplers for Various Fieldbus Systems

Various Bus Couplers can be used to couple the electronic terminal strip quickly and easily to different fieldbus systems. It is also possible to convert to another fieldbus system at a later time. The bus coupler performs all the monitoring and control tasks that are necessary for operation of the connected Bus Terminals. The operation and configuration of the Bus Terminals is carried out exclusively by the Bus Coupler. Nevertheless, the parameters that have been set are stored in each Bus Terminal, and are retained in the event of voltage drop-out. Fieldbus, Standard--Bus and I/O level are electrically isolated.

If the exchange of data over the fieldbus is prone to errors or fails for a period of time, register contents (such as counter states) are retained, digital outputs are cleared, and analog outputs take a value that can be configured for each output when commissioning. The default setting for analog outputs is 0 V or 0 mA. Digital outputs return in the inactive state. The timeout periods for the Bus Couplers correspond to the usual settings for the fieldbus system. When converting to a different bus system it is necessary to bear in mind the need to change the timeout periods if the bus cycle time is longer.

The Interfaces

A Bus Coupler has six different methods of connection. These interfaces are designed as plug connectors and as spring-loaded terminals.

2.3 PROFIBUS DP

In PROFIBUS DP systems, a master (PLC, PC etc.) usually communicates with a large number of slaves (I/Os, drives etc.). Only the master may here actively access the bus (send telegrams on its own initiative), while a DP slave only sends telegrams when it is requested to do so by a master.

DP StartUp

Before the master and slave can cyclically exchange data, the parameter and configuration data is transmitted from the master to the slaves during the DP StartUp phase. After the parameter and configuration data has been sent, the master interrogates the slave's diagnostic data until the slave indicates that it is ready for data exchange. Depending on the extent of the calculations that the slave must carry out after receiving the parameter and configuration data, it can take up to a few seconds before it is ready for data exchange. For this reason the slave possesses the following states:

Parameter Data

The parameter data is sent from the master to the slave in the SetPrmLock request telegram. The SetPrmLock response telegram does not contain any data, and therefore consists of a single byte, the short acknowledgement. The parameter data consists of DP parameters (e.g. the setting of the DP watchdog or checking the IdentNumber (unique to each DP device)), of DPV1-/DPV2 parameters and of application-specific parameters that only have to be transmitted once during the StartUp. If an error is found in the parameter data, this is indicated in the diagnostic data, and the slave either remains in or enters the WAIT-PRM state.

Configuration Data

The configuration data is sent from the master to the slave in the ChkCfg request telegram. The ChkCfg response telegram does not contain any data, and therefore consists of a single byte, the short acknowledgement. The configuration data describes the assignment of the DP modules to the cyclic I/O data that is to be exchanged between the master and slave via the Data_Exchange telegram in the cyclic data exchange phase. The sequence of the DP modules added to a slave in the DP configuration tool determines the sequence of the associated I/O data in the Data_Exchange telegram.

Diagnostic data

The diagnostic data is requested by the master using a SlaveDiag request telegram without any data. The slave replies with the diagnostic data in a SlaveDiag response telegram. The diagnostic data consists of the standard DP diagnostics (e.g. the state of the slave, the IdentNumber) and of application-specific diagnostic data.

Cyclic Data Exchange

The heart of the PROFIBUS DP protocol is cyclic data exchange, during which the master carries out an exchange of I/O data with every slave during a PROFIBUS DP cycle. This involves the master sending the outputs to each slave with a DataExchange request telegram, while the slave replies with the inputs in a DataExchange response telegram. This means that all the output and/or input data is transmitted in one telegram, in which the DP configuration (the sequence of DP modules) specifies the assignment of the output and/or input data to the slave's actual process data.

Diagnosis During Cyclic Data Exchange

A slave can send a diagnostics signal to the master during cyclic data exchange. In this case, the slave sets a flag in the DataExchange response telegram, whereby the master recognizes that there is new diagnostic data in the slave. It then fetches that data in the SlaveDiag telegram. This means that diagnostic data is not transmitted to the controller with the cyclic I/O data in real-time, but is always at least one DP cycle later.

Synchronization with Sync and Freeze

The Sync and Freeze commands in the GlobalControl request telegram (broadcast telegram) allow the master to synchronize the activation of the outputs (Sync) or the reading of the inputs (Freeze) in a number of slaves. When the Sync command is used, the slaves are first switched into Sync mode (a process that is acknowledged in the diagnostic data). The I/O data is then exchanged sequentially with the slaves in the DataExchange telegram. Transmitting the Sync command in the GlobalControl telegram then has the effect of causing the slaves to generate the most recently received outputs. In Freeze operation a Freeze command is first sent in the GlobalControl telegram, in response to which all the slaves latch their inputs. These are then fetched sequentially by the master in the DataExchange telegram.

States in the Master

The master distinguishes between the CLEAR state (all outputs are set to the Fail_Safe value) and the OPERATE state (all outputs have the process value). The Master is usually switched into the CLEAR mode when, for instance, the PLC enters STOP.

Class 1 and Class 2 DP Masters

The Class 1 master refers to the controller that carries out cyclic I/O data exchange with the slaves, while a Class 2 master is a B&B device that generally only has read access to the slaves' I/O data.

2.4 PROFIBUS DPV1

PROFIBUS DPV1 refers primarily to the acyclic read and write telegrams, with which data sets in the slave are cyclically accessed. A distinction between a Class 1 and a Class 2 master is also made for DPV1. The difference between acyclic Class 1 (C1) and Class 2 (C2) connections is that the acyclic C1 connection is established during the DP StartUp phase of cyclic DP operation. Once the slave has reached the WAIT-CFG state it is possible for acyclic DPV1-C1 read and write telegrams to be sent from the master to the slave, whereas the C2 connection is established separately, independently of the cyclic DP connection. This is usually carried out by a second (C2) master so that, for instance, a manufacturer-specific project configuration and diagnostic tool can access the slave's data.

When two masters are used, however, is must always be borne in mind that these share bus access (a token is exchanged), so that time relationships are less favorable than in the case of a single master system.

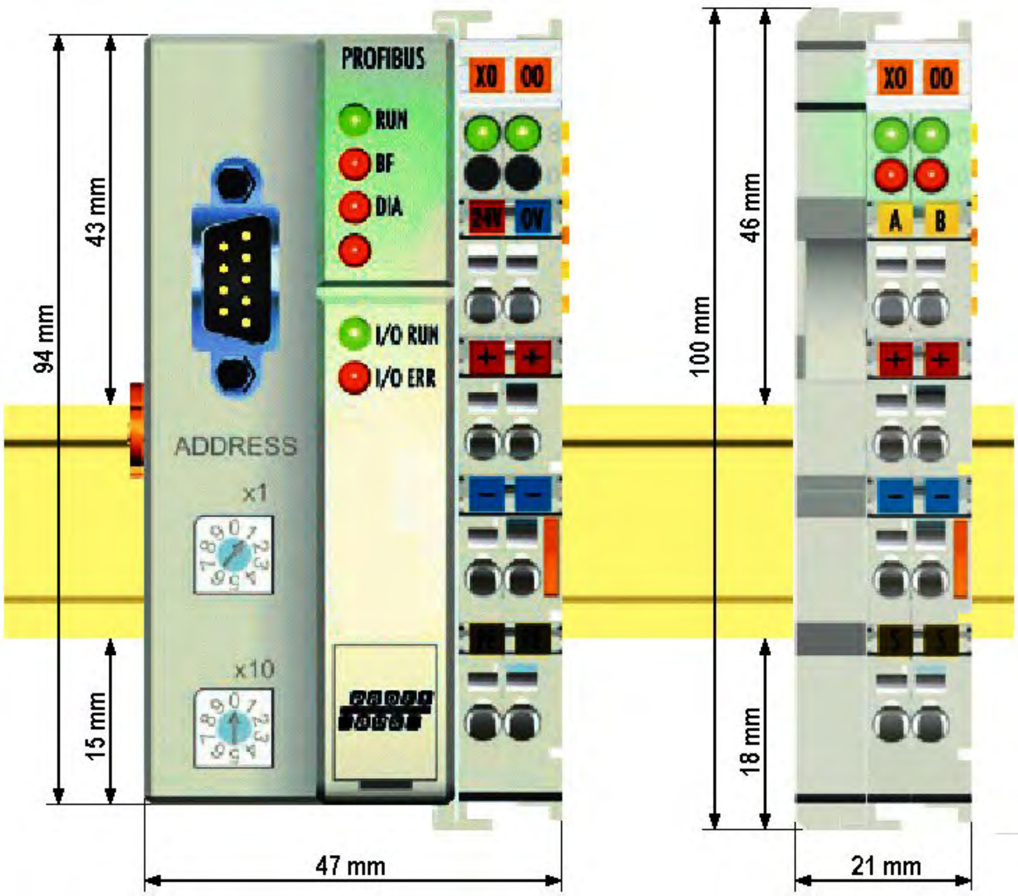
3 MOUNTING AND WIRING

This section provides mounting and wiring information for the PROFIBUS Coupler.

Note: For information about configuring the PROFIBUS Coupler, see the Kollmorgen Automation Suite™ IDE software and online help system.

3.1 Dimensions

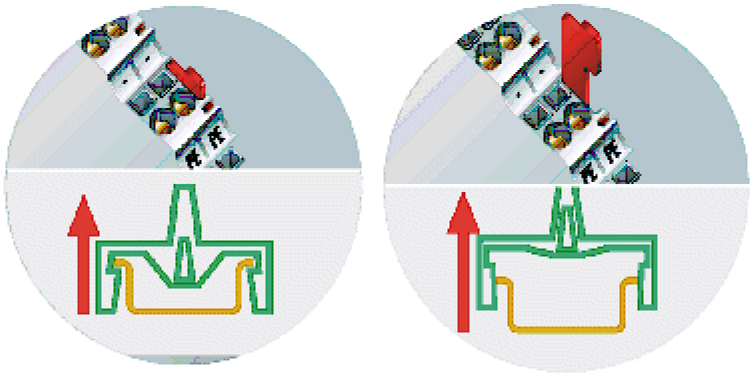
The system of the Bus Terminals is characterized by low physical volume and high modularity. When planning a project it must be assumed that at least one Bus Coupler and a number of Bus Terminals will be used. The mechanical dimensions of the Bus Couplers are independent of the fieldbus system.



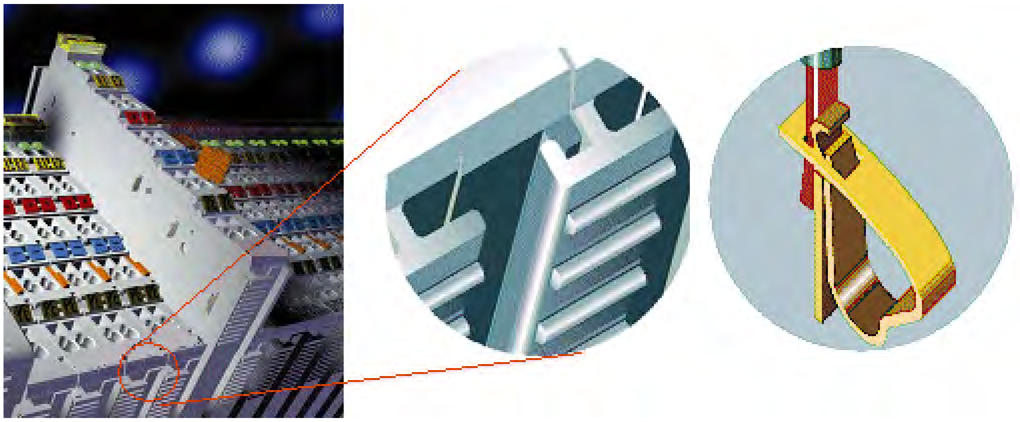
The total width in practical cases is composed of the width of the Bus Coupler with the Bus End Terminal and the width of the Bus Terminals in use. Depending on function, the Bus Terminals are 12 or 24 mm wide. The front wiring increases the total height of 68 mm by about 5 to 10 mm, depending on the wire thickness.

3.2 Installation

The Bus Coupler and all the Bus Terminals can be clipped, with a light press, onto a 35 mm mounting rail. A locking mechanism prevents the individual housings from being pulled off again. For removal from the mounting rail the orange colored tension strap releases the latching mechanism, allowing the housing to be pulled off the rail without any force.



Up to 64 Bus Terminals can be attached to the Bus Coupler on the right hand side. When plugging the components together, be sure to assemble the housings with groove and tongue against each other. A properly working connection can not be made by pushing the housings together on the mounting rail. When correctly assembled, no significant gap can be seen between the attached housings.



WARNING!! Insertion and removal of Bus Terminals is only permitted when switched off. The electronics in the Bus Terminals and in the Bus Coupler are protected to a large measure against damage, but incorrect function and damage cannot be ruled out if they are plugged in under power.

The right hand part of the Bus Coupler can be compared to a Bus Terminal. Eight connections at the top enable the connection with solid or fine wires from 0.08 mm² to 2.5 mm². The connection is implemented with the aid of a spring device. The spring-loaded terminal is opened with a screwdriver or rod, by exerting gentle pressure in the opening above the terminal. The wire can be inserted into the terminal without any force. The terminal closes automatically when the pressure is released, holding the wire securely and permanently.

3.3 Wiring

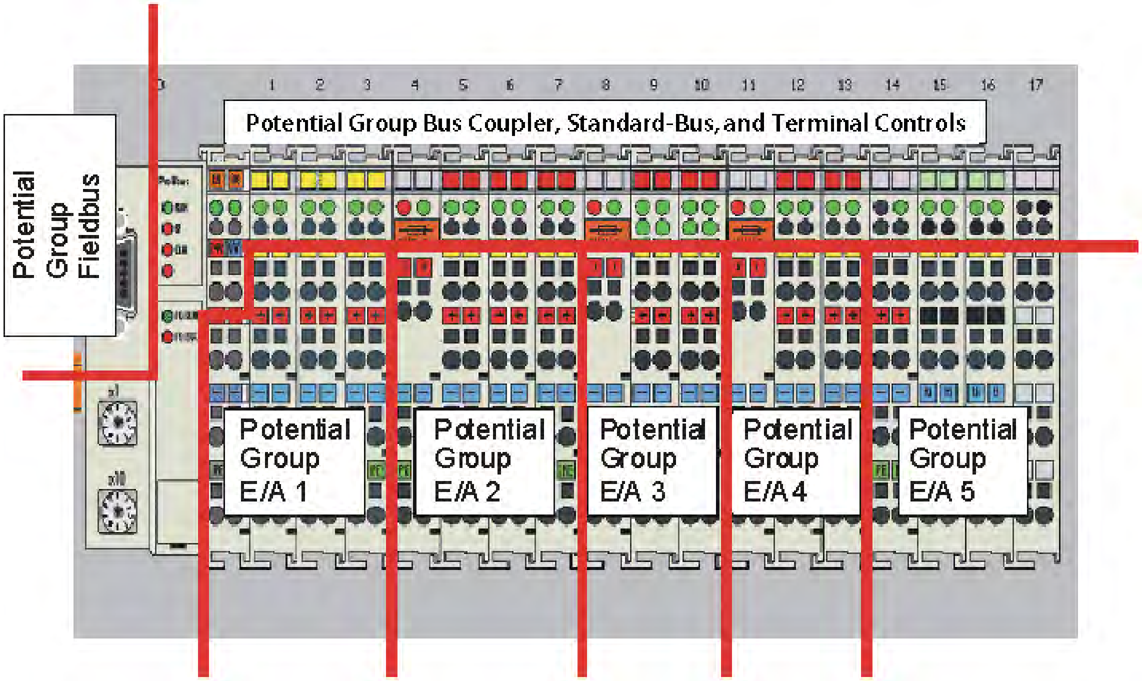
The section provides potential groups, insulation testing, and PE information for the PROFIBUS Coupler.

3.3.1 Potential Groups

The Bus Terminals stations usually have three different potential groups:

- The fieldbus interface is electrically isolated (except for individual Low Cost couplers) and forms the first potential group
- Bus Coupler / Bus Terminal Controller logic, Standard-Bus and terminal logic form a second galvanically separated potential group
- The inputs and outputs are supplied via the power contacts and form further potential groups.

Groups of I/O terminals can be consolidated to further potential groups via potential supply terminals or separation terminals.



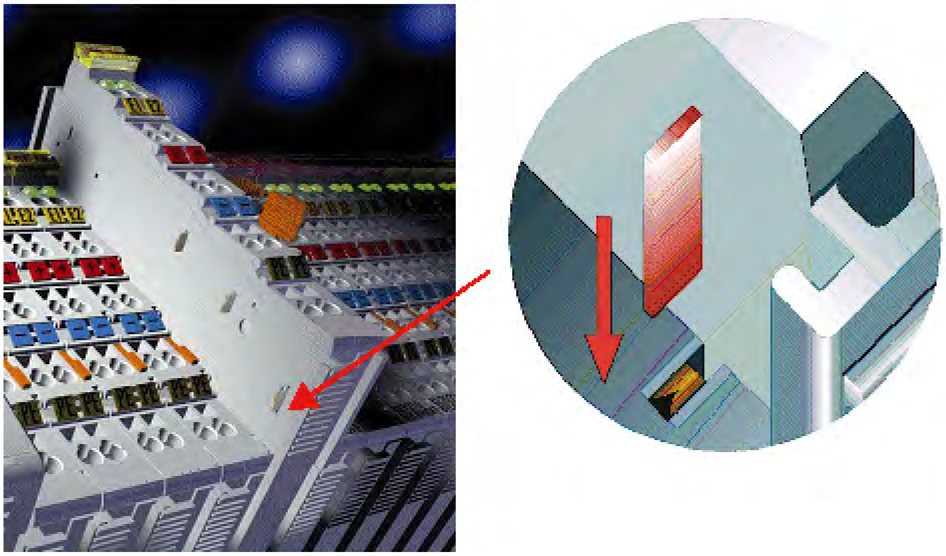
3.3.2 Insulating Testing

The connection between the Bus Coupler / Bus Terminal Controller and the Bus Terminals is automatically realized by pushing the components together. The transfer of the data and the supply voltage for the intelligent electronics in the Bus Terminals is performed by the Standard-Bus. The supply of the field electronics is performed through the power contacts. Plugging together the power contacts creates a supply rail. Since some Bus Terminals (e.g. analog Bus Terminals or 4-channel digital Bus Terminals) are not looped through these power contacts (or not completely) the Bus Terminal contact assignments must be considered.

The potential feed terminals interrupt the power contacts, and represent the start of a new supply rail. The Bus Coupler / Bus Terminal Controller can also be made use of to feed the power contacts.

3.3.3 PE Power Contacts

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.



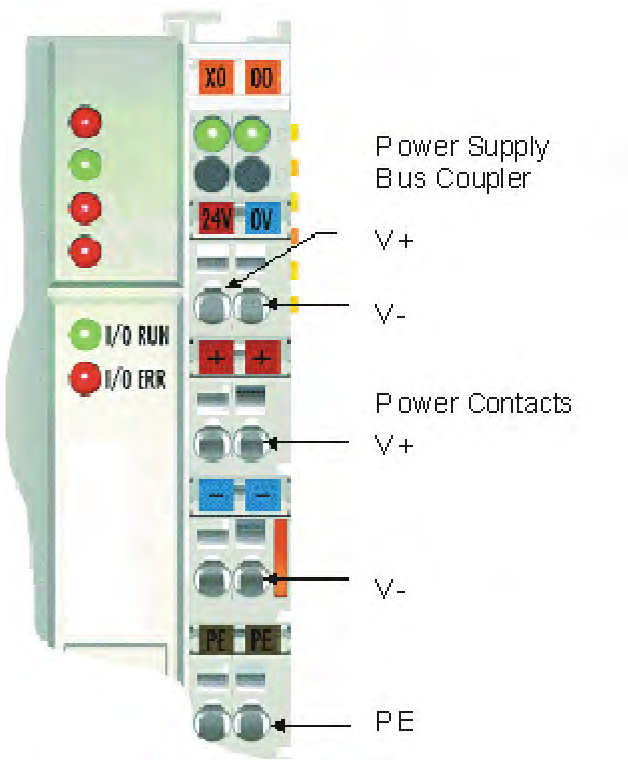
It should be noted that, for reasons of electromagnetic compatibility, the PE contacts are capacitively coupled to the mounting rail. This can both lead to misleading results and to damaging the terminal during insulation testing (e.g. breakdown of the insulation from a 230 V power consuming device to the PE conductor). The PE conductor to the Bus Coupler / Bus Terminal Controller must be disconnected for the insulation testing. In order to uncouple further feed locations for the purposes of testing, the feed terminals can be pulled at least 10 mm out from the connected group of other terminals. In that case, the PE conductors do not have to be disconnected.

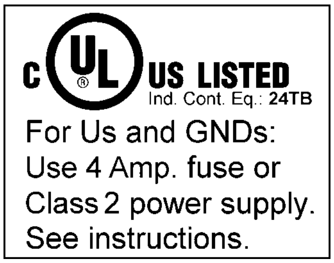
The PE power contact must not be used for other potentials.

3.4 Power Supply

The Bus Coupler / Bus Terminal Controller require a 24 VDC supply for their operation.

The connection is made by means of the upper spring-loaded terminals labeled 24 V and 0 V. This supply voltage feeds the Bus Coupler / Bus Terminal Controller electronics and, over the Standard-Bus, the electronics of the Bus Terminals. It is electrically separated from the potential of the field level.





DANGER!! For the compliance of the UL requirements Us should only be supplied:

- By a 24 VDC supply voltage, supplied by an isolating source and protected by means of a fuse (in accordance with UL248), rated maximum 4 Amp.

- By a 24 VDC power source, that has to satisfy NEC class 2.

  A NEC class 2 power supply shall not be connected in series or parallel with another (class 2) power source!

3.4.1 Power Contacts Supply (Up)

The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The feed for the power contacts has no connection to the voltage supply for the Bus Coupler / Bus Terminal Controller.

The spring-loaded terminals are designed for wires with cross-sections between 0.08 mm^2 and 2.5 mm^2.

The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points. The current drawn from the power contact must not exceed 10 A for long periods. The current carrying capacity between two spring-loaded terminals is identical to that of the connecting wires.

3.4.2 Power Contacts

On the right hand face of the Bus Coupler / Bus Terminal Controller there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they can not be accidentally touched. By attaching a Bus Terminal the blade contacts on the left hand side of the Bus Terminal are connected to the spring contacts. The tongue and groove guides on the top and bottom of the Bus Coupler / Bus Terminal Controller and of the Bus Terminals enables that the power contacts mate securely.

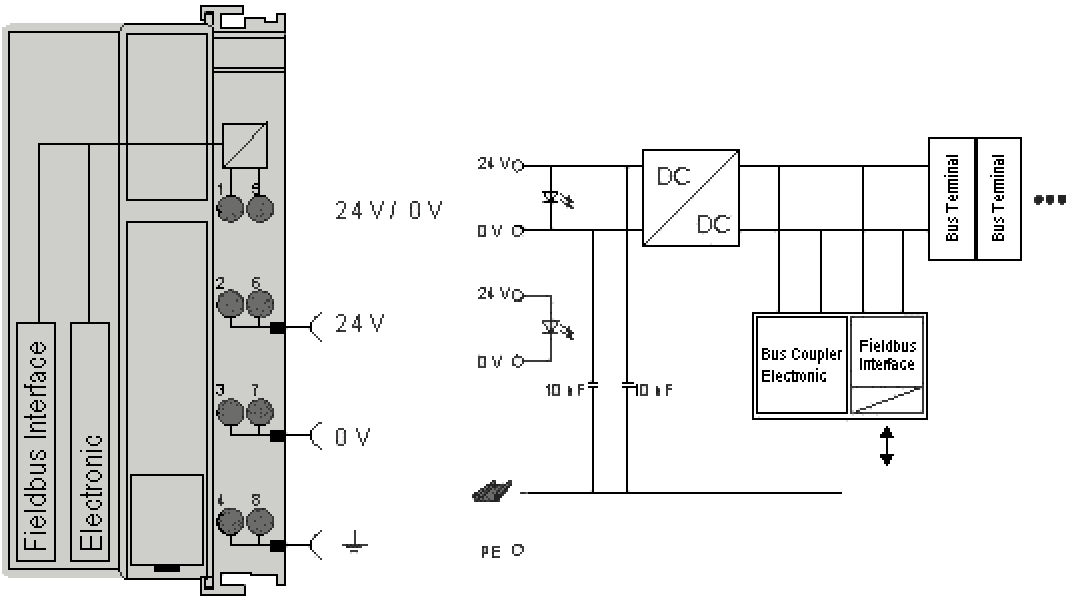
3.4.3 Configuration and Programming Interface

The Bus Coupler / Bus Terminal Controller have an RS232 interface at the bottom of the front face. The miniature connector can be joined to a PC IDE software with the aid of a connecting cable. The interface permits the Bus Terminals to be configured, for example adjusting the amplification factors of the analog channels. The interface can also be used to change the assignments of the bus terminal data to the process image in the Bus Coupler. The functionality of the configuration interface can also be reached via the fieldbus using string communication facility.

3.4.4 Electrical Isolation

The Bus Coupler / Bus Terminal Controller operate by means of three independent potential groups. The supply voltage feeds the Standard-Bus electronics and the Standard-Bus itself. The supply voltage is also used to generate the operating voltage for the fieldbus interface.

Remark: All the Bus Terminals are electrically isolated from the Standard-Bus. The Standard-Bus is thus electrically isolated from everything else.



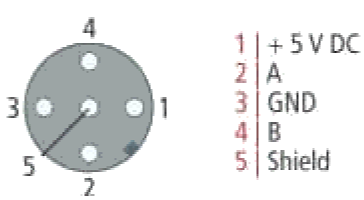
3.5 PROFIBUS Connection

This section provides information about the PROFIBUS connection for the PROFIBUS Coupler.

3.5.1 M12 Circular Connector

The M12 socket is inverse coded, and has five pins. Pin 1 is 5 VDC and 3 is GND for the active termination resistor. These must never be misused for other functions, as this can lead to destruction of the device. Pin 2 and pin 4 are the Profibus signals. These must never be swapped over, as this will prevent communication. Pin 5 is the shield, and this is capacitatively coupled to the Fieldbus Box chassis.

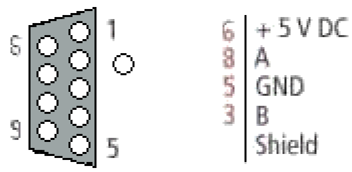
M12 Socket Pin Assignment



3.5.2 Nine Pole D-Sub

Pin 6 is 5 VDC und Pin 5 is GND for the active termination resistor. These must never be misused for other functions, as this can lead to destruction of the device. Pin 3 and pin 8 are the Profibus signals. These must never be swapped over, as this will prevent communication. Shield is connected to the D-Sub housing that is coupled with low-resistance to the mounting rail.

D-Sub Socket Assignment



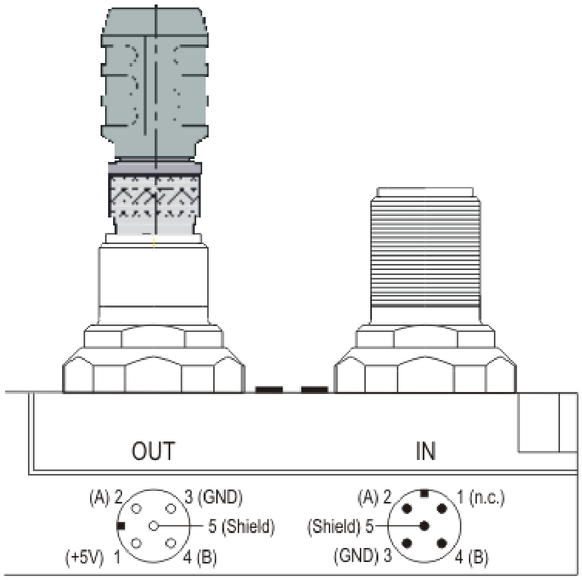
3.5.3 PROFIBUS Conductor Colors

PROFIBUS Conductors	M12	D-Sub
B Red	Pin 4	Pin 3
A Green	Pin 2	Pin 8

3.5.4 Connection of Fieldbus Box Modules

The connection of the Fieldbus Box modules is done direct or via a T-piece (or Y-piece).

The B318 series does have a male and female connector, that means no external T-piece is required. The supply voltage (+5VDC) for the termination resistor is only supplied via the female M12 connector. The termination resistor is only available with male connector, therefore the incoming PROFIBUS line should end in a female connector.



Two T-pieces are available:

- +5VDC on male and female connector for the termination resistor
- +5VDC only on the female connector

3.6 PROFIBUS Cabling

Physical aspects of the data transmission are defined in the Profibus standard (see Profibus layer 1: Physical Layer).

The types of area where a fieldbus system can be used is largely determined by the choice of the transmission medium and the physical bus interface. In addition to the requirements for transmission security, the expense and work involved in acquiring and installing the bus cable is of crucial significance. The Profibus standard therefore allows for a variety of implementations of the transmission technology while retaining a uniform bus protocol.

3.6.1 Cable-Based Transmission

This version, which accords with the American EIA RS-485 standard, was specified as a basic version for applications in production engineering, building management and drive technology. A twisted copper cable with one pair of conductors is used. Depending on the intended application area (EMC aspects should be considered) the screening may be omitted.

Two types of conductor are available, with differing maximum conductor lengths (see the RS-485 table).

RS485 - Fundamental Properties

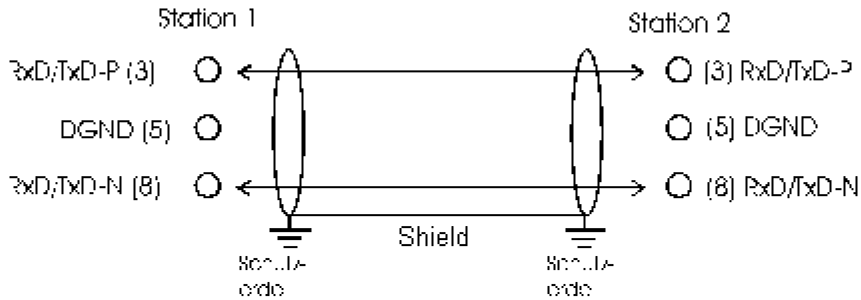
RS-485 Transmission According to the Profibus Standard	
Network topology	Linear bus, active bus terminator at both ends, stubs are possible.
Medium	Screened twisted cable, screening may be omitted, depending upon the environmental conditions (EMC).
Number of stations	32 stations in each segment with no repeater. Can be extended to 127 stations with repeater
Maximum bus length without repeater	100 m at 12 MBit/s 200 m at 1500 KBit/s, up to 1.2 km at 93.75 KBit/s
Maximum bus length with repeater	Line amplifiers, or repeaters, can increase the bus length up to 10 km. The number of repeaters possible is at least 3, and, depending on the manufacturer, may be up to 10.
Transmission speed (adjustable in steps)	9.6 kBit/s; 19.2 kBit/s; 93.75 kBit/s; 187.5 kBit/s; 500 kBit/s; 1500 kBit/s; 12 MBit/s
Plug connector	9-pin D-Sub connector for IP20 M12 round connector for IP65/67

3.6.2 Cabling for Profibus DP and Profibus FMS

Note the special requirements on the data cable for baud rates greater than 1.5 MBaud. The correct cable is a basic requirement for correct operation of the bus system. If a simple 1.5 Mbaud cable is used, reflections and excessive attenuation can lead to some surprising phenomena. It is possible, for instance, for a connected Profibus station not to achieve a connection, but for it to be included again when the neighboring station is disconnected. Or there may be transmission errors when a specific bit pattern is transmitted. The result of this can be that when the equipment is not operating, Profibus works without faults, but that there are apparently random bus errors after start-up. Reducing the baud rate (< 93,75 kBaud) corrects this faulty behavior.

If reducing the baud rate does not correct the error, then in many cases this can indicate a wiring fault. The two data lines maybe crossed over at one or more connectors, or the termination resistors may not be active, or they may be active at the wrong locations.

Note: Installation is made a great deal more straightforward if pre-assembled cables are used! Wiring errors are avoided, and commissioning is more rapidly completed. The range includes fieldbus cables, power supply cables, sensor cables and accessories such as terminating resistors and T-pieces. Connectors and cables for field assembly are nevertheless also available.



Note: In systems with more than two stations all devices are wired in parallel. It is essential that the bus cables are terminated with resistors at the conductor ends in order to avoid reflections and associated transmission problems.

3.6.3 Distances

The bus cable is specified in EN 50170. This yields the following lengths for a bus segment.

Baud Rate in kbits/sec	9.6	19.2	93.75	187.5	500	1500	12000
Cable length in m	1200	1200	1200	1000	400	200	100

Stubs up to 1500 kbaud <6.6 m; at 12 Mbaud stub segments should not be used.

3.6.4 Bus Segments

A bus segment consists of at most 32 devices. 126 devices are permitted in a Profibus network. Repeaters are required to refresh the signal in order to achieve this number. Each repeater is counted as one device.

IP-Link is the subsidiary bus system for Fieldbus Boxes, whose topology is a ring structure. There is an IP master in the coupler modules to which up to 120 extension modules may be connected. The distance between two modules may not exceed 5 m. When planning and installing the modules, remember that because of the ring structure the IP-Link master must be connected again to the last module.

3.6.5 Installation Guidelines

When assembling the modules and laying the cables, observe the technical guidelines provided by the Profibus User Organization for Profibus DP/FMS (see www.profibus.com).

3.6.6 Checking the Profibus Wiring

A Profibus cable (or a cable segment when using repeaters) can be checked with a few simple resistance measurements. The cable should meanwhile be removed from all stations:

1. Resistance between A and B at the start of the lead: approx. 110 Ohm
2. Resistance between A and B at the end of the lead: approx. 110 Ohm
3. Resistance between A at the start and A at the end of the lead: approx. 0 Ohm
4. Resistance between B at the start and B at the end of the lead: approx. 0 Ohm
5. Resistance between screen at the start and screen at the end of the lead: approx. 0 Ohm

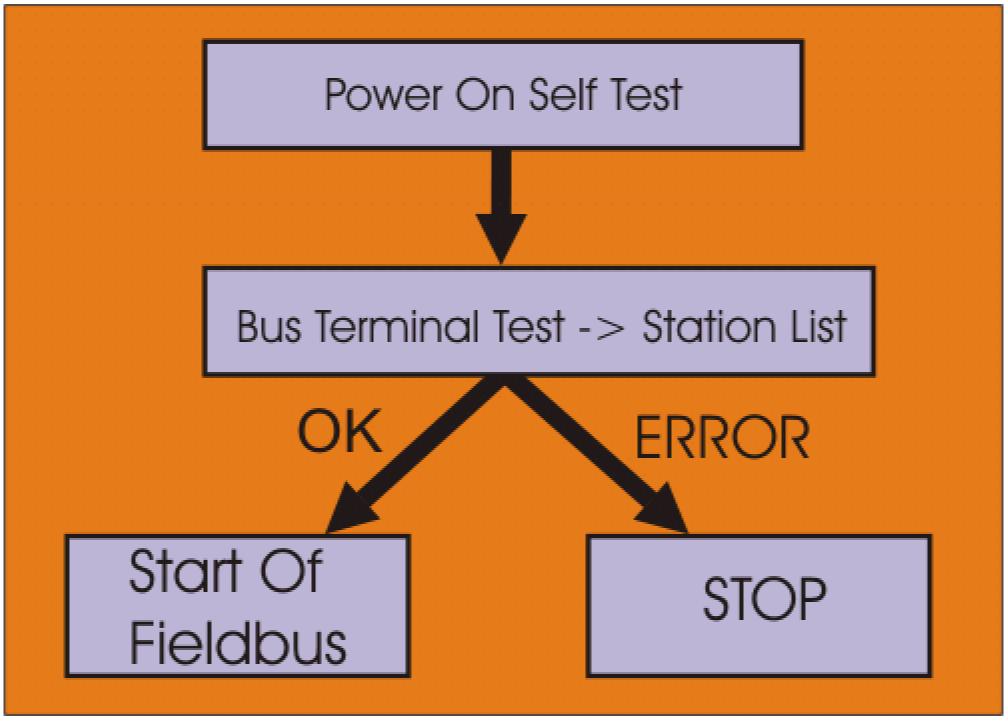
If these measurements are successful, the cable is okay. If, in spite of this, bus malfunctions still occur, this is usually a result of EMC interference. Observe the installation notes from the Profibus User Organization (www.profibus.com).

4 START-UP BEHAVIOR OF THE BUS COUPLER

This chapter describes the start-up behavior of the bus coupler.

4.1 Self-Test

Immediately after being switched on, the Bus Coupler checks, in the course of a self test, all the functions of its components and the communication on the Standard-Bus. The red I/O LED blinks while this is happening After completion of the self-test, the Bus Coupler starts to test the attached Bus Terminals (the Bus Terminal Test), and reads in the configuration. The Bus Terminal configuration is used to generate an internal structure list, which is not accessible from outside. In case of an error, the Bus Coupler enters the STOP state. Once the start-up has completed without error, the Bus Coupler enters the fieldbus start state.



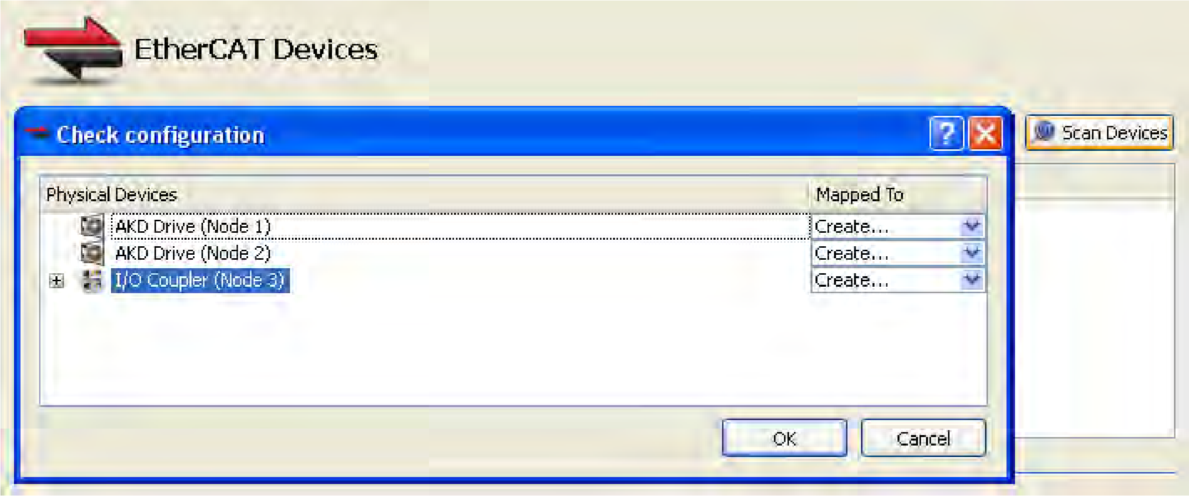
The Bus Coupler can be made to enter the normal operating state by switching it on again once the fault has been rectified.

5 AUTOMATIC CONFIGURATION

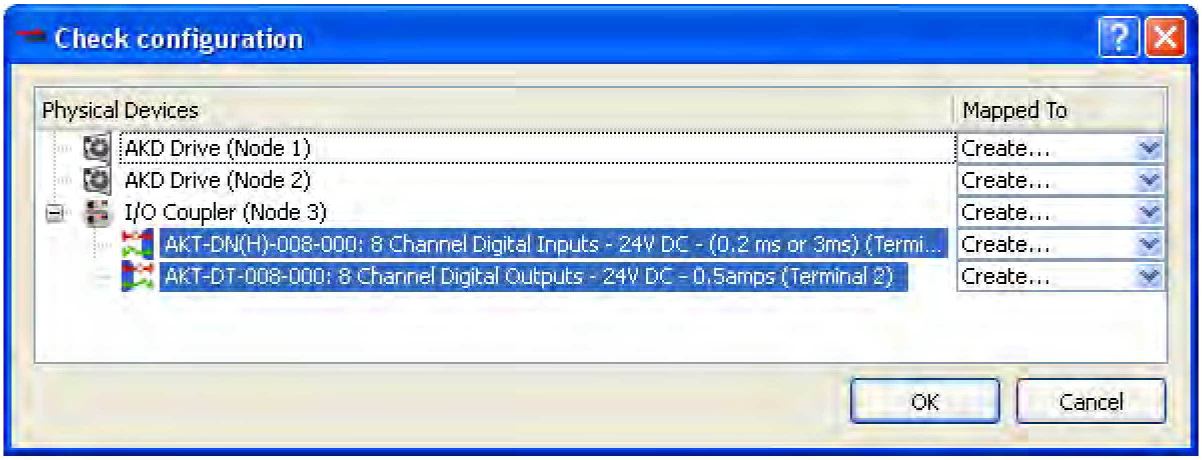
This section describes the basics of automatic configuration within the KAS Integrated Development Environment (IDE).

5.1 Scan Devices

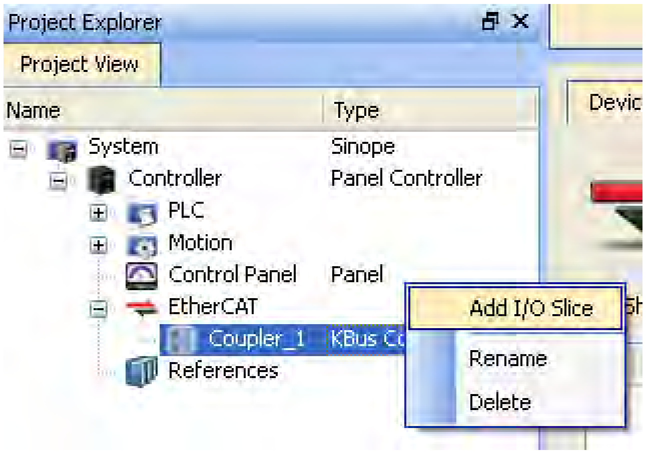
For ease-of-use the KAS IDE Scan Device feature provides automatic integration of I/O devices. This allows you to automatically locate and add I/O couplers to the application project:



Additionally, Scan Device will locate and add I/O slices to the application project:



Also, I/O slices can also be added in the project explorer of the IDE:



For more detailed information on these procedures refer to the section “EtherCAT Scan Device” in the KAS IDE online help.

6 MANUAL CONFIGURATION

Kollmorgen strongly recommends automatic configuration using the KAS IDE over manual configuration. For automatic configuration refer to section 4.2. Manual configuration is for advanced procedures only. The following sections provide the necessary configuration information to manually map the I/O device.

Note: For parameterization of the Profibus coupler in the DP configuration tool refer to the GSE file in the Appendix.

6.1 The Bus Coupler's UserPrmData

The following settings can be made in the Bus Coupler's UserPrmData. So that a more easily understood GSE file is obtained in 90% of applications, some of the settings are only contained in text form in the extended GSE file, and these are indicated in the last column by Extended. The standard settings are contained both in the standard and the extended GSE file.

Byte	Bit	Value	Description	GSE file
0	7	0_{bin}	MSAC_C1 connection is not active (default)	Standard
		1_{bin}	MSAC_C1 connection is active (see DPV1)	
1	0	0_{bin}	CfgData checking is active (default)	Extended
		1_{bin}	CfgData checking is deactivated (see Deactivating the CfgData checking)	
2	3	0_{bin}	Diagnostic data is transferred in a form compatible with the AKT-PRB-000-000	Extended
		1_{bin}	Diagnostic data is transferred in a form compatible with the DPV1 (default)	
3	3	0_{bin}	Multi-configuration mode is not active (default)	Extended
		1_{bin}	Multi-configuration mode is active (see Multi-configuration mode)	
3	4	0_{bin}	Standard-Bus cycle counter is not active (default)	Extended
		1_{bin}	Standard-Bus cycle counter is active (see Standard-Bus cycle)	
3	5	0_{bin}	Dummy output byte not active (default)	Extended
		1_{bin}	Dummy output byte is active (see Standard-Bus cycle)	

Byte	Bit	Value	Description	GSE file
3	6	0_{bin}	In multi-configuration mode, the coupler sets the Stat_Diag bit in the diagnostic data if the configuration is not consistent, and does not yet enter data exchange (default).	Extended
		1_{bin}	In multi-configuration mode the coupler also enters data exchange even when the configuration is not consistent, although Standard-Bus cycles are not yet executed (see Multi-configuration mode)	
5	0	0_{bin}	2-byte PLC interface not activated (default)	Extended
		1_{bin}	2-byte PLC interface is active (see 2-byte PLC interface)	
7	0	0_{bin}	Response to Standard-Bus error: manual Standard-Bus reset (default) (see Standard-Bus interruption)	Standard
		1_{bin}	Response to Standard-Bus error: automatic Standard-Bus reset	
7	1	0_{bin}	Terminal diagnosis is not active (default) (see Terminal diagnosis)	Standard
		1_{bin}	Terminal diagnosis is active	
7	4	0_{bin}	Diagnostic data for digital terminals included in process image (default) (see Terminal diagnosis)	Standard
		1_{bin}	Diagnostic data of digital terminals not in the process image (default)	
9	2	0_{bin}	Analog modules are mapped in compact form (only showing the input and/or output user data) (this is the default, only relevant when CfgData checking has been deactivated, otherwise the terminals are set by means of the CfgData) (see Deactivation of CfgData checking)	Extended
		1_{bin}	Analog modules are mapped in complex form (with control/status for register access and with the same data length in inputs and outputs) (only relevant when CfgData checking has been deactivated, otherwise the terminals are set by means of the CfgData)	
9	3	0_{bin}	Representation in INTEL format	Standard

Byte	Bit	Value	Description	GSE file
		1_{bin}	Representation in Motorola format (default)	
9	4	0_{bin}	Standard-Bus mode slow FreeRun (default) (see Standard-Bus cycle)	Standard
		1_{bin}	Standard-Bus mode fast FreeRun	
9	5	0_{bin}	WORD alignment inactive (default)	Extended
		1_{bin}	WORD alignment active (see WORD alignment)	
9	6	0_{bin}	Standard-Bus mode is synchronous (see Standard-Bus cycle)	Standard
		1_{bin}	Standard-Bus mode FreeRun (default)	
10	0-1	00_{bin}	Reaction to PROFIBUS error: Standard-Bus cycle is abandoned (default, digital outputs become 0, complex outputs are set to a configured substitute value) (see Reaction to PROFIBUS errors)	Standard
		01_{bin}	Reaction to PROFIBUS error: Standard-Bus outputs become 0	
		10_{bin}	Reaction to Standard-Bus error: DP inputs remain unchanged	
10	2-3	00_{bin}	Reaction to Standard-Bus error: DP data exchange is abandoned (default) (see Standard-Bus interruption)	Standard
		01_{bin}	Reaction to Standard-Bus error: DP inputs set to 0	
		10_{bin}	Reaction to Standard-Bus error: DP inputs remain unchanged	
11	3-6	X	Maximum length of the diagnostic data. Allowed values: 16, 24, 32, 40, 48, 56, 64 (see Terminal diagnosis)	Extended
12	0-1	0_{bin}	If Standard-Bus mode is synchronous: standard synchronous mode (default) (see Standard-Bus cycle)	Extended
		01_{bin}	If Standard-Bus mode is synchronous: synchronous mode with optimized input update (one cycle)	
		10_{bin}	If Standard-Bus mode is synchronous: synchronous mode with optimized input update (two cycles)	
12	4-7	0_{bin}	Maximum DP buffer lengths not changed	Extended

Byte	Bit	Value	Description	GSE file
12	4-7	15	The maximum DP buffer lengths are changed using the values from UserPrmData 37-40 (see Multi-configuration mode)	Extended
13	0-7	X	Delay time (in µs) high byte (see Standard-Bus cycle)	Extended
14	0-7	X	Delay time (in µs) low byte (see Standard-Bus cycle)	Extended
15-30	0-7	X	Assignment of Bus Terminals 1 to 64 (see Multi-configuration mode)	Extended
31-36	0-7	-	reserved	Extended
37	0-7	X	Maximum length of the input data (see Multi-configuration mode)	Extended
38	0-7	X	Maximum length of the output data (see Multi-configuration mode)	Extended
39	0-7	X	Maximum length of the diagnostic data (see Multi-configuration mode)	Extended
40	0-7	X	Maximum length of the configuration data (see Multi-configuration mode)	Extended
41-56	0-7	X	Assignment of terminals 65 to 128 (see Multi-configuration mode)	Extended

6.2 Configuration

This section provides the configuration information for the I/O device.

6.2.1 Configuration: CfgData

The CfgData is generated from the modules inserted in the DP configuration tool. When modules are added, the following rules are to be observed:

Sequence of DP modules to be added in the DP configuration tool
Modules for the coupler's functions
Complex function modules
Digital function modules

6.2.2 Configuration of the Coupler Modules

The DP modules for the following Bus Coupler functions are to be added first in the DP configuration tool if the associated function is activated (if the function is not activated, the corresponding DP module is not to be added):

Function Module	Activation of the function
2-byte PLC interface	The 2-byte PLC interface is activated via the UserPrmData (byte 5, bit 0). By default it is not active.
Standard-Bus cycle counter	The Standard-Bus cycle counter is activated via the UserPrmData (byte 3, bit 3). By default it is not active.
Dummy output byte	The dummy output byte is activated via the UserPrmData (byte 3, bit 5). By default it is not active.

6.2.3 Configuration of Complex Modules

After the DP modules for the activated functions of the Bus Coupler have been added to the Bus Coupler in the DP configuration tool, the next step is for the complex terminals to be added in the sequence in which they are plugged in, regardless of whether digital terminals are plugged in between the complex terminals, or of how many there may be:

Complex Function Module	Description	Associated CfgData (as hex code)
AKT-CM-000-000	AKT-CM-000-000	0xB4 (in GSE file)
		0xB5 (alternatively)
		0xF2 (alternatively)
AKT-AN-200-000	only the 16 bit input value of each channel is transmitted	0x51 (in GSE file)
		0x50, 0x50 (alternatively)
AKT-AN-400-000, AKT-AN-410-000, AKT-AN-420-000	only the 16 bit input value of each channel is transmitted	0x53 (in GSE file)
		0x51, 0x51 (alternatively)
		0x50, 0x50, 0x50, 0x50 (alternatively)
AKT-AT-220-000	only the 16 bit input value of each channel is transmitted	0x61 (in GSE file)
		0x60, 0x60 (alternatively)
AKT-AT-410-000, AKT-AT-420-000	only the 16 bit input value of each channel is transmitted	0x63 (in GSE file)
		0x61, 0x61 (alternatively)
		0x60, 0x60, 0x60, 0x60 (alternatively)
AKT-ENC-000-000	AKT-ENC-000-000	0xB5 (in GSE file)
		0xF2 (alternatively)

6.3 Cyclic Data Exchange

This section explains and provides data on Cyclic Data Exchange.

6.3.1 Process Data and Image

The Bus Coupler includes different memory areas, each having a capacity of 256 words. Telegrams passing over the Lightbus can specifically access any desired memory cell. The control and status bytes in the Lightbus telegrams can be used to distinguish between two relevant regions of the memory and to address them separately. In order to initiate a Bus Coupler update, the value in the control and status bytes must be 0x10, while the data byte must contain the constant 80hex. It is possible to access the Bus Coupler data after this. For this purpose the control and status byte contains the value 0x30. Two bytes can be written and two bytes can be read simultaneously with one access. The process is described in detail in the following sections.

After being switched on, the Bus Coupler determines the configuration of the inserted input/output terminals. The assignment of the physical slots for the input/output channels and the addresses in the process image is carried out automatically by the Bus Coupler.

The Bus Coupler creates an internal assignment list, in which the input/output channels have a specific position in the process image of the Bus Coupler. A distinction is made here according to inputs and outputs, and according to bit-oriented (digital) and byte-oriented (analog or complex) signal processing.

Two groups are created, one for inputs and the other for outputs. Each group has the byte-oriented channels in ascending sequence, starting from the lowest address, and these are followed by the bit-oriented channels.

Digital Signals

The digital signals are bit-oriented. This means that one bit in the process image is assigned to each channel. The Bus Coupler creates a memory area containing the current input bits, and ensures that the bits in a second (output) memory area dedicated to the output channels are written out immediately, following the update command.

The details of the assignment of the input and output channels to the controller's process image is explained fully with the aid of an example in the appendix.

Analog Signals

The processing of analog signals is always byte-oriented. Analog input and output values are represented in memory by two bytes each. Values are represented in SIGNED INTEGER format. The number 0 stands for the input/output value 0 V, 0 mA or 4 mA. The maximum value of an output or input value is represented, according to the standard settings, by 0x7FFF. The intermediate values are correspondingly proportional. A range with a resolution of 15 bits is not achieved for all inputs and outputs. If the actual resolution is 12 bits, the last three bits have no effect in outputs, while as inputs they are read as 0. Each channel also has a control and status byte. The control and status byte is the most significant byte in the most significant word. An analog channel is represented by 4 bytes in the process image, of which 3 bytes are used.

Special Signals and Interfaces

The Bus Coupler supports Bus Terminals with other interfaces such as RS232, RS485, incremental encoder and others. These signals can be considered similarly to the analog signals named above. For some special signals the bit width of 16 is not sufficient. The Bus Coupler can support any byte width. It is necessary to consider how data consistency is ensured when accessing these values. This means that update commands must not be issued nor must the Bus Coupler be placed into the free running mode between the accesses.

Default Assignment of the Inputs and Outputs to the Process Image

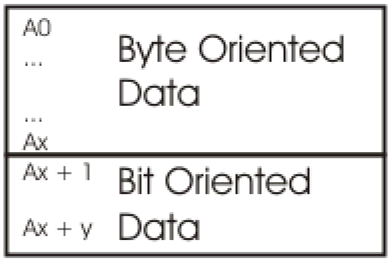
Once it has been switched on, the Bus Coupler finds out how many Bus Terminals are inserted, and creates an assignment list. The analog and digital channels, divided into inputs and outputs, are assembled into separate parts of this list. The assignment starts on the left next to the Bus Coupler. The software in the Bus Coupler collects consecutively the individual entries for each of the channels in order to create the assignment list counting from left to right. Four groups are distinguished in the assignment:

Group	Functional type of the channel	Assignment
1	analog outputs	byte-wise
2	digital outputs	bit-wise
3	analog inputs	byte-wise
4	digital inputs	bit-wise

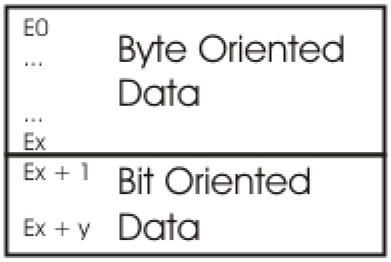
All complex Bus Terminals are represented by analog inputs or outputs.

Overview of the Distribution of the Process Image Within the Bus Coupler

Output data in the Bus Coupler

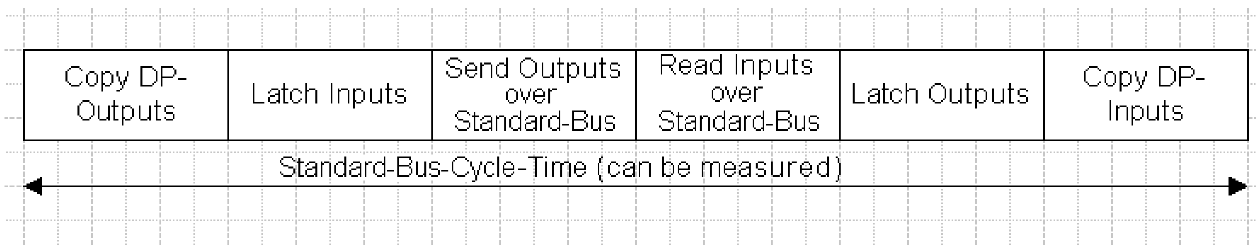


Input data in the Bus Coupler



6.3.2 Standard-Bus Cycle

The Standard-Bus cycle can be set to run freely (FreeRun mode) or synchronously (synchronous mode) with respect to the DP cycle. The Standard-Bus cycle for the DP coupler consists of the following parts:



The Standard-Bus cycle time can be calculated to a precision of approximately 10% by means of the following formula (4-channel terminals or terminals with more than 6 bytes of data require two or more Standard-Bus cycles. The number of Standard-Bus cycles is in register ?? of table 90):

Tcyc (in µs) = number of Standard-Bus cycles x (600 + number of digital channels x 2.5 + number of analog input channels x 32 + number of analog output channels x 42)

The Standard-Bus cycle time can be read via DPV1.

Standard-Bus Modes

The Standard-Bus mode (the type of synchronization between the Standard-Bus cycles and the DP cycle) is set via the UserPrmData:

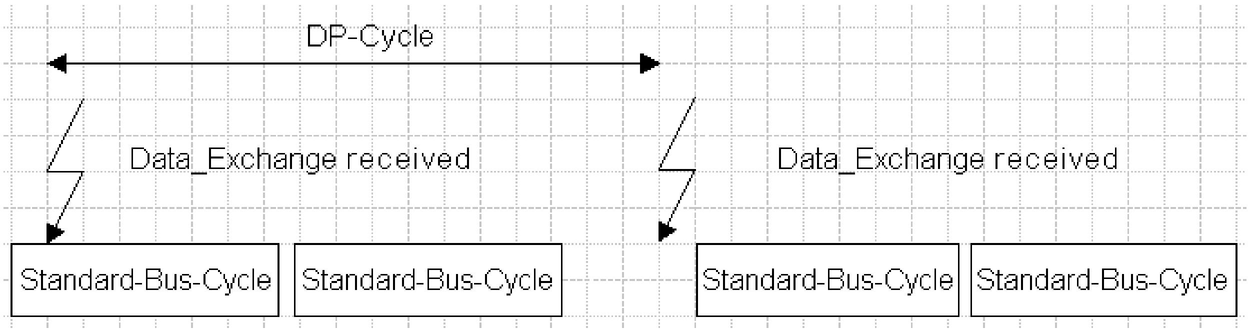
Byte 9, bit 4	Byte 9, bit 6	Byte 12, bit 0	Byte 12, bit 1	Standard-Bus mode
0_{bin}	1_{bin}	0_{bin}	0_{bin}	Slow FreeRun
1_{bin}	1_{bin}	0_{bin}	0_{bin}	Fast FreeRun
0_{bin}	0_{bin}	0_{bin}	0_{bin}	Synchronous
0_{bin}	0_{bin}	1_{bin}	0_{bin}	Synchronous with optimized input update, one cycle
0_{bin}	0_{bin}	0_{bin}	1_{bin}	Synchronous with optimized input update, two cycles

FreeRun Mode

This section covers the types of FreeRun Modes.

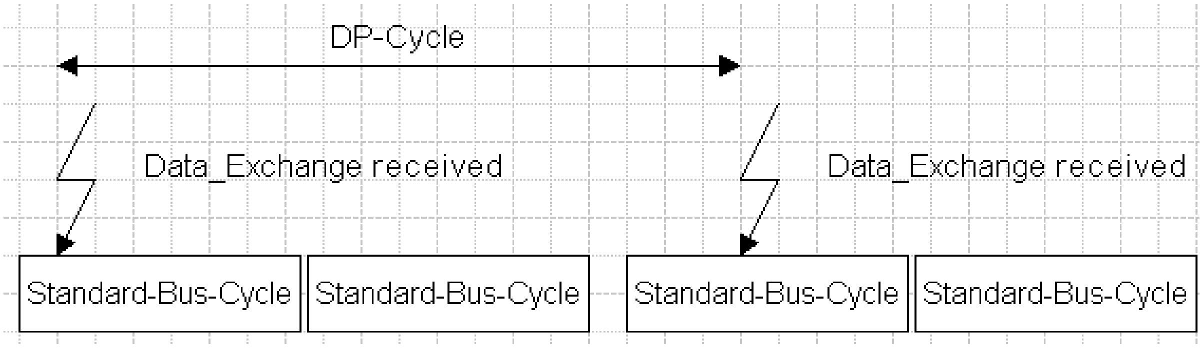
Slow FreeRun(default setting)

In the FreeRun mode there is no synchronization between the Standard-Bus cycle and the DP cycle. It is a characteristic feature of the Slow FreeRun mode that the Standard-Bus cycle is called from the main task. Acyclic communication or events result in heavy jitter in the Standard-Bus cycle (DPV1, terminal diagnosis, etc.), because all of these functions are also called from the main task.



Fast FreeRun

To avoid the jitter resulting from acyclic communication or events and to achieve fast Standard-Bus update times, the Fast FreeRun mode can be activated. The Standard-Bus cycle is called under time control from a high priority task. Following completion of the Standard-Bus cycle, the lower priority tasks (DPV1 etc.) are granted processor time for 12.5% of the duration of the foregoing Standard-Bus cycle, before the next Standard-Bus cycle is started. In fast FreeRun mode therefore the inputs and outputs are tightly up-to-date, but are not synchronized to the DP cycle:

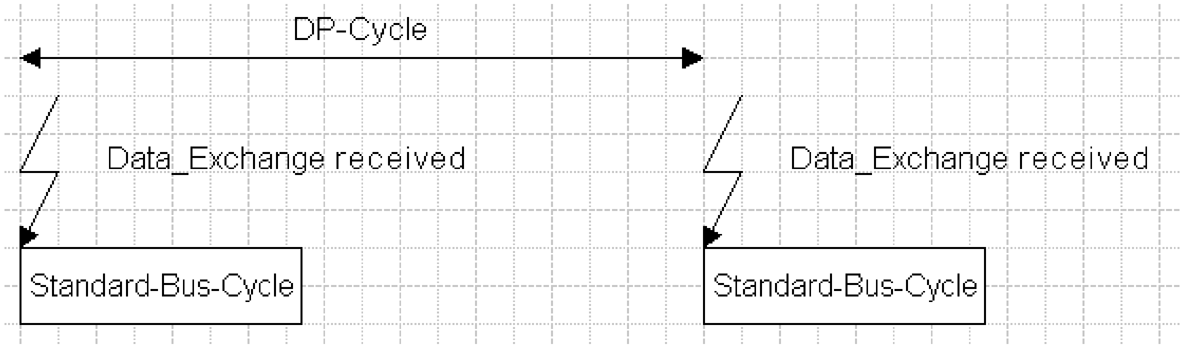


Synchronous Mode

As explained in the table above, there are three different synchronous modes:

Standard Synchronous Mode

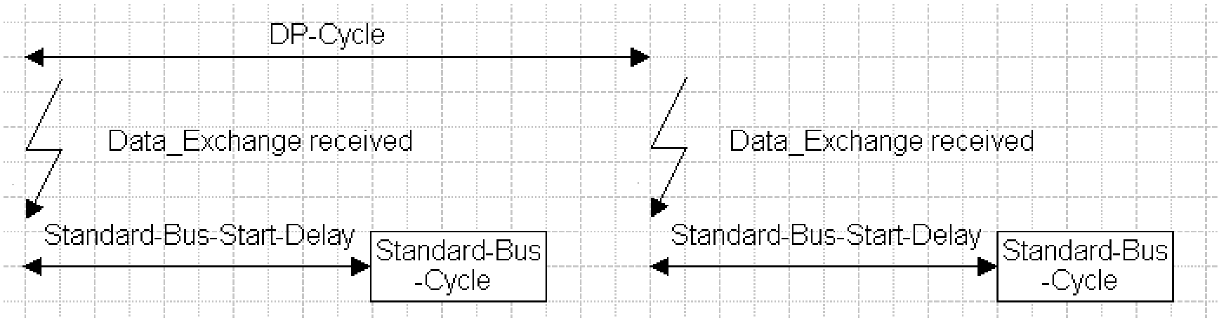
In standard synchronous mode the Standard-Bus cycle is always started immediately following reception of the Data_Exchange telegram from the DP master. The outputs are therefore generated as quickly as possible, while the input cycles are always one DP cycle old:



It is important here to ensure that the duration of the Standard-Bus cycle plus approx. 20% (to allow for the lower priority processes on the coupler) is shorter than the DP cycle time.

Synchronous Mode With Optimized Input Update (one cycle)

In optimized input update, the start of the Standard-Bus cycle can be delayed following reception of the Data_Exchange telegram, so that the inputs are more up-to-date than they are in standard synchronous mode, whereas generation of the outputs is more severely delayed. It is important here to ensure that the duration of the Standard-Bus cycle, plus the delay time, plus approx. 20% (to allow for the lower priority processes on the coupler) is shorter than the DP cycle time.

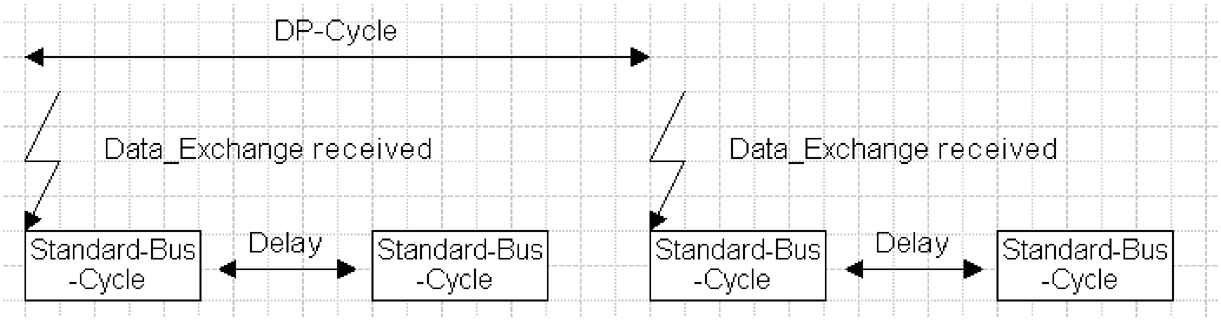


The delay time is set by means of the UserPrmData (in µs, in Motorola format). The extended GSE file of the Bus Coupler is, however, necessary for this:

Byte	Value: Description
13	Delay time (in µs) high byte
14	Delay time (in µs) low byte

Synchronous Mode With Optimized Input Update (two cycles)

In the third mode of synchronous operation, the advantages of the other two operating modes are combined. Two Standard-Bus cycles are carried out within one DP cycle. The first cycle begins immediately after reception of the Data_Exchange telegram from the master, which means that the outputs are generated as quickly as possible. The second cycle is started after a delay time that begins after completion of the first cycle has elapsed, so that the inputs are as recent as possible. It is important here to ensure that twice the duration of the Standard-Bus cycle, plus the delay time, plus approx. 20% (to allow for the lower priority processes on the coupler) is shorter than the DP cycle time.



The delay time is set by means of the UserPrmData (in µs, in Motorola format). The extended GSE file of the Bus Coupler is, however, necessary for this:

Byte	Value: Description
13	Delay time (in µs) high byte
14	Delay time (in µs) low byte

Dummy Output Byte

The Bus Coupler's PROFIBUS DP ASIC can only generate an interrupt after reception of a Data_Exchange telegram if output data has been received. This means that at least one output byte must be transferred via DP in synchronous mode. If only input terminals are plugged in, and no output data is therefore present, a dummy output byte can be configured. It is activated in the UserPrmData, and must be entered as the module in the CfgData. The extended GSE file for the Bus Coupler is, however, necessary for this:

Byte	Bit	Value	Description
3	5	1_{bin}	Dummy output byte activated

It is also necessary for the dummy output byte to be configured in the CfgData before the complex terminals:

CfgData	DP Modules
0x20	Dummy output byte

Standard-Bus Cycle Counter

In order for the master to be able to check reliably whether precisely one (or two) Standard-Bus cycles are always being carried out during one DP cycle, a Standard-Bus cycle counter can be transferred in the input data from the Bus Coupler to the master. This is incremented after each Standard-Bus cycle (0 is omitted , so that 1 follows after 255). The Standard-Bus cycle counter must be activated in the UserPrmData and entered as a module in the CfgData. The extended GSE file for the Bus Coupler is, however, necessary for this:

Byte	Bit	Value	Description
3	3	1_{bin}	Standard-Bus cycle counter activated

It is also necessary for the Standard-Bus cycle counter byte to be configured in the CfgData before the complex terminals:

CfgData	DP Modules
0x10	Standard-Bus cycle counter

6.4 DPV1 – Acyclic Data Transfer

This section explains acyclic data transfers.

6.4.1 DPV1 Interface

By default, one MSAC_C1 connection and one MSAC_C2 connection with 52 bytes of data (4 bytes DPV1 header plus 48 bytes of user data) are supported. The MSAC_C1 connection is established along with cyclic connection, and can be activated via the UserPrmData:

Byte	Bit	Value: Description
0	7	1: MSAC_C1 connection is activated

The MSAC_C2 connection can be used either by the C1 master (which communicates with the slave cyclically) or by a C2 master (which then only communicates with the slave cyclically), and has its own establishment of connection. The parameters at the establishment of the MSAC_C2 connection (Feature_Supported, Profile_Feature_Supported, Profile_Ident_Number, etc.) are not examined, and the parameters of the request are mirrored in the response.

Slot_Number = 0 addresses PROFIBUS coupler data, Slot_Number > 0 addresses the data of the function module(s).

PROFIBUS coupler data (Slot_Number = 0)

The data associated with the PROFIBUS coupler is addressed via an index:

Index	Access	Description
1-2	R/W	Module assignment in multi-configuration mode
5	R	Firmware information
9-19	R/W	Device configuration (Table 9)
90	R	Standard-Bus status (Table 90)
98	R/W	Internal cycle time
99	W	Commands: local bus reset, starting or stopping the internal cycle time measurement

Function module data (Slot_Number > 0)

Depending on the type of function module, access is made either to the registers (max. 4 channels, each with 64 registers) or to the parameters (only supported by a few function modules, where the quantity of data is insufficient for the register model)

Accessing Registers

Index	Access	Length	Description
0-63	R(/W)	2	Registers 0-63 of the channel 1 in the function module
64-127	R(/W)	2	Registers 0-63 of the channel 2 in the function module
128-191	R(/W)	2	Registers 0-63 of the channel 3 in the function module
192-254	R(/W)	2	Registers 0-63 of the channel 4 in the function module

Accessing Parameters

Index	Access	Length	Description
0	R(/W)	4-32 (must be divisible by 4)	Parameters 0x0000-0x0007 of the function module
1	R(/W)	4-32 (must be divisible by 4)	Parameters 0x0008-0x000F of the function module
…	…	…	
127	R(/W)	4-32 (must be divisible by 4)	Parameters 0x03F8-0x03FF of the function module

6.4.2 DPV1 at the Coupler

This section covers DPV1 at the coupler.

Module Assignment

The multi-configuration mode is possible with a maximum of 128 modules (terminals, IE modules, etc.). The specification of which of the modules configured in the CfgData are indeed inserted can be written with DPV1 Write and read with DPV1 Read.

Slot number	Index	Length	Data	Description
0	1	1-15	Byte 0 (bit 0,1)	Assignment of module 1 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 2,3)	Assignment of module 2 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 4,5)	Assignment of module 3 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 6,7)	Assignment of module 4 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit, 0,1)	Assignment of module 5 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			…	
			Byte 15 (bit 6,7)	Assignment of module 64 **0: DP DataExchange (default)** 2: disabled (configured module missing)
	2	1-15	Byte 0 (bit 0,1)	Assignment of module 65 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 2,3)	Assignment of module 66 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 4,5)	Assignment of module 67 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 0 (bit 6,7)	Assignment of module 68 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			Byte 1 (bit 0,1)	Assignment of module 69 **0: DP DataExchange (default)** 2: disabled (configured module missing)
			…	
			Byte 15 (bit 6,7)	Assignment of module 128 **0: DP DataExchange (default)** 2: disabled (configured module missing)

Firmware Information

The following firmware information can be read through DPV1. The data is transferred in Intel format (low byte first):

Slot number	Index	Byte	Description
0	5	0-1	Bus Coupler number
		2-3	Software version
		4-5	Manufacturer type (table 0, register 245)
		6-7	Coupler type (table 0, register 246)
		8-9	Bus Coupler type (table 0, register 247)
		10-11	Reserved

Terminal Composition

The terminal composition can be read by DPV1. A word is transmitted for each terminal containing the terminal number for complex terminals and the length and type information for digital terminals:

Bit	Value	Description
0	1_{bin}	Digital terminal has inputs
1	1_{bin}	Digital terminal has outputs
2-7	-	Reserved
8-14	X	Length in bits
15	1_{bin}	Always 1_{bin} (indicates that the terminal is digital)

Reading the terminal composition

The terminal composition is represented in the DPV1 addressing as follows:

Slot number	Index	Byte	Description
0	9	0-1	Number of the Bus Coupler
		2-3	Value for terminal 1
		…	…
		46-47	Value for terminal 23
	10	0-1	Value for terminal 24
		…	…
		46-47	Value for terminal 47
	11	0-1	Value for terminal 48
	…	…	…
	18	46-47	Value for terminal 239
	19	0-1	Value for terminal 240
		…	…
		30-31	Value for terminal 255

Checking the terminal composition

The same data can also be accessed by a DPV1 Write. In this case the Bus Coupler compares the value that has been written with the true value, returning a negative DPV1 Write response if the data does not agree. This permits more precise checking of the terminal configuration than is possible by checking the CfgData.

Error codes in the write response

Error_Code_1	Error_Code_2
0xBE	Number of terminals
0xBF	First faulty byte in the written data

Standard-Bus Status

The Standard-Bus status can be read through DPV1. The data is transferred in Intel format (low byte first):

Slot number	Index	Byte	Description
0	90	0-1	Bit 0: Fieldbus errors
			Bit 1: Standard-Bus error
			Bit 2: Error on the Bus Terminal
			Bit 3: Coupler error
		2-3	In the presence of a coupler error: Error code
		4-5	Standard-Bus error = 0: Bit length of the Standard-Bus
			Standard-Bus error = 1: Standard-Bus error code (-> Diagnostic data)
		6-7	Standard-Bus error = 0: Number of terminals
			Standard-Bus error = 1: Bus Terminal number following which the Standard-Bus error is detected (-> Diagnostic data)

Cycle Time Measuring

The duration of the process data cycle can be measured with DPV1.

The cycle time measurement is started or stopped using DPV1 Write:

Slot number	Index	Length	Data	Description
0	99	4	Byte 0: 0x04	Start the cycle time measurement
			Byte 1: 0x01	
			Byte 2: 0x01	
			Byte 3: 0x00	
0	99	4	Byte 0: 0x04	Stop the cycle time measurement
			Byte 1: 0x01	
			Byte 2: 0x00	
			Byte 3: 0x00	

The minimum, maximum, mean (of the last 200 cycles) and current cycle time can be read with DPV1 Read and reset with DPV1 Write:

Slot number	Index	Length	Data	Description
0	98	8	Byte 0,1	Minimum cycle time in µs (INTEL format, low byte first)
			Byte 2, 3	Minimum cycle time in µs (INTEL format, low byte first)
			Byte 4, 5	Mean cycle time in µs (INTEL format, low byte first)
			Byte 6, 7	Current cycle time in µs (INTEL format, low byte first)

7 EXTENDED FUNCTIONS

This chapter covers extended functions.

7.1 2-byte PLC Interface

Checking the CfgData can be deactivated if a DP master is not capable of operating with the modules listed in the GSE file. In that case the master can send any CfgData, and as many inputs and outputs are transferred as are described by the CfgData.

Deactivation of the CfgData checking can also be useful if a specific address range is to be reserved in the PLC for future extensions. In that case, more input and output data is to be transferred than is in fact necessary.

Deactivation of the CfgData check can be set in the UserPrmData:

Byte	Bit	Value	Description
3	3	1_{bin}	CfgData checking is deactivated

In general, the I/O data from the modules (terminals or IE modules) is written by the coupler in the standard sequence (first the complex, then the digital modules), as is also the case for other fieldbus couplers; this has already been described in connection with the structure of the process image in the coupler. The decision on a module-to-module basis as to whether the module is mapped in compact or complex form, which would otherwise be possible under DP, is omitted when CfgData checking is deactivated. In that case, the setting made in the UserPrmData applies to all modules:

The compact or complex mapping can be set in the UserPrmData:

Byte	Bit	Value	Description
3	3	0_{bin}	Analog modules are mapped in compact form (only with the input or output user data)
		1_{bin}	Analog modules are mapped in complex form (including control/status for register access and the same data length in the inputs and outputs)

The extended GSE file must be used to deactivate CfgData checking and to specify compact/complex mapping textually in the master's configuration tool.

7.2 Word Alignment

In order to obtain the I/O data in the controller's process image in a clear form in controllers with word-oriented process images, it is possible to specify that word alignment is used when the coupler generates its process image. This involves a dummy byte being inserted for every variable that is larger than one byte and which would start on an uneven address.

Word alignment can be set in the UserPrmData:

Byte	Bit	Value	Description
9	5	1_{bin}	Word alignment is active

When using the DP modules it is necessary to ensure that only those complex modules that are identified with word alignment are used.

The extended GSE file must be used in order to set word alignment in text form in the master's configuration tool and to be able to select the word alignment module.

7.3 Deactivating the CfgData Check

Checking the CfgData can be deactivated if a DP master is not capable of operating with the modules listed in the GSE file. In that case the master can send any CfgData, and as many inputs and outputs are transferred as are described by the CfgData.

Deactivation of the CfgData checking can also be useful if a specific address range is to be reserved in the PLC for future extensions. In that case, more input and output data is to be transferred than is in fact necessary.

Deactivation of the CfgData check can be set in the UserPrmData:

Byte	Bit	Value	Description
1	0	1_{bin}	CfgData checking is deactivated

In general, the I/O data from the modules (terminals or IE modules) is written by the coupler in the standard sequence (first the complex, then the digital modules), as is also the case for other fieldbus couplers; this has already been described in connection with the structure of the process image in the coupler. The decision on a module-to-module basis as to whether the module is mapped in compact or complex form, which would otherwise be possible under DP, is omitted when CfgData checking is deactivated. In that case, the setting made in the UserPrmData applies to all modules:

The compact or complex mapping can be set in the UserPrmData:

Byte	Bit	Value	Description
9	2	0_{bin}	Analog modules are mapped in compact form (only with the input or output user data)
		1_{bin}	Analog modules are mapped in complex form (including control/status for register access and the same data length in the inputs and outputs)

The extended GSE file must be used to deactivate CfgData checking and to specify compact/complex mapping textually in the master's configuration tool.

7.4 Multi-Configuration Mode

Multi-configuration mode can be used for the following types of application. A more extensive consideration, considering, in particular, the various implementation levels of the Bus Coupler, is given in the Requirements of a production machine.

7.4.1 Creating a DP Configuration for Various Implementation Levels

If it is desired to use one PLC program to control different implementation levels of a process, it can be valuable to work with the same DP configuration in spite of differences between the implementation-specific terminal configurations. In this way the address offsets in the process image do not change, nor will the general DP configuration of the Profibus DP master have to be saved again with every new implementation level. With the multi-configuration mode it is now possible to define a maximum configuration for the Bus Coupler, and in this case it will only be necessary to disable those terminals that are not present in accordance with the current implementation level.

7.4.2 Reserved Bus Terminals

Because all the analog terminals are configured first in the DP configuration, before the digital terminals, the consequence of inserting analog terminals at a later stage is that the address offsets of the digital terminals are shifted. The insertion of a digital terminal within the existing terminal structure (which can, for instance, be useful if digital terminals with different input voltages are used) also has the consequence that the offsets of the digital terminals that follow it are shifted. If a digital terminal is inserted before the end terminal however, the offset of the existing terminals are not shifted. With multi-configuration mode it is now possible to configure additional terminals as reserves at any location within the terminal structure.

7.4.3 Assign Bus Terminals to Freely Choose Process Image Addresses

Because digital terminals are always grouped into bytes, which means that the smallest DP configuration module is an 8-bit module, a difficulty arises when the associated terminals are to be distributed over a number of bytes in the PLC process image. This is because in the PLC it is usually only possible to assign addresses for each DP configuration module. With multi-configuration mode it is now possible to configure additional digital terminals as "dummy" terminals at any desired locations, enabling the address offsets of the other terminals to be shifted in the PLC process image.

7.4.4 Setting the Multi-configuration Mode

Multi-configuration mode is activated via the UserPrmData:

Byte	Bit	Description
3	4	1: Multi-configuration mode is active

7.4.5 Rules for Multi-configuration Mode

Multi-configuration mode requires a few additional rules to be observed, in addition to those for standard configuration:

- Only one DP module may be configured for each analog terminal

- The digital terminals are to be declared as Multi-Cfg mode modules at their true position
- The digital terminals are to be declared after the analog modules moreover as input/output sum modules, corresponding to their bit width, as is also the case for standard configuration in the process image.
- All modules for the maximum configuration, including the reserve modules, are to be declared
- Modules that are not inserted must be disabled

7.4.6 Enabling/disabling Bus Terminals

Those Bus Terminals that are present in the DP configuration, but that are not in fact plugged in, must be disabled. This can be done in the UserPrmData, via DPV1 or through the 2-byte PLC interface.

Making the setting through DPV1 or through the 2-byte PLC interface has the advantage that the terminal assignment for the multi-configuration mode can usually be made directly from the PLC program, without having to change the DP configuration of the master.

As long as the inserted Bus Terminals do not agree with the non-disabled Bus Terminals to be expected from the DP configuration, the Bus Terminal will normally set the Stat_Diag bit in the diagnostic data, with the consequence that it is not yet ready for cyclic data exchange.

If, however, the enabling and disabling is to be carried out via the 2-byte PLC interface, it is a precondition for function of the 2-byte PLC interface that the coupler is in cyclic data exchange mode. For that reason it is also possible to deactivate remaining in the Stat_Diag state:

Byte	Bit	Description
3	6	1: In multi-configuration mode the coupler also enters the data exchange even when the configuration is not consistent, although Standard-Bus cycles are not yet executed

Enabling/disabling via UserPrmData

The assignment of the terminals (a maximum of 128 terminals is possible) is entered from byte 15 to byte 30 and from byte 41 to byte 56 of the UserPrmData. Two bits are reserved here for each terminal, indicating whether the relevant terminal is enabled (value 0) or disabled (value 2). If the UserPrmData is to be displayed as text in the DP configuration tool, then the parameters Assignment of module x are to be set to DP DataExchange (enabled) or Multi-Config. mode (disabled).

Byte	Bit	Description
15	0,1	Assignment for terminal 1 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	2,3	Assignment for terminal 2 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	4,5	Assignment for terminal 3 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	6,7	Assignment for terminal 4 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
…	…	…
30	6,7	Assignment for terminal 64 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
41	0,1	Assignment for terminal 65 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
…	…	…
56	6,7	Assignment for terminal 128 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)

Enabling/disabling via DPV1 Write

The terminals are enabled/disabled through Slot_Number 0 and Index 1 or 2:

Index	Byte	Bit	Description
1	0	0,1	Assignment for terminal 1 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
		2,3	Assignment for terminal 2 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
		6,7	Assignment for terminal 4 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	…	…	…

Index	Byte	Bit	Description
	15	6,7	Assignment for terminal 64 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
2	0	0,1	Assignment for terminal 65 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	…	…	…
	15	6,7	Assignment for terminal 128 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)

Enabling/disabling via the 2-byte PLC interface

The terminals are enabled or disabled through table 1, registers 0-31:

Register	Bit	Description
0	0,1	Assignment for terminal 1 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	2,3	Assignment for terminal 2 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	4,5	Assignment for terminal 3 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	6,7	Assignment for terminal 4 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	8,9	Assignment for terminal 5 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	10,11	Assignment for terminal 6 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
	12,13	Assignment for terminal 7 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)

Register	Bit	Description
	14,15	Assignment for terminal 8 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)
…	…	…
31	14,15	Assignment for terminal 128 **0: DP DataExchange (default)** 2: disabled (Multi-Config mode)

Note: It can happen under multi-configuration mode that the CfgData exceeds 64 bytes. In such a case, the CfgData must be enlarged.

7.5 Changing the Size of the Process Data

This section covers changing the size of the process data.

7.5.1 Exceeding the Input Data Length (InputData)

By default, a maximum of 128 bytes of input data is set on the Bus Coupler.

The maximum length of the DP buffer can be changed. The amount, however, by which one length is increased must be taken away from another, and it must be noted that the sizes can only be changed in 8-byte steps:

7.5.2 Exceeding the Output Data Length (OutputData)

By default, a maximum of 128 bytes of output data is set on the Bus Coupler.

The maximum length of the DP buffer can be changed. The amount, however, by which one length is increased must be taken away from another, and it must be noted that the sizes can only be changed in 8-byte steps:

7.5.3 Exceeding the Configuration Data Length (CfgData)

By default, a maximum of 64 bytes of configuration data is set on the Bus Coupler. Normally, this is only a problem in very rare cases. In multi-configuration mode, however, this limit is reached with no more than a 30 digital terminals, because each MultiCfgMode module occupies two bytes in the configuration data, on top of which there is at least one sum byte for digital inputs or for digital outputs.

The maximum length of the DP buffer can be changed. The amount, however, by which one length is increased must be taken away from another, and it must be noted that the sizes can only be changed in 8-byte steps:

Maximum DP buffer sizes

DP buffer	Maximum sizes under default settings
Inputs	128 bytes
Outputs	128 bytes
Diagnostic data	64 bytes
Configuration data	64 bytes

Setting via the 2-BYTE PLC interface

The maximum DP buffer sizes can be modified in Table 100, although it is necessary for the Bus Coupler to be reset (power off/power on, or a software reset) before the new value is adopted:

Byte	Bit	Description
12	4-7	15 dec or 0xF hex: the maximum DP buffer lengths are changed using the values from UserPrmData 37-40
37	0-7	Maximum length of input data
38	0-7	Maximum length of output data
39	0-7	Maximum length of diagnosis data
40	0-7	Maximum length of configuration data

Example 1: Not enough configuration data

128 bytes input

128 bytes output

80 bytes CfgData

48 bytes diagnosis data

Example 2: Not enough input data

160 bytes input

96 bytes output

64 bytes CfgData

64 bytes diagnosis data

8 ERROR HANDLING AND DIAGNOSIS

The Bus Coupler has two groups of LEDs for the display of status. The upper group or left hand group indicates the state of the fieldbus.

On the upper right hand side of the Bus Coupler are two more green LEDs that indicate the supply voltage. The left hand LED indicates the presence of the 24 V supply for the Bus Coupler. The right hand LED indicates the presence of the supply to the power contacts. The two Standard-Bus LEDs (I/O RUN, I/O ERR) are located under the fieldbus LEDs. These indicate the operational state of the Bus Terminals and the connection to these Bus Terminals.

8.1 Fieldbus LEDs

The upper three LEDs (or the two LEDs on the left) indicate the operating state of the PROFIBUS communication:

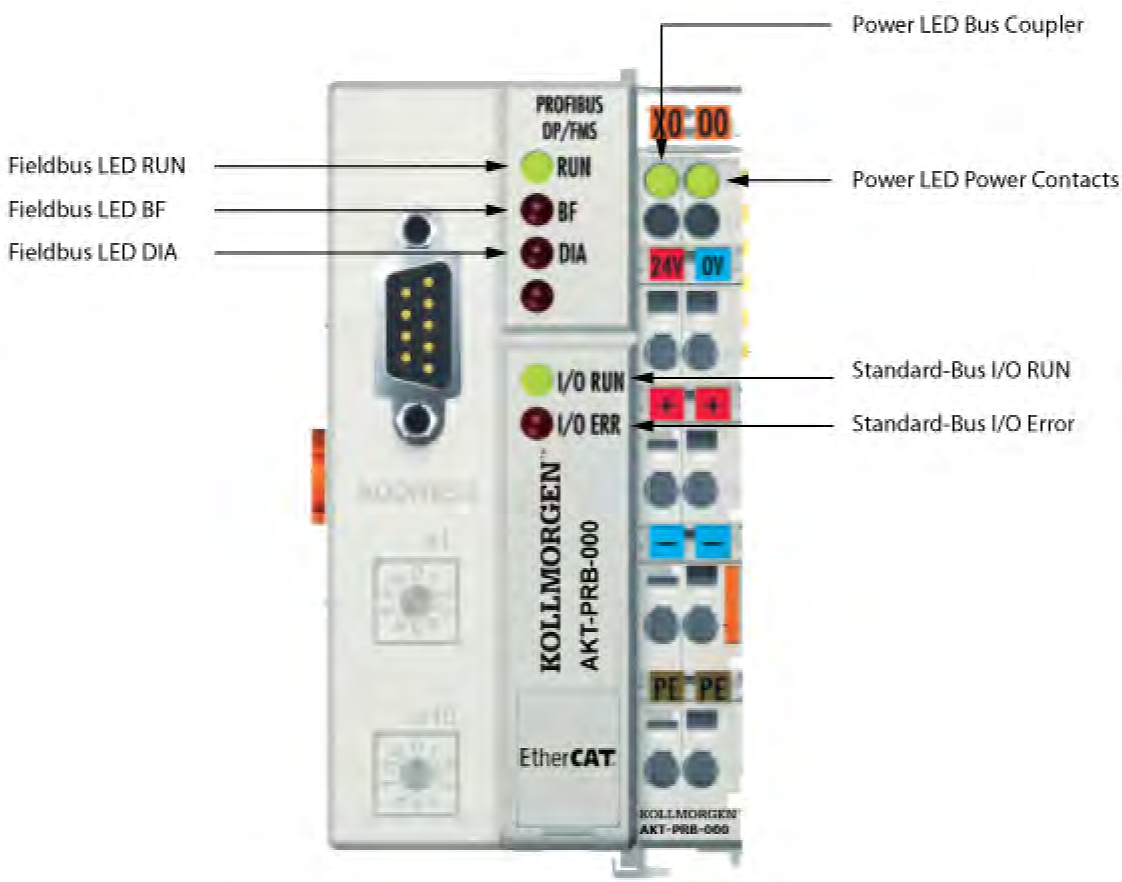


Figure 5.1: PROFIBUS Coupler Diagnostic LEDs

I/O- RUN	BF	DIA	Description	Remedy
On	Off	Off	Operating state: RUN, Inputs are read and outputs are set	Everything is operating correctly
On	On	Off, blinking	1. Bus activity, but slave is already parameterized	Start master
			2. Bus error with reaction to PROFIBUS error: a.) Standard-Bus outputs become 0 or b.) Standard-Bus outputs are retained	Check parameters, configuration (possible error in DP start-up)
Off	Off	Off	Data exchange with the master is not started	Starts the PLC
Off	On	On	No bus activity	Start the master, check the bus cable
Off	On	Off, blinking	Bus error with reaction to PROFIBUS error: Standard-Bus cycle is stopped	Start master, check parameters, configuration (possible error in DP start-up)

8.1.1 DIA-LED Blink Codes

If an error occurs in the parameterization or configuration during DP start-up, this is indicated both through the fieldbus LEDs and in the diagnostic data.

Blink Code

Fast Blinking	Start of the Error Code
First slow sequence	Error code
Second slow sequence	Error argument (error location)

8.1.2 Standard-Bus LEDs (Local Errors)

Two LEDs, the Standard-Bus LEDs, indicate the operational state of the Bus Terminals and the connection to these Bus Terminals. The green LED (I/O RUN) lights up in order to indicate fault-free operation. The red LED (I/O ERR) flashes with two different frequencies in order to indicate an error. The errors are displayed in the blink code in the following way:

Error Type

Error Code	Error Code Argument	Description	Remedy
Persistent continuous blinking		General Standard-Bus error	Check the Bus Terminal Strip
1 pulse	0	EEPROM checksum error.	Set manufacturer's setting with the IDE software
	1	Inline code buffer overflow.	Connect fewer Bus Terminals; too many entries in the table for the programmed configuration
	2	Unknown data type.	Software update required for the coupler
2 pulses	0	Programmed configuration incorrect.	Check programmed configuration for correctness
	n>0	Incorrect table entry Bus Coupler / incorrect table comparison (Bus Terminal n).	Correct table entry / Bus Coupler
3 pulses	0	Standard-Bus command error	No Bus Terminal connected; attach Bus Terminals
			One of the Bus Terminals is defective; halve the number of Bus Terminals attached and check whether the error is still present with the remaining Bus Terminals. Repeat until the defective Bus Terminal is located.
4 pulses	0 n	Standard Bus data error, break behind Bus Coupler n.	Check whether the n+1 Bus Terminal is correctly connected; replace if necessary. Check whether the End Terminal is connected.
5 pulses	n	Standard-Bus error in register communication with Bus Terminal n.	Replace Bus Terminal n.

Error Code	Error Code Argument	Description	Remedy
7 pulses	n	Unsupported Bus Terminal detected at location n.	Only use digital (bit oriented) Bus Terminals, or use a Bus Coupler.
9 pulses	0	Checksum error in program flash memory.	Set manufacturer's setting with the IDE software.
13 pulses	0	Runtime Standard-Bus command error.	One of the Bus Terminals is defective; halve the number of Bus Terminals attached and check whether the error is still present with the remaining Bus Terminals. Repeat until the defective Bus Terminal is located.
14 pulses	n	Bus Terminal n has the wrong format	Start the coupler again, and if the error occurs again then exchange the Bus Terminal.
15 pulses	n	Number of Bus Terminals is no longer correct	Start the coupler again, and if the error occurs again after this, use the IDE software to set manufacturer's settings.
16 pulses	n	Length of the Standard-Bus data (bit length) is no longer correct. n = bit length after booting	
17 pulses	n	Number of Bus Terminals is no longer correct. n = number of Bus Terminals after booting.	
18 pulses	n	Bus Terminal identifier no longer correct after reset (n = Bus Terminal number).	

Error Location

The number of pulses indicates the position of the last Bus Terminal before the fault. Passive Bus Terminals, such as a power feed terminal, are not included in the count.

8.2 DP Diagnostic

This section provides the DP diagnostic information for the I/O device.

8.2.1 DP Diagnostic Data (DiagData)

The DP diagnostic data consists of six bytes of DP standard diagnosis, along with up to 238 bytes of device-specific diagnostic data. The device-specific diagnostic data for slaves is represented in the DPV1 status message.

When the DP diagnostic data changes, the slave reports this fact to the master, and the master will automatically fetch the changed diagnostic data. This means that DP diagnostic data is not included in the DP process data in real-time, but is always sent to the controller a few cycles later.

DP standard diagnostic data

Offset	Meaning
0x00.0	StationNonExistent: slave did not reply to the last telegram
0x00.1	StationNotReady: slave still processing the Set_Prm / Chk_Cfg telegram
0x00.2	CfgFault: slave signaling a configuration error
0x00.3	ExtDiag: extended DiagData available and valid
0x00.4	NotSupported: slave does not support a feature requested via Set_Prm or Global_Control
0x00.5	InvalidSlaveResponse: slave response not DP-compatible
0x00.6	PrmFault: slave reports a Parameterization error
0x00.7	MasterLock: slave currently exchanging data with another master
0x01.0	PrmReq: re-parameterize and reconfigure slave
0x01.1	StatDiag: slave signaling static diagnosis / DPV1 slave application not yet ready for data exchange
0x01.2	PROFIBUS DP slave
0x01.3	WdOn: DP watchdog on
0x01.4	FreezeMode: DP slave in freeze mode
0x01.5	SyncMode: DP slave in sync mode
0x01.6	reserved
0x01.7	Deactivated: DP slave has been deactivated
0x02.0	reserved
0x02.1	reserved
0x02.2	reserved
0x02.3	reserved
0x02.4	reserved
0x02.5	reserved
0x02.6	reserved
0x02.7	ExtDiagOverflow: too much extended data present
0x03	MasterAdd: station address of master with which slave is exchanging data
0x04, 0x05	IdentNumber
From 0x06	Device-specific diagnostic data (extended DiagData)

Device-specific diagnostic data (DPV1 status message)

The meaning of the first 4 bytes of the DPV1 status message is specified by the DPV1 standard, while the bytes that follow are manufacturer-specific.

Byte	Bit	Description
6	0-7	The length of the DPV1 status message (including this byte)
7	0-7	StatusType: the StatusType identifies the format of the diagnostic data starting at byte 16 (0x81: max. 64 modules, 0xA1: more than 64 modules)
8	0-7	SlotNumber: always 0
9	0-7	Specifier: always 0
10	0	EEPROM checksum error (can be cleared by setting the manufacturers setting through KS2000 or DPV1, followed by a power off/power on cycle)
10	4	Unknown module type
10	5	The length of the CfgData is too great (too many modules are inserted)
10	6	The length of the DP input data is too great (too many modules are inserted)
10	7	The length of the DP output data is too great (too many modules are inserted)
11	0-7	Error on an internal bus (Standard-Bus, IP-Link, etc.)
12	0-7	Error code on an internal bus (Standard-Bus, IP-Link, etc.)
13	0-7	Error argument on an internal bus (Standard-Bus, IP-Link, etc.)
14	0-7	DP start-up error code
15	0-7	DP start-up error argument

Errors in the modules (terminals, IP modules, IE module, etc.)

Diagnosis of the modules must be activated through the UserPrmData.

<u>Couplers with a maximum of 64 possible modules</u>

Byte	Bit	Description
16	0-5	Module number (0-63) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
16	6-7	Associated channel number (0-3)`
17	0-7	Status byte of the faulty channel (bits 0-7)
18	0-5	Module number (0-63) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
18	6-7	Associated channel number (0-3)

Byte	Bit	Description
19	0-7	Status byte of the faulty channel (bits 0-7)
…	…	…
60	0-5	Module number (0-63) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
60	6-7	Associated channel number (0-3)
61	0-7	Status byte of the faulty channel (bits 0-7)

Couplers with a maximum of more than 64 possible modules

Byte	Bit	Description
16	0-7	Module number (1-255) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
17	6-7	Associated channel number (0-3)'
17	0-5	Status byte of the faulty channel (bits 0-5)
18	0-7	Module number (1-255) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
19	6-7	Associated channel number (0-3)'
19	0-5	Status byte of the faulty channel (bits 0-5)
…	…	…
60	0-7	Module number (1-255) with an error (bit 6 of the status bytes is set, except for the serial interface modules where bit 3 of the status byte is set)
61	6-7	Associated channel number (0-3)'
61	0-5	Status byte of the faulty channel (bits 0-5)

8.2.2 Errors During DP Start-up

If an error occurs in the parameterization (UserPrmData) or configuration (CfgData) during DP start-up, this is indicated both through the fieldbus LEDs and in the diagnostic data (DiagData).

Possible DP start-up errors are identified by an error code and an error argument.

Errors when checking the UserPrmData

Error code 1

Error code 1 indicates that a reserved bit in the UserPrmData has been set to an incorrect value, or that the function corresponding to the bit in the UserPrmData is not supported. The error argument describes which UserPrmData byte has been detected as containing an error (the offset of the faulty byte + 1).

Error code 3

Error code 3 indicates that a combination of functions selected in the UserPrmData is not allowed. The error argument describes the impermissible combination.

Error Code Argument	Description
1	The Reaction to DP error cannot be set to "Outputs unchanged" in synchronous mode
2	The DPV1-MSAC_C1 connection has been activated by the master, but no DPV1-MSAC_C1 connection is defined
6	The Multi-configuration mode is not allowed if Checking the CfgData is switched off
8	Synchronous mode may only be activated when at least one DP output byte is configured
10	The optimized input cycle is only possible in synchronous mode
11	The length of the DP buffer exceeds the size of the DP RAM in the PROFIBUS ASIC
12	Fast-FreeRun mode may not be activated together with synchronous mode

Errors when checking the CfgData

Error code 2

Error code 2 indicates that a byte in the CfgData is not correct. The error argument describes which CfgData byte has been detected as containing an error (the offset of the faulty byte + 1).

Error code 5

Error code 5 indicates that the length of the digital outputs (in bytes) calculated from the CfgData is not correct. The error argument contains the expected byte length.

Error code 6

Error code 6 indicates that the length of the digital inputs (in bytes) calculated from the CfgData is not correct. The error argument contains the expected byte length.

Error code 7

Error code 7 indicates a variety of errors when checking the CfgData. The error argument describes the error.

Error Argument	Description
1	The length of the CfgData received is not correct
2	The syntax of the CfgData received is not correct
3	The length of the DP input data that has been calculated from the CfgData is too large
4	The length of the DP input data that has been calculated from the CfgData is too large

Errors during slave start-up

Error code 8

Error code 8 indicates that the length of the DP buffer is greater than the size of the DP RAM in the PROFIBUS ASIC. The error argument contains the difference (divided by 8). DP communication is deactivated.

Error code 9

Error code 9 indicates a variety of errors that may be detected as the device boots. The error argument describes the error.

Error Argument	Description
1	The length of the DP input data is too great (too many modules are inserted)
2	The length of the DP input data is too great (too many modules are inserted)
3	The length of the CfgData is too great (too many modules are inserted)

8.2.3 Reaction to PROFIBUS Error

A PROFIBUS error (failure of the master, withdrawal of the PROFIBUS plug etc.) is detected after the DP watchdog has elapsed (usually in the region of 100 ms, unless this has been deactivated in the master) or by bus timeout (the baud rate supervision time is set to 10 s).

The reaction at the output data of the coupler can be set in the UserPrmData:

Byte	Bit	Value	Description
10	0-1	00_{bin}	Reaction to PROFIBUS error: Standard-Bus cycle is abandoned (default, digital outputs become 0, complex outputs are set to a planned substitute value)
		01_{bin}	Reaction to PROFIBUS error: Standard-Bus outputs become 0
		10_{bin}	Reaction to PROFIBUS error: Standard-Bus outputs remain unchanged

8.3 Standard-Bus Diagnostic

This section describes the standard-bus diagnostic for the I/O device.

8.3.1 Standard-Bus Interruption

If the Standard-Bus is interrupted, or suffers from a relatively long malfunction, the coupler enters the Standard-Bus error state. Depending on the setting made for Reaction to Standard-Bus error in the UserPrmData, the coupler abandons DP data exchange and sets the Stat_Diag bit in the diagnostic data at the next DP start-up (with the consequence that DP data exchange is not carried out), sets the DP inputs to 0, or leaves the DP inputs unchanged.

Byte	Bit	Value	Description
10	2-3	00_{bin}	Reaction to Standard-Bus error: DP data exchange is abandoned (default)
		01_{bin}	Reaction to Standard-Bus error: DP inputs set to 0
		10_{bin}	Reaction to Standard-Bus error: DP inputs remain unchanged

When the interruption or malfunction on the Standard-Bus has been rectified, the setting of Response to Standard-Bus error in the UserPrmData determines whether the Standard-Bus error state is left manually (by means of a Standard-Bus reset), or automatically:

Byte	Bit	Value	Description
7	0	0_{bin}	Response to Standard-Bus error: manual Standard-Bus reset (default)
		1_{bin}	Response to Standard-Bus error: automatic Standard-Bus reset

Signaling the Standard-Bus error

A Standard-Bus error is indicated both on the I/O-ERR LED and in the DPV1 status message in the DP diagnostic data (bytes 11-13).

Byte	Bit	Description
11	0	too many Standard-Bus command errors
11	1	too many Standard-Bus timeouts
11	2	too many Standard-Bus receive errors
11	3	too many Standard-Bus transmit errors
11	4	Standard-Bus reset error
11	5	general Standard-Bus error
12	0-7	Standard-Bus error code
13	0-7	Standard-Bus error argument

Standard-Bus reset

A Standard-Bus reset can be carried out manually by means of a DPV1 Write:

Slot number	Index	Byte	Value
0	99	0	2
		1	1
		2	0
		3	0

8.3.2 Terminal Diagnostics

If terminal diagnosis has been activated, then each channel of a complex terminals is examined to see whether bit 6 in the status has changed (exceptions are the KL6001, KL6011 and KL6021, where the relevant bit is bit 3), and whether the diagnostic bit of each channel of a digital terminal with diagnostics (KL12x2 or KL22x2) has changed. If that is the case, the existence of new diagnostic data is reported to the master, and two bytes of diagnostic information starting at byte 16 of each channel for which a diagnosis is pending are inserted (see Diagnostic data).

Terminal diagnosis can be activated in the UserPrmData:

Byte	Bit	Value	Description
7	1	1_{bin}	Terminal Diagnosis is active

Digital terminal diagnosis

By default, the diagnostic bits for the digital terminals that have diagnosis are transmitted cyclically in the process image. These terminals occupy 4 bits each in both the input and output data. If terminal diagnosis is active, then UserPrmData can be used to specify that only the I/O data for the digital terminals with diagnosis is to be included in the cyclic process image transfer:

Byte	Bit	Value	Description
7	4	1_{bin}	Diagnostic data of digital terminals not in the cyclic process image

Real-time capacity of the diagnostic data

When making use of terminal diagnosis, it should always be borne in mind that the diagnostic data always reaches the controller at least one cycle later, and that as a rule access also takes place through different mechanisms from those used for cyclic process data. This means that process data can already be faulty, but the controller program is only informed of this in the following cycle or the one after that. If the diagnostic bits of digital terminals with diagnosis, or the status of complex terminals, is mapped into the process image, then the controller program always has consistency between the process data and the diagnostic data. The appropriate setting therefore depends on the way that the diagnosis is to be used. If it is only intended for diagnostic display, transmission within the cyclic process data is unnecessary, but if on the other hand consistency between the process data and the diagnostic data is desired, then the diagnostic data should be transmitted along with the cyclic process data.

Maximum diagnosis data length

If more terminal diagnosis data is present than is specified in the maximum diagnostic data length, then the ExtDiagOverflow bit is set in the standard diagnostic data. Because older controllers have difficulties with the maximum diagnostic data length of 64 bytes (which is the default setting), the maximum diagnostic data length can be restricted in the UserPrmData:

Byte	Bit	Description
11	3-6	Maximum length of the diagnostic data. Allowed values: 16, 24, 32, 40, 48, 56, 64

It is only possible to set the maximum diagnostic data length in text form in the extended GSE file.

APPENDIX A

This section provides information on applicable GSE files.

A.1 GSE File

The following GSE file is used in order to link the PROFIBUS coupler in the DP configuration tool:

Standard GSE files

The standard GSE file contains all the important and fundamental properties required for operation of any master controller. The Bus Coupler can be parameterized in a clear and comprehensible manner with this GSE file.

```
=======================================================
GSE-Data Table for PROFIBUS-DP/FMS Coupler/SPC 4
Vendor:   Kollmorgen Inc.
Part No.: AKT-PRB-000-000
Dated:    August 10, 2010
=======================================================
```

```
#Profibus_DP
GSE_Revision = 1                          Extended GSE-Data is
                                          supported
Vendor_Name = Kollmorgen Inc.             Vendor name
Model_Name = “AKT-PRB-000-000”            Model name of DP-device
Ident_Number = 0xBECE                     Model type of DP-device
Protocol_Ident = 0                        Protocol identification
                                          PROFIBUS-DP
Station_Type = 0                          DP-Slave
FMS_supp = 1                              FMS/DP-Combination Device
                                          DP-Geraet supports baud
                                          rates
9.6_supp = 1                              9.6  kBaud
19.2_supp = 1                             19.2  kBaud
93.75_supp = 1                            93.75 kBaud
187.5_supp = 1                            187.5  kBaud
500_supp = 1                              500    kBaud
1.5M_supp = 1                             1.5  MBaud
3M_supp = 1                               3  MBaud
6M_supp = 1                               6  MBaud
12M_supp = 1                              12  MBaud
MaxTsdr_9.6 = 60
MaxTsdr_19.2 = 60
MaxTsdr_93.75 = 60
MaxTsdr_187.5 = 60
MaxTsdr_500 = 100
MaxTsdr_1.5M = 150
MaxTsdr_3M = 250
MaxTsdr_6M = 350
MaxTsdr_12M = 550
Redundancy = 0                            No redundant data
                                          transmission
Repeater_Ctrl_Sig = 0                     Repeater signal CNTR-P not
                                          active
24V_Pins = 0                              Repeater signals M24V and
                                          P24V not active
Implementation_Type = "SPC4"              ASIC SPC4 is used
Bitmap_Device = "busklemn"                Bit map for normal
                                          operation
Bitmap_Diag = "busklems"                  Bit map for diagnostics
           -------------------- Slave Specific Data --------------
Freeze_Mode_supp = 1                      Freeze-Mode is supported
Sync_Mode_supp = 1                        Sync-Mode is supported
Auto_Baud_supp = 1                        Automatic baud rate
                                          recognition
Set_Slave_Add_supp = 0                    Set_Slave_Add is not
                                          supported
User_Prm_Data_Len = 15                    15 Bytes User-Parameter-
                                          Data
User_Prm_Data =
0x00,0x00,0x00,0x00,0x00
```

```
                                                  Defaults for User-Prm-Data

Min_Slave_Intervall = 10

Modular_Station = 1                               Modular Station

Max_Module = 64                                   Max. 64 Modules

Max_Output_Len = 64                               Max. 64 Bytes Output-Data

Max_Data_Len = 128                                Max. 128 Bytes total data

Fail_Safe = 0                                     Data telegram without
                                                  content is not acknowledged
                                                  for the CLEAR command
Max_Diag_Data_Len = 64                            Max. length of diagnostic
                                                  data
Modul_Offset = 0                                  First Module in
                                                  configuration tool

Slave_Family = 0                                  Product family
          -------------------- Device Specific Diagnostics ----------
Unit_Diag_Area = 8-15
Value(0) = "Error in Bus Coupler"
Value(1) = "Error in Terminal No. 1"
Value(2) = "Error in Terminal No. 2"
Value(3) = "Error in Terminal No. 3"
Value(4) = "Error in Terminal No. 4"
Value(5) = "Error in Terminal No. 5"
Value(6) = "Error in Terminal No. 6"
Value(7) = "Error in Terminal No. 7"
Value(8) = "Error in Terminal No. 8"
Value(9) = "Error in Terminal No. 9"
Value(10) = "Error in Terminal No. 10"
Value(11) = "Error in Terminal No. 11"
Value(12) = "Error in Terminal No. 12"
Value(13) = "Error in Terminal No. 13"
Value(14) = "Error in Terminal No. 14"
Value(15) = "Error in Terminal No. 15"
Value(16) = "Error in Terminal No. 16"
Value(17) = "Error in Terminal No. 17"
Value(18) = "Error in Terminal No. 18"
Value(19) = "Error in Terminal No. 19"
Value(20) = "Error in Terminal No. 20"
Value(21) = "Error in Terminal No. 21"
Value(22) = "Error in Terminal No. 22"
Value(23) = "Error in Terminal No. 23"
Value(24) = "Error in Terminal No. 24"
Value(25) = "Error in Terminal No. 25"
Value(26) = "Error in Terminal No. 26"
Value(27) = "Error in Terminal No. 27"
Value(28) = "Error in Terminal No. 28"
Value(29) = "Error in Terminal No. 29"
Value(30) = "Error in Terminal No. 30"
Value(31) = "Error in Terminal No. 31"
Value(32) = "Error in Terminal No. 32"
Value(33) = "Error in Terminal No. 33"
Value(34) = "Error in Terminal No. 34"
Value(35) = "Error in Terminal No. 35"
Value(36) = "Error in Terminal No. 36"
Value(37) = "Error in Terminal No. 37"
Value(38) = "Error in Terminal No. 38"
Value(39) = "Error in Terminal No. 39"
Value(40) = "Error in Terminal No. 40"
Value(41) = "Error in Terminal No. 41"
Value(42) = "Error in Terminal No. 42"
Value(43) = "Error in Terminal No. 43"
Value(44) = "Error in Terminal No. 44"
Value(45) = "Error in Terminal No. 45"
```

```
Value(47) = "Error in Terminal No. 47"
Value(48) = "Error in Terminal No. 48"
Value(49) = "Error in Terminal No. 49"
Value(50) = "Error in Terminal No. 50"
Value(51) = "Error in Terminal No. 51"
Value(52) = "Error in Terminal No. 52"
Value(53) = "Error in Terminal No. 53"
Value(54) = "Error in Terminal No. 54"
Value(55) = "Error in Terminal No. 55"
Value(56) = "Error in Terminal No. 56"
Value(57) = "Error in Terminal No. 57"
Value(58) = "Error in Terminal No. 58"
Value(59) = "Error in Terminal No. 59"
Value(60) = "Error in Terminal No. 60"
Value(61) = "Error in Terminal No. 61"
Value(62) = "Error in Terminal No. 62"
Value(63) = "Error in Terminal No. 63"
Value(64) = "Error in Terminal No. 64"
Unit_Diag_Area_End
Unit_Diag_Area = 16-23
Value(0) = "Initialization Error"
Value(1) = "Channel No. 1 defective"
Value(2) = "Channel No. 2 defective"
Value(3) = "Channel No. 3 defective"
Value(4) = "Channel No. 4 defective"
Value(255) = "Field Bus Error"
Unit_Diag_Area_End
        -------------------- Terminal Types -------------------------
Module = "SPS-Interface                  0xB1
EndModule
Module = KL1501 Alternative 4 Bytes      0xB3
EndModule
Module = KL1501 Alternative 6 Bytes      0xB5
EndModule
Module = KL1501 Standard 5 Bytes         0xB4
EndModule
Module = KL2502 1 Channel                0xB2
EndModule
Module = KL2502 2 Channels               0xB5
EndModule
Module = KL3xxx 1 Channel 16In           0x50
EndModule
Module = KL3xxx 1 Channel 24In/24Out     0xB2
EndModule
Module = KL3xxx 1 Channel 24In/8Out      0xC0,0x00,0x82
EndModule
Module = KL3xxx 1 Channel 24In           0x40,0x82
EndModule
Module = KL3xxx 1 Channel 16In/8Out      0xC0,0x00,0x81
EndModule
Module = KL3xx2 2 Channels 16In          0x51
EndModule
Module = KL3xx2 2 Channels 24In/24Out    0xB5
EndModule
Module = KL3xx4 4 Channels 16In          0x53
EndModule
Module = KL3xx4 4 Channels 24In/24Out    0xBB
EndModule
Module = KL4xx2 1 Channel 16Out          0x60
EndModule
Module = KL4xx2 1 Channel 24Out/24In     0xB2
EndModule
Module = KL4xx2 1 Channel 24Out/8In      0xC0,0x82,0x00
EndModule
Module = KL4xx2 1 Channel 16Out/8In      0xC0,0x81,0x00
EndModule
Module = KL4xx2 1 Channel 24Out          0x80,0x82
EndModule
Module = KL4xx2 2 Channels 16Out         0x61
```

```
EndModule
Module = KL4xx2 2 Channels 24Out/24In    0xB5
EndModule
Module = KL4xx4 4 Channels 16Out         0x63
EndModule
Module = KL4xx4 4 Channels 24Out/24In    0xBB
EndModule
Module = KL5001 Alternative 32In         0x93
EndModule
Module = KL5001 Alternative 48In/48Out   0xB5
EndModule
Module = KL5001 Standard 32In            0x93
EndModule
Module = KL5001 Standard 40In/40Out      0xB4
EndModule
Module = KL5001 Standard 40In/8Out       0xC0,0x00,0x84
EndModule
Module = KL5001 Standard 40In            0x40,0x84
EndModule
Module = KL5001 Standard 32In/8Out       0xC0,0x00,0x83
EndModule
Module = KL5051                          0xB5
EndModule
Module = KL5101                          0xB5
EndModule
Module = KL5111                          0xB5
EndModule
Module = KL5302 1 Channel                0xB2
EndModule
Module = KL5302 2 Channels               0xB5
EndModule
Module = KL6001 Alternative 4 Bytes      0xB3
EndModule
Module = KL6001 Alternative 6 Bytes      0xB5
EndModule
Module = KL6001 Standard 2 Bytes         0xB1
EndModule
Module = KL6001 Standard 3 Bytes         0xB2
EndModule
Module = KL6001 Standard 4 Bytes         0xB3
EndModule
Module = KL6001 Standard 5 Bytes         0xB4
EndModule
Module = KL6001 Standard 6 Bytes         0xB5
EndModule
Module = KL6011 Alternative 4 Bytes      0xB3
EndModule
Module = KL6011 Alternative 6 Bytes      0xB5
EndModule
Module = KL6011 Standard 2 Bytes         0xB1
EndModule
Module = KL6011 Standard 3 Bytes         0xB2
EndModule
Module = KL6011 Standard 4 Bytes         0xB3
EndModule
Module = KL6011 Standard 5 Bytes         0xB4
EndModule
Module = KL6011 Standard 6 Bytes         0xB5
EndModule
Module = KL6021 Alternative 4 Bytes      0xB3
EndModule
Module = KL6021 Alternative 6 Bytes      0xB5
EndModule
Module = KL6021 Standard 2 Bytes         0xB1
EndModule
Module = KL6021 Standard 3 Bytes         0xB2
EndModule
Module = KL6021 Standard 4 Bytes         0xB3
EndModule
```

```
Module = KL6021 Standard 5 Bytes        0xB4
EndModule
Module = KL6021 Standard 6 Bytes        0xB5
EndModule
Module = KL6051 4 Bytes                 0xB3
EndModule
Module = KL6051 6 Bytes                 0xB5
EndModule
Module = 8 Bit Digital Inputs           0x10
EndModule
Module = 16 Bit Digital Inputs          0x11
EndModule
Module = 24 Bit Digital Inputs          0x12
EndModule
Module = 32 Bit Digital Inputs          0x13
EndModule
Module = 40 Bit Digital Inputs          0x14
EndModule
Module = 48 Bit Digital Inputs          0x15
EndModule
Module = 56 Bit Digital Inputs          0x16
EndModule
Module = 64 Bit Digital Inputs          0x17
EndModule
Module = 72 Bit Digital Inputs          0x18
EndModule
Module = 80 Bit Digital Inputs          0x19
EndModule
Module = 88 Bit Digital Inputs          0x1A
EndModule
Module = 96 Bit Digital Inputs          0x1B
EndModule
Module = 104 Bit Digital Inputs         0x1C
EndModule
Module = 112 Bit Digital Inputs         0x1D
EndModule
Module = 120 Bit Digital Inputs         0x1E
EndModule
Module = 128 Bit Digital Inputs         0x1F
EndModule
Module = 8 Bit Digital Outputs          0x20
EndModule
Module = 16 Bit Digital Outputs         0x21
EndModule
Module = 24 Bit Digital Outputs         0x22
EndModule
Module = 32 Bit Digital Outputs         0x23
EndModule
Module = 40 Bit Digital Outputs         0x24
EndModule
Module = 48 Bit Digital Outputs         0x25
EndModule
Module = 56 Bit Digital Outputs         0x26
EndModule
Module = 64 Bit Digital Outputs         0x27
EndModule
Module = 72 Bit Digital Outputs         0x28
EndModule
Module = 80 Bit Digital Outputs         0x29
EndModule
Module = 88 Bit Digital Outputs         0x2A
EndModule
Module = 96 Bit Digital Outputs         0x2B
EndModule
Module = 104 Bit Digital Outputs        0x2C
EndModule
Module = 112 Bit Digital Outputs        0x2D
EndModule
Module = 120 Bit Digital Outputs        0x2E
```

```
EndModule
Module = 128 Bit Digital Outputs        0x2F
EndModule

Extended Description of User-Parameters
PrmText = 1                                   Reference No. 1
Text(0) = "Not used"
Text(1) = "Used"
EndPrmText

PrmText = 2                                   Reference No. 2
Text(0) = "Manual Reset"
Text(1) = "Automatic Reset"
EndPrmText

PrmText = 3                                   Reference No. 3
Text(0) = "Not implemented"
Text(1) = "Implemented"
EndPrmText

PrmText = 4                                   Reference No. 4
Text(0) = "Programed Configuration"
Text(1) = "Auto-Configuration"
EndPrmText

PrmText = 5                                   Reference No. 5
Text(0) = "User Data only"
Text(1) = "Complete evaluation"
EndPrmText

PrmText = 6                                   Reference No. 6
Text(0) = "INTEL"
Text(1) = "MOTOROLA"
EndPrmText

PrmText = 7                                   Reference No. 7
Text(0) = "Terminal Bus Cycle is stopped"
Text(1) = "Outputs are set to 0"
Text(2) = "Outputs remain unchanged"
EndPrmText

PrmText = 8
Text(0) = "Data Exchange is exited"
Text(1) = "Inputs are set to 0"           Reference No. 8
Text(2) = "Inputs remain unchanged"
EndPrmText

PrmText = 9                                   Reference No. 9
Text(2) = "16 Bytes"
Text(3) = "24 Bytes"
Text(4) = "32 Bytes"
Text(5) = "40 Bytes"
Text(6) = "48 Bytes"
Text(7) = "56 Bytes"
Text(8) = "64 Bytes"
EndPrmText

PrmText = 10                                  Reference No. 10
Text(0) = "Off"
Text(1) = "On"
EndPrmText

PrmText = 11                                  Reference No. 11
Text(0) = "cycle synchronized"
Text(1) = "free running"
EndPrmText

ExtUserPrmData = 1 "SPS-Interface"            Reference No. 1
Bit(0) 0 0-1                                  Default = 0, Min. = 0, Max. = 1
Prm_Text_Ref = 1                              Reference to Text-Definition 1
EndExtUserPrmData
```

ExtUserPrmData = 2 "Behavior at Terminal Bus Error"	Reference No. 2
Bit(0) 0 0-1	Default = 0, Min. = 0, Max. = 1
Prm_Text_Ref = 2	Reference to Text-Definition 2
EndExtUserPrmData	
ExtUserPrmData = 3 "Terminal Bus Diagnostics"	Reference No. 3
Bit(1) 0 0-1	Default = 0, Min. = 0, Max. = 1
Prm_Text_Ref = 3	Reference to Text-Definition 3
EndExtUserPrmData	
ExtUserPrmData = 4 "Configuration type"	Reference No. 4
Bit(1) 1 0-1	Default = 1, Min. = 0, Max. = 1
Prm_Text_Ref = 4	Reference to Text-Definition 4
EndExtUserPrmData	
ExtUserPrmData = 5 "Evaluation of Analog Terminals"	Reference No. 5
Bit(2) 0 0-1	Default = 0, Min. = 0, Max. = 1
Prm_Text_Ref = 5	Reference to Text-Definition 5
EndExtUserPrmData	
ExtUserPrmData = 6 "Data Format Auto-Configuration"	Reference No. 6
Bit(3) 1 0-1	Default = 1, Min. = 0, Max. = 1
Prm_Text_Ref = 6	Reference to Text-Definition 6
EndExtUserPrmData	
ExtUserPrmData = 7 "Reaction to PROFIBUS-Error"	Reference No. 7
BitArea(0-1) 0 0-2	Default = 0, Min. = 0, Max. = 2
Prm_Text_Ref = 7	Reference to Text-Definition 7
EndExtUserPrmData	
ExtUserPrmData = 8 "Reaction to Terminal Bus Error"	Reference No. 8
BitArea(2-3) 0 0-2	Default = 0, Min. = 0, Max. = 2
Prm_Text_Ref = 8	Reference to Text-Definition 8
EndExtUserPrmData	
ExtUserPrmData = 9 "Max. Length of Diagnostic Data"	Reference No. 9
BitArea(3-6) 2 2-8	Default = 2, Min. = 2, Max. = 8
Prm_Text_Ref = 9	Reference to Text-Definition 9
EndExtUserPrmData	
ExtUserPrmData = 10 "Actualization of Diag in 10ms"	Reference No. 10
Unsigned8 10 10-255	Default = 10, Min. = 10, Max. = 255
EndExtUserPrmData	
ExtUserPrmData = 11 "Reaction to Clear_Data"	Reference No. 11
Bit(2) 0 0-1	Default = 0, Min. = 0, Max. = 1
Prm_Text_Ref = 10	Reference to Text-Definition 10
EndExtUserPrmData	
ExtUserPrmData = 12 "Actualization of Process Image"	Reference No. 12
Bit(6) 1 0-1	Default = 1, Min. = 0, Max. = 1
Prm_Text_Ref = 11	Reference to Text-Definition 11
EndExtUserPrmData	

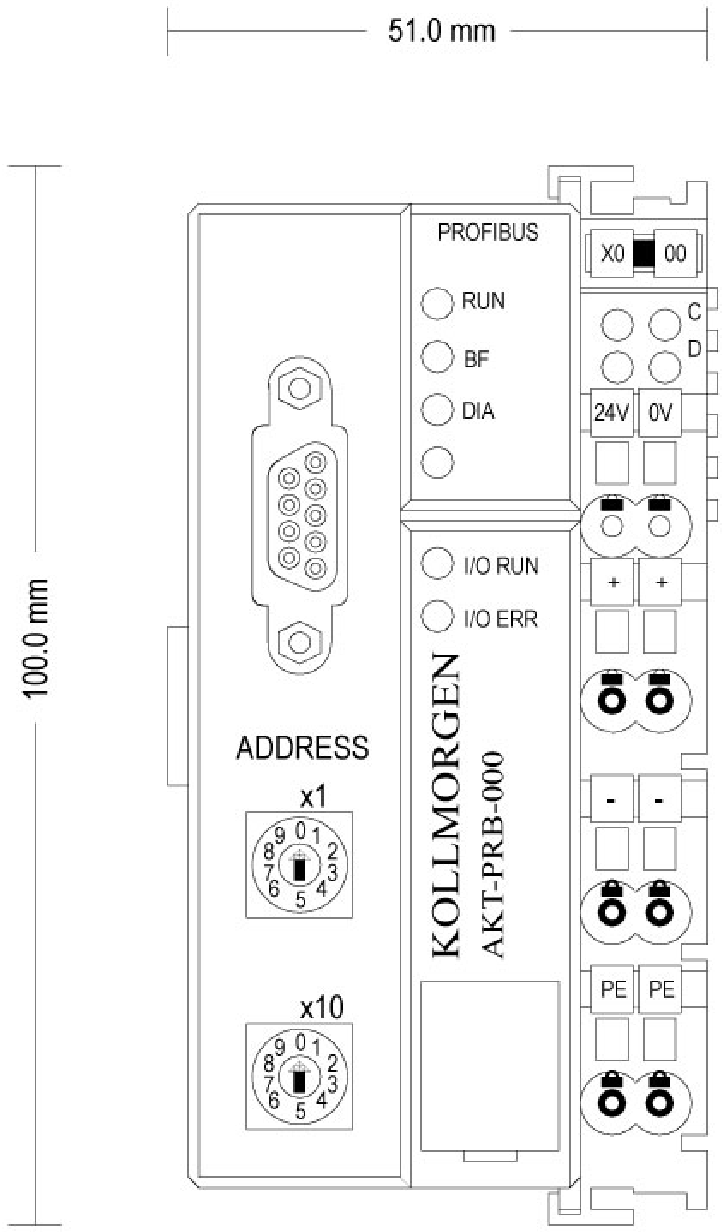
Ext_User_Prm_Data_Const(0) = 0x00,0x00,0x00,0x00,0x00	5 Bytes reserved UserPrmData
Ext_User_Prm_Data_Const(5) = 0x00	Bits 1-7 are assigned 0
Ext_User_Prm_Data_Ref(5) = 1	Reference No. 1
Ext_User_Prm_Data_Const(6) = 0x00	1 Byte reserved UserPrmData
Ext_User_Prm_Data_Ref(7) = 3	Reference No. 3
Ext_User_Prm_Data_Ref(7) = 11	Reference No. 11

```
Ext_User_Prm_Data_Const(8) = 0x00   1 Byte reserved UserPrmData
Ext_User_Prm_Data_Const(9) = 0x61   Bits 0,5,6 are assigned 1, Bits 4 and 7
                                    are assigned 0
Ext_User_Prm_Data_Ref(9) = 4        Reference No. 4
Ext_User_Prm_Data_Ref(9) = 5        Reference No. 5
Ext_User_Prm_Data_Ref(9) = 6        Reference No. 6
Ext_User_Prm_Data_Const(10) = 0x00  Bits 4-7 are assigned 0
Ext_User_Prm_Data_Ref(10) = 7       Reference No. 7
Ext_User_Prm_Data_Ref(10) = 8       Reference No. 8
Ext_User_Prm_Data_Const(11) = 0x00  Bits 0-2 and 7 are assigned 0
Ext_User_Prm_Data_Ref(11) = 9       Reference No. 9
Ext_User_Prm_Data_Const(12) = 0x00  1 Byte reserved UserPrmData
Ext_User_Prm_Data_Ref(13) = 10      Reference No. 10
Ext_User_Prm_Data_Const(14) = 0x00  1 Byte reserved UserPrmData
```

APPENDIX B

This section provides the mechanical drawing of the I/O terminal.

B.1 AKT-PRB-000-000 Mechanical Drawing



About Kollmorgen

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For assistance with your application needs, contact us at: 540-633-3545, contactus@kollmorgen.com or visit www.kollmorgen.com

North America

Kollmorgen

203A West Rock Road
Radford, VA 24141 USA
Phone: 1-540-633-3545
Fax: 1-540-639-4162

Europe

Kollmorgen

Wacholderstraße 40 – 42
40489 Düsseldorf Germany
Phone: + 49 (0) 203-9979-235
Fax: + 49 (0) 203-9979-3314