BECKHOFF New Automation Technology

Documentation | EN

BC5250

Bus Terminal Controller for DeviceNet
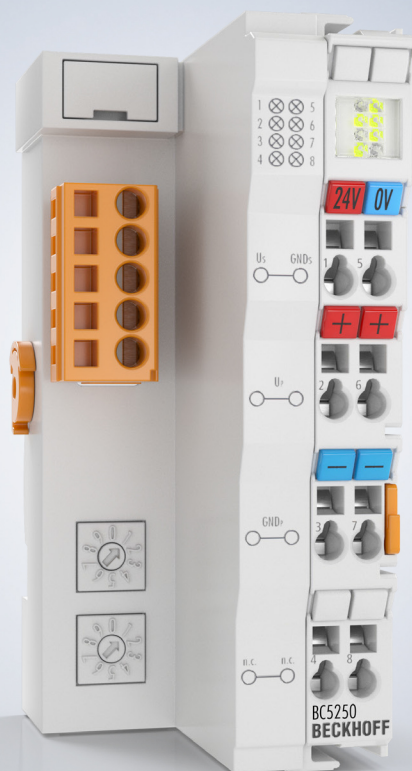
Table of contents

1 Foreword 5

   1.1 Notes on the documentation 5

   1.2 Safety instructions 6

   1.3 Documentation issue status 7

2 Product overview 8

   2.1 Bus Terminal Controllers of the BCxx50 series 8

   2.2 BC5250 - Intoduction 9

   2.3 Technical data 10

      2.3.1 Technical data - BC5250 10

      2.3.2 Technical data - DeviceNet 11

      2.3.3 Technical data - PLC 11

   2.4 The principle of the Bus Terminal 12

   2.5 The Beckhoff Bus Terminal system 12

3 Mounting and wiring 15

   3.1 Mounting 15

      3.1.1 Dimensions 15

      3.1.2 Installation on mounting rails 16

   3.2 Wiring 16

      3.2.1 Potential groups, insulation testing and PE 17

      3.2.2 Power supply 19

      3.2.3 Programming cable 20

      3.2.4 DeviceNet cabling 21

   3.3 ATEX - Special conditions (extended temperature range) 26

   3.4 Continuative documentation for ATEX and IECEx 27

4 Parameterization and Commissioning 28

   4.1 Start-up behavior of the Bus Terminal Controller 28

   4.2 Configuration 28

      4.2.1 Overview 28

      4.2.2 Creating a TwinCAT configuration 30

      4.2.3 Downloading a TwinCAT configuration 31

      4.2.4 Uploading a TwinCAT configuration 33

      4.2.5 Resources in the Bus Terminal Controller 34

      4.2.6 ADS connection via serial interface 37

      4.2.7 DeviceNet slave interface 38

      4.2.8 K-bus 46

      4.2.9 PLC 48

      4.2.10 Configuration software KS2000 51

5 Programming 52

   5.1 BCxx50 PLC features 52

   5.2 TwinCAT PLC 52

   5.3 TwinCAT PLC - Error codes 53

   5.4 Remanent data 55

   5.5 Allocated flags 56

1   Foreword

1.1   Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible 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.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

1.2   Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

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 the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

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

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ **DANGER**
Serious risk of injury!
Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ **WARNING**
Risk of injury!
Failure to follow this safety instruction endangers the life and health of persons.

⚠ **CAUTION**
Personal injuries!
Failure to follow this safety instruction can lead to injuries to persons.

NOTE
Damage to environment/equipment or data loss
Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

● Tip or pointer

ⅈ This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
2.1.0	• Technical data updated • Ex marking added to technical data • Chapter *ATEX - Special conditions (extended temperature range)* added • Chapter *Instructions for ESD protection* added • Chapter *Disposal* added • New title page
2.0.0	• Migration
1.1.0	• Notes to meet the UL requirements added.
1.0.0	• First public issue

BC5250 firmware

For updating your firmware you need a serial cable, the KS2000 configuration software, or the firmware update program.

Firmware	Comment
0xB2	Firmware version 0xB2

The firmware and hardware versions (delivery state) can be found on the sticker on the underside of the Bus Terminal Controller.

2 Product overview

2.1 Bus Terminal Controllers of the BCxx50 series

Bus Terminal Controllers are Bus Couplers with integrated PLC functionality. The BCxx50 Bus Terminal Controllers have a fieldbus interface, are intelligent slaves and can be used as decentralized intelligence within the system. They are located in a cost-optimized and compact housing. In contrast to the BCxx00 range, the BCxx50 range supports up to 255 Bus Terminals via the K-Bus extension.

The Bus Terminal Controller is programmed using the TwinCAT programming system according to IEC 61131-3. The BCxx50 configuration/programming interface is used for loading the PLC program. If the TwinCAT software PLC is in use, the PLC program can also be loaded via the fieldbus.

The inputs and outputs of the connected Bus Terminals are assigned in the default setting of the mini-PLC. Each individual Bus Terminal can be configured in such a way that it exchanges data directly through the fieldbus with the higher-level automation device. Similarly, pre-processed data can be exchanged between the Bus Terminal Controller and the higher-level controller via the fieldbus.

Fieldbus interface

The variants of the BCxx50 series Bus Terminal Controllers differ in terms of their fieldbus interfaces. Various versions cover the most important fieldbus systems:

- BC3150: PROFIBUS DP
- BC5150: CANopen
- BC5250: DeviceNet
- BC8050: RS485, various protocols
- BC8150: RS232, various protocols

Programming

The BCxx50 devices are programmed according to the powerful IEC 61131-3 standard. Like for all other BECKHOFF controllers, the TwinCAT automation software is the basis for parameterization and programming. Users therefore have the familiar TwinCAT tools available, e.g. PLC programming interface, System Manager and TwinCAT Scope. Data is exchanged optionally via the serial interface (COM1) or via the fieldbus through Beckhoff PC FCxxxx fieldbus cards.

Configuration

The configuration is also carried out using TwinCAT. The fieldbus interface can be configured and parameterized via the System Manager. The System Manager can read all connected devices and Bus Terminals. After the parameterization, the configuration is saved on the BCxx50 via the serial interface. The configuration thus created can be accessed again later.

2.2 BC5250 - Intoduction
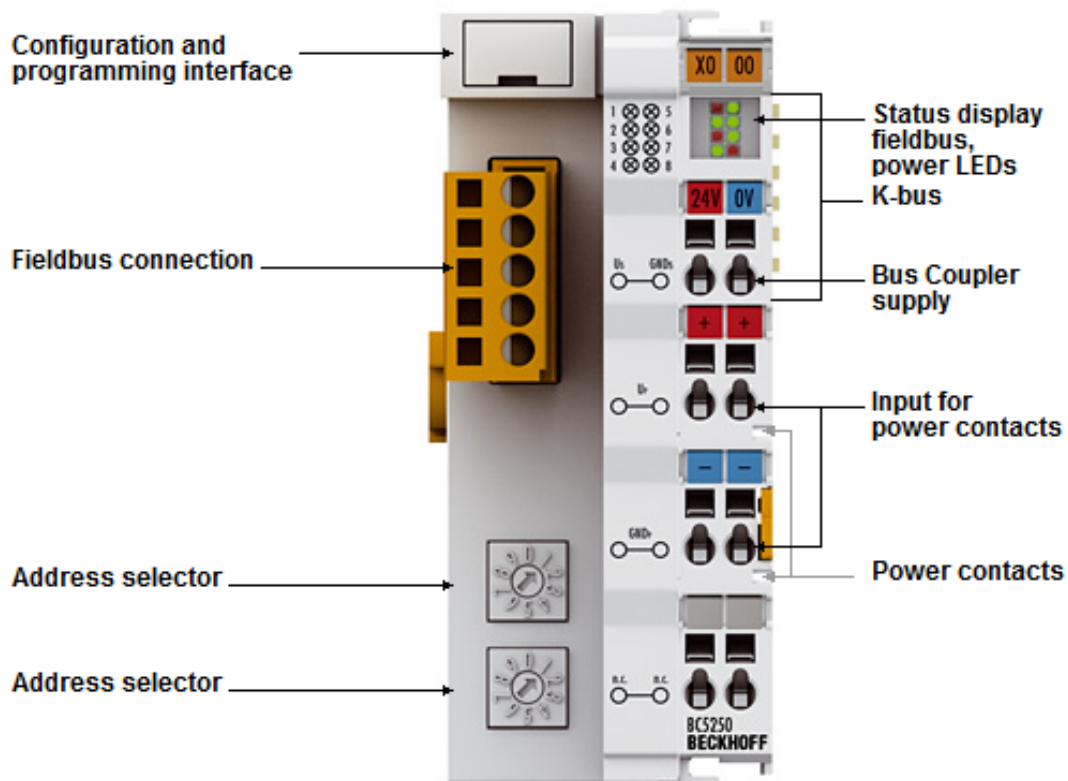
Fig. 1: BC5250 - Bus Terminal Controller for DeviceNet

The Bus Terminal Controllers are Bus Couplers with integrated PLC functionality. The BC5250 Bus Terminal Controller for DeviceNet extends the Beckhoff small controller series by a cost-optimized version in a compact housing. The BC5250 offers automatic baud rate detection up to 500 kbaud and two address selection switches for address assignment.

2.3 Technical data

2.3.1 Technical data - BC5250

Technical data	BC5250
Processor	16 bit micro-controller
Diagnostics LEDs	2 x power supply, 2 x K-Bus
Configuration and programming software	TwinCAT PLC
Fieldbus interface	DeviceNet
Bus connection	Open Style Connector, 5-pin
Serial interface	COM1 (RS232 for configuration and programming, automatic baud rate detection 9600/19200/38400 baud)
Number of bus terminals	64 (255 with K-bus extension)
Digital peripheral signals	512 inputs/outputs
Analog peripheral signals	128 inputs/outputs
Configuration possibility	via TwinCAT or the controller
Maximum fieldbus byte number	512 bytes input and 512 bytes output
Maximum number of bytes - PLC	2048 bytes of input data, 2048 bytes of output data

Supply	BC5250
Power supply (Us)	24 V_{DC} (-15 % /+20 %)!
Input current (Us)	60 mA + (total K-bus current)/4
Starting current	approx. 2.5 x continuous current
K-bus current (5 V)	up to hardware version 06: maximum 1000 mA from hardware version 07: maximum 1750 mA
Power contact voltage (Up)	maximum 24 V_{DC}
Power contact current load (Up)	maximum 10 A
Recommended back-up fuse (Up)	≤10 A
Dielectric strength	500 V (power contact/supply voltage/fieldbus)

> ⚠ **CAUTION**
>
> **UL-Requirements**
>
> For power supply of the Bus Terminal Controller (Us) use a 4 A fuse or an *NEC Class 2* power supply to meet the UL requirements!

Technical data	BC5250
Weight	approx. 100 g
Dimensions (W x H x D)	approx. 44 mm x 100 mm x 68 mm
Permissible ambient temperature range during operation	-25 °C ... +60 °C
Permissible ambient temperature range during storage	-40 °C … +85 °C
Relative humidity	95 % no condensation
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Installation position	variable
Protection class	IP20
Approvals/markings*	CE, UKCA, cULus, EAC, ATEX [▶ 26]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex marking

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc

2.3.2 Technical data - DeviceNet

System data	DeviceNet (BC5250)		
Number of nodes	64		
Number of I/O points	depending on controller		
Data transfer medium	shielded, twisted copper cable, 2 x signal, 1 x CAN ground (recommended)		
Cable length	500 m	250 m	100 m
Data transfer rate	125 kbaud	250 kbaud	500 kbaud
I/O communication types	polling, bit-strobe, change of state, cycle		
Amount of data	128 bytes input and 128 bytes output		
Baud rate	Automatic baud rate detection (for possible baud rates see data transfer rate)		

2.3.3 Technical data - PLC

PLC data	BCxx5x
Programmability	via serial programming interface or via the fieldbus
Program memory	48 kbyte
Source code memory	128 kbyte
Data memory	32 kbyte
Remanent flags	2 kbyte
PLC cycle time	Approx. 3.0 ms for 1000 IL commands (without I/O cycle)
Programming languages	IEC 6-1131-3 (IL, LD, FBD, ST, SFC)
Runtime	1 PLC task
Online Change	Yes
Up/Down Load Code	Yes/Yes

BECKHOFF

2.4 The principle of the Bus Terminal
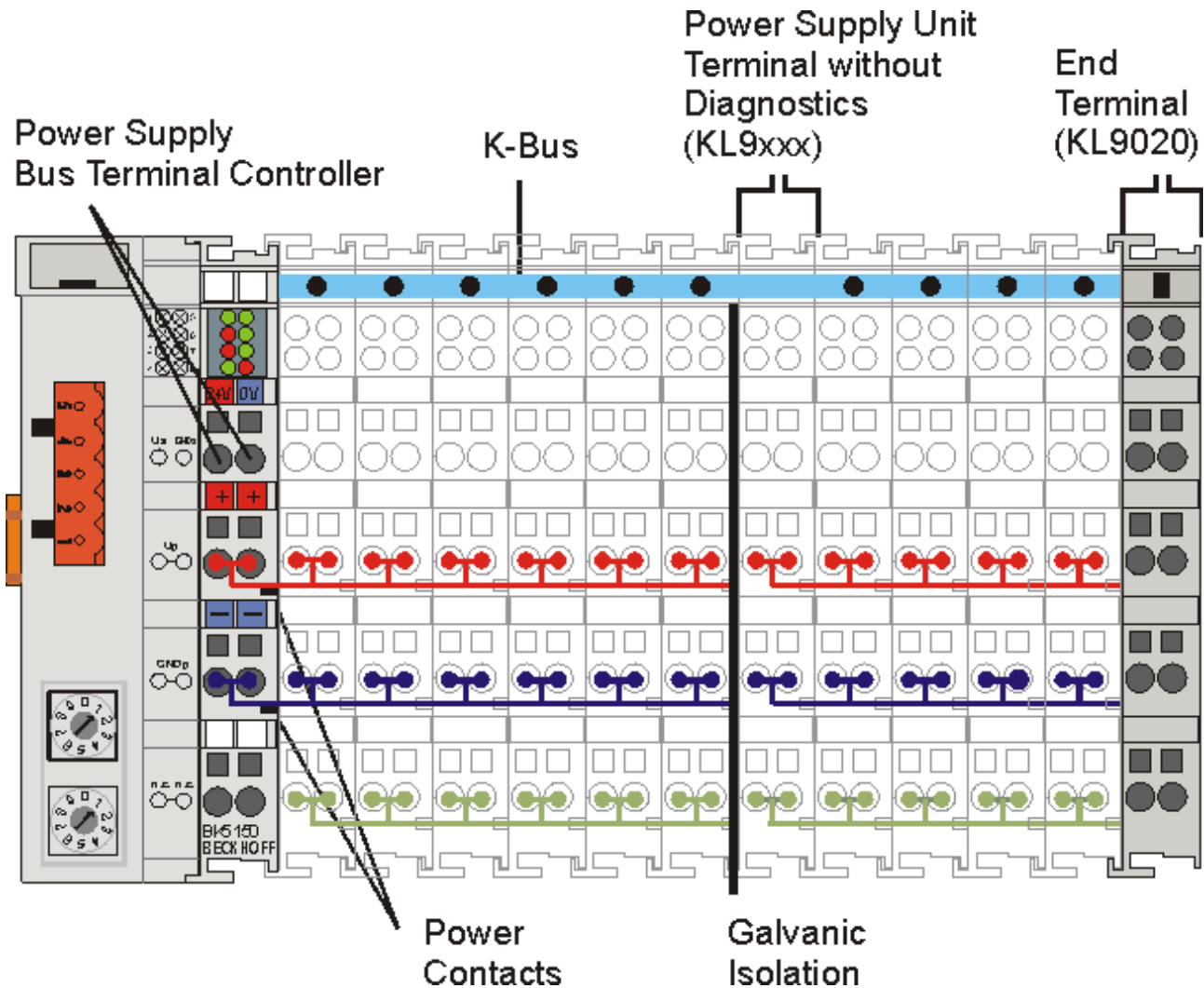
Fig. 2: The principle of the Bus Terminal

2.5 The Beckhoff Bus Terminal system

Up to 256 Bus Terminals, with 1 to 16 I/O channels per 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. Up to 255 Bus Terminals can be connected via the K-Bus extension. For each technical signal form, terminals are available with one, two, four or eight I/O channels, which can be mixed as required. 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 decentrally, using minimum cable lengths. The controller can be installed at any location within the plant.

Industrial PCs as controllers

The use of an Industrial PC 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 Beckhoff 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.

Mounting on standardized mounting rails

The installation is standardized thanks to the simple and space-saving mounting on a standardized mounting rail (EN 60715, 35 mm) and the direct wiring of actuators and sensors, without cross connections between the terminals. The consistent labelling 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.

K-Bus

The K-Bus is the data path within a terminal strip. The K-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 K-Bus. The user does not have to learn anything about the function of the K-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 Bus Terminals can be used in a terminal block, with optional K-Bus extension for up to 256 Bus Terminals. 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, K-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.

3   Mounting and wiring

3.1   Mounting

> ⚠ **WARNING**
>
> **Risk of injury through electric shock and damage to the device!**
>
> Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the components!

3.1.1   Dimensions

The Beckhoff Bus Terminal system 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.
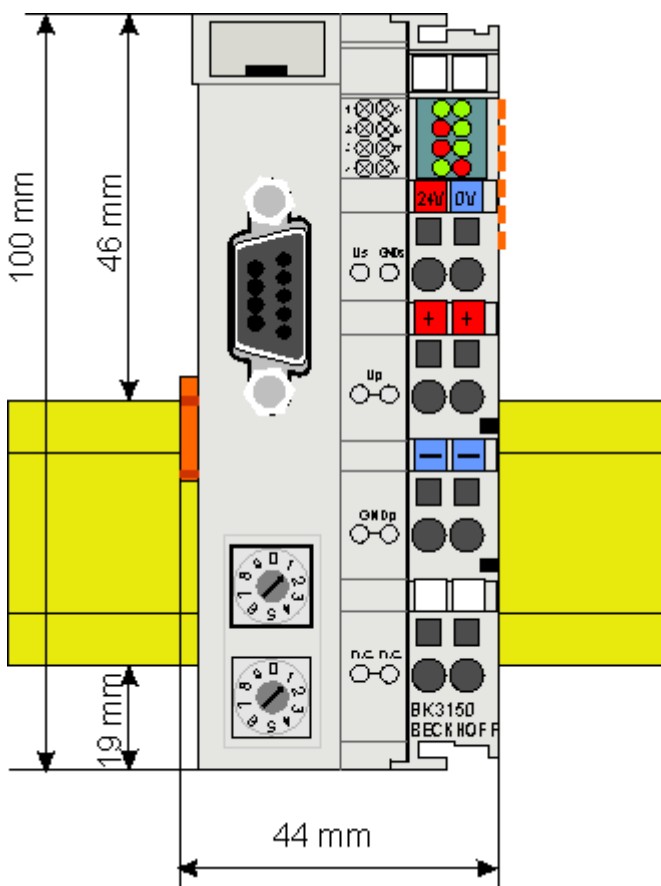
Fig. 3: BCxx50 - Dimensions

The total width of the fieldbus station is the width of the Bus Coupler/Bus Terminal Controller plus the width of the Bus Terminals being used (incl. KL9010 bus end terminal). Depending on design, the Bus Terminals are 12 mm or 24 mm wide. The height is 100 mm.

The BCxx50 series Bus Terminal Controllers are 68 mm deep.

3.1.2   Installation on mounting rails

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.
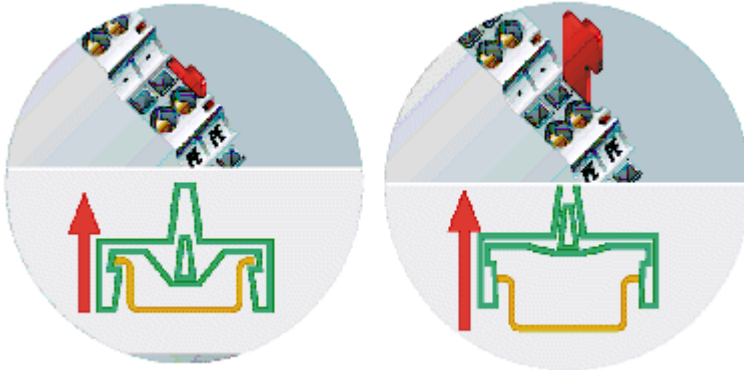
Fig. 4: Release the locking mechanism by pulling the orange tab

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 cannot be made by pushing the housings together on the mounting rail. When correctly assembled, no significant gap can be seen between the attached housings.
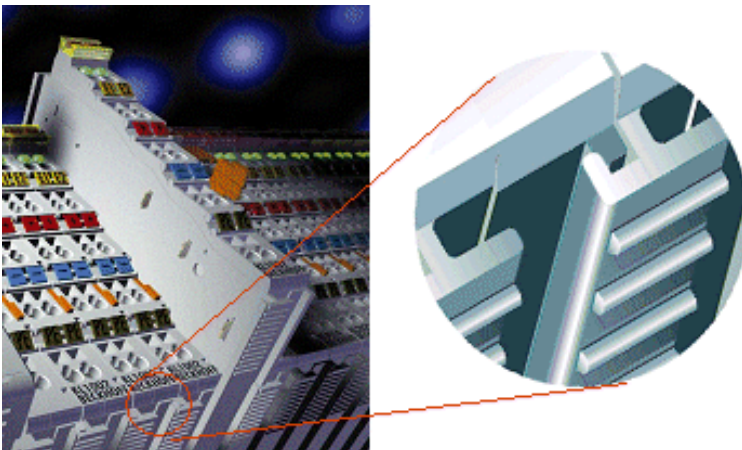
Fig. 5: Groove and tongue of the housings

NOTE
Bus Terminals should only be pulled or plugged in switched-off state.
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.

3.2   Wiring

⚠ WARNING
Risk of injury through electric shock and damage to the device!
Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the components!

3.2.1 Potential groups, insulation testing and PE

Potential groups

A Beckhoff Bus Terminal block usually has 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, K-bus and terminal logic form a second electrically isolated 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.
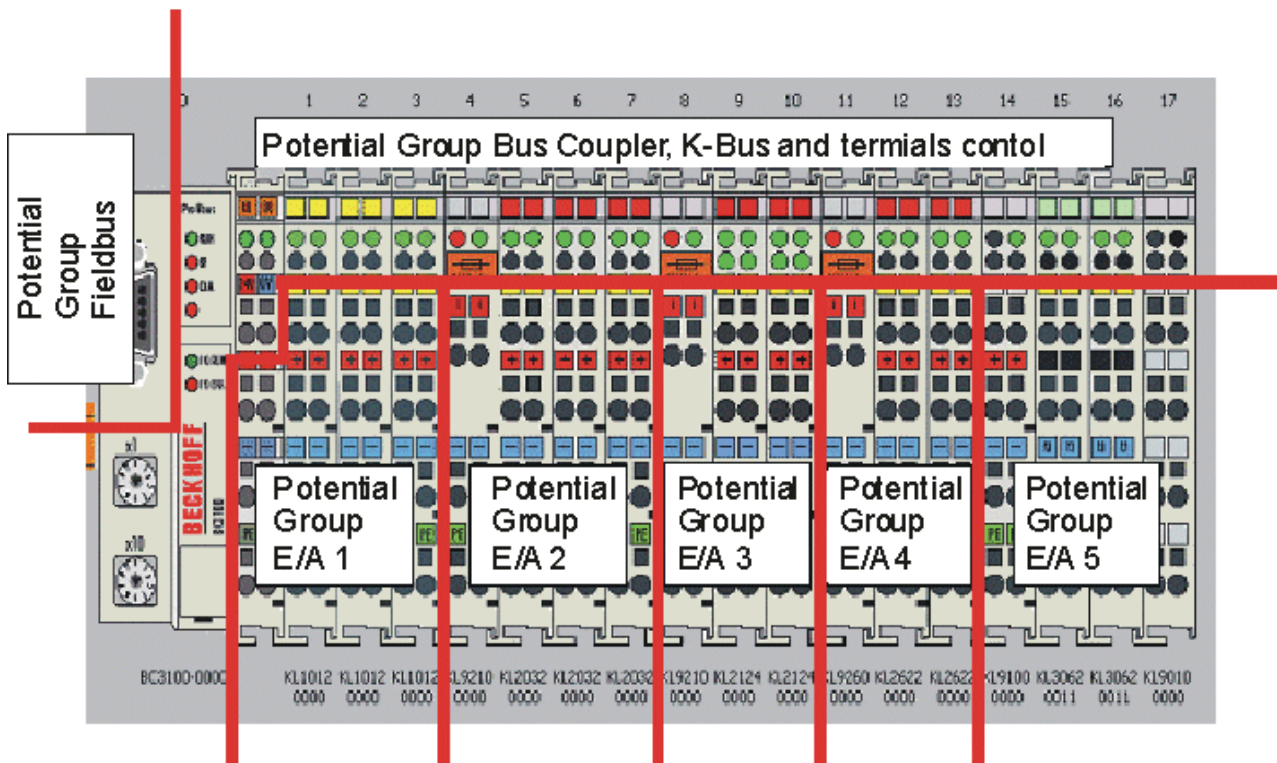
Fig. 6: Potential groups of a Bus Terminal block

Insulation testing

The connection between Bus Coupler / Bus Terminal Controller and Bus Terminals is realized automatically by latching the components. The transfer of the data and the supply voltage for the intelligent electronics in the Bus Terminals is performed by the K-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 used for supplying the power contacts.

PE power contacts

The power contact labelled 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.

BECKHOFF
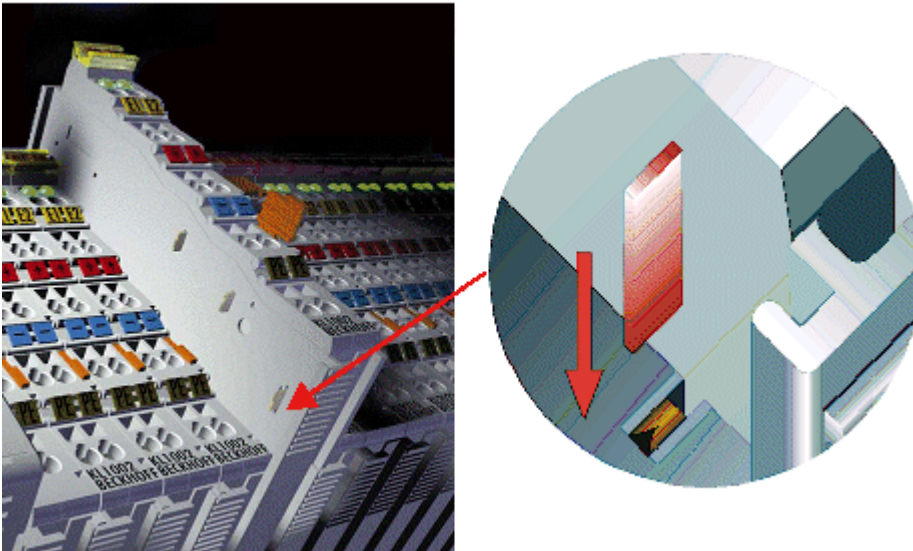
Fig. 7: Power contact on the left

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 supply line at the Bus Coupler / Bus Terminal Controller must be disconnected for an insulation test. 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 power contact with the label PE must not be used for other potentials.

3.2.2 Power supply

⚠ WARNING
Risk of injury through electric shock and damage to the device! Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the components!

Supply of Bus Terminal Controller and Bus Terminals (Us)

The Bus Terminal Controller requires a supply voltage of 24 V_{DC}.

The connection is made by means of the upper spring-loaded terminals labelled *24 V* and *0 V*. This supply voltage is used for the electronic components of the Bus Coupler / Bus Terminal Controllers and (via the K-bus) the electronic components of the Bus Terminals. It is galvanically separated from the field level voltage.
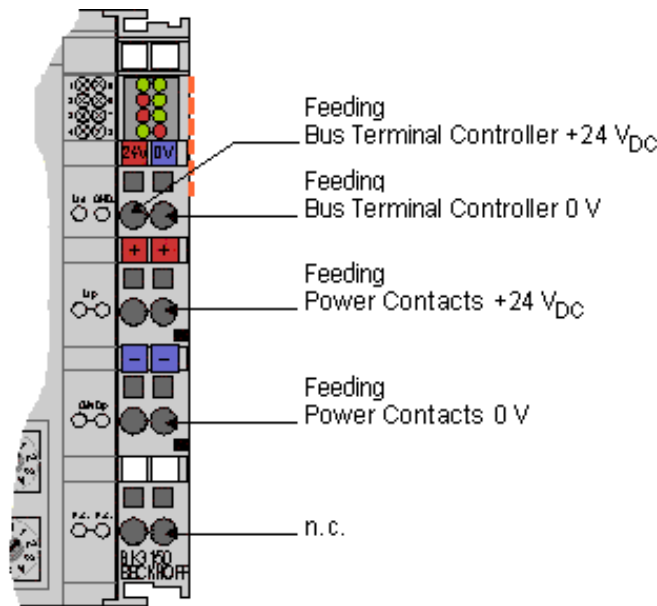
Fig. 8: Terminal points for the Bus Terminal Controller supply

Fig. 9: UL identification

⚠ CAUTION
Note the UL requirements for the power supply. To comply with the UL requirements, the 24 V_{DC} supply voltage for Us must originate • from an isolated source protected by a fuse of max. 4 A (according to UL248) or • from a voltage supply complying with *NEC class 2*. An *NEC class 2* voltage source must not be connected in series or parallel with another *NEC class 2* corresponding voltage source!

⚠ CAUTION
No unlimited voltage sources! To comply with the UL requirements, Us must not be connected with unlimited voltage sources.

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 BC electronics.

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 load 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.

Power contacts

On the right hand face of the Bus Terminal Controller there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they cannot 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 Terminal Controllers and of the Bus Terminals guarantees that the power contacts mate securely.

3.2.3   Programming cable

Use the KS2000-Z2 programming cable for serial programming of the Bus Terminal Controller. This cable is included in the scope of supply of the KS2000 software, or it can be ordered separately (order identifier KS2000-Z2).

Fig. 10: Programming cable KS2000-Z2

KS2000-Z2

The programming cable offers the option of programming the BCxx50 via the serial interface.

NOTE
Do not interrupt the ground connection for the supply voltage
When the programming cable (between BCxx50 and PC) is connected, the ground connection of the Bus Terminal controller must not be interrupted or disconnected, since this may destroy the programming cable.

3.2.4   DeviceNet cabling

3.2.4.1   DeviceNet topology

CAN is a 2-wire bus system, to which all participating devices are connected in parallel (i.e. using short drop lines). The bus must be terminated at each end with a 120 (or 121) Ohm termination resistor to prevent reflections. This is also necessary even if the cable lengths are very short!
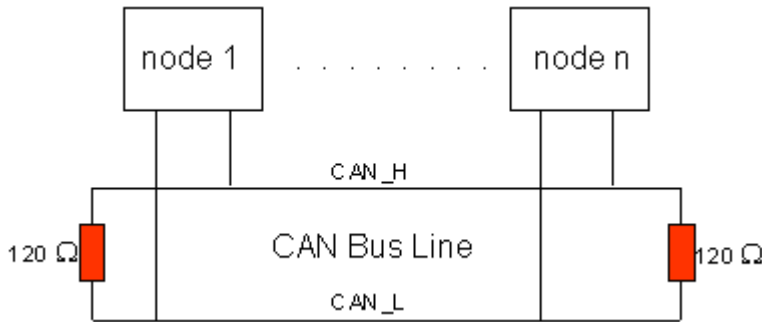
Fig. 11: Termination of the bus with a 120 Ohm termination resistor

Since the CAN signals are represented on the bus as the difference between the two levels, the CAN line is comparatively not very sensitive to incoming interference (EMI). Both lines are affected, so the interference has very little effect on the difference level.
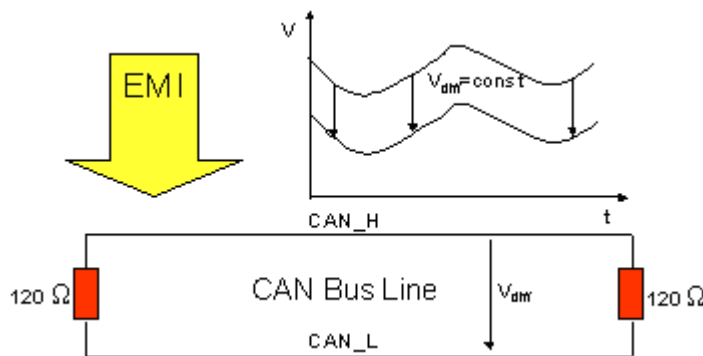
Fig. 12: Insensitivity to incoming interference

3.2.4.2   Bus length

The maximum length of a CAN bus is primarily limited by the signal propagation delay. The multi-master bus access procedure (arbitration) requires signals to reach all the nodes at effectively the same time (before the sampling within a bit time). Since the signal propagation delays in the CAN connecting equipment (transceivers, optocouplers, CAN controllers) are almost constant, the line length must be chosen in accordance with the baud rate.

Baud rate	Bus length
500 kbit/s	< 100 m
250 kbit/s	< 250 m
125 kbit/s	< 500 m

3.2.4.3   Drop lines

Drop lines must always be avoided as far as possible, since they inevitably cause signal reflections. The reflections caused by drop lines are not however usually critical, provided they have decayed fully before the sampling time. In the case of the bit timing settings selected in the Bus Couplers it can be assumed that this is the case, provided the following drop line lengths are not exceeded:

Baud rate	Drop line length	Total length of all drop lines
500 kbit/s	< 5 m	< 25 m
250 kbit/s	< 10 m	< 50 m
125 kbit/s	< 20 m	< 100 m

Drop lines must not have termination resistors.
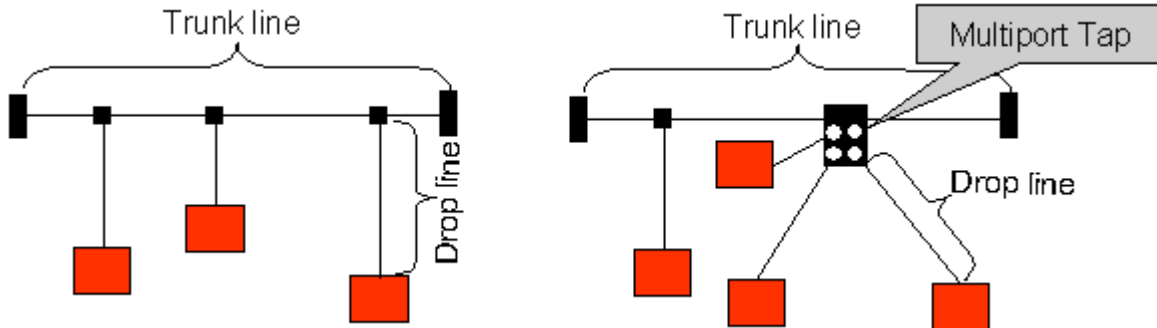
Fig. 13: Sample topology of drop lines

3.2.4.4 Star hub

Star Hub (Multiport Tap)

Shorter drop line lengths must be maintained when passive distributors ("multiport taps"), such as the Beckhoff ZS5052-4500 Distributor Box. The following table indicates the maximum drop line lengths and the maximum length of the trunk line (without the drop lines):

Baud rate	Drop line length with multiport topology	Trunk line length (without drop lines)
500 kbit/s	< 1,2 m	< 66 m
250 kbit/s	< 2,4 m	< 120 m
125 kbit/s	< 4,8 m	< 310 m

3.2.4.5 DeviceNet cable

Screened twisted-pair cables (2x2) with a characteristic impedance of between 108 and 132 Ohm is recommended for the CAN wiring.

ZB5200 CAN/DeviceNet Cable

The ZB5200 cable material corresponds to the DeviceNet specification, and is also suitable for CANopen systems. The ready-made ZK1052-xxxx-xxxx bus lines for the Fieldbus Box modules are made from this cable material. It has the following specification:

- 2 x 2 x 0.34 mm² (AWG 22) twisted pairs
- double screened · braided screen with filler strand
- characteristic impedance (1 MHz): 126 ohm
- Conductor resistance 54 Ohm/km
- sheath: grey PVC, outside diameter 7.3 mm
- printed with "InterlinkBT DeviceNet Type 572" as well as UL and CSA ratings
- stranded wire colors correspond to the DeviceNet specification
- UL recognized AWM Type 2476 rating
- CSA AWM I/II A/B 80 °C 300 V FT1
- corresponds to the DeviceNet "Thin Cable" specification
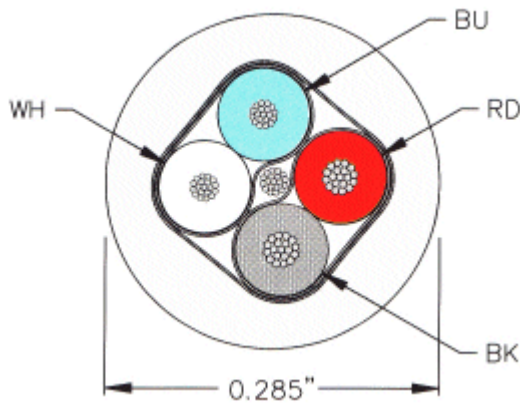
Fig. 14: Structure of CAN/DeviceNet cable ZB5200

3.2.4.6   Shielding

The shield is to be connected over the entire length of the bus cable, and only galvanically grounded at one point, in order to avoid ground loops.
The design of the screening, in which HF interference is diverted through R/C elements to the mounting rail assumes that the rail is appropriately earthed and free from interference. If this is not the case, it is possible that HF interference will be transmitted from the mounting rail to the shield of the bus cable. In that case the shield should not be attached to the couplers - it should nevertheless still be fully connected through.

Notes related to checking the CAN wiring can be found in the Trouble Shooting section.

3.2.4.7   Cable colors

Suggestion for using the Beckhoff DeviceNet cables at the Bus Terminal and the Fieldbus Box:

BK52x0 pin BX5200 (X520) PIN	Fieldbus Box pin	FC520x pin	Function	ZB5200 cable color
5	2	5	V+(red)	**red**
4	4	4	CAN high (CAN+, white)	**white**
3	1	3	SHIELD	Filler strand
2	5	2	CAN low (CAN-, blue)	**blue**
1	3	1	V- (black)	**Black**

3.2.4.8   FC520x: 5-pin open style connector

The DeviceNet bus line is connected to the FC5201 and FC5202 DeviceNet PCI cards via 5-pin open style connectors with the following pin assignment.

Pin	Assignment
5	V+(red)
4	CAN high (CAN+, white)
3	SHIELD
2	CAN low (CAN-, blue)
1	V- (black)

The unlisted pins are not connected.

Note: an auxiliary voltage up to 30 V_{DC} may be connected at pin 9 (some CAN devices use this for supplying the transceivers).

3.2.4.9 BK52x0/BX5200: 5-pin open style connector

The BK52x0/BX5200 (X520) Bus Couplers have a recessed front surface on the left hand side with a five pin connector.
The supplied DeviceNet connecting socket can be inserted here.
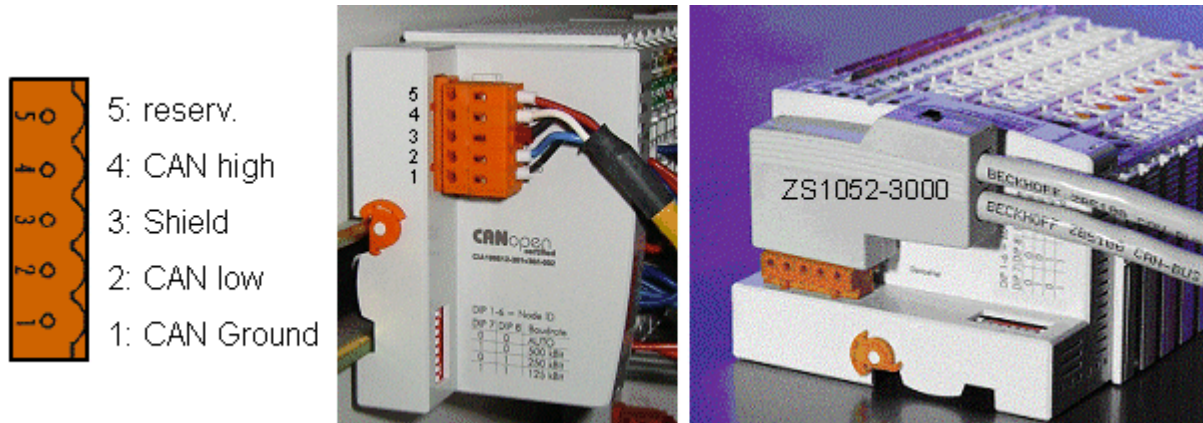
Fig. 15: BK51x0/BX5100 connection socket assignment

The left figure shows the socket in the BK52x0/BX5200 Bus Coupler. Pin 5 is the connection strip's top most pin. Pin 5 is not used. Pin 4 is the CAN high connection, pin 2 is the CAN low connection, and the shield is connected to pin 3 (which is connected to the mounting rail via an R/C network). CAN-GND can optionally be connected to pin 1. If all the CAN ground pins are connected, this provides a common reference potential for the CAN transceivers in the network. It is recommended that the CAN GND be connected to earth at one location, so that the common CAN reference potential is close to the supply potential. Since the CANopen BK52x0/BX5200 Bus Couplers provide full electrical isolation of the bus connection, it may in appropriate cases be possible to omit wiring up the CAN ground.

3.2.4.10 ZS1052-3000 Bus Interface Connector

The ZS1052-3000 CAN Interface Connector can be used as an alternative to the supplied connector. This makes the wiring significantly easier. There are separate terminals for incoming and outgoing lines and a large area of the shield is connected via the strain relief. The integrated termination resistor can be switched externally. When it is switched on, the outgoing bus line is electrically isolated - this allows rapid wiring fault location and guarantees that no more than two resistances are active in the network.

3.2.4.11 Fieldbus Box: M 12 DeviceNet socket

Fieldbus Box: M12 DeviceNet socket

With the IPxxxx-B520 and IL230x-B520 Fieldbus Box modules, a five-pole M12 connector is used for the bus connection.
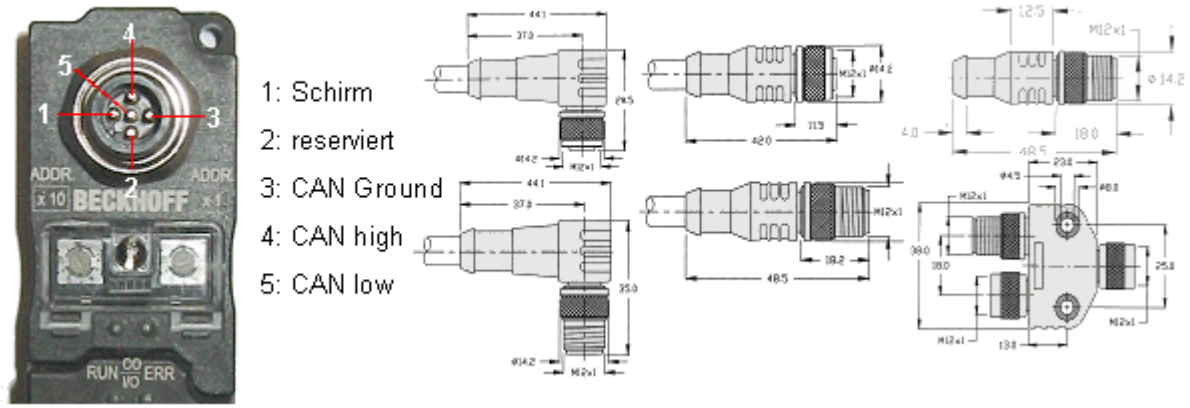
Fig. 16: Pin assignment: M12 plug, fieldbus box

1: Schirm
2: reserviert
3: CAN Ground
4: CAN high
5: CAN low

BECKHOFFoffer plugs for field assembly, passive distributor's, termination resistors and a wide range of preassembled cables for the Fieldbus Box system. Details be found in the catalog, or under www.beckhoff.de

3.3 ATEX - Special conditions (extended temperature range)

⚠ WARNING
Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas (directive 2014/34/EU)! • The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-15! The environmental conditions during use are thereby to be taken into account! • For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas! • Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! • The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

• EN 60079-0:2012+A11:2013
• EN 60079-15:2010
• EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

The Beckhoff fieldbus components with extended temperature range (ET) certified according to the ATEX directive for potentially explosive areas bear the following marking:

II 3G KEMA 10ATEX0075 X Ex nA IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or

II 3G KEMA 10ATEX0075 X Ex nA nC IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.4   Continuative documentation for ATEX and IECEx

NOTE
Continuative documentation about explosion protection according to ATEX and IECEx Pay also attention to the continuative documentation **Ex. Protection for Terminal Systems** Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx, that is available for <u>download</u> within the download area of your product on the Beckhoff homepage www.beckhoff.com!

4 Parameterization and Commissioning

4.1 Start-up behavior of the Bus Terminal Controller

When the Bus Terminal Controller is switched on it checks its state, configures the K-bus, creates a configuration list based on the connected Bus Terminals and starts its local PLC.
The I/O LEDs flash when the Bus Terminal Controller starts up. If the system is in an error-free state, the I/O LEDs should stop flashing after approx. 2-3 seconds. In the event of a fault the error type determines which LED flashes (see chapter *Diagnostic LEDs*).

```
┌─────────────┐
│ Power on    │
│ Self Test   │
└─────────────┘
       │
       ▼
┌─────────────┐
│ K-Bus Test  │
└─────────────┘
   │        │
   ▼        │
┌──────────┐ │
│Structure │ │
│List      │ │
└──────────┘ │
   │         ▼
   ▼     ┌──────────┐
┌──────────┐│Stop - Error│
│PLC Start/││           │
│Communication│        │
│Start      └──────────┘
└──────────┘
```
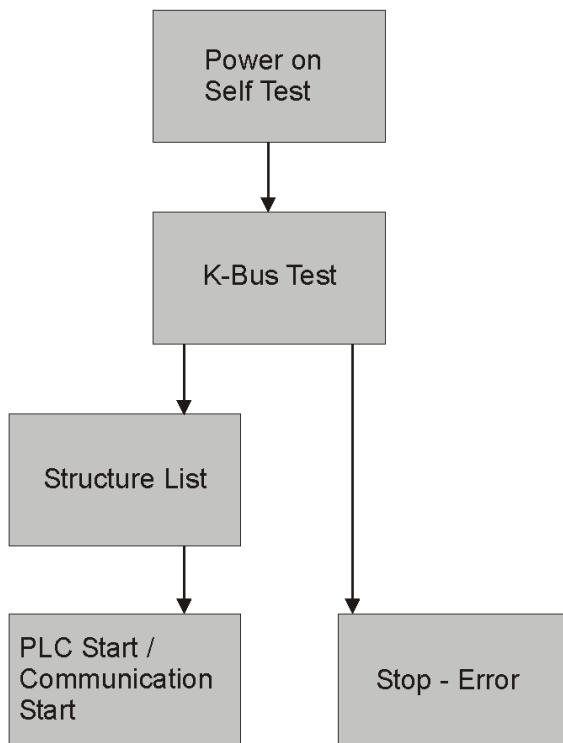
Fig. 17: Start-up behavior of the Bus Terminal Controller

4.2 Configuration

4.2.1 Overview

Configuration types

The Bus Terminal controllers of the BCxx50, BCxx20 and BXxx00 series can be configured in two different ways: DEFAULT CONFIG or TwinCAT CONFIG.

DEFAULT-CONFIG

Bus Terminals are mapped in the order they are inserted, i.e. first the complex Bus Terminals followed by the digital Bus Terminals.

The complex Bus Terminals are mapped as follows:

- Word Alignment
- complex representation

> ⚠ **CAUTION**
>
> **The process image depends on the connected terminals!**
>
> The process image changes when a terminal is added or removed!

The data of the fieldbus slaves interface are referred to as PLC variables. The PLC variables have addresses from %QB1000 and %IB1000

The DEFAULT CONFIG (without PLC program) can also be used for writing and testing of the Connected Bus Terminals. To this end, the Bus Terminal Controller must be scanned in the System Manager, and FreeRun mode must be enabled (to use this function, no PLC program may be active on the Bus Terminal Controller).

TWINCAT-CONFIG

In the TwinCAT CONFIG the Bus Terminals and PLC variables can be freely linked as required (TwinCAT System Manager file required). The configuration is transferred to the coupler via the System Manager and ADS.

The following is required for the TwinCAT configuration (TC file):

- Via the fieldbus (PROFIBUS, CANopen, Ethernet)
  PROFIBUS: (BC3150, BX3100)
    - PC with FC310x from version 2.0 and TwinCAT 2.9 build 1000
    - BX3100 with CIF60 or CP5412
    - TwinCAT 2.9 build 946
      (**NOTE:** with PROFIBUS cards from Hilscher only one ADS communication is permitted, i.e. either System Manager or PLC Control)
      CANopen: (BC5150, BX5100)
    - PC with FC510x from version 1.76 TwinCAT build 1030
      DeviceNet: (BC5250, BX5200)
    - on request
      Ethernet: (BC9050, BC9020, BC9120, BX9000)
    - PC with TwinCAT 2.10 build 1322
- Via the serial ADS TwinCAT 2.9 build 1010
    - BX3100 version 1.00
    - BX5100 version 1.00
    - BX5200 version 1.10
    - BX8000 version 1.00
    - BC3150, BC5150, BC5250, BC9050, BC9020, BC9120 from firmware B0
    - For BC8150 from TwinCAT 2.10 build 1243

BCxx50 and BXxx00 can be parameterized via the System Manager of the TwinCAT program.

- Variable I/O mapping
- Type-specific PROFIBUS data (BC3150 and BX3100 only)
- RTC (real-time clock) (BX series only)
- SSB (Smart System Bus) (BX series only)
- PLC settings
- K-Bus settings

The configuration can be transferred to the BCxx50 or BXxx00 via fieldbus ADS protocol or serial ADS protocol.

The TwinCAT configuration can be used to link variables, I/Os and data. The following is possible:

- PLC - K-BUS
- PLC fieldbus (e.g. PROFIBUS slave interface to PLC)

- K-bus fieldbus (only for BX controllers)
- Support for TwinSAFE terminals (only BX controllers from firmware 1.17)

In addition, the TwinCAT configuration can be used to parameterize special behavior, for example whether data are preserved or set to "0" in the event of a fieldbus error.
The real-time clock can be set via a tab in the system manager.

Work steps

1. Setting the fieldbus address
2. Open the System Manager and create a TC file
3. Configure fieldbus data in the TC file
4. Save the TC file
5. Opening a new system manager, creating a PC file and reading in saved TX file
6. Creating a link to a PLC task
7. Saving the configuration
8. Starting the TwinCAT system
9. Open the TC file in the System Manager, complete the configuration and transfer it to the BCxx50, BCxx20 or BXxx00
10. Transfer the program to BCxx50, BCxx20 or BXxx00
11. Creating a boot project

4.2.2 Creating a TwinCAT configuration

In order to configure a Bus Terminal Controller of the BCxx50, BCxx20, BXxx00 or BC9191 series, create a BX file in the System Manager. To simplify matters, files for the basic units have already been prepared. Open the corresponding Bus Terminal Controller with *New from Template*.
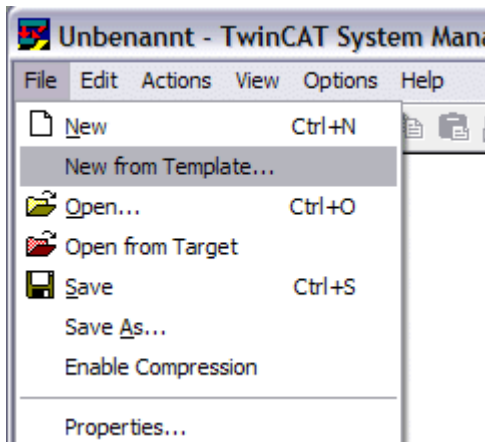
Fig. 18: Creating a TwinCAT configuration

Select the corresponding Bus Terminal Controller.
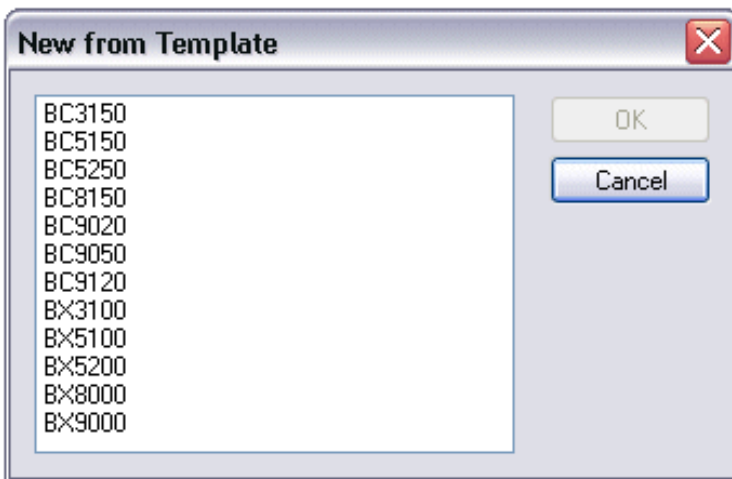
Fig. 19: Selecting the Bus Terminal Controller

All Bus Terminal Controller components are now available:

- Fieldbus interface
- K-bus interface [▶ 46]
- PLC program [▶ 48]
- SSB (only Bus Terminal Controllers of the BX series)

Please refer to the relevant chapter for device configuration.

4.2.3   Downloading a TwinCAT configuration

The TwinCAT configuration is loaded into the Bus Terminal Controller via ADS protocol.

Serial ADS protocol

(all Bus Terminal Controllers of the BXxx00 and BCxx50 series)

Enter the serial ADS connection, as described in the chapter Serial ADS [▶ 37].

ADS protocol via the fieldbus

(BC3150, BC5150, BC9x20, BC9050, BX3100, BX5100, BX9000, BC9191 only)

A prerequisite is that TwinCAT operates as master and is engaged in data exchange, i.e. the physical and fieldbus configuration must be complete, and data exchange must take place between the master (e.g. fieldbus master card) and the Bus Terminal Controller.

Choose Target System

Select the Bus Terminal Controller onto which the configuration is to be loaded. Use the function key F8 to open the dialog for downloading your file to the corresponding device.
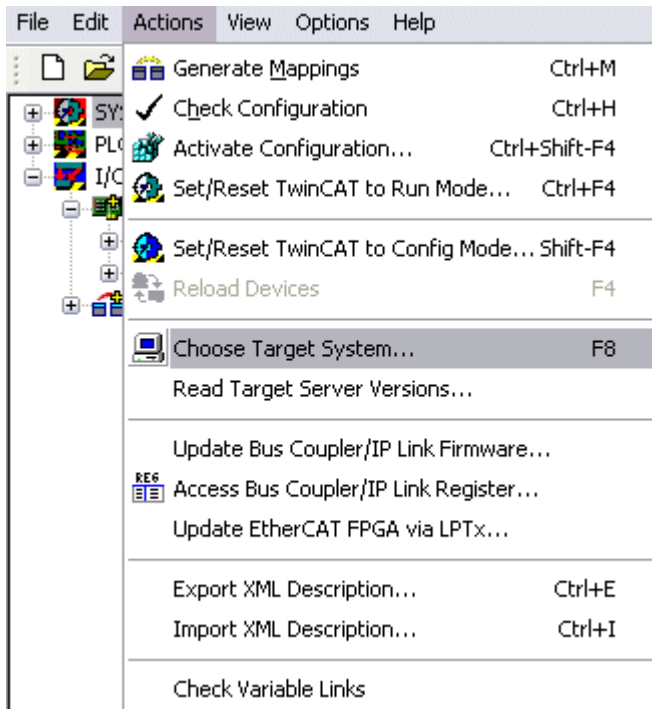
Fig. 20: Downloading a TwinCAT configuration

Select the corresponding Bus Terminal Controller.
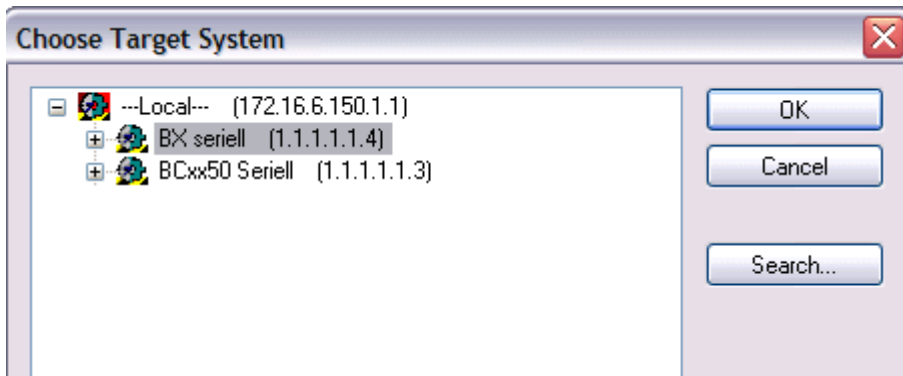
Fig. 21: Selecting the Bus Terminal Controller

The state of the Bus Terminal Controller is shown at the bottom right of the System Manager.
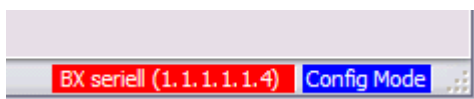
Fig. 22: State of the Bus Terminal Controller

In *Config mode / FreeRun* the configuration can now be downloaded to Bus Terminal Controller. If the Bus Terminal Controller is in *Stop mode*, ADS communication is not yet activated. In this case, it is not possible to download the configuration.

To activate the TwinCAT configuration select Ctrl+Shift+F4 or *Activate Configuration*.
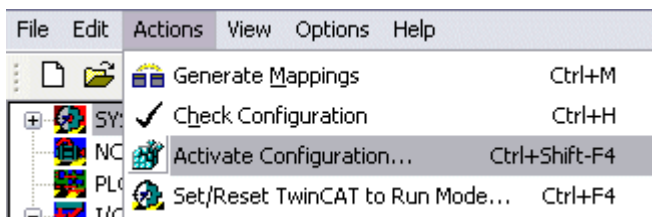
Fig. 23: Activating the TwinCAT configuration

The current configuration is loaded onto the Bus Terminal Controller. The display will show *Store Config*, and the BUS and I/O LED will flash. Once the configuration is successfully loaded onto Bus Terminal Controller, *TwinCAT Config* should appear in the display of a BXxx00. The corresponding program can now be transferred to the Bus Terminal Controller (program-download via the fieldbus).

4.2.4   Uploading a TwinCAT configuration

The TwinCAT configuration is loaded into the Bus Terminal Controller via ADS protocol.

Serial ADS protocol

(all Bus Terminal Controllers of the BCxx50, BCxx20 and BXxx00 series)

Enter the serial ADS connection, as described in the chapter <u>Serial ADS</u> [▶ 37].

ADS protocol via the fieldbus

(BC3150, BC5150, BC9x20, BC9050, BX3100, BX5100, BX9000, BC9191 only)

A prerequisite is that TwinCAT operates as master and is engaged in data exchange, i.e. the physical and fieldbus configuration must be complete, and data exchange must take place between the master (e.g. fieldbus card) and the Bus Terminal Controller.

Choose Target System

Select the Bus Terminal Controller onto which the configuration is to be loaded. Use the function key [F8] to open the dialog for downloading your file to the corresponding device.
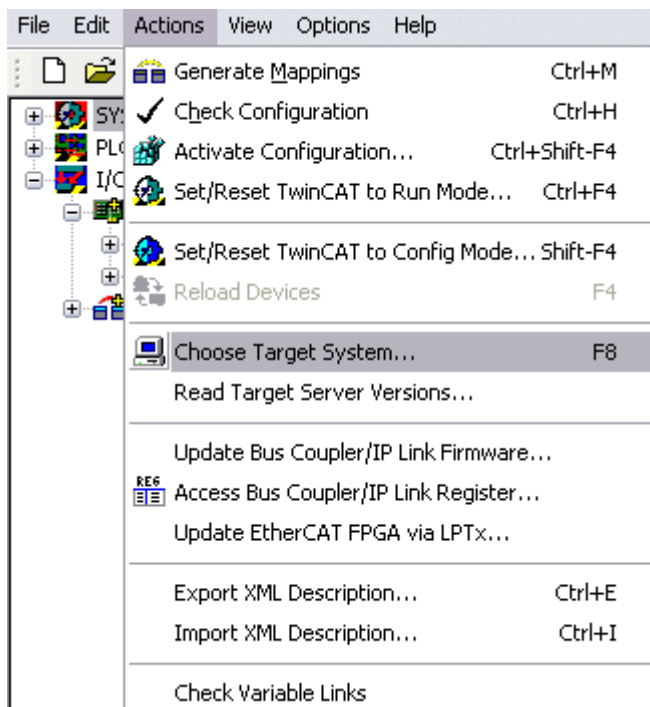
Fig. 24: Choose Target System

Select the corresponding Bus Terminal Controller.
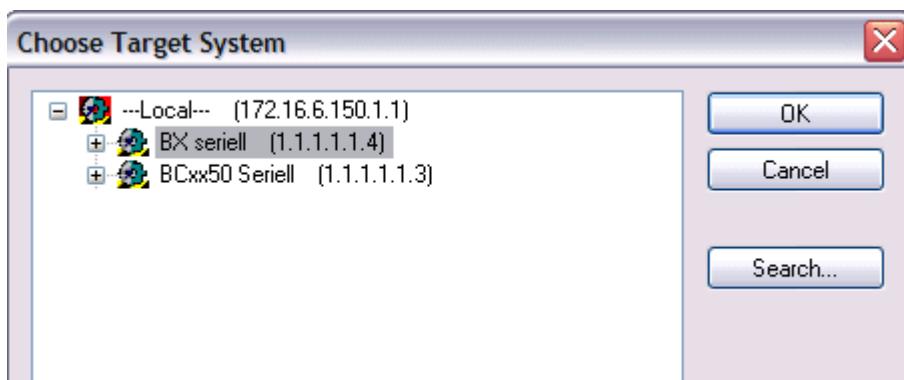
Fig. 25: Selecting the Bus Terminal Controller

The state of the Bus Terminal Controller is shown at the bottom right of the System Manager.
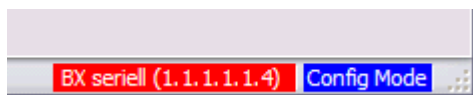
Fig. 26: State of the Bus Terminal Controller

Click on the red folder. The TwinCAT configuration will now be uploaded.
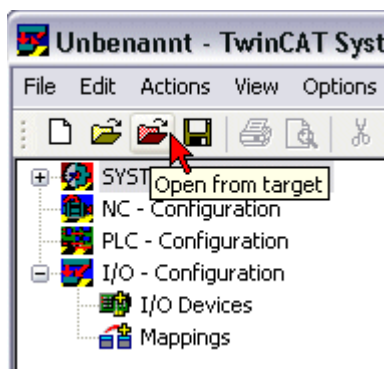
Fig. 27: Uploading the TwinCAT configuration

4.2.5 Resources in the Bus Terminal Controller

The memory resources assigned in the Bus Terminal Controller are shown in the System Manager in the *Resources* tab of the Bus Terminal Controller.

Mapping code

The mapping code is required for calculating the TwinCAT configuration (see Figure *Memory for the code mapping*). The percentages are added here. In the example from Fig. *Memory for code mapping*, 8% of the memory is allocated to the mapping calculation.
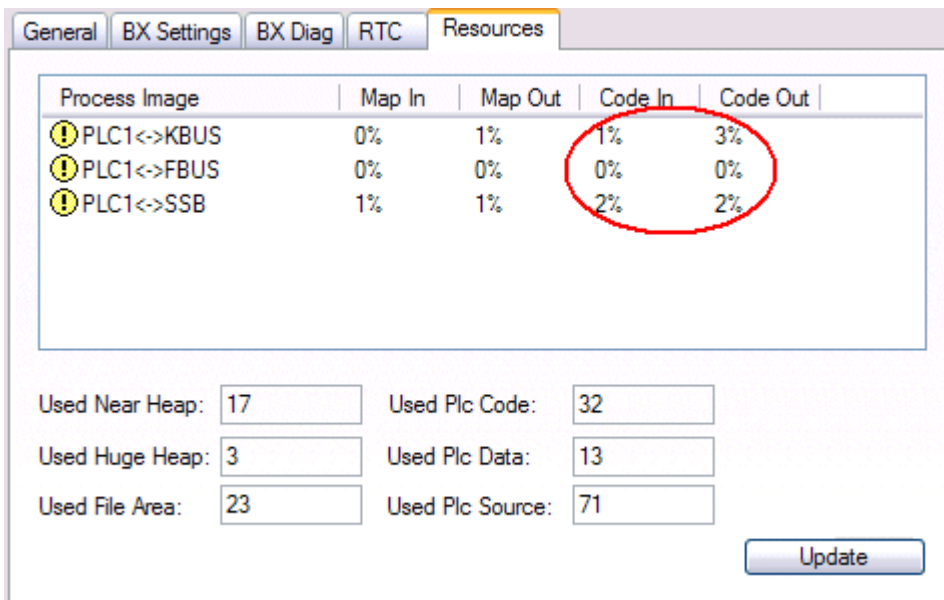
Fig. 28: Memory for code mapping

Data memory mapping

Data memory for mapping. The values are to be considered individually, i.e. each value can be up to 100%.
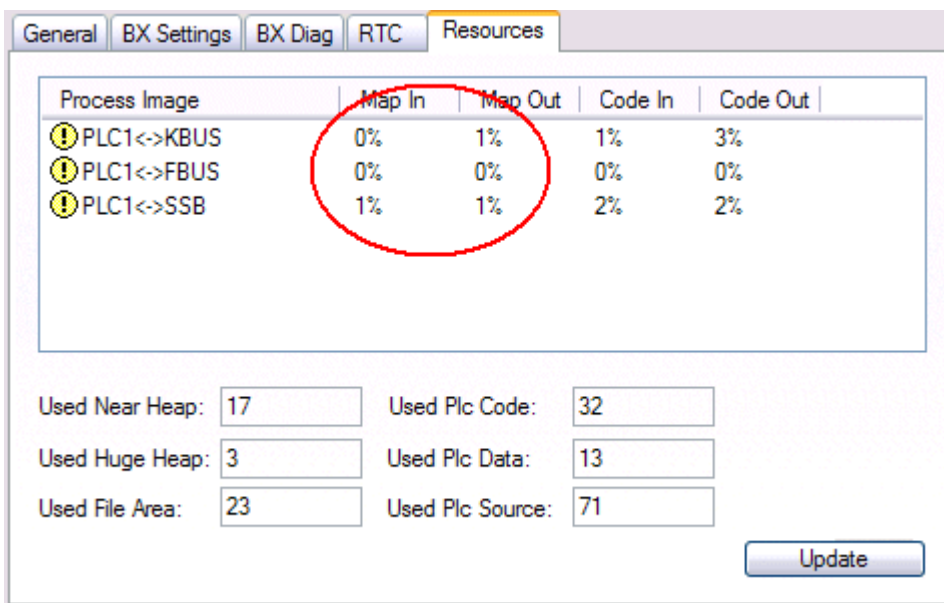
Fig. 29: Data memory mapping

Used code and data memory

Fig. *Code and data memory* (1) "Used PLC code" in %.
Fig. *Code and data memory* (2) "Used PLC data" in %.
Fig. *Code and data memory* (3) "Used PLC source" in %.
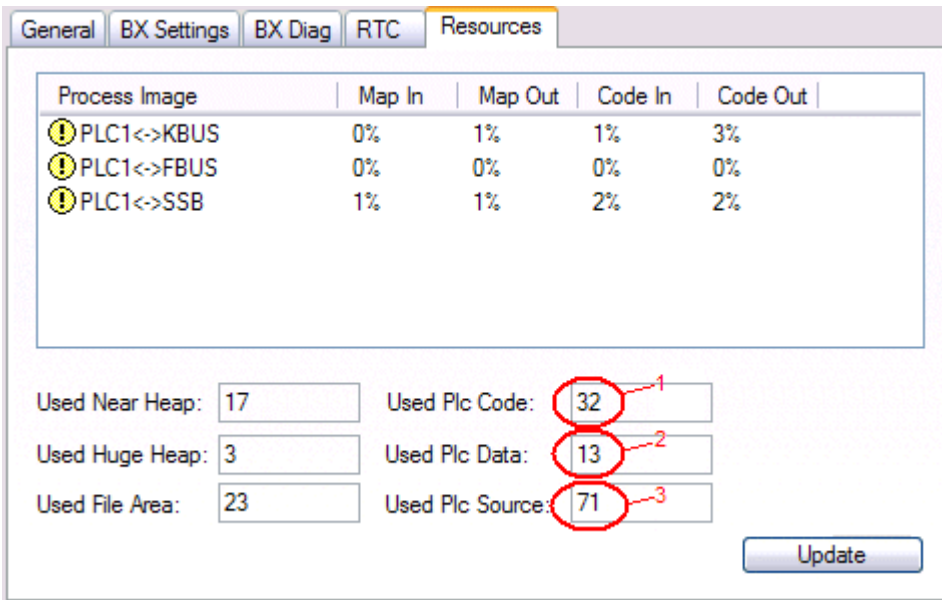
Fig. 30: Code and data memory

Other memory

Fig. *Other Memory* (1) "Used Near Heap" is required for the COM interface and SSB. % values.
Fig. *Other Memory* (2) "Used Huge Heap" is required for the ADS communication. % values. This value should be less than 30 %.
Fig. *Other Memory* (3) "Used File Area" is required for the TwinCAT configuration, the TSM file and the 16 kbyte flash access. % values.
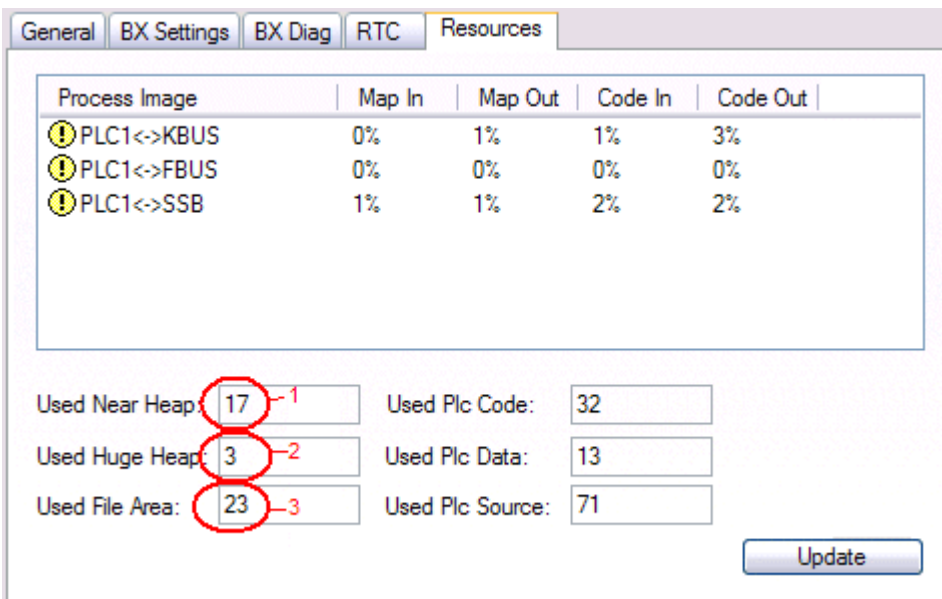
Fig. 31: Other memory

4.2.6 ADS connection via serial interface

(from firmware version 1.xx or 0.99x, Bus Terminal Controllers of the BX series and for all BCxx50)

From TwinCAT 2.9 build 1020 (TwnCAT level PLC, NC or NCI)

ⓘ ● **Use only a serial connection**

To ensure trouble-free operation of the ADS link via the serial interface, only a serial connection to the BX controller is allowed.
After successful configuration via the System Manager, close the System Manager before starting programming.

ⓘ ● **AMS Net ID in delivery state (default)**

For BX9000

The default AMS Net ID is 172.16.21.20.1.1. If the IP address of the BX9000 is changed, the AMS Net ID of the BX9000 also changes. There is a menu option for displaying the current AMS Net ID. Example: If you change the IP address to 10.2.3.7, the AMS Net ID changes to 10.2.3.7.1.1.

For BC9050, BC9020, BC9120

The default AMS Net ID is 172.16.xxx.[DIP switch].1.1. If the IP address of the BX9xxx is changed, the AMS Net ID of the BX9xxx also changes.
Example: If you change the IP address to 10.2.3.7, the AMS Net ID changes to 10.2.3.7.1.1.
BC9050: DEFAULT 172.16.21.[DIP-Switch].1.1
BC9020: DEFAULT 172.16.22.[DIP-Switch].1.1
BC9120: DEFAULT 172.16.23.[DIP-Switch].1.1

Initializing the ADS connection

Enter the Bus Terminal Controller in the remote connection under TwinCAT. Click on the TwinCAT icon and open the features menu. The following settings can be made under the >AMS Remote< tab.
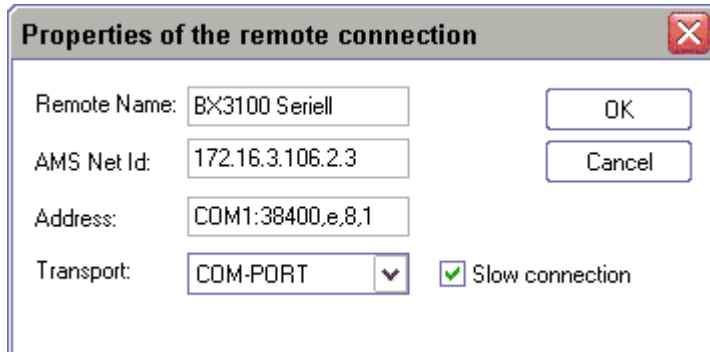
Fig. 32: Properties of the remote connection

Remote Name: Any
AMS-Net-ID: 1.1.1.1.1.1 (Default)
Address: COM Port: Baud rate, parity, data bits, stop bits
Transport: Select "COM port"

When the Bus Terminal Controller is switched on, the default AMS Net ID is always "1.1.1.1.1.1" (except all Ethernet Controllers).
The AMS Net ID can be changed as required. Please note that the new AMS Net ID cannot be changed again in this way.

If you need to change the new AMS Net ID again, you have to restart the Bus Terminal Controller, so that the AMS Net ID is reset to the default AMS Net ID, "1.1.1.1.1.1".
You can now change the AMS Net ID again.

ℹ **Strings can only be entered at the second call**

No strings can be entered under address when the dialog is first called (see above). Enter the name, AMS Net ID and transport type and close the dialog. With the second call you can enter your COM port.

The communication starts when TwinCAT is in Config mode (TwinCAT icon is blue) or RUN mode (TwinCAT icon is green). The COM interface remains open until a TwinCAT stop occurs (TwinCAT icon is red). It is then available again for other programs. No error message is issued if the COM interface is used by another program during a TwinCAT restart (e.g. by the KS2000 configuration software).

ℹ **AMS Net ID after ADS connection via the fieldbus**

If you have addressed the Bus Terminal Controller with an ADS connection via the fieldbus before the serial ADS was used, the AMS Net ID was automatically changed by the System Manager. In this case a new serial ADS connection is only possible, if the AMS Net ID is adjusted.

BX series: reading the AMS Net ID

The current AMS Net ID can be read from the menu via the display of BX series Bus Terminal Controller.

AMS	AMS Net ID
1.1.1.1.1.1	

4.2.7 DeviceNet slave interface

4.2.7.1 DeviceNet slave interface EDS file

BX5200

EDS file BX5200.eds (for controllers other than TwinCAT) (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3602701067.zip)

EDS file BX5200S.eds (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3602705419.zip)

For TwinCAT both EDS files must be copied into the directory *TwinCAT\IO\DeviceNet* .

Image for BX5200.ico (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/4007122315.zip)

BC5250

EDS file BC5250.eds (for controllers other than TwinCAT) (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3602707595.zip)

EDS file BC5250S.eds (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/4007126667.zip)

For TwinCAT both EDS files must be copied into the directory *TwinCAT\IO\DeviceNet* .

Image for BC5250.ico (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3602707595.zip)

4.2.7.2 DeviceNet slave interface

There are two types of configuration. In the default configuration (delivery state) the DeviceNet data of the DeviceNet Slave interface map from the address 1000 of the BX5200/BC5250 and the first 8 bytes are activated. The length of the DeviceNet data and the characteristics of the local controller can be edited via the function blocks.
In the TwinCAT configuration, any required configuration can be created via the System Manager and variables can be connected in any required combination via the DeviceNet slave interface.

Default Configuration

In this configuration, the DeviceNet data are mapped as follows:

DeviceNet data

Number	Read/Write	BX5200/BC5250 process image
8 bytes (Polling Mode)	Rx/Tx	%IB1000...%IB1007/QB1000... %QB1007

If it is required to send or receive more/less than 8 bytes of data, the default setting must be changed by means of the function block (see DeviceNet-specific function blocks).

Characteristics of DeviceNet communication

The following characteristics can be set. Mixed operation of the DeviceNet communication types is not possible.

Polling

The master module ("scanner") sends the output data cyclically to the assigned devices and receives the input data in a response telegram.

Change-of-State

Telegrams are sent as soon as their contents have changed.

Cyclic

The modules send the data automatically after a cycle time has elapsed.

Strobed

The scanner requests the input data using a broadcast telegram to all the devices.

4.2.7.3 TwinCAT configuration

The TwinCAT configuration enables free, address-independent mapping of the PLC data to the CAN slave interface.

TwinCAT configuration

For the configuration you need the TwinCAT System Manager and an ADS connection to the BX/BCxx50.

The ADS connection can be established via the serial interface (see serial ADS).

4.2.7.4 Address

The address of the DeviceNet Slave interface is set via two rotary selection switches. The default setting is 11. All addresses from 0 to 63 are permitted. Each address may only occur once in the network. The address is edited when the BX Controller is switched off. The switches can be set to the required position using a screwdriver. Ensure that the switches engage correctly. The lower switch is the 10-multiplier, the upper switch is the 1-multiplier. The changed address is active as soon as the BX Controller is switched on again.

Example

You want to set address 34.
- lower rotary selection switch S311: 3
- upper rotary selection switch S310: 4
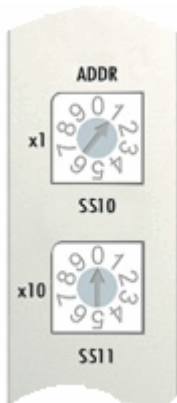
Fig. 33: Setting the node ID

4.2.7.5 Baud rate

Auto-Baud-Rate

In order for automatic baud rate detection to function, it is necessary for a number of valid telegrams to be present on the bus at the desired baud rate. The RUN and CAN ERR LEDs blink in rapid alternation while the baud rate search is in progress. Once a baud rate was detected and accepted, the Bus Terminal Controller continues with the initialization.

A software reset does not lead to a new baud rate search. The previously active baud rate is maintained.

4.2.7.6 Master setting

4.2.7.6.1 Master parameterization

Configuration at a Rockwell/Allen Bradley controller

The BX5200 and BC5250 have two configuration types. In the default configuration, the coupler is supplied and has the following DeviceNet characteristics:

- AutoBaud

- 8 bytes inputs DN (from address %IB1000) - these are then the outputs on the master

- 8 bytes outputs DN (from address %QB1000) - these are then the inputs on the master

If it is necessary to change the preset data, a special library is required.

In the TwinCAT configuration, it is possible with the aid of the System Manager to set the DN Slave-specific characteristics. The library is not to be used for the default configuration.

The EDS file and the icon file are always integrated in the RSNetworx with the EDS wizard:
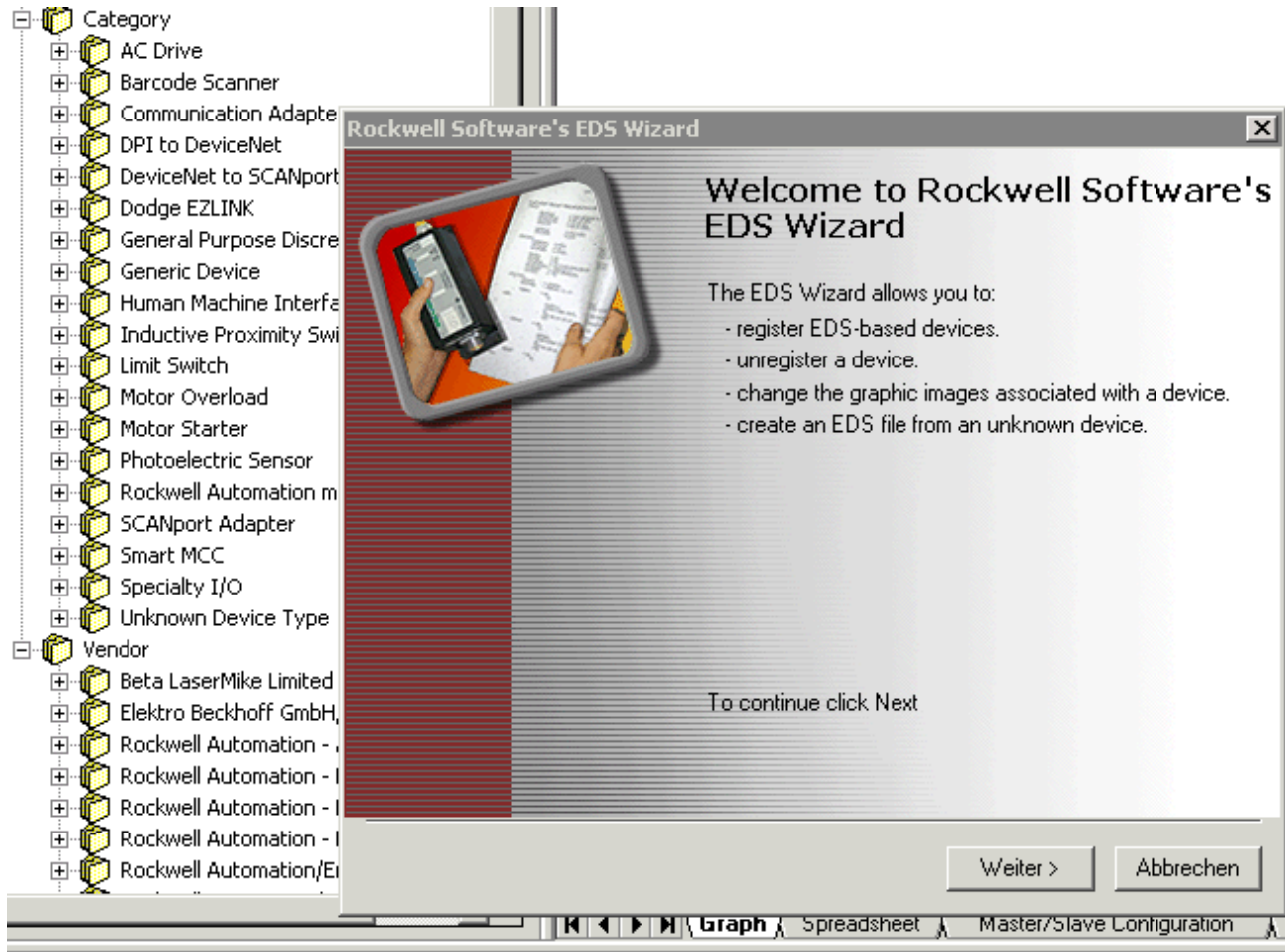
Fig. 34: EDS Wizard

Finally the DeviceNet network is searched with the Network-Browse for the nodes within the network. If the BC/BX are correctly connected to the network with the correct baud rate, they are recognized and correspondingly displayed:
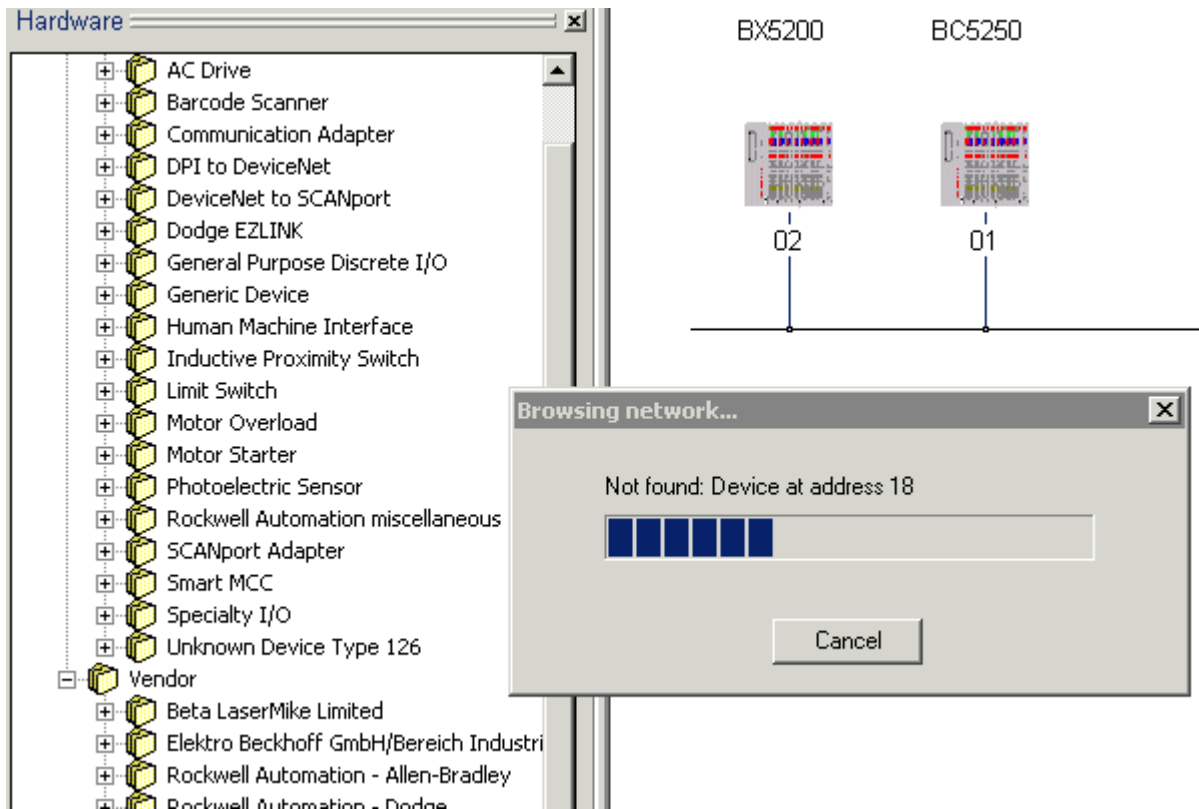
Fig. 35: Network Browse

Double-clicking the icon opens the configuration dialog for the units.

Below Parameter appear the I/O data lengths that are currently set at the BC/BX.
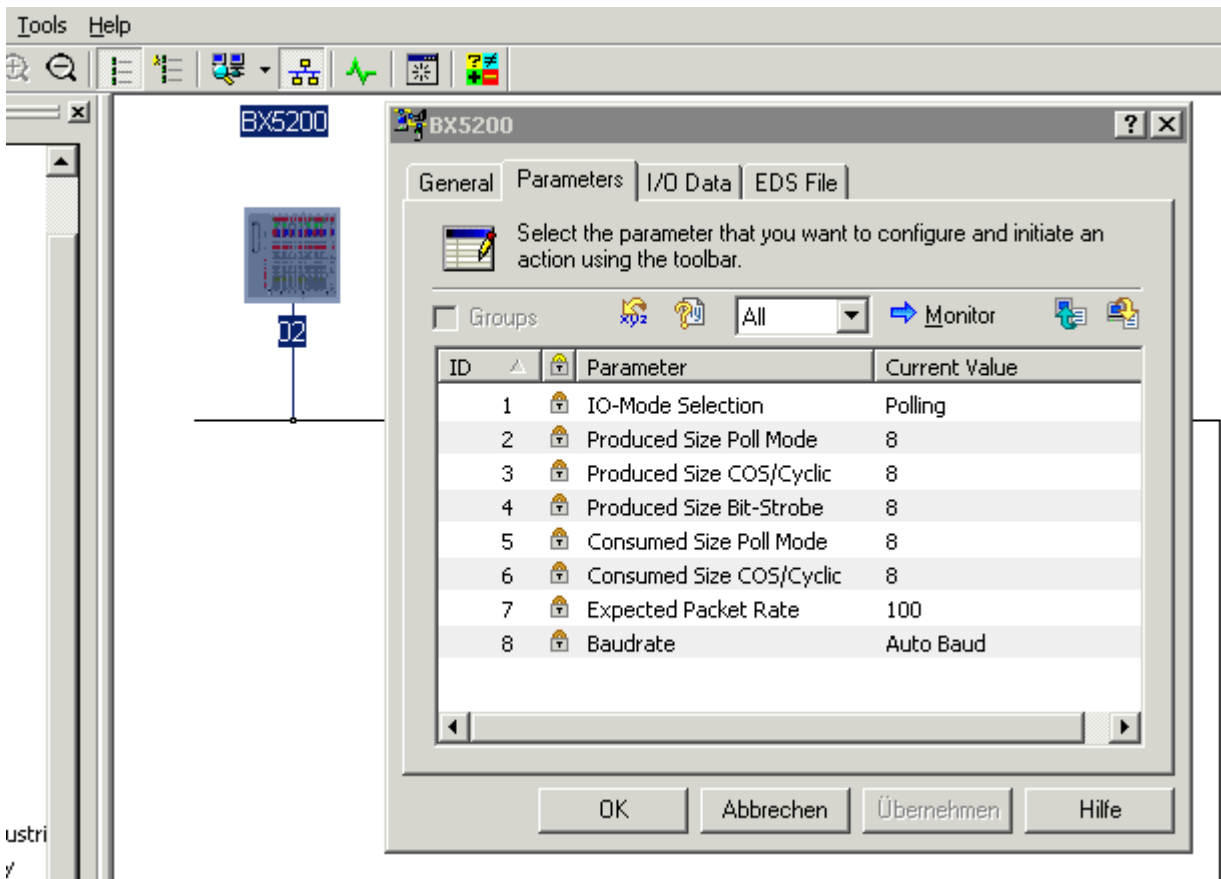
Fig. 36: I/O data lengths set on the BC/BX

The produced and consumed data should always be considered from the point of view of the network, i.e. BC/BX produce data for DeviceNet and consume data from DeviceNet.

- The data produced are thus the input data of the master, i.e. data that are sent from the BC/BX to the master: BC/BX Produced Size = Input Size Scanner
- The data consumed are the output data of the master, i.e. data that are sent from the master to the slave: BC/BX Consumed Size = Output Size Scanner

A double-click on the Scanner/DeviceNet Master icon opens the configuration dialog. The recognized modules appear in the *Available Devices* list and must now be added to the Scanlist.
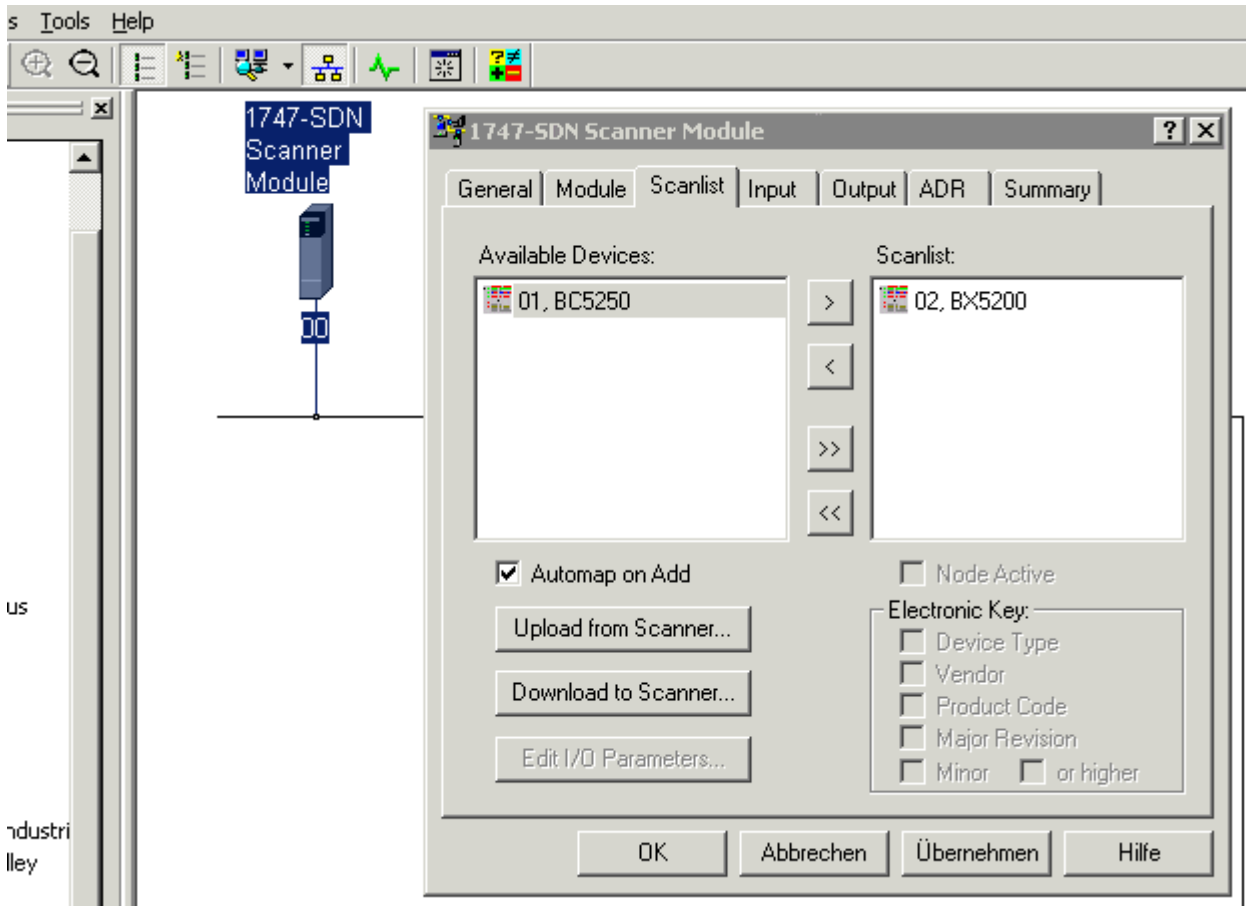
Fig. 37: Adoption of the detected modules into the scan list

A double-click on the icon of the device to be configured opens the dialog for setting the I/O data lengths

BECKHOFF
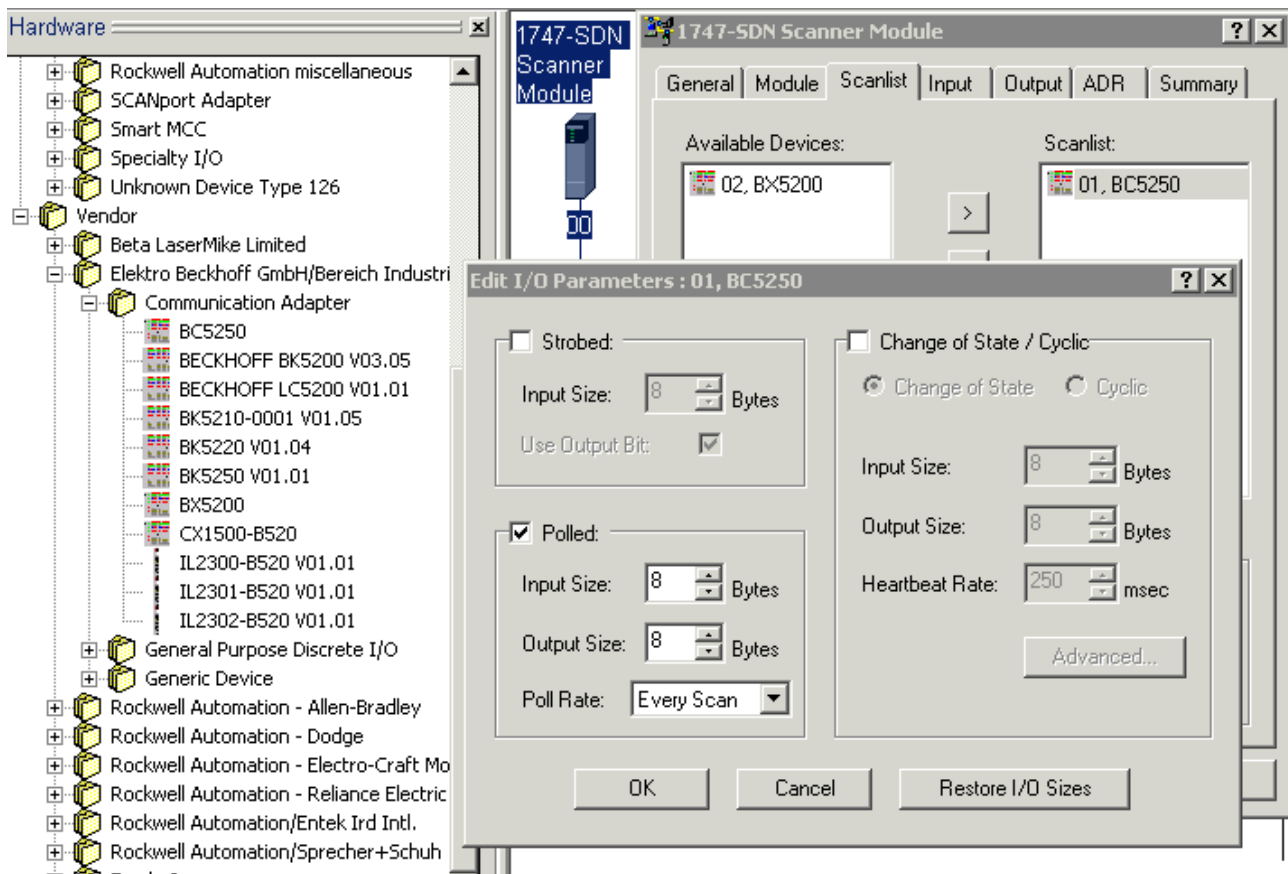
Fig. 38: Setting of the I/O data lengths

- BC/BX Produced-Size = Input-Size
- BC/BX Consumed-Size = Output-Size

Furthermore, it must be ensured that the I/O operation mode selected here corresponds to the I/O mode selection.

The Interscan Delay, that is the time between each I/O cycle, must be selected according to the requirements of the BC/BX with respect to the size of the PLC program and the I/O data lengths.
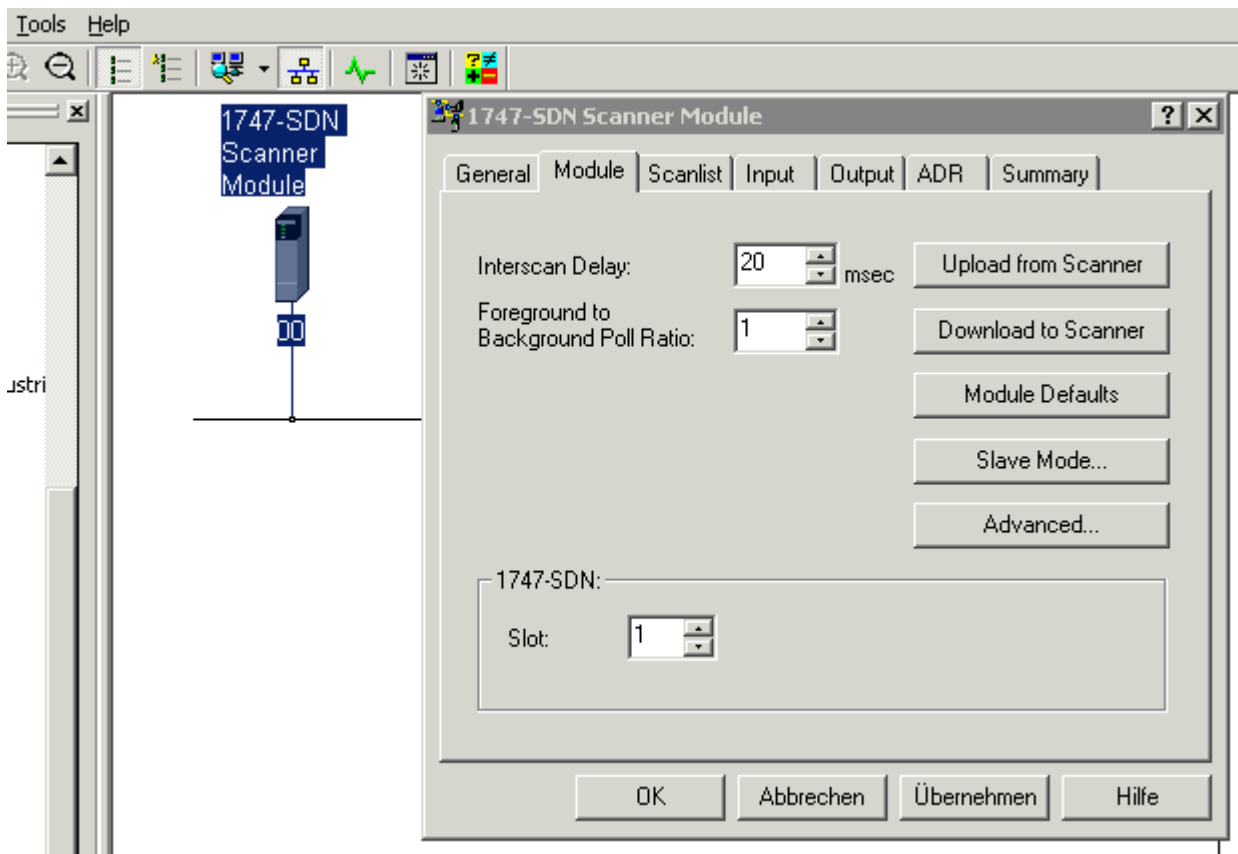
Fig. 39: Selection of the interscan delay

If there are components in the network that require a fast I/O cycle, the I/O cycle can be set to Background under Poll Rate in the I/O parameter settings. More detailed information about this can be obtained from the scanner manual.
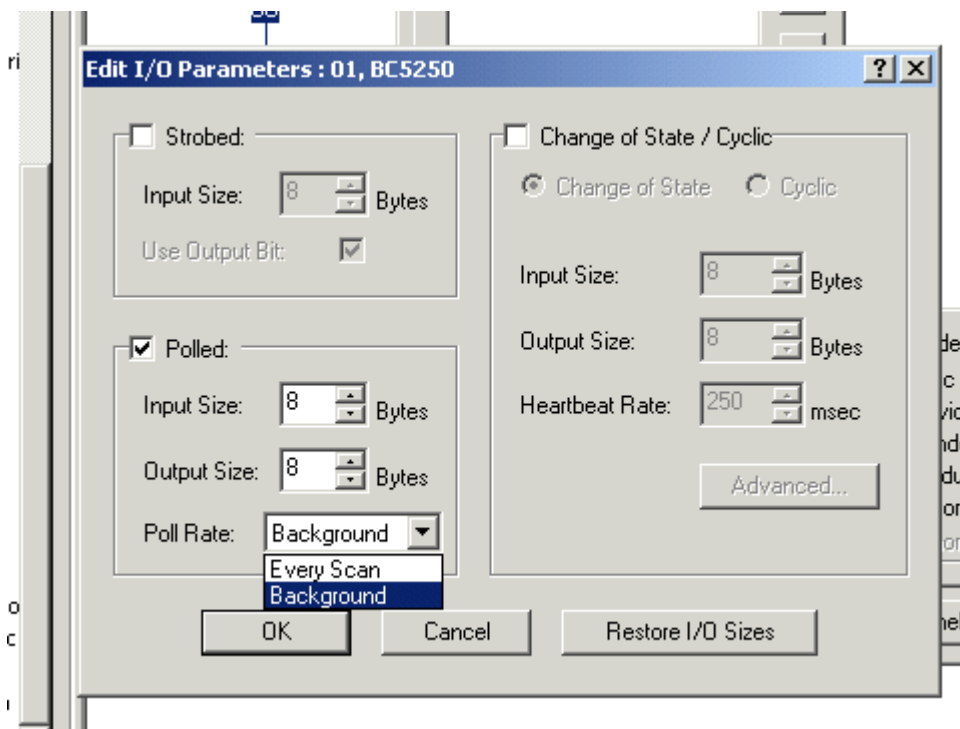
Fig. 40: Setting the poll rate

BECKHOFF

4.2.8 K-bus

i **Bus Terminal and end terminal required**

To operate a Bus Terminal Controller of the BC or BX series, at least one Bus Terminal with process image and the end terminal must be connected to the K-bus.

BX Settings tab
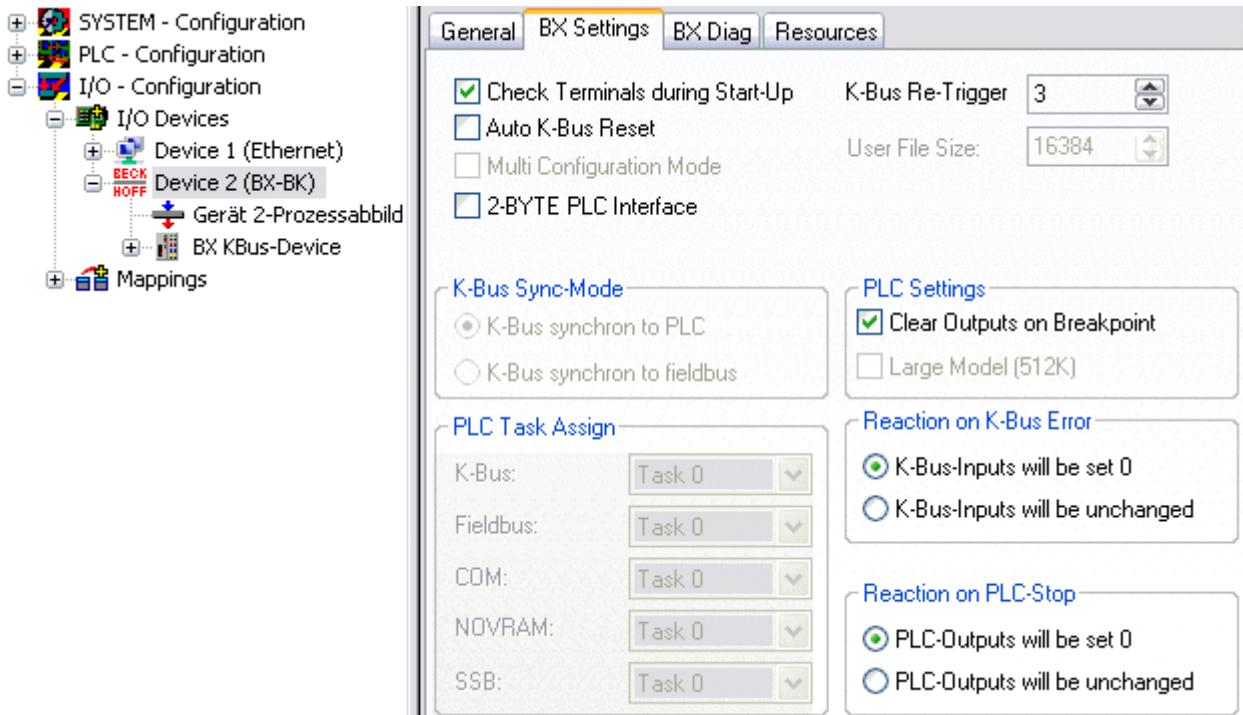
Fig. 41: BX Settings tab

Check Terminals during Start-up

When a boot project is created, the current Bus Terminal configuration is stored. The connected Bus Terminals are checked when the Bus Terminal Controller restarts. If this option is selected, the Bus Terminal Controller does not enter into data exchange. The PLC project will not be started.

Auto K-Bus Reset

Once a K-bus error has been rectified, the Bus Terminal Controller automatically resumes the data exchange.

⚠ **CAUTION**
Once a K-Bus error has been rectified, the outputs become active again immediately!
Ensure that the outputs are reactivated immediately and that analog outputs retain their programmed value, if this is not dealt with in your PLC project.

Clear Outputs on Breakpoint

If breakpoints are set in PLC Control, the K-Bus is no longer processed, i.e. the outputs are set to a safe state (zero).

K-Bus Sync Mode

Writing and reading of the Bus Terminals can take place synchronously with task 1 or the fieldbus.

K-Bus Re-Trigger

If the processor is busy dealing with the PLC project or the SSB, the K-Bus cannot be processed for a certain amount of time. This leads to triggering of the Bus Terminal watchdog and dropping of the outputs. The Bus Terminal Controller is set such that the K-bus watchdog is re-triggered 3 times after 85 ms. The K-Bus watchdog would then be activated.
K-Bus Re-Trigger 0: 100 ms
K-Bus Re-Trigger 1: 2 x 85 ms = 170 ms
K-Bus Re-Trigger 2: 3 x 85 ms = 255 ms
K-Bus Re-Trigger 3: 4 x 85 ms = 340 ms

Reaction on K-Bus Error

In the event of a K-Bus error, the K-Bus inputs are set to "0" or retain their last state.

Response on PLC-Stop

The user can set the behavior of the fieldbus output data in the event of the PLC project being stopped. The master will use these data as input data. In the event of a PLC stop, the data can be set to "0" or remain unchanged.

BX Diag tab

Display of the cycle time for task 1, K-bus, fieldbus processing and the SSB load.
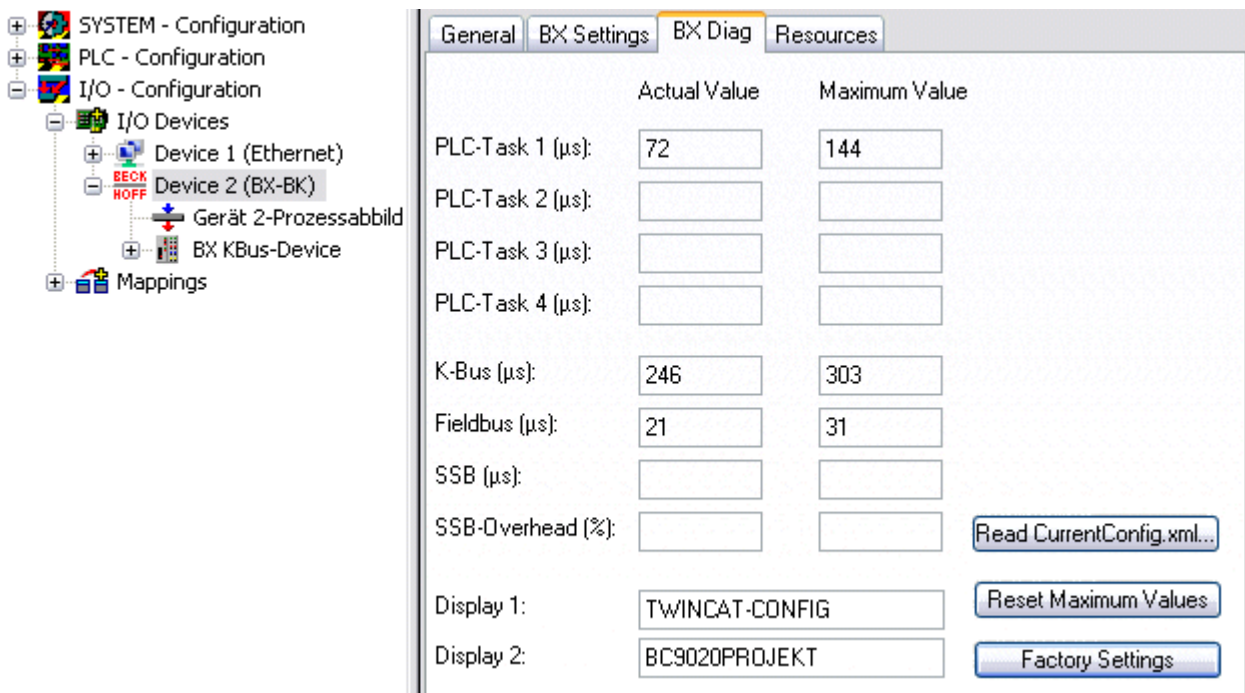
Fig. 42: BX Diag tab

Factory Settings: the Bus Terminal Controller is set to its delivery. These settings are reactivated via Restart System or by switching the system off and on again (display shows DEFAULT-CONFIG).
Reset Maximum Values: resets the maximum values

K-Bus variables

```
□─ ▣ Box 2 (CX1100-KB)
   □─ ◈↑ Inputs
         ◈↑ PlcInterface
         ◈↑ KBus-State
   ⊞─ ◈↓ Outputs
   ⊞─ ▪ Term 2 (KL1032)
   ⊞─ ▪ Term 3 (KL1032)
```
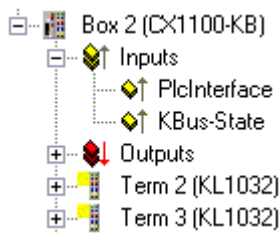
PLC interface: Not supported (only included for moving CX or BX projects)

K-bus state: see Diagnostics

4.2.9 PLC

4.2.9.1 Inserting a PLC project

For variable mapping, configuration has to be specified in the system manager. This is where the link between PLC and hardware is specified. The variables can process and link bit, byte, word or data structures. Automatic addressing via the System Manager is possible, but should be checked for offset.

> **ⓘ** **Word alignment, byte orientation**
>
> With data structures, ensure that the Bus Terminal Controller saves the data in word alignment and the System Manager operates byte-oriented (see Data structures [▶ 61])

A valid project has to be compiled and saved in PLC Control. These data are saved as a *.tpy file. For inserting a PLC project, right-click on *PLC - Configuration*. Select your current PLC project.
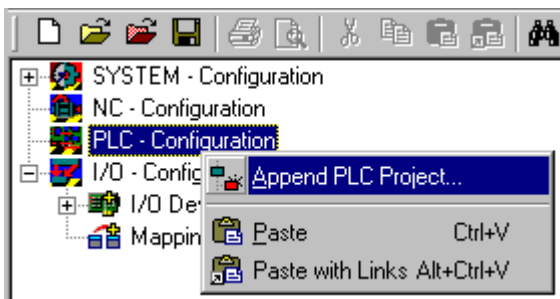
Fig. 43: Selecting the PLC project

Link the PLC variable with the hardware (e.g. digital Bus Terminal).
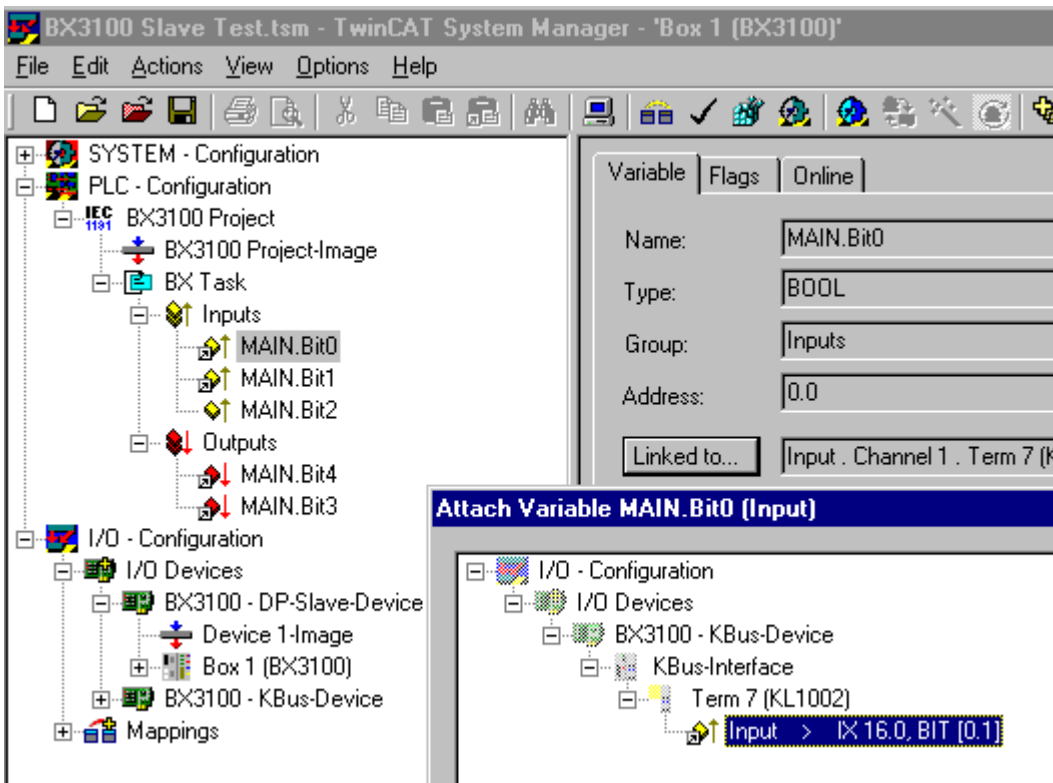
Fig. 44: Connecting PLC variable and hardware

Once all links have been created, activate the configuration *Actions/Activate Configuration* (Ctrl+Shift+F4) and start TwinCAT *Set/Reset TwinCAT to Run Mode*. Ensure that you have selected the correct target system (bottom right in the System Manager window).
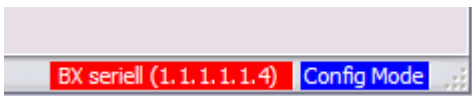
Fig. 45: Target system display

4.2.9.2 Measuring the PLC cycle time

The task time is set in PLC Control. The default setting is 20 ms.
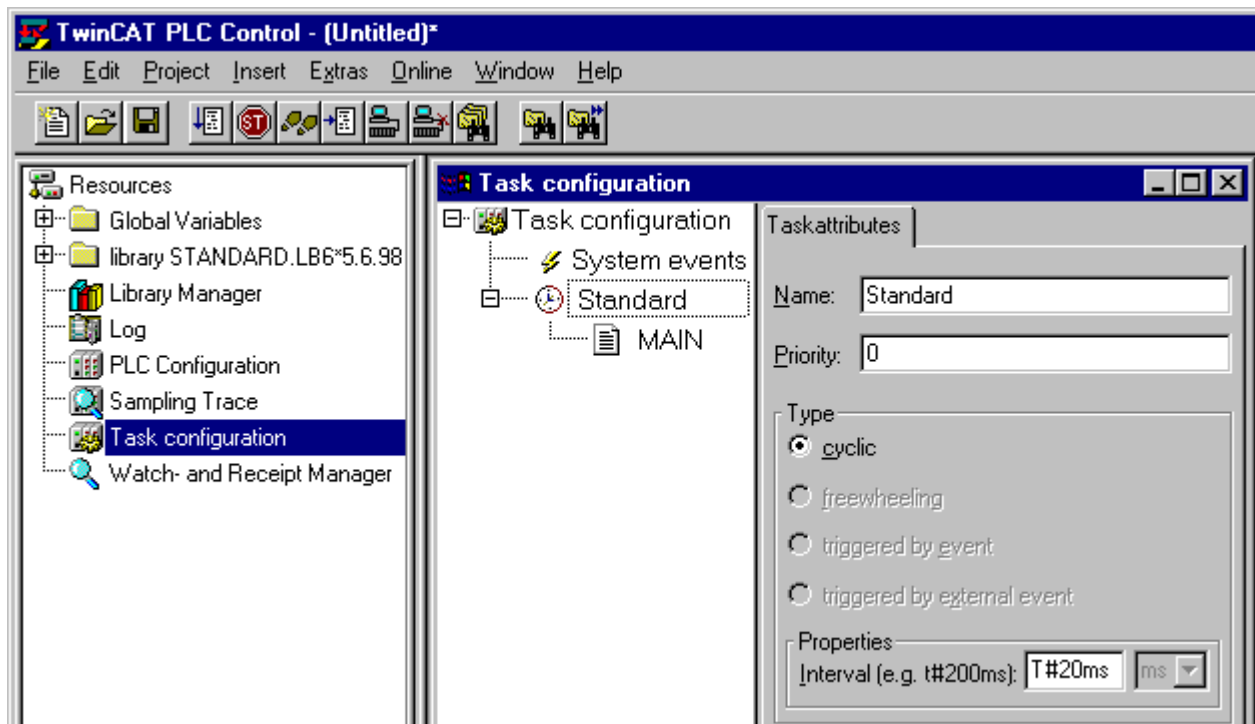
Fig. 46: Setting the task time

In the default setting, the PLC program is called every 20 ms, as long as the general cycle time is less than 20 ms. To determine the load of your system, the PLC cycle time can be measured in the System Manager. In order to ensure trouble-free operation, the set task time should be 20-30 % higher than the measured total cycle time. A precise cycle time breakdown can be found under K-Bus tab [▶ 46] description. The total cycle time is displayed with the TcBase library (see TcBase.lbx or TcBaseBCxx50.lbx).
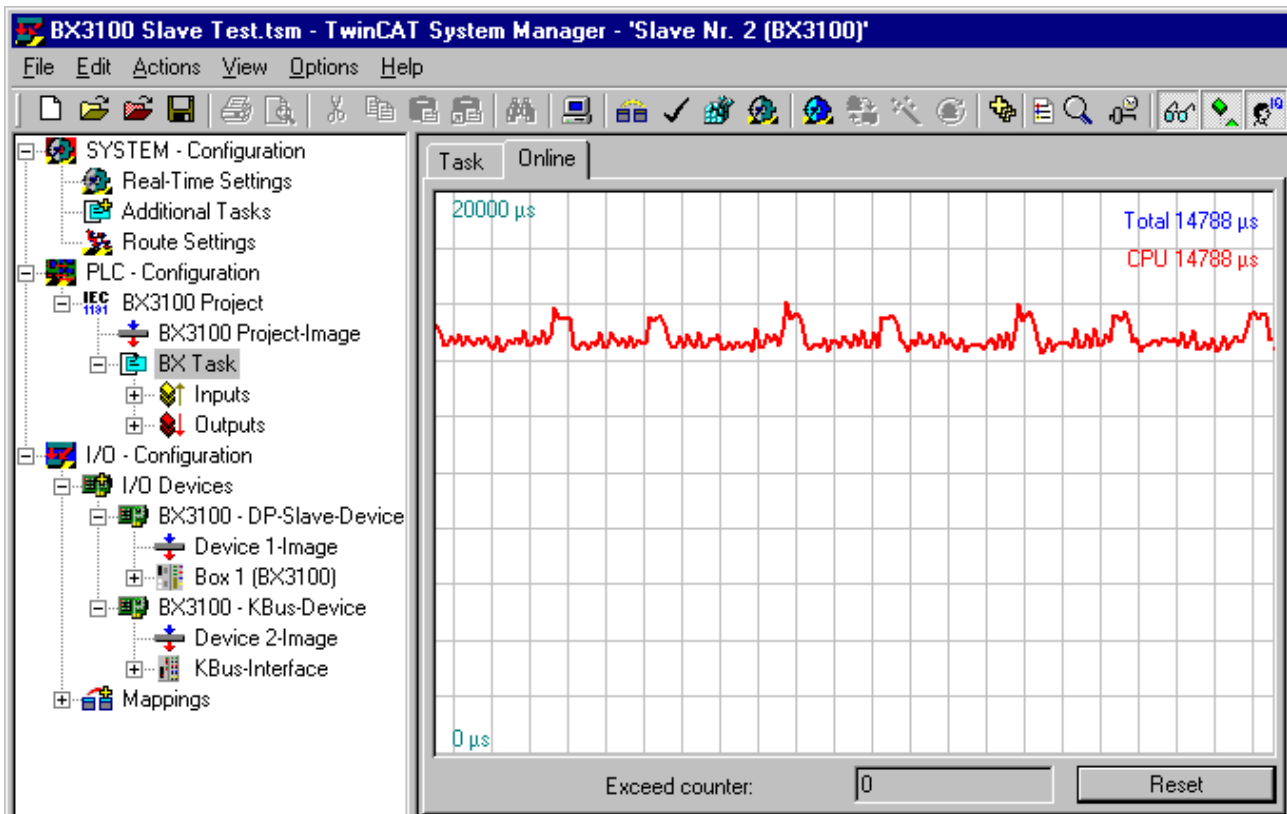
Fig. 47: Displaying the PLC cycle time

4.2.10 Configuration software KS2000

Bus Terminal controllers of the BCxx50, BXxx20 and BXxx00 series cannot be parameterized and configured with the KS2000 configuration software. These devices must be configured with the TwinCAT System Manager.

The KS2000 configuration software offers configuration and diagnostic support for the Bus Terminals attached to the Bus Terminal Controller.
It is advisable to set the baud rate in the KS2000 configuration software and the BCxx50 BCxx20 and BXxx00 to 38400 baud (8 data bits, even, 1 stop bit).

i ● **COM1 - automatic baud rate detection**

The COM 1 interface of the BXxx00 features automatic baud rate detection between 9.6 kbaud and 56.4 kbaud.

i ● **Required KS2000 version**

Configuration or diagnostics of Bus Terminals at BXxx00 is supported from KS2000 version 4.3.14.

In some Bus Terminals (e.g. KL25xx, KL6811, KL6201, KL6401) the following parameters must be set in order to be able to use the configuration dialogs:

- A PLC project or boot project must be deactivated.
- The BX controller must be in its default configuration. Set the manufacturer's setting or switch to Config Mode in the TwinCAT System Manager (blue TwinCAT icon).
- The BX controller must be in FreeRun mode. Activate it with the TwinCAT System Manager.

You can now log in with the KS2000 configuration software via ADS (port 100) or the serial cable and use the KS2000 dialogs in the Bus Terminals.

5 Programming

5.1 BCxx50 PLC features

Description	Value
Data memory	32 kbyte
Program memory	48 kbyte minus task-configuration minus POUs during online change
Source code memory	128 kbyte
RETAIN	2 kbyte
INPUT	2 kbyte
OUTPUT	2 kbyte
FLAG	4 kbyte
Max. variable size	16 kbyte
Max. POUs	Limited by memory

5.2 TwinCAT PLC

The Beckhoff TwinCAT Software System turns any compatible PC into a real-time controller with a multi-PLC system, NC axis control, programming environment and operating station. The TwinCAT programming environment is also used for programming the BC/BX. If you have TwinCAT PLC (Windows NT4/2000/XP) installed, you can use the fieldbus connection or the serial port for downloading and debugging software.

TwinCAT I/O or TwinCAT PLC can also be used as the Ethernet Master (host), in order to exchange process data with the Bus Terminal Controller. TwinCAT provides you with the System Manager as a configuration tool, as well as the drivers and the ADS protocol.

Bus Terminal Controllers of the BCxx50, BCxx20 and BXxx00 series

These 2nd-generation Bus Terminal Controllers are configured with the TwinCAT System Manager and programmed with TwinCAT PLC Control. TwinCAT PLC must be installed for these couplers (Windows NT4, Windows 2000, Windows XP).

Programming and program transfer

- via the serial interface [▶ 72]
- via the fieldbus interface (only for Bus Terminal controllers for PROFIBUS, CANopen and Ethernet)

Online change

The Bus Terminal Controllers of the BX series and the BCxx50 support online change. This means that the PLC program is replaced with a new program without interrupting the program. The switch-over to the new program occurs after the task is completed. This means that two versions of the PLC program have to be stored. 512 kbyte are available, which therefore have to be divided by two, leaving 256 kbyte for the actual PLC program. In addition, several kbyte are required for task configuration etc. During an online change, dynamic data are stored in memory. Should a program approach the memory limit (program size greater than 240 kbyte), the online change may no longer work, even though the program may still be written to the BX after "Rebuild all".

When is online change not available?

Online change is not available under certain conditions,.

- Inserting of a new library
- Changing the task setting

- "Rebuild all"
- Controller memory limit is almost reached (PLC program greater than 90%)

5.3 TwinCAT PLC - Error codes

Error type	Description
PLC compiler error	Maximum number of POUs (...) exceeded
PLC compiler error	Out of global data memory ...

Error POUs

For each function block one POU (process object unit) is created. 256 function blocks are available by default.

Error 3612: Maximum number of POUs (100) exceeded! Compile is aborted.
Data allocation
1 Error(s), 0 Warning(s).

Fig. 48: Maximum number of POUs exceeded

If libraries are integrated this value may be insufficient. In this case, the number of POUs should be increased.

To this end, open in PLC Control under Projects/Options...
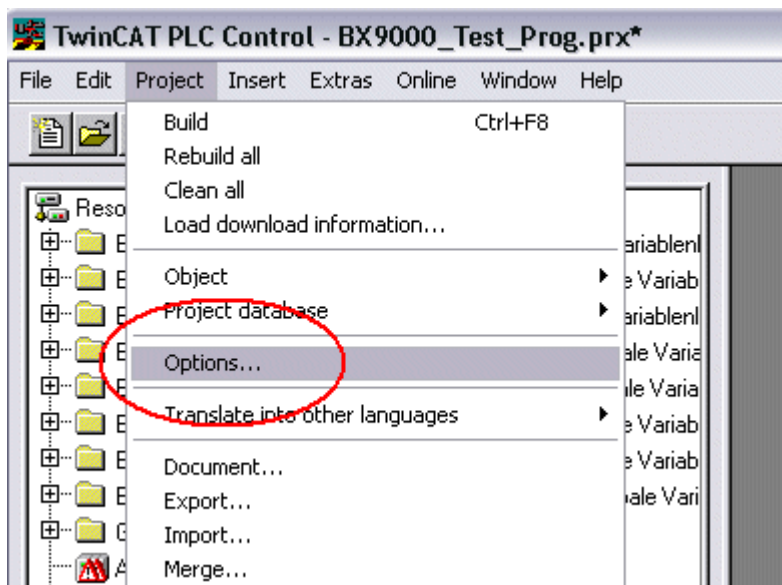
Fig. 49: Menu path Projects / Options / Controller Settings

...the controller settings.
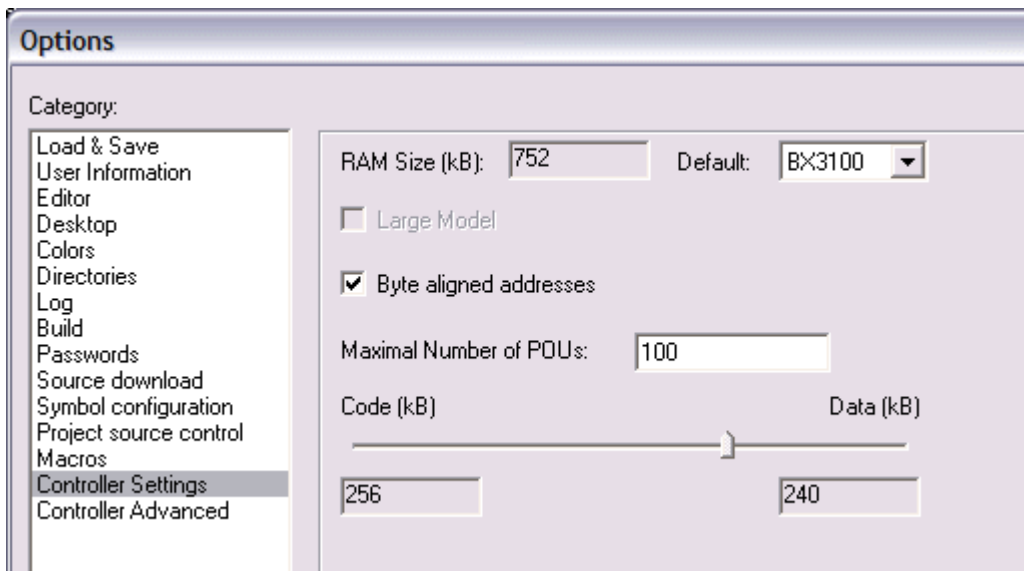
Fig. 50: Controller settings

Changing these settings will deactivate online changes.

Global memory error

Fig. 51: Global memory insufficient

2 x 16 kbyte of data are available by default. If large data quantities are to be used, this range should be increased. A maximum of 14 data segments are possible for the BX.
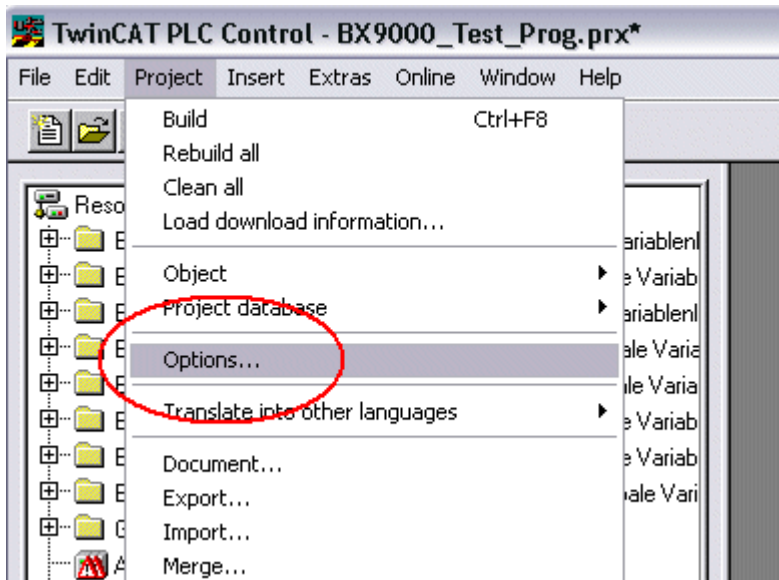
Fig. 52: Menu path Projects / Options / Build
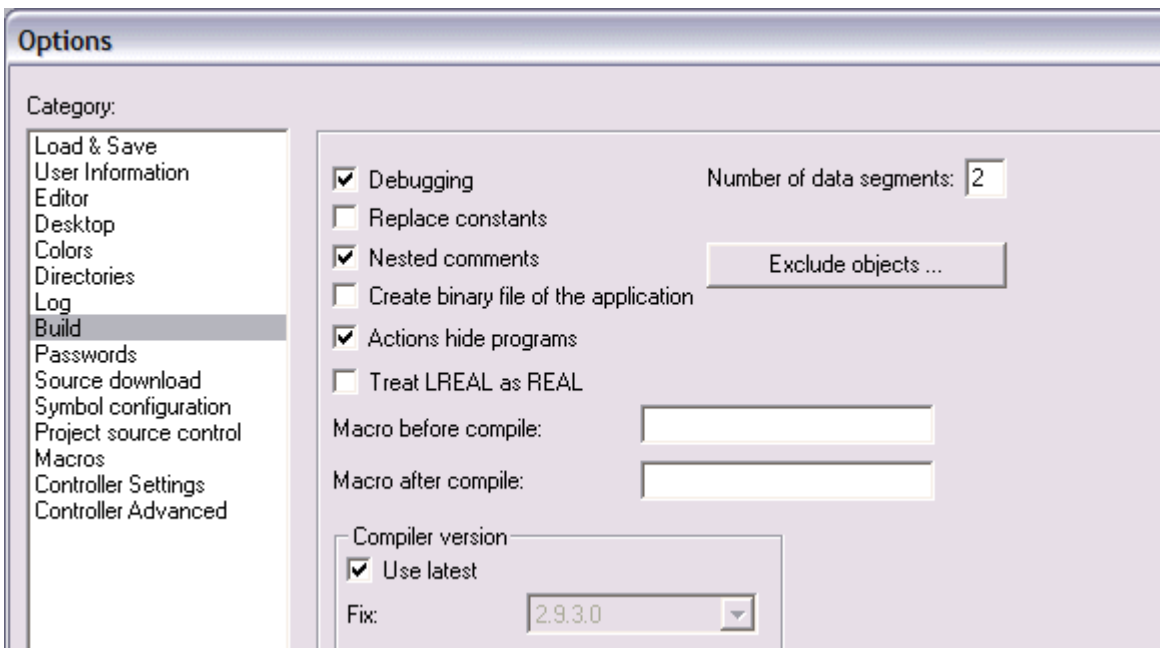
Fig. 53: Build

5.4 Remanent data

2000 bytes of remanent data are available on the BC9191 and the BX controller. These data are declared as VAR RETAIN in PLC Control.

Example

```
VAR RETAIN
    Test    :BOOL;
    Count   :INT;
END_VAR
```

Retain data are located between VAR RETAIN and END_VAR. These data are stored in a NOVRAM and are consistent across the whole 2 kbyte range. The RETAIN data are stored in the NOVRAM after each cycle. For 2 kbyte approx. 2 ms are required (for 1 kbyte approx. 1 ms). The variables can be configured locally or globally. Allocated variables (%MB, %QB, %IB) cannot be used as remanent data.

Do not use VAR_RETAIN in function blocks

VAR_RETAIN should not be used in function blocks. All FB data are copied into the retain memory. This leads to an unnecessary increase in cycle time, and the retain memory is filled with unnecessary data.

Do not use variables with address as remanent data

Variables that have been assigned an address (%MB, %QB, %IB) must not be used as remanent data.

Example for remanent data in the function block

This should be avoided, if possible, since all the data of a function block, in which even just a single remanent bit is found, are stored by default. A program sample can be found below.

Function block test (no program code required - in ST semicolon is sufficient)

```
FUNCTION_BLOCK Test
VAR_INPUT
END_VAR
VAR_OUTPUT
END_VAR
VAR
END_VAR
```

```
VAR_IN_OUT
    Counter   :INT;
END_VAR
```

MAIN program

```
PROGRAM MAIN
VAR
    fb_Test:Test;
END_VAR
VAR RETAIN
    iCounter1:INT;
END_VAR
```

```
fb_Test(Counter:=iCounter1);
```

5.5   Allocated flags

4 kbyte of allocated flags are available. They can be used to assign different variable types to the same address, e.g. for converting strings to bytes. Data can also be placed here that can be read or written via ADS by the controller.

> ⓘ **Allocated variables are not remanent data**
>
> For the Bus Terminal Controllers of the BX series and the BCxx50 the allocated variables are **not** saved as remanent data.

Reading/writing of allocated flags via ADS

The flags may also be read via the controller and ADS. In PROFIBUS, the DPV-1 services are used for this purpose, in CANopen SDO communication is used.
The AmsNetID can be obtained from the System Manager, or it can be displayed via the Bus Terminal Controller menu.
The PLC port number is 800.

Index group	Meaning	Index offset (value range)
0x4020	Flag (only BXxxx0)	0..4096

Example

BX program

```
VAR
    Flag_01 AT %MB0: WORD;
END_VAR
```

TwinCAT PC/CX master program

```
VAR
    fbADRSREAD: ADSREAD;
    Flag_M: WORD;
END_VAR
```

```
fbADRSREAD(
    NETID:='172.16.3.0.2.3' ,   (* AMSNetId BX *)
    PORT:=800 ,                 (* 800 - PLC *)
    IDXGRP:=16#4020 ,           (* 0x4020hex falgs *)
    IDXOFFS:=0 ,                (* byte offset *)
    LEN:=2 ,                    (* Lenght byte *)
    DESTADDR:=ADR(Merker) ,
    READ:=TRUE ,
    TMOUT:=t#1s );
IF NOT fbADRSREAD.BUSY THEN
    fbADRSREAD(READ:=FALSE);
END_IF
```

5.6   Local process image in delivery state

The process image of the BX and BCxx50 series consists of input, output and flag areas. In addition, there are unallocated data without fixed address. They are created without specifying an address. For these variable types the memory allocation is as follows:

- BCxx50 48 kbyte,
- BC9x20 128 kbyte,
- BXxx00 256 kbyte.

For the allocated data 2048 bytes of input data and 2048 bytes of output data are available. In the default configuration, i.e. in delivery state of the BX5200/BC5250, all connected Bus Terminals are assigned a fixed address. The data for DeviceNet communication are to be found from the address offset 1000dec. The amount of DeviceNet data in the default configuration is 8 bytes.

INPUTS	OUTPUTS
Bus Terminal %IB0 ...	Bus Terminal %QB0 ...
DeviceNet DATA (PLC variables) %IB1000 ...	DeviceNet DATA (PLC variables) %QB1000 ...
... %IB2047 maximal	... %QB2047 maximal

The maximum number of data via the fieldbus is 128 bytes inputs and outputs for the BC5250 and 256 bytes inputs and outputs for the BX5200.

DeviceNet data

Mode	Read/Write	BX process image
polling mode	Rx/Tx	%IB1000...%IB1007/QB1000...%QB1007

If you want to use additional data or another mode, then use the TwinCAT configuration or the library for the default configuration.

Addressing of the connected Bus Terminals

The default setting is for all the connected Bus Terminals to be assigned to the local process image.
Mapping within the Bus Terminal Controller is carried out according to the following rule:
First come all the complex Bus Terminals, in whatever sequence they are physically inserted, followed by the digital Bus Terminals which are padded to a whole byte. The default mapping of the complex Bus Terminals is:

- complete evaluation
- Intel format
- Word alignment

Example

Bus Terminal Controller: 1 x BX5200 or BC5250
Position 1: 1 x KL1012
Position 2: 1 x KL1104
Position 3: 1 x KL2012
Position 4: 1 x KL2034
Position 5: 1 x KL1502
Position 6: 1 x KL3002
Position 7: 1 x KL4002
Position 8: 1 x KL6001
Position 9: 1 x KL9010

Process image

Bus Terminal	Position	Input image	Output image
KL1501	5	%IB0...%IB5	%QB0...%QB5
KL3002	6	%IB6...%IB13	%QB6...%QB13
KL4002	7	%IB14...%IB21	%QB14...%QB21
KL6001	8	%IB22...%IB29	%QB22...%QB29
KL1012	1	%IX30.0..30.1	-
KL1104	2	%IX30.1..30.5	-
KL2012	3	-	%QX30.0..30.1
KL2034	4	-	%QX30.2..30.5
KL9010	9	-	-

i ● **Address of the Bus Terminals in the local PLC**

If you do not know the address of the Bus Terminals that you have assigned to the local PLC (BCxx00):
Perform your hardware configuration in the System Manager. After you have entered all the Bus Terminals and PLC variables, click with the right mouse button on the BCxx00 in the hardware tree, and select the menu item *Export variables information*.... A file is saved, and this file can be inserted in the System Manager under *Project - Import*. Now you will have the entry *TwinCAT import* under the global variables, and you will find here all the variables that you have assigned to the local PLC (BCxx00).

5.7 Mapping the Bus Terminals

The precise assignment of the byte-oriented Bus Terminals may be found in the configuration guide for the particular bus terminal. This documentation can be found on the Internet at http://www.beckhoff.de.

Byte oriented Bus Terminals	Bit oriented Bus Terminals
KL15x1	KL10xx, KL11xx, KL12xx, KL17xx, KM1xxx
KL25xx	KL20xx, KL21xx, KL22xx, KL26xx, KL27xx, KM2xxx
KL3xxx	
KL4xxx	
KL5xxx	
KL6xxx	
KL7xxx	
KL8xxx	
	KL9110, KL9160, KL9210, KL9260

5.8 Creating a boot project

The following memory resources are available for generating the boot project

- approx. 250 kbyte flash on the Bus Terminal controllers of the BX series;
- approx. 48 kbyte flash on the Bus Terminal controllers of the BCxx50 series.

PLC Control

After logging into TwinCAT PLC Control, a boot project can be created.

- Opening a PLC project
- Selecting the target system (or selection the serial interface)
- Logging into the BX/BCxx50

- Creating a boot project (Online\Create boot project)

The PLC LED lights up green once a valid boot project is available on the BX/BCxx50.

In the Bus Terminal controllers of the BX series, the PLC LED flashes orange while boot project is created. The PLC LED lights up orange if no boot project is available on the BX.

Deleting a boot project

The boot project can be deleted from the Bus Terminal Controller. The following steps must be followed:

- Opening the project
- Logging into the Bus Terminal Controller
- Deleting the boot project (Online\Delete boot project)

The PLC LED lights up orange when the boot project is deleted.

> ● **Using the current project as boot project**
>
> **i** After an online change the old project is still shown as boot project. To use the current project (after the online change) as the boot project, the boot project has to be recreated.

Bypassing the start of the boot project*

With the Bus Terminal controllers of the BX series, starting of the boot project during booting can be prevented by pressing the Navi button. This does not delete the boot project. The project is reloaded when the Bus Terminal Controller is rebooted.

* from version 0.85

5.9 Local process image in the TwinCAT configuration

The TwinCAT configuration (TwinCAT CONFIG) enables free mapping between fieldbus, K-bus and PLC variables. Variables can be linked independent of their address via the System Manager.
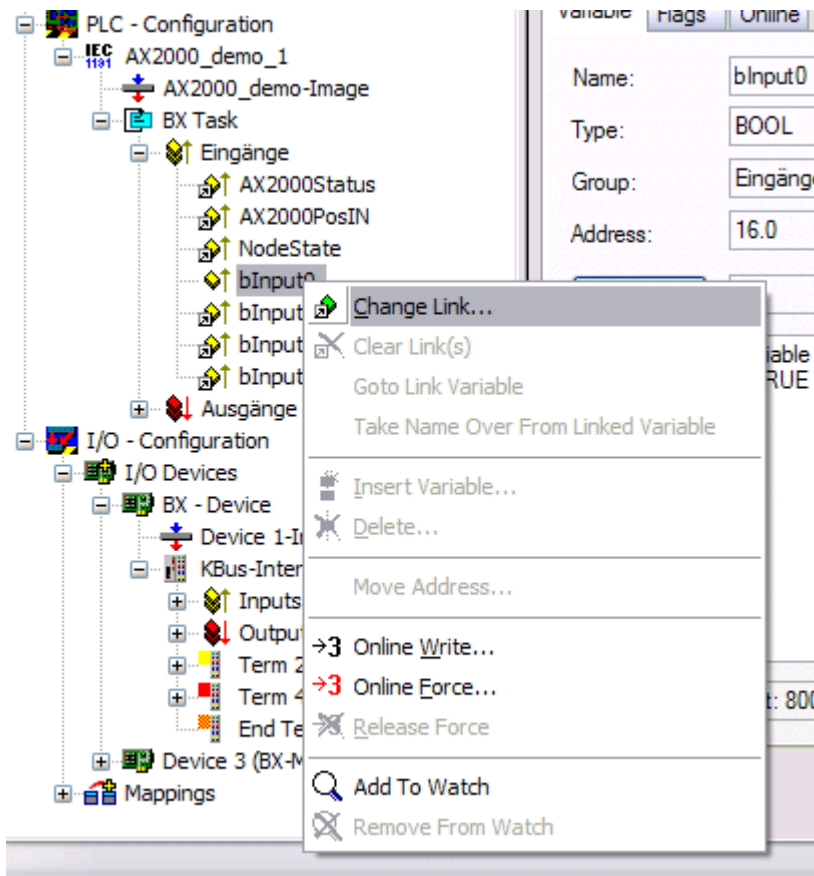
Fig. 54: Changing variable links
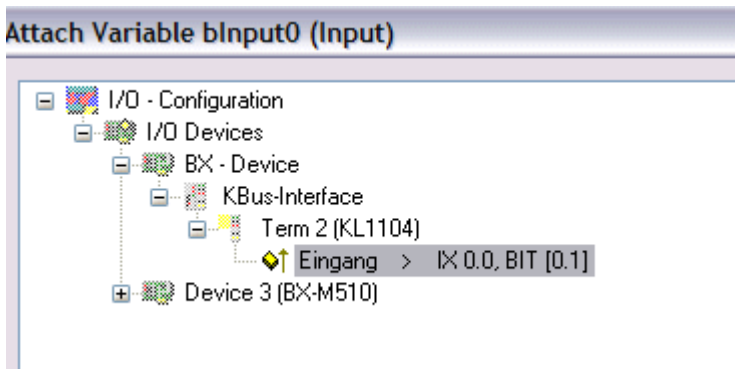
Fig. 55: Linking a variable with an input

In the default configuration all Bus Terminals are assigned fixed addresses. If a Bus Terminal is inserted, the whole address range may be shifted. The TwinCAT configuration enables allocated variables to be linked to a Bus Terminal, as required. This is parameterized in the System Manager, and the configuration is then downloaded to the Bus Terminal Controller (see TwinCAT configuration [▶ 28]). It is also possible to upload an existing TwinCAT configuration.

5.10 Communication between TwinCAT and BX/BCxx50

For transferring data from TwinCAT to the Bus Terminal Controller, it makes sense to organize the data in a structure. Please note the following to account for the differences in data management on the two systems.

- If two different data types are sent in sequence (e.g. byte and INT), the following variable is set to the next even address offset
- Boolean variables should never be allocated individually within a structure, since they would invariably occupy 1 byte. Boolean expressions should always be masked in a byte or word.

Example 1: A structure on the BX/BCxx50 and on the PC

Variable	BX/BCxx50 memory	PC memory (TwinCAT)
Byte	%..B0	%..B0
INT (1)	%..B2	%..B1
INT (2)	%..B4	%..B3

Due to the fact that another variable type (INT) follows the first byte, in the BX/BCxx50 it was assigned the next free even address. In order to achieve the same data structure on both systems, a dummy byte has to be inserted in the PC project (see example 2).

Example 2: A structure on the BX/BCxx50 and on the PC with the same memory allocation

Variable	BX/BCxx50 memory	PC memory (TwinCAT)
Byte	%..B0	%..B0
Byte (dummy)	%..B1 (not necessarily required, since the system deals with this itself if the variable does not exist)	%..B1
INT (1)	%..B2	%..B2
INT (2)	%..B4	%..B4

Data structure

```
Type PB_Data
STRUCT
    wVar_1:WORD;
    iValue_1:INT;
    iValue_2:INT;
    iValue_3:INT;
END_STRUCT
END_TYPE
```

Creating a variable structure

```
VAR_Global
    strData_Out AT %QB1000:PB_Data; (*PLC Variables *)
    bInput_01 AT %IX0.0:BOOL; (* Input from a terminal *)
END_VAR
```

Small programming example

```
strData_Out.wVar_1.0:=bInput_01;
```

ⓘ Do not use real values in a mixed data structure

A mixed data structure should not contain real values. If this is nevertheless the case, the high and low words must be swapped in the BX/BCxx50 or in the TwinCAT master project. It is better to use an array of Real values or to transfer the Real values individually.

ⓘ Larger fieldbus data blocks

You can transfer larger fieldbus data blocks, in order to have a reserve for your structure. Disadvantage: These reserves are then transferred with each fieldbus telegram, resulting in overload of the fieldbus communication.

BECKHOFF

5.11   Up- and downloading of programs

The Bus Terminal Controller has a memory for the source code. It can be used for storing the program, the task configuration, and the libraries. Should the memory be insufficient, the source code may be stored without task configuration and libraries. This takes up significant less memory space!

General settings

The timing of the source code download to the target system can be specified via Edit/Options. Open the options menu.
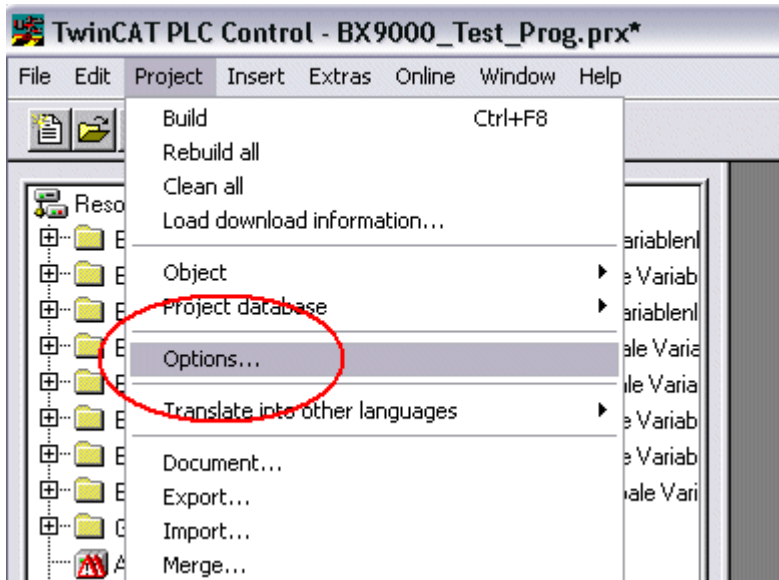
Fig. 56: Opening the options menu

Select Source Download.
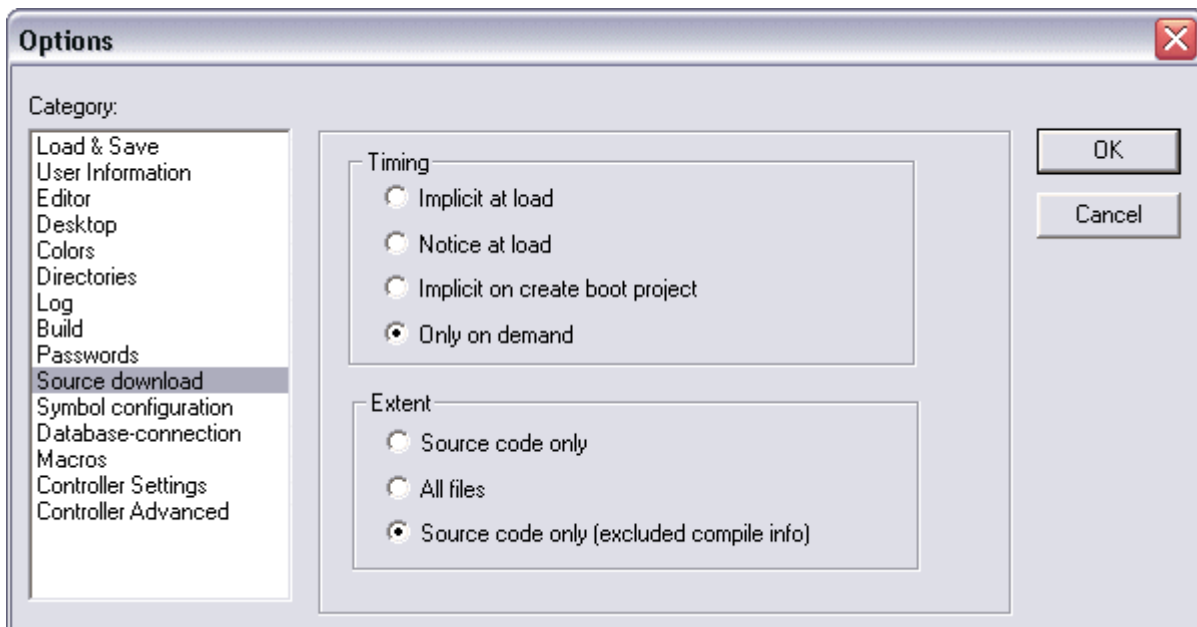
Fig. 57: Selecting Source Download

Here you can set which parts of the source code are to be downloaded to the Bus Terminal Controller, and when.

Source code only: the prx file with information on the online change is transferred. Login via online change is possible (the PLC does not stop).
All files: as *Source code only*, plus all required libraries.
Source code only (compile info excluded): only the prx file is transferred. Login is only possible when the PLC stops.

Which option you can use depends on the size of your projects.

Downloading a program

The source code can be transferred to the target system on request. This requires the user to be logged in with his program. Under Online/Source code download the program code can now be transferred to the Bus Terminal Controller.
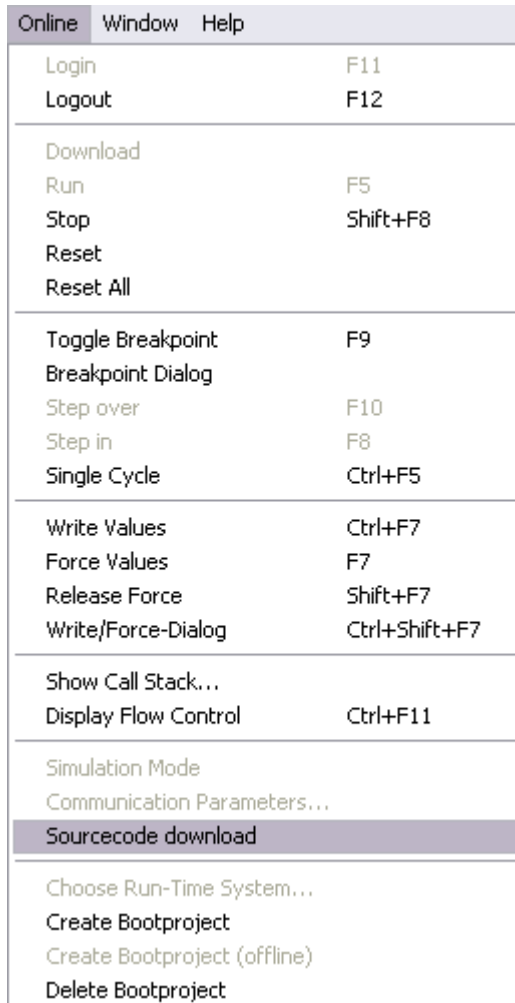
Fig. 58: Downloading the program code

After a short delay, a window will open that indicates the download progress.
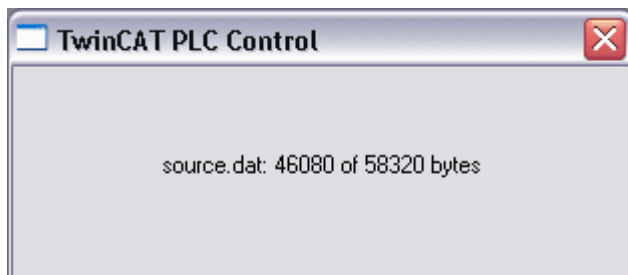
Fig. 59: Download progress

Uploading a program

For uploading the program code again, open a new file in PLC Control. Then click on the PLC button.
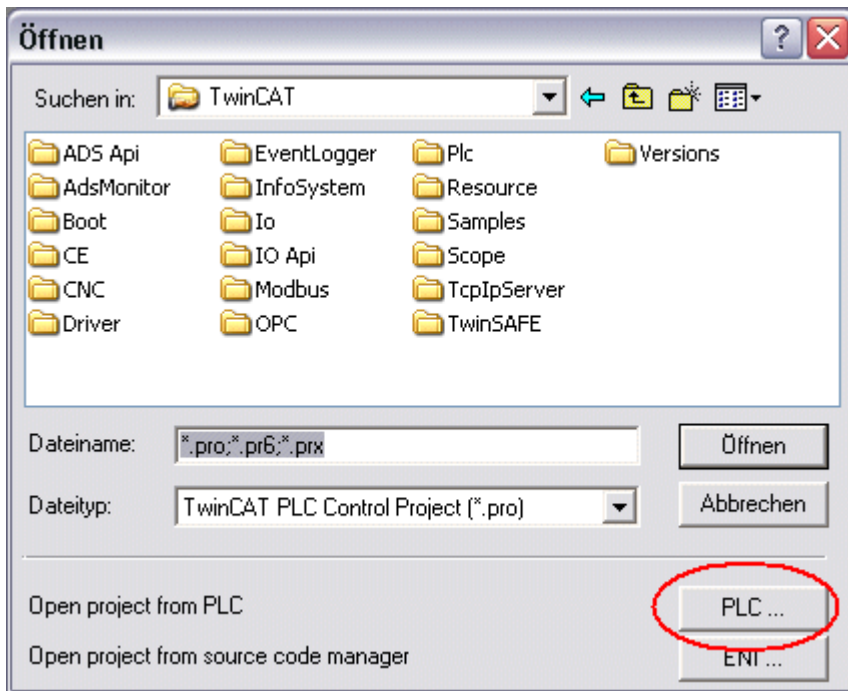
Fig. 60: Uploading a program

Select the data transfer route:

- *BCxx50 or BX via AMS*, if you are connected to the Bus Terminal Controller via the fieldbus, or
- *BCxx50 or BX via serial*, if you are connected to the Bus Terminal Controller via the serial interface.
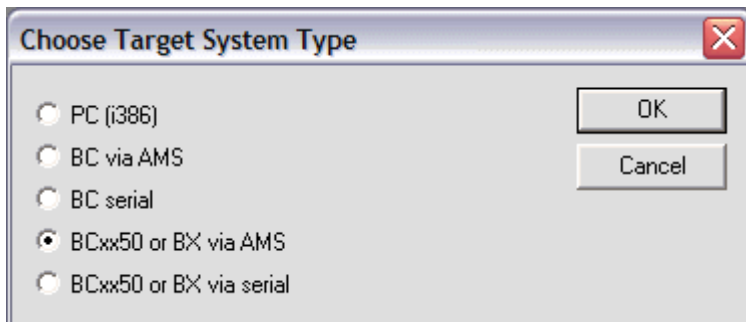
Fig. 61: Selecting the data transfer route

Then select the device and confirm with OK.
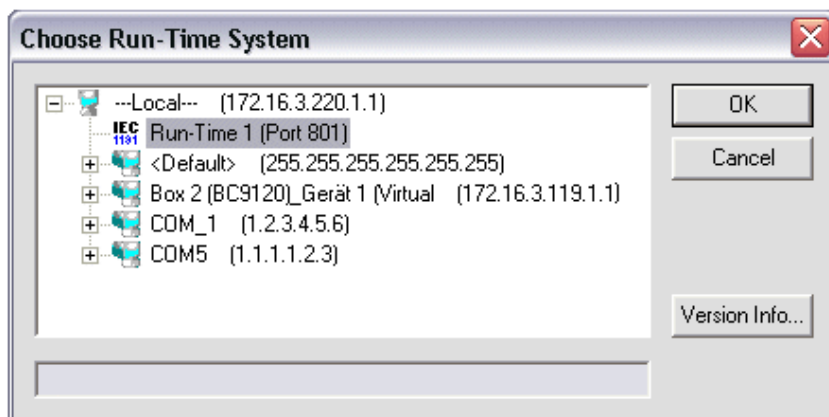
Fig. 62: Selecting the device

The source code will now be uploaded.

Password

You can protect your project with a password (in PLC Control Project/Options/Passwords).

5.12 Libraries

5.12.1 Libraries overview

The TwinCAT Automation Software offers various libraries for the BCxx50 series Bus Terminal Controllers (Bus Coupler with PLC functionality). See Beckhoff Information System.

Download

The libraries are also included in this documentation. To extract the libraries, left-click on the link and copy the libraries to directory TwinCAT\PLC\LIB.

Standard
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3730726795.zip)

TcSystemBCxx50. TcSystemBCxx50 requires the TcBaseBCxx50 library.
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3730728971.zip)

TcBaseBCxx50
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3730731147.zip)

ChrAscBX.lbx
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3730733323.zip)

> **Use the library that matches the firmware**
> The latest firmware requires the latest library. If you update your Bus Terminal Controller, please also update the libraries.
> Copy these libraries to the LIB directory, remove these libraries from your project and add them again.

TcSystemBCxx50

ADS	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
ADSREAD		B0	B0	B1	B0	-
ADSWRITE		B0	B0	B1	B0	-
ADSRDWRT		B0	B0	B1	B0	-
ADSWRTCTL		B0	B0	B1	B0	-
ADSRDSTATE		B0	B0	B1	B0	-
ADSRDDEVINFO		B0	B0	B1	B0	-

Bit Functions	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
CLEARBIT32		B0	B0	B1	B0	-
CSETBIT32		B0	B0	B1	B0	-
GETBIT32		B0	B0	B1	B0	-
SETBIT32		B0	B0	B1	B0	-

Controller	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
FB_BasicPID	-	B0	B0	B1	B0	-
-	-	-	-	-	-	-

File Access	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
FB_ReadFromFile		-	-	-	-	-
FB_WriteToFile		-	-	-	-	-
FB_ReadWriteFile		-	-	-	-	-

Memory Functions	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
MEMCMP		B0	B0	B1	B0	-
MEMCYP		B0	B0	B1	B0	-
MEMMOVE		B0	B0	B1	B0	-
MEMSET		B0	B0	B1	B0	-

NOVRAM Functions	Version	Firmware				
		BX3100	BX5100	BX5200	BX8000	-
-	-	-	-	-	-	-

SFC	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
AnalyzeExpression		-	-	-	-	-
AppendErrorString		-	-	-	-	-
SFCActionControl		-	-	-	-	-

System / Time / TBus	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
DRAND		B0	B0	B1	B0	-
SYSTEMTIME_TO_DT		B0	B0	B1	B0	-
DT_TO_SYSTEMTIME		B0	B0	B1	B0	-
GetSysTick		B0	B0	B1	B0	-
PresetSysTick		B0	B0	B1	B0	-
Reboot		B0	B0	B1	B0	-

Debug	Version	Firmware				
		BC3150	BC5150	BC5250	BC8150	-
F_ReadDebugTimer		B0	B0	B1	B0	-
F_StartDebugTimer		B0	B0	B1	B0	-

5.12.2   Data structure strBX5200_Set

The DeviceNet-specific blocks allow the setting of the DeviceNet-specific parameters in the default configuration of the BX5200 or BC5250. Thus the length of the I/O data, the baud rate, the ERP (Expected Racket Rate) and the transmission mode can be set from the local PLC project. The block is not required for the TwinCAT configuration, as in this case the settings are created via the System Manager.

BX5200/BC5250 library
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/4007139723.zip)

Example of BC5250
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/4007141899.zip)

Example of BX5200
(https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/4007144075.zip)
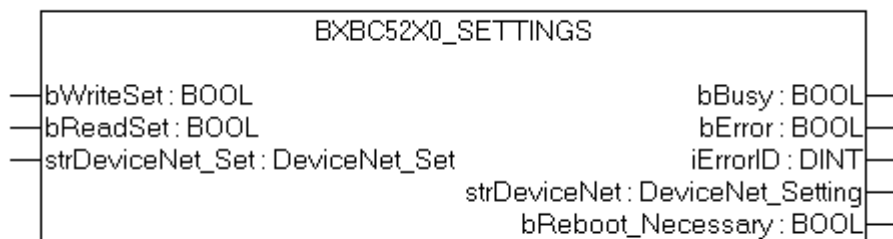
BXBC52x0_Settings

Fig. 63: Function block BXBC52x0_Settings

Function block BXBC52x0_Settings

VAR_INPUT

```
bWriteSet          :BOOL;
bReadSet           :BOOL;
strDeviceNet_Set   :DeviceNet_Set;
```

Key

bWriteSet: Rising edge starts the block and reads/writes the parameters if these have changed. The Bus Coupler must then be restarted. The user is notified if/when the bReboot_Necessary flag is set.
bReadSet: Positive edge reads the set DeviceNet parameters.
strDeviceNet_Set: Data structure for the DeviceNet slave interface.

VAR_OUTPUT

```
bBusy              :BOOL;
bError             :BOOL;
iErrorId           :WORD;
strDeviceNet       :DeviceNet_Setting;
bReboot_Necessary  :BOOL;
```

Key

bBusy: The block is active as long as it is TRUE.
bError: Error bit.
iErrorId: Error number.

strDeviceNet: The type, the firmware and the DeviceNet slave parameters are output here.

bReboot_Necessary: If this bit is TRUE after the bBusy is set to FALSE, then the BC/BX52x0 must be restarted so that the DeviceNet settings are saved.

Data structure strBX5200_Set

The settings for the DeviceNet slave interfaces are transferred with the following data structure.

```
TYPE ST_COMConfig:
STRUCT
   iInputData       :INT; (*BX5200: 0..255/BC5250 0..127*) )1
   iOutputData      :INT; (*BX5200: 0..255/BC5250 0..127*) )1
   E_Mode           :ENUM;(*0-polling,1-bit-strobe, 2-change of state, 3-cycle*)
   iERP             :INT; (*100ms, ERP*4=Watchdog*)
   E_BaudRate       :ENUM;(*0-125kBaud, 1-250kBaud, 2-500kBaud, 3-AutoBaud*)
END_STRUCT
END_TYPE
```

```
)1 If the DN mode is only 8 Byte In and 8 Byte Output allowed. That is fix and you can´t change it.
```

Key

iInputData: Number of input data (from the point of view of the BX). Size in bytes [BX5200: 0..255 bytes, BC5250: 0..127 bytes]

iOutputData: Number of output data (from the point of view of the BX). Size in bytes [BX5200: 0..255 bytes, BC5250: 0..127 bytes]

E_Mode: DeviceNet Mode

iERP: Expected Racket Rate. This value multiplied by 4 results in the watchdog

E_BaudRate: DeviceNet Baudrate

iErrorId

Return parameter iErrorId	Meaning
0	no Error
-1	Wrong BX or BC Typ
-2	Wrong firmware version (BC5250 Version 5 or higher, BX5200 110 or higher)
0x1000_xxxx	xxxx ADS Error Code (see ADS Return Code)

5.12.3   TcBaseBX

5.12.3.1   System task information

```
VAR_GLOBAL
    SystemTaskInfo  :  SYSTEMTASKINFOTYPE;
END_VAR
```

System flags are implicitly declared variables. Using the Input Assistant, a variable SystemTaskInfoArr can be found under system variables. This variable is a field with four structures of type SYTEMTASKINFOTYPE [▶ 68]. The structure definition can be found in the system library. The index in this field is the task ID.

Development environment	Target platform	PLC libraries to be linked
TwinCAT v2.9.0	BCxx50, BC9x20 Controller	TcBaseBCxx50.lbx

5.12.3.2   System Task Info Type

```
TYPE SYSTEMTASKINFOTYPE
STRUCT
    active            :        BOOL;
    taskName          :        STRING(16);
    firstCycle        :        BOOL;
    cycleTimeExceeded :        BOOL;
    cycleTime         :        UDINT;
    lastExecTime      :        UDINT;
```

```
    priority          :          BYTE;
    cycleCount        :          UDINT;
END_STRUCT
END_TYPE
```

Key

active: This variable indicates whether the task is active.

taskName: the task name.

firstCycle: During the first PLC task cycle, this variable has the value: TRUE.

cycleTimeExceeded: this variable indicates whether the set task cycle time was exceeded.

cycleTime: set task cycle time in multiples of 100 ns.

lastExecTime: cycle time required for the last cycle in multiples of 100 ns.

priority: set task priority.

cycleCount: cycle counter.

Development environment	Target platform	PLC libraries to be linked
TwinCAT v2.9.0	BCxx50, BC9x20 Controller	TcBaseBCxx50.lbx

5.12.3.3   System info

```
VAR_GLOBAL
    SystemInfo    : SYSTEMINFOTYPE;
END_VAR
```

System flags are implicitly declared variables. Using the Input Assistant, a variable Systeminfo can be found under system variables. The type SYSTEMINFOTYPE [▶ 69]is declared in the system library. For accessing the variable, the system library has to be integrated in the project.

Development environment	Target platform	PLC libraries to be linked
TwinCAT v2.9.0	BCxx50, BC9x20 Controller	TcBaseBCxx50.lbx

5.12.3.4   System information type

```
TYPE SYSTEMINFOTYPE
STRUCT
    runTimeNo          :          BYTE;
    projectName        :          STRING(32);
    numberOfTasks      :          BYTE;
    onlineChangeCount  :          UINT;
    bootDataFlags      :          BYTE;
    systemStateFlags   :          WORD;
END_STRUCT
END_TYPE
```

Key

runTimeNo: indicates the number of the runtime system (1).

projectName: project name as STRING.

numberOfTasks: number of tasks contained in the runtime system (max. 1).

onlineChangeCount: number of online changes since the last complete download.

bootDataFlags: Reserved

systemStateFlags: Reserved.

Development environment	Target platform	PLC libraries to be linked
TwinCAT v2.9.0	BCxx50, BC9x20 Controller	TcBaseBCxx50.lbx

5.12.3.5 ADS

5.12.3.5.1 Local ADS Port Numbers

Port number	Description
100 [▶ 70] dec	Reading and writing of registers and tables from the coupler and the complex Bus Terminals
801 [▶ 70] dec	Local PLC process image

5.12.3.5.2 ADS services

Local process image task 1 port 800 or 801

Data can be read from and written to the local process image. If it is necessary for outputs to be written, it is important to ensure that they are not used by the local PLC, because the local controller will overwrite these values. The data are not associated with a watchdog, and therefore must not be used for outputs that would have to be switched off in the event of a fault.

Index group	Meaning	Index offset (value range)
0xF020	Inputs	0...2047
0xF030	Outputs	0...2047
0x4020	Flags	0...4095

ADS services

AdsServerAdsState

Data type (read only)	Meaning
String	Start - the local PLC is running Start - the local PLC is stopped

AdsServerDeviceState

Data type (read only)	Meaning
INT	0: Start - the local PLC is running 1: Start - the local PLC is stopped

AdsServerType

Data type (read only)	Meaning
String	BX PLC Server

Register Port 100

On the Bus Terminal Controllers of the BX series, and on the BCxx50, the ADS port number for register communication is fixed at 100.

Index Group	Index offset (value range)		Meaning
	Hi-Word	Lo-Word	
0 [READ ONLY]	0...127	0..255	Registers in the Bus Coupler Hi-Word, table number of the Bus Coupler Lo-Word, register number of the table
1...255	0...3	1-255	Register of the Bus Terminals Hi-Word, channel number Lo-Word, register number of the Bus Terminal

---

ⓘ Minimum timeout

When reading the register, the time out of the ADS block has to be set to a time longer than 1 second.

ⓘ Setting the password

When writing to the registers, the password has to be set (see the documentation for the particular Bus Terminal).

5.12.3.6 BX debugging function

These functions can be used for measuring command execution times in a PLC project. The unit is a tick. One tick corresponds to 5.12 µs.

Start Debug Timer function

```
F_STARTDEBUGTIMER

F_StartDebugTimer : WORD
```
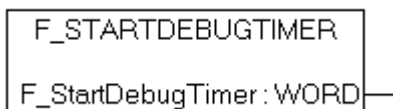
Fig. 64: Function block F_STARTDEBUGTIMER

Calling this function starts the timer. The return value is "0".

Read Debug Timer function

```
F_READDEBUGTIMER

F_ReadDebugTimer : WORD
```
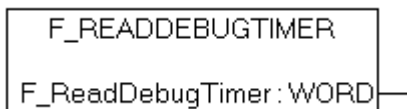
Fig. 65: Function block F_READDEBUGTIMER

This function reads the timer value. The return value has to be multiplied with 5.12 µs.

Example

```
VAR
    Timer_BX      :WORD;
    i             :INT;
END_VAR
```

Program

```
F_STARTDEBUGTIMER();
For i:=0 to 1000 do
    ;
END_FOR
Timer_BX:=F_READDEBUGTIMER();
```

5.13 Program transfer via the serial interface

Every Bus Terminal Controller can be programmed via the PC's RS232 interface.

Select the serial interface in TwinCAT PLC Control.
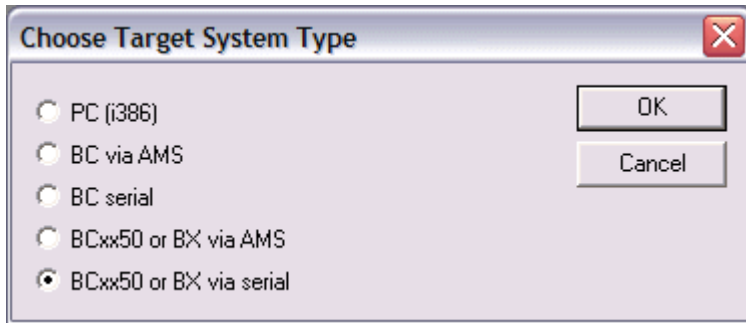
Fig. 66: *Selecting the data transfer route - serial interface*

The settings for the serial interface, port number, baud rate etc. are found under Online/Communication parameters in PLC Control.

The Bus Terminal Controller requires the following setting:

- Baud Rate: 9600/19200/38400/57600 baud (automatic baud rate detection)
- Stop bits: 1
- Parity: Straight line
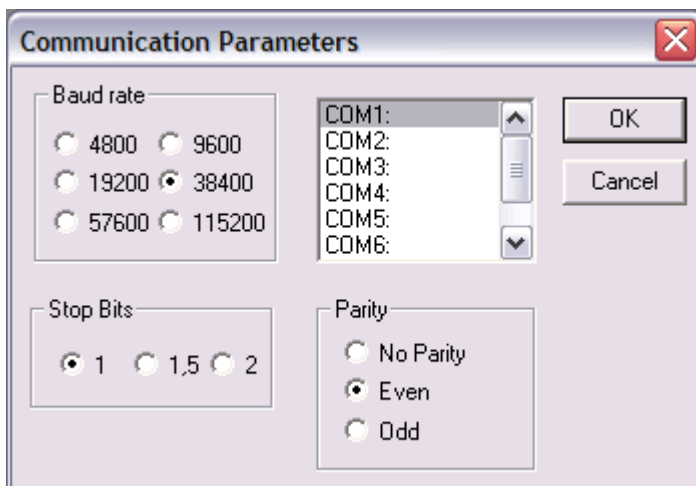
Fig. 67: Parameterization of the serial interface

Program transfer via the serial interface and ADS

The Bus Terminal Controller can be programmed via the PC's RS232 interface. Before you can work with the Bus Terminal Controller, TwinCAT must be notified of it (see serial ADS [▶ 37]).

Select the ADS connection in TwinCAT PLC Control.
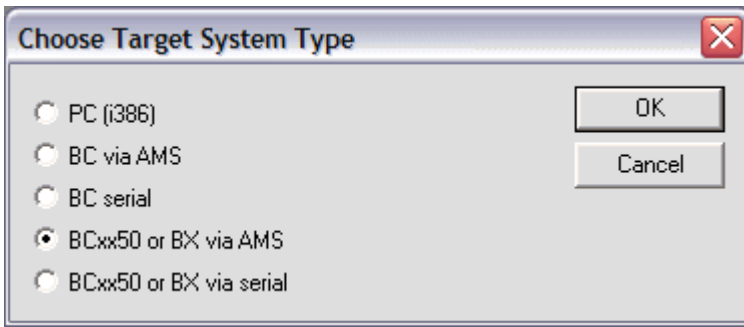
Fig. 68: *Selecting the data transfer route - AMS*

PLC Control can be accessed via *Online/Communication Parameters....*
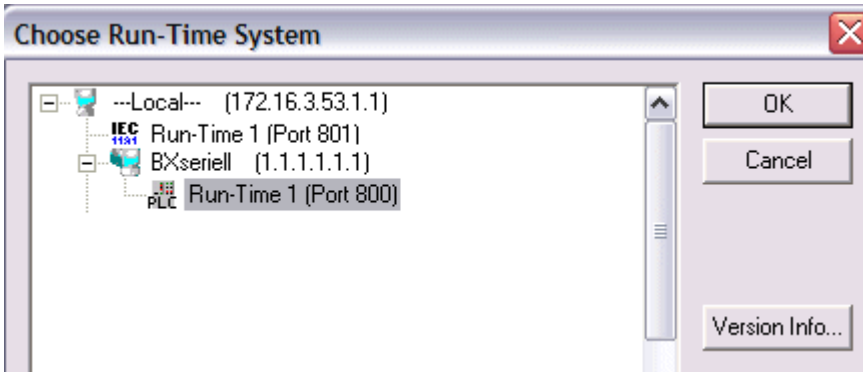
Fig. 69: Selecting the device

6 DeviceNet communication

6.1 DeviceNet Introduction

Fig. 70: DeviceNet

DeviceNet is an open system based on CAN. CAN was developed some years ago by R. Bosch for data transmission in motor vehicles. Millions of CAN chips are now in use. A disadvantage for application in automation is that CAN does not contain definitions for the application layer. CAN only defines the physical and data link layer.

DeviceNet specifies a uniform application layer and this makes it possible to use the CAN protocol for industrial applications. ODVA (the Open DeviceNet Vendor Association) is an independent association which supports manufacturers and users of the DeviceNet system. ODVA ensures that all devices which conform to the specification can operate together in one system, regardless of their manufacturer.
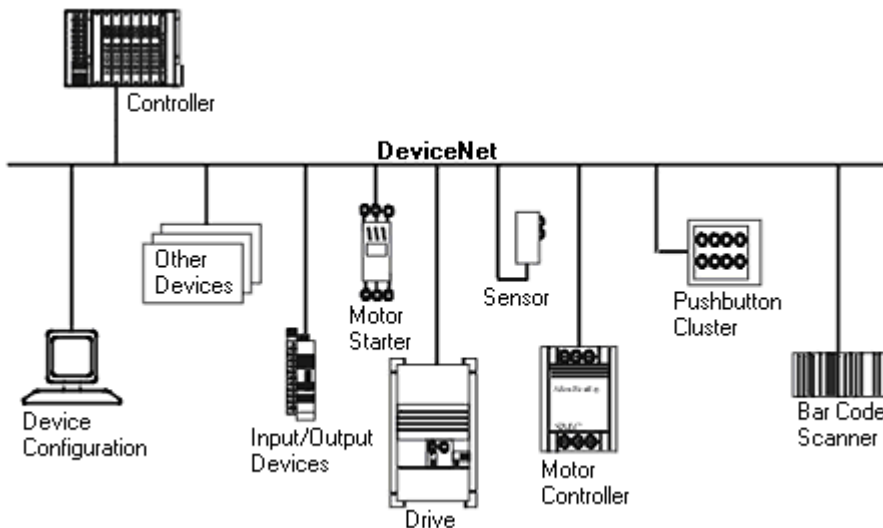
Fig. 71: Example of DeviceNet in use

DeviceNet is a sensor/actuator bus system. It is internationally standardised (EN50325) and is based on CAN (Controller Area Network). DeviceNet supports a number of communication types for the input and output data:

- Polling: The master module ("scanner") sends the output data cyclically to the assigned devices and receives the input data in an answer telegram.
- Change-of-State: Telegrams are sent as soon as their contents have changed.
- Cyclic: The modules send the data automatically after a cycle time has elapsed.
- Strobed: The scanner requests the input data using a broadcast telegram to all the devices.

The DeviceNet devices support all I/O communication types.

The DeviceNet devices are parameterized via acyclical services (explicit messaging).

The effective utilization of the bus bandwidth allows DeviceNet, particularly in Change-of-State mode, to achieve short system reaction times in spite of the relatively low data rates. The BECKHOFF DeviceNet devices have a powerful implementation of the protocol. Through active participation in the ODVA's technical committees, BECKHOFF are contributing to the further development of this bus system, and has in this way itself gathered profound DeviceNet expertise.

Configuration

The node address is set in the range from 0 to 63 using two decimally coded rotary switches. The data transfer rate set at the DeviceNet scanner is automatically recognized by the DeviceNet Box (auto baud rate). "Electronic Data Sheets" (EDS files) for DeviceNet configuration tools are available for download from the Beckhoff internet site (http://www.beckhoff.de), and on the BECKHOFF product CDs. Special I/O parameters that are not covered by the DeviceNet standard can be set via the KS2000 software (serial connection) or via acyclical explicit messages.

Diagnostics

The extensive diagnostic functions of the BECKHOFF DeviceNet devices allow rapid fault localisation. The diagnostic messages are transmitted over the bus and collated by the master. The status of the network connection, the device status, the status of the inputs and outputs and of the power supply are displayed by LEDs.

Data transfer rates

Three data transfer rates from 125 kbaud to 500 kbaud are available for different bus lengths. The effective utilization of the bus bandwidth allows DeviceNet to achieve short system reaction times at relatively low data rates.

Topology

DeviceNet is based on a linear topology. The number of devices participating in each network is logically limited by DeviceNet to 64, but physically the present generation of drivers allows up to 64 nodes in one network segment. The maximum possible size of the network for any particular data rate is limited by the signal propagation delay required on the bus medium. For 500 kbaud, for instance, the network may extend 100 m, whereas at 125 kbaud the network may reach up to 500 m. At low data rates the size of the network can be increased by repeaters, which also allow the construction of tree structures.

Bus access procedures

CAN utilizes the Carrier Sense Multiple Access (CSMA) procedure, i.e. all participating devices have the same right of access to the bus and may access it as soon as it is free (multi-master bus access). The exchange of messages is thus not device-oriented but message-oriented. This means that every message is unambiguously marked with a prioritized identifier. In order to avoid collisions on the bus when messages are sent by different devices, a bit-wise bus arbitration is carried out at the start of the data transmission. The bus arbitration assigns bus bandwidth to the messages in the sequence of their priority. At the end of the arbitration phase only one bus device occupies the bus, collisions are avoided and the bandwidth is optimally exploited.

Configuration and parameterization

The TwinCAT System Manager allows all the DeviceNet parameters to be set conveniently. An "eds" file (electronic data sheet) is available on the BECKHOFF website (http://www.beckhoff.de) for the parameterization of BECKHOFF DeviceNet devices using configuration tools from other manufacturers.

6.2 Network Management

in preparation

6.3 Object directory

in preparation

6.4 ADS-Communication

6.4.1 ADS services

Local process image task 1 port 800 or 801

Data can be read from and written to the local process image. If it is necessary for outputs to be written, it is important to ensure that they are not used by the local PLC, because the local controller will overwrite these values. The data are not associated with a watchdog, and therefore must not be used for outputs that would have to be switched off in the event of a fault.

Index Group	Meaning	Index offset (value range)
0xF020	Inputs	0...2047
0xF030	Outputs	0...2047
0x4020	Flags	0...4095

ADS services

AdsServerAdsState

Data type (read only)	Meaning
String	Start - the local PLC is running Start - the local PLC is stopped

AdsServerDeviceState

Data type (read only)	Meaning
INT	0: Start - the local PLC is running 1: Start - the local PLC is stopped

AdsServerType

Data type (read only)	Meaning
String	BX PLC Server

Register port 100

On the Bus Terminal Controllers of the BX series, and on the BCxx50, the ADS port number for register communication is fixed at 100.

Index group	Index offset (value range)		Meaning
	Hi-Word	**Lo-Word**	
0 [READ ONLY]	0...127	0..255	Registers in the Bus Coupler Hi-Word, table number of the Bus Coupler Lo-Word, register number of the table
1...255	0...3	1-255	Register of the Bus Terminals Hi-Word, channel number Lo-Word, register number of the Bus Terminal

ⓘ Minimum timeout

When reading the register, the time out for the ADS block has to be set to a time longer than 1 second.

● **Setting the password**

i When writing to the registers, the password has to be set (see the documentation for the particular Bus Terminal).

7 Error handling and diagnosis

7.1 Diagnostics

DeviceNet state

In many cases it is important to know whether the communication with the higher-level master is still OK. To this end, link the *NodeState* variable with your PLC program. A TwinCAT configuration is required for this purpose.
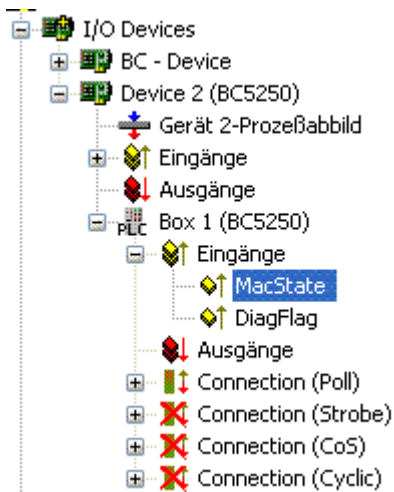
Fig. 72: DeviceNet diagnostics byte in the System Manager

Error number	Description	Remedy
0	no error	none
1	Node is deactivated by the scanner, node is no longer in the masters scan-list. For Slave Devices it means that there is no Data-Exchange between the Master and the Slave. The Master has released the DeviceNet Slave	Check the configuration
2	No data exchange between node and DeviceNet Master, node access timeout	Check the connection
18	Node is configured, ready for data exchange	none
42	Electronic Key Error: Vendor ID	Check identity of DeviceNet slave
43	Electronic Key Error: Device Type	Check identity of DeviceNet slave
44	Electronic Key Error: Product Code	Check identity of DeviceNet slave
45	Electronic Key Error: Revision	Check identity of DeviceNet slave
46	Error writing start-up attributes	Check identity of DeviceNet slave
47	Wrongproduced IO-Data length	Check identity of DeviceNet slave
48	Wrong consumed IO-Data length	Check identity of DeviceNet slave
49	Idle Mode (for Slave Devices): no valid IO-Data is exchanged via DeviceNet	Check whether the master is in idle mode

Reading fieldbus state by ADS

You can read the fieldbus state via ADSREAD in the default configuration or in the TwinCAT configuration.

Parameter ADSREAD function block	Description
NetID	local – empty string
Port	1
IndexGroup	16#0006
IndexOffset	16#000C_AE00
LEN	1

State of the K-bus

An internal bus or Bus Terminal error is indicated in the *K-bus state* variable. A more precise fault description can be obtained via a function block (in preparation). To this end, link the *K-bus state* variable with your PLC program.
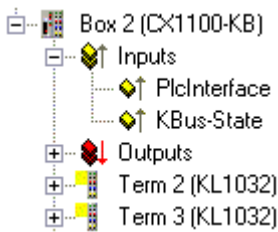
Fig. 73: State of the K-bus

Error bit	Description	Error type
0	No error	No error
Bit 0	K-bus error	Error
Bit 2	K-Bus is re-triggered	Note

Reading K-Bus state by ADS

You can read the fieldbus state via ADSREAD in the default configuration or in the TwinCAT configuration.

Parameter ADSREAD function block	Description
NetID	local – empty string
Port	1
IndexGroup	16#0006
IndexOffset	16#000C_9000
LEN	1

7.2 Diagnostic LEDs

The Bus Terminal Controller has LEDs that indicate the status. The row of LEDs on the left describes the status of the fieldbus and of the PLC. The row of LEDs on the right indicates the supply voltage and the K-Bus state.
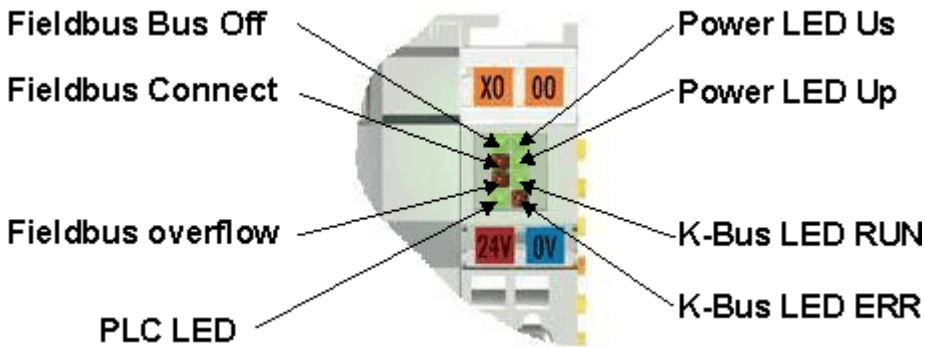
Fig. 74: Diagnostic LEDs

POWER LEDs for diagnostics of power supply

LED (Power LEDs)	Meaning
LED Us	LED off: Bus Terminal Controller has no 24 V_{DC} voltage
LED Up	LED off: No power supply 24 V_{DC} connected at the power contacts

LEDs for K-Bus diagnostics

LED (Power LEDs)	Meaning
LED RUN	LED off: no K-bus update LED on, flashes: K-bus running
LED ERR	LED off: No error LED flashes: see K-Bus error code

Error codes for K-Bus diagnosis

Error code	Error code argument	Description	Remedy
0	-	EMC problems	• Check power supply for undervoltage or overvoltage peaks • Implement EMC measures • If a K-bus error is present, it can be localized by a restart of the coupler (by switching it off and then on again)
1	0	EEPROM checksum error	Enter factory settings with the KS2000 configuration software
	1	Code buffer overflow	Insert fewer Bus Terminals. The programmed configuration has too many entries in the table
	2	Unknown data type	Software update required for the BX Controller
2	-	reserved	-
3	0	K-bus command error	• No Bus Terminal inserted • 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	0	K-bus data error, break behind the BX Controller	Check whether the n+1 Bus Terminal is correctly connected; replace if necessary.
	n	Break behind Bus Terminal n	Check whether the KL9010 Bus End Terminal is connected
5	n	K-bus error in register communication with Bus Terminal n	Exchange the nth Bus Terminal
6	0	Error at initialization	Replace BX Controller
	1	Internal data error	Perform a hardware reset on the BX Controller (switch off and on again)
	2	DIP switch changed after a software reset	Perform a hardware reset on the BX Controller (switch off and on again)
7	0	Note: cycle time was exceeded	Warning: the set cycle time was exceeded. This indication (flashing LEDs) can only be cleared by booting the BX Controller again. Remedy: increase the cycle time
9	0	Checksum error in Flash program	Transmit program to the BX again
	1	Incorrect or faulty library implemented	Remove the faulty library
10	n	Bus Terminal n is not consistent with the configuration that existed when the boot project was created	Check the nth Bus Terminal. The boot project must be deleted if the insertion of an nth Bus Terminal is intentional.
14	n	nth Bus Terminal has the wrong format	Start the BX Controller again, and if the error occurs again then exchange the Bus Terminal.
15	n	Number of Bus Terminals is no longer correct	Start the BX Controller again. If the error occurs again, restore the manufacturers setting using the KS2000 configuration software
16	n	Length of the K-bus data is no longer correct	Start the BX Controller again. If the error occurs again, restore the manufacturers setting using the KS2000 configuration software

LED bus - fieldbus diagnostics

LED BUS OFF	LED CONNECT	LED OVERFLOW	Meaning
on	off	off	No fieldbus connected, Bus Terminal Controller searches for the baud rate, 24 V DeviceNet voltage missing
flashes	Blink	off	Stopped, no error, Bus Terminal Controller searches for the baud rate
off	on	off	No error
off	flashes	off	Bus OFF, wrong baud rate
off	off	on	Warning Level

LED PLC - PLC diagnostics

LED	Meaning
PLC LED	LED on: PLC running LED off: PLC stopped

8   Appendix

8.1   Firmware Update

Firmware update program

The firmware update program is required for loading a new firmware to the Bus Coupler. The program is transferred via the serial interface.

Note for BX3100:
Updates are not available with BX3100 firmware 0.64 (or lower). If these devices need updating, send the BX3100 to the manufacturer with a corresponding note.

Beckhoff Automation GmbH & Co. KG
Service Department
Stahlstr. 31
33415 Verl, Germany

💾 Firmware update program 241 (https://infosys.beckhoff.com/content/1033/bc5250/Resources/zip/3238791819.zip) 71 kbytes (for Windows NT4.0 SP6, 2000, XP).

The program *FirmwareUpdate.exe* and the file *TcRouterHelper.dll* have to be in the same directory. Open the program by double-clicking on *FirmwareUpdate.exe*.

Update for Bus Terminal Controllers

BX series

Select the appropriate device of - in this example "Serial interface (BX)".
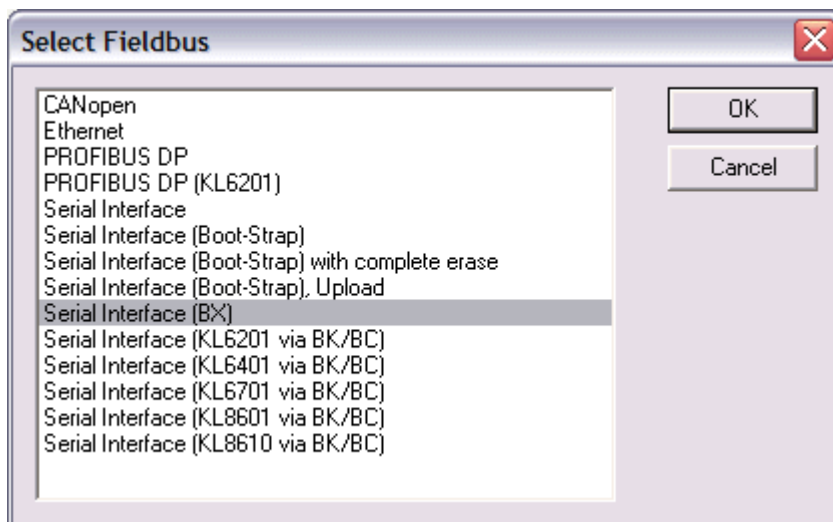
Fig. 75: Selecting a BX series Bus Terminal Controller

BCxx50 series

Select the corresponding device, in this case "Serial Interface".
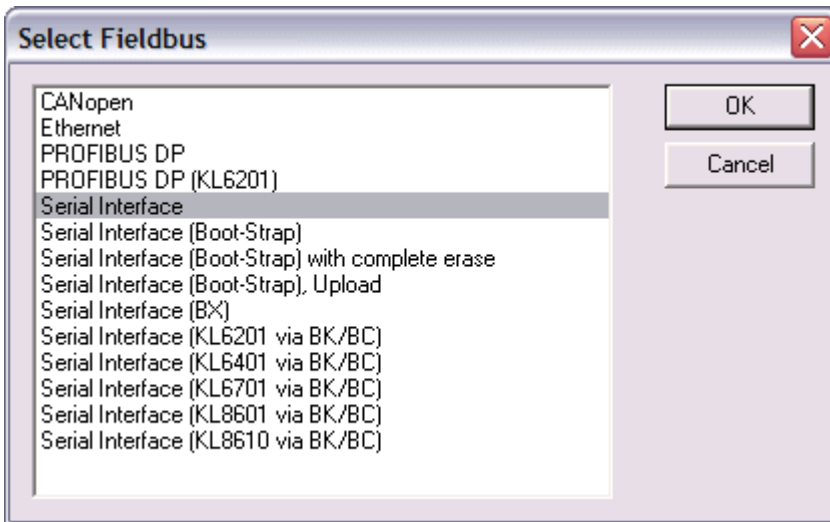
Fig. 76: Selecting a BC series Bus Terminal Controller

BX and BCxx50 series

Then select the COM port.
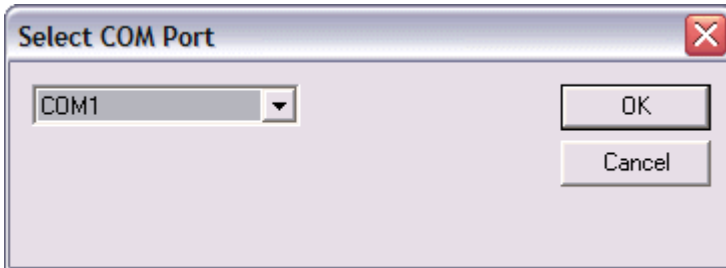
Fig. 77: Select the COM port

Open the file you wish to download.
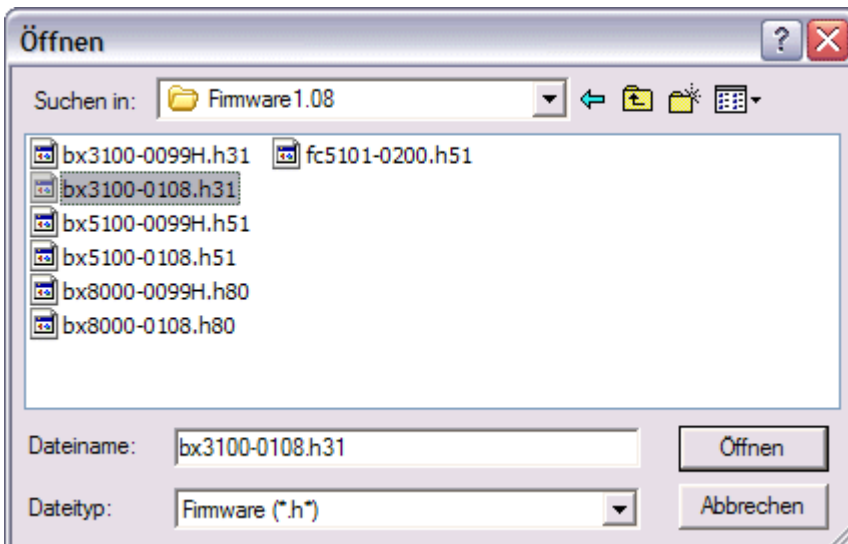
Fig. 78: Open the firmware file

Start the download via the green 'traffic light'. The download begins after about a minute, and is then also shown on the BX's display. After successful download (approx. 2 to 3 minutes) the Bus Terminal Controller reboots automatically.
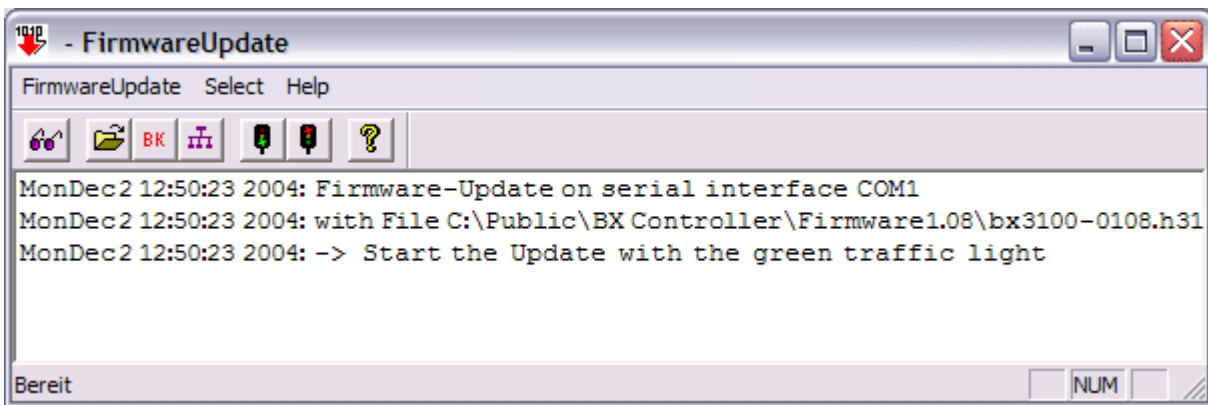
Fig. 79: Status messages relating to the firmware update

8.2 General operating conditions

The following conditions must be met in order to ensure flawless operation of the fieldbus components.

Environmental conditions

Operation

The components may not be used without additional protection in the following locations:

- in difficult environments, such as where there are corrosive vapors or gases, or high dust levels
- in the presence of high levels of ionizing radiation

Condition	Permissible range
Permissible ambient temperature during operation	see technical data
Installation position	variable
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27
EMC immunity	conforms to EN 61000-6-2
Emission	conforms to EN 61000-6-4

Transport and storage

Condition	Permissible range
Permissible ambient temperature during storage	-25°C... +85°C
Relative humidity	95 %, no condensation
Free fall	up to 1 m in the original packaging

Protection classes and types

Condition	Permissible range
Protection class in accordance with IEC 536 (VDE 0106, Part 1)	A protective conductor connection to the profile rail is necessary!
Protection class conforms to IEC 529	IP20 (protection against contact with a standard test finger)
Protection against foreign objects	Less than 12 mm in diameter
Protection against water	no protection

Component identification

Every supplied component includes an adhesive label providing information about the product's approvals. For sample, on the BK2000 Bus Coupler:
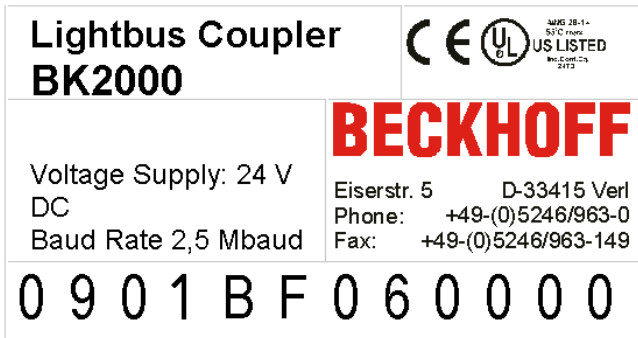
The following information is printed on the label:

Printed item	Meaning for this label
Precise product identification	Lightbus Coupler BK2000
Supply voltage Us	24 V_{DC} (Use a 4 A fuse or a Class 2 power supply to meet UL requirements)
Data transfer rate	2.5 Mbaud
Manufacturer	Beckhoff Automation GmbH & Co. KG
CE mark	Conformity mark
UL mark	Mark for UL approval. UL stands for the Underwriters Laboratories Inc., the leading certification organization for North America, based in the USA. C = Canada, US = USA, UL file number: E172151
Production identification	From left to right, this sequence of characters indicates the week of production (2 characters), the year of production (2 characters), the software version (2 characters) and hardware version (2 characters), along with any special indications (4 characters). In this case the device is a BK2000 - produced in calendar week 9 - of 2001 - with firmware version BF - in hardware version 6 - without special designation

8.3 Approvals

Conformity mark

CE

Protection class

IP20 conforms to EN60529

8.4 Test standards for device testing

EMC

EMC immunity

EN 61000-6-2

Electromagnetic emission

EN 61000-6-4

Vibration / shock resistance

Vibration resistance

EN 60068-2-6

Shock resistance

EN 60068-2-27

8.5 Bibliography

German books

General fieldbus technology

- Gerhard Gruhler (Pub.): **Feldbusse und Geräte-Kommunikationssysteme**, Praktisches Know-How mit Vergleichsmöglichkeiten. (Fieldbus and Device Communication Systems, Practical Know-how with Comparative Resources) Franzis Verlag, 2001. 244 pages. ISBN 3-7723-5745-8

8.6 List of Abbreviations

CAN

Controller Area Network. Serial bus system standardized in ISO 11898 that is used as the basic technology for CANopen

CiA

CAN in Automation e.V.. An international association of manufacturers and users based in Erlangen, Germany.

COB

Communication Object. A CAN telegram with up to 8 data bytes.

COB-ID

Communication Object Identifier. Telegram address (not to be confused with the node address). CANopen uses the 11-bit identifier according to CAN 2.0A.

NMT

Network Management. One of the service primitives of the CANopen specification. Network management is used to initialize the network and to monitor nodes.

PDO

Process Data Object. A CAN telegram for the transfer of process data (e.g. I/O data).

RxPDO

Receive PDO. PDOs are always identified from the point of view of the device under consideration. Thus a TxPDO with input data from an I/O module becomes an RxPDO from the controller's point of view.

SDO

Service Data Object. A CAN telegram with a protocol for communication with data in the object directory (typically parameter data).

TxPDO

Transmit PDO (named from the point of view of the CAN node).

8.7   Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline: +49 5246 963 157
Fax: +49 5246 963 9157
e-mail: support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline: +49 5246 963 460
Fax: +49 5246 963 479
e-mail: service@beckhoff.com

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone: +49 5246 963 0
Fax: +49 5246 963 198
e-mail: info@beckhoff.com
web: https://www.beckhoff.com

Table of figures

More Information:
www.beckhoff.com/BC5250