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**Mit Sicherheit  
in die Zukunft**

**Operating Manual**

**RIO**

**Remote Input Output**

**EC / BC bus couplers**

RIO bus couplers operating manual version 10/03  
Artikel-Nr. 322 157 00

**RIO bus couplers  
operating manual**

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**Previous versions of this operating manual**

11/99 06/00 08/01 09/01 09/02 02/03

## Document conventions

This operating manual uses the following signs to indicate safety-related and handling warnings:



Possible injury to persons or damage to the automation system or the equipment if relevant warnings are not observed.



Important information on the handling of the automation system or the part described in the operating manual.

**Please read and follow the safety-related warnings at the end of this operating manual.**

Other items are represented as follows.

Item	Example
File names	MANUAL.DOC
Menus / Menu items	<i>Insert / Picture / From file</i>
Paths / directories	C:\Windows\System
Hyperlinks	<a href="http://www.schleicher-electronic.com">www.schleicher-electronic.com</a>
Program listings	MaxTsdr_9.6 = 60 MaxTsdr_93.75 = 60
Keys	<Esc> <Enter> (press first key and then next key) <Ctrl+Alt+Del> (press all keys at the same time)

# Contents

<b>1</b>	<b>Overview</b>	<b>7</b>
1.1	Overview of bus coupler versions	9
1.2	RIO expansion modules	10
1.3	Options	13
1.4	Operating manuals	13
<b>2</b>	<b>PROFIBUS-DP</b>	<b>14</b>
2.1	RIO EC DP bus coupler	14
2.1.1	LED displays on the EC PROFIBUS-DP bus coupler	15
2.1.2	Dial for setting the slave address on the EC PROFIBUS-DP bus coupler	15
2.1.3	Bus port on the EC PROFIBUS-DP bus coupler	15
2.2	RIO BC DP bus coupler (PROFIBUS-DP)	16
2.2.1	LED displays on the BC PROFIBUS-DP bus coupler	17
2.2.2	Numerical display on the BC PROFIBUS-DP bus coupler	18
2.2.3	Keypad of the BC bus coupler	19
2.2.4	Setting the slave address for the BC PROFIBUS-DP bus coupler	19
2.2.5	Bus port on the BC PROFIBUS-DP bus coupler	20
2.3	Compatibility of the EC economy bus coupler and the BC PROFIBUS-DP bus coupler	20
2.4	PROFIBUS-DP field bus	21
2.4.1	PROFIBUS-DP bus topology	21
2.4.2	Setup guidelines for PROFIBUS networks	22
2.4.3	PROFIBUS-DP bus cable parameters	23
2.4.4	PROFIBUS-DP bus segment length	23
2.4.5	Pin configuration and wiring of PROFIBUS-DP	24
2.4.6	Configuring PROFIBUS-DP	26
2.4.7	Commissioning PROFIBUS-DP	29
2.4.8	Diagnosis on the PROFIBUS-DP	29
2.4.9	PROFIBUS-DP response times	31
<b>3</b>	<b>InterBus-S</b>	<b>32</b>
3.1	RIO EC InterBus-S bus coupler	32
3.1.1	LED displays on the EC InterBus-S bus coupler	33
3.1.2	DIP switch S1	33
3.1.3	Bus port on the EC InterBus-S bus coupler	34
3.2	RIO BC InterBus-S bus coupler	35
3.2.1	LED displays on the BC InterBus-S bus coupler	36
3.2.2	Numerical display on the BC bus coupler	37
3.2.3	Keypad of the BC bus coupler	38
3.2.4	Bus port on the BC InterBus-S bus coupler	38
3.3	InterBus-S field bus	39
3.3.1	InterBus-S bus topology	40
3.3.2	Pin configuration on the EC InterBus-S bus coupler	41
3.3.3	Pin configuration on the BC InterBus-S bus coupler	41
3.3.4	InterBus-S bus cable	42
3.3.5	Configuring InterBus-S	43
3.3.6	InterBus-S response times	45
<b>4</b>	<b>DeviceNet</b>	<b>46</b>
4.1	Bus coupler RIO EC CAN DN	46
4.1.1	LED display on the EC DeviceNet bus coupler	47
4.1.2	DIP switches	48
4.1.3	Bus port on the EC DeviceNet bus coupler	48
4.2	RIO BC CAN DN bus coupler (DeviceNet)	49
4.2.1	LED display on the BC DeviceNet bus coupler	50
4.2.2	Numerical display on the BC bus coupler	51
4.2.3	Keypad of the BC bus coupler	52
4.2.4	Bus port on the BC DeviceNet bus coupler	52
4.2.5	Setting the node number on the BC DeviceNet bus coupler	53
4.2.6	Setting the baud rate on the BC DeviceNet bus coupler	53
4.3	DeviceNet field bus	54



4.3.1	DeviceNet bus topology .....	54
4.3.2	DeviceNet bus cable .....	55
4.3.3	Configuring DeviceNet .....	57
4.3.4	Electronic Data Sheet (EDS) .....	59
4.3.5	Commissioning DeviceNet .....	59
4.3.6	DeviceNet response times .....	59
<b>5</b>	<b>CANopen .....</b>	<b>60</b>
5.1	RIO EC CANopen bus coupler .....	60
5.1.1	LED displays on the EC CANopen bus coupler .....	61
5.1.2	DIP switches on the EC CANopen bus coupler .....	62
5.1.3	Bus port on the EC CANopen bus coupler .....	62
5.2	RIO BC CANopen bus coupler .....	63
5.2.1	LED displays on the BC CANopen bus coupler .....	64
5.2.2	Numerical display on the BC CANopen bus coupler .....	65
5.2.3	Keypad of the BC bus coupler .....	66
5.2.4	Setting node numbers on the BC CANopen bus coupler .....	67
5.2.5	Setting the baud rate on the BC CANopen bus coupler .....	68
5.2.6	Bus port on the BC CANopen bus coupler .....	68
5.3	CANopen field bus .....	69
5.3.1	CANopen bus cable .....	70
5.3.2	Configuring CANopen .....	71
5.3.3	Mapping of process data objects (PDO default mapping) .....	72
5.3.4	Mapping I/O data to PDOs .....	73
5.3.5	EDS files .....	74
5.3.6	Commissioning with ProCANopen .....	74
<b>6</b>	<b>XRIO .....</b>	<b>75</b>
6.1	RIO EC X2 bus coupler .....	75
6.1.1	LED display on the bus coupler .....	76
6.1.2	Bus port .....	76
6.2	XRIO field bus .....	77
6.2.1	Bus cables .....	78
6.2.2	Configuration and commissioning XRIO .....	79
<b>7</b>	<b>Installation .....</b>	<b>80</b>
7.1	Mechanical installation .....	80
7.1.1	Mounting position for the EC and BC bus couplers .....	80
7.1.2	Mounting dimensions and distance between modules – EC bus coupler .....	80
7.1.3	Mounting dimensions and distance between modules – BC bus coupler .....	81
7.1.4	DIN rail installation .....	82
7.1.5	Connecting modules with each other .....	83
7.2	Electrical installation .....	84
7.2.1	Spring terminals of the EC bus coupler .....	84
7.2.2	Spring terminals of the BC bus coupler .....	85
7.2.3	Conductor sizes and stripping length .....	86
7.2.4	Connecting the power supply .....	87
7.2.5	Installation guidelines .....	87
7.2.6	Emergency stop switches .....	91
<b>8</b>	<b>Bus node power consumption .....</b>	<b>94</b>
<b>9</b>	<b>User lock-out of the BC bus coupler .....</b>	<b>96</b>
<b>10</b>	<b>Operating modes of the BC bus coupler .....</b>	<b>98</b>
10.1	Overview of operating modes .....	98
10.2	RUN .....	100
10.3	FORCE .....	101
10.4	TRIGGER .....	103
10.5	LOCK .....	105
10.6	STOP .....	107
<b>11</b>	<b>Service functions on the BC bus coupler .....</b>	<b>108</b>
11.1	Overview of service functions .....	108
11.2	Selecting and using a service function .....	108
11.3	Service function 1 .....	109
11.4	Service function 2 Set baud rate on DeviceNet and CANopen .....	109
11.5	Service function 3 Display process data width of inputs .....	109

11.6	Service function 4	Display process data width of outputs.....	110
11.7	Service function 5	Switch bus coupler diagnosis on/off.....	110
11.8	Service function 6	Save bus node configuration.....	110
11.9	Service function 7	User lock-out.....	110
11.10	Service function 8	Deactivate user lock-out with password.....	110
11.11	Service function 9	Advanced PROFIBUS-DP diagnosis ON/OFF.....	111
11.12	Service function 10	Byte swap mode.....	111
11.13	Service function 11	Delete bus coupler EEPROM.....	111
11.14	Service function 12	Display/set bus address.....	112
11.15	Service function 13	Set data width of counter and positioning modules.....	112
<b>12</b>	<b>Parameterizing and diagnosis functions for all bus couplers .....</b>	<b>113</b>	
12.1	Overview.....	113	
12.2	Data structure.....	114	
12.3	Sequence.....	114	
12.4	Function 0	Output group error.....	115
12.5	Function 1	Monitor module power supply.....	116
12.6	Function 2	Monitor output driver overload.....	117
12.7	Function 3	Determine bus node process data width.....	118
12.8	Function 4	Output bus node module configuration.....	119
12.9	Function 5	Set preferred shut-off state.....	120
12.10	Function 6	Activate / deactivate bus node user lock-out.....	121
12.11	Function 7	Determine bus node system status.....	122
12.12	Function 8	Output firmware version.....	123
12.13	Function 9	Set data formats for analog modules.....	124
12.14	Function 10	Output temperature module PT100/PT1000 sensor information.....	125
12.15	Function 11	Mode word for temperature module with thermo elements.....	126
12.16	Function 17	Output bus address.....	127
12.17	Function 18	Byte swap mode ON/OFF.....	128
12.18	Function 19	Advanced PROFIBUS-DP diagnosis ON/OFF.....	129
12.19	Function 20	Delete error messages.....	129
12.20	Function 21	Save/delete bus node configuration.....	130
12.21	Function 255	Reset.....	130
<b>13</b>	<b>Specifications for all bus couplers .....</b>	<b>131</b>	
<b>14</b>	<b>Error messages.....</b>	<b>133</b>	
<b>15</b>	<b>What if... ? .....</b>	<b>134</b>	
<b>16</b>	<b>Appendix .....</b>	<b>136</b>	
16.1	Input signal delay.....	136	
16.2	Glossary.....	137	
16.3	Trademarks.....	137	
<b>17</b>	<b>Safety-related information .....</b>	<b>138</b>	
17.1	Correct use of the system.....	138	
17.2	Selection and qualification of personnel.....	138	
17.3	Configuration, programming, installation, commissioning and operation.....	139	
17.4	Maintenance and servicing.....	139	
17.5	High voltage.....	139	
17.6	Used batteries.....	140	
<b>18</b>	<b>Index .....</b>	<b>141</b>	

# 1 Overview

## Bus couplers for PROFIBUS-DP, InterBus-S, DeviceNet, CANopen and XRIO

The RIO module system uses bus couplers to establish the connection between the I/O modules of a bus node and the field bus.



	EC	BC
Diagnosis LEDs	+	++
Diagnosis functions	+	++
Keyboard / display for on-site service and diagnosis		++
Field bus port	+	+

### Features of the EC economy bus coupler and the BC bus coupler.

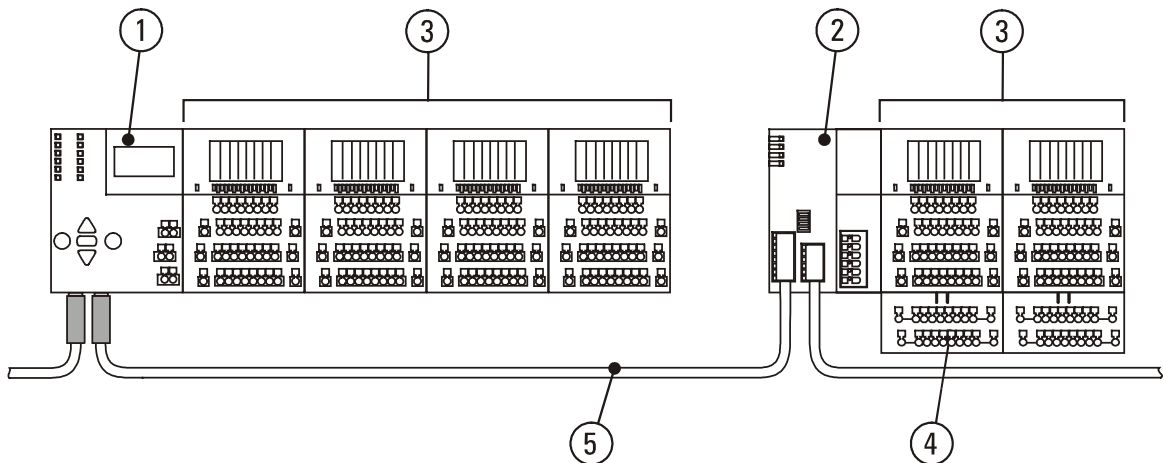
The EC economy bus coupler (EC=Economy) is the base version of the RIO bus coupler. The bus coupler provides ports for the field bus cable, the power supply and LED displays for diagnosing the operating status of the bus node.

In addition to these features the BC bus coupler provides extended service and diagnosis capabilities which can be used on-site via the integrated keypad and the four-digit display.

The BC bus coupler provides the operator with valuable help when diagnosing and commissioning plant parts and machine assemblies before they are connected to the field bus and the PLC.

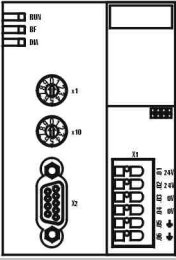
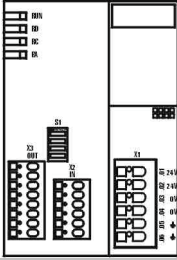
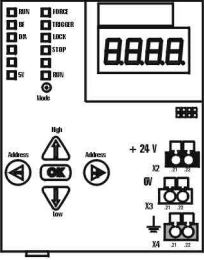
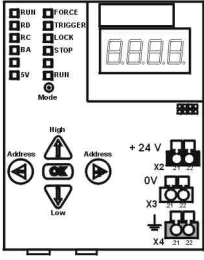
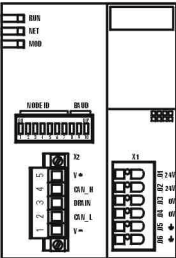
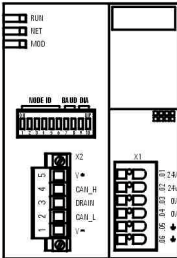
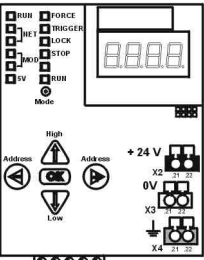
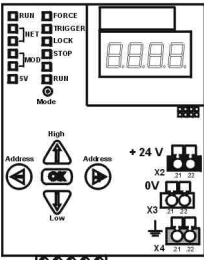
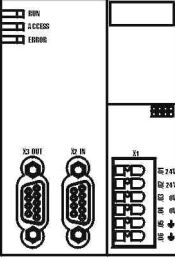
The bus coupler are interchangeable. Only if bus couplers are used for PROFIBUS-DP the master project must be changed using the respective device root file (GSD).

## Bus node configuration



1	<p>Bus couplers</p> <p>You can use either bus couplers (BC) or economy bus couplers (EC) depending on your requirements.</p> <p>Both versions are available for the field buses PROFIBUS-DP, InterBus-S, DeviceNet and CANopen.</p>
2	Economy bus couplers
3	<p>Expansion modules</p> <p>You can use up to 8 expansion modules with different features on each bus coupler.</p>
4	Terminal expansion for modules with more than 8 I/O channels
5	Field bus cable

## 1.1 Overview of bus coupler versions

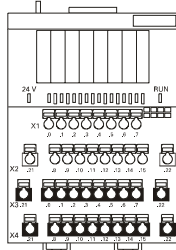
PROFIBUS-DP		InterBus-S	
	RIO EC DP		RIO EC IBS
	RIO BC DP		RIO BC IBS
CANopen		DeviceNet	
	RIO EC CANopen		RIO EC CAN DN
	RIO BC CANopen		RIO BC CAN DN
XRIO			
	RIO EC X2		

Ordering information see [www.schleicher-electronic.com](http://www.schleicher-electronic.com)

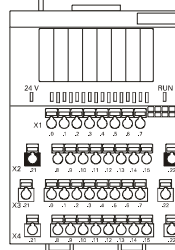
## 1.2 RIO expansion modules

Expansion modules are not described in this manual. Please refer to the RIO Expansion modules operating manual, part no. 322 154 14.

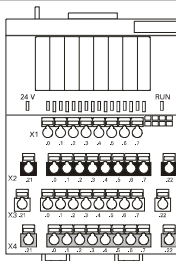
### Digitalmodules



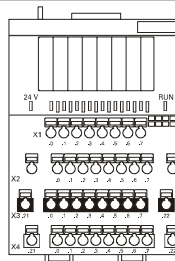
**RIO 16 I**  
16 inputs DC 24 V  
Two-wire connection system



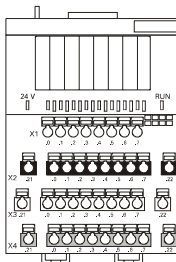
**RIO 16 O**  
16 outputs 1 A  
Two-wire connection system



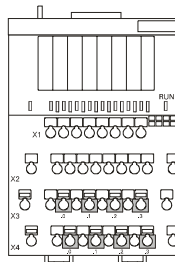
**RIO 8 I/O**  
8 combination I/Os  
All combination I/Os can be used individually as inputs DC 24 V or outputs 1 A.



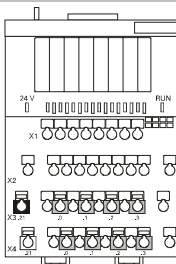
**RIO 8 I 8 I/O**  
8 inputs DC 24 V  
8 combination I/Os  
All combination I/Os can be used individually as inputs DC 24 V or outputs 1 A.  
Two-wire connection system



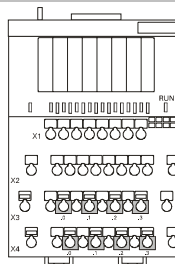
**RIO 8 O 2A**  
8 outputs 2 A  
Four-wire connection system



**RIO 4 I 230 VAC**  
4 inputs AC 230 V



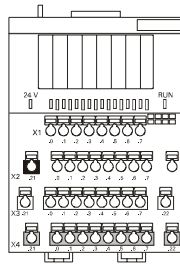
**RIO 4 O R**  
4 outputs relay



**RIO 4 I 120 VAC**  
4 inputs AC 120 V

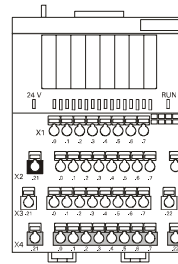
## Analog modules

### Voltage $\pm 10V$

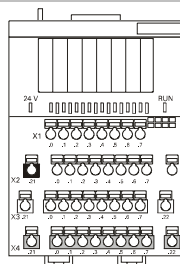


**RIO 4AI  $\pm 10V$**   
4 inputs analog  
Resolution 12 bits

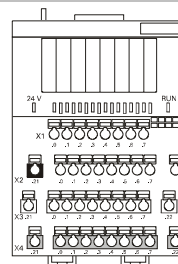
### Current 20mA



**RIO 4AI 20mA**  
4 inputs analog  
Resolution 12 bits

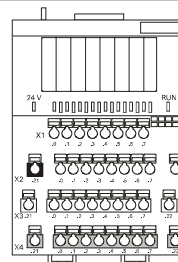


**RIO 4AI/4AO  $\pm 10V$**   
4 inputs analog  
4 outputs analog  
Resolution 12 bits

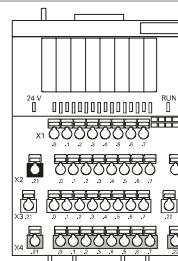


**RIO 4AI/4AO 20mA**  
4 inputs analog  
4 outputs analog  
Resolution 12 bits

### Current 4...20mA

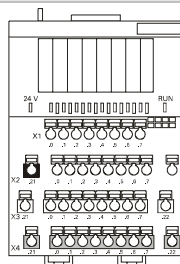


**RIO 4AI 4-20mA**  
4 inputs analog  
Resolution 12 bits



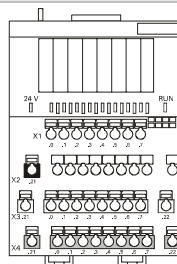
**RIO 4AI/4AO 4-20mA**  
4 inputs analog  
4 outputs analog  
Resolution 12 bits

## Temperature modules



### RIO T10-10

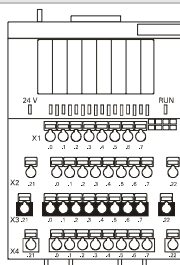
4 inputs for measuring the temperature with Pt100/Pt1000



### RIO T20-10

4 inputs for measuring the temperature with thermo elements

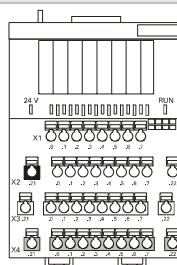
## Counter module



### RIO C24-10

4 counters 16-bit or  
2 counters 32-bit

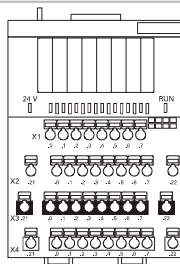
## Axis interface



### RIO A10-10

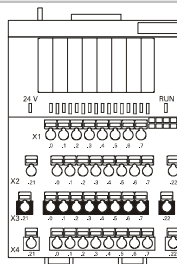
Interface of one Axis

## Positioning module



### RIO P05-10

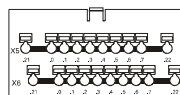
Positioning of two axes  
(5 V counter inputs)



### RIO P24-10

Positioning of two axes  
(24 V counter inputs)

## Potential distributor (terminal expansion)



### RIO KE 16

2 distributors each  
with 10 terminal connections

Only suitable for modules with clips.

Ordering information see [www.schleicher-electronic.com](http://www.schleicher-electronic.com)



## 1.3 Options

Options for CANopen	
Description	Order no.
ProCANopen configuration software	320 156 41
CANcardX PCMCIA card CANopen interface	320 156 40

## 1.4 Operating manuals

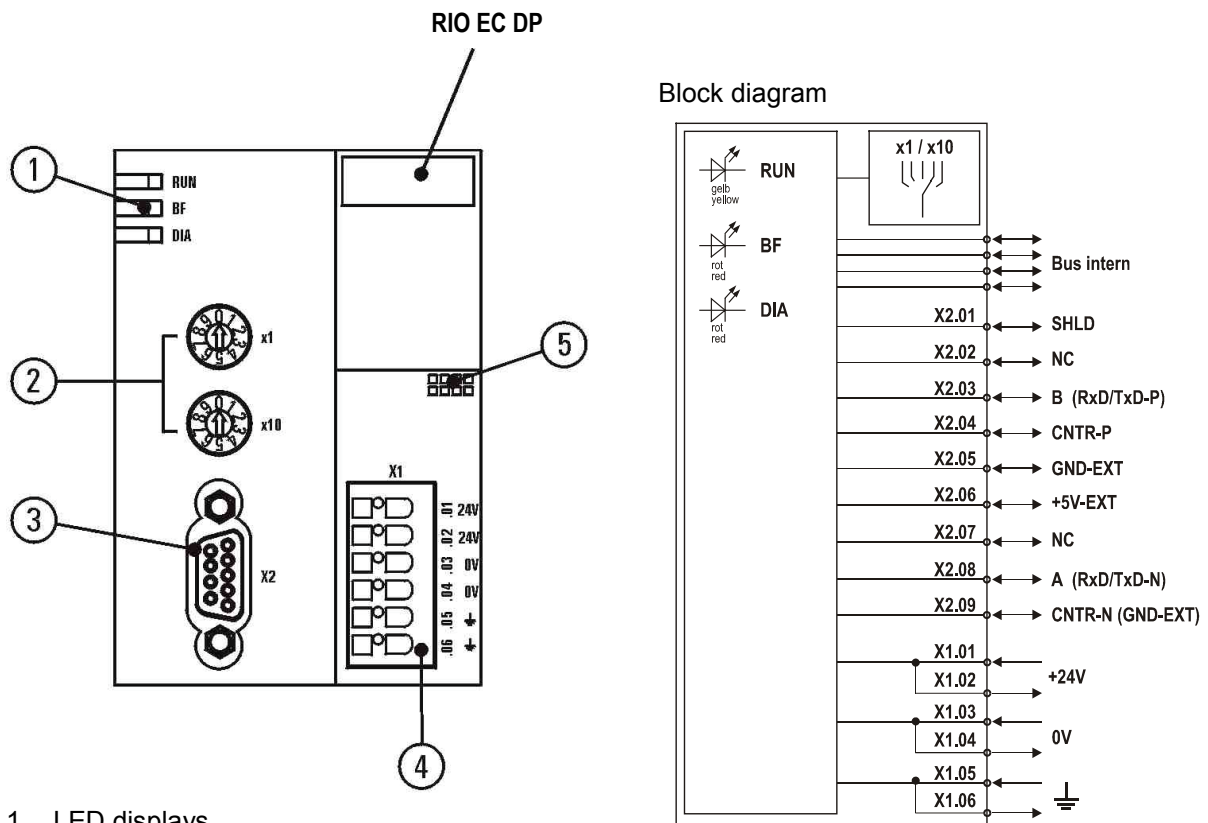
Operating manuals	
Item	Order no.
RIO Kompakt-I/O German	322 156 95
RIO Compact I/O English	322 156 97
RIO Buskoppler German	322 156 98
RIO Bus couplers English	322 157 00
RIO Erweiterungsmodule German	322 154 14
RIO Expansion modules English	322 154 15
Inbetriebnahmehinweise für Feldbussysteme German	322 152 48
Commissioning field bus systems English	322 152 49
Programmieranleitung CANopen PCS	
RIO Gesamtdokumentation (Kompakt-I/O und Modulsystem) German	322 155 50
RIO documentation package (Compact I/O and modular system) English	322 155 80

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 D-13597 Berlin  
 Germany

## 2 PROFIBUS-DP

### 2.1 RIO EC DP bus coupler

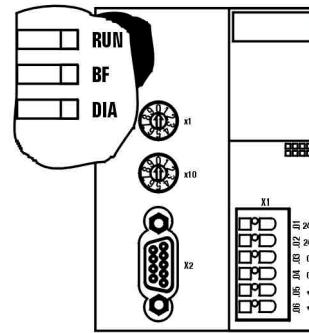


- 1 LED displays
- 2 Dial to set slave address
- 3 Profibus-DP Bus port (subminiature, 9-pin, female connector) X2
- 4 Connections for power supply and forwarding X1
- 5 Gaps to fit the item designation

Specifications RIO EC DP	
Order no.	363 157 09
Bus port	PROFIBUS-DP (subminiature, 9-pin, female connector)
Power supply	24V DC $\pm$ 20%
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 See Process data width and address configuration on page 27 and Bus node power consumption on page 94

See also **Specifications for all bus couplers** from page 131

### 2.1.1 LED displays on the EC PROFIBUS-DP bus coupler



LED	Color/Status	Meaning
RUN	Green	The bus coupler processor is running.
	Red/flashing	An error has occurred. The number of flashing pulses is the flashing code of the <b>Error messages</b> see page 133.
BF	Red	No bus connection (bus fail) Field bus cable break or the master does not operate the bus (any more).
DIA	Red	Diagnosis message The bus coupler has sent a PROFIBUS-DP diagnosis message to the master.

### 2.1.2 Dial for setting the slave address on the EC PROFIBUS-DP bus coupler



x1

One-digit dial



x10

Ten-digit dial

Slave addresses can be set from 0 to 99.

The selected address becomes active when the power supply of the bus coupler is switched on.

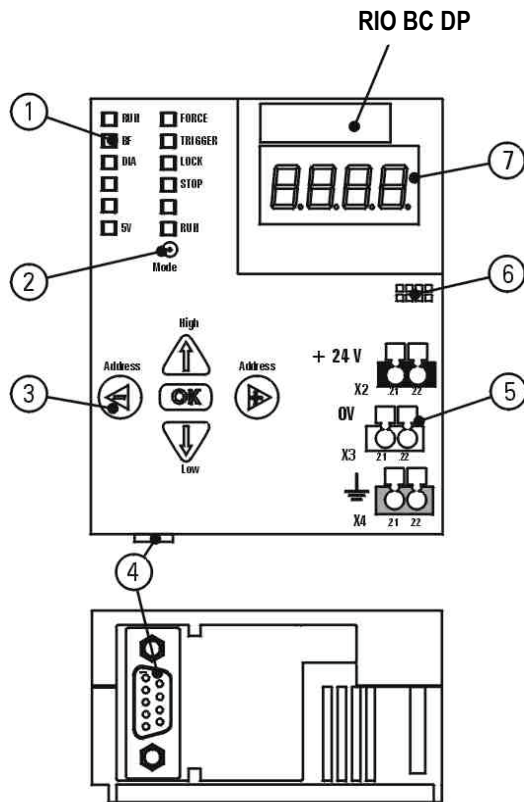
### 2.1.3 Bus port on the EC PROFIBUS-DP bus coupler



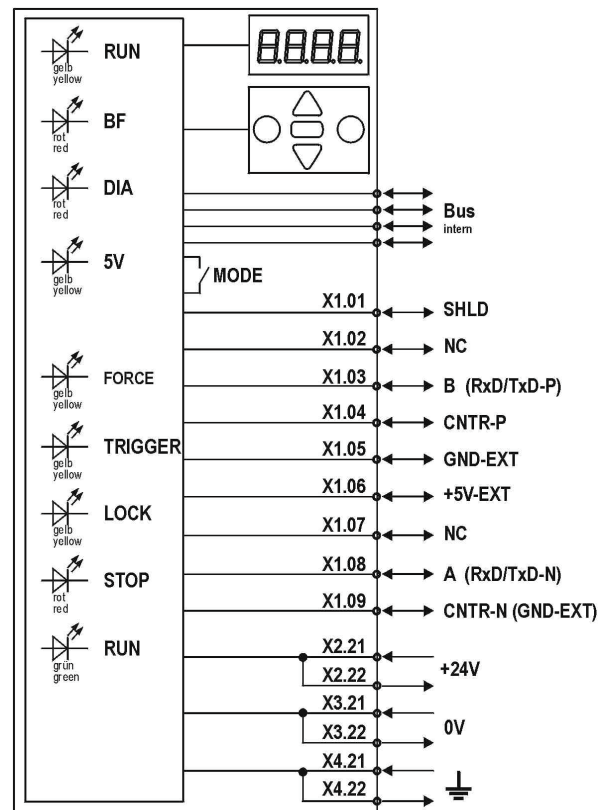
Subminiature, 9-pin, female connector

1	SHLD
2	NC
3	B = RxD/TxD-P
4	CNTR-P
5	GND-EXT
6	+5V-EXT
7	NC
8	A = RxD/TxD-N
9	CNTR-N (GND-EXT)

## 2.2 RIO BC DP bus coupler (PROFIBUS-DP)



Block diagram



- 1 LED displays
- 2 Key (Mode) for the Setting operating modes
- 3 Keypad
- 4 PROFIBUS-DP Bus port (subminiature, 9-pin, female connector)
- 5 Connections for power supply and forwarding
- 6 Gaps to fit the item designation
- 7 Numerical display

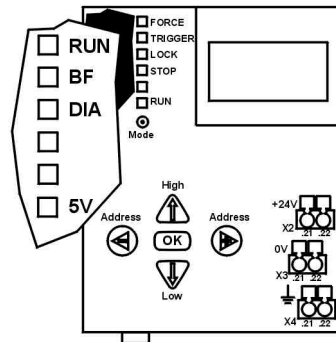
### RIO BC DP Specifications

Order no.	363 155 48
Bus port	PROFIBUS-DP
Power supply	24V DC $\pm$ 20%
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8
	See Process data width and address configuration on page 27 and Bus node power consumption on page 94

See also **Specifications for all bus couplers** from page 131.

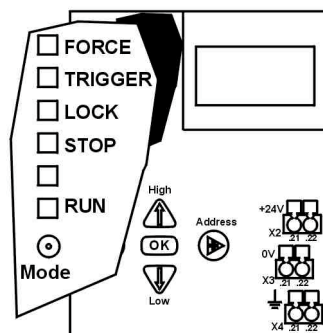
## 2.2.1 LED displays on the BC PROFIBUS-DP bus coupler

### Bus-specific displays



LED	Color	Meaning
RUN	Yellow	The bus coupler processor is running.
BF	Red	No bus connection (bus fail) Field bus cable break or the master does not operate the bus (any more).
DIA	Red	Diagnosis message The bus coupler has sent a PROFIBUS-DP diagnosis message to the master.
5V	Yellow	Internal 5V power supply operates correctly.

### Operating mode display



See Operating modes of the BC bus coupler from page 98

## 2.2.2 Numerical display on the BC PROFIBUS-DP bus coupler

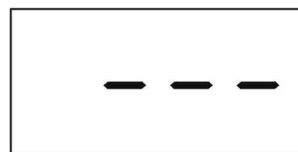
### Display of the active operating mode



RUN mode



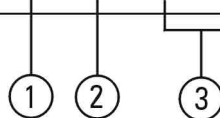
RUN mode can also include information on the TRIGGER and LOCK modes (for details see descriptions from page 98).



STOP mode (see page 107)



Display, TRIGGER, FORCE, LOCK modes show the selected channel.



1. Hexadecimal number of the expansion module
2. Input (E) or output (A)
3. Channel # (decimal)

Example 2E04: module 2, input, channel 04

### Display of error messages

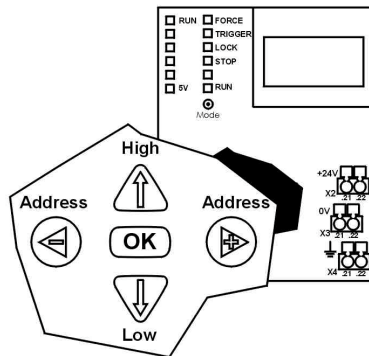


An error message is displayed if a fault occurs.

Example E004: Internal data transfer between bus coupler and module interrupted

See Error messages on the bus coupler display on page 133.

### 2.2.3 Keypad of the BC bus coupler

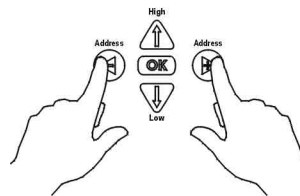


Each key on the keypad has several functions. The function of each key is described in the corresponding section of the manual.

### 2.2.4 Setting the slave address for the BC PROFIBUS-DP bus coupler

The address can be set with **Service function 12** (see page 112) or as follows:

Select STOP mode, then press both Address keys simultaneously.

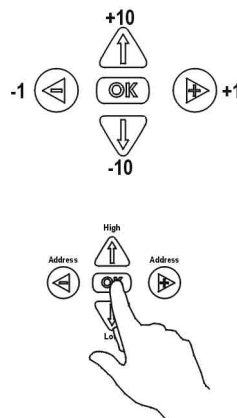


The selected slave address is displayed.

If you do not want to change the address press OK.

Use the keypad to enter a new slave address. You can set addresses from 3 to 126.

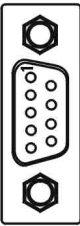
The keys have the following functions:



Pressing the OK key stores the selected slave address in the bus coupler.

The new slave address becomes active when the power supply is switched off and then switched on again.

### 2.2.5 Bus port on the BC PROFIBUS-DP bus coupler

 Subminiature, 9-pin, female connector	1	SHLD
	2	NC
	3	B = RxD/TxD-P
	4	CNTR-P
	5	GND-EXT
	6	+5V-EXT
	7	NC
	8	A = RxD/TxD-N
	9	CNTR-N (GND-EXT)

### 2.3 Compatibility of the EC economy bus coupler and the BC PROFIBUS-DP bus coupler

The bus couplers are interchangeable. If they are interchanged the PROFIBUS master configuration must be changed. The following table shows the differences between the key features and differences for handling the units.

Features	EC bus coupler	BC bus coupler
DP slave address	0 - 99	3 - 126
DP ID	0754 hex	055C hex
Switch off parameterizing and diagnosis functions	Do not configure the EC.	When configuring without GSD do not configure the BC. For configurations with GSD Service function 5 is important.
Save bus node configuration	Parameterizing and diagnosis Function 21	Service function 6
Error display	RUN-LED flashes red, the number of flashing pulses is the error code.	Displays the error number on the display.
Set data width for counter and positioning modules.	Set data width when configuring.	Set data width when configuring and set with Service function 13.



## 2.4 PROFIBUS-DP field bus

PROFIBUS was designed in 1983 as an open field bus, standardized in 1991 (DIN 19 245) and became a European standard in 1996 (EN 50 170).

PROFIBUS-DP has been specially designed for production automation with remote periphery.

When planning a system not only local/building regulations must be met which mainly define the location of machines and field devices, but also physical regulations for a PROFIBUS system in accordance with EN 50 170.

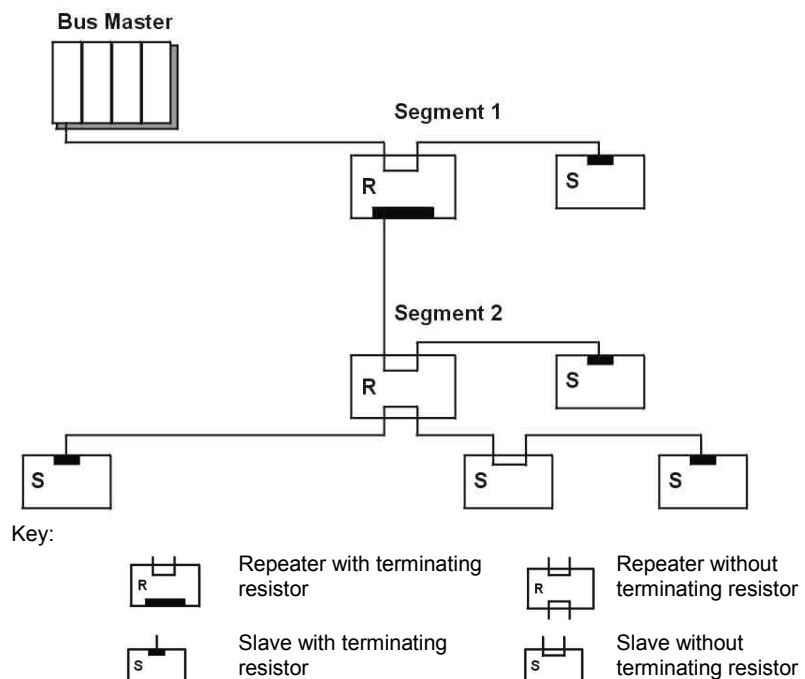


Field-specific installation instructions of the various suppliers and safety-specific guidelines for a system remain in force.

### 2.4.1 PROFIBUS-DP bus topology

According to PROFIBUS-RS485 specification a maximum of 32 slaves can be connected to a bus segment. To operate more PROFIBUS-DP slaves the system must be segmented using repeaters.

Repeaters provide an electrical connections between bus segments and ensure that data signals are amplified and refreshed. Repeaters can be used in addition to isolating bus segments or bus part sections. A repeater adds another bus segment with full line length and the maximum number of field devices that can be connected to a PROFIBUS system. Repeaters will cause signal delays. This must be taken into account when the system is configured.



Max. number of slaves in full setup	126 (addresses from 0 ... 125)
Number of slaves per segment incl. repeater	32
Baud rates	9.6, 19.2, 45.45, 93.75, 187.5, 500, 1500, 3000, 6000, 12000 kBit/s
Number of segments in line (depending on repeaters and bus parameter settings)	3

Individual slaves may fail or shut off during bus operation. All other slaves will continue to operate.

The complete bus topology is configured in the master configuration.

Each slave has a unique manufacturer ID which is assigned by the PROFIBUS user organization (PNO).

## 2.4.2 Setup guidelines for PROFIBUS networks

Important steps for connecting and commissioning PROFIBUS networks are described in the Setup guidelines for PROFIBUS networks. The Setup guidelines are published by the PROFIBUS user organization (PNO).



In addition to the instructions given in this manual the Setup guidelines of the PROFIBUS user organization (PNO) must be observed.

The Setup guidelines can be ordered from the following address (please quote order no. 2111):

PROFIBUS-Nutzerorganisation e. V.

Haid-und-Neu-Straße 7

76131 Karlsruhe, Germany

Phone: +49 (0)721 / 96 58 590

Fax: +49 (0)721 / 96 58 589

[www.profibus.com](http://www.profibus.com)

PROFIBUS\_International@compuserve.com



The following setup guidelines refer exclusively to transmission with copper lines (RS 485) according to EN 50 170.



The guidelines given in the Electrical installation chapter are in addition and for all bus couplers and must be observed.

### 2.4.3 PROFIBUS-DP bus cable parameters

The properties of the bus cable are specified in EN 50170 Part 8-2 as cable type A.

Parameter	Value
Surge impedance ( $\Omega$ )	135 ... 165 (@ frequency from 3...20MHz)
Capacitance per unit length (pF/m)	< 30
Loop resistance ( $\Omega$ /km)	$\leq 110$
Core diameter (mm)	$> 0.64^*$
Core cross-section ( $\text{mm}^2$ )	$> 0.34^*$

\* The core cross-sections must match the connections on the bus connector.

### 2.4.4 PROFIBUS-DP bus segment length

Baud rate in Kbit/s	Max. bus segment length in m
9.6	1200
19.2	1200
93.75	1200
187.5	1000
500	400
1500	200
12000	100



Only one baud rate can be selected in a PROFIBUS-DP system.

## 2.4.5 Pin configuration and wiring of PROFIBUS-DP

The two data wires for PROFIBUS are also called A and B. There is no rule which data wire color must be connected to which pin but it must be done consistently within the whole system (over several slaves and segments).

If a transmission cable with red and green data wires is used the cables should be wired as follows:

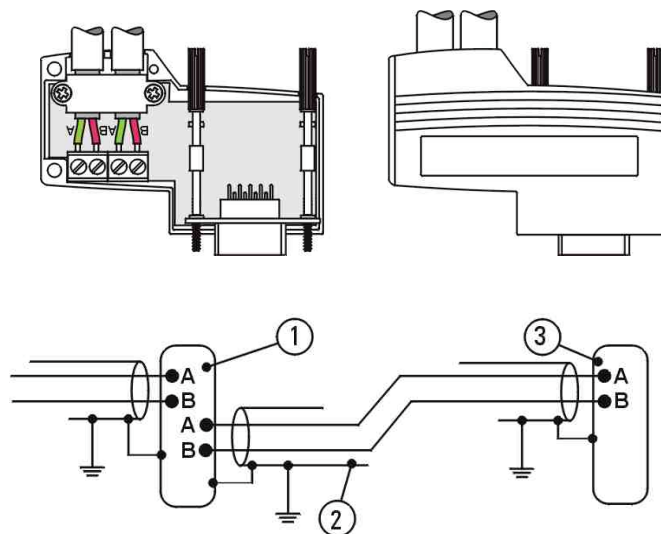
**Data wire A - Green**

**Data wire B - Red**

The names are the same for incoming and off-going data wires.

### PROFIBUS interface connectors

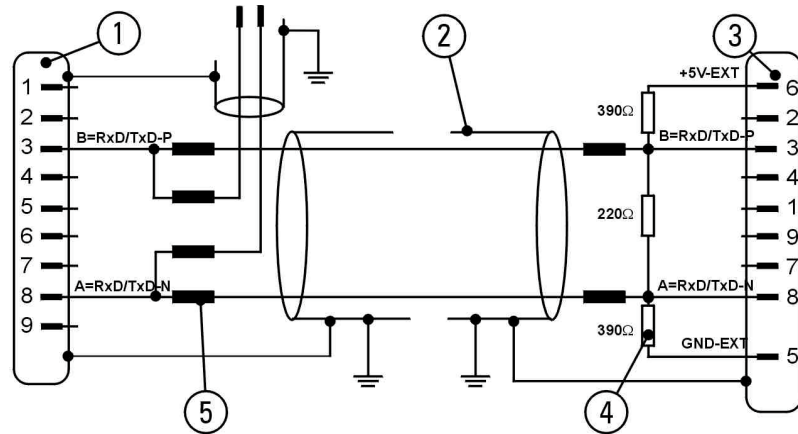
We recommend to use Erbic® PROFIBUS interface connectors from ERNI. The interface connectors can be used for the BC and EC bus couplers.



- 1 Erbic® PROFIBUS node (grey)
- 2 Shielded bus cable, for line parameters see below
- 3 Erbic® PROFIBUS terminator (yellow) A=2, B=1 (with integrated terminating resistors)

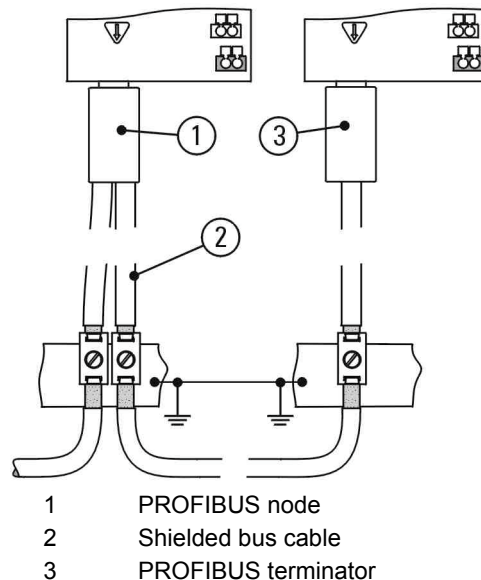
## Subminiature connectors

If subminiature connectors are used connectors with a metal casing must be used. The shield of the bus cable must be connected to the metal casing. Bus nodes and bus terminators must be wired as follows:



- 1 PROFIBUS node, subminiature, 9-pin, male connector
- 2 Shielded bus cable
- 3 PROFIBUS terminator, subminiature, 9-pin, male connector
- 4 Terminating resistors (to be provided at both ends of the transmission line)
- 5 Direct-axis inductance of 110nH with baud rates > 1.5Mbaud must be provided.

The shields of the bus cables must have a broad-surface connection to the potential balance rail providing adequate conduction at the cabinet opening. The potential balance rail is connected to ground for each electronics cabinet and connected to the potential balance rails of other cabinets.



- 1 PROFIBUS node
- 2 Shielded bus cable
- 3 PROFIBUS terminator



The guidelines given in the Electrical installation chapter are in addition and for all bus couplers and must be observed.

## 2.4.6 Configuring PROFIBUS-DP

Perform the following steps:

- Load the GSD file using the configurator or programming system.
- Configure the PROFIBUS-DP master system, define the baud rate, highest L2 address etc., specify the bus address for the PROFIBUS-DP master.
- Configure the I/O setup of the bus node and define the bus address.
- Define the input/output address of the bus node.
- Set the defined bus node address on the bus coupler.
- Transfer the configuration to the PROFIBUS-DP master.
- Program the PROFIBUS-DP master controller, read the PROFIBUS-DP input data, write the PROFIBUS-DP output data.
- Start up the system.

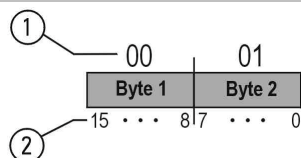
For further details, in particular regarding commissioning with STEP7 see the Commissioning notes for field bus systems description, order no. 322 152 48.

Alternatively you can download the GSD files free of charge from our web site at [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

## Process data width and address configuration

Module type	Bytes Inputs		Bytes Outputs	
RIO BC DP	4 If diagnosis ON otherwise 0.		4 If diagnosis ON otherwise 0.	
RIO EC DP	4 If configured, otherwise 0.		4 If configured, otherwise 0.	
RIO 16 I	Byte 1	Byte 2		
Bit configuration	15 ... 8	7 ... 0		
Pin configuration	X2.15 ... X2.8	X1.7 ... X1.0		
RIO 4I 120 VAC	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
RIO 4I 230 VAC	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
RIO 16 O			Byte 1	Byte 2
Bit configuration			15 ... 8	7 ... 8
Pin configuration			X2.15 ... X2.8	X1.7 ... X1.0
RIO 4 O R			Byte 1	Byte 2
Bit configuration			Not used	3 ... 0
Pin configuration				X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)
RIO 8 I/O	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	Not used	7 ... 0	Not used	7 ... 0
Pin configuration		X1.7 ... X1.0		X1.7 ... X1.0
RIO 8 I 8 I/O	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	15 ... 8X	7 ... 0	Not used	7 ... 0
Pin configuration	2.7 ... X2.0	X1.7 ... X1.0		X1.7 ... X1.0
	Word* Inputs		Word* Outputs	
RIO 4AI ±10V	Word 1 to 4 (channel 0 to 3)			
RIO 4AI/4AO ±10V	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
RIO 4AI 20mA	Word 1 to 4 (channel 0 to 3)			
RIO 4AI/4AO 20mA	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
RIO T10-10	Word 1 to 4 (channel 0 to 3)			
RIO T20-10	Word 1 to 4 (channel 0 to 3)			
RIO C24-10	Word 1 to 5 or 1 to 3 depending on setting with service function 13.		Word 1 to 5 or 1 to 3 depending on setting with service function 13.	
RIO P24-10	Word 1 to 5 or 1 to 3 depending on setting with service function 13.		Word 1 to 5 or 1 to 3 depending on setting with service function 13.	

\*1 word = 2 bytes



1 Byte start addresses

2 Bit numbering

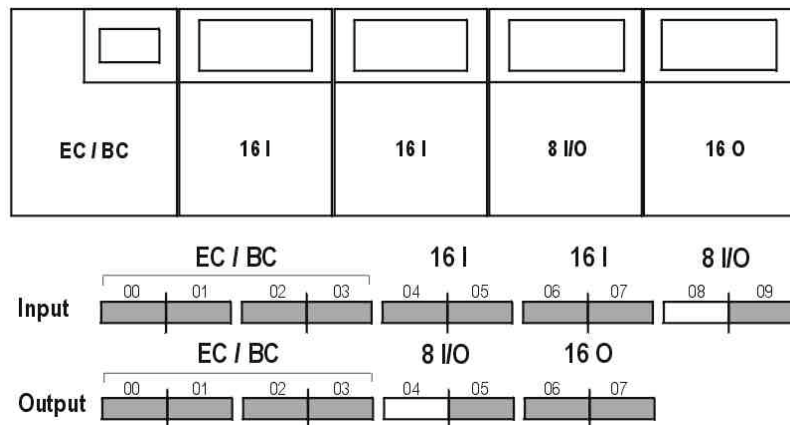


Up to 8 expansion modules can be operated on the DP bus coupler. Note that the maximum number of data bytes is 64 (input) and 64 (output). The number of expansion modules may be restricted by their power consumption. See also the chapter **Bus node power consumption** on page 94.

The current process data width can be determined with **Service function 3** and **Service function 4** (page 110) or diagnosis **Function 3** (page 118). The Byte 1 / Byte 2 order can be changed using the byte swap mode, diagnosis **Function 18** (page 128) and **Service function 10** (page 111).

## Examples of address configurations

Configuration of bus nodes and addresses:



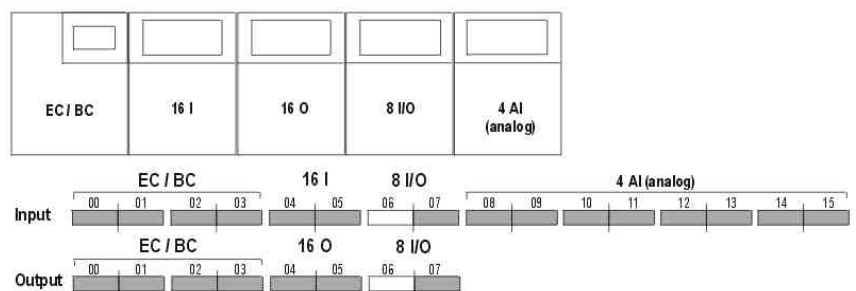
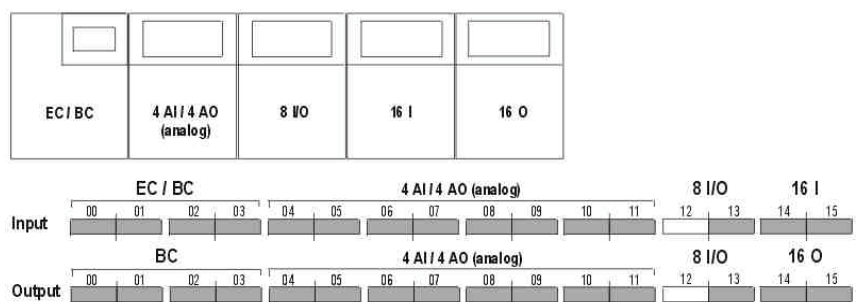
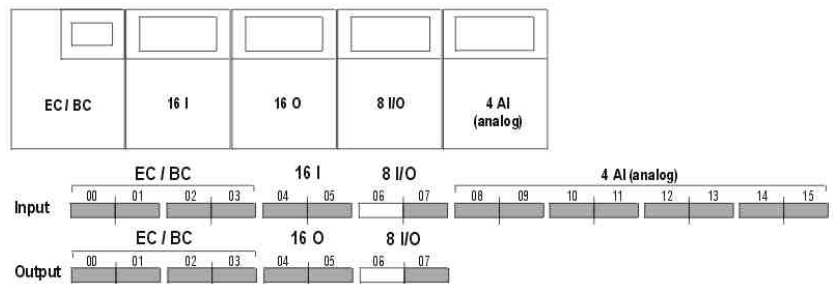
The 00 base addresses have been chosen as an example only and must be adapted to the respective PLC system.

In this example the bus coupler uses 4 bytes for diagnosis data because the diagnosis is switched on. If the diagnosis is switched off no address space is used.

The 8-fold expansion module (8I/O) always uses only the low byte. In this example bytes 08 and 04 are therefore not used.

## Other examples

Diagnosis is switched on in all examples.





### 2.4.7 Commissioning PROFIBUS-DP

See the Commissioning field bus systems manual, order no. 322 152 48.

All operating manuals can be downloaded free of charge at [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

### 2.4.8 Diagnosis on the PROFIBUS-DP

The bus coupler provides the PROFIBUS-DP standard diagnosis in octets\* 1 to 6.

See also DIN 19245 Part 3 from page 40.

(\*) In DIN 19245 a byte is called an octet. This is also the term that we use here.

Octet	Bit	Abbreviation	Description
1	0	non_exist	Slave does not exist (sets master)
	1	station_not_ready	Slave not ready for data exchange
	2	cfg_fault	Configuration data of master and slave does not match
	3	ext_diag	There are advanced diagnosis bytes
	4		
	5	invalid_slave_response	Always set to 0 by slave
	6	prm_fault	Parameterizing error
	7	master_lock	Slave parameterized by a master
2	0	prm_req	Slave must be re-parameterized
	1	stat_diag	Static diagnosis
	2		Always 1
	3	wd_on	Watchdog monitoring active
	4	freeze_mode	Freeze instruction active
	5	sync_mode	Sync instruction active
	6		Reserved
	7	slave_deactivated	1 if slave deactivated by master
3	0 ... 6		Reserved
	7	ext_diag_overflow	Diagnosis data overflow in master or slave

Octet	Description
4	Master address
5, 6	ID

## Advanced diagnosis

Octet	Bit	Description	
7		Length of advanced diagnosis	
8	0	Module 9 without power supply	16 bit information module not supplied with 24V See diagnosis function 1
	.	.	
	.	.	
	7	Module 15 without power supply	
9	0	Module 0 without power supply	16 bit information module overloaded See diagnosis function 2
	.	.	
	.	.	
	7	Module 7 without power supply	
10	0	Module 9 output driver overload	16 bit information module overloaded See diagnosis function 2
	.	.	
	.	.	
	7	Module 15 output driver overload	
11	0	Module 0 output driver overload	16 bit information module overloaded See diagnosis function 2
	.	.	
	.	.	
	7	Module 7 output driver overload	
12		Error code (corresponds to error code display on the bus coupler)	

Switch advanced diagnosis ON and OFF using **Service function 9** on page 111 or parameterizing or diagnosis **Function 19** on page 129. See also the Commissioning field bus systems manual, order no. 322 152 48.

All operating manuals can be downloaded free of charge at [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

## 2.4.9 PROFIBUS-DP response times

The response time is defined as the total time of a message cycle between the master and an individual slave.

A message cycle consists of a request telegram to the slave, mandatory bus idle times and the response time of the slave.

The bus cycle time is the total of all the message cycles.

To calculate the response time:

12Mbaud	$28\mu\text{s} + 1\mu\text{s}/\text{data byte to be transmitted}$
1.5Mbaud	$224\mu\text{s} + 7\mu\text{s}/\text{data byte to be transmitted}$

Example:

10 bus nodes with 8 bytes of output data and 8 bytes of input data each

12Mbaud:

$28 + 8 + 8 = 44\mu\text{s}$	Response time
$44 * 10 = 440\mu\text{s}$	Bus cycle time

1.5Mbaud:

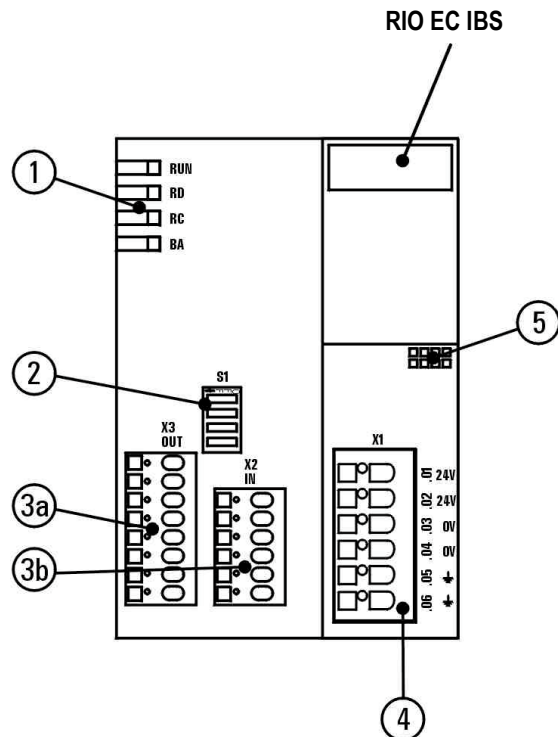
$224 + (7*8) + (7*8) = 336\mu\text{s}$	Response time
$336 * 10 = \underline{3.4\text{ms}}$	Bus cycle time

Add a manufacturer-specific run time in the DP master (typically 1 - 3ms).

Therefore the duration of a bus cycle in which all slaves are contacted once is approx. 2 - 4ms at 12Mbaud.

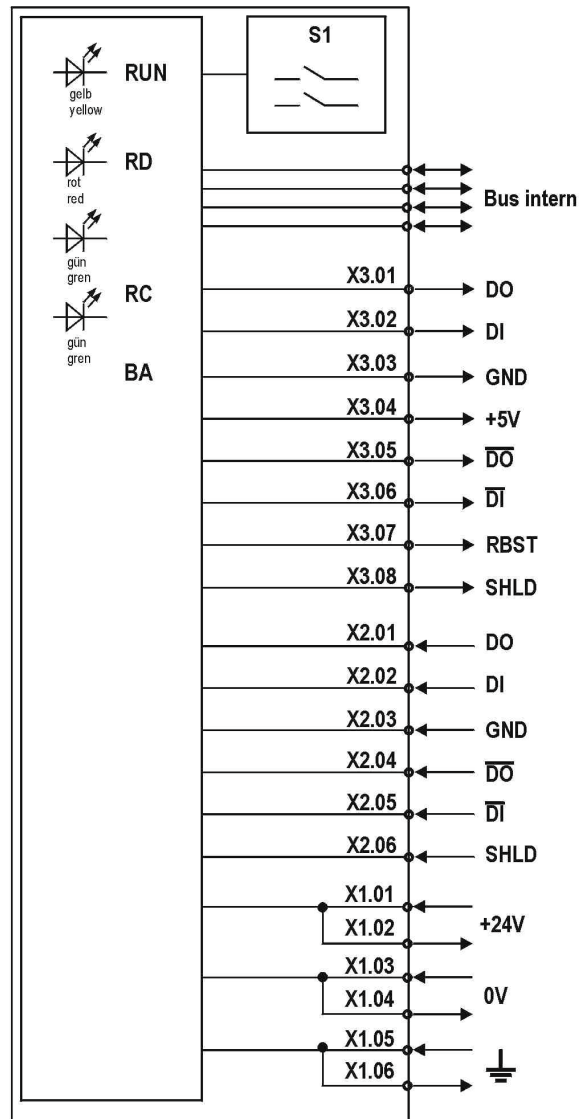
### 3 InterBus-S

#### 3.1 RIO EC InterBus-S bus coupler



- 1 LED displays
- 2 DIP switch to switch diagnosis ON/OFF
- 3a Bus port X3 OUT, detachable spring terminals, 8-pin
- 3b Bus port X2 IN, detachable spring terminals, 6-pin
- 4 Connection for power supply X1
- 5 Gaps to fit the item designation

Block diagram

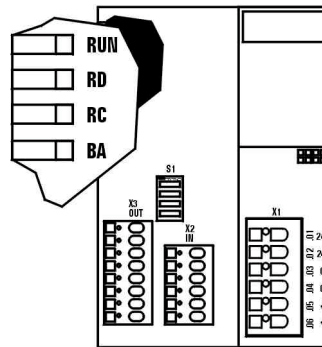


#### RIO EC IBS Specifications

Order no.	363 157 06
Bus port	InterBus-S
Power supply	24V DC +/- 20%
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 See <b>Configuring InterBus-S</b> on page 43 and <b>Bus node power consumption</b> on page 94

See also Specifications for all bus couplers from page 131.

### 3.1.1 LED displays on the EC InterBus-S bus coupler



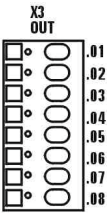
LED	Color/Status	Meaning
RUN	Green	The bus coupler processor is running.
	Red/flashing	An error has occurred. The number of flashing pulses is the flashing code of the <b>Error messages</b> . See page 133
RD	Red	The subsequent remote bus is not operated. (remote bus disabled)
RC	Green	Bus connection established. (remote bus connected)
BA	Green	Data telegrams are transmitted on the bus. (bus access)

In normal operation the RC and BA LEDs are green. Several intermediate states occur during the master initialization phase.

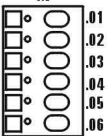
### 3.1.2 DIP switch S1

	<b>DIP1</b>	Diagnosis ON/OFF
	<b>DIP2</b>	Not used
	<b>to</b>	
	<b>DIP4</b>	

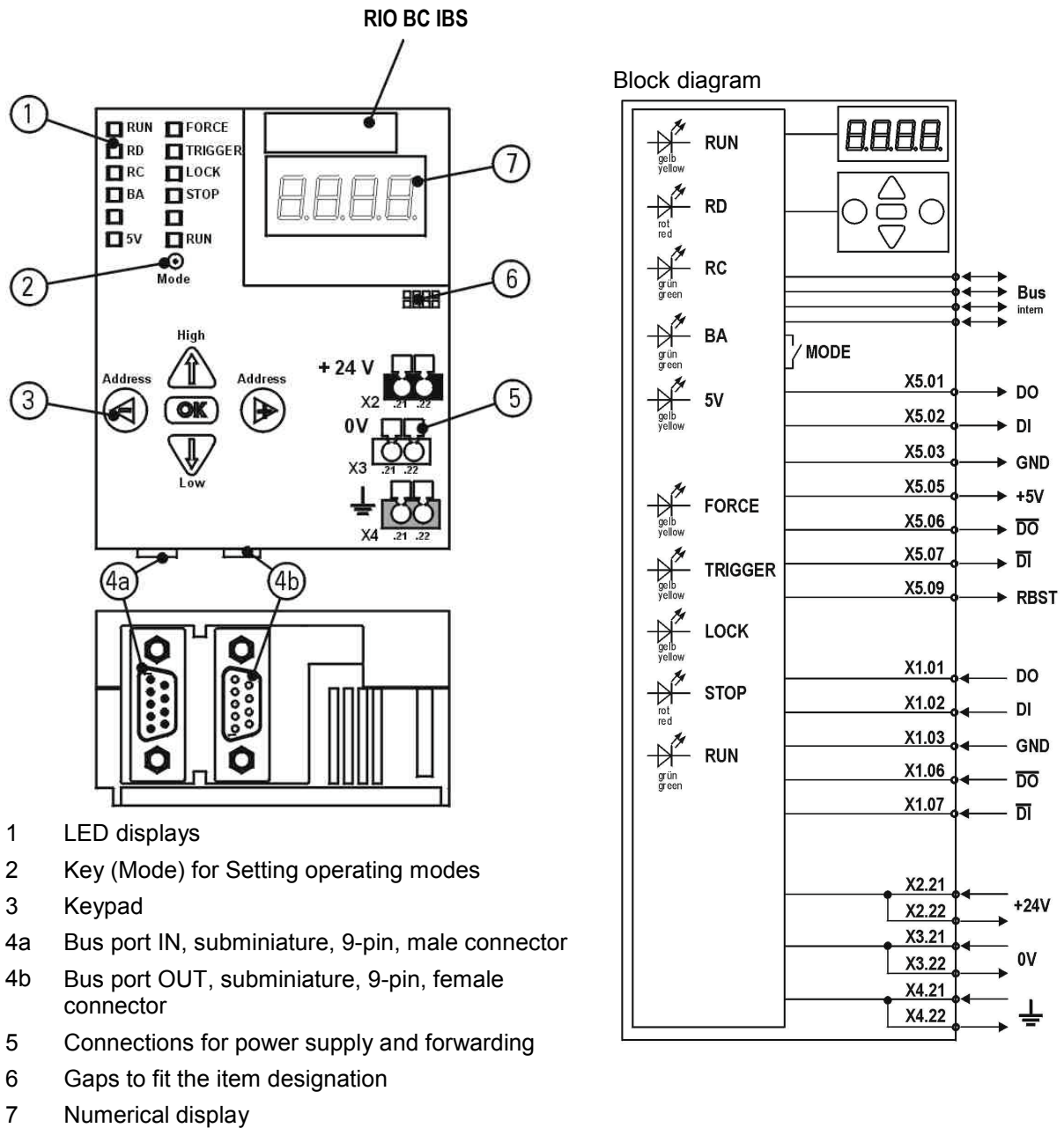
### 3.1.3 Bus port on the EC InterBus-S bus coupler

<b>X3 OUT</b>   Spring terminal 8-pin, detachable	1	DO
	2	DI
	3	GND
	4	+5V
	5	DO-N
	6	DI-N
	7	RBST
	8	SHLD

<b>X2 IN</b>   Spring terminal 6-pin, detachable	1	DO
	2	DI
	3	GND
	4	DO-N
	5	DI-N
	6	SHLD

## 3.2 RIO BC InterBus-S bus coupler



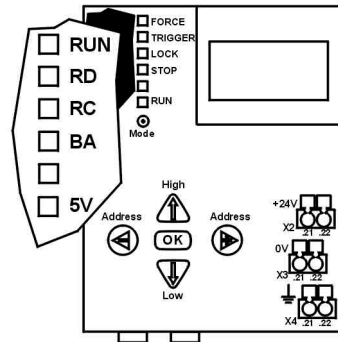
### RIO BC IBS Specifications

Order no.	363 155 49
Bus port	InterBus-S
Power supply	24V DC +/- 20%
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8
	See <b>Configuring InterBus-S</b> on page 43 and <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131

### 3.2.1 LED displays on the BC InterBus-S bus coupler

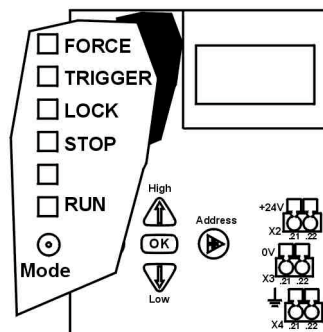
#### InterBus-S specific displays



LED	Color	Meaning
RUN	Yellow	The bus coupler processor is running.
RD	Red	The subsequent remote bus is not operated. (remote bus disabled)
RC	Green	Bus connection established. (remote bus connected)
BA	Green	Data telegrams are transmitted on the bus. (bus access)
5V	Yellow	Internal 5V power supply operates correctly.

In Normal mode the RC and BA LEDs are permanently green. While the master is being initialized the LEDs displays various intermediate states.

#### Operating mode display



See Operating modes of the BC bus coupler from page 98



### 3.2.2 Numerical display on the BC bus coupler

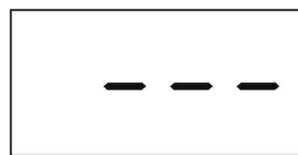
#### Display of the active operating mode



RUN mode



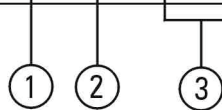
RUN mode can also include information on the TRIGGER and LOCK modes (for details see descriptions from page 98).



STOP mode (see page 107)



Display, TRIGGER, FORCE, LOCK modes show the selected channel.



- 4. Hexadecimal number of the expansion module
- 5. Input (E) or output (A)
- 6. Channel number (decimal)

Example 2E04: module 2, input, channel 04

#### Display of error messages

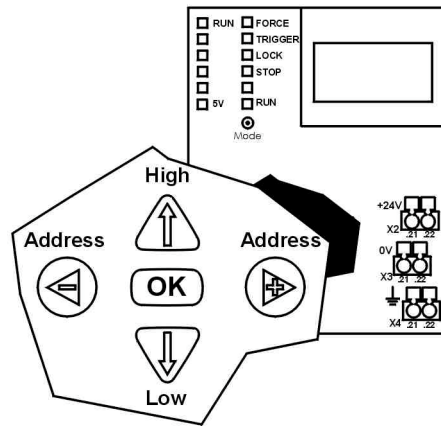


An error message is displayed if a fault occurs.

Example E004: Internal data transfer between bus coupler and module interrupted


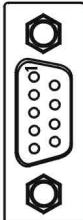
See Error messages on the bus coupler display on page 133.

### 3.2.3 Keypad of the BC bus coupler



Each key on the keypad has several functions. The function of each key is described in the corresponding section of the manual.

### 3.2.4 Bus port on the BC InterBus-S bus coupler

<b>IN</b>    Subminiature, 9-pin, male connector	1	DO
	2	DI
	3	GND
	4	NC
	5	NC
	6	DO-N
	7	DI-N
	8	NC
	9	NC
<b>OUT</b>    Subminiature, 9-pin, female connector	1	DO
	2	DI
	3	GND
	4	NC
	5	+5V
	6	DO-N
	7	DI-N
	8	NC
	9	RBST

### 3.3 InterBus-S field bus

Interbus-S was designed in 1987 as an open field bus system. Interbus-S is standardized in DIN 19258 as a field bus for the sensor/actuator level.

#### General

There are two bus versions:

- **Remote bus** (max. distance between stations 400m, max. coverage 12.8km, RS 485 port with 9-pin subminiature connector)
- **Local bus** (max. coverage 10m, power supply for bus stations via cable, a 5-core cable is required.)



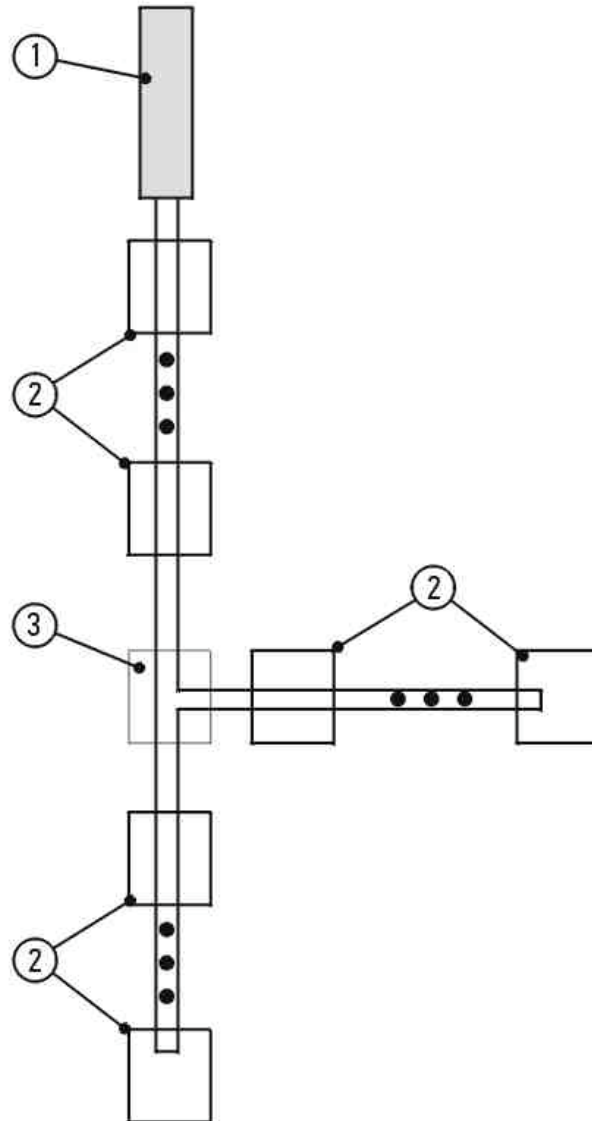
RIO components are remote bus stations.

- When you reboot the master the bus system creates a current list of all the connected stations (slaves).
- The master allocates the I/O addresses in the order in which it finds the slaves.
- We recommend checking this list in the master controller application once the initialization process is completed. This will allow you to detect any problems with slaves.
- RIO bus couplers log on with the required number of I/O addresses. No settings are required.
- The address range for each slave is limited to 20 bytes inputs and 20 bytes outputs. The number of bytes for inputs is always the same as the number of bytes for outputs.
- The maximum number of stations depends on the firmware of the master.

The Schleicher Promodul-U InterBus-S Master USK DIM allows up to 64 slaves. See also USK DIM InterBus-S Master for Promodul-U operating manual, order no.: 322 133 55.

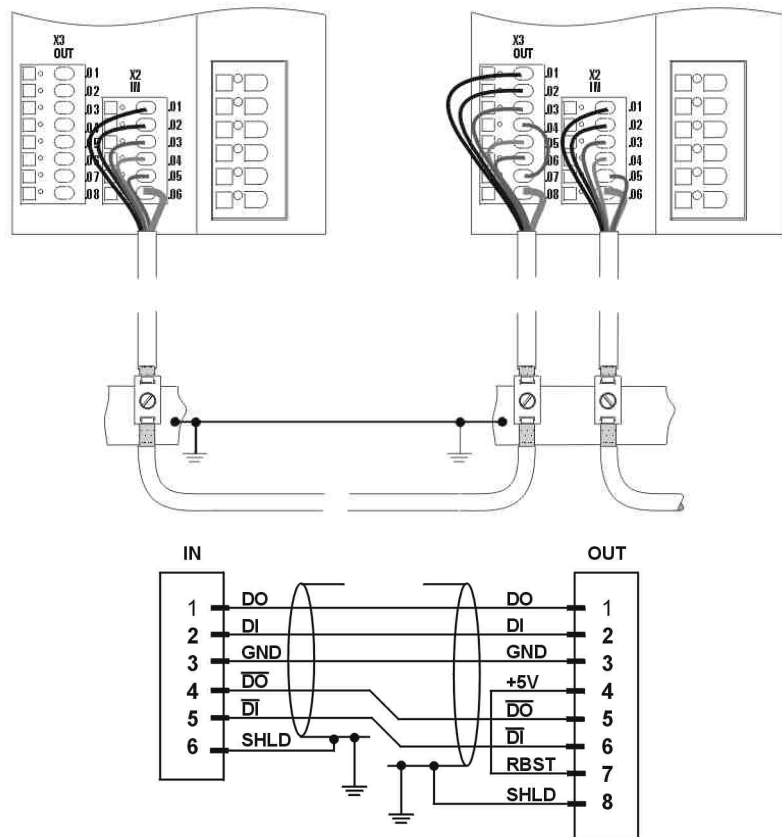
### 3.3.1 InterBus-S bus topology

- The Interbus-S topology is a ring system with active bus stations.
- All stations are connected point-to-point, starting from the master interface. Each station has a connector to the preceding station and a connector to the next station.
- At the last bus station the connector to the next station remains unconnected.



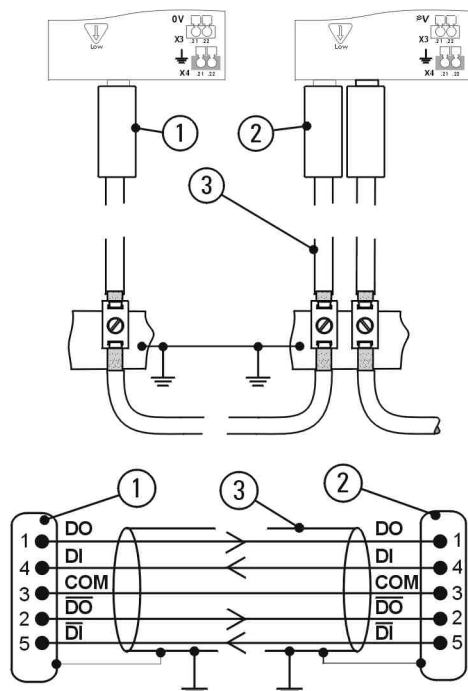
1 Interface module    2 Remote station    3 Bus switch

### 3.3.2 Pin configuration on the EC InterBus-S bus coupler



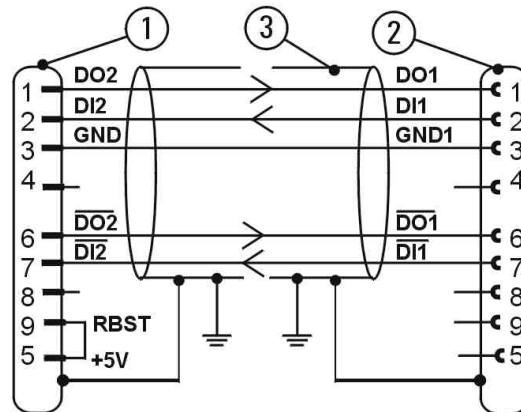
### 3.3.3 Pin configuration on the BC InterBus-S bus coupler

We recommend the use of ERbic® interface connectors from ERNI.



1 ERbic® InterBus male connector 2 ERbic® InterBus female connector 3 Shielded cable

If you use subminiature connectors you must use connectors with a metal casing. The shield of the bus cable must be connected to the metal casing. Bus nodes and bus terminators must be wired as follows:



1 Subminiature, 9-pin, male connector, 2 Subminiature, 9-pin, female connector 3 Shielded cable



The RBST / +5 V bridge in connector 1 is used to detect a subsequent station. If this bridge is missing any following stations will not be detected.

### 3.3.4 InterBus-S bus cable

Cable length	
Remote bus	Up to 12.8km
Local bus	Up to 10m



The guidelines in the Electrical installation chapter apply to all bus couplers and must be followed.

### 3.3.5 Configuring InterBus-S

#### Process data width and addressing

Module type	Bytes Inputs		Bytes Outputs	
<b>RIO BC IBS</b>	4 If diagnosis is switched on with service function 5, otherwise 0.		4 If diagnosis is switched on with service function 5, otherwise 0.	
<b>RIO EC IBS</b>	If diagnosis is switched on, otherwise 0.		If diagnosis is switched on, otherwise 0.	
<b>RIO 16 I</b>	Byte 1	Byte 2		
Bit configuration	15 ... 8	7 ... 0		
Pin configuration	X2.15 ... X2.8	X1.7 ... X1.0		
<b>RIO 4I 120 VAC</b>	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
<b>RIO 4I 230 VAC</b>	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
<b>RIO 16 O</b>			Byte 1	Byte 2
Bit configuration			15 ... 8	7 ... 8
Pin configuration			X2.15 ... X2.8	X1.7 ... X1.0
<b>RIO 4 O R</b>			Byte 1	Byte 2
Bit configuration			Not used	3 ... 0
Pin configuration				X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)
<b>RIO 8 I/O</b>	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	Not used	7 ... 0	Not used	7 ... 0
Pin configuration		X1.7 ... X1.0		X1.7 ... X1.0
<b>RIO 8 I 8 I/O</b>	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	15 ... 8X	7 ... 0	Not used	7 ... 0
Pin configuration	2.7 ... X2.0	X1.7 ... X1.0		X1.7 ... X1.0
	<b>Word* Inputs</b>		<b>Word* Outputs</b>	
<b>RIO 4AI ±10V</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO 4AI/4AO ±10V</b>	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
<b>RIO 4AI 20mA</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO 4AI/4AO 20mA</b>	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
<b>RIO T10-10</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO T20-10</b>	Word 1 to 4 (channel 0 to 3)			
*1 word = 2 bytes	<div><div>①</div><div>00</div><div>01</div><div>Byte 1</div><div>Byte 2</div><div>15 . . . 8</div><div>7 . . . 0</div><div>②</div></div>		1 Byte start addresses 2 Bit numbering	

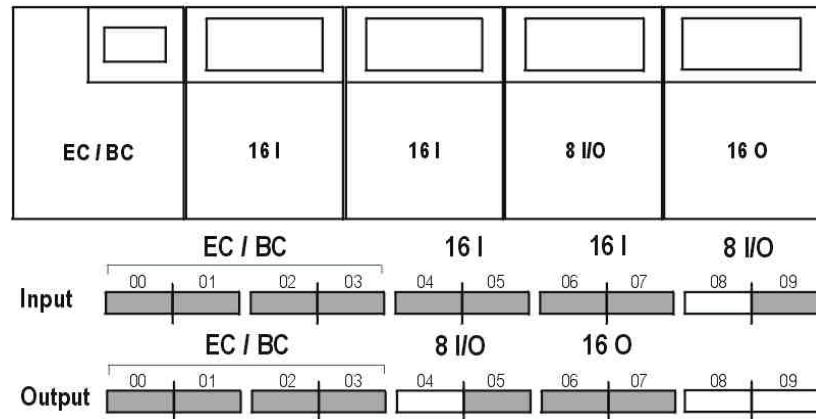


The EC and BC IBS bus couplers can accommodate up to 8 expansion modules. Note that the maximum number of data bytes is 20 for the input and 20 for the output. The number of expansion modules can also be limited by their power consumption. See also chapter Bus node power consumption on page 94.

The current process data width can be determined with **Service function 3** and **Service function 4** (page 110) or diagnosis **Function 3** (page 118). The Byte 1 / Byte 2 order can be changed using the byte swap mode, diagnosis **Function 18** (page 128) and **Service function 10** (page 111).

## Examples of an address configuration

Bus node and address configuration:

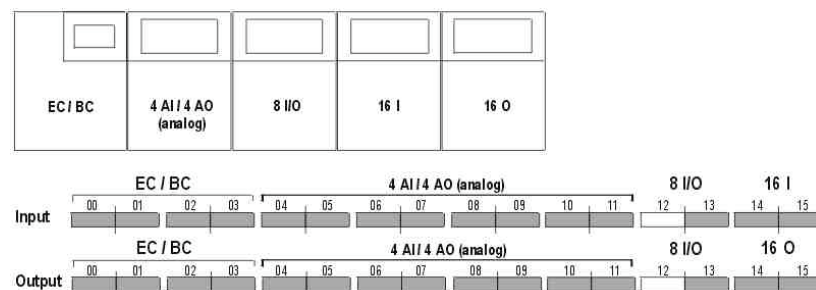
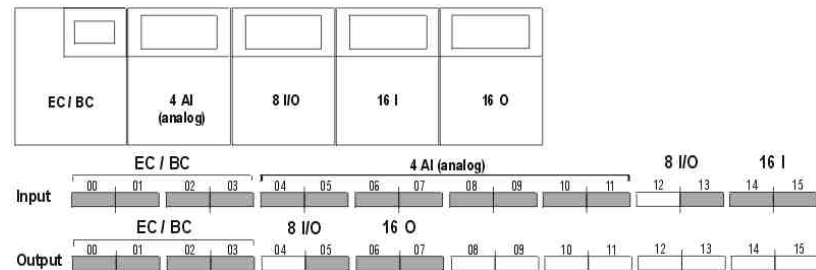


The 00 base addresses have been chosen as an example only and must be adapted to the respective PLC system.

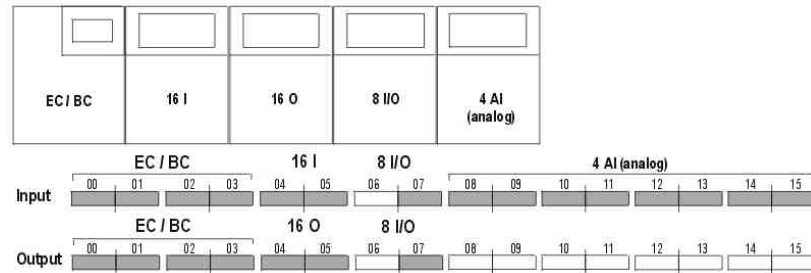
- The bus coupler uses 4 bytes for diagnosis data if the diagnosis is switched on with service function 5.
- The 8 I/O expansion module only uses the lower bytes. Input byte 08 and output byte 04 are not relevant.
- Bytes 08 and 09 are filled because the input range length on InterBus-S always is always the same as the output range length.

## Other examples

All examples have diagnosis switched on.







### 3.3.6 InterBus-S response times

The bus cycle time in an InterBus-S system is more or less in proportion to the number of data bytes to be transmitted.

$$tt = [ 13 * (6 + n) + 4 * m ] * t_{Bit} + t_{SW}$$

tt = Transmission time in ms

n = Number of output data bytes

m = Number of installed slaves

t<sub>Bit</sub> = Bit duration (2μs) @ 500kBit/s

t<sub>SW</sub> = Software run time in master (approx. 800μs for USK DIM)

Example:

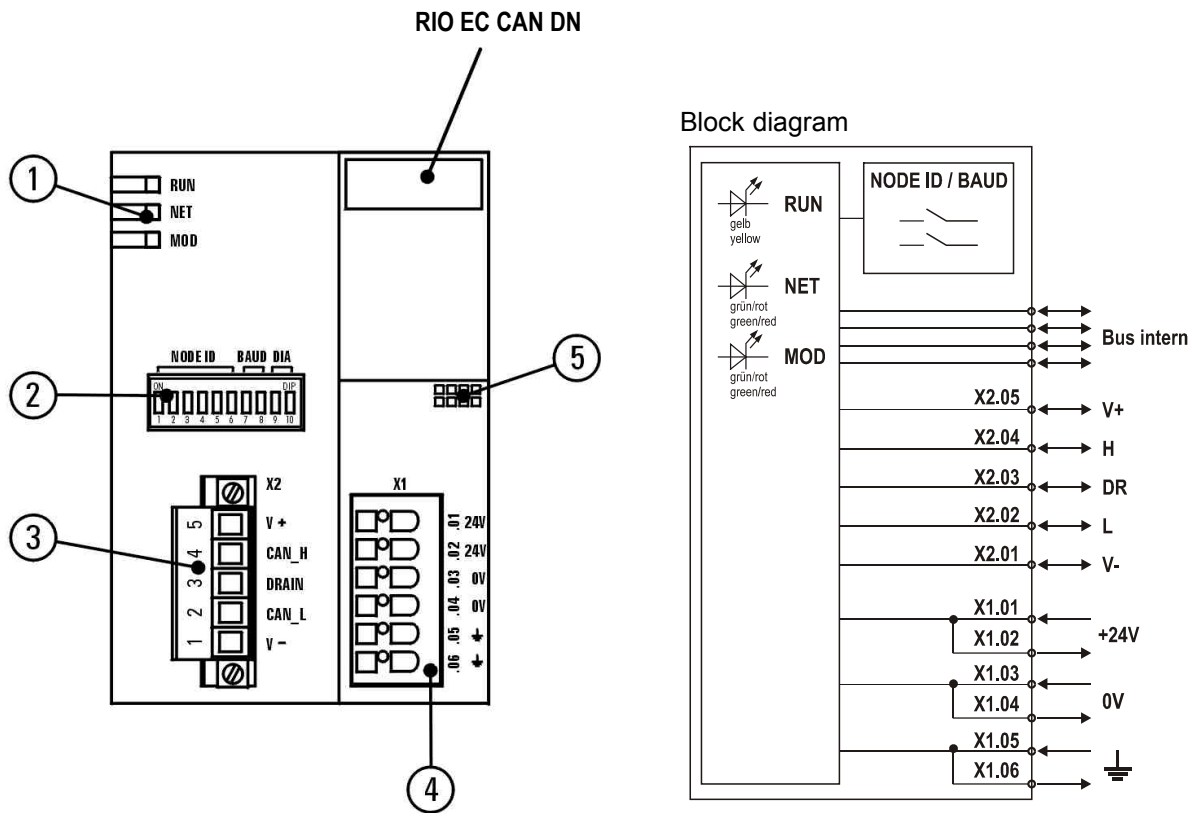
10 bus nodes of which each has 8 bytes of output data and 8 bytes of input data.

$$tt = [ 13 * (6 + 8) + 4 * 10 ] * 2\mu s + 800\mu s$$

$$tt = 1.2ms$$

## 4 DeviceNet

### 4.1 Bus coupler RIO EC CAN DN



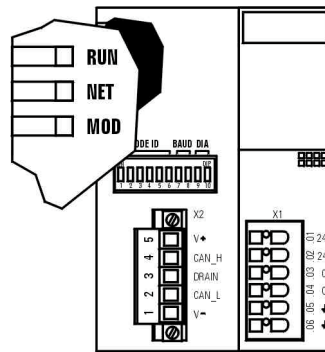
- 1 LED display
- 2 DIP switches to set the node number (NODE ID), data transmission rate (BAUD) and diagnosis (DIA)
- 3 Bus port Open style connector, 5-pin
- 4 Connection for power supply
- 5 Gaps to fit the item designation

#### RIO EC CAN DN Specifications

Order no.	363 157 11
Bus port	DeviceNet
Power supply to module	24V DC +/- 20%
Power supply to CAN interface	DC 11 ... 30V (meets CAN DeviceNet specification)
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 See <b>Configuring DeviceNet</b> on page 57 and <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131

#### 4.1.1 LED display on the EC DeviceNet bus coupler



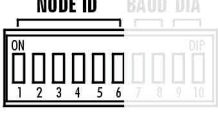
LED	Color/Status	Meaning
RUN	Green	The bus coupler processor is running.
	Red/flashing	An error has occurred. The number of flashing pulses is the flashing code of the <b>Error messages</b> . See page 133.
NET (network status)	OFF	The bus coupler has not yet successfully completed the DUP MAC Check.
	Green/flashing	The bus coupler is operating on the bus but has not yet been detected by a master or no logical connection to the bus coupler has been established.
	Green	The bus coupler has been detected by a master and a logical connection to the bus coupler has been established.
	Red/flashing	The master connection is in the Timeout status.
	Red	The bus coupler has found another device with the same MAC ID whilst performing the DUP MAC Check.
MOD (module status)	Green/flashing	The field bus connection has been interrupted. The PLC is in Stop mode. The master is trying to establish a connection to the bus coupler. The I/O quantity configured in the scan list is incorrect (error 77 on scanner). The display shows an error message (e.g. E006 for cable break).
	Green	The bus coupler is ready and the PLC is in RUN mode.
	Red	One of the expansion modules has an unknown ID. The internal system bus was interrupted (slide contact was opened). Too many expansions modules attached.
	Red/flashing	An error has occurred in the internal EEPROM or the bus coupler has detected a different I/O configuration compared to the last time when it was switched on (E012).

## 4.1.2 DIP switches

### NODE ID Setting the node number

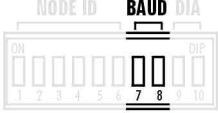
The node number is set using DIP switches 1 to 6. The node number is set using a binary value. DIP1 is the lowest bit ( $2^0$ ) and DIP6 is the highest bit ( $2^5$ ). Node numbers can be between 0 and 63.

Example of MAC IDs 1, 5 and 63

		NODE ID	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6
		1	ON	OFF	OFF	OFF	OFF	OFF
		5	ON	OFF	ON	OFF	OFF	OFF
		63	ON	ON	ON	ON	ON	ON

### BAUD Setting the baud rate

The baud rate is set using DIP7 and DIP8.

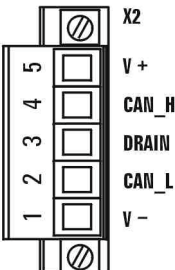
		BAUD	DIP7	DIP8
		125kBaud	OFF	OFF
		250kBaud	ON	OFF
		500kBaud	OFF	ON
		Invalid*	ON	ON

\*Automatically set to 125kBaud.

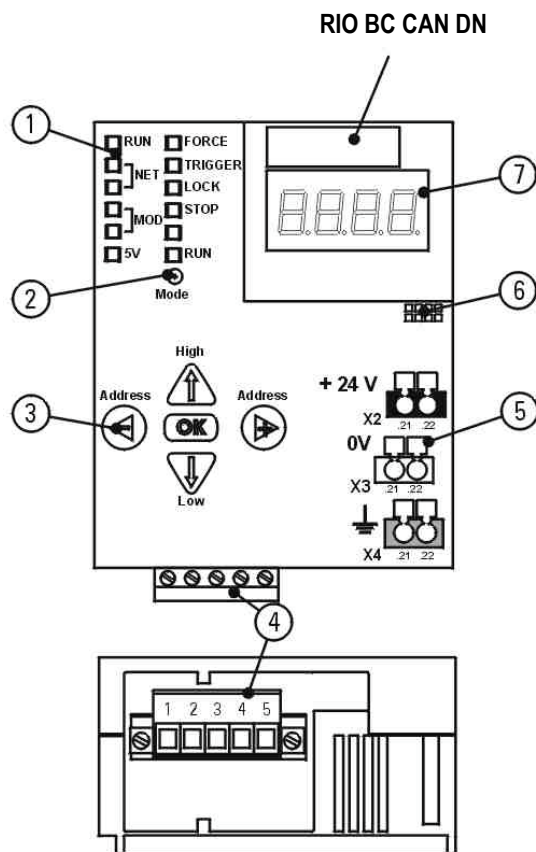
### DIA Switching the diagnosis ON/OFF

DIA	
DIP9	Reserved
DIP10	Diagnosis ON = ON / OFF = OFF

## 4.1.3 Bus port on the EC DeviceNet bus coupler

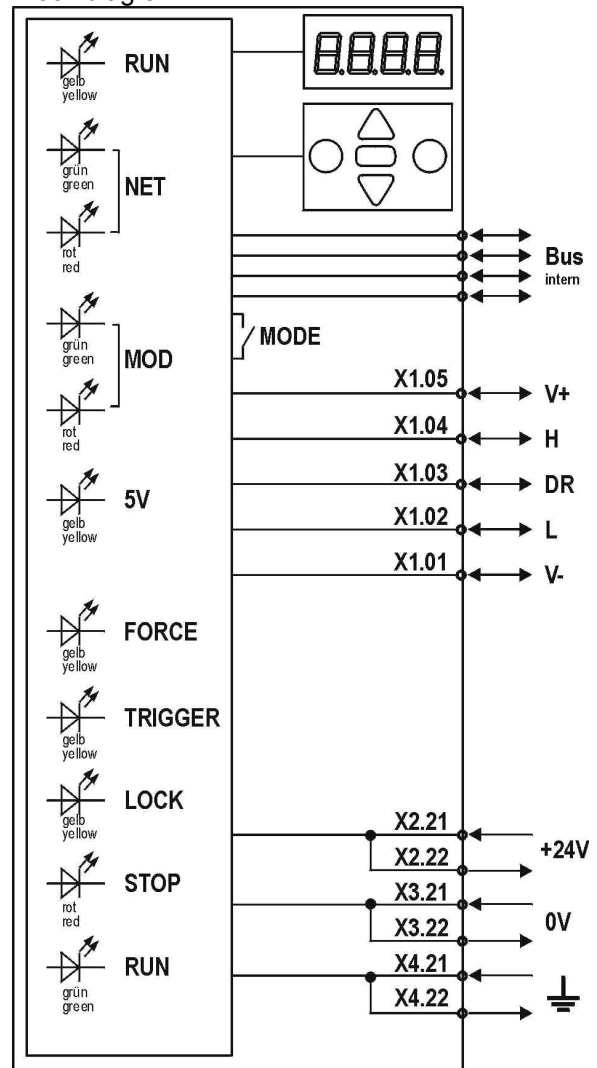
	1	V-	CAN_GND	Ground / 0V
	2	L	CAN_L	CAN Low
	3	DR	(CAN_SHLD)	Shield connection optional
	4	H	CAN_H	CAN High
	5	V+	CAN_V+	Power supply Rated value +24V DC (+18V to +30V)

## 4.2 RIO BC CAN DN bus coupler (DeviceNet)



- 1 LEDs
- 2 Key (Mode) for Setting operating modes
- 3 Keypad
- 4 Bus port Open style connector, 5-pin
- 5 Connections for power supply and forwarding
- 6 Gaps to fit the item designation
- 7 Numerical display

Block diagram



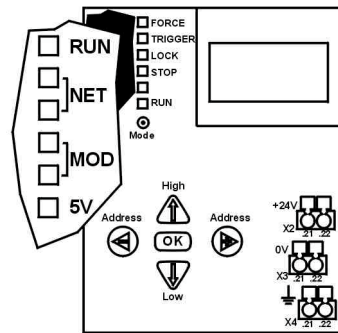
### RIO BC CAN DN Specifications

Order no.	363 140 97
Bus port	DeviceNet
Power supply to module	24V DC +/- 20%
Power supply to CAN interface	DC 11 ... 30V (meets CAN DeviceNet specification)
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 See <b>Configuring DeviceNet</b> on page 57 and <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131

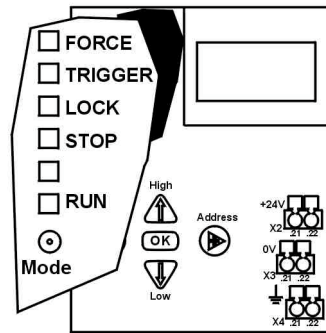
#### 4.2.1 LED display on the BC DeviceNet bus coupler

##### DeviceNet-specific LEDs on the BC bus coupler



LED	Color/Status	Meaning
RUN	Yellow	The bus coupler processor is running.
NET (network status)	OFF	The bus coupler is not switched on. Check 5V LED. The bus coupler has not yet successfully completed the DUP MAC Check.
	Green/flashing	The bus coupler is operating on the bus but has not yet been detected by a master or no logical connection to the bus coupler has been established.
	Green	The bus coupler has been detected by a master and a logical connection to the bus coupler has been established.
	Red/flashing	The master connection is in the Timeout status.
MOD (module status)	Red	The bus coupler has found another device with the same MAC ID whilst performing the DUP MAC Check.
	Green/flashing	The field bus connection has been interrupted. The PLC is in Stop mode. The master is trying to establish a connection to the bus coupler. The I/O quantity configured in the scan list is incorrect (error 77 on scanner). The display shows an error message (e.g. E006 for cable break).
	Green	The bus coupler is ready and the PLC is in RUN mode.
	Red	One of the expansion modules has an unknown ID. The internal system bus was interrupted (slide contact was opened). Too many expansion modules attached.
	Red/flashing	An error has occurred in the internal EEPROM or the bus coupler has detected a different I/O configuration compared to the last time when it was switched on (E012).
5V	Yellow	Internal 5V power supply operates correctly.

## Operating mode display on the BC bus coupler



See Operating modes of the BC bus coupler from page 98.

### 4.2.2 Numerical display on the BC bus coupler

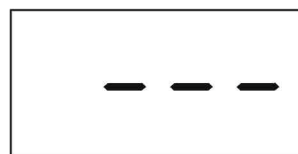
#### Display of the active operating mode



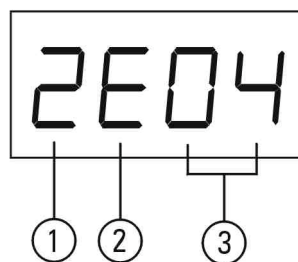
RUN mode



RUN mode can also include information on the TRIGGER and LOCK modes (for details see descriptions from page 98).



STOP mode (see page 107)



Display, TRIGGER, FORCE, LOCK modes show the selected channel.

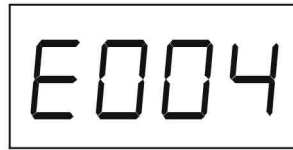
7. Hexadecimal number of the expansion module

8. Input (E) or output (A)

9. Channel # (decimal)

Example 2E04: module 2, input, channel 04

## Display of error messages

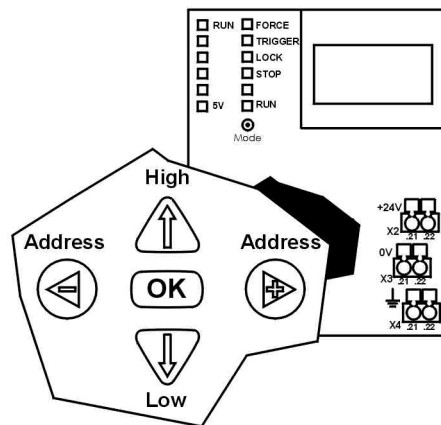


An error message is displayed if a fault occurs.

Example E004: Internal data transfer between bus coupler and module interrupted

See Error messages on the bus coupler display on page 133.

### 4.2.3 Keypad of the BC bus coupler



Each key on the keypad has several functions. The function of each key is described in the corresponding section of the manual.

### 4.2.4 Bus port on the BC DeviceNet bus coupler

	1	V-	CAN_GND	Ground / 0V
	2	L	CAN_L	CAN Low
	3	DR	(CAN_SHLD)	Shield connection optional
	4	H	CAN_H	CAN High
	5	V+	CAN_V+	Voltage supply

Open style connector, 5-pin



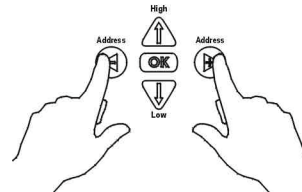
#### 4.2.5 Setting the node number on the BC DeviceNet bus coupler

You can set node numbers from 0 to 63.

Node numbers must be unique. If you configure the same node number twice the system will return errors and you will not be able to commission the network.

Set the node number either with service function 12 (see page 112) or as follows:

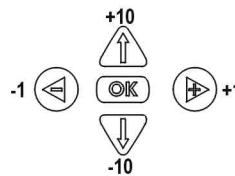
Select STOP mode. Press both Address keys simultaneously.



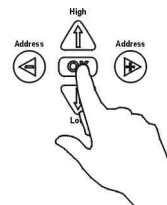
The current node number will be displayed.

Press OK if you don't want to make any changes.

To enter a new node number use the keypad. The keys have the following functions:



Pressing the OK key stores the new node number in the bus coupler and activates it immediately!



#### 4.2.6 Setting the baud rate on the BC DeviceNet bus coupler

The baud rate is set using Service function 2. See page 109.

Parameter	Baud rate in kBaud
0	125
1	250
2	500

To activate the new baud rate switch the supply voltage off and on again.

## 4.3 DeviceNet field bus

DeviceNet is a simple network solution. It is based on an open network standard which is accepted and used worldwide.

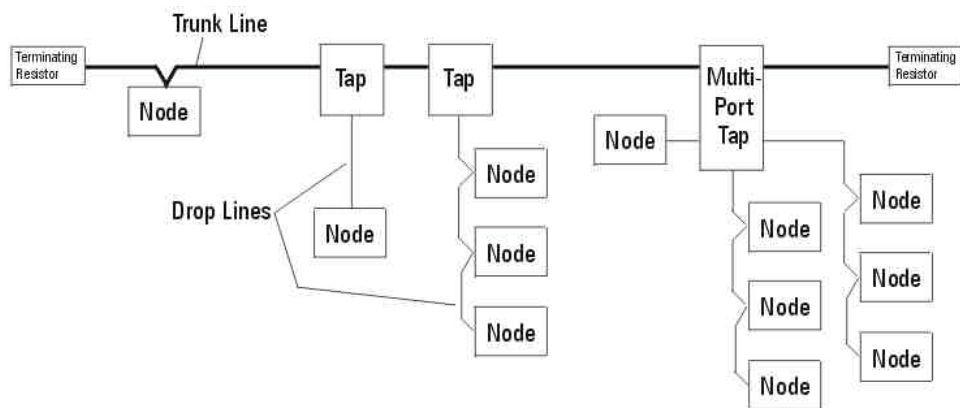
The DeviceNet protocol represents the ISO Application Layer 7 and is based on the CAN data transmission protocol.

CAN (Controller Area Network) is a data transmission protocol according to ISO DIS 11898. It is implemented in integrated circuits and has been marketed worldwide since 1994 in very large quantities by an international consortium of companies.

### General

- Up to 64 nodes
- Simple linear bus topology
- Multi-cast, master-slave, multi-master
- Polling or event message
- Power supply and signal line in one cable
- Network length depends on baud rate

### 4.3.1 DeviceNet bus topology



Nodes are connected by a trunk line and drop lines.

Trunk lines are not split and each end of the line has a terminating resistor.

### 4.3.2 DeviceNet bus cable

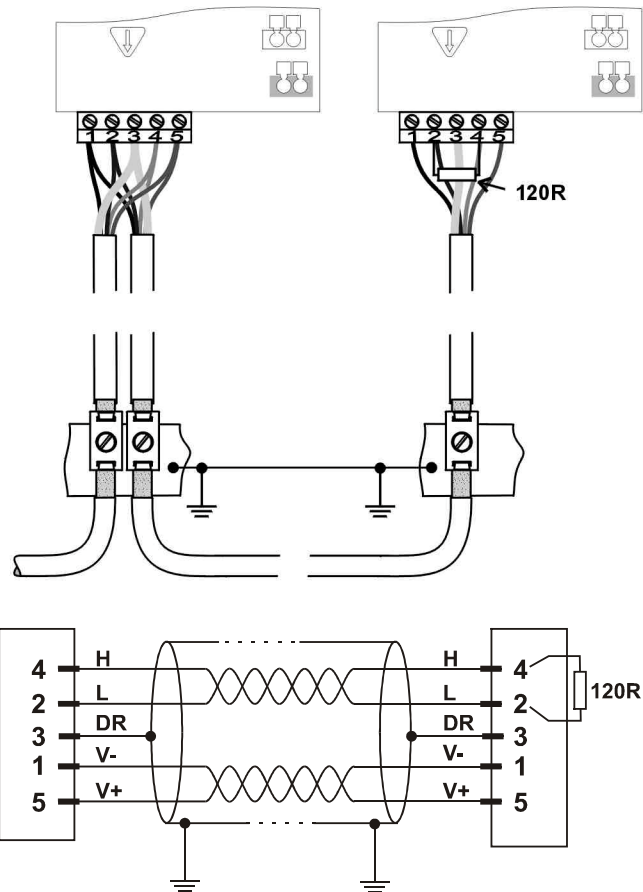
#### Types of cable

Type of cable	Outer diameter	Application
Thick cable	12.2mm	Trunk line
Thin cable	6.9mm	Drop lines

The thick DeviceNet cable consists of two shielded twisted pair cables with a wire in the middle of the cable. One shielding is outside. The trunk line is not split.

The thin cable is designed more flexibly. It allows an easier installation which is desired for drop lines. It can also be used as a trunk line over short distances.

Both cable types use the blue/white wire pair for signal transmission and the black/red wire pair for power supply.

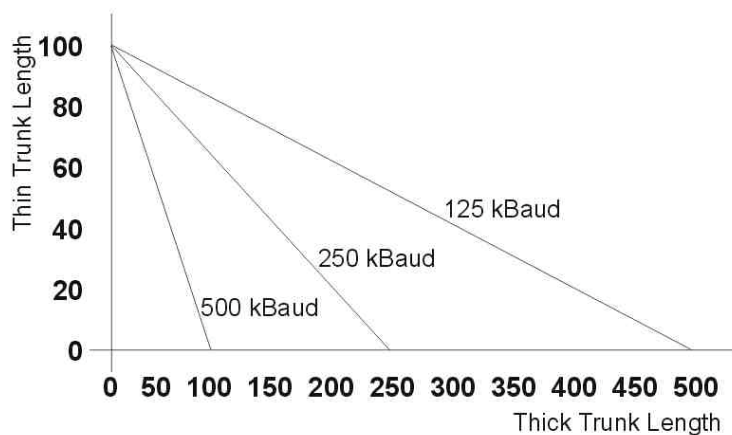


## Cable lengths

The cable length depends on the desired baud rate.

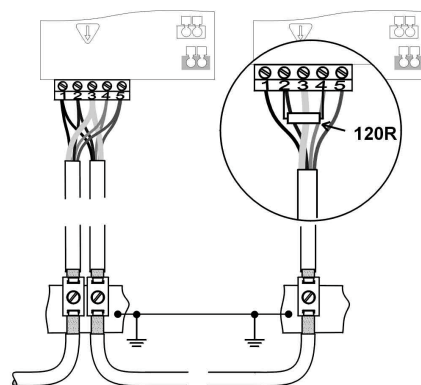
Cable length			
Baud rate in kBaud	125	250	500
Thick trunk line in m	500	250	100
Thin trunk line in m	100	100	100
Max. length of a single drop line in m	6	6	6
Total length of all drop lines in m	156	78	39

If a combination of thin and thick cables is used for the trunk line, the following applies:



## Terminating resistors on DeviceNet

An 120Ω terminating resistor must be fitted at each end of the trunk line between CAN Low (pin2) and CAN High (pin4).



The guidelines in the Electrical installation chapter apply to all bus couplers and must be followed.

### 4.3.3 Configuring DeviceNet

#### Data width and addressing

Module type	Bytes Inputs		Bytes Outputs	
<b>RIO BC CAN DN</b>	4 If diagnosis is switched on with service function 5, otherwise 0.		4 If diagnosis is switched on with service function 5, otherwise 0.	
<b>RIO EC CAN DN</b>	4 If configured, otherwise 0.		4 If configured, otherwise 0.	
<b>RIO 16 I</b>	Byte 1	Byte 2		
Bit configuration	15 ... 8	7 ... 0		
Pin configuration	X2.15 ... X2.8	X1.7 ... X1.0		
<b>RIO 4I 120 VAC</b>	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
<b>RIO 4I 230 VAC</b>	Byte 1	Byte 2		
Bit configuration	Not used	3 ... 0		
Pin configuration		X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)		
<b>RIO 16 O</b>			Byte 1	Byte 2
Bit configuration			15 ... 8	7 ... 8
Pin configuration			X2.15 ... X2.8	X1.7 ... X1.0
<b>RIO 4 O R</b>			Byte 1	Byte 2
Bit configuration			Not used	3 ... 0
Pin configuration				X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)
<b>RIO 8 I/O</b>	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	Not used	7 ... 0	Not used	7 ... 0
Pin configuration		X1.7 ... X1.0		X1.7 ... X1.0
<b>RIO 8 I 8 I/O</b>	Byte 1	Byte 2	Byte 1	Byte 2
Bit configuration	15 ... 8X	7 ... 0	Not used	7 ... 0
Pin configuration	2.7 ... X2.0	X1.7 ... X1.0		X1.7 ... X1.0
	<b>Word* Inputs</b>		<b>Word* Outputs</b>	
<b>RIO 4AI ±10V</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO 4AI/4AO ±10V</b>	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
<b>RIO 4AI 20mA</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO 4AI/4AO 20mA</b>	Word 1 to 4 (channel 0 to 3)		Word 1 to 4 (channel 0 to 3)	
<b>RIO T10-10</b>	Word 1 to 4 (channel 0 to 3)			
<b>RIO T20-10</b>	Word 1 to 4 (channel 0 to 3)			
	*1 word = 2 bytes			
	<div><div><div>①</div><div>00</div></div><div><div>01</div><div>Byte 1</div></div><div><div>Byte 2</div><div>15 ... 8</div></div><div><div>7</div><div>...</div></div><div><div>0</div><div>0</div></div></div> <div>1 Byte start addresses 2 Bit numbering</div>			

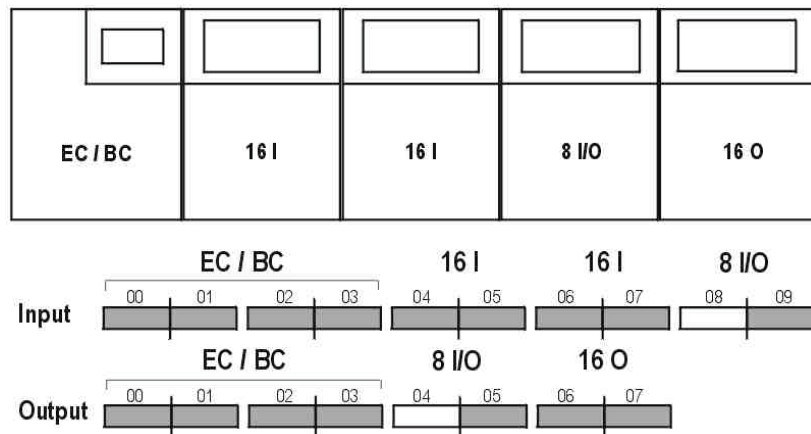


Up to 8 expansion modules can be operated on the CAN DN bus coupler. Note that the maximum number of data bytes is 64 (input) and 64 (output). The number of expansion modules can also be limited by their power consumption. See also chapter **Bus node power consumption** on page 94.

The current process data width can be determined with **Service function 3** and **Service function 4** (page 110) or diagnosis **Function 3** (page 118). The Byte 1 / Byte 2 order can be changed using the byte swap mode, diagnosis **Function 18** (page 128) and **Service function 10** (page 111).

## Examples of address configurations

Configuration of bus nodes and addresses:

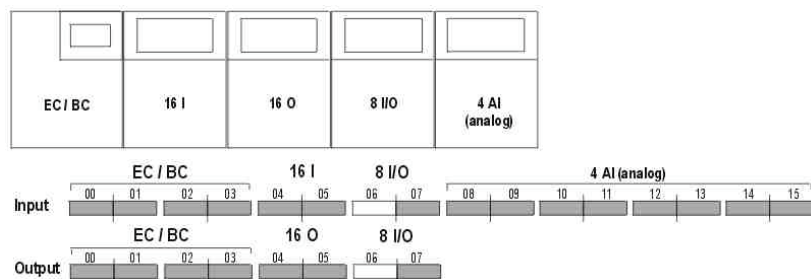
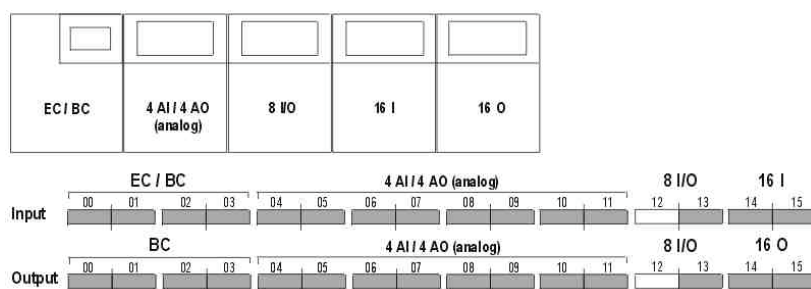
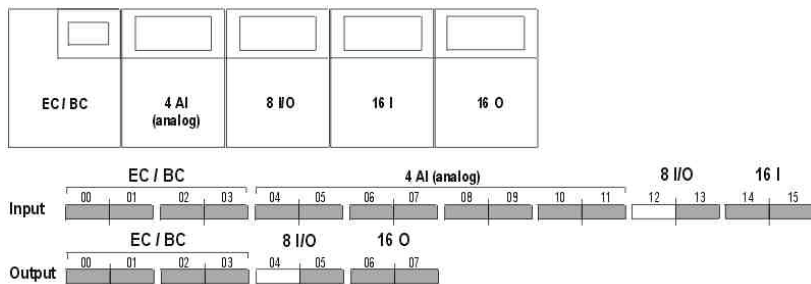


The 00 base addresses have been chosen as an example only and must be adapted to the respective PLC system.

- The bus coupler (BC) uses 4 bytes for diagnosis data if diagnosis is switched on with service function 5.
- The 8 I/O expansion module only uses the lower bytes. Input byte 08 and output byte 04 are not relevant.

## Other examples

All examples have diagnosis switched on.



#### 4.3.4 Electronic Data Sheet (EDS)

You can download files for all Schleicher devices free of charge from our web site at [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

#### 4.3.5 Commissioning DeviceNet

See the Commissioning Field Bus Systems operating manual, order no. 322 152 48.

All operating manuals can be downloaded free of charge from [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

#### 4.3.6 DeviceNet response times

The DeviceNet scanner polls the slaves in the order of priority of their MAC IDs. A slave with a low MAC ID has for example a higher priority than a slave with a high MAC ID.

The DeviceNetManager configuration utility provides a dialog box which allows you to set the *Interscan Delay* and the *Foreground to Background Poll Ratio*. To open this dialog box double-click on the scanner symbol in the graphical project representation.

##### Interscan Delay

The DeviceNet scanner polls the expansion modules at a fixed rate of x ms. This means that each slave which is configured in the scan list is polled once every x ms.

##### Foreground to Background Poll Ratio

This foreground to background ratio tells the scanner to poll some of the slaves less often than the rest of the expansion modules. A slave which is polled once in each *Scan* (see Interscan Delay) is polled in the *foreground*. A slave which is polled in the *background* is only polled every x scans.

##### Note

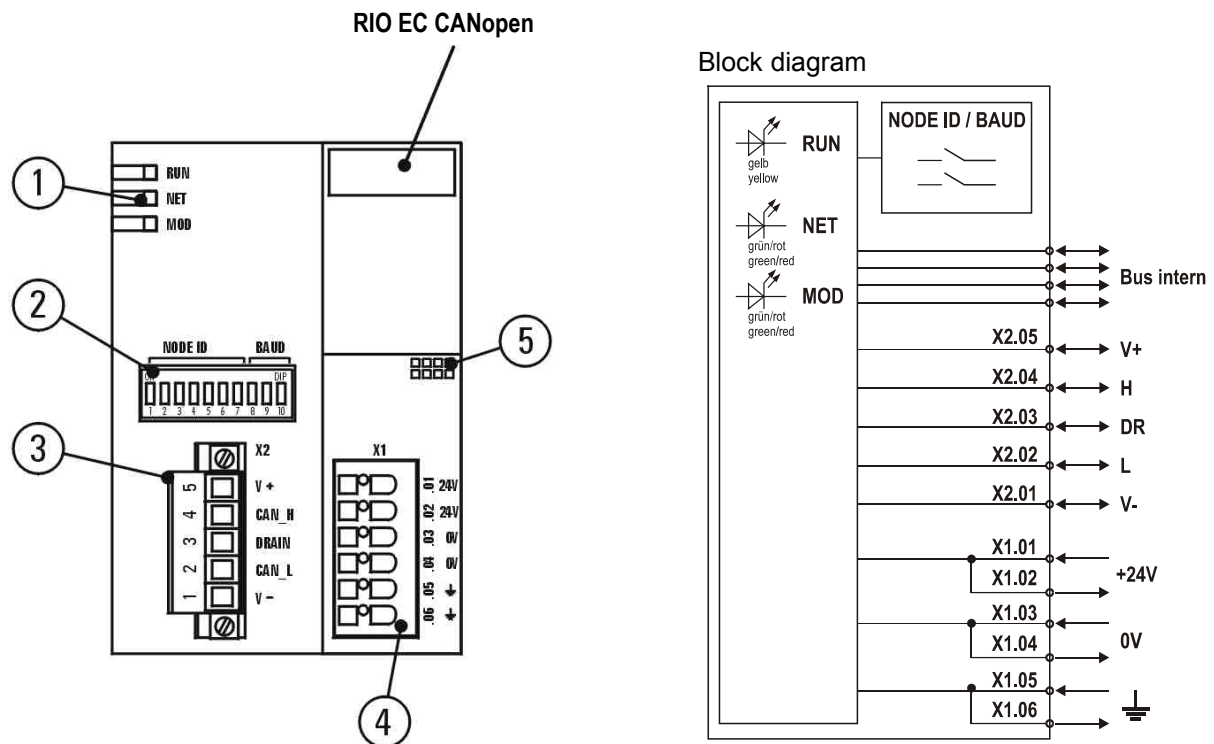
A slave with a large number of I/O points returns its input data to the master in *fragments*. However, the Allen Bradley scanner starts a new scan cycle even if some fragments of a response from a slave have not yet been received. If the Interscan Delay is too short this behavior can cause the corruption of data. This is particularly likely to cause problems if the slave in question has a low priority, i.e. if it is at the bottom of the scan list.

To correct or prevent this problem, ensure that

- Slaves with a large number of I/O points have a high priority or are at the top of the scan list (a low MAC ID),
- The Interscan Delay is not set too low.

## 5 CANopen

### 5.1 RIO EC CANopen bus coupler



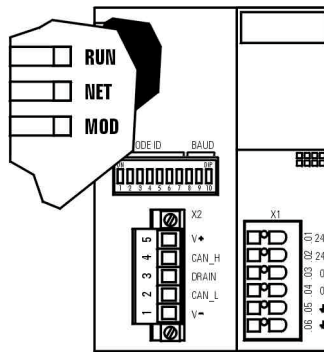
- 1 LED displays
- 2 DIP switches to set the node number (NODE ID) and the baud rate (BAUD)
- 3 Bus port Open style connector, 5-pin
- 4 Connection for power supply and forwarding
- 5 Gaps to fit the item designation

RIO EC CANopen Specifications	
Order no.	363 157 10
Bus port	CANopen (Open Style Connector, screw terminal, 5-pin)
Power supply to module	24V DC +/- 20%
Power supply to CAN interface	DC 11 ... 30V (meets CAN specification)
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 see <b>Configuring CANopen</b> on page 71 and <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131.



### 5.1.1 LED displays on the EC CANopen bus coupler



LED	Color	Status	Meaning
RUN	Green	ON	The bus coupler processor is running.
	Red	Flashing	An error has occurred. The number of flashing pulses is the flashing code of the <b>Error messages</b> . See page 133.
NET (network status)	Green	ON	CANopen status: Operational (PDO + SDO Data Exchange)
		Flashing	CANopen status: Pre-Operational (SDO Data Exchange)
	Red	ON	CAN status: Bus OFF, CAN bus cannot be accessed without any errors. Possible causes for errors: No 24V supply to bus connector Incorrect baud rate selected Cables in network are incorrectly wired Another CAN controller in the network has a hardware error
		Flashing	Node guarding has failed (NMT master no longer monitors the slave)
MOD (module status)	Green	ON	CANopen ready
		Flashing	After cable break
	Red	ON	Unknown module ID or error 004 (internal system bus interrupted) or too many modules connected
		Flashing	Access error internal EEPROM

#### Examples of error states

MOD Green / NET Red	No field bus cable connected or no 24V on bus connector.
MOD Green / NET Flashing Green	CANopen ready, 24V on bus connector but no other CAN controller available or the NMT master does not give the Operational instruction.

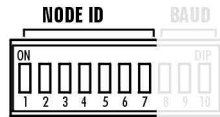
## 5.1.2 DIP switches on the EC CANopen bus coupler

### NODE ID Setting the node number

The node number (NODE ID) is set using DIP switches 1 to 7. The node number is set using a binary value. DIP1 is the lowest bit ( $2^0$ ) and DIP7 is the highest bit ( $2^6$ ). Node numbers can be between 1 and 127.

Example of node numbers 1, 5 and 127

NODE ID	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
...							
127	ON	ON	ON	ON	ON	ON	ON

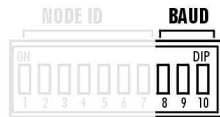


### BAUD Setting the baud rate

The baud rate is set using DIP switches 8 to 10.

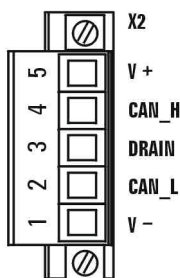
Baud rate in kBaud	DIP8	DIP9	DIP10
10*	OFF	OFF	OFF
20*	ON	OFF	OFF
50*	OFF	ON	OFF
125	ON	ON	OFF
250	OFF	OFF	ON
500	ON	OFF	ON
800	OFF	ON	ON
1000	ON	ON	ON

\* not possible in moment

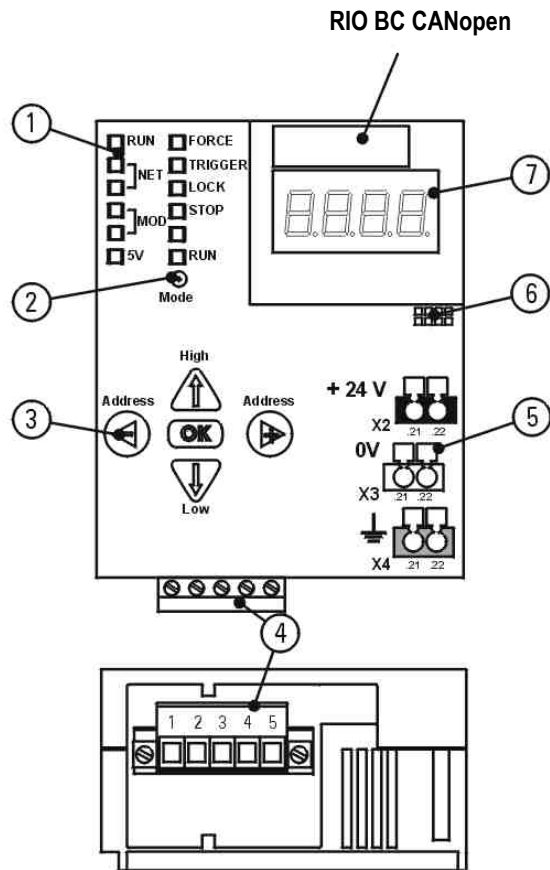


## 5.1.3 Bus port on the EC CANopen bus coupler

1	V-	CAN_GND	Ground / 0V
2	L	CAN_L	CAN Low
3	DR	(CAN_SHLD)	Shield connection optional
4	H	CAN_H	CAN High
5	V+	CAN_V+	Power supply Rated value +24V DC (+18V to +30V)

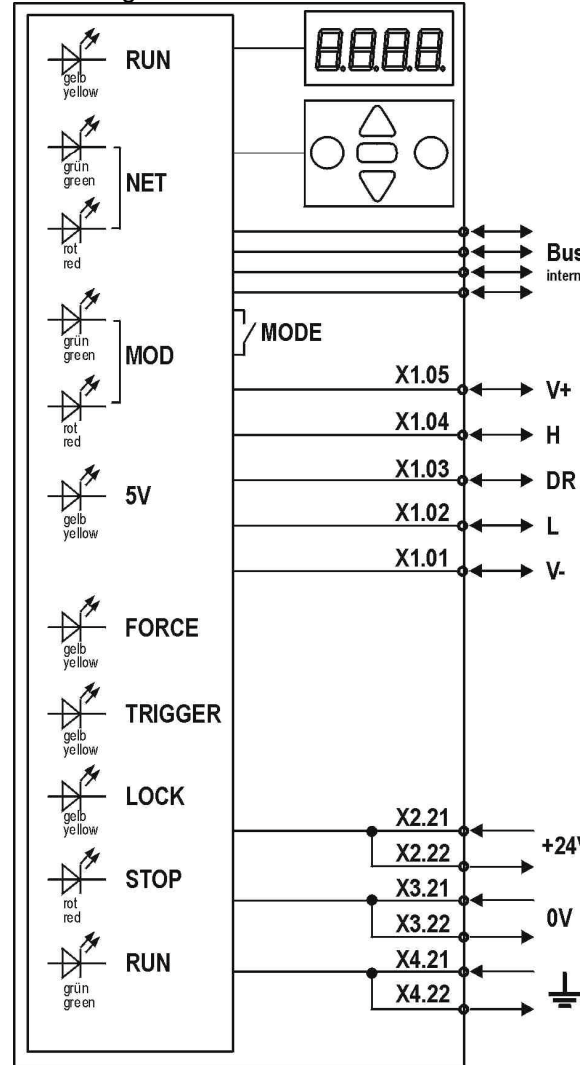


## 5.2 RIO BC CANopen bus coupler



- 1 LED displays
- 2 Key (Mode) for Setting operating modes
- 3 Keypad
- 4 Bus port Open style connector, 5-pin
- 5 Connections for power supply and forwarding
- 6 Gaps to fit the item designation
- 7 Numerical display

Block diagram

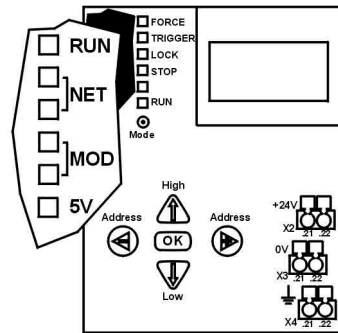


### Specifications RIO BC CANopen

Order no.	363 154 98
Bus port	CANopen
Power supply to module	24V DC +/- 20%
Power supply to CAN interface	DC 11 ... 30V (meets CAN specification)
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 see <b>Configuring CANopen</b> on page 71 and <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131.

## 5.2.1 LED displays on the BC CANopen bus coupler



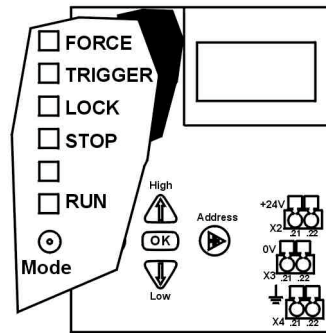
LED	Color	Status	Meaning
RUN	Yellow	ON	The bus coupler processor is running.
NET (network status)	Green	ON	CANopen status: Operational (PDO + SDO Data Exchange)
		Flashing	CANopen status: Pre-Operational (SDO Data Exchange)
	Red	ON	CAN status: Bus OFF, CAN bus cannot be accessed without any errors. Possible causes for errors: No 24V supply to bus connector Incorrect baud rate selected Cables in network are incorrectly wired Another CAN controller in the network has a hardware error
		Flashing	Node guarding has failed (NMT master no longer monitors the slave)
MOD (module status)	Green	ON	CANopen ready
		Flashing	After cable break
	Red	ON	Unknown module ID or error 004 (internal system bus interrupted) or too many modules connected
		Flashing	Access error internal EEPROM
5V	Yellow	ON	Internal 5V power supply operates correctly.

### Examples of error states

MOD Green / NET Red                      No field bus cable connected or no 24V on bus connector.

MOD Green / NET Flashing Green      CANopen ready, 24V on bus connector but no other CAN controller available or the NMT master does not give the Operational instruction.

## Operating mode display on the BC CANopen bus coupler



See Operating modes of the BC bus coupler from page 98

### 5.2.2 Numerical display on the BC CANopen bus coupler

#### Display of the active operating mode



RUN mode



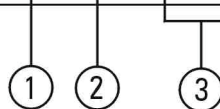
RUN mode can also include information on the TRIGGER and LOCK mode (for details see descriptions from page 98).



STOP mode (see page 107)



Display, TRIGGER, FORCE, LOCK mode show the selected channel.



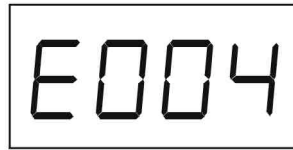
10.Hexadecimal number of the expansion module

11.Input (E) or output (A)

12.Channel # (decimal)

Example 2E04: module 2, input, channel 04

## Display of error messages

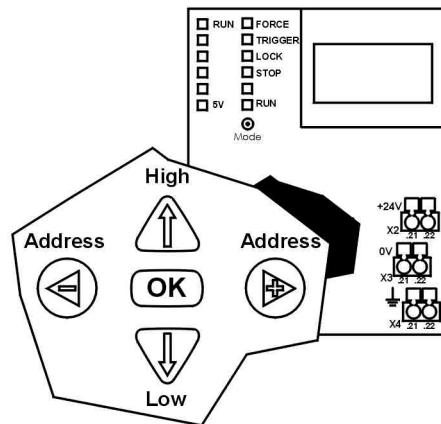


An error message is displayed if a fault occurs.

Example E004: Internal data transfer between bus coupler and module interrupted

See Error messages on the bus coupler display on page 133.

### 5.2.3 Keypad of the BC bus coupler



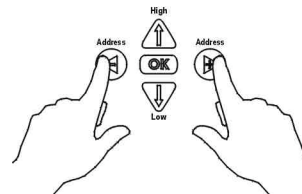
Each key on the keypad has several functions. The function of each key is described in the corresponding section of the manual.

## 5.2.4 Setting node numbers on the BC CANopen bus coupler

Node numbers must be unique. If you configure the same node number twice the system will return errors and you will not be able to commission the network. You can assign a number between 1 and 127. Node number 127 is used by the ProCANopen configuration software.

Set the node number either with service function 12 (see page 112) or as follows:

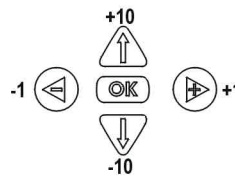
Select STOP mode. Press both Address keys simultaneously.



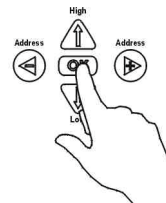
The current number will be displayed.

Press OK if you don't want to make any changes.

You can enter a new number using the keypad. The keys have the following functions:



To save the new number press OK.



To activate the new number turn the operating voltage off and on again.

### 5.2.5 Setting the baud rate on the BC CANopen bus coupler

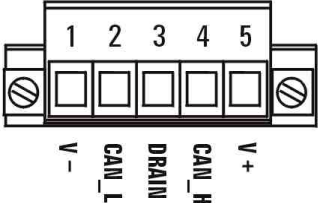
Use service function 2 (page 109) to set the parameter for the CAN baud rate.

Parameter	Baud rate in kBaud
0	10*
1	20*
2	50*
3	125
4	250
5	500
6	800
7	1000

\* not possible in moment

To activate the new baud rate switch the supply voltage off and on again.

### 5.2.6 Bus port on the BC CANopen bus coupler

	1	V-	CAN_GND	Ground / 0V
	2	L	CAN_L	CAN Low
	3	DR	(CAN_SHLD)	Shield connection optional
	4	H	CAN_H	CAN High
	5	V+	CAN_V+	Power supply



### 5.3 CANopen field bus

CANopen is based on the CAN Application Layer for industrial CAN applications. The CANopen communications profile CiA DS-301 specifies the mechanisms for configuring and the communication between devices in real-time environments. CANopen uses the data transmission layer to ISO 11898 and CAN 2.0 A+B.

The devices are based on CANopen Communications Profile CiA Draft Standard 301 Version 3.0 with additional text for modular systems and on CANopen Device Profile for I/O Modules CiA Draft Standard 401 Version 1.4.

Only objects declared in the applicable EDS file are implemented.

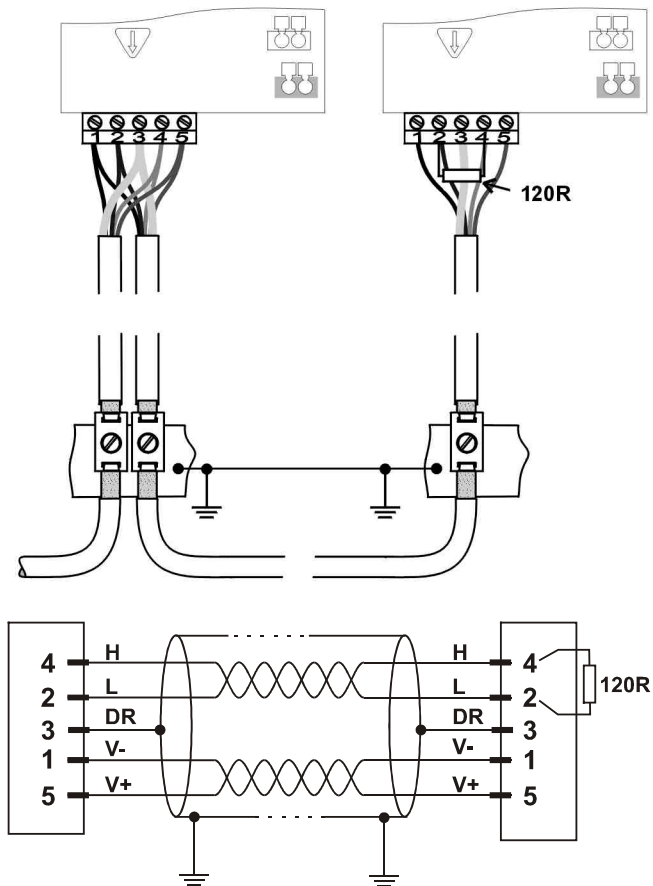
#### General

- Device details are described through an EDS (Electronic Data Sheet).
- Object-oriented communication with PDOs and SDOs.
- Transmission of real-time data with 'pure' CAN as the PDO (Process Data Object).
- Complex or low-priority services are transmitted using SDOs (Service Data Objects).
- PDOs can be sent event-driven or synchronized by all slaves.
- CANopen masters manage the network, however, they are not necessary for communication between the slaves.

There are differences between CANopen and CANopen PCS see "Programmieranleitung CANopen PCS".

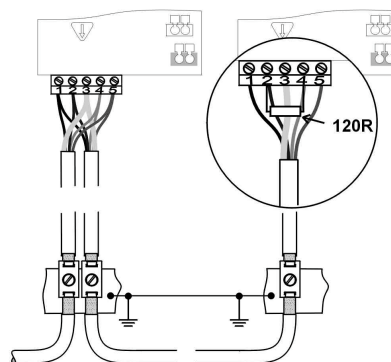
### 5.3.1 CANopen bus cable

Always use shielded cables with 4 wires for bus cables. The wires must be twisted in pairs.



#### Terminating resistors for CANopen

A 120Ω terminating resistor must be fitted at each end of the bus cable between CAN\_L (pin 2) and CAN\_H (pin 4).



The guidelines in the Electrical installation chapter apply to all bus couplers and must be followed.

### 5.3.2 Configuring CANopen

There are differences between CANopen and CANopen PCS see "Programmieranleitung CANopen PCS".

#### Pre-defined connection set

When you start up the RIO BC CANopen the RPDO1,2 and TPDO1,2 are available with the following default IDs:

RPDO1 = 200h + Node ID

RPDO2 = 300h + Node ID

TPDO1 = 180h + Node ID

TPDO2 = 280h + Node ID

The other T/RPDOS do not have a default ID. They will be assigned automatically by a configurator when the devices are configured.

The TPDOs for the digital inputs will be sent when the input signals have changed (change of status).

The TPDOs for the analog inputs will be sent and the RPDOs will be transferred to the analog outputs when the bus coupler has received a sync telegram.

#### Node guarding

Node guarding allows the network administrator to detect a failed slave. To detect a failed slave the master sends messages to the guarding ID (100Eh) of the slave in periodic cycles. The slave replies with a guarding message which also includes a toggle bit.

#### Life guarding

While node guarding is used by network administrators to detect a failed slave, the slave uses guarding telegrams to detect a failed master. This monitoring function of the slave is called life guarding.



To detect a broken cable and enforce a shut-down of the outputs with CANopen, the node and life guarding functions must be activated.

To activate life guarding the master must describe the Guard Time (100Ch) and the Life Time Factor (100Dh) objects. If the monitoring time resulting from

*Life Time = Life Time Factor \* Guard Time [ms]*

expires before the slave receives a guarding telegram, the RIO CANopen bus coupler activates error 6 which results in a complete shut-down of all outputs.

If one of the above mentioned objects is 0, no life guarding and thus no cable break detection is carried out.

### 5.3.3 Mapping of process data objects (PDO default mapping)

There are differences between CANopen and CANopen PCS see "Programmieranleitung CANopen PCS".

RPDO		TPDO	
RPDO1	Digital outputs module 0-3	TPDO1	Digital inputs module 0-3
RPDO2	Word output module 0	TPDO2	Word input module 0
RPDO3	Digital outputs module 4-7	TPDO3	Digital inputs module 4-7
RPDO4	Word output module 1	TPDO4	Word input module 1
RPDO5	Word output module 2	TPDO5	Word input module 2
RPDO6	Word output module 3	TPDO6	Word input module 3
RPDO7	Word output module 4	TPDO7	Word input module 4
RPDO8	Word output module 5	TPDO8	Word input module 5
RPDO9	Diagnosis interface	TPDO9	Diagnosis interface

Default mapping supports up to 8 digital modules or 6 analog modules. Installed modules are mapped to the PDOs. If less modules are installed the diagnosis interface is mapped to the unused PDOs.

The positioning and counter modules use 5 words each and are mapped to subsequent PDOs. The first 4 words are mapped to the first available PDO for word modules and the fifth word is mapped to the second available PDO for word modules.

For the maximum number of word modules the positioning and counter modules are regarded as two modules.

### 5.3.4 Mapping I/O data to PDOs

There are differences between CANopen and CANopen PCS see “Programmieranleitung CANopen PCS”.

Module type	Bytes Outputs	Bytes Inputs
<b>RIO BC CANopen</b>	RPDO9 (4 bytes) Unsigned 32	TPDO9 (4 bytes) Unsigned 32
<b>RIO EC CANopen</b>	RPDO9 (4 bytes) Unsigned 32	TPDO9 (4 bytes) Unsigned 32
<b>RIO 16 I</b>		TPDO1 or TPDO3 Byte 1                      Byte 2
Bit configuration Pin configuration		7    ...    0                      15    ...    8 X1.7.....X1.0                      X2.15.....X2.8
<b>RIO 4 I 120 VAC</b>		TPDO1 or TPDO3 Byte 1
Bit configuration Pin configuration		3                      ...                      0 (bit 4 to 7 not used) X3.3/4.3 ... X3.0/4.0
<b>RIO 4 I 230 VAC</b>		TPDO1 or TPDO3 Byte 1
Bit configuration Pin configuration		3                      ...                      0 (bit 4 to 7 not used) X3.3/4.3 ... X3.0/4.0
<b>RIO 16 O</b>	RPDO1 or RPDO3 Byte 1                      Byte 2	
Bit configuration Pin configuration	X1.7.....X1.0                      X2.15.....X2.8 7    ...    0                      15    ...    8	
<b>RIO 4 O R</b>	RPDO1 or RPDO3 Byte 1	
Pin configuration Bit configuration	3                      ...                      0 X3.3/4.3 ... X3.0/4.0 (Bit 4 to 7 not used)	
<b>RIO 8 I/O</b>	RPDO1 or RPDO3 Byte 1	TPDO1 or TPDO3 Byte 1
Pin configuration Bit configuration	X1.7.....X1.0                      X1.7.....X1.0 7    ...    0                      7    ...    0	
<b>RIO 8 I 8 I/O</b>	RPDO1 or RPDO3 Byte 1	TPDO1 or TPDO3 Byte 1                      Byte 2
Pin configuration Bit configuration	X1.7.....X1.0                      X1.7.....X1.0                      X2.7.....X2.0 7    ...    0                      7    ...    0                      7    ...    0	
	Word* Outputs	Word* Inputs
<b>RIO 4AI ±10V</b>		TPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)
<b>RIO 4AI/4AO ±10V</b>	RPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)	TPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)
<b>RIO 4AI 20mA</b>		TPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)
<b>RIO 4AI/4AO 20mA</b>	RPDO2/4/5/6/7/8 Word 1 to 4 (channel 0 to 3)	TPDO2/4/5/6/7/8 Word 1 to 4 (channel 0 to 3)
<b>RIO T10-10</b>		TPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)
<b>RIO T20-10</b>		TPDO2/4/5/6/7/8 Word 1 to 4 (Channel 0 to 3)
<b>RIO C24-10</b>	RPDO2/4/5/6/7/8 Word 1 to 5 (in two subsequent PDOs)	TPDO2/4/5/6/7/8 Word 1 to 5 (in two subsequent PDOs)
<b>RIO P24-10</b>	RPDO2/4/5/6/7/8 Word 1 to 5	TPDO2/4/5/6/7/8 Word 1 to 5

(in two subsequent PDOs)

(in two subsequent PDOs)

\*1 word = 2 bytes



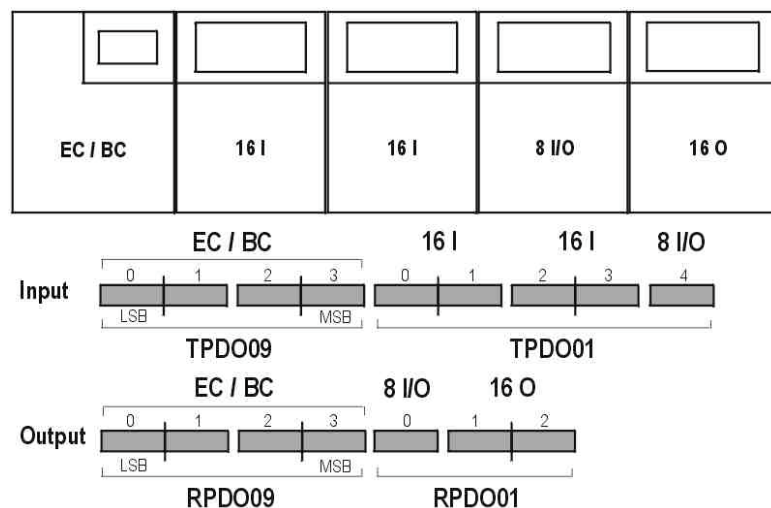
Up to 8 expansion modules can be operated on the CANopen bus coupler. The following restrictions apply:

- The total of all data bytes must not exceed 64 bytes.
- A maximum of 6 word modules can be operated simultaneously, in which case the total of data bytes in the word range must not exceed 48 bytes. More than 6 modules are allowed for variable mapping.
- The positioning and counter modules are regarded as two word modules in default mapping.
- The power consumption of the connected expansion modules must not exceed the output power of the BC CANopen power supply. See also chapter **Bus node power consumption** on page 94.

The current process data width can be determined with **Service function 3** and **Service function 4** (page 110) or diagnosis **Function 3** (page 118).

### Example of PDO mapping

Bus node configuration and PDO mapping:



### 5.3.5 EDS files

You can download files for all Schleicher devices free of charge from our web site at [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

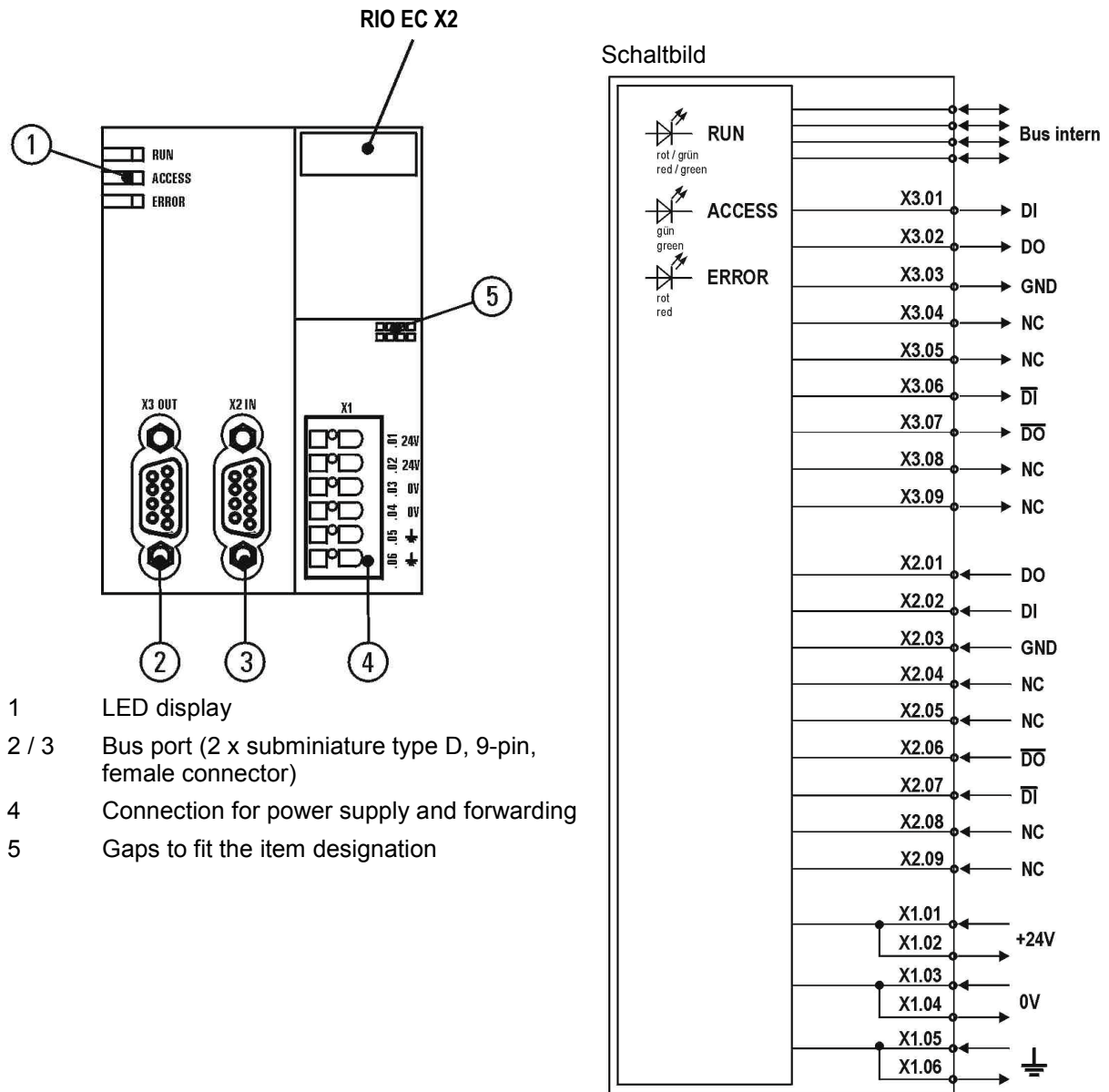
### 5.3.6 Commissioning with ProCANopen

See the Commissioning Field Bus Systems operating manual, order no. 322 152 48.

All operating manuals can be downloaded free of charge from [www.schleicher-electronic.com](http://www.schleicher-electronic.com).

## 6 XRIO

### 6.1 RIO EC X2 bus coupler

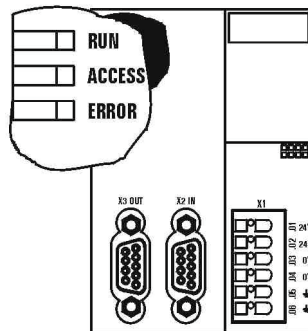


On every RIO EC X2 eighth expansion modules of the modular RIO system can be connected. to controls of the XCx family about a XRIO connection. Up to 4 RIO EC X2 can be cascaded.

RIO EC X2 Specifications	
Bus port	XRIO
Power supply to module	24V DC +/- 20%
Residual ripple (power supply)	Max. 5%
Power consumption	See <b>Bus node power consumption</b> on page 94
Number of attachable expansion modules	8 see <b>Bus node power consumption</b> on page 94

See also **Specifications for all bus couplers** from page 131.

### 6.1.1 LED display on the bus coupler



LED	Color	Status	Meaning
RUN	green	off	No power supply
		on	Data transmission between coupler and expansion modules is running.
	red	on	Data transmission between coupler and expansion modules is put back, e.g. PLC stop or data transmission error.
ACCESS	green	on	The PLC accesses the bus coupler, data transmission is running.
ERROR	red	on	Data transmission error in the actual data transmission between PLC and bus coupler.

### 6.1.2 Bus port

<p><b>X2 IN</b></p> <p>Subminiature type D, 9-pin, female connector</p>	1	DO	Output data
	2	DI	Input data
	3	GND	Ground Data
	4	NC	
	5	NC	
	6	/DO	Output data inveted
	7	/DI	Input data inveted
	8	NC	
	9	NC	
<p><b>X3 OUT</b></p> <p>Subminiature type D, 9-pin, female connector</p>	1	DI	Input data
	2	DO	Output data
	3	GND	Ground Data
	4	NC	
	5	NC	
	6	/DI	Input data inveted
	7	/DO	Output data inveted
	8	NC	
	9	NC	



## 6.2 XRIO field bus

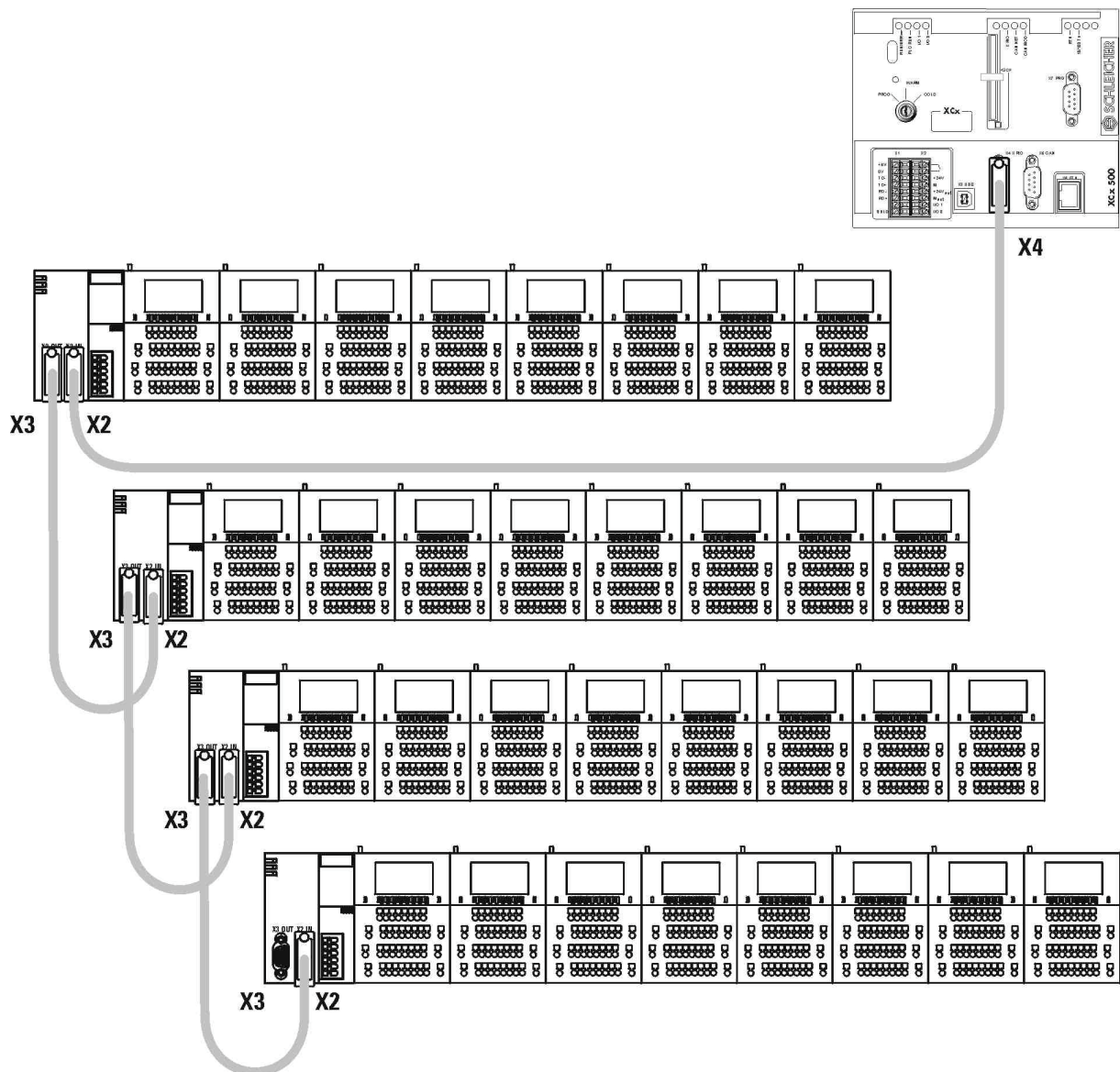
XRIO is the specific Schleicher field bus with efficient and fast data exchange. XRIO is built up electrically like InterBus-S. It is a point-to-point connection with one data line per transmission direction according to RS422 with a 500 kBaud data transfer rate.

The bus coupler has interfaces for each incoming and outgoing data lines.

Up to 4 bus couplers RIO EC X2 can be cascaded.

The maximum cable length is 10 meters point to point

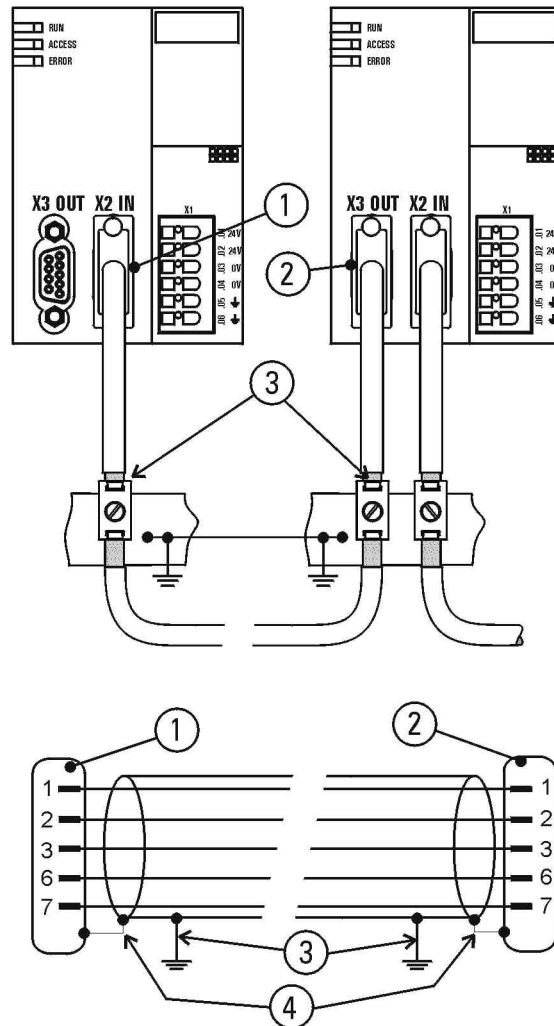
Cheap shielded bus cables can be used with customary plug connectors.



XRIO maximum configuration with XCx 500

## 6.2.1 Bus cables

The bus cables must be shielded.  
The maximum cable length from point to point is 10 meters.



- 1 Subminiature type D, 9-pin, male connector
- 2 Subminiature type D, 9-pin, male connector
- 3 Shield connection to earth near the device
- 4 Shield connection on the connector housings

Using of 1:1 cable is also possible. All pins can be connected.



The guidelines in the Electrical installation chapter apply to all bus couplers and must be followed.

## 6.2.2 Configuration and commissioning XRIO

The configuration and commissioning is carried out fully automatically at a SPS from the XCx family. In the programming software ProdocPlus the XRIO configuration tool is available. See operating manual XCx

You can download all our operating manuals free of charge from our web site at [www.schleicher-electronic.com](http://www.schleicher-electronic.com) or order them by writing to the following address (please quote part no.):

SCHLEICHER Electronic  
GmbH & Co. KG  
Pichelswerderstraße 3-5  
D-13597 Berlin  
Germany

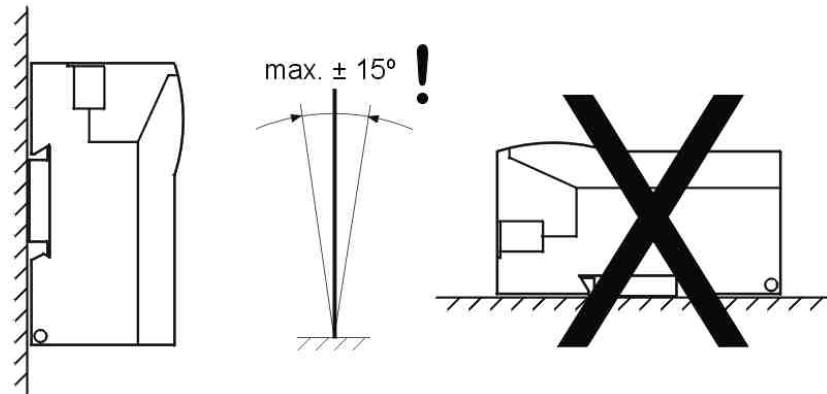
## 7 Installation

### 7.1 Mechanical installation

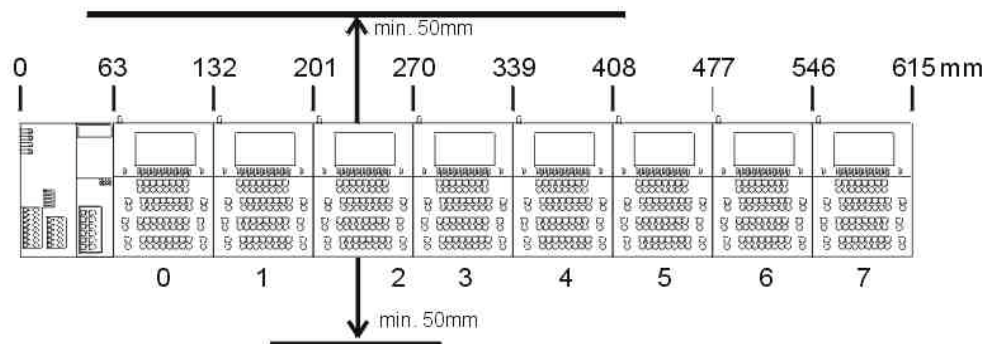
#### 7.1.1 Mounting position for the EC and BC bus couplers



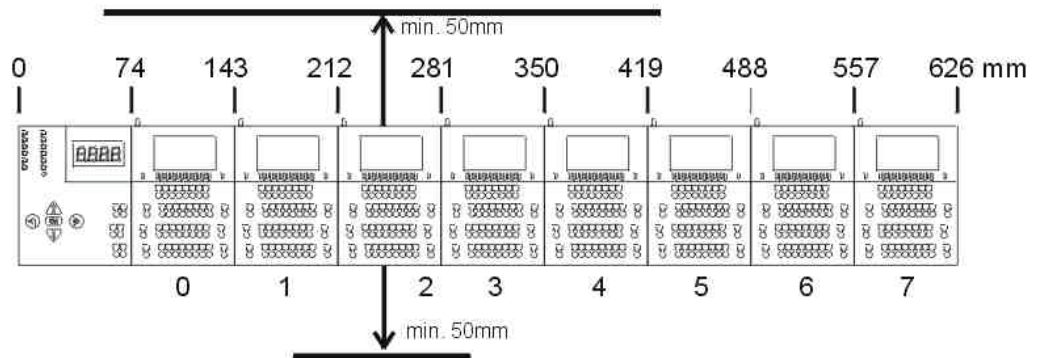
Modules must be installed vertically.



#### 7.1.2 Mounting dimensions and distance between modules – EC bus coupler



### 7.1.3 Mounting dimensions and distance between modules – BC bus coupler

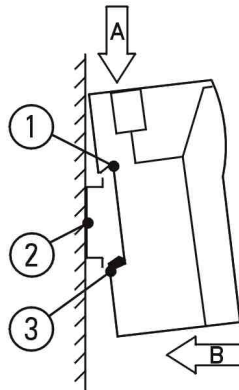


Do not attach more than 8 modules to one bus coupler. We do not recommend attaching more than 8 modules to one bus coupler.

#### 7.1.4 DIN rail installation

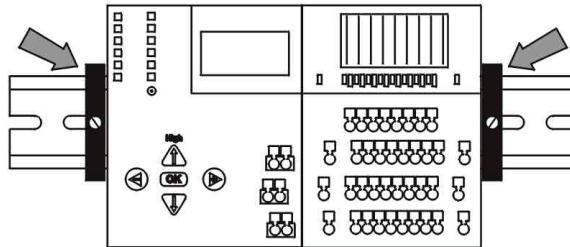
Use DIN rail type TS 35mm/7.5 to DIN EN 50022.

##### Installation

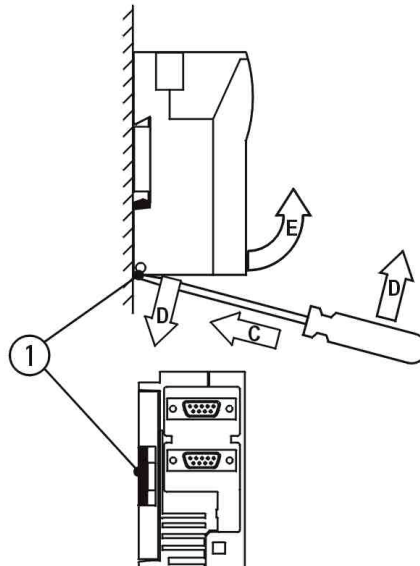


- A** Tilt device slightly and position in guide (1) on DIN rail (2).
- B** Push device towards DIN rail (2) until the latch (3) locks into place.

Install the modules directly next to each other and secure them with an end clip.



##### Dismantling



- Open the orange slide contact on top of the module (move to the right).
- C** Insert screwdriver in latch (1).
- D** Use the screwdriver to lever the latch downwards. The latch remains in the open position.
- E** Tilt device and remove it. Push the latch (1) back into place.

### 7.1.5 Connecting modules with each other

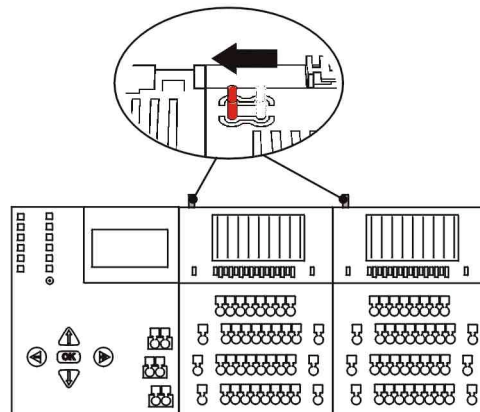
The orange slide contacts on top of the module connect the modules to the bus coupler.



Make sure that the slide contacts are open when actuating (opening) the spring terminals in order to reduce mechanical wear on the contact points.

Align the modules before you close the slide contacts. Do not use force when closing the slide contacts.  
Close the slide contacts before commissioning the unit.

Do not open the slide contacts during operation.

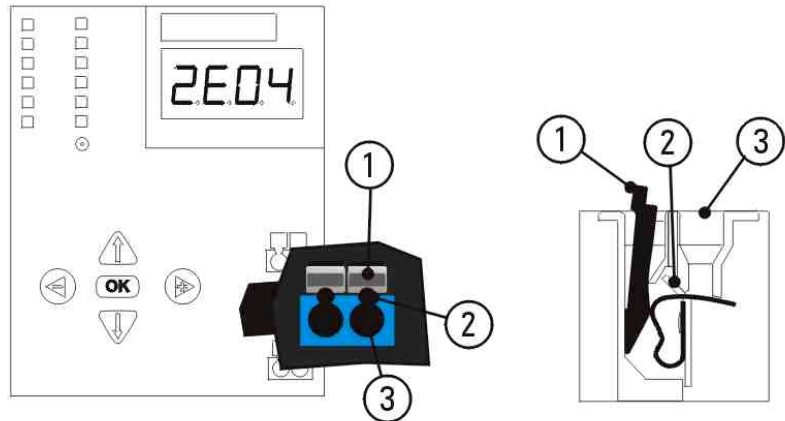






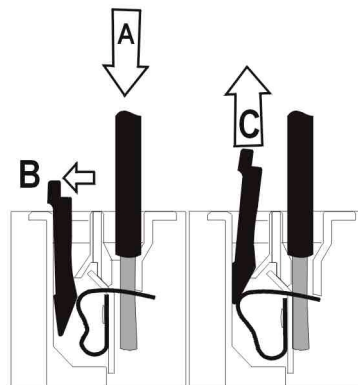
## 7.2.2 Spring terminals of the BC bus coupler

At delivery: Terminals open



The terminals are pre-tensioned with a clamping key (1). The terminal area (3) is open. Each terminal has a measuring point (2) which can be accessed using a normal 2mm test prod.

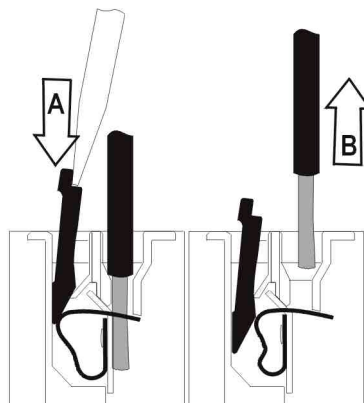
### Closing the terminal



**A** Insert wire in terminal area. Push the clamping key towards **B**. The clamping key is pushed up towards **C** by the tension of the spring and remains in the terminal.

### Opening the terminal

Make sure that the slide contacts of the module are open before opening the terminals to reduce mechanical wear on the contact points.

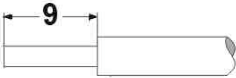
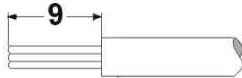


Use the screwdriver to push the clamping key towards **A**. The clamping key levers the spring terminal open and remains in this position. Remove the cable by pulling it towards **B**.



You can also open the spring terminal without a clamping key. Use a screwdriver in place of the clamping key.

### 7.2.3 Conductor sizes and stripping length

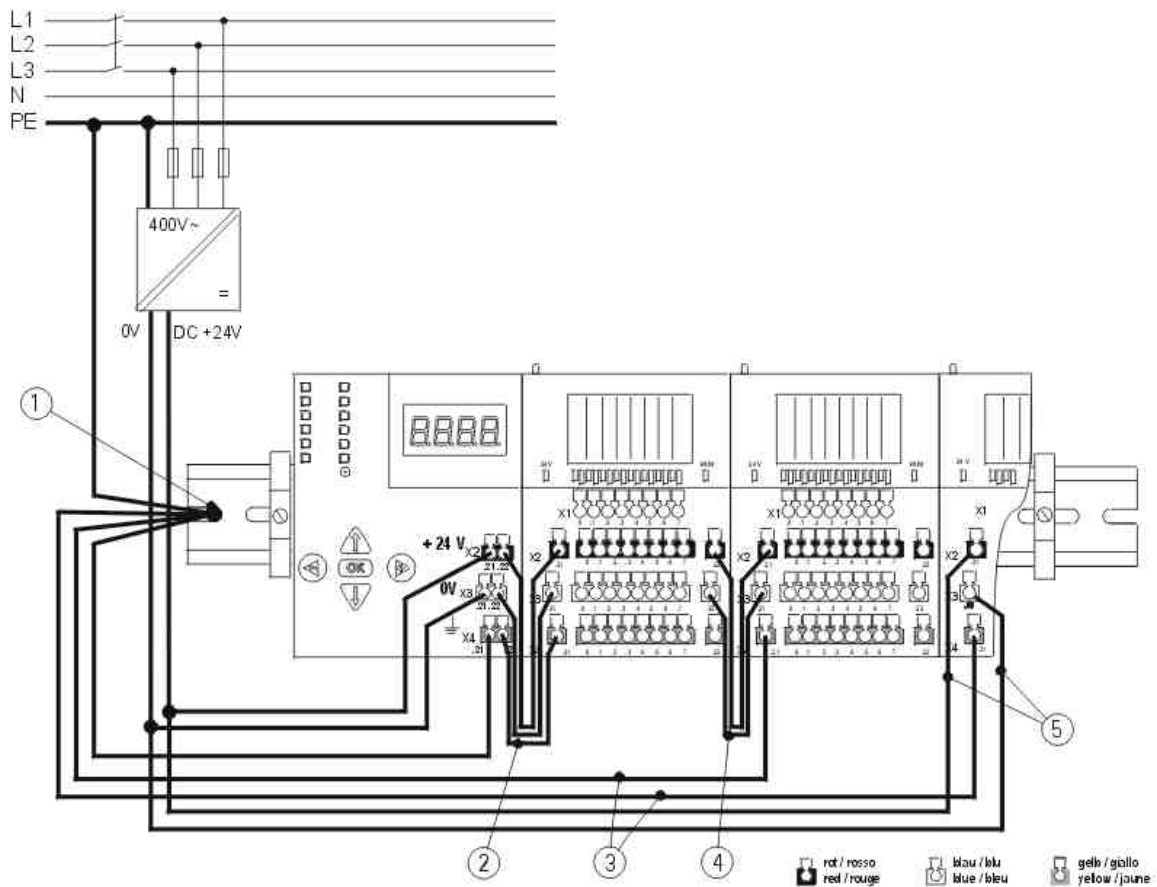
#### EC bus coupler

 <p>0,5 - 2,5 mm<sup>2</sup> 20 - 14 AWG</p>	 <p>0,14 - 1,5 mm<sup>2</sup> 26 - 16 AWG</p>
---	--

#### BC bus coupler

 <p>0,5 - 2,5 mm<sup>2</sup> 20 - 14 AWG</p>	 <p>0,14 - 1,5 mm<sup>2</sup> 26 - 16 AWG</p>
---	--

## 7.2.4 Connecting the power supply



The diagram shows a bus coupler with expansion modules of the RIO 8 I/O type.

For details on the diagram refer to the following section Installation guidelines.

## 7.2.5 Installation guidelines

### Control cabinet installation

RIO bus nodes must be installed in closed metal housings connected to ground (e.g. control boxes or control cabinets).



To protect the modules against electrostatic discharge, operators must not carry any electrostatic charge when opening control boxes or control cabinets.

### Connecting the DIN rail to ground (1)

The DIN rail which holds the modules must have a broad-surface connection to ground providing adequate conduction.

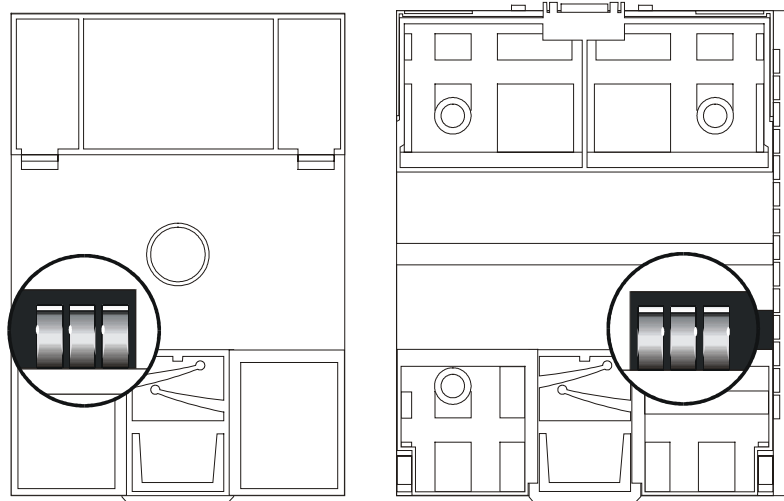
### Connecting the bus coupler and expansion modules to ground (2) (3)

The bus coupler and the 8 I/O expansion module (8I/O) have a connecting terminal marked with the ground symbol. To increase interference immunity this terminal must be connected to ground (or PE potential) with a conductor which is as short as possible (2.5mm<sup>2</sup>).

**For optimum EMC properties the first expansion module on the right of the bus coupler should be powered via the potential relay terminal on the bus coupler.**

All other modules can also be powered individually.

The contact spring located in the module clamp base is used to divert EMC interference. This spring provides the connection between the PCB shield potential and the DIN rail. Do not fit modules without a contact spring or with a defective contact spring.



Contact springs of the EC and BC bus couplers in the clamp base on the rear of the housing.

### Relaying the power supply (4)

To provide an optimum wiring the power supply can be relayed from one module to the next. When using modules with digital outputs the current on each relay terminal must not exceed a specific value. If the maximum current is exceeded an additional power supply feed must be provided (see below).

### Additional power supply feeds (5)

When relay terminals are used to relay the power supply from one module to the next the current on each relay terminal must not exceed a specific value.



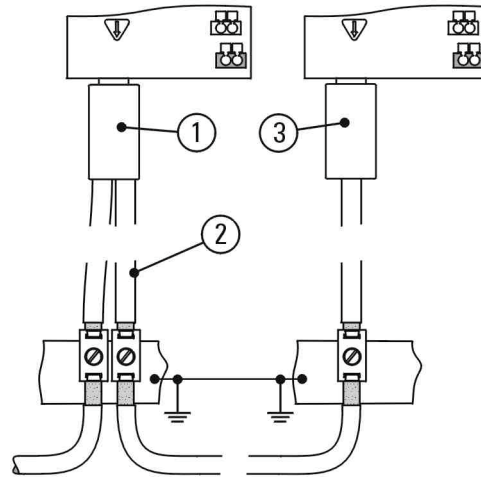
Make sure that the load on a terminal does **not exceed**  $I_{max} = 8A$ .

If the maximum current may be exceeded you need to provide additional power supply feeds.

## Shielding the bus cable

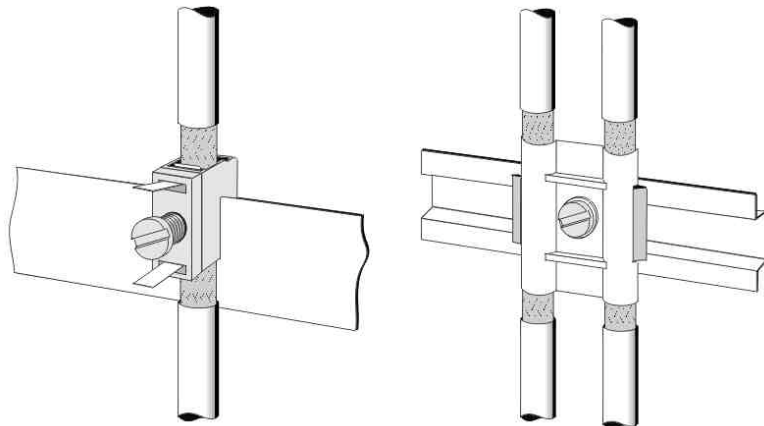
The bus cable must be shielded. The shields of the bus cables must have a broad-surface connection to the potential balance rail providing adequate conduction at the cabinet opening. The potential balance rail must be connected to ground for each electronics cabinet and connected to the potential balance rails of other cabinets. The shield must be applied on both sides.

The shield must cover the whole cable up to the bus coupler and be fitted according to the manufacturer's instructions. Ensure that contact is made over a broad surface area and that it is sufficiently conductive.



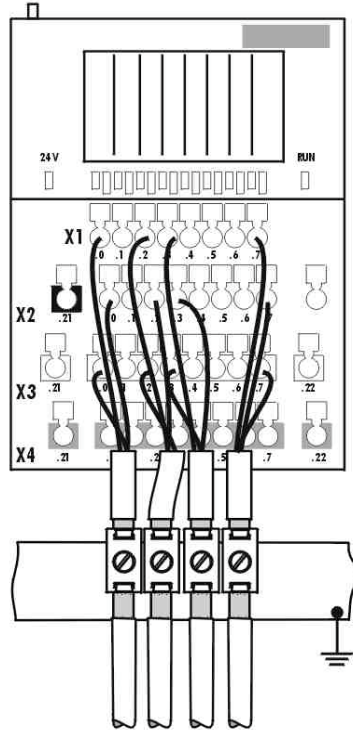
- 1 PROFIBUS node
- 2 Shielded bus cable
- 3 PROFIBUS terminator

Example of proper fitting of the shield.



## Shielding analog signal lines

Analog signal lines must be shielded. The shield must be fitted with a large-surface connection to ground in the immediate vicinity of the modules. To secure the shield use metal cable clips which surround a large area of the shield and provide a good contact to GND. The conductive shield must be fitted on both sides.



## Power supply for modules with combination channels



When using modules with digital combination channels note that you cannot connect a 24V supply to a combination channel without connecting the module to the power supply. If you do, the power supply will be fed back via the output circuit of the module. This may result in a malfunction or destruction of the output circuit.

In an emergency stop do not just switch off the power supply to the modules with combination channels. You must switch off the power supply to the modules and the sensors and actuators at the same time.

The same also applies to digital output signals if they have been incorrectly connected to 24V.

## Wiring

All digital and analog I/O lines must be wired separately from DC/AC conductors > 60V. Always wire modules vertically starting from the top to enable modules to be tilted.

## 7.2.6 Emergency stop switches

The switches and information outlined in this section are examples of setting up emergency stop devices. They are not generally applicable and cannot be used in every application.



Follow the safety guidelines and guidelines for preventing accidents (e.g. machinery safety directive) and the division in safety categories.



Emergency stop devices according to IEC 204 must be operational in all operating modes of the plant or the system.

If the emergency stop is released the bus node must restart without uncontrolled or undefined responses.

The examples refer to bus nodes with 8I/O expansion modules fitted with combination channels.

If combination channels are used and emergency stop is triggered the power supply to the module and the sensors and actuators must be turned off at the same time. It is therefore a good idea to supply power to sensors and actuators via the modules.

If a separate power supply is used it must be turned off when the emergency stop is triggered.

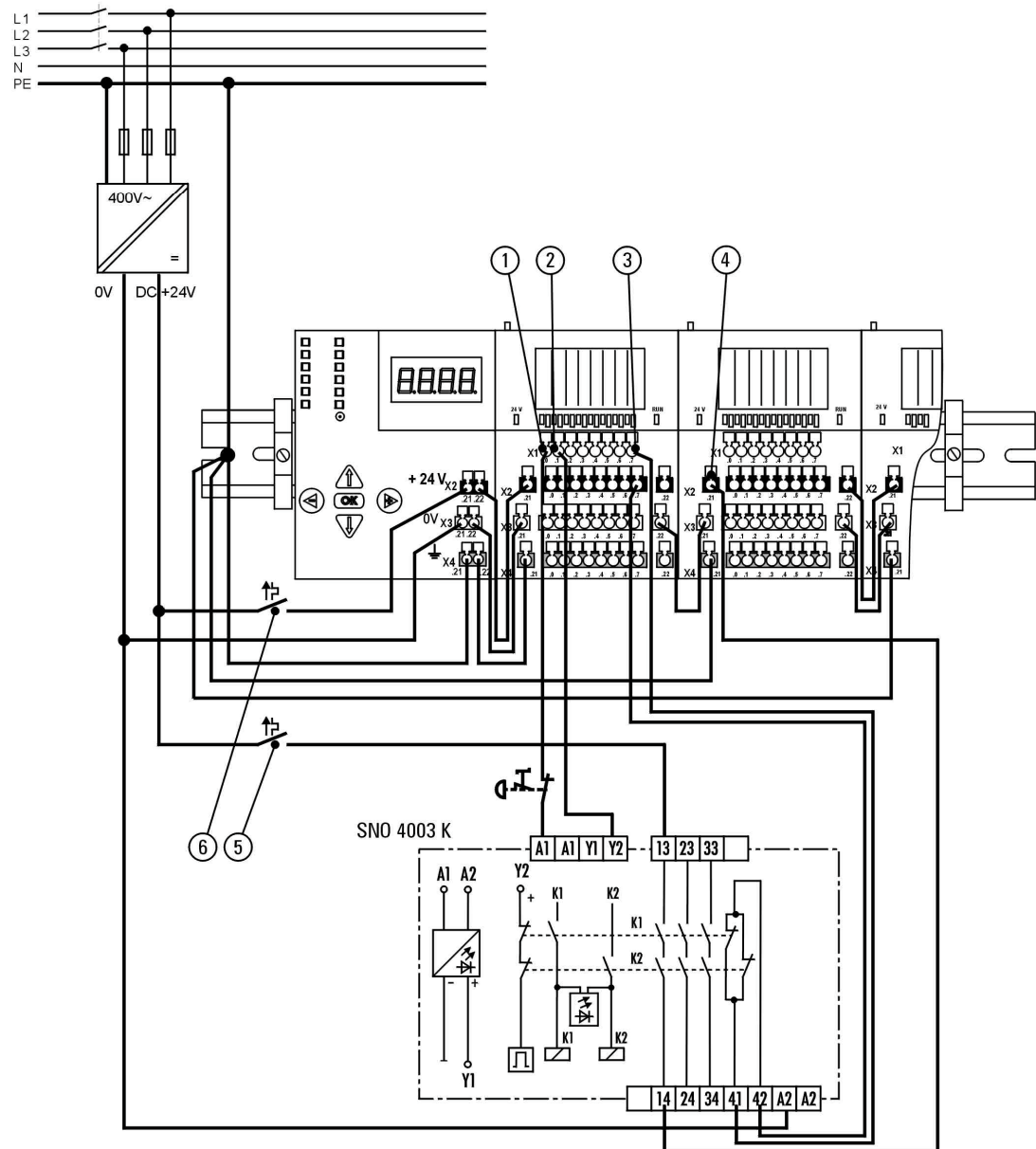
All control circuits are fitted with the SNO 4003 K emergency stop relay from SCHLEICHER.

## Emergency stop circuit with partial disconnection of expansion modules

In this case the bus coupler and the first module are not turned off. This enables you to release the emergency stop from the PLC and initiate a restart.

However, the first module is reserved for the emergency stop circuit and cannot be used to process sensors and actuators.

If the bus coupler or PLC stop fails an emergency stop is forced via output (1) because the output switches to zero (preferred shut-off state must be set to zero).

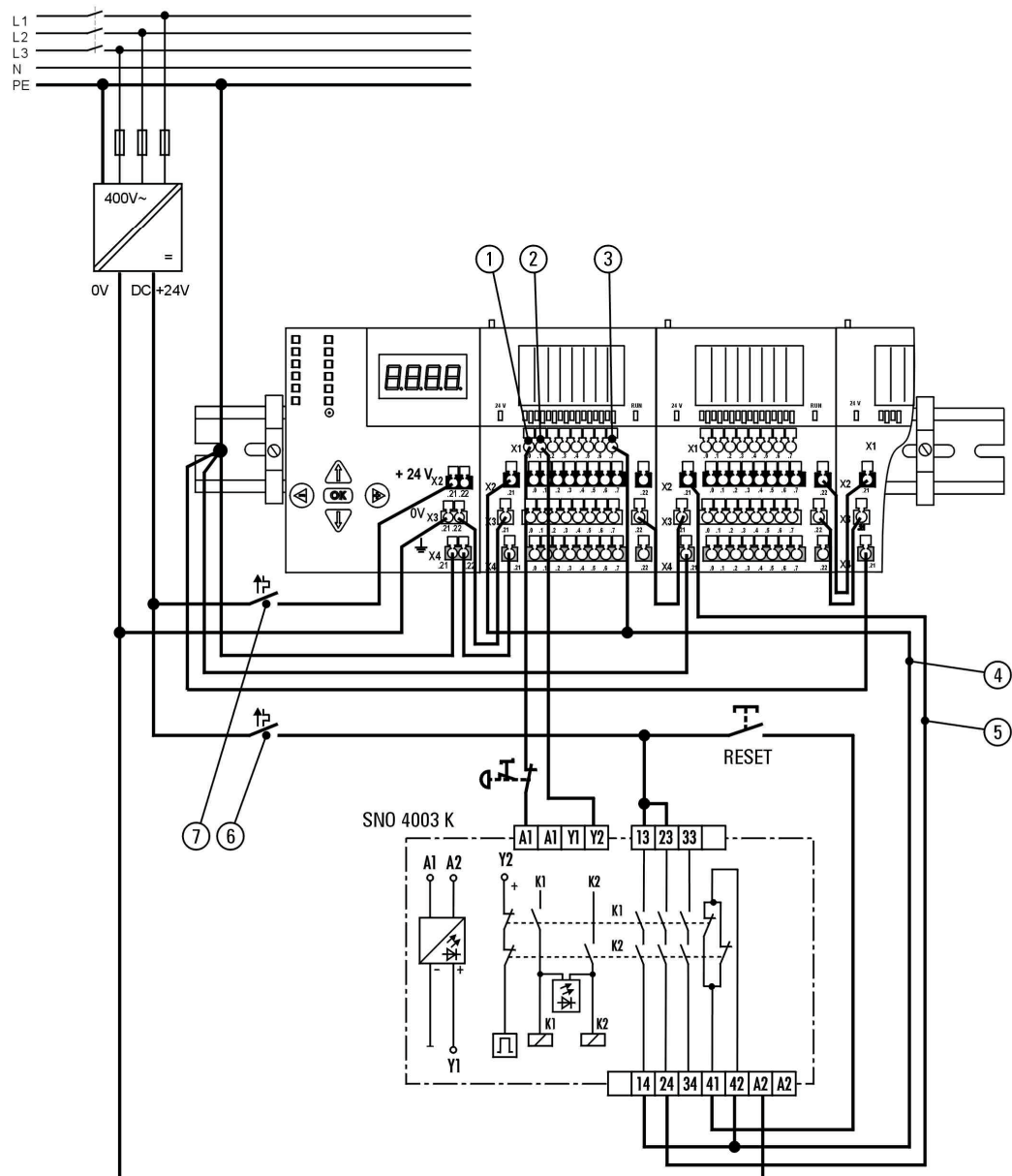


- |   |   |
|---|---|
| 1 | Emergency stop output signal active (permanent signal)<br>The PLC can force an emergency stop via this output if necessary. |
| 2 | Release emergency stop output signal (pulse signal)   |
| 3 | Emergency stop input signal not triggered<br>Can be used to check the emergency stop status via the PLC.                    |
| 4 | Power supply feed (with disconnection via emergency stop)   |
| 5 | Power supply for expansion modules 2 to n (with automatic circuit breaker, max. 6A).  |
| 6 | Power supply for bus coupler and first expansion module (with automatic circuit breaker).                                   |



## Emergency stop circuit with disconnection of all expansion modules

If all modules are turned off the first module can also be used for control tasks. However, to initiate the bus node the RESET key must be used to supply the first expansion module with power. If the bus coupler or PLC stop fails an emergency stop is forced via output (1) because the output switches to zero (preferred shut-off state must be set to zero).



1	Emergency stop output signal active (permanent signal) The PLC can force an emergency stop via this output if necessary
2	Release emergency stop output signal (pulse signal)
3	Emergency stop input signal not triggered Can be used to check the emergency stop status via the PLC.
4	Power supply feed at emergency stop for the first module (emergency stop can be bypassed with RESET key).
5	Power supply feed (with disconnection via emergency stop) for all following modules.
6	Power supply for all expansion modules (with automatic circuit breaker).
7	Power supply for the bus coupler (with automatic circuit breaker).

## 8 Bus node power consumption

### Load of the internal 5V power supply

The bus coupler is supplied with a built-in power supply unit which provides the internal 5V power supply for the expansion modules from the 24V power supply.

To determine the load of the internal 5V power supply the maximum power consumption of every expansion module connected to it must be added together.



The maximum load of the internal 5V power supply is 5 watts.

If the maximum load is exceeded expansion modules must be removed from the bus node.

Power consumption of expansion modules from the internal 5V power supply (maximum values)	
RIO 16 I	0.275W
RIO 4 I 120 VAC	0.2W
RIO 4 I 230 VAC	0.2W
RIO 16 O	0.325W
RIO 4 O R	0.25W
RIO 8 I/O	0.325W
RIO 8 I 8 I/O	0.325W
RIO 4AI ±10V	0.325W
RIO 4AI/4AO ±10V	0.325W
RIO 4AI 20mA	0.325W
RIO 4AI/4AO 20mA	0.325W
RIO 4AI 4-20mA	0.325W
RIO 4AI/4AO 4-20mA	0.325W
RIO T10-10	0.325W
RIO T20-10	0.325W
RIO C24-10	1.1W
RIO P24-10 / RIO P05-10	1.25 W
RIO A10-10	0.5 W

## Power consumption from the external 24V power supply

To determine the power consumption of a bus node from the external 24V power supply the power consumption of the bus coupler and the power consumption of the expansion modules connected to it must be added together.

The power consumption of the bus coupler is calculated by adding the bus coupler's own consumption (5 watts) to the internal (5V power supply) consumption of the expansion modules connected to it.

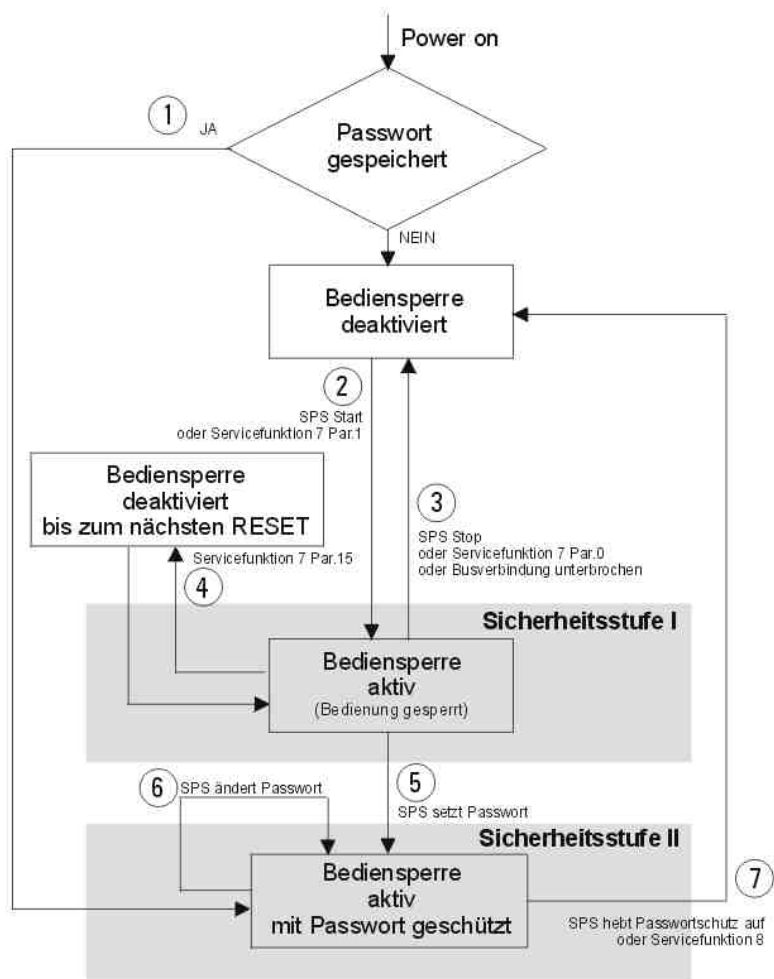
Power consumption from the external 24V power supply (maximum values) for the bus coupler and expansion modules		
Bus coupler	5W + total of internal power consumption (from internal 5V power supply) of the expansion modules connected to it	
RIO 16 I	0.25W	Without input currents
RIO 4 I 120 VAC	None	
RIO 4 I 230 VAC	None	
RIO 16 O	0.25W	Without load currents
RIO 4 O R	2W	
RIO 8 I/O	0.25W	Without input / load currents
RIO 8 I 8 I/O	0.25W	Without input / load currents
RIO 4AI ±10V	3.6W	With maximum load on analog outputs
RIO 4AI/4AO ±10V	4.3W	
RIO 4AI 20mA	3.6W	
RIO 4AI/4AO 20mA	6W	
RIO 4AI 4-20mA	3.6W	
RIO 4AI/4AO 4-20mA	6W	Including load current 4 x PT 100
RIO T10-10	3.8W	
RIO T20-10	2.9W	
RIO C24-10	0.25W	Without input / load currents
RIO P24-10 / RIO P05-10	0.25 W	Without input / load currents
RIO A10-10	2.1 W	Without input / load currents

## 9 User lock-out of the BC bus coupler

Some functions which you can access via the keypad of the bus coupler must be protected against unauthorized use as they will have a direct impact on the operation of the controlled plant.

A user lock-out is therefore provided for FORCE, LOCK, STOP modes and service functions 1, 2, 5, 6, 9, 10.

You can activate a user lock-out on **safety level I or II**. Safety level II uses a password protection.



Key to picture:

Power on

1 Password saved YES / NO

User lock-out deactivated

2 PLC Start or Service function 7 par. 1

3 PLC Stop or Service function 7 par. 0 or bus connection interrupted

4 User lock-out deactivated until next Reset

Service function 7 par. 15

Safety level I

5 User lock-out active (Operation locked)

PLC sets password

6 PLC changes password

### Safety level II

User lock-out active, password-protected

PLC releases password protection or service function 8

1. When you switch the bus coupler on it will check whether or not a password has been saved in the bus coupler. If a password has been saved the user lock-out on safety level II will be activated.
2. If no password has been saved the unit can be operated until the PLC or bus is started. The user lock-out will be activated on safety level I when you start up the PLC.
3. If the PLC is stopped, a bus cable breaks or you enter service function 7 (page 110) using parameter 0000 the user lock-out function will be disabled.
4. If you have to carry out maintenance work on the unit you can use service function 7, parameter 0015 to disable the user lock-out function until you reset the bus coupler again.
5. The PLC can lock the operation with a password via the diagnosis data (diagnosis code 6). The password will be saved in the bus coupler. The password must be a four-digit number between 0000 and 9999.
6. The password can be changed at any time from the PLC.
7. If you enter the password on the bus coupler (via service function 8, password as the parameter) the user lock-out will be deactivated. The password will not be deleted.  
If the PLC changes the password to 0000 the password protection is deactivated and the password in the bus coupler is deleted.



Confirm or cancel activation of the above operating modes and service functions with error code E016 (on safety level I) or error code E017 (on safety level II).

---

## 10 Operating modes of the BC bus coupler

### 10.1 Overview of operating modes

Operating modes	Description
<b>RUN</b>	Bus interface running, I/Os are refreshed, active LOCK and TRIGGER conditions are analyzed. You can display the control states of individual I/O channels on the bus coupler.
<b>FORCE</b>	You can use this mode to set the control status of individual I/O channels. FORCE overrides the I/O control states and the lock definitions.
<b>TRIGGER</b>	After a trigger event the I/O map will be saved with a memory depth of 20. The trigger event is an I/O status change that can be defined.
<b>LOCK</b>	Like FORCE but used to permanently set the control status of individual I/O channels. The LOCK definition will be stored permanently in the bus coupler.
<b>STOP</b>	RUN mode is interrupted. I/O refresh is switched off. The unit is set to a preferred shut-off state (see diagnosis code 5).

RUN mode is active after the bus coupler has been switched on.  
The FORCE, TRIGGER, LOCK modes can be activated during RUN mode. The RUN mode will not be interrupted.



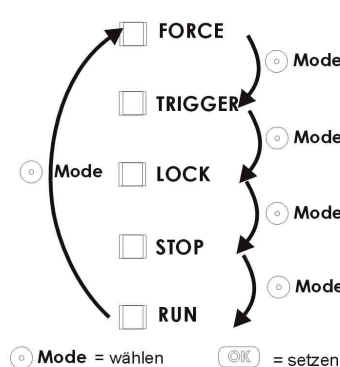
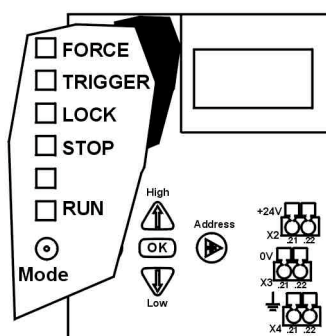
FORCE and LOCK directly influence the control states of I/O channels. Beware of dangerous operating states in the controlled processes!

Take appropriate measures to prevent invalid operating states.

#### Setting operating modes



The bus coupler is protected from unauthorized operation by a user lock-out.  
To select an operating mode the user lock-out must be deactivated.  
See User lock-out of the BC bus coupler on page 96



Press the Mode key to move the flashing LED from one mode to the next.  
Press OK to confirm the selected mode.

## Display of the active operating mode

The active operating mode and its sub-modes are indicated by the respective LED. In addition, the following information is shown on the bus coupler display:



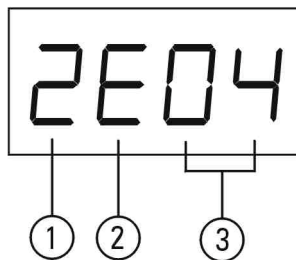
RUN mode



STOP mode

## Display of the selected I/O channel

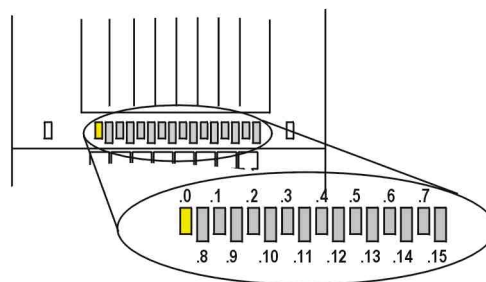
If you manually select a channel in RUN mode with Display, FORCE, TRIGGER and LOCK mode the following will be displayed:



1. Hexadecimal number of the expansion module
2. Input (E) or output (A)
3. Channel # (decimal)

Example: 2E04 module 2, input, channel 4

## Display of the channel cursor



In RUN with FORCE, TRIGGER, LOCK mode and Display mode the two-color channel LED turns yellow (= channel cursor) when you press the left or right key. This has no impact on the control state of the respective input/output.

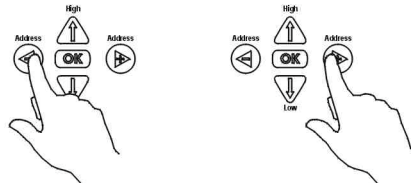
Each channel LED is assigned to a channel (0-15).  
On 8-channel modules only channel LEDs 0-7 are active.  
On analog modules the channel LEDs 0, 2, 4, and 6 are assigned to the inputs, LEDs 8, 10, 12, and 14 to the outputs.

## 10.2 RUN

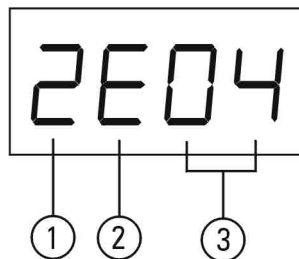
In RUN mode I/O channels are refreshed with the current PLC data.

### Display mode

In RUN mode you can select Display mode. This continuously shows the current control status of an I/O channel on the bus coupler display. Select the channel using the left/right keys (active yellow LED on the expansion modules = channel cursor).

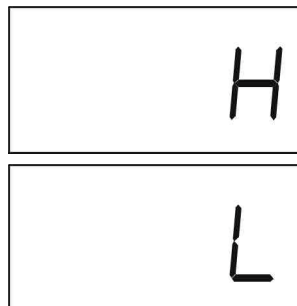


The bus coupler display shows the selected channel.



1. Hexadecimal number of the expansion module
2. Input (E) or output (A)
3. Channel # (decimal)

Example: 2E04 module 2, input, channel 4



The control status will be displayed after about 0.5s and is updated continuously. On analog channels the current/voltage will be displayed in mV or  $\mu$ A.

Press OK to exit Display mode.



## 10.3 FORCE

**FORCE mode allows you to set the control status of individual I/O channels.**



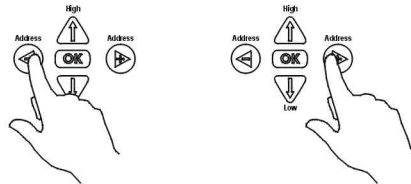
FORCE has a direct impact on the control states of I/O channels. FORCE overrides any control states set using LOCK.

Beware of dangerous operating states in the controlled processes! Take appropriate measures to prevent invalid operating states.

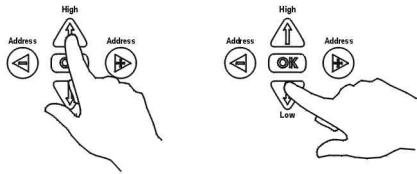
### Procedure

Press the Mode key to select FORCE. Press OK to confirm your selection.

Select the channel using the Left/Right keys. (The selected channel will be displayed on the bus coupler. The active yellow LED on the expansion modules is the channel cursor.)



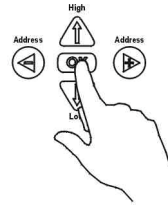
Select the control status using the High/Low keys.



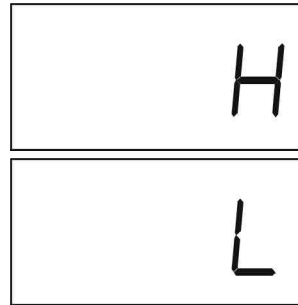
The selected control status is immediately active.

If you have selected an analog channel the input/output value will be increased/reduced by 100mV or 100µA every time you press one of the keys.

Press OK to review the FORCE status of a selected channel.



The FORCE status is displayed for approx. 0.5s after you have pressed the OK key. On analog channels the input/output value will be displayed in mV or  $\mu$ A.



The channel LED of the forced channel is yellow even if you move the channel cursor to a different channel.

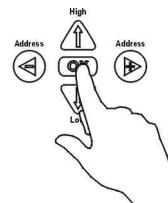
#### Resetting FORCE for all channels

Exit FORCE mode.

#### Resetting FORCE for one channel

Move the channel cursor to the channel which you want to reset and press OK 3 times.

**3X**



The display briefly looks as follows:



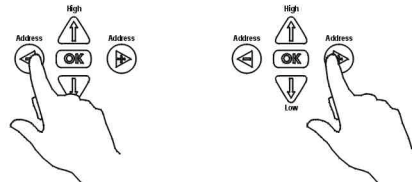
## 10.4 TRIGGER

**TRIGGER mode is used to display the last 20 saved changes to the digital process map when a trigger condition occurs.**  
**Not for analog modules.**

### Procedure

Press the Mode key to select TRIGGER. Press OK to confirm your selection.

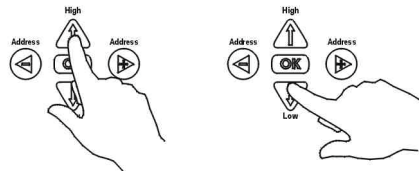
Select the channel which you want to use to activate the trigger stop:  
Move the channel cursor using the Left/Right keys.



Set the trigger condition using the High/Low keys.

High key: Triggers to rising edge

Low key: Triggers to falling edge



You can define any number of inputs and outputs as trigger inputs.  
They are linked by OR which means that the trigger condition which is fulfilled first ends the recording.

Press the Mode key to set the mode back to RUN and press OK. The trigger function is active when you have returned to RUN.

The display shows the trigger status as follows:



Trigger condition defined.  
The I/O maps will now be saved every time data is modified.



Trigger condition defined and occurred.  
No more maps are saved.

## Display of the last 20 I/O maps

Return to TRIGGER mode when the trigger condition has been fulfilled. E-00 is displayed. The last current input map when the trigger condition occurred is now displayed as a yellow LED on the expansion module. Use the Left key to see the previous map. The display will show the previous number E=n (n=0..19). Use the Right key to display the next map.

Use the High key to set the display to input and the Low key to set it to output.

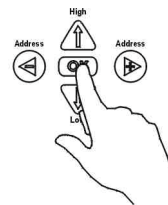
## Resetting the trigger condition

Press the Mode key to select TRIGGER. Press OK to confirm your selection.

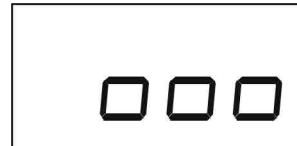
### Trigger condition is not fulfilled:

Move the channel cursor to the channel which you want to reset and press OK 3 times.

**3X**



This deletes one trigger condition. The display briefly looks as follows:



### Trigger condition is fulfilled:

If a trigger condition has been fulfilled delete all the trigger conditions and the trigger buffer by pressing OK 3 times.



Trigger conditions are not permanently stored. They are, however, stored until the bus coupler is switched off.



Trigger function not available from BC/EC CANopen version 01.45

## 10.5 LOCK

**LOCK mode allows you to permanently set the control status of individual I/O channels.**

### Procedure

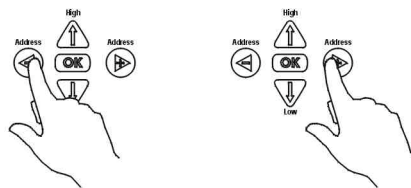


LOCK has a direct impact on the control states of I/O channels.  
Beware of dangerous operating states in the controlled processes!

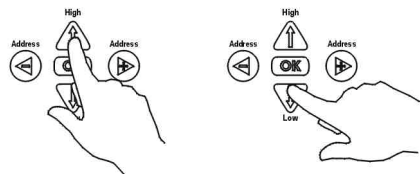
Take appropriate measures to prevent invalid operating states.

Press the Mode key to select LOCK. Press OK to confirm your selection.

Move the channel cursor to the desired channel using the Left/Right keys.



Use the High/Low keys to select the control status.

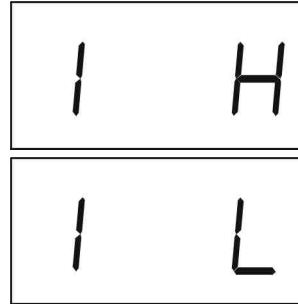


If you have selected an analog channel the input/output value will be increased/reduced by 100mV or 100μA every time you press one of the keys.



The selected control status is immediately active.

The selected control status will be briefly displayed.



The LOCK setting will be permanently stored in the bus coupler when you exit LOCK mode. Do not switch the bus coupler off for about 5 seconds after exiting the mode.

As in FORCE you can review the current control status by pressing OK. The value with which the channel is LOCKed will be displayed when you press OK.

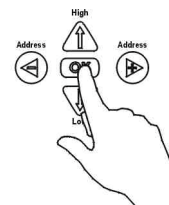
You can recognize LOCK by the vertical bar in the display.



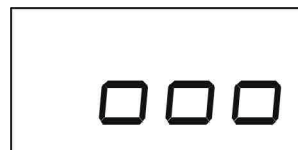
### Resetting the LOCK status

Go to LOCK mode and move the channel cursor to the channel which you want to reset. Press OK 3 times.

**3X**



The display briefly looks as follows:



## 10.6 STOP

**In Stop mode all inputs/outputs are switched off, i.e. all outputs are set to zero and are no longer refreshed. Inputs are no longer sent to the PLC.**



If a preferred shut-off state has been set this state is adopted in Stop mode. For preferred shut-off states see parameterizing function 5.

Channels whose control status was set using LOCK will **not** be overridden by the preferred shut-off state.

If you have set shut-off code 2 for a module the I/O channels of this module will continue to be refreshed.  
The shut-off code is set using parameterizing and diagnosis function 5.

## 11 Service functions on the BC bus coupler

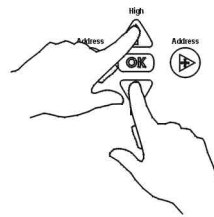
The BC bus coupler allows you to carry out service functions via the integrated keypad and the display.

### 11.1 Overview of service functions

Service function 1	Reserved
Service function 2	Set baud rate
Service function 3	Display process data width of inputs
Service function 4	Display process data width of outputs
Service function 5	Bus coupler diagnosis range ON/OFF
Service function 6	Save specified bus node configuration
Service function 7	User lock-out ON/OFF
Service function 8	User lock-out with password
Service function 9	Advanced PROFIBUS-DP diagnosis ON/OFF
Service function 10	Byte swap mode ON/OFF
Service function 11	Delete bus coupler EEPROM
Service function 12	Display/set bus address
Service function 13	Set data width of counter and positioning modules

### 11.2 Selecting and using a service function

Press the High/Low keys simultaneously in RUN or STOP mode.



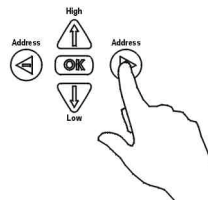
The display shows S 00.



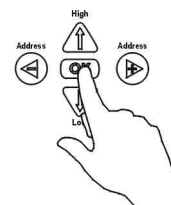
If error code E016 or E017 is displayed the user lock-out on the bus coupler is active.

Use service function 7 to deactivate the user lock-out.

Use the Right key to set the required service function.



Then press the OK key.



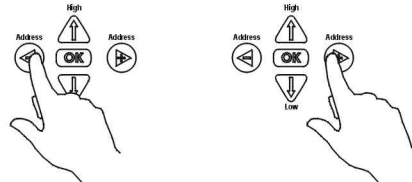


### Service function without parameters

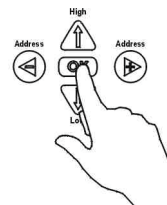
The value of this function is immediately displayed. After 1s the display returns automatically to its initial state.  
e.g. service functions 3 and 4.

### Service function with parameters

The currently set parameter value is displayed.  
Change the value with the Left/Right keys.



Press OK to confirm the new parameter.



## 11.3 Service function 1

Reserved

## 11.4 Service function 2 Set baud rate on DeviceNet and CANopen

DeviceNet	Baud rate in kBaud
Parameter = 0	125
Parameter = 1	250
Parameter = 2	500

CANopen	Baud rate in kBaud
Parameter = 0	10*
Parameter = 1	20*
Parameter = 2	50*
Parameter = 3	125
Parameter = 4	250
Parameter = 5	500
Parameter = 6	800
Parameter = 7	1000

\* not possible in moment

## 11.5 Service function 3 Display process data width of inputs

Displays the size of the input address area used by the bus node in bytes.

**11.6 Service function 4 Display process data width of outputs**  
 Displays the size of the output address area used by the bus node in bytes.

**11.7 Service function 5 Switch bus coupler diagnosis on/off**

Parameter = 1	Bus coupler uses the first 4 bytes of I/O data for diagnosis data
Parameter = 0	Bus coupler does not provide diagnosis data, and does not use the 4 bytes of the I/O data

Default setting: Parameter 1

**11.8 Service function 6 Save bus node configuration**

You can save the current bus node configuration as the specified configuration. If the configuration is changed (e.g. if a slide contact is opened accidentally) error E012 will be displayed when you switch the bus coupler on.

Parameter = 0	No specified configuration
Parameter = 1	Save current configuration as specified configuration

Default setting: Parameter 0

**11.9 Service function 7 User lock-out**

Parameter = 0	User lock-out OFF
Parameter = 1	User lock-out ON
Parameter = 15	User lock-out deactivated until next RESET

Default setting: Parameter 0 (must be confirmed with service function)  
 See also User lock-out of the BC bus coupler on page 96

**11.10 Service function 8 Deactivate user lock-out with password**

To deactivate the user lock-out enter the password specified by the PLC (a number between 0001 and 9999) as the parameter.

Parameter = 1.. 9999	Operation enabled
----------------------	-------------------

See also User Lock-out on page 96

### 11.11 Service function 9 Advanced PROFIBUS-DP diagnosis ON/OFF

Parameter = 0	Advanced PROFIBUS-DP diagnosis OFF
Parameter = 1	Advanced PROFIBUS-DP diagnosis ON

Default setting: Parameter 1

### 11.12 Service function 10 Byte swap mode

Byte swap mode changes the assignment of input/output data to the I/O maps.

Not for CANopen bus couplers.

Parameter = 0	OFF
Parameter = 1	ON for all digital expansion modules
Parameter = 2	ON for all digital expansion modules, counter, positioning and analog modules, and diagnosis data
Parameter = 3	ON for all counter, positioning and analog modules, and diagnosis data

Default setting: Parameter 0

For data assignment in the I/O map of the expansion modules refer to the RIO Expansion Modules operating manual, order no. 322 154 14.

### 11.13 Service function 11 Delete bus coupler EEPROM



All settings for the bus node configuration, bus address, lock masks and service functions are deleted or set to the default setting.

Parameter <>15	No changes
Parameter = 15	EEPROM is deleted, the default settings are set.

Press OK to confirm the service function. The following delete message appears:

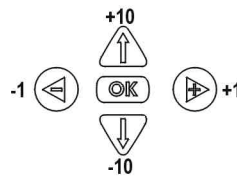


You have to switch the bus coupler power supply off and on after the delete message has disappeared.

## 11.14 Service function 12 Display/set bus address

Displays the bus address.

Change the bus address using the keypad on the bus coupler. The keys have the following values:

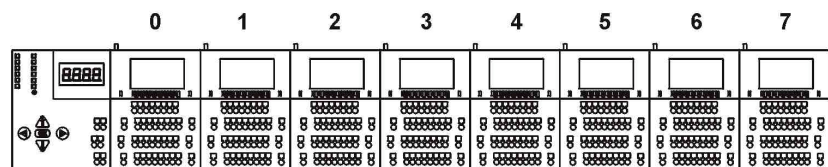


## 11.15 Service function 13 Set data width of counter and positioning modules

For counter and positioning modules only, not for BC CANopen.

Select this service function to set the module location number for the selected module.

Module location numbers:



Press OK to confirm the new values.

Set the required data width using the following parameters:

Parameter = 1	Data width 3 words
Parameter = 2	Data width 5 words

Default setting: Parameter 2

Turn the bus coupler off and on again. This will activate your new settings.

## 12 Parameterizing and diagnosis functions for all bus couplers

The PLC can initiate parameterizing and diagnosis functions in the bus coupler. To initiate a function a function code (FC) - with parameters if required - is transmitted to the bus coupler. The bus coupler executes the functions, creates diagnostic data (if required) and makes the data available for the PLC. The data can then be evaluated and processed in the user program.

### 12.1 Overview

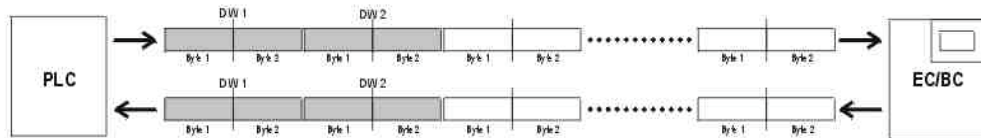
Function 0	Output group error
Function 1	Monitor module power supply
Function 0	Monitor output driver overload
Function 3	Determine bus node process data width
Function 4	Output bus node module configuration
Function 5	Set preferred shut-off state
Function 6	Activate/deactivate bus node user lock-out (BC bus coupler only)
Function 7	Determine bus node system status
Function 8	Output firmware version
Function 9	Set data formats for analog modules
Function 10	Output temperature module sensor information (PT100/PT1000)
Function 11	Mode word for temperature module with thermo elements
12..16	Reserved
Function 17	Set bus address of bus node
Function 18	Byte swap mode ON/OFF
Function 19	Advanced PROFIBUS-DP diagnosis ON/OFF
Function 20	Delete error messages
Function 21	Save/delete bus node configuration (EC bus coupler only)
Function 255	Reset

You can switch the functions on and off using service function 5 (see page 110).

If the functions are switched off no address space is used.

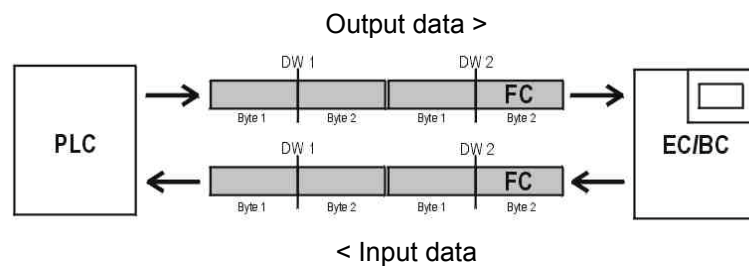
## 12.2 Data structure

Parameterizing and diagnosis data is always mapped on the first 2 words of output data (PLC --> bus coupler) and the first 2 words of input data (bus coupler --> PLC).



EC/BC = EC / BC bus coupler

Byte 2 of data word 2 (DW 2) is always reserved for the function code (FC).



## 12.3 Sequence

The PLC initiates a function by sending the relevant function code to the bus coupler in DW2 byte 2. The bus coupler executes the function within one bus or PLC cycle. Once the function has been processed, the function code is repeated in the bus coupler response in DW2 byte 2.

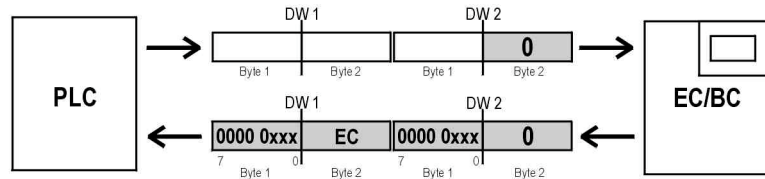


If the master uses the same function several times in sequence, function 255 (Reset) must be executed in-between. This ensures correct evaluation of the finished message from the bus coupler.

## 12.4 Function 0 Output group error

Function 0 supplies the group error message and the last error code.

Output data >



< Input data

Input data

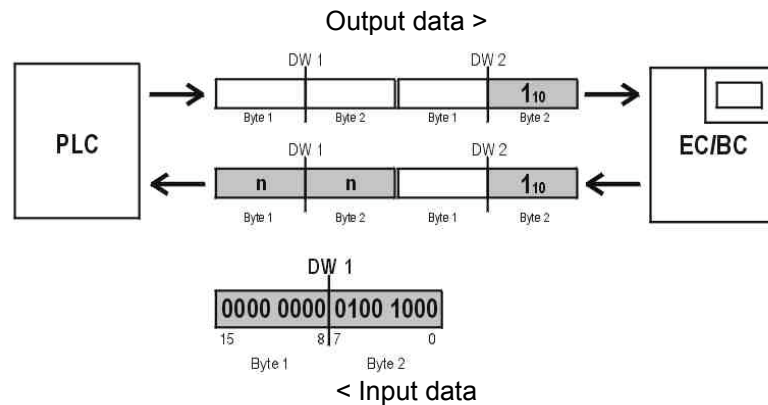
DW1 byte1	Current error bits
	Bit no.
	0 A module on the bus node signals output driver overload.
	1 A module on the bus node has signaled an error in the 24V power supply.
	2 An error message is generated and displayed on the bus coupler. The error message is transmitted in coded form in DW1 byte2 (see below).
DW2 byte1	Static error bits (error bits from DW1 byte1 saved statically) Error bits are deleted when diagnosis has been reset with function 255 (Reset) or the bus coupler has been switched off.

### DW 1 byte 2 EC (error code)

The error code is also displayed as an error message on the BC bus coupler (see error messages page 133).

## 12.5 Function 1 Monitor module power supply

Function 1 provides information on the status of the output driver power supply of the expansion modules.



In the above example the bus coupler signals a fault on the output driver power supply for expansion modules 3 and 6.

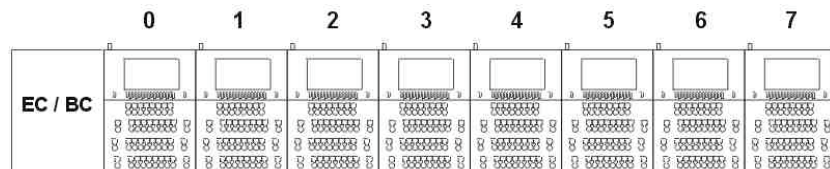
### Input data

#### DW 1, error bits 0 – 15

Bit value	Meaning
0	Output driver of expansion module at position n is correctly supplied with 24V
1	24V supply to module at position n* not connected

The module position n is the same as the bit position in the diagnosis word

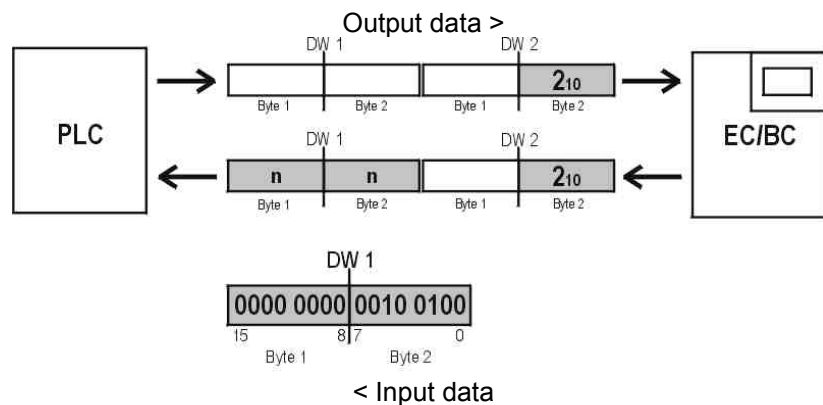
Module location numbers:





## 12.6 Function 2 Monitor output driver overload

Function 2 provides information on the status of the 24V output drivers of the expansion modules.



In the above example the bus coupler signals an overload fault on the output drivers of expansion modules 2 and 5.

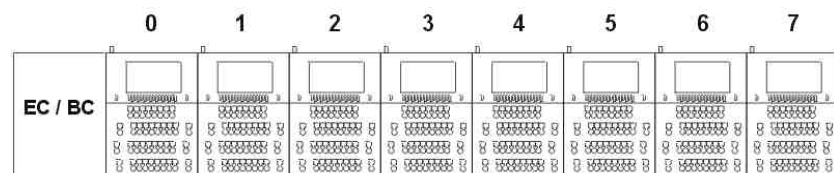
### Input data

#### DW 1, Status bits 0 –15

Bit value	Meaning
0	All output drivers of module at position n* functioning correctly
1	At least one of the output drivers of the expansion module at position n* is overloaded

\* The module position n is the same as the bit position in the diagnosis word.

Module location numbers:

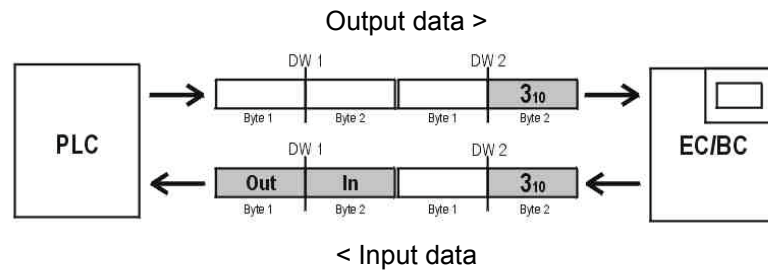


This diagnosis refers to the whole module and not to the individual channels.

This diagnosis is only applicable if the relevant module has a 24V supply. Where there is no voltage supply this diagnosis bit is irrelevant.

## 12.7 Function 3 Determine bus node process data width

Function 3 supplies the process data width of the bus node.

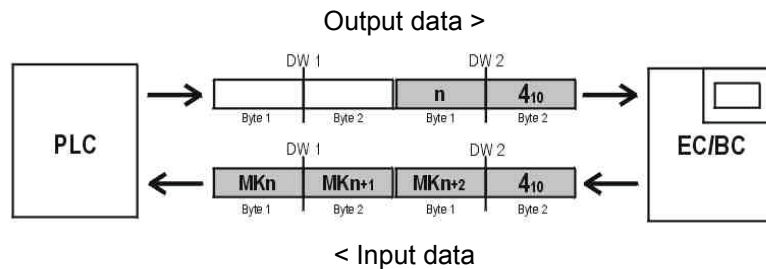


Input data

DW 1 Byte 1, Out	Number of output bytes
DW 1 Byte 2, In	Number of input bytes

## 12.8 Function 4 Output bus node module configuration

Function 4 supplies the current configuration of any 3 consecutive expansion modules.

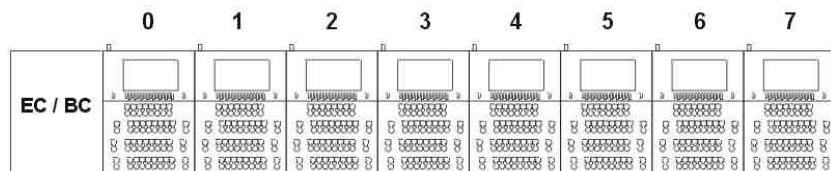


### Input data

DW 2 Byte 1, n (position of first module\*)

You have to enter the position n of the module from which the actual configuration on positions n, n+1, n+2 is to be determined.

Module location numbers:



### DW 1 and DW 2, MK (module ID)

Diagnosis words 1 and 2 provide the module IDs (MK) of the modules which are currently connected to the bus module starting from position n.

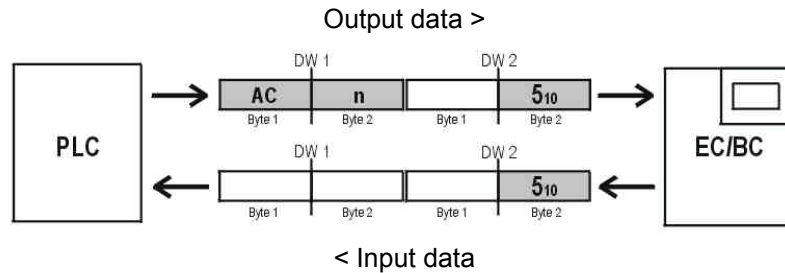
Module Ids	Module name
1	RIO 8 I/O
2	RIO 16 I
3	RIO 16 O
4	RIO 8I 8I/O
5	RIO 4AI/4AO ±10V
6	RIO 4AI ±10V
7	RIO 4AI/4AO 20mA
8	RIO 4AI 20mA
14d / 0Eh	RIO T10-10
10d / 0Ah (6 I/O bytes) 11d / 0Bh (10 I/O bytes)	RIO C24-10
12d / 0Ch (6 I/O bytes) 13d / 0Dh (10 I/O bytes)	RIO P24-10
16d / 10h	RIO 4AI/4AO 4-20mA
17d / 11h	RIO 4AI 4-20mA
19d / 13h	RIO 4 O R
20d / 14h	RIO T20-10
23d / 17h	RIO 8° 2°
24d / 18h	RIO 4 I 120 VAC
25d / 19h	RIO 4 I 230 VAC
28d / 1Ch	RIO A10-10

## 12.9 Function 5 Set preferred shut-off state

Function 5 provides a preferred shut-off state to define the shut-off behavior of outputs. The preferred shut-off state is adopted:

- If the bus connection is interrupted.
- In STOP mode

Each module can have its own shut-off code (AC) which defines its preferred shut-off state.



Output data

### DW 1 Byte 1, AC (shut-off codes)

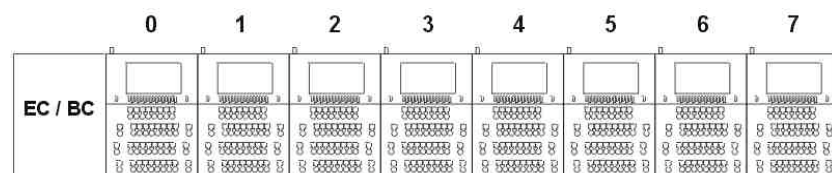
Shut-off codes		Meaning
dec.	bin.	
0	0000 0000	All digital outputs on the respective expansion module are set to Low, all analog outputs are set to 0V / 0mA.
1	0000 0001	All outputs on the respective expansion module are set to High, all analog outputs are set to +10V / 20mA.
2	0000 0010	All outputs on the respective expansion module continue to be refreshed. If the bus connection is interrupted the last control status of the I/O channels is retained.

Default setting: Shut-off code 0 for all modules

### DW 1 Byte 2, n (position of module)

You have to enter the position (n) of the module for which you want to define the preferred shut-off state.

Module location numbers:

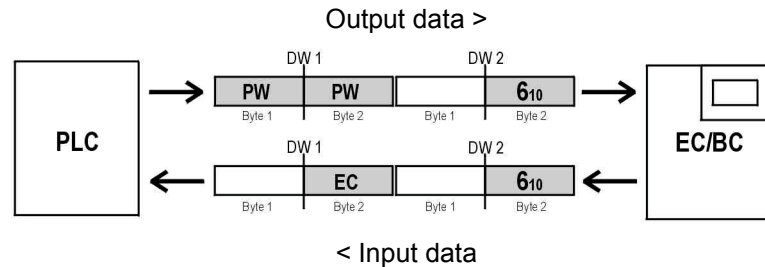


The LOCK configuration overrides the preferred shut-off state.

## 12.10 Function 6 Activate / deactivate bus node user lock-out

For BC bus coupler only.

Function 6 activates the user lock-out with password on safety level II. The password (PW) is a decimal 16-bit number between 0001 and 9999.



### Output data

#### DW 1, PW (password)

0000	Local operation of bus coupler is enabled if a user lock-out had previously been active on safety level II.
0001 to 9999	User lock-out active on safety level II, password-protected.

The password will be permanently saved in the bus coupler.

If you change the password from (0001 to 9999) to 0000 operation is enabled and safety levels 1 and 2 are not active.

See also User Lock-out on page 96.

### Input data

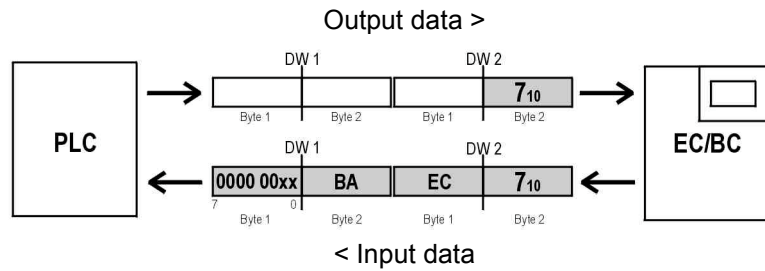
#### DW 1, Byte 2 EC (error code)

1	Successful
FFhex	Password outside range

Diagnosis word 1 signals whether the password was saved successfully.

## 12.11 Function 7 Determine bus node system status

Function 7 supplies the current system status of the bus node.



### Input data

The system status includes the following information:

#### DW 1 Byte 1, status of TRIGGER- or LOCK conditions

Bit no.	Bit value	Status
0	0	Trigger input not defined
	1	Trigger input defined
1	0	Lock condition not defined
	1	Lock condition defined

#### DW 1 Byte 2, BA (mode)

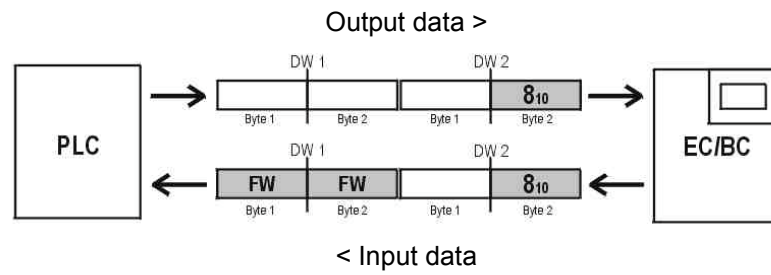
Value	Operating mode
6	FORCE
7	TRIGGER
8	LOCK
9	STOP
10dec	ONLINE
11dec	RUN

#### DW 2 Byte 1, EC (error code)

The error code is the same as the error message which is displayed on the bus coupler.

## 12.12 Function 8 Output firmware version

Function 8 supplies the firmware version of the bus coupler.



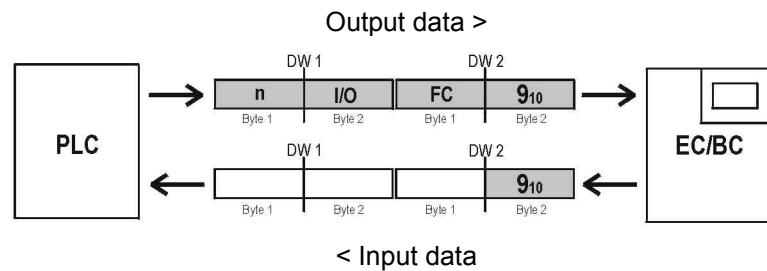
### Input data

#### DW 1, FW (firmware version)

The firmware version appears in hexadecimal code in DW1.

## 12.13 Function 9 Set data formats for analog modules

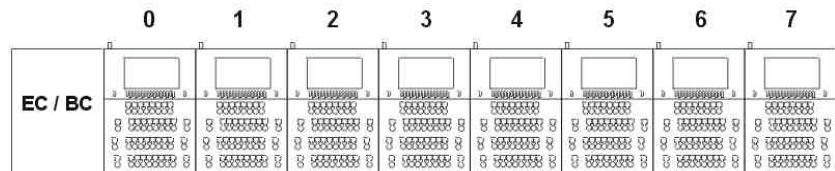
Function 9 sets the data format of analog values for the analog modules.



Output data

### DW 1 Byte 1, n (position of module)

Data word 1 defines the module for which the data format is to be set. Module location numbers:



### DW 1 Byte 2, I/O selection inputs or outputs

0 = Inputs 1 = Outputs

### DW 2 Byte 1, FC (format code)

Format code	Data format
0	$\pm 10V$ in two's complement (-2048 .... +2047)
1	$\pm 10V$ in mV (-10000 .... +10000)
2	0...20mA in two's complement (0...4095)
3	0...20mA in $\mu A$ (0...20000)
4	4...20mA (S5 format for 0 ... 20mA module)
5	0 ... 10V (in mV 0 ... 10000)
6	PT 100 in 0.1°C
7	4...20mA S7 format
8	4...20mA S5 format



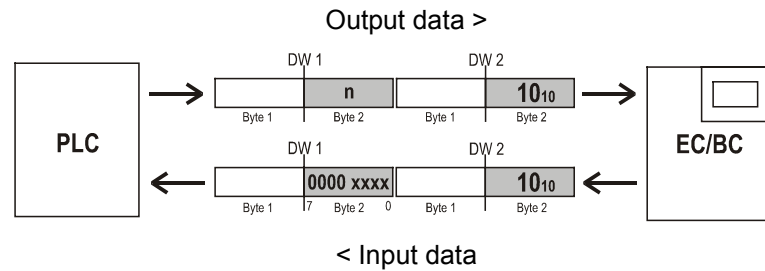
If the mV or  $\mu A$  data format is used the input signal of the digital I/O modules which are operated on the same bus coupler is delayed by 2ms.

For default settings and explanations of data formats refer to the Expansion modules operating manual, order no.: 322 154 14.



## 12.14 Function 10 Output temperature module PT100/PT1000 sensor information

Function 10 supplies data on the sensors on the temperature module.

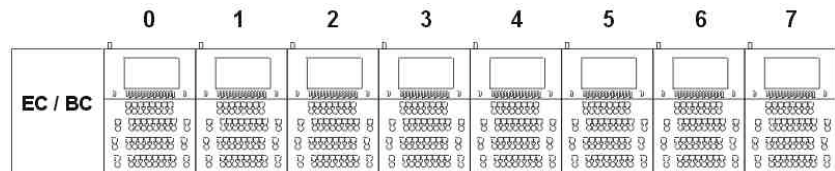


### Output data

#### DW 1 Byte 2, n (position of module)

Data word 1 defines the temperature module from which information is to be obtained.

Module location numbers:



### Input data

#### DW 1 Byte 2 sensor information

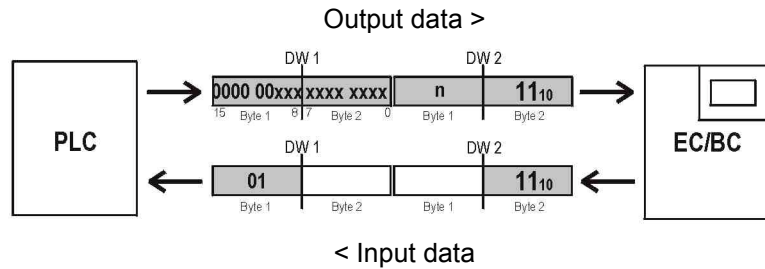
Bit no.	Bit value	Meaning
0	0	PT100 on channel 1
	1	PT1000 on channel 1
1	0	PT100 on channel 2
	1	PT1000 on channel 2
2	0	PT100 on channel 3
	1	PT1000 on channel 3
3	0	PT100 on channel 4
	1	PT1000 on channel 4

If there is a constant measured value of 4500 there is a malfunction on the associated channel. The sensor data can be used to distinguish between cable break and short-circuit.

Bit value	Meaning
0	Short-circuit
1	Cable break or sensor not connected

## 12.15 Function 11 Mode word for temperature module with thermo elements

Function 11 is used for parameterizing a temperature module with thermo elements.



Output data

### DW 1 Mode word

Data word 1 is used to transmit the parameters for characteristics, channel numbers, resolutions and number formats.

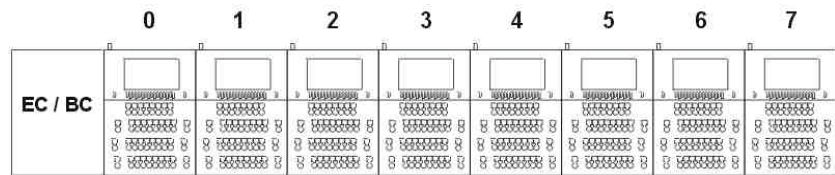
Parameter		Meaning																																				
Characteristics	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>0</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	0	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			K-characteristic
																	0	0																				
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																						
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15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							
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Spare	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>0</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	0	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			Spare (must always be 00)
																0	0																					
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Channel number	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>0</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	0	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			4 channels used
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	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																						
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15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							
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Number format	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>0</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	0	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			SIMATIC S7
																	0	0																				
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																						
	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>1</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	0	1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			SIMATIC S5
																0	1																					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							
<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>0</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	1	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			Voltage	
																1	0																					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							
<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>1</td></tr><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr></table>																	1	1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			Spare	
																1	1																					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							

Default setting: all bits = 0 (K-characteristic; 4 channels; 0.1°C; S7)

### DW 2 Byte 2, n (position of module)

Data word 2 Byte 2 transmits for which temperature module the information applies.

Module location numbers:

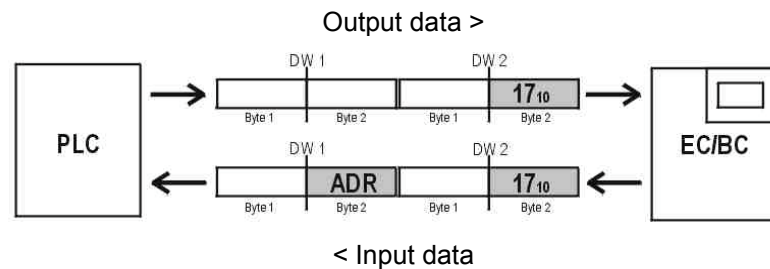


Input data

**DW 1 Byte 1, always 01**

## 12.16 Function 17 Output bus address

Function 17 supplies the bus address of the bus coupler.



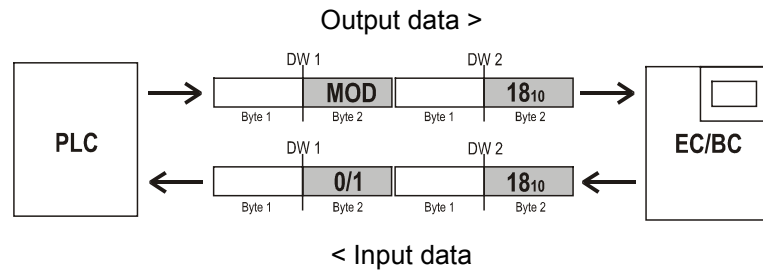
Input data

**DW1 Byte 2, ADR (bus address 0 to 255)**

## 12.17 Function 18 Byte swap mode ON/OFF

### Not for CANopen bus couplers.

Function 18 sets the byte swap mode. The byte swap mode changes the assignment of input/output data to the I/O maps. See also service function 10 on page 111.



#### Output data

##### DW 1 Byte 2 MOD (mode)

0	OFF
1	ON for all digital expansion modules
2	ON for all digital expansion modules, counter, positioning and analog modules, and diagnosis data
3	ON for all counter, positioning and analog modules, and diagnosis data

Default setting: Mode 0

#### Input data

##### DW 1 Byte 2 0/1

0	Setting rejected
1	Byte swap mode turned on successfully



The setting will be stored permanently in the bus coupler.

#### Example

##### RIO 16 I without byte swap

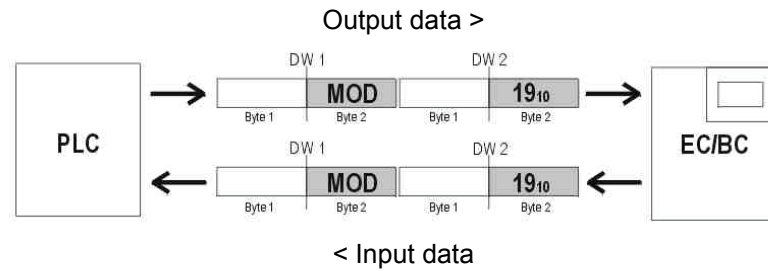
Byte 1		Byte 2	
Bit	Terminal	Bit	Terminal
8	X2.8	0	X1.0
9	X2.9	1	X1.1
10	X2.10	2	X1.2
11	X2.11	3	X1.3
12	X2.12	4	X1.4
13	X2.13	5	X1.5
14	X2.14	6	X1.6
15	X2.15	7	X1.7

##### With byte swap

Byte 1		Byte 2	
Bit	Terminal	Bit	Terminal
8	X1.0	0	X2.8
9	X1.1	1	X2.9
10	X1.2	2	X2.10
11	X1.3	3	X2.11
12	X1.4	4	X2.12
13	X1.5	5	X2.13
14	X1.6	6	X2.14
15	X1.7	7	X2.15

## 12.18 Function 19 Advanced PROFIBUS-DP diagnosis ON/OFF

Function 19 switches advanced PROFIBUS-DP diagnosis ON or OFF.



### Output data

#### DW 1 Byte 2 MOD (mode)

><1	Advanced diagnosis OFF
1	Advanced diagnosis ON

Default setting: Mode 1

### Input data

#### DW 1 Byte 2 MOD (mode)

The parameters are reflected on DW1, Byte 2 of the input data.

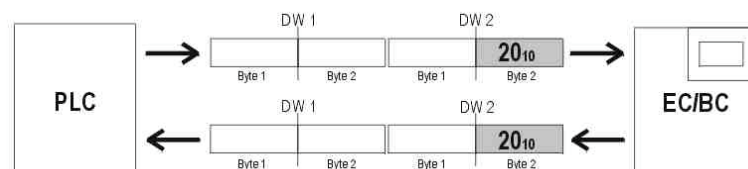
See also service function 9 and diagnosis on the PROFIBUS-DP on page 111 and 29.

## 12.19 Function 20 Delete error messages

Function 20 deletes:

- The blinking code of the red RUN LED on the EC bus coupler.
- The error message which is displayed on the BC bus coupler.
- The current error bits and the error code see function 0 page 115.

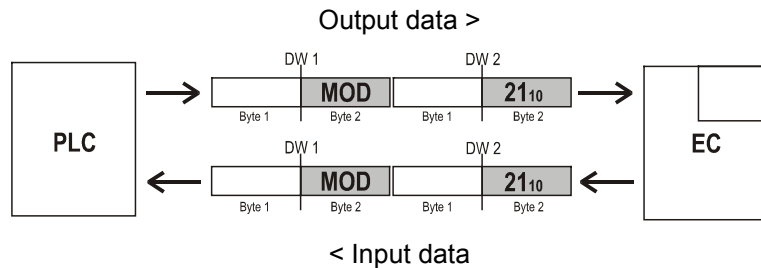
The functions carried out are the same as if you were deleting error messages using the OK key on the BC bus coupler.



## 12.20 Function 21 Save/delete bus node configuration

EC and BC bus couplers from software version 01xx only

The current bus node configuration can be saved as the specified configuration. If the current configuration is changed (e.g. if a slide contact is opened accidentally) error E012, flashing code 4, will be displayed when you switch the bus coupler on.



### Output data

#### DW 1, Byte 2 MOD (mode)

><1	Delete specified configuration and do not check anymore
1	Save current configuration as specified configuration

Default setting: 0

### Input data

#### DW 1, Byte 2 MOD (mode)

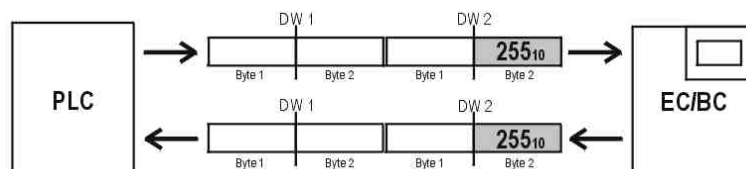
The parameters are reflected on DW1, Byte 2 of the input data.

## 12.21 Function 255 Reset

Has the same function like the function 20 page 129.

Additional reset the static error bits see function 0 page 115.

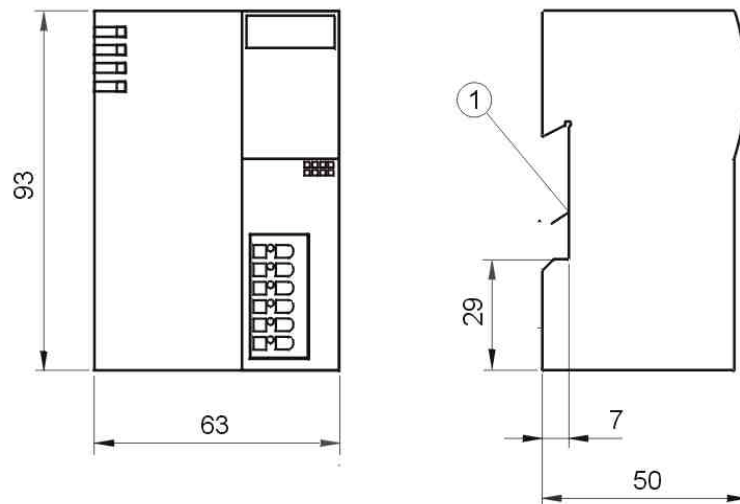
No other functions are executed.



## 13 Specifications for all bus couplers

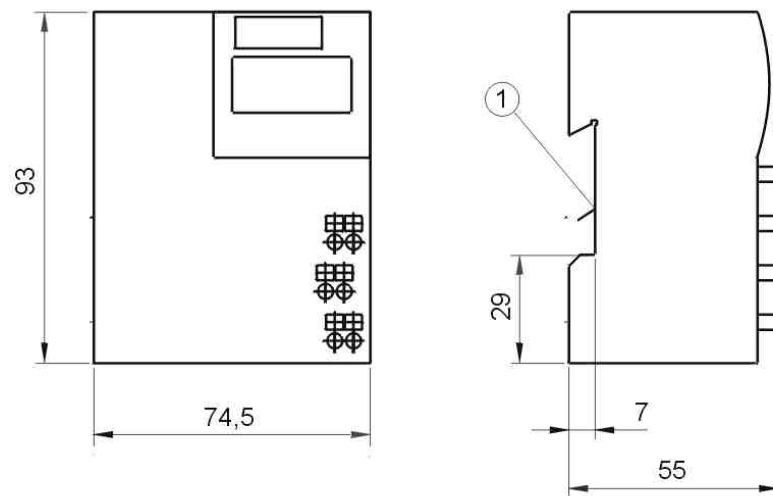
<b>Climatic conditions</b>	
Ambient operating temperature	0 ... +55°C (class KV to DIN 40040), vertical installation, free air circulation
Storage temperature	-25 ... +70°C (class HS to DIN 40040)
Relative humidity	30 ... 95% (class F, DIN 40040), no condensation
Air pressure in operation	860 ... 1060 hPa
<b>Mechanical strength</b>	
Vibration	DIN IEC 68-2-6 10 ... 57Hz constant amplitude 0.075mm 57 ... 150Hz constant acceleration 1g
<b>Electrical safety</b>	
Protection class	IP 20 to EN 60529
Clearance/creepage distance	DIN EN 61131-2 and DIN EN 50178 between electrical circuits and objects as well as between electrically isolated circuits in accordance with overload category II, contamination level 2
Test voltage	350VAC/50Hz for rated equipment voltage 24VDC
<b>Electromagnetic compatibility</b>	
Electrostatic discharge	EN 61000-4-2: 4kV contact discharge
Electromagnetic fields	EN 61000-4-3: Field intensity 10V/m, 80 ... 1000MHz
Burst	EN 61000-4-4: 2KV on DC supply lines, 1KV on I/O signal and serial interface lines
Interference emissions	EN 55011: Class A, Group 1
<b>Mechanical and installation</b>	
Housing material	PA 6.0 GF20 black
Rail	DIN rail EN 50022-35
<b>Connection system</b>	
Connection	Spring terminal
Conductor size	Finely stranded*: 0.14-1.5mm <sup>2</sup> single-core: 0.5-2.5mm <sup>2</sup> <small>*If a wire end ferrule is used it must be pressed air-tight.</small>
Stripping length	10mm BC bus coupler 9mm EC bus coupler

### Dimensions EC bus coupler



1 For DIN rail EN 50022-35

### Dimensions BC bus coupler



1 For DIN rail EN 50022-35



## 14 Error messages

Error messages are output as flashing codes on the RUN LED of the EC bus coupler and as error messages on the numerical display of the BC bus coupler.

Flashing code Number of flashing codes on the RUN LED of the EC bus coupler	Error message Numerical display on the BC bus coupler	Explanation
<b>6</b>	<b>E001</b>	No expansion module connected.
<b>7</b>	<b>E002</b>	An expansion module with an ID not supported by the bus coupler was connected.
<b>8</b>	<b>E004</b>	Internal data transmission (bus coupler <---> expansion module) was interrupted (e.g. slide contact open).
<b>9</b>	<b>E005</b>	The bus coupler has identified a transgression of the maximum number of expansion modules.
<b>3</b>	<b>E006</b>	The field bus was interrupted or is no longer operated.
<b>2</b>	<b>E007</b>	Write access to the EEPROM in the bus coupler failed.
<b>10</b>	<b>E011</b>	0 I/O bytes transmitted (no modules connected and service interface switched off)
<b>4</b>	<b>E012</b>	Current I/O configuration of bus node does not match specified configuration. The specified configuration can be set on the EC bus coupler using parameterizing function 21 and on the BC bus coupler using parameterizing function 6.
<b>5</b>	<b>E014</b>	A PROFIBUS-DP master has sent an incorrect I/O configuration to the bus coupler.
	<b>E016</b>	BC bus coupler only. User lock-out violated on safety level 1.
	<b>E017</b>	BC bus coupler only. User lock-out violated on safety level 2.
	<b>E018</b>	More than 8 lock conditions set for analog channels.



Error messages 2,4,5:

All inputs/outputs are switched off, i.e. all outputs are set to zero and are no longer refreshed. Inputs are no longer sent to the PLC. The diagnosis continues to operate in the bus coupler, the diagnosis messages are transmitted.

The bus coupler continues to operate with all other error messages. The error message can be deleted on the bus couplers using diagnosis function 20.

On the BC bus coupler the message can also be deleted using the OK and Mode keys.

## 15 What if... ?

*... error message 1 indicates that the bus coupler is operating without expansion modules?*

The bus coupler will still work.

You can, for example, set and save the desired address for the next application via the PROFIBUS-DP bus coupler keypad.

*... error message 2 indicates that an expansion module with an unknown ID has been detected?*

The connected expansion modules include at least one whose ID is not supported by the existing firmware version in the bus coupler. I.e. one of the expansion modules is a new development which was unknown at the time when the bus coupler was manufactured.

*... error message 4 indicates that the internal system bus has been interrupted?*

During operation the orange slide contact has been opened and this has caused internal data communication to be interrupted. A monitoring function integrated in the expansion modules switches all existing 24V outputs to 0V after the watchdog time ( $t_w = 100\text{ms}$ ).

The bus coupler is still active on the field bus but only operates its diagnosis interface.

*... error message 5 indicates that too many expansion modules are connected to the bus coupler?*

You must not exceed the maximum process data width of the bus coupler. See chapter Process data width.

*error message 6 indicates that the field bus has been interrupted?*

In this case either the field bus has been disconnected from the bus coupler or the relevant field bus master is no longer operating the bus. The reason for this error can also be a failure of the bus cable over a short time or a cable break.

A pre-defined preferred shut-off state (see parameterizing function 5) will now be activated by the bus coupler.

On InterBus-S the master can no longer operate the bus if a cable breaks as the physical bus is based on a ring topology. On PROFIBUS-DP part of the network may continue to operate depending on where the cable break occurred. If the connection is re-established the bus will automatically resume operation.

*... error message 7 is displayed in LOCK mode?*

A write instruction to the internal EEPROM of the bus coupler could not be carried out. If this error is displayed repeatedly the hardware is defective. Despite this error the system can continue to be operated normally. Only saving *new* parameterizing data such as a new PROFIBUS-DP address or a modified LOCK mask is no longer available.

*... error message 12 is displayed when I switch the system on?*

After you have switched the system on the bus coupler has detected that the bus node configuration is different from the specified configuration.

Either you have forgotten to close one of the orange slide contacts (e.g. after a maintenance job) or the number or the order of the expansion modules has changed since the last time the system was switched on.

NOTE: If necessary, set the new specified configuration using service function 6 (BC bus coupler) or parameterizing function 21 (EC bus coupler).

*... error message E016 or E017 indicates an active user lock-out? (BC bus coupler only)*

Ensure that the desired operation does not produce an unauthorized operating state.

Press OK to confirm the error message. Cancel the user lock-out using service function 7 with parameter 0 or service function 8 with password.

*... error message 14 is displayed?*

The configuration in the PROFIBUS-DP master does not match the current I/O configuration. Also check the orange slide contacts and service function 6.

*... the red BF LED or the red RD LED is permanently ON after you have switched on the DeviceNet bus coupler?*

A field bus cable is faulty.

The field bus is not connected to the bus coupler.

The master component is not operating the field bus properly.

The slave address is set incorrectly.

*... you have pressed the Mode key on the BC bus coupler by mistake and pre-selected one of the commissioning modes?*

The pre-selected mode indicated by the flashing LED will automatically stop flashing after 8s.

*... diagnosis function 2 or 0 signals overloaded output drivers for one or more modules although none of the relevant outputs are connected?*

There is no 24V supply to the output drivers on the relevant expansion modules. Diagnosis function 2 only works correctly if the expansion module has a 24V supply.

*... you cannot operate the BC bus coupler?*

Either the local operation of the bus node has been locked by the master control via diagnosis function 6 or the bus coupler is not ready for operation because of an error message.

**If you need any further help please phone Technical Support on ++49 30 33005-304 (hotline).**

## 16 Appendix

### 16.1 Input signal delay

Input signal delay	
Typical (any bus coupler with 3 digital I/O modules)	2 - 7ms

The input signal delay is longer:

- If you use analog I/O modules on the same bus coupler (approx. 7 - 14ms with 2 x analog, 1 x digital)
- When you press individual keys on the BC bus coupler (approx. 4ms)
- When you use the advanced operating modes on the BC bus coupler (e.g. LOCK 3ms)

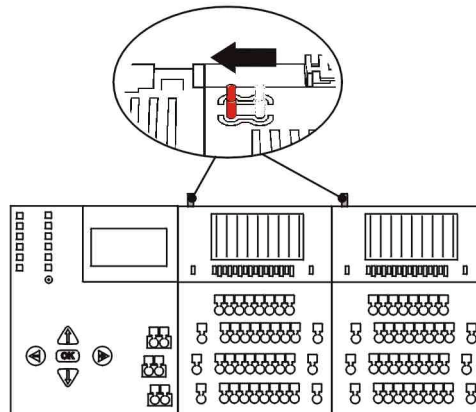
## 16.2 Glossary

### Combination channels

I/O channels which can be used as inputs or outputs. I.e. an input address space and an output address space are reserved for the process map.

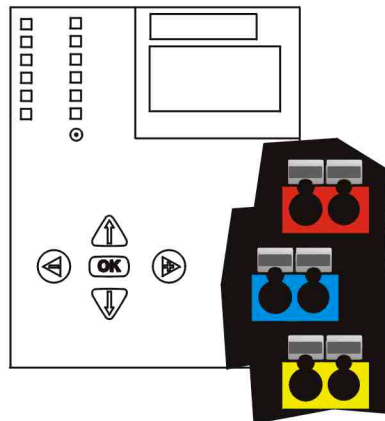
### Slide contacts

The orange slide contacts on top of the module connect the modules to the bus coupler.



### Terminals for relaying the power supply

Spring terminals which can be used to relay the power supply from one module to the next in order to reduce the number of terminal contacts.



## 16.3 Trademarks

- SIMATIC and SINEC are registered trademarks of Siemens AG.
- DeviceNet is a registered trademark of the Open DeviceNet Vendor Association (O.D.V.A.).
- All other trademarks or product names are registered trademarks of their respective owners.

## 17 Safety-related information

The term automation system as used in this manual includes controls, their components (modules), other parts (such as racks, cables), operator panels, and the software used for programming, commissioning and operating the controls. This operating manual can only describe a fraction of the automation system (e.g. modules).

The technical design of SCHLEICHER automation systems is based on the EN 61131-2 (IEC 61131-2) product standard for programmable logic controls. The systems and devices have CE marking according to the EMC directive 89/336/EEC and, if applicable, the low-voltage directive 73/23/EEC.

The machinery directive 89/392/EEC is not applicable because the safety objectives of the directive are covered by the low-voltage and EMC directives.

When SCHLEICHER automation systems are part of the electrical equipment of a machine, the manufacturer must include them in the conformity evaluation process. In this case the DIN EN 60204-1 standard must be observed (safety of machines, general requirements for electrical equipment of machines).

When an automation system is properly used and serviced for its intended purpose it will not normally cause damage to property or present health hazards. However, improper configuration, installation, maintenance or operation of the system or machine, ignoring the instructions in this manual, or intervention by insufficiently qualified personnel may result in connected actuators (such as motors, hydraulic units, etc.) becoming a source of danger.

### 17.1 Correct use of the system

SCHLEICHER automation systems are state-of-the-art products and manufactured to recognized safety requirements. Their use can, however, cause danger to the health and safety of operators and others, or damage machines, systems or other property.

The automation system must only be used in perfect technical condition for its intended purpose, with attention given to safety and danger, and observing the operating manual. Correct transport, storage, installation, operation and maintenance of the system are all prerequisites for smooth and safe operation of the control. Malfunctions, in particular those which may affect safety, must be immediately resolved.

Automation systems are designed exclusively to control machines and systems. Automation systems are not intended for any other use than the above. The manufacturer will therefore accept no liability for any damages resulting from the incorrect use of the systems.

When using automation systems, all instructions given in this manual regarding mechanical and electrical setup, commissioning and operation must be observed.

### 17.2 Selection and qualification of personnel



All configuring, programming, installation, commissioning, operation and servicing work on the automation system must be carried out by trained personnel such as electricians or electrical engineers.

Personnel responsible for configuring and programming the system must be familiar with all safety-related issues in automation technology.

System operators must be instructed on the operation of the control and be familiar with the relevant operating instructions.

All personnel responsible for installing, commissioning and servicing the system must have had appropriate training qualifying them to work on automation systems.

### 17.3 Configuration, programming, installation, commissioning and operation

The automation system will in most cases be a part of a larger system in which machines or systems are controlled. When configuring, installing and commissioning automation systems to control machines the machine manufacturer and the user must observe the safety regulations as defined in the machinery directive 89/392/EEC. For specific applications national accident prevention regulations such as VBG 4.0 will apply.

Safety-related components on the controlled machine must be designed such that they operate independently from the control. Emergency stop components must be effective in all operating modes of the control. In an emergency stop the power supply to all switching elements controlled by the control must be cut off. The power supply can be cut off using a safety relay such as SCHLEICHER type SNO 2002-17.

Measures must be taken for restarting an interrupted control program following voltage dips or power failures. Operating states should never cause danger, not even for a short time. In the event of danger the emergency stop must be immediately triggered.

In order to prevent an open-circuit in the signal circuit causing non-controllable states in the control, the relevant hardware and software safety precautions must be taken for I/O interfacing. Control elements and their assigned control panel elements must be installed in a place where they are sufficiently protected against inadvertent use.

### 17.4 Maintenance and servicing

Measuring and testing on active devices must be carried out in accordance with the regulations and instructions of the VBG 4.0 accident prevention regulation. The appropriate power tools must be used.

Repairs on control components must be carried out at repair shops authorized by SCHLEICHER. Opening the components and repairs by unauthorized personnel may lead to personal injury or damage to property.

Always disconnect the device from the mains before opening it (either disconnect the mains plug or use the cut-out switch).

Control modules may only be replaced when the power is switched off. Disassembly and assembly must be carried out according to the directives for mechanical assembly.

Fuses may only be replaced with those types specified in Specifications.

Batteries may only be replaced with those types specified in Specifications. Batteries must always be disposed as hazardous waste.

### 17.5 High voltage



When the cabinet is opened or the housing removed from system components certain parts of the automation system are exposed. These parts may be subject to dangerous high voltages.

The user must prevent any unauthorized and incorrect access to the system (for example, by ensuring that the cabinet is locked).

Personnel must be familiar with all sources of danger and measures for commissioning and servicing the system in line with the instructions given in this manual.

## 17.6 Used batteries

When the batteries in the automation system have reached the end of their life they must be disposed of in a battery return system or through special public waste disposal facilities.

Batteries should be fully discharged before disposal. A battery is discharged when the function of the device is impaired due to insufficient battery capacity.

When batteries for disposal are not fully discharged precautions must be taken to prevent short circuits. This can be done by sticking tape over the poles of the battery.



## 18 Index

### A

#### Address

Setting on DeviceNet 48

#### Address configuration

DeviceNet 57  
 InterBus-S 43  
 PROFIBUS-DP 27

#### Address map

CANopen 73

#### Addressing See Address configuration

### B

#### Baud rate

DeviceNet 53, 109  
 DeviceNet see Baud rate 53

#### Baud rate and line length

PROFIBUS-DP 23

#### Baud rate for data

CANopen 68, 109

#### Baud rate, setting for EC CANopen bus coupler 62

#### BC bus coupler

Conductor sizes 86  
 Stripping length 86

#### BC bus coupler, spring terminals 85

#### bus cable

XRIO 78

#### Bus cables

DeviceNet 55  
 PROFIBUS-DP 23  
 RIO EC IBS 41

#### Bus coupler

RIO EC X2 75

#### Bus couplers

RIO BC CAN DN 49  
 RIO BC CANopen 63  
 RIO BC DP 16  
 RIO EC CANopen 60  
 RIO EC DP 14

#### Bus node power consumption 94

#### Bus port

BC CANopen bus coupler 68  
 BC DeviceNet bus coupler 52  
 EC CANopen bus coupler 62  
 RIO BC IBS 38, 41  
 RIO BC PROFIBUS-DP 20  
 RIO EC IBS 34  
 RIO EC PROFIBUS-DP 15  
 RIO EC X2 (XRIO) 76

#### Bus port on EC DeviceNet bus coupler 48

#### Bus segment length

PROFIBUS-DP 23

#### Byte swap mode 128

### C

#### Cable length

DeviceNet 56  
 InterBus-S 42  
 PROFIBUS-DP 23

#### cables

XRIO 78

#### CANopen

Address map 73

Baud rate 68

Bus port on BC bus coupler 68

Bus port on EC bus coupler 62

Connection set 71

EDS files 74

I/O data mapping 73

Keypad on bus coupler 66

LED display on BC bus coupler 64

LED display on EC bus coupler 61

Life guarding 71

Node guarding 71

Numerical display on bus coupler 65

Operating mode display on bus coupler 65

PDO 72, 73

Process data width 73

RPDO 71

Setting the baud rate 109

Setting the module ID see Setting the node number 62

Setting the node number 67

Terminating resistors 70

TPDO 71

Wiring 70

#### Channel cursor 99

#### Climatic conditions 131

#### Combination channels

Power supply 90

#### Compatibility

EC bus coupler and BC PROFIBUS-DP 20

#### Conductor sizes 86, 131

#### Connecting modules with each other 83

#### Connection set 71

#### Connectors

DeviceNet 52  
 InterBus-S 41  
 PROFIBUS-DP 24

### D

#### Data width See Process data width

#### DeviceNet

Address configuration 57

Bus cables 55

Bus port on BC bus coupler 52

Bus port on EC bus coupler 48

Cable length 56

Connectors 52

EDS files 59

Keypad on bus coupler 52

LED display on BC bus coupler 50

LED display on EC bus coupler 47

Length of wire 56

Numerical display on bus coupler 51

Operating mode display on bus coupler 51

Pin configuration 52

Process data width 57

Response times 59

Setting the address 53

Setting the baud rate 48, 53, 109

Setting the baud rate see Baud rate 53

Setting the MAC ID 48

Setting the MAC ID see Node ID 53

Terminating resistors 56

#### Diagnosis

On the PROFIBUS-DP 29

**Diagnosis functions**

- Data structure 114
- Overview 113
- Via field bus 113

**Diagnosis ON/OFF**

- EC DeviceNet bus coupler 48

**Dimensions**

- Bus couplers 132
- See Mounting dimensions 80

**DIN rail 82, 131**

**DIN rail installation 82**

- End clip 82

**DIP switches**

- RIO EC CANopen 62
- RIO EC DN 48
- RIO EC IBS 33

**Display mode (during Run mode) 100**

**Distance between modules**

- BC bus coupler 81
- EC bus coupler 80

## E

**EC bus coupler**

- Conductor sizes 86
- Stripping length 86

**EC DeviceNet bus coupler**

- Switching the diagnosis ON/OFF 48

**EDS files**

- CANopen 74

**EDS files for**

- DeviceNet 59

**Electrical installation 84**

- Connecting the power supply 87

**Electrical safety 131**

**EMC 131**

**Emergency stop 91**

**End clip for DIN rail installation 82**

**Error messages 133, 134**

**Error numbers see Error messages 133**

## F

**FORCE mode 101**

## H

**Housing material 131**

## I

**Input signal delay 136**

**Installation**

- Electrical 84
- Guidelines for electrical installation 87
- Mechanical 80

**Installation position see Mounting position 80**

**InterBus-S**

- Address configuration 43
- Cable length 42
- Connectors 41
- Interface connectors 41
- Keypad on bus coupler 38
- LED display on BC bus coupler 36
- Length of wire 42
- Operating mode display on bus coupler 36
- Pin configuration 41

Process data width 43

Response times 45

Wiring 41

**Interchangeability of the EC and BC PROFIBUS-DP bus couplers 20**

**Interface connectors**

- InterBus-S 41
- PROFIBUS-DP 24

## K

**Keypad**

- CANopen bus coupler 66
- DeviceNet bus coupler 52
- InterBus-S bus coupler 38
- PROFIBUS-DP bus coupler 19

## L

**LED display**

- BC DeviceNet bus coupler 50
- EC DeviceNet bus coupler 47
- RIO BC PROFIBUS-DP 17

**LED display on BC bus coupler**

- CANopen 64

**LED display on bus coupler**

- EC PROFIBUS-DP 15

**LED display on bus coupler EC X2 (XRIO) 76**

**LED display on EC bus coupler**

- CANopen 61

**LED displays**

- RIO BC IBS 36
- RIO EC IBS 33

**Length of wire**

- DeviceNet see Cable length 56
- InterBus-S 42

**Life guarding 71**

**Line length**

- PROFIBUS-DP 23

**LOCK mode 105**

## M

**MAC ID**

- DeviceNet see Node ID 53
- Setting 48

**Mechanical strength 131**

**Module IDs 119**

**Mounting dimensions BC bus coupler 81**

**Mounting dimensions EC bus coupler 80**

**Mounting position 80**

## N

**Node guarding 71**

**Node ID, setting for EC CANopen bus coupler 62**

**Numerical display**

- CANopen bus coupler 65
- DeviceNet bus coupler 51
- RIO BC PROFIBUS-DP 18

## O

**Operating mode display**

- CANopen bus coupler 65
- DeviceNet bus coupler 51
- InterBus-S bus coupler 36
- RIO BC PROFIBUS-DP 17

**Operating modes 98**

Display mode 100  
 Display of active mode 99  
 FORCE 101  
 LOCK 105  
 RUN 100  
 Setting 98  
 STOP 107  
 TRIGGER 103

## P

### Parameterizing functions

Data structure 114  
 Overview 113  
 Via field bus 113

### Password 96

### PDO 72, 73

### Pin configuration

DeviceNet 52  
 InterBus-S 41  
 PROFIBUS-DP 24

### Power consumption

External (24V) 95  
 Internal (5V) 94

### Power supply

Connecting 87  
 Spring terminals 84

### Preferred shut-off state 107

### Process data width

CANopen 73  
 DeviceNet 57  
 InterBus-S 43  
 PROFIBUS-DP 27

### PROFIBUS-DP

Address configuration 27  
 Baud rate and line length 23  
 Bus cables 23  
 Bus segment length 23  
 Cable length 23  
 Compatibility of the EC and BC bus couplers 20  
 Connectors 24  
 Diagnosis 29  
 Interchangeability of the EC and BC bus couplers 20  
 Interface connectors 24  
 Keypad on bus coupler 19  
 LED display on BC bus coupler 17  
 LED display on EC bus coupler 15  
 Line length 23  
 Operating mode display on bus coupler 17  
 Pin configuration 24  
 Process data width 27  
 Response times 31  
 Setting the address 19  
 Wiring 24

## R

### Response times

DeviceNet 59  
 InterBus-S 45  
 PROFIBUS-DP 31

### RIO BC CAN DN 49

Specifications 49

### RIO BC CANopen 63

Specifications 63

### RIO BC DP 16

### RIO BC IBC

Bus port 38, 41

### RIO BC IBS 35

LED displays 36  
 Specifications 35

### RIO BC PROFIBUS-DP

Bus port 20  
 LED displays 17  
 Numerical display 18

### RIO EC CAN DN 46

Specifications 46

### RIO EC CANopen 60

DIP switches 62

### RIO EC DN

DIP switches 48

### RIO EC DP 14

### RIO EC IBC

Bus cables 41  
 Bus port 34

### RIO EC IBS 32

DIP switches 33  
 LED displays 33  
 Specifications 32

### RIO EC PROFIBUS-DP

Bus port 15  
 Setting the address 15

### RIO EC X2 75

Bus port 76  
 LED display 76

### RPDO 71

### RUN mode 100

## S

### Safety level I and II 96

### Safety-related information 138

Accident prevention regulation 139  
 Commissioning 139  
 Configuration 139  
 Correct use of the system 138  
 Emergency stop component 139  
 Installation 139  
 Maintenance 139  
 Programming 139  
 Selection of personnel 138  
 Servicing 139  
 Warning signs 3

### Service functions

Overview 108  
 Selecting on bus coupler 108

### Set preferred shut-off state 120

### Setting

Baud rate for DeviceNet 53  
 Baud rate for EC CANopen bus coupler 62  
 CANopen baud rate 68  
 CANopen node number 67  
 DeviceNet MAC ID 48  
 Node number for EC CANopen bus coupler 62  
 Operating modes 98  
 PROFIBUS-DP address 19

### Setting the address

CANopen 67  
 DeviceNet 53  
 EC CANopen bus coupler 62  
 PROFIBUS-DP 19  
 RIO EC PROFIBUS-DP 15

### Setting the baud rate

DeviceNet 48

### Setting the node number

CANopen 67

## Shield

Signal lines 90

**Slave address** See Address / Addressing

**Slide contacts** 83

**Spacing between modules** see Distance between modules 80

## Specifications

All bus couplers 131

Climatic conditions 131

Conductor sizes 131

Connection system 131

Electrical safety 131

Electromagnetic compatibility EMC 131

Mechanical and installation 131

Mechanical strength 131

RIO BC CAN DN 49

RIO BC CANopen 63

RIO BC DP 16

RIO BC IBS 35

RIO EC CAN DN 46

RIO EC CANopen 60

RIO EC DP 14

RIO EC IBS 32

Stripping length 131

Wire end ferrule 131

## Spring terminals

BC bus coupler 85

EC bus coupler 84

**STOP mode** 107

**Stripping length** 86, 131

## T

**Technical Support (hotline)** ++49 30 33005-304 135

**Terminals for relaying the power supply** 88

**Terminating resistors**

CANopen 70

DeviceNet 56

**TPDO** 71

**Trademarks** 137

**TRIGGER mode** 103

## U

**User lock-out** 96

Via parameterizing function 121

## W

**Wire end ferrule** 131

## Wiring

CANopen 70

DeviceNet 55

InterBus-S 41

PROFIBUS-DP 24

## X

## XRIO

bus cable 78

Bus port RIO EC X2 76

cables 78

LED display 76