

Operating Manual

RIO

Remote Interface Output

Expansion Modules

Operating Manual RIO Expansion Modules Version 03/08
Part No. R4.322.1730.0 (322 154 15)



schleicher
control systems

**Operating Manual
RIO Expansion Modules**

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SCHLEICHER Electronic
GmbH & Co. KG
Pichelswerderstraße 3-5
D-13597 Berlin
Germany
Phone +49 30 33005-330
Fax +49 30 33005-305
Hotline +49 30 33005-304
Internet <http://www.schleicher-electronic.com>

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Previous versions of this operating manual

01/99 04/00 02/01 08/01 02/02 02/03 02/02 10/03 09/05 01/08

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 respective part in the operating manual.

You must follow the safety-related warnings at the end of this operating manual.

Other objects are represented as follows.

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

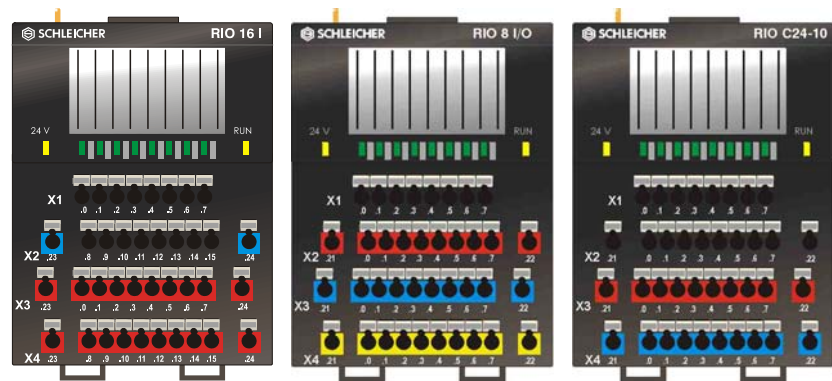
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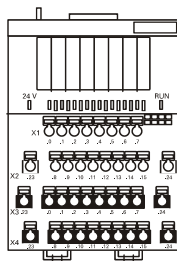
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1 Overview

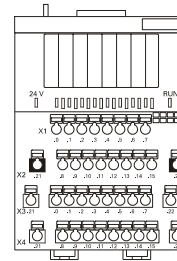


The expansion modules can be used together with RIO bus couplers and microLine and XCx controllers.

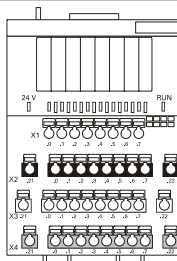
Digital modules



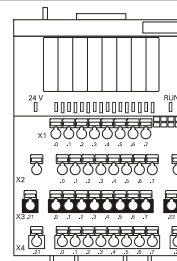
RIO 16 I
 16 inputs DC 24 V
 Two-wire connection system



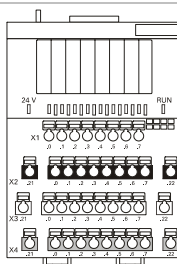
RIO 16 O
 16 outputs 1A
 Two-wire connection system



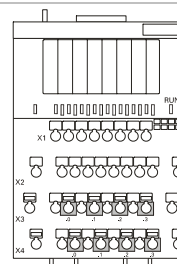
RIO 8 I/O
 8 combination I/Os
 All combination I/Os can be used individually as 24V DC inputs or 1A outputs.
 Four-wire connection system



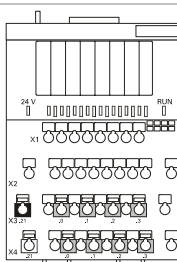
RIO 8 I 8 I/O
 8 inputs 24V DC
 8 combination I/Os
 All combination I/Os can be used individually as 24V DC inputs or 1A outputs.
 Two-wire connection system



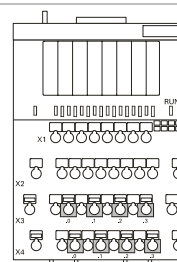
RIO 8 O 2A
 8 outputs 2 A
 Four-wire connection system



RIO 4 I 230 VAC
 4 inputs 230 V AC



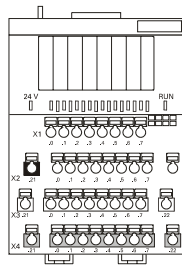
RIO 4 O R
 4 relay outputs



RIO 4 I 120 VAC
 4 inputs 120 V AC

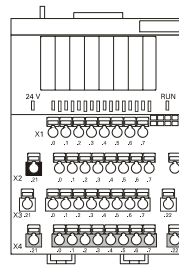
Analog modules

Voltage ± 10 V

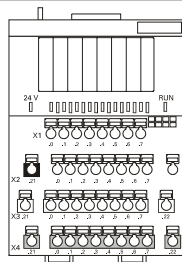


RIO 4AI ± 10 V
4 analog inputs
Resolution 12-bit

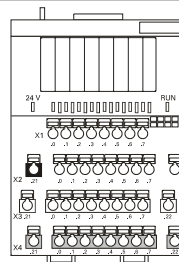
Current 20mA



RIO 4AI 20mA
4 analog inputs
Resolution 12-bit

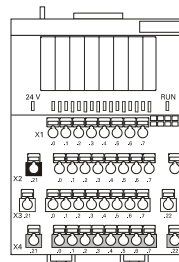


RIO 4AI/4AO ± 10 V
4 analog inputs
4 analog outputs
Resolution 12-bit

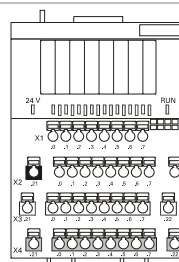


RIO 4AI/4AO 20mA
4 analog inputs
4 analog outputs
Resolution 12-bit

Current 4...20mA

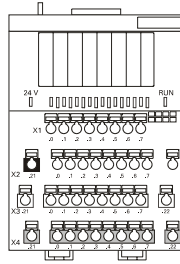


RIO 4AI 4-20mA
4 analog inputs
Resolution 12-bit



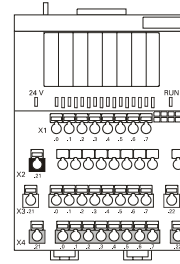
RIO 4AI/4AO 4-20mA
4 analog inputs
4 analog outputs
Resolution 12-bit

Temperature modules



RIO T10-10

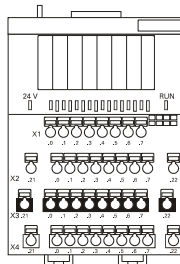
4 inputs for measuring temperature with Pt100/Pt1000



RIO T20-10

4 inputs for measuring temperature with thermoelements

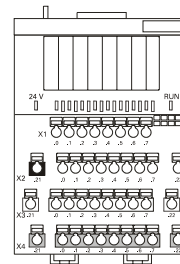
Counter module



RIO C24-10

Four 16-bit counters or two 32-bit counters

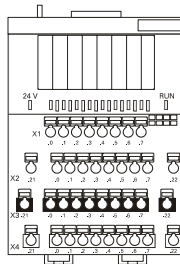
Axis interface module



RIO A10-10

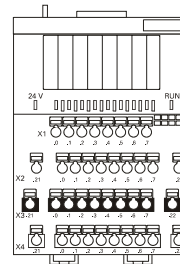
Interface for one axis

Positioning modules



RIO P05-10

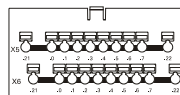
Positioning for two axes (5 V counter inputs)



RIO P24-10

Positioning for two axes (24 V counter inputs)

Potential distributor (terminal expansion)



RIO KE 16

2 distributors each with 10 terminal connections

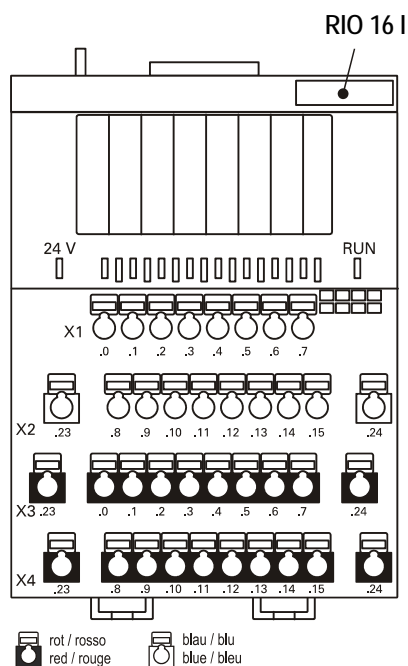
Only suitable for modules with clips.

1.1 Operating Manuals – Overview and Ordering Information

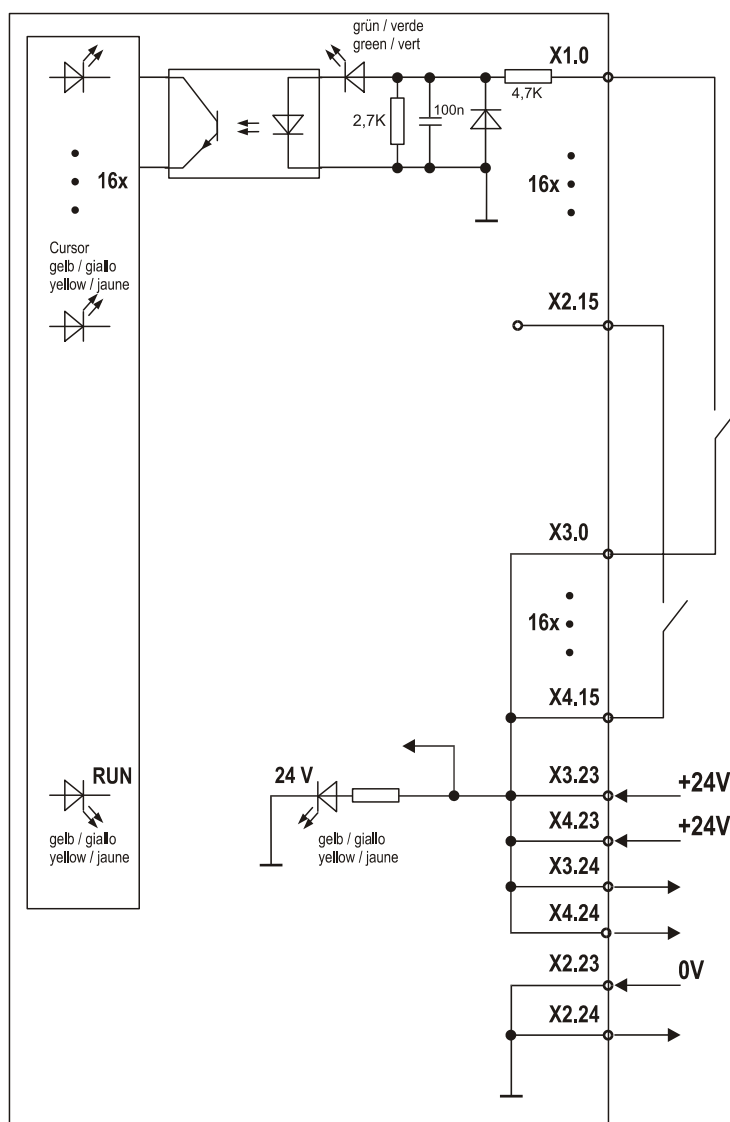
Operating manuals	
Item	Article No.
RIO Kompakt-I/O (German)	R4.322.1820.0 (322 156 95)
RIO Compact I/O (English)	R4.322.1830.0 (322 156 97)
RIO Buskoppler (German)	R4.322.1840.0 (322 156 98)
RIO Bus Couplers (English)	R4.322.1850.0 (322 157 00)
RIO Erweiterungsmodule (German)	R4.322.1720.0 (322 154 14)
RIO Expansion Modules (English)	R4.322.1730.0 (322 154 15)
RIO Gesamtdokumentation (Kompakt-I/O und Modulsystem) German	R4.322.1800.0 (322 155 50)
RIO Complete Documentation (Compact I/O and Modular System) English	R4.322.1810.0 (322 155 80)

2 Module Descriptions

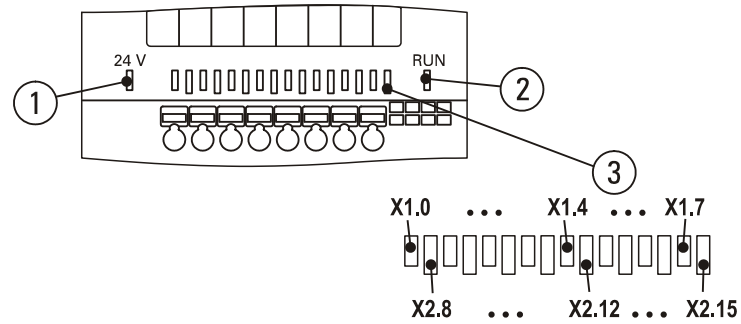
2.1 Digital I/O Module 16 Inputs RIO 16 I



- 16 inputs DC 24 V
- Two-wire connection system



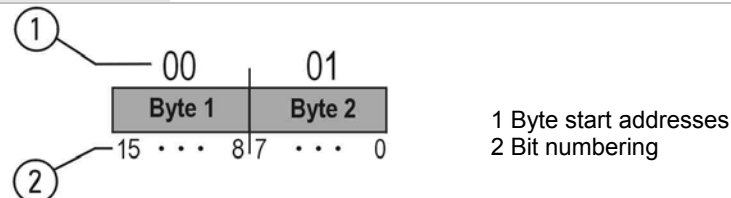
2.1.1 LED displays on RIO 16 I



LED displays RIO 16 I			
No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7 X2.8 ... X2.15	green	Control state
		yellow	Channel cursor

2.1.2 Data width, addressing and terminal assignment for RIO 16 I

RIO 16 I				
	Byte inputs		Byte outputs	
Data width	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

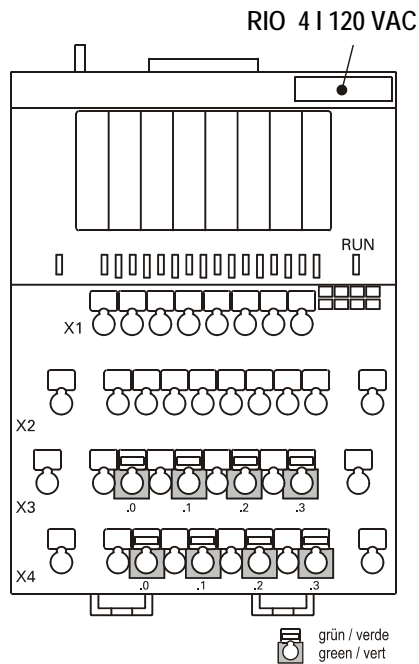


2.1.3 Technical data RIO 16 I

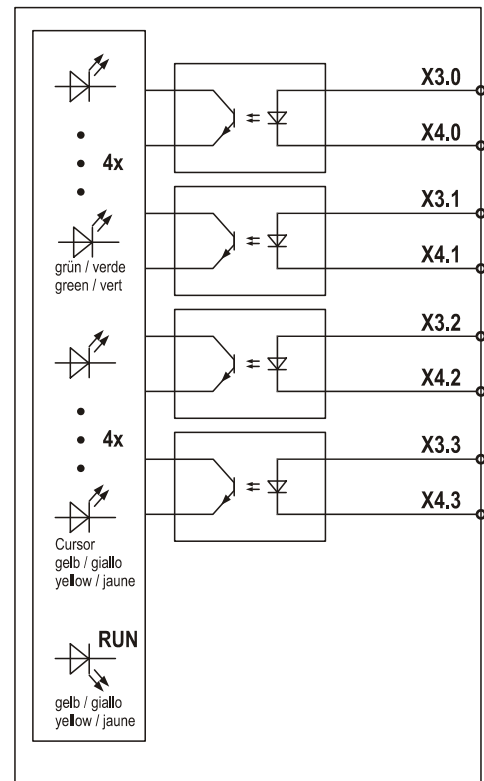
RIO 16 I	
Module ID	2
Number of inputs	16
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without input current)
Power consumption from internal 5 V supply	0.275 W
Inputs	
Switching level	H level +15 V to +30 V L level -30 V to +5 V
Input current	min. H level (+15 V), $I \geq 2.5$ mA max. L level (+5 V), $I \leq 0.7$ mA Typical (+24 V), $I = 4.5$ mA
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Signal delay	Typical 100 μ s (hardware)

See also General Technical Data, page 94.

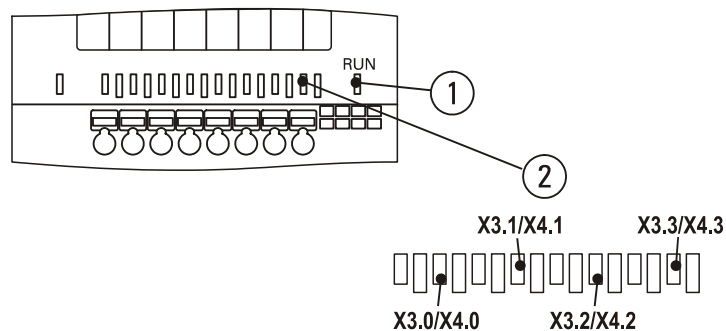
2.2 Digital I/O Module 4 Inputs AC 120 V RIO 4 I 120 VAC



- 4 inputs AC 120 V



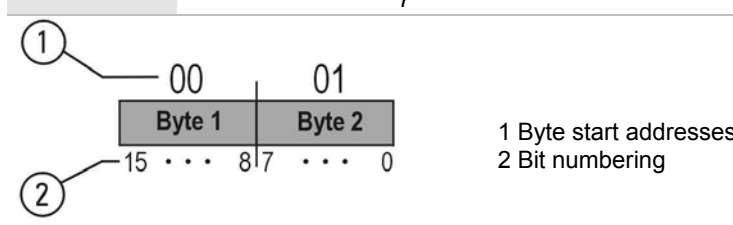
2.2.1 LED displays RIO 4 I 120 VAC



LED displays RIO 4 I 120 VAC			
No.	LED	Colour	Meaning
1	RUN	yellow	Internal data transfer to bus coupler is running
2	Control state of terminals X3.0/X4.0 X3.1/X4.1 X3.2/X4.2 X3.3/X4.3	green	Control state
		yellow	Channel cursor

2.2.2 Data width, addressing and terminal assignment for RIO 4 I 120 VAC

RIO 4 I 120 VAC			
	Byte inputs		Byte outputs
Data width	Byte 1	Byte 2	
	not used	Bit	Terminal
		0	X3.0/4.0
		1	X3.1/4.1
		2	X3.2/4.2
		3	X3.3/4.3
		4	not used
		5	
		6	
		7	



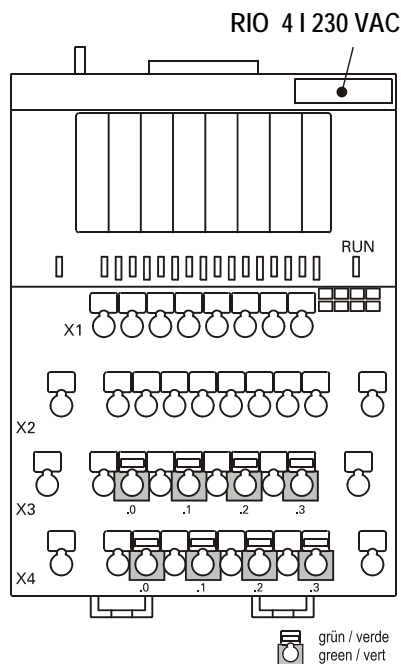
1 Byte start addresses
2 Bit numbering

2.2.3 Technical data RIO 4 I 120 VAC

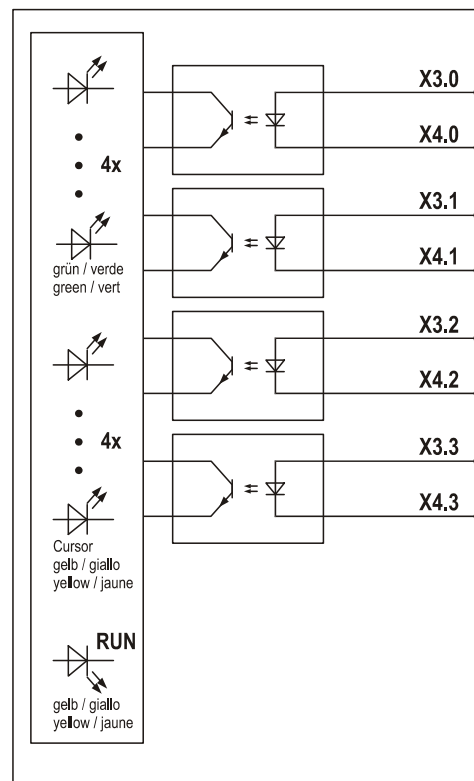
RIO 4 I 120 VAC	
Module ID	24d / 18h
Number of inputs	4
Supply voltage external	none
Power consumption from external 24 V supply	none
Power consumption from internal 5 V supply	0.2 W
Inputs	
Switching level	H level AC 74 to 132 V L level AC 0 to 20 V
Input current	min. H level (AC 74 V) ≥ 5 mA max. L level (AC 20 V) ≥ 2.3 mA
Isolation from internal bus	Yes, each channel separately by means of optocouplers

See also General Technical Data, page 94.

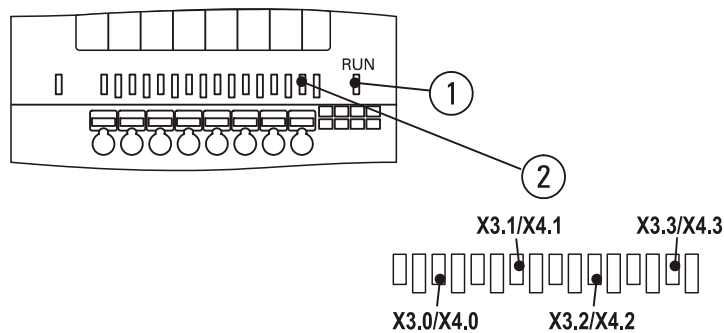
2.3 Digital I/O Module 4 Inputs AC 230 V RIO 4 I 230 VAC



- 4 inputs AC 230 V



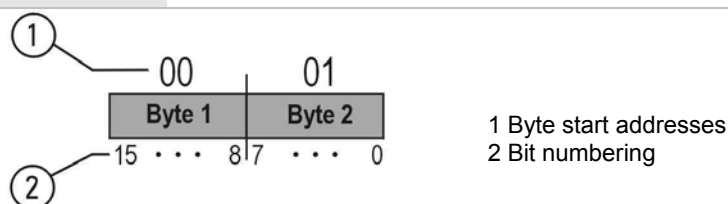
2.3.1 LED displays RIO 4 I 230 VAC



LED displays RIO 4 I 230 VAC			
No.	LED	Colour	Meaning
1	RUN	yellow	Internal data transfer to bus coupler is running
2	Control state of terminals X3.0/X4.0 X3.1/X4.1 X3.2/X4.2 X3.3/X4.3	green	Control state
		yellow	Channel cursor

2.3.2 Data width, addressing and terminal assignment for RIO 4 I 230 VAC

RIO 4 I 230 VAC			
	Byte inputs		Byte outputs
Data width	Byte 1	Byte 2	
	not used	Bit	Terminal
		0	X3.0/4.0
		1	X3.1/4.1
		2	X3.2/4.2
		3	X3.3/4.3
		4	not used
		5	
		6	
		7	

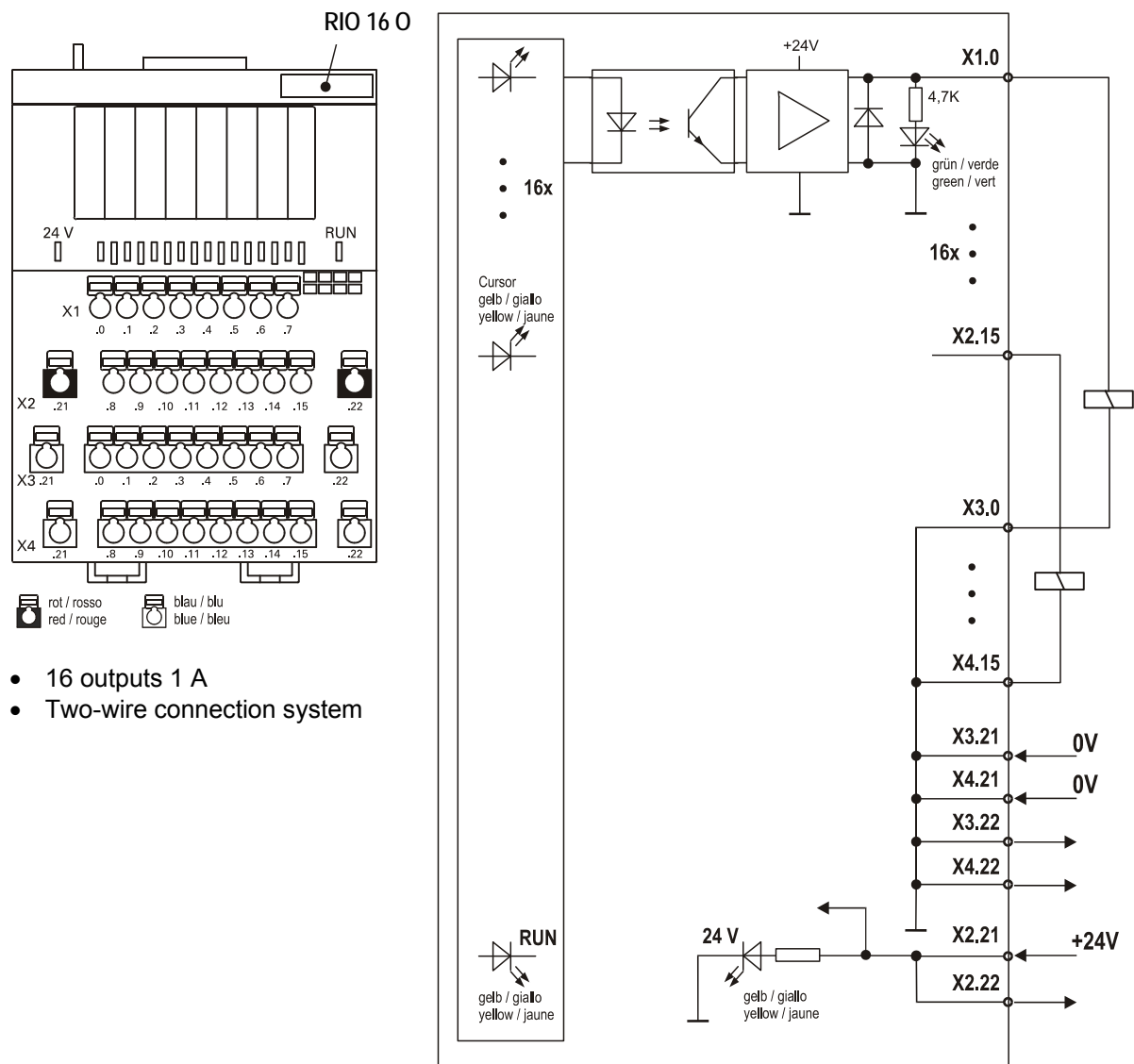


2.3.3 Technical data RIO 4 I 230 VAC

RIO 4 I 230 VAC	
Module ID	25d /19h
Number of inputs	4
Supply voltage external	none
Power consumption from external 24 V supply	none
Power consumption from internal 5 V supply	0.2 W
Inputs	
Switching level	H level AC 159 to 253 V L level AC 0 to 40 V
Input current	min. H level (AC 159 V) ≥ 5 mA max. L level (AC 40 V) ≥ 2.3 mA
Isolation from internal bus	Yes, each channel separately by means of optocouplers

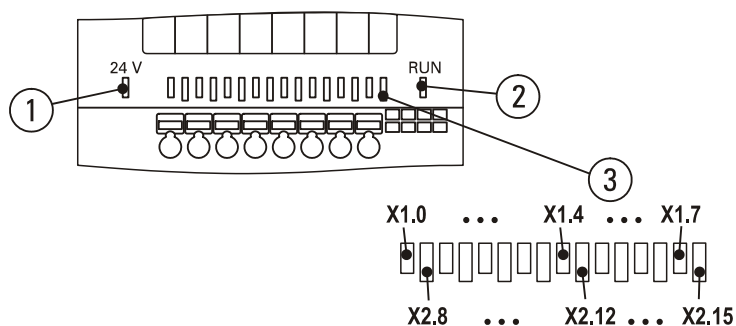
See also General Technical Data, page 94.

2.4 Digital I/O Module 16 Outputs RIO 16 O



- 16 outputs 1 A
- Two-wire connection system

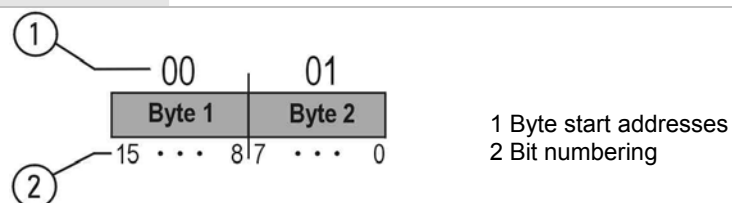
2.4.1 LED displays on RIO 16 0



LED displays RIO 16 0			
No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7 X2.8 ... X2.15	green	Control state
		yellow	Channel cursor

2.4.2 Data width, addressing and terminal assignment for RIO 16 0

RIO 16 0					
Byte inputs			Byte outputs		
Data width			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	

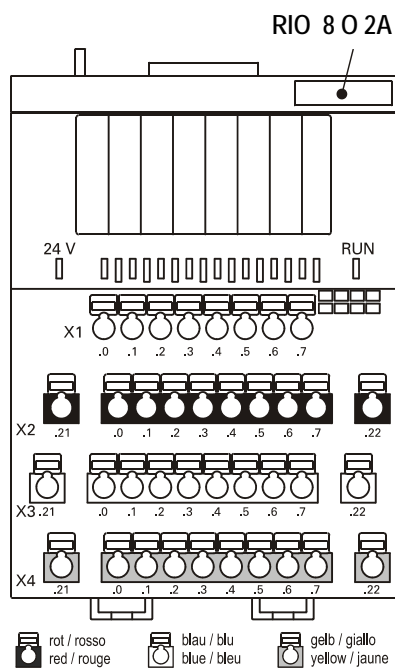


2.4.3 Technical data RIO 16 O

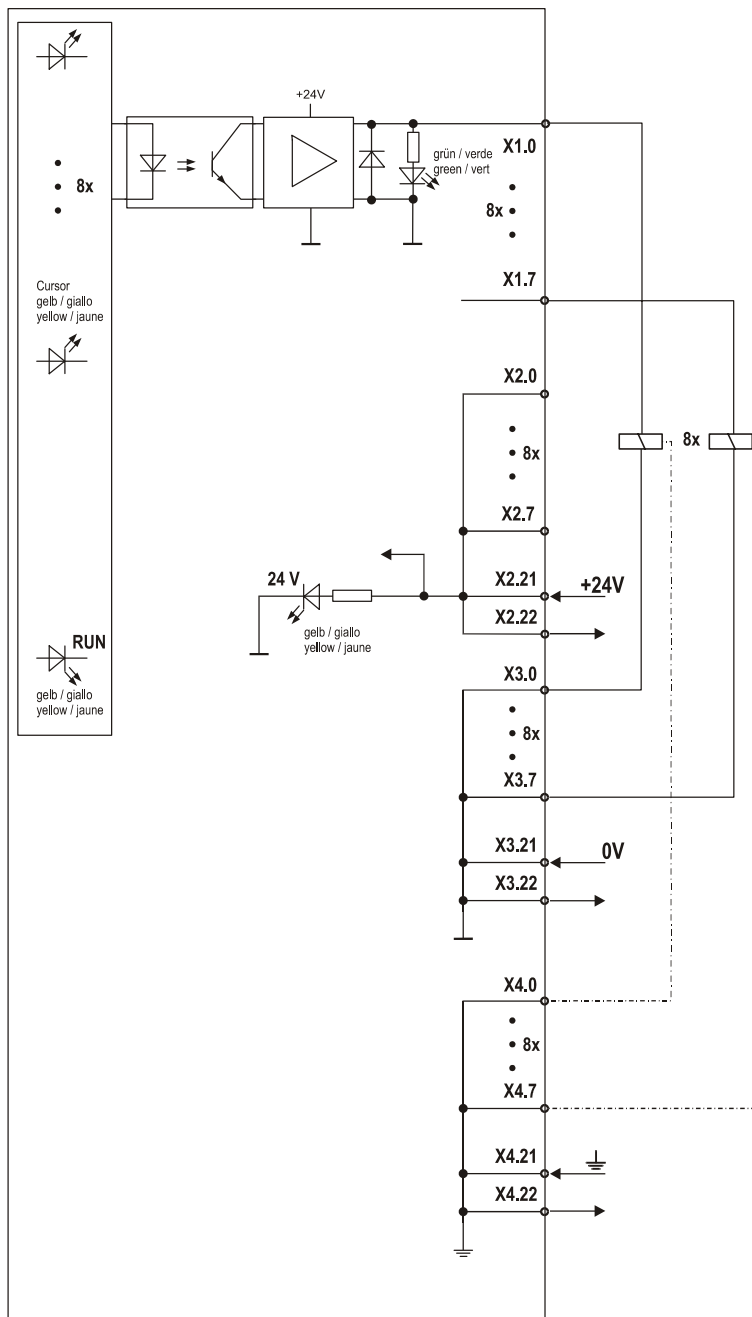
RIO 16 O	
Module ID	3
Number of outputs	16
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without load current)
Power consumption from internal 5 V supply	0.325 W
Outputs	
Output current per output max.	1 A Overload and short-circuit proof, parallel operation possible in groups (4 groups: 0-3,4-7,8-11,12-15)
Total current for whole module max.	8 A
Switching level	H level = supply voltage - 0.5 V ($I_L < 1$ A) L level ≤ 1 V ($I_L = 0$ A)
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	50%
Free-wheeling diode	Integrated
Signal delay	<100 μ s (hardware) see also Response Times section

See also General Technical Data, page 94.

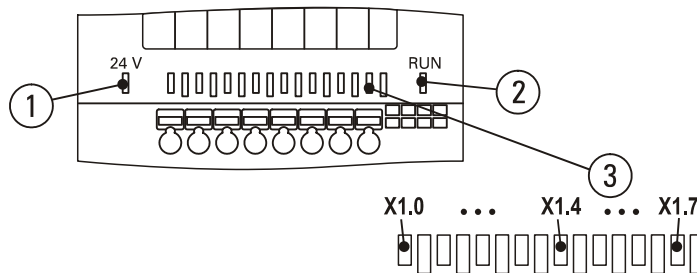
2.5 Digital I/O Module 8 Outputs 2 A RIO 8 O 2A



- 8 outputs 2 A
- Four-wire connection system



2.5.1 LED displays RIO 8 O 2A

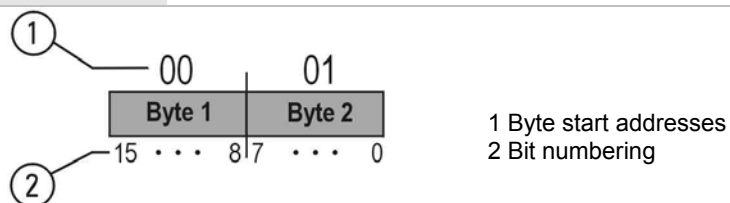


LED displays RIO 8 O 2A

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7	green	Control state
		yellow	Channel cursor

2.5.2 Data width, addressing and terminal assignment for RIO 8 O 2A

RIO 8 O 2A			
Byte inputs		Byte outputs	
Data width		Byte 1	Byte 2
		not used	Bit Terminal
			0 X1.0
			1 X1.1
			2 X1.2
			3 X1.3
			4 X1.4
			5 X1.5
			6 X1.6
			7 X1.7

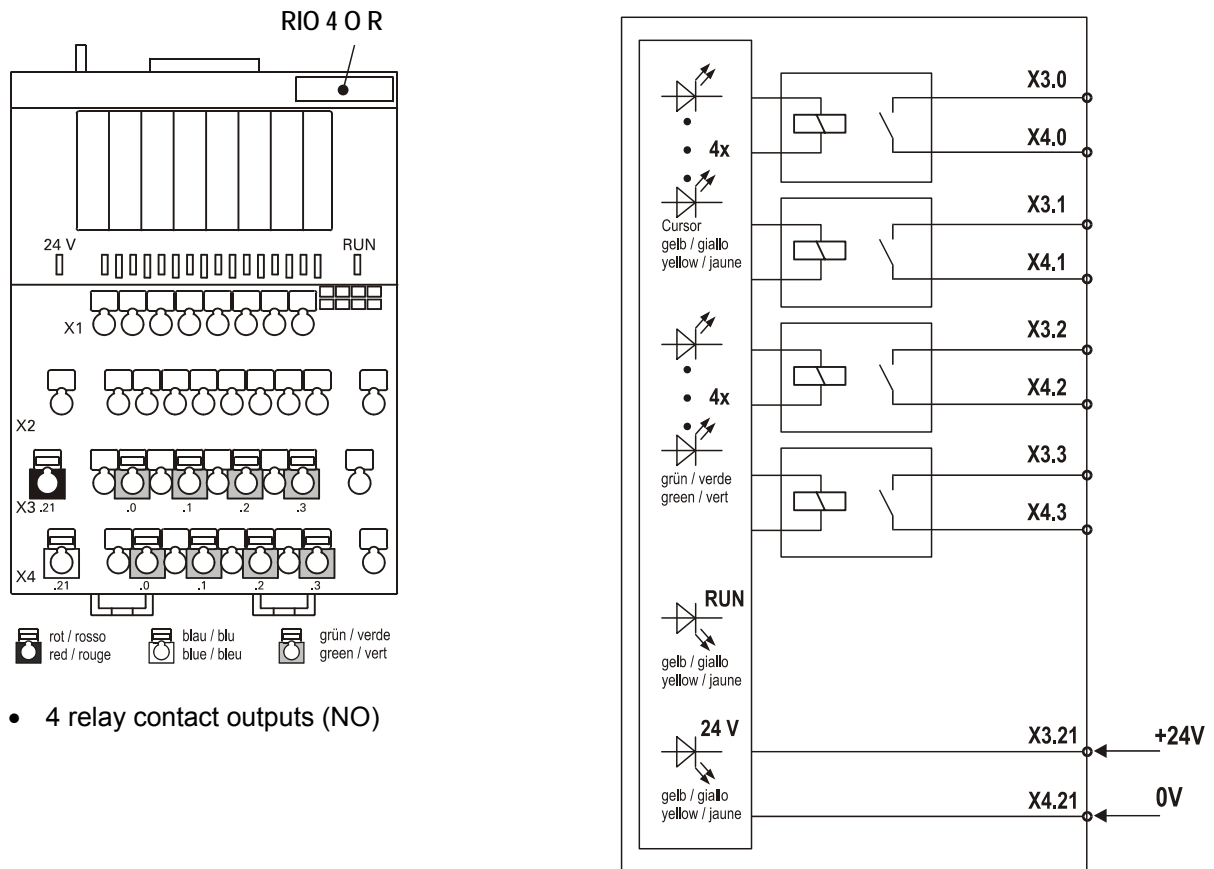


2.5.3 Technical Data RIO 8 O 2A

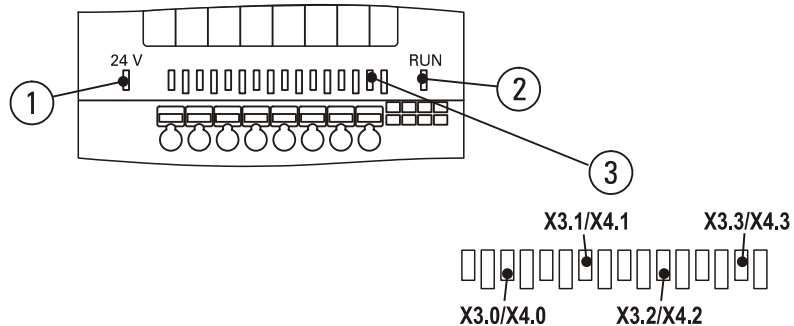
RIO 8 O 2A	
Module ID	23d / 17h
Number of outputs	8
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without load current)
Power consumption from internal 5 V supply	0.325 W
Outputs	
Output current per output max.	2 A short-circuit-proof and overcurrent-protected
Total current for whole module max.	8 A
Switching level	H level = supply voltage - 0.5 V (IL < 2 A) L level \leq 1 V (IL = 0 A)
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	50%
Free-wheeling diode	Integrated
Signal delay	<100 μ s (hardware) see also Response Times section

See also General Technical Data, page 94.

2.6 Digital I/O Module 4 Relay Outputs RIO 4 O R



2.6.1 LED displays RIO 4 O R



LED displays RIO 4 O R			
No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X3.0/X4.0 X3.1/X4.1 X3.2/X4.2 X3.3/X4.3	green	Control state
		yellow	Channel cursor

2.6.2 Data width, addressing and terminal assignment for RIO 4 O R

RIO 4 O R			
	Byte inputs	Byte outputs	
Data width		Byte 1	Byte 2
		not used	Bit Terminal
			0 X3.0/4.0
			1 X3.1/4.1
			2 X3.2/4.2
			3 X3.3/4.3
			4 not used
			5
			6
			7

① — 00 01

Byte 1				Byte 2			
15	...	8	7	7	...	0	0

② —

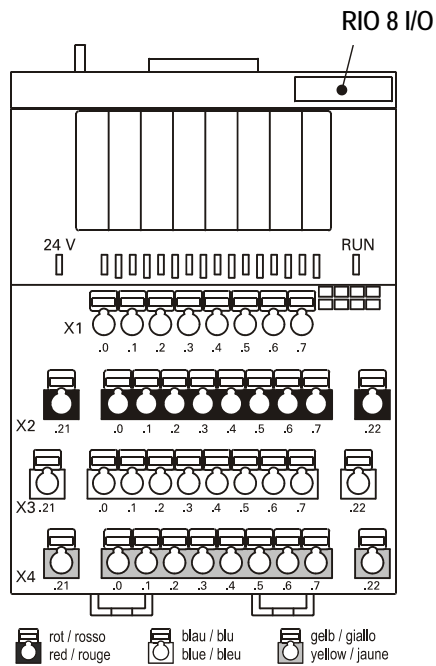
1 Byte start addresses
2 Bit numbering

2.6.3 Technical data RIO 4 O R

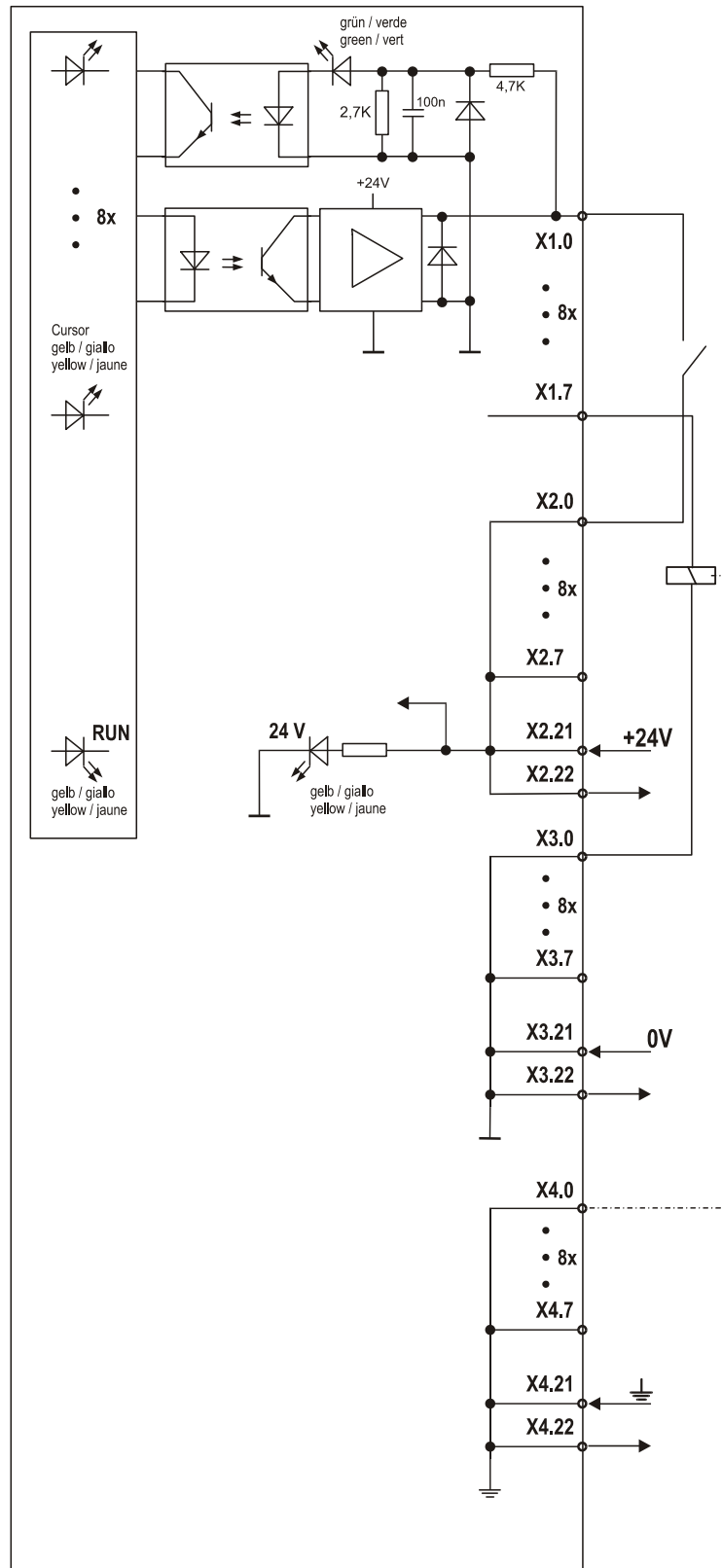
RIO 4 O R	
Module ID	19d / 13h
Number of outputs	4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	2 W
Power consumption from internal 5 V supply	0.25 W
Outputs	
Output current per output max.	5 A
Total current for whole module max.	12 A
Minimum contact load	AC/DC 5 V / 10 mA
Rated operating voltage	AC/DC 24 to 240 V
Utilization category according to IEC 60947-5-1	AC-15 U_e AC 230 V, I_e 3 A DC-13 U_e DC 24 V, I_e 2 A
Permissible switching frequency	\leq 3600 switching cycles/h
Mechanical service life	30×10^6 switching cycles
Electrical service life 20/2 A, AC 250 V, $\cos\varphi = 0.3$	0.12×10^6 switching cycles AC-15
Isolation from internal bus	Yes, each channel separately via relay contacts
Simultaneity	100%
Free-wheeling diode	Integrated
Signal delay	$<100 \mu\text{s}$ (hardware) see also Response Times section

See also General Technical Data, page 94.

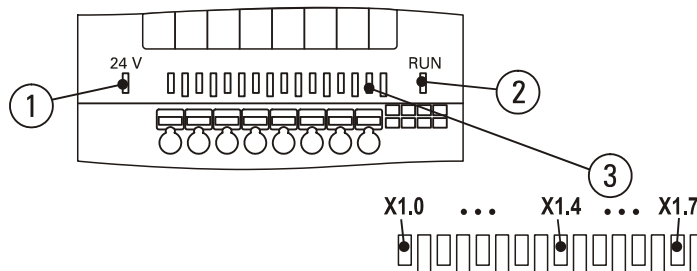
2.7 Digital I/O Module 8 Inputs/Outputs RIO 8 I/O



- 8 combination I/Os
Can be used individually as 24 V DC inputs or 1 A outputs
- Four-wire connection system



2.7.1 LED displays RIO 8 I/O

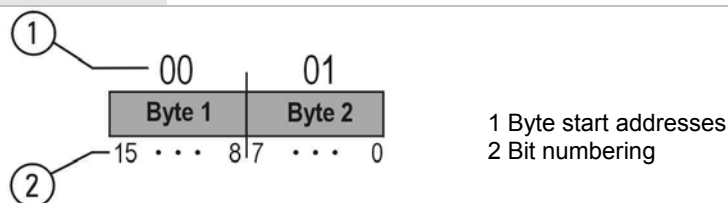


LED displays RIO 8 I/O

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7	green	Control state
		yellow	Channel cursor

2.7.2 Data width, addressing and terminal assignment for RIO 8 I/O

RIO 8 I/O						
Data width	Byte inputs			Byte outputs		
	Byte 1	Byte 2		Byte 1	Byte 2	
	not used	Bit	Terminal	not used	Bit	Terminal
		0	X1.0		0	X1.0
		1	X1.1		1	X1.1
		2	X1.2		2	X1.2
		3	X1.3		3	X1.3
		4	X1.4		4	X1.4
		5	X1.5		5	X1.5
		6	X1.6		6	X1.6
		7	X1.7		7	X1.7



2.7.3 Technical data RIO 8 I/O

RIO 8 I/O	
Module ID	1
Number of inputs/outputs	8 combination I/Os can be used individually as input or output
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without input current/load current)
Power consumption from internal 5 V supply	0.325 W
Inputs	
Switching level	H level +15 V to +30 V L level -30 V to +5 V
Input current	min. H level (+15 V), $I \geq 3.6$ mA max. L level (+5 V), $I \leq 1.2$ mA Typical (+24 V), $I = 6.1$ mA
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Signal delay	<100 μ s (hardware) see also Response Times section
Outputs	
Output current per output max.	1A Overload and short-circuit proof, parallel operation possible in groups (2 groups: 0-3, 4-7)
Total current for whole module max.	8 A
Switching level	H level = supply voltage - 0.5 V ($I_L < 1$ A) L level ≤ 1 V ($I_L = 0$ A)
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	100%
Free-wheeling diode	Integrated
Signal delay	<100 μ s (hardware) see also Response Times section

See also General Technical Data, page 94.



Each of the 8 channels can be used either as an input or an output. This means that both an input address space and an output address space are reserved as process map in the bus coupler. Ensure that an input channel (e.g. initiator) is not used as an output channel at the same time. However, an output can be read back as an input. This way the PLC can monitor the switching function.

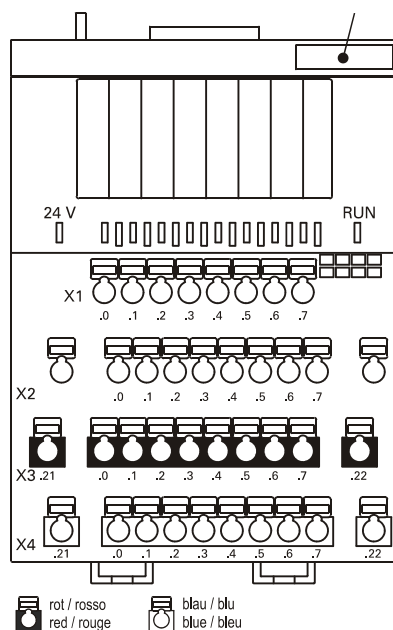


When using modules with digital combination channels note that you cannot connect a 24 V supply to a combination channel without connecting the module to the power supply.

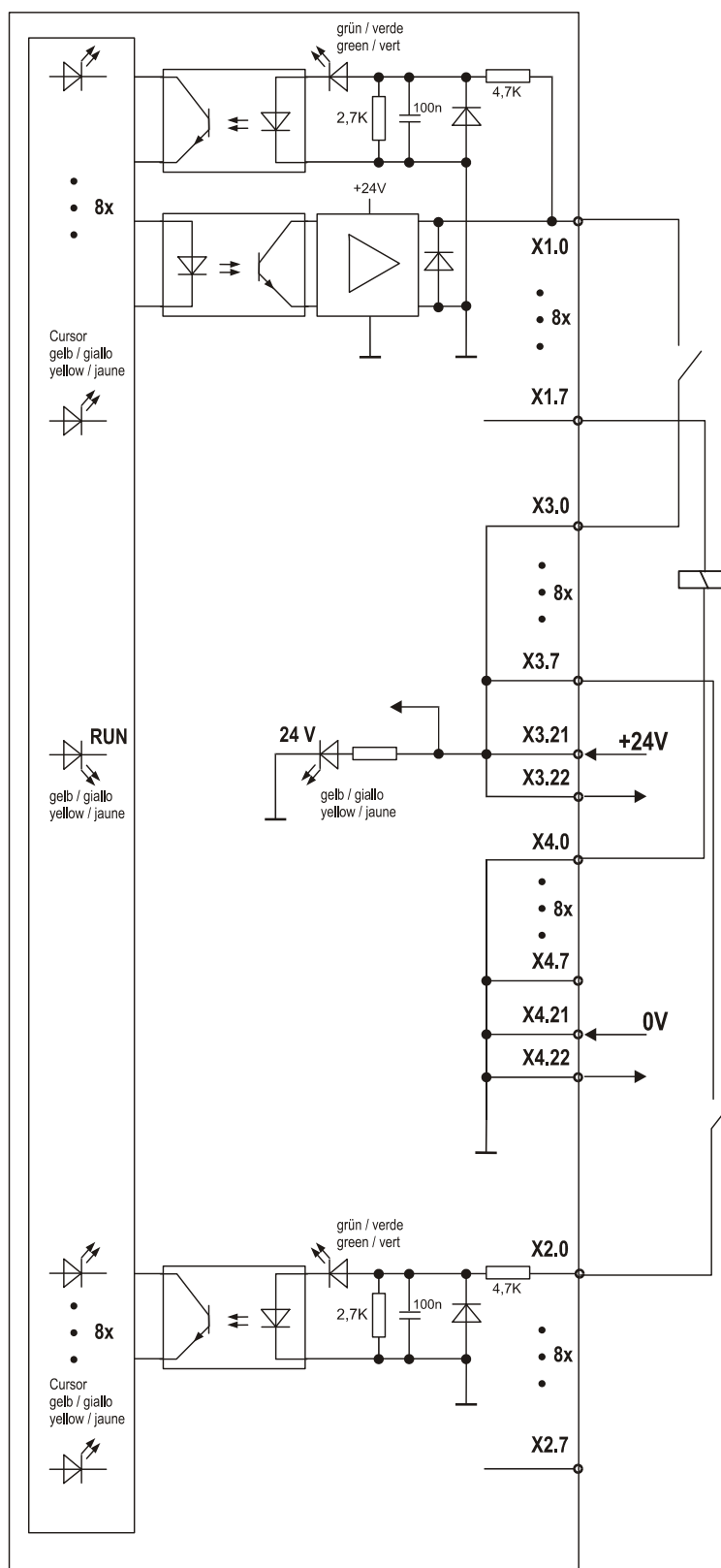
If you do, the power supply will be fed back via the output circuit of the module. This may result in a malfunction or destruction of the output circuit.

2.8 Digital I/O Module 8 Inputs 8 Inputs/Outputs RIO 8 I 8 I/O

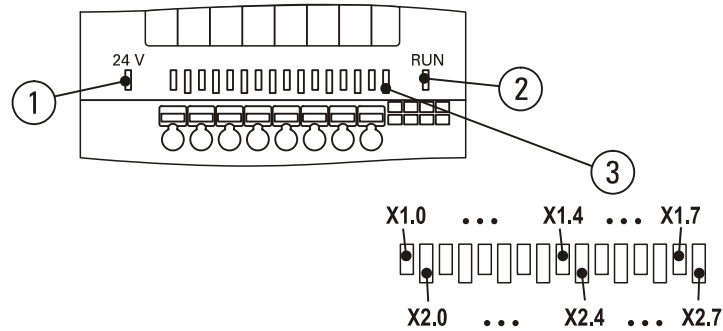
RIO 8 | 8 I/O



- 8 inputs DC 24 V
- 8 combination I/Os
Can be used individually as 24 V DC inputs or 1 A outputs
- Two-wire connection system



2.8.1 LED displays RIO 8 I 8 I/O

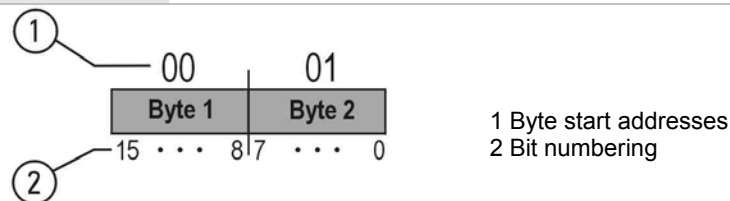


LED displays RIO 8 I 8 I/O

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7 X2.0 ... X2.7	green yellow	Control state Channel cursor

2.8.2 Data width, addressing and terminal assignment for RIO 8 I 8 I/O

RIO 8 I 8 I/O							
Byte inputs				Byte outputs			
Data width	Byte 1		Byte 2		Byte 1		Byte 2
	Bit	Terminal	Bit	Terminal	not used	Bit	Terminal
	8	X2.0	0	X1.0		0	X1.0
	9	X2.1	1	X1.1		1	X1.1
	10	X2.2	2	X1.2		2	X1.2
	11	X2.3	3	X1.3		3	X1.3
	12	X2.4	4	X1.4		4	X1.4
	13	X2.5	5	X1.5		5	X1.5
	14	X2.6	6	X1.6		6	X1.6
	15	X2.7	7	X1.7		7	X1.7



2.8.3 Technical data RIO 8 I 8 I/O

RIO 8I 8I/O	
Module ID	4
Number of inputs/outputs	8 inputs and 8 combination I/Os which can be used individually as input or output
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without input current/load current)
Power consumption from internal 5 V supply	0.325 W
Inputs	
Switching level	H level +15 V to +30 V L level -30 V to +5 V
Input current	min. H level (+15 V), $I \geq 2.5$ mA/3.6 mA* max. L level (+5 V), $I \leq 0.7$ mA/1.2 mA* Typical (+24V), $I = 4.5$ mA/6.1 mA* *for combination I/Os
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Signal delay	<100 μ s (hardware) see also Response Times section
Outputs	
Output current per output max.	1 A Overload and short-circuit proof, parallel operation possible in groups (2 groups: 0-3, 4-7)
Total current for whole module max.	8 A
Switching level	H level = supply voltage - 0.5 V L level ≤ 1 V
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	100%
Free-wheeling diode	Integrated
Signal delay	<100 μ s (hardware) see also Response Times section

See also General Technical Data, page 94.

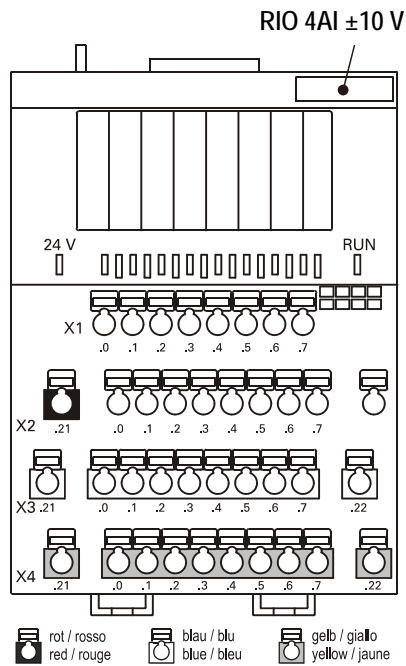


Each of the 8 combination I/O channels can be used either as an input or an output. This means that both an input address space and an output address space are reserved as process map in the bus coupler. Ensure that an input channel (e.g. initiator) is not used as an output channel at the same time. However, an output can be read back as an input. This way the PLC can monitor the switching function.

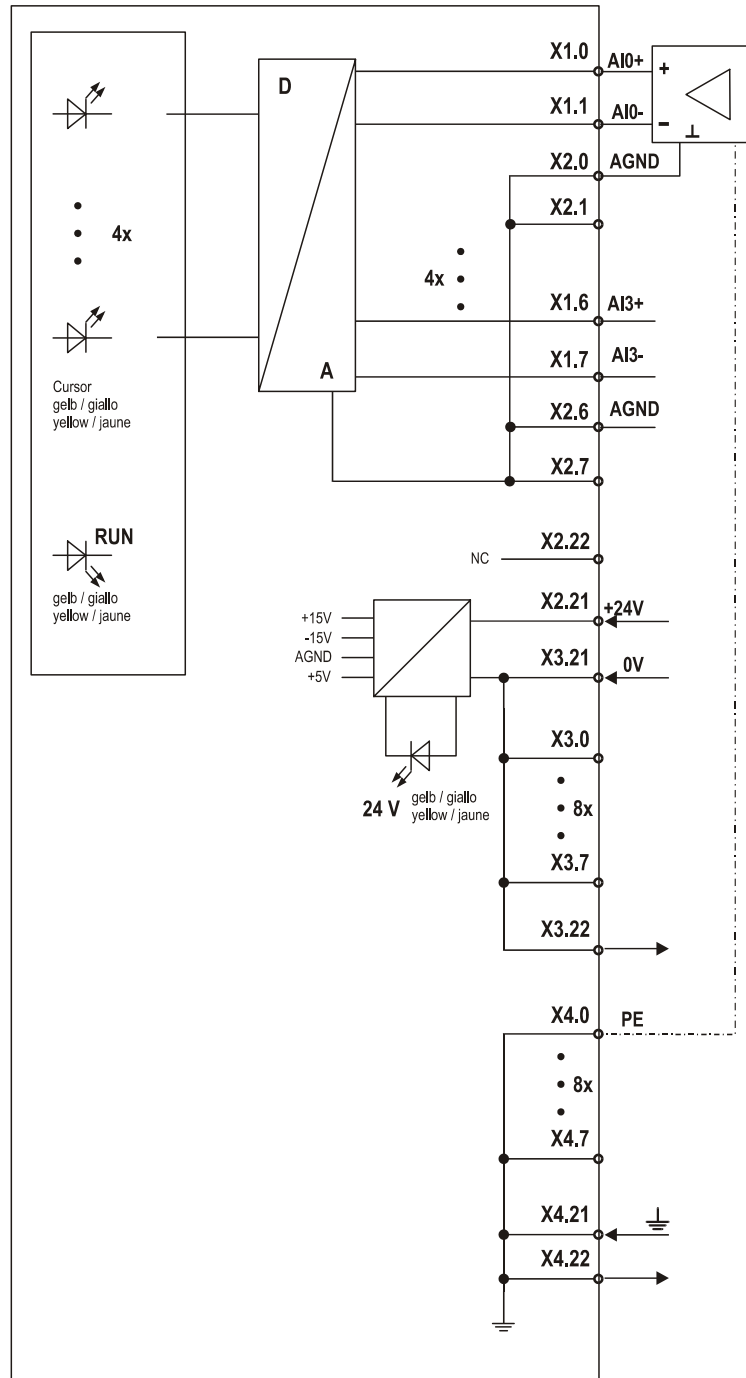


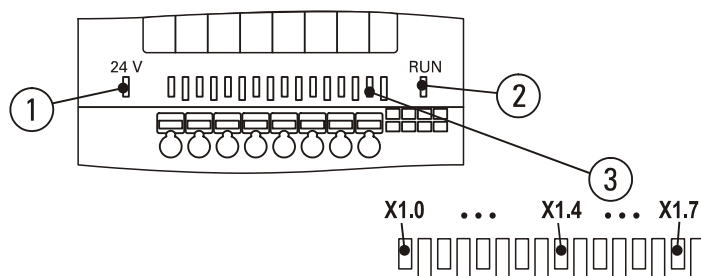
When using modules with digital combination channels note that you cannot connect a 24 V supply to a combination channel without connecting the module to the power supply. If you do, the power supply will be fed back via the output circuit of the module. This may result in a malfunction or destruction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

2.9 Analog Module 4 Inputs ± 10 V RIO 4AI ± 10 V



- 4 analog inputs ± 10 V

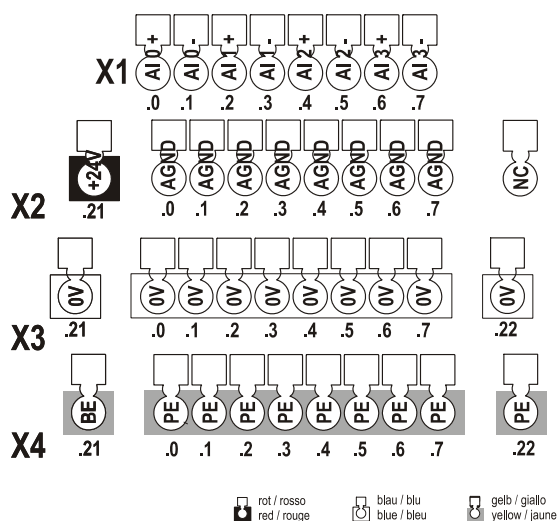


2.9.1 LED displays RIO 4AI $\pm 10V$ LED displays RIO 4AI $\pm 10V$

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

2.9.2 Data width RIO 4AI $\pm 10V$

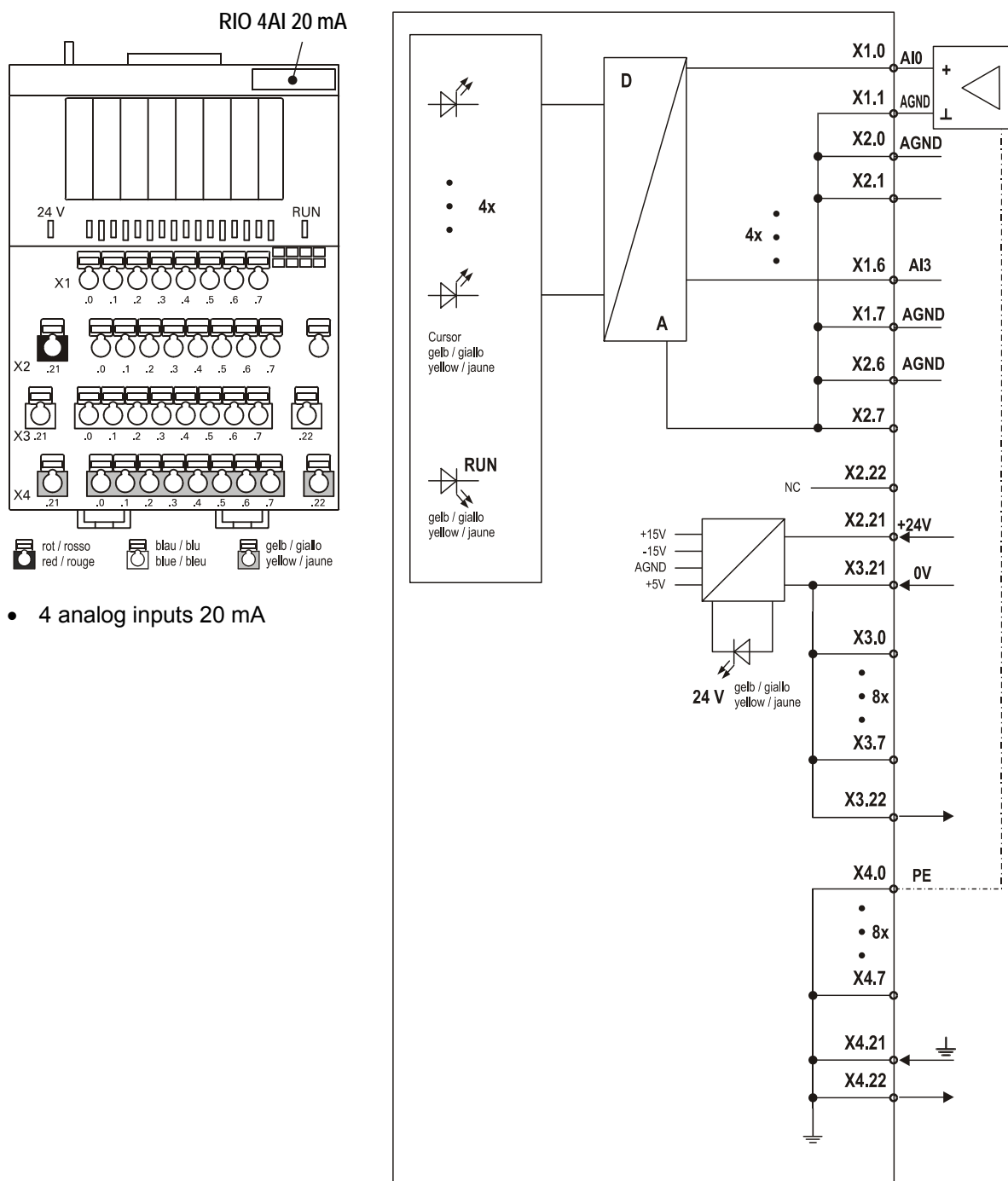
RIO 4AI $\pm 10V$		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	

2.9.3 Terminal assignment for RIO 4AI $\pm 10V$ 

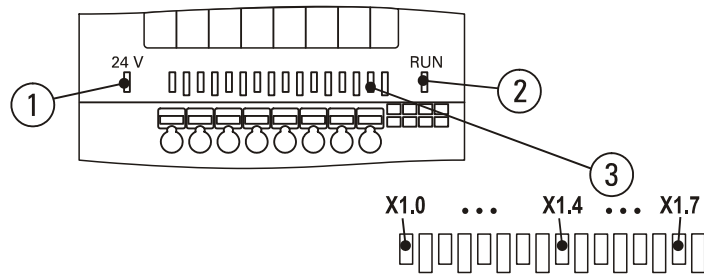
2.9.4 Technical data RIO 4AI ± 10 V

RIO 4AI ± 10 V	
Module ID	6
Number of inputs	4
Supply voltage external	24 V DC $\pm 20\%$ max. 5% residual ripple
Power consumption from external 24 V supply	3.6 W
Power consumption from internal 5 V supply	0.325 W
Data format default setting	± 10 V in two's complement $-2048\dots+2047$ (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs, page 95
 and General Technical Data, page 94.



2.10.1 LED displays RIO 4AI 20mA

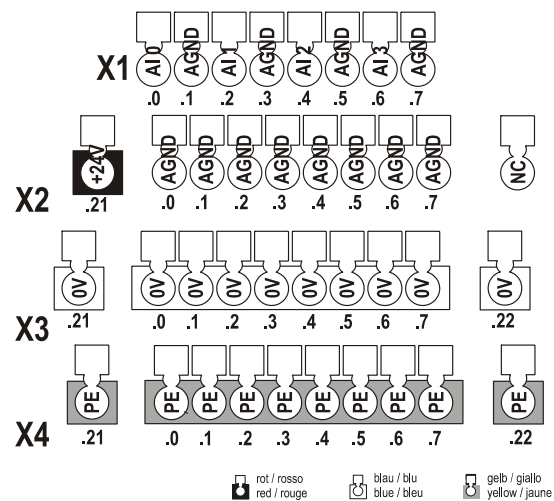


LED displays RIO 4AI 20mA				
No.	LED	Colour	Meaning	
1	24 V	yellow	24 V DC power supply is connected	
2	RUN	yellow	Internal data transfer to bus coupler is running	
3		yellow	Channel cursor	

2.10.2 Data width RIO 4AI 20mA

RIO 4AI 20mA		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	

2.10.3 Terminal assignment for RIO 4AI 20mA

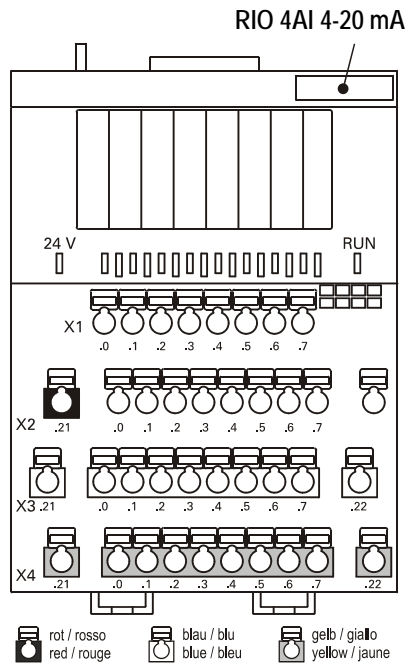


2.10.4 Technical data RIO 4AI 20mA

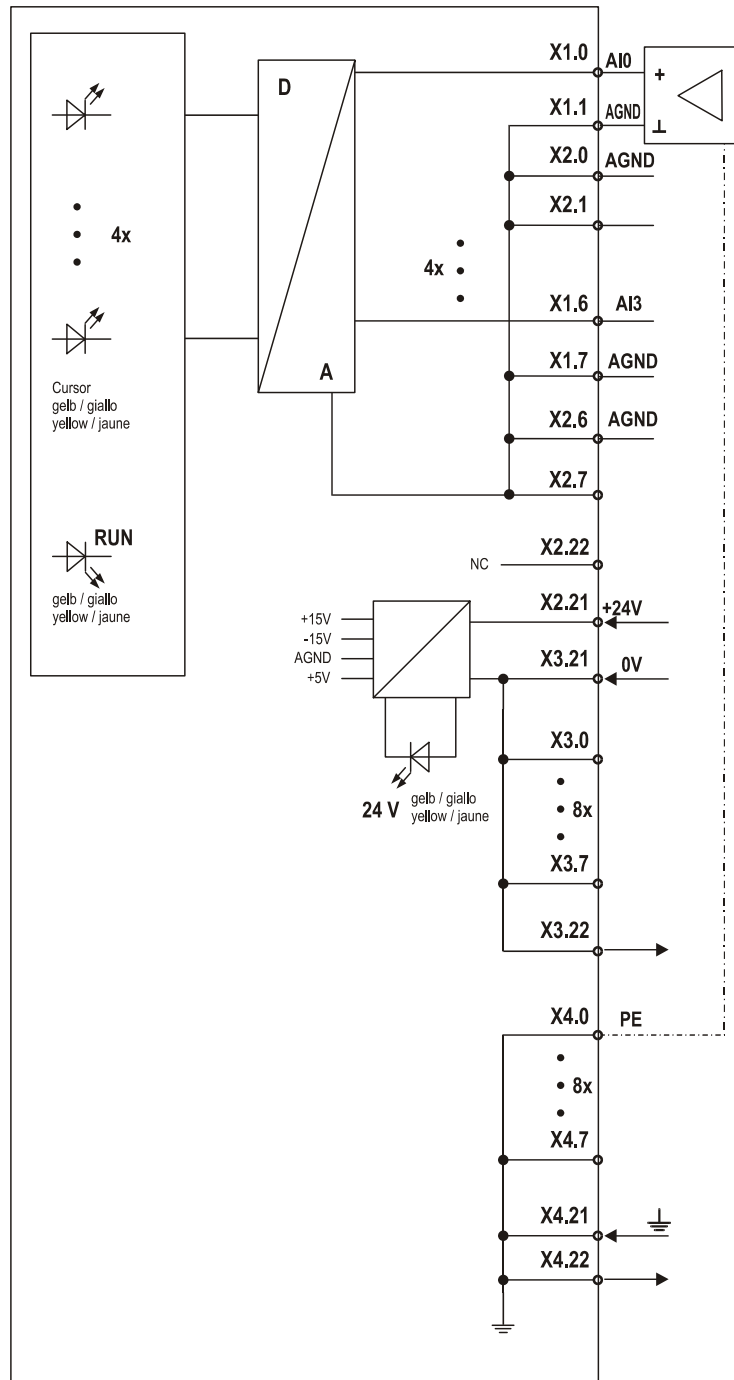
RIO 4AI 20mA	
Module ID	8
Number of inputs	4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	3.6 W
Power consumption from internal 5 V supply	0.325 W
Data format default setting	0...20 mA (0...4095) (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs, page 95
and General Technical Data, page 94.

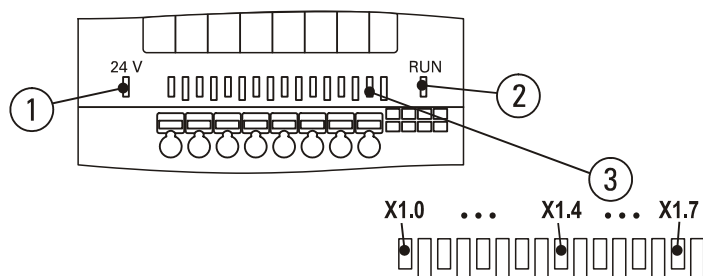
2.11 Analog Module 4 Inputs 4-20 mA RIO 4AI 4-20 mA



- 4 analog inputs 4...20 mA



2.11.1 LED displays RIO 4AI 4-20mA



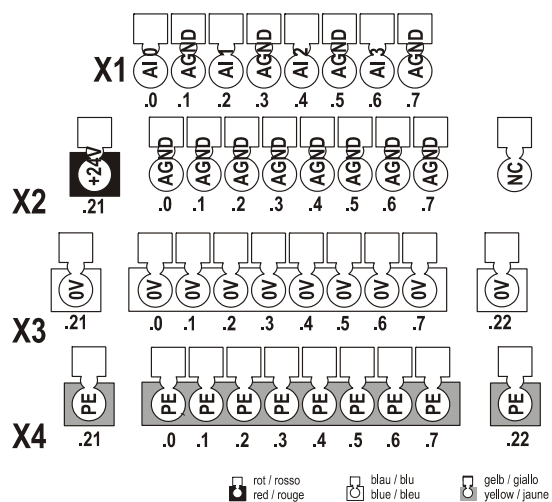
LED displays RIO 4AI 4-20mA

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

2.11.2 Data width RIO 4AI 4-20mA

RIO 4AI 4-20mA		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	

2.11.3 Terminal assignment for RIO 4AI 4-20mA

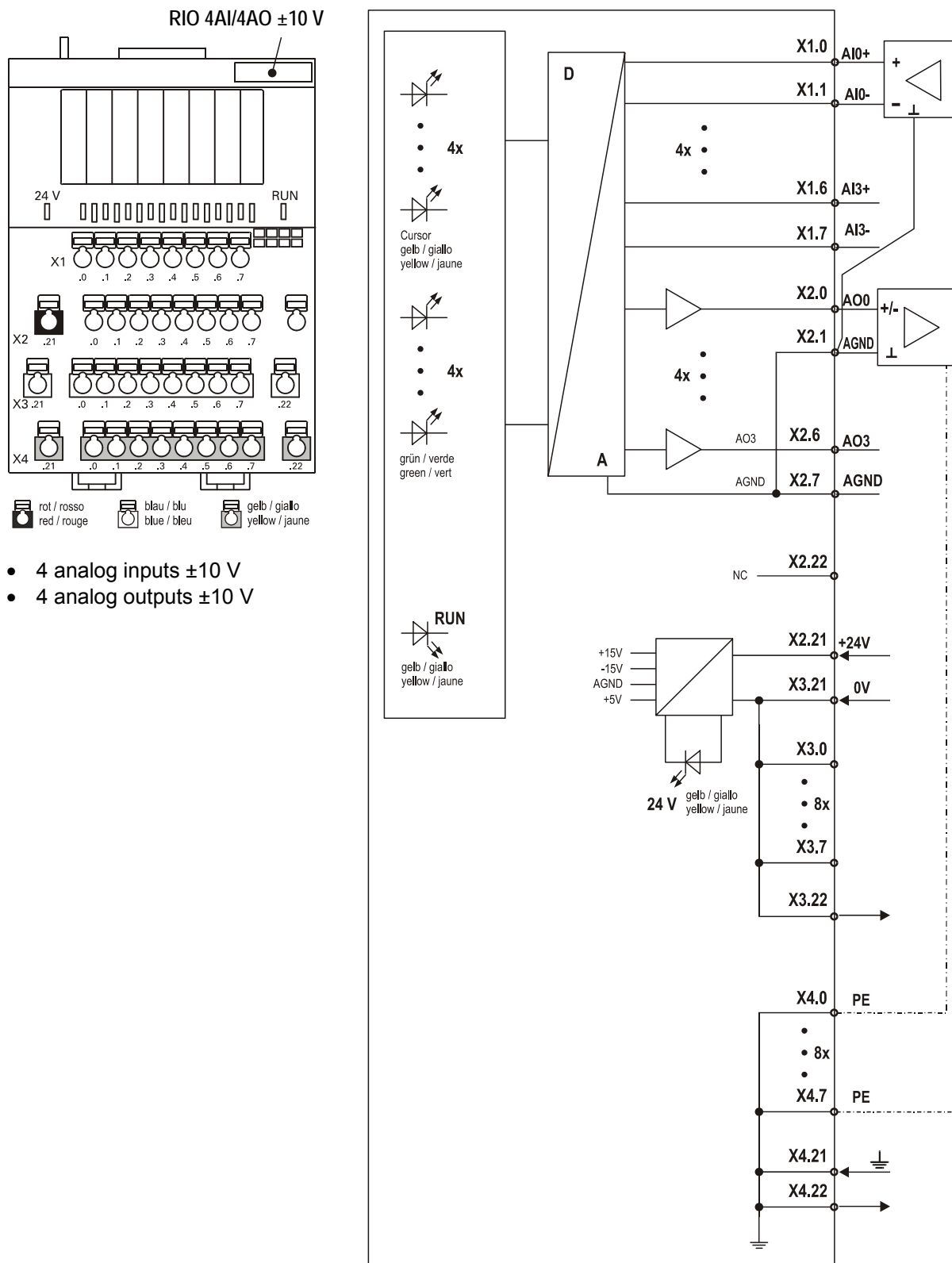


2.11.4 Technical data RIO 4AI 4-20mA

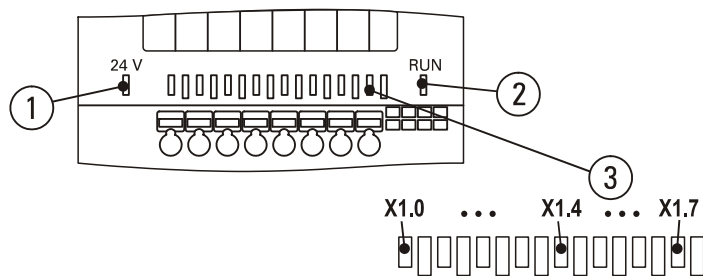
RIO 4AI 4-20mA	
Module ID	17d / 11h
Number of inputs	4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	3.6 W
Power consumption from internal 5 V supply	0.325 W
Data format default setting	4...20 mA S7 format (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs , page 95
 and General Technical Data, page 94.

2.12 Analog Module 4 Inputs 4 Outputs ± 10 V RIO 4AI/4AO ± 10 V



2.12.1 LED displays RIO 4AI/4AO ± 10 V

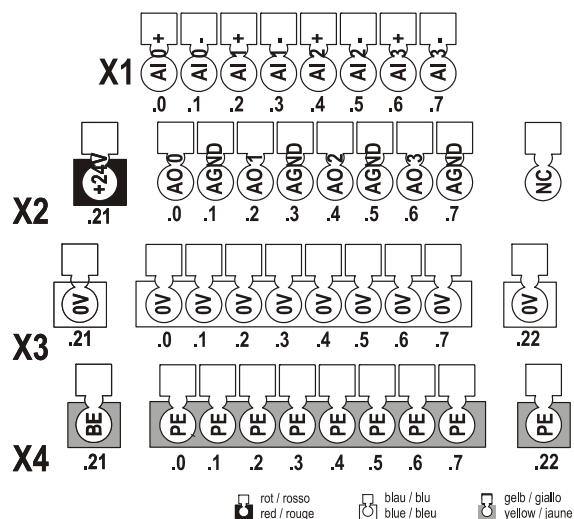


LED displays RIO 4AI/4AO ± 10 V			
No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

2.12.2 Data width RIO 4AI/4AO ± 10 V

RIO 4AI/4AO ± 10 V		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	Word 1 to 4

2.12.3 Terminal assignment for RIO 4AI/4AO ± 10 V

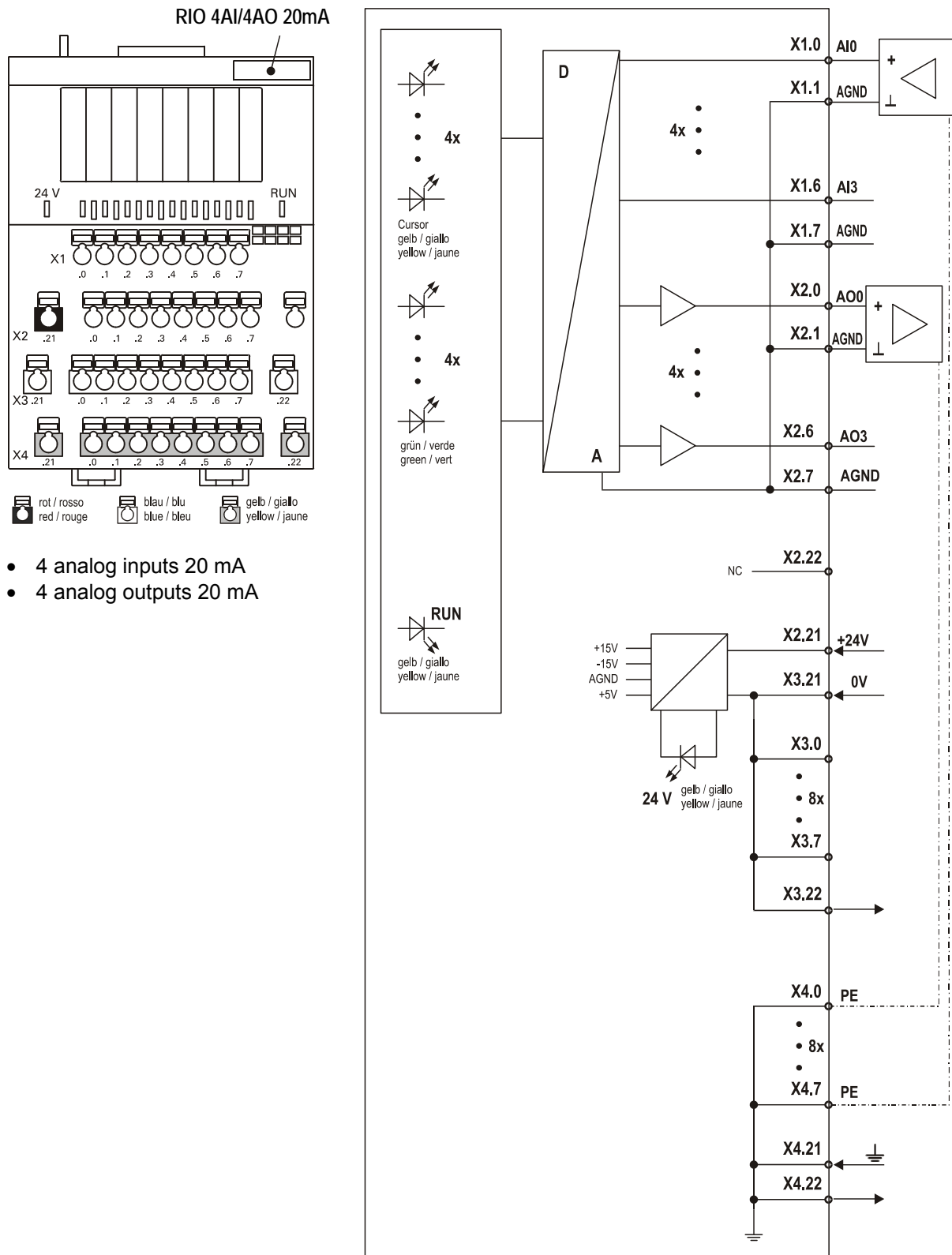


2.12.4 Technical Data RIO 4AI/4AO \pm 10 V

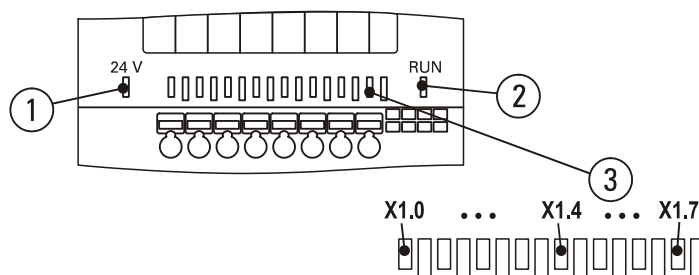
RIO 4AI/4AO \pm 10 V	
Module ID	5
Number of inputs/outputs	4/4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	4.3 W (maximum load on analog outputs)
Power consumption from internal 5 V supply	0.325 W
Data format default setting	\pm 10 V in two's complement -2048...+2047 (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs , page 95
and General Technical Data, page 94.

2.13 Analog Module 4 Inputs 4 Outputs 20mA RIO 4AI/4AO 20mA



2.13.1 LED displays RIO 4AI/4AO 20mA



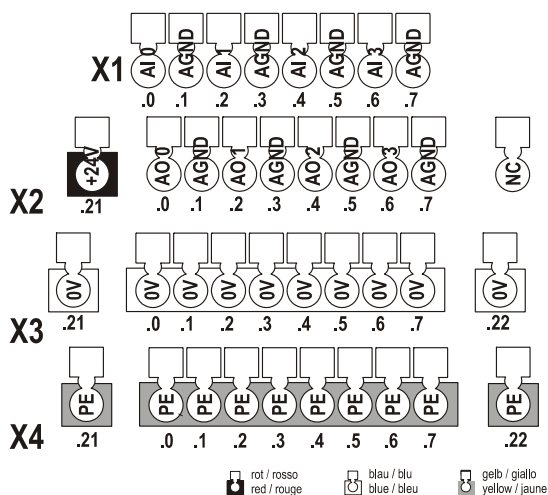
LED displays RIO 4AI/4AO 20mA

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

2.13.2 Data width RIO 4AI/4AO 20mA

RIO 4AI/4AO 20mA		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	Word 1 to 4

2.13.3 Terminal assignment for RIO 4AI/4AO 20mA

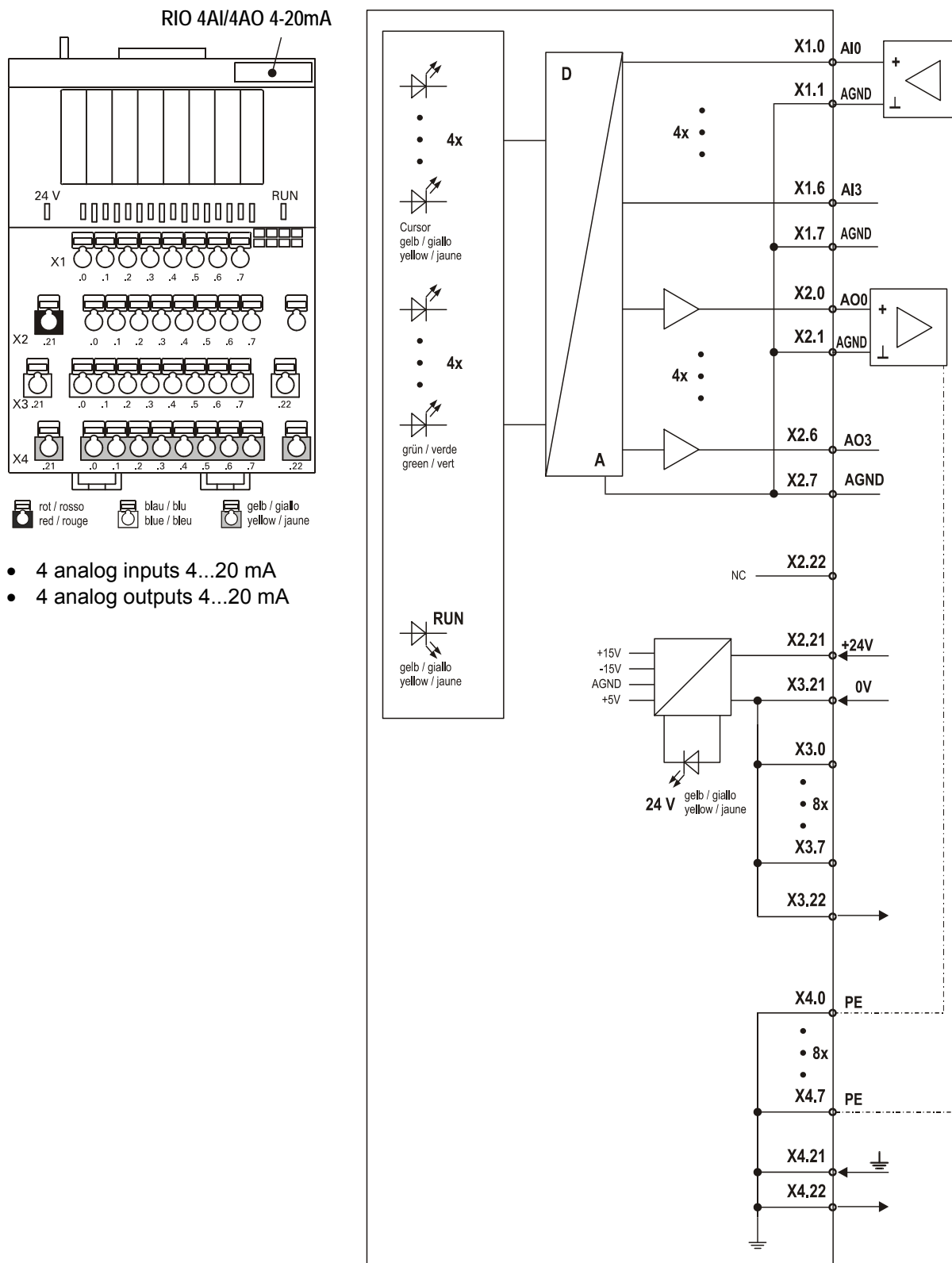


2.13.4 Technical data RIO 4AI/4AO 20mA

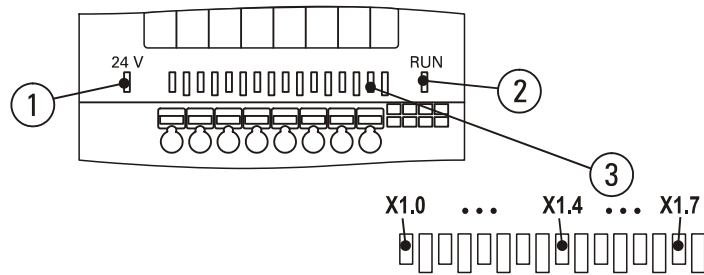
RIO 4AI/4AO 20mA	
Module ID	7
Number of inputs/outputs	4/4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	6 W (maximum load on analog outputs)
Power consumption from internal 5 V supply	0.325 W
Data format default setting	0...20 mA in two's complement 0...4095 (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs , page 95
 and General Technical Data, page 94.

2.14 Analog Module 4 Inputs 4 Outputs 4-20mA RIO 4AI/4AO 4-20mA



2.14.1 LED displays RIO 4AI/4AO 4-20mA



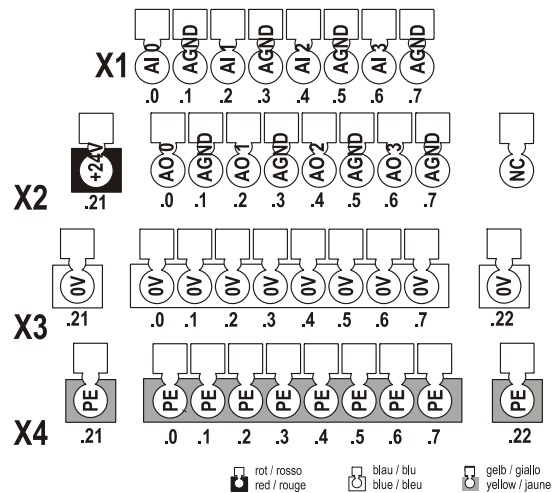
LED displays RIO 4AI/4AO 4-20mA

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

2.14.2 Data width RIO 4AI/4AO 4-20mA

RIO 4AI/4AO 4-20mA		
	Word inputs	Word outputs
Data width	Word 1 to 4 (channel 0 to 3)	Word 1 to 4

2.14.3 Terminal assignment RIO 4AI/4AO 4-20mA

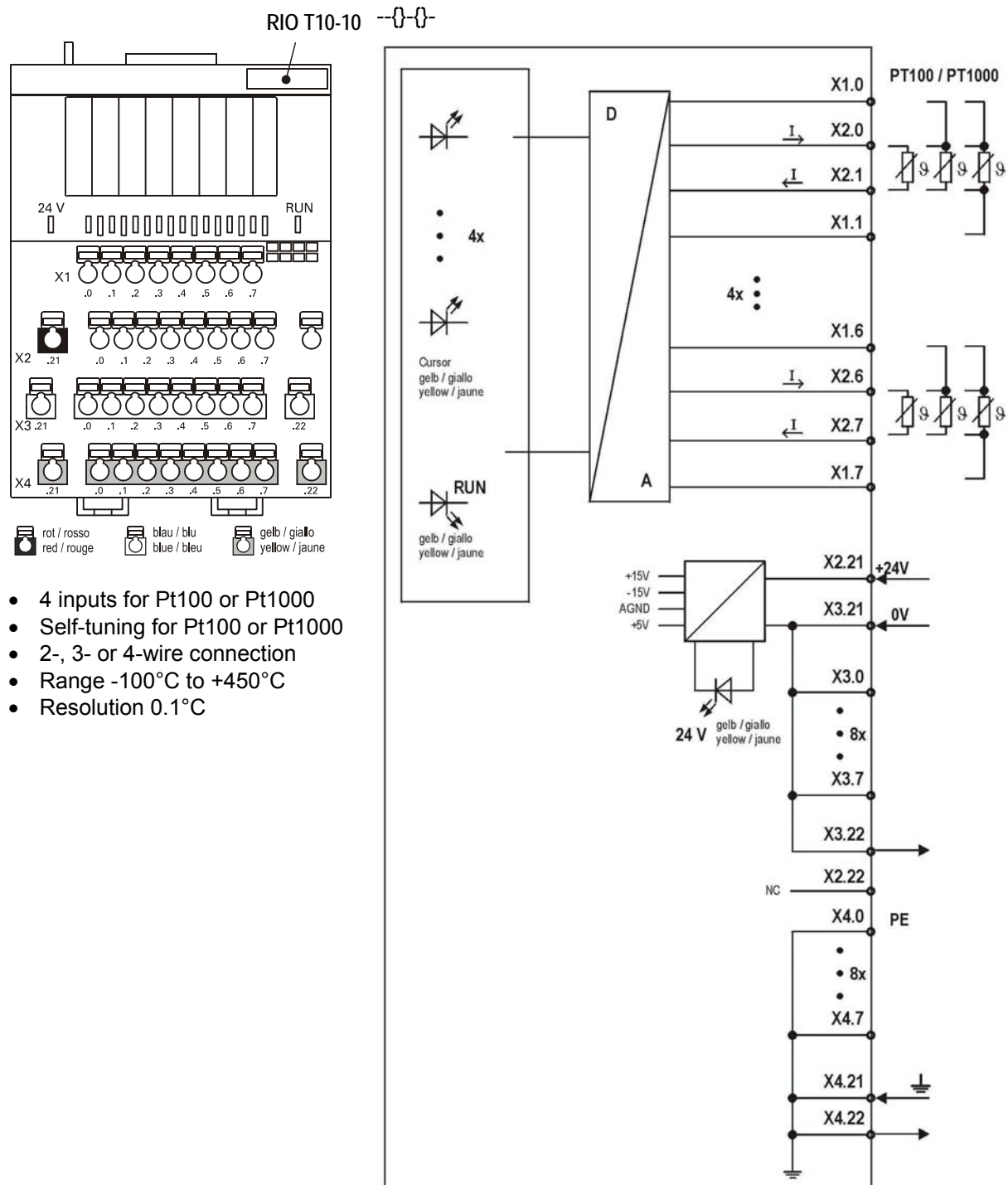


2.14.4 Technical data RIO 4AI/4AO 4-20mA

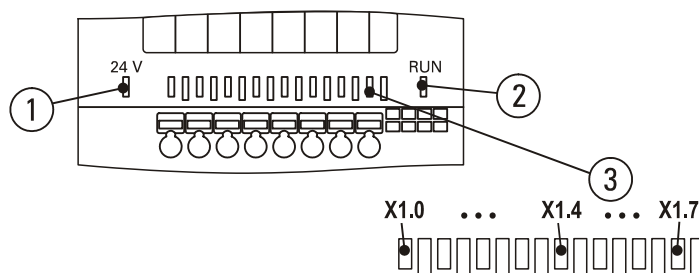
RIO 4AI/4AO 4-20mA	
Module ID	16d / 10h
Number of inputs/outputs	4/4
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	6 W (maximum load on analog outputs)
Power consumption from internal 5 V supply	0.325 W
Data format default setting	4...20 mA S7 format (software-configurable, see Data Formats for Analog Modules page 100)

See Technical Data Analog Inputs/Outputs , page 95
and General Technical Data, page 94.

2.15 Temperature Module PT100/PT1000 RIO T10-10



2.15.1 LED displays RIO T10-10



LED displays RIO T10-10

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3		yellow	Channel cursor

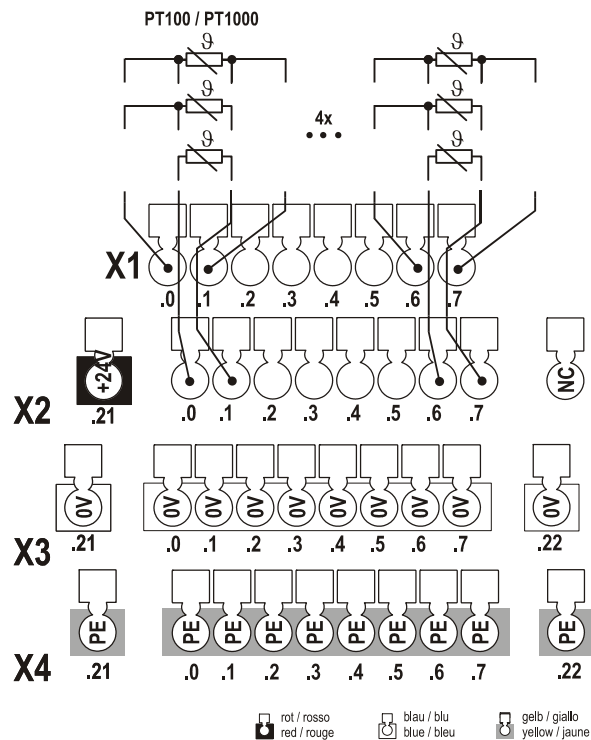
2.15.2 Data width RIO T10-10

RIO T10-10					
	Word inputs				Word outputs
Data width	Word 1 to 4				
Two-wire connection	Word	Chann el	Terminal	3-wire connect ion	4-wire connectio n
	1	0	X2.0/2.1	X1.0	X1.1
	2	1	X2.2/2.3	X1.2	X1.3
	3	2	X2.4/2.5	X1.4	X1.5
	4	3	X2.6/2.7	X1.6	X1.7

2.15.3 Data format RIO T10-10

Measured value in °C	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
400	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	4000	0FA0
50	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	500	01F4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-50	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	-500	FE0C
-75	1	1	1	1	1	1	0	1	0	0	0	1	0	0	1	0	-750	FD12

2.15.4 Terminal assignment for RIO T10-10



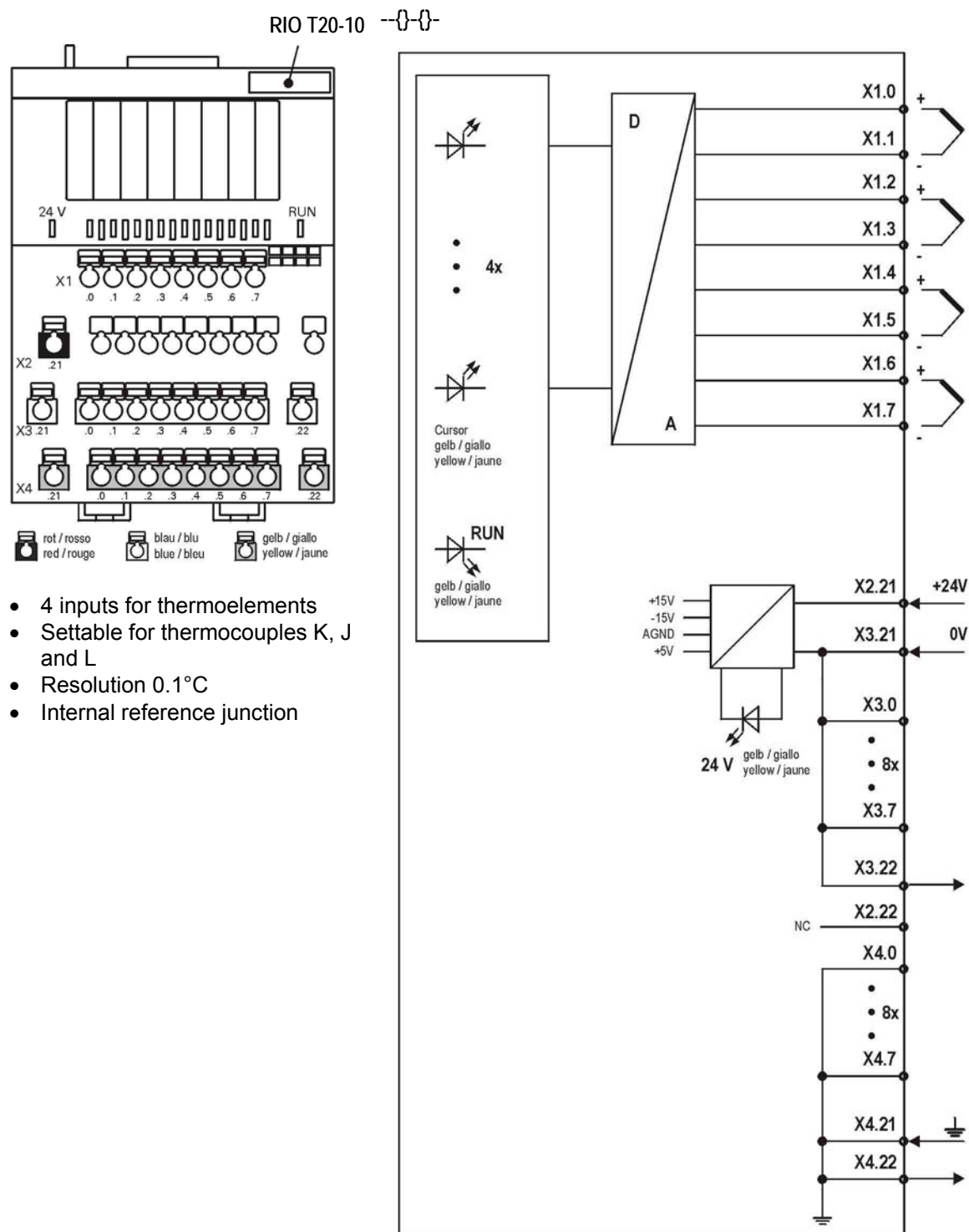
With 2-wire and 3-wire connection you do not need external jumpers to the spare terminals.

2.15.5 Technical data RIO T10-10

RIO T10-10		
Module ID		14d / 0Eh
Number of inputs		4, self-tuning for Pt100 / Pt1000
Temperature sensor		Pt100 / Pt1000
Range		-100°C to +450°C
Measuring error	typ.	<±1°C
	max.	±0.3°C ±0.25% from measured value
Resolution		0.1°C
A/D converter		16-bit
Measuring time		< 100 ms
Supply voltage external		24 V DC ± 20% max. 5% residual ripple
Power consumption from external 24 V supply		3.8 W (incl. load current 4 x Pt100)
Power consumption from internal 5 V supply		0.325 W

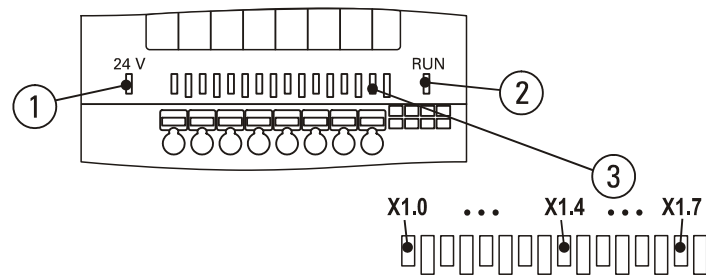
See also General Technical Data, page 94.

2.16 Temperature Module Thermoelements RIO T20-10



Thermoelement		Range
K	NiCr-Ni	-200°C to +1369°C
J	FeCu-Ni	-200°C to 1200°C
L	FeCu-Ni	-199°C to 900°C

2.16.1 LED displays RIO T20-10



LED displays RIO T20-10				
No.	LED	Colour	Meaning	
1	24 V	yellow	24 V DC power supply is connected	
2	RUN	yellow	Internal data transfer to bus coupler is running	
3		yellow	Channel cursor	

2.16.2 Data width, channel and terminal assignment for RIO T20-10

RIO T20-10			
	Word inputs		Word outputs
Data width	Word 1 to 4		
	Word	Channel	Terminal
	1	0	X1.0/1.1
	2	1	X1.2/1.3
	3	2	X1.4/1.5
	4	3	X1.6/1.7

2.16.3 Data format RIO T20-10

For data format setting instructions please refer to Parameterizing RIO T20-10, page 56

The following data formats are available:

SIMATIC S7 format

SIMATIC S7 format for thermoelements K, J and L																		
Measured value in °C	Binary representation																Hex.	Units
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
+100	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	03E8	1000
+1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	000A	10
+0,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0001	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000	0
-0,1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	FFFF	-1
-1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	FFF6	-10
-100	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	FC18	-1000

SIMATIC S5 format

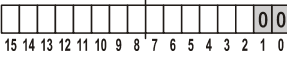
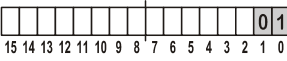
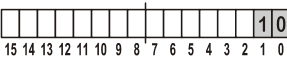
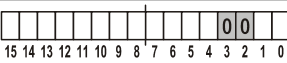
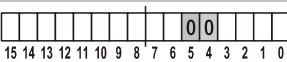
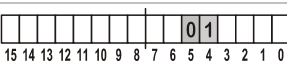

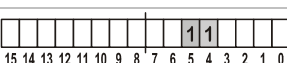
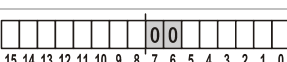
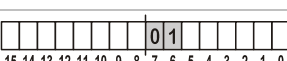
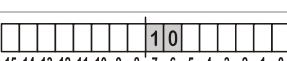
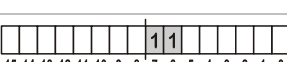
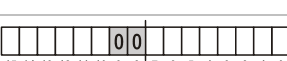
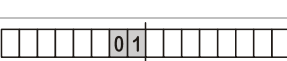
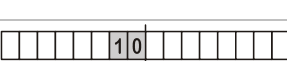
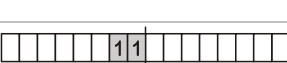
SIMATIC S5 format for thermoelements K, J and L																	
Measured value in °C	Binary representation																Units
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
+100	0	0	0	0	0	0	1	1	0	0	1	0	0	x	x	x	100
+1	0	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	0
-1	1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	-1
-100	1	1	1	1	1	1	0	0	1	1	1	0	0	x	x	x	-100

x Not applicable

2.16.4 Parameterizing RIO T20-10

The data format is set using parameterizing and diagnosis function 11 on the respective bus coupler (e.g. RIO BC or EC) or PLC (e.g. microLine). For a description of the parameterizing and diagnosis functions please refer to the respective operating manual.

The following parameters are available:

Parameter	Mode word	Meaning
Characteristic curves		K characteristic curve
		J characteristic curve
		L characteristic curve
Reserved		Reserved (must always be 00)
Number of channels		4 channels used
		1 channel used
		2 channels used
		3 channels used
Resolution		0.1°C
		0.2°C
		Reserved
		Reserved
Numerical format		SIMATIC S7
		SIMATIC S5
		Reserved
		Reserved

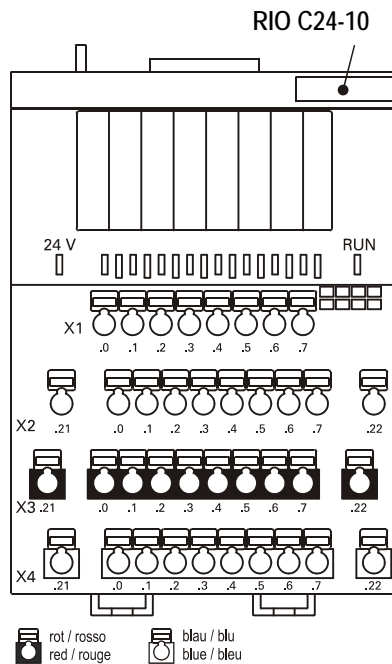
Default setting: All bits = 0 (K characteristic curve; 4 channels; 0.1°C; S7)

2.16.5 Technical data RIO T20-10

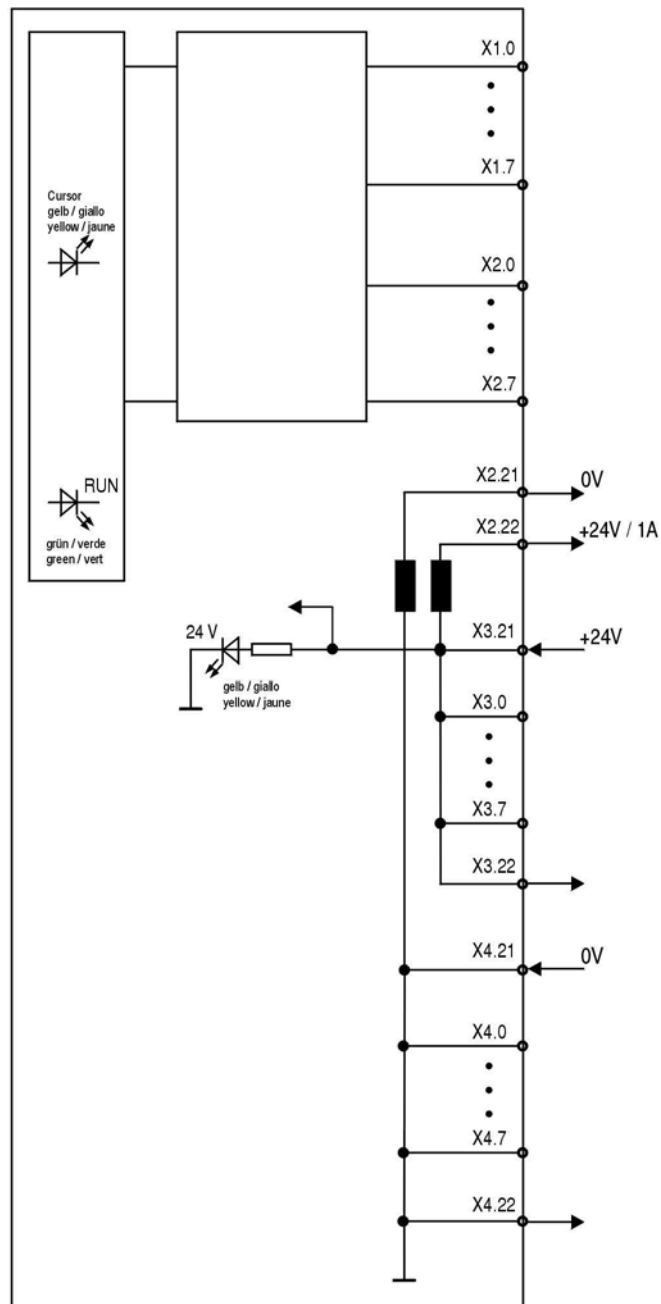
RIO T20-10	
Module ID	20d / 14h
Number of inputs	4
Thermoelements	K, J and L
Range	-268°C to +1372°C
Resolution	0.1°C
A/D converter	24-bit
Supply voltage	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	2.9 W
Power consumption from internal 5 V supply	0.325 W

See also General Technical Data, page 94.

2.17 Counter Module RIO C24-10



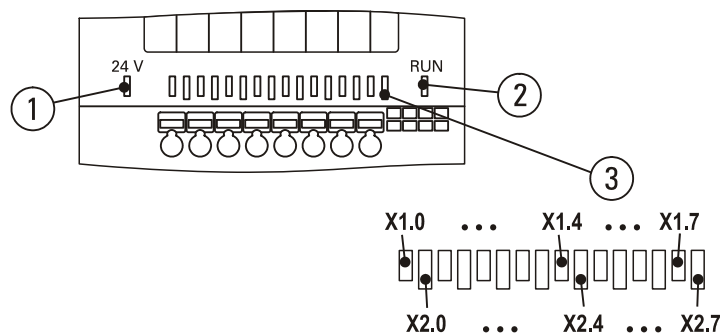
- Four 16-bit up/down counters or two 32-bit up/down counters, software-settable
- Counting frequency up to 200 kHz
- Software-settable interference suppression with digital filters
- Max./min. counter limits software-settable
- Software-settable thresholds
- Signal output for threshold reached
- Enabling input



2.17.1 Connecting

- If interference suppression is activated for counting frequencies ≤ 20 kHz the signal lines can be unshielded. Power can then be supplied to the encoders via terminal rows X3 (0 V) and X4 (DC 24 V).
- If interference suppression is deactivated (counting frequencies up to 200 kHz) the signal lines must be shielded. Power is then supplied to the encoders through filtered supply voltage via terminals X2.21 (0 V) and X2.22 (DC 24 V / 1 A). Interference suppression is set using control data.

2.17.2 LED displays RIO C24-10



LED displays RIO C24-10			
No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	X1.0 ... X1.7 X2.0 ... X2.7	green	Control state
		yellow	Channel cursor

2.17.3 Terminal assignment for RIO C24-10

Terminal assignment for four 16-bit counters

Four 16-bit counters				
Counters	Clock pulse+ (counter+ input)	Clock pulse- (counter- input)	Gate (enabling inputs)	Signal outputs (in basic functions always off)
1	X1.0	X1.2	X1.4	X1.6 threshold comparison
2	X1.1	X1.3	X1.5	X1.7 threshold comparison
3	X2.0	X2.2	X2.4	X2.6 threshold comparison
4	X2.1	X2.3	X2.5	X2.7 threshold comparison

Terminal assignment for two 32-bit counters

Terminal assignment for two 32-bit counters				
Counters	Clock pulse+ (counter+ input)	Clock pulse- (counter- input)	Gate (enabling inputs)	Signal outputs (in basic functions always off)
1	X1.0	X1.2	X1.4	X1.6 threshold comparison 1 X1.7 threshold comparison 2
2	X2.0	X2.2	X2.4	X2.6 threshold comparison 1 X2.7 threshold comparison 2

Clock pulse+ Counter incremented on rising edge or each edge with incremental encoder function

Clock pulse- Counter decremented on rising edge or each edge with incremental encoder function

Gate 0 (0 V): Counter disabled, 1 (24 V): Counter enabled

Multiple connections can be made at the clock pulse- terminal (see optional functions).

2.17.4 Data width RIO C24-10

	Input	Output
Data width in words	5 or 3*	5 or 3*

*If you use only one 32-bit counter or only two 16-bit counters you can reduce the data width to 3 words. Set the data width with service function 13 of the bus coupler.

*Words 4 and 3 are not transmitted if the data width is set to 3. In this case word 5 is transmitted as word 3.

2.17.5 Basic functions RIO C24-10

The following basic functions are activated when the power supply is switched on:

- Counter actual values = 0
- Counter start values = 0
- Four 16-bit counters (to set two 32-bit counters use control data word 5)
- Interference suppression for counting frequencies up to 20 kHz
- Each counter counts the input signals as long as the enabling signal (gate) is active.
- Method: up to respective min./max. value, no delete when counter max. reached

Data assignment for four 16-bit counters

Word	Input	Output
1	Counter 1 actual value	Counter 1 start value
2	Counter 2 actual value	Counter 2 start value
3	Counter 3 actual value	Counter 3 start value
4	Counter 4 actual value	Counter 4 start value
5	Control state of terminals X1.0 ... X1.7 and X2.0 ... 2.7	Control data (see next table)
Control data word 5		
Bit	Value	Function
0-7		For feedback bit
8-10	0	For optional functions
11	i0	Four 16-bit counters
12	1	Set counter 1 to start value
13	1	Set counter 2 to start value
14	1	Set counter 3 to start value
15	1	Set counter 4 to start value

Data assignment for two 32-bit counters

Word	Input	Output
1	Counter 1 MSB actual value	Counter 1 MSB start value
2	Counter 1 LSB actual value	Counter 1 LSB start value
3	Counter 2 MSB actual value	Counter 2 MSB start value
4	Counter 2 LSB actual value	Counter 2 LSB start value
5	Control state of terminals X1.0 ... X1.7 and X2.0 ... 2.7	Control data (see next table)
Control data word 5		
Bit	Value	Function
0-7		For feedback bit
8-10		For optional functions
11	Always 1	Select: module operates as two 32-bit counters
12	1	Set counter 1 to start value
13		No function
14	1	Set counter 2 to start value
15		No function

MSB: Most Significant Byte LSB: Least Significant Byte

2.17.6 Optional functions RIO C24-10

The optional functions are activated using the control data. The functions are available for all counters.

- The function of the clock pulse- input terminal can be changed to:
 1. Reset counter
 2. Select counting direction
 3. Incremental encoder
- Changes with incremental encoder function:
 1. The counter value change with every edge of the clock pulse + and clock pulse - signal.
 2. The minimal counter value is set if the maximal counter value is reached.
 3. The maximal counter value is set if the minimal counter value is reached.
- The function of the input gate terminal also can be changed in:
Zero signal, for the unique deletion of the counter reading with rising edge.
- Threshold comparison with fast output signals. (delay switching on approx. 0.02 ms, delay switching off approx. 0.2 ms)
- Two options for threshold comparison:
 1. Counter value < threshold value
 2. Counter value >= threshold value
- If you use the module for two 32-bit counters you can set 2 threshold values.
- Interference suppression with digital filters for 200 Hz, 2 KHz, 20 KHz, 200 KHz.

2.17.7 Complete control data from PLC to module (outputs)

The PLC transfers 5 words to the module. The meaning of the first four words depends on word 5:

Four 16-bit counters (word 5 bit 11 = 0)					
Word 1	Word 2	Word 3*	Word 4*	Word 5 (binary representation)	
X	X	X	X	0000 0000 xxxx xxxx	No effect, i.e. no data is loaded into the module
X	X	X	X	xxxx xxxx nnnn 1xxr	Feedback bit is active. The state of bit r is mirrored to the PLC on bit n word 5.
Counter value Counter 1	X	X	X	xxx1 0000 xxxx xxxx	Load counter 1
X	Counter value Counter 2	X	X	xx1x 0000 xxxx xxxx	Load counter 2
X	X	Counter value Counter 3	X	x1xx 0000 xxxx xxxx	Load counter 3
X	X	X	Counter value Counter 4	1xxx 0000 xxxx xxxx	Load counter 4
Counter value Counter 1	Counter value Counter 2	Counter value Counter 3	Counter value Counter 4	1111 0000 xxxx xxxx	Load counters 1 to 4
Threshold 1 Counter 1	Threshold 1 Counter 2	Threshold 1 Counter 3	Threshold 1 Counter 4	xxxx 0001 xxxx xxxx	Load thresholds 1 (Counters 1 to 4)
Override data Counter 1*	Override data Counter 2*	Override data Counter 3*	Override data Counter 4*	xxxx 0011 xxxx xxxx	Load override data (Counters 1 to 4)
Configuration data Counter 1*	Configuration data Counter 2*	Configuration data Counter 3*	Configuration data Counter 4*	xxxx 0100 xxxx xxxx	Load configuration data (Counters 1 to 4)

X: any word value x: any bit value

*Words 3 and 4 are not transmitted if the data width is set to 3. In this case word 5 is transmitted as word 3.

Two 32-bit counters (word 5 bit 11 = 1)					
Word 1	Word 2	Word 3	Word 4	Word 5 (binary representation)	
X	X	X	X	0000 1000 xxxx xxxx	No effect, i.e. no data is loaded into the module
X	X	X	X	xxxx xxxx nnnn 1xxr	Feedback bit is active. The state of bit r is mirrored to the PLC on bit n word 5.
Counter value Counter 1 (MSB)	Counter value Counter 1 (LSB)	X	X	xxx1 1000 xxxx xxxx	Load counter 1
X	X	Counter value Counter 2 (MSB)	Counter value Counter 2 (LSB)	x1xx 1000 xxxx xxxx	Load counter 2
Counter value Counter 1 (MSB)	Counter value Counter 1 (LSB)	Counter value Counter 2 (MSB)	Counter value Counter 2 (LSB)	x1x1 1000 xxxx xxxx	Load counters 1 and 2
Threshold 1 Counter 1 (MSB)	Threshold 1 Counter 1 (LSB)	Threshold 1 Counter 2 (MSB)	Threshold 1 Counter 2 (LSB)	xxxx 1001 xxxx xxxx	Load thresholds 1 (Counters 1 and 2)
Threshold 2 Counter 1 (MSB)	Threshold 2 Counter 1 (LSB)	Threshold 2 Counter 2 (MSB)	Threshold 2 Counter 2 (LSB)	xxxx 1010 xxxx xxxx	Load thresholds 2 (Counters 1 and 2)
Override data Counter 1*	X	Override data Counter 2*	X	xxxx 1011 xxxx xxxx	Load override data (Counters 1 and 2)
Configuration data Counter 1*	X	Configuration data Counter 2*	X	xxxx 1100 xxxx xxxx	Load configuration data (Counters 1 and 2)
X: any word value x: any bit value MSB: Most Significant Byte LSB: Least Significant Byte					

Configuration data

Bit values	Description
xxxx xxxx xxxx xx00 b	Default function of clock pulse- terminal
xxxx xxxx xxxx xx01 b	Reset function of clock pulse- terminal
xxxx xxxx xxxx xx10 b	Direction function of clock pulse- terminal
xxxx xxxx xxxx xx11 b	Incremental encoder function of clock pulse- terminal
xxxx xxxx xxxx 00xx b	Interference suppression 20 kHz
xxxx xxxx xxxx 01xx b	Interference suppression 2 kHz
xxxx xxxx xxxx 10xx b	Interference suppression 200 Hz
xxxx xxxx xxxx 11xx b	Interference suppression 200 kHz
xxxx xxxx xxx0 xxxx b	Threshold comparison 1 = 1 if counter value < threshold value 1
xxxx xxxx xxx1 xxxx b	Threshold comparison 1 = 1 if counter value \geq threshold value 1
xxxx xxxx xx0x xxxx b	Threshold comparison 2 = 1 if counter value < threshold value 2
xxxx xxxx xx1x xxxx b	Threshold comparison 2 = 2 if counter value \geq threshold value 1
xxxx xxxx x0xx xxxx b	Default function of gate terminal
xxxx xxxx x1xx xxxx b	Zero signal of gate terminal
xxxx xxxx 1xxx xxxx b	Acknowledgment of an active zero signal edge

x: any bit value b: binary representation

Optional function of clock pulse- terminal

Reset function	
Input signal	Function
0	Do not reset
1	Reset counter to zero
Counting direction function	
0	Counting direction + (rising edge incremented)
1	Counting direction - (rising edge decremented)
Incremental encoder function	
	The counter value change with every edge of the clock pulse + and clock pulse - signal.

Optional function of gate terminal

Zero signal function	
	The 1. rising edge of the zero signal deletes the counter reading and sets the corresponding status bit in word 5. With the acknowledgement this status bit is deleted.

Override data

Bit values	Description
xxxx xxx0 xxxx xxxx b	Do not overwrite clock pulse+
xxxx xxx1 xxxx xxx0 b	Overwrite clock pulse+ with 0
xxxx xxx1 xxxx xxx1 b	Overwrite clock pulse+ with 1
xxxx xx0x xxxx xxxx b	Do not overwrite clock pulse-
xxxx xx1x xxxx xx0x b	Overwrite clock pulse- with 0
xxxx xx1x xxxx xx1x b	Overwrite clock pulse- with 1
xxxx x0xx xxxx xxxx b	Do not overwrite gate / zero signal
xxxx x1xx xxxx x0xx b	Overwrite gate / zero signal with 0
xxxx x1xx xxxx x1xx b	Overwrite gate / zero signal with 1
xxxx 0xxx xxxx xxxx b	Do not overwrite reset
xxxx 1xxx xxxx 0xxx b	Overwrite reset with 0
xxxx 1xxx xxxx 1xxx b	Overwrite reset with 1
xxx0 xxxx xxxx xxxx b	Do not overwrite direction
xxx1 xxxx xxx0 xxxx b	Overwrite direction with 0
xxx1 xxxx xxx1 xxxx b	Overwrite direction with 1
xx0x xxxx xxxx xxxx b	Do not overwrite threshold comparison 1
xx1x xxxx xx0x xxxx b	Overwrite threshold comparison 1 with 0
xx1x xxxx xx1x xxxx b	Overwrite threshold comparison 1 with 1
x0xx xxxx xxxx xxxx b	Do not overwrite threshold comparison 2
x1xx xxxx x0xx xxxx b	Overwrite threshold comparison 2 with 0
x1xx xxxx x1xx xxxx b	Overwrite threshold comparison 2 with 1

x: any bit value b: binary representation

2.17.8 Process data from module to PLC (inputs)

The module transmits 5 words* to the PLC. Words 1-4 always contain the current counter value.

*Words 3 and 4 are not transmitted if the data width is set to 3. In this case word 5 is transmitted as word 3.

Depending on control data word 5 one bit can be used as feedback bit.

Word 5: Status of inputs/outputs

Bit values	Description
xxxx xxxx xxxx xxx0 b	State of clock pulse+ counter 1/16 or 1/32 is 0 (0V)
xxxx xxxx xxxx xxx1 b	State of clock pulse+ counter 1/16 or 1/32 is 1 (24 V)
xxxx xxxx xxxx xx0x b	State of clock pulse+ counter 2/16 is 0 (0 V)
xxxx xxxx xxxx xx1x b	State of clock pulse+ counter 2/16 is 1 (24 V)
xxxx xxxx xxxx x0xx b	State of clock pulse-/reset/direction counter 1/16 or 1/32 is 0 (0 V)
xxxx xxxx xxxx x1xx b	State of clock pulse-/reset/direction counter 1/16 or 1/32 is 1 (24 V)
xxxx xxxx xxxx 0xxx b	State of clock pulse-/reset/direction counter 2/16 is 0 (0 V)
xxxx xxxx xxxx 1xxx b	State of clock pulse-/reset/direction counter 2/16 is 1 (24 V)
xxxx xxxx xxx0 xxxx b	State of gate counter 1/16 or 1/32 is 0 (0 V) / no zero signal counter 1 *
xxxx xxxx xxx1 xxxx b	State of gate counter 1/16 or 1/32 is 1 (24 V) / zero signal counter 1 *
xxxx xxxx xx0x xxxx b	State of gate counter 2/16 is 0 (0 V) / no zero signal counter 2 *
xxxx xxxx xx1x xxxx b	State of gate counter 2/16 is 1 (24 V) / zero signal counter 2 *
xxxx xxxx x0xx xxxx b	State of threshold comparison 1 counter 1/16 or 1/32 is 0 (0 V)
xxxx xxxx x1xx xxxx b	State of threshold comparison 1 counter 1/16 or 1/32 is 1 (24 V)
xxxx xxxx 0xxx xxxx b	State of threshold comparison 1 counter 2/16 or threshold comparison 2 counter 1/32 is 0 (0 V)
xxxx xxxx 1xxx xxxx b	State of threshold comparison 1 counter 2/16 or threshold comparison 2 counter 1/32 is 1 (24 V)
xxxx xxx0 xxxx xxxx b	State of clock pulse+ counter 3/16 or 2/32 is 0 (0 V)
xxxx xxx1 xxxx xxxx b	State of clock pulse+ counter 3/16 or 2/32 is 1 (24 V)
xxxx xx0x xxxx xxxx b	State of clock pulse+ counter 4/16 is 0 (0 V)
xxxx xx1x xxxx xxxx b	State of clock pulse+ counter 4/16 is 1 (24 V)
xxxx x0xx xxxx xxxx b	State of clock pulse-/reset/direction counter 3/16 or 2/32 is 0 (0 V)
xxxx x1xx xxxx xxxx b	State of clock pulse-/reset/direction counter 3/16 or 2/32 is 1 (24 V)
xxxx 0xxx xxxx xxxx b	State of clock pulse-/reset/direction counter 4/16 is 0 (0 V)
xxxx 1xxx xxxx xxxx b	State of clock pulse-/reset/direction counter 4/16 is 1 (24 V)
xxx0 xxxx xxxx xxxx b	State of gate counter 3/16 or 2/32 is 0 (0 V) / no zero signal counter 3 *
xxx1 xxxx xxxx xxxx b	State of gate counter 3/16 or 2/32 is 1 (24 V) / zero signal counter 3 *
xx0x xxxx xxxx xxxx b	State of gate counter 4/16 is 0 (0 V) / no zero signal counter 4 *
xx1x xxxx xxxx xxxx b	State of gate counter 4/16 is 1 (24 V) / zero signal counter 4 *
x0xx xxxx xxxx xxxx b	State of threshold comparison 1 counter 3/16 or 2/32 is 0 (0 V)
x1xx xxxx xxxx xxxx b	State of threshold comparison 1 counter 3/16 or 2/32 is 1 (24 V)
0xxx xxxx xxxx xxxx b	State of threshold comparison 1 counter 4/16 or threshold comparison 2 counter 2/32 is 0 (0 V)
1xxx xxxx xxxx xxxx b	State of threshold comparison 1 counter 4/16 or threshold comparison 2 counter 2/32 is 1 (24 V)

x: any bit value b: binary representation

Depending on word 5 of the control data a bit can be occupied alternatively also as an acknowledgment bit.

* Depending on bit 8 of the configuration data the state gate or the zero signal of the corresponding counter is displayed.

2.17.9 Examples

General

- When writing threshold values, configuration data and override data a particular sequence has to be observed in some cases.
- When the module is used on a local PLC (e.g. microLine) new data can be sent to the counter in any PLC cycle.
- When used in a field bus system, there has to be a delay of at least one field bus cycle before data is written to the module, if the data is to reach the module securely.

Example 1: Basic function

- Configuration as four 16-bit counters.
 - The counter values are read by the PLC. The PLC also resets the counters.
 - Connection: Signal to X1.0 (clock pulse+) and +24 V to X1.4 (gate)
1. PLC reads and evaluates input words 1-5. For example, to reset counter 1: PLC sets counter to zero
→ Word 1 = 0; Word 5 = 2000h
 2. 1 cycle later: PLC resets control word
→ Word 5 = 0
h: hex format

Example 2: Clock pulse- terminal with reset function

- Configuration as four 16-bit counters.
 - The counter values are read by the PLC.
 - Counters 1 and 2 are to be reset with an external signal.
 - Maximum input frequency of signals 1 kHz
 - Connection: Signal for counter 1 to X1.0 clock pulse+, ext. reset signal to X1.2 and +24 V to X1.4
Signal for counter 2 to X1.1 clock pulse+, ext. reset signal to X1.3 and +24 V to X1.5
1. PLC waits until field bus sends valid values or input word 5 not equal to zero
 2. PLC writes configuration data interference suppression 2 kHz and terminal assignment
 3. Reset → Word 1 = 0005h; Word 2 = 0005h; Word 5 = 0400h
 4. PLC resets control word
→ Word 1 = 0; Word 2 = 0; Word 5 = 0
 5. PLC reads and evaluates input words 1-5.
h: hex format

Example 3: Threshold comparison

- Configuration of four 16-bit counters.
 - Counter channel 1 is to activate output X1.6 at 35000.
The PLC shuts down the output and restarts the counter.
 - Maximum input frequency of signals 10 kHz
 - Connection: Signal for counter 1 to X1.0 (clock pulse+)
1. PLC waits until field bus supplies valid values.
 2. PLC writes override data: Output signal counter 1 to zero
→ Word 1 = 2000h; Word 5 = 0300h
 3. PLC writes configuration data: Output counter 1=1 if counter 1>= threshold
→ Word 1 = 0010h; Word 5 = 0400h
 4. PLC writes threshold value in counter 1
→ Word 1 = dec35000 ; Word 5 = 0100h
 5. PLC may write counter 1 reset (only if actual counter value <> 0)
→ Word 1 = 0 ; Word 5 = 1000h
 6. PLC writes override data: Output signal counter 1 enabled and enable counter 1 (gate)
→ Word 1 = 0404h ; Word 5 = 0300h
 7. PLC sets all to zero
→ Word 1 = 0; Word 5 = 0
 8. Now the module counts. At pulse 35000 the module sets output X1.6 to 1

9. The PLC waits until the module has switched the output (input word 5 / bit 6 = 1= and PLC waits until counting is to be restarted.
PLC writes: Delete counter 1
→ Word 1 = 0; Word 5 = 1000h
10. Output X1.6 is shut down and PLC sets all to zero
→ Word 1 = 0; Word 5 = 0
11. Continue with step 8.
h: hex format

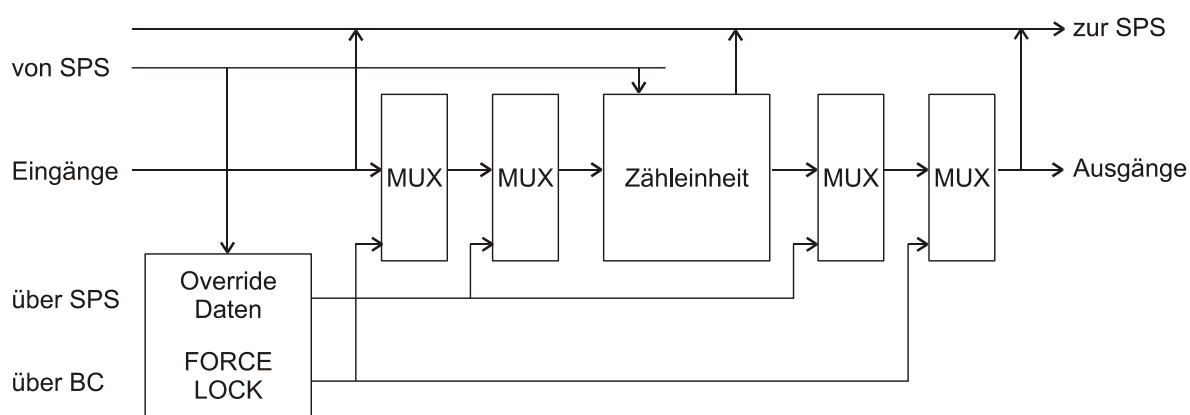


Always set interference suppression to match the maximum input signal frequency. This ensures that the counter functions properly.
Example:
Max. input signal frequency = 120 Hz → Interference suppression 200 Hz

2.17.10 Priorities in FORCE, LOCK and display modes

You can overwrite all inputs and outputs in FORCE or LOCK.
FORCE/LOCK have a direct effect on inputs and outputs.

If you select FORCE/LOCK and at the same time send override data via the PLC the following applies:



In display mode counter data is displayed in four-position hex. format. With 32-bit counters the four least significant and four most significant are displayed separately. The following display appears, depending on the channel cursor position (yellow LED):

Number and type of counter	Channel cursor position:	Display
4 x 16-bit	X1.0, X1.2, X1.4, X1.6	Counter value Z1
	X1.1, X1.3, X1.5, X1.7	Counter value Z2
	X2.0, X2.2, X2.4, X2.6	Counter value Z3
	X2.1, X2.3, X2.5, X2.7	Counter value Z4
2 x 32-bit	X1.0, X1.2, X1.4, X1.6	Counter value Z1 MSW
	X1.1, X1.3, X1.5, X1.7	Counter value Z1 LSW
	X2.0, X2.2, X2.4, X2.6	Counter value Z2 MSW
	X2.1, X2.3, X2.5, X2.7	Counter value Z2 LSW

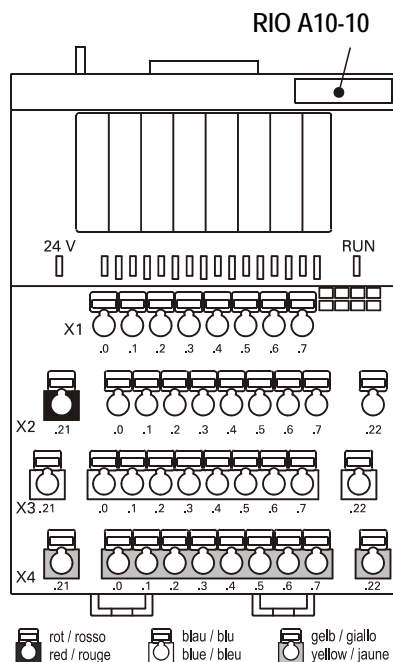
MSW: Most Significant Word
LSW: Least Significant Word

2.17.11 Technical data RIO C24-10

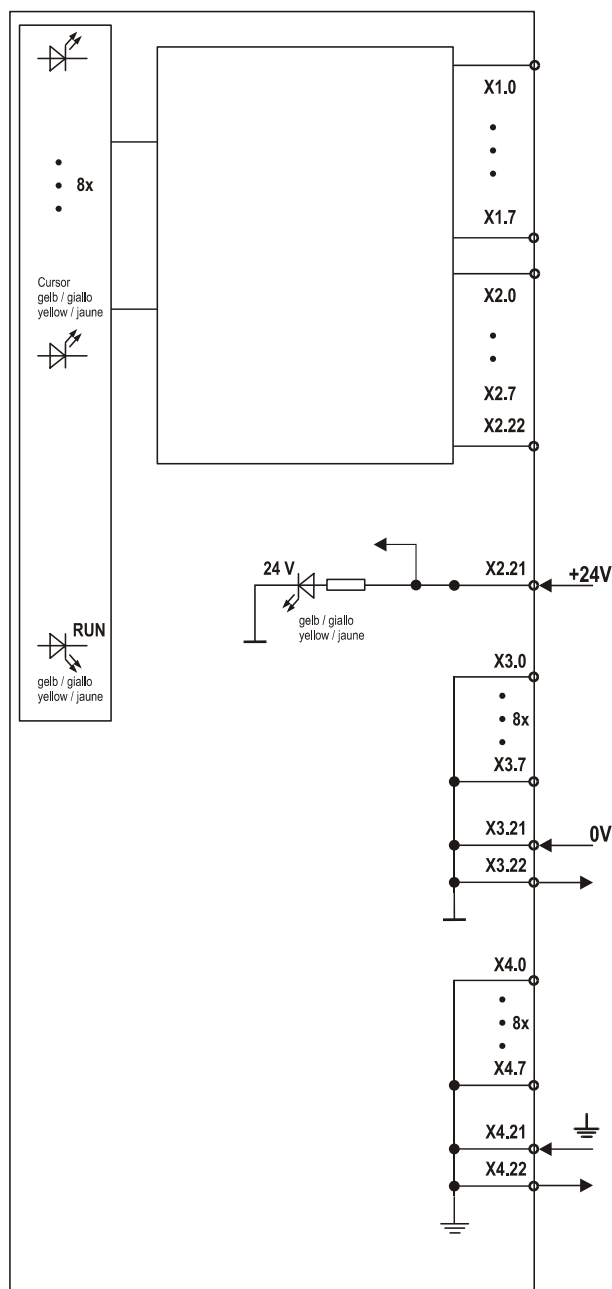
RIO C24-10	
Module ID	10d / 0Ah (6 I/O bytes) 11d / 0Bh (10 I/O bytes)
Number of counters	4 (16-bit) or 2 (32-bit)
Counting frequency	max. 200 KHz Interference suppression settable 200 Hz, 2 KHz, 20 KHz, 200 KHz
Number of inputs/outputs	12 inputs 4 outputs
Supply voltage external	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without input current/load current)
Power consumption from internal 5 V supply	1.1 W
Inputs	
Switching level	H level +15 V to +30 V L level -30 V to +5 V
Input current	min. H level (+15 V), $I \geq 3.5$ mA max. L level (+5 V), $I \leq 1.0$ mA Typical (+24 V), $I = 7.5$ mA
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	100%
Signal delay	< 1 μ s (hardware)
Outputs	
Output current per output max.	1A short-circuit proof and overcurrent-protected
Total current for whole module max.	4 A
Switching level	H level = supply voltage - 0.5 V L level \leq 1 V
Isolation from internal bus	Yes, each channel separately by means of optocouplers
Simultaneity	100%
Free-wheeling diode	Integrated
Signal delay	< 300 μ s (hardware)
Power supply for fast encoders (terminals X2.21 / X2.22)	
Voltage	DC 24 V
Current	max. 1A

See also General Technical Data, page 94.

2.18 Axis Interface RIO A10-10



- The RIO axis interface module (RIO A10-10) allows you to control a position-controlled axis using just one module, by means of an actual value system and an analog setpoint output.
- It supplies an encoder actual value to a PLC/CNC and generates an analog output voltage from a desired speed supplied by the PLC/CNC.
- It also has a number of digital inputs/outputs that are directly sent to or controlled by the PLC/CNC.
- The RIO A10-10 simply provides interfaces. Unlike position controllers, etc., it has no integral intelligence.



If you are operating the RIO A10-10 together with bus couplers, the bus couplers must have software version 03.23 or higher.

The diagram shows the rear panel of the power supply unit with the following connections:

- Callout 1:** Points to the **24 V** terminal on the left side of the terminal block.
- Callout 2:** Points to the **RUN** terminal on the right side of the terminal block.
- Callout 3:** Points to the output terminals, which are labeled **X1.0** through **X2.7**. The terminals are arranged in two rows: X1.0 to X1.7 on top and X2.0 to X2.7 on the bottom.

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2.18.2 Terminal assignment for RIO A10-10

Terminal	Designation		Level
X1.0	ENABLE	Digital output controller enable	DC 24 V, 0.5 A
X2.0	I/O	Digital input/output	DC 24 V, 0.5 A
X1.1	READY	Digital input ready	DC 24 V
X2.1	REF	Digital input home	DC 24 V
X1.2	END+	Digital input limit switch positive	DC 24 V
X2.2	END-	Digital input limit switch negative	DC 24 V
X1.3	A, DATA	Digital input encoder signal A or DATA	Similar to RS422
X2.3	/A, /DATA	Digital input encoder signal A or DATA inverted	Similar to RS422
X1.4	B	Encoder input encoder signal B	Similar to RS422
X2.4	/B	Encoder input encoder signal B inverted	Similar to RS422
X1.5	NULL	Digital input zero signal	Similar to RS422
X2.5	/NULL	Digital input zero signal inverted	Similar to RS422
X1.6	CLOCK	Digital output encoder clock	RS422
X2.6	/CLOCK	Digital output encoder clock inverted	RS422
X1.7	GND CLOCK*	GND to CLOCK	0 V
X2.7	AOUT	Analog output	-10 V ... +10 V
X2.21	+24V	+24 V	DC 24 V
X2.22	GND AOUT*	GND to AOUT	0 V
X3.xx	GND	GND to 24 V	0 V
X4.xx	SHLD	Shield	Shield

* The GND CLOCK and GND AOUT terminals are connected in the module.

2.18.3 Settings RIO A10-10

You can set the following properties and functions using the PLC output data.

- Incremental/absolute value encoder
- Enable next zero pulse to reset actual value
- Absolute value encoder code
- Absolute value encoder data length
- Absolute value encoder clock rate
- Reset actual value
- Monitoring ready
- Monitoring limit switch
- Cable breakage monitoring

2.18.4 Functions RIO A10-10

If an incremental encoder is connected, the encoder actual value supplied is generated by an up/down counter counting the encoder pulses.

If an absolute value encoder is connected, the encoder supplies the actual value directly.

Incremental encoder	A, /A, B, /B, NULL, /NULL
• Method	Periodical, when maximum has been reached counter continues at minimum, when minimum has been reached counter continues at maximum
• Counting frequency	up to 500 kHz
• Width	32-bit
• Range	-2^{31} to $2^{31}-1$
• Edge evaluation	4-fold
Absolute value encoder	DATA, /DATA, CLOCK, /CLOCK, GND CLOCK
• Protocol	SSI
• Coding	Gray, binary
• Data length	24-bit, 21-bit, 13-bit
• Clock pulse	100 kHz, 200 kHz, 500 kHz, 1 MHz (derived from RIO bus clock)
• Adaptation	DATA and /DATA are evaluated to detect whether CLOCK, /CLOCK and DATA, /DATA are correctly connected or inverted. Inversions are corrected in the module.

An analog output voltage is generated from the desired speed value.

Analog output	AOUT, GND AOUT
• Resolution	16-bit
• Range	-10 V ... +10 V
Digital inputs	READY, REF, END+, END-
Digital output	ENABLE
Digital input/output	I/O

The status of the digital inputs listed above is sent to the bus coupler. The digital and analog outputs are controlled by the bus coupler. The encoder inputs and absolute value encoder clock are not sent, nor can they be controlled directly. However, the zero signal is sent to the bus coupler.

The module possesses limited functionalities of its own.

If monitoring detects a malfunction analog output X2.7 and output X1.0 ENABLE (controller enable) are set to 0 V.

The following monitoring functions can be set (output data byte 7)

- Ready
- Limit switch +/-
- Broken cable

These functions are conducted by the module itself. You can set the events that lead to shutdown.

The PLC must reset the controller enable (output data byte 4, bit 0) to acknowledge the shutdown.

If a monitoring function was not activated, controller enable reset by the PLC (output data byte 4, bit 0) will also shut down the outputs.

The module possesses a watchdog function.

The watchdog function deactivates the module if a RIO bus contact is interrupted for more than 80 ms; all outputs on the module are shut down. The encoder actual value remains valid. Evaluation of incremental encoder signals continues.



Data and configurations will **not** be saved if there is a power failure.

2.18.5 Data width RIO A10-10

RIO A10-10		
Data width	4 words input data	4 words output data

2.18.6 Input data assignment (module to PLC)

Input data			
Word 1 and word 2	Byte 0 to byte 3 encoder actual value	Byte 1 MSByte Byte 4 LSByte	
Word 3	Byte 4 Status of inputs	Bit 0	ENABLE (X1.0)
		Bit 1	I/O digital input/output (X2.0)
		Bit 2	READY (X1.1)
		Bit 3	REF (X2.1)
		Bit 4	END+ limit switch positive (X1.2)
		Bit 5	END- limit switch negative (X2.2)
		Bit 6	NULL /NULL zero pulse encoder (X1.5/X2.5)
	Byte 5 messages encoder	Bit 0	Cable break With incremental encoder: Signal A, /A, B, /B, NULL or /NULL lost With absolute value encoder: Signal DATA, /DATA lost
		Bit 1	Check zero pulse encoder This function is only active if output data byte 5, bit 1 = 1: When the 1st zero pulse from the incremental encoder is detected this bit is set until it is reset by output data byte 5, bit 1 = 0.
Word 4	Byte 6 messages encoder	Bit 0	Check-back bit, no function in module This bit can be used to check that the module outputs are written. The PLC writes a value into output byte 6, bit 0, which can be read via input byte 6, bit 0.
	Byte 7 messages monitoring	Bit 0	Shutdown due to ready function
		Bit 1	Shutdown due to limit switch +
		Bit 2	Shutdown due to limit switch -
		Bit 3	Shutdown due to cable break monitoring

2.18.7 Output data assignment (PLC to module)

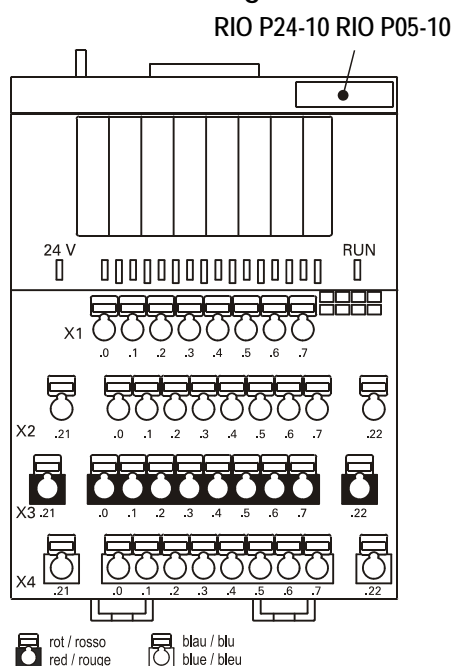
Output data			
Word 1	Byte 0	not used	
	Byte 1	not used	
Word 2	Byte 2 to byte 3 desired speed	Byte 3 MSByte Byte 4 LSByte	16-bit, binary, two's complement
Word 3	Byte 4 outputs	Bit 0	ENABLE sets controller enable (X1.0)
		Bit 1	I/O digital input/output (X2.0)
	Byte 5 configuration encoder	Bit 0	0 = incremental encoder, 1 = absolute value encoder
		Bit 1	0 = zero pulse has no effect, 1 = enable next zero pulse to reset actual value
		Bit 2	Absolute value encoder code: 0 = gray, 1 = binary
		Bit 3	Encoder connection 0 = normal, 1 = A, /A inverted
		Bit 5,4	Absolute value encoder data: 00 = 24-bit, 01 = 21-bit, 10 = 13-bit
		Bit 7,6	Absolute value encoder clock: 00 = 100 kHz, 01 = 200 kHz, 10 = 500 kHz, 11 = 1 MHz (applies with RIO clock 8 MHz)
Word 4	Byte 6 configuration encoder	Bit 0	Check-back bit, no function in module This bit can be used to check that the module outputs are written. The PLC writes a value into output byte 6, bit 0, which can be read via input byte 6, bit 0.
		Bit 1	0 = do not reset actual value, 1 = reset actual value
	Byte 7 monitoring setting	Bit 0	0 = Ready monitoring off 1 = Ready monitoring on
		Bit 1	0 = Limit switch + monitoring off 1 = Limit switch + monitoring on
		Bit 2	0 = Limit switch - monitoring off 1 = Limit switch - monitoring on
		Bit 3	0 = Cable break monitoring off 1 = Cable break monitoring on

2.18.8 Technical data RIO A10-10

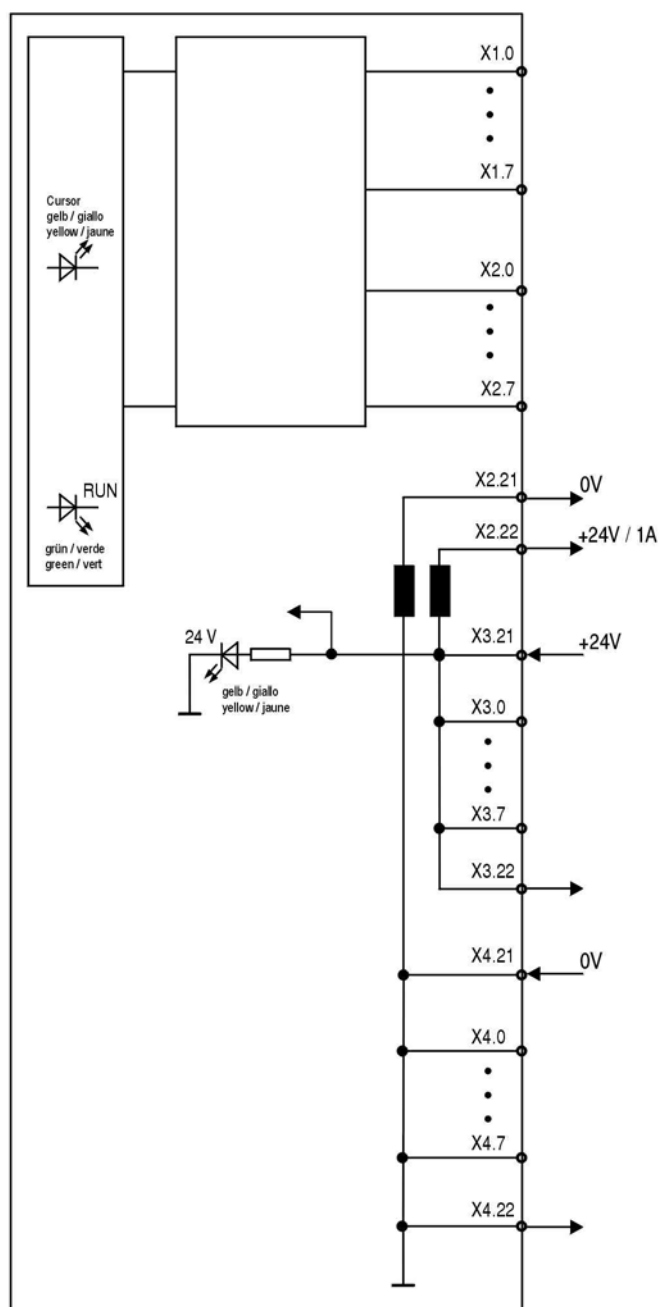
RIO A10-10	
Module ID	28d / 1Ch
Number of controllable axes	1
Counting frequency	Max. 500 kHz
Supply voltage	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	2.1 W
Power consumption from internal 5 V supply	0.5 W
Digital inputs 24 V	
Switching level	H level +11 V ... +30 V L level -30 V ... +5 V
Input current	min. H level (+11 V), $I \geq 2.0$ mA max. L level (+5 V), $I \leq 2.0$ mA Typical (+24 V), $I = 8.5$ mA max. (+30 V), $I \leq 15$ mA
Simultaneity	100 %
Isolation from internal bus	Yes, each channel by means of optocouplers
Signal delay	< 250 μ s (hardware)
Digital outputs 24 V	
Output current per output	0.5 A, short-circuit-proof and overcurrent-protected
Switching level	H level = supply voltage - 0.5 V L level ≤ 1 V
Isolation from internal bus	Yes, each channel by means of optocouplers
Simultaneity	100 %
Free-wheeling diode	Integrated
Signal delay	< 300 μ s (hardware)
Digital inputs similar to RS422	
Differential input voltage	Typical, 2.6 V...4.8 V Worst case 3.2 V...4.6 V
Input current	5 mA ... 15 mA
Isolation from internal bus	Yes, each channel by means of optocouplers
Digital output RS422	
Differential output voltage	> 2 V
Isolation from internal bus	Yes, by optocouplers
Analog output ± 10 V	
Output voltage	-10 V ... +10 V
Load impedance	$\geq 1000 \Omega$
Output current	= 10 mA, short-circuit-proof, short-circuit current 40 mA
Resolution	16-bit
Zero error	< 10 mV
Overall error	< 100 mV
Isolation from internal bus	Yes, by optocouplers

See also General Technical Data, page 94.

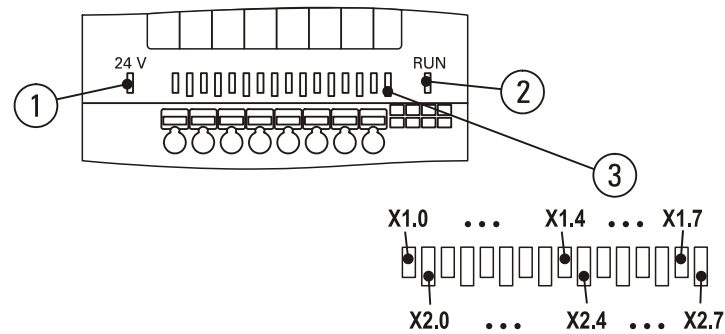
2.19 Positioning Module RIO P24-10, RIO P05-10



- The positioning module is designed for positioning two axes. In a single unit it provides two mutually independent up/down counters with 24 V inputs/outputs (RIO P24-10) or 5 V inputs/outputs (RIO P05-10).
- It has 16 terminals for I/O. 10 terminals for 24 V, 10 for 0 V and one each for 24 V / 0 V (X2.21 / X2.22) with interference suppression. These can be used for encoders (for fast encoder voltage with interference suppression) and outputs as reference or supply. There is only one common ground for all encoders and outputs.



2.19.1 LED displays RIO P24-10, RIO P05-10



LED displays RIO P24-10, RIO P05-10

No.	LED	Colour	Meaning
1	24 V	yellow	24 V DC power supply is connected
2	RUN	yellow	Internal data transfer to bus coupler is running
3	Control state of terminals X1.0 ... X1.7 X2.0 ... X2.7	green	Control state
		yellow	Channel cursor

2.19.2 Terminal assignment for RIO P24-10, RIO P05-10

Inputs	Counter 1	Counter 2	
Tracking signal A	X1.0	X2.0	Incremental encoder track A
Tracking signal B	X1.1	X2.1	Incremental encoder track B
Tracking signal N	X1.2	X2.2	Incremental encoder track N, zero pulse
End+	X1.3	X2.3	Limit switch End+, actuated 0 V, unactuated 24 V
End-	X1.4	X2.4	Limit switch End-, actuated 0 V, unactuated 24 V
Outputs (standard assignment)			
Move+	X1.5	X2.5	Move axis +
Move-	X1.6	X2.6	Move axis -
Velocity	X1.7	X2.7	Travel velocity 0: slow, 1: fast
Outputs can also be altered by the master PLC software:		Alternative output assignment must be selected by PLC program	
Move direction	X1.5	X2.5	Direction of axis, 0: -, 1: + direction
Move	X1.6	X2.6	Move axis
Velocity	X1.7	X2.7	Travel velocity 0: slow, 1: fast

2.19.3 Functions

Each up/down counter counts the pulses from an incremental encoder (you cannot connect absolute value encoders). The counter value is compared with two threshold values, allowing an axis to be controlled. Via the limit switch inputs, motion is stopped independently of the counting process. You can use the PLC to configure counters. The PLC can write into configuration memories and threshold and counter values and read counter values and input/output states (except for tracking signals A, B).

- Method: Periodical,
- when maximum has been reached counter continues at minimum, when minimum has been reached counter continues at maximum
- Counting frequency: up to 200 kHz
- Width: 32-bit
- Range: -2^{31} to $2^{31}-1$
- Edge evaluation: 4-fold
- Setting via PLC:
 - Mode, homing direction, homing velocity, using N for homing, select outputs, reset counter, counting direction inverted, motion direction outputs inverted, velocity output inverted, counter value, pre-shutdown value, shutdown value, override for inputs/outputs
- Setting via bus coupler/microLine
 - Overwrite inputs/outputs with FORCE/LOCK
- Saving of data:
 - Data or configurations will not be saved if there is a power failure.
- 24 V DC signal level for input/output signals
- Inputs: Tracking signals A, B and N, End+, End-
- Outputs: Move+, Move-, Velocity
 - can be switched to: Direction, move, velocity

Operating modes

Homing: Version 1 (feed positioning)

Fast (default, can be changed to slow) in homing direction until End+ or End- active. Then slowly in the opposite direction until N is active. Reset counter and off.

Homing: Version 2 (feed positioning)

Fast (can be changed to slow) in homing direction until End+ or End- active. Then slowly in the opposite direction until the limit switch is no longer active. Reset counter and off.

Homing: Version 3 (band positioning)

Fast (can be changed to slow) in homing direction. After End+ on 24 V (i.e. alternative use of this limit switch) until N is active. Reset counter and off. The PLC is notified when homing is completed.

Positioning:

Fast until pre-shutdown threshold, slowly until shutdown threshold, then off.
The PLC is notified when positioning is completed.

Positioning: Version 2 (position measurement after zero pulse):

Fast in preselected homing direction until input “N” active. Reset counter. Fast until pre-shutdown value, slowly until shutdown value, then off.
The PLC is notified when positioning is completed.

OFF

Motion outputs off.



If used with a RIO bus coupler, the outputs on the RIO P24-10 module do not shut down if a cable break occurs on the field bus.

If used in the microLine system, the outputs on the RIO P24-10 module do not shut down on PLC STOP.

On the RIO P24-10 module (hardware version 02 and later) setting the “Enable outputs” bit in word 5 of the control data causes the outputs to reset after cable break and PLC STOP.

2.19.4 Data width RIO P24-10, RIO P05-10

RIO P24-10, RIO P05-10		
	Word inputs	Word outputs
Data width	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

* If you position only one axis you can reduce the data width to be transmitted to 3 words. Set the data width with service function 13 of the bus coupler (not CANopen bus coupler).

2.19.5 Control data from PLC to module (outputs)

The PLC transfers 5 words to the module. Their meanings depend on word 5 (see below):

Word 1	Word 2	Word 3*	Word 4*	Word 5	
X	X	X	X	xx00 x000 xxxx xxxx b	No effect, i.e. no data is loaded into the module
X	X	X	X	xxxx xxxx xxxx xx1x b	Enable outputs (0=off)
X	X	X	X	xxxx xxxx nnnn 1xxr b	Check-back bit active. I.e. the status of r is mirrored to the PLC in bit n of word 5
Counter value Counter 1 (MSB)	Counter value Counter 1 (LSB)	X	X	xx01 x000 xxxx xxxx b	Load counter 1
X	X	Counter value Counter 2 (MSB)	Counter value Counter 2 (LSB)	xx10 x000 xxxx xxxx b	Load counter 2
Counter value Counter 1 (MSB)	Counter value Counter 1 (LSB)	Counter value Counter value 2 (MSB)	Counter value Counter 2 (LSB)	xx11 x000 xxxx xxxx b	Load counters 1 and 2
Pre-shutdown value Counter 1 (MSB)	Pre-shutdown value Counter 1 (LSB)	Pre-shutdown value Counter 2 (MSB)	Pre-shutdown value Counter 2 (LSB)	xxxx x001 xxxx xxxx b	Load pre-shutdown values (Counters 1 and 2)
Shutdown value Counter 1 (MSB)	Shutdown value Counter 1 (LSB)	Shutdown value Counter 2 (MSB)	Shutdown value Counter 2 (LSB)	xxxx x010 xxxx xxxx b	Load shutdown values (Counters 1 and 2)
Override data Counter 1*	X	Override data Counter 2*	X	xxxx x011 xxxx xxxx b	Load override data (Counters 1 and 2)
Configuration data Counter 1*	X	Configuration data Counter 2*	X	xxxx x100 xxxx xxxx b	Load configuration data (Counters 1 and 2)

X: any word value x: any bit value MSB: Most Significant Bit
b: binary representation *: for details see below LSB: Least Significant Bit

*Words 3 and 4 are not transmitted if the data width is set to 3. In this case word 5 is transmitted as word 3.

Override data

Bit values	Description
xxxx xxx0 xxxx xxxx b	Do not overwrite tracking signal A
xxxx xxx1 xxxx xxx0 b	Overwrite tracking signal A with 0
xxxx xxx1 xxxx xxx1 b	Overwrite tracking signal A with 1
xxxx xx0x xxxx xxxx b	Do not overwrite tracking signal B
xxxx xx1x xxxx xx0x b	Overwrite tracking signal B with 0
xxxx xx1x xxxx xx1x b	Overwrite tracking signal B with 1
xxxx x0xx xxxx xxxx b	Do not overwrite tracking signal N
xxxx x1xx xxxx x0xx b	Overwrite tracking signal N with 0
xxxx x1xx xxxx x1xx b	Overwrite tracking signal N with 1
xxxx 0xxx xxxx xxxx b	Do not overwrite limit switch End+
xxxx 1xxx xxxx 0xxx b	Overwrite limit switch End+ with 0
xxxx 1xxx xxxx 1xxx b	Overwrite limit switch End+ with 1
xxx0 xxxx xxxx xxxx b	Do not overwrite limit switch End-
xxx1 xxxx xxx0 xxxx b	Overwrite limit switch End- with 0
xxx1 xxxx xxx1 xxxx b	Overwrite limit switch End- with 1
xx0x xxxx xxxx xxxx b	Do not overwrite Move+/Direction
xx1x xxxx xx0x xxxx b	Overwrite Move+/Direction with 0
xx1x xxxx xx1x xxxx b	Overwrite Move+/Direction with 1
x0xx xxxx xxxx xxxx b	Do not overwrite Move-/Move
x1xx xxxx x0xx xxxx b	Overwrite Move-/Move with 0
x1xx xxxx x1xx xxxx b	Overwrite Move-/Move with 1
0xxx xxxx xxxx xxxx b	Do not overwrite velocity
1xxx xxxx 0xxx xxxx b	Overwrite velocity with 0
1xxx xxxx 1xxx xxxx b	Overwrite velocity with 1

x: any bit value b: binary representation

Configuration data

Bit values	Description
xxxx xxxx xxxx xxx0 b	Select outputs: move+, move-, velocity
xxxx xxxx xxxx xxx1 b	Select outputs: direction, move, velocity
xxxx xxxx xxxx xx0x b	Motion direction outputs not inverted
xxxx xxxx xxxx xx1x b	Motion direction outputs inverted, i.e. Move+ and Move- inverted or direction inverted
xxxx xxxx xxxx x0xx b	Velocity output not inverted, i.e. Velocity=0: slow Velocity=1: fast
xxxx xxxx xxxx x1xx b	Velocity output inverted, i.e. Velocity=0: fast Velocity=1: slow
xxxx xxxx xxxx 0xxx b	Counting direction not inverted
xxxx xxxx xxxx 1xxx b	Counting direction inverted
xxxx xxxx xxx0 xxxx b	Counter counts according to tracking signals A and B
xxxx xxxx xxx1 xxxx b	Counter is reset
xxxx x000 0xxx xxxx b	Operating mode off (for description see below)
xxxx x001 0xxx xxxx b	Positioning mode, version 1 (for description see below)
xxxx x001 1xxx xxxx b	Positioning mode, version 2 measuring after zero pulse (for description see below)
xxxx x010 0xxx xxxx b	Homing mode, version 1 (for description see below)
xxxx x011 0xxx xxxx b	Homing mode, version 2 (for description see below)
xxxx x100 0xxx xxxx b	Homing mode, version 3 (for description see below)
xxxx 0xxx xxxx xxxx b	Homing direction, decrementing to limit switch End-
xxxx 1xxx xxxx xxxx b	Homing direction, incrementing to limit switch End+
xxx0 xxxx xxxx xxxx b	Homing velocity: slow
xxx1 xxxx xxxx xxxx b	Homing velocity: fast

x: any bit value b: binary representation

2.19.6 Process data from module to PLC (inputs)

The module transmits 5 words to the PLC.

Word 1	Word 2	Word 3*	Word 4*	Word 5
Counter value Counter 1 (MSB)	Counter value Counter 1 (LSB)	Counter value Counter 2 (MSB)	Counter value Counter 2 (LSB)	Status of inputs/outputs*

*Words 3 and 4 are not transmitted if the data width is set to 3. In this case word 5 is transmitted as word 3. Single bits are used differently, see below.

Status of inputs/outputs

Bit values word 5	Description
xxxx xxxx xxxx xxx0 b	Message homing counter 1 reset
xxxx xxxx xxxx xxx1 b	Homing counter 1 successfully completed
xxxx xxxx xxxx xx0x b	Message positioning counter 1 reset
xxxx xxxx xxxx xx1x b	Positioning counter 1 successfully completed
xxxx xxxx xxxx x0xx b	Status of tracking signal N counter 1 is 0 (0 V)
xxxx xxxx xxxx x1xx b	Status of tracking signal N counter 1 is 1 (24 V)
xxxx xxxx xxxx 0xxx b	Status of End+ counter 1 is 0 (0 V)
xxxx xxxx xxxx 1xxx b	Status of End+ counter 1 is 1 (24 V)
xxxx xxxx xxx0 xxxx b	Status of End- counter 1 is 0 (0 V)
xxxx xxxx xxx1 xxxx b	Status of End- counter 1 is 1 (24 V)
xxxx xxxx xx0x xxxx b	Status of Move+/Direction counter 1 is 0 (0 V)
xxxx xxxx xx1x xxxx b	Status of Move+/Direction counter 1 is 1 (24 V)
xxxx xxxx x0xx xxxx b	Status of Move-/Direction counter 1 is 0 (0 V)
xxxx xxxx x1xx xxxx b	Status of Move-/Direction counter 1 is 1 (24 V)
xxxx xxxx 0xxx xxxx b	Status of velocity counter 1 is 0 (0 V)
xxxx xxxx 1xxx xxxx b	Status of velocity counter 1 is 1 (24 V)
xxxx xxx0 xxxx xxxx b	Message homing counter 2 reset
xxxx xxx1 xxxx xxxx b	Homing counter 2 successfully completed
xxxx xx0x xxxx xxxx b	Message positioning counter 2 reset
xxxx xx1x xxxx xxxx b	Positioning counter 2 successfully completed
xxxx x0xx xxxx xxxx b	Status of tracking signal N counter 2 is 0 (0 V)
xxxx x1xx xxxx xxxx b	Status of tracking signal N counter 2 is 1 (24 V)
xxxx 0xxx xxxx xxxx b	Status of End+ counter 2 is 0 (0 V)
xxxx 1xxx xxxx xxxx b	Status of End+ counter 2 is 1 (24 V)
xxx0 xxxx xxxx xxxx b	Status of End- counter 2 is 0 (0 V)
xxx1 xxxx xxxx xxxx b	Status of End- counter 2 is 1 (24 V)
xx0x xxxx xxxx xxxx b	Status of Move+/Direction counter 2 is 0 (0 V)
xx1x xxxx xxxx xxxx b	Status of Move+/Direction counter 2 is 1 (24 V)
x0xx xxxx xxxx xxxx b	Status of Move-/Direction counter 2 is 0 (0 V)
x1xx xxxx xxxx xxxx b	Status of Move-/Direction counter 2 is 1 (24 V)
0xxx xxxx xxxx xxxx b	Status of velocity counter 2 is 0 (0 V)
1xxx xxxx xxxx xxxx b	Status of velocity counter 2 is 1 (24 V)

x: any bit value b: Binary representation
Depending on word 5 of the control data,
one bit may be assigned as a check-back bit.

2.19.7 Operation / operating modes

Powering Up

When you power the unit up all settings in the module are reset, i.e.

- Counter values, pre-shutdown values, shutdown values are 0000 h
- Override data is 0000 h
- Configuration data is 0000 h

After the unit is powered up the following settings are active:

- No data is loaded into the module.
- No inputs/outputs are overwritten.
- Select outputs: Move+, Move-, Velocity
- Motion direction outputs not inverted
- Velocity output not inverted, i.e. velocity = 0: slow, velocity = 1: fast
- Counting direction not inverted
- Counter counts according to tracking signals A and B
- Operating mode off
- Homing direction, decrementing to limit switch End-
- Homing velocity: slow

OFF

Move+ and Move- or Move outputs are off.

Enable outputs after shutdown due to limit switch activation.

Positioning: Version 1

1. Move fast up to pre-shutdown value
2. Move slowly up to shutdown value
3. Shut down Move+ and Move- (or Move) outputs

A message is sent to the PLC indicating successful completion of positioning.

When you switch to another operating mode this message is deleted.

The direction is determined by comparing the thresholds with the current counter value.

Positioning with pre-shutdown value behind the shutdown value is possible. In this case the direction is inverted when the pre-shutdown value is reached.

If End+=0 or End-=0 the Move+ and Move- or Move outputs are switched off. Select operating mode OFF to re-activate the outputs.

Positioning: Version 2 (position measurement after zero pulse)

1. Move fast in preset direction (homing direction bit) until zero pulse (input tracking signal N)
2. Reset counter and continue fast until pre-shutdown value
3. Continue slowly up to shutdown value
4. Shut motion outputs off

A message is sent to the PLC indicating successful completion of positioning.

When you switch to another operating mode this message is deleted.

If End+=0 or End-=0 the Move+ and Move- (or Move) outputs are switched off. Select operating mode OFF to re-activate the outputs.

Homing: Version 1

1. Move at pre-set velocity and direction (velocity and direction for homing) until the corresponding limit switch is active. If the counting direction is incrementing during homing the axis must reach End+. If not it must reach End-.
2. Motion direction reverses. Leave limit switch at slow speed. Carry on to zero pulse (tracking signal N).
3. Reset counter and switch off outputs Move+ and Move- (or Move). A message is sent to the PLC indicating successful completion of homing.

When you switch to another operating mode this message is deleted.

If the "other" limit switch becomes active during homing the Move+ and Move- or Move outputs are switched off. Select operating mode OFF to re-activate the outputs.

Homing: Version 2

1. Move at pre-set velocity and direction (velocity and direction for homing) until the corresponding limit switch is active. If the counting direction is incrementing during homing the axis must reach End+. If not it must reach End-.
2. Motion direction reverses. Leave limit switch at slow speed.
3. Reset counter and switch off outputs Move+ and Move- (or Move). A message is sent to the PLC indicating successful completion of homing.

When you switch to another operating mode this message is deleted.

If the "other" limit switch becomes active during homing the Move+ and Move- or Move outputs are switched off. Select operating mode OFF to re-activate the outputs.

Homing: Version 3

1. Move at pre-set velocity and direction (velocity and direction for homing) until End+=1 (24 V) (alternative use of this limit switch).
2. Carry on in the same direction at slow velocity until zero pulse (tracking signal N).
3. Reset counter and switch off outputs Move+ and Move- (or Move). A message is sent to the PLC indicating successful completion of homing.

When you switch to another operating mode this message is deleted.

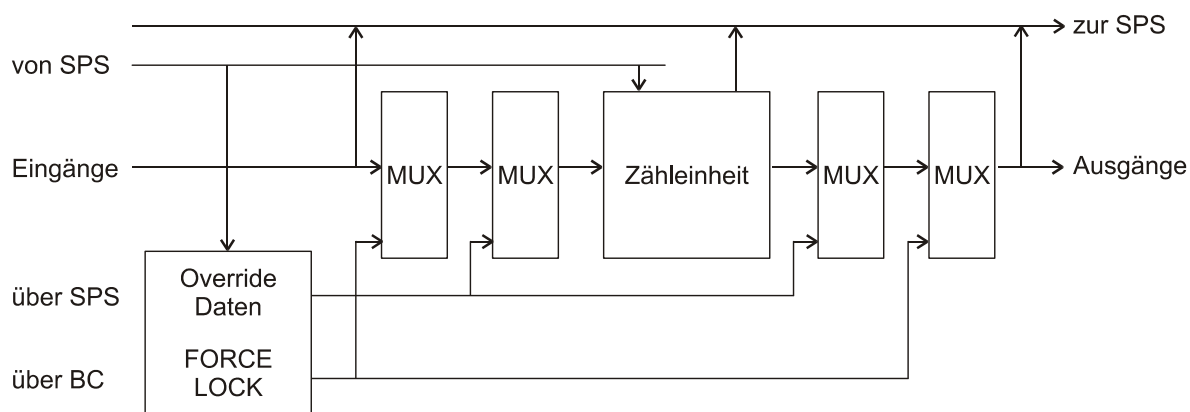
End- is not evaluated during homing.

2.19.8 Operation on RIO bus coupler and microLine

You can overwrite all inputs and outputs in FORCE or LOCK.

FORCE/LOCK have a direct effect on inputs and outputs.

If you select FORCE/LOCK on the bus coupler and at the same time send override data via the PLC the following applies:



In display mode counter data is displayed in four-position hex. format. The four least significant and four most significant values are displayed separately. The following display appears, depending on the channel cursor position (yellow LED):

Number and type of counter	Channel cursor position:	Display
2 x 32-bit	X1.0, X1.2, X1.4, X1.6	Counter value Z1 MSW
	X1.1, X1.3, X1.5, X1.7	Counter value Z1 LSW
	X2.0, X2.2, X2.4, X2.6	Counter value Z2 MSW
	X2.1, X2.3, X2.5, X2.7	Counter value Z2 LSW

MSW: Most Significant Word

LSW: Least Significant Word

2.19.9 Example

Connecting an incremental encoder

1. Tracking signal A on X1.0
2. Tracking signal B on X1.1
3. Tracking signal N on X1.2

Connecting the limit switch (active 0 V, open-circuit potential 24 V)

1. Limit switch End+ on X1.3 (reached by incrementing)
2. Limit switch End- on X1.4 (reached by decrementing)

Connecting the drive

1. Move+ on X1.5 (incremental axis movement)
2. Move- on X1.6 (decremental axis movement)
3. Velocity on X1.7 (0 V: slow; 24 V: fast)

Operating the module from the PLC program

General points about the program interface

- When writing control data a particular sequence has to be observed in some cases.
- When the module is used on a local PLC (e.g. microLine) new data can be sent to the counter in any PLC cycle.
- When used in a field bus system, there has to be a delay of at least one field bus cycle before data is written to the module, if the data is to reach the module securely.
 If the field bus cycle time is unknown, you can use a check-back bit (bit 0 or 3 of control data word 5) to arrange secure data transfer to the module regardless of the field bus cycle time.

Homing, version 1: to Limit Switch End+

1. Selecting the mode starts homing
 0A00 0000 0000 0000 0400
 (PLC->Module, words 1 - 5, hex. format)
2. Possibility: Deselect configuration data
 0A00 0000 0000 0000 0000
 (PLC->Module, words 1 - 5, hex. format)
 One cycle later: Deselect start instruction
 0000 0000 0000 0000 0000
 (PLC->Module, words 1 - 5, hex. format)
3. Axis moves slowly towards End+
 (Move+=24 V, Move-=0 V, Velocity=0 V)
4. At End+ (End+=0 V) the axis **must** travel back (Move+=0 V, Move-=24 V, Velocity=0 V)
IMPORTANT: If the direction does not change and the axis has already left the limit switch again, homing will not be completed with the next zero pulse.
"Limit switch left" is not evaluated until after a change of direction. The next zero pulse ends homing.
5. When the axis leaves the limit switch in decrementing direction the axis is stopped after the first zero pulse (Move+=0 V, Move-=0 V, Velocity=0 V), the counter is reset and the end of the homing procedure is signalled.
 0000 0000 0000 0000 0019
 (Module->PLC, words 1 - 5, hex. format)

Positioning, version 1

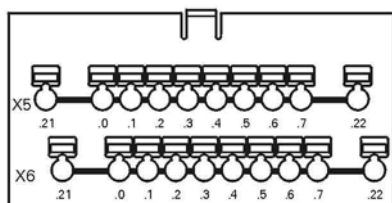
1. Load pre-shutdown value (0000 0800)
0000 0800 0000 0000 0100
(PLC->Module, words 1 - 5, hex format)
2. Load shutdown value (0000 1000)
0000 1000 0000 0000 0200
(PLC->Module, words 1 - 5, hex format)
3. Selecting the mode starts positioning
0100 0000 0000 0000 0400
(PLC->Module, words 1 - 5, hex. format)
4. Axis moves fast (incremental movement)
(Move+=24 V, Move-=0 V, Velocity=24 V)
5. When axis reaches pre-shutdown value it moves slowly (incremental axis movement)
(Move+=24 V, Move-=0 V, Speed=0 V)
6. When axis reaches shutdown value the axis is stopped (Move+=0 V, Move-=0 V, Speed=0 V) and the end of the positioning procedure is signalled.
0000 1000 0000 0000 001A
(PLC->Module, words 1 - 5, hex. format)

2.19.10 Technical data RIO P24-10, RIO P05-10

RIO P24-10, RIO P05-10	
Module RIO P24-10, RIO P05-10	12d / 0Ch (6 I/O bytes) 13d / 0Dh (10 I/O bytes)
Number of controllable axes	2
Counting frequency	Max. 200 kHz
Number of inputs/outputs	10 inputs 6 outputs
Supply voltage	24 V DC \pm 20% max. 5% residual ripple
Power consumption from external 24 V supply	0.25 W (without input current/load current)
Power consumption from internal 5 V supply	1.25 W
Inputs	
Input signal level 24 V signals	H level +15 V to +30 V L level -30 V to +5 V
Input current 24 V signals	min. H level (+15 V), $I \geq 3.5$ mA max. L level (+5 V), $I \leq 1.0$ mA Typical (+24 V), $I = 7.5$ mA
Input signal level 5 V signals (RIO P05-10 counter inputs only)	H level 3 V to 5 V L level -5 V to +0.8 V
Input current 5 V signals (RIO P05-10 only)	Typical (5 V), $I = 9.5$ mA
Isolation from internal bus	Yes, each channel separately via optocouplers
Simultaneity	100%
Signal delay	< 1 μ s (hardware)
Outputs	
Output signal level	H level = power supply - 0.5V L level ≤ 1 V
Output current per output max.	1 A short-circuit-proof and overcurrent-protected
Total current for whole module max.	6 A
Isolation from internal bus	Yes, each channel separately via optocouplers
Simultaneity	100%
Free-wheeling diode	Integrated
Signal delay	< 300 μ s (hardware)
Power supply for fast encoders (terminals X2.21 / X2.22)	
Voltage	DC 24 V
Current	max. 1 A

See also General Technical Data, page 94.

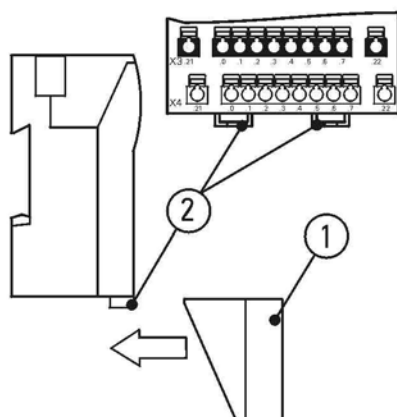
2.20 Potential Distributor RIO KE 16



The potential distributor is a terminal expansion for the DC 24 V and 0 V potentials. It has 2 separate rows of terminals with 10 terminal connections on each. This means that the connection system can always be extended to 3-wire or 4-wire.

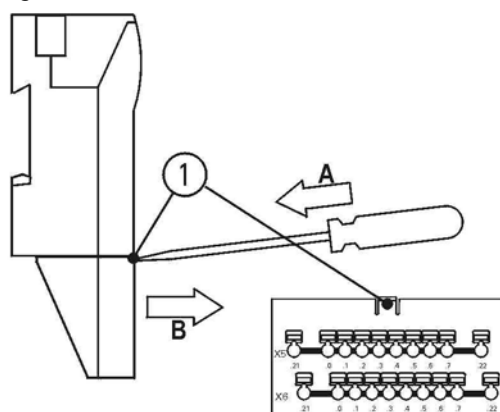
The potential distributor can only be fitted on a module with the appropriate clips.

Installation



Push the potential distributor (1) from the front into the receptor (2) on the module, until the catch engages.

Dismantling



Use a screwdriver to push the catch (1) of the potential distributor in direction A.

At the same time pull the potential distributor away in direction B.

2.20.1 Technical data potential distributor RIO KE 16

RIO KE16	
Number of terminal rows	2 (isolated)
Number of terminal connections	20 (10 per row)
Max. current load on individual terminal	8 A

See also General Technical Data, page 94.

3 Technical Data, Connection Hints and Dimensions

3.1 General Technical Data

Climatic conditions	
Ambient operating temperature	0 ... +55°C (category KV to DIN 40040), vertical installation, free air circulation
Storage temperature	-25 ... +70°C (category HS to DIN 40040)
Relative humidity	30 ... 95% (category F to DIN 40040), no condensation
Air pressure in operation	860 ... 1060 hPa
Mechanical strength	
Vibration	DIN IEC 68-2-6 10 ... 57 Hz constant amplitude 0.075 mm 57 ... 150 Hz constant acceleration 1 g
Electrical safety	
Protection type	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 decoupled electrical circuits corresponding to overload category II, contamination level 2
Test voltage	350 V AC / 50 Hz for device rated voltage 24 V DC
Electromagnetic compatibility	
Electrostatic discharge	4 kV contact discharge
Electromagnetic fields	EN 61000-4-3: field intensity 10 V/m, 80 ... 1000 MHz
Burst	EN 61000-4-4: 2 kV on DC supply lines, 1 kV on I/O signal and serial interface lines
Interference emissions	EN 55011: Limit Category A, Group 1
Mechanical and installation	
Housing material	PA 6.0 GF20 black
Rail	DIN rail EN 50022-35
Connection system	
Device connection	Spring terminal
Conductor size	Finely stranded*: 0.14-1.5 mm ² Single-core: 0.5-2.5 mm ² *If a wire end ferrule is used it must be pressed air-tight.
Stripping length	10 mm

3.2 Technical Data Analog Inputs/Outputs

Analog inputs ± 10

Parameter	Conditions	min.	typ.	max.	Unit
Range		-10.000		+9.995	V
Resolution				12	Bit
Conversion time				2	ms
Common-mode range	to AGND	-12.1		+12.8	V
Input resistance	+input or -input to AGND		1		M Ω
Input current	+input to AGND		- 15		μ A
	-input to AGND		+ 15		μ A
Acceptable source voltage range for two-way wire breakage detection	Floating source	-10		+9.9	V
	- pole connected to AGND:	-2.1		+9.9	V
	+ pole connected to AGND:	-2.8		+9.9	V
Max. overall error	± 40 mV $\pm 0.35\%$ from measured value				
Isolation	Only from bus, not between analog channels				

Analog inputs 20mA

Parameter	Conditions	min.	typ.	max.	Unit
Range		0		19.995	mA
Resolution				12	Bit
Conversion time				2	ms
Input load	Current input to AGND	99.9	100.0	100.1	Ω
Acceptable continuous input load				200	mW
Acceptable continuous input current		-40		40	mA
Acceptable continuous input voltage		-4		4	V
Dyn. input resistance	f > 2 kHz		95		Ω
Offset error			0.5	1	LSB
Channel crosstalk	f < 100 Hz		-74		dB
Gain error			0.2	0.45	% FSR
Noise voltage			0.5	2	LSB
Max. overall error	± 40 μ A $\pm 0.35\%$ from measured value				
Isolation	Only from bus, not between analog channels				

Analog outputs ± 10 V

Parameter	Conditions	min.	typ.	max.	Unit
Resolution				12	Bit
Gain error			0.05	0.12	% FSR
Offset error			3	10	mV
Refresh rate			2		ms
Drift rate			2		mV / ms
Output current	Ua = -10 V ... +10 V, to AGND	-10		10	mA
Short-circuit current			20		mA
Short-circuit duration				∞	

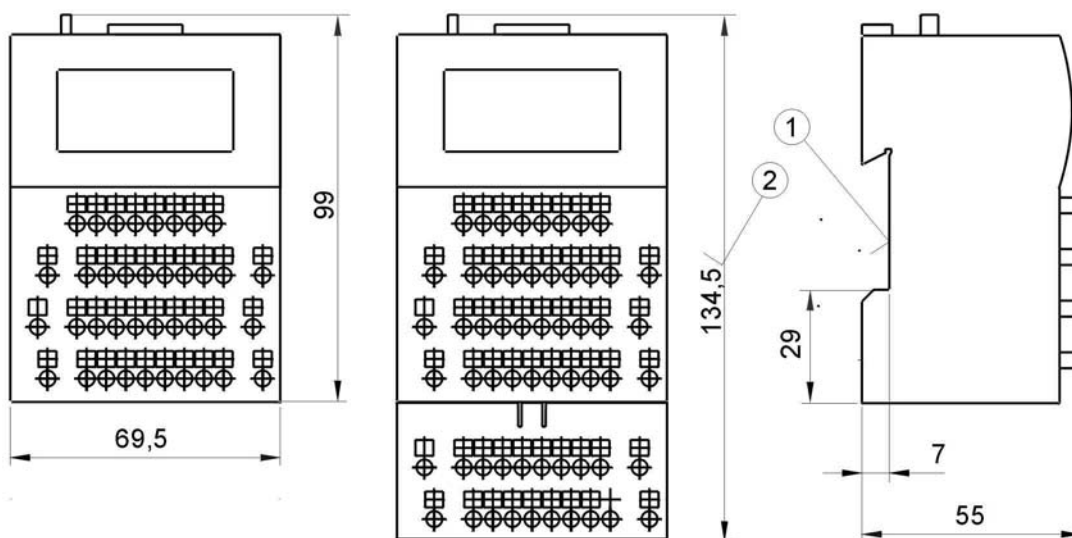
Max. overall error	± 40 mV $\pm 0.35\%$ from measured value				
Isolation	Only from bus, not between analog channels				

Analog outputs 20mA

Parameter	Conditions	min.	typ.	max.	Unit
Resolution				12	Bit
Gain error			0.2	0.5	% FSR
Offset error			10	20	μ A
Refresh rate			2		ms
Drift rate			4		μ A / ms
Load		0		500	Ω
Short-circuit current		0		20	mA
Short-circuit duration				∞	
Output voltage		0		10	V

Max. overall error	± 40 μ A $\pm 0.35\%$ from measured value				
Isolation	Only from bus, not between analog channels				

3.3 Dimensions



(1) For DIN rail EN 50022-35

(2) Height with potential distributor

4 Appendix

4.1 Connecting Signal Sources to Analog Modules

Voltage inputs

The 4 analog inputs are non-floating differential inputs. The voltage potentials of the positive and negative signal poles should not exceed the acceptable common-mode range (-12.1 ... + 12.8 V in relation to AGND). Signals in excess of these limits would be clipped by the following amplifiers. The result would be a corrupted measuring value. The analog input potentials are isolated from the supply (+24 V, 0 V) and from PE.

Observe the following when connecting signal sources to analog inputs:

a) Floating signal sources:

If you connect a completely potential-free signal source to AIx+ and AIx- only, high-resistance resistors in the module ensure that the pole potentials are drawn to approximately the middle of the range. However, since the potential coupling is only very high-resistance (to prevent corruption of measured data) and thus very soft, the typically occurring ripple voltages can result in a strong fluctuation of the pole potentials and even exceed the common-mode range. Strongly fluctuating or completely corrupted measured values are an indication of this problem. To prevent this, fix the pole potentials by adding an external potential connection to AGND.

b) Non-floating signal sources:

If you connect several non-floating signal sources to the various analog inputs of the module, add a potential connection to AGND to avoid freely floating signal potentials. Normally connection of a single signal source potential with AGND is sufficient. If you use non-floating signal sources make sure that the respective pole potentials are within the common-mode range. If the pole potentials of two signal sources are very different (example: 1st signal source supplies voltages related to 0 V external, the 2nd signal source supplies voltages related to +24V external), NEVER connect them to the same analog input module!



If you have open voltage inputs (differential input) the digital value 07FF hex is transferred.

Current inputs

The 4 analog inputs are “single ended” inputs, i.e. the negative signal pole of all inputs is AGND.

The analog potentials (AIx and AGND) are isolated from the supply (+24 V, 0 V) and from PE.

Observe the following when connecting current sources to analog inputs:

a) Floating signal sources:

Required potential coupling is already provided by referencing the input signal potential to AGND.

b) Non-floating signal sources:

If you use different non-floating signal sources make sure that the signal sources are not shorted between them when connected to AGND.

4.2 Data Formats for Analog Modules

The data format is set using parameterizing and diagnosis function 11 on the respective bus coupler (e.g. RIO BC or EC) or PLC (e.g. microLine). For a description of the parameterizing and diagnosis functions please refer to the respective operating manual.

The following data formats are available:

Parameter	Data format	Suitable for
0	±10 V in two's complement (-2048 +2047)	RIO 4AI ±10V RIO 4AI/4AO ±10V
1	±10 V in mV (-10000 +10000)	RIO 4AI ±10V RIO 4AI/4AO ±10V
2	0...20 mA in two's complement (0...4095)	RIO 4AI 20mA RIO 4AI/4AO 20mA
3	0...20 mA in µA (0...20000)	RIO 4AI 20mA RIO 4AI/4AO 20mA
4	4...20 mA in S5 format	0 ... 20 mA modules RIO 4AI 20mA RIO 4AI/4AO 20mA
5	0...10 V in mV (0 ... 10000)	RIO 4AI 0-10V RIO 4AI/4AO 0-10V
7	4...20 mA in S7 format	4...20 mA modules
8	4...20 mA in S7 format	RIO 4AI 4-20mA RIO 4AI/4AO 4-20mA

4.2.1 Data formats for voltage inputs/outputs

±10 V in two's complement (-2048 ... +2047)																		
Measured value	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
10.000 V	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2047	07FF
5.000 V	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1024	0400
0.000 V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
-5.000 V	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-1024	FC00
-10.000 V	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	-2048	F800

±10 V in mV (-10000...+10000)																		
Measured value	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
10.000 V	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	10000	2710
5.000 V	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	5000	1388
0.000 V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5.000 V	1	1	1	0	1	1	0	0	0	1	1	1	1	0	0	0	-5000	EC78
-10.000 V	1	1	0	1	1	0	0	0	1	1	1	1	0	0	0	0	-10000	D8F0

0...10 V in mV (0...10000)																		
Measured value	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
10.000 V	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	10000	2710
5.000 V	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	5000	1388
0.000 V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4.2.2 Data formats for current inputs/outputs

0...20 mA in two's complement																		
Measured value	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
20 mA	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	4095	0FFF
10 mA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2048	0800
0 mA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0...20 mA in μ A (0...20000)																		
Measured value	Binary																Dec.	Hex.
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
20 mA	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	20000	4E20
10 mA	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0	10000	2710
0 mA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

In bus couplers with software 00.50 and later you can also set the representation to SIMATIC S5 format:

0...20 mA SIMATIC S5 format for inputs (module 4AI/4AO 20mA)																			
Measured value	Binary representation															T	F	Ü	Units
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
20.000 mA	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2560		
19.992 mA	0	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	2559		
16.000 mA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2048		
4.000 mA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	512		
3.992 mA	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	511		
3.000 mA	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	384		
1.179 mA	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	151		
1.171 mA	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	1	150		
0.000 mA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		

T Activity bit always = 0

F Error bit always = 0

Ü Overflow bit < 1.179 mA = 1 and >= 20 mA = 1

Measuring range 4 ... 20 mA is divided into 2048 units in the interval 512 ... 2560.

The software provides an overflow message on 1.179 mA.

4...20 mA SIMATIC S5 format for outputs (module 4AI/4AO 20mA)																	
Output value	Binary representation												x	x	x	x	Units
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
20.000 mA	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	1024
19.984 mA	0	0	1	1	1	1	1	1	1	1	1	1	x	x	x	x	1023
12.000 mA	0	0	1	0	0	0	0	0	0	0	0	0	x	x	x	x	512
4.016 mA	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	1
4.000 mA	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	0
3.984 mA	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	-1
0.000 mA	1	1	1	1	0	0	0	0	0	0	0	0	x	x	x	x	-256

x Not applicable

Measuring range 4 ... 20 mA is divided into 1024 units.

This corresponds to a resolution of 10-bit or 0.015625 mA/digit.

4...20 mA SIMATIC S7 format for inputs and outputs (module 4AI/4AO 4-20mA)			
Input / output value	Units		Range
	decimal	hexadecimal	
>22.810 mA	32767	7FFFh	Overrun
22.810 mA	32511	7EFFh	Overrange
.	.	.	
.	.	.	
20,0005 mA	27649	6C01h	
20.000 mA	27648	6C00h	Rated Range
16.000 mA	20736	5100h	
.	.	.	
.	.	.	
4.000 mA	0	0	
3.9995 mA	-1	FFFFh	Underrange
.	.	.	
.	.	.	
1.1852 mA	-4864	ED00h	
<1.1852 mA	-32768	8000h	Underflow

4.3 Module IDs

Module IDs	Module designation
1	RIO 8 I/O
2	RIO 16 I
3	RIO 16 O
4	RIO 8I 8I/O
5	RIO 4AI/4AO $\pm 10V$
6	RIO 4AI $\pm 10V$
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 / RIO P05-10
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 O 2A
24d / 18h	RIO 4 I 120 VAC
25d / 19h	RIO 4 I 230 VAC
28d / 1Ch	RIO A10-10

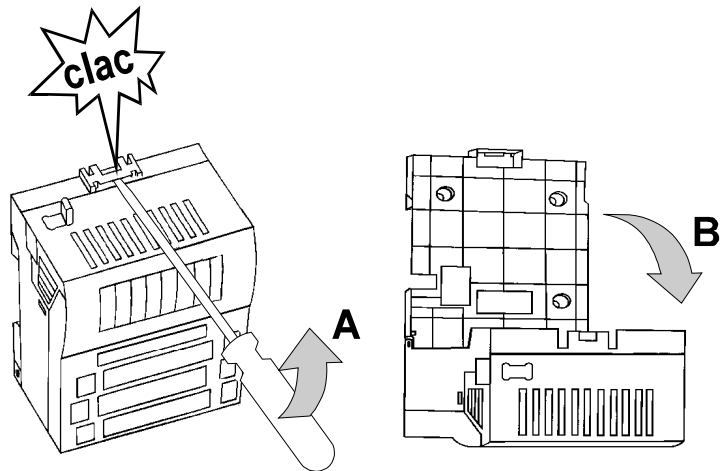
4.4 Replacing Electronic Parts in the Module



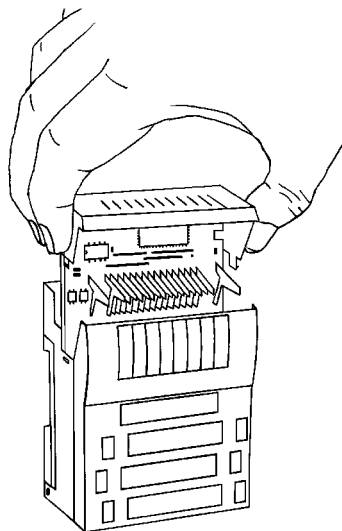
Always switch the unit off before replacing parts.

All lines can stay on the module.

1. Open contact slide
2. Tilt module forward.



3. Hold module on textured areas, press together and remove electronic parts.



4.5 Glossary

Combination channels

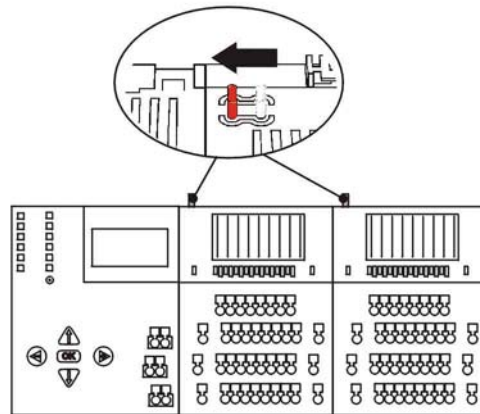
I/O channels which can be used as either inputs or outputs, as required. I.e.: for a process map an input address space and an output address space are reserved.



Note that you cannot connect a 24 V 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.

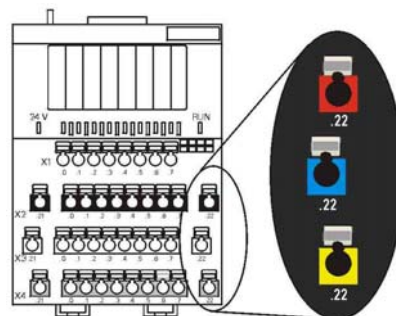
Slide contacts

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



Potential relay terminals

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.



Note that the maximum current per terminal is 8 A.

4.6 Trademarks

- MS-DOS is a registered trademark of Microsoft Corporation.
- WINDOWS is a registered trademark of Microsoft Corporation.
- IBM is a registered trademark of International Business Machines.
- SIMATIC and SINEC are registered trademarks of Siemens AG.
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5 Safety-related information

The term automation system as used in this manual includes control units, their components (modules), other parts (such as racks, cables), operator panels, and the software used for programming, commissioning and operating the control units. 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 norm. 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 norm must be observed (safety of machines, general requirements for electrical equipment of machines).

When an automation system is properly maintained and used 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.

5.1 Proper Use

SCHLEICHER automation systems are state-of-the-art products and manufactured to recognized safety requirements. All the same, their use can 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 system. 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.

5.2 Selection and Qualification of Personnel



All configuring, programming, installation, commissioning, operation and maintenance 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 system and be familiar with the relevant operating instructions.

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

5.3 Configuring, Programming, Installation, Commissioning and Operation

The automation system will in most cases be a part of a larger system in which machines 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/EWG. 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 system. Emergency stop components must be operational in all control modes. In an emergency stop the power supply to all switching elements controlled by the control system 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 conditions 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 conditions in the control system, 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.

5.4 Maintenance

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 unauthorised 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 Technical Data.

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

5.5 High Voltages



When the cabinet is opened or casing is 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 unauthorised 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 maintaining the system in line with the instructions given in this manual.

5.6 Dealing With Used Batteries

When the batteries in the automation system are dead they must be disposed of in a battery return system or through 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. For example by sticking tape over the poles of the battery.

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