Chapter 4 • I/O modules

1. General information

1.1 Remote connection of peripherals

The space-saving Compact I/O system modules reduce wiring of sensors and actuators. Discrete I/O signals are bundled on the modules and transferred to the controller via a fieldbus connection. The system is ideally suited for use in standard IP20 operating environments.

1.2 Flexibility for sensors and actuators

Compact I/O system modules already include signal adaptation for various purposes. In addition to classic digital signals, there are also modules that can handle rotational encoder evaluation, gate measurement, event counters or pulse width signals. Analog modules are also supplemented with temperature inputs, strain gauge evaluation or resistance measurement. The Compact I/O system always provides the right I/O combination for each application.

1.3 Communication

Compact I/O system modules are equipped with CAN I/O or X2X Link interfaces. All I/O signals are bundled and sent to the higher level controller using this channel. This expands the I/O backplane in the field. The Compact I/O system can be combined with all B&R controller families and other components as desired. This allows a customized and cost-effective automation architecture to be created for each application.

1.4 I/O modules for distributed applications

IP20 compact I/O modules offer outstanding solutions when it comes to applications that handle remote I/O signals, ranging from simple digital inputs to SSI encoders. In addition to being able to mount this system directly on the machine or on a mounting rail, its optimal performance and compact size of 170 x 80 x 30 mm (H x W x D) translates into nearly unlimited possibilities.

2. Overview

	7CX408.50-1	7CX436.50-1	7XX408.50-1	7XX410.50-1	7XX412.50-1	7XX415.50-K02	7XX426.50-1	7XX436.50-1
Communication interface	CAN	CAN	X2X	X2X	X2X	X2X	X2X	X2X
Digital inputs 24 VDC	16	8	16	3	-	16	8	8
Digital outputs 24 VDC	(16)	(8)	(16)	-	16	8	8	8
Analog inputs	-	(4)	-	-	(2)	-	1	(4)
Analog outputs	-	4	-	3	-	-	3	4
Displacement gauge / Potentiometer	-	-	-	-	-	-	4	
Full-bridge strain gauge	-	-	-	-	-	2	-	-
SSI Absolute Encoder 5 V and Incremental Encoder 5 V	-	-	-	3	-	-	-	-
Temperature measurement	-	(2)	-	-	(8)	-	-	(2)
Event counter	✓	✓	✓	-	-	✓	✓	✓
Incremental encoder	✓	✓	✓	-	-	✓	✓	✓
Gate measurement	✓	✓	✓	-	-	✓	✓	✓
Period and frequency measurement	✓	✓	✓	-	-	✓	✓	✓
PWM output	(2)	(2)	(2)	-	-	-	-	-
Comparator function	-	-	-	-	-	-	✓	✓
Page	63	93	121	147	167	186	209	235

Table 35: Compact I/O modules - overview

3. Installation

Generally, horizontal and vertical installation are both possible.

3.1 Horizontal installation

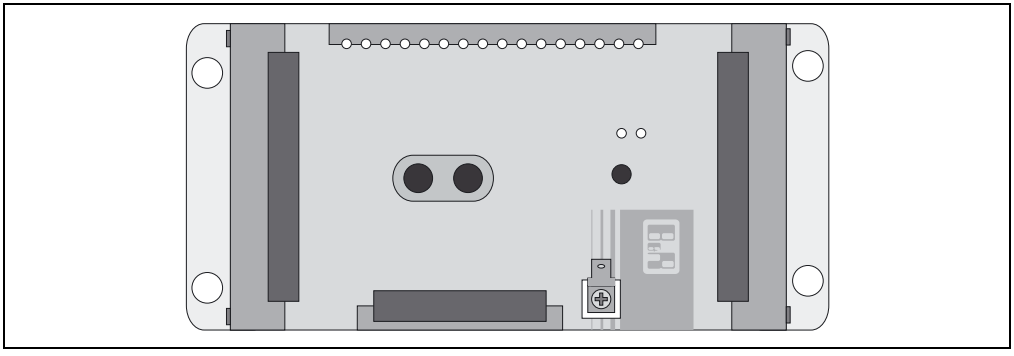


Figure 7: Compact I/O modules - horizontal installation

Due to the better convection of horizontal installation, this method is recommended.

When installing, make sure that there are 30 mm free space above and below the module and that the cooling vents are not covered. The free space on the left and right sides is provided by the mounting plates.

3.2 Vertical installation

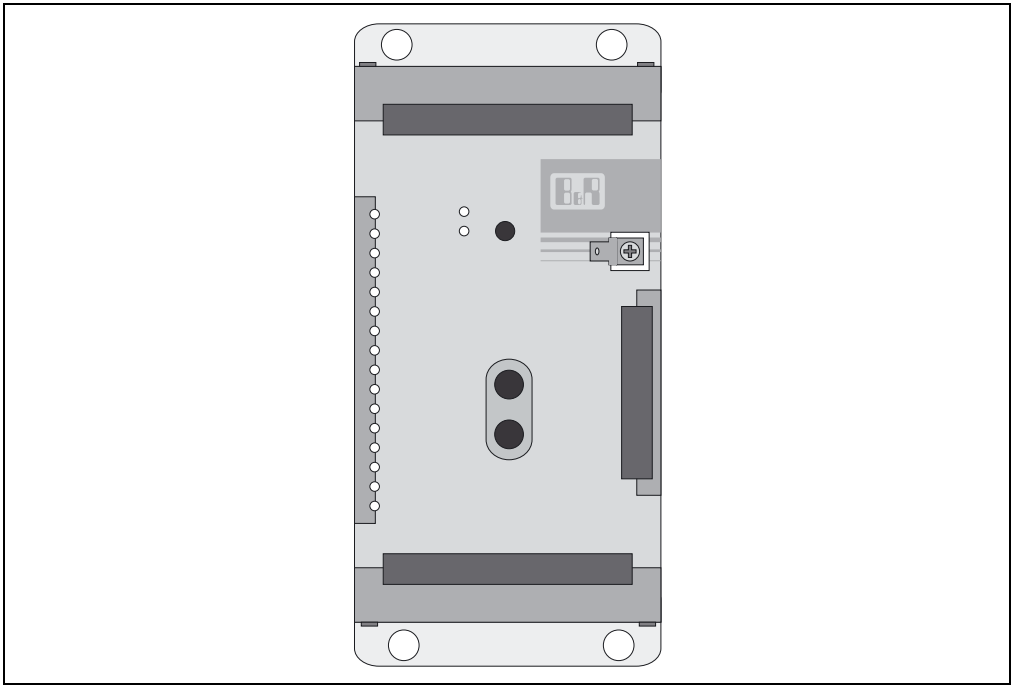


Figure 8: Compact I/O modules - vertical installation

When installing, make sure that there are 30 mm free space above and below the module and 10 mm free space on the left and right sides of the module. The cooling vents are not allowed to be covered.

3.3 Installation dimensions

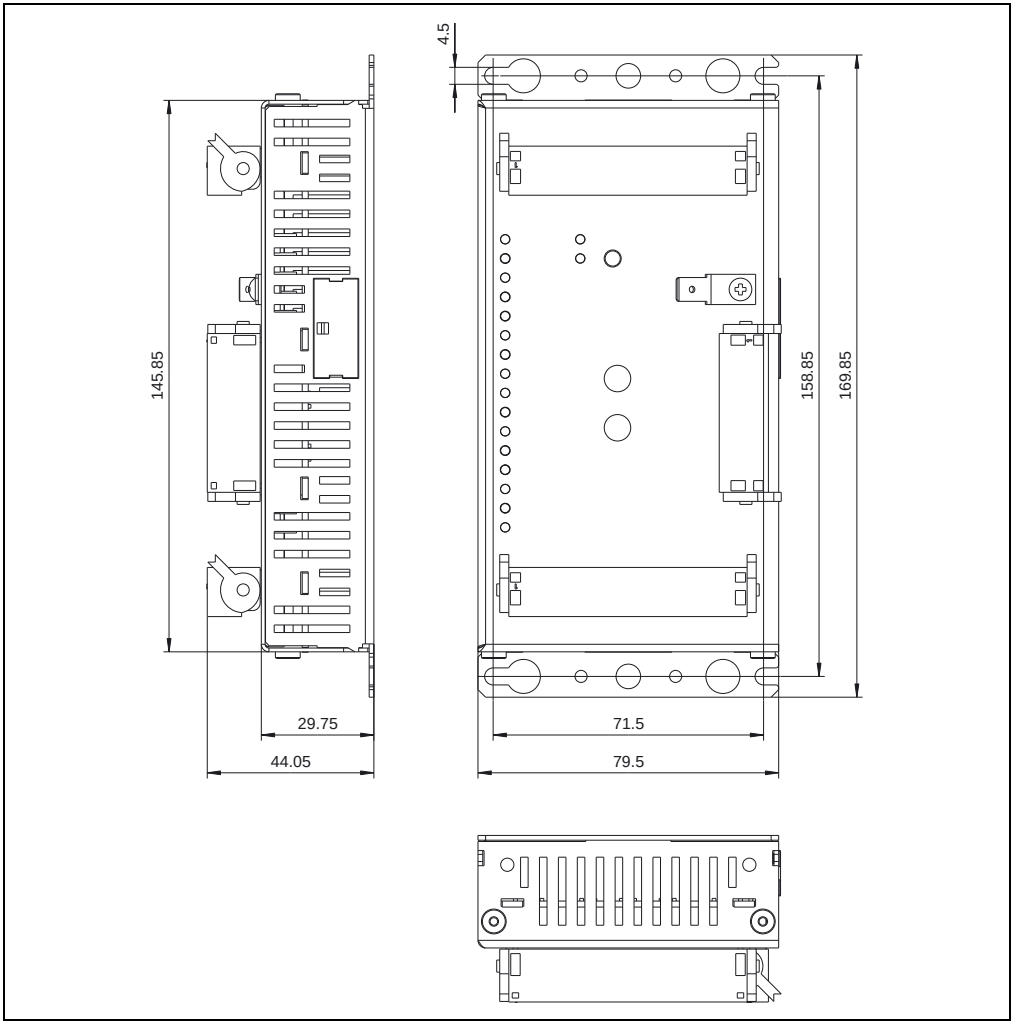


Figure 9: Compact I/O modules - installation dimensions

3.4 Figure

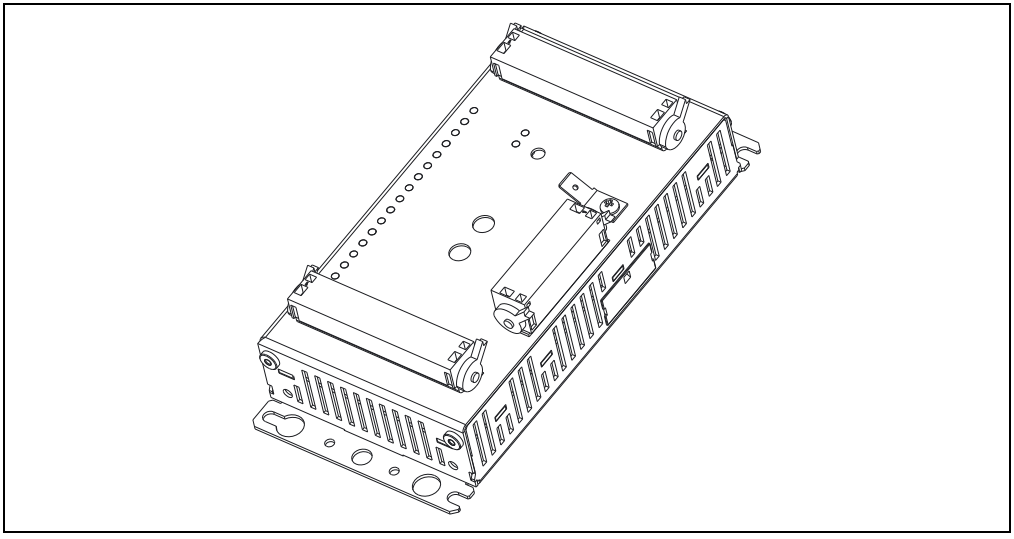


Figure 10: Compact I/O modules - image

3.5 Ground connection

For most applications, industrial controllers are installed in switching cabinets, in which electromagnetic switching elements (relays, contactors), transformers, motor controllers and frequency inverters are also found. Different kinds of electromagnetic interference inevitably exists in such switching cabinets.

Generally this kind of interference cannot be avoided. However, if suitable grounding, shielding and other protective measures are taken, the negative influence of the devices can be considerably reduced. These protective measures include control cabinet grounding module grounding, cable shield grounding, protective circuits on electromechanical switching elements, and correct use of cables (choosing the proper cable cross section and type)

Grounding has essentially two different functions:

- Protective grounding
- Dissipation of electromagnetic disturbances

The grounding measures depend on whether the module is mounted directly to the back wall of the switching cabinet or on the mounting rail.

3.5.1 Directly to the back wall of the switching cabinet

The housing should be conductively connected (screwed in) to the back wall of the switching cabinet using the four mounting holes.

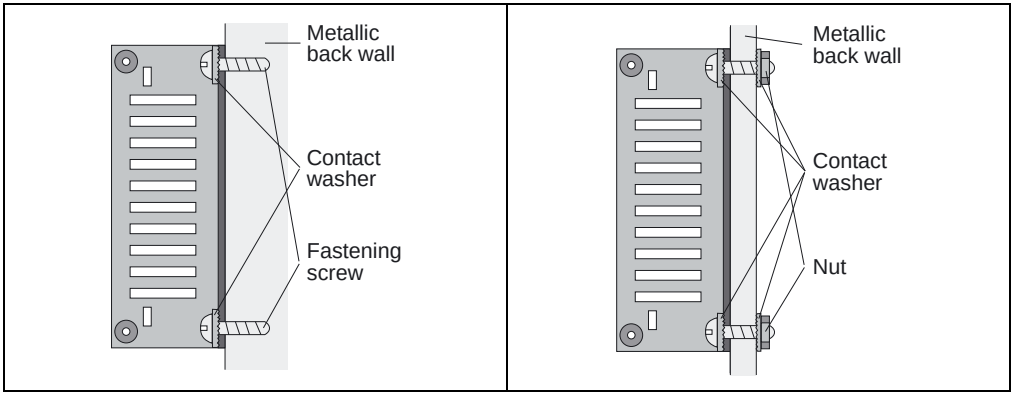


Figure 11: Compact I/O modules - ground connection when mounting to the control cabinet back wall

For lacquered or coated back walls, an adequate connection is only guaranteed if the screw has been threaded into the back wall. If this is not the case, a contact washer must be must be placed between the fastening nut and the back wall.

3.5.2 On a mounting rail

The grounding connection for the module should be connected to the back wall with as short a connection as possible. If this connection is not possible, a protective conductor terminal block should be used directly in the connection beside the module. The module should be connected to this terminal block using a blade connector.

The mounting rail must be grounded or should have a good conductive connection to the metal back wall.

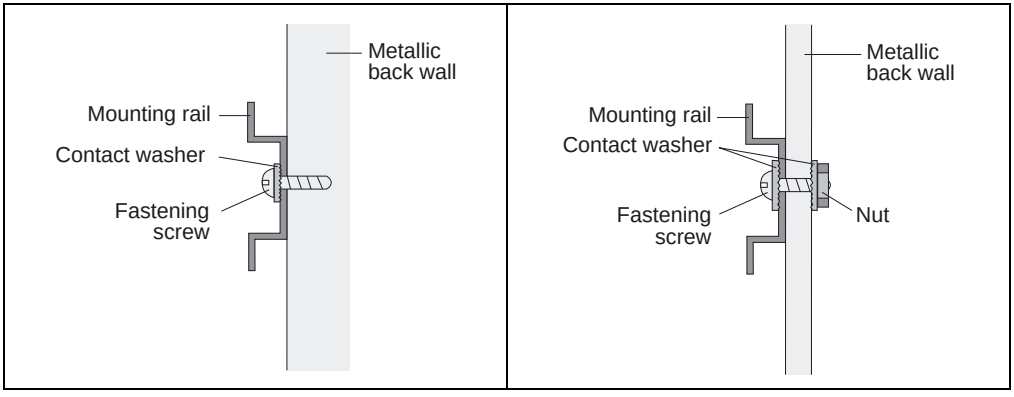


Figure 12: Compact I/O modules - ground connection when mounting to the mounting rail

The same rules apply for lacquered or coated back walls as apply when grounding directly to the back wall of the switching cabinet.

Warning!

The switching cabinet back wall must be connected with GND

4. I/O modules with CAN interface

4.1 7CX408.50-1

4.1.1 Order data

Model number	Short description	Figure
7CX408.50-1	Remote I/O, 24 VDC, 1 CAN interface (electrically isolated, network capable), 16 digital inputs, 24 VDC sink, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement, 12 digital outputs 0.4 A, 4 digital outputs 2 A, 24 VDC, 2 digital outputs with PWM functionality. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 36: 7CX408.50-1 - Order data

4.1.2 Technical data

Product ID	7CX408.50-1
Short description	
Module type	B&R CAN expansion
Digital channels	16 inputs, 16 outputs
Interfaces	1 x CAN I/O slave
Electrical isolation Input - Output CAN - input / output	 No Yes
Supply voltage	24 VDC
Power consumption	1.6 W
Digital inputs	
Rated voltage	24 VDC
Input filter Hardware Software	 ≤2 ms -
Input circuit	Sink
Additional functions	Event counting, incremental encoder operation, gate, frequency and period measurement
Digital outputs	
Rated voltage	24 VDC
Rated output current Output 1 - 12 Output 13 - 16	 0.4 A 2.0 A
Total current	10.0 A
Output circuit	Source
Output protection	Thermal cutoff for over-current or short circuit, integrated protection for switching inductances
Additional functions	Pulse width modulation
Sensor supply	External
Interfaces	
Application interface Fieldbus Design Maximum transfer rate	 CAN I/O slave 12-pin multipoint connector 500 kBit/sec
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function for each channel, status
Diagnostics I/O function CAN interface	 Yes, with LEDs Yes, with status LED

Table 37: 7CX408.50-1 - Technical data

Product ID	7CX408.50-1
Operational conditions	
Operating temperature Horizontal installation Vertical installation	 0 to 55°C 0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	365 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 37: 7CX408.50-1 - Technical data

4.1.3 Additional technical data

Product ID	7CX408.50-1
Digital inputs	
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC
Switching threshold LOW HIGH	 <5 V >15 V
Input current at rated voltage	Approx. 4.2 mA
Event counter operation	
Amount	2
Counter 1/2	Input 1 / 2
Counter size Counter 1 Counter 2	 32-bit (16-bit with active overflow recognition, see "Configuration register" on page 85) 16-bit
Input frequency	Max. 50 kHz
Signal form	Square wave pulse
Evaluation	Positive or negative edge, cyclic counter

Table 38: 7CX408.50-1 - Additional technical data

Product ID	7CX408.50-1
Incremental encoder operation	
Amount	1
Type	ABR or AB
Counter size ABR A/B	 16-bit 32-bit
Input frequency	Max. 20 kHz
Evaluation	4x
Signal form	Square wave pulse
Gate measurement	
Amount	1
Gate measurement on channel 1	Input 1
Counter size	16-bit
Evaluation	Positive or negative edge
Input frequency	Max. 50 kHz
Pulse length	10 µs
Length of pauses between pulses	10 µs
Count frequency Internal External	 4 MHz or 31.25 kHz Max. 50 kHz
Signal form	Square wave pulse
Period measurement	
Amount	1
Measurement on channel 1	Input 1
Counter size	16-bit
Evaluation	Positive or negative edge
Input frequency	Max. 50 kHz
Count frequency Internal External	 4 MHz or 31.25 kHz Max. 50 kHz
Signal form	Square wave pulse

Table 38: 7CX408.50-1 - Additional technical data

Product ID	7CX408.50-1		
Digital outputs			
Channel	1-8	9-12	13-16
Type	Highside driver (source)		
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC		
Switching frequency	Max. 100 Hz	Max. 5 kHz	Max. 100 Hz
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Pulse width modulation			
Period duration Resolution	1 ms - 1 s 1 ms	1 ms - 1 s 1 ms	10 ms - 1 s 1 ms
Pulse length Resolution	0.0% - 100.0% 0.1%	0.0% - 100.0% 0.1%	0.0% - 100.0% 0.1%
Interfaces			
Application interface Fieldbus Design Maximum baud rate Bus length 60 m Bus length 200 m Bus length 1000 m Distance	 CAN I/O slave 12-pin multipoint connector 500 kBit/s 500 kBit/sec 250 kBit/sec 50 kBit/sec Max. 1000 m		
Status indicators			
Status LED	Yes, color and blink code		
I/O Select LED	**Green**: LEDs 01-16 indicate the status of the **inputs** **Yellow**: LEDs 01-16 indicate the status of the **outputs**		
01 - 16 LEDs	Status of the inputs/outputs (green/yellow)		
Control elements			
I/O Select button	Selects whether the I/O-LEDs represent the inputs or outputs		
Number switch	Sets the node number and baud rate		
Power supply			
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC		
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.		
Power consumption	Max. 1.6 W		
General information			
B&R ID code	$4296		

Table 38: 7CX408.50-1 - Additional technical data

4.1.4 Diagnostic LEDs

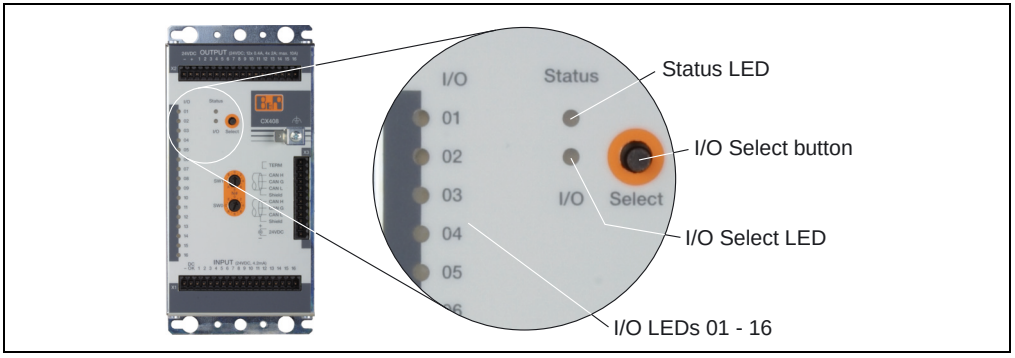


Figure 13: 7CX408.50-1 - Diagnostic and status LEDs

Status LEDs

Color	Meaning
Red - lit	Reset (Hold)
Green - blinking	Boot phase (initialization and connection to the CAN network). If an error occurs during this phase, the green LED stops blinking. The error is indicated by periodic blinking of the red LED. A hardware reset (switch off/on) is necessary. The amount of pulses periodically output provides information about the cause of the error: • 1 red pulse: Node switch set to 0 and configuration EEPROM is invalid. • 2 red pulses: Error initializing the CAN unit
Green - blinking with double pulse	The controller indicates when time monitoring responds and updates the digital and analog outputs. If a CAN object does not appear within the defined time (default: 640 ms), the effected outputs are reset and the green LED begins to blink (double pulse). After the first valid object arrives, the current values are accepted immediately. The green LED only returns to normal operation after a time delay of 30 s. This time delay is used to identify intermittent problems with the outputs. These problems are otherwise very difficult to detect.
Green - lit	Normal operation: data is being exchanged
Orange - lit	Faulty outputs. However, the CAN bus controller is still in network operation.
Orange - blinking	Outputs not being supplied or the sensor supply is not being monitored.
Red - blinking	Warning: The node number was changed during operation. The new node number is ignored and the function of the node remains the same.

Table 39: 7CX408.50-1 - Status LEDs

I/O Select LED

2 color LEDs 01-16 are provided for displaying the status of the inputs and outputs. The display is switched using the "I/O Select" button. The status is indicated by the I/O LED:

Color	Meaning
Green	The I/O LEDs 01-16 indicate the status of the inputs.
Red	The I/O LEDs 01-16 indicate the status of the outputs.

Table 40: 7CX408.50-1 - I/O LED

I/O 01-16, if I/O Select LED green

Color	Meaning
Green	The corresponding input = 1.
Off	The corresponding input = 0.

Table 41: 7CX408.50-1 - LEDs 01-16 (green)

I/O LEDs 01-16, if I/O Select LED yellow

Color	Meaning
Yellow	The corresponding output = 1.
Off	The corresponding output = 0.
Blinking, approximately 10 Hz	The corresponding output is operating in PWM mode.

Table 42: 7CX408.50-1 - LEDs 01-16 (green)

4.1.5 Digital inputs

Terminal block connections

Inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.). The supply voltage for the digital inputs can be monitored with the application program.

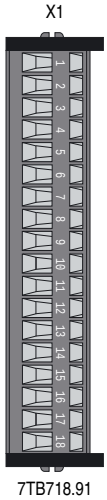
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	GND[1)]
	2	+ 24 VDC sensor supply monitor
	3	Digital input 1 / counter 1 / A
	4	Digital input 2 / counter 2 / B
	5	Digital input 3 / ext. CLK / R
	6	Digital input 4
	7	Digital input 5
	8	Digital input 6
	9	Digital input 7
	10	Digital input 8
	11	Digital input 9
	12	Digital input 10
	13	Digital input 11
	14	Digital input 12
	15	Digital input 13
	16	Digital input 14
	17	Digital input 15
	18	Digital input 16

Table 43: 7CX408.50-1 - Pin assignments X1 / digital inputs

1) Same potential as the housing

Connection examples

Sink connection

If the inputs on the CX408 are operated with three line connection, the TB736 terminal block is used as additional jumper terminal.

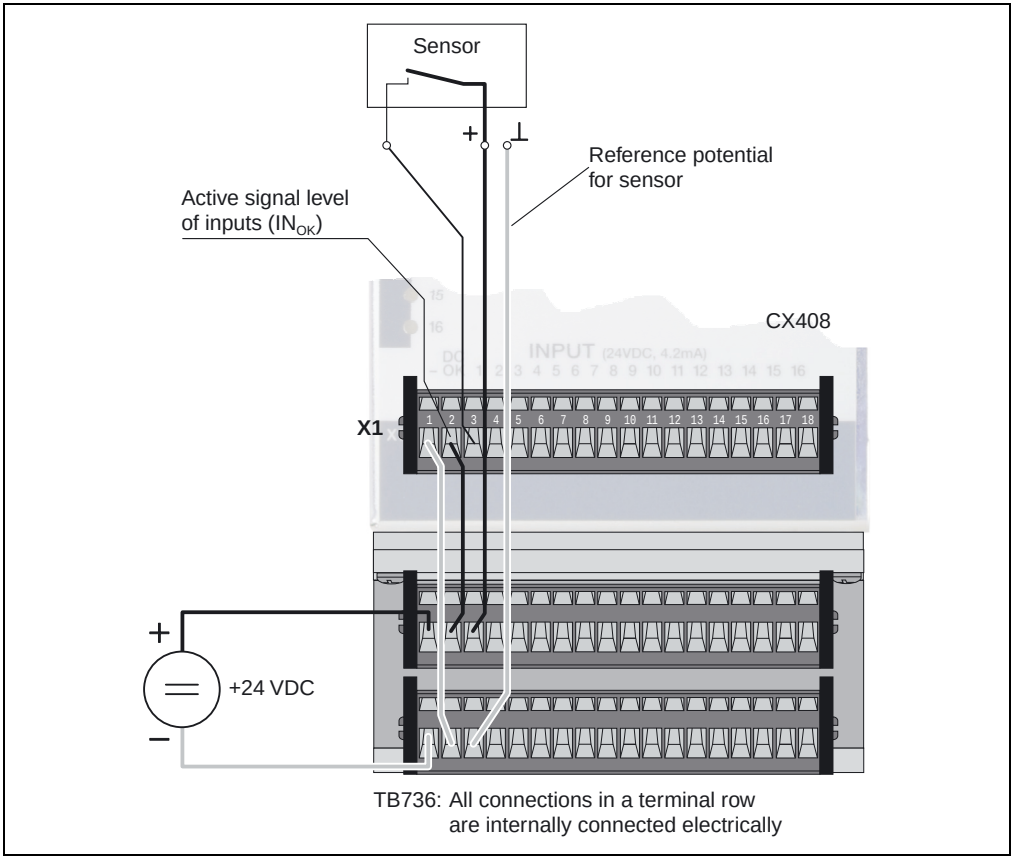


Figure 14: 7CX408.50-1 - Connection example / digital input (sink connection)

Counter inputs

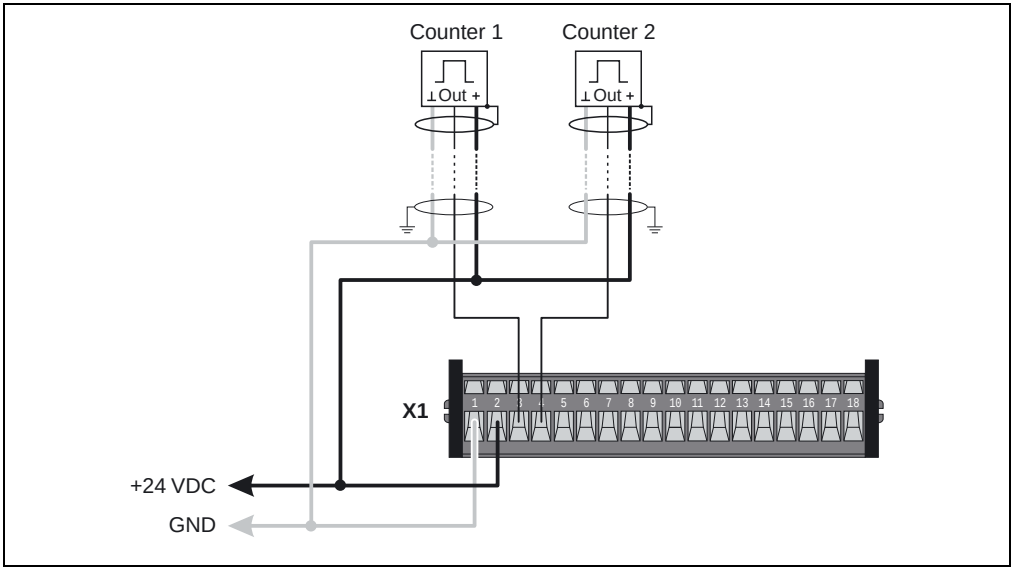


Figure 15: 7CX408.50-1 - Connection example / counter input

Period or gate measurement

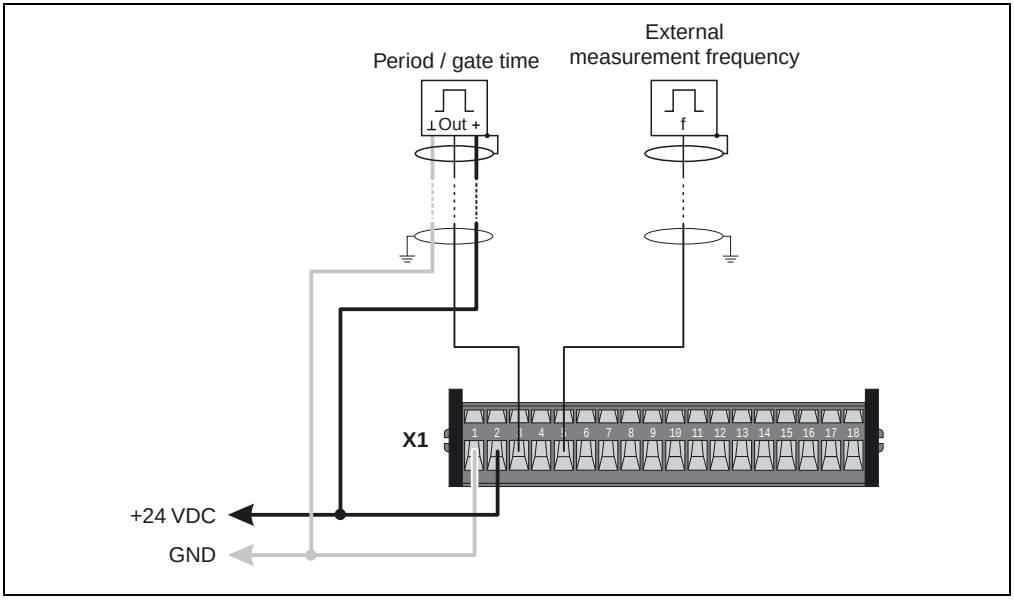


Figure 16: 7CX408.50-1 - Connection example / period and gate measurement

Incremental encoder

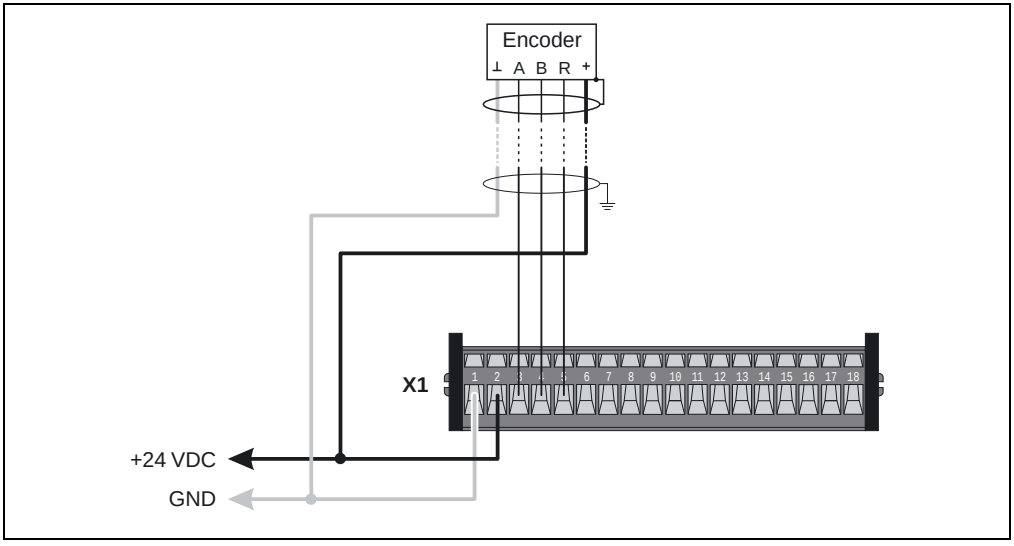


Figure 17: 7CX408.50-1 - Connection example / incremental encoder

Input circuit diagram

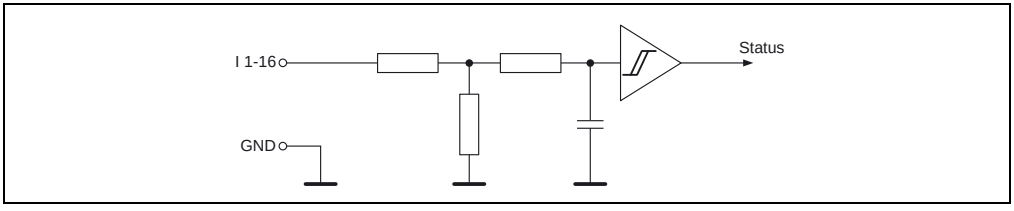


Figure 18: 7CX408.50-1 - Input circuit diagram / digital inputs

4.1.6 Digital outputs

Terminal block connections

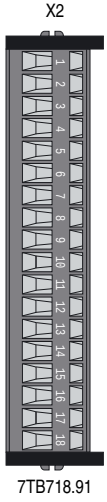
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	GND[1)]
	2	+ 24 VDC sensor supply monitor
	3	Digital output 1
	4	Digital output 2
	5	Digital output 3
	6	Digital output 4
	7	Digital output 5
	8	Digital output 6
	9	Digital output 7
	10	Digital output 8
	11	Digital output 9 / PWM 1
	12	Digital output 10 / PWM 2
	13	Digital output 11
	14	Digital output 12
	15	Digital output 13
	16	Digital output 14
	17	Digital output 15 / PWM 1
	18	Digital output 16 / PWM 2

Table 44: 7CX408.50-1 - Pin assignment - X2 / digital outputs

1) Same potential as the housing

Connection example

If the outputs on the CX408 are operated with three line connection, the TB736 terminal block is used as additional jumper terminal.

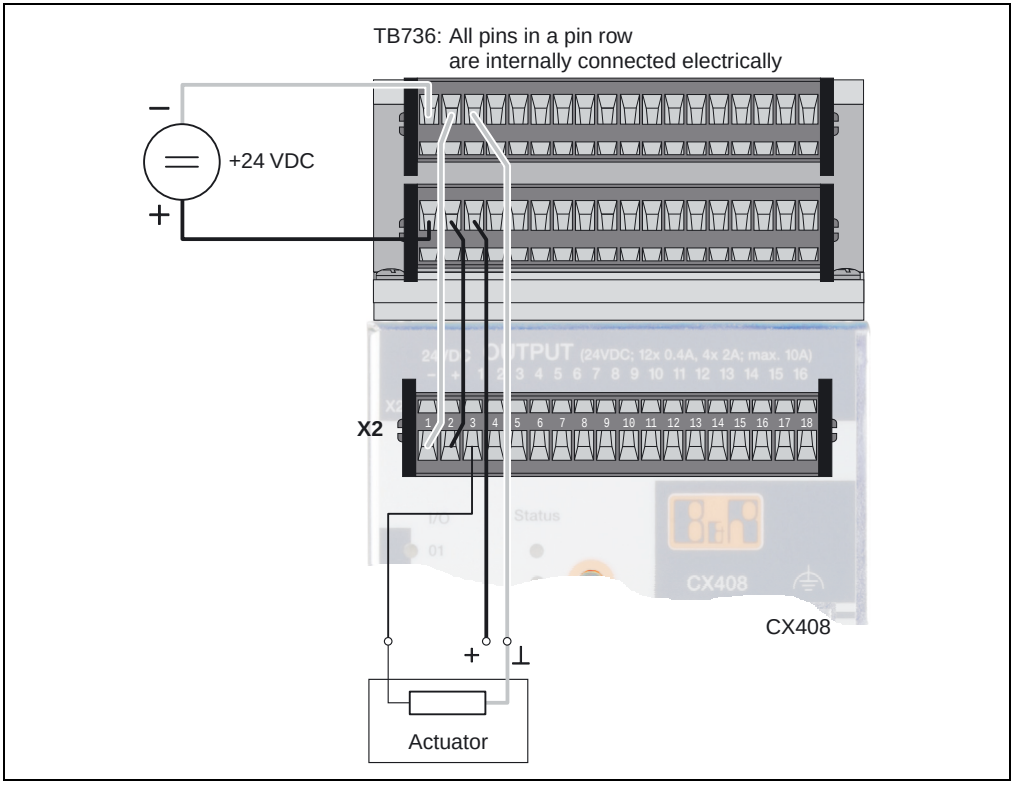


Figure 19: 7CX408.50-1 - Connection example / digital outputs

Output circuit diagram

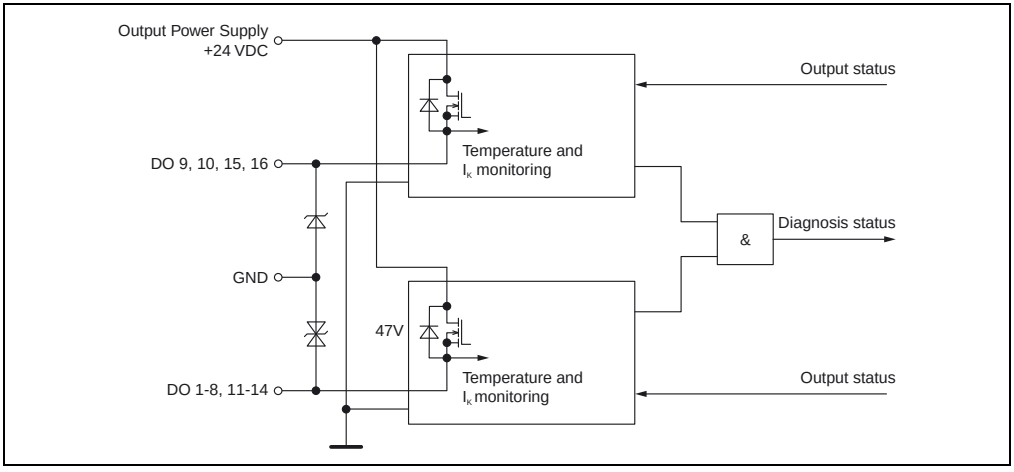


Figure 20: 7CX408.50-1 - Output circuit diagram / digital outputs

Because of the inverse diodes required for PWM-capable digital outputs 9, 10, 15 and 16, reverse polarity protection of the output supply is not guaranteed for these outputs!

Switching inductive loads

Digital outputs 1 to 8

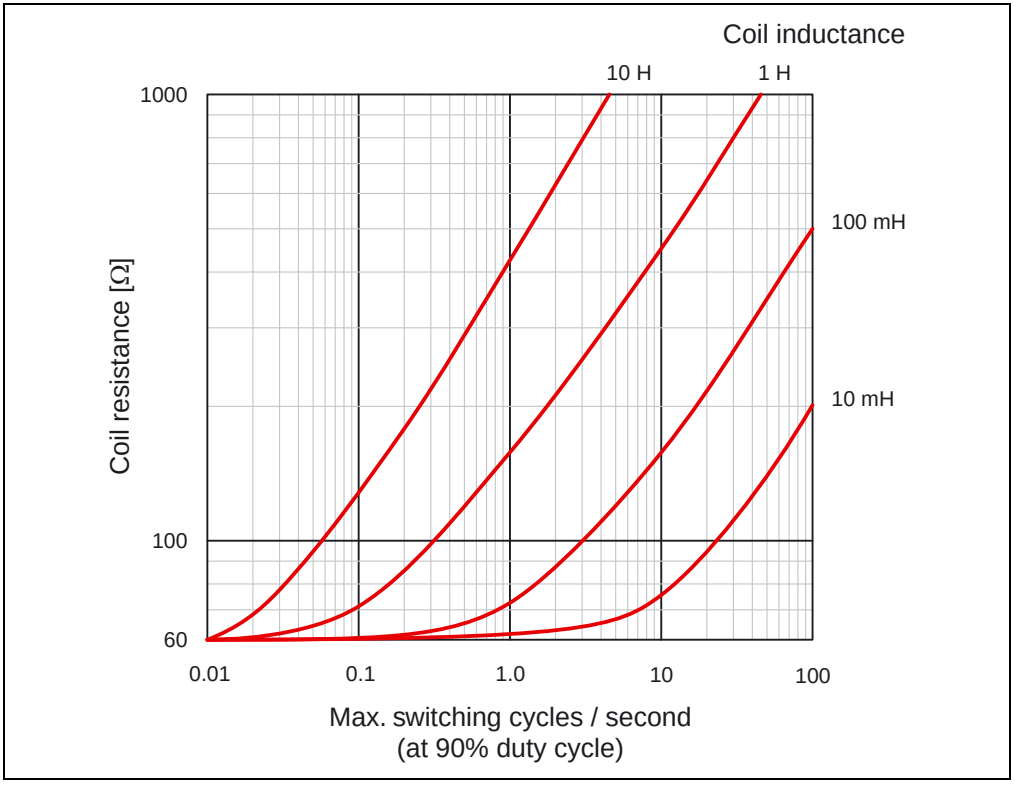


Figure 21: 7CX408.50-1 - Switching inductive loads / Digital outputs 1 to 8

Digital outputs 9 to 12

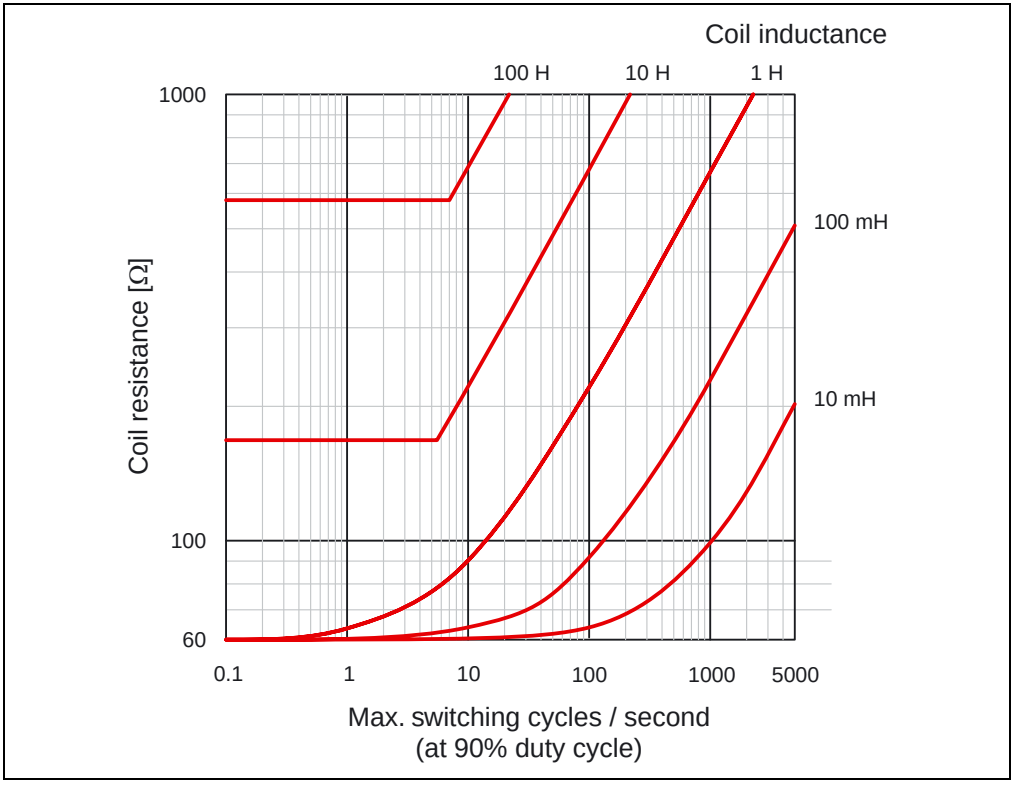


Figure 22: 7CX408.50-1 - Switching inductive loads / Digital outputs 9 to 12

Digital outputs 13 to 16

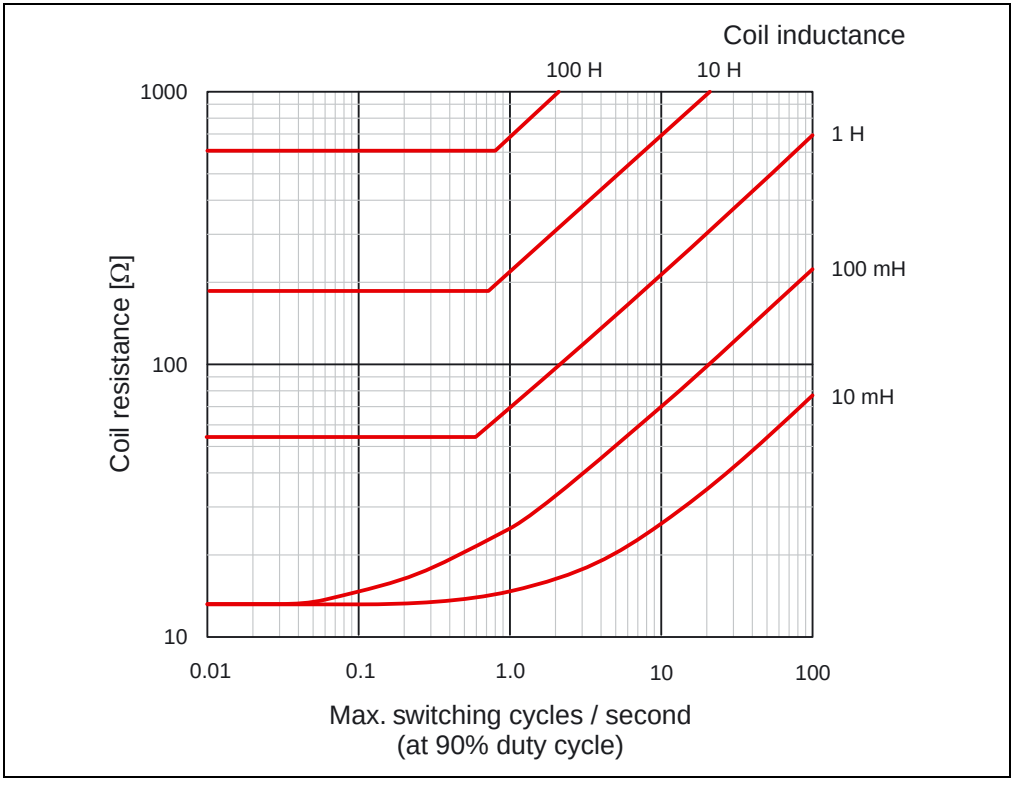


Figure 23: 7CX408.50-1 - Switching inductive loads / Digital outputs 13 to 16

4.1.7 CAN and module supply

The voltage supply and the CAN interface connections are made using a 12-pin terminal block. The reference potential is internally connected with all plugs.

The electrically isolated CAN interface is available twice on the plug. The individual CAN connections are linked with each other which allows a node to be easily connected to a CAN network.

The bus controller is equipped with a bus termination resistor. To activate it, a jumper must be placed between pin 1 and pin 2.

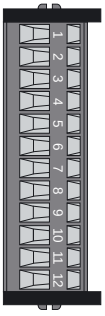
18-pin terminal block	Terminal	Assignment
X3  7TB712.91	1	Bridge for CAN terminating resistor
	2	
	3	CAN high
	4	CAN GND
	5	CAN low
	6	Shield [1]
	7	CAN high
	8	CAN GND
	9	CAN low
	10	Shield [1]
	11	+24 VDC module supply
	12	GND[1]

Table 45: 7CX408.50-1 - Pin assignments X3 / CAN and module supply

1) Same potential as the housing

Connection example with continued CAN bus connection

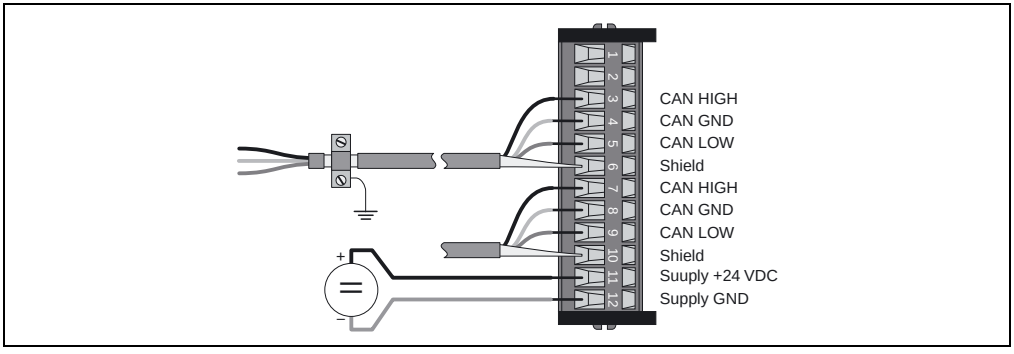


Figure 24: 7CX408.50-1 - Connection example with continued CAN bus connection

Connection example with activated bus termination resistor

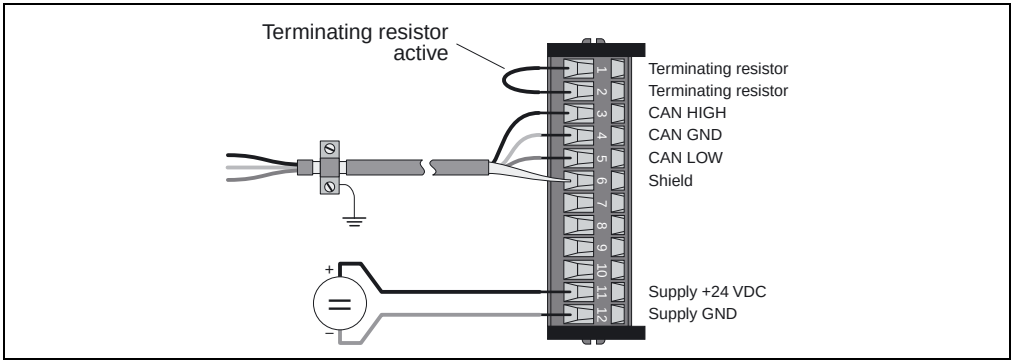


Figure 25: 7CX408.50-1 - Connection example with activated bus termination resistor

4.1.8 Monitoring

Circuit diagram for the module supply

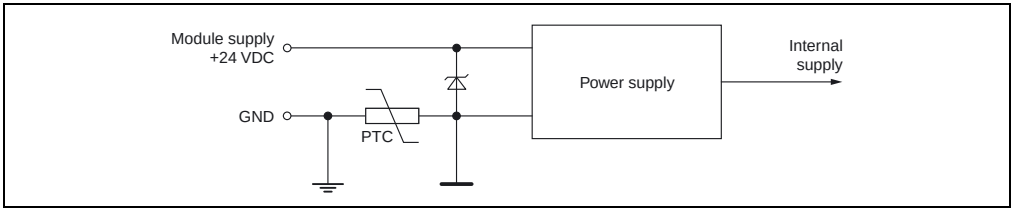


Figure 26: 7CX408.50-1 - Circuit diagram for the module supply

Sensor supply monitor

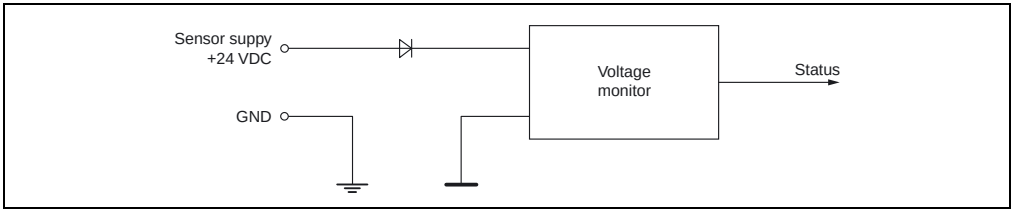


Figure 27: 7CX408.50-1 - Sensor supply monitor

Circuit diagram for the supply of the digital outputs

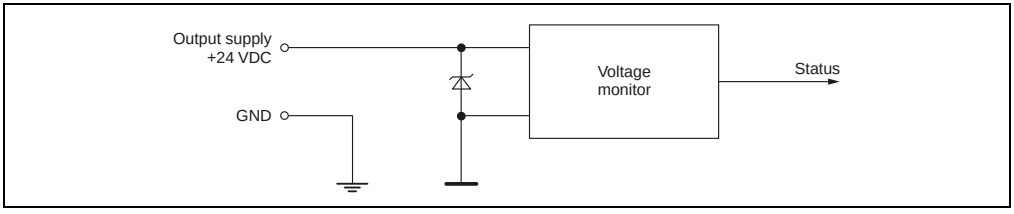


Figure 28: 7CX408.50-1 - Circuit diagram for the supply of the digital outputs

Current monitoring for the 2A outputs

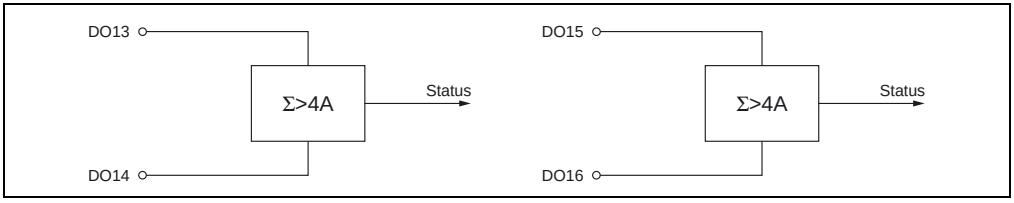


Figure 29: 7CX408.50-1 - Current monitoring for the 2A outputs

4.1.9 Node numbers, baud rate

After booting, the CAN bus controller goes into "Listen Only" Mode. That means the controller behaves passively on the bus and only listens:

	Baud rate	
↓	1000 kBaud	The controller tries to receive valid objects during the "Listen Only" mode. If errors occur during receiving, the controller switches to the next baud rate from the search table. If no objects are received, all baud rates are tested cyclically. This procedure is repeated until valid objects are received. The controller tests the baud rate according to this table. Beginning with the starting baud rate, the controller switches to the next lower baud rate. At the end of the table, the controller starts searching from the beginning again.
	500 kBaud	
	250 kBaud	
	125 kBaud	
	50 kBaud	
	20 kBaud	
	10 kBaud	

Table 46: 7CX408.50-1 - Search table - baud rate in the "Listen Only" mode

Node numbers and the starting baud rate are configured using both CAN bus controller number switches.

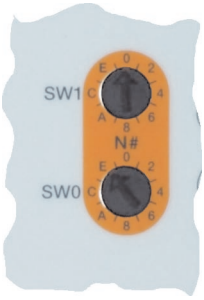
Node number switches	SW1	SW0	Node number	Start baud rate [kBit/s]
	0	0	From S-EEPROM	From S-EEPROM
	0	1...F	1...15	250
	1	0...F	16...31	250
	2	0...F	32...47	250
	3	0...F	48...64	250
	4	0	From S-EEPROM	From S-EEPROM
	4	1...F	1...15	125
	5	0...F	16...31	125
	6	0...F	32...47	125
	7	0...F	48...64	125
	8	0	From S-EEPROM	From S-EEPROM
	8	1...F	1...15	20
	9	0...F	16...31	20
	A	0...F	32...47	20
	B	0...F	48...64	20
	C	0	From S-EEPROM	From S-EEPROM
	C	1...F	1...15	500
	D	0...F	16...31	500
	E	0...F	32...47	500
	F	0...F	48...64	500

Table 47: 7CX408.50-1 - Setting for the node number and start baud rate

4.1.10 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	Counter01	UINT	1	●	●		
0	PWMPeriod	UINT	1			●	●
1	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
1	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
2	DigitalInput09 - DigitalInput16	BOOL	1	●	●		
2	DigitalOutput09 - DigitalOutput16	BOOL	1			●	●
2	Counter02	UINT	1	●	●		
2	PulsWidth01	UINT	1			●	●
4	Counter03	UINT	1	●	●		
4	PulsWidth02	UINT	1			●	●
6	StatusInput01	UINT	1	●	●		
96	StatusOutput01	UINT	1			●	●
96	StatusInput02	UINT	1	●	●		

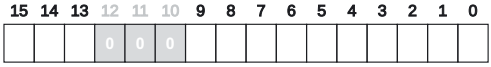
Table 48: 7CX408.50-1 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput16	Reads the digital inputs 1 - 16
DigitalOutput01 - DigitalOutput16	Sets the digital outputs 1 - 16
Counter01	Counter 1 (Counter01 = LowWord, Counter02 = HighWord)
Counter02	
Counter03	Counter 2
PWMPeriod	Period for pulse width modulation (1-1000 ms)
PulsWidth01	Pulse width for digital outputs 9 and 15 (in 0.1% steps, valid values: 0-1000).
PulsWidth02	Pulse width for digital outputs 10 and 16 (in 0.1% steps, valid values: 0-1000).
StatusInput01	Reads back the digital outputs 1 - 16
StatusInput02	Status register: The user can use this register to call up various status information.
StatusOutput01	Configuration register: General configuration of the individual counter/encoder inputs.

Table 49: 7CX408.50-1 - Register description

Configuration register



Bit	Description
0	0 ... All digital inputs are read 1 ... Counter inputs (1-3) are not read as digital inputs[1)]
1	0 ... R disabled (in AB(R) mode, see bit 4 and 5) 1 ... R enabled (in AB(R) mode)
2	0 ... Period measurement 1 ... Gate measurement
3	0 ... Measurement starts at increasing edge 1 ... Measurement starts at decreasing edge
4 - 5	00 ... No counter operation 01 ... AB(R) counter 10 ... Event counter 11 ... Period or gate measurement
6 - 7	Counter frequency: 00 ... 4 Mhz 01 ... External (input 3) 10 ... 32.25 kHz 11 ... Not allowed
8	Reads back the digital outputs (DA_Readback) 0 ... Disabled 1 ... Enabled
9	Overflow recognition 0 ... Disabled (reset counter overflow bit in configuration register) 1 ... Enabled (value of the counter is limited to $7FFF when overflow)[2)]
10 - 12	Reserve (set to 0)
13	PWM function for digital outputs: 0 ... 9 and 10 1 ... 15 and 16
14	PWM function 0 ... Off 1 ... On
15	0 ... Time/counter reset 1 ... Enable time/counter (set this bit to 1 after counter has been configured)

Table 50: 7CX408.50-1 - Configuration register

1) Only valid when counter operation is active (configuration word bit 4-5). If the R input (input 3) is disabled (configuration word bit 1) then the inputs 1 and 2 are not read, and otherwise also input 3.

2) Starting with Revision B9

Status registers



Bit	Description
0 - 8	Reserve (must be 0)
9	0 ... Period or gate measurement within the counter range 0 - $7FFF (only valid if bit 9 is set in the configuration register)[1)] 1 ... Counter overflow during period or gate measurement, acknowledge by resetting bit 9 of the configuration word
10 - 11	Reserve (must be 0)
12	Input voltage monitor: 0 ... DC OK is ok 1 ... DC OK error
13	Total current monitor of the digital outputs 13 and 14: 0 ... < 4 A 1 ... > 4 A
14	Total current monitor of the digital outputs 15 and 16: 0 ... < 4 A 1 ... > 4 A
15	Output voltage monitor: 0 ... 24 VDC is ok 1 ... 24 VDC error

Table 51: 7CX408.50-1 - Status register

1) Starting with Revision B9

Reads back the digital outputs (DA_Readback)

The readback function is switched off by default. The configuration register must be set in order to use this function.

Pulse width modulation settings

The period (*PWMPeriod*) can be set between 1 and 1000 ms. The decimal value 1000 corresponds to a period of 1 sec.

The pulse width (*PulsWidth01* and *PulsWidth02*) can be set in 0.1% steps between 0% and 100%. The decimal value 1000 corresponds to a pulse width of 100%.

Counter settings

The configuration register must be set in order to set the correct counter modes. The counter 1 (LW/HW) and counter 2 registers have different meanings for different modes.

Unnecessary CAN bus load can be prevented by setting bit 0 in the configuration register because the status of the inputs is automatically sent when an input changes with the default setting.

Incremental encoder operation

If the reference input (digital input 3) in the configuration register is enabled, then the module is a 16-bit ABR counter whose actual value is located in counter 1 (only LW) and the stored R-value in counter 2 (functions as latch).

If the reference input is disabled, then it is a 32-bit AB incremental encoder counter input which should be read with counter 1 (LW and HW).

Assignment of the digital inputs 1-3:

- A = input 1
- B = input 2
- R = input 3

Event counter operation

If the counters are initialized as event counters in the configuration register, we get a 32-bit counter (counter 1 LW+HW) and a 16-bit counter (counter 2):

- Input 1 = counter 1
- Input 2 = counter 2

Period measurement

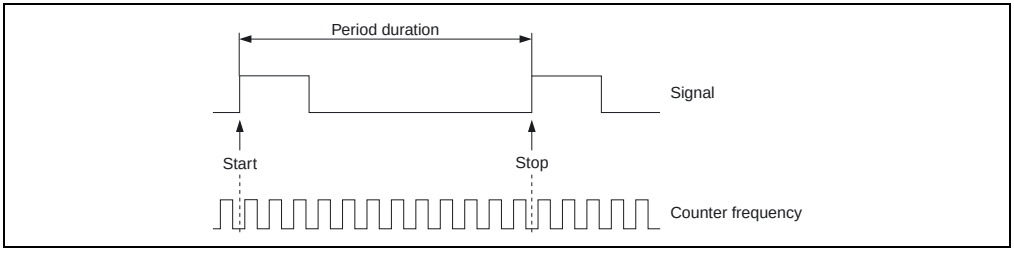


Figure 30: 7CX408.50-1 - Period measurement

The measurement can be begin at the decreasing or increasing edge depending on the configuration register. The R enable bit must be 0. Measurement always occurs up to the next identical edge. The pauses between two period measurements must last for at least 2 periods of the counter frequency. The counter frequency can be set to one of two levels (4 MHz or 31.25 kHz) or with an external frequency. The external frequency must however be < 50 kHz. The measured counter state is a 16-bit value and is displayed in counter 1 (only LW). The value in the temporary register is only updated at the end of the active measurement.

The frequency of the signal to be measured can be a maximum of 50 kHz.

Assignment of the digital inputs:

- Input 1 = measurement input
- Input 2 = external counter frequency

A potential overflow of the continuous counter during the period measurement (e.g. due to an incorrect counter frequency), can be detected by setting bit 9 in the configuration register. However, the maximum value of counter is limited to $7FFF as a result. The error bit in the status register is acknowledged by resetting bit 9 of the configuration register.

Gate measurement

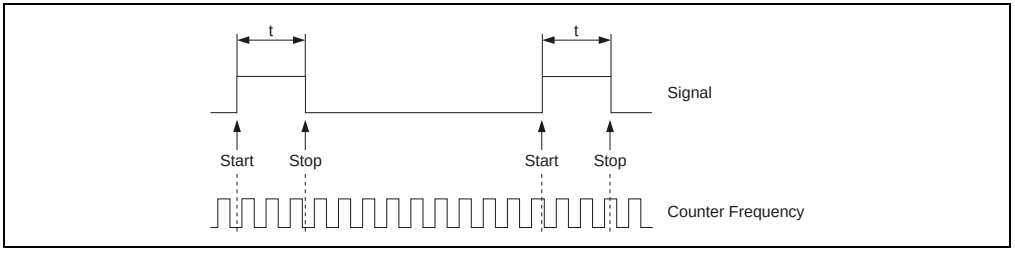


Figure 31: 7CX408.50-1 - Gate measurement

The measurement can be begin at the decreasing or increasing edge depending on the configuration register. The R enable bit must be 0. Measurement always occurs up to the next edge. The pauses between two gate measurements must last for at least 2 periods of the counter frequency. The counter frequency can be set in two steps (4MHz or 31.25 kHz) or with an external frequency. The external frequency must however be < 50 kHz. The measured counter state is a 16-bit value and is displayed in counter 1 (only LW). The value in the temporary register is only updated at the end of the active measurement.

The frequency of the signal to be measured can be a maximum of 25 kHz.

Assignment of the digital inputs:

- Input 1 = measurement input
- Input 2 = external counter frequency

A potential overflow of the continuous counter during the gate measurement (e.g. due to an incorrect counter frequency), can be detected by setting bit 9 in the configuration word. However, the maximum value of counter is limited to $7FFF as a result. The error bit in the status word is acknowledged by resetting bit 9 of the configuration word.

4.1.11 Access using CAN identifiers

Access via CAN identifiers is used if the slave is being controlled by a device from another manufacturer.

Access via CAN identifiers is described in the B&R SYSTEM 2003 User's Manual in an example in Chapter 4 "Module Addressing".

The module with the node number 1 is discussed in the examples listed below.

Digital inputs

CAN ID packed

All 16 digital inputs are read in packed mode.

CAN ID[1)]	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
286	0	DI 1-8	DI 9-16	0	0	0	0	0

Table 52: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID packed)

1) CAN ID = 286 + (nn - 1) x 4
(nn .... Node number of the CAN slave = 1)

CAN ID Unpacked

The digital inputs are read using 2 identifiers in unpacked mode.

Module #	CAN ID[1)]	Byte
1	286	Not used
2	287	Digital inputs 1-8 (DI 1-8)
3	288	Digital inputs 9-16 (DI 9-16)
4	289	Not used

Table 53: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID unpacked)

1) CAN ID = 286 + (nn - 1) x 4
(nn .... Node number of the CAN slave = 1)

Digital outputs

CAN ID packed

All 16 digital outputs are transferred in packed mode.

CAN ID[1)]	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
414	0	DO 1-8	DO 9-16	0	0	0	0	0

Table 54: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID packed)

1) CAN ID = 414 + (nn - 1) x 4
(nn .... Node number of the CAN slave = 1)

CAN ID Unpacked

The digital outputs are transferred using 2 identifiers in unpacked mode.

Module #	CAN ID[1)]	Byte
1	414	Not used
2	415	Digital outputs 1-8 (DO 1-8)
3	416	Digital outputs 9-16 (DO 9-16)
4	417	Not used

Table 55: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID unpacked)

1) CAN ID = 414 + (nn - 1) x 4
(nn .... Node number of the CAN slave = 1)

Status and counter inputs

Counter input data cannot be packed. Only the first object from this group of four for counter inputs will be created and sent. The first word of the last object is intended for status information.

If the "DA_Readback" bit in the configuration register is set, then the last data word is equal to the actual status of the digital outputs.

Three operating modes are available to the digital inputs.

- Incremental encoder operation
- Event counter operation
- Period or gate measurement operation

The assignment for the counter states depends on the operating mode being used.

Further information can be found in the section: 4.1.10 "Register description" on page 84

Slot	CAN ID[1)]	Word 1		Word 2		Word 3		Word 4
1	542	Counter 1 LL	Counter 1 ML	Counter 1 MH	Counter 1 HH	Counter 2 LB	Counter 2 HB	0 or DA_Readback
2	543	Not used						
3	544	Not used						
4	545	Status LB	Status HB	Not used				

Table 56: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID unpacked)

1) CAN ID = 542 + (nn - 1) x 16
(nn .... Node number of the CAN slave = 1)

Configuration of the PWM outputs

PWM data cannot be packed. Only the first object from this group of four for PWM outputs will be created. The first word of the last object is intended for the configuration.

The PWM function can be switched to the outputs A9, A10 or A15, A16.

Further information can be found in the section: 4.1.10 "Register description" on page 84

Slot	CAN ID[1)]	Word 1	Word 2	Word 3	Word 4
1	1054	Period duration in ms	Pulse width 1 in 1/10%	Pulse width 2 in 1/10%	Not used
2	1055	Not used			
3	1056	Not used			
4	1057	Configuration register	Not used		

Table 57: 7CX408.50-1 - Access via CAN-ID - digital inputs (CAN-ID unpacked)

1) CAN ID = 1054 + (nn - 1) x 16
(nn .... Node number of the CAN slave = 1)

4.2 7CX436.50-1

4.2.1 Order data

Model number	Short description	Figure
7CX436.50-1	Remote I/O, 24 VDC, 1 CAN interface (electrically isolated, network capable), 8 digital inputs, 24 VDC sink, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement, 4 digital outputs 0.4 A, 4 digital outputs 2 A, 24 VDC, 2 digital outputs with PWM functionality, 4 analog inputs, ±10 V, 12-bit + sign, two of the analog inputs can be used as KTY10 or PT1000 input, 4 analog outputs ±10 V, 12-bit. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 58: 7CX436.50-1 - Order data

4.2.2 Technical data

Product ID	7CX436.50-1
Short description	
Module type	B&R CAN expansion
Digital channels	8 inputs, 8 outputs
Analog channels	4 inputs (2 of these can be configured for temperature and resistance measurement), 4 outputs
Interfaces	1 x CAN I/O slave
Electrical isolation Digital - Analog Digital - Digital Analog - Analog CAN - Digital/Analog	 Yes No No Yes
Supply voltage	24 VDC
Power consumption	5 W
Digital inputs	
Rated voltage	24 VDC
Input filter Hardware Software	 ≤2 ms -
Input circuit	Sink
Additional functions	Event counting, incremental encoder operation, gate, frequency and period measurement
Digital outputs	
Rated voltage	24 VDC
Rated output current Output 1 - 4 Output 5 - 8	 0.4 A 2.0 A
Total current	9.6 A
Output circuit	Source
Output protection	Thermal cutoff for over-current or short circuit, integrated protection for switching inductances
Additional functions	Pulse width modulation
Sensor supply	External
Analog inputs	
Input	±10 V
Digital converter resolution	12-bit + sign
Conversion time	≤5 ms for all channels
Output format	INT
Input impedance in signal range	20 MΩ
Basic accuracy	±0.071% at 25°C, based on the current measurement value
Input protection	Protection against wiring with supply voltage

Table 59: 7CX436.50-1 - Technical data

Product ID	7CX436.50-1
temperature measurement	
Measuring procedure	Resistance measurement with constant current feed for 2 wires
Digital converter resolution	12-bit
Conversion time	≤5 ms for all channels
Output format	INT
Basic accuracy	±0.35% at 25°C, based on the current measurement value
Sensors KTY10-6 PT1000	Can be configured for each channel using software -50 to +125°C -200 to +850°C
Resistance measurement range	0 to 4000 Ω
Input protection	Protection against wiring with supply voltage
resistance measurement	
Measuring procedure	Resistance measurement with constant current feed for 2 wires
Input	0 - 4000 Ω
Digital converter resolution	12-bit
Conversion time	≤5 ms for all channels
Output format	INT
Basic accuracy	±0.35% at 25°C, based on the current measurement value
Input protection	Protection against wiring with supply voltage
Analog outputs	
Output	±10 V
Digital converter resolution	12-bit
Data format	INT
Conversion time	≤5 ms for all channels
Power on/off behavior	Internal enable relay for boot procedure and errors
Basic accuracy	±0.088% at 25°C, based on the current measurement value
Input protection	Protection against wiring with supply voltage, short-circuit protection
Interfaces	
Application interface Fieldbus Design Maximum transfer rate	 CAN I/O slave 12-pin multipoint connector 500 kBit/sec
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function for each channel, status
Diagnostics I/O function CAN interface	 Yes, with LEDs Yes, with status LED

Table 59: 7CX436.50-1 - Technical data

Product ID	7CX436.50-1
Operational conditions	
Operating temperature	0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-20 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	410 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 59: 7CX436.50-1 - Technical data

4.2.3 Additional technical data

Product ID	7CX436.50-1
Digital inputs	
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC
Switching threshold LOW HIGH	 <5 V >15 V
Input current at rated voltage	Approx. 4.2 mA
Event counter operation	
Amount	2
Counter 1/2	Input 1 / 2
Counter size Counter 1 Counter 2	 32-bit (16-bit with active overflow recognition, see "Configuration Register 1" on page 118) 16-bit
Input frequency	Max. 50 kHz
Signal form	Square wave pulse
Evaluation	Positive or negative edge, cyclic counter

Table 60: 7CX436.50-1 - Additional technical data

Product ID	7CX436.50-1
Incremental encoder operation	
Amount	1
Type	ABR or AB
Counter size ABR A/B	 16-bit 32-bit
Input frequency	Max. 20 kHz
Evaluation	4x
Signal form	Square wave pulse
Gate measurement	
Amount	1
Gate measurement on channel 1	Input 1
Counter size	16-bit
Evaluation	Positive or negative edge
Input frequency	Max. 50 kHz
Pulse length	10 µs
Length of pauses between pulses	10 µs
Count frequency Internal External	 4 MHz or 31.25 kHz Max. 50 kHz
Signal form	Square wave pulse
Period measurement	
Amount	1
Measurement on channel 1	Input 1
Counter size	16-bit
Evaluation	Positive or negative edge
Input frequency	Max. 50 kHz
Count frequency Internal External	 4 MHz or 31.25 kHz Max. 50 kHz
Signal form	Square wave pulse

Table 60: 7CX436.50-1 - Additional technical data

Product ID	7CX436.50-1	
Digital outputs		
Channel	1-4	5-8
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 5 kHz	Max. 100 Hz
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Pulse width modulation		
Period duration Resolution	1 ms - 1 s 1 ms	10 ms - 1 s 1 ms
Pulse length Resolution	0.0% - 100.0% 0.1%	0.0% - 100.0% 0.1%
Analog inputs		
Value range +10 V 0 V -10 V	 $7FFF $000 $8001	
Input filter Limit frequency Attenuation	 225 Hz 60 dB	
temperature measurement		
Measuring current	1 mA	
Conversion of measurement values to temperature values	Automatic in the module	
Resolution in°C KTY10-6 PT1000	 0.075°C 0.3°C	
resistance measurement		
Measuring current	1 mA	
Analog outputs		
Value range / output signal +10 V 0 V -10 V	 $7FFF $000 $8001	
Maximum load per output	±10 mA (load ≥1 kΩ)	
Interfaces		
Application interface Fieldbus Design Maximum baud rate Bus length 60 m Bus length 200 m Bus length 1000 m Distance	 CAN I/O slave 12-pin multipoint connector 500 kBit/s 500 kBit/sec 250 kBit/sec 50 kBit/sec Max. 1000 m	

Table 60: 7CX436.50-1 - Additional technical data

Product ID	7CX436.50-1
Status indicators	
Status LEDs	Yes, color and blink code
DI - LEDs	Green, for displaying the input states
DO - LEDs	Yellow, for displaying the outputs states
Control elements	
Number switch	Sets the node number and baud rate
Power supply	
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.
General information	
B&R ID code	$4747

Table 60: 7CX436.50-1 - Additional technical data

4.2.4 Diagnostic LEDs

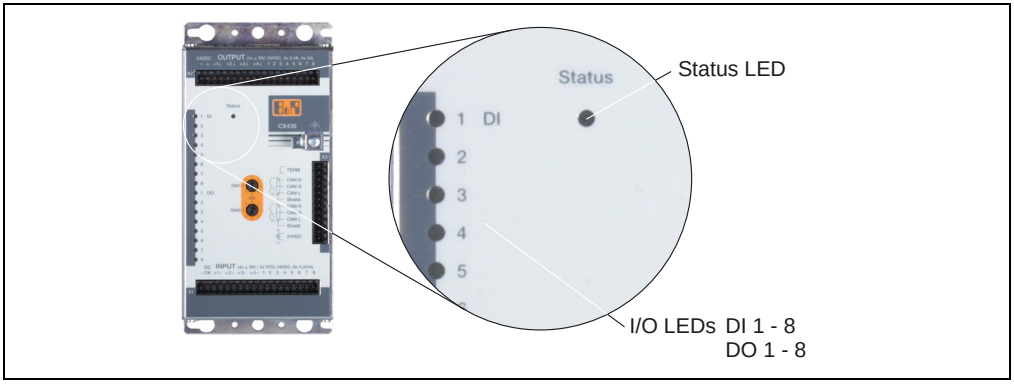


Figure 32: 7CX436.50-1 - Diagnostic and status LEDs

Status LEDs

Color	Meaning
Red - lit	Reset (Hold)
Green - blinking	Boot phase (initialization and connection to the CAN network). If an error occurs during this phase, the green LED stops blinking. The error is indicated by periodic blinking of the red LED. A hardware reset (switch off/on) is necessary. The amount of pulses periodically output provides information about the cause of the error: • 1 red pulse: Node switch set to 0 and configuration EEPROM is invalid. • 2 red pulses: Error initializing the CAN unit
Green - blinking with double pulse	The controller indicates when time monitoring responds and updates the digital and analog outputs. If a CAN object does not appear within the defined time (default: 640 ms), the effected outputs are reset and the green LED begins to blink (double pulse). After the first valid object arrives, the current values are accepted immediately. The green LED only returns to normal operation after a time delay of 30 s. This time delay is used to identify intermittent problems with the outputs. These problems are otherwise very difficult to detect.
Green - lit	Normal operation: data is being exchanged
Orange - lit	Faulty outputs. However, the CAN bus controller is still in network operation.
Orange - blinking	Outputs not being supplied or the sensor supply is not being monitored.
Red - blinking	Warning: The node number was changed during operation. The new node number is ignored and the function of the node remains the same.

Table 61: 7CX436.50-1 - Status LEDs

I/O LEDs DI 1-8

Color	Meaning
Green	The corresponding input = 1.
Off	The corresponding input = 0.

Table 62: 7CX436.50-1 - LEDs 1-8 (green)

I/O LEDs DO 1-8

Color	Meaning
Yellow	The corresponding output = 1.
Off	The corresponding output = 0.
Blinking, approximately 10 Hz	The corresponding output is operating in PWM mode.

Table 63: 7CX436.50-1 - LEDs 1-8 (green)

4.2.5 Analog / digital inputs

Terminal block connections

Digital inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.). The supply voltage can be monitored with the application program.

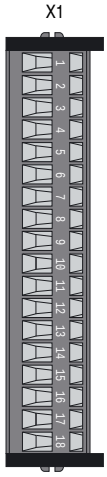
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	GND[1)]
	2	+ 24 VDC sensor supply monitor
	3	Analog input 1 +
	4	Analog input 1 ⊥
	5	Analog input 2 +
	6	Analog input 2 ⊥
	7	Analog input 3 +
	8	Analog input 3 ⊥
	9	Analog input 4 +
	10	Analog input 4 ⊥
	11	Digital input 1 / counter 1 / A
	12	Digital input 2 / counter 2 / B
	13	Digital input 3 / ext. CLK / R
	14	Digital input 4
	15	Digital input 5
	16	Digital input 6
	17	Digital input 7
	18	Digital input 8

Table 64: 7CX436.50-1 - Pin assignments X1 / digital inputs

1) Same potential as the housing

Connection examples

Analog inputs

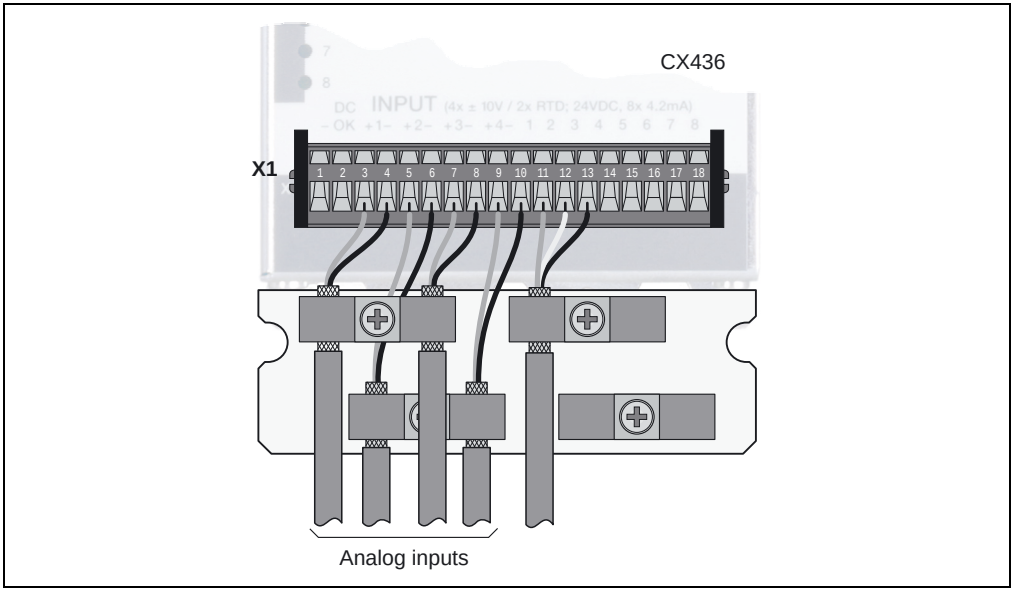


Figure 33: 7CX436.50-1 - Connection example / analog inputs

Digital inputs (sink connection)

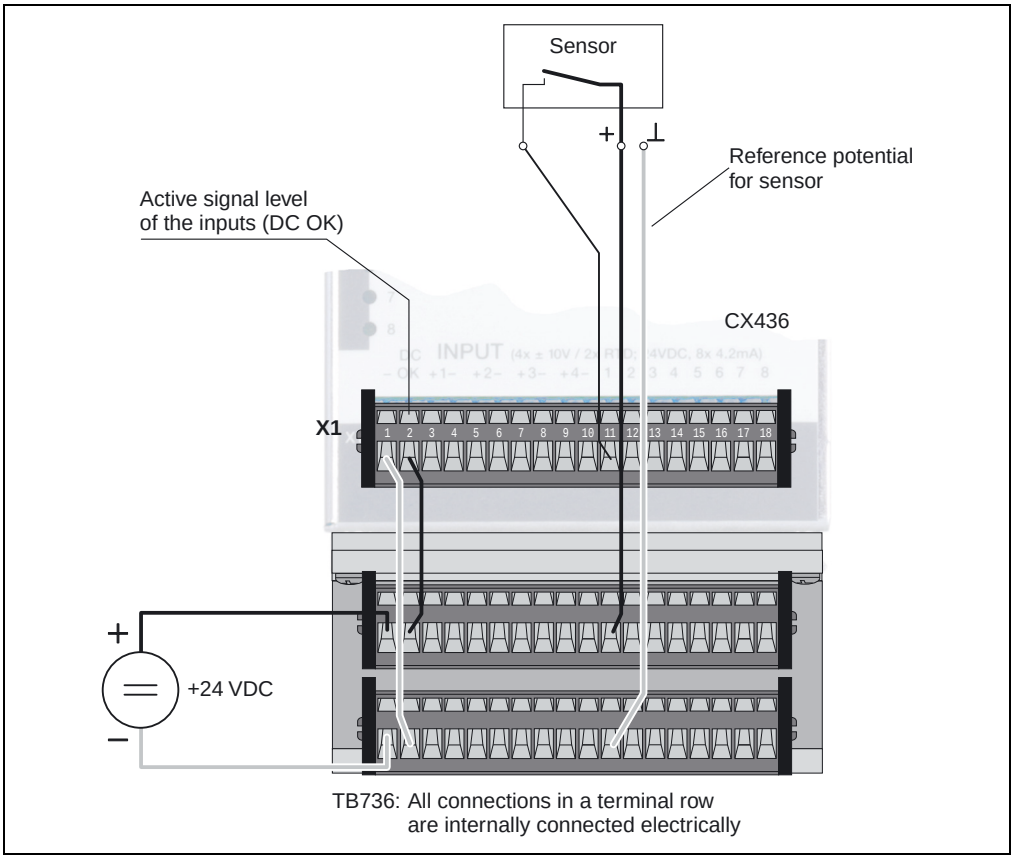


Figure 34: 7CX436.50-1 - Connection example / digital input (sink connection)

Counter inputs

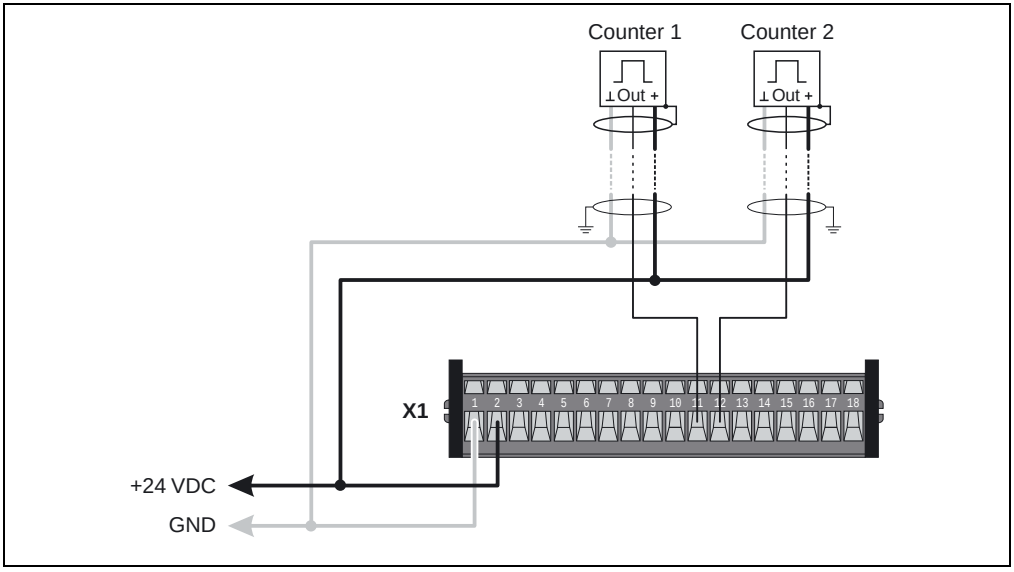


Figure 35: 7CX436.50-1 - Connection example / counter input

Period or gate measurement

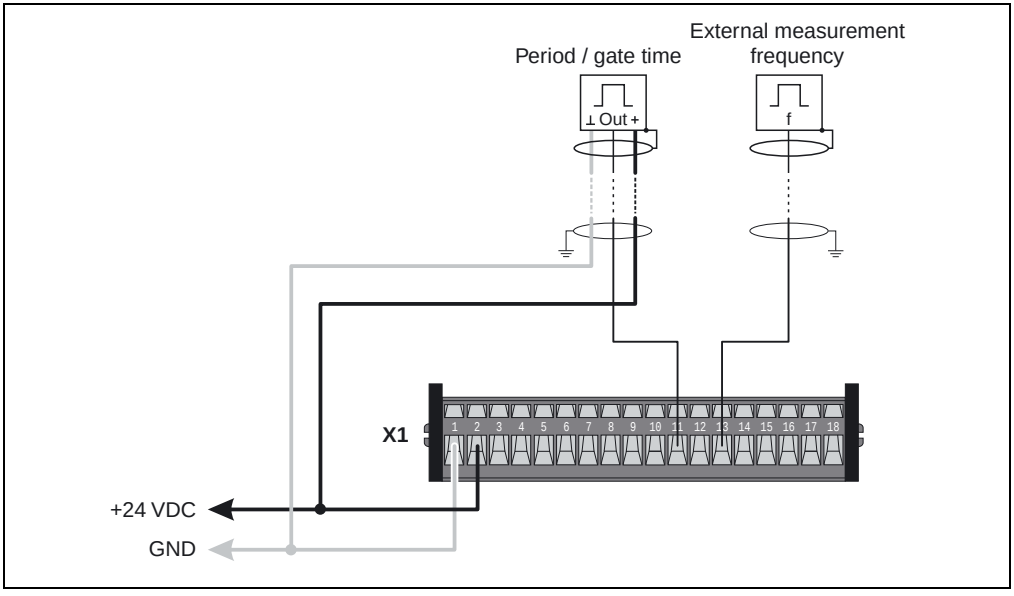


Figure 36: 7CX436.50-1 - Connection example / period and gate measurement

Incremental encoder

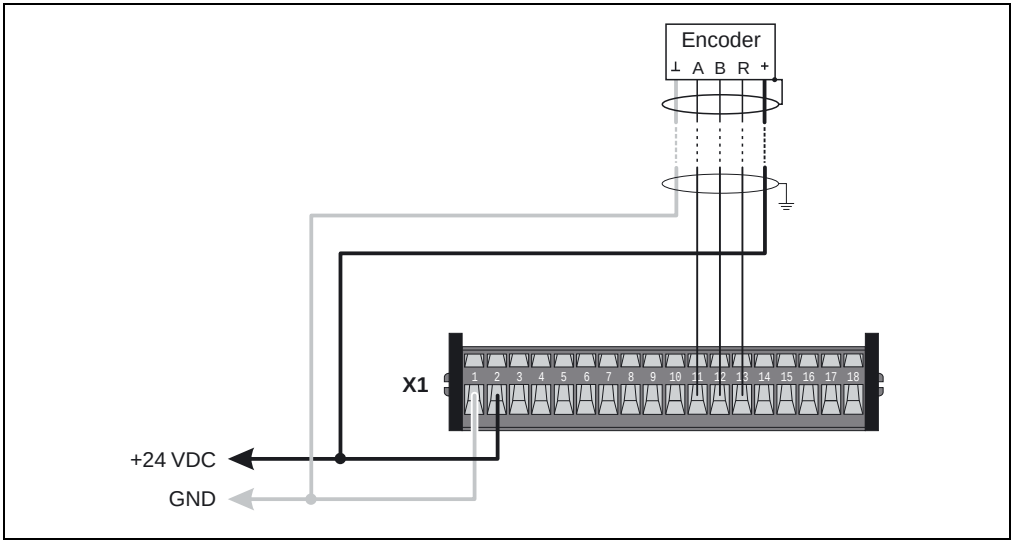


Figure 37: 7CX436.50-1 - Connection example / incremental encoder

Input circuit diagram

Analog inputs (voltage measurement)

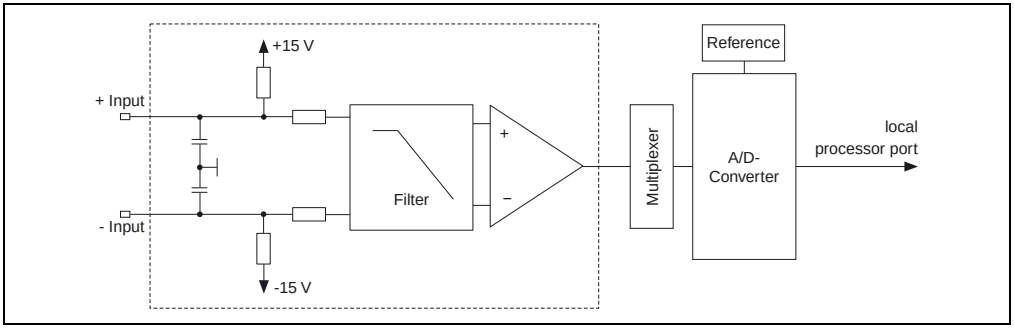


Figure 38: 7CX436.50-1 - Input circuit diagram / analog inputs (voltage measurement)

Analog inputs (temperature, resistance measurement)

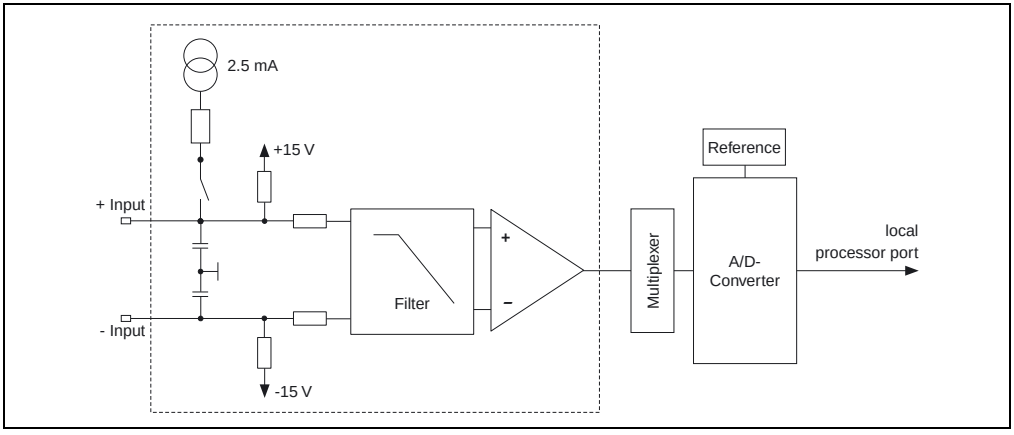


Figure 39: 7CX436.50-1 - Input circuit diagram / analog inputs (temperature measurement)

Digital inputs

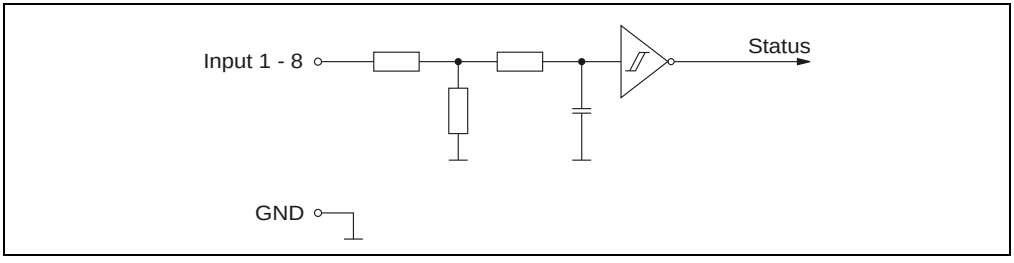


Figure 40: 7CX436.50-1 - Input circuit diagram / digital inputs

4.2.6 Analog / digital outputs

Terminal block connections

The digital outputs 1/7 and 2/8 are equipped with the additional function "pulse width modulation". The supply voltage can be monitored with the application program.

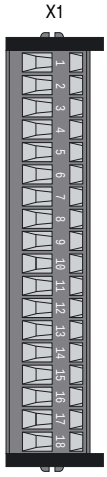
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	GND[1)]
	2	+ 24 VDC sensor supply monitor
	3	Analog output 1 +
	4	Analog output 1 ⊥
	5	Analog output 2 +
	6	Analog output 2 ⊥
	7	Analog output 3 +
	8	Analog output 3 ⊥
	9	Analog output 4 +
	10	Analog output 4 ⊥
	11	Digital output 1 / PWM 1
	12	Digital output 2 / PWM 2
	13	Digital output 3
	14	Digital output 4
	15	Digital output 5
	16	Digital output 6
	17	Digital output 7 / PWM 1
	18	Digital output 8 / PWM 2

Table 65: 7CX436.50-1 - Pin assignment - X2 / analog/digital outputs

1) Same potential as the housing

Connection examples

Analog outputs

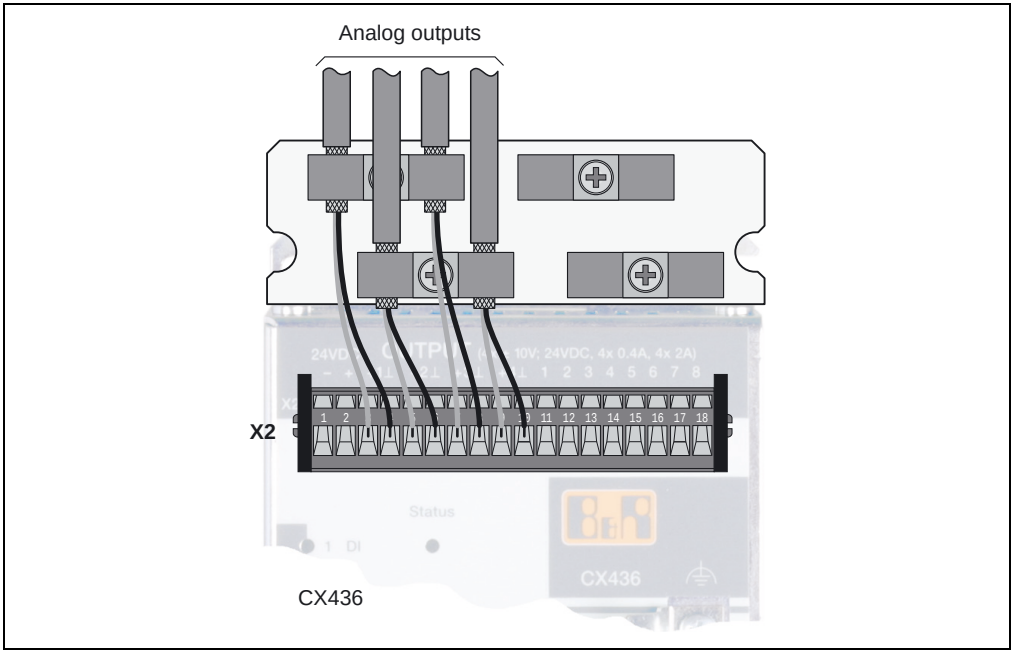


Figure 41: 7CX436.50-1 - Connection example / analog outputs

Digital outputs

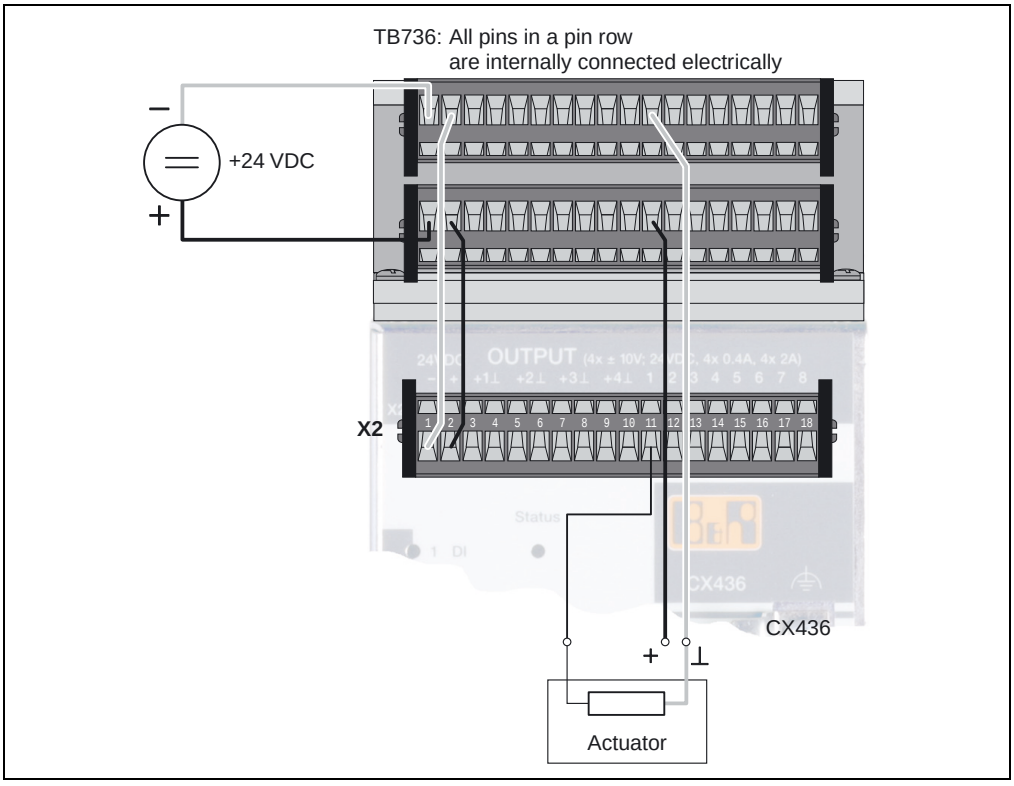


Figure 42: 7CX436.50-1 - Connection example / digital outputs

Output circuit diagram

Analog outputs

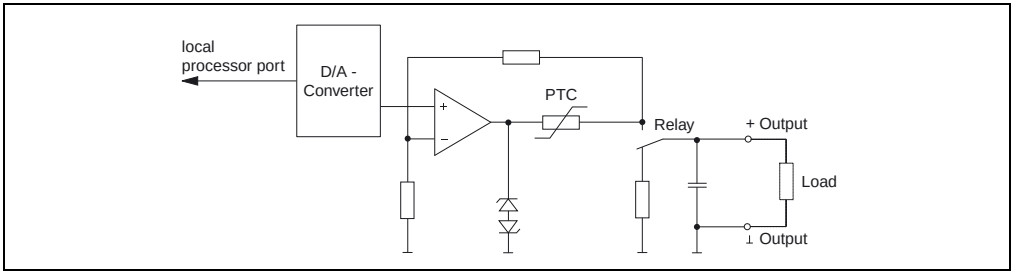


Figure 43: 7CX436.50-1 - Input circuit diagram / analog outputs

Digital outputs

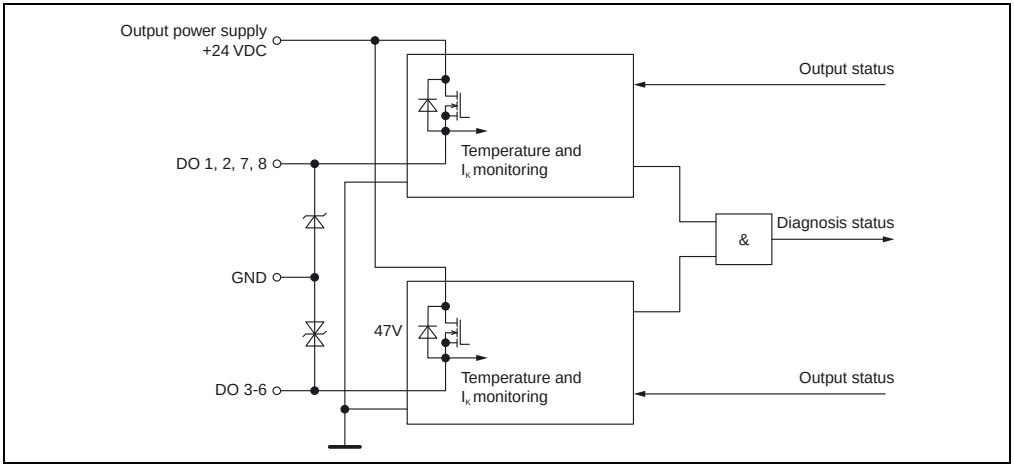


Figure 44: 7CX436.50-1 - Input circuit diagram / digital outputs

Because of the inverse diodes required for PWM-capable digital outputs 1, 2, 7 and 8, reverse polarity protection of the output supply is not guaranteed for these outputs!

Switching inductive loads

Digital outputs 1 to 4

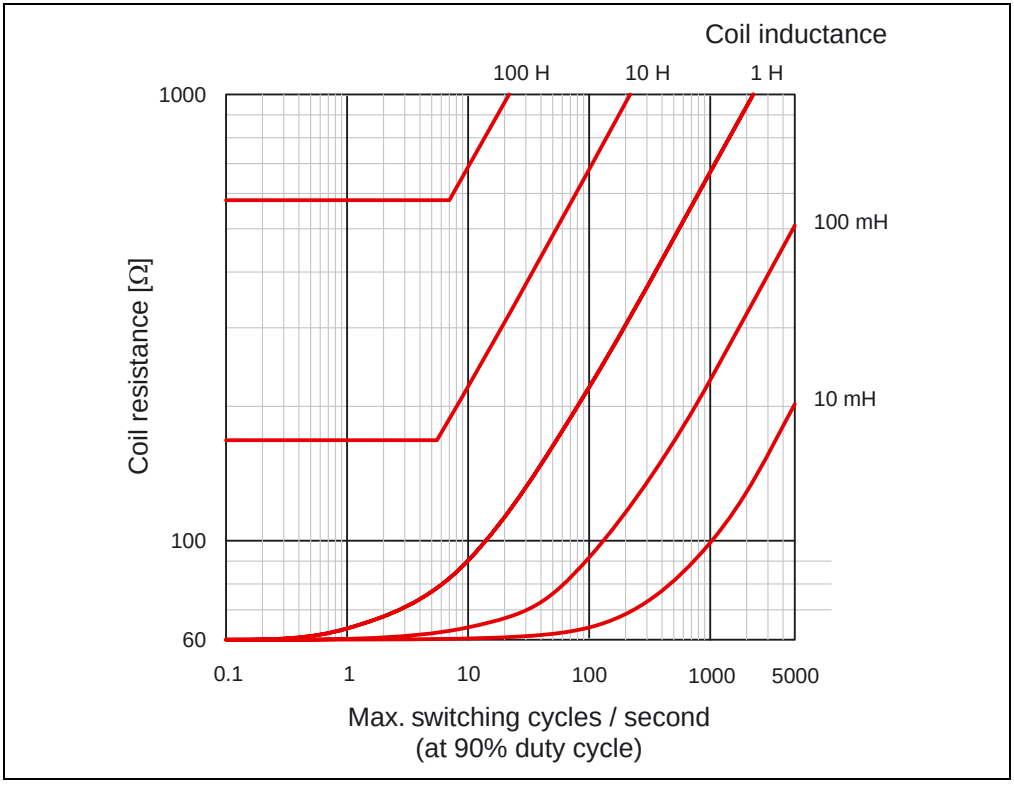


Figure 45: 7CX436.50-1 - Switching inductive loads / Digital outputs 1 to 4

Digital outputs 5 to 8

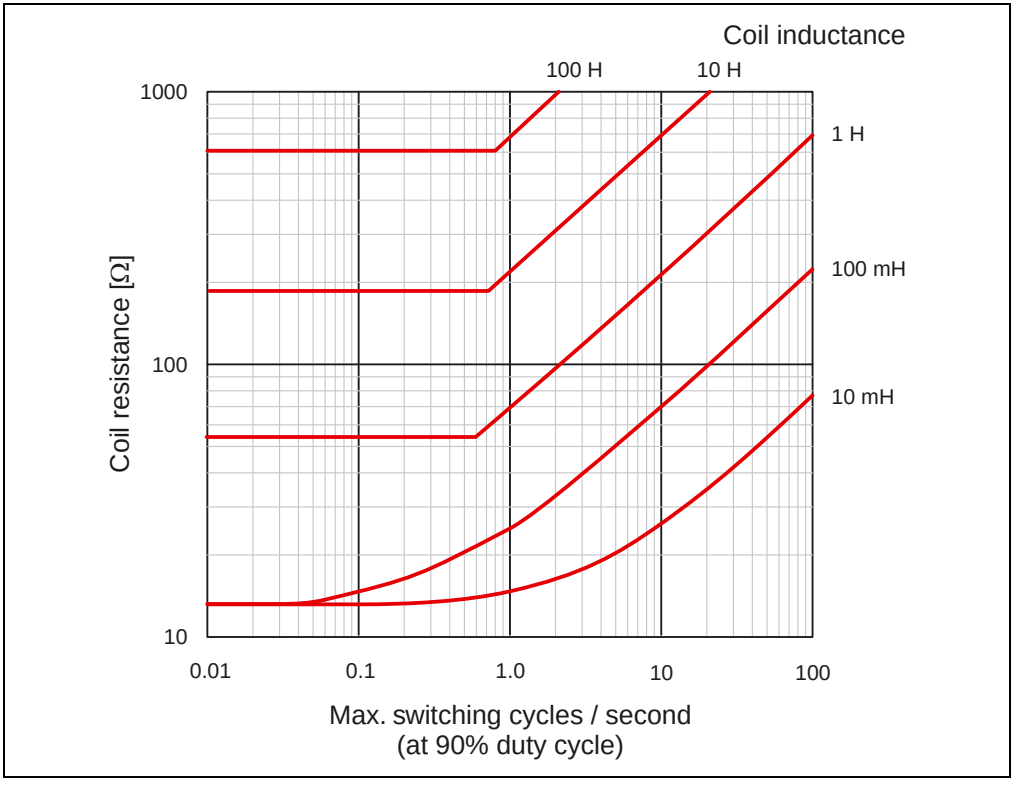


Figure 46: 7CX436.50-1 - Switching inductive loads / Digital outputs 5 to 8

4.2.7 CAN and module supply

The voltage supply and the CAN interface connections are made using a 12-pin terminal block. The reference potential is internally connected with all plugs.

The electrically isolated CAN interface is available twice on the plug. The individual CAN connections are linked with each other which allows a node to be easily connected to a CAN network.

The bus controller is equipped with a bus termination resistor. To activate it, a jumper must be placed between pin 1 and pin 2.

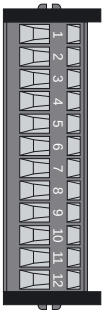
18-pin terminal block	Terminal	Assignment
X3  7TB712.91	1	Bridge for CAN terminating resistor
	2	
	3	CAN high
	4	CAN GND
	5	CAN low
	6	Shield [1]
	7	CAN high
	8	CAN GND
	9	CAN low
	10	Shield [1]
	11	+24 VDC module supply
	12	GND[1]

Table 66: 7CX436.50-1 - Pin assignments X3 / CAN and module supply

1) Same potential as the housing

Connection example with continued CAN bus connection

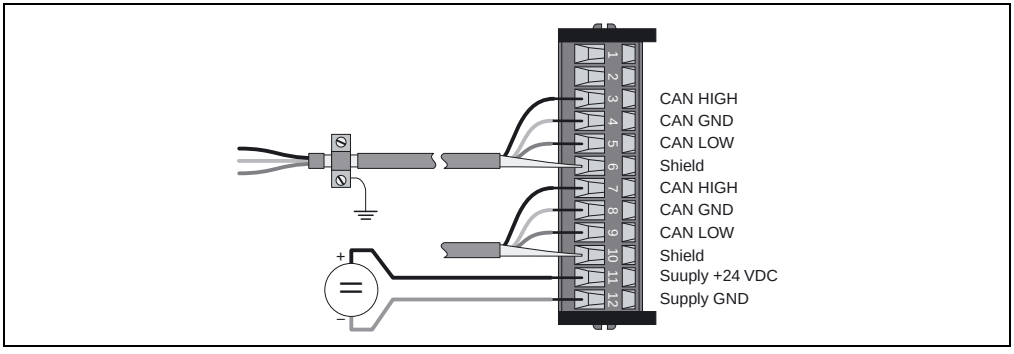


Figure 47: 7CX436.50-1 - Connection example with continued CAN bus connection

Connection example with activated bus termination resistor

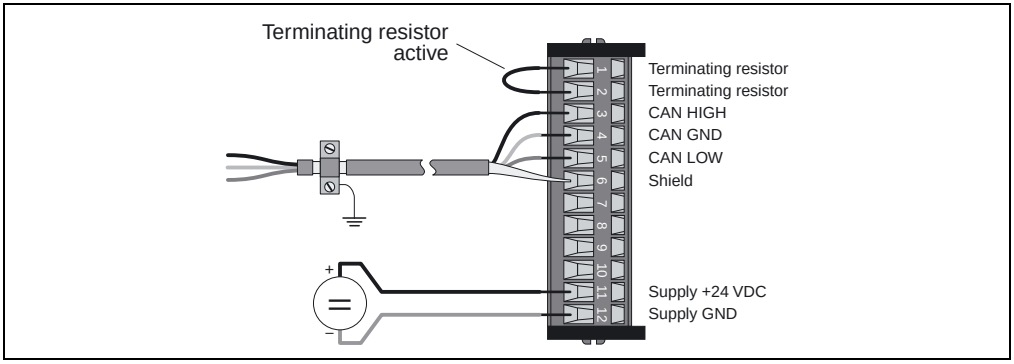


Figure 48: 7CX436.50-1 - Connection example with activated bus termination resistor

4.2.8 Node numbers, baud rate

After booting, the CAN bus controller goes into "Listen Only" Mode. That means the controller behaves passively on the bus and only listens:

	Baud rate	
↓	1000 kBaud	The controller tries to receive valid objects during the "Listen Only" mode. If errors occur during receiving, the controller switches to the next baud rate from the search table. If no objects are received, all baud rates are tested cyclically. This procedure is repeated until valid objects are received. The controller tests the baud rate according to this table. Beginning with the starting baud rate, the controller switches to the next lower baud rate. At the end of the table, the controller starts searching from the beginning again.
	500 kBaud	
	250 kBaud	
	125 kBaud	
	50 kBaud	
	20 kBaud	
	10 kBaud	

Table 67: 7CX436.50-1 - Search table - baud rate in the "Listen Only" mode

Node numbers and the starting baud rate are configured using both CAN bus controller number switches.

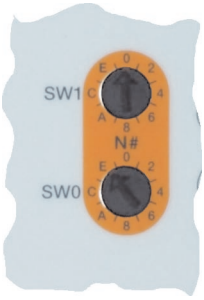
Node number switches	SW1	SW0	Node number	Start baud rate [kBit/s]
	0	0	From S-EEPROM	From S-EEPROM
	0	1...F	1...15	250
	1	0...F	16...31	250
	2	0...F	32...47	250
	3	0...F	48...64	250
	4	0	From S-EEPROM	From S-EEPROM
	4	1...F	1...15	125
	5	0...F	16...31	125
	6	0...F	32...47	125
	7	0...F	48...64	125
	8	0	From S-EEPROM	From S-EEPROM
	8	1...F	1...15	20
	9	0...F	16...31	20
	A	0...F	32...47	20
	B	0...F	48...64	20
	C	0	From S-EEPROM	From S-EEPROM
	C	1...F	1...15	500
	D	0...F	16...31	500
	E	0...F	32...47	500
	F	0...F	48...64	500

Table 68: 7CX436.50-1 - Setting for the node number and start baud rate

4.2.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	Counter01	UINT	1	●	●		
0	PWMPeriod	UINT	1			●	●
1	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
1	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
2	Counter02	UINT	1	●	●		
2	PulsWidth01	UINT	1			●	●
4	Counter03	UINT	1	●	●		
4	PulsWidth02	UINT	1			●	●
6	StatusInput01	UINT	1	●	●		
32 34 36 38	AnalogInput01 AnalogInput02 AnalogInput03 AnalogInput04	INT INT INT INT	1 1 1 1	● ● ● ●	● ● ● ●		
32 34 36 38	AnalogOutput01 AnalogOutput02 AnalogOutput03 AnalogOutput04	INT INT INT INT	1 1 1 1			● ● ● ●	● ● ● ●
96	StatusInput02	UINT	1	●	●		
96	StatusOutput01	UINT	1			●	●
98	StatusInput03	UINT	1	●	●		
98	StatusOutput02	UNIT	1			●	●

Table 69: 7CX436.50-1 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput08	Reads the digital inputs 1 - 8
DigitalOutput01 - DigitalOutput08	Sets the digital outputs 1 - 8
AnalogInput01 - AnalogInput04	Reads the analog inputs 1 - 4
AnalogOutput01 - AnalogOutput04	Writes the analog outputs 1 - 4
Counter01	Counter 1 (Counter01 = LowWord, Counter02 = HighWord)
Counter02	
Counter03	Counter 2
PWMPeriod	Period for pulse width modulation (1-1000 ms)
PulsWidth01	Pulse width for digital outputs 1 and 7 (in 0.1% steps, valid values: 0-1000).
PulsWidth02	Pulse width for digital outputs 2 and 8 (in 0.1% steps, valid values: 0-1000).
StatusInput01	Reads back the digital outputs 1 - 8
StatusInput02, StatusInput03	Status register 1 and 2: The user can use this register to call up various status information.
StatusOutput01, StatusOutput02	Configuration register 1 and 2: General configuration of the individual counter/encoder inputs.

Table 70: 7CX436.50-1 - Register description

Configuration Register 1

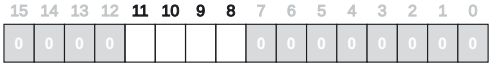


Bit	Description
0	0 ... All digital inputs are read 1 ... Counter inputs (1-3) are not read as digital inputs[1)]
1	0 ... R disabled (in AB(R) mode, see bit 4 and 5) 1 ... R enabled (in AB(R) mode)
2	0 ... Period measurement 1 ... Gate measurement
3	0 ... Measurement starts at increasing edge 1 ... Measurement starts at decreasing edge
4 - 5	00 ... No counter operation 01 ... AB(R) counter 10 ... Event counter 11 ... Period or gate measurement
6 - 7	Counter frequency: 00 ... 4 Mhz 01 ... External (input 3) 10 ... 32.25 kHz 11 ... Not allowed
8	Reads back the digital outputs (DA_Readback) 0 ... Disabled 1 ... Enabled
9	Overflow recognition 0 ... Disabled (reset counter overflow bit in configuration register) 1 ... Enabled (value of the counter is limited to $7FFF when overflow)
10 - 12	Reserve (set to 0)
13	PWM function for digital outputs: 0 ... 1 and 2 1 ... 7 and 8
14	PWM function 0 ... Off 1 ... On
15	0 ... Time/counter reset 1 ... Enable time/counter (set this bit to 1 after counter has been configured)

Table 71: 7CX436.50-1 - Configuration Register 2

1) Only valid when counter operation is active (configuration word bit 4-5). If the R input (input 3) is disabled (configuration word bit 1) then the inputs 1 and 2 are not read, and otherwise also input 3.

Configuration register 2



Bit	Description
0 - 7	Reserve (must be 0)
8 - 9	Selects the type of measurement for analog input 1 00 ... Voltage measurement 01 ... PT1000 10 ... KTY10-6 11 ... Resistance measurement 1-4000 Ω
10 - 11	Selects the type of measurement for analog input 2 00 ... Voltage measurement 01 ... PT1000 10 ... KTY10-6 11 ... Resistance measurement 1-4000 Ω
12 - 15	Reserve (must be 0)

Table 72: 7CX436.50-1 - Configuration Register 2

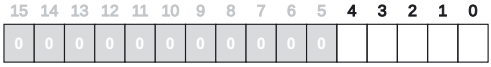
Status register 1



Bit	Description
0 - 8	Reserve (must be 0)
9	0 ... Period or gate measurement within the counter range 0 - $7FFF (only valid if bit 9 is set in the configuration register) 1 ... Counter overflow during period or gate measurement, acknowledge by resetting bit 9 of the configuration word
10 - 11	Reserve (must be 0)
12	Input voltage monitor: 0 ... DC OK is ok 1 ... DC OK error
13	Total current monitor of the digital outputs 5 and 6: 0 ... < 4 A 1 ... > 4 A
14	Total current monitor of the digital outputs 7 and 8: 0 ... < 4 A 1 ... > 4 A
15	Output voltage monitor: 0 ... 24 VDC is ok 1 ... 24 VDC error

Table 73: 7CX436.50-1 - Status register 1

Status register 2



Bit	Description
0	Validity of the analog input data: 0 ... Valid 1 ... Invalid (this is not the case when switching on the supply voltage)
1	Analog input 1 0 ... OK 1 ... Error (wire break, measurement range exceeded or not reached)
2	Analog input 2 0 ... OK 1 ... Error (wire break, measurement range exceeded or not reached)
3	Analog input 3 0 ... OK 1 ... Error (wire break, measurement range exceeded or not reached)
4	Analog input 4 0 ... OK 1 ... Error (wire break, measurement range exceeded or not reached)
5 - 15	Reserve (must be 0)

Table 74: 7CX436.50-1 - Status register 2

5. I/O module with X2X Link

5.1 7XX408.50-1

5.1.1 Order data

Model number	Short description	Figure
7XX408.50-1	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 16 digital inputs, 24 VDC sink/source, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement, 12 digital outputs 0.5 A, 4 digital outputs 2 A, 24 VDC, 2 digital outputs (2A) with PWM functionality. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 75: 7XX408.50-1 - Order data

5.1.2 Technical data

Product ID	7XX408.50-1	
Short description		
Digital channels	16 inputs, 16 outputs	
Interfaces	1x X2X Link slave	
Electrical isolation Input - Output X2X - Input/Output 24 VDC - sensor supply 24 VDC - input 24 VDC - output	 Yes Yes Yes Yes No	
Supply voltage	24 VDC	
Power consumption	Max. 2 W	
Digital inputs		
Channels	1-3	4-16
Rated voltage	24 VDC	24 VDC
Input filter Hardware Software	 ≤4 µs -	 ≤200 µs -
Input circuit	Sink or source	Sink or source
Additional functions	Event counting, incremental encoder operation, gate, frequency and period measurement	-
Digital outputs		
Rated voltage	24 VDC	
Rated output current Output 1 - 12 Output 13 - 16	 0.5 A 2 A	
Total current	10.0 A	
Output circuit	Source	
Output protection	Thermal cutoff for over-current or short circuit, integrated protection for switching inductances	
Additional functions	Pulse width modulation	
Sensor supply	External	
Interfaces		
Application interface Type Design	 X2X Link slave 12-pin multipoint connector	
General information		
Certification	CE, C-UL-US, GOST-R	
Status indicators	I/O function for each channel, status	
Diagnostics I/O function CAN interface	 Yes, with LEDs Yes, with status LED	

Table 76: 7XX408.50-1 - Technical data

Product ID	7XX408.50-1
Operational conditions	
Temperature	0 to 55°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	356 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 76: 7XX408.50-1 - Technical data

5.1.3 Additional technical data

Product ID	7XX408.50-1	
Channels	1-3	4-16
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC	18 VDC / 24 VDC / 30 VDC
Switching threshold LOW HIGH	 <5 V >15 V	 <5 V >15 V
Input current at rated voltage	Approx. 10 mA	Approx. 5 mA
Event counter operation		
Amount	2	
Counter 1/2	Input 1 / 2	
Counter size Counter 1 Counter 2	 32-bit 16-bit	
Input frequency	Max. 100 kHz	
Pulse length / distance between edges	>4 µs	
Signal form	Square wave pulse	
Evaluation	Positive or negative edge, cyclic counter	

Table 77: 7XX408.50-1 - Additional technical data

Product ID	7XX408.50-1
Incremental encoder operation	
Amount	1
Type	ABR or AB
Counter size ABR A/B	 16-bit 32-bit
Input frequency	Max. 30 kHz
Evaluation	4x
Signal form	Square wave pulse
Gate measurement	
Amount	1
Gate measurement on channel 1	Input 1
Counter size	32-bit
Evaluation	Positive or negative edge
Input frequency	Max. 100 kHz
Pulse length	10 µs
Length of pauses between pulses	10 µs
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz
Signal form	Square wave pulse
Period measurement	
Amount	1
Measurement on channel 1	Input 1
Counter size	32-bit
Evaluation	Positive or negative edge
Input frequency	Max. 100 kHz
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz
Signal form	Square wave pulse

Table 77: 7XX408.50-1 - Additional technical data

Product ID	7XX408.50-1	
Digital outputs		
Channel	1-12	13-16
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 100 Hz (with resistive load)	
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Pulse width modulation (channel 15 + 16)		
Period duration Resolution	10 ms - 1 s 1 ms	
Pulse length Resolution	0.0% - 100.0% 0.1%	
Interfaces		
Application interface Type Design Min. cycle time on the X2X bus	 X2X Link slave 12-pin multipoint connector >200 µs	
Status indicators		
Status LED	Yes	
I/O Select LED	**Green**: LEDs 01-16 indicate the status of the **inputs** **Yellow**: LEDs 01-16 indicate the status of the **outputs**	
01 - 16 LEDs	Status of the inputs/outputs (green/yellow)	
Control elements		
I/O Select button	Selects whether the I/O-LEDs represent the inputs or outputs	
Power supply		
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.	
General information		
B&R ID code	$5468	

Table 77: 7XX408.50-1 - Additional technical data

5.1.4 Diagnostic LEDs

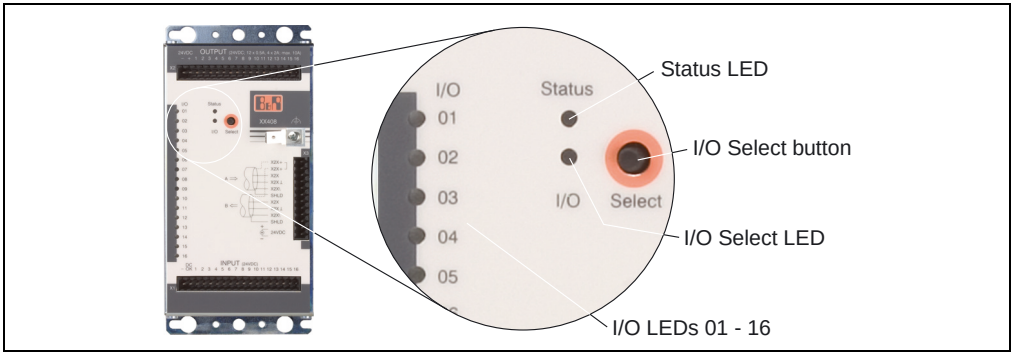


Figure 49: 7XX408.50-1 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error for an I/O channel - Level monitoring for digital outputs has responded.
	Double flash	Possible error: • Module supply voltage is outside the valid range. • Sensor supply monitor responded. • The monitor for the supply of digital outputs registered an error.
	On	Error or reset state

Table 78: 7XX408.50-1 - Status-LED

I/O Select LED

2 color LEDs 01-16 are provided for displaying the status of the inputs and outputs. The display is switched using the "I/O Select" button. The status is indicated by the I/O LED:

Color	Meaning
Green	The I/O LEDs 01-16 indicate the status of the inputs.
Red	The I/O LEDs 01-16 indicate the status of the outputs.

Table 79: 7XX408.50-1 - I/O LED

I/O 01-16, if I/O Select LED green

Color	Meaning
Green	The corresponding input = 1.
Off	The corresponding input = 0.

Table 80: 7XX408.50-1 - LEDs 01-16 (green)

I/O LEDs 01-16, if I/O Select LED yellow

Color	Meaning
Yellow	The corresponding output = 1.
Off	The corresponding output = 0.
Blinking, approximately 10 Hz	The corresponding output is operating in PWM mode.

Table 81: 7XX408.50-1 - LEDs 01-16 (green)

5.1.5 Digital inputs

Terminal block connections

Inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.). The supply voltage for the digital inputs can be monitored with the application program.

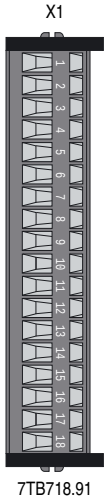
18-pin terminal block	Terminal	Assignment
	1	COM si (GND in sink operation, +24 VDC in source operation)
	2	COM so (+24 VDC in sink operation, GND in source operation)
	3	Digital input 1 / counter 1 / A
	4	Digital input 2 / counter 2 / B
	5	Digital input 3 / ext. CLK / R
	6	Digital input 4
	7	Digital input 5
	8	Digital input 6
	9	Digital input 7
	10	Digital input 8
	11	Digital input 9
	12	Digital input 10
	13	Digital input 11
	14	Digital input 12
	15	Digital input 13
	16	Digital input 14
	17	Digital input 15
	18	Digital input 16

Table 82: 7XX408.50-1 - Pin assignments X1 / digital inputs

Connection examples

Sink connection

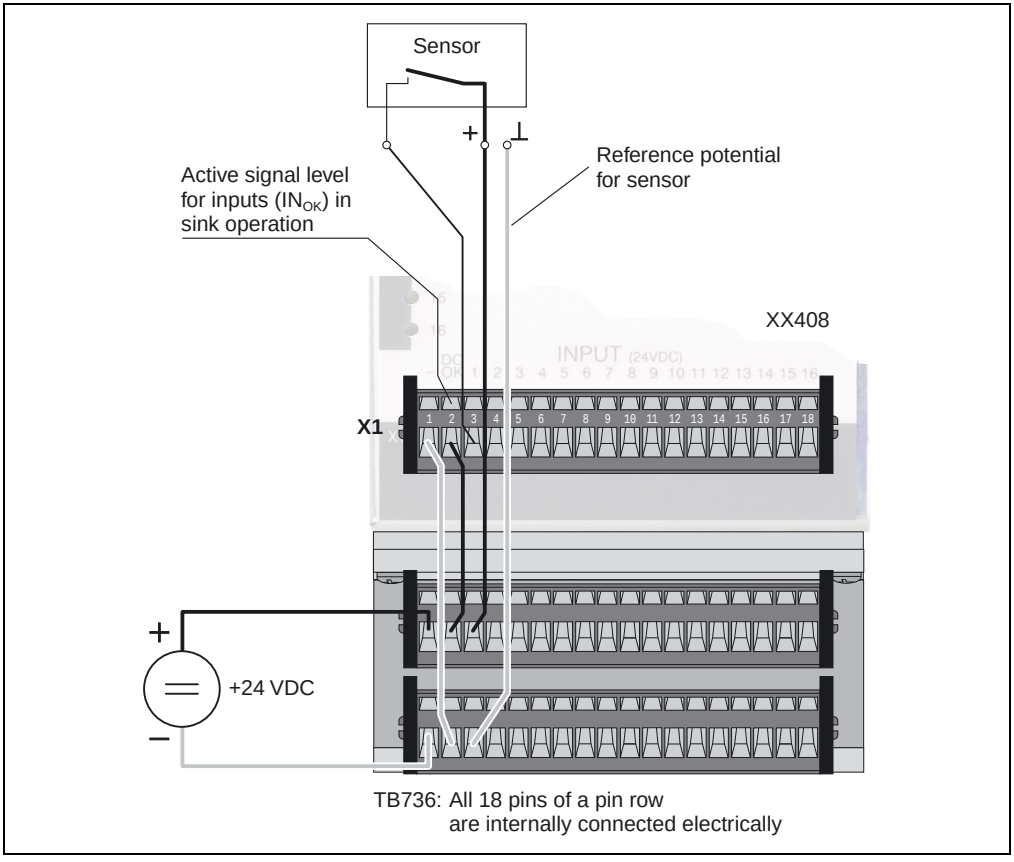


Figure 50: 7XX408.50-1 - Connection example / digital input (sink connection)

If the inputs on the XX408 are operated with three line connection, the TB736 terminal block is used as additional jumper terminal.

Source connection

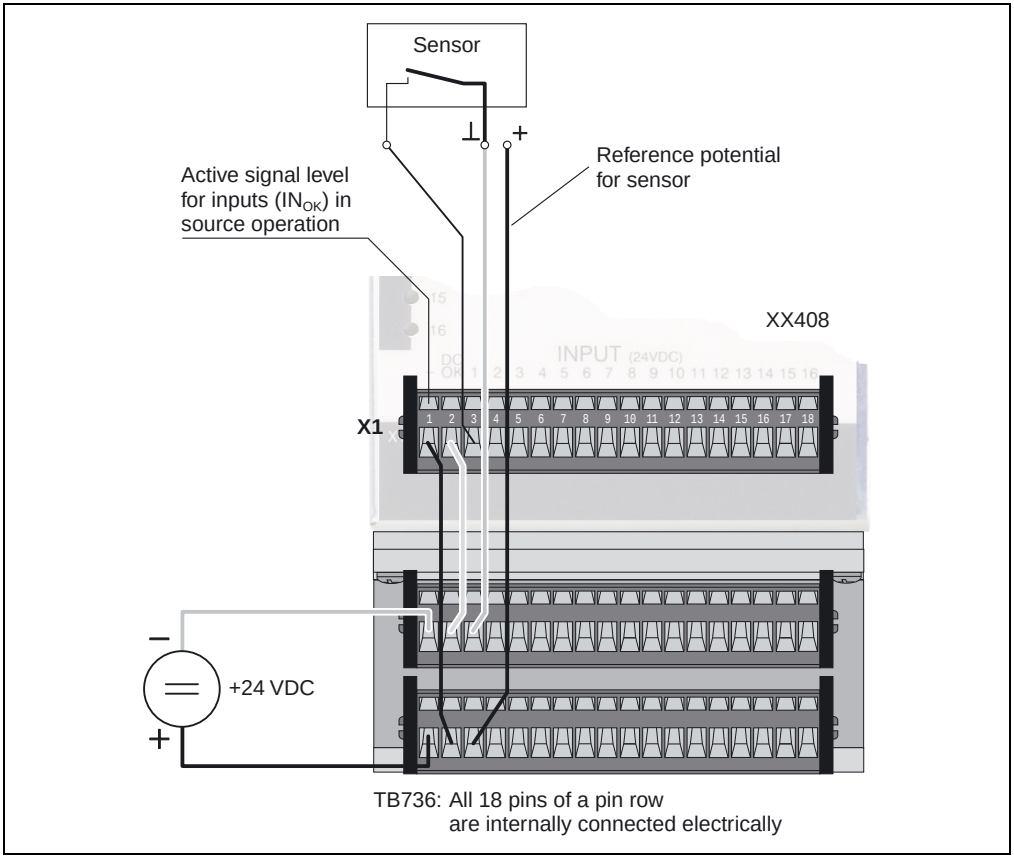


Figure 51: 7XX408.50-1 - Connection example / digital inputs (source connection)

If the inputs on the XX408 are operated with three line connection, the TB736 terminal block is used as additional jumper terminal.

Counter inputs

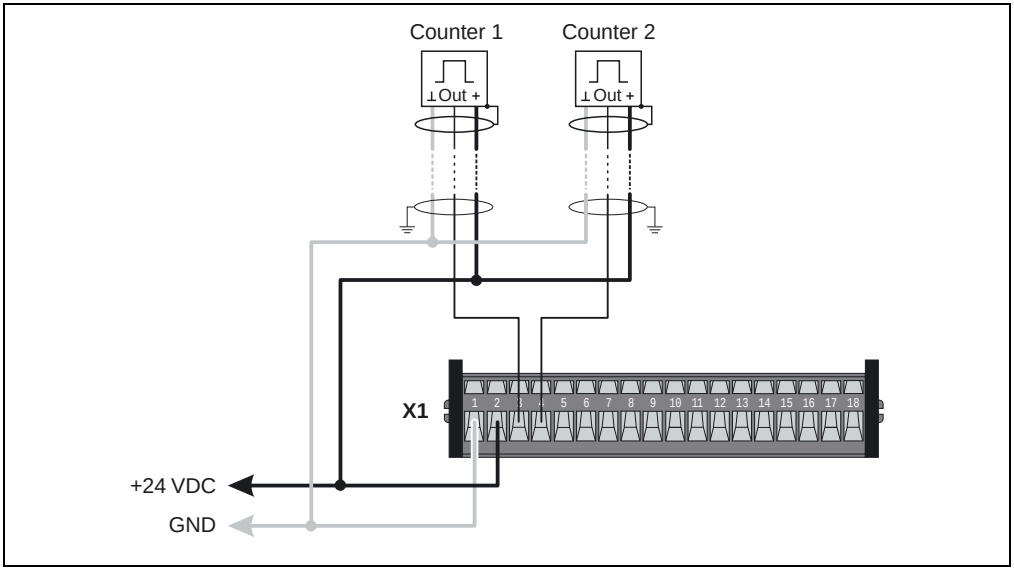


Figure 52: 7XX408.50-1 - Connection example / counter input

Period or gate measurement

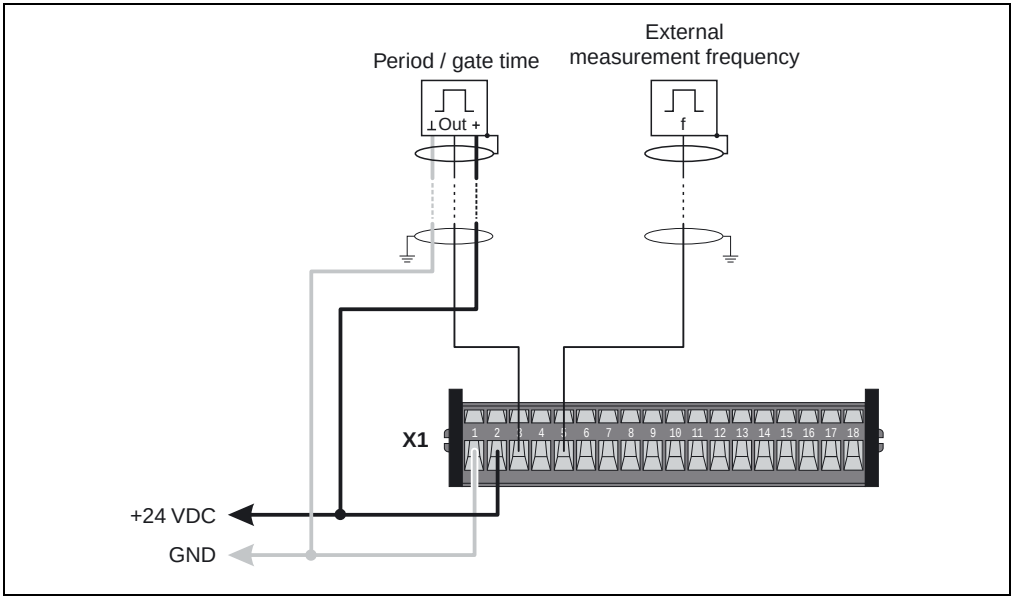


Figure 53: 7XX408.50-1 - Connection example / period and gate measurement

Incremental encoder

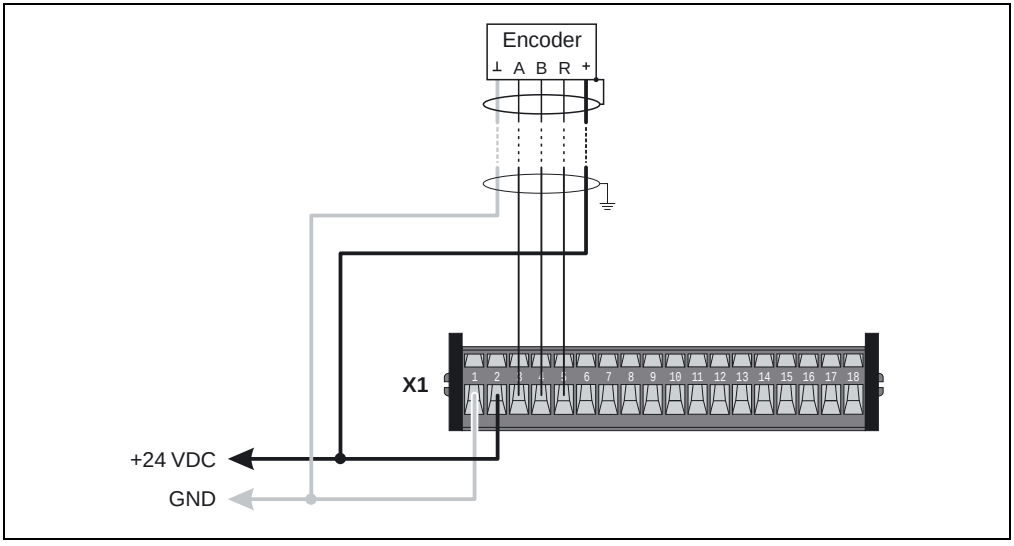


Figure 54: 7XX408.50-1 - Connection example / incremental encoder

Input circuit diagram

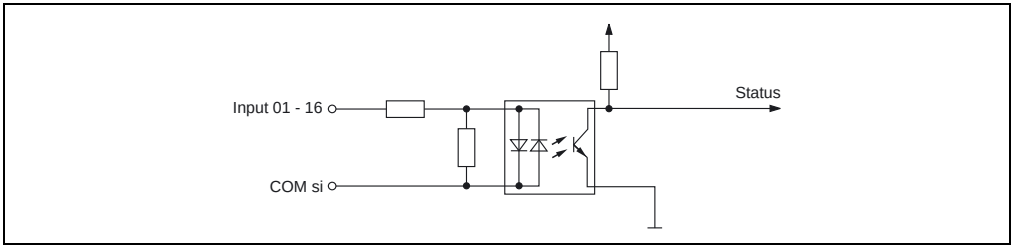


Figure 55: 7XX408.50-1 - Input circuit diagram / digital inputs

5.1.6 Digital outputs

Terminal block connections

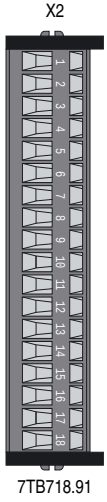
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	GND output supply
	2	+24 VDC output supply
	3	Digital output 1
	4	Digital output 2
	5	Digital output 3
	6	Digital output 4
	7	Digital output 5
	8	Digital output 6
	9	Digital output 7
	10	Digital output 8
	11	Digital output 9
	12	Digital output 10
	13	Digital output 11
	14	Digital output 12
	15	Digital output 13
	16	Digital output 14
	17	Digital output 15 / PWM 1
	18	Digital output 16 / PWM 2

Table 83: 7XX408.50-1 - Pin assignment - X2 / digital outputs

Connection example

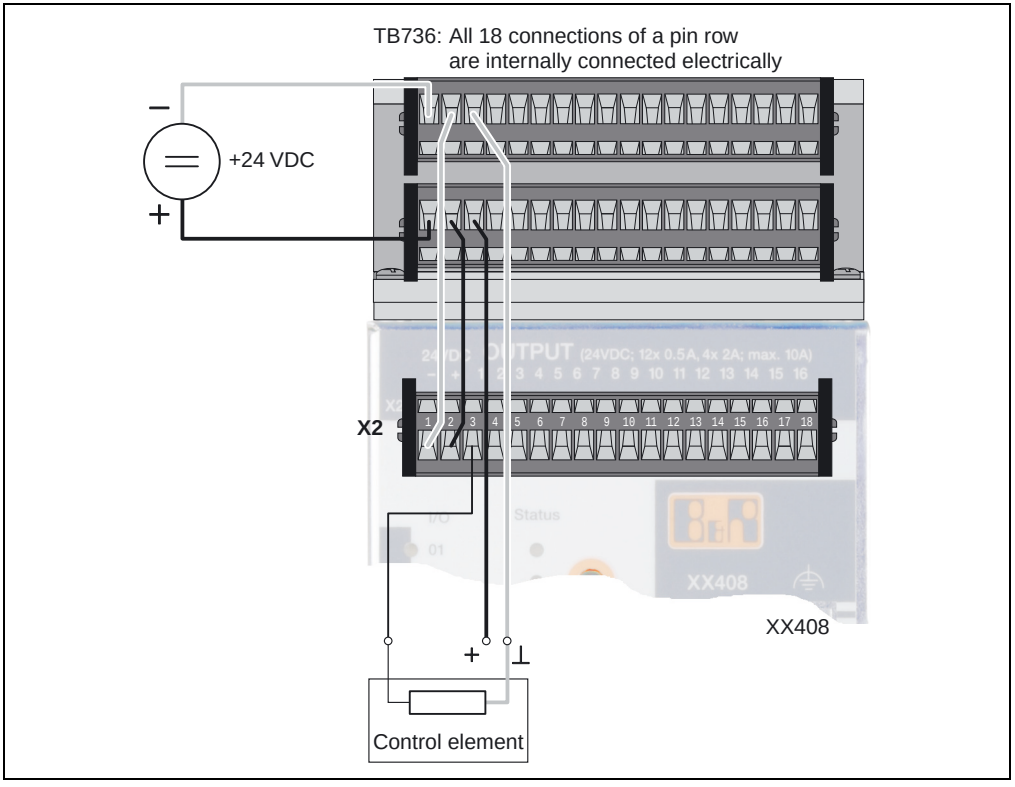


Figure 56: 7XX408.50-1 - Connection example / digital outputs

If the outputs on the XX408 are operated with three line connection, the TB736 terminal block is used as additional jumper terminal.

Output circuit diagram

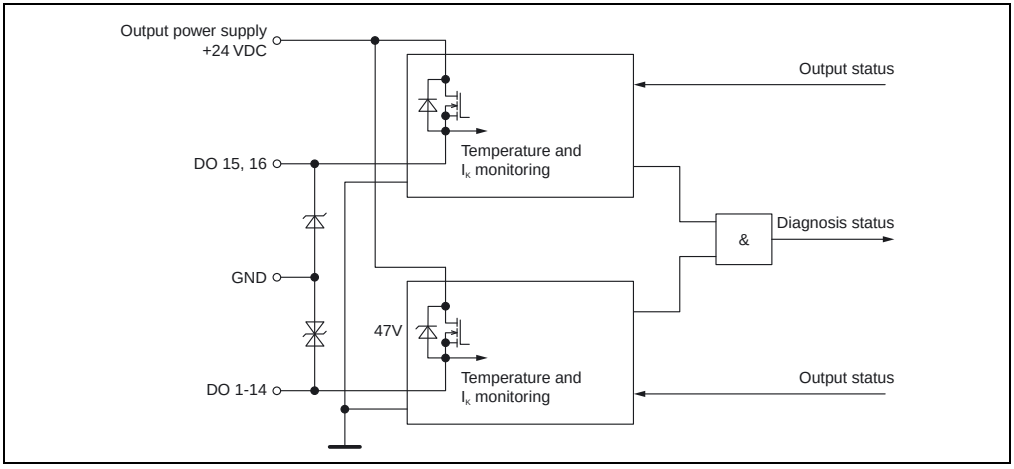


Figure 57: 7XX408.50-1 - Output circuit diagram / digital outputs

Information:

Because of the inverse diodes required for PWM-capable digital outputs 15 and 16, reverse polarity protection of the output supply is not guaranteed for these outputs!

Switching inductive loads

Digital outputs 1 to 12

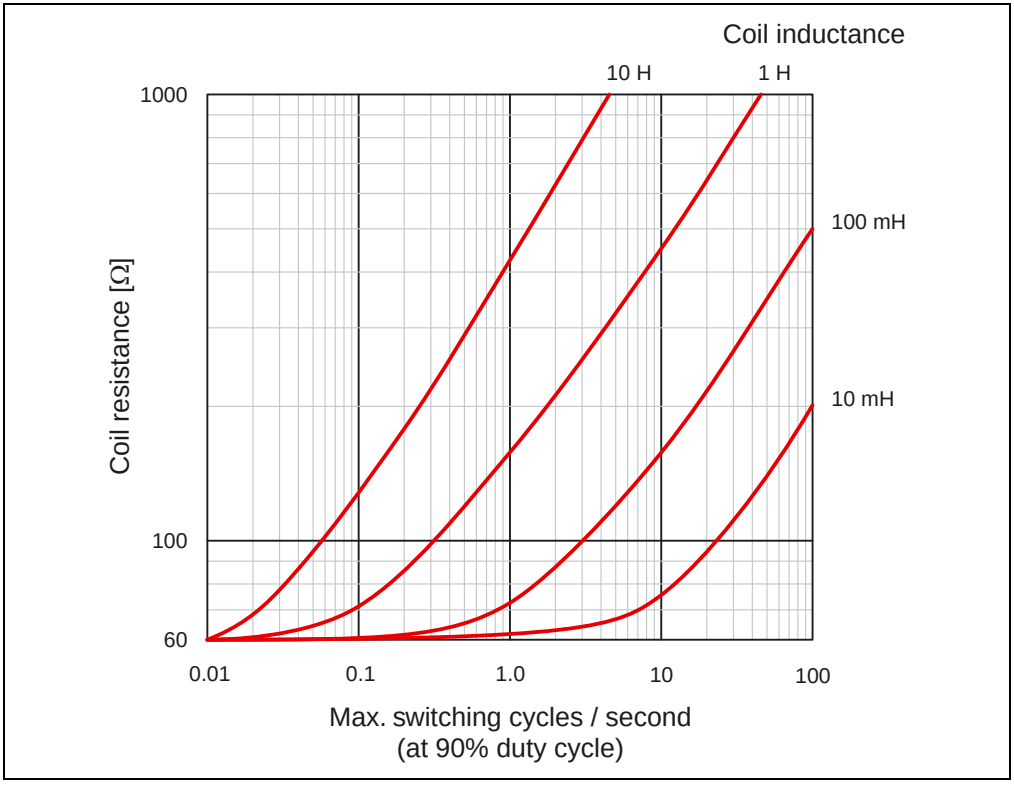


Figure 58: 7XX408.50-1 - Switching inductive loads / Digital outputs 1 to 12

Digital outputs 13 to 16

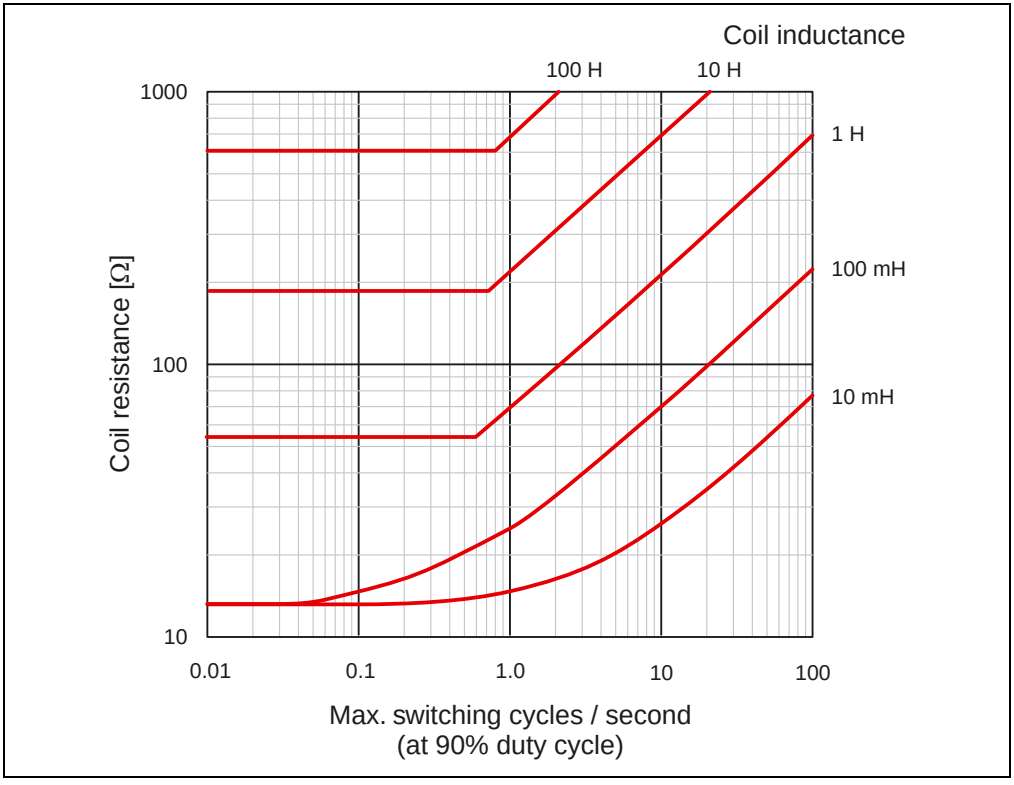


Figure 59: 7XX408.50-1 - Switching inductive loads / Digital outputs 13 to 16

5.1.7 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

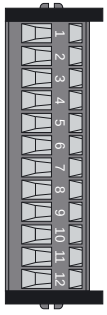
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 84: 7XX408.50-1 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

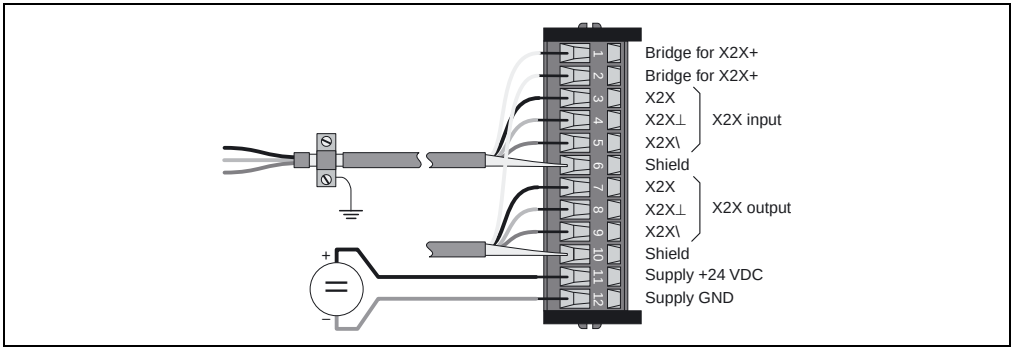


Figure 60: 7XX408.50-1 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

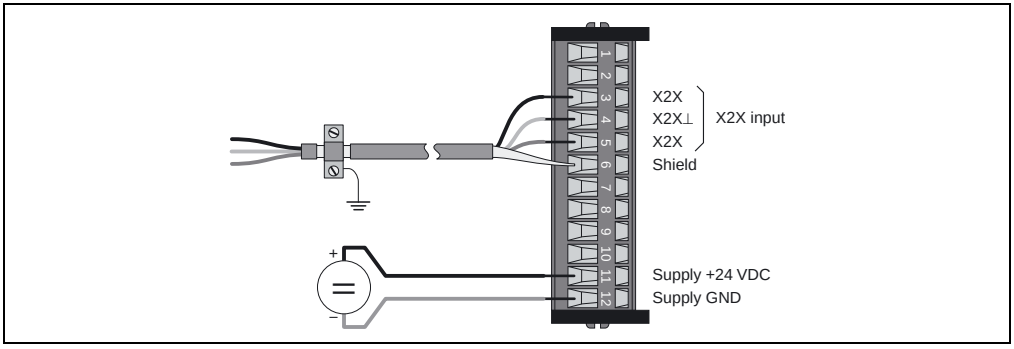


Figure 61: 7XX408.50-1 - Connection example of X2X Link as last X2X Link slave

5.1.8 Monitoring

Monitoring the module supply voltage

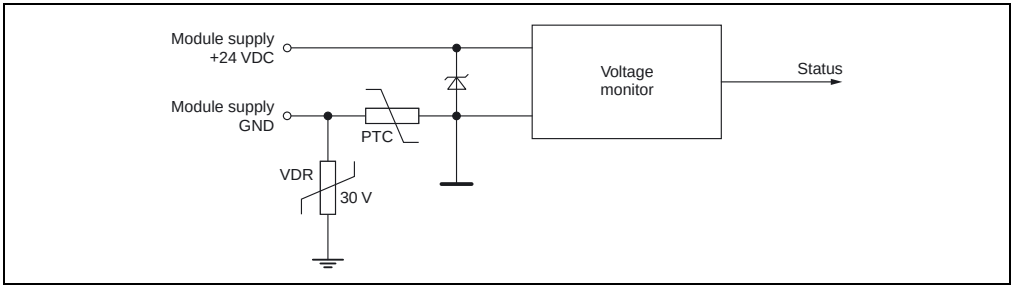


Figure 62: 7XX408.50-1 - Monitoring the module supply

Sensor supply monitor

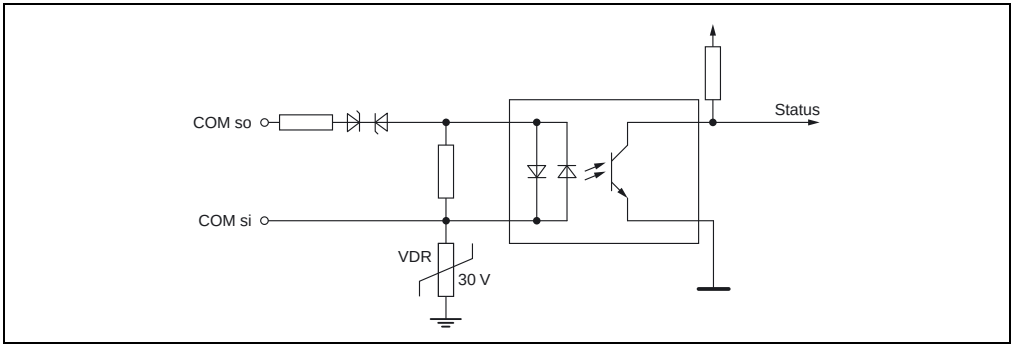


Figure 63: 7XX408.50-1 - Sensor supply monitor

Monitoring the supply of the digital outputs

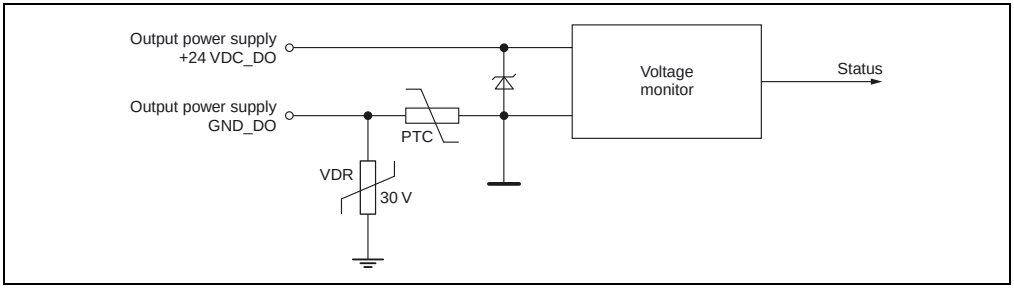


Figure 64: 7XX408.50-1 - Monitoring the supply of the digital outputs

Current monitoring for the 2A outputs

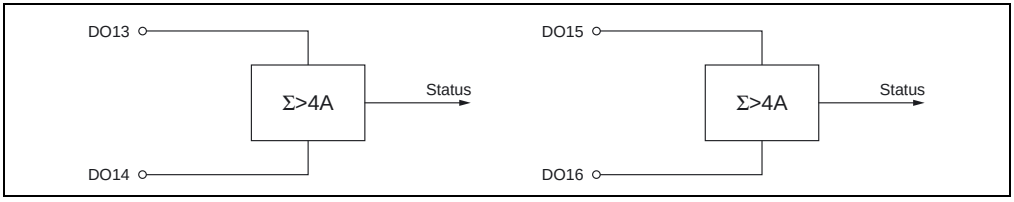


Figure 65: 7XX408.50-1 - Current monitoring for the 2A outputs

5.1.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
1	DigitalInput09 - DigitalInput16	BOOL	1	●	●		
2	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
2	StatusDigitalOutput01 - StatusDigitalOutput08	BOOL		●	●		
3	DigitalOutput09 - DigitalOutput16	BOOL	1			●	●
3	StatusDigitalOutput09 - StatusDigitalOutput16	BOOL		●	●		
4	ABREncoder01 ABEncoder01 EventCounter01	DINT	1	●	●		
8	LatchABREncoder02 EventCounter02	UINT	1	●	●		
20	PWMPeriod	UINT	1			●	●
22	PulsWidth01	UINT	1			●	●
24	PulsWidth02	UINT	1			●	●
26	StatusOutput01	UINT	1			●	●
30	StatusInput01	UINT	1	●	●		

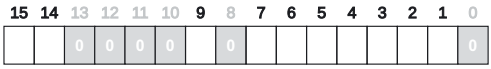
Table 85: 7XX408.50-1 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput16	Reads the digital inputs 1 - 16
DigitalOutput01 - DigitalOutput16	Sets the digital outputs 1 - 16
StatusDigitalOutput01 - StatusDigitalOutput16	
ABREncoder01	Counter sum in ABR mode
LatchABREncoder02	
ABEncoder01	Counter sum in AB mode
EventCounter01	Counter sum in Event Counter mode
EventCounter02	
PWMPeriod	Period for pulse width modulation (1-1000 ms)
PulsWidth01	Pulse width for digital output 15 (in 0.1% steps, valid values: 0-1000).
PulsWidth02	Pulse width for digital output 16 (in 0.1% steps, valid values: 0-1000).
StatusInput01	Reads back the digital outputs 1 - 16
StatusInput01	Status register: The user can use this register to call up various status information.
StatusOutput01	Configuration register: General configuration of the individual counter/encoder inputs.

Table 86: 7XX408.50-1 - Register description

Configuration register



Bit	Description
0	Reserve (must be 0)
1	0 ... R disabled (in AB(R) mode, see bit 4 and 5) 1 ... R enabled (in AB(R) mode)
2	0 ... Period measurement 1 ... Gate measurement
3	0 ... Measurement starts at increasing edge 1 ... Measurement starts at decreasing edge
4 - 5	00 ... No counter operation 01 ... AB(R) counter 10 ... Event counter 11 ... Period or gate measurement
6 - 7	Counter frequency: 00 ... 4 MHz 01 ... External (input 3) 10 ... 32.25 kHz 11 ... Not allowed
8	Reserve (must be 0)
9	Overflow recognition 0 ... Disabled (reset counter overflow bit in configuration register) 1 ... Enabled (value of the counter is limited to $7FFF when overflow)
10 - 13	Reserve (set to 0)
14	PWM function 0 ... Off 1 ... On
15	0 ... Time/counter reset 1 ... Enable time/counter (set this bit to 1 after counter has been configured)

Table 87: 7XX408.50-1 - Configuration register

Status registers



Bit	Description
0 - 8	Reserve (must be 0)
9	0 ... Period or gate measurement within the counter range 0 - $7FFF (only valid if bit 9 is set in the configuration register) 1 ... Counter overflow during period or gate measurement, acknowledge by resetting bit 9 of the configuration word
10	Reserve (must be 0)
11	Monitoring the module supply voltage 0 ... Module supply ok (within the limits 18 V to 30 V) 1 ... Error (module supply outside of the limits)
12	Input voltage monitor: 0 ... DC OK is ok 1 ... DC OK error
13	Total current monitor of the digital outputs 13 and 14: 0 ... < 4 A 1 ... > 4 A
14	Total current monitor of the digital outputs 15 and 16: 0 ... < 4 A 1 ... > 4 A
15	Output voltage monitor: 0 ... 24 VDC is ok 1 ... 24 VDC error

Table 88: 7XX408.50-1 - Status register

Pulse width modulation settings

The period (*PWMPeriod*) can be set between 1 and 1000 ms. The decimal value 1000 corresponds to a period of 1 sec.

The pulse width (*PulsWidth01* and *PulsWidth02*) can be set in 0.1% steps between 0% and 100%. The decimal value 1000 corresponds to a pulse width of 100%.

Counter settings

The configuration register must be set in order to set the correct counter modes. Counter 1 and counter 2 registers have different meanings for different modes.

Incremental encoder operation

If the reference input (digital input 3) in the configuration register is enabled, then the module is a 16-bit ABR counter whose actual value is located in counter 1 (only LW) and the stored R-value in counter 2 (functions as latch).

If the reference input is disabled, then it is a 32-bit AB incremental encoder counter input which should be read with counter 1 (LW and HW).

Assignment of the digital inputs 1-3:

- A = input 1
- B = input 2
- R = input 3

Event counter operation

If the counters are initialized as event counters in the configuration register, we get a 32-bit counter (counter 1 LW+HW) and a 16-bit counter (counter 2):

- Input 1 = counter 1
- Input 2 = counter 2

Period measurement

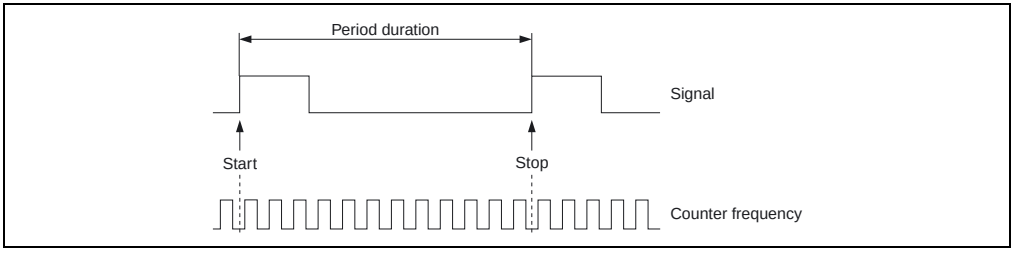


Figure 66: 7XX408.50-1 - Period measurement

The measurement can be begin at the decreasing or increasing edge depending on the configuration register. The R enable bit must be 0. Measurement always occurs up to the next identical edge. The pauses between two period measurements must last for at least 2 periods of the counter frequency. The counter frequency can be set to one of two levels (4 MHz or 31.25 kHz) or with an external frequency. The external frequency must however be < 50 kHz. The measured counter state is a 16-bit value and is displayed in counter 1 (only LW). The value in the temporary register is only updated at the end of the active measurement.

The frequency of the signal to be measured can be a maximum of 50 kHz.

Assignment of the digital inputs:

- Input 1 = measurement input
- Input 2 = external counter frequency

A potential overflow of the continuous counter during the period measurement (e.g. due to an incorrect counter frequency), can be detected by setting bit 9 in the configuration register. However, the maximum value of counter is limited to $7FFF as a result. The error bit in the status register is acknowledged by resetting bit 9 of the configuration register.

Gate measurement

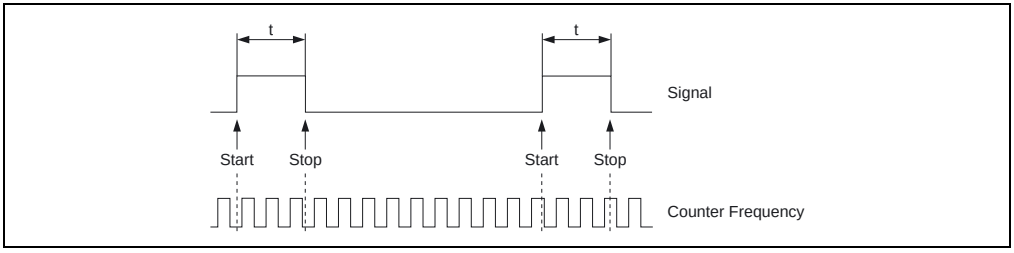


Figure 67: 7XX408.50-1 - Gate measurement

The measurement can be begin at the decreasing or increasing edge depending on the configuration register. The R enable bit must be 0. Measurement always occurs up to the next edge. The pauses between two gate measurements must last for at least 2 periods of the counter frequency. The counter frequency can be set in two steps (4MHz or 31.25 kHz) or with an external frequency. The external frequency must however be < 50 kHz. The measured counter state is a 16-bit value and is displayed in counter 1 (only LW). The value in the temporary register is only updated at the end of the active measurement.

The frequency of the signal to be measured can be a maximum of 25 kHz.

Assignment of the digital inputs:

- Input 1 = measurement input
- Input 2 = external counter frequency

A potential overflow of the continuous counter during the gate measurement (e.g. due to an incorrect counter frequency), can be detected by setting bit 9 in the configuration word. However, the maximum value of counter is limited to $7FFF as a result. The error bit in the status word is acknowledged by resetting bit 9 of the configuration word.

5.2 7XX410.50-1

5.2.1 Order data

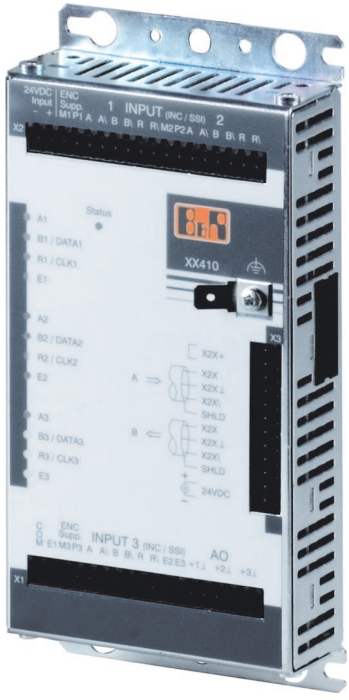
Model number	Short description	Figure
7XX410.50-1	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 3x absolute encoder inputs or incremental encoder inputs, 3 digital inputs, 24 VDC sink, 3 analog outputs, ±10 V, 12-bit. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 89: 7XX410.50-1 - Order data

5.2.2 Technical data

Product ID	7XX410.50-1
Short description	
Digital channels	3 inputs
Analog channels	3 outputs
Encoder inputs	3 inputs for SSI or incremental encoder (can be configured using software)
Interfaces	1 x X2X Link slave
Electrical isolation Encoder - Encoder/Analog Encoder - 24 VDC/Digital X2X - Encoder X2X - Analog/Digital	 No Yes Yes Yes
Supply voltage	24 VDC
Power consumption Without encoder supply With 5 V encoder supply (600 mA)	 Max. 3.0 W Max. 7.5 W
Digital inputs	
Rated voltage	24 VDC
Input filter Hardware Input 1 Input 2, 3 Software	 ≤100 µs ≤10 µs ≤16 µs
Input circuit	Sink
Additional functions	-
Encoder inputs	
SSI encoder inputs 5 V Counter size Maximum baud rate	 Max. 31-bit 400 kBit/sec
Incremental encoder inputs 5 V Counter size Input frequency Evaluation	 32-bit Max. 400 kHz 4x
Encoder inputs	Symmetric
Design	18-pin multipoint connector
External encoder supply Current per channel	+24 VDC Max. 300 mA
Internal encoder supply Current per channel Current for all channels	+5 VDC Max. 300 mA Max. 600 mA

Table 90: 7XX410.50-1 - Technical data

Product ID	7XX410.50-1
Analog outputs	
Output	±10 V
Digital converter resolution	12-bit
Data format	INT
Conversion time	≤300 µs for all channels
Power on/off behavior	Internal enable relay for boot procedure and errors
Output protection	Protection against wiring with supply voltage, short-circuit protection
Interfaces	
Application interface Type Design	 X2X Link slave 12-pin multipoint connector
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function, status
Diagnostics I/O function Power supply Status, X2X	 Yes, with LEDs Yes, with software status Yes, with status LED
Operational conditions	
Temperature	0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	400 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 90: 7XX410.50-1 - Technical data

5.2.3 Additional technical data

Product ID	7XX410.50-1
Digital inputs	
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC
Switching threshold LOW HIGH	 <5 V >15 V
Input current at rated voltage	Approx. 5 mA
Encoder inputs	
SSI encoder inputs 5 V Coding Parity Max. signal delay clock - data Input level Output level	 Gray, Binary Yes ≤1.25 µs 5 V (differential) 5 V (differential)
Incremental encoder inputs 5 V Counter frequency Signal form Inputs Input level Phase offset between channel A and B	 1.200 MHz Square wave pulse A, /A - B, /B - R, /R 5 V (differential) 90° ±15°
Analog outputs	
Value range / output signal +10 V 0 V -10 V	 $7FFF $000 $8001
Maximum load per output	±10 mA (load ≥1 kΩ)
Interfaces	
X2X Link slave user interface Min. cycle time on the X2X bus	 >300 µs
Status indicators	
Status LED	Yes, color and blink code
Encoder input / encoder error	Yes, blink code
Power supply	
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.
General information	
B&R ID code	$6102

Table 91: 7XX410.50-1 - Additional technical data

5.2.4 Diagnostic LEDs

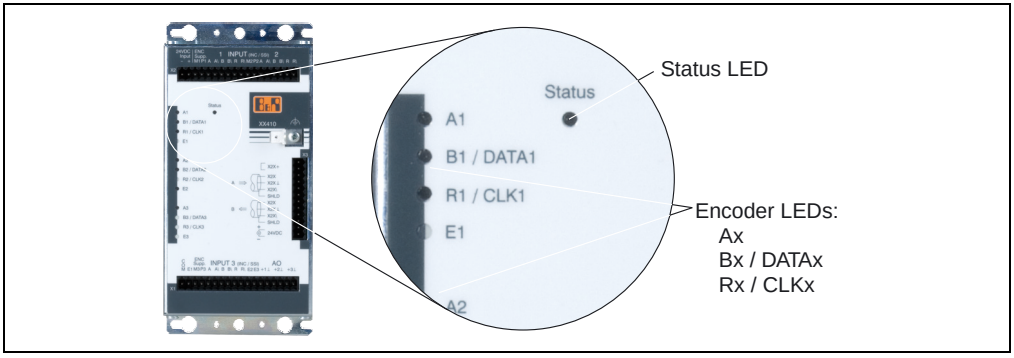


Figure 68: 7XX410.50-1 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error: Encoder 1 - 3 not connected
	Double flash	The voltage on the input module supply or encoder supply is outside of the valid range. • If bit 15 is set in the configuration register (24 VDC encoder supply), then 24 VDC must be connected to the encoder supply input. • If bit 15 is cleared in the configuration register (5 VDC encoder supply), then the encoder supply input must be voltage-free.
	On	Error or reset state

Table 92: 7XX410.50-1 - Status-LED

Encoder LEDs

The encoder LEDs indicate the status of the encoder inputs or an encoder error depending on the defined encoder type:

LEDs R1, R2, R3	Meaning
Off	Status R input
On	Status R input
Blinking	Encoder error: Wire-break or no encoder connected The error can be acknowledged by setting the corresponding bit in the configuration register.

Table 93: 7XX410.50-1 - I/O LED

5.2.5 Input/output connections

Terminal X1

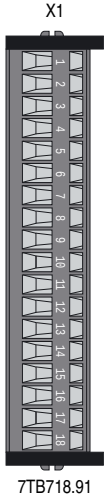
18-pin terminal block	Terminal	Assignment	
 7TB718.91	1	COM (reference potential for digital inputs 1-3)	
	2	Digital input 1	
	3	Output for encoder supply ⊥	
	4	Output for encoder supply +	
	5	A3	Encoder input 3
	6	A3\	
	7	B3 - DATA3	
	8	B3\ - DATA3\	
	9	R3 - CLK3	
	10	R3\ - CLK3\	
	11	Digital input 2	
	12	Digital input 3	
	13	Analog output 1 +	
	14	Analog output 1 ⊥	
	15	Analog output 2 +	
	16	Analog output 2 ⊥	
	17	Analog output 3 +	
	18	Analog output 3 ⊥	

Table 94: 7XX410.50-1 - X1 pin assignments

Terminal X2

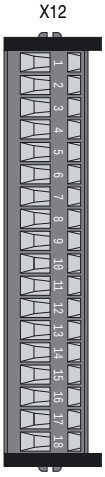
18-pin terminal block	Terminal	Assignment	
	1	Input for encoder supply ⊥	
	2	Input for encoder supply +	
	3	Output for encoder supply ⊥	
	4	Output for encoder supply +	
	5	A1	Encoder input 1
	6	A1\	
	7	B1 - DATA1	
	8	B1\ - DATA1\	
	9	R1 - CLK1	
	10	R1\ - CLK1\	
	11	Output for encoder supply ⊥	
	12	Output for encoder supply +	
	13	A2	Encoder input 2
	14	A2\	
	15	B2 - DATA2	
	16	B2\ - DATA2\	
	17	R2 - CLK2	
	18	R2\ - CLK2\	

Table 95: 7XX410.50-1 - X1 pin assignments

Encoder supply

Warning!

The output for the encoder supply must be free of voltage.

The following must be noted depending on the encoder:

- When using 24 VDC encoders, 24 VDC must be connected to the input for the encoder supply and bit 15 must be set in the configuration register.
- When using 5 VDC encoders, the input for the encoder supply must be voltage-free and bit 15 must be cleared in the configuration register.

Connection examples

Digital inputs (sink connection)

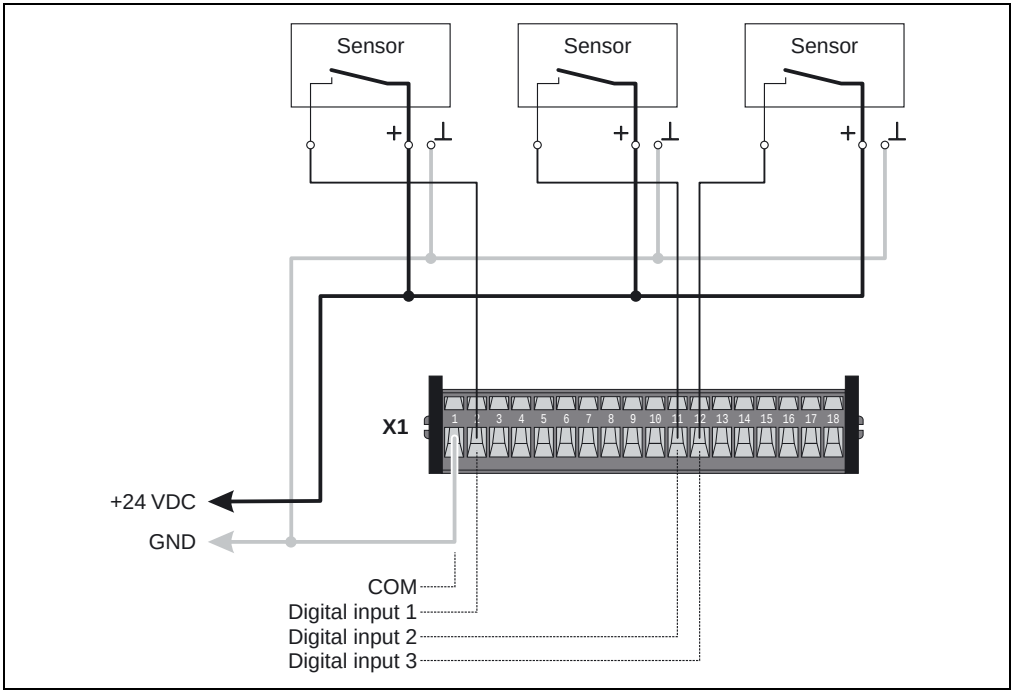


Figure 69: 7XX410.50-1 - Connection example / digital input (sink connection)

Analog outputs

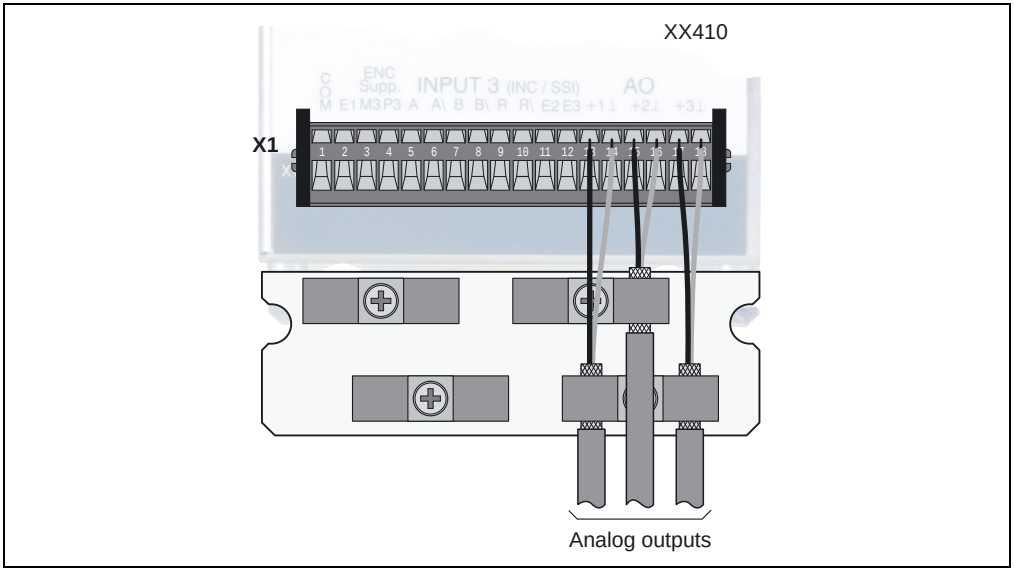


Figure 70: 7XX410.50-1 - Connection example / analog outputs

SSI encoder

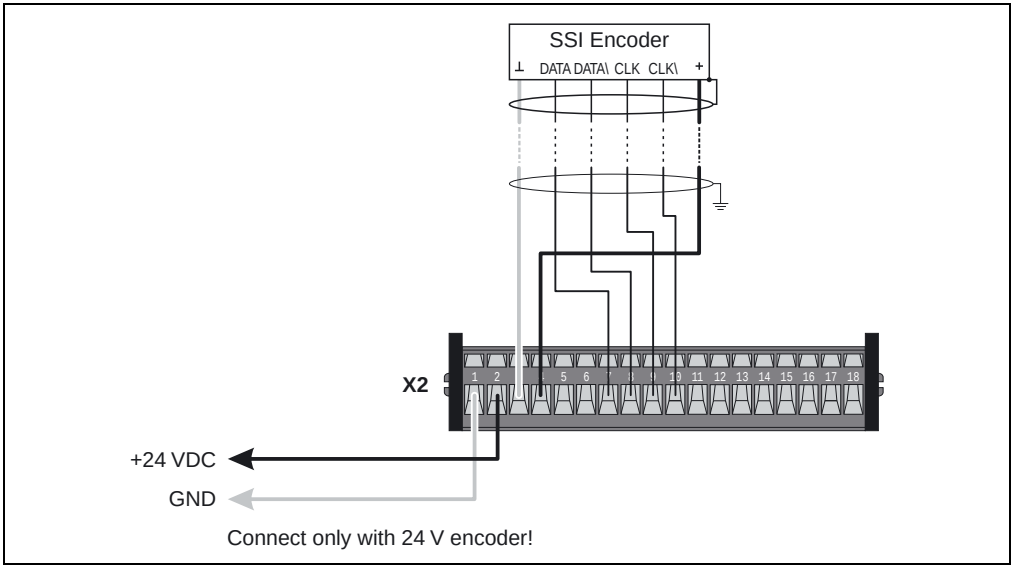


Figure 71: 7XX410.50-1 - Incremental encoder / SSI encoder

Incremental encoder

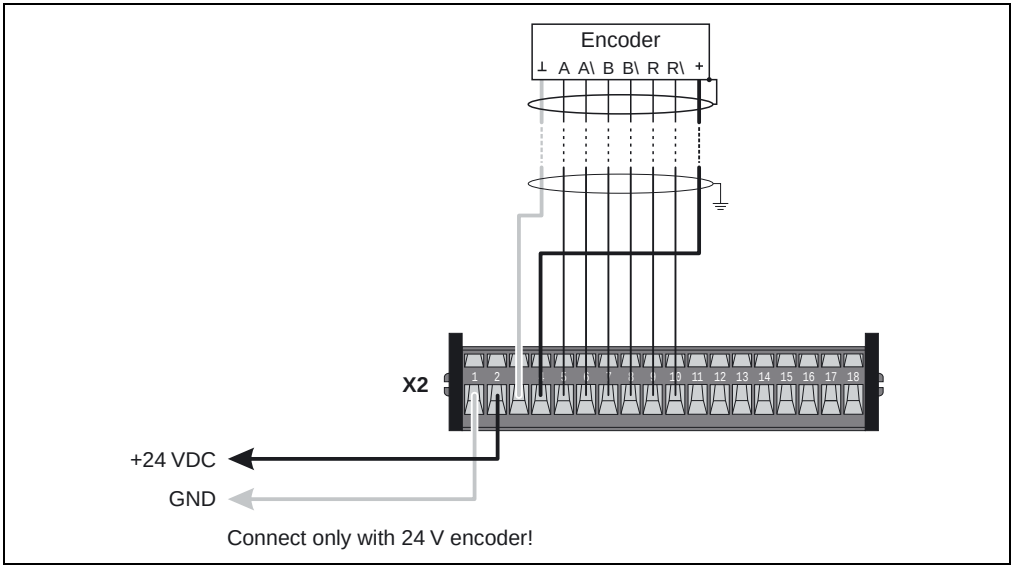


Figure 72: 7XX410.50-1 - Connection example / incremental encoder

Input circuit diagram

5 V Encoder

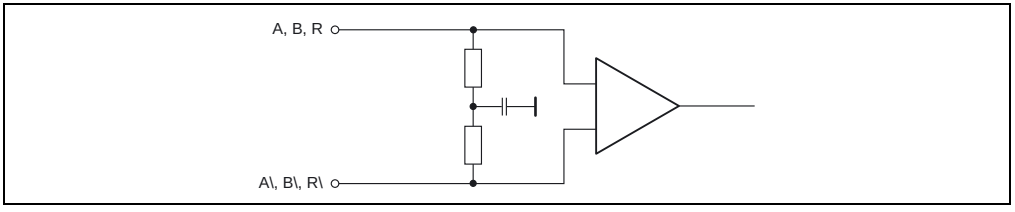


Figure 73: 7XX410.50-1 - Input circuit diagram / 5 V encoder

Digital inputs

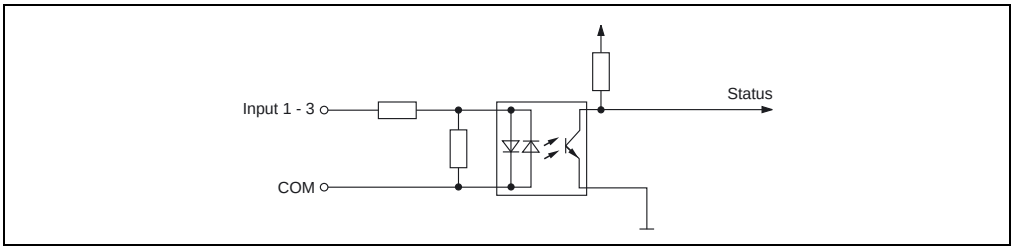


Figure 74: 7XX410.50-1 - Input circuit diagram / digital inputs

Output circuit diagram

Analog outputs

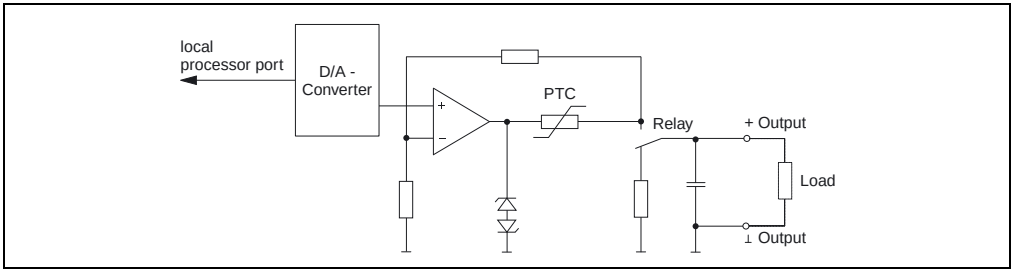


Figure 75: 7XX410.50-1 - Output circuit diagram / analog outputs

5 V encoder (SSI, CLK)

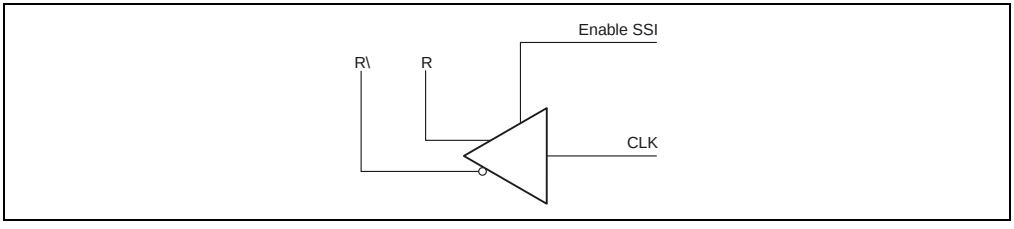


Figure 76: 7XX410.50-1 - Output circuit diagram / 5 V encoder (SSI, CLK)

5.2.6 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

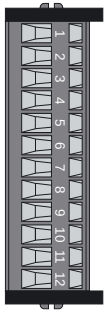
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 96: 7XX410.50-1 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

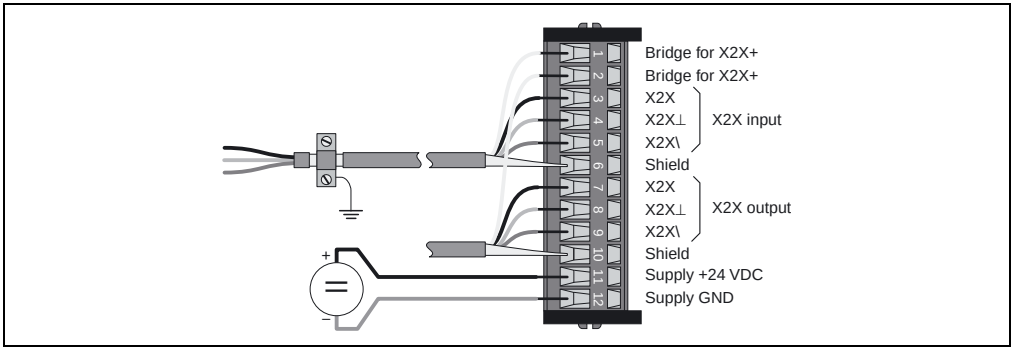


Figure 77: 7XX410.50-1 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

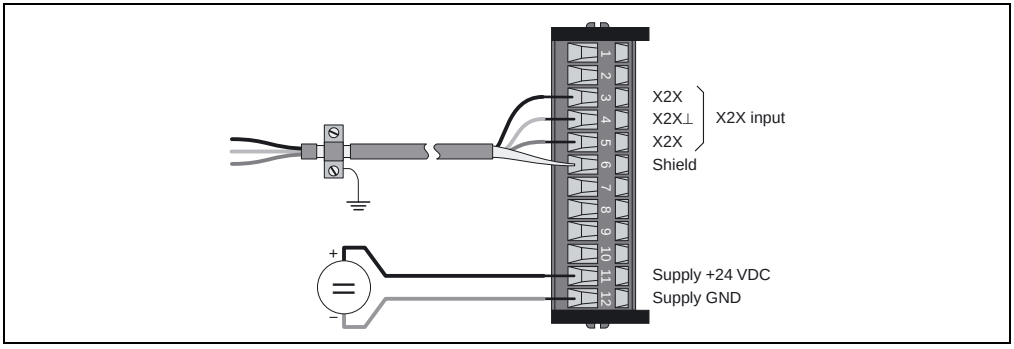


Figure 78: 7XX410.50-1 - Connection example of X2X Link as last X2X Link slave

5.2.7 Monitoring

Monitoring the module supply voltage

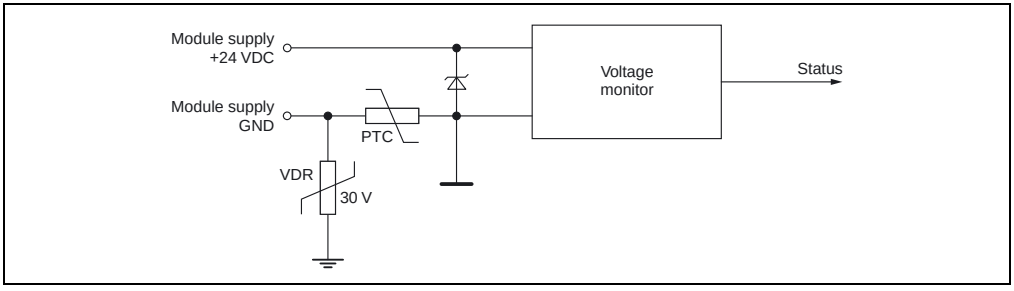


Figure 79: 7XX410.50-1 - Monitoring the module supply

Monitoring the encoder supply

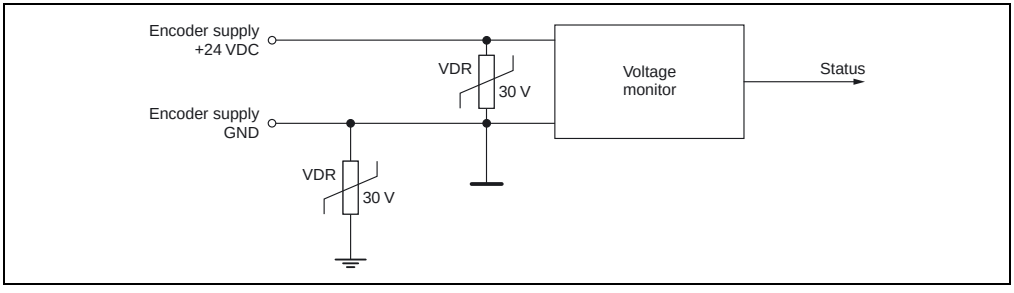


Figure 80: 7XX410.50-1 - Monitoring the encoder supply

Monitoring the ABR inputs

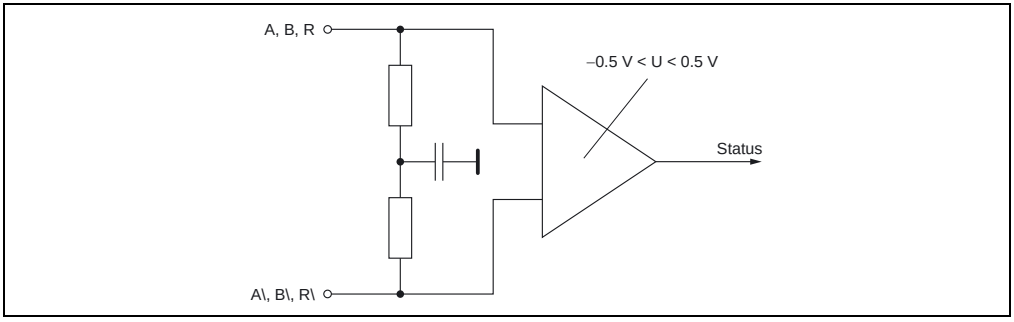


Figure 81: 7XX410.50-1 - Monitoring the ABR inputs

5.2.8 Shielding for the counter inputs

In order to simplify the necessary shielding procedures on the counter inputs (X1, X2), it is recommended to use the shielding clamp 0AC301.9.

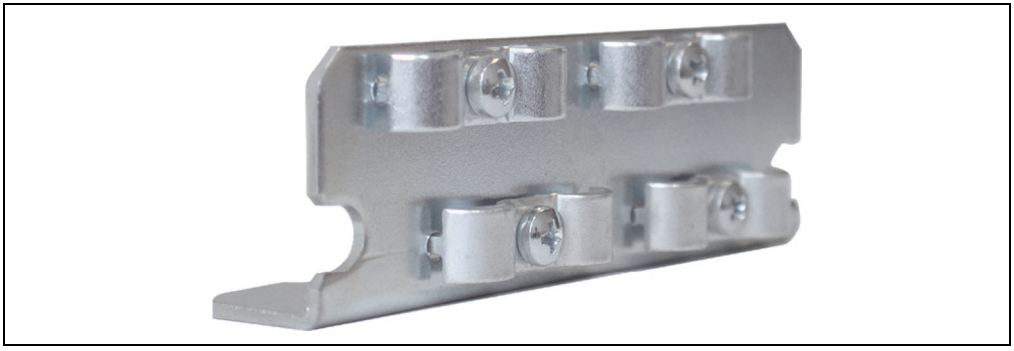


Figure 82: 7XX410.50-1 - Shielding clamp 0AC301.9

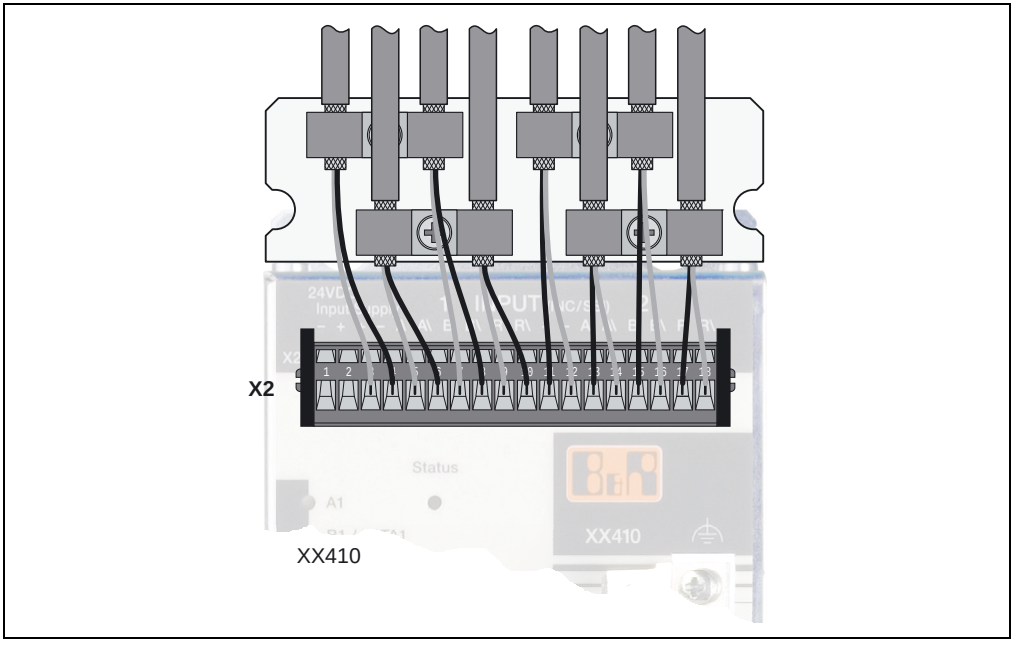


Figure 83: 7XX410.50-1 - Shielding for the encoder inputs

5.2.9 Register description

Register overview

Registers in the function model 0 (default)

Register	Name	Data type	Length	Read		Write	
Bank 0				Cyclic	Acyclic	Cyclic	Acyclic
16	Counter 1 value	DINT	1	●	●		
20	Counter 2 value	DINT	1	●	●		
24	Counter 3 value	DINT	1	●	●		
16	Counter 1 control	UINT	1			●	●
18	Counter 2 control	UINT	1			●	●
20	Counter 3 control	UINT	1			●	●
24	Analog output 1	INT	1			●	●
26	Analog output 2	INT	1			●	●
28	Analog output 3	INT	1			●	●
32	Status register	UINT	1	●	●		
32	Configuration register	UINT	1			●	●

Table 97: 7XX410.50-1 - Registers in the function model 0 (default)

Registers in the function model 1

Register	Name	Data type	Length	Read		Write	
Bank 0				Cyclic	Acyclic	Cyclic	Acyclic
10	Trigger counter 1	UINT	1	●	●		
12	Trigger counter 2	UINT	1	●	●		
14	Trigger counter 3	UINT	1	●	●		
16	Counter 1 value	LONG	1	●	●		
20	Counter 2 value	LONG	1	●	●		
24	Counter 3 value	LONG	1	●	●		
16	Counter 1 control	UINT	1			●	●
18	Counter 2 control	UINT	1			●	●
20	Counter 3 control	UINT	1			●	●
24	Analog output 1	WORD	1			●	●
26	Analog output 2	WORD	1			●	●
28	Analog output 3	WORD	1			●	●
32	Status register	UINT	1	●	●		
32	Configuration register	UINT	1			●	●

Table 98: 7XX410.50-1 - Registers in the function model 1

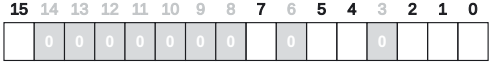
Register description

Register	Description
Trigger counter X	The "Trigger Counter X" register is started at the corresponding edge of the input (see "Configuration Register" bit 8-10). The "Trigger Counter X" registers are counted with a timing of 1 MHz to 65536. The respective "Trigger Counter X" register is cleared by changing bit 3-5 ("Configuration Register"). The "Trigger Counter X" registers are only present in the function model 1.
Counter X value	These registers receive the counter status of the individual encoder inputs.
Counter X control	These registers configure the operating mode and encoder type for the individual encoder inputs.
Analog output X	These registers control the analog outputs. A voltage signal in the range from -10 VDC to +10 VDC is sent to the outputs with a digital value in the range from -32,768 ($8001) to +32,767 ($7FFF).
Status register	The user can use this register to call up various status information.
Configuration register	General configuration of the individual encoder inputs.

Table 99: 7XX410.50-1 - Register description

Configuration of the encoder type (Counter X control)

Incremental encoder



Bit	Description
0 - 2	000 Unconditional referencing 001 Invalid 010 Referencing with positive edge of R 011 Referencing with negative edge of R 100 Referencing with positive edge of Ex 101 Referencing with negative edge of Ex 110 Referencing with negative edge of R OR Ex 111 Referencing with negative edge of R OR NOT Ex
3	0 Reserved
4 - 5	Selection of Ex: 00 Ex is the input assigned to the encoder 01 Select E1 for Ex 10 Select E2 for Ex 11 Select E3 for Ex
6	0 Reserved
7	Latch mode 0 Normal mode 1 Latch mode: In this mode, a 16-bit word counter is temporarily saved during referencing and output to bits 16 to 31 of the encoder value (Counter X Value).
8 - 14	0 Reserved
15	0 Encoder input configured for incremental encoder

Table 100: 7XX410.50-1 - Counter X control / incremental encoder

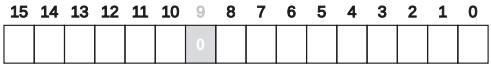
SSI absolute encoder



Bit	Description
0 - 4	NEBit: The encoder's bit size is entered here. Make sure that the number of valid bits **minus 1** is entered. Example: If the encoder bit size is 20-bits, then NEBit = 19 must be entered (binary: 10011)
5 - 9	NZero: Number of preceding zeros before the MSB of the encoder value.
10	Parity: 0 No parity 0 Parity bit is transferred (see also bit 14)
11	Encoder signal coding: 0 Binary coded SSI encoder signal 1 Gray coded SSI encoder signal
12 - 13	Transfer rate: 00 100 kBaud 01 200 kBaud 10 400 kBaud
14	Parity even/odd: 0 Even 0 Odd
15	0 Encoder input configured for absolute encoder

Table 101: 7XX410.50-1 - Counter X control / absolute encoder

Encoder configuration (configuration register)



Bit	Description
0	Referencing for encoder 1: • Pos. edge: Start referencing of counter 1 • Neg. edge: End referencing of counter 1
1	Referencing for encoder 2: • Pos. edge: Start referencing of counter 2 • Neg. edge: End referencing of counter 2
2	Referencing for encoder 3: • Pos. edge: Start referencing of counter 3 • Neg. edge: End referencing of counter 3
3	Clear "Trigger Counter 1" when this bit is changed
4	Clear "Trigger Counter 2" when this bit is changed
5	Clear "Trigger Counter 3" when this bit is changed
6	0 Start "Trigger Counter 1" at pos. edge of E1 1 Start "Trigger Counter 1" at neg. edge of E1
7	0 Start "Trigger Counter 2" at pos. edge of E2 1 Start "Trigger Counter 2" at neg. edge of E2
8	0 Start "Trigger Counter 3" at pos. edge of E3 1 Start "Trigger Counter 3" at neg. edge of E3
9	0 Reserved
10 - 11	Error mode: 00 Show wire break and encoder error 01 Show only wire break 10 Show only ABR or parity error
12	1 Clear error from encoder 1
13	1 Clear error from encoder 2
14	1 Clear error from encoder 3
15	Encoder supply: 0 5 VDC 1 24 VDC

Table 102: 7XX410.50-1 - Configuration register

Status registers



Bit	Description
0	Changes its state depending on the referencing of encoder 1
1	0 Encoder 1 is currently being referenced 1 Encoder 1 is referenced
2	Status of E1
3	Changes its state depending on the referencing of encoder 2
4	0 Encoder 2 is currently being referenced 1 Encoder 2 is referenced
5	Status of E2
6	Changes its state depending on the referencing of encoder 3
7	0 Encoder 3 is currently being referenced 1 Encoder 3 is referenced
8	Status of E3
9 - 10	0 Reserved
11	Module supply 0 Ok 1 <18 VDC
12	Encoder 1 error: 0 No error 1 Wire break error (??? is this true, or corresponding configuration "error mode" bits 10+11)
13	Encoder 2 error: 0 No error 1 Wire break error (??? is this true, or corresponding configuration "error mode" bits 10+11)
14	Encoder 3 error: 0 No error 1 Wire break error (??? is this true, or corresponding configuration "error mode" bits 10+11)
15	Encoder supply 0 Ok 1 <18 VDC

Table 103: 7XX410.50-1 - Status register

5.3 7XX412.50-1

5.3.1 Order data

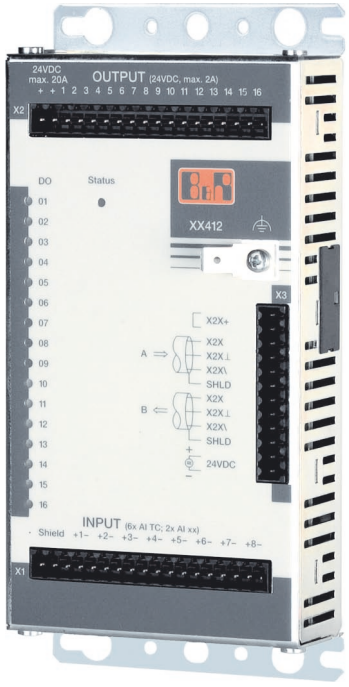
Model number	Short description	Figure
7XX412.50-1	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 12 digital outputs 2 A 50%, 4 digital outputs 2 A 100%, 24 VDC; 8 thermocouple inputs J,K,S, two of these can be used as analog input, ±10 V, 12-bit or, KTY10 or PT1000 inputs. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 104: 7XX412.50-1 - Order data

5.3.2 Technical data

Product ID	7XX412.50-1
Short description	
Digital channels	16 outputs
Analog channels	8 thermocouple inputs (using software, 2 of these can be configured as analog inputs for resistance measurement and temperature measurement)
Interfaces	1 x X2X Link slave
Electrical isolation X2X - Digital/Analog 24 VDC - Digital 24 VDC - Analog Digital - Analog	 Yes No Yes Yes
Supply voltage	24 VDC
Power consumption	4.0 W
Digital outputs	
Rated voltage	24 VDC
Rated output current Output 1 - 12 Output 13 - 16	 2.0 A, 50% 2.0 A, 100%
Total current Output 1 - 12 Output 13 - 16	20.0 A 12.0 A 8.0 A
Output circuit	Source
Output protection	Thermal cutoff for over-current or short circuit, integrated protection for switching inductances, reverse polarity of output supply
Additional functions	-
Sensor supply	External
Thermocouple inputs	
Digital converter resolution	16-bit
Output format	INT
Measurement range Type J (FeCuNi) Type K (NiCrNi) Type S (PtRhPt)	 -180 to +1190°C -200 to +1380°C -27 to +1815°C
Terminal temperature compensation	Yes
Input protection	Protection against wiring with supply voltage

Table 105: 7XX412.50-1 - Technical data

Product ID	7XX412.50-1	
Analog inputs	**Voltage measurement**	**Resistance measurement**
Number of channels	Using software, up to 2 of the thermocouple inputs can be configured as differential inputs	
Input Voltage Resistance	 ±10 VDC 0 - 4000 Ω	
Digital converter resolution Voltage input Resistance input	 12-bit 11-bit	
Conversion time	≤300 µs for all channels	
Output format	INT	
Input impedance in signal range	20 MΩ	
Input protection	Protection against wiring with supply voltage	
Temperature measurement		
Number of channels	Using software, up to 2 of the thermocouple inputs can be configured for temperature measurement	
Input type	Resistance measurement with constant current supply for 2 wires	
Conversion time	≤300 µs for all channels	
Output format	INT	
Sensors KTY10-6 PT1000	Can be configured for each channel using software -50 to +125°C -200 to +850°C	
Resistance measurement range	0 - 4000 Ω	
Input protection	Protection against wiring with supply voltage	
Interfaces		
Application interface Type Design	 X2X Link slave 12-pin multipoint connector	
General information		
Certification	CE, C-UL-US, GOST-R	
Status indicators	I/O function for each digital output, status	
Diagnostics I/O function X2X Interface	 Yes, with LEDs Yes, with status LED	
Operational conditions		
Temperature	0 to 50°C	
Relative humidity	5 - 95%, non-condensing	
Storage and transport conditions		
Temperature	-25 to +70°C	
Relative humidity	5 - 95%, non-condensing	

Table 105: 7XX412.50-1 - Technical data

Product ID	7XX412.50-1
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	410 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 105: 7XX412.50-1 - Technical data

5.3.3 Additional technical data

Product ID	7XX412.50-1	
Digital outputs		
Channel	1-12	13-16
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 100 Hz (with resistive load)	
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Thermocouple inputs		
Resolution	0.1°C / LSB	
Analog inputs	**Voltage measurement**	**Resistance measurement**
Resolution	4.88 mV / LSB	1 Ω / LSB
Value range / input signal $7FFF $0000 $8001	 +10 VDC 0 VDC -10 VDC	 4000 Ω 0 Ω -
Input filter Limit frequency Attenuation	 10 kHz 60 dB	
Temperature measurement		
Digital converter resolution	12-bit	
Conversion of measurement values to temperature values	Automatic in the module	
Wiring	2-wire	
Measuring current	1 mA	
Interfaces		
X2X Link slave user interface Min. cycle time on the X2X bus	 >300 µs	

Table 106: 7XX412.50-1 - Additional technical data

Product ID	7XX412.50-1
Status indicators	
Status LED	Yes
I/O LEDs	16 LEDs, per digital output
Power supply	
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.
General information	
B&R ID code	$6038

Table 106: 7XX412.50-1 - Additional technical data

5.3.4 Diagnostic LEDs

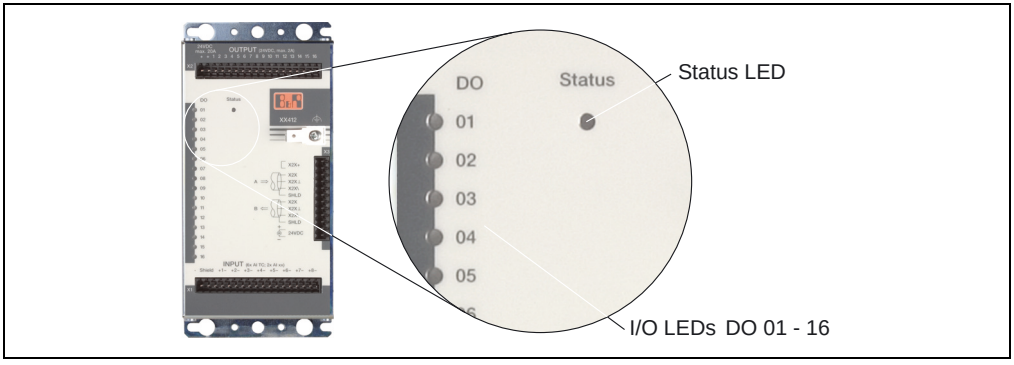


Figure 84: 7XX412.50-1 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error for an I/O channel - Level monitoring for digital outputs has responded.
	Double flash	Possible error: • Module supply voltage is outside the valid range. • The monitor for the supply of digital outputs registered an error.
	On	Error or reset state

Table 107: 7XX412.50-1 - Status-LED

5.3.5 Thermocouple inputs / analog inputs

Terminal block connections

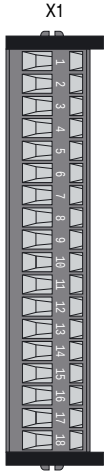
18-pin terminal block	Terminal	Assignment	
 7TB718.91	1	Shield [1]	
	2	Shield [1]	
	3	Thermocouple 1 +	
	4	Thermocouple 1 ⊥	
	5	Thermocouple 2 +	
	6	Thermocouple 2 ⊥	
	7	Thermocouple 3 +	
	8	Thermocouple 3 ⊥	
	9	Thermocouple 4 +	
	10	Thermocouple 4 ⊥	
	11	Thermocouple 5 +	
	12	Thermocouple 5 ⊥	
	13	Thermocouple 6 +	
	14	Thermocouple 6 ⊥	
	15	Thermocouple 7 +	Analog input 1 +
	16	Thermocouple 7 ⊥	Analog input 1 ⊥
	17	Thermocouple 8 +	Analog input 2 +
	18	Thermocouple 8 ⊥	Analog input 2 ⊥

Table 108: 7XX412.50-1 - Pin assignments X1 / digital inputs

1) Same potential as the housing

Connection examples

Thermocouple inputs / analog inputs

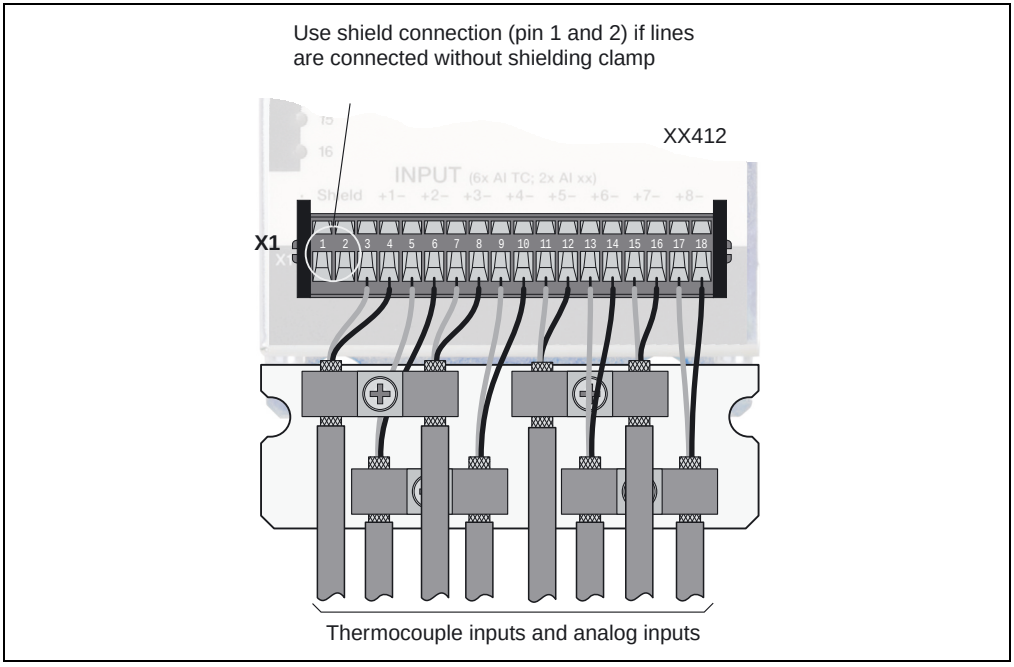


Figure 85: 7XX412.50-1 - Connection example / thermocouple and analog inputs

Resistance measurement

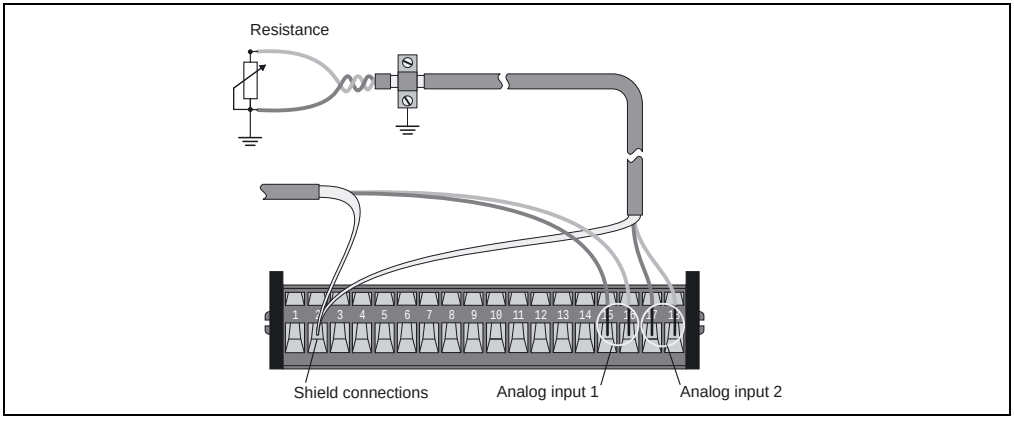


Figure 86: 7XX412.50-1 - Connection example / resistance measurement

Temperature measurement

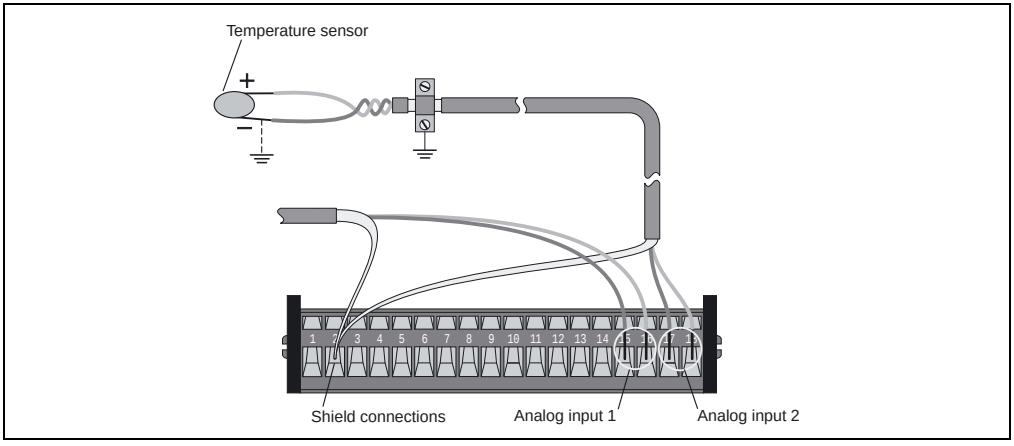


Figure 87: 7XX412.50-1 - Connection example / temperature measurement

Input circuit diagram

Thermocouple inputs

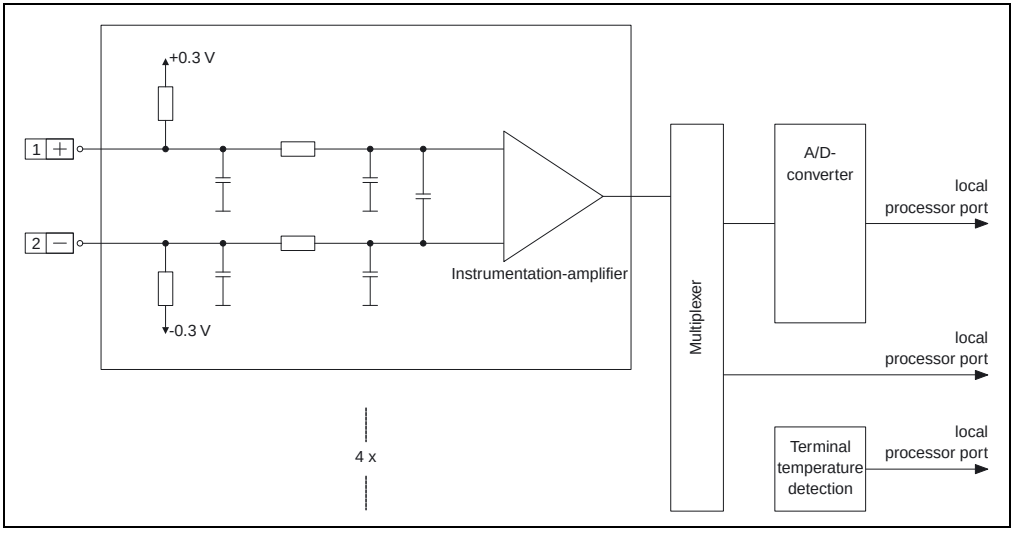


Figure 88: 7XX412.50-1 - Input circuit diagram / thermocouple inputs

Resistance, temperature measurement (analog inputs 1 + 2)

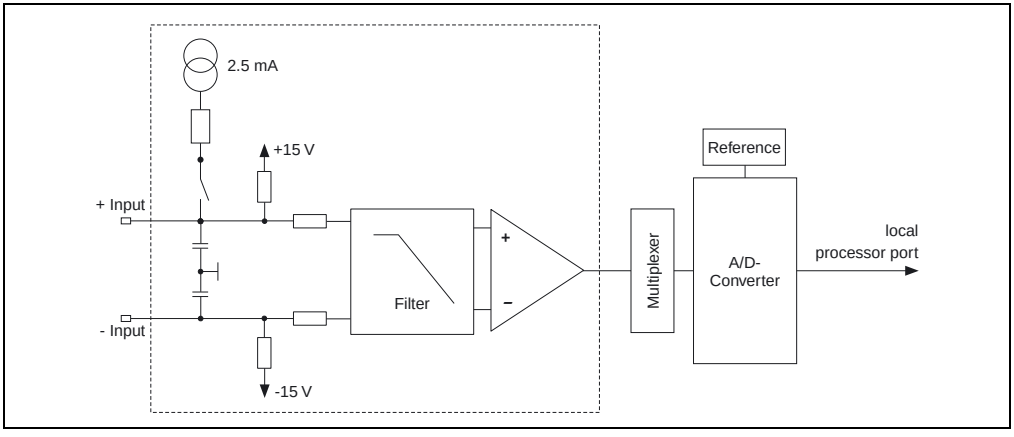


Figure 89: 7XX412.50-1 - Input circuit diagram / resistance and temperature measurement

Analog inputs (analog inputs 1 + 2)

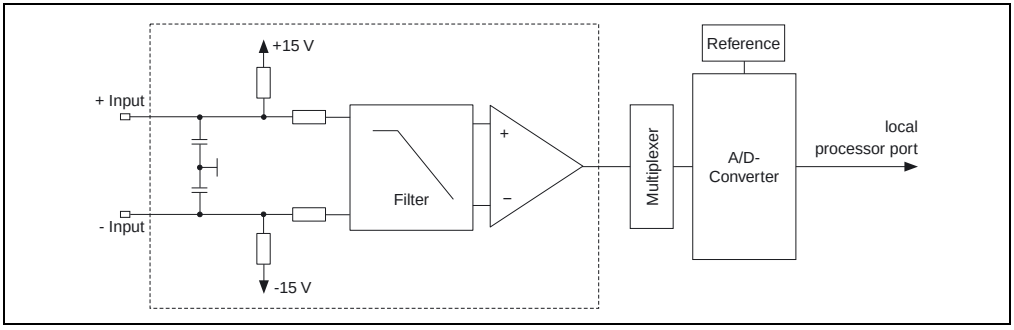


Figure 90: 7XX412.50-1 - Input circuit diagram / analog inputs

5.3.6 Digital outputs

Terminal block connections

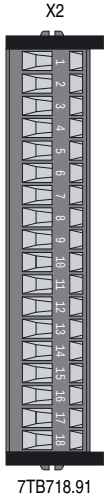
18-pin terminal block	Terminal	Assignment
	1	+ 24 VDC output supply
	2	+ 24 VDC output supply
	3	Digital output 1
	4	Digital output 2
	5	Digital output 3
	6	Digital output 4
	7	Digital output 5
	8	Digital output 6
	9	Digital output 7
	10	Digital output 8
	11	Digital output 9
	12	Digital output 10
	13	Digital output 11
	14	Digital output 12
	15	Digital output 13
	16	Digital output 14
	17	Digital output 15
	18	Digital output 16

Table 109: 7XX412.50-1 - Pin assignment - X2 / digital outputs

Connection example

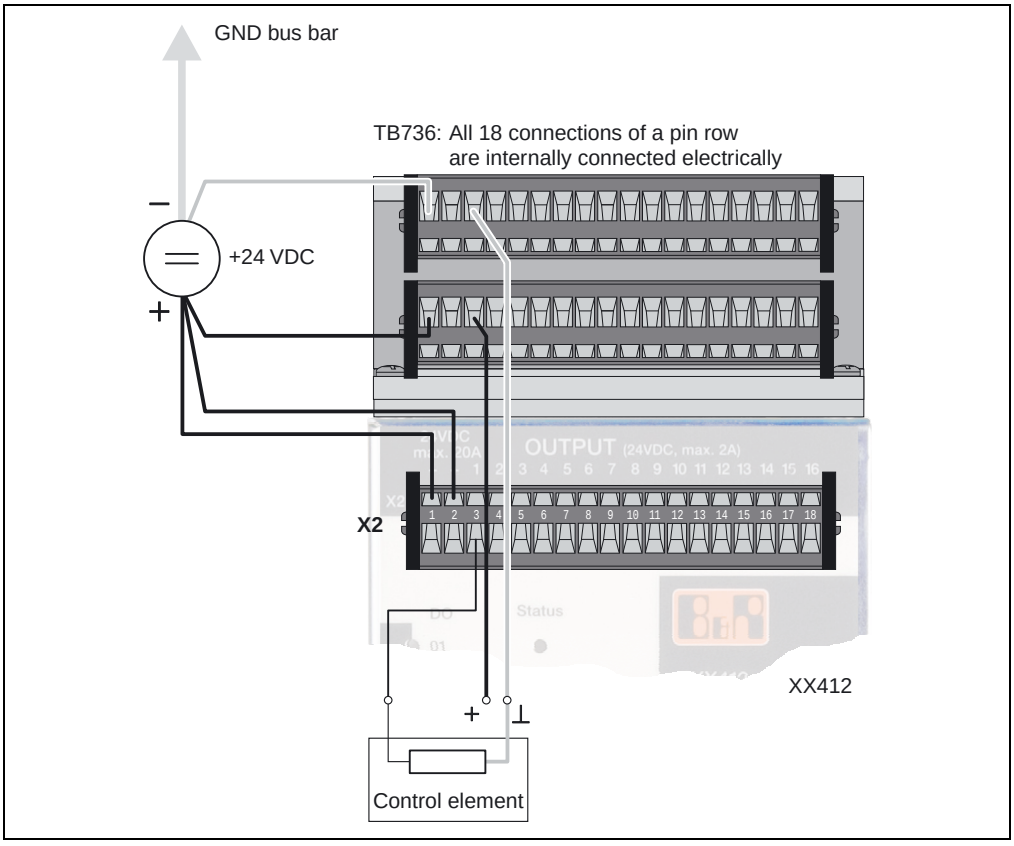


Figure 91: 7XX412.50-1 - Connection example / digital outputs

Output circuit diagram

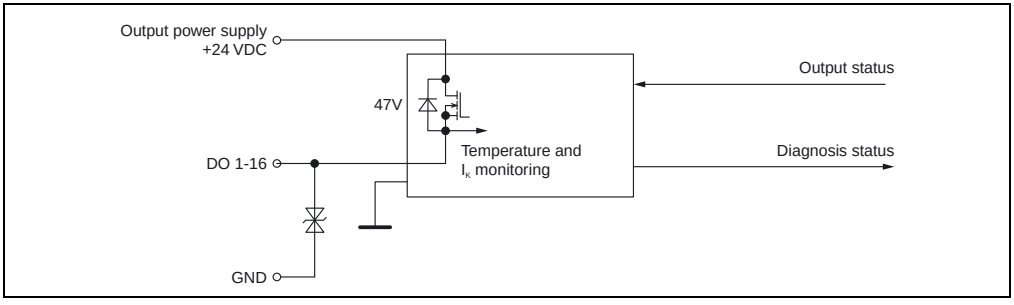


Figure 92: 7XX412.50-1 - Output circuit diagram / digital outputs

Switching inductive loads

Digital outputs 1 to 12

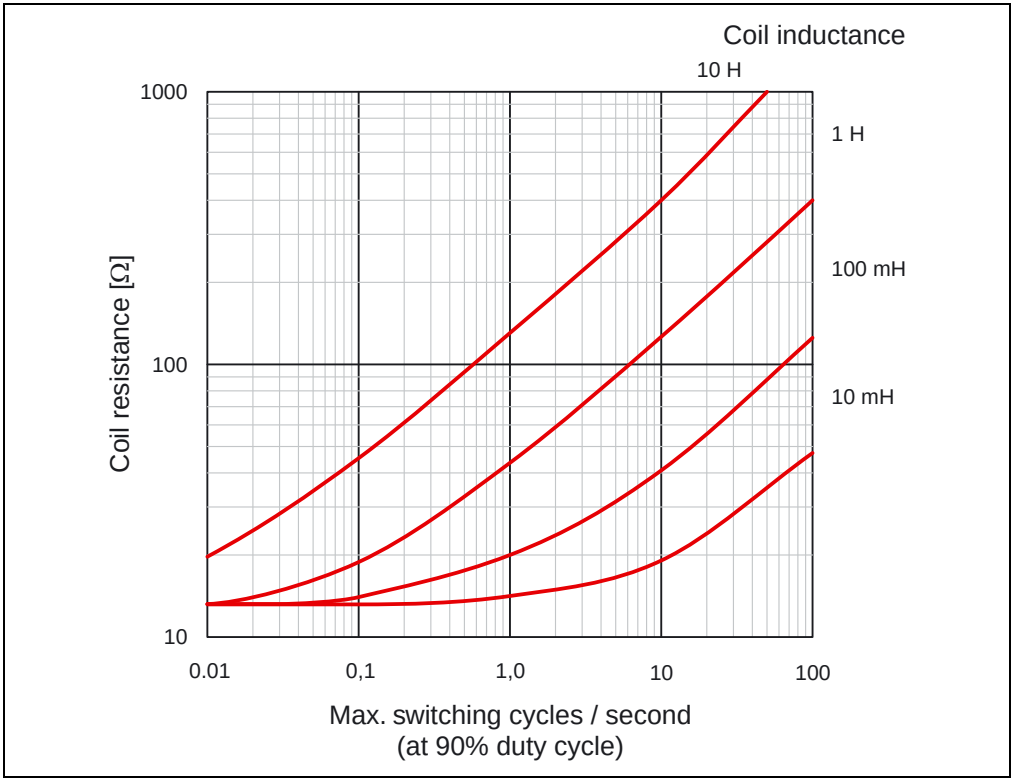


Figure 93: 7XX412.50-1 - Switching inductive loads / Digital outputs 1 to 12

Digital outputs 13 to 16

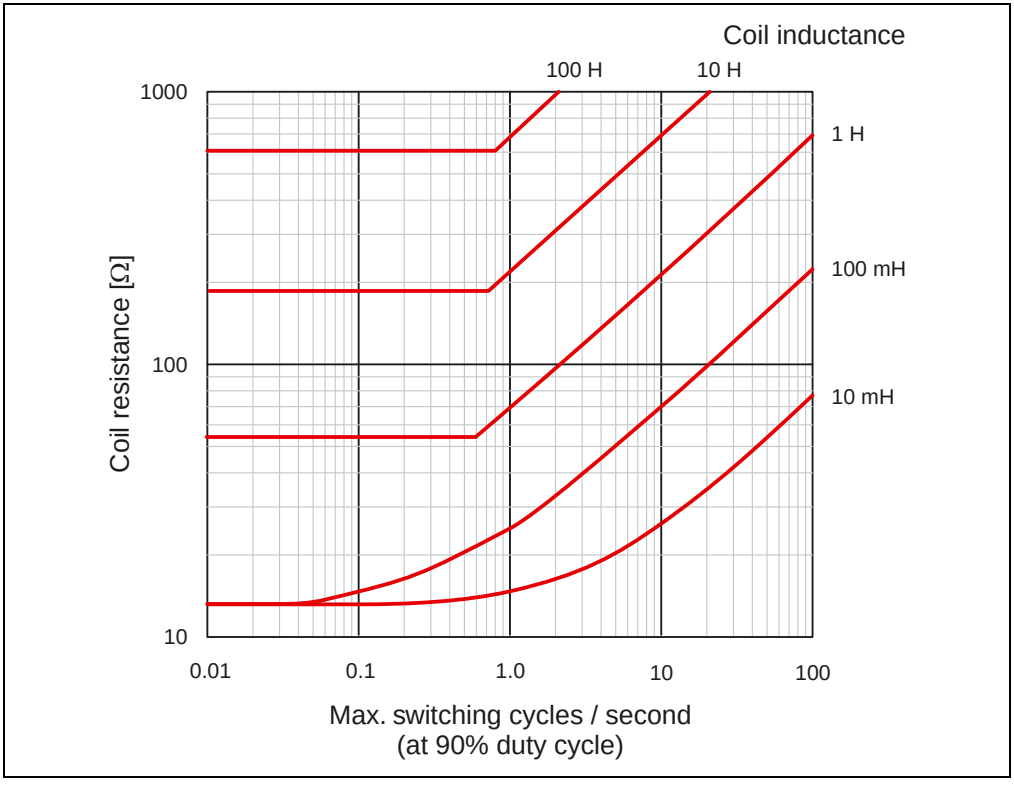


Figure 94: 7XX412.50-1 - Switching inductive loads / Digital outputs 13 to 16

5.3.7 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

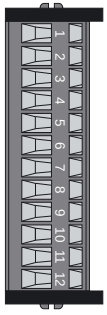
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 110: 7XX412.50-1 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

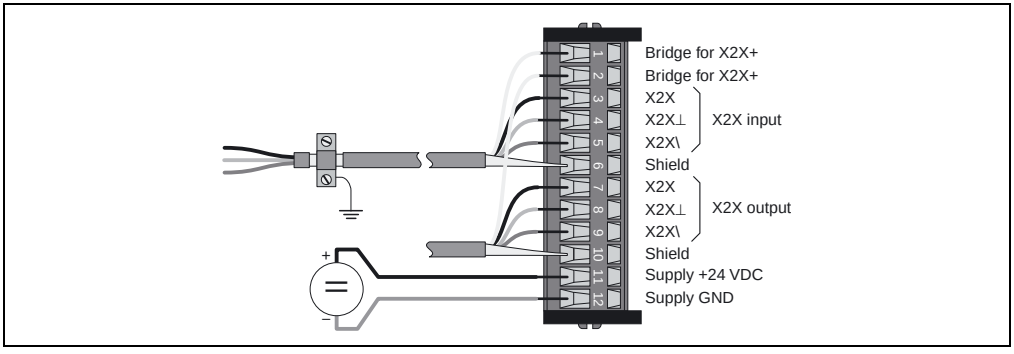


Figure 95: 7XX412.50-1 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

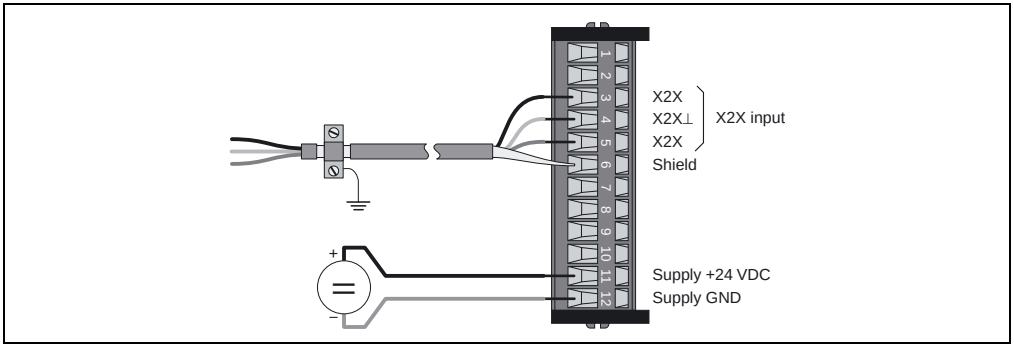


Figure 96: 7XX412.50-1 - Connection example of X2X Link as last X2X Link slave

5.3.8 Monitoring

Monitoring the module supply voltage

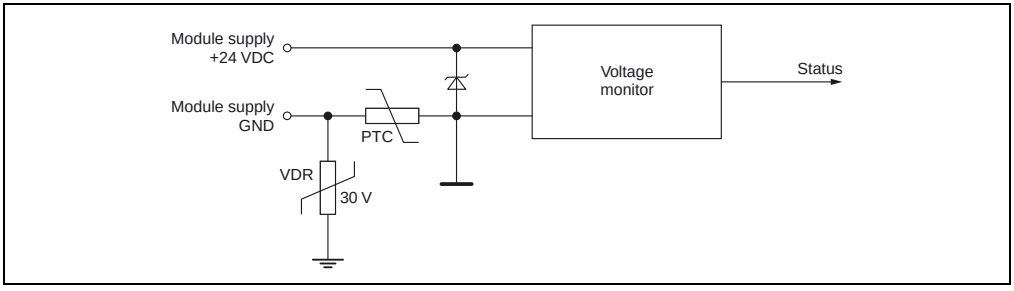


Figure 97: 7XX412.50-1 - Circuit diagram for the module supply

Current monitoring for the 2A outputs

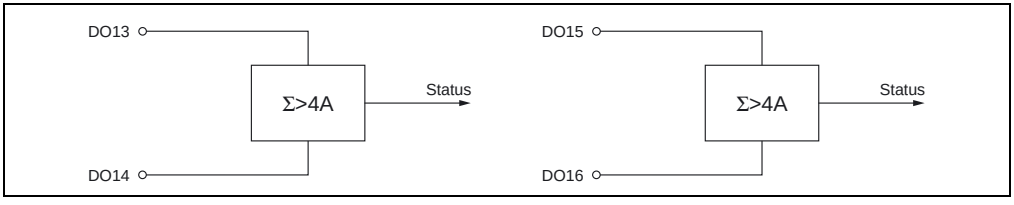


Figure 98: 7XX412.50-1 - Current monitoring for the 2A outputs

5.3.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	DigitalOutput01 - DigitalOutput16	BOOL	1			●	●
8	StatusDigitalOutput01 - StatusDigitalOutput16	BOOL	1	●	●		
16	Temperature01	INT	1	●	●		
18	Temperature02	INT	1	●	●		
20	Temperature03	INT	1	●	●		
22	Temperature04	INT	1	●	●		
24	Temperature05	INT	1	●	●		
26	Temperature06	INT	1	●	●		
28	Temperature07, AnalogInput01, Resistor01	INT	1	●	●		
30	Temperature08, AnalogInput02, Resistor02	INT	1	●	●		
32	StatusInput01	UINT	1	●	●		
32	ConfigOutput01	UINT	1			●	●
34	Reserved	UINT	1	●	●		
34	Reserved	UINT	1			●	●

Table 111: 7XX412.50-1 - Register overview

Register description

Register	Description	
DigitalOutput01 - DigitalOutput16	Setting the digital outputs	
StatusDigitalOutput01 - StatusDigitalOutput16	Reading back the digital outputs	
Temperature01 - Temperature08	Temperature measurement with thermocouple type J, K or S (0.1°C per LSB).	
Temperature07 - Temperature08	Temperature measurement with sensor KTY10-6 or PT1000. The measured values are automatically converted to temperature values in the module.	In addition to the measurement with thermocouples type J, K or S, the inputs for thermocouple 7 and 8 can also be configured as analog input for these measurements.
AnalogInput01, AnalogInput02	Voltage measurement	
Resistor01, Resistor02	Resistance measurement	
StatusInput01	Status information about the module	
ConfigOutput01	Module configuration	

Table 112: 7XX412.50-1 - Register description

Voltage measurement

The analog inputs deliver data in 16-bit 2s complement (INT format).

Relationship between numerical value and input voltage:

Numerical value (INT)		Voltage measurement
Hexadecimal	Decimal	
8001	-32767	-10 V
C001	-16383	-5 V
FFF8	-8	- 2.44 mV
0000	0	0 V
0008	8	2.44 mV
3FFF	16383	5 V
7FFF	32767	10 V

Table 113: 7XX412.50-1 - Numerical value for voltage measurement

Resistance measurement

Relationship between numerical value and resistance:

Numerical value (INT)		Resistance measurement
Hexadecimal	Decimal	
0000	0	0 Ω
0008	8	1 Ω
3FFF	16383	2000 Ω
7FFF	32767	4000 Ω

Table 114: 7XX412.50-1 - Numerical value of the resistance measurement

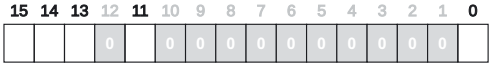
Module configuration



Bit	Description
0	Thermocouple - terminal temperature compensation switched on (1) or off (0)
1	Thermocouple - ADCs sinc3 filter frequency: 0 50 Hz 1 60 Hz
2 - 3	00 Thermocouple type J 01 Thermocouple type K 10 Thermocouple type S 11 Not allowed
4 - 5	Configuration of thermocouple inputs 7 and 8: 00 Channel 7+8: Thermocouple 01 Channel 7: Thermocouple Channel 8: Analog input 10 Channel 7+8: Analog input 11 Not allowed
6 - 7	Analog input type, when channel is configured as analog input (bit 5+4)): 00 Channel 7+8: Voltage measurement 01 Channel 7: Thermocouple Channel 8: Resistance measurement 10 Channel 7+8: Resistance measurement 11 Not allowed
8 - 9	Type of resistance measurement on channel 8, if configured as analog input (bit 5+4) with resistance measurement (bit 7+6): 00 Standard resistance measurement 01 Temperature sensor KTY10-6 10 Temperature sensor PT1000 11 Not allowed
10 - 11	Type of resistance measurement on channel 7, if configured as analog input (bit 5+4) with resistance measurement (bit 7+6): 00 Standard resistance measurement 01 Temperature sensor KTY10-6 10 Temperature sensor PT1000 11 Not allowed
12 - 15	0 Reserved

Table 115: 7XX412.50-1 - Configuration register

Status information about the module



Bit	Description
0	Validity of the analog input data: 0 Valid 1 Invalid This is not the case when switching on the supply voltage or after changing one or more ADC parameters in the configuration register
1 - 10	0 Reserved
11	Monitoring the module supply: 0 Supply within the limits 18 VDC to 30 VDC 1 Supply outside the limits 18 VDC to 30 VDC
12	0 Reserved
13	Total current of the digital outputs 5 and 6: 0 <4 A 1 >4 A
14	Total current of the digital outputs 7 and 8: 0 <4 A 1 >4 A
15	Monitoring the 24 VDC supply of the digital outputs: 0 Ok 1 Error

Table 116: 7XX412.50-1 - Status register

5.4 7XX415.50-K02

5.4.1 Order data

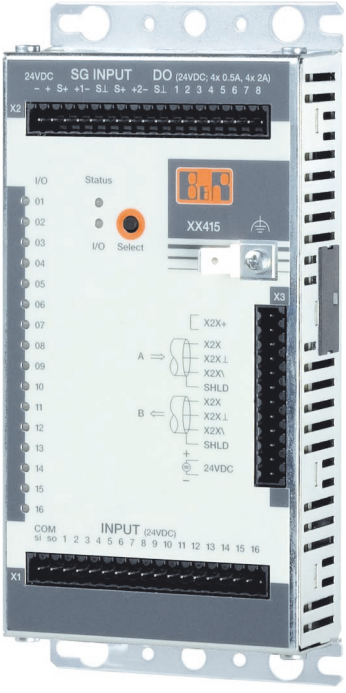
Model number	Short description	Figure
7XX415.50-K02	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 2 full-bridge strain gauge inputs; 4 digital outputs 0.5 A, 4 digital outputs 2 A; 24 VDC; 16 digital inputs, 24 VDC sink, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement and 1 event counter. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 117: 7XX415.50-K02 - Order data

5.4.2 Technical data

Product ID	7XX415.50-K02	
Short description		
Digital channels	16 inputs, 8 outputs	
Analog channels	2 full-bridge strain gauge inputs	
Interfaces	1 x X2X Link slave	
Electrical isolation 24 VDC - Dig. Output 24 VDC - Dig. Input 24 VDC - Analog Dig. Input - Dig. Output Analog - Digital X2X - All channels X2X - 24 VDC	 No Yes Yes Yes Yes Yes Yes	
Supply voltage	24 VDC	
Power consumption	4.0 W	
Digital inputs		
Channels	1-3	4-16
Rated voltage	24 VDC	24 VDC
Input filter Hardware Software	 ≤4 µs -	 ≤200 µs -
Input circuit	Sink	Sink or source
Additional functions	Event counting, incremental encoder operation, gate, frequency and period measurement	-
Digital outputs		
Rated voltage	24 VDC	
Rated output current Output 1 - 4 Output 5 - 8	 0.5 A 2.0 A	
Total current	10.0 A	
Output circuit	Source	
Output protection	Thermal cutoff for overcurrent or short circuit, integrated protection for switching inductances, reverse polarity of output supply	
Additional functions	-	
Sensor supply	External	

Table 118: 7XX415.50-K02 - Technical data

Product ID	7XX415.50-K02
Analog inputs	
Full-bridge strain gauge inputs	2
Type	Differential
Conversion method	Sigma Delta
Digital converter resolution	24-bit
Effective resolution	15 to 18-bit (depending on the data output rate and measurement range)
Operating range / measurement sensor	75 to 5000 Ω
Bridge voltage	4.5 VDC / max. 60 mA
Wiring	4-wire
Measurement area	Approximately ±8 to ±65 mV, can be configured using software
Input current	<140 nA
Conversion time	Configurable between 3 and 20 ms
Output format	DINT
Input protection	Protection against wiring with supply voltage
Interfaces	
Application interface Type Design	 X2X Link slave 12-pin multipoint connector
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function for each digital output, status
Diagnostics I/O function Power supply X2X	 Yes, with software status Yes, with software status Yes, with status LED
Operational conditions	
Temperature	0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	405 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 118: 7XX415.50-K02 - Technical data

5.4.3 Additional technical data

Product ID	7XX415.50-K02	
Digital inputs		
Channels	1-3	4-16
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC	18 VDC / 24 VDC / 30 VDC
Switching threshold LOW HIGH	<5 V >15 V	
Input current at rated voltage	Approx. 10 mA	Approx. 5 mA
Event counter operation		
Amount	3	
Counter 1/2/3	Input 1/2/3	
Counter size Counter 1 Counter 2+3	 32-bit 16-bit	
Input frequency	Max. 100 kHz	
Pulse length / distance between edges	>4 µs	
Signal form	Square wave pulse	
Evaluation	Positive or negative edge, cyclic counter	
Incremental encoder operation		
Amount	1	
Type	ABR or AB	
Counter size	32-bit	
Input frequency	Max. 30 kHz	
Evaluation	4x	
Signal form	Square wave pulse	
Gate measurement		
Amount	1	
Gate measurement on channel 1	Input 1	
Counter size	16-bit	
Evaluation	Positive or negative edge	
Input frequency	Max. 100 kHz	
Pulse length	10 µs	
Length of pauses between pulses	10 µs	
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz	
Signal form	Square wave pulse	

Table 119: 7XX415.50-K02 - Additional technical data

Product ID	7XX415.50-K02	
Period measurement		
Amount	1	
Measurement on channel 1	Input 1	
Counter size	16-bit	
Evaluation	Positive or negative edge	
Input frequency	Max. 100 kHz	
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz	
Signal form	Square wave pulse	
Digital outputs		
Channel	1-4	5-8
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 100 Hz (with resistive load)	
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Interfaces		
X2X Link slave user interface Min. cycle time on the X2X bus	 >350 µs	
Status indicators		
Status LED	Yes (color and blink code)	
I/O LEDs	16 LEDs, per digital input 8 of these can be switched to digital output using the I/O Select button	
I/O Select LED	**Green**: LEDs 01-08 indicate the status of the **inputs** **Yellow**: LEDs 01-08 indicate the status of the **outputs**	
Control elements		
I/O Select button	Selects whether the I/O-LEDs 01-08 represent the inputs or outputs	
Power supply		
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.	
General information		
B&R ID code	$6437	

Table 119: 7XX415.50-K02 - Additional technical data

5.4.4 Diagnostic LEDs

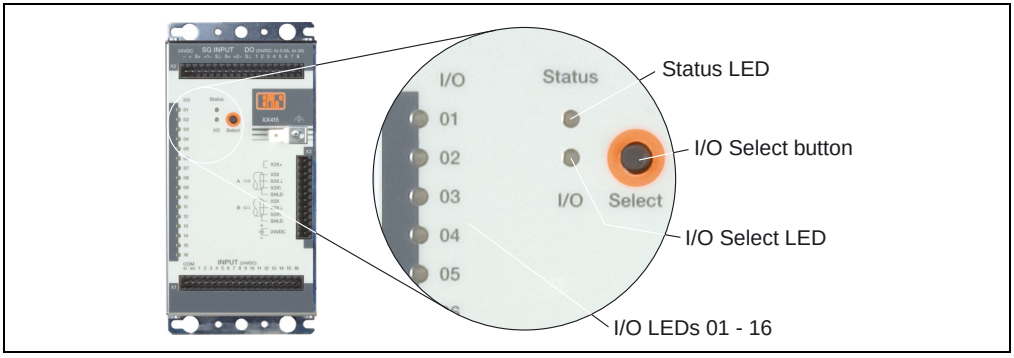


Figure 99: 7XX415.50-K02 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error for an I/O channel - Level monitoring for digital outputs has responded.
	Double flash	Possible error: • Module supply voltage is outside the valid range. • The monitor for the supply of digital outputs registered an error.
	On	Error or reset state

Table 120: 7XX415.50-K02 - Status-LED

I/O Select LED

The 2 color LEDs 01-08 indicate the status of the inputs and outputs 01-08. The display is switched using the "I/O Select" button. The status is indicated by the I/O Select LED:

Color	Meaning
Green	The I/O LEDs 01-08 indicate the status of the inputs.
Red	The I/O LEDs 01-08 indicate the status of the outputs.

Table 121: 7XX415.50-K02 - I/O Select LED

I/O 01-08, if I/O Select LED green

Color	Meaning
Green	The corresponding input = 1.
Off	The corresponding input = 0.

Table 122: 7XX415.50-K02 - LEDs 01-16 (green)

I/O LEDs 01-08 (if I/O Select LED yellow) and I/O LEDs 09-16

Color	Meaning
Yellow	The corresponding output = 1.
Off	The corresponding output = 0.

Table 123: 7XX415.50-K02 - LEDs 01-16 (green)

5.4.5 Digital inputs

Terminal block connections

Inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.).

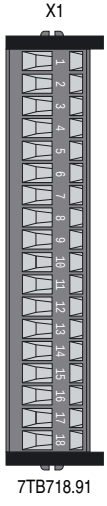
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	COM si (GND in sink operation, +24 VDC in source operation)
	2	COM so (+24 VDC in sink operation, GND in source operation)
	3	Digital input 1 / counter 1 / A
	4	Digital input 2 / counter 2 / B
	5	Digital input 3 / counter 3 / R / ext. CLK
	6	Digital input 4
	7	Digital input 5
	8	Digital input 6
	9	Digital input 7
	10	Digital input 8
	11	Digital input 9
	12	Digital input 10
	13	Digital input 11
	14	Digital input 12
	15	Digital input 13
	16	Digital input 14
	17	Digital input 15
	18	Digital input 16

Table 124: 7XX415.50-K02 - Pin assignments X1 / digital inputs

Connection examples

Sink connection

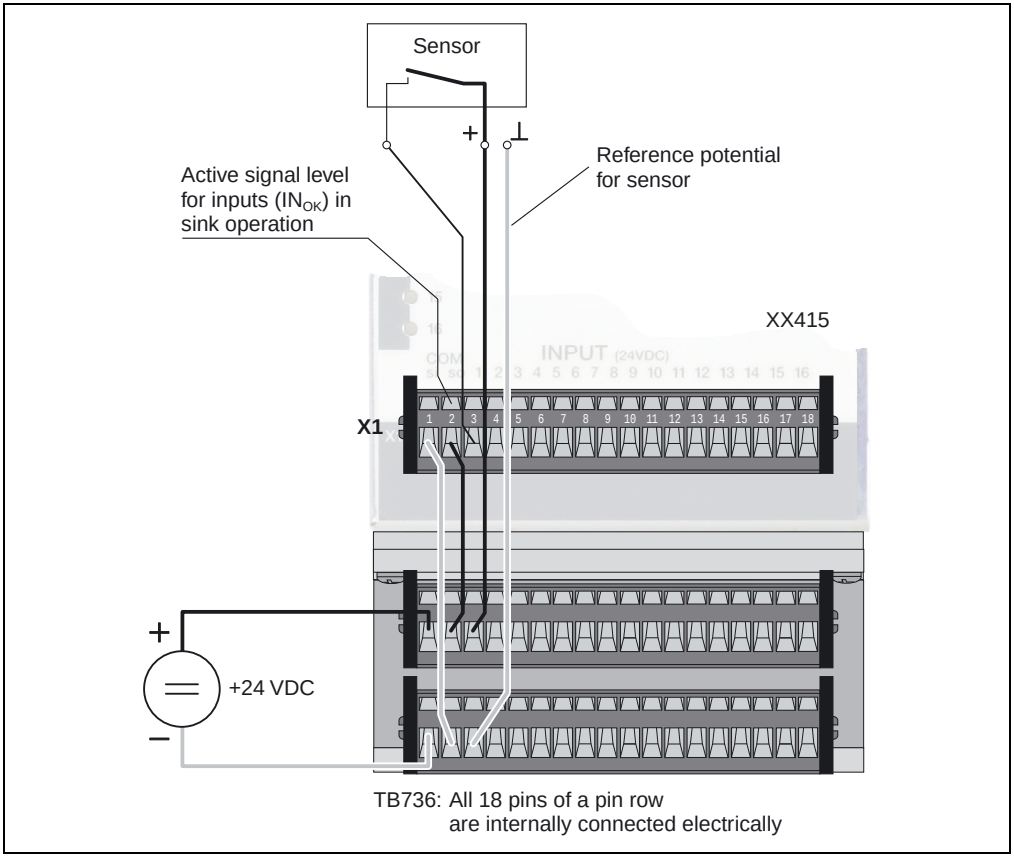


Figure 100: 7XX415.50-K02 - Connection example / digital input (sink connection)

Source connection

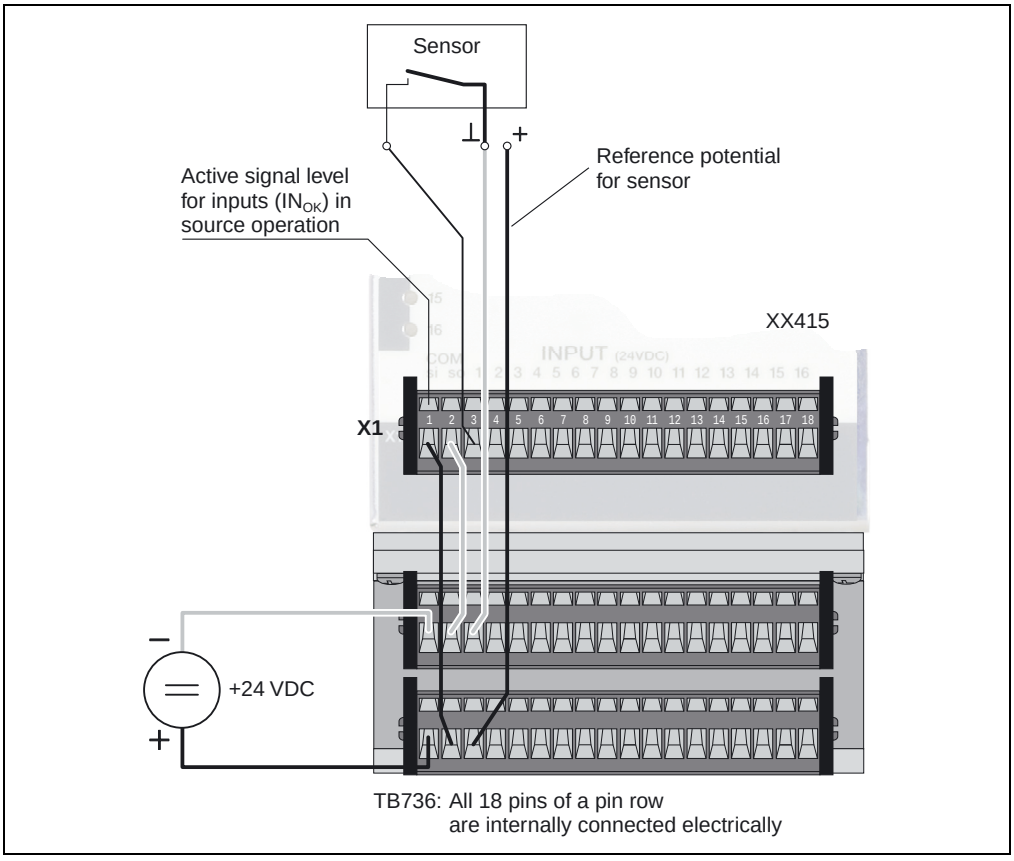


Figure 101: 7XX415.50-K02 - Connection example / digital inputs (source connection)

Counter inputs

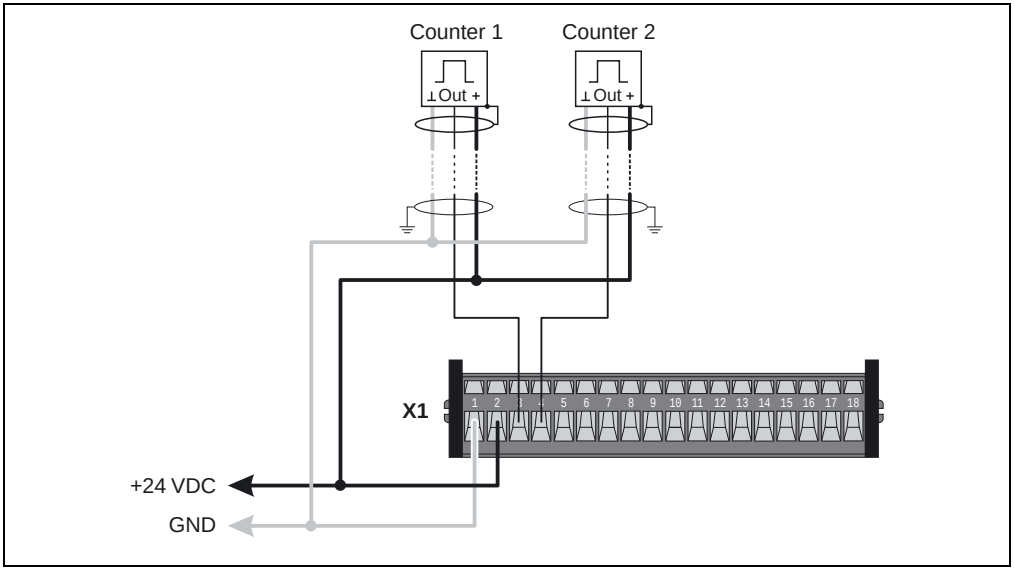


Figure 102: 7XX415.50-K02 - Connection example / counter input

Period or gate measurement

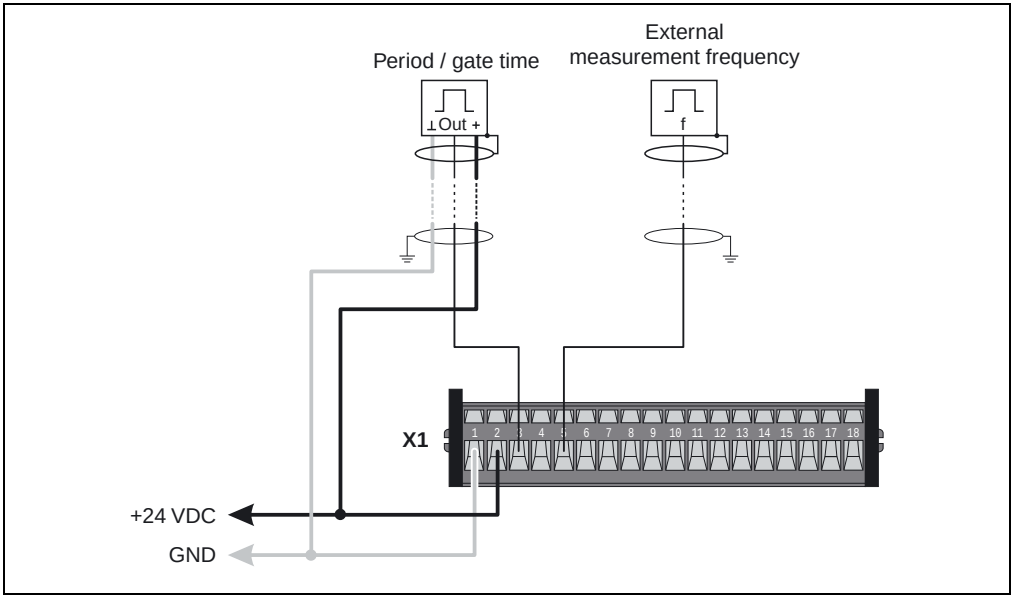


Figure 103: 7XX415.50-K02 - Connection example / period and gate measurement

Incremental encoder

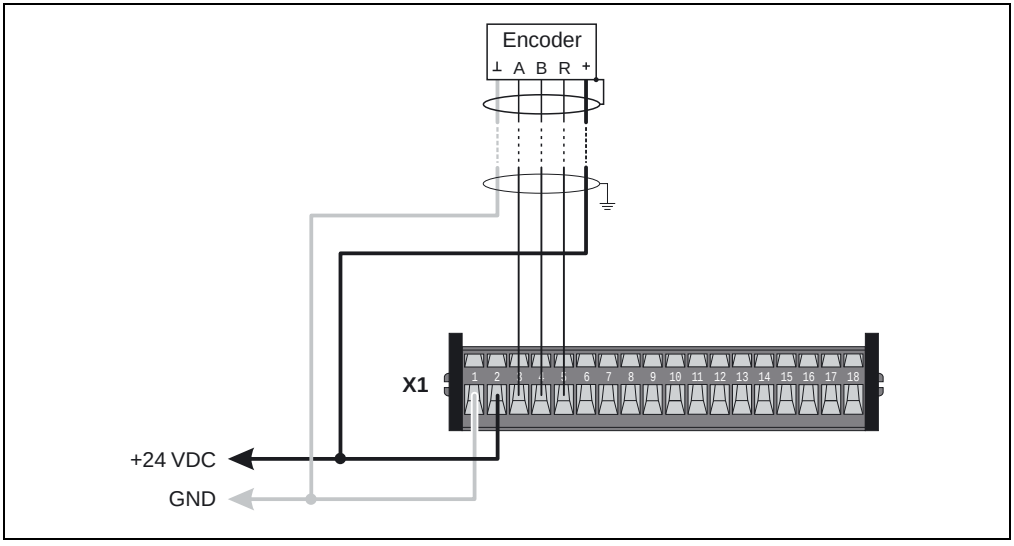


Figure 104: 7XX415.50-K02 - Connection example / incremental encoder

Input circuit diagram

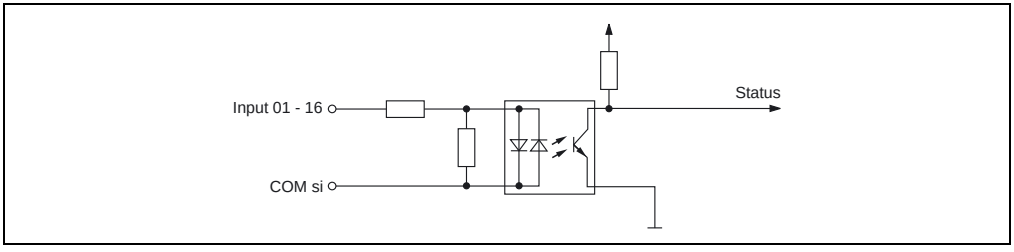


Figure 105: 7XX415.50-K02 - Input circuit diagram / digital inputs

5.4.6 Strain gauge inputs and digital outputs

Terminal block connections

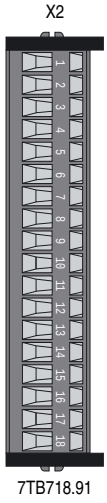
18-pin terminal block	Terminal	Assignment
 7TB718.91	1	-24 VDC output supply
	2	+24 VDC output supply
	3	Strain gauge channel 1 supply +
	4	Strain gauge channel 1 +
	5	Strain gauge channel 1 ⊥
	6	Strain gauge channel 1 supply ⊥
	7	Strain gauge channel 2 supply +
	8	Strain gauge channel 2 +
	9	Strain gauge channel 2 ⊥
	10	Strain gauge channel 2 supply ⊥
	11	Digital output 1
	12	Digital output 2
	13	Digital output 3
	14	Digital output 4
	15	Digital output 5
	16	Digital output 6
	17	Digital output 7
	18	Digital output 8

Table 125: 7XX415.50-K02 - Pin assignments for X2 / strain gauge inputs and digital outputs

Connection example

Strain gauge inputs

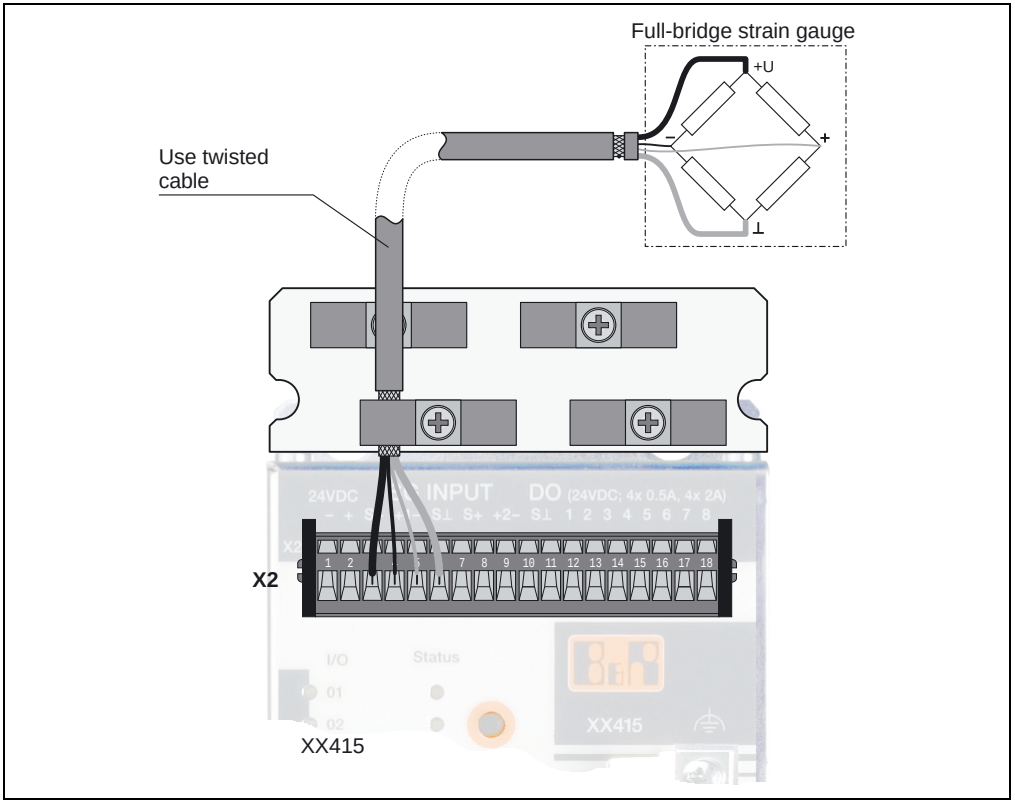


Figure 106: 7XX415.50-K02 - Connection example / strain gauge inputs

Digital outputs

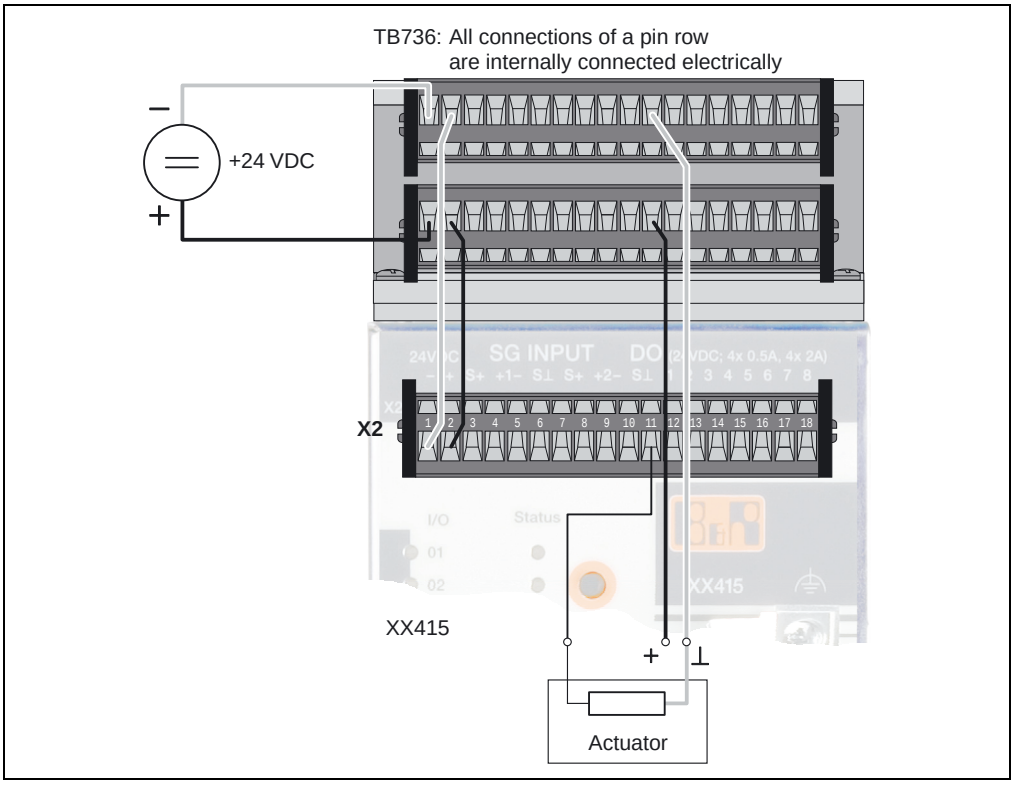


Figure 107: 7XX415.50-K02 - Connection example / digital outputs

Input circuit diagram of the strain gauge inputs

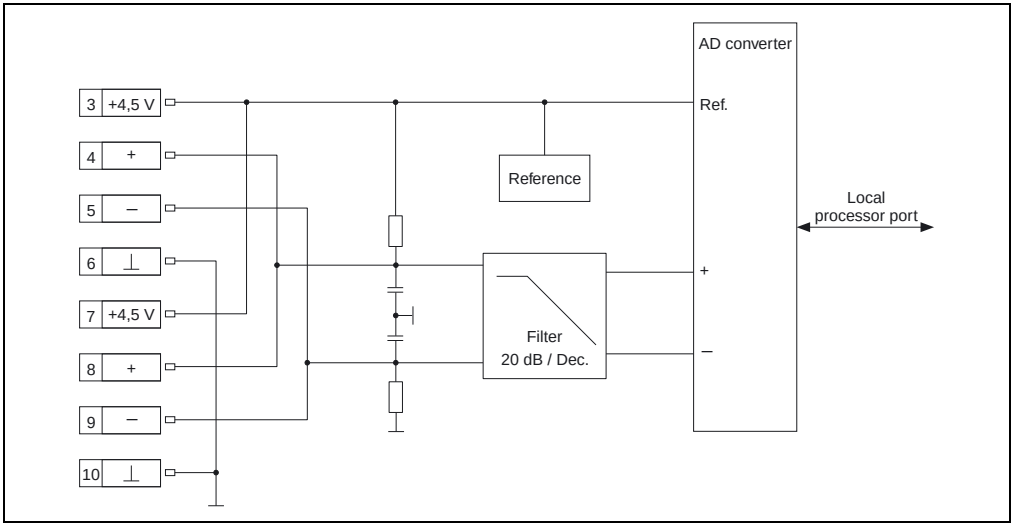


Figure 108: 7XX415.50-K02 - Input circuit diagram / strain gauge inputs

Output circuit diagram

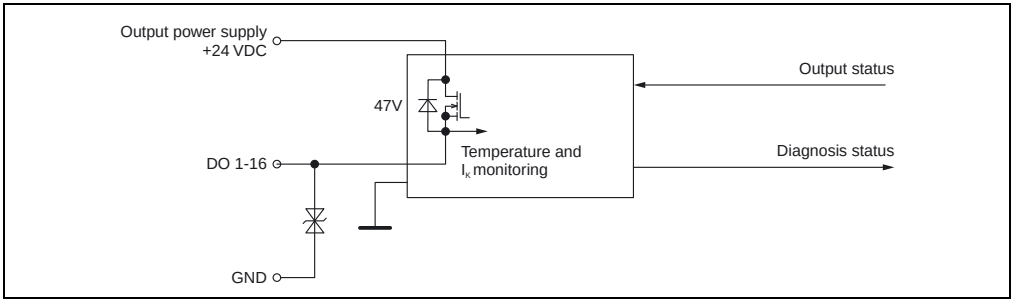


Figure 109: 7XX415.50-K02 - Output circuit diagram / digital outputs

Switching inductive loads

Digital outputs 1 to 4

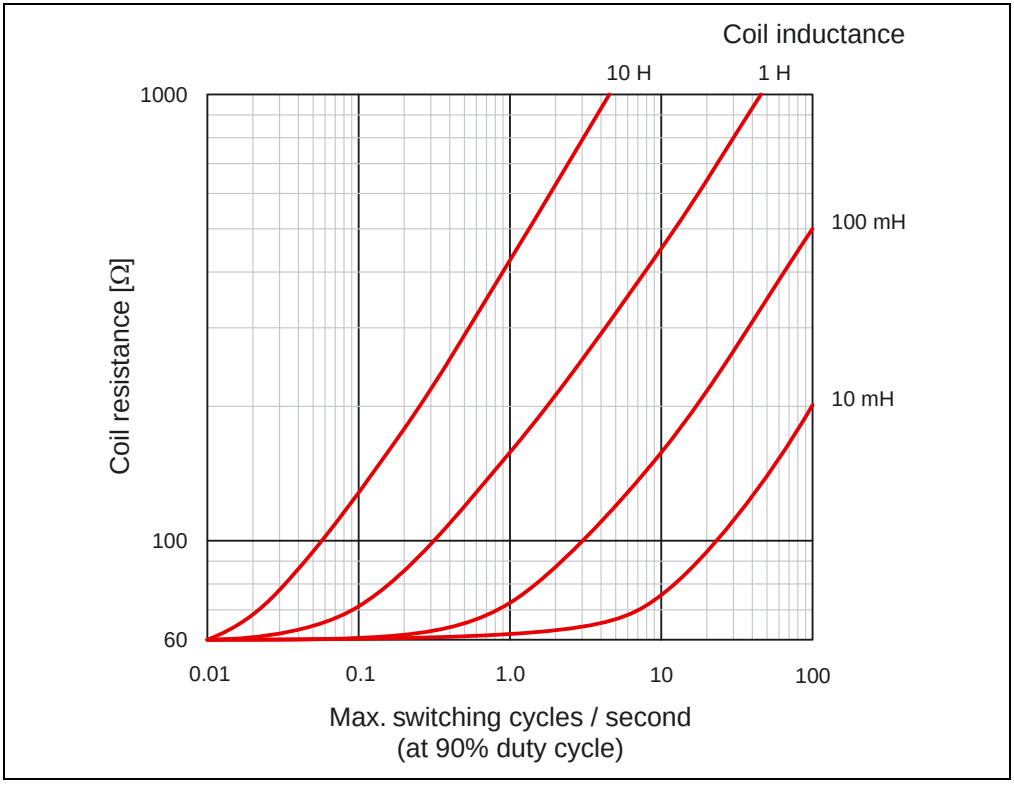


Figure 110: 7XX415.50-K02 - Switching inductive loads / Digital outputs 1 to 4

Digital outputs 5 to 8

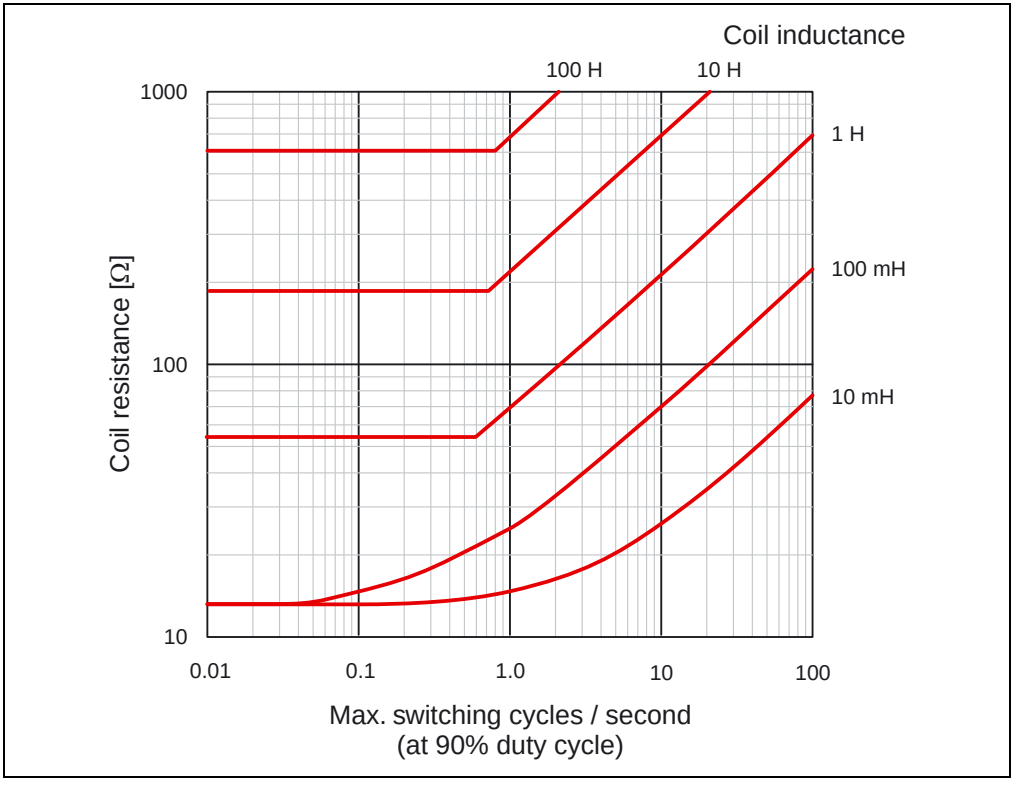


Figure 111: 7XX415.50-K02 - Switching inductive loads / Digital outputs 5 to 8

5.4.7 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

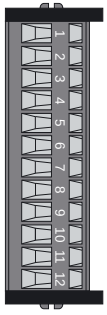
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 126: 7XX415.50-K02 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

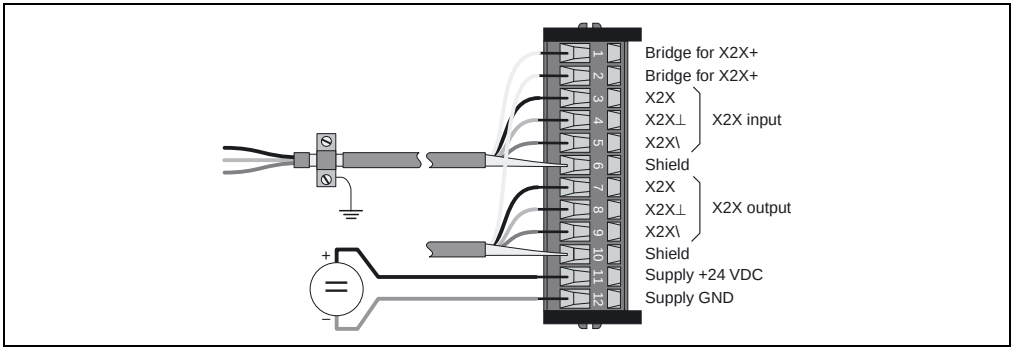


Figure 112: 7XX415.50-K02 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

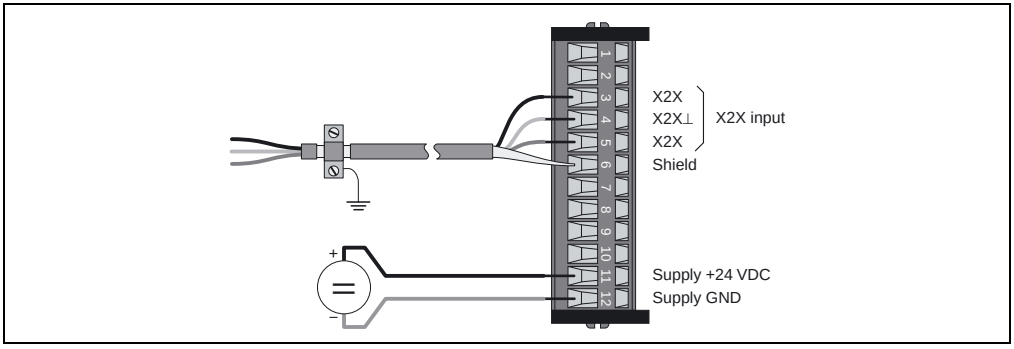


Figure 113: 7XX415.50-K02 - Connection example of X2X Link as last X2X Link slave

5.4.8 Monitoring

Monitoring the module supply voltage

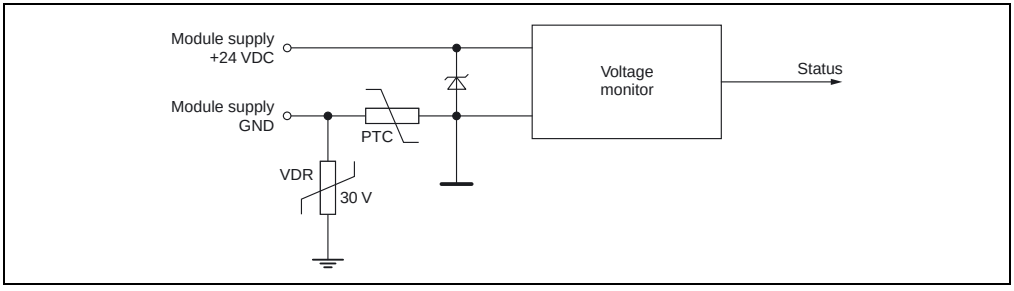


Figure 114: 7XX415.50-K02 - Circuit diagram for the module supply

Current monitoring for the 2A outputs

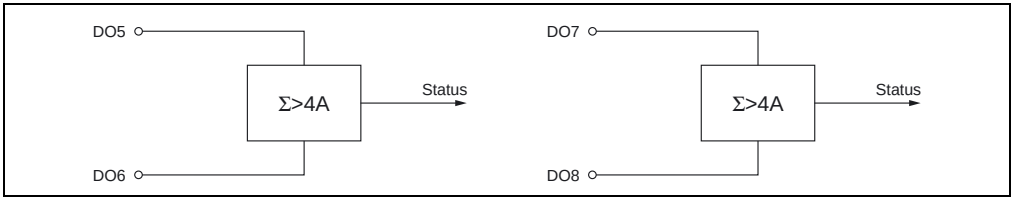


Figure 115: 7XX415.50-K02 - Current monitoring for the 2A outputs

5.4.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
0	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
1	DigitalInput09 - DigitalInput16	BOOL	1	●	●		
8	StatusDigitalOutput01 - StatusDigitalOutput08	BOOL	1	●	●		
16	Counter01	UDINT	1	●	●		
20	Counter02	UDINT	1	●	●		
22	Counter03	UDINT	1	●	●		
24	AnalogInput01	UDINT	1	●	●		
28	AnalogInput02	UDINT	1	●	●		
32	StatusInput01	UINT	1	●	●		
32	ConfigOutput01	UINT	1			●	●

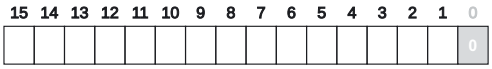
Table 127: 7XX415.50-K02 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput16	Level of digital inputs 1 - 16
DigitalOutput01 - DigitalOutput08	Setting the digital outputs 1 - 8
StatusDigitalOutput01 - StatusDigitalOutput08	Reading back the digital outputs 1-8
Counter01-Counter03	Counter value
AnalogInput01	Strain gauge analog input 1
AnalogInput02	Strain gauge analog input 2
StatusInput01	Status information about the module
ConfigOutput01	Module configuration

Table 128: 7XX415.50-K02 - Register description

Module configuration



Bit	Description
0	0 Reserved
1	0 R mode for AB(R) counter, off 1 R mode for AB(R) counter, on
2	0 Period measurement 1 Gate measurement
3	0 Measurement starts at positive edge 1 Measurement starts at negative edge (only valid for period or gate measurement)
5 - 4	00 No counter operation 01 AB(R) counter 10 Counter 1, 2 and 3: Event counter 11 Counter 1: Period or gate measurement Counter 2: Event counter
6 - 7	Counter frequency 00 4 MHz 01 31.25 kHz 10 External counter frequency (input 3) 11 Not allowed
8	0 Strain gauge ADC FASTStep mode, off 1 Strain gauge ADC FASTStep mode, on
9	0 Overflow recognition off; overflow bit from counter 1 is reset 1 Overflow recognition of the continuous counter 1 (value limited to $7FFFFFFF)
10 - 11	Strain gauge ADC measurement area: 00 bipolar: approx. ±8 mV; unipolar: 0 to approx. 8 mV 01 bipolar: approx. ±17 mV; unipolar: 0 to approx. 17 mV 10 bipolar: approx. ±35 mV; unipolar: 0 to approx. 35 mV 11 bipolar: approx. ±65 mV; unipolar: 0 to approx. 65 mV
12	Strain gauge ADC operating mode: 0 Bipolar: 1 Unipolar
13 - 14	Strain gauge ADC sinc3 filter frequency: 00 50 Hz 01 100 Hz 10 60 Hz 11 300 Hz
15	0 Time / counter reset 1 Time/counter switched on (set this bit to 1 after counter has been configured)

Table 129: 7XX415.50-K02 - Configuration register

FASTStep mode (bit 8 of configuration register)

If the FASTStep mode is activated, then the ADC internally changes the filtering, which allows it to react faster to changes on the strain gauge input.

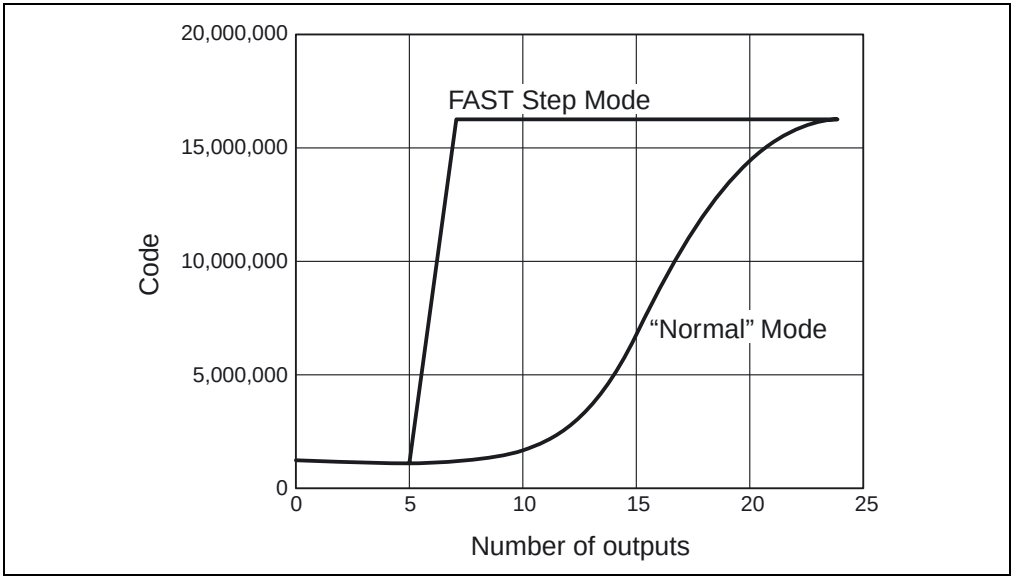


Figure 116: 7XX415.50-K02 - FASTStep mode

Status information about the module



Bit	Description
0	Validity of the analog input data: 0 Valid 1 Invalid This is because Initialization when switched on or when one or more ADC parameters in the configuration register are changed
1 - 8	0 Reserved
9	Counter 1: Period or gate measurement 0 Valid value in the range from 0 to $7FFFFFFF (only valid if bit 9 is set in the configuration register) 1 Counter overflow (acknowledge by resetting bit 9 in the configuration register)
10	0 Reserved
11	24 VDC module supply 0 Within the warning limits (18 VDC - 30 VDC) 1 Outside the warning limits (18 VDC - 30 VDC)
12	Input voltage monitor 0 Ok 1 Error
13	Total current for the outputs 5 + 6 0 <4 A 1 >4 A
14	Total current for the outputs 7 + 8 0 <4 A 1 >4 A
15	Monitoring of the 24 VDC output supply 0 Ok 1 Error

Table 130: 7XX415.50-K02 - Status register

Analog inputs (strain gauge)

The analog inputs deliver data in 32-bit 2s complement (DINT format).

Relationship between numerical value and input voltage:

Numerical value (INT)		Voltage measurement	
Hexadecimal	Decimal	Bipolar	Unipolar
80000001	-2147483647	Neg. full-scale deflection	-
00000000	0	0 V	0 V
7FFFFFFF	2147483647	Pos. full-scale deflection	Pos. full-scale deflection

Table 131: 7XX415.50-K02 - Numerical value for the analog inputs

The operating mode bipolar/unipolar is selected in the configuration register bit 12 and the measurement range (full-scale deflection) is defined in the bits 11+10.

5.5 7XX426.50-1

5.5.1 Order data

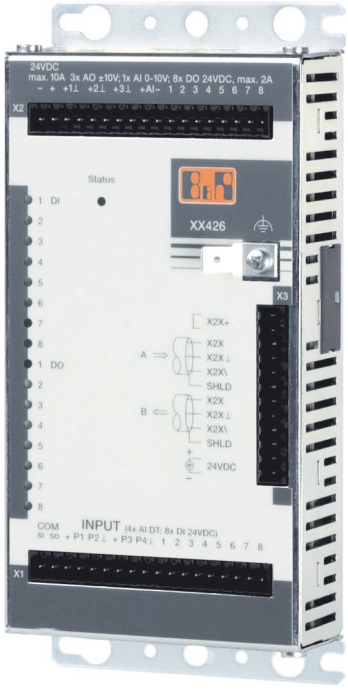
Model number	Short description	Figure
7XX426.50-1	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 8 digital inputs, 24 VDC sink/source, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement, 4 digital outputs 2 A 50%, 4 digital outputs 2 A 100%, 24 VDC; 4 analog inputs for potentiometer, 4.5 V, 14-bit, 1 analog input, 0 - 10 V, 12-bit, 3 analog outputs, ±10 V, 12-bit. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 132: 7XX426.50-1 - Order data

5.5.2 Technical data

Product ID	7XX426.50-1	
Short description		
Digital channels	8 inputs, 8 outputs	
Analog channels	5 inputs (4x potentiometer, 1x differential input, comparator), 3 outputs	
Interfaces	1 x X2X Link slave	
Electrical isolation 24 VDC - Dig. Inputs 24 VDC - Dig. Outputs 24 VDC - Analog Analog - Digital Analog - Analog X2X - Digital/Analog X2X - 24 VDC	 Yes No Yes Yes No Yes Yes	
Supply voltage	24 VDC	
Power consumption	5.0 W	
Digital inputs		
Channels	1-3	4-8
Rated voltage	24 VDC	24 VDC
Input filter Hardware Software	 ≤4 µs -	 ≤200 µs -
Input circuit	Sink or source	Sink or source
Additional functions	Event counting, incremental encoder operation, gate and period measurement	-
Digital outputs		
Rated voltage	24 VDC	
Rated output current Output 1 - 4 Output 5 - 8	 2.0 A, 50% 2.0 A, 100%	
Total current Output 1 - 4 Output 5 - 8	10.0 A 4.0 A 8.0 A	
Output circuit	Source	
Output protection	Thermal cutoff for overcurrent or short circuit, integrated protection for switching inductances, reverse polarity of output supply	
Additional functions	-	
Sensor supply	External	

Table 133: 7XX426.50-1 - Technical data

Product ID	7XX426.50-1
Potentiometer, displacement gauge	
Input type	Single ended input in the range from 0 to U_{pot}
Digital converter resolution	14-bit
Potentiometer supply voltage U_{pot}	4.5 VDC / max. 9 mA
Measurement sensor	1 kΩ to 10 kΩ, potentiometer
Conversion time	≤300 µs for all channels
Output format	INT
Input protection	Protection against wiring with supply voltage
Differential input	
Input type	Voltage input
Input	0 to +10 V
Digital converter resolution	12-bit
Conversion time	≤300 µs
Output format	INT
Input impedance in signal range	20 MΩ
Input protection	Protection against wiring with supply voltage
Comparator	
Number of channels	1, can be configured using software
Trigger threshold	Can be used on an analog input (potentiometer/displacement gauge 4 or differential output)
Triggering	Takes place either on digital output 1 or on analog output 3 using predefinable values
Timestamp for trigger	Yes
Trigger threshold for triggering	Yes
Response time	≤200 µs
Analog outputs	
Output	±10 V
Digital converter resolution	12-bit
Data format	INT
Conversion time	≤300 µs for all channels
Maximum load per output	±10 mA (load ≥1 kΩ)
Power on/off behavior	Internal enable relay for boot procedure and errors
Output protection	Protection against wiring with supply voltage, short-circuit protection
Interfaces	
Application interface Type Design	 X2X Link slave 12-pin multipoint connector

Table 133: 7XX426.50-1 - Technical data

Product ID	7XX426.50-1
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function for each digital input/output, status
Diagnostics I/O function X2X Interface	 Yes, with LEDs Yes, with status LED and software status
Operational conditions	
Temperature	0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	410 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 133: 7XX426.50-1 - Technical data

5.5.3 Additional technical data

Product ID	7XX426.50-1	
Digital inputs		
Channels	1-3	4-8
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC	18 VDC / 24 VDC / 30 VDC
Input current at rated voltage	Approx. 10 mA	Approx. 5 mA
Switching threshold LOW HIGH	 <5 V >15 V	 <5 V >15 V
Event counter operation		
Amount	2	
Counter 1/2	Input 1 / 2	
Counter size Counter 1 Counter 2	 32-bit 16-bit	
Input frequency	Max. 100 kHz	
Pulse length / distance between edges	>4 µs	
Signal form	Square wave pulse	
Evaluation	Positive or negative edge, cyclic counter	

Table 134: 7XX426.50-1 - Additional technical data

Product ID	7XX426.50-1	
Incremental encoder operation		
Amount	1	
Type	ABR or AB	
Counter size ABR A/B	 16-bit 32-bit	
Input frequency	Max. 30 kHz	
Evaluation	4x	
Signal form	Square wave pulse	
Gate measurement		
Amount	1	
Gate measurement on channel 1	Input 1	
Counter size	32-bit	
Evaluation	Positive or negative edge	
Input frequency	Max. 100 kHz	
Pulse length	> 4 µs	
Length of pauses between pulses	> 4 µs	
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz	
Signal form	Square wave pulse	
Period measurement		
Amount	1	
Measurement on channel 1	Input 1	
Counter size	32-bit	
Evaluation	Positive or negative edge	
Input frequency	Max. 100 kHz	
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz	
Signal form	Square wave pulse	
Digital outputs		
Channels	1-4	5-8
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 100 Hz (with resistive load)	
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs

Table 134: 7XX426.50-1 - Additional technical data

Product ID	7XX426.50-1
Potentiometer, displacement gauge	
Value range / input signal Slider voltage = U_{pot} Slider voltage = GND	 $7FFF $0000
Differential input	
Value range / input signal + 10 VDC 0 VDC	 $7FFF $0000
Input filter Limit frequency Attenuation	 10 kHz 60 dB
Analog outputs	
Value range / output signal +10 V 0 V -10 V	 $7FFF $000 $8001
Interfaces	
X2X Link slave user interface Min. cycle time on the X2X bus	 >300 µs
Status indicators	
Status LED	Yes (color and blink code)
DI1 - DI8 LEDs	Status of the digital inputs (green)
DO1 - DO8 LEDs	Status of the digital outputs (yellow)
Power supply	
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.
General information	
B&R ID code	$6095

Table 134: 7XX426.50-1 - Additional technical data

5.5.4 Diagnostic LEDs

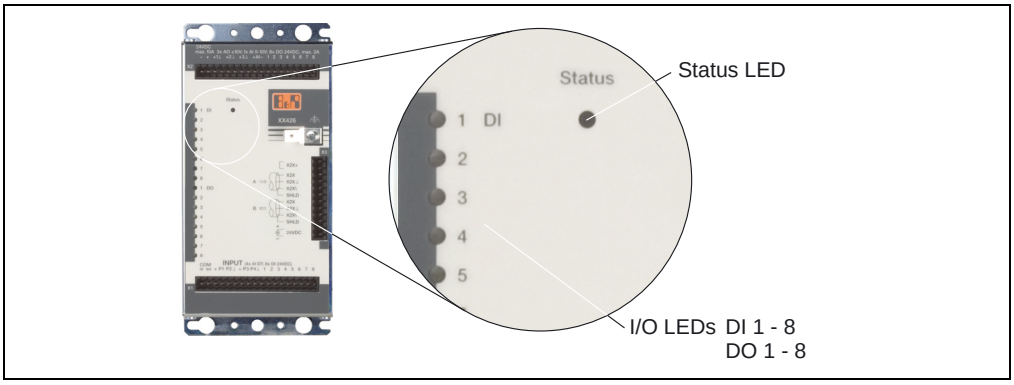


Figure 117: 7XX426.50-1 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error for an I/O channel - Level monitoring for digital outputs has responded.
	Double flash	Possible error: • Module supply voltage is outside the valid range. • The monitor for the supply of digital outputs registered an error.
	On	Error or reset state

Table 135: 7XX426.50-1 - Status-LED

5.5.5 Analog / digital inputs

Terminal block connections

Inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.). The supply voltage for the digital inputs can be monitored with the application program.

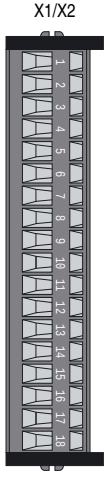
18-pin terminal block	Terminal	X1 pin assignments	X2 pin assignments
 7TB718.91	1	COM si (GND in sink operation, +24 VDC in source operation)	GND output supply
	2	COM so (+24 VDC in sink operation, GND in source operation)	+24 VDC output supply
	3	+ Supply voltage for pots 1 + 2	Analog output 1 +
	4	Slider on potentiometer 1	Analog output 1 ⊥
	5	Slider on potentiometer 2	Analog output 2 +
	6	⊥ Supply voltage for pots 1 + 2	Analog output 2 ⊥
	7	+ Supply voltage for pots 3 + 4	Analog output 3 +
	8	Slider on potentiometer 3	Analog output 3 ⊥
	9	Slider on potentiometer 4	Analog input 5 +
	10	⊥ Supply voltage for pots 3 + 4	Analog input 5 ⊥
	11	Digital input 1 / counter 1 / A	Digital output 1
	12	Digital input 2 / counter 2 / B	Digital output 2
	13	Digital input 3 / ext. CLK / R	Digital output 3
	14	Digital input 4	Digital output 4
	15	Digital input 5	Digital output 5
	16	Digital input 6	Digital output 6
	17	Digital input 7	Digital output 7
	18	Digital input 8	Digital output 8

Table 136: 7XX426.50-1 - Pin assignments X1 / digital/analog inputs

Connection examples

Digital inputs (sink connection)

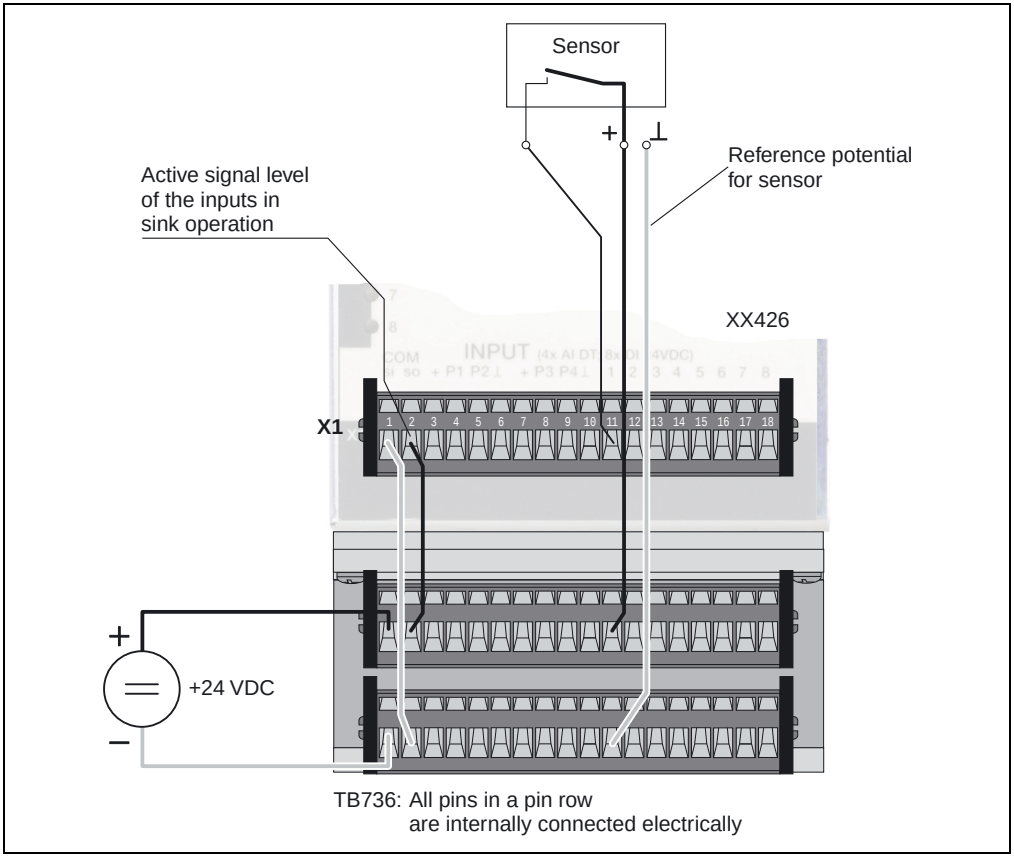


Figure 118: 7XX426.50-1 - Connection example / digital input (sink connection)

Digital inputs (source connection)

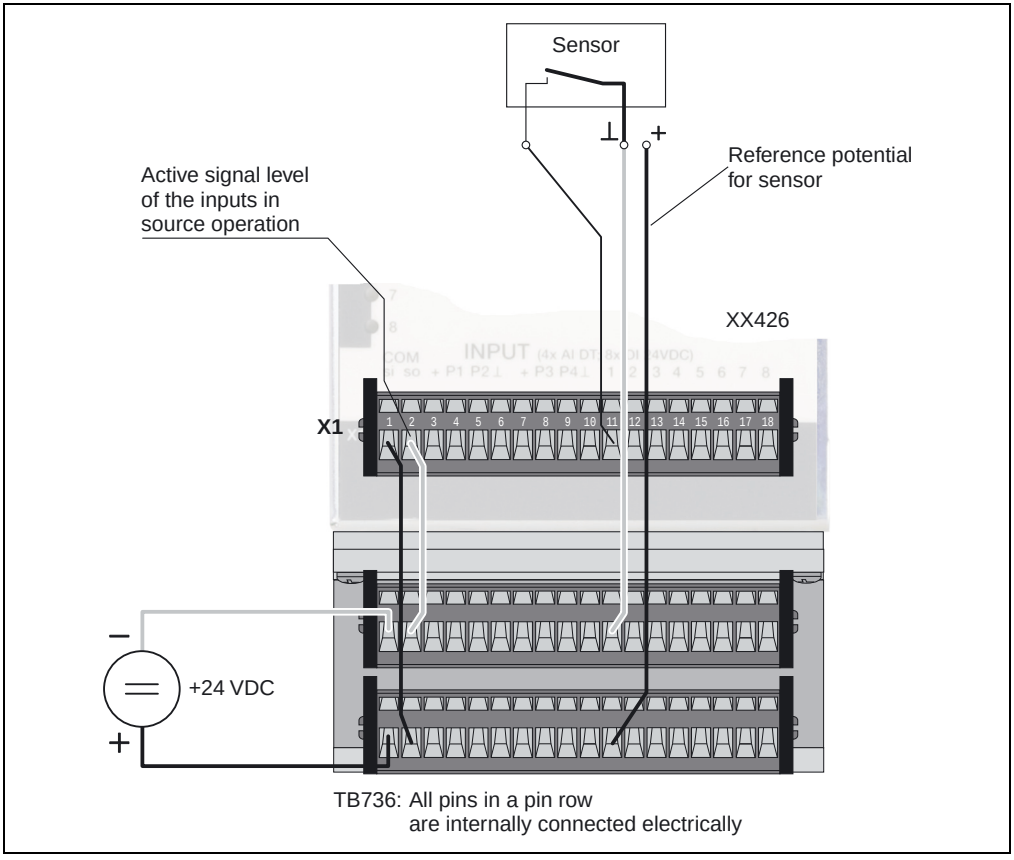


Figure 119: 7XX426.50-1 - Connection example / digital inputs (source connection)

Counter inputs

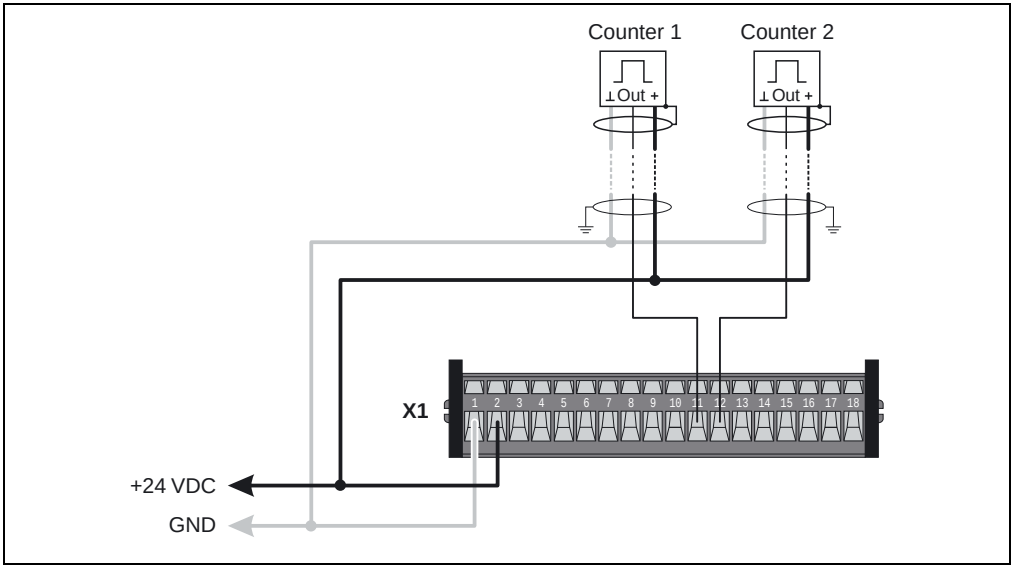


Figure 120: 7XX426.50-1 - Connection example / counter input

Period or gate measurement

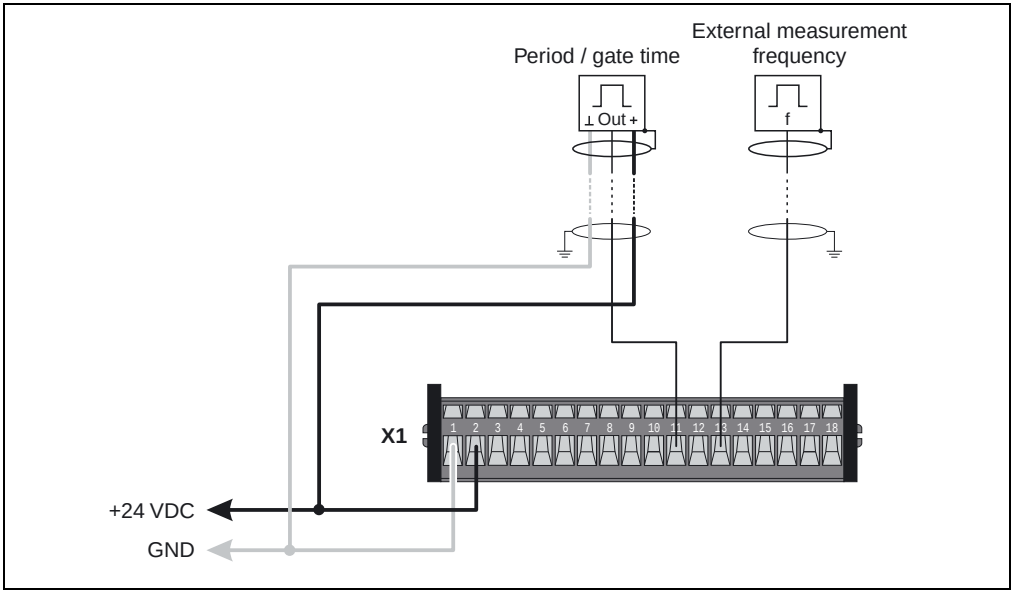


Figure 121: 7XX426.50-1 - Connection example / period and gate measurement

Incremental encoder

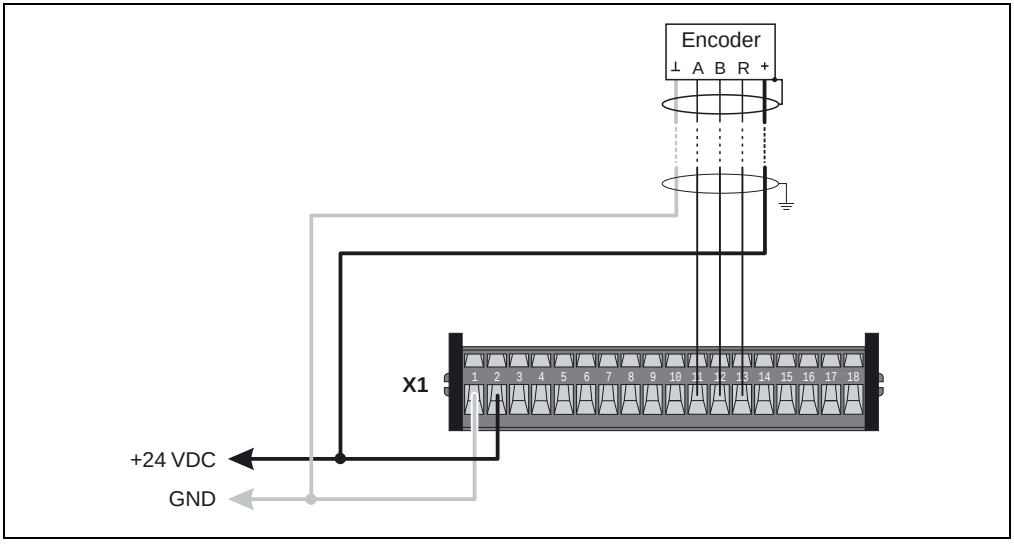


Figure 122: 7XX426.50-1 - Connection example / incremental encoder

Analog input - potentiometer

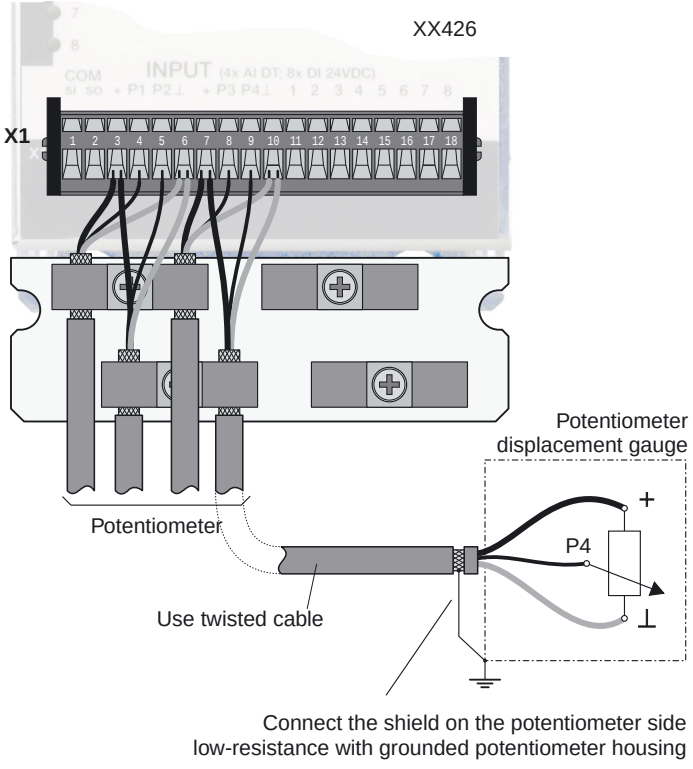


Figure 123: 7XX426.50-1 - Connection example / analog input - potentiometer

Analog input - voltage measurement

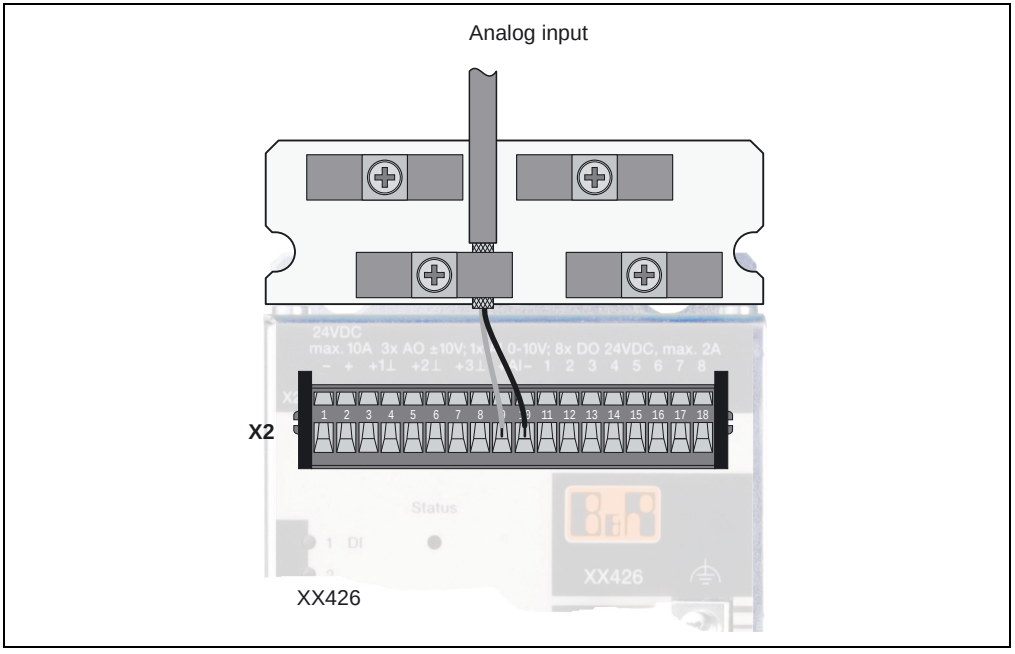


Figure 124: 7XX426.50-1 - Connection example / analog input - voltage measurement

Input circuit diagram

Digital inputs

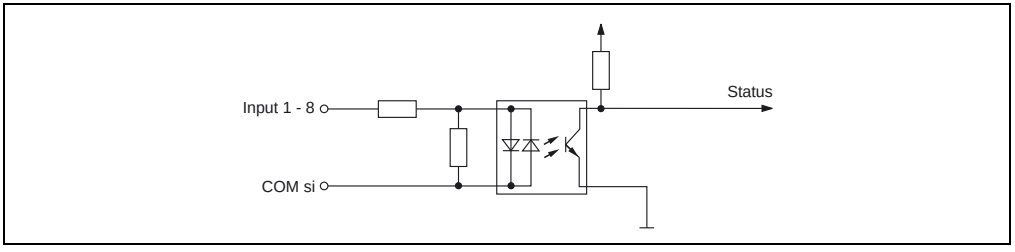


Figure 125: 7XX426.50-1 - Input circuit diagram / digital inputs

Potentiometer input

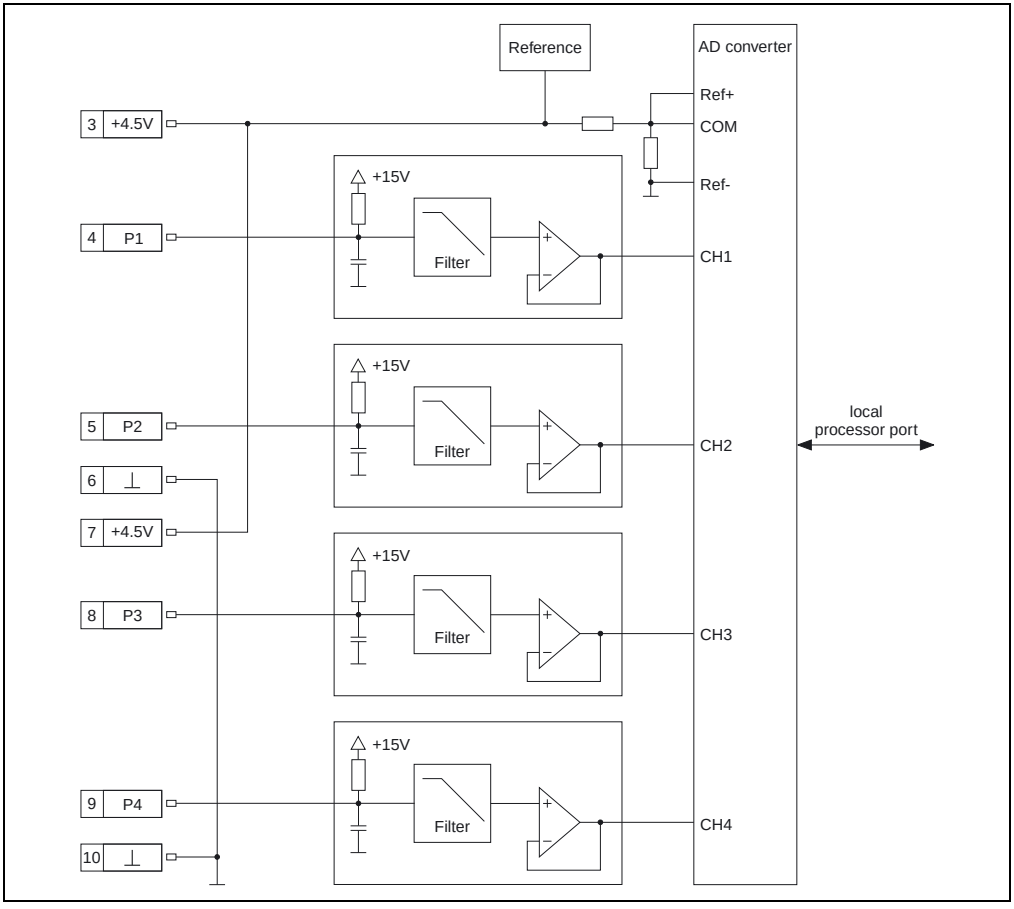


Figure 126: 7XX426.50-1 - Input circuit diagram / potentiometer input

Voltage input

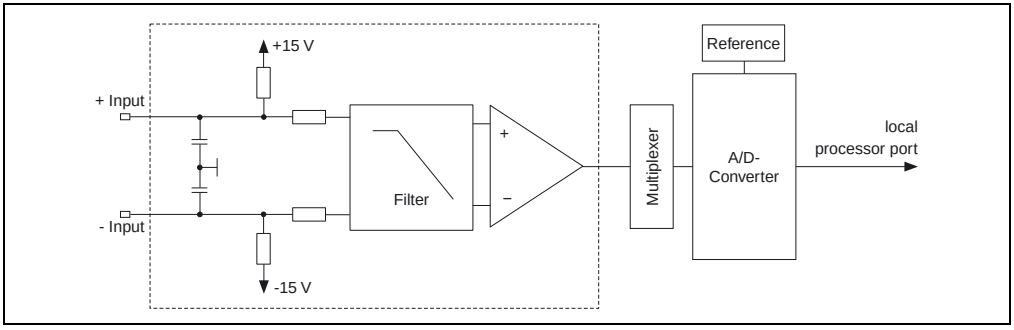


Figure 127: 7XX426.50-1 - Input circuit diagram / voltage input

5.5.6 Analog / digital outputs

Terminal block connections

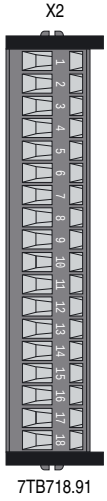
18-pin terminal block	Terminal	Assignment
	1	GND output supply
	2	+24 VDC output supply
	3	Analog output 1 +
	4	Analog output 1 ⊥
	5	Analog output 2 +
	6	Analog output 2 ⊥
	7	Analog output 3 +
	8	Analog output 3 ⊥
	9	Analog input 5 +
	10	Analog input 5 ⊥
	11	Digital output 1
	12	Digital output 2
	13	Digital output 3
	14	Digital output 4
	15	Digital output 5
	16	Digital output 6
	17	Digital output 7
	18	Digital output 8

Table 137: 7XX426.50-1 - Pin assignment - X2 / analog/digital outputs

Connection example

Digital outputs

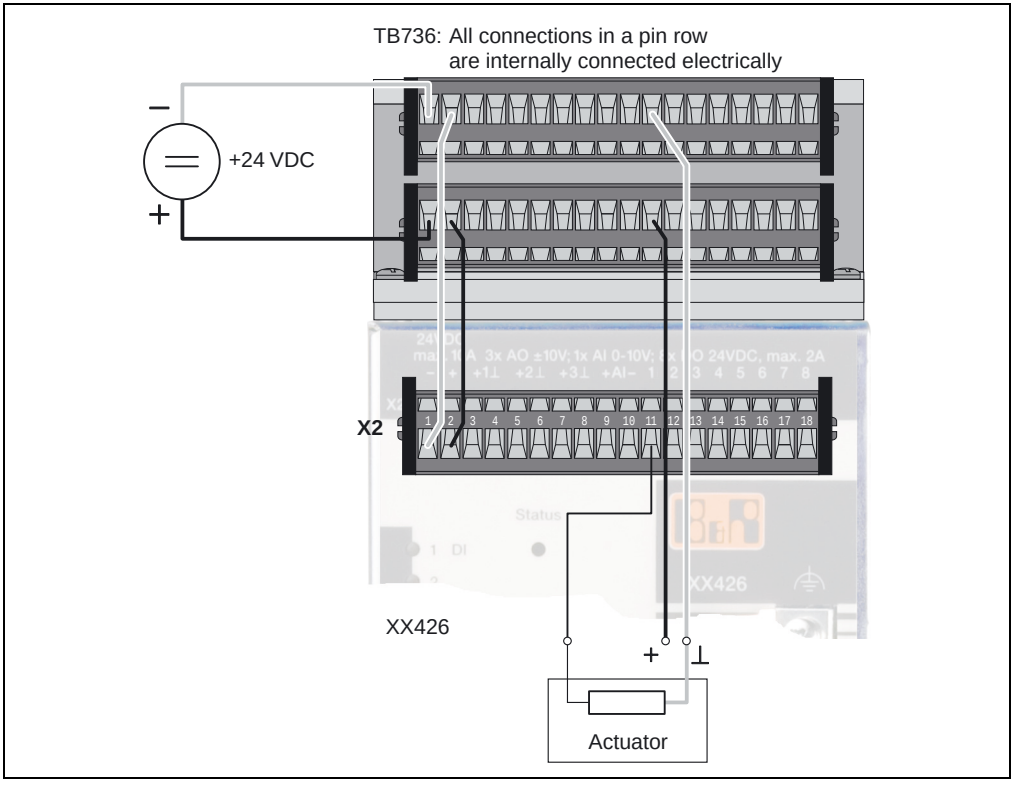


Figure 128: 7XX426.50-1 - Connection example / digital outputs

Analog outputs

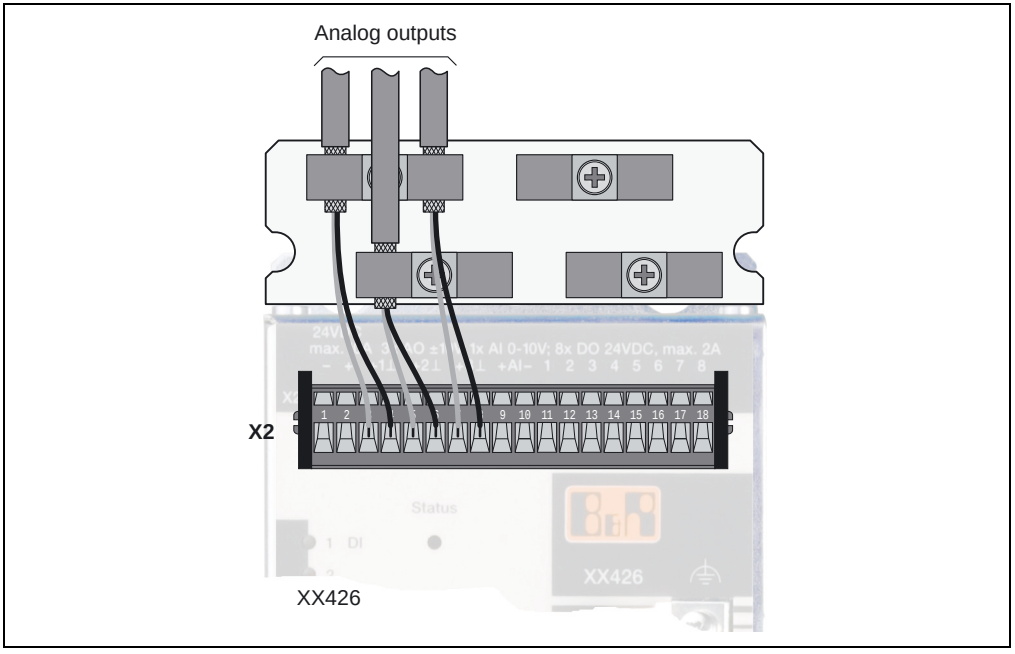


Figure 129: 7XX426.50-1 - Connection example / analog outputs

Output circuit diagram

Digital outputs

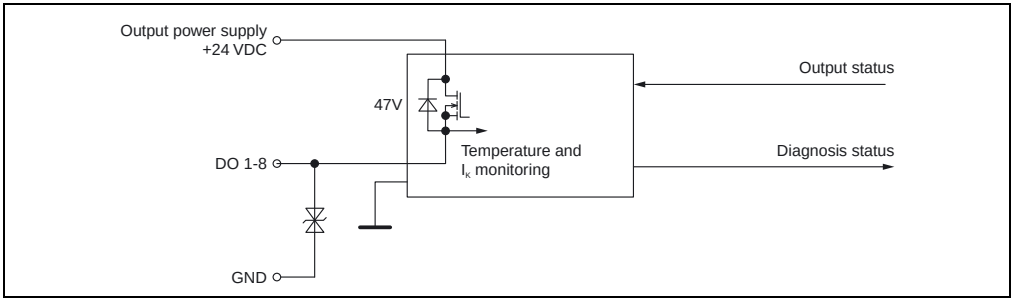


Figure 130: 7XX426.50-1 - Output circuit diagram / digital outputs

Analog outputs

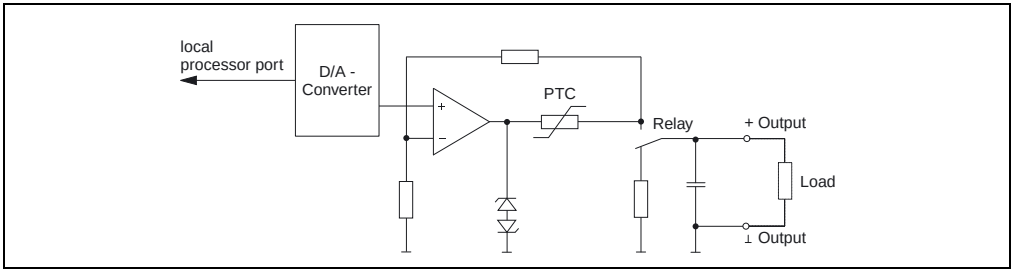


Figure 131: 7XX426.50-1 - Output circuit diagram / analog outputs

Switching inductive loads

Digital outputs 1 to 4

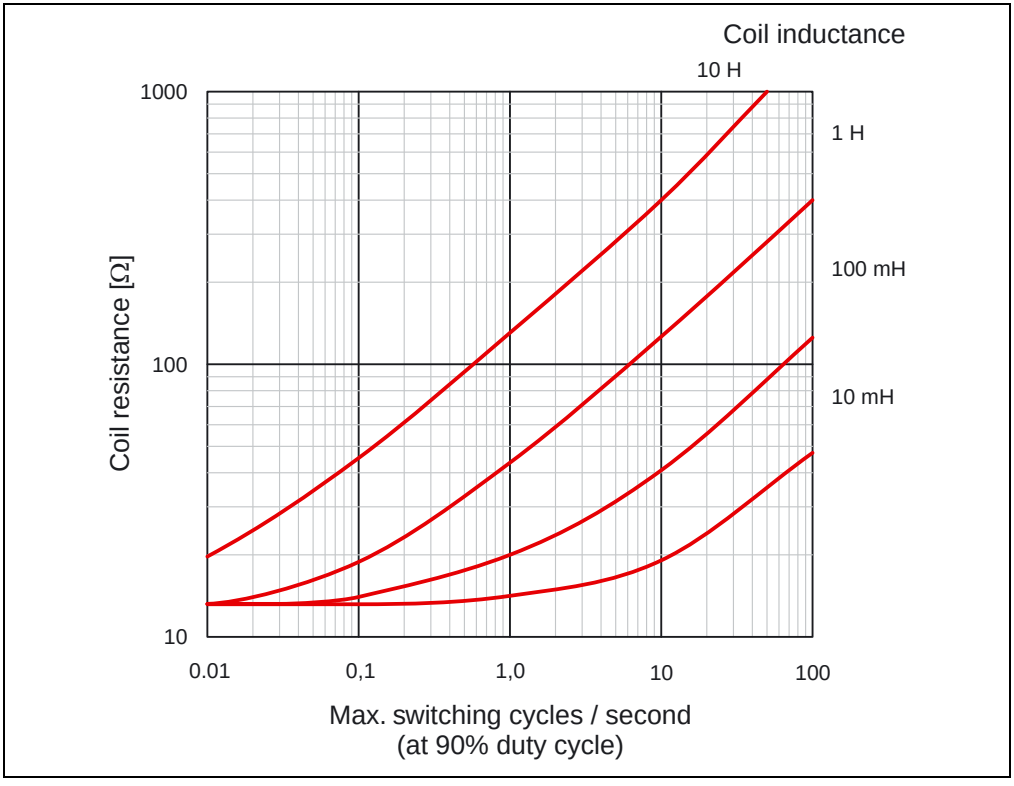


Figure 132: 7XX426.50-1 - Switching inductive loads / Digital outputs 1 to 4

Digital outputs 5 to 8

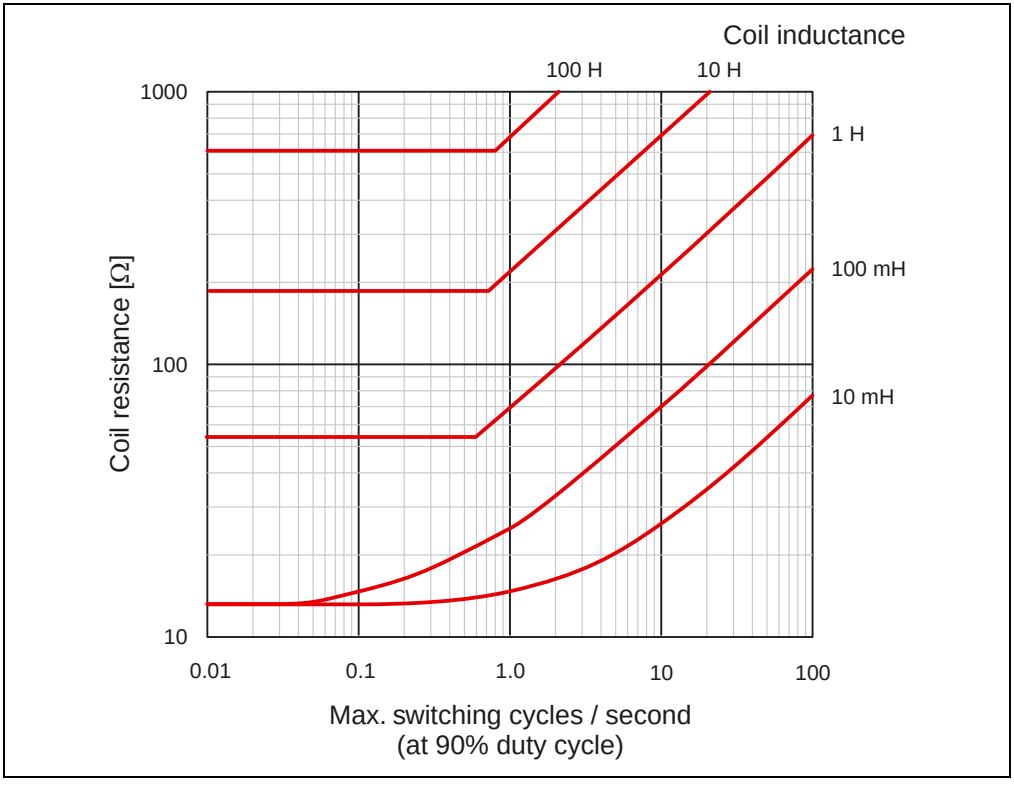


Figure 133: 7XX426.50-1 - Switching inductive loads / Digital outputs 5 to 8

5.5.7 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

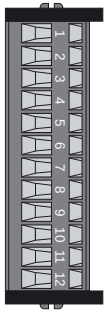
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 138: 7XX426.50-1 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

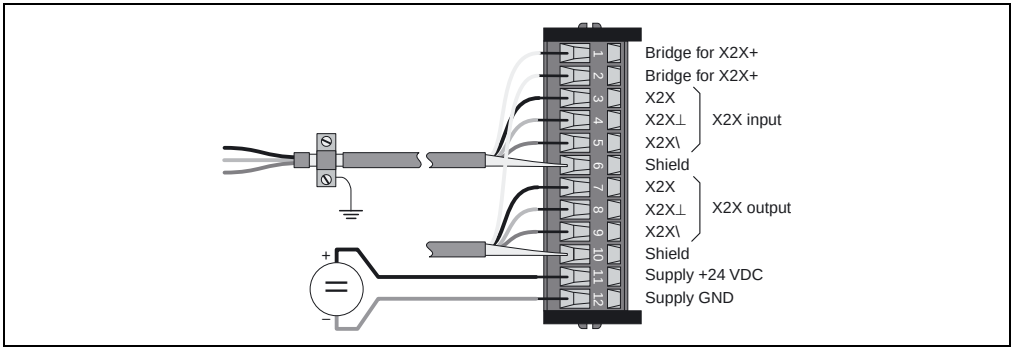


Figure 134: 7XX426.50-1 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

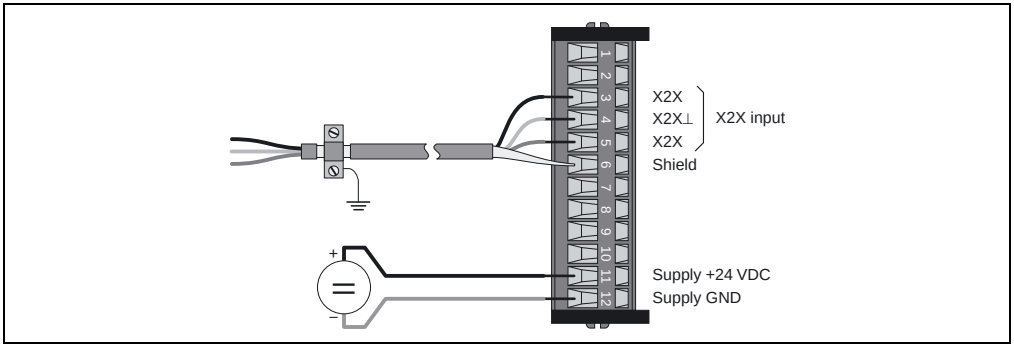


Figure 135: 7XX426.50-1 - Connection example of X2X Link as last X2X Link slave

5.5.8 Monitoring

Monitoring the module supply voltage

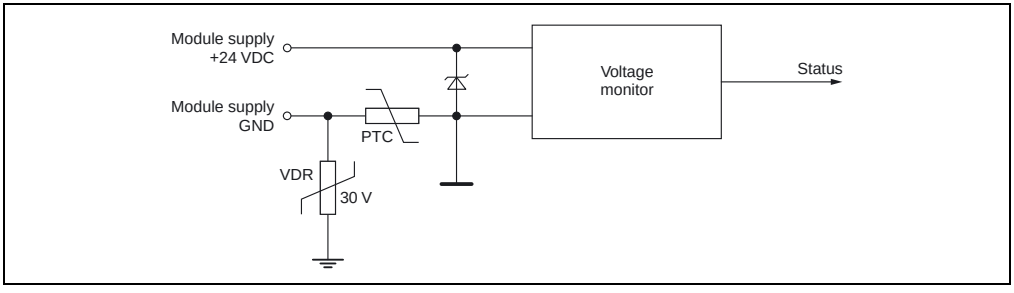


Figure 136: 7XX426.50-1 - Circuit diagram for the module supply

Current monitoring for the 2A outputs

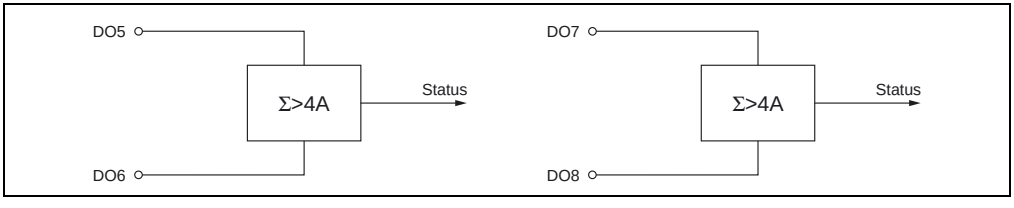


Figure 137: 7XX426.50-1 - Current monitoring for the 2A outputs

5.5.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
0	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
8	StatusDigitalOutput01 - StatusDigitalOutput08	BOOL	1	●	●		
16	EventCounter01	DINT	1	●	●		
20	EventCounter02	UINT	1	●	●		
22	AnalogInput01	INT	1	●	●		
24	Resistor01	INT	1	●	●		
26	Resistor02	INT	1	●	●		
28	Resistor03	INT	1	●	●		
30	Resistor04	INT	1	●	●		
24	AnalogOutput01	INT	1			●	●
26	AnalogOutput02	INT	1			●	●
28	AnalogOutput03	INT	1			●	●
32	StatusInput01	UINT	1	●	●		
32	ConfigOutput01	UINT	1			●	●
36	TriggerValue	INT	1	●	●		
38	TriggerTimestamp	INT	1	●	●		
36	TriggerLevel	INT	1			●	●
38	ComparatorOutput	INT	1			●	●

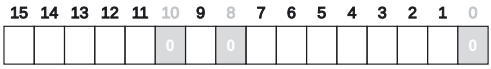
Table 139: 7XX426.50-1 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput08	Level of digital inputs 1 - 8
DigitalOutput01 - DigitalOutput08	Setting the digital outputs 1 - 8
StatusDigitalOutput01 - StatusDigitalOutput08	Reading back the digital outputs 1-8
EventCounter01-EventCounter02	Counter state of the digital inputs 1-2
AnalogInput01	Voltage input (value range $0000 to $7FFF)
Resistor01-Resistor04	Potentiometer input 1-4 (value range $0000 to $7FFF)
AnalogOutput01-AnalogOutput03	Analog input 1-4 (value range $8001 to $7FFF)
StatusInput01	Status information about the module
ConfigOutput01	Module configuration
TriggerValue	Input value which triggered the comparator. This value remains the same until the next time the comparator is triggered.
TriggerTimestamp	Time at which the comparator was triggered (microseconds since the end of the last X2X cycle). This value remains the same until the next time the comparator is triggered.
TriggerLevel	Threshold value / trigger value of the comparator
ComparatorOutput	If the comparator is not switched on or has not been triggered, then the active comparator output is determined by the default output. The active output is defined as follows when the comparator is triggered: • Active analog output (bit 14 of the configuration register is 1): ComparatorOutput contains the value ($8001-$7FFF), which is output to the analog output 3. • Active digital output (bit 14 of the configuration register is 0): Bit 0 of ComparatorOutput is output to the digital output 1.

Table 140: 7XX426.50-1 - Register description

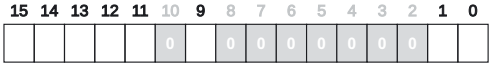
Module configuration



Bit	Description
0	0 Reserved
1	0 R mode for AB(R) counter, off 1 R mode for AB(R) counter, on
2	0 Period measurement 1 Gate measurement
3	For period or gate measurement: 0 Measurement starts at positive edge 1 Measurement starts at negative edge
4 - 5	Counter mode: 00 No counter operation 01 AB(R) counter 10 Event counter 11 Counter 1: Period or gate measurement Counter 2: Event counter
6 - 7	Counter frequency: 00 4 MHz 01 31.25 kHz 10 External counter frequency (digital input 3) 11 Not allowed
8	0 Reserved
9	0 Overflow recognition off; overflow bit from counter 1 is reset 1 Overflow recognition of the continuous counter 1 (value limited to $7FFFFFFF)
10	0 Reserved
11	0 Comparator is triggered when the value falls below the threshold value 1 Comparator is triggered when the value exceeds the threshold value
12	0 Comparator function off 1 Comparator function on (if the comparator has been triggered once, then it keeps its status until it is switched off and switched back on if necessary)
13	Comparator input 0 Analog input 1 Potentiometer input 4
14	Active comparator output 0 Digital output 1 1 Analog output 3
15	0 Time / counter reset 1 Time/counter switched on (set this bit to 1 after counter has been configured)

Table 141: 7XX426.50-1 - Configuration register

Status information about the module



Bit	Description
0	0 Comparator has not been triggered 1 Comparator has been triggered
1	Monitoring of the supply voltage for the potentiometer 0 Ok 1 Error
2 - 8	0 Reserved
9	Counter 1: Period or gate measurement 0 Valid value in the range from 0 to $7FFFFFFF (only valid if bit 9 is set in the configuration register) 1 Counter overflow (acknowledge by resetting bit 9 in the configuration register)
10	0 Reserved
11	Monitoring the module supply 0 Voltage within the warning limits (18 to 10 VDC) 1 Voltage outside the warning limits (18 to 10 VDC)
12	Monitoring of the supply for the digital inputs 0 Ok 1 Error
13	Total current for the outputs 5 + 6 0 <4 A 1 >4 A
14	Total current for the outputs 7 + 8 0 <4 A 1 >4 A
15	Monitoring of the output supply 0 Ok 1 Error

Table 142: 7XX426.50-1 - Status register

5.6 7XX436.50-1

5.6.1 Order data

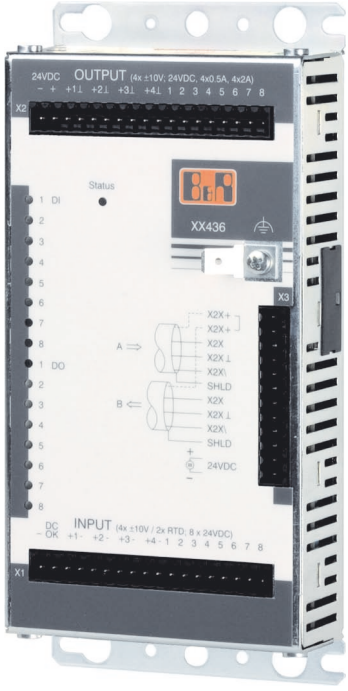
Model number	Short description	Figure
7XX436.50-1	Remote I/O, 24 VDC, with X2X Link, electrically isolated, 8 digital inputs, 24 VDC sink/source, 2 event counters, 1 incremental encoder, or 1 gate-/period measurement, 4 digital outputs 0.5 A, 4 digital outputs 2 A, 24 VDC, 4 analog inputs, ±10 V, 12-bit, two of the analog inputs can be used as KTY10 or PT1000 inputs, 4 analog outputs, ±10 V, 12-bit. 2x TB718 and 1x TB712 terminal blocks must be ordered separately.	
Terminal blocks		
7TB712.9	Accessory terminal block, 12-pin, screw clamp, 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamps, 1.5 mm²	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm²	
7TB718.91	Accessory terminal block, 18-pin, cage clamps, 1.5 mm²	
7TB722.9	2003 Terminal block, 22-pin screw clamps	
7TB722.91	2003 Terminal block, 22-pin cage clamps	
7TB733.9	2003 Terminal block, 33-pin screw clamps	
7TB733.91	2003 Terminal block, 33-pin cage clamps	
7TB736.9	2003 Terminal block, 36-pin screw clamps	
7TB736.91	2003 Terminal block, 36-pin cage clamps	
7TB772.91	2003 Terminal block, 72-pin cage clamps	
0AC002.9	Retaining clips TB712/TB718	
0AC301.9	Accessory, 8x shielding clamp	
Additional accessories		
For information about additional accessories, see the "Accessories" section of the B&R 2003 User's Manual.		

Table 143: 7XX436.50-1 - Order data

5.6.2 Technical data

Product ID	7XX436.50-1	
Short description		
Digital channels	8 inputs, 8 outputs	
Analog channels	4 inputs (differential inputs, two of which can be used as temperature inputs, comparator can be configured using software), 4 outputs	
Interfaces	1 x X2X Link slave	
Electrical isolation 24 VDC - Dig. Inputs 24 VDC - Dig. Outputs 24 VDC - Analog Analog - Digital Analog - Analog X2X - Digital/Analog X2X - 24 VDC	 Yes No Yes Yes No Yes Yes	
Supply voltage	24 VDC	
Power consumption	5.0 W	
Digital inputs		
Channels	1-3	4-8
Rated voltage	24 VDC	24 VDC
Input filter Hardware Software	 ≤4 µs -	 ≤200 µs -
Input circuit	Sink or source	Sink or source
Additional functions	Event counting, incremental encoder operation, gate and period measurement	-
Digital outputs		
Rated voltage	24 VDC	
Rated output current Output 1 - 4 Output 5 - 8	 0.5 A 2.0 A	
Total current	10.0 A	
Output circuit	Source	
Output protection	Thermal cutoff for overcurrent or short circuit, integrated protection for switching inductances, reverse polarity of output supply	
Additional functions	-	
Sensor supply	External	

Table 144: 7XX436.50-1 - Technical data

Product ID	7XX436.50-1
Analog inputs	
Input type	Differential input (2 channels can be individually configured as temperature inputs)
Input	±10 V
Digital converter resolution	12-bit
Conversion time	≤300 µs for all channels
Output format	INT
Differential input resistance	20 MΩ
Input protection	Protection against wiring with supply voltage
Comparator	
Number of channels	1, can be configured using software
Trigger threshold	Can be used on an analog input
Triggering	Takes place either on digital output 1 or on analog output 1 using predefinable values
Timestamp for trigger	Yes
Trigger threshold for triggering	Yes
Response time	≤200 µs
Temperature measurement	
Number of channels	Up to 2 (depending on the configuration)
Measuring procedure	Resistance measurement with constant current feed for 2 wires
Conversion time	≤300 µs for all channels
Output format	INT
Sensors KTY10-6 PT1000	Can be configured for each channel using software -50 to +125°C -200 to +850°C
Resistance measurement range	0 to 4000 Ω
Analog outputs	
Output	±10 V
Digital converter resolution	12-bit
Data format	INT
Conversion time	≤300 µs for all channels
Power on/off behavior	Internal enable relay for boot procedure and errors
Output protection	Protection against wiring with supply voltage, short-circuit protection
Interfaces	
Application interface Type Design	 X2X Link slave 12-pin multipoint connector

Table 144: 7XX436.50-1 - Technical data

Product ID	7XX436.50-1
General information	
Certification	CE, C-UL-US, GOST-R
Status indicators	I/O function for each digital input/output, status
Diagnostics I/O function Power supply Status	 Yes, with LEDs Yes, with software status Yes, with status LED and software status
Operational conditions	
Temperature	0 to 50°C
Relative humidity	5 - 95%, non-condensing
Storage and transport conditions	
Temperature	-25 to +70°C
Relative humidity	5 - 95%, non-condensing
Mechanical characteristics	
Dimensions (W x H x D [mm])	80 x 170 x 30 (incl. mounting plates)
Weight	410 g
Protection type	IP20
Installation	On EN50022 compliant mounting rails or screw mounting
Comment	1 x TB712 terminal block must be ordered separately 2 x TB718 terminal blocks must be ordered separately

Table 144: 7XX436.50-1 - Technical data

5.6.3 Additional technical data

Product ID	7XX436.50-1	
Digital inputs		
Channels	1-3	4-8
Input voltage (min./nom./max.)	18 VDC / 24 VDC / 30 VDC	18 VDC / 24 VDC / 30 VDC
Input current at rated voltage	Approx. 10 mA	Approx. 5 mA
Switching threshold LOW HIGH	 <5 V >15 V	 <5 V >15 V

Table 145: 7XX436.50-1 - Additional technical data

Product ID	7XX436.50-1
Event counter operation	
Amount	2
Counter 1/2	Input 1 / 2
Counter size Counter 1 Counter 2	 32-bit 16-bit
Input frequency	Max. 100 kHz
Pulse length / distance between edges	>4 µs
Signal form	Square wave pulse
Evaluation	Positive or negative edge, cyclic counter
Incremental encoder operation	
Amount	1
Type	ABR or AB
Counter size ABR A/B	 16-bit 32-bit
Input frequency	Max. 30 kHz
Evaluation	4x
Signal form	Square wave pulse
Gate measurement	
Amount	1
Gate measurement on channel 1	Input 1
Counter size	32-bit
Evaluation	Positive or negative edge
Input frequency	Max. 100 kHz
Pulse length	> 4 µs
Length of pauses between pulses	> 4 µs
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz
Signal form	Square wave pulse

Table 145: 7XX436.50-1 - Additional technical data

Product ID	7XX436.50-1	
Period measurement		
Amount	1	
Measurement on channel 1	Input 1	
Counter size	32-bit	
Evaluation	Positive or negative edge	
Input frequency	Max. 100 kHz	
Counter frequency Internal External	 4 MHz or 31.25 kHz Max. 100 kHz	
Signal form	Square wave pulse	
Digital outputs		
Channels	1-4	5-8
Type	Highside driver (source)	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC	
Switching frequency	Max. 100 Hz (with resistive load)	
Switch-on time for the output driver from 0 to 1 (90% V_{out}) at full load	Typ. 100 µs Max. 250 µs	Typ. 70 µs Max. 150 µs
Switch-off time for the output driver from 1 to 0 (10% V_{out}) with no load	Typ. 100 µs Max. 270 µs	Typ. 80 µs Max. 200 µs
Analog inputs		
Value range +10 V 0 V -10 V	 $7FFF $000 $8001	
Input filter Limit frequency Attenuation	 10 kHz 60 dB	
Temperature measurement		
Digital converter resolution	11-bit	
Measuring current	1 mA	
Output format	INT (1 LSB = 0.1°C)	
Conversion of measurement values to temperature values	Automatic in the module	
Resolution in°C KTY10-6 PT1000	 0.13°C 0.56°C	
Wiring	2-line	
Analog outputs		
Value range / output signal +10 V 0 V -10 V	 $7FFF $000 $8001	
Maximum load per output	±10 mA (load ≥1 kΩ)	

Table 145: 7XX436.50-1 - Additional technical data

Product ID	7XX436.50-1
Interfaces	
X2X Link slave user interface Min. cycle time on the X2X bus	>300 µs
Status indicators	
Status LED	Yes (color and blink code)
I/O LEDs	Status of the digital inputs/outputs (green/yellow)
Power supply	
Supply voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Voltage monitoring	The power supply is only enabled starting with an input voltage of approx. 15 V.
General information	
B&R ID code	$5756

Table 145: 7XX436.50-1 - Additional technical data

5.6.4 Diagnostic LEDs

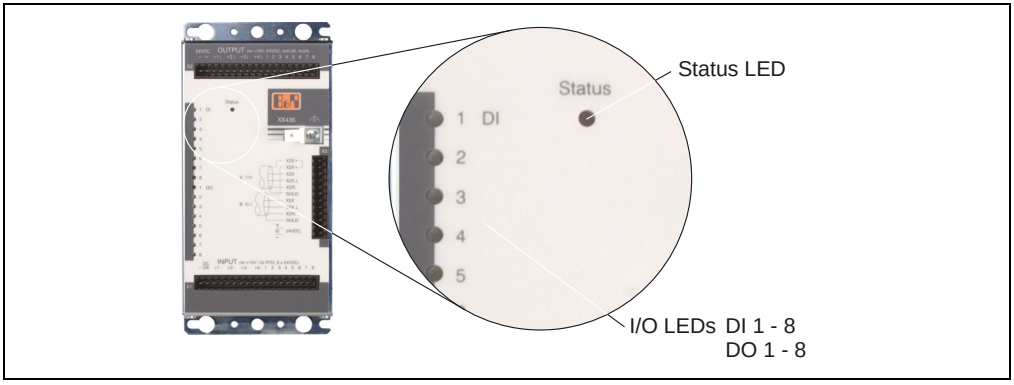


Figure 138: 7XX436.50-1 - Diagnostic and status LEDs

Status LEDs

Status is indicated using color and blink code:

LED	Status	Description
Green	Off	Module supply not connected
	Single flash	Reset mode
	Double flash	Preoperational mode
	On	Run mode
Red	Off	Module supply not connected or everything is OK
	Single flash	Warning/error for an I/O channel - Level monitoring for digital outputs has responded.
	Double flash	Possible error: • Module supply voltage is outside the valid range. • The monitor for the supply of digital outputs registered an error.
	On	Error or reset state

Table 146: 7XX436.50-1 - Status-LED

5.6.5 Analog / digital inputs

Terminal block connections

Inputs 1 - 3 are equipped with additional functions (event counter, ABR evaluation, etc.). The supply voltage for the digital inputs can be monitored with the application program.

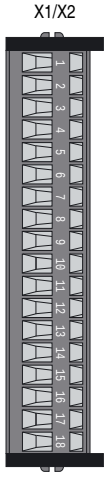
18-pin terminal block	Terminal	X1 pin assignments
	1	COM si (GND in sink operation, +24 VDC in source operation)
	2	COM so (+24 VDC in sink operation, GND in source operation)
	3	Analog input 1 +
	4	Analog input 1 ⊥
	5	Analog input 2 +
	6	Analog input 2 ⊥
	7	Analog input 3 +
	8	Analog input 3 ⊥
	9	Analog input 4 +
	10	Analog input 4 ⊥
	11	Digital input 1 / counter 1 / A
	12	Digital input 2 / counter 2 / B
	13	Digital input 3 / ext. CLK / R
	14	Digital input 4
	15	Digital input 5
	16	Digital input 6
	17	Digital input 7
	18	Digital input 8

Table 147: 7XX436.50-1 - Pin assignments X1 / digital/analog inputs

Connection examples

Digital inputs (sink connection)

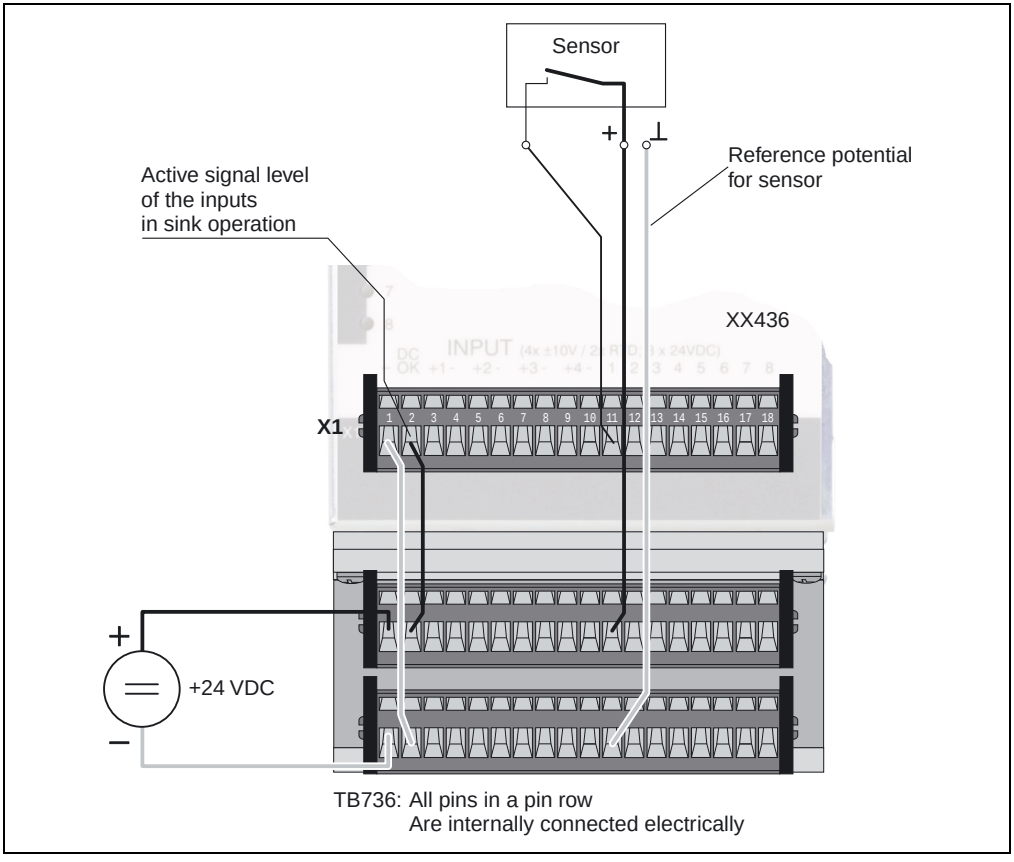


Figure 139: 7XX436.50-1 - Connection example / digital input (sink connection)

Digital inputs (source connection)

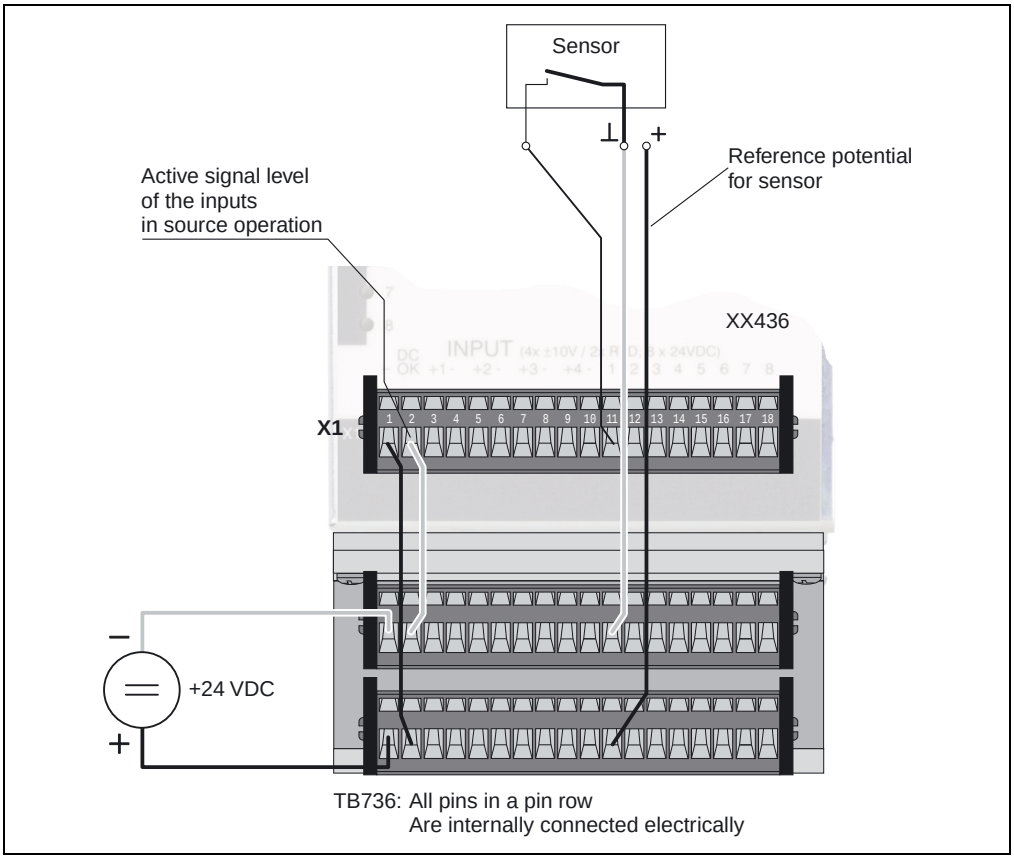


Figure 140: 7XX436.50-1 - Connection example / digital inputs (source connection)

Counter inputs

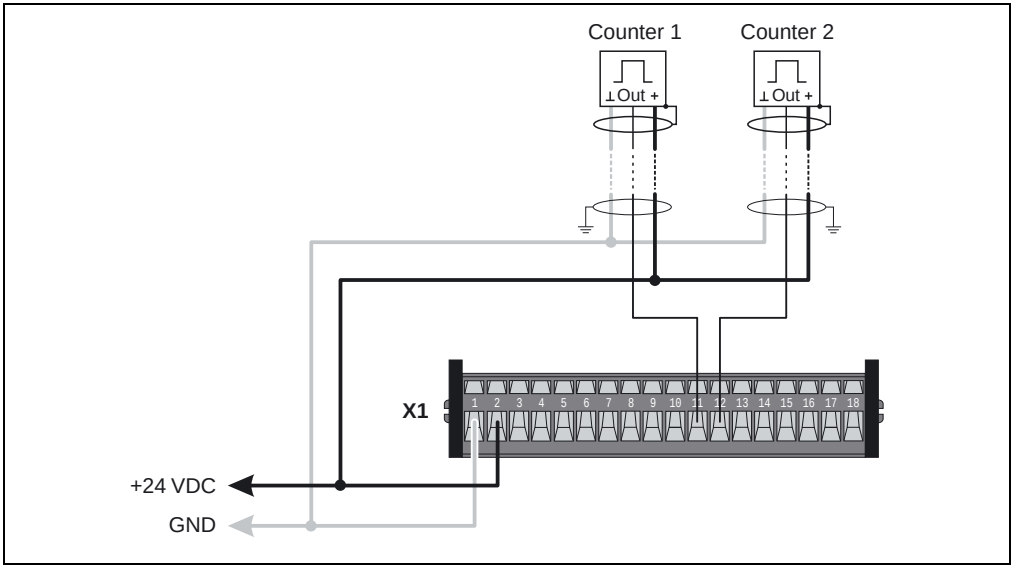


Figure 141: 7XX436.50-1 - Connection example / counter input

Period or gate measurement

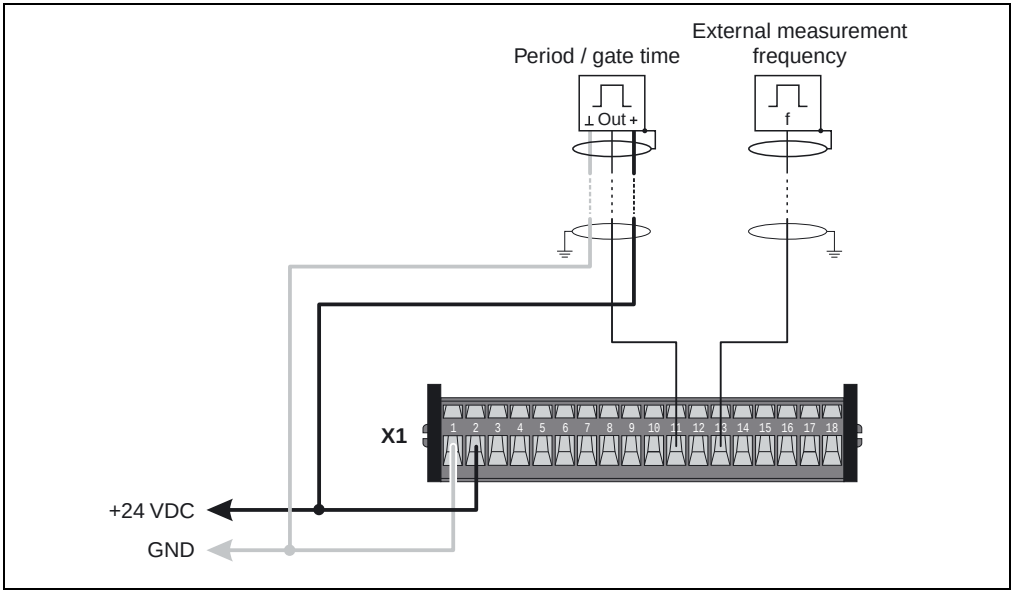


Figure 142: 7XX436.50-1 - Connection example / period and gate measurement

Incremental encoder

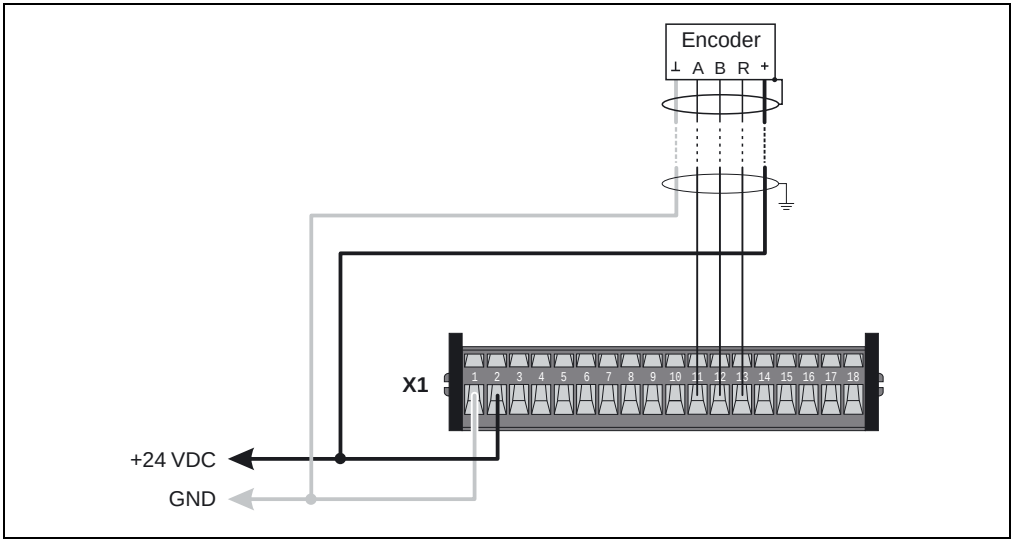


Figure 143: 7XX436.50-1 - Connection example / incremental encoder

Analog inputs

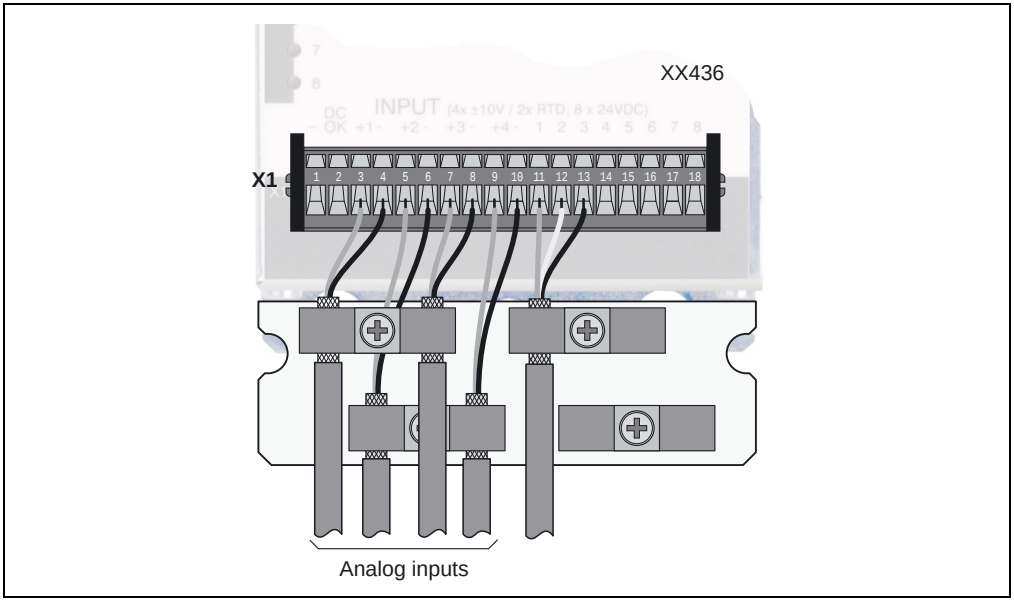


Figure 144: 7XX436.50-1 - Connection example / analog inputs

Input circuit diagram

Digital inputs

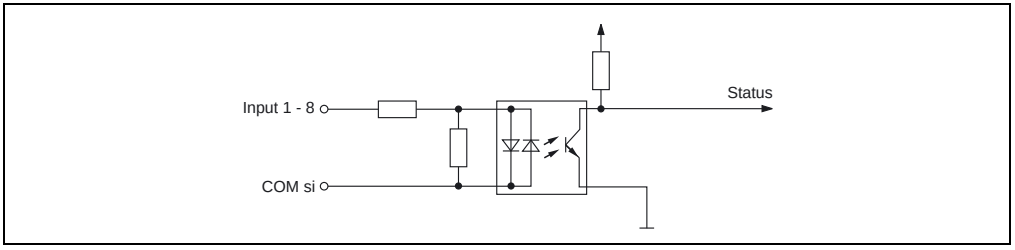


Figure 145: 7XX436.50-1 - Input circuit diagram / digital inputs

Analog inputs (voltage measurement)

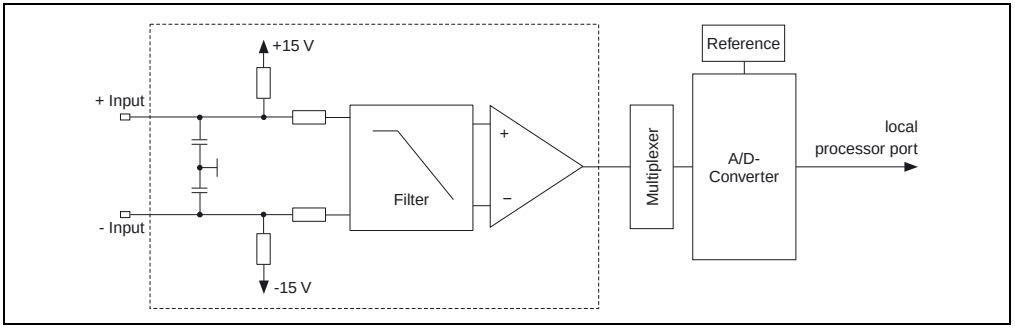


Figure 146: 7XX436.50-1 - Input circuit diagram / analog inputs (voltage measurement)

Analog inputs (temperature measurement)

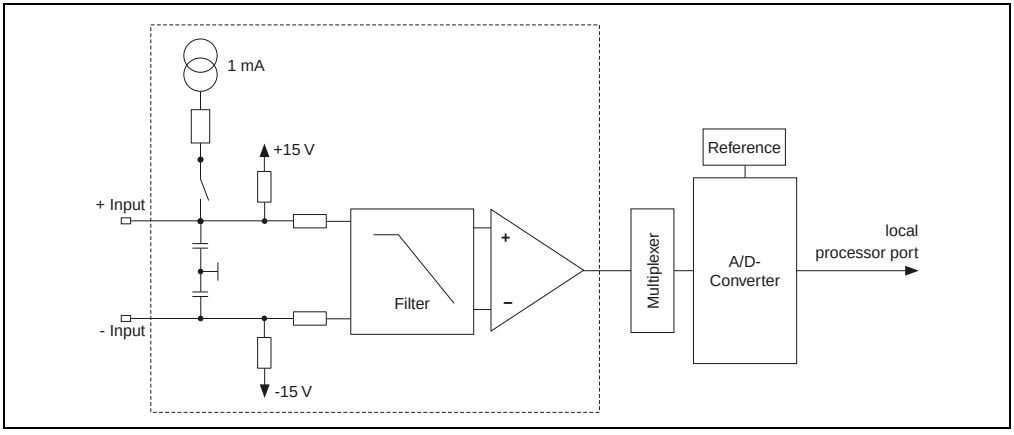


Figure 147: 7XX436.50-1 - Input circuit diagram / analog inputs (temperature measurement)

5.6.6 Analog / digital outputs

Terminal block connections

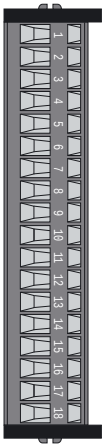
18-pin terminal block	Terminal	Assignment
X2  7TB718.91	1	GND output supply
	2	+24 VDC output supply
	3	Analog output 1 +
	4	Analog output 1 ⊥
	5	Analog output 2 +
	6	Analog output 2 ⊥
	7	Analog output 3 +
	8	Analog output 3 ⊥
	9	Analog input 5 +
	10	Analog input 5 ⊥
	11	Digital output 1
	12	Digital output 2
	13	Digital output 3
	14	Digital output 4
	15	Digital output 5
	16	Digital output 6
	17	Digital output 7
	18	Digital output 8

Table 148: 7XX436.50-1 - Pin assignment - X2 / analog/digital outputs

Connection example

Digital outputs

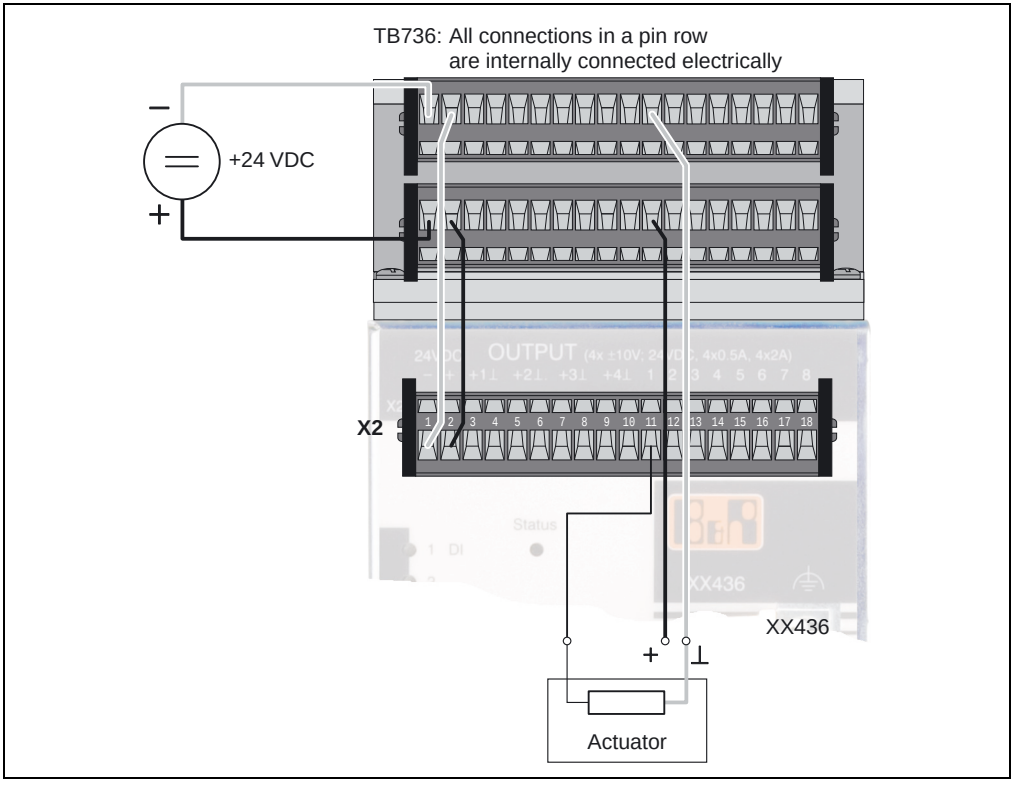


Figure 148: 7XX436.50-1 - Connection example / digital outputs

Analog outputs

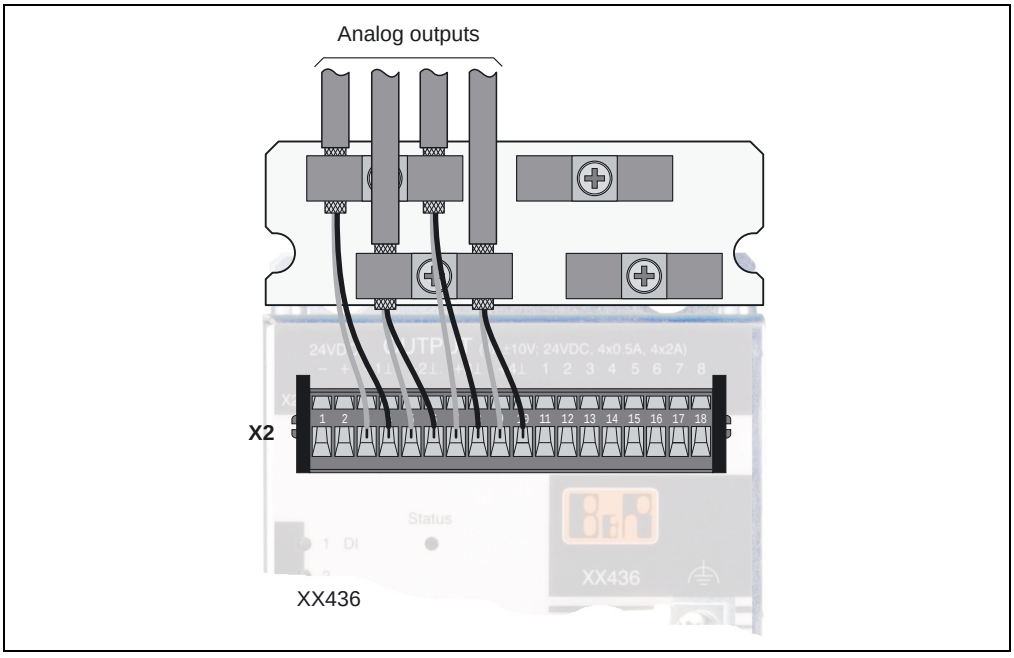


Figure 149: 7XX436.50-1 - Connection example / analog outputs

Output circuit diagram

Digital outputs

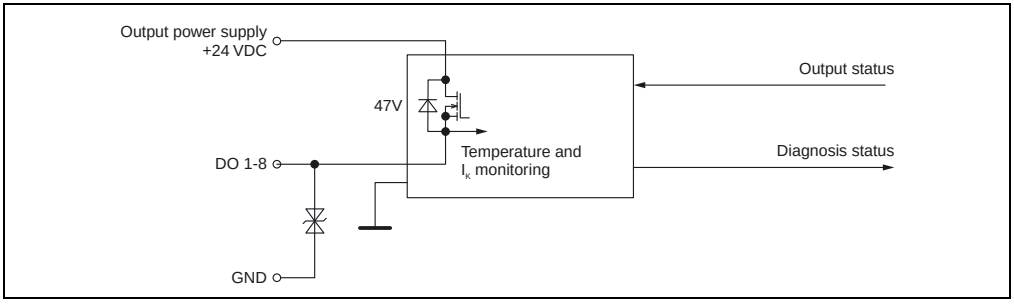


Figure 150: 7XX436.50-1 - Output circuit diagram / digital outputs

Analog outputs

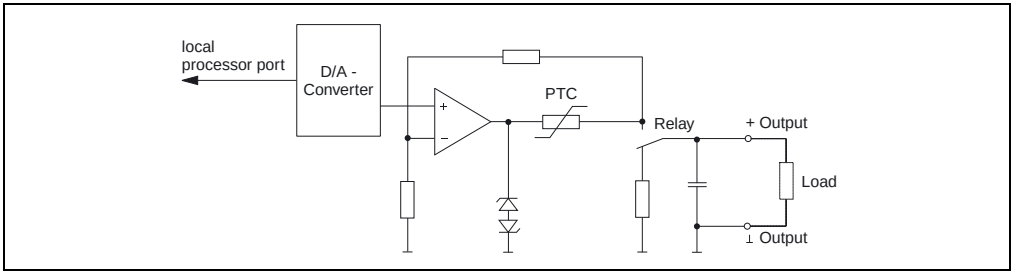


Figure 151: 7XX436.50-1 - Output circuit diagram / analog outputs

Switching inductive loads

Digital outputs 1 to 4

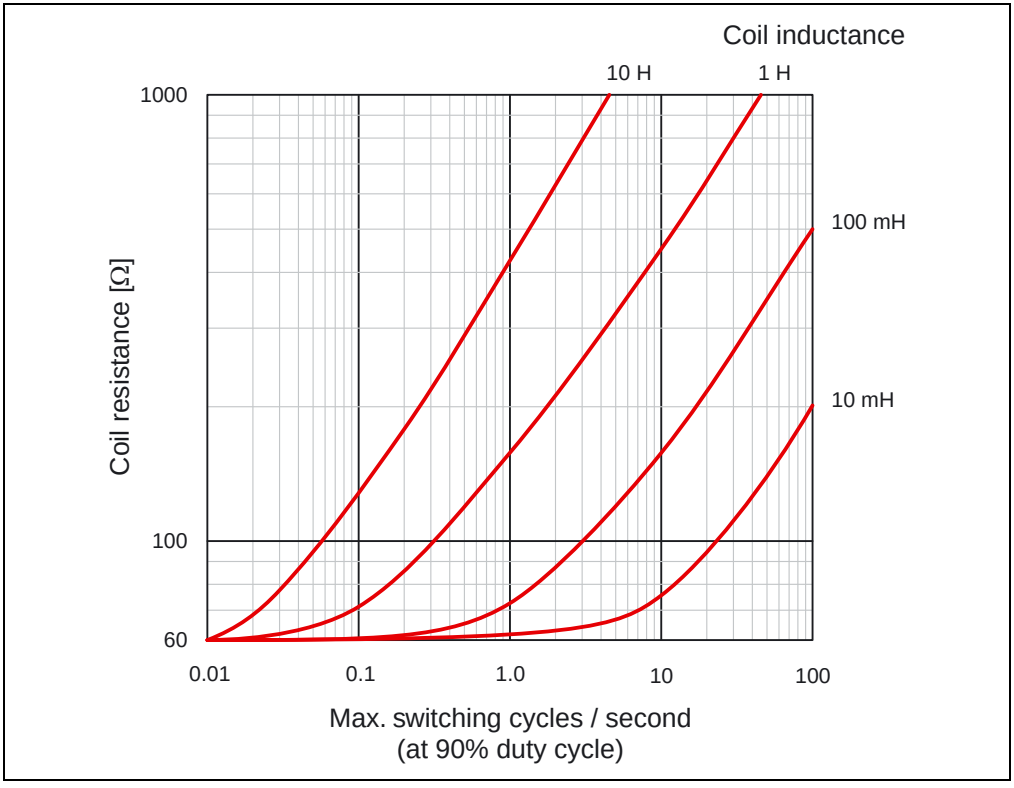


Figure 152: 7XX436.50-1 - Switching inductive loads / Digital outputs 1 to 4

Digital outputs 5 to 8

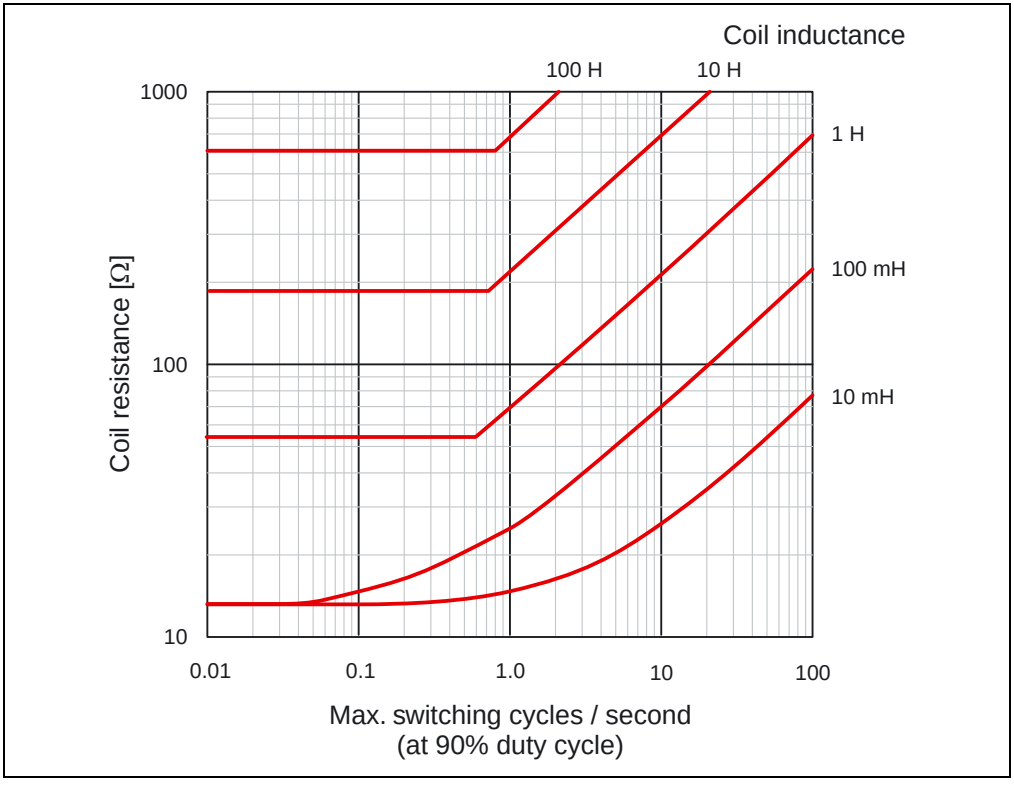


Figure 153: 7XX436.50-1 - Switching inductive loads / Digital outputs 5 to 8

5.6.7 X2X interface and module supply

The voltage supply and the X2X Link interface connections are made using a 12-pin terminal block.

The module is equipped with a bridge to loop through the X2X bus supply (for subsequent X2X Link slaves).

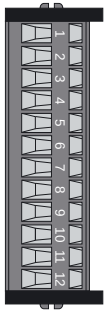
18-pin terminal block	Terminal	Assignment	
X3  7TB712.91	1	Bridge for X2X+	
	2	Bridge for X2X+	
	3	X2X	X2X input
	4	X2X⊥	
	5	X2X\	
	6	Shield [1]	
	7	X2X	X2X Output
	8	X2X⊥	
	9	X2X\	
	10	Shield [1]	
	11	+24 VDC module supply	
	12	Module supply GND	

Table 149: 7XX436.50-1 - Pin assignments X3 / X2X interface and module supply

1) Same potential as the housing

Connection example for X2X Link with subsequent X2X Link slaves

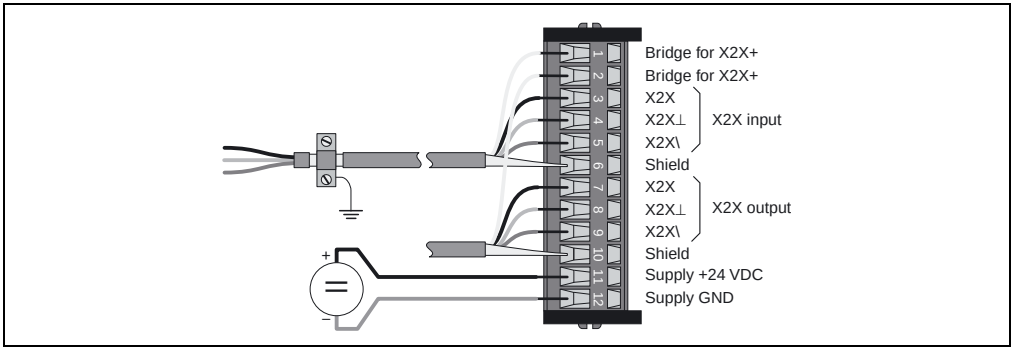


Figure 154: 7XX436.50-1 - Connection example of X2X Link with subsequent X67 slaves

Connection example of X2X Link as last X2X Link slave

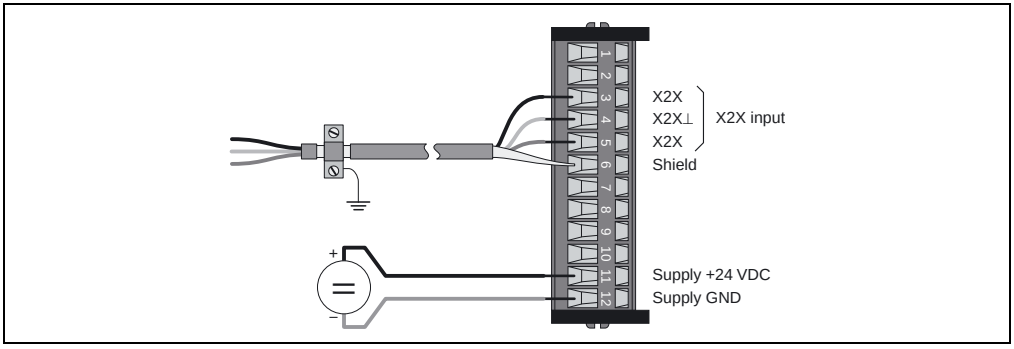


Figure 155: 7XX436.50-1 - Connection example of X2X Link as last X2X Link slave

5.6.8 Monitoring

Monitoring the module supply voltage

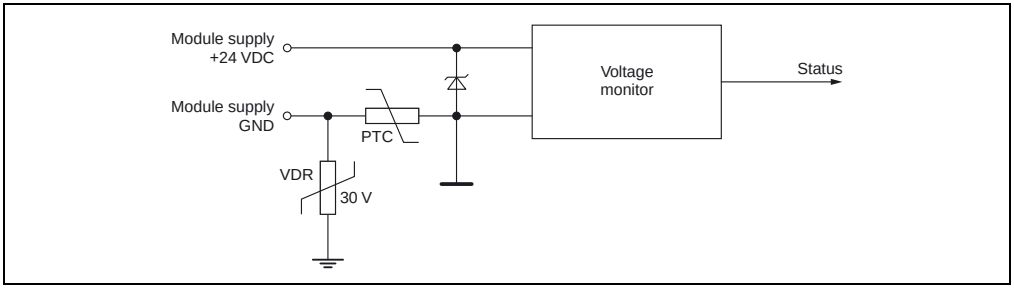


Figure 156: 7XX436.50-1 - Circuit diagram for the module supply

Current monitoring for the 2A outputs

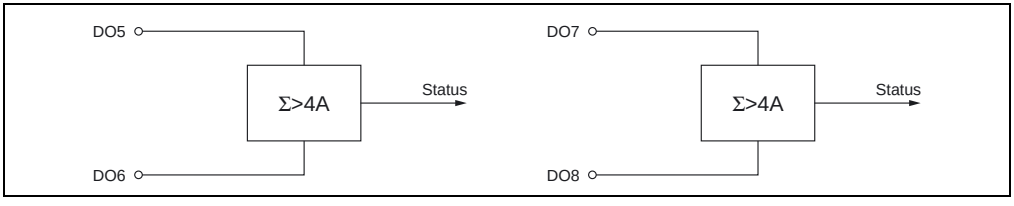


Figure 157: 7XX436.50-1 - Current monitoring for the 2A outputs

5.6.9 Register description

Register overview

Register	Name	Data type	Length	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
0	DigitalInput01 - DigitalInput08	BOOL	1	●	●		
0	DigitalOutput01 - DigitalOutput08	BOOL	1			●	●
8	StatusDigitalOutput01 - StatusDigitalOutput08	BOOL	1	●	●		
16	EventCounter01 ABREncoder01 ABEncoder	DINT	1	●	●		
20	EventCounter02 LatchABREncoder01 TimeCounter	UINT	1	●	●		
24	AnalogInput01 Temperature01 Resistor01	INT	1	●	●		
26	AnalogInput02 Temperature02 Resistor02	INT	1	●	●		
28	AnalogInput03	INT	1	●	●		
30	AnalogInput04	INT	1	●	●		
24	AnalogOutput01	INT	1			●	●
26	AnalogOutput02	INT	1			●	●
28	AnalogOutput03	INT	1			●	●
30	AnalogOutput04	INT					
32	StatusInput01	UINT	1	●	●		
32	ConfigOutput01	UINT	1			●	●
36	TriggerValue	INT	1	●	●		
38	TriggerTimestamp	INT	1	●	●		
36	TriggerLevel	INT	1			●	●
38	ComparatorOutput	INT	1			●	●

Table 150: 7XX436.50-1 - Register overview

Register description

Register	Description
DigitalInput01 - DigitalInput08	Level of digital inputs 1 - 8
DigitalOutput01 - DigitalOutput08	Setting the digital outputs 1 - 8
StatusDigitalOutput01 - StatusDigitalOutput08	Reading back the digital outputs 1-8
EventCounter01	Counter state of digital input 1 (event counter or gate/period measurement)
EventCounter02	Counter state of digital input 2 (event counter)
ABREncoder01	Counter state / encoder value of the incremental encoder in ABR mode
LatchABREncoder01	Temporarily saved counter state / encoder value of the last R pulse (digital input 3)
ABEncoder	Counter state of the incremental encoder in AB mode
TimeCounter	Time counter in µs (time is temporarily saved and reset at every edge of the A or B signal)
AnalogInput01 - AnalogInput04	Voltage input (value range $0000 to $7FFF)
Temperature01-Temperature02	Temperature measurement (1 LSB = 0.1°C) of the analog inputs 1+2, if they are configured accordingly.
Resistor01-Resistor02	Resistance measurement (1 LSB = 1 Ω) of the analog inputs 1+2, if they are configured accordingly.
AnalogOutput01 - AnalogOutput04	Analog input 1-4 (value range $8001 to $7FFF)
StatusInput01	Status information about the module
ConfigOutput01	Module configuration
TriggerValue	Input value which triggered the comparator. This value remains the same until the next time the comparator is triggered.
TriggerTimestamp	Time at which the comparator was triggered (microseconds since the end of the last X2X cycle). This value remains the same until the next time the comparator is triggered.
TriggerLevel	Threshold value / trigger value of the comparator
ComparatorOutput	If the comparator is not switched on or has not been triggered, then the active comparator output is determined by the default output. The active output is defined as follows when the comparator is triggered: • Active analog output (bit 8 of the configuration register is 1): ComparatorOutput contains the value ($8001-$7FFF), which is output to the analog output 3. • Active digital output (bit 8 of the configuration register is 0): Bit 0 of ComparatorOutput is output to the digital output 1.

Table 151: 7XX436.50-1 - Register description

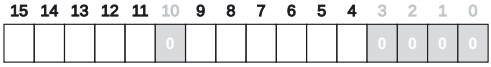
Module configuration



Bit	Description
0	0 Comparator function off 1 Comparator function on (if the comparator has been triggered once, then it keeps its status until it is switched off and switched back on if necessary)
1	0 R mode for AB(R) counter, off 1 R mode for AB(R) counter, on
2	0 Period measurement 1 Gate measurement
3	For period or gate measurement: 0 Measurement starts at positive edge 1 Measurement starts at negative edge
4 - 5	Counter mode: 00 No counter operation 01 AB(R) counter 10 Event counter 11 Counter 1: Period or gate measurement Counter 2: Event counter
7-6	Counter frequency: 00 4 MHz 01 31.25 kHz 10 External counter frequency (digital input 3) 11 Special mode (only valid for incremental encoder mode without R input): Value in TimerCounter: Time counter in µs (time is temporarily saved and reset at every edge of the A or B signal)
8	Active comparator output 0 Digital output 1 1 Analog output 3
9	0 Overflow recognition off; overflow bit from counter 1 is reset 1 Overflow recognition of the continuous counter 1 (value limited to $7FFFFFFF)
10 - 11	Analog input 1: 00 Voltage measurement 01 Temperature measurement PT1000 10 Temperature measurement KTY10-6 11 Resistance measurement 1-4000Ω
12 - 13	Analog input 2: 00 Voltage measurement 01 Temperature measurement PT1000 10 Temperature measurement KTY10-6 11 Resistance measurement 1-4000Ω
14	0 Comparator is triggered when the value falls below the threshold value 1 Comparator is triggered when the value exceeds the threshold value
15	0 Time / counter reset 1 Time/counter switched on (set this bit to 1 after counter has been configured)

Table 152: 7XX436.50-1 - Configuration register

Status information about the module



Bit	Description
0 - 3	0 Reserved
4	Analog input 1 0 Ok 1 Error
5	Analog input 2 0 Ok 1 Error
6	Analog input 3 0 Ok 1 Error
7	Analog input 4 0 Ok 1 Error
8	0 Comparator has not been triggered 1 Comparator has been triggered
9	Counter 1: Period or gate measurement 0 Valid value in the range from 0 to $7FFFFFFF (only valid if bit 9 is set in the configuration register) 1 Counter overflow (acknowledge by resetting bit 9 in the configuration register)
10	0 Reserved
11	Monitoring the module supply 0 Voltage within the warning limits (18 to 10 VDC) 1 Voltage outside the warning limits (18 to 10 VDC)
12	Monitoring of the supply for the digital inputs 0 Ok 1 Error
13	Total current for the outputs 5 + 6 0 <4 A 1 >4 A
14	Total current for the outputs 7 + 8 0 <4 A 1 >4 A
15	Monitoring of the output supply 0 Ok 1 Error

Table 153: 7XX436.50-1 - Status register