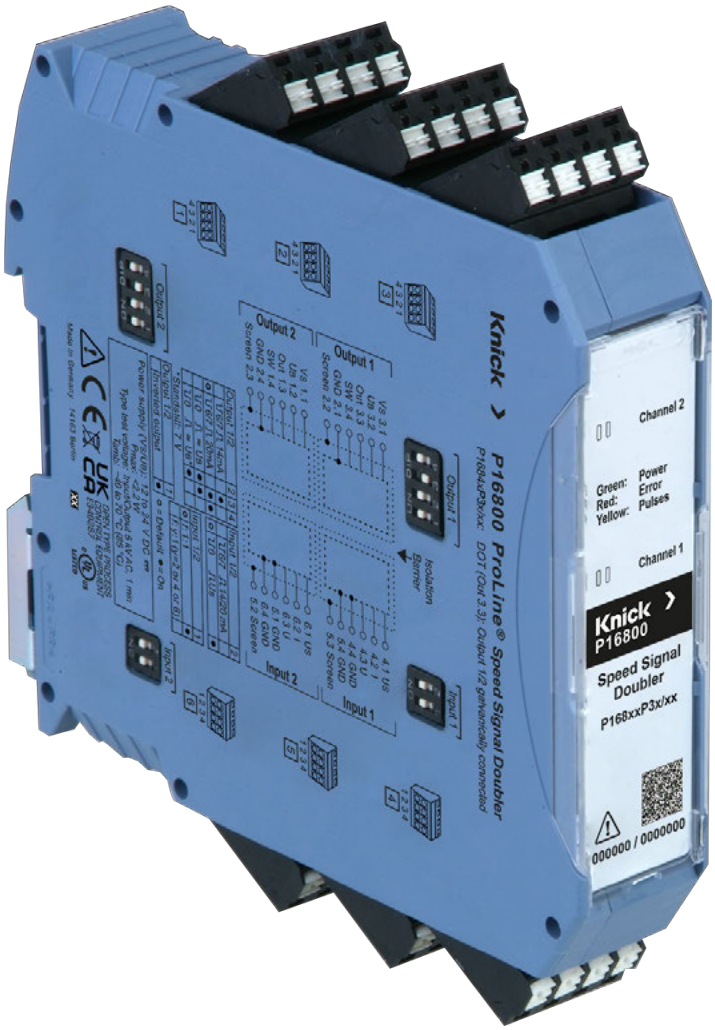
Knick

User Manual

ProLine P16800

Speed Signal Doubler



Read before installation.
Keep for future use.

www.knick.de

Supplemental Directives

READ AND SAVE THIS DOCUMENT FOR FUTURE REFERENCE. BEFORE ATTEMPTING TO ASSEMBLE, INSTALL, OPERATE OR MAINTAIN THE PRODUCT, PLEASE ENSURE A COMPLETE UNDERSTANDING OF THE INSTRUCTIONS AND RISKS DESCRIBED HEREIN. ALWAYS OBSERVE ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS IN THIS DOCUMENT COULD RESULT IN SERIOUS INJURY AND/OR PROPERTY DAMAGE. THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE.

These supplemental directives explain how safety information is laid out in this document and what content it covers.

Safety Chapter

This document's safety chapter is designed to give the reader a basic understanding of safety. It illustrates general hazards and gives strategies on how to avoid them.

Warnings

This document uses the following warnings to indicate hazardous situations:

Symbol	Category	Meaning	Remark
⚠	**WARNING**	Designates a situation that can lead to death or serious (irreversible) injury.	The warnings contain information on how to avoid the hazard.
⚠	**CAUTION**	Designates a situation that can lead to slight or moderate (reversible) injury.	
None	**NOTICE**	Designates a situation that can lead to property or environmental damage.	

Table of Contents

1 Safety

This document contains important instructions for the use of the product. Always follow all instructions and operate the product with caution. If you have any questions, please contact Knick Elektronische Messgeräte GmbH & Co. KG (sometimes hereafter referred to as "Knick") using the information provided on the back page of this document.

1.1 Intended Use

The P16800 speed signal doubler detects pulses from speed sensors and transmits them, electrically isolated from each other, to the output. The inputs on the P16800 process the sensor signals without interaction, specified according to SIL4. → *Functional Safety (Optional), p. 6*

The product is suitable for use in rolling stock and in industrial applications.

The speed signal doubler can be used in the following areas of application:

- decoupling and multiplying speed sensor signals
- providing galvanically isolated and thus independent speed signals for ATP systems, door control systems, electronic journey registration, and other systems requiring route/time or speed information
- speed/velocity measurements on rolling stock
- applications with encoders and speed sensors in general industrial environments

The various versions of the speed signal doubler are referred to as device, product, or P16800.

The nameplates on the products clearly specify the product properties.
→ *Nameplate, p. 8*

USE CAUTION AT ALL TIMES WHEN INSTALLING, USING, OR OTHERWISE INTERACTING WITH THE PRODUCT. ANY USE OF THE PRODUCT EXCEPT AS SET FORTH HEREIN IS PROHIBITED, AND MAY RESULT IN SERIOUS INJURY OR DEATH, AS WELL AS DAMAGE TO PROPERTY. THE OPERATING COMPANY SHALL BE SOLELY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM OR ARISING OUT OF AN UNINTENDED USE OF THE PRODUCT.

1.2 Personnel Requirements

The operating company shall ensure that any personnel using or otherwise interacting with the product is adequately trained and has been properly instructed.

The operating company shall comply and cause its personnel to comply with all applicable laws, regulations, codes, ordinances and relevant industry qualification standards related to product. Failure to comply with the foregoing shall constitute a violation of operating company's obligations concerning the product, including but not limited to an unintended use as described in this document.

1.3 Residual Risks

Note the different levels of functional safety depending on the selected product variant.

The product has been developed and manufactured in accordance with generally accepted safety rules and regulations, as well as an internal risk assessment. Despite the foregoing, the product may among others bear the following risks:

Environmental Influences

The effects of moisture, corrosion, and ambient temperature as well as high voltages and transient overvoltages may affect the safe operation of the product. Observe the following instructions:

- Only operate the P16800 in compliance with the stated operating conditions.
  → *Specifications, p. 36*

1.4 Functional Safety (Optional)

The P16800 decouples signals from safety-related signal circuits without influencing them. The input signal is transmitted to the output signal with the specified accuracy in a functionally safe manner.

The nameplates on the products clearly specify the product properties.
→ *Nameplate, p. 8*

SRAC – Safety Related Application Conditions

The information regarding use of the P16800 and the conditions of use specified in this User Manual are to be followed as safety-related application conditions (SRACs) in order to achieve the specified functional safety characteristics regarding absence of interaction and signal transmission. The reinforced insulation of the SIL product between input and output and the specified limits for altitude, overvoltage category, and working voltage must be observed.

1.5 Installation and Operation

All national and local regulations relating to the installation and operation of the product in force at the destination must be followed.

All connected current or voltage circuits must meet the SELV, PELV, or Area I requirements according to EN 50153.

- The product must be installed by qualified electrical engineering personnel.
- The product may not be opened, modified, or independently repaired. Replace it with an equivalent product. Repairs may only be carried out by Knick.
- The operating company must ensure compliance with the specified interface parameters and ambient conditions.
- The product must be installed in a lockable control cabinet.

See also
→ *Installation, p. 22*

2 Product

2.1 Package Contents

- P16800 in the version ordered
- Three-pole insertable jumpers
  - For 1-channel device: 1 unit
  - For 2-channel device: 2 units
- Two-pole insertable jumpers
  - For 1-channel device: 3 units
  - For 2-channel device: 6 units
- Test Report 2.2 according to EN 10204
- Installation Guide with safety instructions

Note: The User Manual (this document) is published in electronic form. → *knick.de*

2.2 Product Identification

The different versions of the P16800 are encoded in a model designation.

2.2.1 Product Code

Speed Signal Doubler	P	1	6	8	_	_	P	3	1	/	_	0
Pulse input / pulse output				8								
1 input → 1 output					1							
2 inputs → 2 outputs					2							
2 inputs → 1 output and DOT (direction of travel)[1)]					4	0						
Without SIL						0						
With non-interacting input (SIL 4)						1						
With non-interacting input (SIL 4) and safe transmission of signals to output (SIL 2)						2						
Modular housing[2)]							P	3				
Push-in two-tier terminals, pluggable									1			
Frequency division 1:1 or 2:1											2	
Frequency division 1:1 or 4:1											4	
Frequency division 1:1 or 8:1											8	
Voltage supply/power supply 12 ... 24 V												0

2.2.2 Example of a Version

Speed Signal Doubler	P	1	6	8	2	2	P	3	1	/	2	0
Pulse input / pulse output				8								
2 inputs → 2 outputs					2							
With non-interacting input (SIL 4) and safe transmission of signals to output (SIL 2)						2						
Modular housing							P	3				
Push-in two-tier terminals, pluggable									1			
Frequency division 1:1 or 2:1											2	
Voltage supply/power supply 12 ... 24 V												0

1) Without SIL

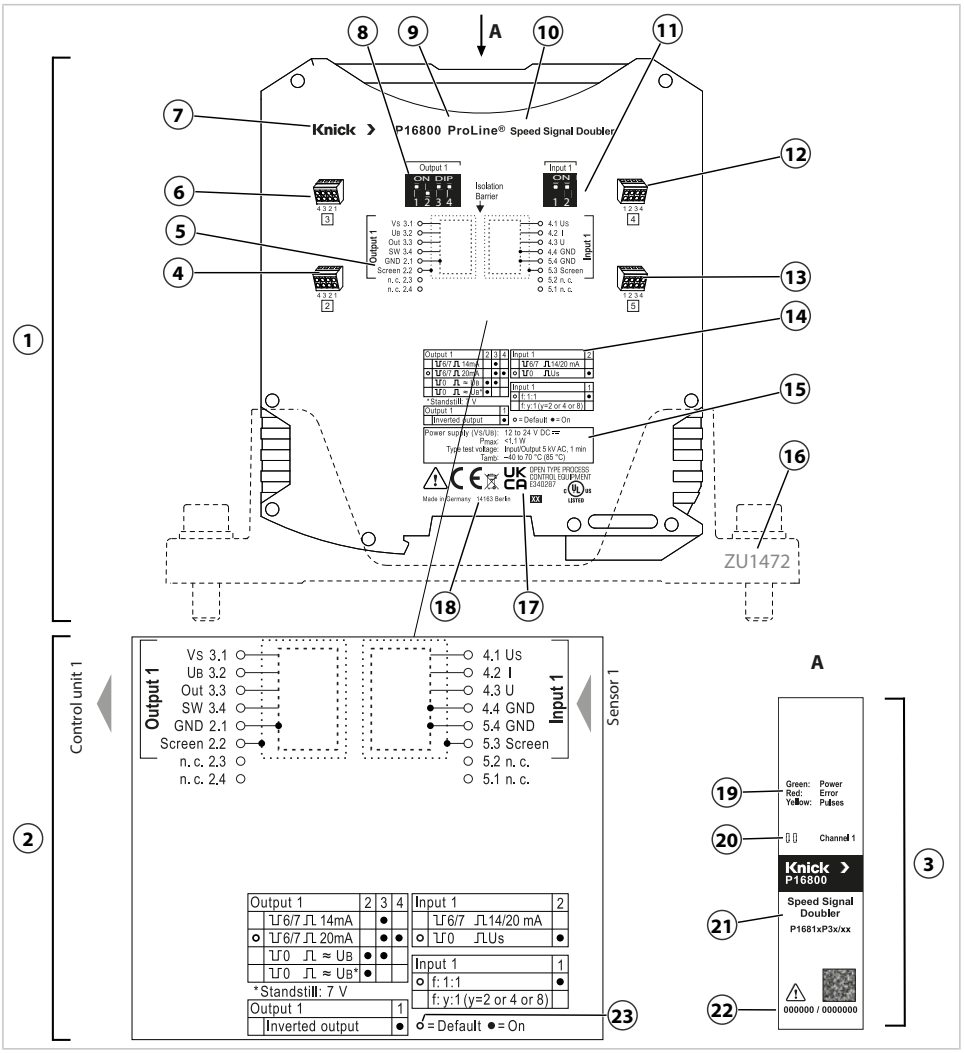
2) for 35-mm DIN rail or ZU1472 wall-mount adapter (optional)

2.2.3 Nameplate

The P16800 is identified by nameplates on the side and front of its housing. The information on the nameplates varies depending on the version of the product.

→ *Product Code, p. 7*

1-Channel Speed Signal Doubler

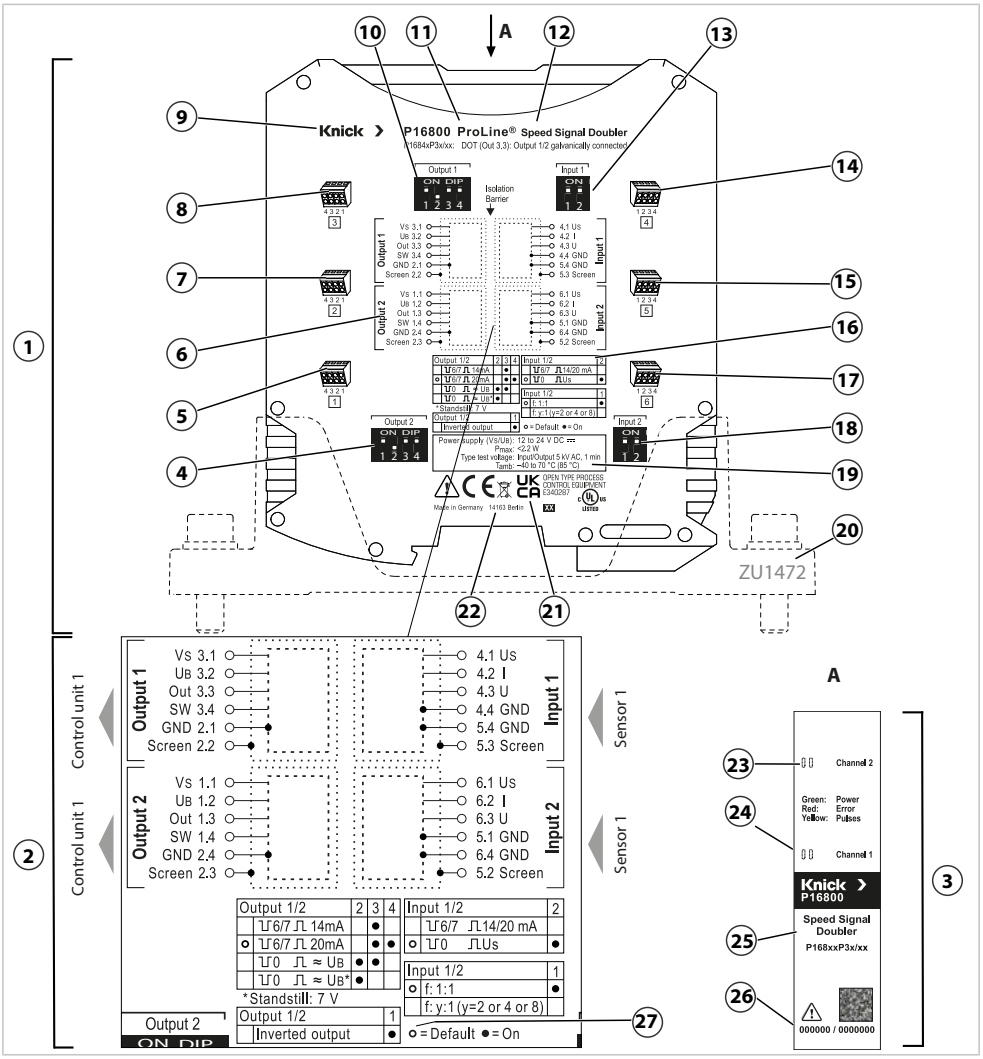


1	Nameplate, side	**13**	Two-tier terminal 5
2	Terminal assignments and configuration overview (extract from nameplate, side)	**14**	Configuration overview
3	Device front nameplate (legend no. 3)	**15**	Connected loads: Power supply, max. power consumption, type test voltage, permissible ambient temperature
4	Two-tier terminal 2	**16**	Wall-mount adapter (optional accessory ZU1472)
5	Connection diagram	**17**	Conformity/approvals
6	Two-tier terminal 3	**18**	Manufacturer's address with designation of origin
7	Manufacturer	**19**	Meaning of the LED display
8	DIP switch output 1	**20**	Channel 1 LED (x2)
9	Product family	**21**	Product name, model designation
10	Product name	**22**	Item number/serial number
11	DIP switch input 1	**23**	Factory setting
12	Two-tier terminal 4		

See also

→ *Symbols and Markings, p. 10*

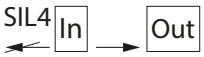
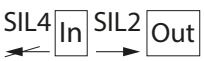
2-Channel Speed Signal Doubler and Optional DOT Function



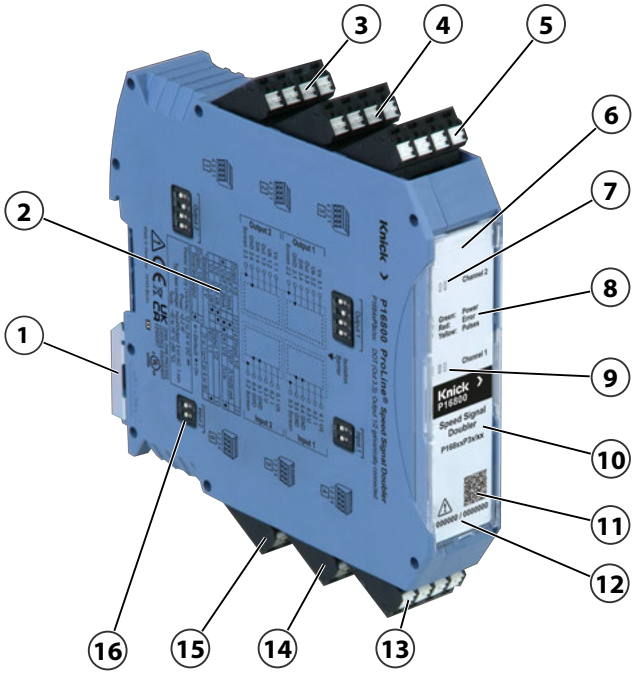
1	Device side nameplate	**15**	Two-tier terminal 5
2	Terminal assignments and configuration overview (extract from nameplate, side)	**16**	Configuration overview
3	Device front nameplate (legend no. 3)	**17**	Two-tier terminal 6
4	DIP switch output channel 2	**18**	DIP switch input channel 2
5	Two-tier terminal 1	**19**	Connected loads: Power supply, max. power consumption, type test voltage, permissible ambient temperature
6	Terminal assignments	**20**	Wall-mount adapter (optional accessory ZU1472)
7	Two-tier terminal 2	**21**	Conformity/approvals
8	Two-tier terminal 3	**22**	Manufacturer's address with designation of origin
9	Manufacturer	**23**	Channel 2 LED (x2)
10	DIP switch output channel 1	**24**	Channel 1 LED (x2)
11	Product family	**25**	Product name, model designation
12	Product name	**26**	Item number/serial number
13	DIP switch input channel 1	**27**	Factory setting
14	Two-tier terminal 4		

See also
→ *Symbols and Markings, p. 10*

2.3 Symbols and Markings

	Special conditions and danger points! Observe the safety information and instructions on safe use of the product as outlined in the product documentation.
	Attaching the CE marking to the product means that the product satisfies the applicable requirements specified in the European Union harmonization legislation.
	UL Listed: Combined UL mark for Canada and the United States
	UK Conformity Assessed: Conformity mark for the United Kingdom (England, Scotland, and Wales)
	The symbol on Knick products means that the waste devices must be disposed of separately from unsorted municipal waste.
	Square-wave signal, high level
	Square-wave signal, low level
	DIP switch: Function ON
	DIP switch: Function OFF
	DIP switch: Factory setting (default)
	Absence of interaction SIL (crossed-out arrow)
	Transmission SIL

2.4 Design



1	Mounting metal foot catch	**9**	LED (x2) channel 1
2	Nameplate, side	**10**	Product name
3	Two-tier terminal 1	**11**	DataMatrix code
4	Two-tier terminal 2	**12**	Item/serial number
5	Two-tier terminal 3	**13**	Two-tier terminal 4
6	Nameplate, device front	**14**	Two-tier terminal 5
7	LED (x2) channel 2 (if available)	**15**	Two-tier terminal 6
8	Meaning of the LED display	**16**	DIP switch (application-specific), see configuration

See also

→ *DIP Switches, p. 30*
→ *LED Signaling, p. 32*
→ *Nameplate, p. 8*

2.5 Functional Description

The P16800 is available in 1- and 2-channel versions and is used to detect speed sensor signals. The input of the P16800 is designed in such a way that speed sensors with current or voltage output can be connected. The outputs of the product can be configured as current or voltage outputs and behave like a speed sensor for the control units. → *Product Code, p. 7*

P16810	1 input, 1 output
P16820	2 inputs, 2 outputs
P16840	2 inputs, 1 output, 1 DOT output

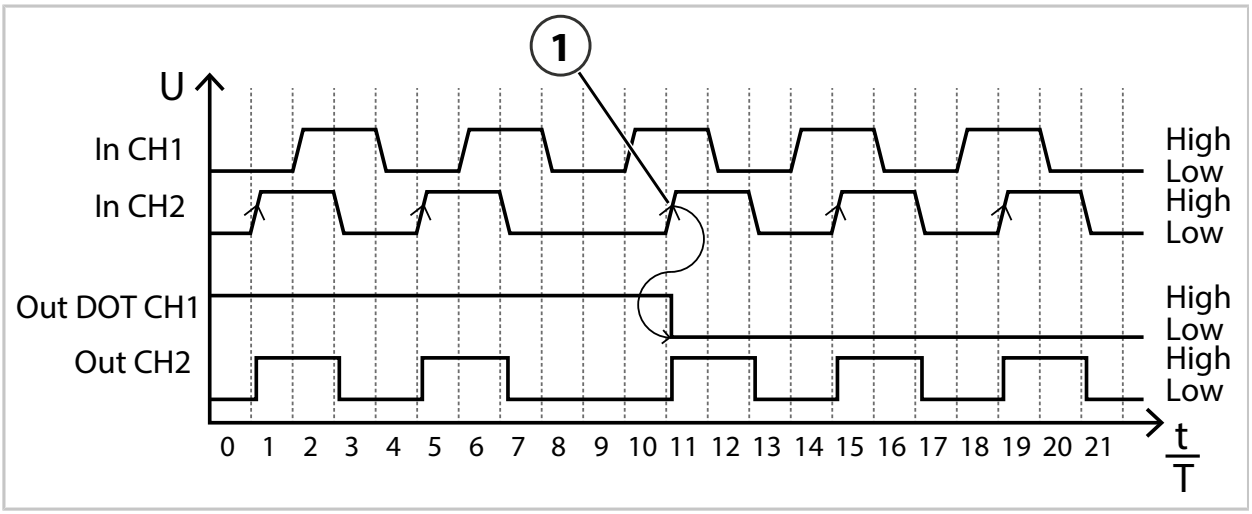
- The P16800 transmits the pulse signal from speed sensors from the input to the output in a galvanically isolated process. The product is used to double signals, i.e., to decouple them from existing measuring circuits, or to protect control units from voltage loads on the speed sensor.
- The galvanic isolation protects the equipment and contributes to an unaltered transmission of the measuring signals. This may improve the signal quality and decouple the control units. EMC interference at the control units can thus be reduced.
- The P16800 can detect the standstill of an axle or a vehicle if the input pulses fall below the minimum frequencies.
- P16840 only: The product can detect the direction of rotation of an axle or the direction of travel of a vehicle.
- The speed sensor's voltage U_S at the input of the P16800 is required in order to define the switching threshold. U_S is not used to supply the P16800.
- The P16800 can process signals from speed sensors and other pulse transmitters, e.g., turbochargers or flow sensors.
- The P16800 detects the pulse signals from speed sensor circuits without influencing them. The absence of interaction can be set for safety-related applications up to SIL 4.
- The pulse transmission from the input to the output can optionally be set for safety-related applications up to SIL 2.
- Pulse transmission can be set as 1:1 or, with frequency division, as 2:1 (4:1 or 8:1 available ex works). With enabled frequency division, the output signal has a pulse-pause ratio of 50 %. Frequency division connecting both channels in series is possible up to 64 times.
- The pulse signals can be inverted.
- The output is the binary image of the input signals (high/low level, true zero speed response).
- The enclosure is suitable for mounting on 35 mm DIN rails and walls (ZU1472 wall-mount adapter, optional → *Accessories, p. 34*).
- The following SIL products are suitable for safety-related applications:
  - SIL: P16811***, P16812*** in 1-channel version
  - SIL: P16821***, P16822 *** in 2-channel version → *Abbreviations, p. 44*

Product Version with DOT Function

Device version P16840 generates a direction-of-travel (DOT) signal. The output of the first channel (Out DOT CH1) supplies the result of the input channel phase comparison as a DOT signal.

The output of the second channel reproduces the signal from the input of the second channel. With the P16840, the outputs are galvanically interconnected. The inputs are galvanically isolated from each other and from the outputs.

Pulse Diagram (Schematic)



1 Direction change

With a rising signal edge (1) at the input of channel 2 (In CH2), the output level of the DOT signal is set at the output of the first channel.

The DOT signal can be output inverted or not inverted via the DIP switch at the output. Inverting a channel at the current or voltage output changes the polarity of the DOT signal. → *DIP Switches, p. 30*

See also

→ *DIP Switches, p. 30*
→ *Transmission Behavior, p. 38*

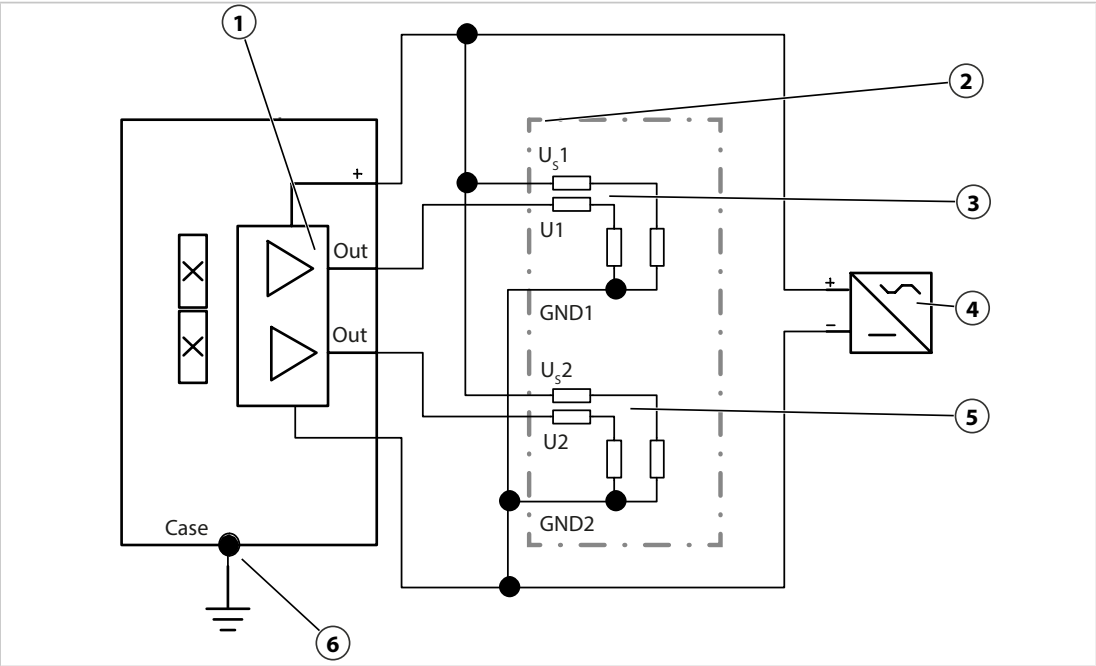
2.6 Input/Output

Speed sensors with voltage output and current output can be connected at the input of the P16800.

2-Channel Speed Sensor with Voltage Output

When using speed sensors with voltage output, the voltage supply of the speed sensor is connected to the inputs U_S and GND of the P16800. The threshold voltage for the level detection of the input is set via input U_S. The P16800 is supplied with energy via the V_S terminal and GND (not shown in the diagram).

The output signals of the speed sensor are connected at the U and GND voltage inputs of the P16800.

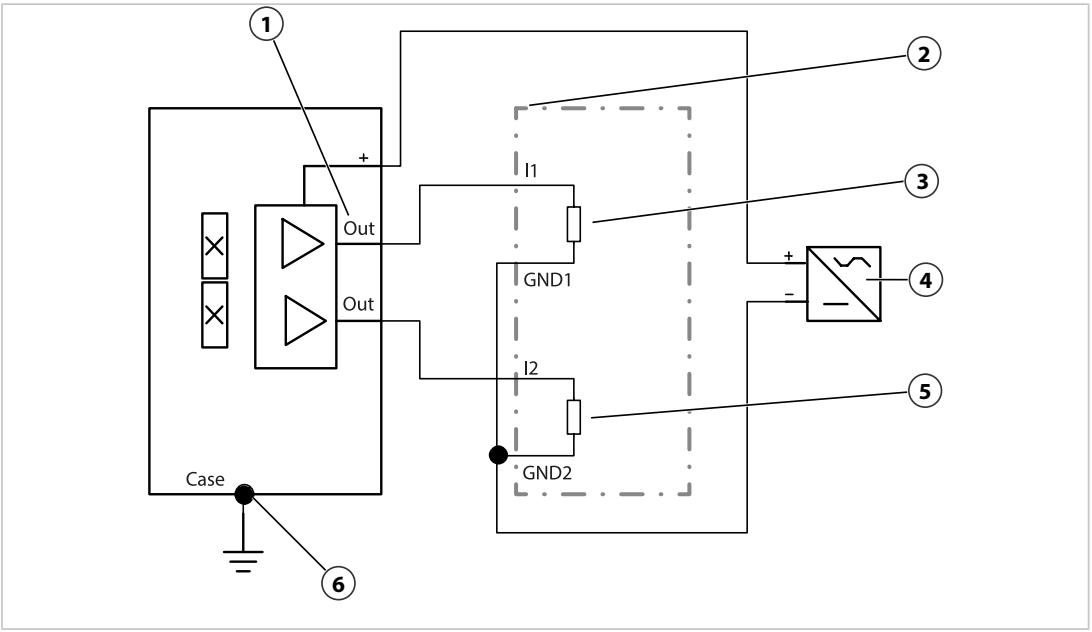


1	Voltage outputs of a 2-channel speed sensor	**4**	Power supply
2	Voltage inputs of the P16820	**5**	Input voltage divider channel 2 with U input 2 and GND input 2
3	Input voltage divider channel 1 with U input 1 and GND input 1	**6**	Equipotential bonding

When using 2-channel speed sensors, U_S1 and U_S2 must each be connected to the speed sensor's voltage supply. The voltage connected to U_S1 and U_S2 is used exclusively to determine the internal switching thresholds, not to supply the product's inputs. The input resistors of U_S1 and U_S2 are high-impedance. The input circuit, consisting of the input voltage divider channel 1 **(3)** and the input voltage divider channel 2 **(5)**, do not require a separate supply voltage.

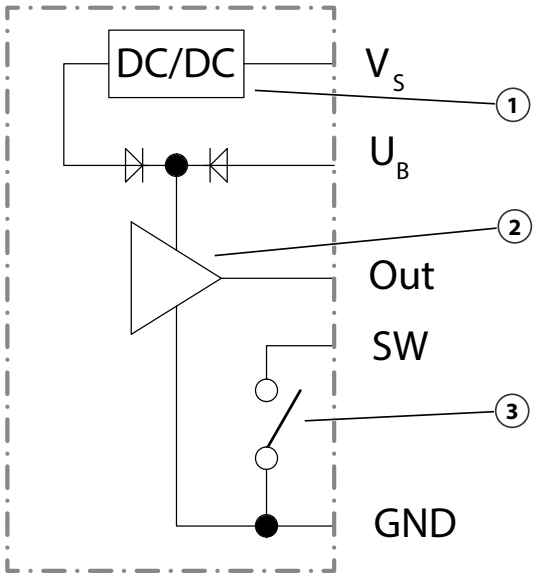
2-Channel Speed Sensor with Current Output

When using speed sensors with current output, the signal currents are conducted via internal load resistors in the P16800. The load resistors are protected against overload with diodes connected in parallel. To ensure that the current flow is not interrupted when the plug is disconnected, diodes can be inserted in the two-tier terminals.



1	Current outputs of a 2-channel speed sensor	**4**	Power supply
2	Current inputs of the P16800	**5**	Channel 2 load
3	Channel 1 load	**6**	Equipotential bonding

Output Circuit of a P16800 Channel



1 Internal voltage converter	**3** Switching output for status signaling
2 Output driver for current and voltage	

The P16800 is supplied via the V_S terminal and GND (supply not shown in the diagram).

The output of the P16800 has two supply connections: V_S and U_B. If the U_B terminal is used, the output driver is supplied by the voltage applied to U_B via the diode network. If the U_B terminal is open, the output driver is supplied via V_S and an internal voltage converter.

The signal output OUT can be parameterized as current or voltage output via DIP switches. With active standstill detection and detected standstill (frequency < 1 Hz), a constant voltage of 7.2 V is measured at the output. The U_B terminal must be connected in this mode. To activate the standstill detection, the voltage output must be selected via the DIP switches. The switching output SW is a diagnostic switch and signals a detected error when it is open. All output connections are protected with bipolar suppressor diodes.

See also
→ *Current Output, p. 37*
→ *Voltage Output, p. 37*

2.7 Voltage Supply

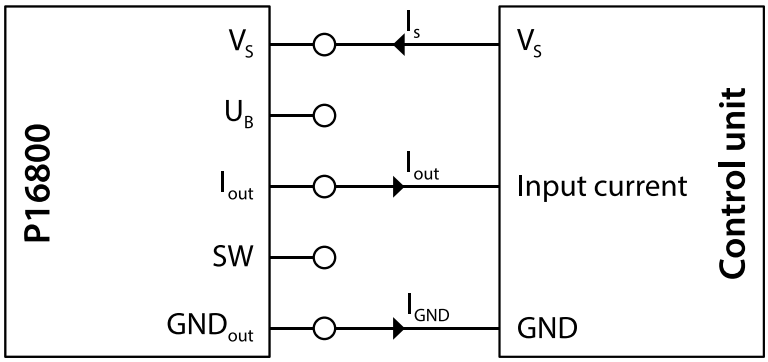
The P16800 is supplied with power via the output circuit. The typical voltage supply is nominally 12 ... 24 V. The permissible voltage range is 10 ... 32 V DC. The voltage supply must be provided by a SELV, PELV power supply. The output circuit and the associated galvanically isolated input circuit are supplied via terminal V_S or U_B. The channel 1 and 2 supplies are galvanically isolated. The voltage supply is not galvanically isolated from the output.

The P16800 can be supplied via a downstream control unit or a power supply. The available currents (power output) are usually limited when power is supplied via a control unit. If the current is exceeded, an error message may be displayed in the control unit. By selecting the terminal variant it is possible to adjust the current through the downstream control unit.

The following figures show the supply options for current and voltage outputs. The terminal options shown differ in their use of terminal U_B. If the U_B terminal is not connected, the P16800 supplies the output driver internally. This reduces the energy absorption and the temperature, so that the long-term availability increases. If the downstream control unit can evaluate reduced levels, the U_B terminal can remain open.

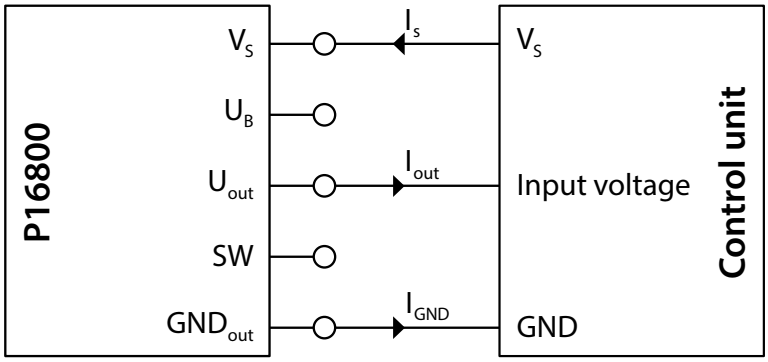
Supply via the Control Unit at Terminal V_S

Active current output



$$I_s = I_{GND} + I_{out}\ (R_{load,max} = 200\ \Omega)$$

Voltage output

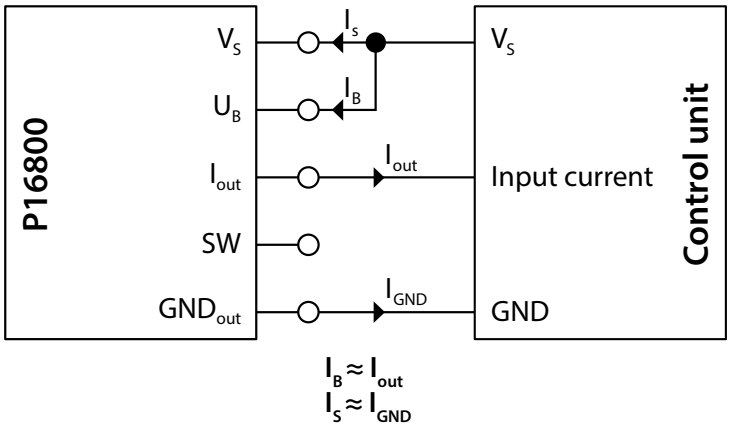


$$I_S = I_{GND} + I_{out}\ (U_{out,max} \approx 4\ V)$$

The current I_S that flows into terminal V_S is provided by the control unit. The signal output voltage U_{Out}, or the load voltage of a channel is approx. 4 V. The use of the standstill detection with an output voltage of 7.2 V is not possible in this terminal type.

Supply via the Control Unit at Terminal V_S and U_B

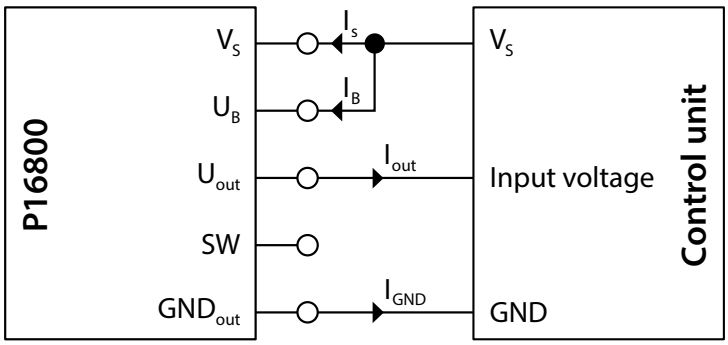
Passive current output



$I_B \approx I_{out}$
$I_S \approx I_{GND}$

The current, which flows from the control unit and into the supply of the P16800, is shared as I_S for terminal V_S and I_B for terminal U_B.

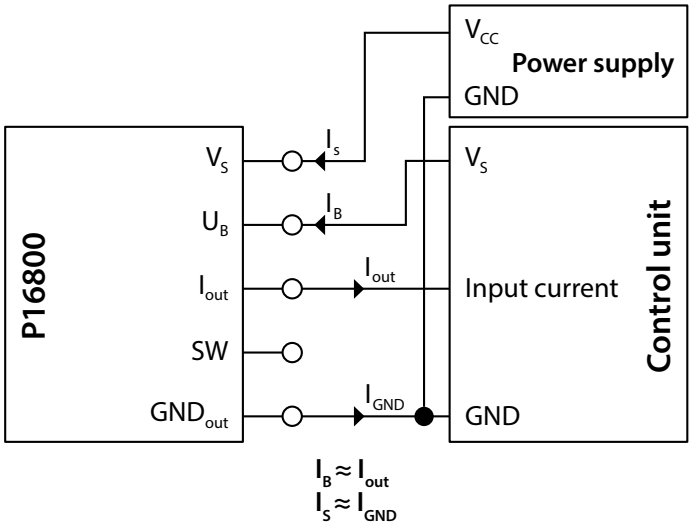
Voltage output

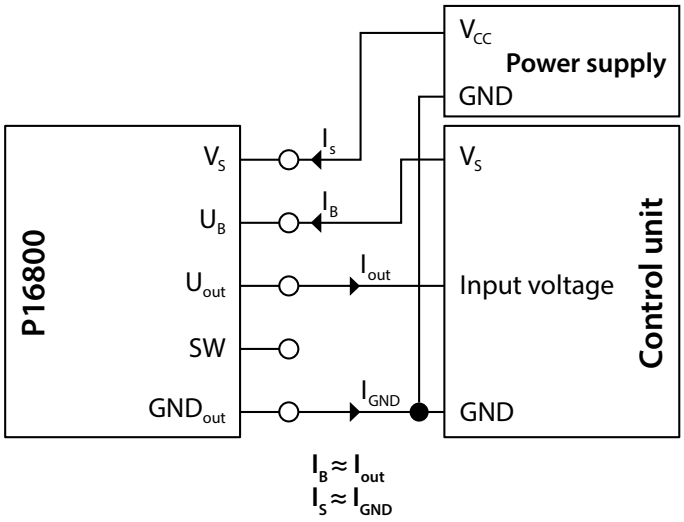


$I_B \approx I_{out}$ ($U_{out} \approx U_B$)
$I_S \approx I_{GND}$

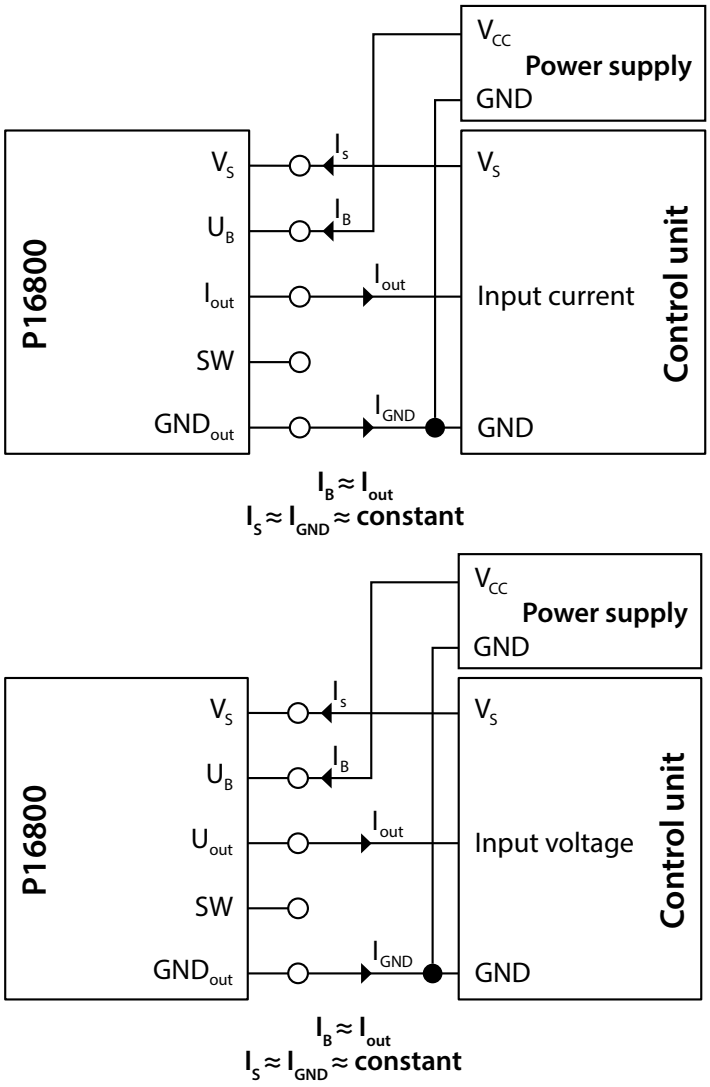
The current into terminal U_B is equal to the current that flows out of terminal I_{OUT}/U_{OUT}.

Auxiliary Power Supply at Terminal V_S





Auxiliary Power Supply at Terminal U_B (Output Driver)



If the load on the control unit is to correspond to the load through a speed sensor, an additional power supply may be used. Should the control unit tolerate a higher load, the additional power supply may be omitted. In this case, change the configuration of the connection to supply via the control unit (active current output or passive current output). → *Voltage Supply, p. 17*

See also
→ *Abbreviations, p. 44*

2.8 Shielding

The input and output range of the P16800 are separately and doubly shielded. The double shielding consists of an inner shield with connection to the circuit ground and a floating, outer shield.

Shielding for Current Input

Changing input currents generate a changing potential at the base of the measuring resistor and thus also at the input ground. The input ground is firmly connected to the inner shield, so that an alternating potential is created between the inner shield and the outer shield. The outer input shield is connected to the cable shield. Due to the double shielding of the input and the shielding of the output, the alternating currents do not affect the output.

Various shielding configurations are shown in the → *Configuration, p. 27* chapter.

NOTICE! There may be signal interference if the shielding is not connected. The screen terminals must be correctly connected and must not be left open.

The wire shields are connected to control cabinet ground in the respective control cabinets. Whether this is done on one or both sides depends on the equipotential bonding and the distance between the control cabinets.

See also

→ *Nameplate, p. 8*
→ *Voltage Supply, p. 17*
→ *Terminal Assignments, p. 23*
→ *Insertable Jumpers, p. 26*

3 Installation

3.1 Mounting

Comply with the conditions below:

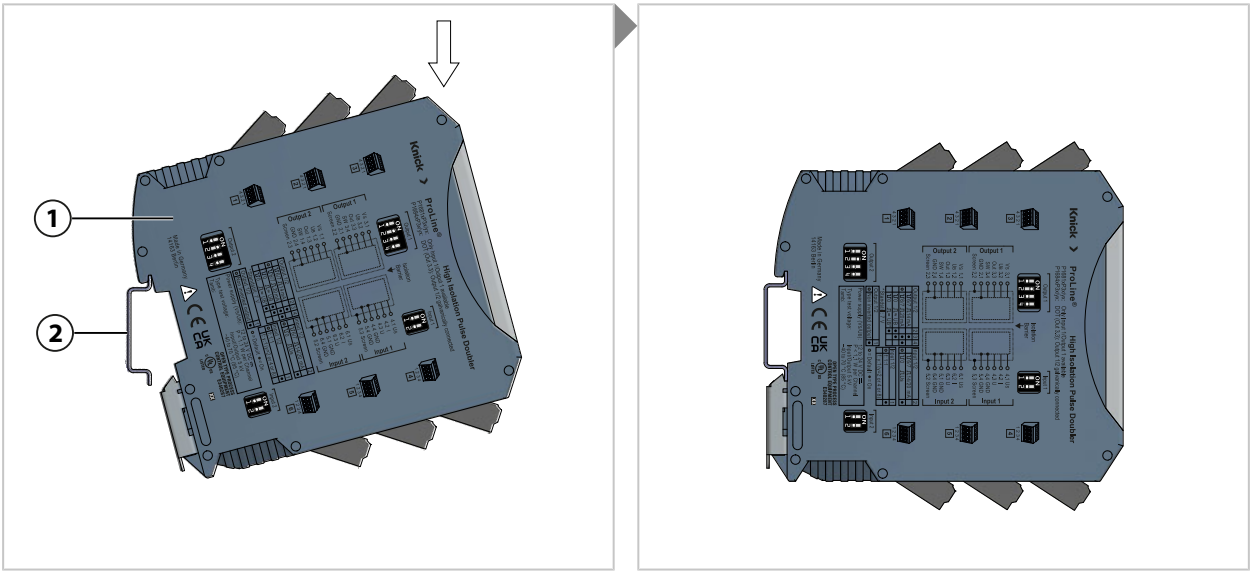
The product may be installed in underfloor containers, roof containers, and engine rooms of locomotives and traction units. Inside rolling stock, the product must be installed inside a closed, lockable control cabinet.

In industrial installations, the product must be operated inside a closed, lockable control cabinet.

The P16800 can be installed in any installation position as follows:

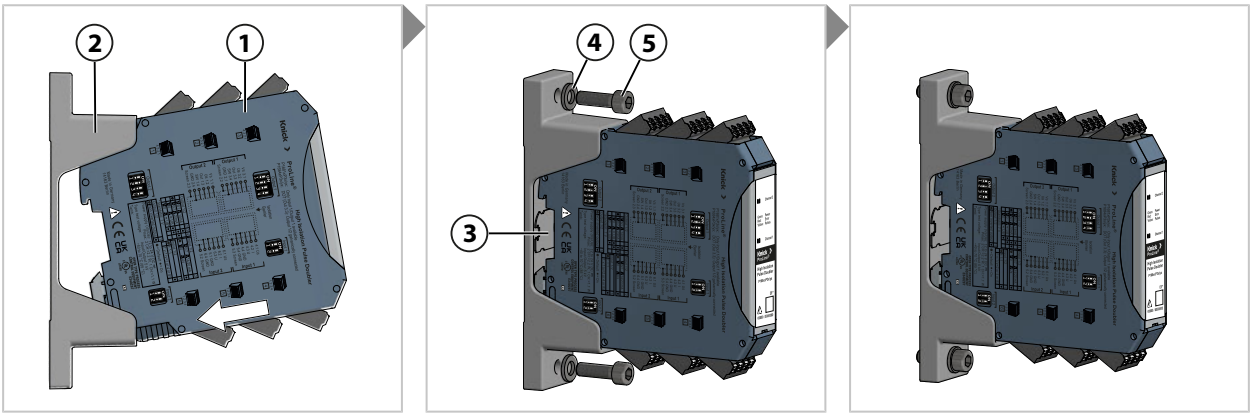
- On 35 mm DIN rails, side-by-side mounting possible (without using a DIN rail bus connector)
- On flat surfaces with accessory ZU1472 wall-mount adapter

Mounting on 35 mm DIN Rail



01. Snap the P16800 **(1)** on to the 35 mm DIN rail **(2)**.

Mounting on Flat Surfaces with Accessory ZU1472 Wall-Mount Adapter (Can be Ordered Separately)



Note: The miniature depiction **(3)** on the wall-mount adapter shows the correct installation position of the P16800 **(1)** in the ZU1472 wall-mount adapter **(2)**.

01. Snap the P16800 **(1)** into the ZU1472 **(2)**.
02. Position ZU1472 **(2)** with the P16800 **(1)** at the installation location.
03. Fasten ZU1472 **(2)** with two M6 screws **(5)** and washers **(4)** (not included in the package contents). Tighten the M6 screws **(5)** with 5 Nm.

Removing the P16800 from the Wall-Mount Adapter

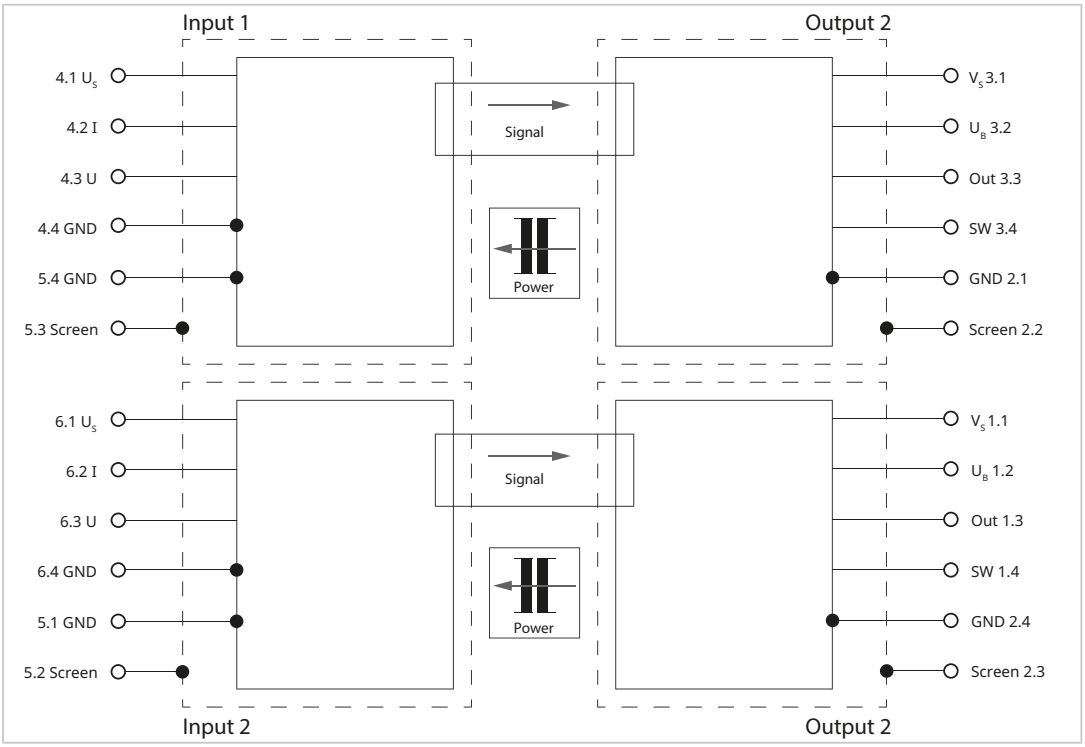
To remove the P16800 from the wall-mount adapter, the M6 screws must first be loosened. Slightly bend up one side of the wall-mount adapter to separate it from the product.

See also
→ *Dimension Drawings, p. 35*

3.2 Terminal Assignments

Terminal	Label	Input/ Output	Channel	Function
1.1	V_S	Output	2	Voltage supply
1.2	U_B	Output	2	Voltage supply (output driver) If terminal U_B is open, the output driver is supplied via V_S and an internal DC/DC converter.
1.3	Out	Output	2	Output signal (current or voltage)
1.4	SW	Output	2	Switching output, open in the case of a detected error.
2.1	GND	Output	1	Ground (reference potential)
2.2	Screen	Output	1	Shield
2.3	Screen	Output	2	Shield
2.4	GND	Output	2	Weight
3.1	V_S	Output	1	Voltage supply
3.2	U_B	Output	1	Voltage supply (output driver) If terminal U_B is open, the output driver is supplied via V_S and an internal DC/DC converter.
3.3	Out	Output	1	Output signal (current or voltage); With product variant with DOT function (P16840, direction of rotation/ direction of travel detection): Result of the phase comparison.
3.4	SW	Output	1	Switching output, open in the case of a detected error.
4.1	U_S	Input	1	Speed sensor voltage supply (U_{sense})
4.2	I	Input	1	Signal current from speed sensor
4.3	U	Input	1	Signal voltage from speed sensor
4.4	GND	Input	1	Speed sensor ground
5.1	GND	Input	2	Speed sensor ground
5.2	Screen	Input	2	Shield
5.3	Screen	Input	1	Shield
5.4	GND	Input	1	Speed sensor ground
6.1	U_S	Input	2	Speed sensor voltage supply (U_{sense})
6.2	I	Input	2	Signal current from speed sensor
6.3	U	Input	2	Signal voltage from speed sensor
6.4	GND	Input	2	Speed sensor ground

Block Diagram and Terminal Assignments



See also

→ *Abbreviations, p. 44*

3.3 Electrical Installation

⚠ **WARNING! Shock potential.** Do not install the product live.

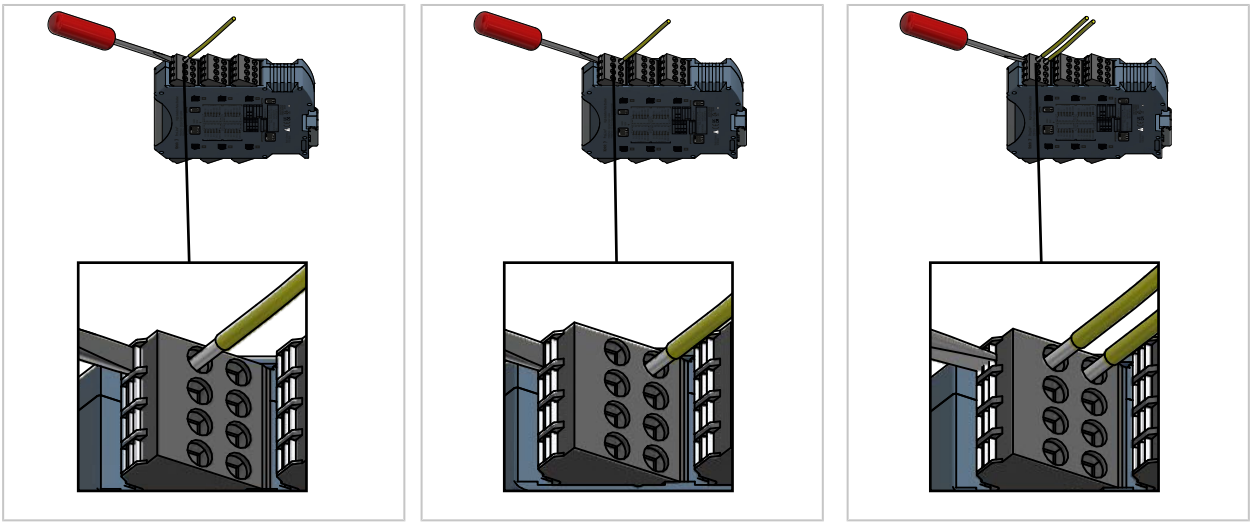
NOTICE! Product damage due to electrostatic discharge (ESD). Take protective measures against electrostatic discharge.

01. Disconnect the electrical system from live parts.
02. Secure the electrical system against restart.
03. Verify that the electrical system is dead.
04. Ground and short-circuit the electrical system.
05. Cover or isolate adjacent live parts with insulating materials.
06. Prepare the wires.

Note: Use only shielded copper wires. The cables must be temperature resistant to at least 75 °C (167 °F), unless higher requirements result from the application. The wires must be rated for the limit value of the circuit's protective device.

Conductor cross-sections
0.2 … 1.5 mm^2, AWG 24 … 16
Stranded with ferrule or solid

07. Strip 10 mm of insulation from the wire ends. Fit fine-stranded wires with ferrule.



08. Insert the wire into the two-tier terminal (push-in version) without using tools. If necessary, open the two-tier terminal with a screwdriver to make it easier to insert the wire. To remove the wire from the two-tier terminal, use the screwdriver as shown.
09. Alternatively, use screw terminals.

Note: The current output must always terminate with a load.

Note: For 2-channel devices, input signals 1 and 2 must come from the same speed sensor. The output signals must only go to one control unit.

Note: When using the current input, U_S, U_{in}, and GND are connected to the three-pole insertable jumper. If voltage inputs are used, the current input must not be used.

10. Connect the P16800 in accordance with the selected wiring (signal type, shielding).
11. Check that the wire is securely attached.
12. Reset the electrical system to its initial state. Reverse the steps taken to ensure voltage-free operation.

See also
→ *Terminal Assignments, p. 23*
→ *Terminals, p. 27*

3.4 Insertable Jumpers

The wires and insertable jumpers are connected to the two-tier terminals (push-in version).
→ *Terminal Assignments, p. 23*

Two-pole or three-pole insertable jumpers can be used:

- When using the passive current output, terminals V_S and U_B are connected to a two-pole insertable jumper. → *Voltage Supply, p. 18*
- When using the current input, terminals U_S, U_{IN}, and GND are connected to a three-pole insertable jumper.
- Depending on the selected shielding, terminals GND and Screen are connected to a two-pole insertable jumper.

4 Configuration

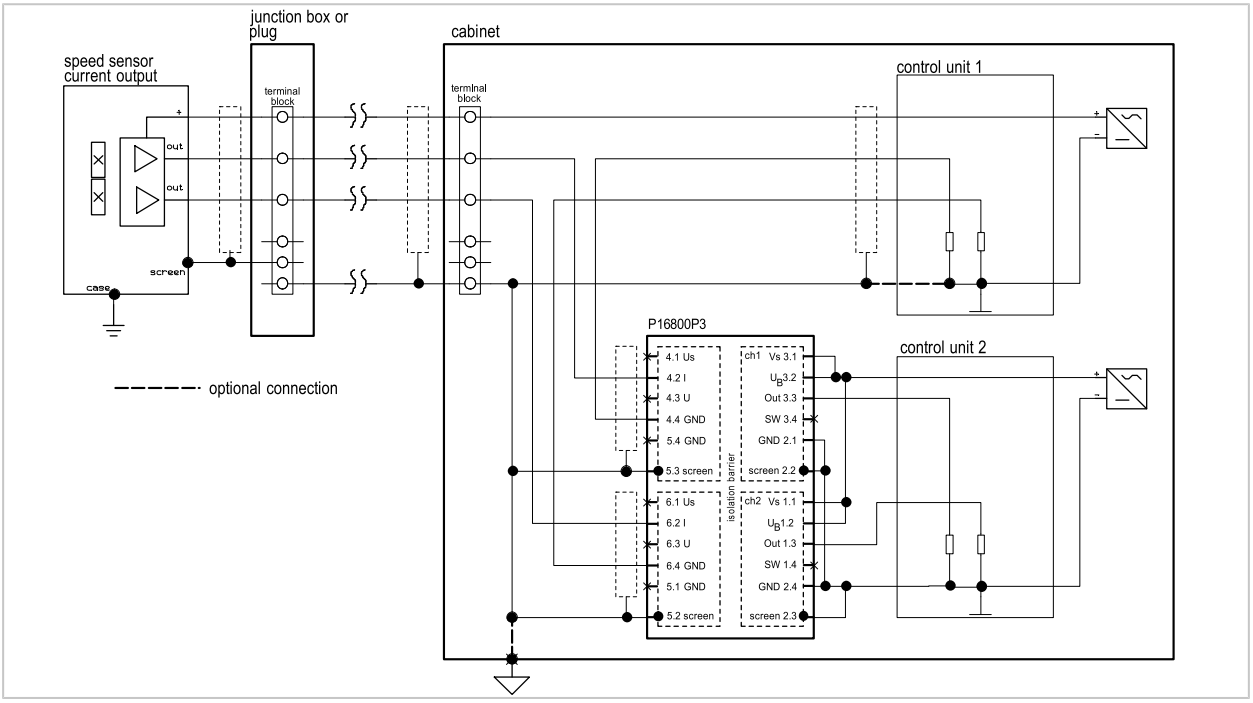
4.1 Terminals

The diagrams below show the terminals of a speed sensor on the P16800 in the control cabinet. In all configurations, the output of the product can be set individually to current or voltage for each channel. The P16800 acts like a speed sensor on the output side.

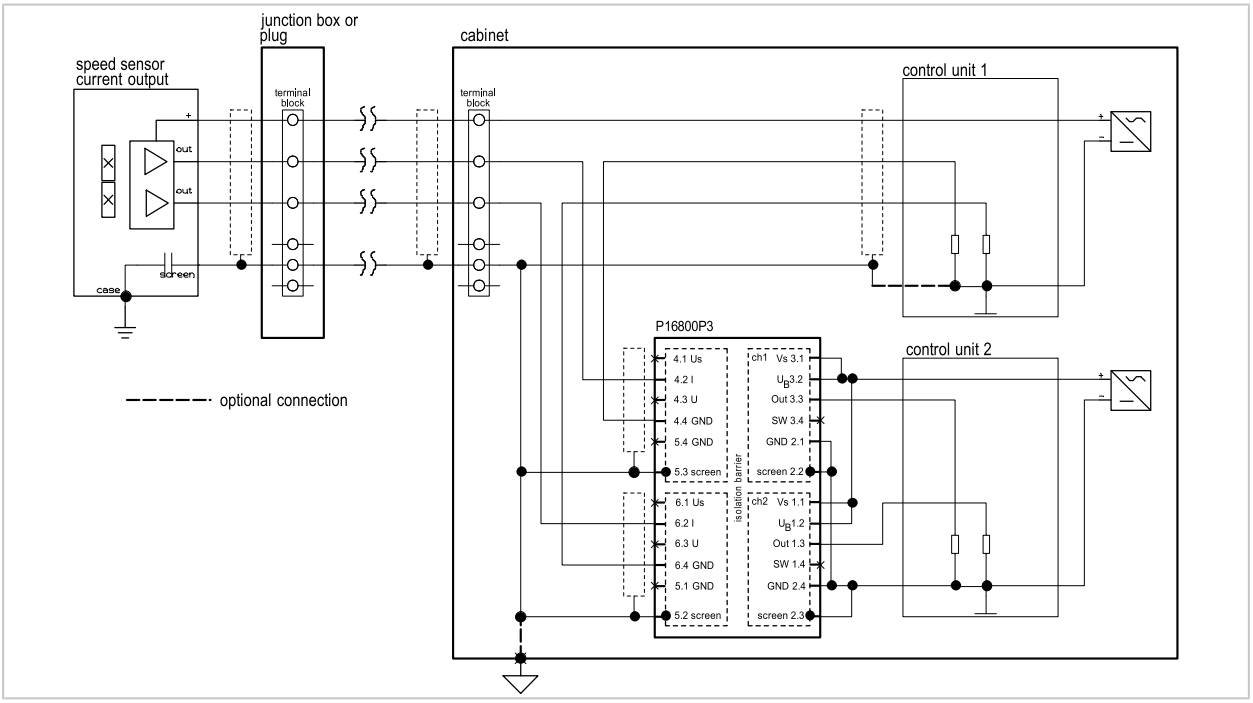
Due to the different circuit options for the output of the product, it is possible to adjust the load of the control unit so that it corresponds to the load of a speed sensor. → *Voltage Supply, p. 17*

4.1.1 Terminal of the Speed Sensor to the Current Input of the Speed Signal Doubler

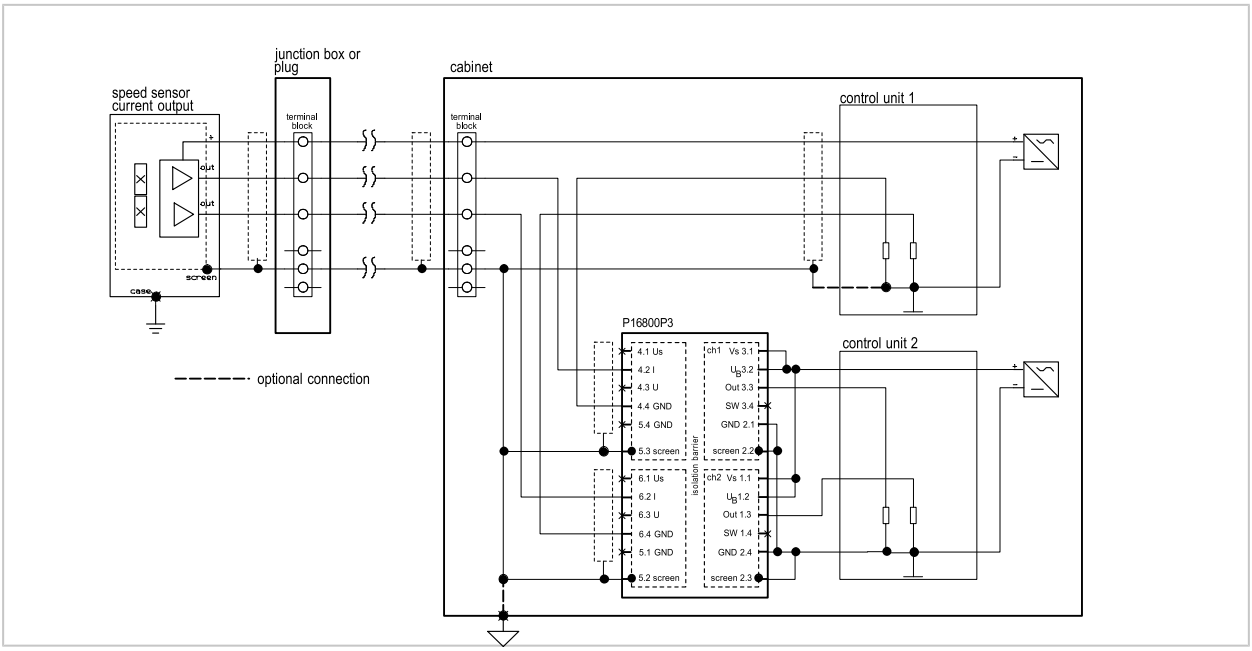
Shielding via the enclosure of the speed sensor:



Shielding via a capacitor in the enclosure of the speed sensor:

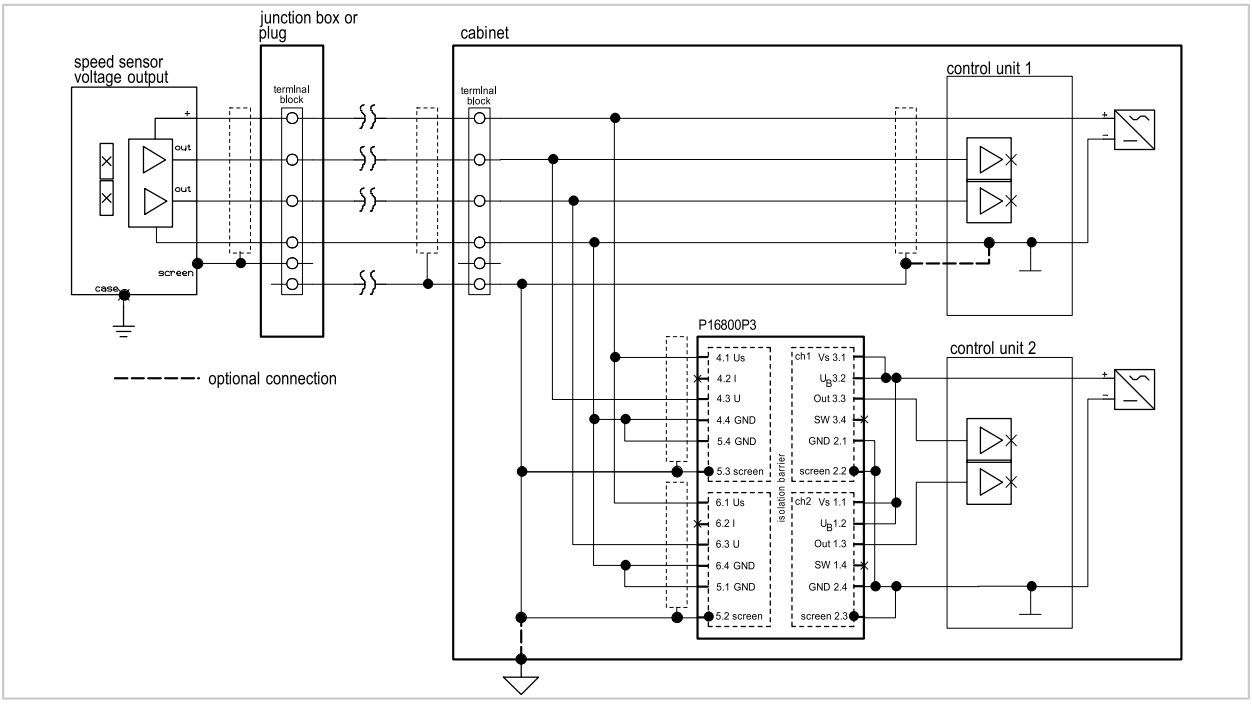


Shielding via the inner shield of the speed sensor enclosure:

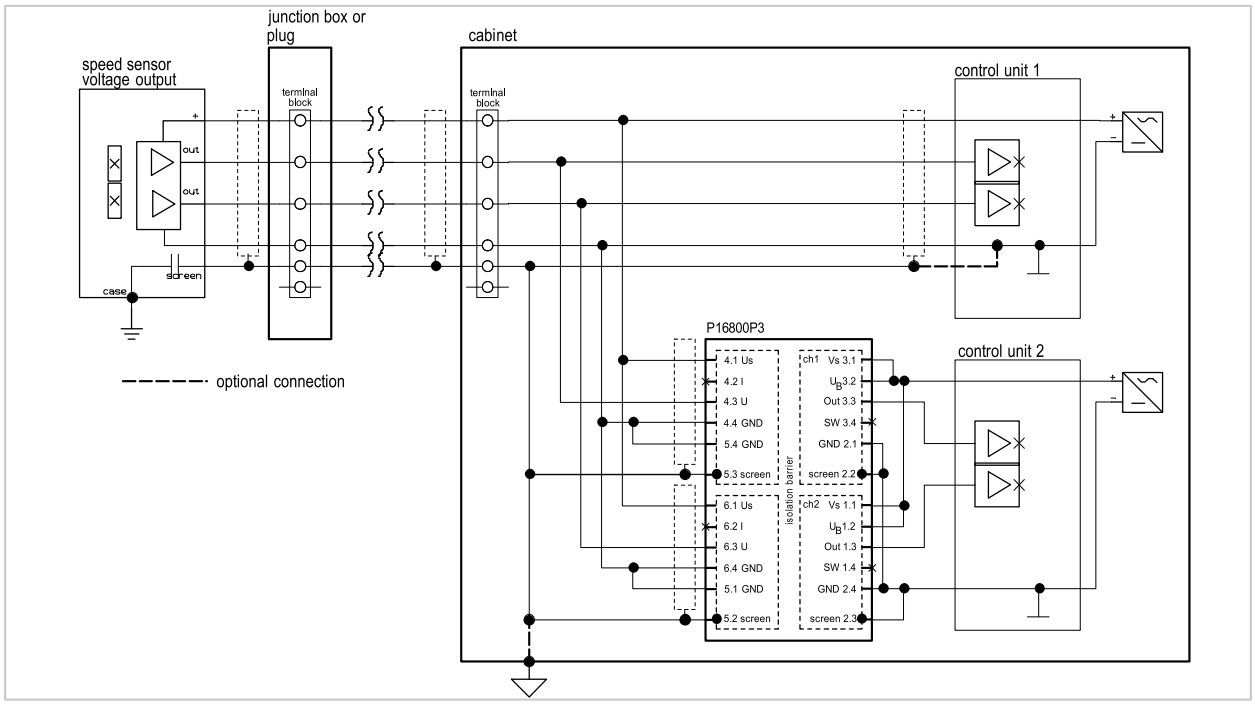


4.1.2 Terminal of the Speed Sensor to the Voltage Input of the Speed Signal Doubler

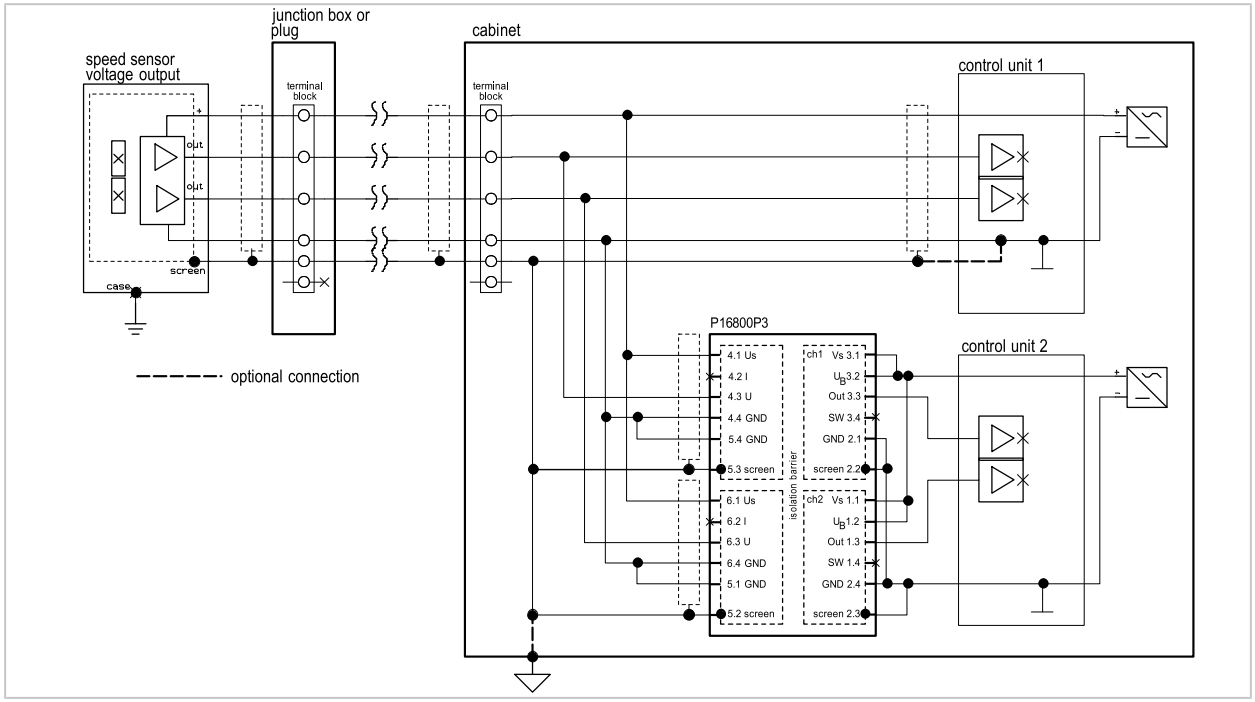
Shielding via the enclosure of the speed sensor:



Shielding via a capacitor on the enclosure of the speed sensor:



Shielding via the inner shield of the speed sensor enclosure:



4.2 DIP Switches

The input and output functions of the P16800 can be individually adjusted via DIP switches on the product. Which functions go with which DIP switch positions is indicated on the nameplate.

NOTICE! Do not change the measuring range during operation.

01. Set the DIP switches according to the desired function.
02. Following configuration, check the speed signal doubler to make sure it is functioning correctly.

DIP Switch at Input

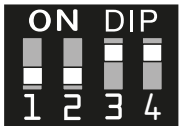
Overview of the functions of the DIP switches at input:

- DIP switch input 1 and input 2 (optional)
  - Choice of current or voltage input
  - Choice between 1:1 pulse transmission or 2:1 frequency division (optional ex works: 4:1 or 8:1)

DIP 1	DIP 2	Input Value	Notes	Factory Setting
On (ON)	On	Low 0 V High U_S	Voltage input, pulse transmission 1:1, no frequency division	◯
On	Off (OFF)	Low 6/7 mA High 14/20 mA	Current input, pulse transmission 1:1, no frequency division	
Off	On	Low 0 V High U_S	Voltage input, frequency division 2:1 (optional ex works: 4:1 or 8:1)	
Off	Off	Low 6/7 mA High 14/20 mA	Current input, frequency division 2:1 (optional ex works: 4:1 or 8:1)	

DIP Switch at Output

Overview of the functions of the DIP switches at output:



- DIP switch output 1 and output 2 (optional)
  - Choice of current or voltage output
  - For current output: Choice of high level 14 mA or 20 mA
  - Choice of standstill detection (middle voltage)
  - Choice of an inverted or non-inverted output signal

DIP 1	DIP 2	DIP 3	DIP 4	Output Value	Note	Factory Setting
Off	Off	On	On	Low 6/7 mA High 20 mA	Current output, installation protection	◯
Off	Off	On	Off	Low 6/7 mA High 14 mA	Current output	
Off	On	On	Off	Low 0 V High ≈ U_B	Voltage output	
Off	On	Off	Off	Low 0 V High ≈ U_B Standstill = 7.2 V	Voltage output with standstill detection	
On	Off	On	On	Low 20 mA High 6/7 mA	Current output, inverted, installation protection	◯
On	Off	On	Off	Low 14 mA High 6/7 mA	Current output, inverted	
On	On	On	Off	Low ≈ U_B High 0 V	Voltage output, inverted	
On	On	Off	Off	Low ≈ U_B High 0 V Standstill = 7.2 V	Voltage output with standstill detection, voltage output, inverted	

See also

→ *DIP Switches, p. 30*
→ *Nameplate, p. 8*

5 Operation

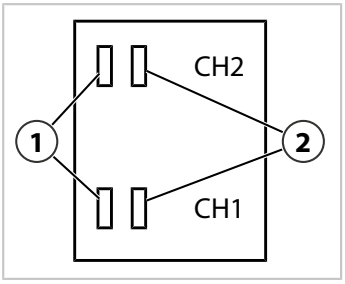
5.1 Commissioning

01. Set the desired function using the DIP switches. → *DIP Switches, p. 30*
02. Mount the P16800. → *Mounting, p. 22*
03. Electrically install the P16800. → *Electrical Installation, p. 25*
04. Check functionality of the P16800.

5.2 Operation

5.2.1 LED Signaling

There are two LEDs for each channel (CH1/CH2) on the front of the device.



1 LED left: green/red **2** LED right: yellow

Green	LED left	Operating display, operating voltage available.
Red	LED left	Error detected.
Yellow	LED right	Pulse signaling (LED blinks in time with the input pulses. With high pulse frequencies, this is perceived as a continuous light). With DOT function, the second channel's LED blinks in time with the second channel's input pulses. The first channel's LED shows the result of the direction-of-travel detection.

See also
→ *Design, p. 11*

5.3 Maintenance and Repair

Maintenance

The devices are maintenance-free. They are not to be opened.

Repair

The product cannot be repaired by the user. The local contact persons and information on the repair procedure can be found at www.knick.de.

Storage

Familiarize yourself with the information on storage temperatures and relative humidity in the Specifications. → *Ambient Conditions, p. 41*

5.4 Decommissioning

5.4.1 Decommissioning

The product must be removed from operation and secured against reconnection if the following applies:

- The product is visibly damaged
- Failure to perform the intended function
- Prolonged storage at temperatures outside the specified temperature range

The product may only be recommissioned following a professional routine test conducted by the manufacturer.

5.4.2 Removal

⚠ **WARNING! Shock potential.** Do not uninstall the product live.

01. Disconnect the electrical system from live parts.
02. Secure the electrical system against restart.
03. Verify that the electrical system is dead.
04. Ground and short-circuit the electrical system.
05. Cover or isolate adjacent live parts with insulating materials.
06. Check the input of the P16800 to ensure it is dead.
07. Switch off the power supply.
08. Open the screw terminals using a screwdriver and remove the cables.
09. Remove the housing of the P16800.

5.4.3 Disposal

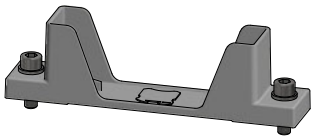
Local codes and regulations must be observed when disposing of the product.

Customers can return their waste electrical and electronic devices.

Details on the return and environmentally friendly disposal of electrical and electronic equipment can be found in the manufacturer's declaration on our website. If you have any queries, suggestions, or questions regarding the recycling of waste electrical and electronic equipment from Knick, please send an email to → *support@knick.de*

See also
→ *Symbols and Markings, p. 10*

6 Accessories



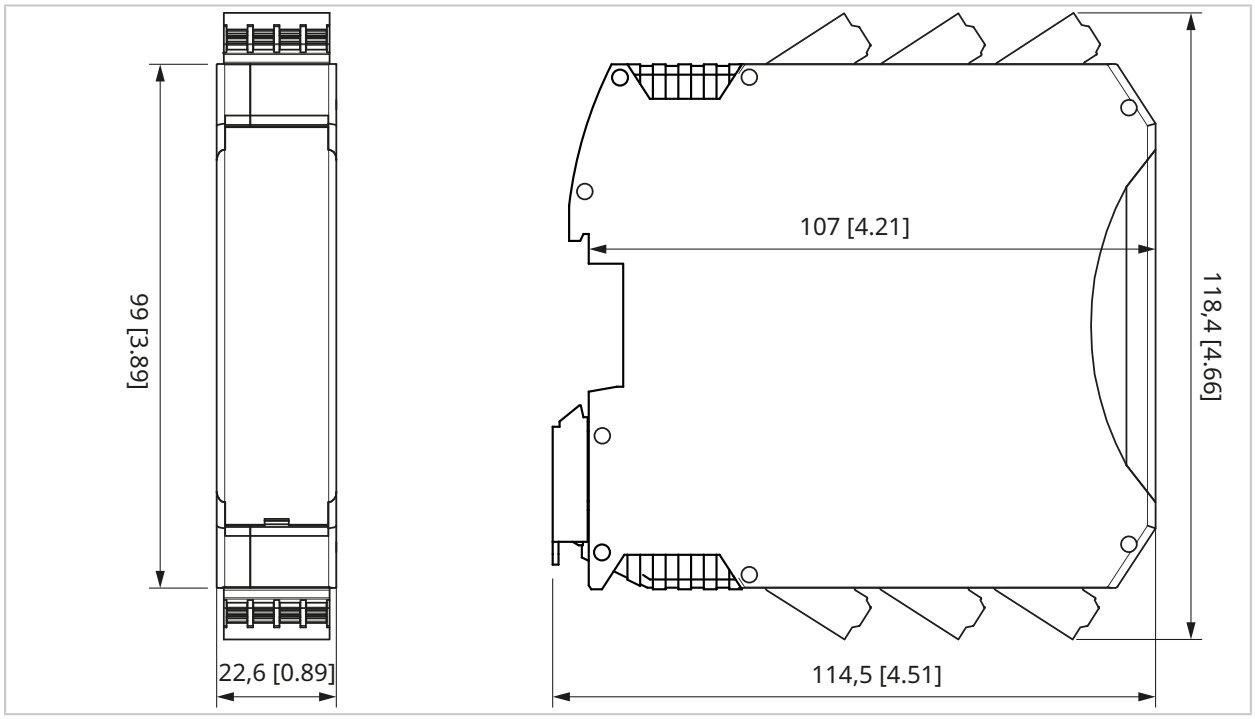
ZU1472 Wall-Mount Adapter P16800, Optional

The accessory ZU1472 enables the installation of the P16800 on a flat surface. The accessories includes a wall-mount adapter.

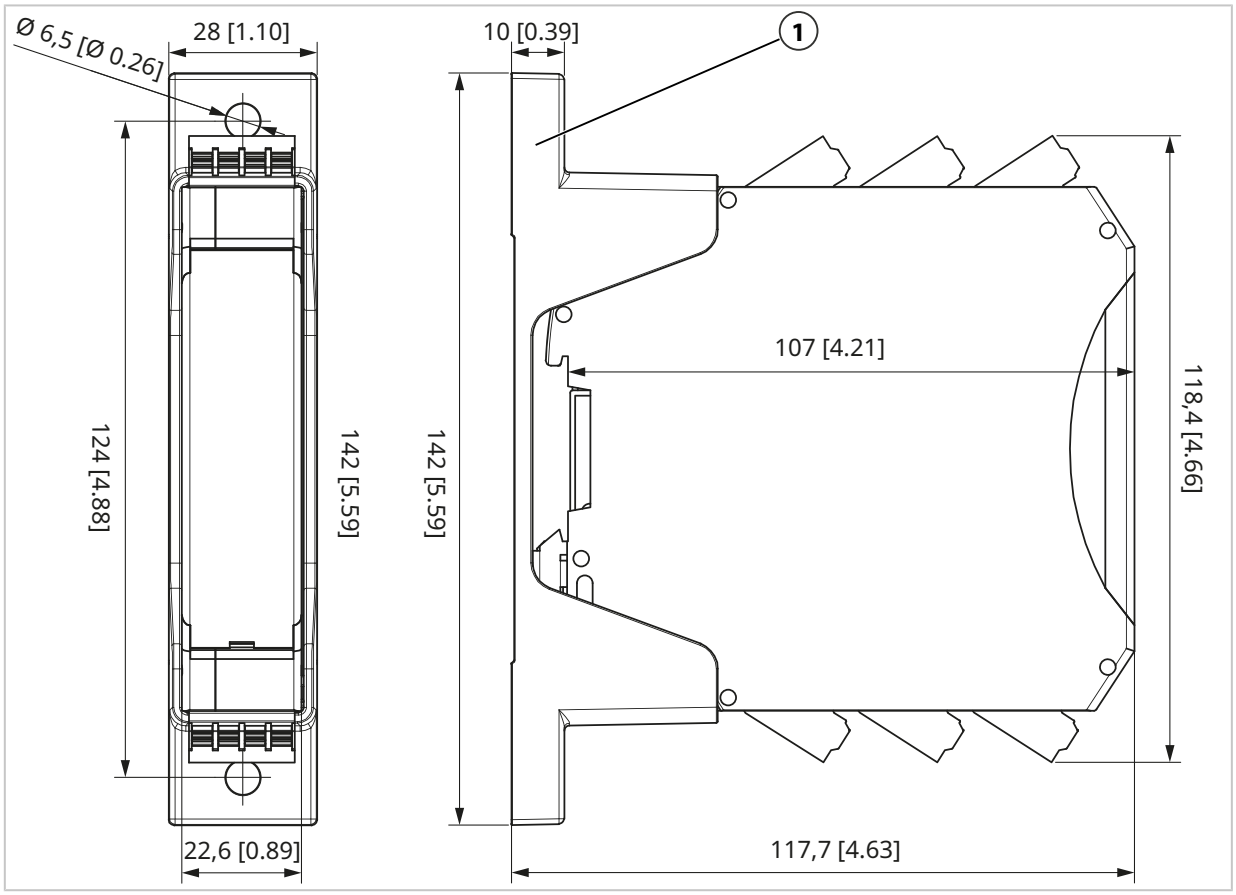
Use two M6 screws (EN 912/ISO 4762) with washers (EN 125/ISO 7089) to mount the wall-mount adapter. (Screws and washers are not included in the scope of delivery).

7 Dimension Drawings

Note: All dimensions are given in millimeters [inches].



The accessory ZU1472, "Wall-mount adapter," is available as an option and not included in the P16800 package contents. The hole spacing for accessory ZU1472, "Wall-mount adapter," is 124 mm [4.88"].



1 ZU1472 wall-mount adapter

8 Specifications

8.1 Input

Voltage or current signal	Dependent on setting of the DIP switches
Waveform	Square
Sensor	Speed encoder, speed sensor, path pulse generator, or pulse generator

8.1.1 Voltage Input

Voltage input $U_{S(Sense)}$	10 ... 33.6 V DC ± 2 % peak-peak (max. 35 V)
Fault detection	Open line: U_S threshold = 8.5 ... 9.9 V
Voltage input threshold value	Logical 0 (low): < 30 % of U_S Logical 1 (High): > 70 % of U_S
Protection from overload/external voltage	Up to max. 35 V DC continuous load
Input resistance	≥ 60 kΩ
Input capacitance	≤ 100 pF

8.1.2 Current Input

Current input	Max. 200 mA **Note:** The reference voltage input $U_{S(Sense)}$ must be open, i.e., short-circuited with the three-pole insertable jumper. → *Insertable Jumpers, p. 26*
Threshold value Low: 6/7 mA High: 14/20 mA	 Logical 0 (low): < 9.5 mA Logical 1 (high): > 11.5 mA
Fault detection	Open line: I threshold = 1.8 ... 2.6 mA
Voltage drop	< 0.7 V
Protection from overload	Up to max. 0.2 A continuous load
Input resistance	< 20 Ω
With absence of interaction: Voltage drop	< 1 V

8.2 Output

Waveform	Square
Output types	Current or voltage signal The outputs of channel 1 and channel 2 may be configured differently.
Signal conversion options	Current → current Voltage → voltage Current → voltage Voltage → current

8.2.1 Voltage Output

Voltage level	Low < 1 V High ≈ U_B High (U_B open) ≈ 5 V 7.2 V ± 0.3 V with detected standstill (U_B must be connected.)
Reaction to middle voltage at input of P16800	Dependent on U_S and prior input level
Voltage signal load capability	Max. 20 mA Max. 2 mA with detected standstill
Protection from overload caused by external voltage	With max. U_B/max. 200 mA
Short-circuit response	Short-circuit-proof (limited to 50 mA)
Voltage output cable lengths	Max. 100 m (0.25 nF/m)
Rise time	$t_{10 \ldots 90}$ < 10 µs

8.2.2 Current Output

Passive current output, configurable	Suitable for following control unit inputs: Low 6/7 mA, High 14 mA
	Suitable for following control unit inputs: Low 6/7 mA, High 20 mA
Active current output, configurable	Suitable for following control unit inputs: Low 6/7 mA, High 14 mA
	Suitable for following control unit inputs: Low 6/7 mA, High 20 mA
Fault current signal	No Can be activated at the factory: With detected error 0 mA
Current signal level error	Max. 2 mA
Maximum load voltage	< U_B – 2 V at 20 mA < 5 V, if U_B open
Internal parallel resistance to output	> 150 kΩ
Overload capacity, external voltage	Up to max. U_B / max. 200 mA
Open-circuit response	Open-circuit-proof
Rise time	$t_{10...90}$ < 10 µs (pulse edge slope for ohmic loads)

8.2.3 Switching Output

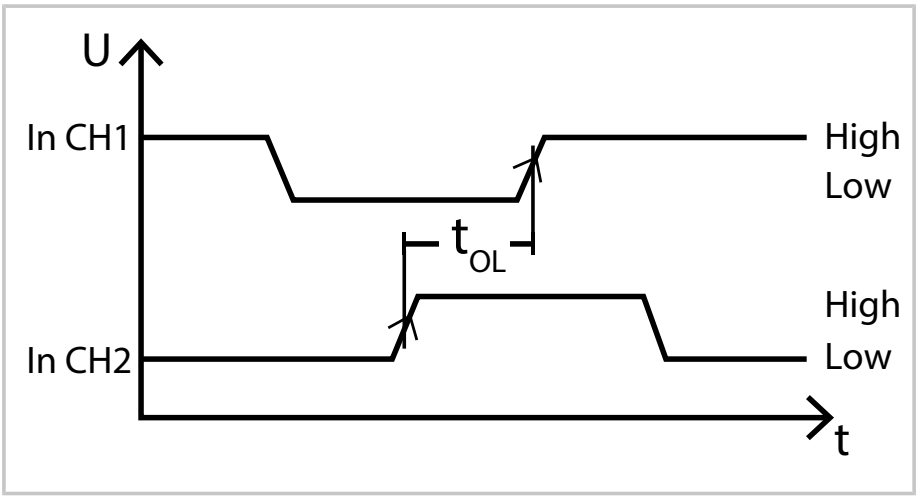
Switching output: SW	Solid state relay, normally closed, normally closed contact, opens in event of fault
$U_{SW\ max}$ / $I_{SW\ max}$	33.6 V / 100 mA
Internal voltage drop	< 0.2 V at 20 mA
U_{SW} with open switch without external switching voltage	> 1 V
I_{SW} with open switch	Approx. 130 µA
Reference potential	GND
Fault response time	< 1 s

8.3 Transmission Behavior

Rated frequency range	0 ... 25 kHz
Duty cycle of speed sensor signals to be transmitted	20 % ... 80 %
Flow-through time	t_p < 10 µs
Flow-through time difference in both channels	Δt_{pHL} or Δt_{pLH} < 2 µs → *Abbreviations, p. 44*
Frequency division, factory set	P168*****/2*: 1:1, 2:1, switchable P168*****/4*: 1:1, 4:1, switchable P168*****/8*: 1:1, 8:1, switchable → *Abbreviations, p. 44*
Maximum duty cycle deviation output signal to input signal without frequency division	± 10 %
Duty cycle of output signal with frequency division independent of input signal duty cycle	50 % ± 10 %
Standstill detection	f < 1 Hz ± 0.3 Hz
Static function response (true zero speed response)	The output level follows the input level (valid for 1:1 transmission)
Middle voltage level for standstill signaling	U_{out} = 7.2 V ± 0.3 V

8.4 DOT Signals

Overlapping time	$t_{OL} \geq 1\mu s$



See also
→ *Abbreviations, p. 44*

8.5 Reaction to Input Signals

		Input level	U_{out} 1/2	I_{out} 1/2	Switching output SW 1/2
Voltage input	U	Low	Low	Low	Closed
		High	High	High	Closed
		Middle voltage	Low or high, depending on input level/hysteresis	Low or high, depending on input level/hysteresis	Closed
		f < 1 Hz (with enabled middle voltage generation only)	7.2 V	Invalid setting	Closed
		Open	Low	Low	Closed
	U_S	10 ... 33.6 V	Dependent on input level/hysteresis	Dependent on input level/hysteresis	Closed
		< approx. 9.5 V	Undefined	Undefined	Open
Current input	I	Low	Low	Low	Closed
		High	High	High	Closed
		< Low	High	High	Open
		Open	High	High	Open
Active inversion of the input signals via DIP switch: High and low levels are swapped.					
The output signal evaluates middle voltage generation. All input errors are also evaluated in the process.					

8.6 Power Supply

Input channel supply	From the respective output circuit, galvanically isolated
Supply of the output channels	V_S: Output circuit U_B: Output driver → *Voltage Supply, p. 17*
Power supply V_S, U_B (rail applications)	24 V, SELV, PELV
Voltage supply V_S, U_B (industrial applications)	12 ... 24 V, SELV, PELV
Electrical safety	All connected current or voltage circuits must meet the SELV, PELV, or Area I requirements according to EN 50153.
Overvoltage and undervoltage limits	V_S: 10 ... 33.6 V DC U_B: 10 ... 33.6 V DC
Interruption class	S1 according to EN 50155 table 6
Switching class	C1 according to EN 50155 table 8
Current via U_B per channel	Max. 5 mA + I_{OUT} Max. 5 mA + U_{OUT}/R_L
Power consumption via V_S per channel	Max. 600 mW
Power consumption P_{Max}	< 2.2 W two-channel product variant < 1.1 W one-channel product variant
DC ripple factor	5 % according to EN 50155 table 7
Readiness for operation (after switching on the power supply)	≤ 20 ms
Inrush current at V_S per channel With V_S = 24 V, U_{OUT} at R_L = 1 kΩ	< 0.0002 A^2/s
Inrush current at U_B per channel With U_B = 24 V, U_{OUT} at R_L = 1 kΩ	< 0.0001 A^2/s

8.7 Isolation

Galvanic isolation	Across input circuit and output circuits, across channel 1 and channel 2 → *Standards and Directives, p. 42*
Type test voltages	Across input and output: 8.8 kV AC/5 s 5 kV AC/1 min Across channel 1 and channel 2: 3.55 kV AC/5 s 3 kV AC/1 min
Routine test voltages	Across input and output: 4.6 kV AC/10 s Across channel 1 and channel 2: 1.9 kV AC/10 s
Rated insulation voltage	→ *Details on Isolation, Isolating Distances, Contamination, and Overvoltage, p. 43*
Reinforced insulation	→ *Details on Isolation, Isolating Distances, Contamination, and Overvoltage, p. 43*

8.8 Safety Function: Absence of Interaction, Input

Systematic capability for safety level	SC for SIL 4
FFR	$< 2.0 \cdot 10^{-9}$
U, U_S	Input impedance > 60 kΩ Current from input < ±100 µA
I	U < 1 V
Routine test of the insulation between shield and the rest of the signals of a channel	1.4 kV AC, duration 60 s

See also

→ *Details on Isolation, Isolating Distances, Contamination, and Overvoltage, p. 43*

8.9 Safety Function: Signal Transmission

Systematic capability for safety level	SC for SIL, Configuration 1oo1 (1 out of 1)
FFR	$< 1.0 \cdot 10^{-7}$
Safety function	Frequency-precise transmission $f_{out} = f_{in} \pm 0.1$ % of measured value

8.10 Ambient Conditions

Operating environment	Use in enclosed, non-forced-ventilated areas on rolling stock
Installation site according to EN 50155	Closed control cabinet, Appendix C: 1 and 2
Pollution degree	PD 2
Height class according to EN 50125	AX
Operating temperature class according to EN 50155	OT4
Increased operating temperature class at power-on according to EN 50155	ST1, ST2
Temperature change class for rapid temperature changes according to EN 50155	H1
Ambient temperature range: Operation	-40 ... 70 °C (-40 ... 158 °F) short-time 85 °C (185 °F)
Ambient temperature range: Storage and transport	-40 ... 90 °C (-40 ... 194 °F)
Temperature at enclosure	Max. 95 °C (203 °F)
Relative humidity (operation, storage, and transport)	
Annual mean value	≤ 75 %
Continuous operation	15 ... 75 %
Continuously for 30 days a year	75 ... 95 %
Occasionally on the other days	95 ... 100 %

8.11 Further Data

Terminals	Push-in two-tier terminals, pluggable
Conductor cross-sections	0.2 ... 1.5 mm^2 AWG 24 ... 16, Fine-stranded with ferrule or solid
Cable types	Shielded cables
Degree of protection according to EN 60529	Input, IP20 Output, IP20
Mechanical load Shock and vibration according to EN 61373, IEC 61373	Category 1, Class B Tested by independent test laboratory
MTBF	> $2.6 \cdot 10^6$ h (383 FIT per channel)
Service life according to EN 50155	20 years, L4 according to EN 50155
Useful operating life according to EN 13849	20 years
Weight	Approx. 170 g

9 Appendix

9.1 Standards and Directives

The devices have been developed in compliance with the following standards and directives:

Directives	
Directive 2014/30/EU (EMC)	
Directive 2014/35/EU (Low voltage)	
Directive 2011/65/EU (RoHS)	
Directive 2012/19/EU (WEEE)	
Regulation (EC) No. 1907/2006 (REACH)	
Standards	
Rail applications	EN 50155, EN 50153
Resistance to vibration and shock	EN 61373, IEC 61373
Fire protection	EN 45545-1, EN 45545-2, EN 45545-5
EMC	EN 50121-1, EN 50121-3-2
Functional safety	EN 50129
Isolation requirements	EN 50124-1
Climate	EN 50125-1
Industrial applications	EN 61010-1
EMC	EN IEC 61326-1
Isolation requirements	EN 61010-1, EN IEC 60664-1
Restriction of Hazardous Substances/RoHS	EN IEC 63000
Electrical safety and fire protection (Canada)	CAN/CSA-C22.2 No. 61010-1-12
Electrical safety and fire protection (USA)	UL 61010-1, UL File: E340287

The current standards and directives may differ from those specified here. The standards applied are documented in the Declaration of Conformity and the corresponding certificates. You can find these at www.knick.de under the corresponding product.

9.2 Material Evaluation

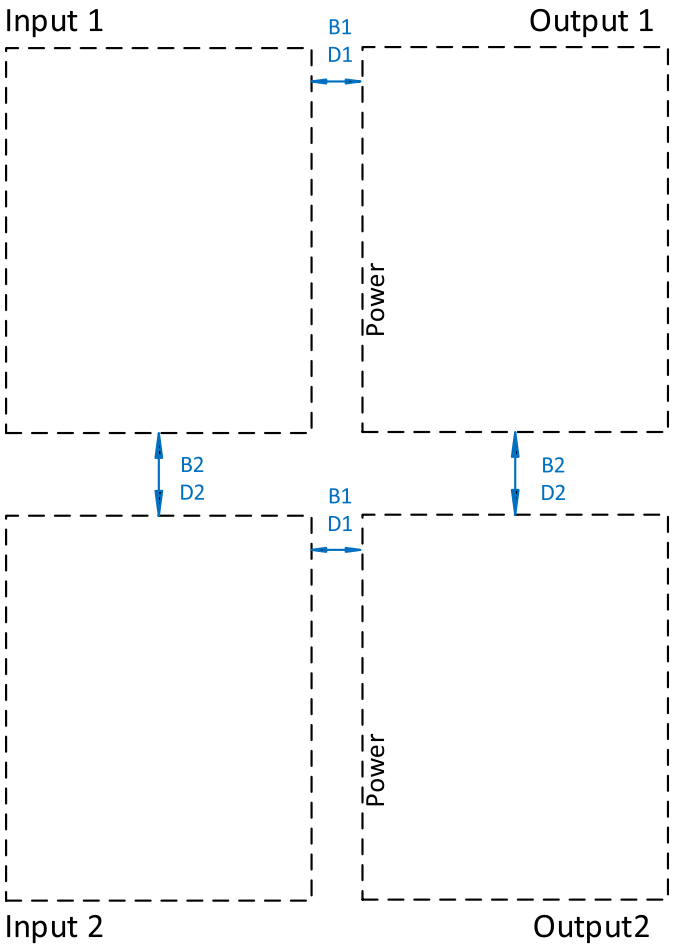
Fire Protection

The product does not contain flammable materials according to EN 45545. The product is certified for interior and exterior applications up to hazard level HL3 certified according to EN 45545-2. This was confirmed by a notified body.

Protective Coating

All assembled printed circuit boards were provided with a protective coating of class PC2 on both sides.

9.3 Details on Isolation, Isolating Distances, Contamination, and Overvoltage



Rated Isolation Voltages (Excerpt)

Section	Actual Value [mm]		ISO	OV	PD	≤ Altitude [km]		Rated Isolation Voltage [V]
	Clearance	Creepage distance				2	4	EN 50124-1, EN 60664-1, EN 61010-1, UL 61010-1
B1	11	11	B	III	2	x	x	1000
D1	11	11	D	II	2	x		1000
D1	11	11	D	III	2	x		600
D1	11	11	D	II	2	x	x	600
D1	11	11	D	III	2	x	x	300
B2 [1) 2)]	3	3	B	III	2	x		300
D2 [1) 2)]	3	3	D	II	2	x		300
D2 [1) 2)]	3	3	D	II	2	x	x	150

Legend:

D: Reinforced insulation

B: Basic insulation

OV: Overvoltage category

PD: Pollution degree

1) No galvanic isolation of outputs in versions with DOT

2) No galvanic isolation of inputs when the two inputs are connected in parallel

10 Abbreviations

AWG	American Wire Gauge
CE	Conformité Européenne (European conformity)
CH	Channel: 1-channel or 2-channel version of a product
DIP	Dual Inline Package: Slide switch with position ON and OFF
DOT	Direction of travel
FFR	Functional Failure Rate (failure rate of a product)
f_{in}	Frequency of the input signal
FIT	Failures in Time (failures per 10^9 hours)
f_{out}	Frequency of the output signal
GND	Ground
GND (output 1)	Common ground at output for U_{B1}, V_{S1}, SW_1
GND (output 2)	Common ground at output for U_{B2}, V_{S2}, SW_2
I	Current input
I_B	Current into terminal V_B
I_{GND}	Current from terminal GND
I_{out}	Output current
I_s	Current into terminal V_S
NC	Normally closed contact
Out	Output
OV	Overvoltage category
P168***	"*" = placeholder for product variants, → *Product Code, p. 7*
PD	Pollution degree
PELV	Protective extra low voltage
P_{max}	Maximum power output used by the device
R_L	Resistance at output
R_{max}	Maximum resistance value
Screen, SHLD	Shield (input/output)
SELV	Safety extra low voltage
SIL	Safety integrity level
SW	Switch (switching output)
T	Cycle duration
t_{OL}	Overlapping time
t_p	Flow-through time of signal $t_p = (t_{pHL} + t_{pLH})/2$ with the delay from High to Low t_{pHL} and from Low to High t_{pLH} with the time interval from the 50 % value of the input signal to the 50 % value at the output
U	Voltage input
U_B	Voltage supply (output driver)
UL	Underwriter Laboratories (recognized testing and certification organization)
U_S	U_{Sense} – speed sensor voltage supply, input side, definition of the level detection of the voltage supply
V_S	V_{Supply} – output circuit, supply of the output channels

Index

P

Q

R

S

T

V

W

Notes

Knick
Elektronische Messgeräte
GmbH & Co. KG

Headquarters
Beuckestraße 22 • 14163 Berlin
Germany
Phone: +49 30 80191-0
Fax: +49 30 80191-200
info@knick.de
www.knick.de

Local Contacts
www.knick-international.com

Translation of the original instructions

Version 4 • This document was published on July 19, 2023.
The latest documents are available for download on our website under the corresponding product description.

TA-257.401-KNEN04

101142