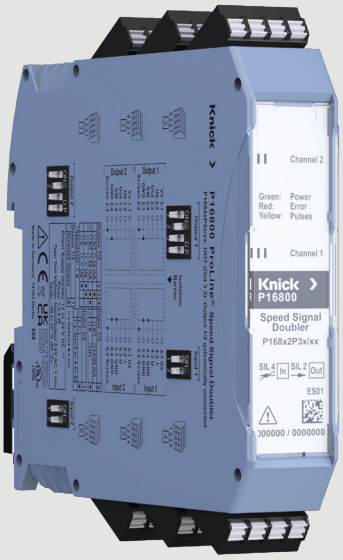
Speed signal doubler



P16800

Doubling, Conversion, and Isolation of Speed Sensor Signals

The P16800 speed signal doubler is used to double the signals from speed sensors. It decouples signals from single or dual-channel speed sensors in a functionally safe and non-interacting manner in accordance with EN 50129 (SIL 4). The pulses are transmitted 1:1 from the input to the output, i.e., frequency and phase angle remain unchanged. The transmission of the rotary encoder signals is also functionally safe in accordance with EN 50129 (SIL 2), whereby the P16800 also galvanically isolates the signals. For the connected controller, the outputs of the P16800 appear like a rotary encoder. Like the rotary encoders, the P16800 is supplied with power via the connected controller.

If required, the signal can be converted from a current signal to a voltage signal or from a voltage signal to a current signal. Optionally, the frequency at the output can be reduced compared to the input at a ratio of 2:1, 4:1, or 8:1.

Use of the P16800 simplifies the retrofitting of rolling stock with control systems that require speed information, or makes such retrofitting possible in the first place. In new vehicles, the number of speed sensors can also be reduced, which optimizes acquisition and maintenance costs.

Function

- Doubling of speed signals and thus simplification of system integration in rolling stock
- Optional conversion of the speed signal and thus increased compatibility of speed sensors
- Galvanic isolation of the speed signal and thus protection of downstream components
- Functionally safe signal processing according to EN 50129 (SIL 4 and SIL 2)
- Compact modular housing for DIN rail or wall mounting

5-year warranty!

c UL us LISTED

UK CA

CE

SIL 4 SIL 2 EN 50129

EN 50155

P16800

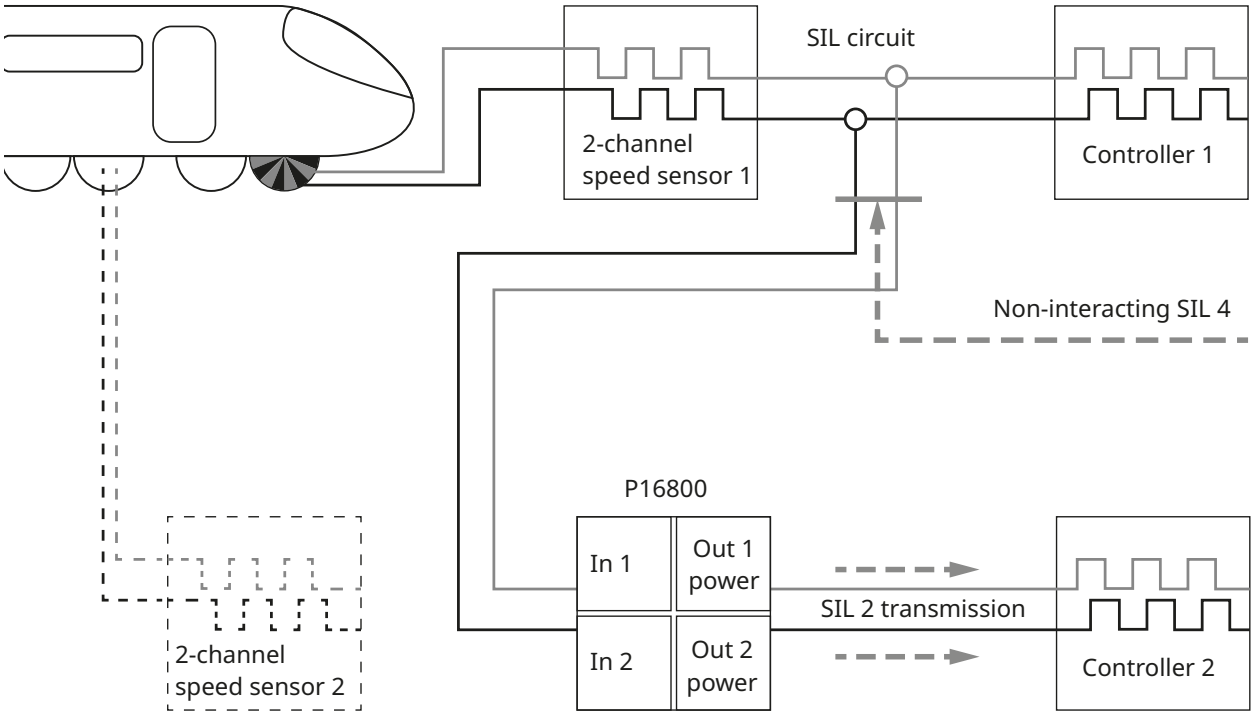
Product Line

Speed signal doubler		P	1	6	8			P	3	1	/		0
Input/output	Pulses				8								
	1 input –> 1 output					1							
	2 inputs –> 2 outputs					2							
	2 inputs –> 1 output and DOT (direction of travel)					3							
SIL	None						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								P	3				
Two-tier terminals	Push-in version, pluggable									1			
Frequency division	1:1 and 2:1											2	
	1:1 and 4:1											4	
	1:1 and 8:1											8	
Voltage supply/power supply	12 ... 24 V												0

Accessories

Wall-mount adapter	ZU1472

Application Example



Specifications

Inputs

Waveform	Square
Input sources	Signals from a speed sensor
Speed encoder supply	From primary controller or via external supply

Voltage Input

Voltage input U_S	10 ... 33.6 V DC ± 2 % peak-peak (max. 35 V)	
Fault detection	US < ≈ 9.5V; open line U_S, switch SW opens	
Switching level	Logical 0:	< 30 % of U_S
	Logical 1:	> 70 % of U_S
Signal level tolerance	< 10 %	
Protection from overload/external voltage	Up to max. 35 V DC continuous load	
Input resistance	> 120 kΩ	
	With absence of interaction SIL 4:	> 60 kΩ
Input capacitance	≤ 100 pF	

Current Input

Switching level (dependent on setting of the DIP switches)	Low: 6/7 mA	Logical 0 (low): < 8.5 mA
	High 14/20 mA	Logical 1 (high): > 12.5 mA
Fault detection	< 2.2 mA; open line	Switch SW opens
Signal level tolerance	< 5 %	
Voltage drop	< 0.7 V	
Protection from overload	Up to max. 0.2 A DC continuous load	
Input resistance	< 20 Ω	
With absence of interaction:	Voltage drop	< 1 V

Output

Waveform	Square
Output types	Current or voltage signal
	The two output circuits do not need to be configured identically.
Signal conversion options	Current –> current
	Voltage –> voltage
	Current –> voltage
	Voltage –> current

Speed signal doubler

Specifications

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 may not be open)
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	Up to 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

Current Output

Passive current output, configurable	Suitable for following control inputs:	Low 6 mA / High 14 mA, Low 7 mA / High 14 mA Low 6 mA / High 20 mA, Low 7 mA / High 20 mA
Active current output, configurable	Suitable for following c ontrol inputs:	Low 6 mA / High 14 mA, Low 7 mA / High 14 mA Low 6 mA / High 20 mA, Low 7 mA / High 20 mA R_{OUT} < 250 Ω
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	$t_{10 \ldots 90}$ < 10 µs (pulse edge slope for resistive loads)	

Specifications

Switching Output

Switching output (solid state relay): SW	Fault contact, normally closed contact (NC), opens in case 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	

Transmission Behavior

Rated frequency range	0 ... 25 kHz	
Duty cycle of speed sensor signals to be transmitted	20 % ... 80 %	
Response time	t_{99} < 1 ms	
Response time difference in both channels	< 10 µs	
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
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	
Reference voltage generation for standstill signaling	U_{out} = 7.2 V	
True zero speed	The output level follows the input level (valid for 1:1 transmission)	
Response in the event of input frequency jump	Immediate transmission with specified latency period	
Direction of travel signal DOT (without SIL), P16840 only	Δφ = φ2 - φ1; Δ φ > 0 –> High; Δφ < 0 –> Low	

Specifications

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.

Specifications

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
Power supply V_S, U_B (rail applications)	24 V, SELV, PELV	
Power 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	
Switching class	C1 according to EN 50155	
Power consumption via V_S per channel	Max. 600 mW	
Current via U_B per channel	Max. 5 mA + I_{OUT}	Max. 5 mA + U_{OUT}/R_L
Maximum power conversion P_{Max}	< 2.2 W	P1681****/**: < 1.1 W
DC ripple factor	5 % according to EN 50155	
Readiness for operation (after switching on the power supply)	≤ 50 ms	
Inrush current at V_S per channel	At V_S = 24 V, U_{OUT} at R_L = 1 kΩ	< 0.0002 A^2 per s
Inrush current at U_B per channel	At U_B = 24 V, U_{OUT} at R_L = 1 kΩ	< 0.0001 A^2 per s

Specifications

Isolation			
Galvanic isolation	Across input and output circuits		
	Across channel 1 and channel 2 according to EN 50124, EN 61010-1, UL 61010-1		
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	
Safety Function:	Absence of Interaction, Input		
Safety level	SIL 4		
FFR	$< 2.0 \cdot 10^{-9}$		
U_I, U_S	Input impedance	> 60 kΩ current from input	
	Current from input	< ±100 µA	
I	U < 1 V		
Reinforced insulation	between shield and the rest of	50 V, OV IV, 4000 m, PD 2	
Isolation routine test	the signals of a channel	1.4 kV AC, duration 60 s	
Safety Function:	Signal transmission		
Safety level	SIL 2		
FFR	$< 1.00 \cdot 10^{-7}$		
Safety function	Frequency-precise transmission	$f_{out} = f_{in}$ ± 0.1 % of measured value	

Specifications

Ambient Conditions

Operating environment	Use in enclosed, non-forced-ventilated areas on rolling stock	
Installation site according to EN 50155	Enclosed control cabinet	
Pollution degree	PD 2	
Height class according to EN 50125	AX, reduced isolation data for altitudes of 2000 to 4000 m above MSL	
Temperature class according to EN 50125	TX	
Ambient temperature range: Operation	-40 … 70 °C (-40 … 158 °F)	OT4 / ST1 & ST 2 / H2, 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, transport)	
	Annual mean value	≤ 75 %
	Continuous operation	15 … 75 %
	Continuously for 30 days a year	75 … 95 %
	Occasionally on the other days	95 … 100 %

Further Data

Terminals	Push-in two-tier terminals, pluggable	
Conductor cross-sections	0.2 … 1.5 mm² AWG 24 … 16	Stranded with ferrule or solid
Cable types	Shielded cables	
Degree of protection according to EN 60529	Input, IP20	Output, IP20
Mechanical load	Vibration and shock according to EN 61373, IEC 61373	Category 1, Class B Tested by independent test laboratory
MTBF	> 2.6 · 106 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	

Standards and Directives
The devices were 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)

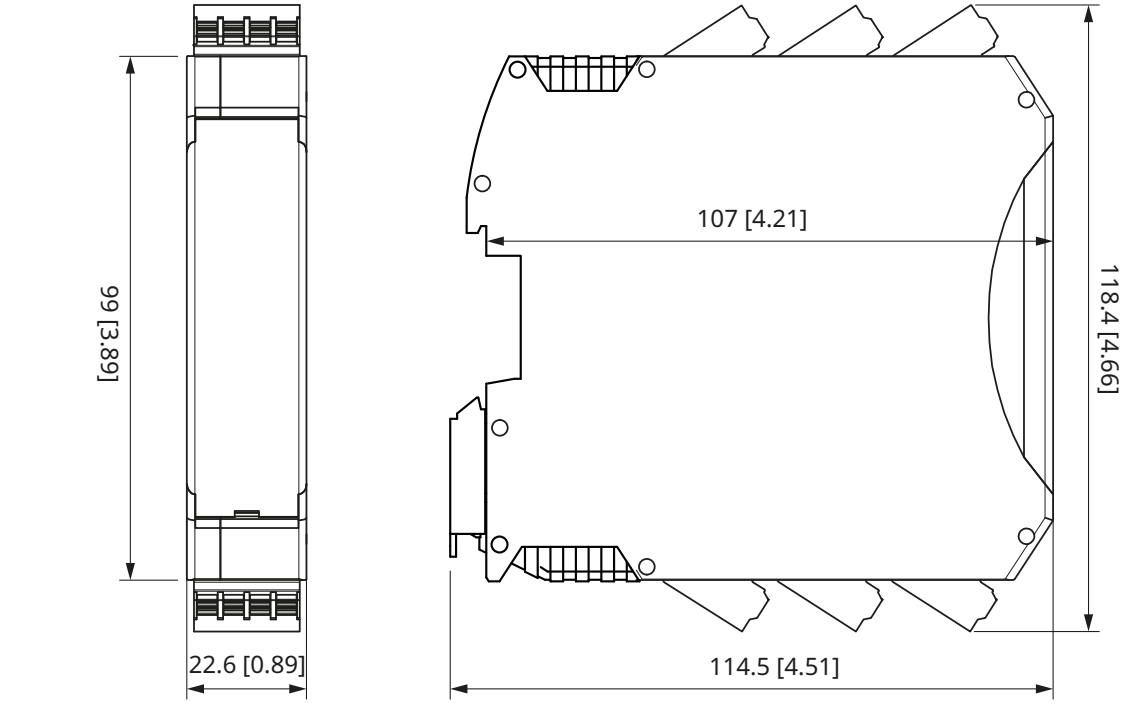
Standards

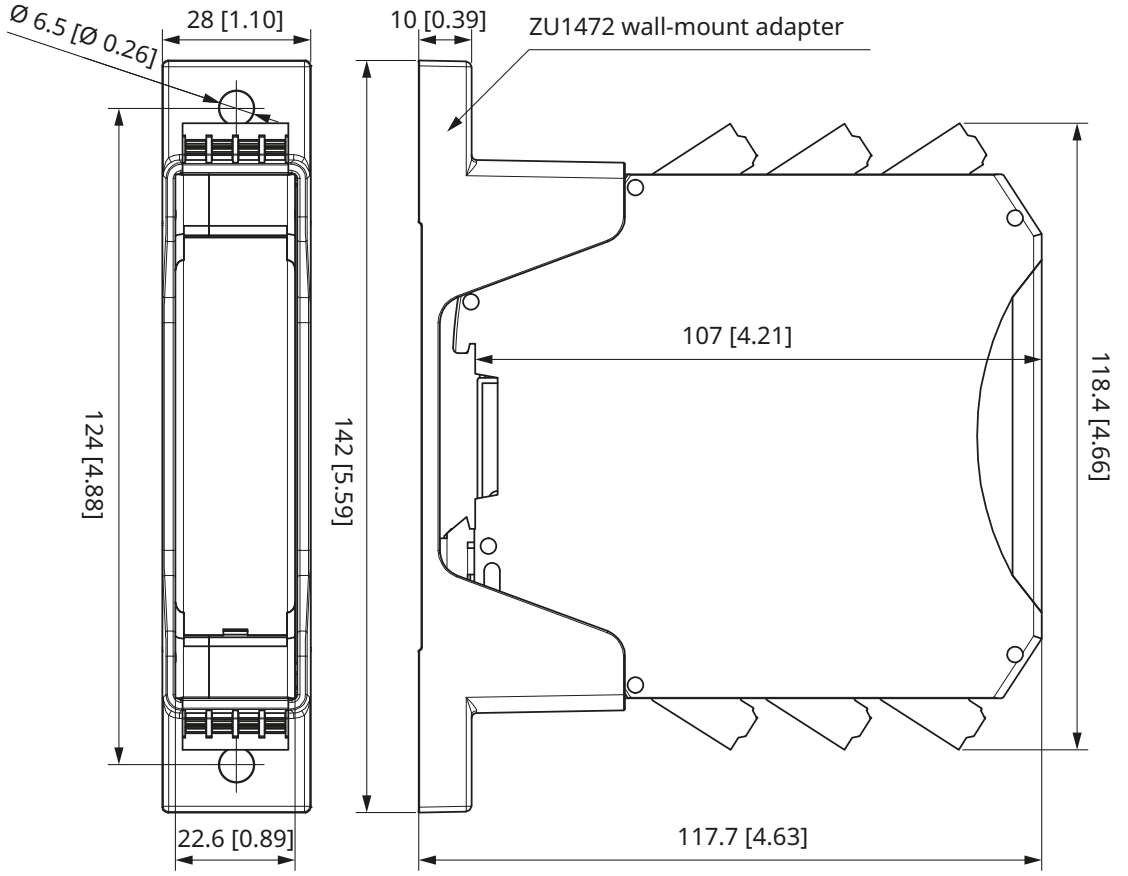
Rail Applications	EN 50155, EN 50153
Resistance to vibration and shock	EN 61373, IEC 61373
Fire protection	EN 45545-1, EN 45545-2, EN 45545-5
EMC	EN 50121-1, EN 50121-3-2
Functional safety	EN 50129
Isolation requirements	EN 50124-1
Climate	EN 50125-1

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

Dimension Drawings





All dimensions in mm [inches]

Terminal assignments

Terminal	Designation	Input/output	Channel	Function
1.1	V_S	Output	2	Supply voltage
1.2	U_B	Output	2	Supply voltage (output driver) If terminal UB is open, the output driver is supplied via VS and an internal DC/DC converter.
1.3	Out	Output	2	Output signal (current or voltage)
1.4	SW	Output	2	Switching output, opens in the event of an 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	Supply voltage
3.2	U_B	Output	1	Supply voltage (output driver) If terminal UB is open, the output driver is supplied via VS and a DC/DC converter.
3.3	Out	Output	1	Output signal (current or voltage) For product version with DOT Function (P16840, direction-of-travel detection): result of phase comparison
3.4	SW	Output	1	Switching output, opens in the event of an error.
4.1	US	Input	1	Speed sensor supply voltage
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	US	Input	2	Speed sensor supply voltage
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

Terminal Assignments and Block Diagram