

**Hella KGaA Hueck & Co.**  
Rixbecker Straße 75  
D-59552 Lippstadt/Germany  
Telefon + 49 29 41 38-3 11 74  
Telefax + 49 29 41 38-4 73 11 74  
[www.hella.com/electric-electronic-components](http://www.hella.com/electric-electronic-components)  
[electric-electronic-components@hella.com](mailto:electric-electronic-components@hella.com)

## **Sensors and Actuators**

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## The Hella sensors/actuators product range – versatile, innovative, tried-and-trusted millions of times!

Thanks to its versatility, this range of sensors and actuators can be used wherever processes are to be controlled, measured, regulated and monitored. No matter whether these processes are in vehicles (such as buses, tractors, construction machinery etc.) or industrial applications.

Take advantage of this synergy by using Hella components in your application, benefiting from our decades of experience in the development and high-volume production of these sensors and actuators.

As a global player in lighting, engineering and electronics, Hella is one of the top companies in the international supplier industry. Hella's success strategy: Innovative technologies that have proved themselves millions of times over in rough applications, in combination with intensive technical support.

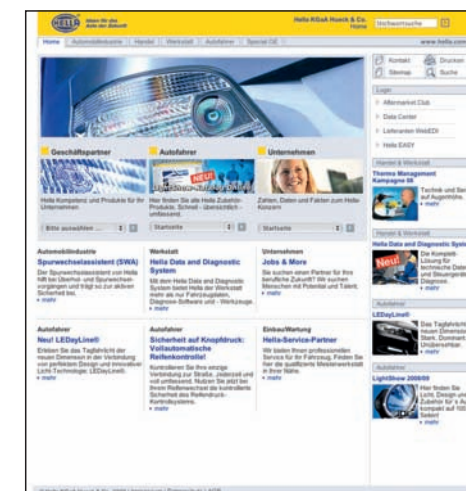
### Innovative Technologies

Creativity and know-how – the pillars of our success. Backed up by decades of experience in development and production for small-batch and high-volume production, this strategy has put us among the world's leaders. In addition, one of Hella's mottos is: If you don't go forwards, you go backwards. Reason enough to invest significantly in research and development year after year. The objective: To know today what the customer of tomorrow will need. Investments that pay off.

### Intensive Support

At Hella, personal contact is the foundation for every customer relationship. After all, you know best what your customers expect from you. For Hella as a supplier, the requirements are formidable, because we would like to support each and every one of our customers as personally as possible. And this is exactly where we combine the advantages of a medium-sized company with the characteristics of a global player: lean organisation, flexibility and short delivery times coupled with a powerful branch network.

## Online information



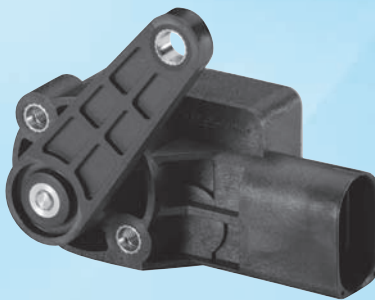
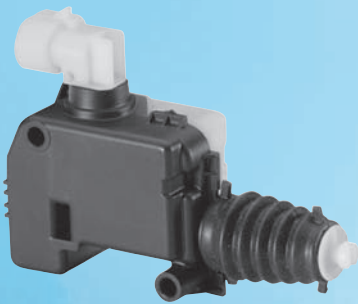
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The internet cannot be beaten for fast and up-to-date information. We make sure that important customer information is available online directly.

You can find the Hella online catalogue for electric and electronic components on the Special OE page, as well as under the direct link [www.hella.com/electric-electronic-components](http://www.hella.com/electric-electronic-components).

Here, we keep the contents of this printed copy up-to-date and extend them further. Use the electric and electronic components online catalogue to reference illustrations, drawings, dimensions and technical data – directly with practical search and comparison possibilities.



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## ***Summary of applications***

In this catalogue, you will find the most important technical data to select a sensor or actuator and estimate its use in your application and the overall system. These sensors and actuators are produced under high-volume production conditions due to high original equipment manufacturer quality standard, and are used in passenger cars, trucks and special vehicles such as tractors, construction machines, fork lifts, trucks, motor homes and buses. Their versatility also makes these components suitable for a wide range of industrial applications, including the following fields:

- Automation
- Mechanical engineering
- Environment engineering
- Heating & sanitary
- Process engineering
- Facility management
- Energy management

The adjacent overview contains some application examples. The system supplier has always the responsibility that these components work safely in the required application or in the overall system. Give us a call or drop us a line if you need support during component pre-selection, electrical integration, sample requesting or in other detailed technical matters.

Phone + 49 29 41 38-3 11 74  
Fax + 49 29 41 38-4 73 11 74  
[www.hella.com/electric-electronic-components](http://www.hella.com/electric-electronic-components)  
[electric-electronic-components@hella.com](mailto:electric-electronic-components@hella.com)

Subject to factual and technical alterations. Hella does not accept liability for the function of your overall system, only for the components described and their product characteristics.

Sensors/actuators	Examples of vehicle applications	Examples of possible industrial applications
<b>Temperature sensors</b>		
Measurement of air temperatures.	Measurement of the temperature in the air flow to regulate climate systems or display exterior air temperature.	Measurement of the air temperature in devices and air-conditioning systems with temperature regulation and/or display e.g. in household appliances, automatic machines, buildings, climate chambers, thermostats, heating, sanitary equipment, freezing monitors etc.
Measurement of liquid temperatures.	Measurement of the temperature of liquids (coolants, fuels, oil) in engines.	Measurement of liquid temperatures in systems with liquid temperature regulation e.g. drive systems, heating systems, pump systems, sanitary equipment, heat pumps etc.
<b>Absolute pressure sensors</b>		
Absolute pressure measurement of liquids and gases.	Oil pressure measurement at the oil pump. Fuel pressure, compressor pressure	Pressure measurement in heating systems, sanitary equipment, industrial systems, filter systems or electrical devices.
<b>Level sensors</b>		
Detection and measurement of level.	Monitoring of levels in windscreen water tanks (washing water level switch). Monitoring or measurement of the level of motor oil in engines (oil level switch or oil level sensors).	Monitoring or measurement of the level (water or oil) in storage tanks, oil tanks, wind power plants, block-type thermal power stations, stationary motors etc.
<b>Angle of position sensors</b>		
Precise and reliable measurement of angle settings and changes.	Measurement of the horizontal adjustment of the reel on combine harvesters, determination of fork positions, path measurement for pedal sensors, jig angle for telescopic handling equipment.	Measurement of the setting lever angle in monitoring systems, control systems and industrial systems.
<b>Pedal sensors</b>		
Floor mounted and suspended pedal.	Pedals in vehicles such as tractors, construction machinery, fork lift trucks and buses.	
<b>Solar sensors</b>		
Measurement of light intensity and sun radiation.	Air-conditioning regulation in passenger cars and trucks.	Measurement of light intensity and sun radiation for the regulation of intelligent climate or lighting systems in buildings, angle of position control of solar systems or sunshade systems for modern housing.
<b>Electrical actuators</b>		
Electrical locking and/or unlocking, tightening of closing and opening mechanisms.	Electrical locking and/or unlocking, tightening of closing systems for doors, hoods, boot and service flaps, fuel cap covers and boot lids, compartments flaps, roof hatches.	Electrical locking and unlocking of closing systems in door security systems in hotels, hospitals etc.. Electrical unlocking of closing and/or opening mechanisms in industrial systems or automatic machinery.

# ***IP protective ratings***

IP stands for International Protection. IP protective ratings are determined according to DIN 40050 Part 9.

The purpose of the standard is to provide an exact definition against the penetration of solid particles including dust and against water penetration.

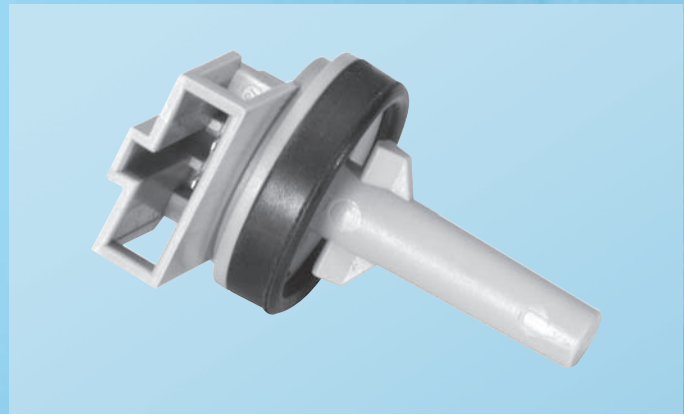
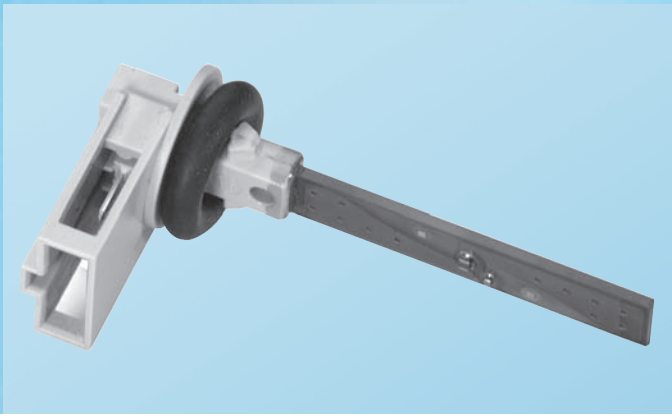
The adjacent overview of IP protective ratings and the explanation of their meaning is intended to help you choose the right components for the respective requirements in your application.

## **Example:**

Code **IP 65**

First index: Protection against the penetration of particles  
Second index: Protection against liquid

Protective ratings against solid particles (dust)			Protective ratings against water		
First index	Brief description	Definition	Second index	Brief description	Definition
0	Not protected	No requirements	0	Not protected	No requirements.
1	Protected against solid particles > 50 mm	The object probe, a sphere 50 mm in diameter, must not be able to fully penetrate.	1	Protected against drops of water	Vertical drops must not have any damaging effect.
2	Protected against solid particles > 12.5 mm diameter	The object probe, 12.5 mm in diameter, must not be able to penetrate at all.	2	Protection against drops of water when the housing is tilted to up to 15°.	Vertical drops must not have any damaging effect when the housing is tilted to either side of the perpendicular.
3	Protected against solid particles > 2.5 mm diameter	The object probe, 2.5 mm in diameter, must not be able to penetrate at all.	3	Protected against water spray	Water that is sprayed at an angle of up to 60° on either side of the perpendicular must not have any damaging effect.
4	Protected against solid particles > 1.0 mm diameter	The object probe, 1.0 mm in diameter, must not be able to penetrate at all.	4	Protected against water spray	Water that is sprayed onto the housing from one direction must not have any damaging effect.
			4K	Protected against water spray with increased pressure	Water that is sprayed onto the housing at increased pressure from any direction must not have any damaging effect.
5K	Dust protection	Penetration of dust is not completely prevented, but dust must not be allowed to penetrate to such an extent that the device can no longer work satisfactorily or is no longer safe.	5	Protection against water jets	Water that is directed onto the housing as a powerful jet from any direction must not have any damaging effect.
6K	Dustproof	No dust penetration	6	Protection against powerful water jets	Water that is directed onto the housing as a powerful jet from any direction must not have any damaging effect.
			6K	Protected against water jets with increased pressure	Water that is directed onto the housing as a jet with increased pressure from any direction must not have any damaging effect.
			7	Protected against the effect of temporary submersion in water	Water must not penetrate to an extent that it has a damaging effect if the housing is temporarily submerged in water under restricted pressure and time conditions.
			8	Water in the case of permanent submersion	Water may not penetrate in such a quantity as to cause damaging effects if the housing is submerged permanently under water under firmly defined conditions.
			9	Protected against the effect of permanent submersion in water	Water must not penetrate to an extent that it has a damaging effect if the housing is permanently submerged in water.
			9K	Protection against water during high-pressure/steam-jet cleaning	Water that is directed onto the housing under greatly increased pressure from any direction must not have any damaging effect.



## Sensors

Temperature sensors

Measurement of air temperatures

### Product features

- Different design shapes
- EMC stable
- Fast reaction times

### Application

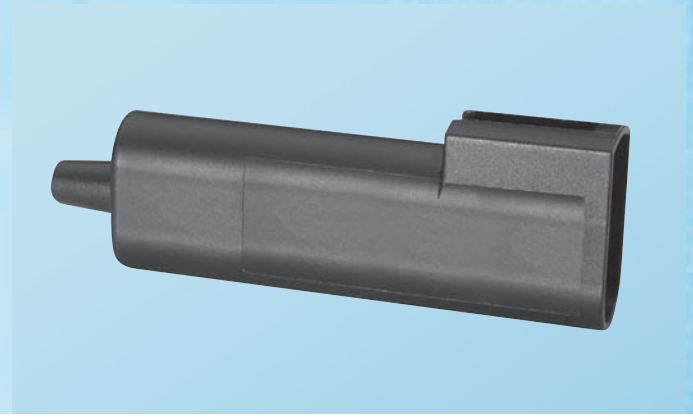
Air temperature sensors are used to measure temperatures in the air flow of the air-conditioning system. In addition, respective variants can be used to measure exterior temperature and interior temperature in a range of industrial fields, taking the respective reaction times and protective ratings into account. Examples for this are air-conditioning systems in

- Vehicles
- Heating/sanitary
- Refrigeration
- Building

### Structure and function

Basically, each of these sensor variants is made up of an NTC resistor. NTC resistors have a negative temperature coefficient and increase their conductivity as temperature increases. Some of the variants in the product range have an open NTC element which is covered by a protective glass layer. These sensor variants stand out particularly thanks to their fast reaction times of up to six seconds ( $\tau$  according to DIN EN 60539). Encased sensor variants have longer reaction times, but provide better protection for the NTC element against external environmental conditions. The basic circuit diagram comprises a sensor and a constant resistor connected in series. The resistance of the NTC temperature sensor can be calculated using the voltage divider law on the basis of the voltage drop at the resistor or at the sensor. The temperature can be assigned to the resistance of the NTC sensor by means of the resistance curve. There are four air temperature sensors to choose from.





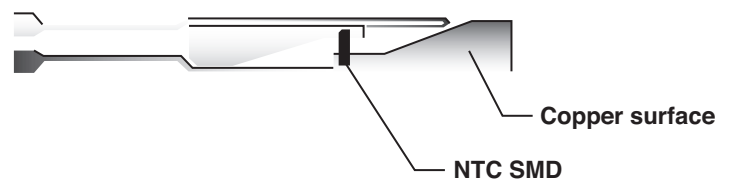
The first variant (part no.: 6PT 007 843-131) is an integrating probe that can record the average temperature in an air flow thanks to its design structure. A parallel capacitor improves the electromagnetic compatibility. Despite this improvement, the electromagnetic compatibility of each of these variants still has to be checked in the respective application.

The second variant (part no.: 6PT 005 855-121) has been designed for monitoring evaporator temperatures. The design structure provides good humidity resistance and a very sturdy design.

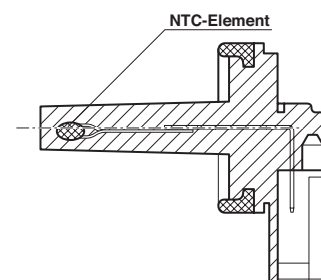
The third variant (part no.: 6PT 965 419-011) is the latest product for monitoring evaporator temperatures. The technical design enables a very fast reaction speed and high measuring accuracy at application temperatures.

The fourth variant (part no.: 6PT 009 522-011) has been designed as an exterior temperature sensor and is splash-water-protected. The temperature curve is linearized by the use of a resistor connected in parallel. A parallel capacitor improves the electromagnetic compatibility of this sensor variant.

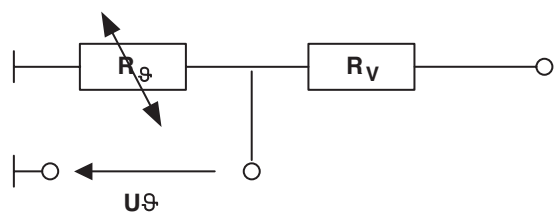
**Schematic sensor structure (not encased), first variant**



**Schematic sensor structure (encased), second variant**

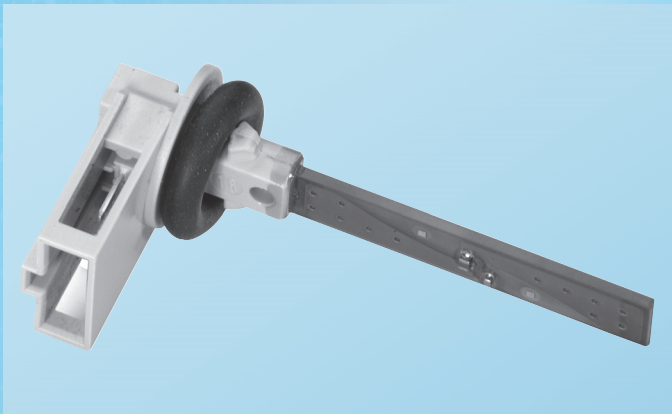


**Equivalent circuit diagram**



**Summary of variants**

Temperature range	Application areas	Time constant	Counterplug	Encased	Protection	Part number	Technical Data on page
- 40 °C to + 90 °C	Air	< 18 s (in oil bath)	Lear 13069	no	IP 5K4	6PT 007 843-131	8
- 40 °C to + 90 °C	Air	< 120 s (in air)	Lear 13069	yes	IP 5K4	6PT 005 855-121	9
- 40 °C to + 90 °C	Air	< 24 s (in air)	Tyco MQS 2 pol.	no	IP 5K4	6PT 965 419-011	10
- 40 °C to + 65 °C	Exterior air temperature	< 35 s (in water/alcohol bath)	Tyco 2-1437712-5	yes	IP 67	6PT 009 522-011	11



# Sensors

Temperature sensors

Measurement of air temperatures

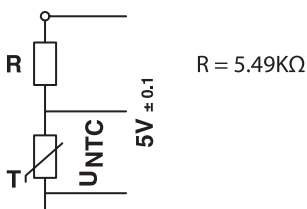
Part number 6PT 007 843-131

Technical data	
Rated voltage	5 V
Temperature measuring range	- 40 °C to + 90 °C
Time constant	18 s (according to DIN EN 60539-1 in the oil bath)
Vibration resistance	Duration 8 h, 5 g (10 and 50 Hz), 0,5 g. (66,7 Hz and 100 Hz), 0,05g (1000 Hz), eff. acceleration 19 m/s <sup>2</sup>
Shock resistance	400 m/s <sup>2</sup> duration 11 ms
Resistant to	interior cleaner, windscreen cleaner
Storage temperature	- 40 °C to + 90 °C
Protection	IP 5K4
Corrosion tested to	DIN 50021, 144 h, sprayed with 5 % salt solution, PCB completely coated
Lifetime	15 years
Housing material	PBT GF 30
Contact pin	CuNiSi F59
Pin coating	tin-plated
Sealing ring	EPDM 30±5 Shore A
Counterplug <sup>1)</sup>	Lear 13069
Weight	7.3 g

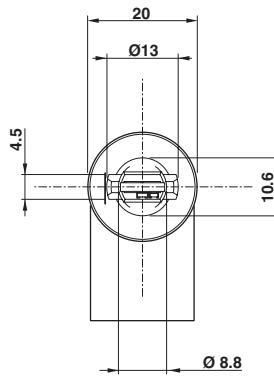
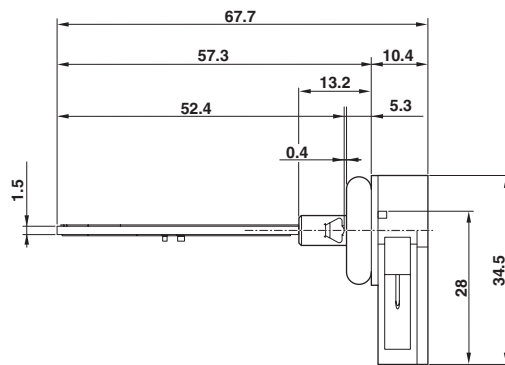
<sup>1)</sup> This accessory is not part of the scope of supply. To be purchased from Lear.

Resistance key values		
Temperature	Resistance (R nom.)	Percentage deviation
- 40 °C	213.46 kΩ	12.95 %
- 20 °C	72.86 kΩ	9.37 %
0 °C	28.22 kΩ	6.30 %
+ 25 °C	10.00 kΩ	3.00 %
+ 60 °C	2.98 kΩ	6.82 %
+ 90 °C	1.21 kΩ	9.09 %

### Circuit inside the control unit

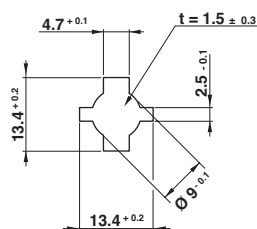


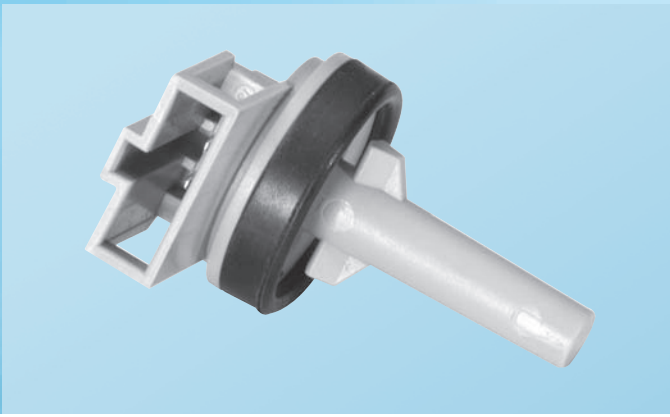
### Technical drawing



FLOW ORIENTATION OF AIR

### Installation opening





# Sensors

Temperature sensors

Measurement of air temperatures

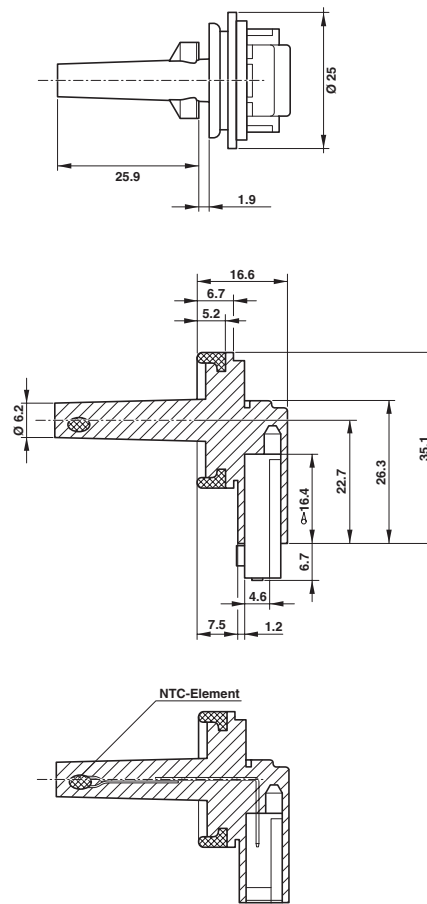
Part number 6PT 005 855-121

Technical data	
Rated voltage	5 V
Temperature measuring range	- 40 °C to + 90 °C
Time constant	< 120 s (according to DIN EN 60539-1 in air)
Vibration resistance	Duration per main axis 8h, 5 g (10 and 50 Hz), 0,5 g. (66,7 Hz and 100 Hz), 0,05 g (1000 Hz), eff. acceleration 19 m/s <sup>2</sup>
Shock resistance	40 g, duration 11 ms
Resistant to	interior cleaner, windscreen cleaner
Storage Temperature	- 40 °C to + 90 °C
Protection	IP 5K4
Corrosion tested to	DIN 50021-SS, 250 h, sprayed with 5 % salt solution
Lifetime	15 years
Housing material	PBT GF30
Contact pin	CuSn6 F41
Pin coating	gal Sn 2516bk according to Hella-N47102-04
Material Sealing ring	EPMD
Counterplug <sup>1)</sup>	Lear 13069
Weight	8,9 g

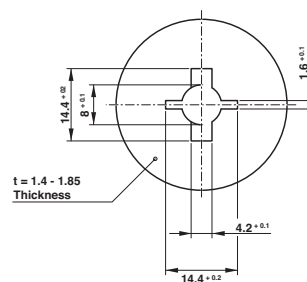
<sup>1)</sup> This accessory is not part of the scope of supply. To be purchased from Lear.

Resistance key values		
Temperature	Resistance (R nom.)	Percentage deviation
- 40 °C	33.344 kΩ	6.32 %
- 20 °C	9.863 kΩ	4.70 %
0 °C	3.281 kΩ	3.00 %
+ 25 °C	0.998 kΩ	4.92 %
+ 60 °C	0.249 kΩ	7.04 %
+ 90 °C	0.093 kΩ	8.84 %

## Technical drawing



## Installation opening





# Sensors

Temperature sensors

Measurement of air temperatures

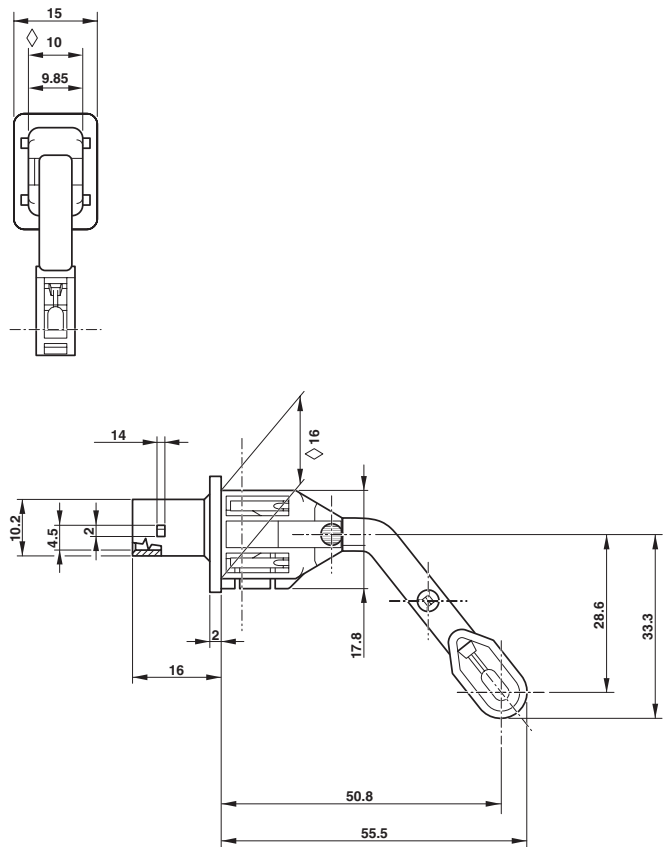
Part number 6PT 965 419-011

Technical data	
Rated voltage	5 V
Temperature measuring range	- 40 °C to + 100 °C
Time constant	< 24 s (according to DIN EN 60539-1 in air)
Dielectric strength	500 V
Vibration resistance	5 g ± 0,5 g at 70 °C and at - 20 °C, sine oscillation, up to 200 Hz, one octave per minute, implementation frequency 0 Hz ± 2 Hz, 24 hours per axis
ESD	according to DIN EN 61000-4-2 (IEC 61000-4-2), discharge through contact ± 6 kV, discharge through air ± 8 kV
Resistant to	interior cleaner, windscreen cleaner
Storage Temperature	- 40 °C to + 90 °C
Protection	IP 5K4
Corrosion tested to	DIN 50021-SS, 240 h
Lifetime	15 years
Housing material	PA6 GF30
Contact pin	CuMg 01
Pin coating	galvanically tin-coated or hot tin-coated, solderable
Counterplug <sup>1)</sup>	Tyco MQS 2pol
Weight	5.9 g

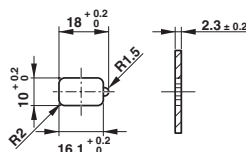
<sup>1)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics.

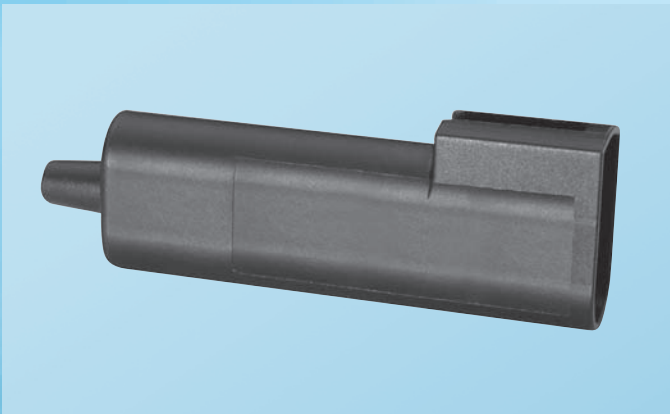
Resistance key values		
Temperature	Resistance (R nom.)	Percentage deviation
- 40 °C	95.353 kΩ	3.40 %
- 20 °C	26.987 kΩ	2.37 %
0 °C	9.000 kΩ	1.50 %
+ 25 °C	2.741 kΩ	2.44 %
+ 60 °C	0.677 kΩ	3.45 %
+ 90 °C	0.248 kΩ	4.18 %

## Technical drawing



## Installation opening





# Sensors

Temperature sensors

Measurement of air temperatures

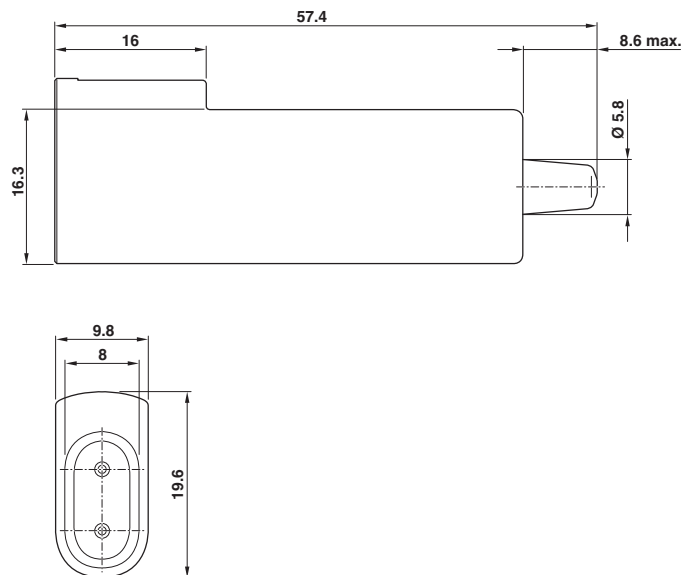
Part number **6PT 009 522-011**

Technical data	
Rated voltage	5 V
Temperature measuring range	- 40 °C to + 65 °C
Time constant	< 35 s (in water/alcohol bath)
Vibration resistance	1 g, frequency cycle 10 Hz to 100 Hz up to 10 Hz, change in frequency 1 Hz/s, 94 hours per direction (flat), in three test directions
Storage Temperature	- 40 °C to + 90 °C
Protection	IP 67
Corrosion tested to	ASTM 13117, 96 h
Lifetime	15 years
Housing material	PA6 GF30
Contact pin	Sheet metal EN 1652-CuSn6-R420-03
Pin coating	NiAu and NiSn, solderable
Counterplug <sup>1)</sup>	Tyco 2-1437712-5
Weight	5.9 g

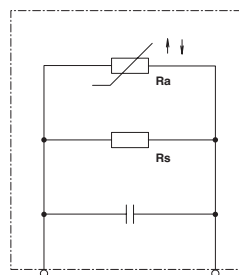
<sup>1)</sup> This accessory is not part of the scope of supply.  
To be purchased from Tyco Electronics.

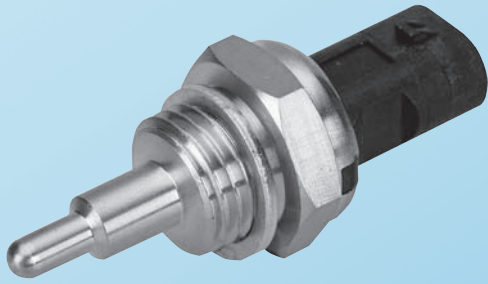
Resistance key values		
Temperature	Resistance (R nom.)	Percentage deviation
- 40 °C	9.820 kΩ	1.5 %
-10 °C	7.931 kΩ	1.5 %
0 °C	5.179 kΩ	0.5 %
+ 4 °C	4.632 kΩ	0.5 %
+ 35 °C	0.249 kΩ	1.0 %
+ 65 °C	0.588 kΩ	1.0 %

## Technical drawing



## Circuit diagram





## Sensors

Temperature sensors

Measurement of liquid temperatures

### Product features

- Universal use for the measurement of liquid temperatures
- Two thread sizes (M12 and M14) available
- Suitable for media such as coolants, oils, fuels
- Measuring range -40 °C to + 155 °C

### Structure and function

There is a NTC precision resistor made of semi-conductor material with a negative temperature coefficient (NTC) in the housing of the liquid temperature sensors. The NTC precision resistor has a high resistance at lower temperatures, with resistance decreasing as temperature increases.

### Application

This type of sensor is used for the following applications in vehicles, for example:

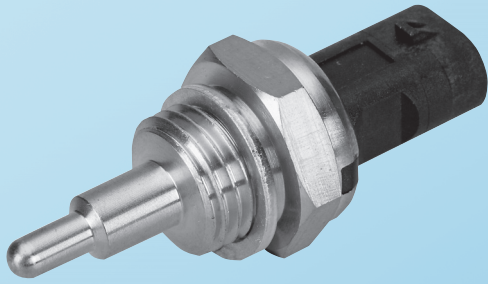
- Engine coolant circuit (coolant temperature)
- Fuel system (fuel temperature)
- Engine air intake

Applications in the industrial field are the measurement of liquid temperatures in general.

## Summary of variants

Temperature measuring range	Media used	Thread (spanner width)	Counterplug	Protection	Part number	Technical data on page
- 40 °C to + 155 °C	Coolant, oils, water	M12 x 1.5 (17)	Hirschmann, MLK 1,2	IP 6K9K	6PT 009 309-171	14
- 40 °C to + 155 °C	Coolant, oils, water	M14 x 1.5 (19)*	Hirschmann, MLK 1,2	IP 6K9K	6PT 009 309-181	15

\* upon request



## Sensors

Temperature sensors

Measurement of liquid temperatures

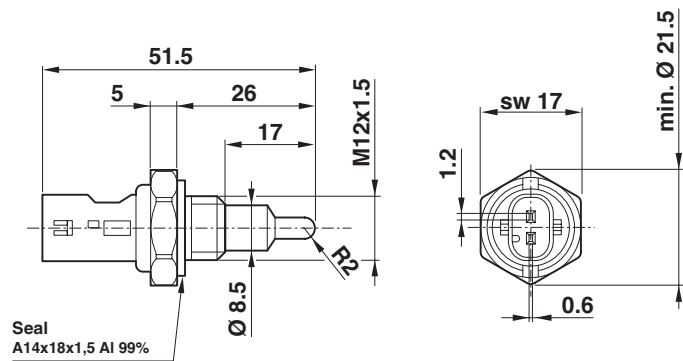
Part number 6PT 009 309-171

Technical data	
Operating pressure	up to max. 50 bar
Protection	IP 6K9K
Corrosion test according to	DIN 50021 - SS
Rated voltage	5 V
Current	typ. 1 mA, max. 5 mA
Medium	Water, oil, coolants, fuels
Housing material	CuZn39Pb2F43
Material Sealing ring	Al
Plug material	PA6/6T GF30
Measuring range	- 40 °C to + 155 °C
Tolerance at + 20 °C	+/- 1.9 %
Tolerance at +100 °C	+/- 1.0 %
Nominal resistance at 25 °C	2.251 Ω
Reaction time to changes in the medium's temperature (Temperature Time constant $T_{90}$ )	< 10 sec (in water)
Oscillation test	following DIN EN 60068 - 2 - 47
Service life	10 years and/or 1,000,000 km and/or 15,000 operating hours
Thread	M12 x 1.5
Tightening torque max.	16 Nm
Counterplug <sup>1)</sup>	Hirschmann, 2-pole MLK 1.2, coding A, No. 872-857-561
Pin material	Bronze CuSu6 (hardness: R420)
Pin coating	CuO, 1Ag 4

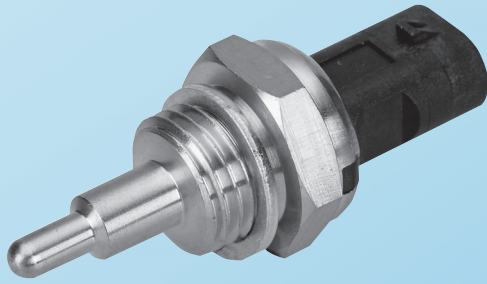
<sup>1)</sup> This accessory is not part of the scope of supply.  
To be purchased from Hirschmann.

Hot conductor resistor temperature curve supporting values 5°						
T	R ref.	R min.	R max.	Δ R/R	Δ T	α
[°C]	[Ω]	[Ω]	[Ω]	[±%]	[±°C]	[%/K]
15 °C	3,537	3,466	3,607	2.0	0.4	4.7
20 °C	2,812	2,758	2,866	1.9	0.4	4.5
25 °C	2,251	2,210	2,293	1.9	0.4	4.4
40 °C	1,199	1,179	1,219	1.7	0.4	4.0
85 °C	241.4	238.6	244.3	1.2	0.4	3.2
90 °C	206.6	204.3	209.0	1.1	0.4	3.1
100 °C	153.1	151.6	154.6	1.0	0.3	2.9

## Technical drawing







## Sensors

Temperature sensors

Measurement of liquid temperatures

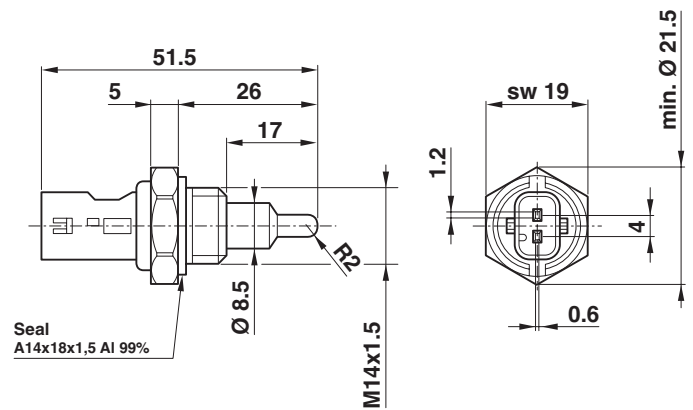
Part number 6PT 009 309-181

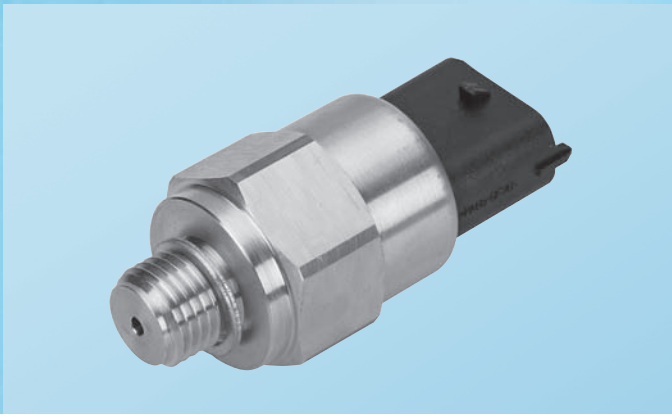
Technical data	
Operating pressure	up to max. 50 bar
Protection	IP 6K9K
Corrosion test according to	DIN 50021 - SS
Rated voltage	5 V
Current	typ. 1 mA, max. 5 mA
Medium	Water, oil, coolants, fuels
Housing material	CuZn39Pb2F43
Sealing ring material	Al
Plug material	PA6/6T GF30
Measuring range	- 40 °C to + 155 °C
Tolerance at + 20 °C	+/- 1.9 %
Tolerance at + 100 °C	+/- 1.0 %
Nominal resistance at 25 °C	2.251 Ω
Reaction time to changes in the medium's temperature (temperature time constant $T_{90}$ )	< 10 sec (in water)
Oscillation test	according to DIN EN 60068 - 2 - 47
Service life	10 years and/or 1,000,000 km and/or 15,000 operating hours
Thread	M14 x 1.5
Tightening torque max.	16 Nm
Counterplug <sup>1)</sup>	Hirschmann, 2-pole MLK 1.2, coding A, No. 872-857-561
Pin material	Bronze CuSn6, hardness R420
Pin coating	Cu0, 1Ag4

<sup>1)</sup> This accessory is not part of the scope of supply. To be purchased from Hirschmann.

Hot conductor resistor temperature curve supporting values 5°						
T	R ref.	R min.	R max.	Δ R/R	Δ T	α
[°C]	[Ω]	[Ω]	[Ω]	[±%]	[±°C]	[%/K]
15 °C	3,537	3,466	3,607	2.0	0.4	4.7
20 °C	2,812	2,758	2,866	1.9	0.4	4.5
25 °C	2,251	2,210	2,293	1.9	0.4	4.4
40 °C	1,199	1,179	1,219	1.7	0.4	4.0
85 °C	241.4	238.6	244.3	1.2	0.4	3.2
90 °C	206.6	204.3	209.0	1.1	0.4	3.1
100 °C	153.1	151.6	154.6	1.0	0.3	2.9

### Technical drawing





## Sensors

*Absolute pressure measurement of liquids and gases*

### Product features

- Pressure measurement from 0 to 10 bar
- Can be used in a wide range of different liquids and gases
- Two thread sizes: M14 or M18

### Structure and function

The pressure sensor comprises a copper-tin alloy (brass) with a polyamide plug mechanically connected. The pressure of the medium is transformed into an electrical signal through a ceramic thick-layer measuring cell. This signal is processed by the ASIC (Application Specific Integrated Circuit) integrated in the sensor. The output is a ratiometric analogue voltage signal of 0.5 V (0 bar) to 4.5 V (10 bar).

### Application

This pressure sensor is suitable for the pressure measurement of liquids and gases (non-explosive media) that do not corrode the housing material and ceramic membrane. The sensor measures medium pressures from 0 to 10 bar in relation to the atmospheric pressure of the environment (relative pressure measurement).

Classical applications include, for example, the measurement of:

- Oil and fuel pressures (in engine and gears)
- Operating pressures (of compressed air e.g. in filter systems and hydraulic oils)

## Summary of variants

Measuring range	Medium	Thread (spanner width)	Counterplug	Protection	Part number	Technical data on page
Absolute pressure 0 to 10 bar	Gases & liquids (water, coolant, fuels, oils)	M14 x 1,5 (27)	Bosch no. 1 928 403 966	IP 6K9K	6PP 010 350-001	18
Absolute pressure 0 to 10 bar	Gases & liquids (water, coolant, fuels, oils)	M18 x 1,5 (27)	Bosch no.1 928 403 966	IP 6K9K	6PP 010 350-011	20



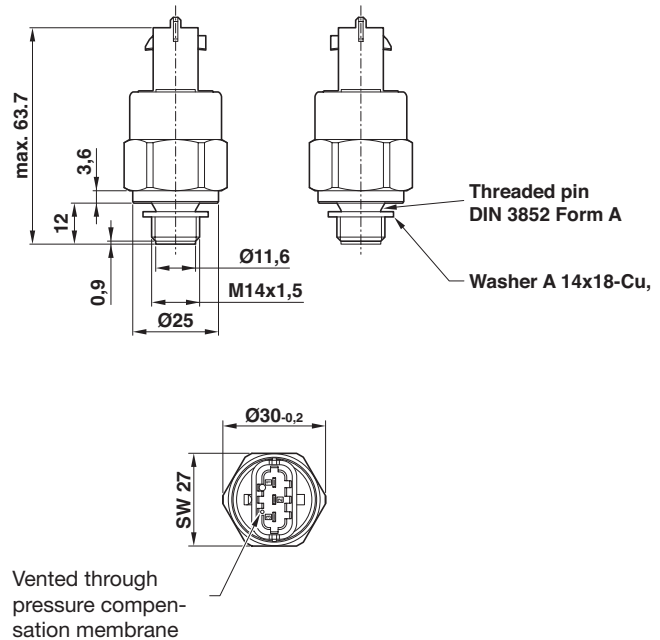
## Sensors

Absolute pressure measurement of liquids and gases

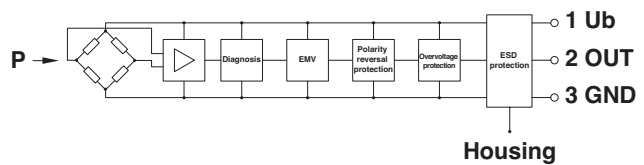
Part number 6PP 010 350-001

Technical data	
Pressure range	0 bar (0.5 V) to 10 bar (4.5 V) relative
Over pressure	30 bar/ 60 s/ 20 °C
Burst pressure	> 50 bar
Underpressure resistance	minus 0.5 bar/ 15 s/ 20 °C in relation to -> atmosphere
Mounting position	any
Thread	M 14 x 1,5
Installation torque	max. 40 Nm + 5 Nm with Cu ring
Burst torque at thread	> 55 Nm
Burst torque at connector	> 10 Nm at 20 °C
Output signal	ratimetric / with clamping <sup>1)</sup>
Output impedance	typ. 100 ± 20 % kOhm and 100 ± 20 % nF against ground
Noise	< 0.1 mV eff $\sqrt{Hz}$ (20 KHz)
Response time T <sub>90</sub>	< 80 msec. (T <sub>63</sub> typ. 16 ms)
Signal tolerance	± 2,5% F.S. 0 °C to + 80 °C; otherwise ± 5 % F.S.
Supply voltage [U <sub>s</sub> ]	5 VDC (± 0.25 V), Fuction standby 100 ms after switch-on
Over voltage	max. 10 VDC / 70 °C / 60 min. → function status C <sup>2)</sup>
Polarity reversal	- 5 VCD / 5 min. → function status D <sup>3)</sup> , short-circuit test output to ground and U <sub>b</sub>
Typ. current consumption	typ. 5 mA, max. 15 mA
Protection	IP 6K9K (with counterplug firmly locked in place)
EDI	PV 0162 0063 dated January 1999, 50 V/m Stripline with functional status A (fully functional)
Operating and (storage) temperature	- 30 °C (- 48 °C) up to + 125 °C (+ 135 °C)
Application	Motor oil, gear oil, petrol, diesel fuel, brake fluid, water (only in combination with another seall), AdBlue on request
Vibration resistance	Sine vibration, 50 cycles per axis, (in the case of rotation symmetrical test samples 2 axes parallel and perpendicular to the longitudinal axis are sufficient)
Oscillation cycle	10 Hz to 2000 Hz to 10 Hz in 15 min, acceleration ± 10 g (61 ... 2000 Hz), amplitude ± 0.75 mm at 10 Hz to 61 Hz, temperature T = 25 °C ± 15K
Lifetime	10 years and/or 1,000,000 km and/or 15,000 operating hours
Housing material	CuZn39Pb3 F43
Counterplug	Bosch no. 1 928 403 966
Pin material	Bronze CuSn6, hardness R420
Pin coating	gal. Cu2Sn 5 shiny

### Technical drawing



### Equivalent circuit diagram



<sup>1)</sup> Output signal remains constant under 0.5 V and over 4.5 V.

<sup>2)</sup> Functional status C: test specimen does not work or does not work properly, but returns to functional status A (full functional) after the problem has been resolved.

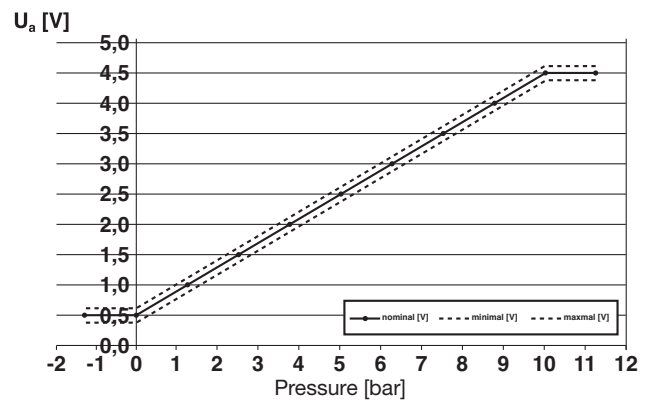
<sup>3)</sup> After the problem has been resolved, the test specimen is fully available, but does not return to functional status A on its own.

### Pressure measuring value table

Tolerance		± 2,5% F.S.		± 5% F.S.	
Temperature range		0 °C to 80 °C		- 30 °C to 0 °C and 110 °C and 125 °C	
Pressure nominal [bar]	[M]	minimum [M]	maximum [M]	minimal [M]	maximum [M]
p < 0	0.50	0.300	0.600	0.300	0.700
0	0.50	0.400	0.600	0.300	0.700
2	1.30	1.200	1.400	1.100	1.500
4	2.10	2.000	2.200	1.900	2.300
6	2.90	2.800	3.000	2.700	3.100
8	3.70	3.600	3.800	3.500	3.900
10	4.50	4.400	4.600	4.300	4.700
p > 10	4.50	4.400	4.700	4.300	4.700

constant signal at 0.5 V and 4.5 V

### Sensor characteristic in the temperature range





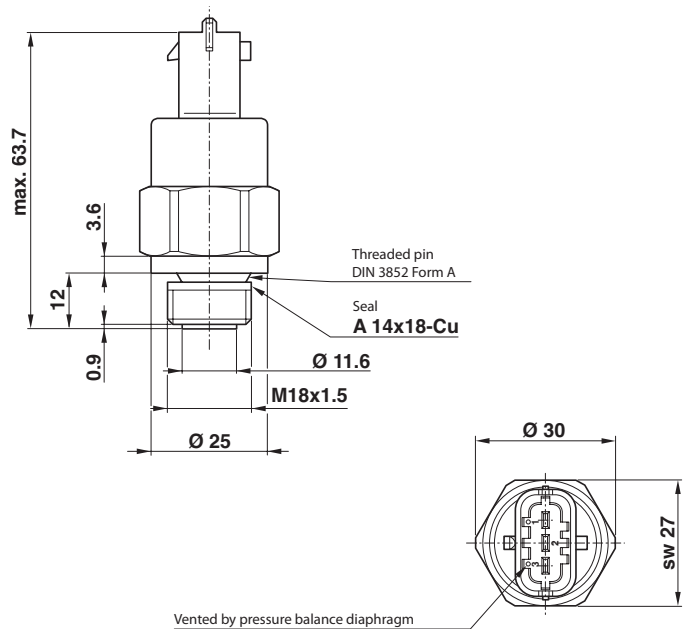
## Sensors

Absolute pressure measurement of liquids and gases

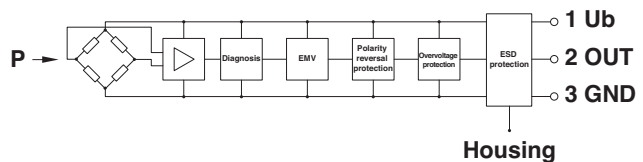
Part number 6PP 010 350-011

Technical data	
Pressure range	0 bar (0.5 V) to 10 bar (4.5 V) relative
Over pressure	minus 30 bar/ 60 s/ 20 °C
Burst pressure	> 50 bar
Underpressure resistance	minus 0.5 bar/ 15 s/ 20 °C in relation to -> atmosphere
Mounting position	any
Thread	M 18 x 1,5
Installation torque on the hexagon	max. 40 Nm + 5 Nm with Cu ring
Burst torque at	> 55 Nm
Burst torque at thread connector	> 10 Nm at 20 °C
Output signal	ratimetric / with clamping <sup>1)</sup>
Output impedance	typ. 100 ± 20 % kOhm and 100 ± 20 % nF against ground
Noise	< 0.1 mV eff $\sqrt{Hz}$ (20 KHz)
Response time T90	< 80 msec. (T63 typ. 16 ms)
Signal tolerance	± 2,5 % F.S. 0 °C to + 80 °C, otherwise ± 5 % F.S.
Operating voltage [U <sub>b</sub> ]	5 VDC (± 0.25 V),
Function	Function standby 100 ms after switch-on
Supply voltage	max. 10 VDC / 70 °C / 60 min. → function status C <sup>2)</sup>
Polarity reversal	- 5 VCD / 5 min. → function status D <sup>3)</sup> , short-circuit test output to ground and U <sub>b</sub>
Typ. current consumption	typ. 5 mA, max. 15 mA
Protection	IP 6K9K (with counterplug firmly locked in place)
EDI	PV 0162 0063 dated January 1999, 50 V/m Stripline with functional status A (fully functional)
Operating and (storage) temperature	- 30 °C (- 48 °C) bis + 125 °C (+ 135 °C)
Application	Motor oil, gear oil, petrol, diesel fuel, brake fluid, water (only in combination with another seal!), AdBlue on request
Vibration resistance	Sine vibration, 50 cycles per axis, (in the case of rotation symmetrical test samples 2 axes parallel and perpendicular to the longitudinal axis are sufficient)
Oscillation cycle	10 Hz to 2000 Hz to 10 Hz in 15 min, acceleration ± 10 g (61 ... 2000 Hz), amplitude ± 0.75 mm at 10 Hz to 61 Hz, temperature T = 25 °C ± 15K
Lifetime	10 years and/or 1,000,000 km and/or 15,000 operating hours
Housing material	CuZn39Pb3 F43
Counterplug	Bosch no. 1 928 403 966
Pin material	Bronze CuSn6, hardness R420
Pin coating	gal. Cu2Sn5, shiny

### Technical drawing



### Equivalent circuit diagram



<sup>1)</sup> Output signal remains constant under 0.5 V and over 4.5 V (clamping)

<sup>2)</sup> Functional status C: test specimen does not work or does not work properly, but returns to functional status A (full function) after the problem has been resolved.

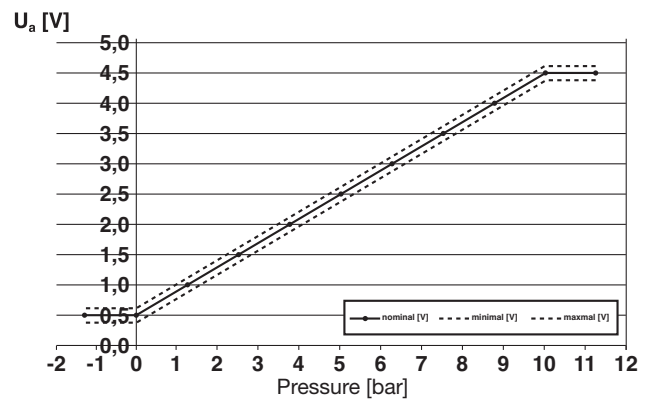
<sup>3)</sup> After the problem has been resolved, the test specimen is fully available, but does not return to functional status A on its own.

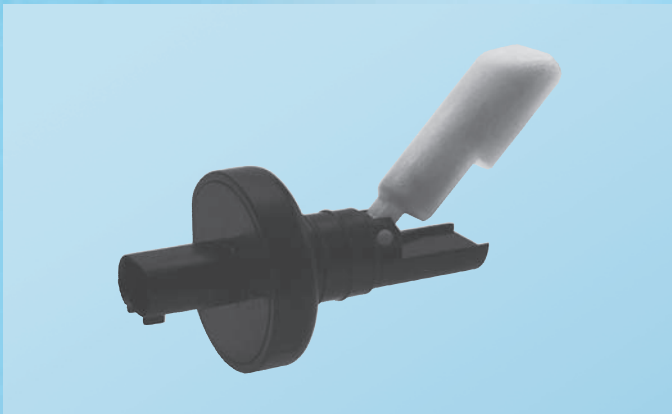
### Pressure measuring value table

Tolerance		± 2,5% F.S.		± 5% F.S.	
Temperature range		0 °C to 80 °C		- 30 °C to 0 °C and 110 °C to 125 °C	
Pressure nominal [bar]		minimum [M]	maximum [M]	minimum [M]	maximum [M]
p < 0	0.50	0.300	0.600	0.300	0.700
0	0.50	0.400	0.600	0.300	0.700
2	1.30	1.200	1.400	1.100	1.500
4	2.10	2.000	2.200	1.900	2.300
6	2.90	2.800	3.000	2.700	3.100
8	3.70	3.600	3.800	3.500	3.900
10	4.50	4.400	4.600	4.300	4.700
p > 10	4.50	4.400	4.700	4.300	4.700

constant signal (clamping) at 0.5 V and 4.5 V

### Sensor characteristic in the temperature range





## Sensors

*Level sensors*

*Detection of liquid levels*

### Product features

- Simple application solution for minimum level monitoring
- Simple electrical connection
- Level monitoring of media such as water or coolant

### Structure and function

The coolant/windscreen washer supply switch comprises a Reed contact and a float which is actuated through its buoyancy depending on the liquid level. The opening of the Reed switch indicates that the liquid level has fallen below the fixed switching point of the level switch. This allows a faulty function to be diagnosed, since the level switch is closed above the minimum level.

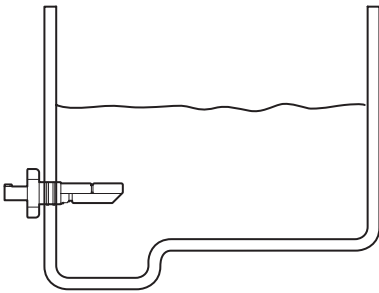
### Application

This level switch is used to monitor levels in tanks. The main application is guaranteeing the minimum level in water or coolant tanks. Thanks to the simplicity of its application, the sensor can also be used in industrial applications to secure minimum levels and thus minimum filling quantities of tanks and containers.

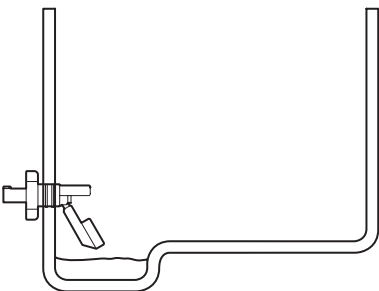


### Basic sketch

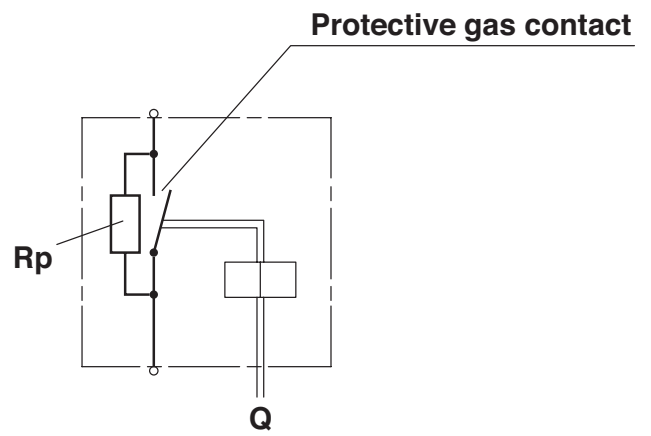
Contact closed



Contact open

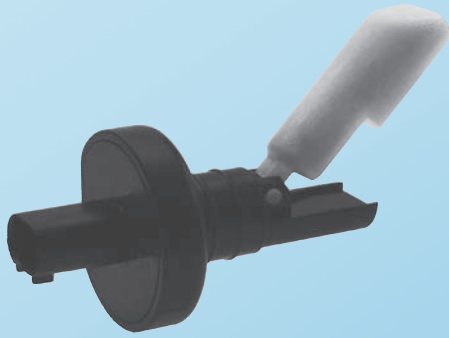


### Circuit diagram



### Summary of variants

Installation	Counterplug	Material	Part number	Technical data on page
From the side	AMP 967078	POM black (base plate and plug housing)	6PR 007 968-041	24



# Sensors

Level sensors

Recording liquid levels

**Part number 6PR 007 968-041**

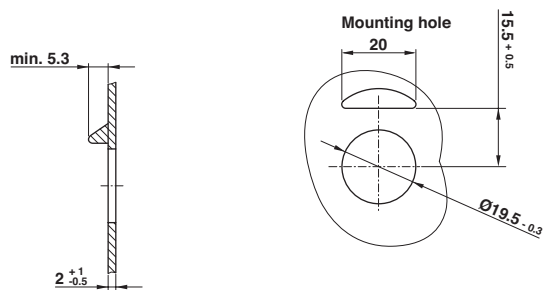
Technical data	
Switching current	≤ 20 mA
Switch opens	as the level falls (according to the installation position shown in the technical drawing)
Operating voltage	e.g. 8 V (with input resistor 357 )
Nominal resistance	$R_p = 174 \Omega \pm 1 \% 0,25 \text{ W}$ (DIN 4592)
Test criteria	U <sub>max.</sub> at operating voltage and Reed closed 10 mV
Operating temperature (functional reliability)	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 80 °C
Service life	50.000 Switching cycles
Air-tightness installed in the tank with counterplug attached	IP 68
Resistant to reagents	antifreeze, water, corrosion protection agent, salt water, cold cleaner
Vibration resistance (installed, without liquid, with rubber parts) according to DIN IEC 68 Part 2 to 6	a-3 g (floating sine-vibration test) f = 10 to 50 Hz, t = 8 h / main axis
Insertion force per blade terminal	min. 25 N at RT
Electromagnetic properties	specified for field-free space <sup>1)</sup>
Counterplug <sup>2)</sup>	AMP 967644
Plug housing and base plate material	POM black
Pin material	POM natural colour
Float material	PP spumed natural colour
Magnet material	hard ferrite
Pin coating	Cu Ni tin-plated
Rubber grommet material <sup>3)</sup>	soft rubber 60-6, Shore hardness 60, black Hella-N 38 014

<sup>1)</sup> The level switch is specified for electromagnetic field-free space. This means the electromagnetic compatibility must be checked individually for every application.

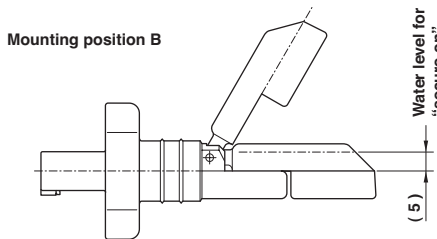
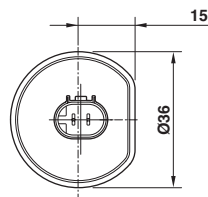
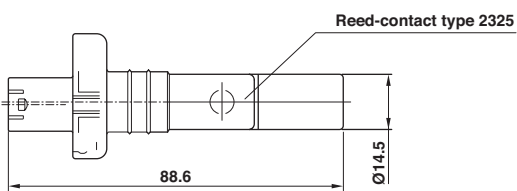
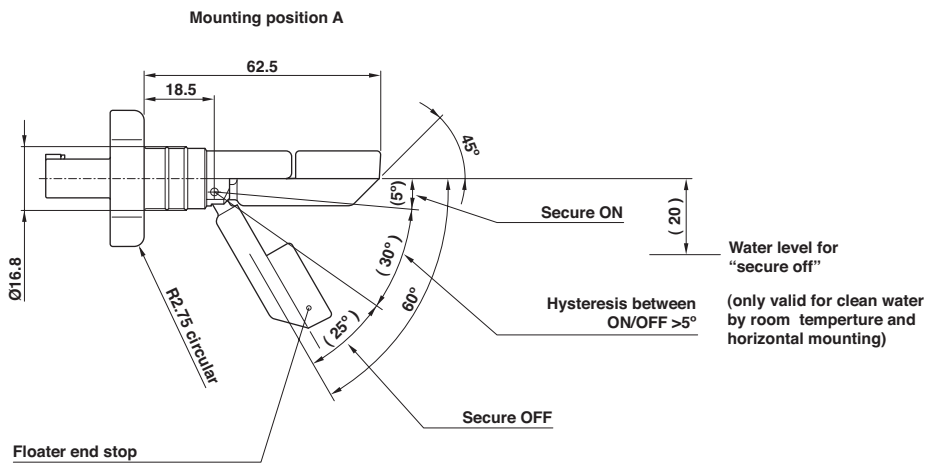
<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics.

<sup>3)</sup> Included in the scope of supply.

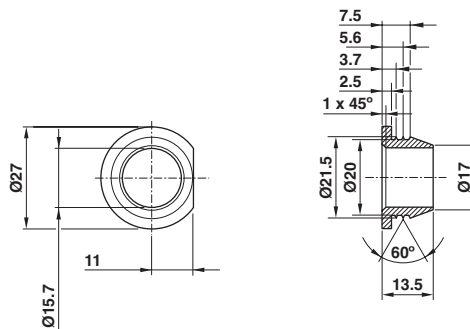
## Installation note



**Technical drawing**



**Rubber grommet**





## Sensors

### Level sensors

Detection of liquid levels (static or dynamic)

#### Product features

- Compact sensor design
- Installation in oil pan
- Simple electrical connection
- Principle use for motor oil
- Application in further media possible

#### Application

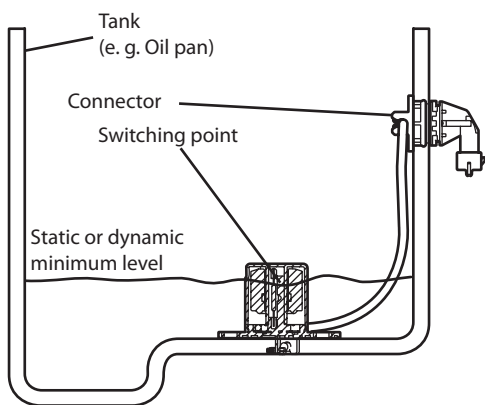
This level switch is used to monitor levels. The main application is monitoring motor oil level, and thus securing a minimum filling quantity in the static range (engine at a standstill) or in the dynamic range (engine in operation) in various vehicle engines - tractors, fork lifts, trucks, construction machinery, special vehicles etc.. In addition, thanks to the simplicity of its application, the sensor can also be used in industrial applications to secure minimum levels and thus minimum filling quantities of tanks and containers.

#### Structure and function

The oil level switch comprises a Reed contact and a float which is actuated through its buoyancy depending on the liquid level. The opening of the Reed switch indicates that the liquid level has fallen below the fixed switching point of the oil level switch. This allows a faulty function to be diagnosed, since the oil level switch is closed above the minimum level. The signal evaluation of the oil level switch is by means of a customer-specific evaluation algorithm which is stored in the vehicle control unit/control system. The minimum warning takes place through a defined switch-off length for the signal within the evaluation algorithm.

This sensor has to be installed on the bottom of the oil pan. The oil level switch is usually on a ledge in the oil pan or on an additional holder in order to adapt the minimum level of the application to that of the oil level switch.

### Basic sketch (Installation in oil pan)



### Summary of variants

Installation	Counterplug	Material	Part number	Technical data on page
Interior (e.g. on the bottom of the oil pan)	Delphi ZFW2-141 or Bosch ZFW2-83 with 190 mm cable	PA6, 6T Ultramid TKR 4350, black (housing)	6PR 232 000-001	28
Interior (e.g. on the bottom of the oil pan)	Delphi ZFW2-141 or Bosch ZFW2-83 with 275 mm cable	PA6, 6T Ultramid TKR 4350, black (housing)	6PR 232 000-011	30



## Sensors

### Level sensors

Detection of liquid levels (static or dynamic)

**Part number 6PR 232 000-001**

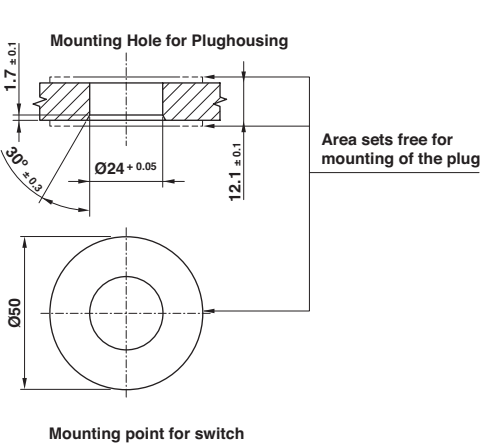
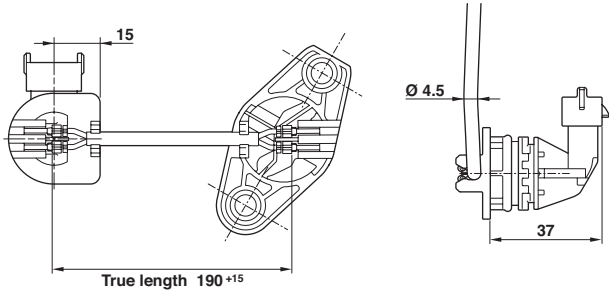
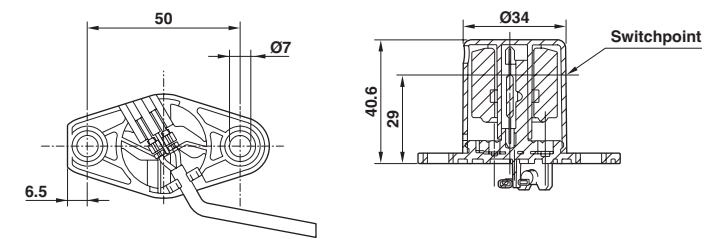
Technical data	
Switching point	29 ± 1 mm
Max. tilt of the oil level switch	≤ 8°
Supply voltage	5 V ± 5 % oder 14,5 V ± 5 %
Switching current	min. 5 mA / typ. 12 mA / max. 20 mA
Pin 1	Signal
Pin 2	Masse
Drop in voltage	max. 2 mV
Insulating resistance	> 1 M at 500 V direct voltage for 60 sec
Dielectric strength	.....up to 500 V <sub>eff.</sub> With alternating voltage (50 Hz) and 2 sec
Permanent operating temperature	- 40 °C to + 150 °C
Qualified oils	Standard motor oils (e.g. Shell Helix Ultra 5W30)
Resistant to	Exhaust gases, dust, diesel fuels according to DIN EN 590, rapeseed oil (DIN E 51606), lead-free fuels (DIN EN 339), brake fluid DOT4, hydraulic oil Pentosin CHF11S
Lifetime	50.000 switching cycles
Storage temperature	- 40 °C to +70 °C
Operating pressure	- 5 kPa to 0 kPa
Protection for sealing the plug to the oil pan	IP69K
Weight	≤ 60 g
Cable length	190 + 15 mm
Cable cross-section	2 x 0,8 mm
Cable insulating material	Polyester Betax-HX FL 33 x 33 x 109
Individual wire	tin-plated, oil-resistant
Plug housing material	PA66 Zytel 70G35 HSLX black BK 357
Plug O-ring material	ACM or AEM, black, shore hardness 70 ± 5
Oil level switch housing material	PA6, 6T Ultramide TKR 4350, black
Base plate material	Oil level switch PA66 Zytel 70G35 HSLX, black, BK 357
Bushing material	CuZn 39Pb3 R430 EN12164
Contact material	Bd EN 1652 O. 6 CuNi10Fe1Mn
Float material	PA6 Ultramide B3S, natural colour
Reed contact	Contact wire: alloy 52 F52%Ni48%, Ri = 100 m max.
Magnet material	Hartferrit 24/23, M = 10.33 ± 0,9 x 10 - 6 Vscm
Plug air-tightness	up to 50 ± 5 kPa oil pressure
Plug	Bosch compact plug 1928 497 999 E
Pin coating (plug)	galvanically silver-coated 2701 according to Hella norm 47 102-6 (coat thickness acc. to DIN 50 987 minimum 3 µm Ag)
Counterplug <sup>1)</sup>	Delphi ZFW2-141 or Bosch ZFW2-83

Technical data	
Vibration resistance (carried out in succession)	
Sine-shaped (according to IEC 60068-2-6)	
Greatest offset at 100 Hz: 0.177 mm,	
200 Hz: 280 m/s <sup>2</sup> , 220 Hz: 280 m/s <sup>2</sup> , 240 Hz: 160 m/s <sup>2</sup> ,	
320 Hz: 160 m/s <sup>2</sup> , 340 Hz: 125 m/s <sup>2</sup> , 440 Hz: 125 m/s <sup>2</sup>	
Broadband noise (according to IEC 60068-2-64)	
Eff. total acceleration = 170 m/s <sup>2</sup>	
10 Hz: 10 (m/s <sup>2</sup> ) <sup>2</sup> /Hz, 100 Hz: 10 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	
300 Hz: 0.51 (m/s <sup>2</sup> ) <sup>2</sup> /Hz, 500 Hz: 45.6 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	
1500 Hz: 15.26 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	

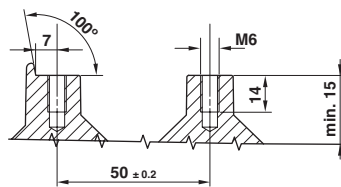
Magnetic properties have to be checked individually for every application.

<sup>1)</sup>This accessory is not part of the scope of supply.  
To be purchased from Bosch/Delphi.

Technical drawing



Mounting point for switch





## Sensors

### Level sensors

Detection of liquid levels (static or dynamic)

**Part number 6PR 232 000-011**

Technical data	
Switching point	29 ± 1 mm
Max. tilt of the oil level switch	≤ 8°
Supply voltage	5 V ± 5 % or 14.5 V ± 5 %
Switching current	min. 5 mA / typ. 12 mA / max. 20 mA
Pin 1	Signal
Pin 2	Ground
Drop in voltage	max. 2 mV
Insulating resistance	> 1 M at 500 V direct voltage for 60 sec
Dielectric strength	up to 500 V <sub>eff.</sub> With alternating voltage (50 Hz) and 2 sec
Permanent operating temperature	- 40 °C to +150 °C
Qualified oils	Standard motor oils (e.g. Shell Helix Ultra 5W30)
Resistant to	Exhaust gases, dust, diesel fuels according to DIN EN 590, rapeseed oil (DIN E 51606), lead-free fuels (DIN EN 339), brake fluid DOT4, hydraulic oil Pentosin CHF11S
Lifetime	50.000 switching cycles
Storage temperature	- 40 °C to +70 °C
Operating pressure	- 5 kPa to 0 kPa
Protection for sealing the plug to the oil pan	IP69K
Weight	≤ 60 g
Cable length	275 + 15 mm
Cable cross-section	2 x 0,8 mm
Cable insulating material	Polyester Betax-HX FL 33 x 33 x 109
Individual wire	tin-plated, oil-resistant
Plug housing material	PA66 Zytel 70G35 HSLX black BK 357
Plug O-ring material	ACM or AEM, black, Shore hardness 70 ± 5
Oil level switch housing material	PA6, 6T Ultramide TKR 4350, black
Base plate material	Oil level switch PA66 Zytel 70G35 HSLX, black, BK 357
Bushing material	CuZn 39Pb3 R430 EN12164
Contact material	Bd EN 1652 O. 6 CuNi10Fe1Mn
Float material	PA6 Ultramide B3S, natural colour
Reed contact	Contact wire: alloy 52 F352%Ni48%, Ri = 100 m max.
Magnet material	Hartferrit 24/23, M = 10.33 ± 0,9 x 10 - 6 Vscm
Plug air-tightness	up to 50 ± 5 kPa oil pressure
Plug	Bosch compact plug 1928 497 999 E
Pin coating (plug)	galvanically silver-coated 2701 according to Hella norm 47 102-6 (coat thickness acc. to DIN 50 987 minimum 3 µm Ag)
Counterplug <sup>1)</sup>	Delphi ZFW2-141 or Bosch ZFW2-83

Technical data	
Vibration resistance (carried out in succession)	
Sine-shaped (according to IEC 60068-2-6)	
Greatest offset at 100 Hz: 0.177 mm,	
200 Hz: 280 m/s <sup>2</sup> , 220 Hz: 280 m/s <sup>2</sup> , 240 Hz: 160 m/s <sup>2</sup> ,	
320 Hz: 160 m/s <sup>2</sup> , 340 Hz: 125 m/s <sup>2</sup> , 440 Hz: 125 m/s <sup>2</sup>	
Broadband noise (according to IEC 60068-2-64)	
Eff. total acceleration = 170 m/s <sup>2</sup>	
10 Hz: 10 (m/s <sup>2</sup> ) <sup>2</sup> /Hz, 100 Hz: 10 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	
300 Hz: 0.51 (m/s <sup>2</sup> ) <sup>2</sup> /Hz, 500 Hz: 45,6 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	
1500 Hz: 15.26 (m/s <sup>2</sup> ) <sup>2</sup> /Hz,	

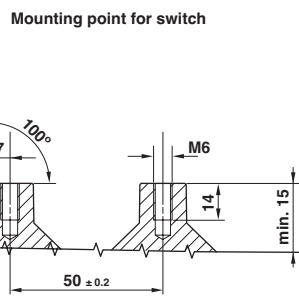
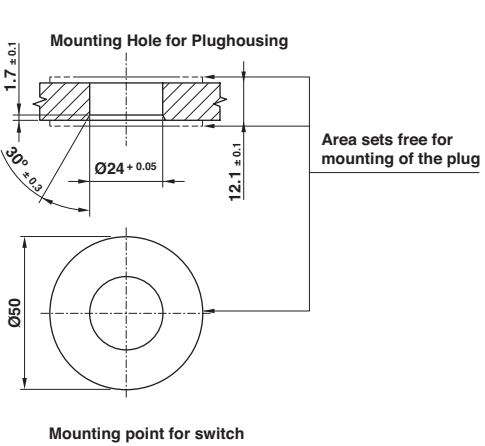
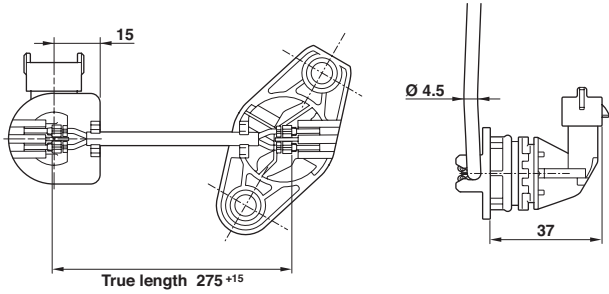
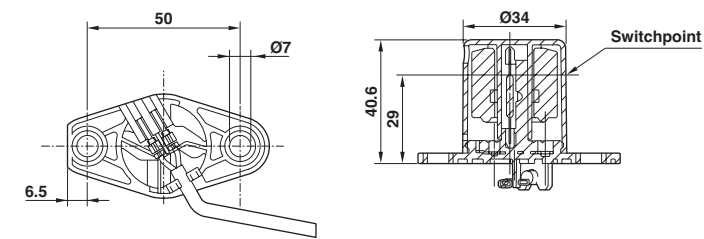
Magnetic properties have to be checked individually for every application.

<sup>1)</sup>This accessory is not part of the scope of supply.

To be purchased from Bosch/Delphi.



Technical drawing





# Sensors

## Level sensors

### Measurement of liquid levels (static and dynamic)

#### Product features

- Continuous measurement of the motor oil level in the static and dynamic range
- Compact sensor architecture with one multi-chip module
- Integrated temperature sensor
- Immediate measurement after switch-on

#### Application

In vehicles, oil sensors ensure that the engine does not work with too little oil without this being noticed. The tried-and-trusted technology of ultrasonic sensors works on the delay time principle and records the filling level continuously when the vehicle is being driven. During engine operation (dynamic measuring range) the filling level is significantly lower than the filling level when the engine is at a standstill (static measuring range). In mobile engines, an oil dipstick only records the oil level in the static range. The oil level continuously, i.e. both in the dynamic and in the static range. It thus provides information about the oil level during overall engine operation, which in the case of construction machinery, tractors, fork lifts, trucks, etc. can often cover several hours. The sensor provides continuous monitoring of the oil level the whole time the engine is running, thus preventing the oil level falling short of the minimum level during operation and interrupting the oil film (which would cause engine damage). Marginal influences such as vehicle tilt, cross and longitudinal acceleration are compensated by calculating an average value in the vehicle control unit.

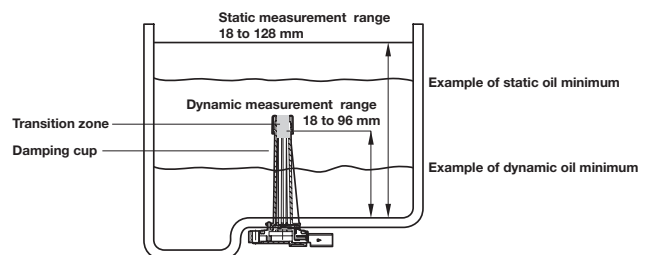
#### Structure and function

The sensor architecture of the oil level sensor PULS (Packed Ultrasonic Level Sensor) comprises one single multi-chip module where the ultrasonic and temperature sensor as well as an ASIC (Application Specific Integrated Circuit) are integrated. This compactness gives the sensor a higher level of impact and vibration resistance than sensors fitted with a large number of electronic components. The ultrasonic sensor integrated in the multi-chip module transmits a signal which is reflected from the oil/air interface of the motor oil.

The signal delay time is measured and the height is calculated depending on the speed of sound in the medium. The damping cap installed above the multi-chip module serves to calm the medium (in particular) in the dynamic measuring range.

The damping cap has openings at the base and at the tip which make a permanent oil flow possible.

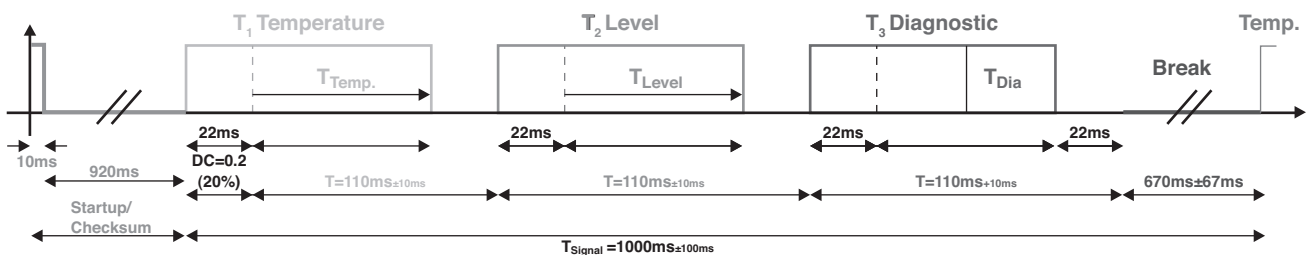
#### Basic sketch



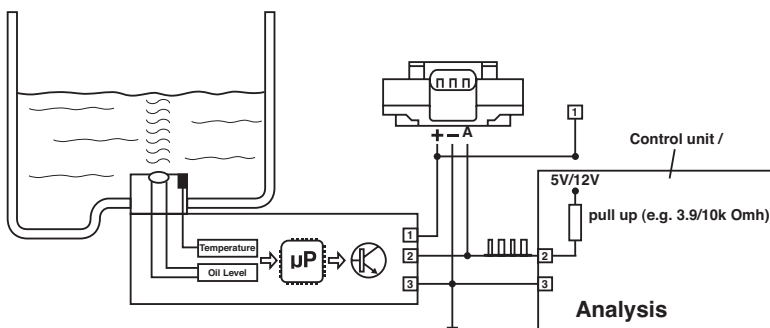
## Installation

The sensor has been designed for vertical installation from below in the bottom of an oil pan. The oil level sensor is usually located on a ledge in the oil pan to protect the sensor sub-structure. This installation position, combined with the openings which make a permanent oil flow possible, prevent sludge forming within the damping cap.

### PWM (open collector) signal evaluation



### Circuit diagram



## Summary of variants

Installation	Supply voltage	Measurement range	Part number	Technical data on page
From below	12 V	static 18 to 128 mm, dynamic 18 to 96 mm	6PR 009 622-051	36
From below	5 V	static 18 to 128 mm, dynamic 18 to 96 mm	6PR 009 622-041	38



## Sensors

Level sensors

Measurement of liquid levels (static and dynamic)

### Basic information about the duration of the signal

Startup check sum = 920 ms

PWM block duration  $T_1 = 110 \text{ ms} \pm 10 \text{ ms}$

PWM block duration  $T_2 = 110 \text{ ms} \pm 10 \text{ ms}$

PWM block duration  $T_3 = 68.2 \text{ ms}$  (fixed)

Overall PWM block duration  $T_{\text{signal}} = 1000 \text{ ms} \pm 100 \text{ ms}$

Break signal  $670 \text{ ms} \pm 67 \text{ ms}$

$$\text{Temp (}^\circ\text{C)} = \frac{(T_1/T - 0.32)}{0.003}$$

$$\text{Level (mm)} = [(T_2/T - 0.2) \times 183.33 + 12.66] \times \frac{T_{[\text{ms}]}}{110} + 5.34$$

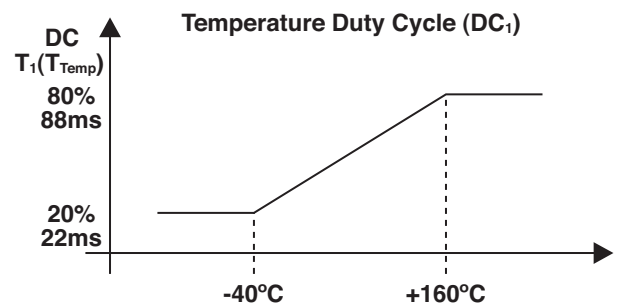
Calculation in the control unit

### Temperature evaluation (T<sub>1</sub> Temp)

20 % of the PWM block duration T<sub>2</sub> (22 ms) correspond to the lowest measuring point of the measuring range of -40 °C

80% of the PWM block duration T<sub>1</sub> (88 ms) correspond to the uppermost point of the measuring range of 160 °C

Corresponding to the temperature, the signal duration is  $T_1 \text{ms} = (\text{Temp. } [^{\circ}\text{C}] + 40) \times 0.33 + 22$



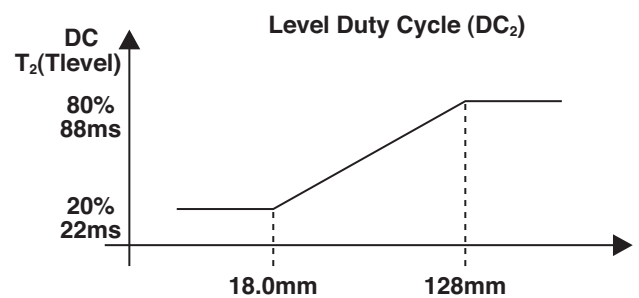
Temperature Duty Cycle (D1)

### Level evaluation (T<sub>2</sub> Level)

20 % of the PWM block duration T<sub>2</sub> (22 ms) correspond to the lowest measuring point of the measuring range of 18 mm

80% of the PWM block duration T<sub>2</sub> (88 ms) correspond to the uppermost point of the measuring range of 128 mm

Corresponding to the level, the signal duration is  $T_2 \text{ms} = (\text{Level [mm]} - 18) \times 0.6 + 22$



Level Duty Cycle (D2)



# Sensors

## Level sensors

Detection and measurement of liquid levels (static and dynamic)

**Part number 6PR 009 622-051**

Technical data	
Measurement range (static)	18 mm to 128 mm
Measurement range (dynamic)	18 mm to 96 mm
Accuracy (absolute) <sup>1)</sup>	± 3 mm
Accuracy in the transition zone <sup>2)</sup>	- 2 to + 4 mm
Response time for level measurement	< 1 ms
Maximum tilt of the sensor	4° in all directions
Qualified oils	Standard motor oils (e.g. Castrol 10W30)
Supply voltage	12 V
Voltage range	9 V to 16 V
Temperature measurement range	- 40 °C to + 160 °C
Accuracy (between 60 °C and 120 °C) <sup>3)</sup>	± 2 K
Response time for temperature measurement	< 1 ms
Output	PWM (open collector, lowside)
Signal output voltage (high)	according to voltage range
(low)	max. 1 V
Signal output current (high)	20 µA
(low)	10 mA
Load	10 k
Current consumption	6 mA (typical), 50 mA (maximum)
Operating temperature	- 40 °C to + 150 °C
Storage temperature	- 40 °C to + 140 °C
EMC	on request
Temperature resistance (IEC 60068-2-2)	750 h at 150 °C
Resistant to	brake fluid, petrol, salt, battery fluid
Vibration resistance (IEC 60068-2-6)	
Directions	Three dimensions (X, Y, Z)
Duration	t = 216 h, 72 h per direction
Thermal cycle	-40 to +140 °C,
Test Ambient	Oil (Castrol SLK R-tec); Level ~21 mm,
Temp. change speed	1K/min (25 cycles per direction),
No measurement during the test DUT shall be fitted like in the vehicle and in normal used direction.	
	10 - 50 Hz -> 1 g Peak
	50 - 250 Hz -> 15 g Peak
	250 - 2500 Hz -> 35 g Peak
Shock resistance (IEC 60068-2-27)	
Magnitude	± 100 g
Duration	10 ms
Number of cycles	6/axis
Test ambient	20 °C air,
	no measurement during the test

Technical data	
Maximum operating pressure	
Sensor includes just electronics and no glass body like a reed contact.	
The typical pressure in an oil pen is about - 0,5 bar. This sensor is independent on pressure. The sealing is the same as an oil pressure sensor and therefore able to work theoretically in an environment of 40 bar.	
Housing material	Polyamide 66, 36 % glass fibre
Sealing ring	AEM 70 ± 5 Shore A (ethylene acrylate rubber)
Pin material	CuNi10
Pin coating	Silver
Counterplug <sup>4)</sup>	Kostal no. 09 44 13 82
Protection	IP69K
Lifetime	15 years or 300,000 km

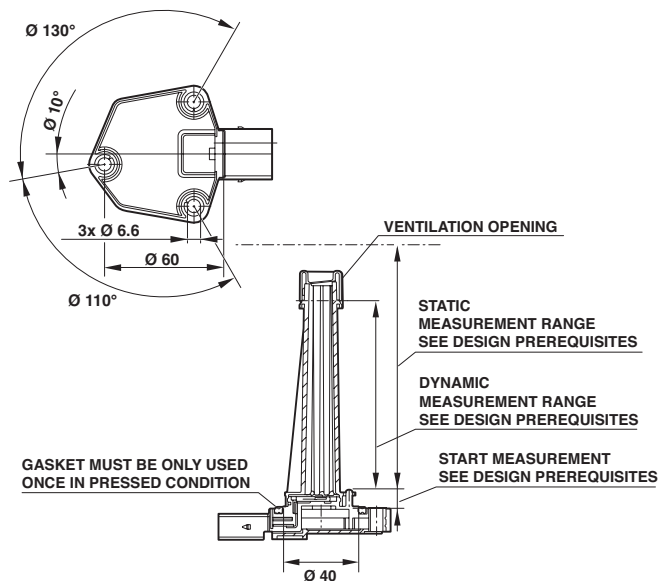
<sup>1)</sup>In the temperature range from 0 °C to 150 °C, ± 2 mm accuracy at ≤ 100 mm and 30 °C to 120 °C

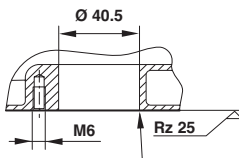
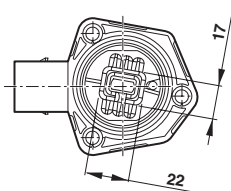
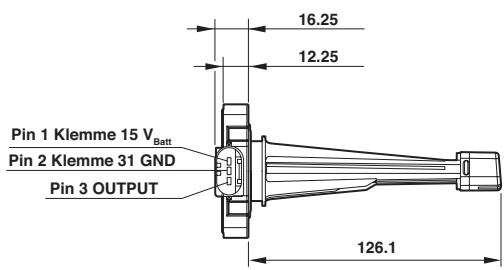
<sup>2)</sup>In the temperature range of 30 °C to 150 °C

<sup>3)</sup>± 3K in the temperature range - 40 °C to 60 °C and 120 °C to 160 °C

<sup>4)</sup>This accessory is not part of the scope of supply. To be purchased from Kostal

## Technical drawing





SEALING AREA FREE OFF BURR  
 MAX. ACCEPTED CIRC. RADII R0.3mm  
 OPTIONALLY CHAMFER CIRC. 0.3 mm X 45°



# Sensors

## Level sensors

Detection and measurement of liquid levels (static and dynamic)

**Part number 6PR 009 622-041**

Technical data	
Measurement range (static)	18 mm to 128 mm
Measurement range (dynamic)	18 mm to 96 mm
Accuracy (absolute) <sup>1)</sup>	± 3 mm
Accuracy in the transition zone <sup>2)</sup>	- 2 to + 4 mm
Response time for level measurement	< 1 ms
Maximum slope of the sensor	4° in all directions
Qualified oils	Standard motor oils (e.g. Castrol 10W30)
Supply voltage	5 V
Voltage range	4.9 V to 9 V
Temperature measurement range	- 40 °C to + 160 °C
Accuracy (between 60 °C and 120 °C) <sup>3)</sup>	± 2 K
Response time for temperature measurement	< 1 ms
Output	PWM (open collector, lowside)
Signal output voltage (high)	according to voltage range
(low)	max. 1 V
Signal output current (high)	20 µA
(low)	10 mA
Load resistance	10 k
Current consumption	6 mA (typical), 50 mA (maximum)
Operating temperature	- 40 °C to + 150 °C
Storage temperature	- 40 °C to + 140 °C
EMC	on request
Temperature resistance (IEC 60068-2-2)	750 h at 150 °C
Resistant to	brake fluid, petrol, salt, battery fluid
Vibration resistance (IEC 60068-2-6)	
Directions	Three dimensions (X, Y, Z)
Duration	t = 216 h, 72 h per direction
Thermal cycle	-40 to +140 °C,
Test ambient	Oil (Castrol SLK R-tec); Level ~21 mm,
Temp. change speed	1K/min (25 cycles per direction),
No measurement during the test DUT shall be fitted like in the vehicle and in normal used direction.	
	10 - 50 Hz -> 1 g Peak
	50 - 250 Hz -> 15 g Peak
	250 - 2500 Hz -> 35 g Peak
Shock resistance (IEC 60068-2-27)	
Magnitude	± 100 g
Duration	10 ms
Number of cycles	6/axis
Test ambient	20 °C air,
	no measurement during the test

Technical data	
Maximum operating pressure	
Sensor includes just electronics and no glass body like a reed contact.	
The typical pressure in an oil pen is about - 0,5 bar. This sensor is independent on pressure. The sealing is the same as an oil pressure sensor and therefore able to work theoretically in an environment of 40 bar.	
Housing material	Polyamide 66, 36 % glass fibre
Sealing ring	AEM 70 ± 5 Shore A (ethylene acrylate rubber)
Pin material	CuNi10
Pin coating	Silver
Counterplug <sup>4)</sup>	Kostal no. 09 44 13 82
Protection	IP69K
Lifetime	15 years or 300,000 km

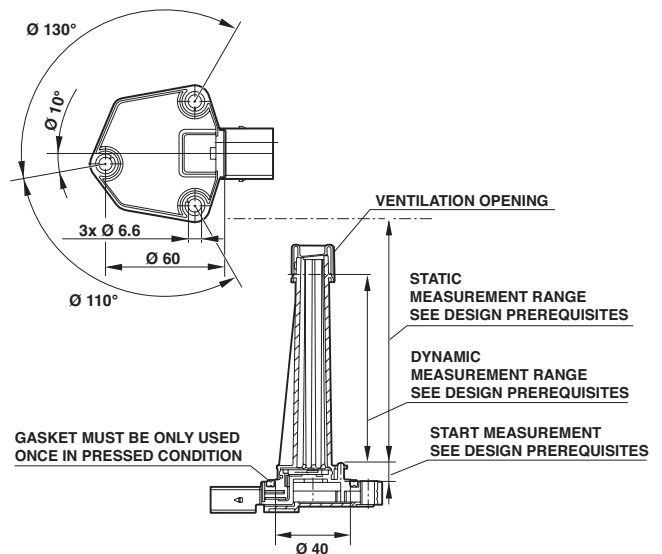
<sup>1)</sup> In the temperature range of 0 °C to 150 °C accuracy at ≤ 100 mm and 30 °C to 120 °C

<sup>2)</sup> In the temperature range of 30 °C to 150 °C

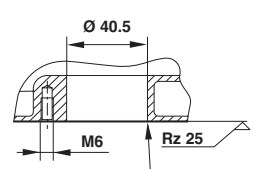
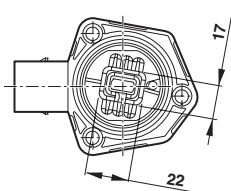
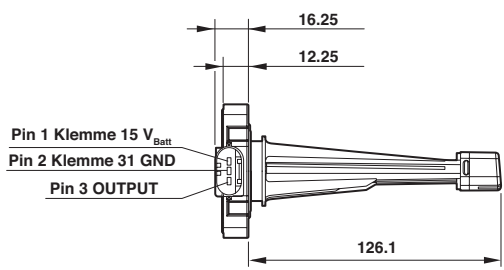
<sup>3)</sup> ± 3K in the temperature range - 40 °C to 60 °C and 120 °C to 160 °C

<sup>4)</sup> This accessory is not part of the scope of supply. To be purchased from Kostal.

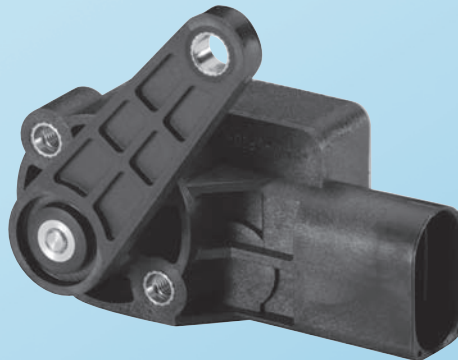
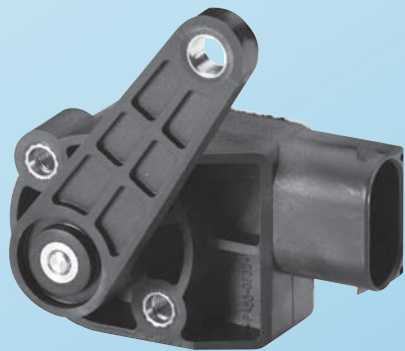
## Technical drawing







SEALING AREA FREE OFF BURR  
 MAX. ACCEPTED CIRC. RADII R0.3mm  
 OPTIONALLY CHAMFER CIRC. 0.3 mm X 45°



## Sensors

Angular position sensors

Single and double sensors

### Product features

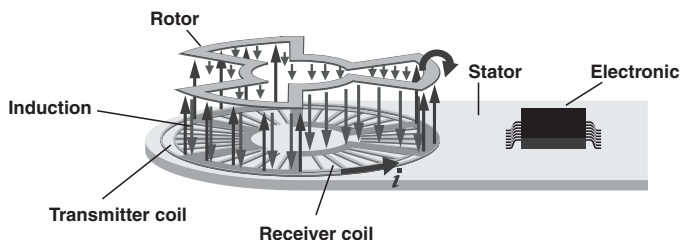
- Single or redundant sensors
- High precision due to internal 14 bit resolution
- High thermal stability and linearity
- High insensitiveness to magnetic fields
- Zero position programmable individually

### Function

Inside the laser-welded polyamide housing (PA66), the rotary motion of the lever arm is transferred to the rotor and measured by induction. An ASIC (Application Specific Integrated Circuit) accurately computes the rotor position. Due to a repeating characteristic curve of the output signal (which depends on the structure of the sensor used), various mounting positions are possible and the flexibility of sensor application is thus enhanced.

### Application

The CIPOS®-type angular position sensors (Contactless Inductive Position Sensor) are designed for many different applications to measure angles accurately and reliably even in tough environments. Their insensitiveness to magnetic fields and high temperature stability in particular are the characteristic qualities of the CIPOS® technology used in all angular position sensors. Angle measurement takes place inductively using a contactless and thus wear-resistant method. This guarantees high measuring accuracy throughout the entire life of the sensor. The redundant sensors in particular (double sensors) enable failure detection, thus improving the safety of the overall system.



### Table of variants

Angle range	Supply voltage	Output signal	Resolution	Linearity error including temperature drift
Single sensors				
- 30° to + 30°	5 V	ratiometric (10% to 90%) and PWM	0.12°	± 0.6°
- 30° to + 30°	9 V to 32 V	0.5 V to 4.5 V	0.06°	± 0.3°
- 51° to + 51°	5 V	ratiometric (10% to 90%) and PWM	0.12°	± 0.6°
- 54° to + 54°	9 V to 32 V	0.5 V to 4.5 V	0.06°	± 0.3°
Double sensors				
- 30° to + 30°	5 V or 9 V to 32 V	ratiometric (10% to 90%) at 5V supply 0.5 V to 4.5 V at 9 V to 32 V supply	0.06°	± 0.3°
- 54° to + 54°	5 V or 9 V to 32 V	ratiometric (10% to 90%) at 5V supply 0.5 V to 4.5 V at 9 V to 32 V supply	0.06°	± 0.3°

Other sensor variants with PWM or current output available upon request.

Redundant sensors normally output a „synchronized“ signal but are also available as „crossed“, „half-scale“ and „shifted offset“ signal variants.

### Current output

The angle measured is shown as a current between 4 mA and 20 mA available on request.

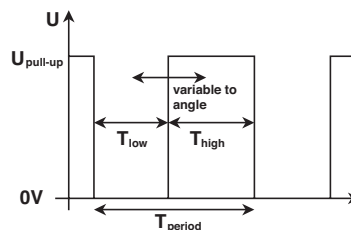
### Analog output

With 5 VDC being supplied, the angle measured is shown as the ratio of the output voltage ( $U_{out}$ ) and operating voltage ( $U_s$ ) (ratio-metric to power supply). This signal is output by a high-side driver (HSD).

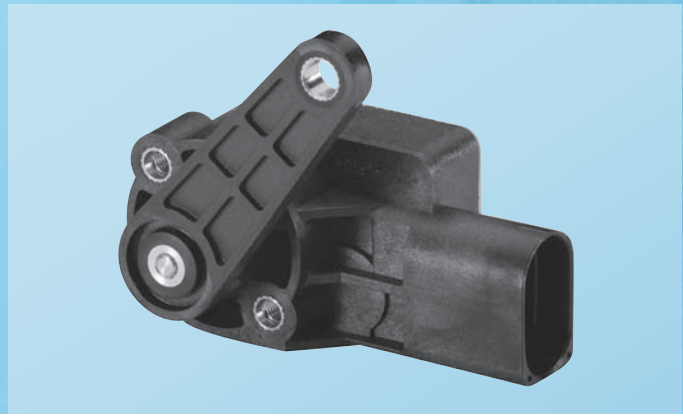
At a supply voltage between 9 V and 32 V (multi-voltage) the angle measured is shown as a voltage between 0.5 V and 4.5 V.

### PWM output (digital)

When the PWM signal is used, the actual position of the angular position sensor is equivalent to the ratio of the PWM signal Low time ( $T_{low}$ ) and the period ( $T_{period}$ ). The absolute duration of the High or Low signal level is not indicative of the angle. The PWM signal is output by a low-side driver (LSD). You can of course also choose to look at the ratio between High time ( $T_{high}$ ) and period ( $T_{period}$ ) which will invert the characteristic with reference to the analogue signal.



Type of housing	Origin position	Lever	Part number	Catalogue page
A	0° / 120° / 240°	50 mm	6PM 008 161-241	44
B	0° / 120° / 240°	50 mm	6PD 009 583-101	45
A	0° / 120° / 240°	50 mm	6PM 008 161-251	46
B	0° / 120° / 240°	50 mm	6PD 009 583-111	47
B	0° / 120° / 240°	50 mm	6PD 009 583-001	48
B	0° / 120° / 240°	50 mm	6PD 009 583-011	50

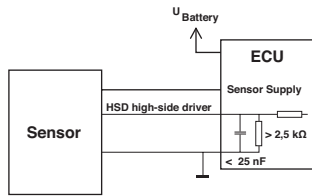


# Sensors

Angular position sensors  
Single and double sensors

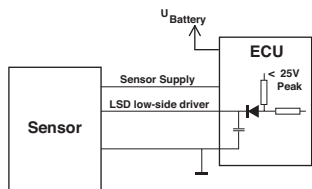
## Wiring of ratiometric (10 % to 90 %) or fixed-voltage output (0.5 V to 4.5 V)

This variant requires an external pull-down resistor. If 5 V are supplied the resistor should be rated at 2.7 k to 10 k, for example. The output current of the analogue output should not exceed 2 mA. Since the high-side driver (HSD) is used as the analogue output, the output voltage is relative to the supply voltage.

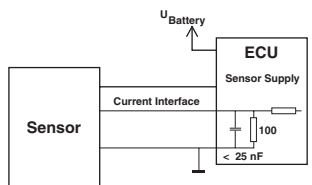


## Wiring of PWM output and low-side driver (LSD)

Since an LSD is used as the PWM output, the maximum current through the pull-up resistor is set by the external ECU. To keep the output current at the lowest possible minimum, Hella recommends using 10 kΩ. The pull-up resistor also limits the current output by the sensor which should not exceed 5 mA. Voltage and transients at the pull-up resistor must not exceed 25 V.



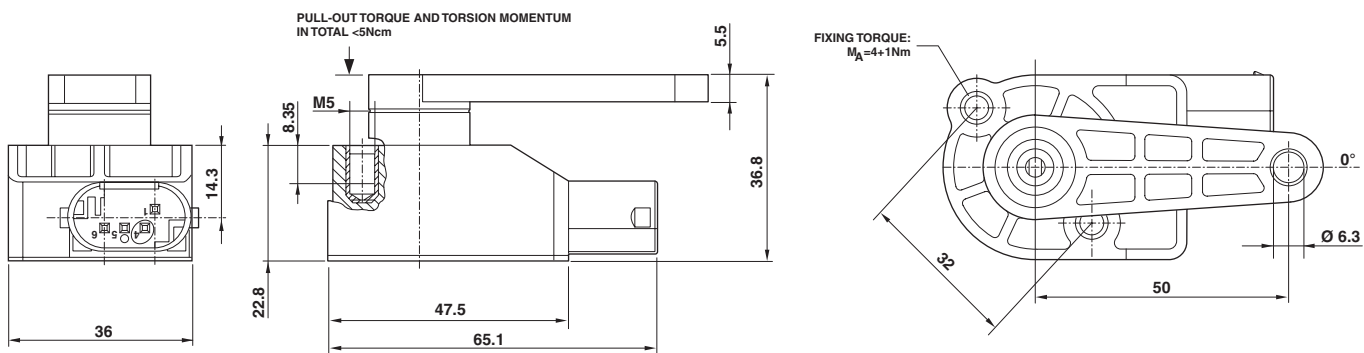
## Wiring of current output



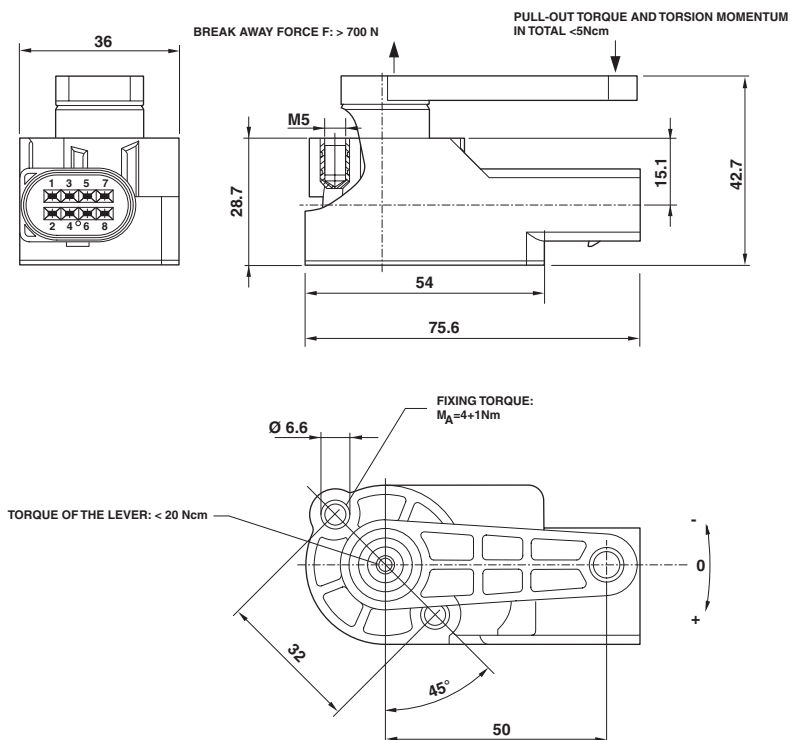
## Environmental test

Humidity /heat	DIN EN 60068-2-38, -Z/AD TO = +65 °C ± 2 °C, T <sub>U</sub> = -10 °C ± 2 °C Frel = 93% ± 3%, no. of cycles: 10
Salt spray	IEC 60068-2-11 Ka, test period: 168 h
Vibration resistance	Broadband noise with reference to ISO 16750-3, section 4.1.3.2.3, DIN EN 60068-2-64, incl. temperature cycle DIN EN 60068-2-14 Nb, test period per axis: 8 h, T <sub>min</sub> = -40 °C, T <sub>max</sub> = +85 °C
Resistance to shock	ISO 16750-3, section 4.2.2, DIN EN 60068-2-29, test method: semi-sine Acceleration 500 m/s <sup>2</sup> , duration 6 ms Number of shocks: 10 in every direction
Conducted electromagnetic interference	in accordance with IEC-CISPR 25, Class 5
Radiated electromagnetic interference	in accordance with IEC-CISPR 25, Class 5
Other EMC tests	ISO 7637-2, 3 / ISO 11452-2,-5 / ISO TR 10605
IP protective rating DIN 40050, Part 9	IP6K5 and IP6K9K
Salt spray to IEC 60068-2-11 Ka, duration:	168 h
Resistance to high voltage	ISO 16750-2, section 4.2 (if applicable)
Short-circuit resistance	ISO 16750-2, section 4.8.2 (if applicable)
Insulation resistance	With reference to ISO 16750-2, section 4.10 T <sub>amb</sub> = 35 °C ± 5 °C, F <sub>rel</sub> = 50% ± 5% U = 500 V DC, duration = 60 s ± 6 s
Dielectric strength	With reference to ISO 16750-2, section 4.9 T <sub>amb</sub> = 35 °C ± 5 °C, F <sub>rel</sub> = 50% ± 5% U = 500 V <sub>eff</sub> , AC, f = 50 Hz to 60 Hz Duration 60 s

### Technical drawing of housing type A



### Technical drawing of housing type B





# Sensors

Angular position sensors

Single sensors

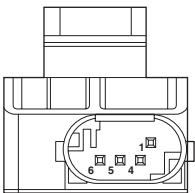
Part number 6PM 008 161-241

Technical data	
Angle range	- 30° to + 30°
Mechanical angel range	unlimited (full 360° circle)
Supply voltage	U <sub>s</sub> 5 V ± 10 %
Output signal 1	0,5 V to 4,5 V ratiometric
Output signal 2	PWM
Resolution	0.12°
Linearity error incl. temperature drift	< ± 0.6°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Max. current (PWM output)	< 5 mA
PWM frequency	200 Hz
Type of housing	A
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K5, IP6K9K
Operating temperature	- 40 °C to +125 °C
Service life	5 million cycles
Inverse polarity protection	no, mechanical protection only
Counterplug <sup>1)</sup>	AMP 1-967616-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

This special variant outputs two different signals, i.e. a voltage indicative of the angle measured (analogue) and a PWM signal (pulse width modulated digital signal), ensuring the universal applicability of this angular position sensor.

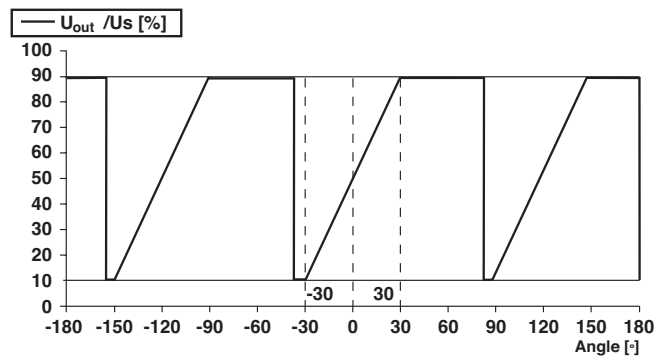
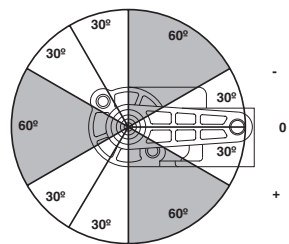
### Pin assignment of housing type A

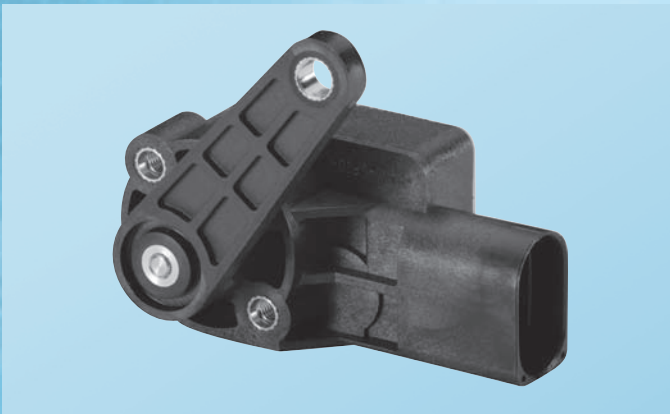


- Pin 1: ground
- Pin 4: output signal 0.5 V to 4.5 V ratiometric
- Pin 5: 5 V DC supply
- Pin 6: PWM output

### Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 60°. If this is exceeded by up to 82,5° in the positive turn direction or 7,5° in the negative turn direction, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.





# Sensors

Angular position sensors

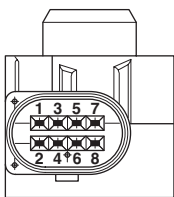
Single sensors

**Part number 6PD 009 583-101**

Technical data	
Angle range	- 30° to + 30°
Mechanical angle range	unlimited (full 360° circle)
Supply voltage	9 V to 32 V
Output signal	0.5 V to 4.5 V
Resolution	0.06°
Linearity error incl. temperature drift	< ± 0.3°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Type of housing	B
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K5, IP6K9K
Operating temperature	- 40 °C to + 85 °C
Service life	5 million cycles
Inverse polarity protection	yes
Counterplug <sup>1)</sup>	AMP 1-394416-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

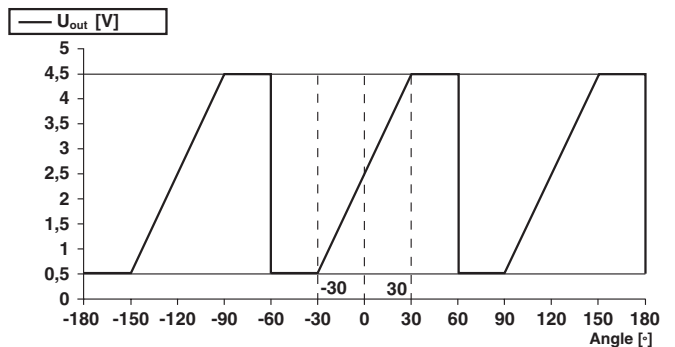
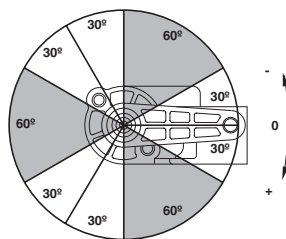
## Pin assignment of housing type B



- Pin 1: not used
- Pin 2: output signal 0.5 V to 4.5 V
- Pin 3: supply 9 V to 32 V
- Pin 4: not used
- Pin 5: not used
- Pin 6: not used
- Pin 7: not used
- Pin 8: ground

## Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 60°. If this is exceeded by up to 30°, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.





# Sensors

Angular position sensors

Single sensors

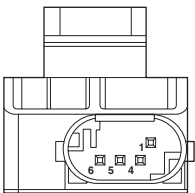
Part number 6PM 008 161-251

Technical data	
Angle range	- 51° to + 51°
Mechanical angle range	unlimited (full 360° circle)
Supply voltage	5 V ± 10 %
Output signal 1	0.5 V to 4.5 V ratiometric
Output signal 2	PWM
Resolution	0.12°
Linearity error incl. temperature drift	± 0.6°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Max. current (PWM output)	< 5 mA
PWM frequency	200 Hz
Type of housing	A
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K5, IP6K9K
Operating temperature	- 40 °C to + 125 °C
Service life	5 million cycles
Inverse polarity protection	no, mechanical protection only
Counterplug <sup>1)</sup>	AMP 1-967616-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

This special variant outputs two different signals, i.e. a voltage indicative of the angle measured (analogue) and a PWM signal (pulse width modulated digital signal), ensuring the universal applicability of this angular position sensor.

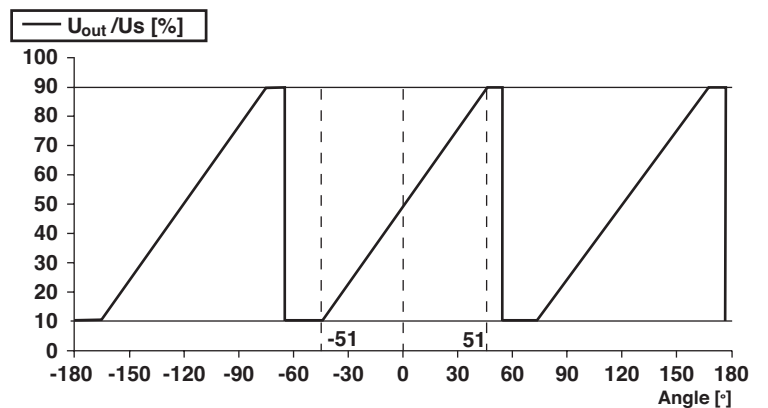
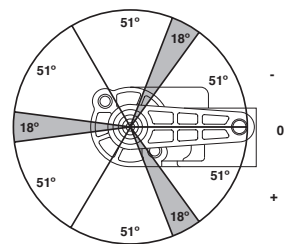
## Pin assignment of housing type A



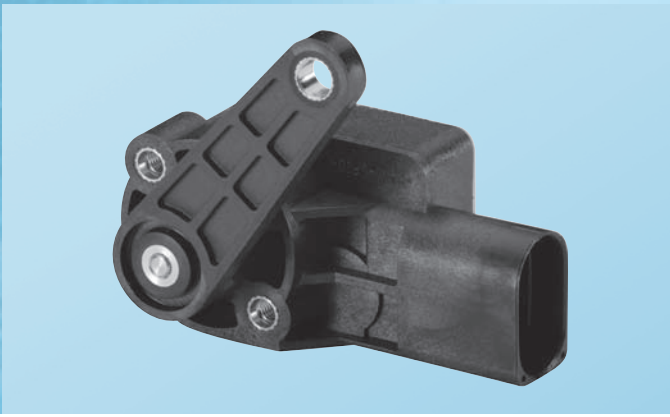
- Pin 1: ground
- Pin 4: output signal 0.5 V to 4.5 V ratiometric
- Pin 5: 5 V DC supply
- Pin 6: PWM output

## Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 102°. If this is exceeded by up to 5,25° in the positive turn direction or 12,75° in the negative turn direction, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.







# Sensors

Angular position sensors

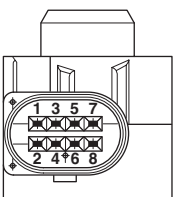
Single sensors

Part number **6PD 009 583-111**

Technical data	
Angle range	- 54° to + 54°
Mechanical angle range	unlimited (full 360° circle)
Supply voltage	9 V to 32 V
Output signal	0.5 V to 4.5 V
Resolution	0.06°
Linearity error incl. temperature drift	± 0.3°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Type of housing	B
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K5, IP6K9K
Operating temperature	- 40 °C to + 85 °C
Service life	5 million cycles
Inverse polarity protection	yes
Counterplug <sup>1)</sup>	AMP 1394416-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

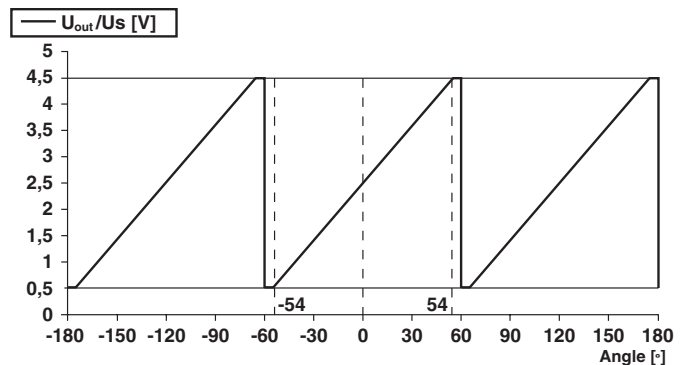
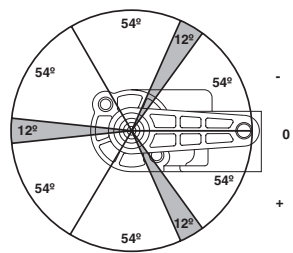
## Pin assignment of housing type B

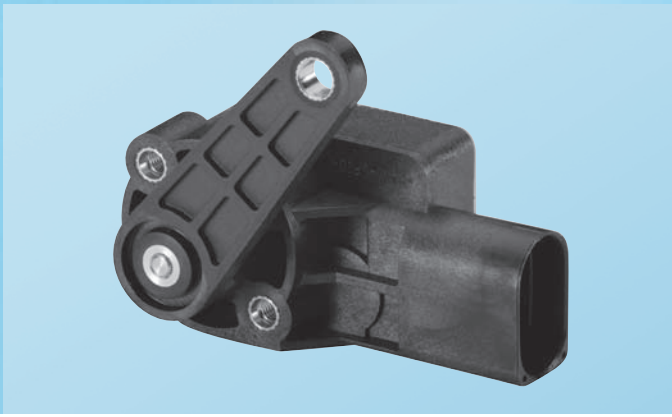


- Pin 1: not used
- Pin 2: output signal 0.5 V to 4.5 V
- Pin 3: supply 9 V to 32 V
- Pin 4: not used
- Pin 5: not used
- Pin 6: not used
- Pin 7: not used
- Pin 8: ground

## Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 108°. If this is exceeded by up to 6°, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.





## Sensors

Angular position sensors

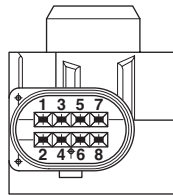
Double sensors

Part number **6PD 009 583-001**

Technical data	
Angle range	- 30° to + 30°
Mechanical angle range	unlimited (full 360° circle)
Supply voltage	5 V ± 10 % or 9 V to 32 V
Output signal "Crossed Scale"	
Voltage supply	$U_s = 5\text{ V}$ Output $U_{out1}$ 0.5 V to 4.5 V ratiometric Output $U_{out2}$ 4.5 V to 0.5 V ratiometric
Voltage supply	$U_s = 9\text{ V to }32\text{ V}$ Output $U_{out1}$ 0.5 V to 4.5 V Output $U_{out2}$ 4.5 V to 0.5 V
Resolution	0.06°
Linearity error incl. temperature drift	± 0.3°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Type of housing	B
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K9K
Operating temperature	- 40 °C to + 85 °C
Service life	5 million cycles
Inverse polarity protection	no, mechanical protection only
Counterplug <sup>1)</sup>	AMP 1394416-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

### Pin assignment of double sensor in housing type B



#### Voltage supply at 5 V DC<sup>2)</sup>

- Pin 1: 5 V DC sensor 2
- Pin 2: Output  $U_{out1}$  0.5 V to 4.5 V ratiometric
- Pin 3: not used
- Pin 4: 5 V DC sensor 1
- Pin 5: Output  $U_{out2}$  4.5 V to 0.5 V ratiometric
- Pin 6: not used
- Pin 7: Sensor 2 ground
- Pin 8: Sensor 1 ground

<sup>2)</sup> To reduce the number of wires, the power supply lines (Pin 1 and Pin 4) and the ground supply lines (Pin 7 and Pin 8) can be bridged externally (e.g. in the counterplug).

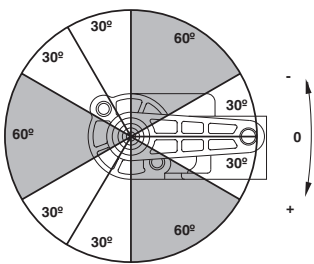
#### Voltage supply at 9 V to 32 V DC<sup>3)</sup>

- Pin 1: bridge to pin 4 (external)
- Pin 2: Output  $U_{out1}$  0.5 V to 4.5 V
- Pin 3: 9 V DC to 32 V DC sensors 1 & 2
- Pin 4: bridge to pin 1 (external)
- Pin 5: Output  $U_{out2}$  4.5 V to 0.5 V
- Pin 6: not used
- Pin 7: Sensor 2 ground
- Pin 8: Sensor 1 ground

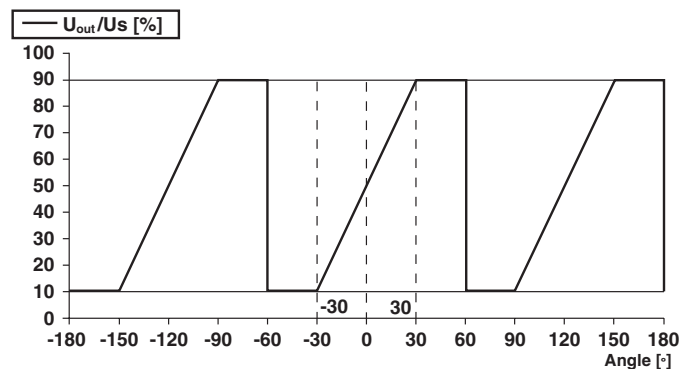
<sup>3)</sup> Pin 1 and Pin 4 have to be bridged externally (e.g. in mating connector).  
To reduce the number of wires, the ground supply lines (Pin 7 and Pin 8) can be bridged externally (e.g. in the counterplug).

### Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 60°. If this is exceeded by up to 30°, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.

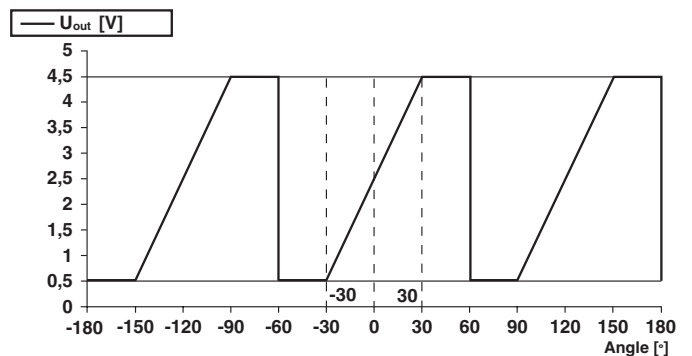


### Output signal $U_{out1}$ with voltage supply 5 V

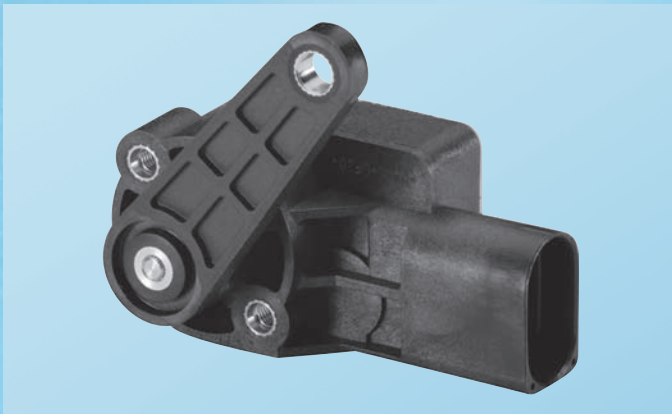


Output signal  $U_{out2} = 100\% - U_{out1}/U_s$  [%] (opposite curve)

### Output signal $U_{out1}$ with voltage supply 9 V to 32 V



Output signal  $U_{out2} = 5 V - U_{out1}$  [V] (opposite curve)



## Sensors

Angular position sensors

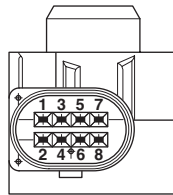
Double sensors (redundant measuring of angles in applications critical to safety)

Part number **6PD 009 583-011**

Technical data	
Angle range	- 54° to + 54°
Mechanical angle range	unlimited (full 360° circle)
Supply voltage	5 V ± 10 % or 9 V to 32 V
Output signal "Crossed Scale"	
Voltage supply	$U_S = 5\text{ V}$ Output $U_{out1}$ 0.5 V to 4.5 V ratiometric Output $U_{out2}$ 4.5 V to 0.5 V ratiometric
Voltage supply	$U_S = 9\text{ V to }32\text{ V}$ Output $U_{out1}$ 0.5 V to 4.5 V Output $U_{out2}$ 4.5 V to 0.5 V
Resolution	0.06°
Linearity error incl. temperature drift	± 0.3°
Power consumption	< 15 mA
Max. current (analogue output)	< 2 mA
Type of housing	B
Zero position	0° / 120° / 240°
Lever arm	50 mm
Protective rating	IP6K9K
Operating temperature	- 40 °C to + 85 °C
Service life	5 million cycles
Inverse polarity protection	no, mechanical protection only
Counterplug <sup>1)</sup>	AMP 1394416-1
Pin coating	Sn

<sup>1)</sup> This accessory is not included.  
Please purchase at Tyco Electronics.

### Pin assignment of double sensor in housing type B



#### Voltage supply at 5 V DC<sup>2)</sup>

- Pin 1: 5 V DC sensor 2
- Pin 2: Output  $U_{out1}$  0.5 V to 4.5 V ratiometric
- Pin 3: not used
- Pin 4: 5 V DC sensor 1
- Pin 5: Output  $U_{out2}$  4.5 V to 0.5 V ratiometric
- Pin 6: not used
- Pin 7: Sensor 2 ground
- Pin 8: Sensor 1 ground

<sup>2)</sup> To reduce the number of wires, the power supply lines (Pin 1 and Pin 4) and the ground supply lines (Pin 7 and Pin 8) can be bridged externally (e.g. in the counterplug).

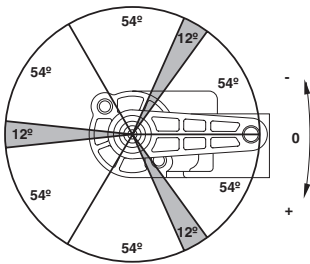
#### Voltage supply at 9 V to 32 V DC<sup>3)</sup>

- Pin 1: bridge to pin 4 (external)
- Pin 2: Output  $U_{out1}$  0.5 V to 4.5 V
- Pin 3: 9 V DC to 32 V DC to sensor 1 & 2
- Pin 4: bridge to pin 1 (external)
- Pin 5: Output  $U_{out2}$  4.5 V to 0.5 V
- Pin 6: not used
- Pin 7: sensor 2 ground
- Pin 8: sensor 1 ground

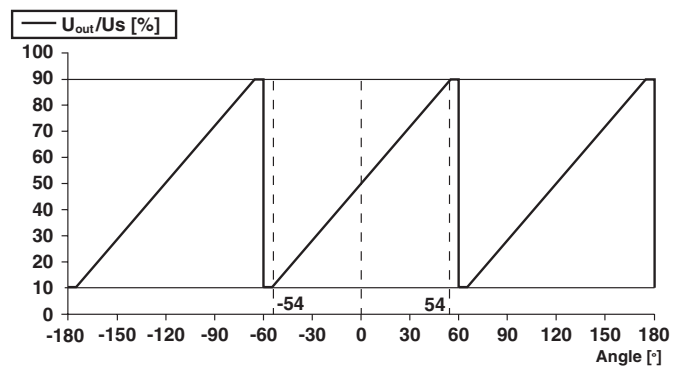
<sup>3)</sup> Pin 1 and Pin 4 have to be bridged externally (e.g. in mating connector).  
To reduce the number of wires, the ground supply lines (Pin 7 and Pin 8) can be bridged externally (e.g. in the counterplug).

### Characteristic of the angular position sensor

The characteristic of the angular position sensor repeats every 120°. Sensor installation is therefore not limited to the mounting position shown but free to move to any offset angle that is an integer multiple of 120°. This will not affect the behaviour of the connected system in any way. The measuring angle range is 108°. If this is exceeded by up to 6°, the output signal remains at the limit of the measuring range. If it is exceeded by more than that, the next section of the characteristic will apply. The resulting measuring ranges and zero positions are shown in the graph. The segments of the circle shown in grey represent the angles that cannot be measured.

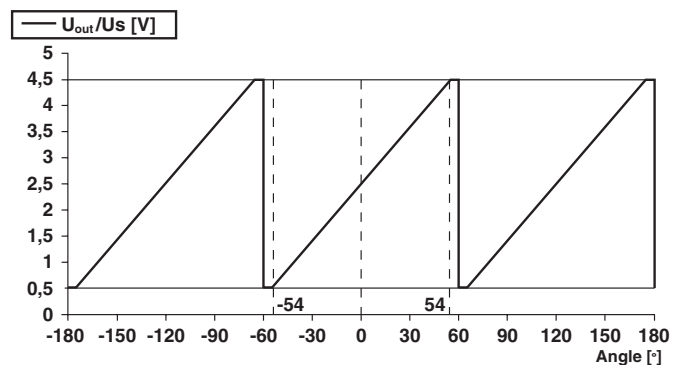


### Output signal $U_{out1}$ with voltage supply 5 V



Output signal  $U_{out2} = 100\% - U_{out1}/U_s$  [%] (opposite curve)

### Output signal $U_{out1}$ with voltage supply 9 V to 32 V



Output signal  $U_{out2} = 5\text{ V} - U_{out1}$  [V] (opposite curve)



## **Pedal sensors**

### *Floor mounted pedals*

#### **Product features**

- Contactless measuring principle
- Slim and sturdy design
- Straightforward mechanical connection
- Redundant output signal
- High measuring accuracy, which means no learning process is necessary at vehicle production line
- High interference immunity against electrical and magnetic fields

#### **Structure and function**

Housing and pedal plate are constructed completely of recyclable, glass fibre reinforced plastic. The sensor is completely waterproof, being enclosed in a housing which is within the overall dimensions of the device. The actuation force is generated by two springs, each of which makes safe resetting possible.

The electrical output signal is procured by means of the CIPOS® measuring principle. For this purpose, a sheet metal cursor is routed from the pedal plate with a deflection rod via sensor conductive paths on the measuring board. Two output signals are generated with two galvanic superated sensors.

#### **Application**

The pedal for floor mounted installation is suitable for driver cabins in agricultural and construction machinery. Thanks to the wear-free measuring principle of the CIPOS sensors developed in-house at Hella (see structure and functional description of the angular rotation sensors) and the extremely low mechanical wear, this type is especially to be preferred to contact-type pedals wherever frequent small movements are involved.



### Summary of variants

Pedal material	Part number	Technical data on page
Plastic	6PV 312 010-001	54



## Pedal sensors

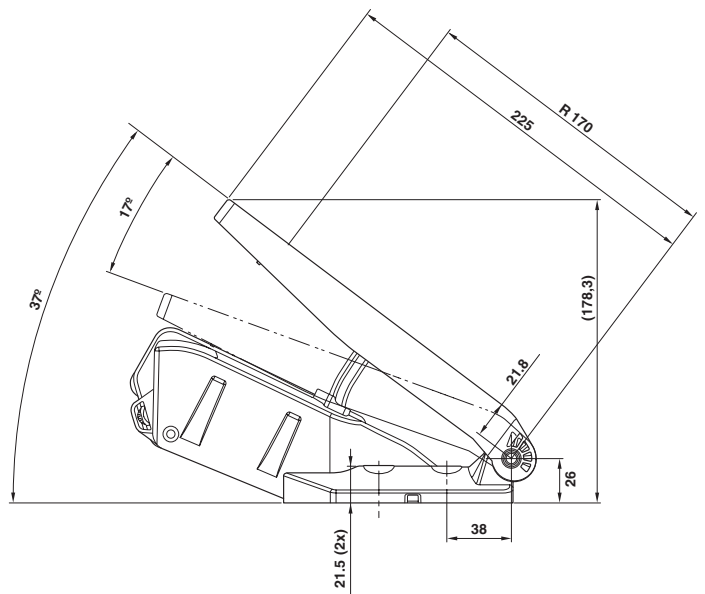
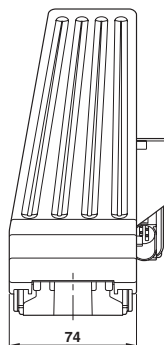
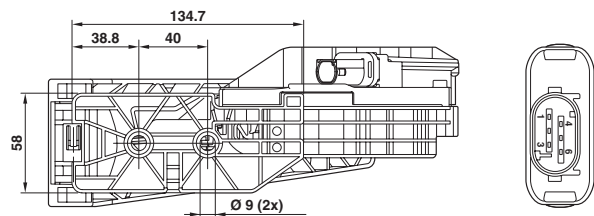
Floor mounted pedals

Part number 6PV 312 010-001

Technical data	
Operating voltage	5 V ± 6 %
Current consumption per channel	max. 10 mA
Excess voltage resistance, duration $t \rightarrow \infty$	16 V
Initial force	17 N
Final force	33 N
Actuation angle	17°
Resolution	0.04°
Output signal	2 x analogue ratiometric, 2nd channel half scale
Linearity	≤ 1.5 %
Synchronisation	≤ 3 %
No-load voltage	15 % / 7,5 %
Full load voltage	80 % / 40 %
Load resistance	typ. 5 kΩ to 100 kΩ
Load capacity	max. 100 nF
Filter constant in the control unit	1 ms ± 5 %
Signal output current	max. 1 mA
Operating temperature	- 40 °C to + 85 °C
Storage temperature	- 40 °C to + 105 °C
Protective rating (electronic)	IP6K9K
Housing material	PP; GF 30 to GF 40
Counterplug <sup>1)</sup>	AMP 1-967616-1
Weight	≤ 400 g
Vibration resistance	4.4 g
Actuations	min. 3.5 million
EMC	CISPR 25, Class 5; electrical and magnetic fields
ESD	4 kV, 8 kV, 15 kV

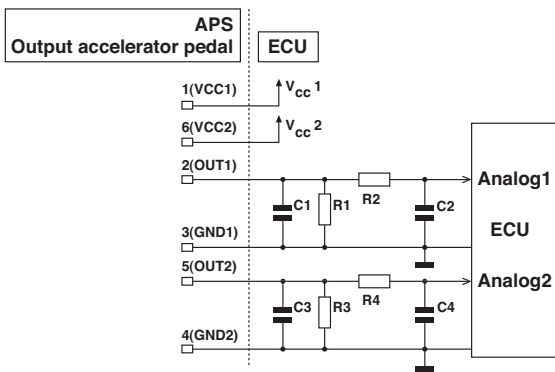
<sup>1)</sup> This accessory is not part of the scope of supply.  
To be purchased from Tyco Electronics  
Gold-plated contacts and the individual wire seal are required.

### Technical drawing





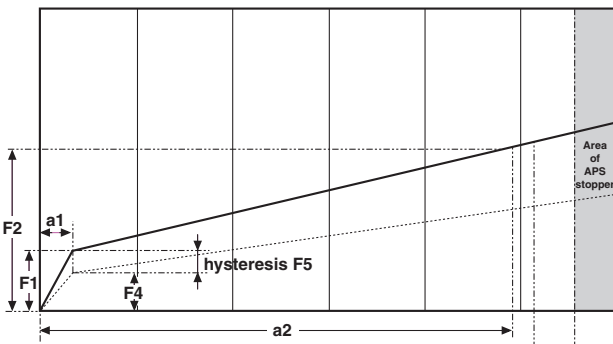
### Recommended circuit in the control unit



### Pin assignment

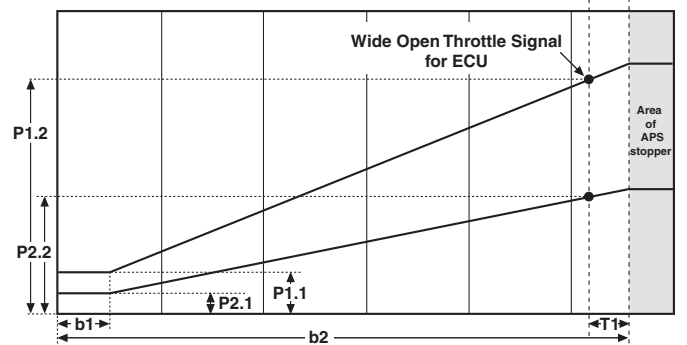
- Pin 1: 5 V supply: sensor 1
- Pin 2: Analogue signal: sensor 1
- Pin 3: Ground: sensor 1
- Pin 4: Ground: sensor 2
- Pin 5: Analogue signal: sensor 2
- Pin 6: 5 V supply: sensor 2

### Mechanical characteristic curve



		Rated values
R	/[mm]	170.0
F1	/[N]	17.0 ± 6.0
F2	/[N]	33.0 ± 8.0
F4	/[N]	> 5.0
F5	/[N]	> 5.0
a1	/[degrees]	< 1.5
a2	/[degrees]	16.0

### Electrical characteristic curve



		Rated values
b2	/[grad]	17.5 ± 1.0
P1.1	/[%]	15.0 ± 1.0
P2.1	/[%]	7.5 ± 1.0
P1.max	/[%]	< 81.8
P2.max	/[%]	< 40.9
P1.2	/[%]	76.8
P2.2	/[%]	38.4
T1	/[degrees]	< 2.0
b1	/[degrees]	< 1.5



## **Pedal sensors**

### *Suspended pedals*

#### **Product features**

- Contactless measuring principle
- Slim and sturdy design
- Straightforward mechanical connection
- Redundant output signal
- High measuring accuracy, which means no learning process is necessary at the vehicle production line
- High interference immunity against electrical and magnetic fields

#### **Structure and function**

Housing and actuation lever are constructed completely of recyclable, glass fibre reinforced plastic. The sensor is completely waterproof, being enclosed in a housing which is within the overall dimensions of the device. The actuation force is generated by two springs, each of which makes safe resetting possible. The electrical output signal is procured by means of the CIPOS® measuring principle. For this purpose, a sheet metal cursor is routed from the pedal arm via sensor conductive patterns of the measuring board. Two output signals are generated with two galvanic superated sensors. In addition, individual characteristic curves can be programmed on request.

#### **Application**

The pedal for pendant installation is suitable for driver cabins in agricultural and construction machinery. Thanks to the wear-free measuring principle of the CIPOS® sensors developed in-house at Hella (see structure and functional description of the angular rotation sensors) and the extremely low mechanical wear, this type is especially to be preferred to contact-type pedals wherever frequent small movements are involved.



### Summary of variants

Pedal material	Part number	Technical data on page
Plastic	6PV 009 591-011	58



# Pedal sensors

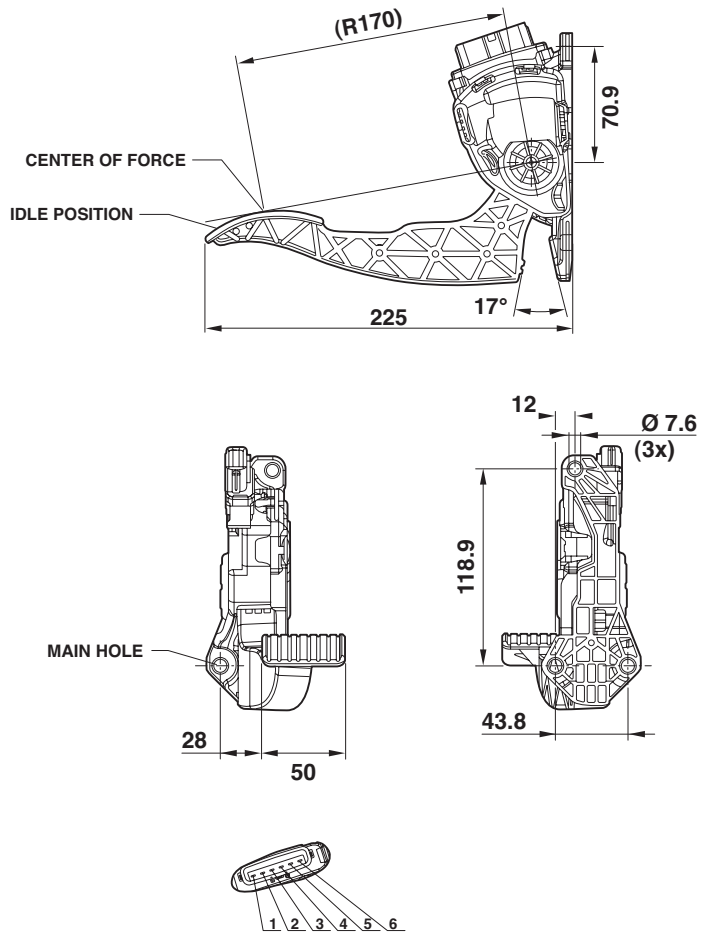
Suspended pedals

Part number 6PV 009 591-011

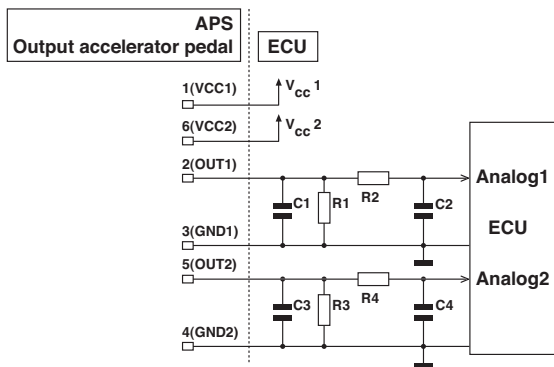
Technical data	
Operating voltage	5 V ± 6 %
Current consumption per channel	max. 10 mA
Excess voltage resistance, duration t → ∞	16 V
Initial force	24 N
Final force	42 N
Actuation angle	17°
Resolution	0.04°
Output signal	2 x analogue ratiometric, 2nd channel half scale
Linearity	≤ 1,5 %
Synchronisation	≤ 3 %
Idling voltage 1	10 % / 5%
Full throttle voltage	90 % / 45 %
Load resistance	typ. 5 kΩ to 100 kΩ
Load capacity	max. 100 nF
Filter constant in the control unit	1 ms ± 5 %
Signal output current	max. 1 mA
Operating temperature	- 40 °C to + 85 °C
Storage temperature	- 40 °C to + 105 °C
Protective rating (electronic)	IP6K9K
Housing material	PP; GF 30 to GF 50
Counterplug <sup>1)</sup>	Yazaki 7283-1968-30
Weight	≤ 400 g
Vibration resistance	4.4 g
Actuations	min. 3.5 million
EMC	CISPR 25, Class 5; electrical and magnetic fields
ESD	4 kV, 8 kV, 15 kV

1) This accessory is not part of the scope of supply.  
To be purchased from Yazaki.  
Gold-plated contacts and the individual wire seal are required.

## Technical drawing



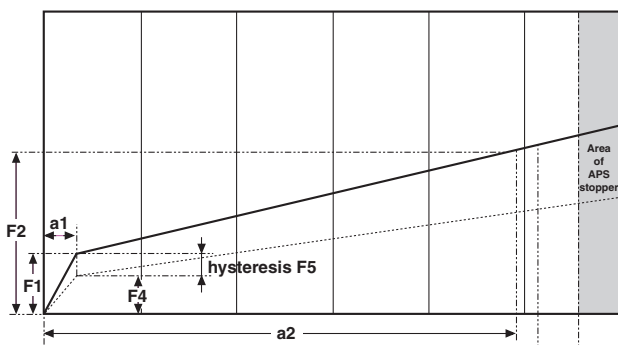
### Recommended circuit in the control unit



### Pin assignment

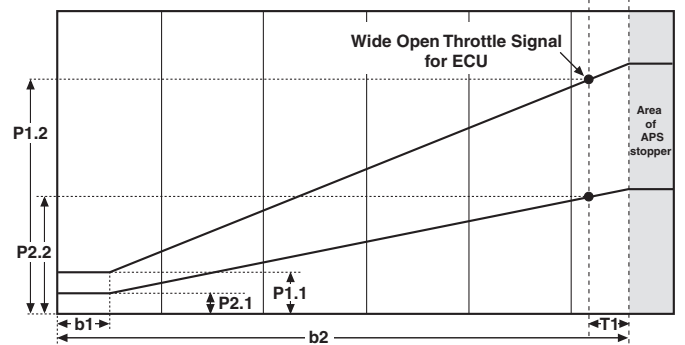
- Pin 1: 5 V supply: sensor 1
- Pin 2: Analogue signal: sensor 1
- Pin 3: Ground: sensor 1
- Pin 4: Ground: sensor 2
- Pin 5: Analogue signal: sensor 2
- Pin 6: 5 V supply: sensor 2

### Mechanical characteristic curve



		Rated values
R	/[mm]	170.0
F1	/[N]	24.0 ± 6.0
F2	/[N]	42.0 ± 8.0
F4	/[N]	> 5.0
F5	/[N]	> 4.0
a1	/[degrees]	< 1.2
a2	/[degrees]	15.5

### Electrical characteristic curve



		Rated values
b2	/[grad]	17.0 ± 1.2
P1.1	/[%]	10.0 ± 1.0
P2.1	/[%]	5.0 ± 1.0
P1.max	/[%]	< 90.0
P2.max	/[%]	< 45.0
P1.2	/[%]	84.0
P2.2	/[%]	42.0
T1	/[degrees]	< 2.0
b1	/[degrees]	< 1.5



## Sensors

### Solar sensors

#### Measurement of light intensity and sun radiation

##### Product features

- Small design
- Straightforward mechanical connection
- Measurement of light intensity (ambient sensor) and sun radiation (solar sensor)
- Three separate analogue outputs for the measurement of ambient light (ambient light function) and sun radiation on the left and right-hand sides (dual solar sensor)
- Different functionalities can be represented depending on placement

##### Application

This sensor measures the light intensity and sun radiation. Through measuring the light intensity (ambient light function), the sensor makes the automatic switching on and off of all kinds of lighting possible, for example in

- Vehicles
- Buildings
- Interiors

according to the brightness of the environment.

In addition it is also possible to carry out regulation of vehicle or building air conditioning through the integrated solar sensors.

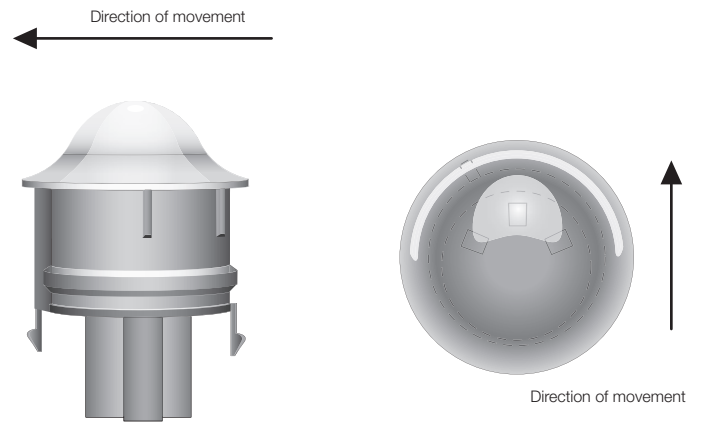
#### Summary of variants

Supply voltage	Measurement of light intensity [Lux]	Measurement of sun radiation [W/m <sup>2</sup> ]	Part number	Technical data on page
5V	yes	yes	6PT 009 373-021	62

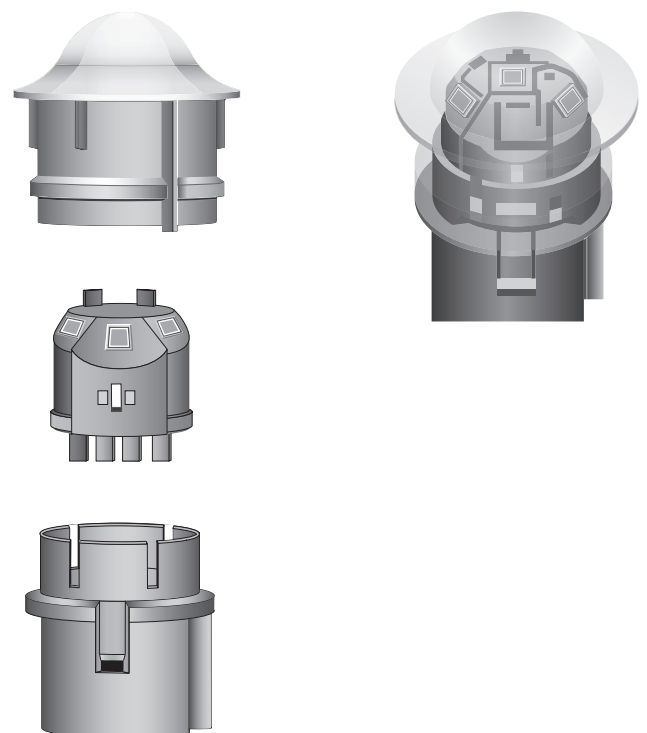
### Structure and function

The measurement of the sun radiation of the solar sensor elements is based on two separate integrated circuits (ASICs – Application Specific Integrated Circuit). In each case, there are two sensor elements in one sensor in order to determine the direction from which the sun is shining in the form of a 180 degree semi-circle. This characteristic makes it possible, for example, to realise separate climate regulation for driver and front seat passenger in vehicles, or to determine which solar collector is shone on by sunlight in the case of buildings. The sun radiation is recorded by means of a photosensitive element integrated on the ASIC. In addition, amplifier and current interface are also on the ASIC. The output signal of the photosensitive element of the dual solar sensor is proportional to the sun radiation [W/m<sup>2</sup>]. The function of controlling the lighting according to the environmental light intensity is realised by the ambient sensor. The ambient sensor element is positioned in the centre of the carrier and supplies a proportional output signal depending on the light intensity [Lux] through a modified ASIC.

### Sensor alignment



### Sensor structure





# Sensors

## Solar sensors

Measurement of light intensity and sun radiation

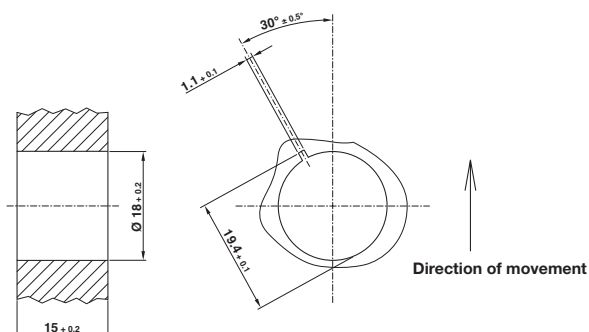
Part number 6PT 009 373-021

Technical data	
Rated voltage	5 V ± 0.1 V
Current consumption	max. 10 mA
Excess voltage resistance	< 16 V
Measurable sun radiation	0 to 700 W/m <sup>2</sup>
Detectable radiation spectrum	400 to 1050 nm
Measurable light intensity	0 to 3500 Lux
Detectable radiation spectrum	400 to 600 nm
Absolute measuring accuracy <sup>1)</sup>	± 3 %
Response time	≤ 10 ms
Output (analogue, pin 1, 2, 3)	0 to 2.5 mA
Signal output current (low)	10 mA
Load resistance	1.33 k
Operating temperature	- 40 °C to + 105 °C
Storage temperature	- 40 °C to + 105 °C
Vibration resistance	30.8 m/s <sup>2</sup>
Protection	IP 30
Lifetime	15 years
Cover cap material	PC Macrolon
Housing material	PBT GF30
Pin coating	CuSn 6
Counterplug <sup>1)</sup>	AMP 929170 coding C
Weight	4.14 g

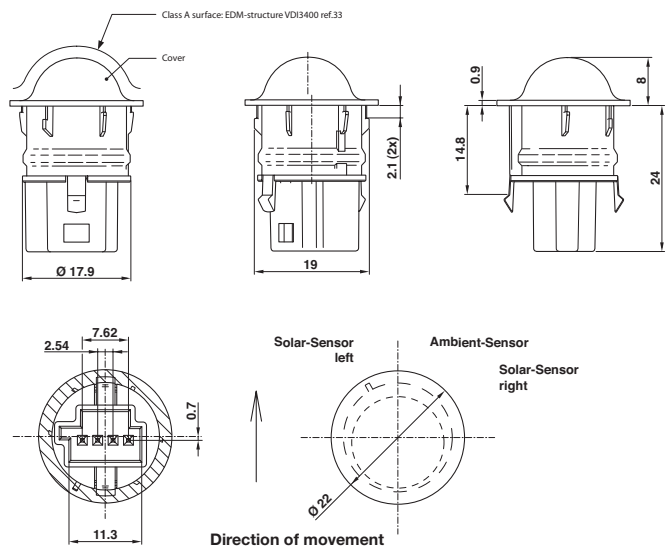
<sup>1)</sup> Tolerance specification of the sensor does not take the influence of windscreen or other windows into account

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

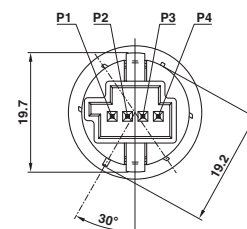
### Installation note



### Technical drawing



### Pin assignment



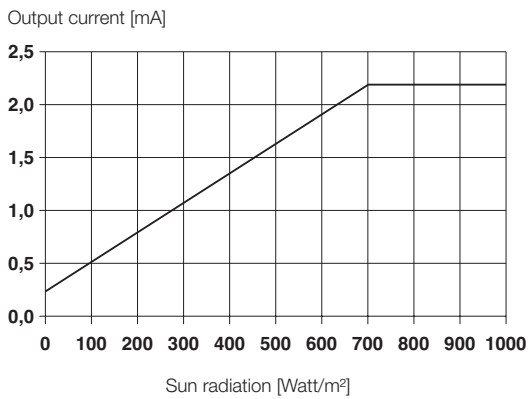
- Pin 1: Current supply and output of the ambient sensor
- Pin 2: Current supply and output of the left solar sensor
- Pin 3: Current supply and output of the right solar sensor
- Pin 4: Ground



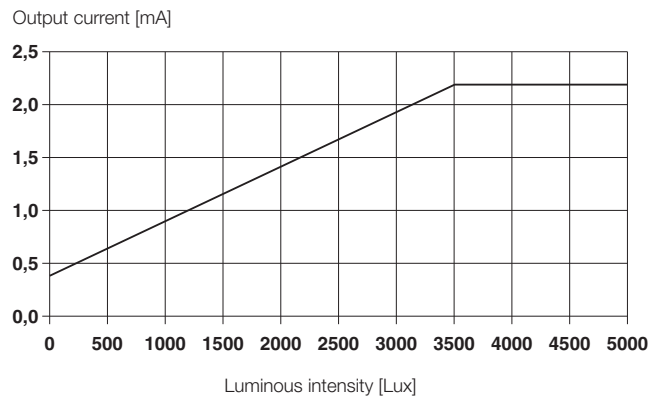


### Characteristic curves

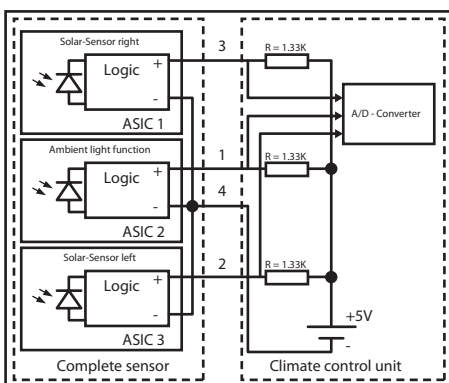
#### Measurement of sun radiation (solar function)

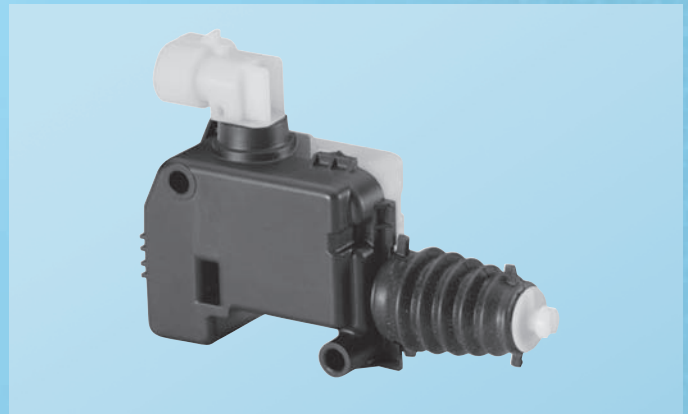
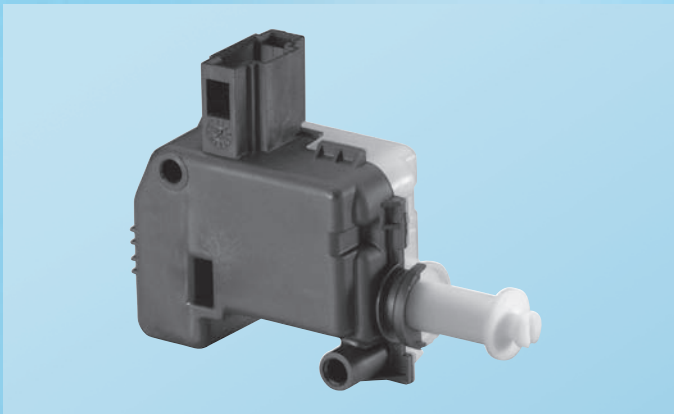


#### Measurement of light intensity (ambient light function)



### Circuit diagram – example of climate regulation in vehicles





# Actuators

*Electrical actuators*

*Electrical locking/unlocking & pull/push function (medium force)*

## Product features

- High actuating force
- Precise laser-welded housing
- Three basic functional variants
- Dust or waterproof
- With or without manual displacement
- Thermal overload protection through PTC (PolySwitch)
- For multi-purpose use

## Function

There is an electric motor in the two laser-welded Polyamide housing halves. When the electric motor supplies current through Pin 1 and Pin 2, the motor moves a spindle gear which makes the positioning mechanism retract or extend depending on the direction of rotation. Electrical supply with plus to Pin 1 and minus to Pin 2 makes the positioning mechanism extend.

Electrical supply with minus to Pin 1 and plus to Pin 2 makes the positioning mechanism retract. There is a PolySwitch (PTC) integrated in the motor as thermal overload protection. In addition, the actuators are equipped with a clockwork spring for mechanical reset (retraction or extension).

## Accessories

The comprehensive accessories for the electrical actuator comprise a wide range of different joining elements. These enable the actuator to be integrated into the application easily without additional development expenditure being necessary.

**An overview can be found on pages 78-81.**

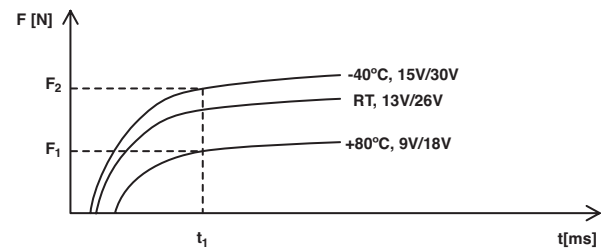
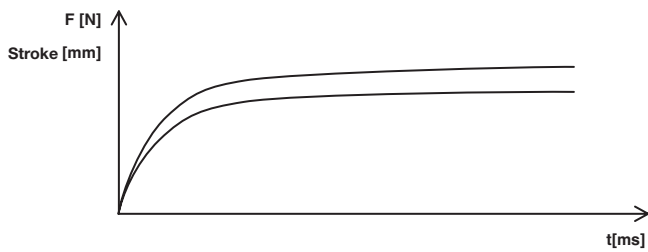
## Application

The motor-driven actuator is used for the electrical locking, unlocking or pull/push function of closing and flap systems in automotive and industrial fields.

Examples for applications in mechanisms include:

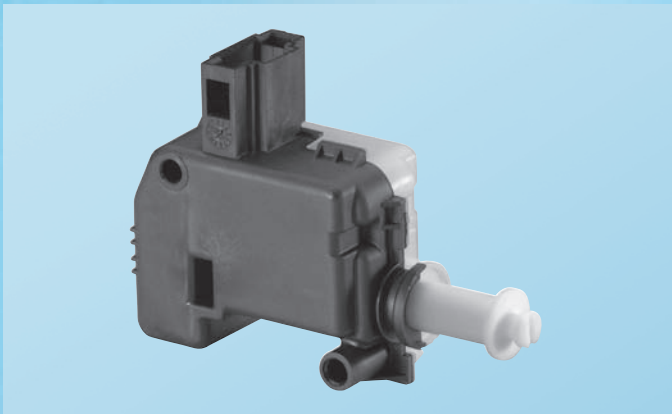
- Electrical locking and unlocking
- Electrical pull/push function
- Electrical opening and closing of flaps  
on all kinds of doors (locking systems), flaps, sunroofs, seats, covers etc..

### Dependencies of actuation force curves



### Summary of variants

Function	Voltage	Actuation force	Manual adjustment	Protection	Part number	Technical data on page
Electrical extension and return motion						
	12 V	30 N	yes	IP 5K0	6NW 009 203-401	66
	12 V	50 N	no	IP 5K0	6NW 009 203-411	67
	12 V	30 N	yes	IP 5K4	6NW 009 203-421	68
	12 V	50 N	no	IP 5K4	6NW 009 203-431	69
	24 V	30 N	yes	IP 5K4	6NW 009 203-441	70
	24 V	50 N	no	IP 5K4	6NW 009 203-451	71
Electrical return motion, extension with clockwork spring						
	12 V	50 N	no	IP 5K0	6NW 009 203-461	72
	12 V	50 N	no	IP 5K4	6NW 009 203-471	73
	24 V	50 N	no	IP 5K4	6NW 009 203-481	74
Electrical extension, return motion with clockwork spring						
	12 V	50 N	no	IP 5K0	6NW 009 203-491	75
	12 V	50 N	no	IP 5K4	6NW 009 203-501	76
	24 V	50 N	no	IP 5K4	6NW 009 203-511	77



## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

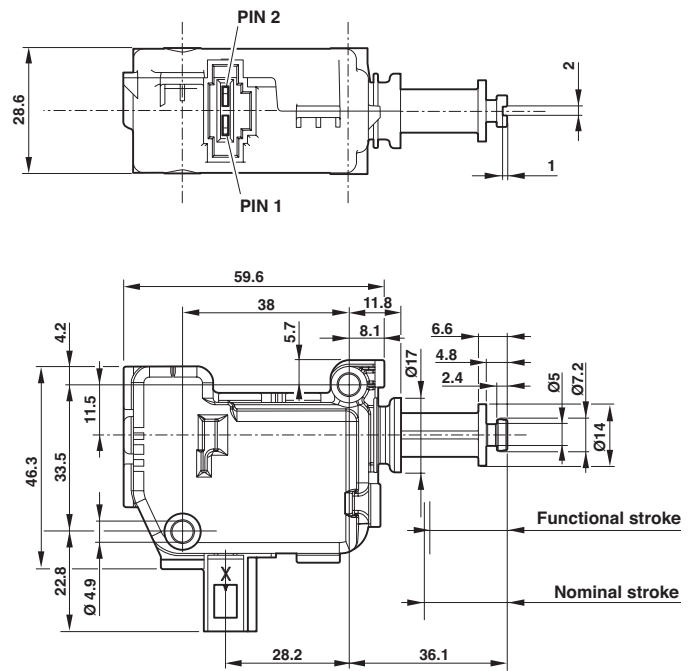
Part number 6NW 009 203-401

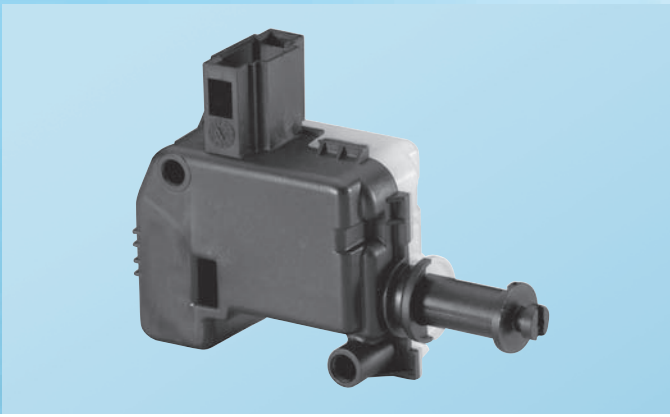
Technical data	
Position on supply	retracted
Clockwork spring resetting	none
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	5.5 A
Idling current	350 mA
Actuation force at the stroke (at 80 °C and 9 V)	30 N
Manual adjustment	≤ 15 N
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	100.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB µV
Functional stroke	≤ 18 mm
Protection	IP 5K0
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	AMP C1355390

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

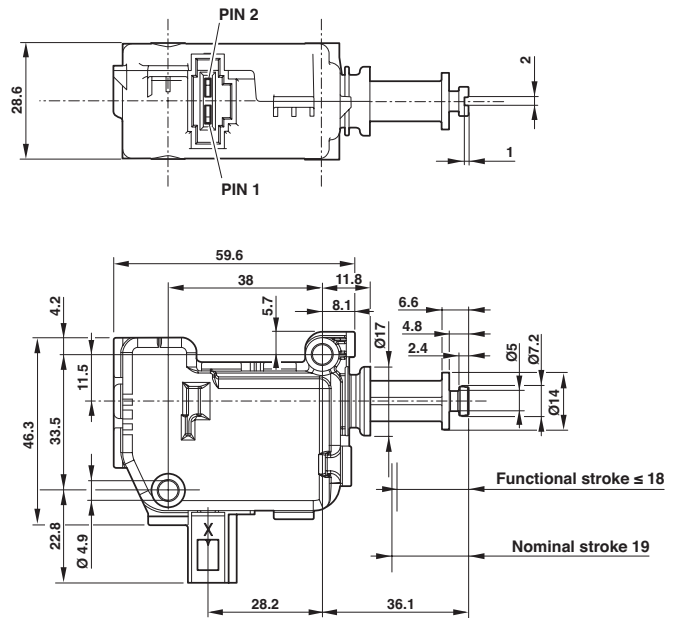
**Part number 6NW 009 203-411**

Technical data	
Position on supply	retracted
Clockwork spring resetting	none
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	5.5 A
Idling current	350 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	100.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K0
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	AMP C1355390

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

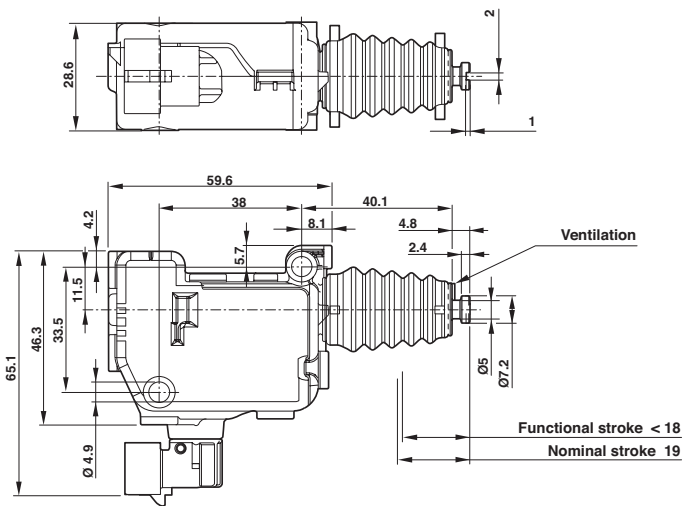
**Part number 6NW 009 203-421**

Technical data	
Position on supply	extended
Clockwork spring resetting	none
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	5,5 A
Idling current	350 mA
Actuation force at the stroke (at 80 °C and 9 V)	30 N
Manual adjustment	≤ 15 N
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB µV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g Eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

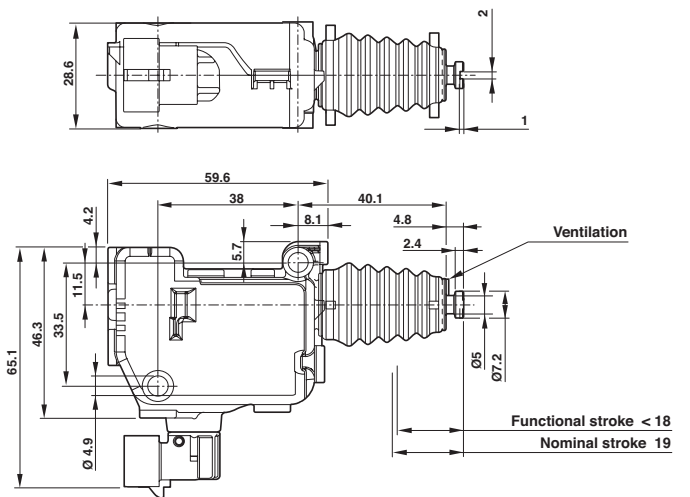
**Part number 6NW 009 203-431**

Technical data	
Position on supply	extended
Clockwork spring resetting	none
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	5.5 A
Idling current	350 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

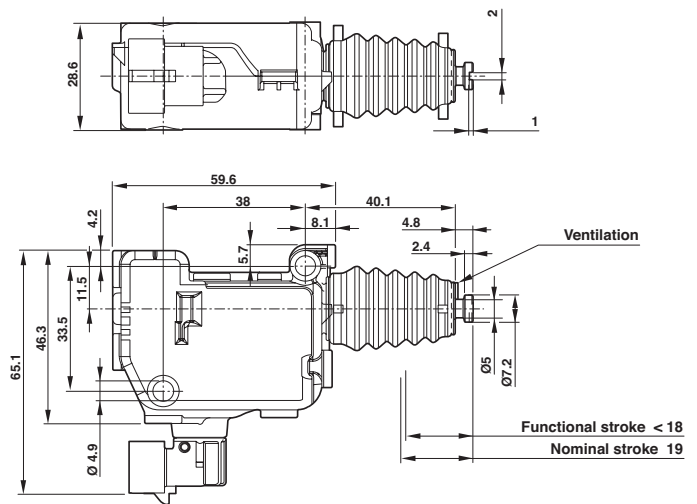
**Part number 6NW 009 203-441**

Technical data	
Position on supply	extended
Clockwork spring resetting	none
Weight	90 g
Rated voltage	24 V
Voltage range	18 V to 30 V
Maximum current consumption	2.6 A
Idling current	185 mA
Actuation force at the stroke (at 80 °C and 9 V)	30 N
Manual adjustment	≤ 15 N
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB µV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing







## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension and return motion

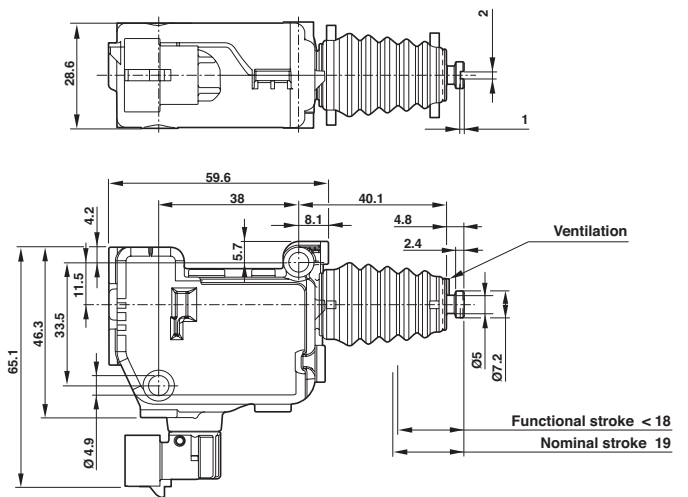
**Part number 6NW 009 203-451**

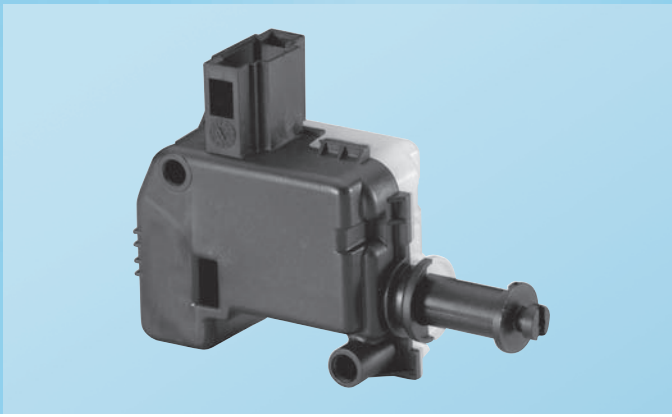
Technical data	
Position on supply	extended
Clockwork spring resetting	none
Weight	90 g
Rated voltage	24 V
Voltage range	18 V to 30 V
Maximum current consumption	2.6 A
Idling current	185 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	< - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB $\mu$ V
Functional stroke	$\leq$ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical return motion, extension with clockwork spring

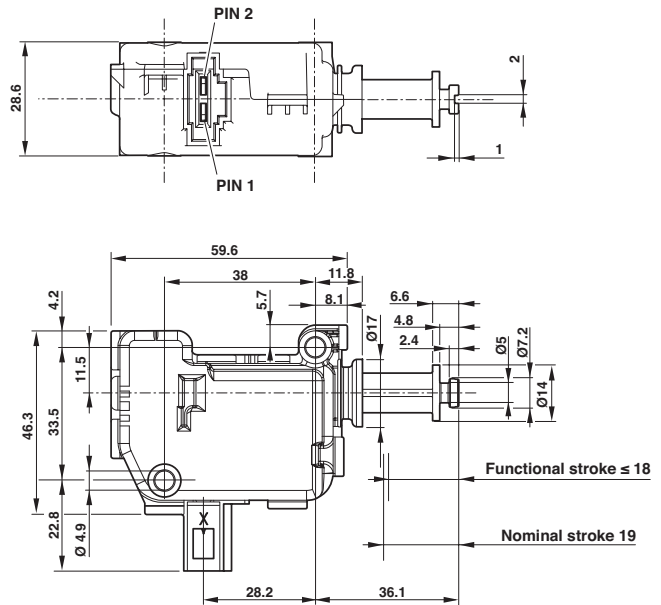
**Part number 6NW 009 203-461**

Technical data	
Position on supply	extended
Clockwork spring resetting	extended
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	10.5 A
Idling current	577 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K0
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	AMP C1355390

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical return motion, extension with clockwork spring

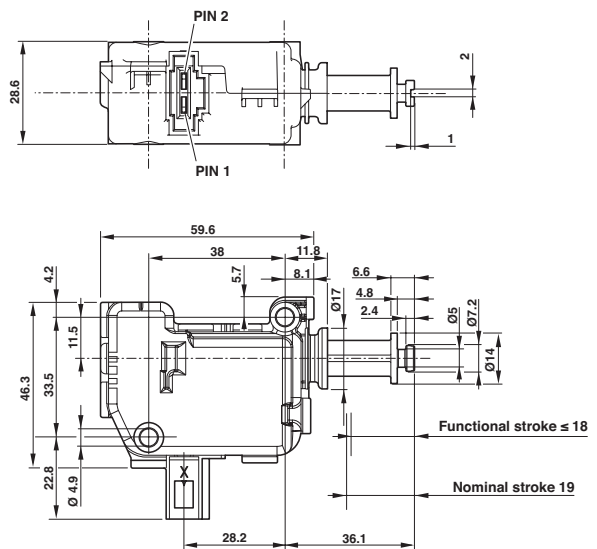
**Part number 6NW 009 203-471**

Technical data	
Position on supply	extended
Clockwork spring resetting	extended
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	10.5 A
Idling current	577 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical return motion, extension with clockwork spring

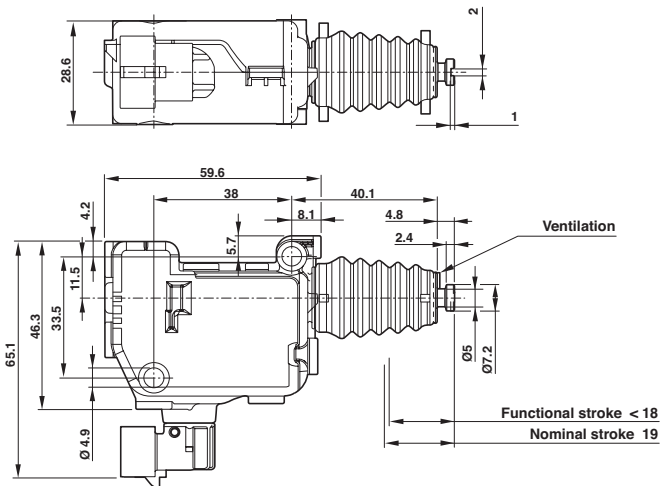
**Part number 6NW 009 203-481**

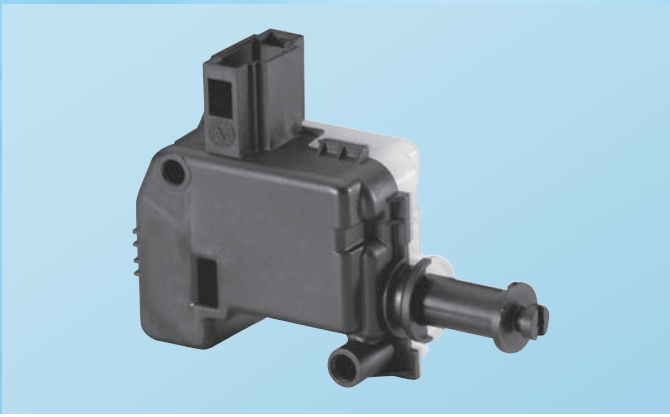
Technical data	
Position on supply	extended
Clockwork spring resetting	extended
Weight	90 g
Rated voltage	24 V
Voltage range	18 V to 30 V
Maximum current consumption	5 A
Idling current	250 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension, return motion with clockwork spring

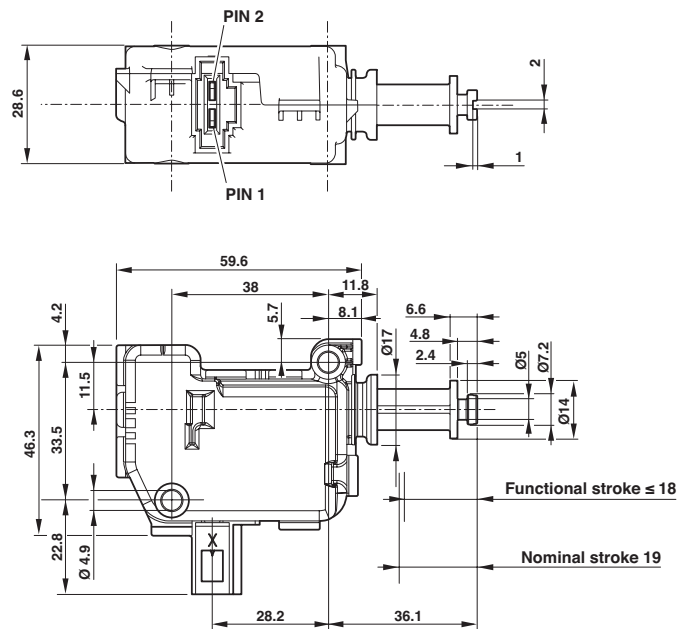
**Part number 6NW 009 203-491**

Technical data	
Position on supply	retracted
Clockwork spring resetting	retracted
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	10.5 A
Idling current	577 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K0
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	AMP C1355390

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension, return motion with clockwork spring

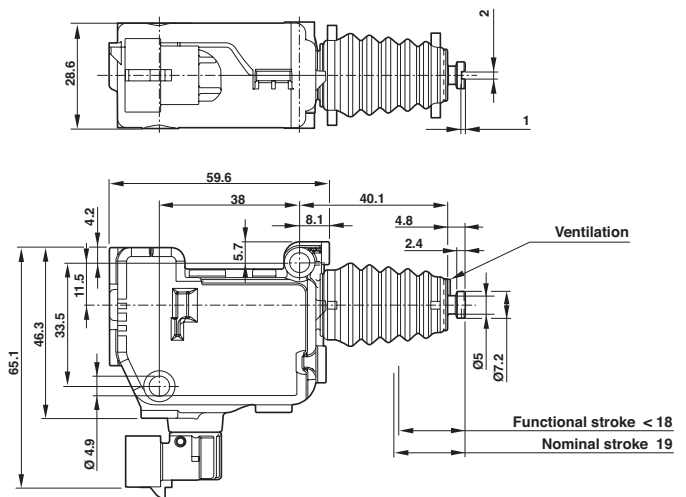
**Part number 6NW 009 203-501**

Technical data	
Position on supply	retracted
Clockwork spring resetting	retracted
Weight	90 g
Rated voltage	12 V
Voltage range	9 V to 15 V
Maximum current consumption	10.5 A
Idling current	577 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 80 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Electrical extension, return motion with clockwork spring

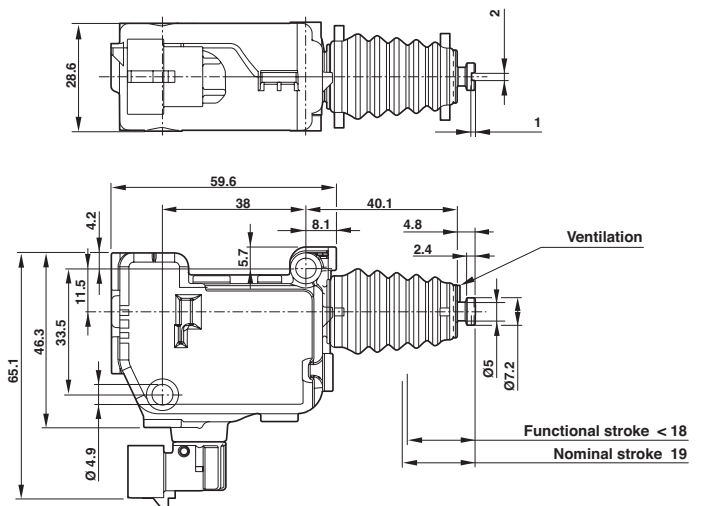
**Part number 6NW 009 203-511**

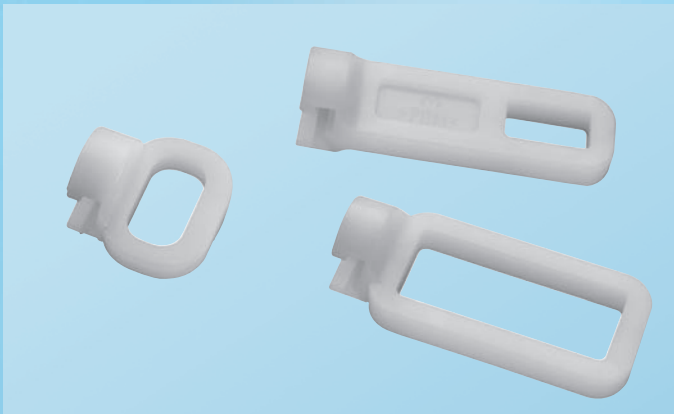
Technical data	
Position on supply	retracted
Clockwork spring resetting	retracted
Weight	90 g
Rated voltage	24 V
Voltage range	18 V to 30 V
Maximum current consumption	5 A
Idling current	250 mA
Actuation force at the stroke (at 80 °C and 9 V)	50 N
Manual adjustment	none
Actuating time for 18 mm stroke <sup>1)</sup>	max. 400 ms
Thermal overload protection	through PTC (PolySwitch)
Operating temperature	- 40 °C to + 90 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime	50.000 Switching cycles
Conducted interference	≤ - 75 V
Interference suppression (in all fields)	Intensity level 1 + 10 dB μV
Functional stroke	≤ 18 mm
Protection	IP 5K4
Vibration resistance	2.7 g eff.
Housing material (upper side)	Polyamide 6 GF15
Housing material (bottom side)	Polyamide 6 M25 GF15
Pin coating	Tin
Counterplug <sup>2)</sup>	Tyco C282080

<sup>1)</sup> At the plunger over the operating voltage and temperature range

<sup>2)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing





## Actuators

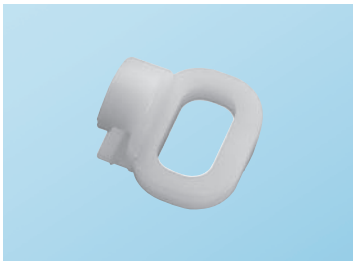
Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Joining elements for actuator function extension and return motion

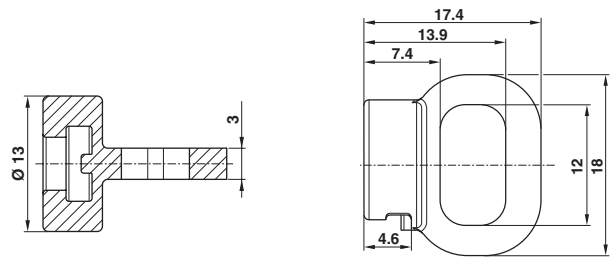
### Technical data

Storage temperature	- 40 °C to + 90 °C
Material	POM white

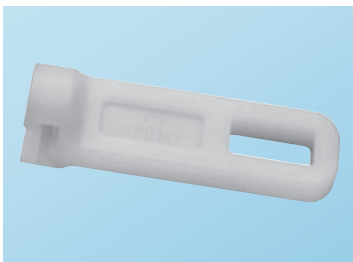
### Part number 9XD 860 912-001



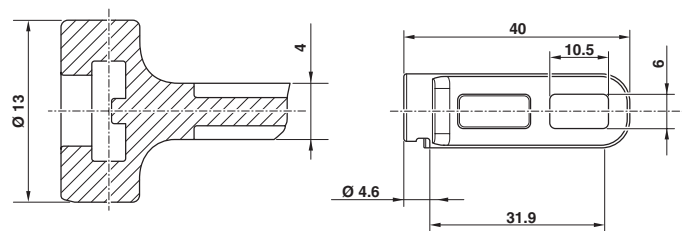
### Technical drawing



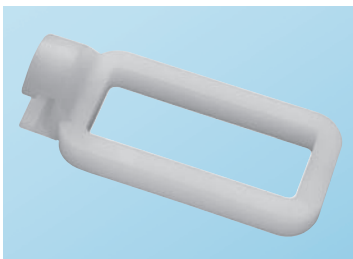
### Part number 9XD 862 354-001



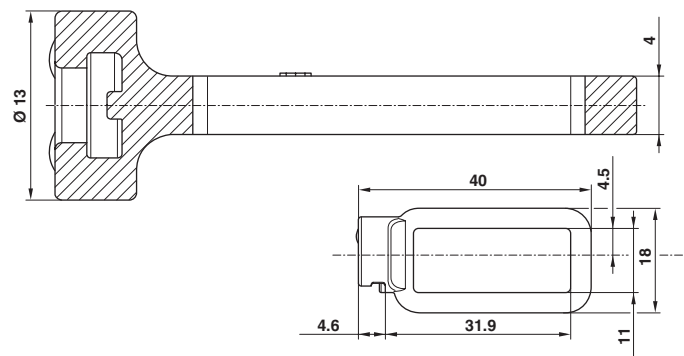
### Technical drawing



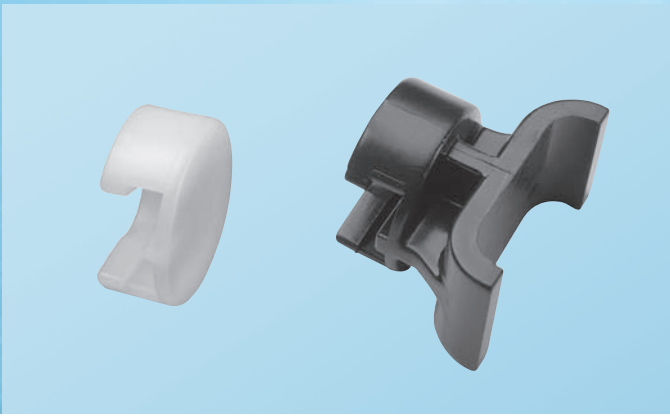
### Part number 9XD 863 049-001



### Technical drawing







## Actuators

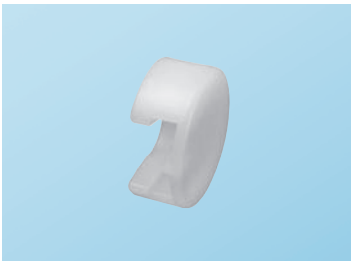
Electrical actuators, electrical locking/unlocking & push/pull function (medium force)

Joining elements for actuator function extension motion

### Technical data

Storage temperature	- 40 °C to + 90 °C
Material	POM white

### Part number 9XD 862 098-001



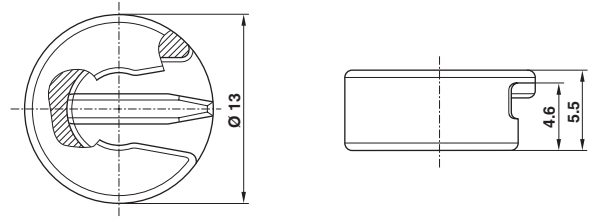
### Technical data

Storage temperature	- 40 °C to + 90 °C
Material	POM black

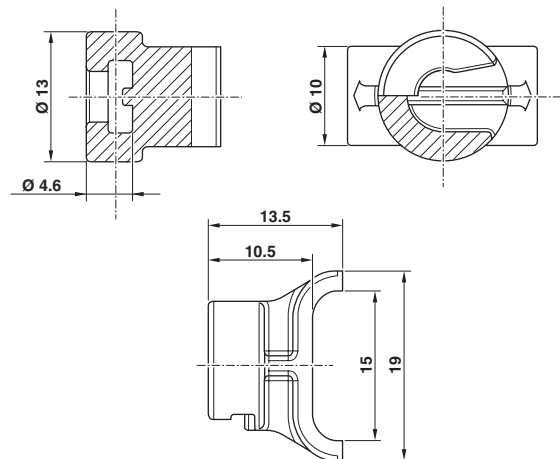
### Part number 9XD 861 450-001

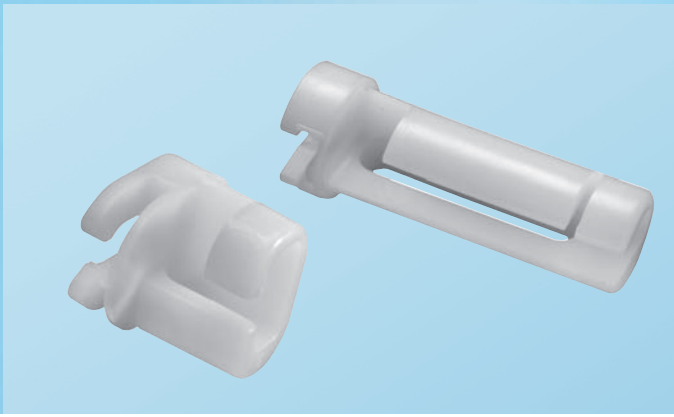


### Technical drawing



### Technical drawing





## Actuators

Electrical actuators, electrical locking/unlocking & pull function (medium force)

Joining elements for actuator function extension and return motion with rod

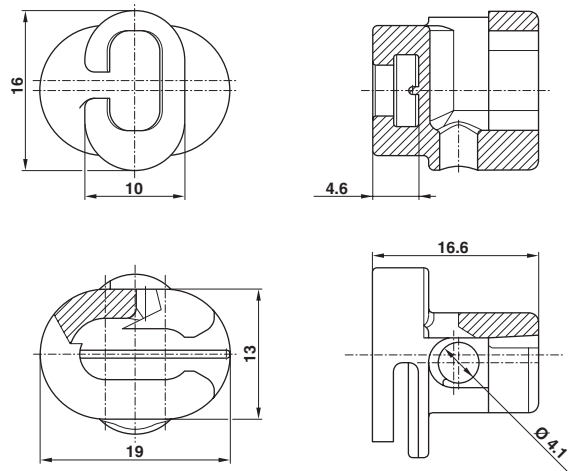
### Technical data

Storage temperature	- 40 °C to + 90 °C
Material	POM white

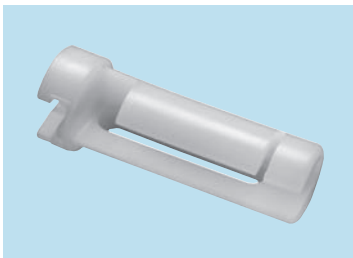
### Part number 9XD 861 771-001



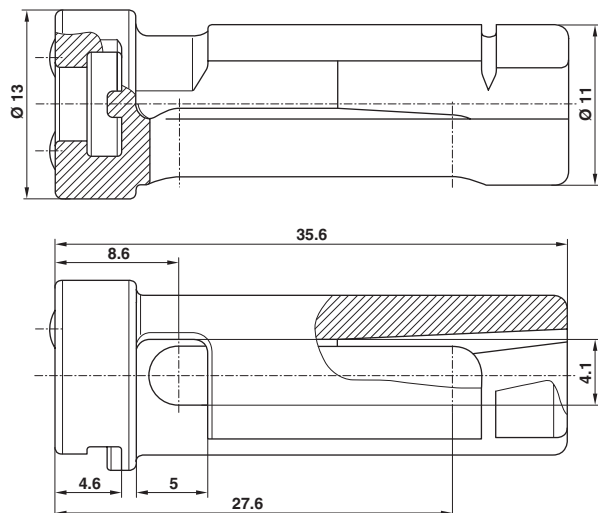
### Technical drawing

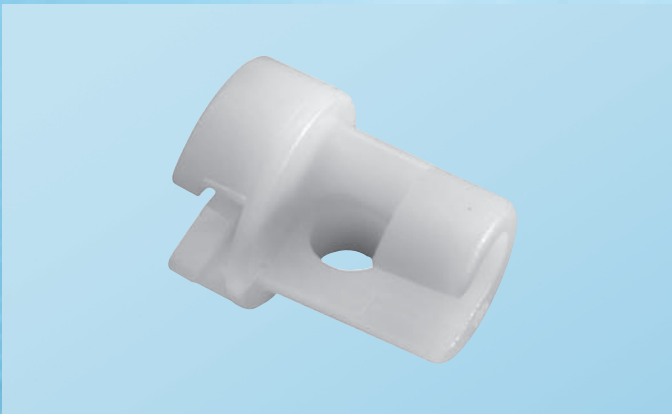


### Part number 9XD 862 516-001



### Technical drawing





## Actuators

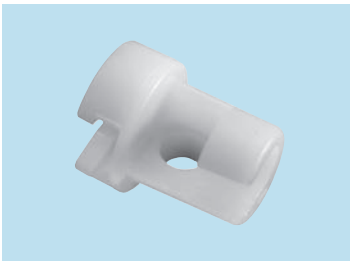
Electrical actuators, electrical locking/unlocking & pull function (medium force)

Joining elements for actuator function extension and return motion with rod

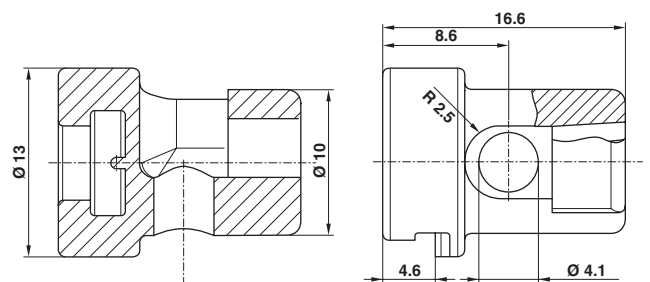
### Technical data

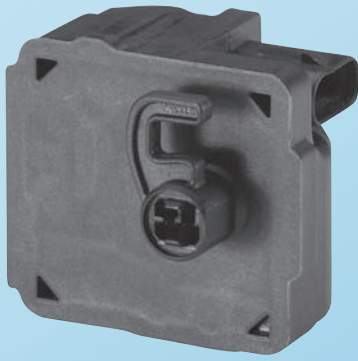
Storage temperature	- 40 °C to + 90 °C
Material	POM white

### Part number 9XD 860 913-001



### Technical drawing





# Actuators

*Electrical actuators*

*Electrical locking/unlocking & closing, space-saving with micro-switch (low force)*

## Product features

- Compact, space-saving design
- Electrical resetting or automatic resetting (without current through spring)
- Easy to fix in place thanks to snap-in assembly
- Waterproof
- With or without micro-switch
- Explosion report for tank modules

## Application

This actuator's extremely compact design makes it particularly suitable for locking and unlocking applications in dry and wet areas (also through remote control, for example) where the available space is tight.

Examples are:

- Tank modules
- Service flaps
- Glove compartments etc.

## Function

When a voltage is applied, the motor integrated in the electromotive actuator moves the locking lever attached to the motor shaft.

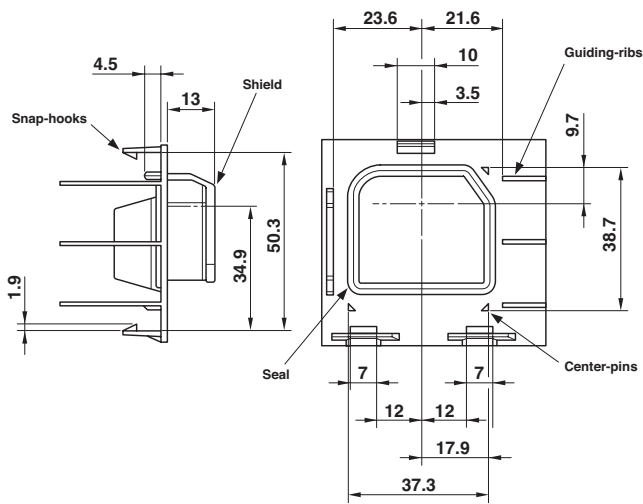
There are two product variants available in the range. The first actuator variant with electrical locking and unlocking function is especially suitable for classical applications where the locking ratchet locks a hinged arm attached in the closing system by applying a voltage, and unlocks it by reversing the voltage.

The stability of the locking positions open/closed is achieved by the motor being short-circuited after triggering has taken place.

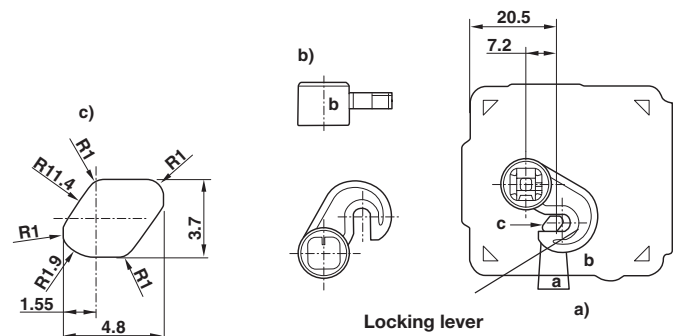
In the second actuator variant a return spring and a micro-switch are integrated. The micro-switch is actuated by a slight movement of the locking lever, e.g. by pressing a service flap. Then current is applied to the actuator via a control unit. This has the effect of a full retraction of the actuator locking ratchet so that the closing system is open, thus allowing the service flap to open by means of a spring force. After this, the actuator is switched off and the locking lever returns to the locking position through the integrated spring without current.

For locking the service flap is pushed closed, whereby the hinged arm of the service flap engages in the actuator locking ratchet. The switch signal triggered must be ignored by the control unit.

### Interface for mounting

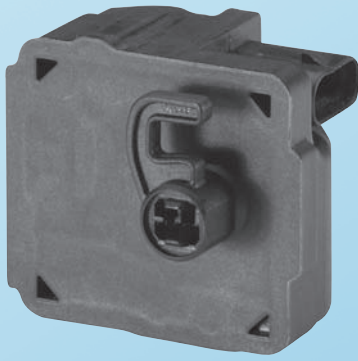


### Locking interface (second actuator variant)



### Summary of variants

Function	Voltage	Actuation force	Manual adjustment	Protection	Part number	Technical data on page
Forward and reverse rotation electrical	12 V	-	yes	IP 5K4	6NW 863 330-011	84
Forward rotation electrical, reverse rotation through spring, with micro-switch	12 V	-	yes	IP 5K4	6NW 863 330-001	85



# Actuators

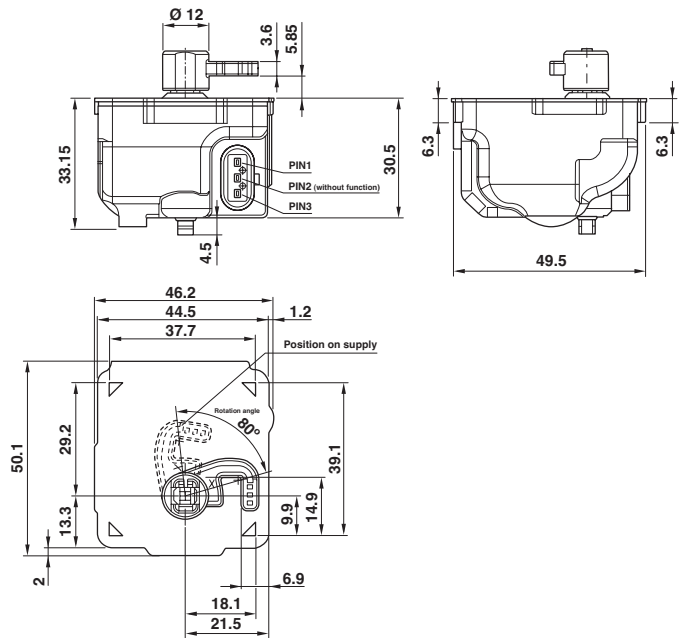
Electrical actuators, electrical locking/unlocking, space-saving with micro-switch (low force), forward and reverse rotation electrical

**Part number 6NW 863 330-011**

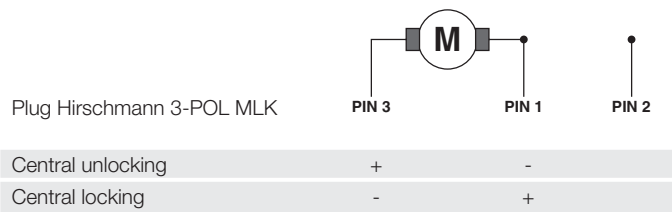
Technical data	
Resetting by spring	none
Weight	60 g
Rated voltage	12 V
Voltage range	9 V to 15.5 V
Maximum current consumption	3.2 A
Idling current	≤ 250 mA
Removal force locking lever	≥ 75 N
Breaking force locking lever	≥ 300 N
Functional angle	≤ 78°
Actuating time for 78° over functional angle <sup>1)</sup>	max. 200 ms
Triggering time	max. 600 ms
Thermal overload protection	none
Operating temperature	- 40 °C to + 85 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime <sup>2)</sup>	100.000 cycles
Conducted interference	
DIN ISO 7637, SAE J1113-42	≤ - 75 V
Interference suppression of electric devices	
CISPR25, SAE J-1113-41	Intensity level 1 + 10 dB µV
Final position stability with motor short-circuit	≤ 6°
Protection	IP 5K4
Salt spray test according to DIN 50 021 SS	96 h
Vibration resistance according to IEC 68-2-64	2.7 g
Housing material	PP-GF30 black
Sealing ring	NBR 70 Shore A
Locking lever material	PAA GF60 black
Resistant to	Petrol, diesel, bio-diesel, ozone
Pin coating	CuSn 6 bronze plate
Plug	Hirschmann, 3-pole
Counterplug <sup>3)</sup>	3-pole MLK coupler ELA 872-858-541

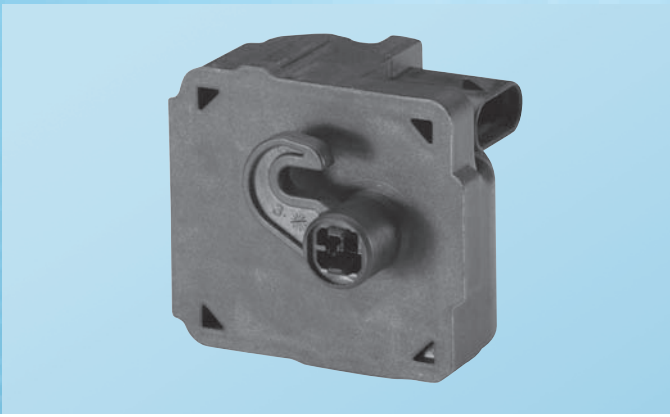
<sup>1)</sup> Over operating voltage and temperature range  
<sup>2)</sup> One switching cycle equals one forward and one reverse rotation  
<sup>3)</sup> This accessory is not part of the scope of supply.  
 To be purchased from Hirschmann Automotive.

## Technical drawing



## Electrical connection





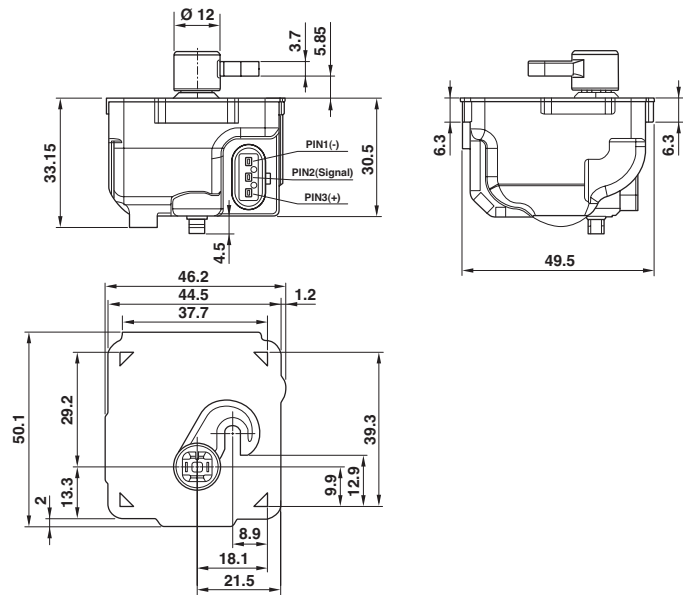
# Actuators

Electrical actuators, electrical locking/unlocking, space-saving with micro-switch (low force), forward rotation electrical, reverse rotation through spring, with micro-switch

**Part number 6NW 863 330-001**

Technical data	
Resetting by spring	Mainspring
Weight	60 g
Rated voltage	12 V
Voltage range	9 V to 15.5 V
Maximum current consumption	4,5 A
Idling current	≤ 600 mA
Removal force locking lever	75 N
Breaking force locking lever	300 N
Triggering force of the micro-switch	≤ 24 N
Functional angle	≤ 78°
Actuating time for 78° over functional angle <sup>1)</sup>	max. 220 ms
Reset time	≤ 90 ms
Triggering time	max. 600 ms
Thermal overload protection	none
Operating temperature	- 40 °C to + 85 °C
Storage temperature	- 40 °C to + 90 °C
Lifetime <sup>2)</sup>	7.500 cycles
Conducted interference	
DIN ISO 7637, SAE J1113-42	< - 75 V
Interference suppression of electric devices	
CISPR25, SAE J-1113-41	Intensity level 1 + 10 dB µV
Switching angle micro-switch	8° – 18°
Final position stability with motor short-circuit	≤ 6°
Protection	IP 5K4
Salt spray test according to DIN 50 021 SS	96 h
Vibration resistance according to IEC 68-2-64	2.7 g
Housing material	PP-GF30
Sealing ring	NBR 70 Shore A
Locking lever material	PAA GF60 black
Resistant to	Petrol, diesel, bio-diesel, ozone
Pin coating	CuSn 6 bronze plate
Plug	Hirschmann, 3-pole
Counterplug <sup>3)</sup>	3-pole MLK coupler ELA 872-858-541

## Technical drawing

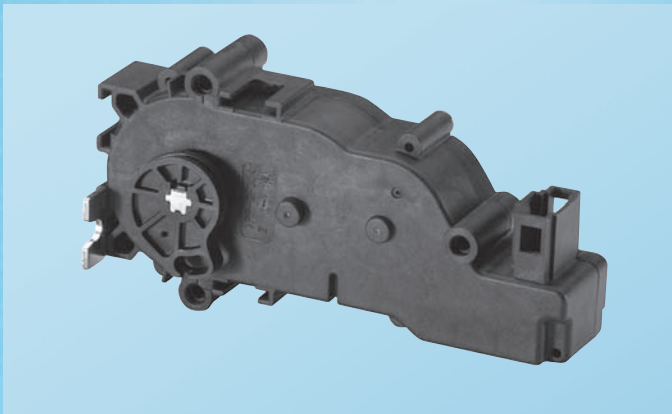


## Electrical connection



Softtouch unlocking	+	-	Signal
Softtouch locking	O	O	Signal

<sup>1)</sup> Over operating voltage and temperature range  
<sup>2)</sup> One switching cycle equals one forward and one reverse rotation  
<sup>3)</sup> This accessory is not part of the scope of supply.  
 To be purchased from Hirschmann Automotive



# Actuators

*Electrical actuators*

*Electrical locking/unlocking & pull function (high force)*

### Product features

- High actuation force
- Sturdy and compact design
- Class 3 interference suppression
- Universal interface for Bowden cable
- For universal use

### Function

This electromotive actuator is an actuator driven by a DC motor with rotatory output. The actuator is driven through a 2-pole plug with the contacts „+“ (Pin A, for clockwise rotation) and „Ground“ (Pin B, for anticlockwise rotation) when a voltage is applied. Resetting takes place by simply reversing polarity. Direction of rotation and running time are prescribed by the control unit. The actuator can be attached at three connection points.

### Application

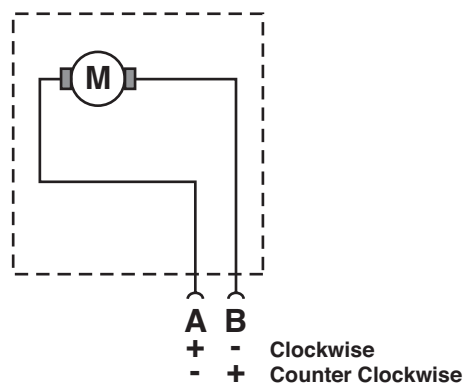
The actuator is particularly suitable for locking and tightening applications where high forces are required.

Examples of this are:

- Large locks and
- Large flaps

Where a Bowden cable is used, the actuator can work without body attachment, since it is fixed to the application via the Bowden cable sleeve and can be embedded in a foam body for noise insulation.

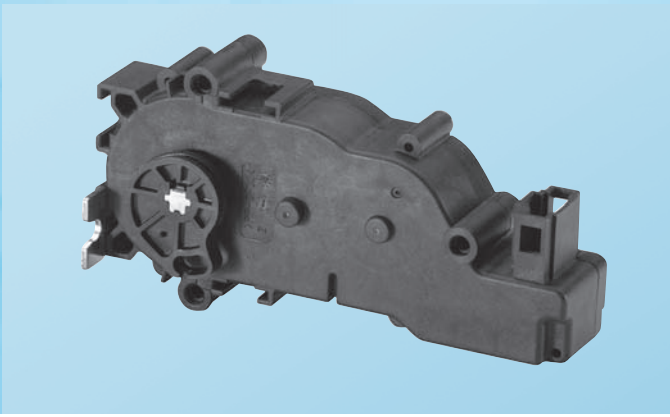
### Basic circuit diagram



### Summary of variants

Function	Voltage	Actuation force	Manual adjustment	Protection	Part number	Technical data on page
Forward and reverse rotation electrical	12 V	200 N	no	IP 5K0	6NW 009 424-791	87





## Actuators

Electrical actuators, electrical locking/unlocking & pull function (high force)

Forward and reverse rotation electrical

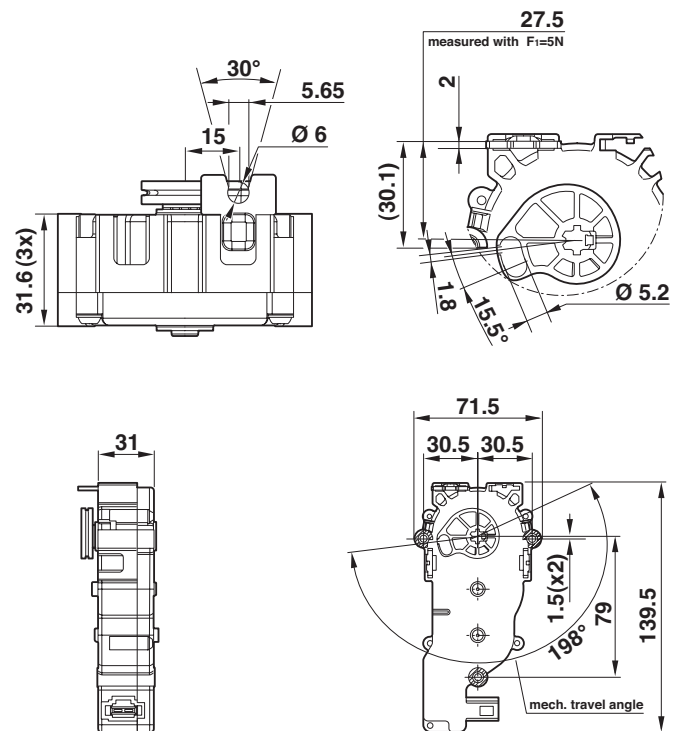
Part number 6NW 009 424-791

### Technical data

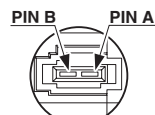
Clockwork spring resetting	none
Weight	181 g
Rated voltage	12 V
Voltage range	9 V to 16 V
Maximum current consumption	6 A
Idling current	150 mA
Rated torque	300 Ncm
Functional angle	0° to 198°
Tensile path	ca. 45 mm
Rated speed	15 min <sup>-1</sup> at RT and 13 V
Manual adjustment	none
Thermal overload protection	not available
Operating temperature	- 40 °C to + 85 °C
Lifetime	50.000 Switching cycles
Conducted interference	< - 75 V
Interference suppression (in all fields)	Intensity level 3
Protection	IP 5K0
Vibration resistance (IEC 68-2-64)	3 g eff.
Housing material (upper side)	PP-GF30
Housing material (bottom side)	PP-GF30
Pin coating	Tin
Counterplug <sup>1)</sup>	AMP C1355390

<sup>1)</sup> This accessory is not part of the scope of supply. To be purchased from Tyco Electronics

### Technical drawing



### Pin assignment



## Notes

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# Sensors/Actuators

**Hella KGaA** Hueck & Co.  
Rixbecker Straße 75  
D-59552 Lippstadt/Germany  
Phone + 49 29 41 38-3 11 74  
Fax + 49 29 41 38-4 73 11 74  
www.hella.com/electric-electronic-components  
electric-electronic-components@hella.com

You are also welcome to use the fax form below to send us any inquiries you may have about the product range.  
Please use this inquiry fax as a template and send us the copy.

Date \_\_\_\_\_

## Your company address

Contact \_\_\_\_\_  
Function \_\_\_\_\_  
Phone \_\_\_\_\_  
e-mail \_\_\_\_\_

## I have a question

general       about part number \_\_\_\_\_

## Use of the sensor or actuator

Passenger car     Truck             Bus                 Caravan             Tractor     Construction machine  
 Fork lift             Motorbike         Boat                 Other vehicle  
 Engine               Closing system     Household appliance     Facility management     Industrial plant     Industrial machine  
 Other machine or system     I am a supplier to one of the above groups

## Description of your application (measuring parameter, application sketch etc.)

## Does a solution for the application already exist?

No                       Yes, we currently solve the application using \_\_\_\_\_

## What advantage does the use of the new Hella component offer you?

## What environmental requirements do you make of the sensor/actuator?

What quantities of sensor/actuator are you likely to require per year?

When do you need the sensors/actuators?