

ENGINEERING  
TOMORROW



Technical Information

# Speed and Temperature Sensor

## Hydrostatic Propel Products



**Revision history***Table of revisions*

| Date          | Changed  | Rev   |
|---------------|--|-------|
| January 2026  | Updated speed ring information for BMV and MP1M  | 0704  |
| March 2025    | Updated 7-32V table, cleaned up wording  | 0703  |
| October 2023  | Updated 7-32V information, speed ring info, added H1F image                              | 0702  |
| January 2021  | Changed document number from 'BC00000047' to 'BC152886482203' and added new speed sensor | 0701  |
| January 2020  | Added MP1P and MP1M target ring information  | 0508  |
| November 2019 | Corrected speed sensor pinout information.   | 0507  |
| June 2019     | Formula for temperature calculation corrected.   | 0506  |
| May 2019      | Minor update.  | 0505  |
| February 2018 | Minor update.  | 0504  |
| November 2017 | Minor layout changes.  | 0503  |
| December 2015 | Data for size 210 of H1B motor.  | 0502  |
| 2011-2014     | Various changes.   | BA-FB |
| Sep 2009      | First edition  | AA    |

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## General Information

### Description

Function of the speed sensor is to detect the shaft speed. Typically the sensor is mounted to the housing of a Danfoss pump or motor and senses the speed from a target ring that is rotating inside the pump or motor.

Because of the digital output signals for speed the sensor is ideal for high and low speed measurements.

The speed sensor is designed for rugged outdoor, mobile or heavy industrial speed sensing applications.

The detection of the speed is contactless. It is custom-designed for Danfoss. It is a *Plug and Perform* device that does not need any calibration or adjustments.

For diagnostics and other purposes, the sensor also has the capability to detect the driving direction and the case oil temperature.

### Theory of Operation

The speed sensor is externally powered and, in response to the speed of the target ring, outputs a digital pulse signal. A magnet inside the sensor provides the magnetic field that changes with the position of the target teeth.

The target ring is attached to the cylinder block or the shaft. Hall-effect sensors change from high/low state as the target teeth pass by the sensor's face. The digital (on-off-on-off) pulse train is fed to a controller, which interprets its rate of change as a speed.

The speed sensor uses two Hall-effect sensors with specific distance and orientation resulting in a pulse train output shift of 90° between the two sensors. A logic circuit decodes the two signals to provide an additional direction indication (high or low depending on direction).

Due to the design of the sensor, the duty cycle (ratio between on and off time at constant speed) of both speed signals at any working condition is close to 50 % and can be used for better resolution at low speeds.

### Speed Rings

Speed (target) rings vary according to the diameter of the cylinder block or shaft on which they are installed. The number of teeth is shown in the table below.

*The number of speed (target) ring teeth*

| <b>H1P size</b> | <b>045/053</b> | <b>060/068</b> | <b>069/078</b> | <b>089/100</b> | <b>115/130</b> | <b>147/165/180</b> | <b>210/250/280</b> |
|-----------------|----------------|----------------|----------------|----------------|----------------|--------------------|--------------------|
| Teeth           | 79             | 86             | 86             | 92             | 102            | 108                | 90                 |

*The number of speed (target) ring teeth*

| <b>H1B and H1F size</b> | <b>060</b> | <b>080</b> | <b>110</b> | <b>160</b> | <b>210</b> | <b>250</b> |
|-------------------------|------------|------------|------------|------------|------------|------------|
| Teeth                   | 71         | 78         | 86         | 95         | 104        | 108        |

*The number of speed (target) ring teeth*

| <b>MP1P size</b> | <b>028/032</b> | <b>038/045</b> |
|------------------|----------------|----------------|
| Teeth            | 9              | 11             |

*The number of speed (target) ring teeth*

| <b>MP1M size</b> | <b>020/024</b> | <b>028/032</b> |
|------------------|----------------|----------------|
| Teeth            | 9              |                |

## General Information

*Target ring for integrated drives*

| Integrated drive size | IDMV 044 | IDMV 053 |
|-----------------------|----------|----------|
| Teeth                 | 75       | 79       |

*Target ring for integrated drives*

| Integrated drive size | BMV 28/32 | BMV 041/51 |
|-----------------------|-----------|------------|
| Teeth                 | 18        |            |

If a product is not seen in the tables, refer to technical information of the specific product.

## Temperature Range

| Parameter                   | Minimum | Maximum |
|-----------------------------|---------|---------|
| Operation temperature range | -40 °C  | 104 °C  |

115°C intermittent = short term;  $t < 1\text{min}$  per incident and not exceeding 2 % of duty cycle based load-life.

## Protection Characteristics

| Parameter   | Data   |
|---|--|
| Protection Code (IP class)<br>according IEC 60529 and DIN 40050 | IP 67 (without connector installed)<br>IP 69k (with connector installed) |
| EMC Emission  | EN 61000-6-3   |
| EMC Immunity (EMI)  | 100 V/m incl. 1 kHz AM 80 %; ISO 11452-5 and -2                          |
| ESD   | EN 61000-4-2<br>Air discharge: 15 kV<br>Contact discharge: 8 kV          |
| Vibration   | 30 G (294 m/s <sup>2</sup> )   |
| Shock   | 50 G (490 m/s <sup>2</sup> )   |
| Case maximum pressure   | 5 bar [72.5 psi]   |

## Mating connectors

There are available two types of mating connectors Assembly Bag DEUTSCH DTM06-6S, Black and Grey.

| Ordering number  |  |
|--|--|
| 11033865   | 11033863   |
| Assembly Bag, DEUTSCH DTM06-6S-E004; black, (24-20 AWG) 0.21 -0.52 mm <sup>2</sup> | Assembly Bag, DEUTSCH DTM06-6S, gray, (24-20 AWG) 0.21 -0.52 mm <sup>2</sup> |

## Available Sensors

There are two speed sensors available according to different supply voltage range: 4.5 to 8 V<sub>DC</sub> and 7 to 32 V<sub>DC</sub>.

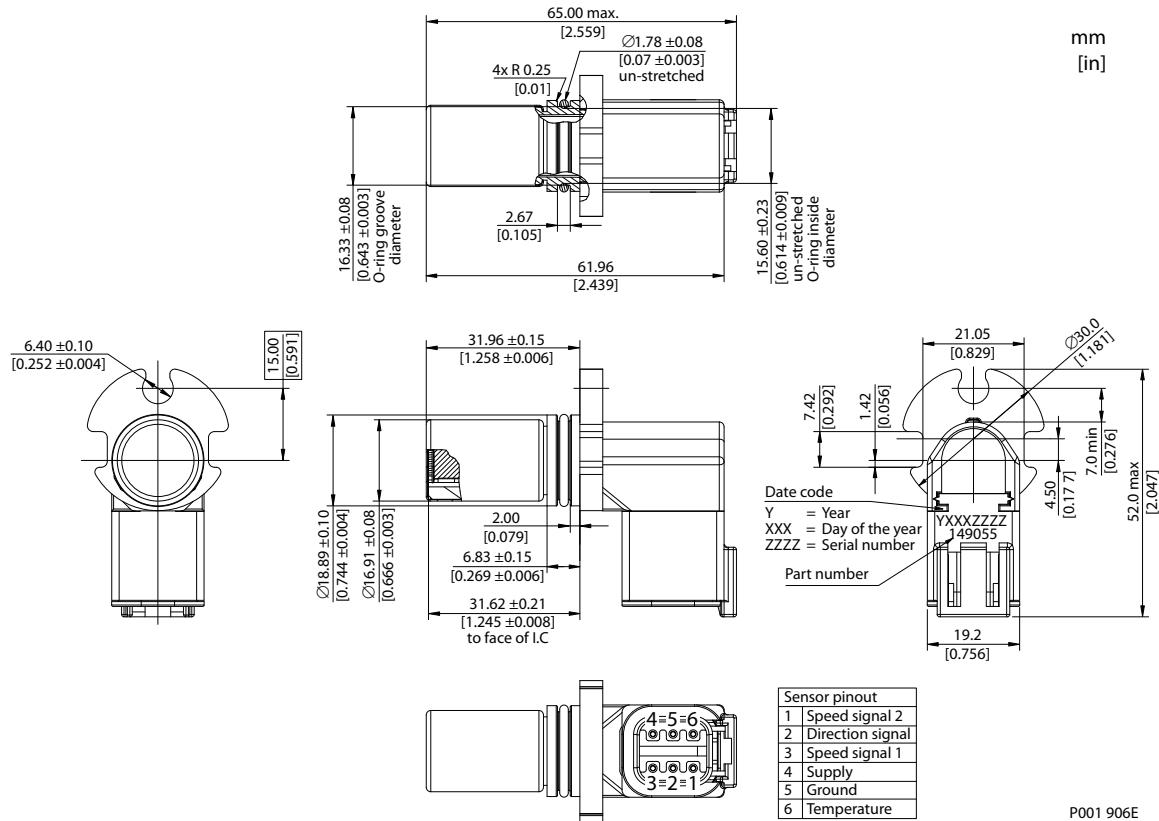
| Description    | Order number         |                      |
|----------------|----------------------|----------------------|
|                | 149055               | 11232698             |
| Supply voltage | 4.5 – 8 V            | 7 – 32 V             |
| Speed signals  | Two, 90° Phase shift | Two, 90° Phase shift |

## General Information

| Description        | Order number |          |
|--------------------|--------------|----------|
|                    | 149055       | 11232698 |
| Direction signal   | One          | One      |
| Temperature signal | One          | One      |

For more information, see below.

## Dimensions

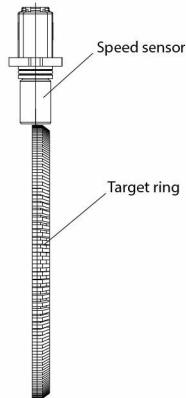
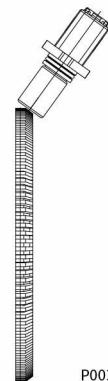
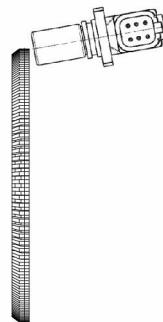


For more details about Mating connector, see the chapters #unique\_10 and #unique\_11

## Sensor Installation

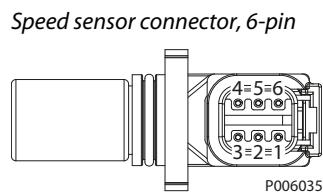
The sensor is positioned in the housing and fastened by one screw.

The gap between the sensor and the target does not need to be adjusted, nor it does need to be rotated for direction sensing.

**General Information***Example:***H1B** Motor housing  
SAE & DIN**H1B** Motor housing  
Cartridge**H1F** Motor housing  
SAE, DIN & Cartridge

P003 523E

## Speed sensor 4.5 – 8 V



1. Speed signal 2
2. Direction signal
3. Speed signal 1
4. Supply
5. Ground
6. Temperature

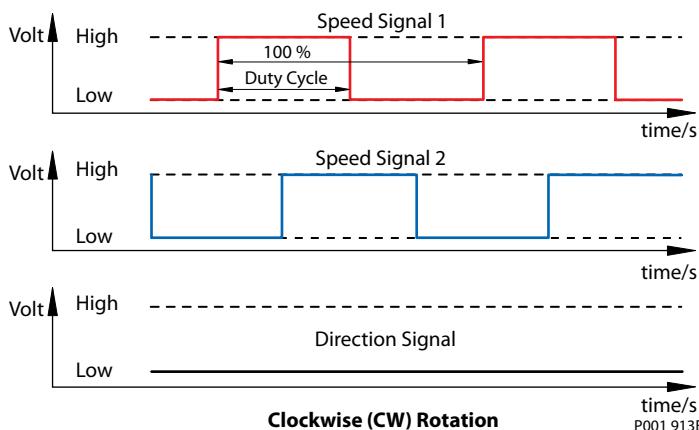
## Technical data

| Parameter                           | Min.                 | Nom.              | Max.               | Note  |
|-------------------------------------|----------------------|-------------------|--------------------|---|
| <b>Supply voltage</b>               | 4.5 V <sub>DC</sub>  | 5 V <sub>DC</sub> | 8 V <sub>DC</sub>  | Regulated supply voltage. Reverse polarity protected.                         |
| <b>Supply protection</b>            | –                    | –                 | 30 V <sub>DC</sub> | Shuts off above 9 V.  |
| <b>Max. required supply current</b> | –                    | –                 | 25 mA              | At supply voltage   |
| <b>Max. output current</b>          | –                    | –                 | 50 mA              |   |
| <b>Operation mode</b>               | <b>NPN &amp; PNP</b> |                   |                    | Push-Pull amplifier   |
| <b>Temperature signal</b>           | -40°C = 2.318V       | –                 | 100°C = 0.675V     |   |
| <b>Output low</b>                   | 5 %                  | 8.5 %             | 12 %               | Ratiometric output voltage<br>Low state > 0 V to provide wire fault detection |
| <b>Output high</b>                  | 88 %                 | 91.5 %            | 95 %               |   |
| <b>Detectable frequency range</b>   | 1 Hz                 | –                 | 10 000 Hz          |   |
| <b>Ordering number</b>              | <b>149055</b>        |                   |                    |   |
| <b>Color of connector</b>           | Black                |                   |                    |   |

## Duty Cycles

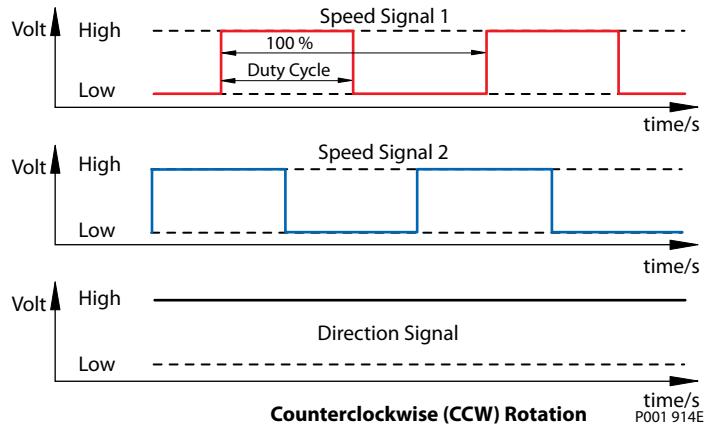
Output speed signal technical data and duty cycles graphs (clockwise and counterclockwise rotation).

## Duty cycle clockwise rotation

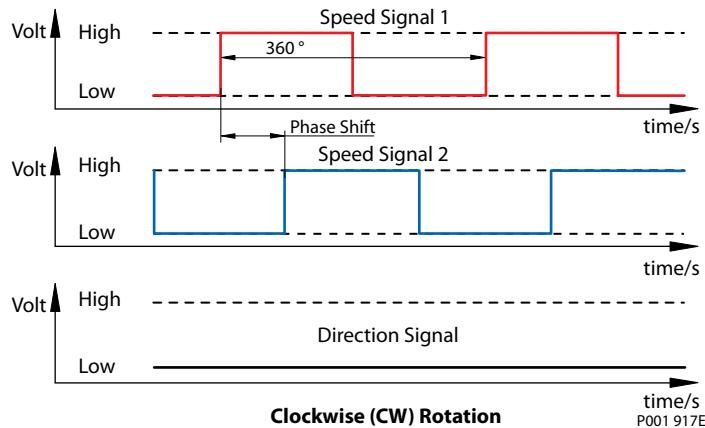


## Speed sensor 4.5 – 8 V

Duty cycle counterclockwise rotation



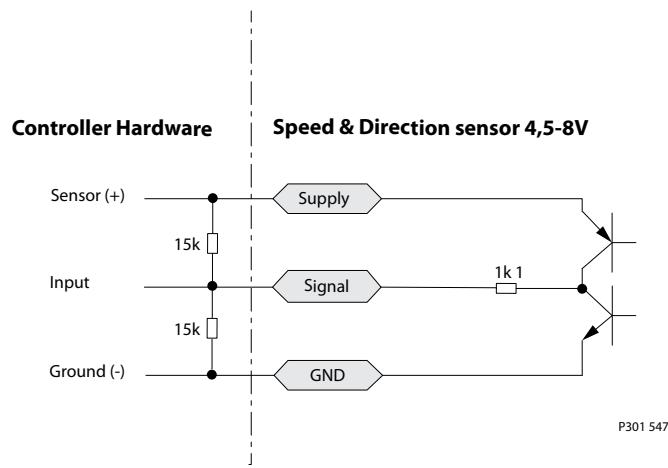
Phase shift clockwise rotation



## Wire Fault Detection

The output voltage levels are defined for a direct connection of the sensor to supply. The outputs are directly connected to a load which is 15k Ohm to ground and 15k Ohm to Supply.

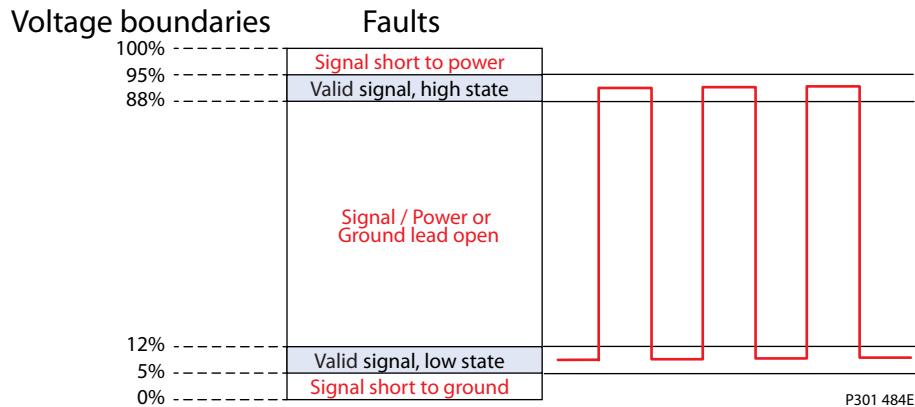
The signal outputs are protected by an 1100 ohm (1k1) resistor. Speed signal 1 (pin 3) offers an advanced error detection by providing different signal levels in case of an error.



## Speed sensor 4.5 – 8 V

## Output Signals

### *Speed signals 1, 2 and direction signal*



## Temperature Signal

For calculation of the case fluid temperature and the output signal voltage, see the formulas below:

### **V<sub>O</sub> – Measured output voltage (V)**

$$V_o = (-3.88 \cdot 10^{-6} \cdot T^2) + (-1.15 \cdot 10^{-2} \cdot T) + 1.8639$$

### T – Temperature (°C)

$$T = -1481.96 + \sqrt{2.1962 \cdot 10^6 + \frac{(1.8639 - V_0)}{3.88 \cdot 10^{-6}}}$$

### *Output signal voltage vs. Temperature*

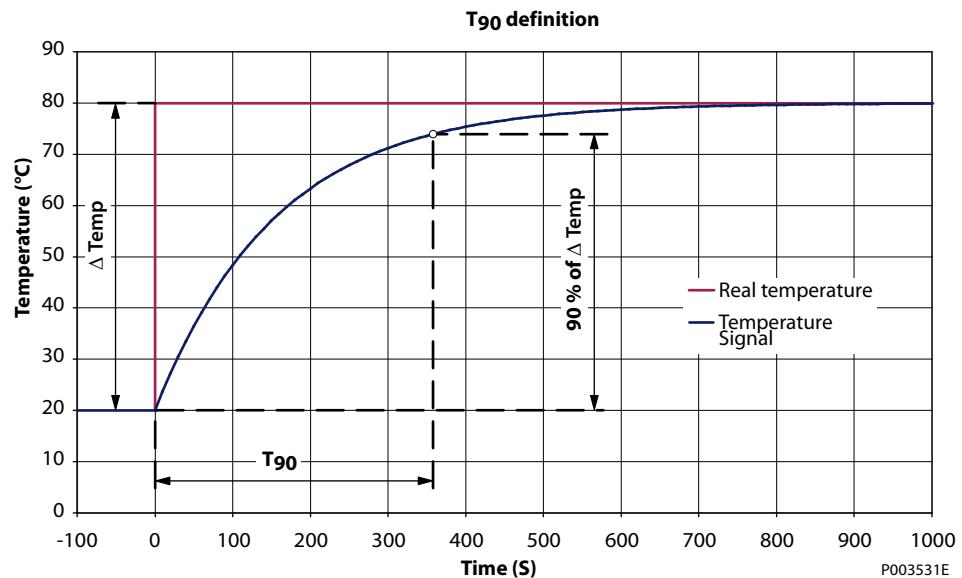
| Temperature range |         |         |         |         |         |         |           |
|-------------------|---------|---------|---------|---------|---------|---------|-----------|
| -55 °C**          | -40 °C  | -30 °C  | 0 °C    | +30 °C* | +80 °C  | +100 °C | +130 °C** |
| 2.485 V           | 2.318 V | 2.205 V | 1.864 V | 1.515 V | 0.919 V | 0.675 V | 0.303 V   |

\* Accuracy:  $\pm 1.5$  to  $\pm 4$  °C

\*\* Accuracy:  $\pm 2.5$  to  $\pm 5$  °C

## Speed sensor 4.5 – 8 V

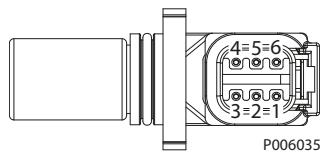
## Response time in fluid

 $T_{90}$  definitionResponse time in fluid ( $T_{90}$ ) = 360 s

## Speed Sensor 7 - 32 V

 Speed Sensor 7 – 32 V<sub>DC</sub> technical data and information about connector.

Speed sensor connector, 6-pin



## Pinout:

1. Speed signal 2
2. Direction signal
3. Speed signal 1
4. Supply
5. Ground
6. Temperature signal

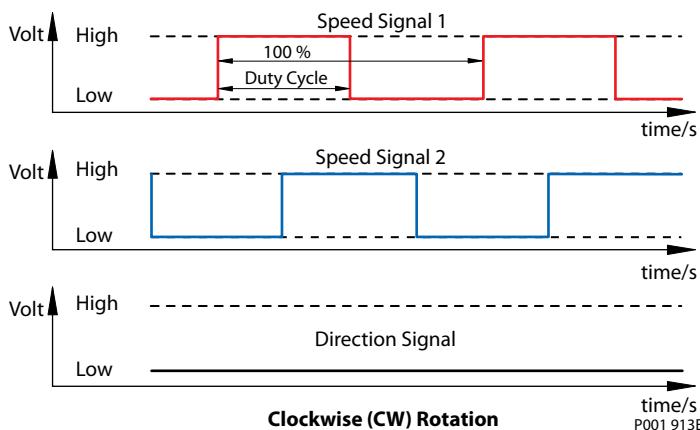
## Technical data

| Parameter                           | Min.                      | Max.               | Note  |
|-------------------------------------|---------------------------|--------------------|---|
| <b>Supply voltage range</b>         | 7 V <sub>DC</sub>         | 32 V <sub>DC</sub> |   |
| <b>Supply protection</b>            | –                         | 36 V <sub>DC</sub> | 36 V <sub>DC</sub> over voltage protection<br>-36 V <sub>DC</sub> permanent reverse polarity protection |
| <b>Max. required supply current</b> | –                         | 30 mA              |   |
| <b>Max. output current</b>          | –                         | 50 mA              |   |
| <b>Operation mode</b>               | <b>NPN open collector</b> |                    | Internal 2k7 pull-up resistor to supply   |
| <b>Temperature signal</b>           | -40°C = 2.318V–           |                    | 100°C = 0.675V  |
| <b>Output low signal range</b>      | 2 %                       | 8%                 | Max. output voltage 24 V <sub>DC</sub>  |
| <b>Output high signal range</b>     | 55 %                      | 85 %               |   |
| <b>Detectable frequency range</b>   | 1 Hz                      | 10 000 Hz          |   |
| <b>Speed sensor order number</b>    | 11232698                  |                    |   |
| <b>Color of connector</b>           | Yellow                    |                    |   |

## Duty Cycles

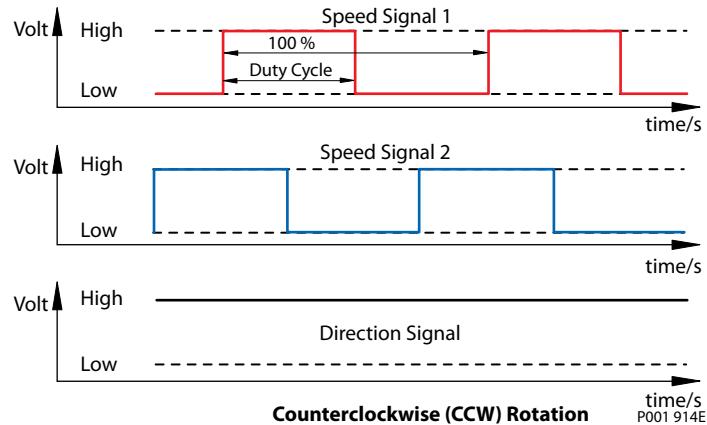
Output speed signal technical data and duty cycles graphs (clockwise and counterclockwise rotation).

## Duty cycle clockwise rotation

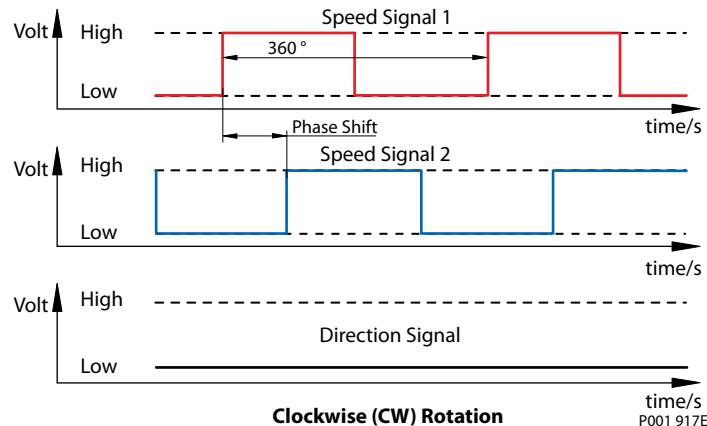


## Speed Sensor 7 - 32 V

Duty cycle counterclockwise rotation



Phase shift clockwise rotation

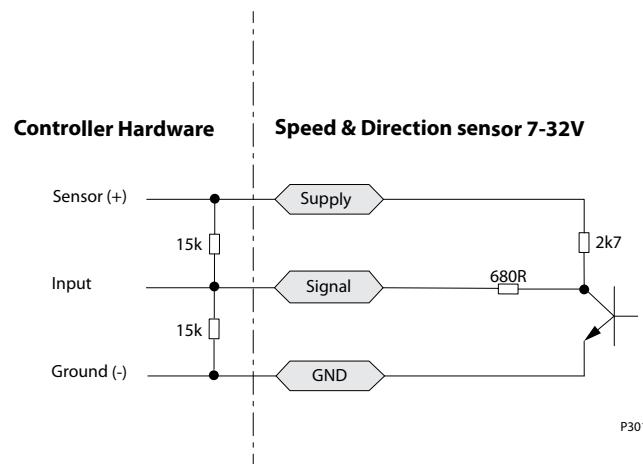


## Wire Fault Detection

The output voltage levels are defined for a direct connection of the sensor to supply. The outputs are directly connected to a load which is 15k Ohm to ground and 15k Ohm to Supply.

The internal voltage regulator will limit the output signal to max. 24V in high state. The output is protected by 680 Ohm resistor. The pull-up resistor to supply is 2k7 Ohm.

This circuitry will generate voltage levels per condition as follows (typical outputs shown for reference only):



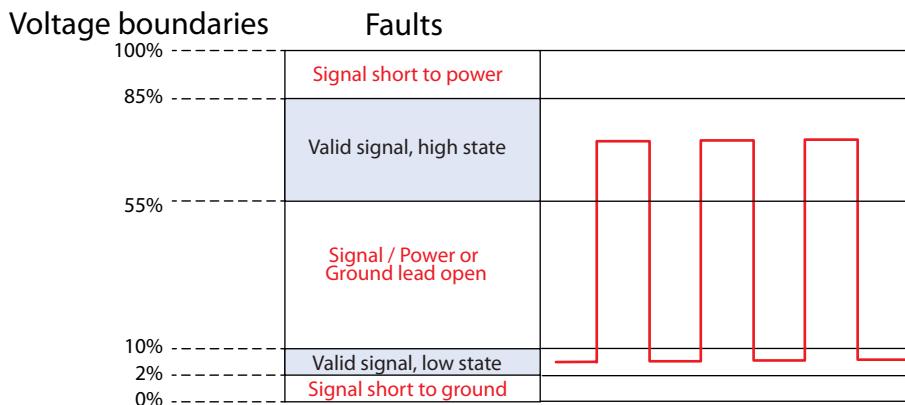
P301 548

## Speed Sensor 7 - 32 V

|  |  |  |
|--|--|--|
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Output Signals

Speed Signals 1, 2 and direction signal



## Temperature Signal

For calculation of the case fluid temperature and the output signal voltage, see the formulas below.

**V<sub>o</sub> – Measured output voltage (V)**

$$V_o = (-3.88 \cdot 10^{-6} \cdot T^2) + (-1.15 \cdot 10^{-2} \cdot T) + 1.8639$$

**T – Temperature (°C)**

$$T = -1481.96 + \sqrt{2.1962 \cdot 10^6 + \frac{(1.8639 - V_o)}{3.88 \cdot 10^{-6}}}$$

Output signal voltage vs. Temperature

| Temperature range |         |         |         |         |         |         |           |
|-------------------|---------|---------|---------|---------|---------|---------|-----------|
| -55 °C**          | -40 °C  | -30 °C  | 0 °C    | +30 °C* | +80 °C  | +100 °C | +130 °C** |
| 2.485 V           | 2.318 V | 2.205 V | 1.864 V | 1.515 V | 0.919 V | 0.675 V | 0.303 V   |

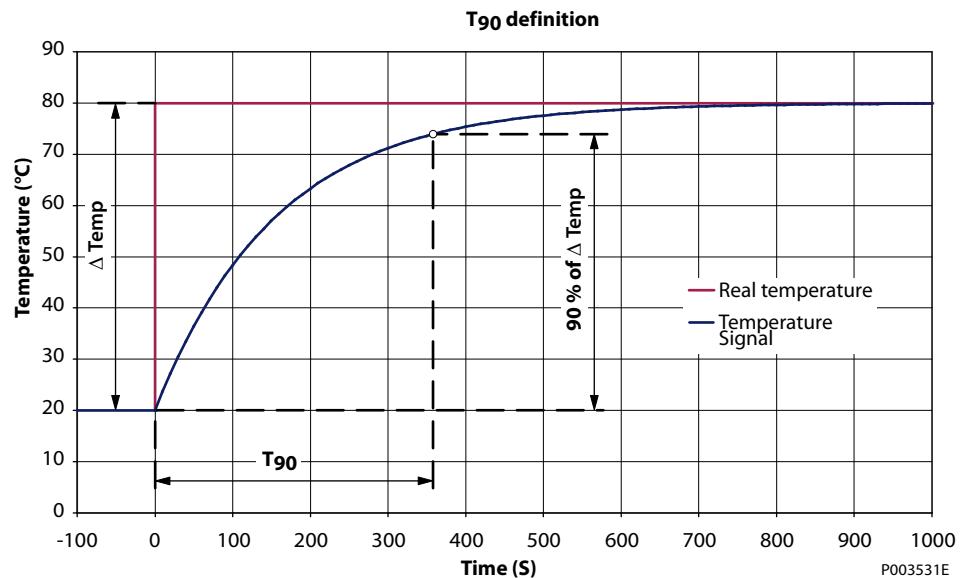
\* Accuracy: 30 ± 2.5 °C (max)

\*\* Nonlinearity ± 0.4 °C

## Speed Sensor 7 - 32 V

## Response time in fluid

Temperature sensor response time

Response time in fluid ( $T_{90}$ ) = 360 s

## Appendix

### MTTFd Values

MTTFd values are calculated per ISO 13849, assuming 50 % of all failures are dangerous.

Duty cycle is 67% and main operating temperature assumption is 80 °C. According to the internal Danfoss standard 504H0078, the daily working time is calculated with 8 hours/day and 200 working days per year.

| <b>Sensor</b>  | <b>Order Number</b> |                 |
|----------------|---------------------|-----------------|
|                | <b>149055</b>       | <b>11232698</b> |
| Supply voltage | 4,5-8V              | 7-32V           |
| Speed Signals  | two                 | two             |
| MTTFd values   | 2098 years          | 301 years       |

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