



# HAL 302x

## Fast Stray-Field Robust Motor Position Sensor Family with Analog Output



**SF**robust  
Technology

**SIX**sense

**ASIL**ready

HAL 302x is a fast angular position sensor family addressing the need for stray-field robust position sensing as well as the ISO 26262 compliance. This new sensor family features differential or single-ended sine and cosine analog outputs with passive wire-break detection working with pull-up or pull-down resistors. The rotation angle of a magnet can be calculated by an external A/D-converter and a microcontroller / ECU. This new family has three members (HAL 3020, HAL 3021 and HAL 3025). All members measure, based on Hall-effect technology, vertical magnetic-field components ( $B_z$ ). A key advantage of the HAL 3021 and HAL 3025 is their enhanced robustness against both static and dynamic mechanical tolerances, enabled by SixSense technology.

All devices are able to suppress external magnetic stray-fields by design by an array of Hall plates. Only a cost effective two-pole magnet in an end-of-shaft configuration is required to measure the absolute angular position. The magnet can be placed above or below the sensor.

Major characteristics like sine and cosine gain, offset, (absolute) 0-angle,

orthogonality and bandwidth can be adjusted using the integrated signal path by programming the non-volatile memory of HAL 302x.

HAL 3020 and HAL 3021 are defined as Safety Element out of Context (SEooC) ASIL C ready according to ISO 26262:2018. HAL 3025 is defined as SEooC ASIL D ready according to ISO 26262:2018. HAL 302x contain on-board diagnostic features, such as overvoltage and undervoltage detection as well as wire-break monitoring.

The devices are designed for operation in an ambient temperature range of  $-40\text{ }^{\circ}\text{C}$  up to  $150\text{ }^{\circ}\text{C}$ .

The sensors are available in the SOIC8 SMD package.

### Features

- High-speed  $360^{\circ}$  contactless angle measurement
- High output bandwidth for applications up to 60,000 rpm
- Very small sine/cosine delay time variation over full operating range
- Robust against DC and AC magnetic stray-fields (according to ISO 11452-8:2015)

- Up to SEooC ASIL D ready according to ISO 26262:2018 to support functional safety applications
- Wide usable magnetic range  $\pm 5 \dots \pm 250\text{ mT}$
- Various integrated diagnostic mechanisms ensure correct operation and enable simplified external safety supervision
- EMC robust differential or single-ended sine/cosine analog output signals
- Ratiometric analog outputs related to the supply voltage
- Programming via the sensor's output pin. No additional programming pin required
- Configurable signal processing parameters, like output gain, offset, (absolute) 0-angle, orthogonality and magnetic signal bandwidth
- Operates from 3.0 V up to 5.5 V supply voltage
- Operates from  $-40\text{ }^{\circ}\text{C}$  up to  $170\text{ }^{\circ}\text{C}$  junction temperature (max. ambient temperature:  $T_{A,absmax} = 160\text{ }^{\circ}\text{C}$ )
- Overvoltage and reverse-voltage protection
- AEC-Q100 qualified (Grade 0)

# HAL 302x Family Overview

Type	Device-Specific Features
HAL 3020	<ul style="list-style-type: none"> <li>- Lower current consumption</li> </ul>
HAL 3021	<ul style="list-style-type: none"> <li>- Higher robustness against static and dynamic mechanical tolerances</li> <li>- Higher signal-to-noise ratio</li> <li>- Lower inherent angular error drifts</li> <li>- Support of closer air gaps and smaller target magnets</li> </ul>
HAL 3025	<ul style="list-style-type: none"> <li>- SEooC ASIL D ready according to ISO 26262:2018</li> </ul>

## Major Applications

Thanks to the sensor's fast analog signal path and its stray-field robustness, HAL 302x is a potential solution for the following application examples:

- Rotary position measurement for commutation of:
  - brushless DC motors (BLDC)
  - permanent magnet synchronous motors (PMSM)
  - AC induction motors (ACIM)
- Powertrain actuators
- Brake-by-wire
  - Electrohydraulic braking motor
  - Electromechanical braking motor
- Electric pumps (active suspension)
- Electric valves

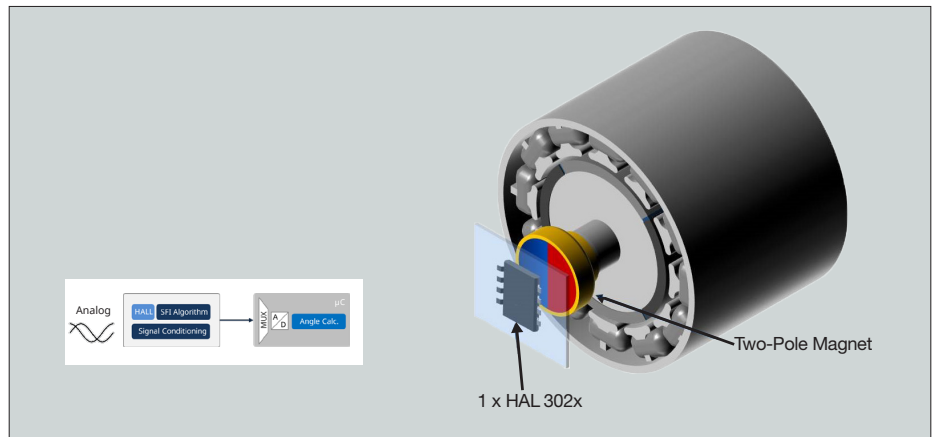


Fig. 1: Sensor application setup

## Development Tools

HAL 302x can be programmed during the final manufacturing process by adjusting the output signals directly to the input signal. With this calibration procedure, the tolerances of the sensor, the magnet, and the mechanical positioning can be compensated in the final assembly.

TDK-Micronas offers an easy-to-use evaluation kit for engineering:

- Micronas programmer board (TDK-MSP V1.x)
- USB programming kit
- LabVIEW™ programming software

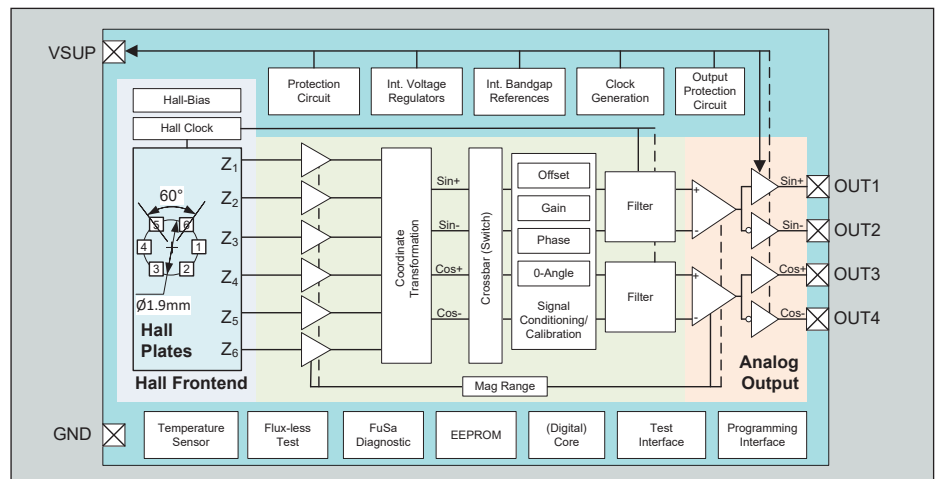


Fig. 2: Block diagram of HAL 3025

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