⬧TDK

# HAL® 302x

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

HAL 302x is a fast 2D angular position sensor family addressing the need for stray-field robust motor position sensing as well as the ISO 26262 compliant development. This new sensor family features differential or single-ended sine and cosine analog outputs with integrated wire-break detection. The rotation angle of a magnet can be calculated by an external A/D converter and a microcontroller/ECU. This new family has two members. Both members measure, based on Hall-effect technology, vertical magnetic-field components ($B_Z$). Speciality of HAL 3021 is that the device offers a higher robustness against static and dynamic mechanical tolerances.

Both devices are able to suppress external magnetic stray fields by using the array of Hall plates. Only a simple 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.

The measuring principle of the Hall plate array minimizes errors due to supply voltage and temperature variations.

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.

This product is defined as Safety Element out of Context (SEooC) ASIL C ready according to

ISO 26262:2018. HAL 302x contains on-board diagnostic features, such as overvoltage and undervoltage detection as well as wire-break monitoring during normal operation.

The device is designed for automotive and industrial applications. It operates in the ambient temperature range from –40 °C to 150 °C.

The sensor is available in the eight-pin SOIC8 SMD package.

## Features

◆ High-speed 360° contactless angle measurement

◆ EMC robust differential or single-ended sine/cosine analog output signals

◆ Non-ratiometric or ratiometric analog outputs related to the supply voltage

◆ Robust against DC and AC magnetic stray fields (according to ISO 11452-8:2015)

◆ SEooC ASIL C ready according to ISO 26262:2018 to support Functional Safety applications (The device can be integrated in automotive safety-related systems up to ASIL D)

◆ Various integrated diagnostic mechanisms ensure correct operation and enable simplified external safety supervision

◆ Operates from 3.0 V up to 5.5 V supply voltage

◆ Fast response time and high output bandwidth for applications up to 150,000 rpm

◆ Operates from –40 °C up to 170 °C junction temperature (max. ambient temperature: $T_{A,absmax}$ = 160 °C)

◆ Programming via the sensor's output pin. No additional programming pin required

◆ Programmable characteristics in a non-volatile memory (EEPROM) with redundancy and lock function

◆ Configurable signal processing parameters, like output gain, offset, (absolute) 0-angle, orthogonality and magnetic signal bandwidth

◆ Overvoltage and reverse-voltage protection

◆ Under- and overvoltage detection of $V_{SUP}$

◆ Crossbar switch for signal routing (pin assignment for output signals)

◆ Passive wire-break detection working with external pull-up or pull-down resistor

◆ On-chip temperature sensor for over-temperature supervision

◆ Qualification according to AEC-Q100

# HAL 302x

❖ MICRONAS

## HAL 302x Family Overview

| Type | Device-Specific Features |
|------|--------------------------|
| HAL 3020 | – Lower current consumption |
| HAL 3021 | – Higher robustness against static and dynamic mechanical tolerances<br>– Higher signal- to-noise ratio<br>– Lower inherent angular error drifts<br>– Support of closer air gaps and smaller target magnets |

## 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 BLDC motor commutation

◆ Clutch and transmission actuators

◆ Starter/generator systems

◆ Electromechanical brake booster

◆ Electric pumps

◆ Electric valves

## 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)

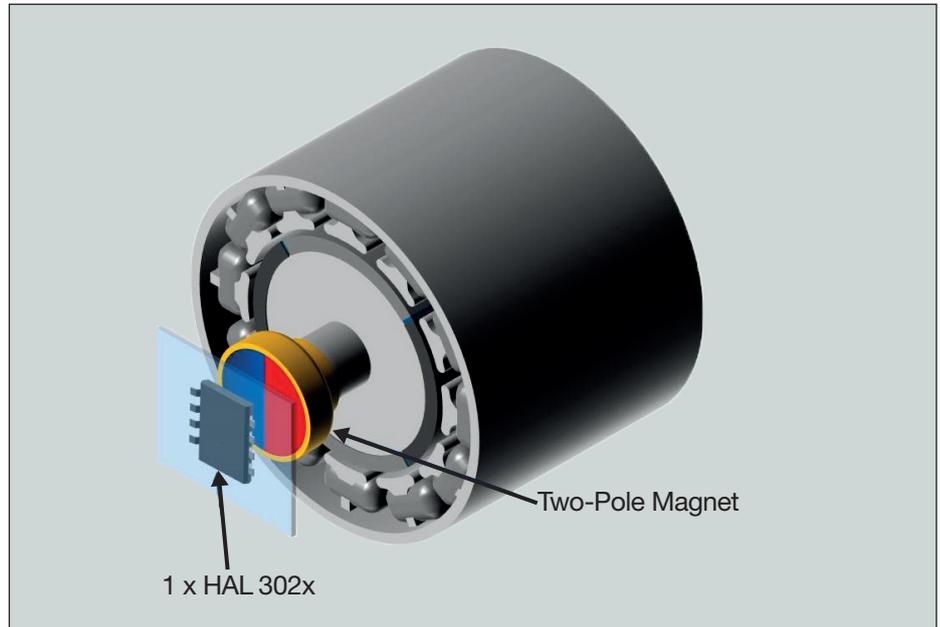◆ USB programming kit

◆ LabVIEW™ programming software for Windows®
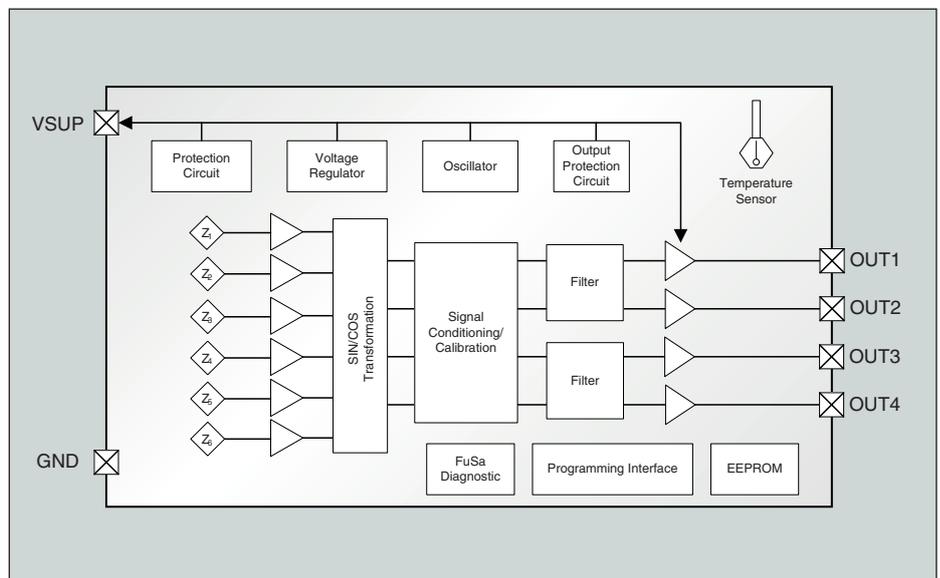


**Fig. 1:** Sensor application setup



**Fig. 2:** Block diagram of HAL 3021