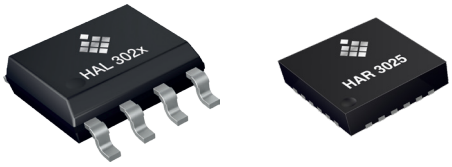
HAL/HAR 302x

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

SF robust Technology
ASIL ready
SIX sense



HAL/HAR 302x is a fast angular position sensor family addressing the need for stray-field robust position sensing as well as ISO 26262 compliance. This new sensor family features differential and 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 various members. A detailed overview can be found on the back page.

All members measure, based on Hall-effect technology, vertical magnetic-field components (B_z).
A key advantage of the HAL 3021, HAL 3025 and HAR 3025 is their enhanced robustness against both static and dynamic mechanical tolerances, enabled by the SixSense technology.

All devices are able to suppress external magnetic stray-fields by design using 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/HAR 302x.

HAL 3020 and HAL 3021 are developed as Safety Element out of Context (SEooC) ASIL C ready according to ISO 26262:2018.
HAL 3025 and HAR 3025 are developed as SEooC ASIL D ready according to ISO 26262:2018. The dual-die integration of HAR 3025 supports fail operational architectures. All devices 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 °C up to 150 °C.

The single-die versions HAL 302x are available in the compact SOIC8 SMD package. The dual-die version HAR 3025 is available in a very small QFN24 (4x4 mm) package.

Features

- High-speed 360° contactless angle measurement
- High output bandwidth for applications up to 60,000 rpm
- Very small redundant information 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 (fail safe and fail operational designs)
- Various integrated diagnostic mechanisms ensure correct operation and enable simplified external safety supervision
- Wide usable magnetic range +/-5 mT ... +/-250 mT
- EMC robust differential or single-ended sine/cosine analog output signals
- 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 °C up to 170 °C junction temperature (max. ambient temperature: $T_{A,absmax}$ = 160 °C)
- Overvoltage and reverse-voltage protection

HAL/HAR 302x Family Overview

Type	Device-Specific Features
HAL 3020	– Lower current consumption – SEooC ASIL C ready according to ISO 26262:2018
HAL 3021	– Higher robustness against static and dynamic mechanical tolerances – Higher signal-to-noise ratio – Lower inherent angular error drifts – Support of closer air gaps and smaller target magnets – SEooC ASIL C ready according to ISO 26262:2018
HAL 3025	– SEooC ASIL D ready according to ISO 26262:2018
HAR 3025	– SEooC ASIL D ready according to ISO 26262:2018 – Full redundancy in a single package through two independent stacked dies with coinciding centers of sensitivity, supporting fail operational architectures – Compact 4×4 mm QFN24 package with wettable flanks for lean automated optical inspection (AOI)

Major Applications

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

- Absolute rotary position measurement for commutation of electric motors
- Powertrain actuators
- Steer-by-wire / electric power steering (EPS) motor
  - Steering rack actuator
  - Steering wheel actuator
- HV traction motors
- Brake-by-wire
  - Electrohydraulic braking motor
  - Electromechanical braking motor
- Electric pumps (active suspension)
- Electric valves

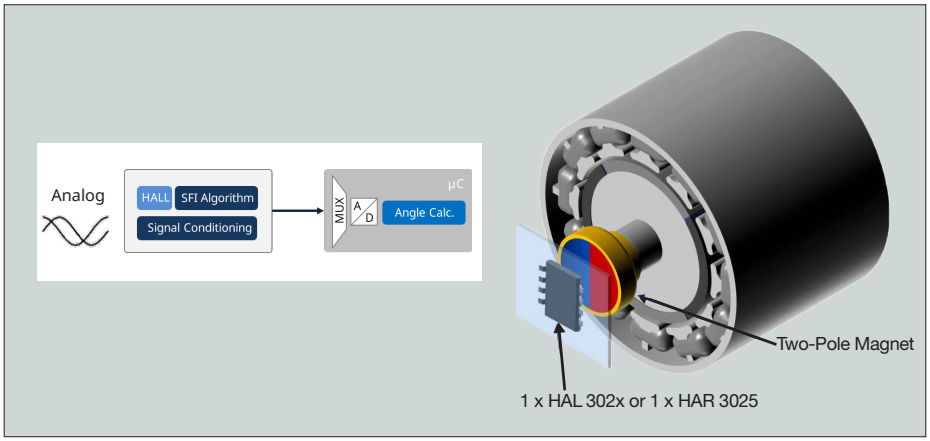


Fig. 1: Sensor application setup

Development Tools

HAL/HAR 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™ based programming software

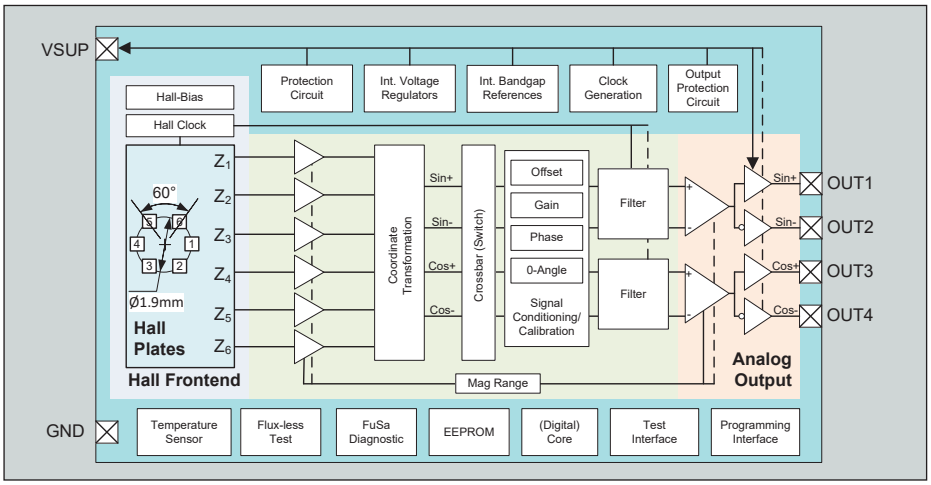


Fig. 2: Block diagram of HAL 3025

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