

Magnetic Sensors

TDK presents stray-field robust ASIL C ready Hall-effect position sensor family for high-speed e-motor applications

- TDK expands its innovative stray-field robust sensor portfolio with an optimized sensor for high-speed, low-latency motor position applications
- Best-in-class angular accuracy performance under extremely difficult mechanical and electrical conditions
- Full compliance with ISO 26262 ASIL C functional safety guidelines

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TDK Corporation (TSE:6762) introduces the Micronas fast 2D Hall-effect position sensor family HAL 302x addressing the need for stray-field robust motor position sensing as well as ISO 26262 compliant developments in automotive and industrial applications. This new sensor family initially consists of two members, HAL 3020 and HAL 3021, and features differential and single-ended sine and cosine analog outputs for standard angle calculation by an external microcontroller/ECU. HAL 3020 is the right choice for cost-effective applications like electric pumps or electric valves. For those types of applications, the sensor can easily be combined with TDK's Micronas embedded motor controller portfolio for more precise and safe motor control. HAL 3021 suits for demanding high-speed sensing applications like electric power steering, e-motors (e-axle), electric brake booster and electromechanical braking (EMB).* Samples are available now, with the start of production planned for the first half of 2024.

HAL 302x sensors can measure a full 360° rotational angle by evaluating vertical magnetic-field components (B_z). While HAL 3020 uses an array of three horizontal Hall plates, HAL 3021 uses six. Both sensors are able to suppress external DC and AC magnetic stray fields (ISO 11452-8). By suppressing harmonic disturbances in the stimulation signals through device-internal calculations, a simple and cost-efficient two-pole ferrite magnet in an on-axis (end-of-shaft) configuration is sufficient to measure the absolute angular position. Thanks to the inherent stray-field robustness, the need for expensive magnetic shielding and the use of stronger target magnets is eliminated. This gives more flexibility in the design and production of next-generation electric motors to be used in hybrid and electric vehicles.

A key strength of HAL 3021 is that the device offers best-in-class robustness against static and dynamic mechanical misalignments, such as off-axis displacement, airgap variation and tilt. This ensures highly reliable and efficient field-oriented control of motors over their lifetime. To lower the load of the ECU, the sensor can compensate on-chip for the main sensor- and system-level non-idealities, like sine and cosine amplitude mismatch, offset errors, (absolute) 0-angle, and orthogonality errors.

HAL 302x is defined as Safety Element out of Context (SEooC) ASIL C ready according to ISO 26262, supporting system level integration up to ASIL D. The sensor integrates various safety monitoring functions, which help to increase diagnostic coverage and simplify the external safety supervision on the ECU side. It operates in the junction temperature range from -40 °C to +170 °C. The sensor is available in the small eight-pin SOIC8 SMD package.

Glossary

- Stray-field compensation: Modern Hall-effect sensors must be insensitive against disturbing fields generated by e-motors or power lines in hybrid or electric vehicles (xEV)

Main applications*

- Brushless DC (BLDC) and permanent-magnet synchronous motor (PMSM) commutation in a safety-relevant environment
- Electric brake booster
- Electromechanical brake (EMB)
- Clutch and transmission actuators
- Starter/generator systems
- Electric pumps
- Electric valves

Main features and benefits**

- High-speed 360° contactless angle measurement
- 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)
- EMC robust differential and single-ended SIN/COS analog output signals
- On-chip calibration capability and integrated safety monitoring reduce effort on ECU side
- Wide customer programmable magnetic-field range between 5 and 250 mT to adjust for different mechanical requirements and magnetic fields
- 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
- Programming via the sensor’s output pin. Programmable at module level and no additional programming pin required
- Overvoltage and reverse-voltage protection

Key data	
Type	HAL 3020, HAL 3021
Package	SOIC8
Output formats	Single-ended and differential SIN/COS analog output
Angular error (over temperature and lifetime)	±0.4° (with external static orthogonality and dynamic offset and gain compensation)
Delay Time	Configurable between 5 µs to 20 µs
Safety	ASIL C ready development according to ISO 26262

* Any mention of target applications for our products are made without a claim for fit for purpose as this has to be checked at system level.

** All operating parameters must be validated for each customer application by customers’ technical experts

About TDK Corporation

TDK Corporation is a world leader in electronic solutions for the smart society based in Tokyo, Japan. Built on a foundation of material sciences mastery, TDK welcomes societal transformation by resolutely remaining at the forefront of technological evolution and deliberately “Attracting Tomorrow.” It was established in 1935 to commercialize ferrite, a key material in electronic and magnetic products. TDK’s comprehensive, innovation-driven portfolio features passive components such as ceramic, aluminum electrolytic and film capacitors, as well as magnetics, high-frequency, and piezo and protection devices. The product spectrum also includes sensors and sensor systems such as temperature and pressure, magnetic, and MEMS sensors. In addition, TDK provides power supplies and energy devices, magnetic heads and more. These products are marketed under the product brands TDK, EPCOS, InvenSense, Micronas, Tronics and TDK-Lambda. TDK focuses on demanding markets in automotive, industrial and consumer electronics, and information and communication technology. The company has a network of design and manufacturing locations and sales offices in Asia, Europe, and in North and South America. In fiscal 2022, TDK posted total sales of USD 15.6 billion and employed about 117,000 people worldwide.

About TDK-Micronas

TDK-Micronas is the center of competence for magnetic-field sensors and CMOS integration within the TDK group. TDK-Micronas has gained operational excellence for sensors and actuators production in over 25 years of in-house manufacturing. It was the first company to integrate a Hall-effect based sensor into CMOS technology in 1993. Since then, TDK-Micronas has shipped over six billion Hall sensors to the automotive and industrial market. The operational headquarters are located in Freiburg im Breisgau (Germany). Currently, TDK-Micronas employs around 1,000 people.

You can download this text and associated images from <https://www.micronas.tdk.com/en/tradenews/pr2302>.

Further information on the products can be found <https://www.micronas.tdk.com/en/products/direct-angle-sensors/hal-30xy>.

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