Hall-effect sensors

All-rounders for automotive electronics

Micronas, the manufacturer of Hall-effect sensors acquired by TDK, has now been renamed TDK-Micronas and its portfolio of products is being marketed under the Micronas product brand. A large number and variety of sensor applications can be implemented in automotive and industrial electronics using Micronas Hall sensors − from the commutation of brushless DC electric motors, to the precise measurement of steering angles.

The combination of Hall sensor and permanent magnet allows a host of variables such as rotational speed, angle, rotation, fill level, pressure, torque or current to be measured. Compared to other technologies, Hall sensors have the advantage that they are not sensitive to dust, contamination or water, provided they are optimally enclosed. As they make no physical contact with the object being measured, they experience virtually no wear and are therefore extremely reliable.

Hall switches

When a magnet is brought near to the sensor, the measured magnetic field strength is compared with a threshold value. As soon as this value (switching point) is exceeded, the switching status changes at the output of the sensor which, depending on its type, exhibits unipolar, bipolar or latch-switching behavior.

For this purpose, TDK offers two families of Micronas switches: the programmable switches of the HAL 10xy and HAL15 xy series with predefined characteristic values. The HAL 15xy series was designed primarily for automotive applications and meets the requirements for functional safety according to ISO 26262. This switch is available in TO92 or SOT23 packages as 3-wire or 2-wire versions. The latter has a current source output and therefore only needs two supply cables. Typical applications are end position detection and rotational speed measurement.

Hall switches are increasingly replacing conventional microswitches, for example in seat belt buckles. Moreover, they can be used in combination with a motor controller for the commutation of brushless DC electric motors.

Linear Hall-effect sensors

Path measurements or the measurement of rotary movements require the more complex Micronas linear Hall sensors with linear output characteristics which output a signal that is proportional to the magnetic field strength. This signal can be provided as an analog output voltage, a pulse width modulated signal (PWM) or in the SENT protocol. The TDK portfolio includes four programmable linear Hall sensor series. The output characteristic can be linearized with the aid of as many as 32 grid points. This enables tolerances of the magnets or of the mechanical design to be fully compensated.

The latest generation of Micronas HAL 24xy sensors has diagnostics capability and was designed for precise distance measurement up to 40 mm and for angle measurements up to 180 degrees. Designed for use in particularly safety-critical drive-by-wire applications, the HAR 24xy sensor variant can offer a redundancy function. In this case, two independent sensor chips (dual-die) are integrated into a single TSSOP package. Applications include magnetic field measurements and the substitution of conventional potentiometers that are prone to wear. In vehicle applications linear Hall sensors are used in particular for detecting pedal positions or steering torque.
Direct angle sensors

Whereas linear sensors (1D) measure only the absolute magnetic field, direct angle sensors (2D) are also capable of capturing the field vector. In addition to the magnetic field component perpendicular to the chip surface, vertical Hall elements measure the components in the chip plane. From this, the internal signal processing calculates angle and position information.

The Micronas HAL 37xy series of sensors uses the in-house 3D-HAL technology and offers a high degree of measuring accuracy. Apart from the output characteristic, the main characteristics can be adapted to the magnetic circuit by programming the non-volatile memory. The HAC 37xy is equipped with integral capacitors, in order to achieve the best EMC properties, saving both money and space, and also to facilitate applications without printed circuit boards. HAR 37xy is the dual-die version of the HAL 37xy series. Typical areas of application include high-precision measurement of magnetic field orientation or linear movement of up to 40 mm and angles of up to 360 degrees. Direct angle sensors are ideally suitable for the detection of the position of the throttle valve or clutch pedal.

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