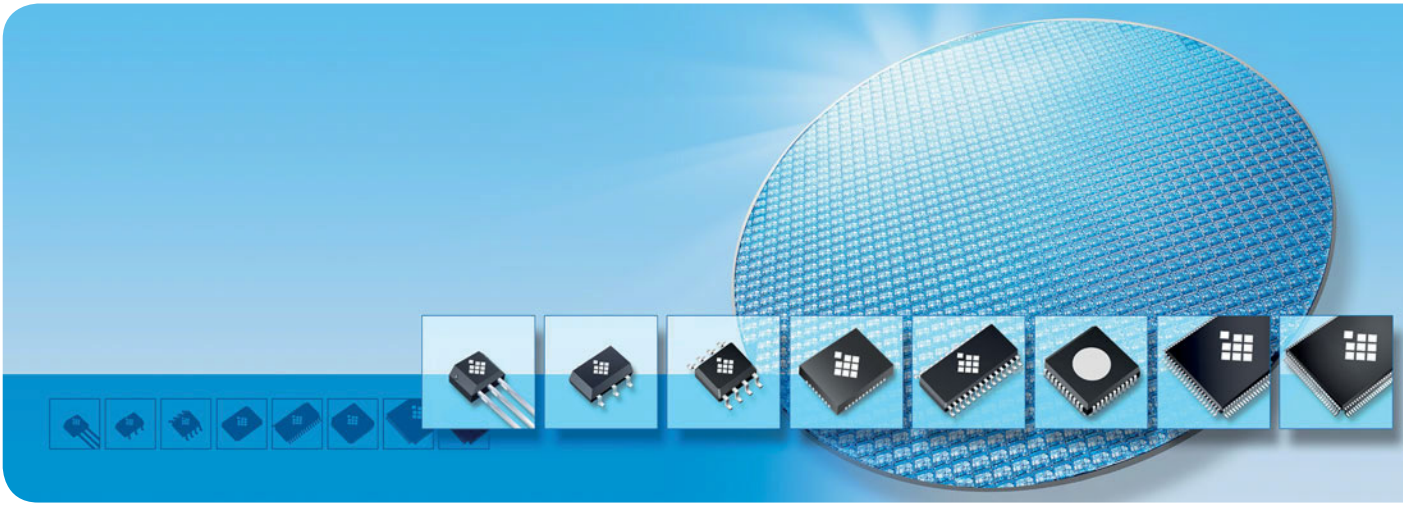
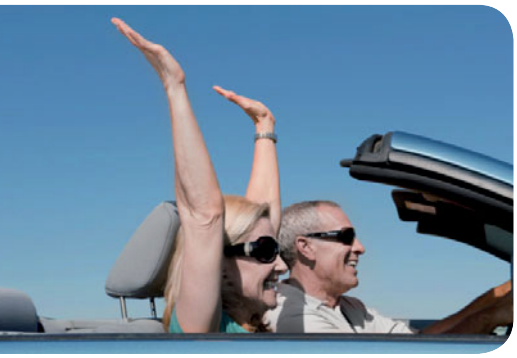
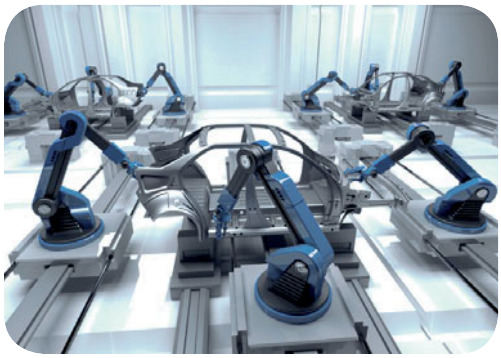
MICRONAS



# Explore Intelligent Technologies

Sensors and Embedded Controllers
for Automotive and Industrial 2012/2013





# About Micronas



Micronas (SIX Swiss Exchange: MASN) is known and recognized in the automotive and industrial business as a reliable global acting partner for intelligent, sensor-based system solutions. Micronas offers a variety of Hall sensors and embedded controllers for smart actuators for automotive and industrial applications, such as drive trains, chassis frames, engine management, and convenience functions.

Micronas serves all major automotive electronics customers worldwide, many of them in continuous partnerships seeking joint success. While the holding company is headquartered in Zurich (Switzerland), operational headquarters are based in Freiburg (Germany). Currently, the Micronas Group employs around 900 persons. For more information about Micronas and its products, please visit www.micronas.com.

**Sensor solutions from Micronas – from the idea to the finished product**

Micronas is one of the rare manufacturers worldwide that is able to develop and produce semiconductor solutions literally under one roof. Innovative ideas from top-class engineers are realized just a few meters away by the site's own plant including front-end, back-end and final testing in the operational headquarters Freiburg, Germany.

**Supply of more than 500 million linear Hall sensors**

In May 2010, Micronas delivered the 500 millionth linear Hall sensor of the HAL 8xy family. The HAL 8xy family is mainly used in cars to control throttle valves and adjust headlights, as well as in electrical power steering systems and fuel level measurement. The success of these linear Hall sensors is based on their programmability via an EEPROM (electrically erasable programmable read-only memory) on the chip itself – which is a unique feature – and their resistance to a wide range of junction temperatures from –40 to +170 °C.

**Key figures as at December 31, 2011**

Around 900 employees

CHF 159 million net sales

CHF 11.5 million profit for the period

# Corporate Principles



**Quality has Top Priority**

We do not make compromises – and therefore aim to zero ppm. The success and the satisfaction of our customers is our measure of quality. We deliver our customers with high-grade products at reasonable prices and with best support. Therefore, we make a great effort to ensure highest quality and reliability. The immediate reaction to quality matters has top priority. Everyone here at Micronas is brought to report quality issues before they could affect our products corresponding to our principle - prevention instead of correction.

Our quality management is geared to the international series of standards ISO 16949 and fulfills the high requirements of the automotive industry. Periodically, key figures are determined and audits are held to assess its efficiency.

zero ppm automotive

**We carry Responsibility**

As an international company, we have a global responsibility to protect the environment. Our economic success-oriented acting has to meet ethic and ecological standards. Our primary goal is to prevent and avoid environmental impacts and safety risks during normal operation and in the event of an emergency, rather than limiting effects or damages. All of our activities are targeted not only to a short time but to sustainable process optimizing and behavior changing. This requires making optimum use of the resources we consume and a forward-looking assessment of potential environmental impacts in all cases.

The group's commitment to environmental protection dates back long time ago: Since as early as the mid-80s, a dedicated department has been working on the issues addressed and standardized by ISO 14001 and EMAS. Micronas finally was certified to ISO 14001 for the first time in 2000 and to EMAS in 2002. The recent certifications confirm that the results of the efforts undertaken meet all requirements of both standards.

**AAA Certificate**

ACE Risk Management Services also affirms the high standard of property loss control by the issuance of the AAA Certificate to Micronas.

**AEO Certificate**

Supply chain security refers to efforts to enhance the security of the supply chain: the transport and logistics system for the world's cargo.
Authorised Economic Operator (AEO) is an accreditation granted to businesses that satisfy strict customs criteria to demonstrate consistent quality, compliance and trustworthiness in the international supply chain.

ISO 9001 Certificate

ISO 16949 Certificate

EMAS Certificate

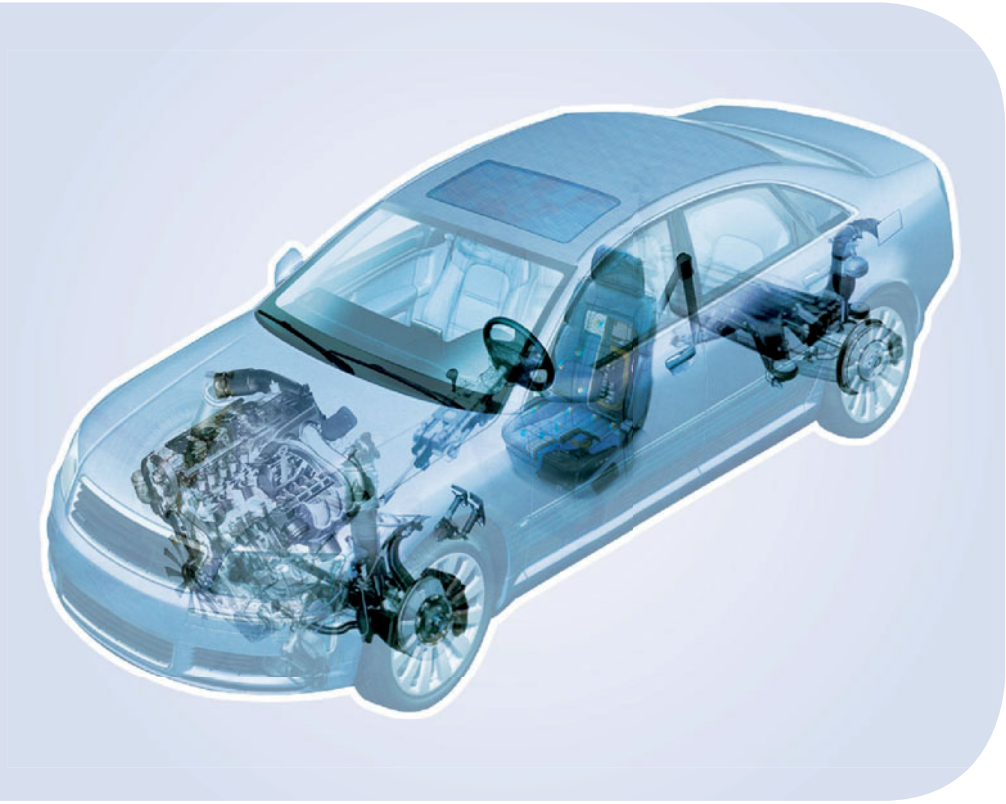
ISO 14001 Certificate

AAA Certificate


AEO Certificate

# Application Fields

## Automotive



In automotive electronics, Micronas is focusing both on highly integrated control systems for car interior applications, as well as on sensor systems for a wide range of applications. They require on one hand rather simple Hall switches to detect a position and on the other hand quite complex linear Hall-effect sensors for the measurement of a travel distance or of a rotational movement. Beyond that, with its embedded controller HVC 2480B Micronas offers an utmost level of integrated functionality applicable at various places in the car, e.g. LED fan control for headlights, automated grill module (AGM), window lifter, door lock module, sunroof control, etc.

The variety of integrated modules and functions (all-in-one solution) minimizes the number of required external components in most cases almost to zero. Thus, the reliability of the entire system increases because of the omission or reduction of soldered and mechanical connections as well as PCB area leading to less points of attack for electrical and mechanical disturbances. This becomes noticeable in a low effort of resources, costs and time for the development, as well as low costs and effort to steadily use the system by providing a maximum of energy efficiency and environmental compatibility.

### Powertrain

High accuracy sensors designed to withstand harsh environments: Insensitive to vibrations, temperature drift and dirt.

HAL 825 Throttle Position Sensor (TPS), Exhaust Gas Recirculation (EGR)

HAL 855 Movement Detection in Clutch

HAL 182x Travel Measurement (Dual-Clutch)

HAL 549 End-Position Detection in Clutch

HVC 2480B Smart Actuator

### Chassis and Body

Programmable sensors with integrated communication links provide flexibility.

HAL 506 Brake Pedal: End-Position Sensor

HAL 825 Accelerator Pedal Sensor (APS): Travel Measurement

HAL 880 Seat Position

HAL 2850 Steering Torque Sensor

### Safety and Security

Proven history of meeting Automotive's highest quality standards. Expanding portfolio addresses increasing safety requirements.

HAL 710/730 Window Lifter

HAL 566 Central Lock

HAL 574 Roof Rack Detection

HAL 85x Electric Parking Brake (EPB)

HAL 8x5 Seat Belt Force Sensor

# Application Fields

## Industrial

Micronas' sensor and embedded controller solutions are also sought after in non-automotive applications. They are widely used in all types of white goods, such as washing machines, tumble dryers, and induction cookers, as well as heating and cooling systems. Further areas of applications can be found in the industrial arena, for example to control robots or to automate assembly equipment. Hall-effect sensors can be found in almost any machine that needs to measure position, linear or rotational movement or even current. By means of the Hall-effect other parameters can also be measured indirectly like rpm, leveling, pressure, force or even torque.

More and more industrial and white goods applications require reliable sensing solutions and even smart sensors reflect the market demand for energy efficient solutions. With the high integration level of our HVC 2480B embedded controller we are directly targeting a significant reduction on system cost level by means of reduced weight, space and overall components of the system. On top of that, the overall quality of the system increases. With both product lines Hall-effect sensors as well as embedded controllers we can offer our customers attractive system solutions.

**Heavy Machines / Factory Automation**

Micronas products have been developed to meet the demands for long lifetime and high reliability in harsh environments.

HAL 202 BLDC Motor (Commutation)
HAL 502 Linear Encoder
HAL 817 Industrial Joystick
HAL 1000 Front Lever Position

**Building, Home, and Office Automation**

Micronas products offer intelligent sensor solutions for smart automation networks for an increased comfort and lifestyle.

HAL 817 Valve/Flap Position
HAL 202 Rolling Shutter Position
HAL 1821 Current Measurement

**White Goods / Home Appliances**

Micronas offers a wide range of cost-effective sensor solutions for eco-friendly home appliances at minimal size.

HAL 210 Flow Meter
HAL 101 Selection Switch
HAL 202 BLDC Motor (Commutation)
HAL 401 Control Knob
HAL 565 Door Lock

# Overview of Major Product Families



## Hall Switches

### Single Hall Plate

**HAL 1xy**

- 3-wire output
- Different switching points
- $T_J$ =–20 to 125 °C
- TO92 or SOT89 package

**HAL 2xy**

- Open-drain output
- Chopper stabilized
- Different switching points
- $T_J$ =–40 to 140 °C
- TO92 or SOT89 package

**HAL 5xy**

- 3-wire- and 2-wire open-drain output
- Chopper stabilized
- High-precision thresholds
- Different switching points
- $T_J$ =–40 to 170 °C
- TO92 or SOT89 package

### Dual Hall Plate

**HAL 3x0**

- Open-drain output
- Zero speed differential sensor
- Chopper stabilized
- $T_J$ =–40 to 170 °C
- TO92 or SOT89 package

**HAL 7xy**

- Open-drain output
- Speed and direction signal
- Chopper stabilized
- Different switching points
- $T_J$ =–40 to 140 °C
- SOT89 package

## Linear Distance Sensors

**HAL 4xy**

- $T_J$ =–40 to 170 °C
- SOT89 package

**HAL 4x1**

- Differential output
- Magnetic flux range: –50...+50 mT
- Chopper stabilized

**HAL 8xy**

- $T_J$ =–40 to 170 °C
- TO92 or SOIC8 package
- Programmable (EEPROM)

**HAL 81x/82x**

- Different linear output formats (Analog, PWM)
- High accuracy

**HAL 85x**

- Arbitrary Output Characteristic
- Different output formats (PWM, Serial Output)

**HAL 880**

- Analog Output
- Limited Temperature Range

**HAL 18xy**

- $T_J$ =–40 to 170 °C
- TO92 or SOT89 package
- Ratiometric analog output

**HAL 1820**

- Programmable (EEPROM)
- Value-optimized version (10 bit)

**HAL 1821/22/23**

- Pre-configured sensitivity (EEPROM)
- Value-optimized version (10 bit)

**HAL 24xy**

- $T_J$ =–40 to 170 °C
- TO92 package
- Programmable (EEPROM)
- High-precision sensors
- Extended distance measurement

**HAL 2420**

- 2-point calibration

**HAL 2425**

- 2-point calibration
- 16 setpoints linearization

**HAL 28xy**

- $T_J$ =–40 to 170 °C
- TO92 package
- Programmable (EEPROM)
- High-precision sensors
- Digital output
- Direct battery connection

**HAL 283x**

- SENT interface
- Up to 16-bit resolution

**HAL 2850**

- PWM output
- 12-bit resolution

**HAL 38xy**

- $T_J$ =–40 to 170 °C
- SOIC8 package
- Programmable (EEPROM)
- Extended distance measurement

**HAL 3855**

- Position and distance measurement
- Programmable characteristics in a non-volatile memory
- 32 setpoints linearization

# Overview of Major Product Families

## Direct Angle Sensors

**HAL 36xy**
- $T_J$ =–40 to 170 °C
- SOIC8 package
- Programmable (EEPROM)

**HAL 3625**
- Ratiometric output
- Measurement of rotating angles in a range of 0° to 360°
- High accuracy
- Programmable characteristics in a non-volatile memory

## Current Transducers

**CUR 310x**
- $T_J$ =–40 to 170 °C
- TO92 or SOIC8 package

**CUR 3105**
- Ratiometric output
- High-precision current transducer
- Digital signal processing

**CUR 311x**
- $T_J$ =–40 to 170 °C
- SOIC8 package

**CUR 3115**
- Ratiometric output
- High-precision current transducer
- Digital signal processing
- "Die down" package

## Gas Sensors

**GAS 86xyB**
- $T_J$ =–40 to 85 °C
- QFN20 open cavity package
- 2 independent gas sensing devices
- Target gases: $NO_2$, $NH_3$, $H_2$, and VOC
- Integrated temperature and relative humidity sensor
- Digital SPI interface

**GAS 8614B**
- Target gases: $H_2$ + $NH_3$

**GAS 8616B**
- Target gases: $H_2$ + $NO_2$

**GAS 8645B**
- Target gases: $NH_3$ + VOC

**GAS 8646B**
- Target gases: $NH_3$ + $NO_2$

**GAS 8656B**
- Target gases: $NO_2$ + VOC

## Embedded Controllers for Smart Actuators

**HVC 24xyB**
- $T_J$ =–40 to 150 °C
- QFN40 package

**HVC 2480B**
- Supply voltage: 9 V ... 18 V
- Three integrated half-bridges for direct driving of small motors up to 3 × 300mA
- Directly driving motors with up to 3 × 300 mA
- Driving of motors with higher current via external half-bridges
- LIN 2.x transceiver

# Introduction



Edwin Herbert Hall (1855–1938) was an US American physicist. In 1879 he made a revolutionary discovery while working on his dissertation at the Harvard University: In his experiments Hall exposed thin gold leaf on a glass plate and taped off the gold leaf at points down its length. Then he perpendicularly applied a magnetic field. The effect was a potential difference on opposite sides of this thin sheet of gold through which flew an electric current. Later he used various other conducting and semiconducting materials. Little by little Hall discovered the background of this phenomenon. The electrons of the current flow in an electrical conductor are diverted from their normal direct path by an outer magnetic field perpendicular to their motion. Due to the so-called Lorentz force, a potential difference is created, proportional to the field strength of the magnetic field and to the current strength. Since that time the Hall-effect carries the name of its discoverer.

Nowadays, Silicon is used almost exclusively as a basic material for the technical implementation of magnetic field sensors, as the Hall-effect is most pronounced in semiconductors. In modern Hall-effect sensor devices, the magnetic field sensitive Hall element is combined with the signal processing on a single silicon chip. Owing to their various advantages like contactless sensing and high reliability, Hall-effect sensors are indispensable components in the automotive and industrial sector. Three different types of sensor architecture are available today:

**Hall Switches**

The simplest application is to use the sensor as a "digital switch". The magnetic field strength is measured and compared with a fixed threshold level predefined or programmable in the sensor. As soon as this value is exceeded (switching point) the switching state at the output of the sensor changes and the output transistor is switched on or off. Two types of switches are available. 3-wire version with an open-drain output or 2-wire versions with current-coded output.

**Linear Hall Sensors**

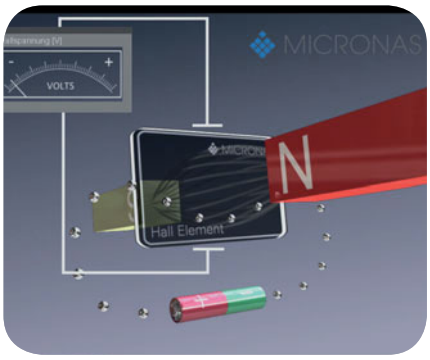
Linear Hall sensors differ from the switches as follows: Depending on the magnetic field, the output does not have a discrete switching state, but provides a signal proportional to the magnetic field strength. This output signal can be delivered as an analog output voltage, a pulse-width-modulated signal (PWM) or even as a modern bus protocol (SENT).

**Direct Angle Sensors**

New types of Hall-effect sensors do not measure the absolute magnetic field anymore. So-called direct angle sensors capture the field vector by measuring sine and cosine components of the magnetic field. This is possible due to the new 3D HAL technology from Micronas. Vertical Hall plates measure the magnetic field components in the chip plane and not the components perpendicular to the chip surface. These kind of sensors provide angular and position information directly via an output signal proportional to the measured angle or position.

# Functions and Generic Applications

## Functions




**Position Detection**
Hall switches are commonly used for end-position detection. The sensor recognizes the presence of a magnetic field by signaling an ON/OFF state. Therefore Hall switches are widely used to replace micro switches, offering superior quality and durability performance.

**Linear Movement**
In many applications, linear sensors are used that provide a signal proportional to the linear movement being measured. The output signals can be analog or in digital formats. Hall-effect sensors are widely used to replace conventional potentiometers due to these proven advantages.

**Current Measurement**
Depending on the application requirements, linear Hall sensors can either be utilized to indicate max/min levels or the direct current level providing an analog output value proportional to the current level.

## Generic Applications

**RPM Measurement**
When applying a magnet to a propeller or tooth wheel, the Hall-effect sensor (typically a Hall switch) detects the change of the magnetic field (ON/OFF state) and counts these changes.

**Rotary Position**
Typically linear and direct angle Hall sensors are used in applications where a rotary position has to be continuously measured. Both sensor types output a signal, which is proportional to the angular positions. Linear Hall sensors are typically used for smaller angular ranges whereas a direct angle sensor is well suited for angles up to 360°.

**Leveling**
The measurement of a liquid level is carried out via detection of either a rotary position (when a float gauge module is used) or a linear movement.

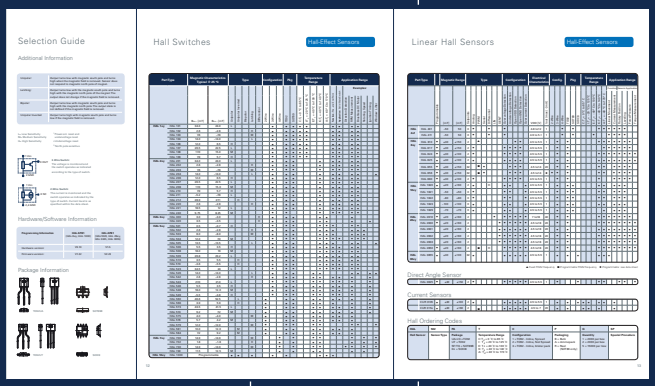
**Force/Pressure Measurement**
The Hall-effect sensor detects the displacement of a spring or a membrane when applying force or pressure to it. The displacement is nothing but a linear movement.

**Torque Measurement**
Torque measurement represents a subform of force measurement. When a force or torque is applied, the displacement of one object or two objects adjacent to each other can be measured by a linear Hall sensor.

# Selection Guide

## Hall-Effect Sensors

Guide Linear Distance Sensors




Guide Hall Switches

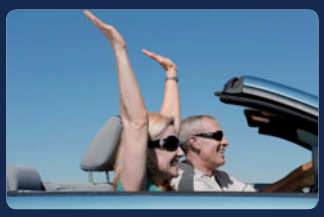
Guide Current Transducers

## Functions

- Position Detection
- Linear Movement
- Current Measurement

## Generic Applications

- RPM Measurement
- Rotary Position
- Leveling
- Force/Pressure Measurement
- Torque Measurement




PRESSURE · EMBEDDED CONTROLLER · HUMIDITY · GAS · POSITION

CURRENT · TEMPERATURE · TORQUE · DISTANCE · ANGLE

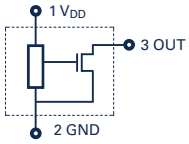
# Selection Guide

## Additional Information

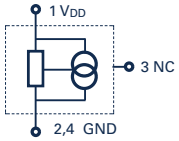
| | |
|---|---|
| Unipolar: | Output turns low with magnetic south pole and turns high when the magnetic field is removed. Sensor does not respond to magnetic north pole of magnet. |
| Latching: | Output turns low with the magnetic south pole and turns high with the magnetic north pole of the magnet. The output does not change if the magnetic field is removed. |
| Bipolar: | Output turns low with magnetic south pole and turns high with the magnetic north pole. The output state is not defined if the magnetic field is removed. |
| Unipolar Inverted | Output turns high with magnetic south pole and turns low if the magnetic field is removed. |

L= Low Sensitivity
M= Medium Sensitivity
H= High Sensitivity

[1] Power-on reset and undervoltage reset
[2] Undervoltage reset
[3] North pole sensitive
[4] 16 setpoints
[5] "Die down" package




**3-Wire Switch:**
The voltage is monitored and the switch operates as indicated according to the type of switch.

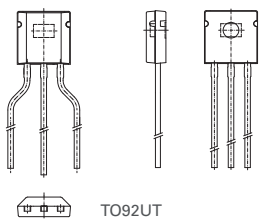



**2-Wire Switch:**
The current is monitored and the switch operates as indicated by the type of switch. Current level is as specified within the data sheet.

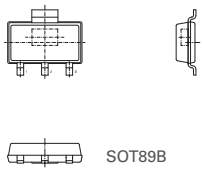
## Hardware/Software Information

| **Programming Information** | **HAL APB1** (HAL 8xy, HAL 1000) | **HAL APB1** (HAL1820, HAL 28xy, HAL 3625, HAL 3855) |
|---|---|---|
| Hardware version: | V5.10 | V1.5 |
| Firmware version: | V1.32 | V2.23 |

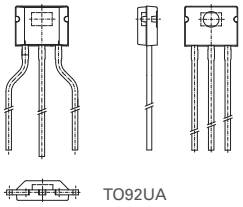
## Package Information



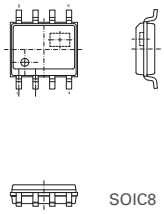
TO92UT



SOT89B



TO92UA



SOIC8

## Switches

| Part Type | | Magnetic Characteristics Typical @ 25 °C | | Type | | | | | Configuration | | | Pkg | | Temperature Range | | | | | Application Range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Examples: | | | | | | |
| | | $B_{ON}$ – [mT] | $B_{OFF}$ – [mT] | Unipolar | Unipolar Inverted | Bipolar | Latching | Differential | 2-Wire | 3-Wire | 4-Wire | TO92 | SOT89 | C: $T_J$ = 0 °C to 85 °C | I: $T_J$ = -20 °C to 125 °C | E: $T_J$ = -40 °C to 100 °C | K: $T_J$ = -40 °C to 140 °C | A: $T_J$ = -40 °C to 170 °C | **Function:** Pos. and End-Point | **Application:** Solid State Switch | Direction Detection | RPM Measurement | Brushless DC Motor | Rotating Speed | Ignition Timing | Window Lifter |
| **HAL 1xy** | HAL 101 | 34.0 | 24.0 | L | | | | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 102 | 2.6 | –2.6 | | | | H | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 103 | 7.6 | –7.6 | | | | M | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 104 | 14.0 | –14.0 | | | | L | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 106 | 12.0 | 6.5 | H | | | | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 107 | 26.5 | 22.5 | L | | | | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 108 | 17.0 | 15.0 | M | | | | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| | HAL 109 | 7.9 | 5.7 | H | | | | | | ● | | ● | ● | ● | ● | | | | ● | ● | | ● | ● | | | |
| **HAL 2xy** | HAL 201 | 34.0 | 24.0 | L | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 202 | 2.6 | –2.6 | | | | H | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 203 | 7.6 | –7.6 | | | | M | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 204 | 14.0 | –14.0 | | | | L | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | ● |
| | HAL 206 | 12.0 | 6.5 | H | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 207 | 26.5 | 22.5 | L | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 208 | 17.0 | 15.0 | M | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 210[1] | 7.9 | 5.7 | H | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 211[1] | –5.2 | –7.6 | | H | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 212 | 28.9 | 27.1 | L | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 220[1] | 2.6 | –2.6 | | | | H | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 221[1] | 18.5 | 12 | L | | | | | | ● | | ● | ● | | | | ● | | ● | ● | | ● | ● | | | |
| | HAL 240 | 9.75 | 8.25 | M | | | | | | ● | | ● | | | | | ● | | ● | ● | | ● | ● | | | |
| **HAL 3xy** | HAL 300 | 1.2 | –1.0 | | | | | H | | ● | | ● | ● | | | | ● | ● | | | | ● | | | | |
| | HAL 320 | 3.5 | –3.5 | | | | | H | | ● | | ● | ● | | | | ● | ● | | | | ● | | | ● | |
| **HAL 5xy** | HAL 501 | 0.5 | –0.7 | | | H | | | | ● | | ● | ● | | | | ● | ● | ● | | | ● | ● | | | |
| | HAL 502 | 2.6 | –2.6 | | | | H | | | ● | | ● | ● | | | | ● | ● | ● | | | ● | ● | ● | | |
| | HAL 503 | 8.0 | –8.0 | | | | M | | | ● | | ● | ● | | | | ● | ● | ● | | | ● | ● | ● | | |
| | HAL 504 | 12.0 | 7.0 | M | | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | ● | | |
| | HAL 505 | 13.5 | –13.5 | | | | L | | | ● | | ● | ● | | | | ● | ● | ● | | | ● | ● | | | ● |
| | HAL 506 | 5.5 | 3.5 | H | | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 508 | 18.0 | 16 | M | | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 509 | 26.8 | 23.2 | L | | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 516 | 3.5 | 5.5 | | H | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 519[3] | –3.6 | –5.5 | | H | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 523 | 34.5 | 24 | L | | | | | | ● | | ● | ● | | | | ● | ● | ● | ● | | ● | ● | | | |
| | HAL 526 | 14.0 | –14.0 | | | | L | | | ● | | ● | ● | | | ● | ● | | | | | ● | ● | | ● | ● |
| | HAL 542[1] | 2.6 | –2.6 | | | | H | | | ● | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 543[1] | 27.0 | 21.0 | L | | | | | | ● | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 546[1] | 5.5 | 3.5 | H | | | | | | ● | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 548 | 18.0 | 12.0 | M | | | | | | ● | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 549[2,3] | –5.5 | –3.6 | H | | | | | | ● | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 560 | 46.6 | 52.5 | | L | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 566 | 3.9 | 5.9 | | H | | | | ● | | | ● | ● | | | ● | ● | | ● | | | ● | | | ● | |
| | HAL 573 | 43.5 | 41.5 | L | | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 574 | 9.2 | 7.2 | M | | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | ● | |
| | HAL 575 | 4.0 | –4.0 | | | | M | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | | |
| | HAL 576 | 5.7 | 4.2 | M | | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | | |
| | HAL 579 | 12.0 | –12.0 | | | | M | | ● | | | ● | ● | | | ● | ● | | | | | ● | ● | | | ● |
| | HAL 581 | 10.0 | 12.0 | | M | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | | |
| | HAL 584 | 7.2 | 9.2 | | M | | | | ● | | | ● | ● | | | ● | ● | | ● | ● | | ● | | | | |
| **HAL 7xy** | HAL 700 | 14.9 | –14.9 | | | | M | | | | ● | | ● | | | ● | ● | | | | | ● | | ● | | ● |
| | HAL 702 | 1.8 | –1.8 | | | | H | | | | ● | | ● | | | ● | | | | | | ● | | ● | | ● |
| | HAL 730 | 14.9 | –14.9 | | | | M | | | | ● | | ● | | | ● | ● | | | | ● | ● | | ● | | ● |
| | HAL 740 | 11.5 | 12.5 | M | | | | | | | ● | | ● | | | ● | ● | | | | | ● | | ● | | |
| **HAL 10xy** | HAL 1000 | Programmable | | ● | ● | | ● | | | ● | | ● | | | | | ● | ● | ● | | | | | | | |

## Linear Distance Sensors

| Part Type | | | Magnetic Range | | Type | | | | | | Configuration | | | | | Electrical Characteristics | | Config. | | | Pkg | | | Temperature Range | | | | | Application Range | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Function | | Generic Application | | | |
| | | Programmable | [mT] | [mT] | Setpoints | Analog | PWM | Serial | Differential | SENT | Overvoltage Detection | Undervoltage Detection | Open VDD Detection | Open GND Detection | Overcurrent Detection | VDD [V] | Iout (max) - [mA] | 2-Wire | 3-Wire | 4-Wire | TO92 | SOT89 | SOIC8 | C: $T_J$ = 0 °C to 85 °C | I: $T_J$ = –20 °C to 125 °C | E: $T_J$ = –40 °C to 100 °C | K: $T_J$ = –40 °C to 140 °C | A: $T_J$ = –40 °C to 170 °C | Linear Movement | Current Measurement | Rotary Position | Leveling | Force/Pressure | Torque Measurement |
| **HAL 4x1** | HAL 401 | | –50 | 50 | 0 | ● | | | ● | | ● | | | | | 4.8 to 12 | 1 | | | ● | | ● | | | | | ● | ● | ● | ● | ● | ● | | |
| | HAL 411 | | –50 | 50 | 0 | ● | | | ● | | ● | | | | | 4.9 to 5.1 | 1 | | | ● | | ● | | | | ● | | | ● | ● | ● | ● | | |
| **HAL 8xy** | HAL 810 | ● | ±30 | ±150 | 2 | | ▲ | | | | | | ● | ● | | 4.5 to 5.5 | 1 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | HAL 817 | ● | ±30 | ±150 | 2 | ● | | | | | ● | ● | ● | ● | | 4.5 to 5.5 | 1 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | HAL 825 | ● | ±30 | ±100 | 2 | ● | | | | | ● | ● | ● | ● | | 4.5 to 5.5 | 1 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 855 | ● | ±30 | ±150 | 32 | | ■ | ● | | | | ● | ● | ● | | 4.5 to 14 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | HAL 856 | ● | ±30 | ±150 | 32 | | ■ | ● | | | | ● | ● | ● | | 4.5 to 14 | ◆ | ● | | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | HAL 880 | ● | ±30 | ±100 | 2 | ● | | | | | ● | ● | ● | ● | | 4.5 to 5.5 | 1 | | ● | | ● | | ● | | | | ● | | ● | ● | ● | ● | ● | |
| **HAL 18xy** | HAL 1820 | ● | ±20 | ±160 | 2 | ● | | | | | ● | ● | | | ● | 4.5 to 5.5 | 1 | | ● | | ● | ● | | | | | ● | ● | ● | ● | ● | | | |
| | HAL 1821 | | –50 | +50 | 0 | ● | | | | | ● | ● | | | ● | 4.5 to 5.5 | 1 | | ● | | ● | ● | | | | | ● | ● | ● | ● | ● | | | |
| | HAL 1822 | | –80 | +80 | 0 | ● | | | | | ● | ● | | | ● | 4.5 to 5.5 | 1 | | ● | | ● | ● | | | | | ● | ● | ● | ● | ● | | | |
| | HAL 1823 | | –100 | +100 | 0 | ● | | | | | ● | ● | | | ● | 4.5 to 5.5 | 1 | | ● | | ● | ● | | | | | ● | ● | ● | ● | ● | | | |
| **HAL 24xy** | HAL 2420 | ● | ±200 | ±200 | 2 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1.2 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 2425[4] | ● | ±200 | ±200 | 2 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1.2 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| **HAL 28xy** | HAL 2830 | ● | ±20 | ±160 | 2 | | | | | ● | ● | ● | ● | ● | ● | 4.5 to 18 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 2831 | ● | ±20 | ±160 | 2 | | | | | ● | ● | ● | ● | ● | ● | 4.5 to 18 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 2832 | ● | ±20 | ±160 | 2 | | | | | ● | ● | ● | ● | ● | ● | 4.5 to 18 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 2833 | ● | ±20 | ±160 | 2 | | | | | ● | ● | ● | ● | ● | ● | 4.5 to 18 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | HAL 2850 | ● | ±20 | ±160 | 2 | | ■ | | | | ● | ● | ● | ● | ● | 4.5 to 18 | 20 | | ● | | ● | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| **HAL 38xy** | HAL 3855 | ● | ±30 | ±100 | 32 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1 | | ● | | ● | | ● | | | | ● | ● | ● | ● | ● | | | |

▲ Fixed PWM frequency ■ Programmable PWM frequency ◆ Programmable: see data sheet

## Direct Angle Sensor

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HAL 3625 | ● | ±30 | ±150 | 2 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1 | | ● | | ● | | ● | | | | ● | ● | | | ● | ● | | |

## Current Transducers

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUR 3105 | ● | ±30 | ±100 | 2 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1 | | ● | | ● | | ● | ● | ● | | ● | ● | | ● | | | | |
| | CUR 3115[5] | ● | ±30 | ±100 | 2 | ● | | | | | ● | ● | ● | ● | ● | 4.5 to 5.5 | 1 | | ● | | | | ● | ● | ● | | ● | ● | | ● | | | | |

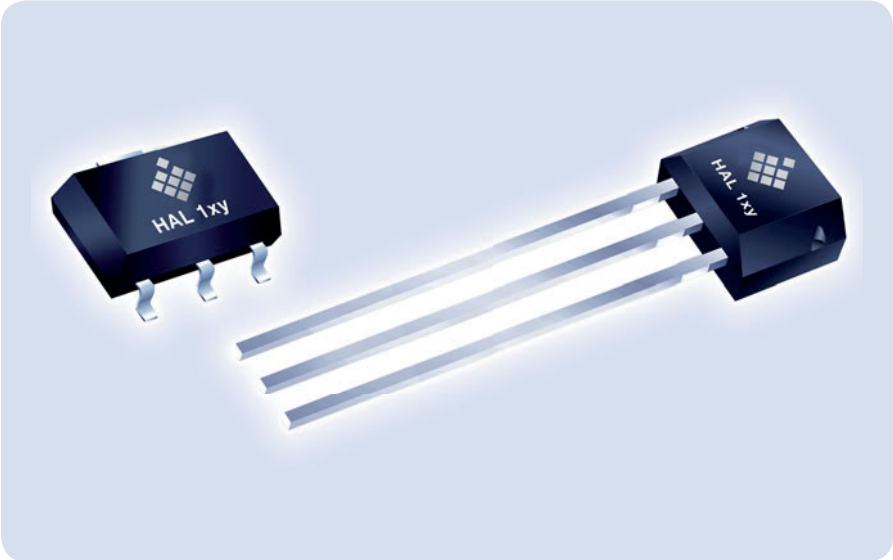
## Hall Ordering Codes

| HAL | 502 | PA | T | C | P | Q | SP |
|---|---|---|---|---|---|---|---|
| **Hall Sensor** | **Sensor Type** | **Package**<br>UA/UQ = TO92<br>UT = TO92<br>SF/TQ = SOT89B<br>DJ = SOIC8<br>DZ = SOIC8 "Die down" | **Temperature Range**<br>C: $T_J$ = 0 °C to 85 °C<br>I: $T_J$ = –20 °C to 125 °C<br>E: $T_J$ = –40 °C to 100 °C<br>K: $T_J$ = –40 °C to 140 °C<br>A: $T_J$ = –40 °C to 170 °C | **Configuration**<br>1 = TO92 - Inline, Spread<br>2 = TO92 - Inline, Not Spread<br>3 = TO92 - Inline, blister pack | **Packaging**<br>B = Bulk<br>A = Ammopack<br>R = Reel (SOT89 only) | **Quantity**<br>1 = 2000 per box<br>2 = 2000 per box<br>5 = 15000 per box | **Special Procedure** |

# HAL 1xy



## Hall Switch Family designed for White Goods and Industrial Applications




The HAL 1xy family represents easy-to-use Hall switches for white goods and industrial applications. It is the optimal system solution to detect a position by means of contactless measurement. In motor applications, the Hall sensor family is often used to derive an RPM measurement.

Technically, the sensors are produced in CMOS technology and include a temperature-compensated Hall plate with active offset compensation, a comparator, and an open-drain output transistor.

The comparator compares the actual magnetic flux through the Hall plate (Hall voltage) with the fixed reference values (switching points). Accordingly, the output transistor is switched on or off.

The active offset compensation leads to magnetic parameters which are robust against mechanical stress effects. In addition, the magnetic characteristics are constant in the full supply voltage and temperature range.

The HAL 1xy family is available in the SOT89B SMD package and in the leaded TO92UA package.

### Features

- Temperature ranges:
  C (Commercial, $T_J$ = 0 °C to 85 °C)
  I (Industrial, $T_J$ = –20 °C to 125 °C)
- Operates from 3.8 V to 24 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 10 kHz
- Overvoltage protection at all pins
- Reverse-voltage protection at $V_{DD}$ pin
- Magnetic characteristics are robust against mechanical stress effects
- Short-circuit protected open-drain output by thermal shut down
- Constant switching points over a wide supply voltage and temperature range
- The decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of the magnetic characteristics
- High temperature stability for home appliances and industrial applications
- High ESD rating

### Functions

The HAL 1xy is the optimal system solution for application fields, such as:

- Position detection

### Generic Applications

- RPM measurement

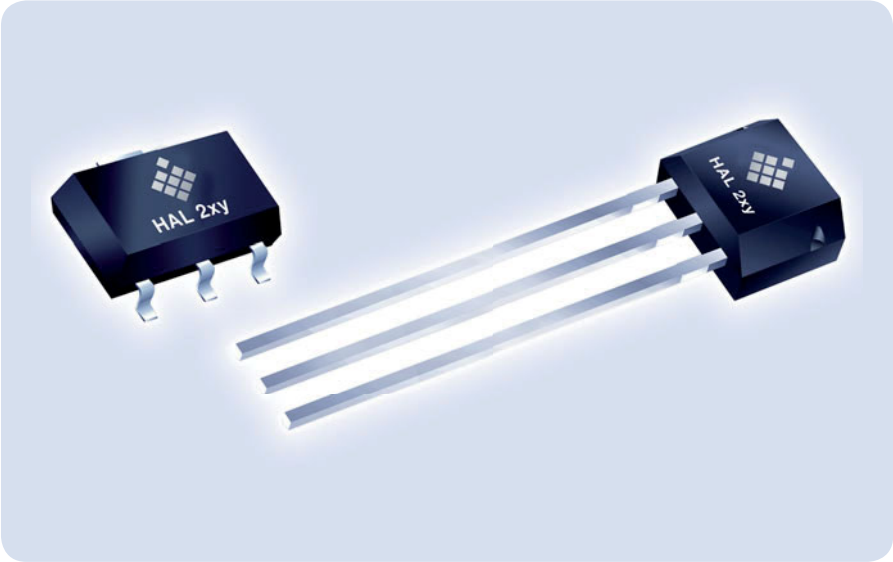
### Application Examples

- Motor commutation
- Door look
- Selector switches
- Speed control
- Flow meter

# HAL 2xy



## Value-Optimized Hall-Effect Sensor Family




The HAL 2xy Hall switch family is fully compatible to the HAL 1xy family, adding the general use for automotive in-cabin applications by expanding the temperature range to a level of $T_J$ = –40 °C up to 140 °C.

Like the HAL 1xy, the HAL 2xy Hall switch family is produced in CMOS technology. The sensors include a temperature-compensated Hall plate with active offset compensation, a comparator, and an open-drain output transistor.

The comparator compares the actual magnetic flux through the Hall plate (Hall voltage) with the fixed reference values (switching points). Accordingly, the output transistor is switched on or off.

The active offset compensation leads to magnetic parameters, which are robust against mechanical stress effects. In addition, the magnetic characteristics are constant in the full supply voltage and temperature range.

The sensors are designed for automotive and industrial applications and operate with supply voltages from 3.8 V to 24 V in the junction temperature range from – 40 °C up to 140 °C.

The HAL 2xy family is dedicated to automotive and industrial applications available in the SMD package SOT89B and in the leaded version TO92UA.

### Features

- Temperature range K: $T_J$ = – 40 °C to 140 °C
- Operates from 3.8 V to 24 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 10 kHz
- Overvoltage protection at all pins
- Reverse voltage protection at $V_{DD}$ pin
- Magnetic characteristics are robust against mechanical stress effects
- Short-circuit protected open-drain output by thermal shut down
- Constant switching points over a wide supply voltage and temperature range
- The decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of the magnetic characteristics
- High temperature stability for automotive or industrial applications
- High ESD rating

### Functions

The HAL 2xy is the optimal system solution for applications, such as:

- Position detection

### Generic Applications

- RPM measurement

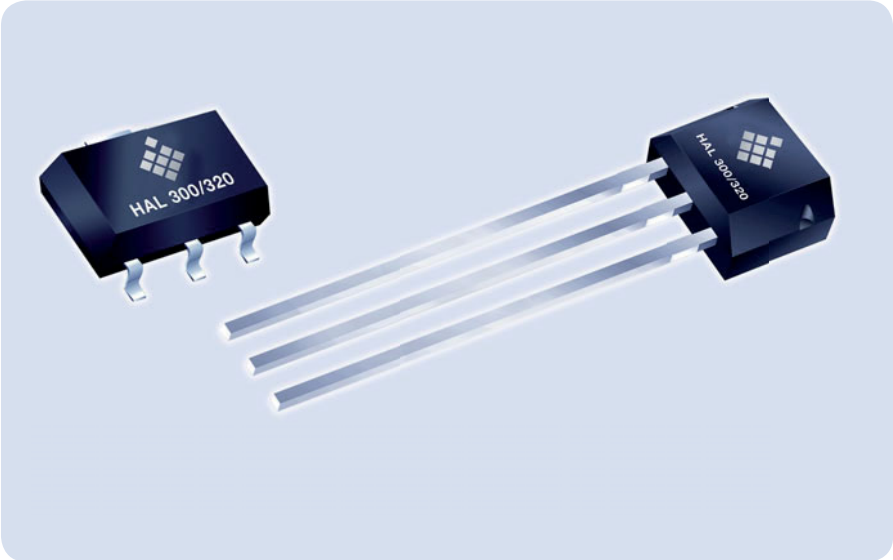
### Application Examples

- Motor commutation
- Anti-squeeze protection (power-window)
- Speed control
- Flow meter
- Gear selector

# HAL 300, HAL 320



## Differential Hall-Effect Sensor ICs





The HAL 300 and the HAL 320 are differential Hall switches produced in CMOS technology. The sensors include two temperature-compensated Hall plates with active offset compensation, a differential amplifier with a Schmitt trigger, and an open-drain output transistor.

These differential sensors respond to spatial differences of the magnetic field. The Hall voltages at the two Hall plates, $S_1$ and $S_2$, are amplified with a differential amplifier. The differential signal is compared with the actual switching level of the internal Schmitt trigger. Accordingly, the output transistor is switched on or off. The differential signal can be derived via a rotating multi-pole-ring in front of the branded side of the package (HAL 300) or via a magnet on the back side of the package generating a back-bias field at both Hall plates (HAL 320).

The active offset compensation leads to constant magnetic characteristics over supply voltage and temperature. The sensors are designed for automotive and industrial applications and operate with supply voltages from 4.5 to 24 V in the junction temperature range –40 °C up to 170 °C.

The sensors are available in the SMD package SOT89B and in the leaded version TO92UA.

### Features

- Temperature range K: $T_J$ = – 40 °C to 170 °C
- Operates from 4.5 V to 24 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 10 kHz
- Overvoltage protection at all pins
- Reverse voltage protection at $V_{DD}$ pin
- Magnetic characteristics are robust against mechanical stress effects
- Short-circuit protected open-drain output by thermal shut down
- Constant switching points over a wide supply voltage and temperature range
- The decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of the magnetic characteristics
- High temperature stability for automotive or industrial applications
- High ESD rating

### Functions

The HAL 300 and HAL 320 are the optimal system solutions for applications such as:

- Position detection

### Generic Applications

- RPM measurement

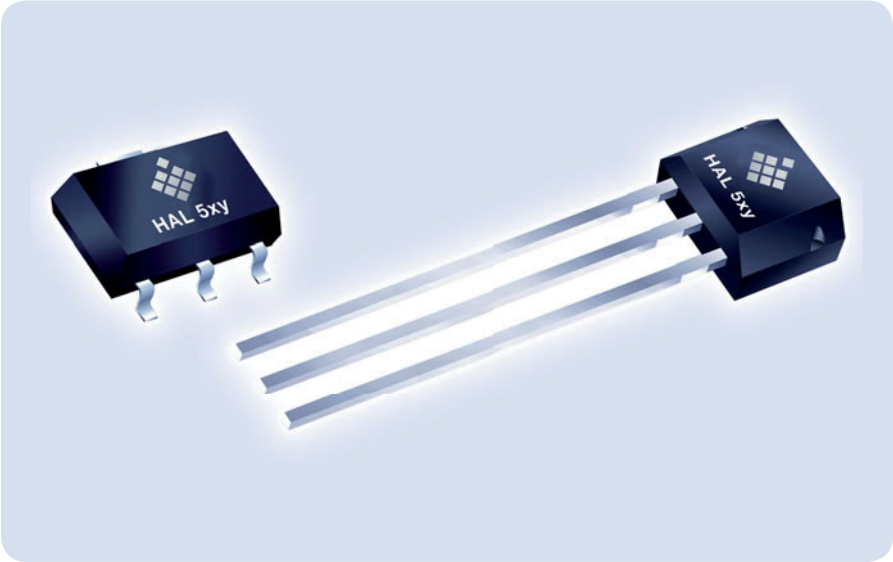
### Application Examples

- Speed control
- Flow meter

# HAL 5xy



## High-Performance Hall-Effect Sensor Family




The HAL 5xy family complements Micronas' Hall sensor portfolio towards the higher end by offering an extended automotive temperature range of $T_J$ = –40 °C to 170 °C. The HAL 5xy family consists of different Hall switches produced in CMOS technology. All sensors include a temperature-compensated Hall plate with active offset compensation and a comparator.

Depending on the family member, the switching state is output via an open-drain transistor or by altering the supply current level (two-wire Hall-effect sensor).

The comparator compares the actual magnetic flux through the Hall plate (Hall voltage) with the fixed reference values (switching points). Accordingly, the output transistor is switched on or off.

The sensors of this family differ in the switching behavior and the switching points. The active offset compensation leads to constant magnetic characteristics over supply voltage and temperature range. In addition, the magnetic parameters are robust against mechanical stress effects.

The sensors are designed for automotive and industrial applications and operate with supply voltages from 3.8 V to 24 V in the junction temperature range from –40 °C up to 170 °C.

All sensors are available in the SMD package SOT89B and in the leaded version TO92UA.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Two- and three-wire versions
- Operates from 3.8 V to 24 V supply voltage
- Overvoltage protection at all pins
- Reverse voltage protection at $V_{DD}$ pin
- Magnetic characteristics are robust regarding mechanical stress effects
- Short-circuit protected open-drain output by thermal shut down or current output for two-wire applications
- Operates with static magnetic fields and dynamic magnetic fields up to 10 kHz
- Constant switching points over a wide supply voltage range
- The decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of the magnetic characteristics
- Ideal sensor for applications in extreme automotive and industrial environments
- EMC corresponding to ISO 7637

### Functions

The HAL 5xy is the optimal system solution for applications, such as:

- Position detection

### Generic Applications

- RPM measurement
- Powertrain

### Application Examples

- Motor commutation
- Anti-squeeze protection (power-window)
- Speed control
- Buckle-switch
- Gear selector
- Steering lock

# HAL 7xy



## Dual Hall-Effect Sensors with two Independent Outputs


HAL 7xy is a family of monolithic integrated Hall-effect sensors manufactured in CMOS technology with two independent Hall plates S1 and S2. Both devices have two open-drain outputs.

The sensor HAL 730 is particularly featuring a count and a direction output. The count output operates like a single latched Hall switch according to the magnetic field present at Hall plate S1. The direction output indicates the direction of a linear or rotating movement of magnetic objects.

In combination with an active target providing a sequence of alternating magnetic north and south poles, the sensors generate the signals required to control position, speed, and direction of the target movement.

The HAL 7xy sensors include temperature compensation and active offset compensation. These features provide excellent stability and matching of the switching points in the presence of mechanical stress over the whole temperature and supply voltage range.

The HAL 7xy family is designed for automotive and industrial applications and operate with supply voltages from 3.8 V to 24 V in the junction temperature range from –40 °C up to 170 °C. The sensors are available in the SMD package SOT89B.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Operates from 3.8 V to 24 V supply voltage
- Generation of a direction signal (HAL 730 only)
- Operates with static magnetic fields and dynamic magnetic fields up to 10 kHz
- Overvoltage protection at all pins
- Reverse-voltage protection at $V_{DD}$ pin
- Magnetic characteristics are robust against mechanical stress effects
- Short-circuit protected open-drain outputs by thermal shut down
- Constant switching points over a wide supply voltage and temperature range
- The decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of the magnetic characteristics
- High temperature stability for automotive or industrial applications
- High ESD rating

### Functions

The HAL 7xy is the optimal system solution for applications, such as:

- Position and direction detection

### Generic Applications

- RPM measurement

### Application Examples

- Motor commutation
- Anti-squeeze protection
- Power-window

# HAL 1000



## In-System Programmable Hall Switch


Compared with the standard Hall switches, the HAL 1000 offers full in-system programmability. The major sensor characteristics, the two switching points $B_{ON}$ and $B_{OFF}$, and the output behavior are programmable for the specific application.

The HAL 1000 features a temperature-compensated Hall plate with chopped offset compensation, an A/D converter, digital signal processing, a push-pull output stage, an EEPROM memory with redundancy and lock function for the calibration data, a serial interface for programming the EEPROM, and protection devices at all pins.

Due to the digital signal processing, analog offsets, temperature shifts, and mechanical stress effects do not degrade the sensor accuracy.

The HAL 1000 is programmable by modulating the supply voltage. No additional programming pin is needed. The tolerances of the sensor, the magnet, and the mechanical positioning can be compensated via programming for the final assembly. This offers a low-cost alternative for all applications that presently require mechanical adjustment.

The sensor is designed for the use in harsh automotive and industrial applications with nominal supply voltage of 5 V in the junction temperature range from –40 °C up to 170 °C. The HAL 1000 is available in the leaded package TO92UT.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- High-precision Hall switch with programmable switching points and switching behavior
- Switching points programmable from –150 mT up to 150 mT in steps of 0.5% of the magnetic field range
- Multiple programmable magnetic characteristics in a non-volatile memory (EEPROM) with redundancy and lock function
- Temperature characteristics are programmable for matching all common magnetic materials
- Programming through modulation of the supply voltage
- Operates from 4.5 V up to 5.5 V supply voltage in specification and functions up to 8.5 V
- Operates with static magnetic fields and dynamic magnetic fields up to 2 kHz
- Magnetic characteristics are extremely robust against mechanical stress effects
- Overvoltage and reverse-voltage protection at all pins
- Short-circuit protected push-pull output
- EMC and ESD optimized design

### Functions

The HAL 1000 is the optimal system solution for applications, such as:

- Position detection
- Current measurement

### Application Examples

- End position detection
- Liquid-level detection
- Electronic fuse

# HAL 4xy



## Pre-configured Linear Hall-Effect Sensor IC in CMOS Technology


The HAL 4xy family represents Hall sensors that include a temperature-compensated Hall plate with choppered offset compensation, two linear output stages, and protection devices.

The output voltage is proportional to the magnetic flux density through the Hall plate. The choppered offset compensation leads to stable magnetic characteristics over supply voltage and temperature.

The HAL 4x1 family can be used for magnetic field measurements, current measurements, and detection of any mechanical movement. Accurate angle measurements or distance measurements can also be done. The sensor is very robust and can be used in electrical and mechanical hostile environments.

The sensors are designed for automotive and industrial applications and operate in the junction temperature range from –40 °C up to 170 °C (HAL 401) / –40 °C up to 100°C (HAL 411) and are available in the SMD-package SOT89B.

### Features

- Wide temperature range $T_J$ = –40 °C to 170 °C (HAL 401 only)
- Offset compensation at 147 kHz switching speed
- Low magnetic offset
- Extremely sensitive
- Operates from 4.8 to 12 V (HAL 401)/ 4.9 to 5.1 V (HAL 411) supply voltage
- Overvoltage protection
- Reverse voltage protection of $V_{DD}$ pin
- Differential output
- Accurate absolute measurements of DC and low frequency magnetic fields
- On-chip temperature compensation

### Functions

- Current measurement
- Linear movement detection

### Generic Applications

- Rotary position
- Leveling

### Application Examples

- Potentiometer replacement

# HAL 81x



## Programmable Linear Hall-Effect Sensors


The HAL 810 and the HAL 817 are programmable linear Hall-effect sensors which can be used for angle or distance measurements. The major characteristics are programmable in a non-volatile memory.

The HAL 817 has a ratiometric output characteristic; its output voltage is proportional to the magnetic flux and the supply voltage. The HAL 810 provides a pulse-width modulated (PWM) output signal.

The sensors feature a temperature-compensated Hall plate with choppered offset compensation, an A/D converter, an EEPROM memory with redundancy and lock function for the calibration data and protection devices at all pins. Due to the digital signal processing, analog offsets, temperature shifts, and mechanical stress do not degrade the sensor accuracy.

The tolerances of the sensor, the magnet, and the mechanical positioning can be compensated via programming by customer/user in the final assembly. This offers a low-cost alternative for all applications that presently need mechanical adjustment or laser trimming for calibration.

The HAL 810 and HAL 817 are designed for hostile automotive and industrial applications and operate with a supply voltage of typically 5 V in the junction temperature range from –40 °C up to 170 °C.

**Note:** The HAL 817 replaces the previous versions HAL 805 and HAL 815.

The sensors are available in the very small leaded packages TO92UT.

### Features

- Operation from –40 °C up to 170 °C junction temperature
- High-precision linear Hall effect sensors with digital signal processing
- PWM output signal with a refresh rate of typically 125 Hz and up to 11 bit resolution (HAL 810)
- D/A converter with output driver (HAL 817)
- Multiple programmable magnetic characteristics in a non-volatile memory (EEPROM) with redundancy and lock function
- Open-circuit feature (ground and supply line break detection)
- Overvoltage and undervoltage detection (HAL 817)
- For programming an individual sensor within several sensors in parallel to the same supply voltage, a selection can be done via the output pin (HAL 817)
- Programmable clamping function
- Programming via modulation of the supply voltage
- Temperature characteristics programmable for matching all common magnetic materials
- Operation with 4.5 V to 5.5 V supply voltage in specification and functions with up to 8.5 V
- Operation with static magnetic fields and dynamic magnetic fields
- Overvoltage and reverse-voltage protection at all pins
- Magnetic characteristics extremely robust against mechanical stress
- Short-circuit protected push-pull output
- EMC and ESD optimized design

### Functions

The HAL 810 and HAL 817 are the optimal system solutions for applications such as:

- Linear movement
- Current measurement

### Generic Applications

- Rotary position
- Leveling
- Force/pressure measurement

### Application Examples

- Accelerator pedal
- Throttle position
- Exhaust gas recirculation

# HAL 82x



## High-Precision Programmable Hall-Effect Sensors


The HAL 824 and the HAL 825 expand the existing Hall-effect sensor family HAL 8xy. Both high-precision magnetic field sensors provide a ratiometric, linear output signal. This sensor family is designed to fulfill high requirements in respect of low temperature drifts of sensitivity and offset.

Due to the very low drifts of this sensor family, it can be used for applications with very high requirements on offset and sensitivity drift stability. This is mandatory for applications like throttle position detection, accelerator pedal sensing or current measurement.

The sensors provide either a ratiometric analog output signal or a multiplexed analog output. In multiplex analog output mode, the sensor transmits LSN and MSN of the output value separately. This enables the sensor to transmit a signal with 14-bit accuracy.

Major characteristics like magnetic field range, output format, sensitivity, the output voltage at zero magnetic field (VOQ), and the temperature coefficients can easily be adjusted to the magnetic circuit (linear and quadratic) by programming the non-volatile memory.

Both sensors are available in the very small leaded package TO92UT.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Sensitivity drift over temperature less than ±1% (HAL 825 less than ±2%)
- Offset drift over temperature less than ±0.2% (HAL 825 less than ±0.3%) of VDD
- DNL of analog output ±0.9 LSB (±2 LSB for HAL 825)
- Wire break detection with 5 kΩ pull-up or pull-down resistor
- Four programmable magnetic ranges: ±30, ±60, ±80, and ±100 mT
- Two programmable 3 dB filter frequencies: 500 Hz and 1 kHz
- Programmable sensitivity and offset (VOQ)
- 12-bit ratiometric analog output
- 14-bit signal path
- Digital signal processing
- Temperature characteristics programmable to match all common magnetic materials
- 13 customer data bits
- Programming by modulation of the supply voltage
- Operates from 4.5 V up to 5.5 V supply voltage
- Magnetic characteristics extremely robust against mechanical stress

### Functions

Due to the sensor's versatile programming characteristics and low drifts, the HAL 82x is the optimal system solution for functions, such as:

- Linear movement
- Current measurement

### Generic Applications

- Rotary position
- Leveling
- Force/pressure measurement
- Torque measurement

### Application Examples

- Potentiometer replacement
- Accelerator pedal
- Throttle position
- Steering torque
- Exhaust gas recirculation

# HAL 85x



## Programmable Hall-Effect Sensors with Arbitrary Output


The HAL 85x complement the existing Hall-effect sensor family HAL 8xy. Both universal magnetic field sensors (HAL 855 and HAL 856) provide an arbitrary output signal. The sensors are produced in submicron CMOS technology.

In combination with a rotating or moving magnet, the sensors can be employed for angle, distance, and level measurements. The sensors provide either a pulse-width modulated (PWM) output signal or a serial Biphase-M output.

Major characteristics like magnetic field range, output characteristic, output format sensitivity, shift (duty cycle of the PWM output signal or the serial output word), PWM period, low and high current, and the temperature coefficients can easily be adjusted to the magnetic circuit (linear and quadratic) by programming the non-volatile memory. The output characteristic can be set via 32 setpoints.

The sensors were designed to translate a linear magnetic field into an arbitrary output signal or a non-linear magnetic field into a linear output signal.

The sensors are available in the very small leaded package TO92UT.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- High-precision linear Hall-effect sensors with different output formats
- Various programmable magnetic characteristics with non-volatile memory
- Programmable output characteristic (32 setpoints)
- Programmable output formats (PWM or serial Biphase-M)
- Programmable PWM period
- Open-drain output for HAL 855
- Programmable output current source for HAL 856 (low and high current)
- Digital signal processing
- Temperature characteristics programmable for matching all common magnetic materials
- Programming by modulation of the supply voltage
- Lock function and built-in redundancy for EEPROM memory
- Operates from 4.5 V up to 14 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 2 kHz
- Choppered offset compensation
- Overvoltage protection on all pins
- Reverse voltage protection on $V_{DD}$ pins
- Magnetic characteristics extremely robust against mechanical stress
- Short-circuit protected output
- EMC-optimized design

### Functions

Due to the sensor's versatile programming characteristics, the HAL 85x is the optimal system solution for functions such as:

- Linear movement

### Generic Applications

- Rotary position
- Leveling
- Force/pressure measurement

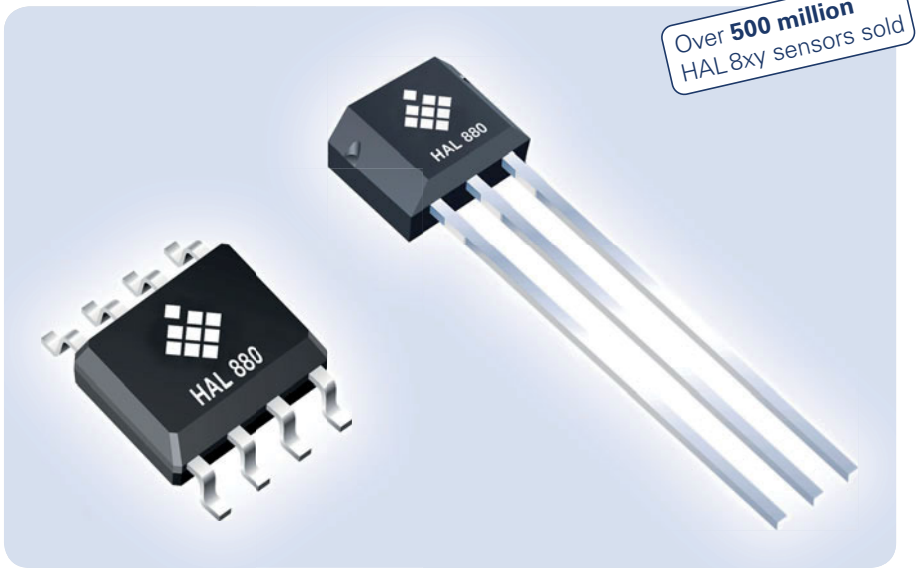
### Application Examples

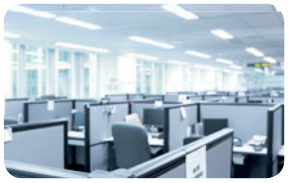
- Liquid-Level detection
- Accelerator pedal
- Gear position
- Exhaust gas recirculation

# HAL 880



## Programmable Linear Hall-Effect Sensors



The HAL 880 is designed to fulfill the requirements of today's state-of-the-art applications for linear and angular measurements that require flexibility to compensate system tolerances.

Due to its programmability, it also offers the additional advantage of compensation of system tolerances. This is mandatory for applications like accelerator pedal sensing, current measurement, bending light or head light adjustment. The sensor provides a linear, ratiometric analog output signal with implemented wirebreak detection working with pull-up or pull-down resistor.

Major characteristics like magnetic-field range, sensitivity, VOQ (output voltage at zero magnetic field) and the temperature coefficients can easily be adjusted to the magnetic circuit (linear and quadratic) by programming the non-volatile memory.

The HAL 880 is available in the leaded package TO92UT or in the SMD package SOIC8.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Sensitivity drift over temperature less than ±6%
- Offset drift over temperature less than ±15 µT/K
- Integral non-linearity error of output signal ±1% of VDD
- Ratiometric error of output signal ±1%
- Low output noise of 25 mV peak-peak
- Wire-break detection with 5 kΩ pull-up or pull-down resistor
- Four programmable magnetic ranges: ±30, ±60, ±80, and ±100 mT
- Two programmable 3 dB filter frequencies: 500 Hz and 1 kHz
- Programmable sensitivity and offset (VOQ)
- 12-bit ratiometric analog output
- Digital signal processing
- Temperature characteristics programmable to match all common magnetic materials
- 13 customer data bits
- Programming by modulation of the supply voltage
- Operates from 4.5 V up to 5.5 V supply voltage
- Magnetic characteristics extremely robust against mechanical stress

### Functions

The HAL 880 is the optimal system solution for functions such as:

- Linear movement
- Current measurements

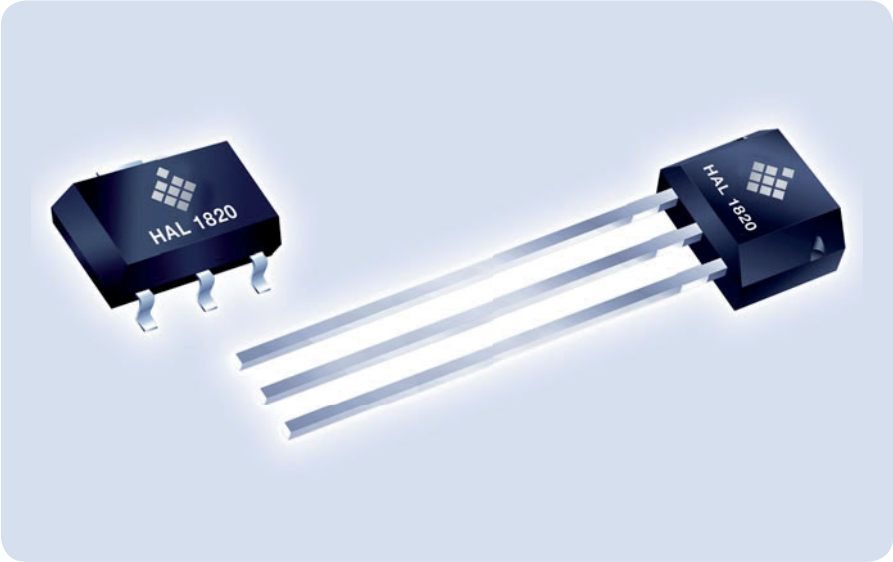
### Generic Applications

- Rotary position
- Leveling

# HAL 1820



## Value-Optimized Programmable Linear Hall-Effect Sensor




The HAL 1820 is a new member of the Micronas family of value-optimized linear Hall sensors HAL 18xy. It is a universal magnetic field sensor with a linear analog output based on the Hall effect. The IC can be used for angle and linear measurements if combined with a rotating or moving magnet. The major characteristics like magnetic field range, sensitivity, offset (output voltage at zero magnetic field) and the temperature coefficients are programmable in a non-volatile memory.

The HAL 1820 is programmable by modulating the supply voltage of the sensor. No additional programming pin is needed. The easy programmability allows a 2-point calibration by adjusting the output signal directly to the input signal (like mechanical angle, distance or current). Individual adjustment of each sensor during the customer's manufacturing process is possible. With this calibration procedure, the tolerances of the sensor, the magnet and the mechanical positioning can be compensated in the final assembly.

This offers an alternative for all applications that presently need mechanical adjustment or laser trimming for calibrating the system. The sensor is designed to be used in automotive or industrial applications. It operates in a wide junction temperature range from –40 °C up to 170 °C.

The HAL 1820 is available in the very small leaded package TO92UA and in the small SMD package SOT89B.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Linear Hall-effect sensor with ratiometric analog output
- Various programmable magnetic characteristics with non-volatile memory
- Digital signal processing
- Continuous measurement ranges from ±20 mT to ±160 mT
- Temperature characteristics programmable for matching all common magnetic materials
- Programming via supply voltage
- Lock function and built-in redundancy for EEPROM memory
- Operates from 4.5 V up to 5.5 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 1 kHz
- Overvoltage and reverse-voltage protection on $V_{DD}$ pin
- Magnetic characteristics extremely robust against mechanical stress
- Short-circuit protected output

### Functions

The HAL 1820 is the optimal system solution for functions such as:

- Linear movement
- Angle measurements
- Distance measurements
- Current measurements
- Magnetic field measurements

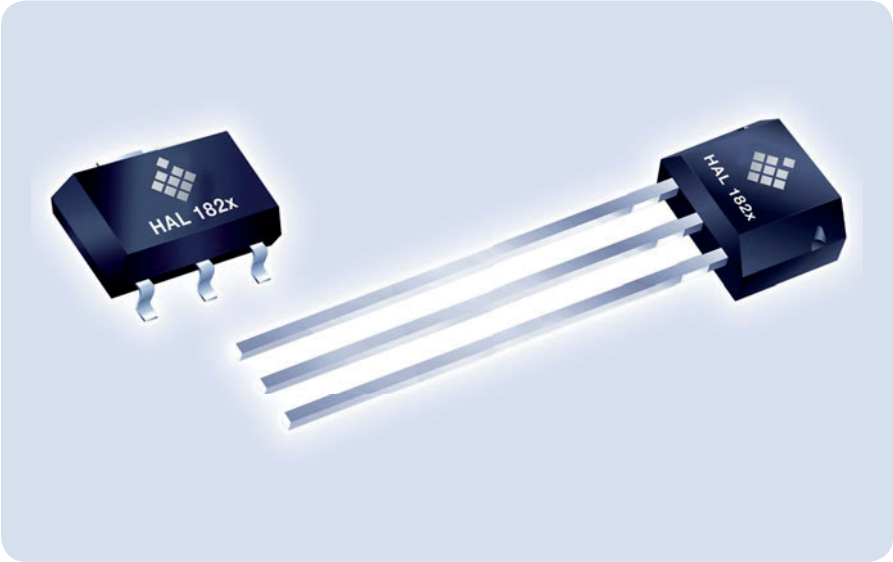
### Generic Applications

- Rotary position
- Leveling

# HAL 182x



## Value-Optimized Linear Hall-Effect Sensors with Fixed Sensitivity




The HAL 182x sub-family contains factory-set members of the Micronas family of value-optimized linear Hall sensors, offering excellent performance/price trade-off. They are universal magnetic field sensors with a ratiometric, linear analog output. The members of the sensor family can be used for magnetic field measurements, current measurements and detection of any mechanical movement. Very accurate angle measurements or distance measurements can also be carried out. The sensors are very robust and can be used in harsh electrical and mechanical environments. The output voltage is proportional to the magnetic flux density through the Hall plate. The choppered offset compensation leads to stable magnetic characteristics over supply voltage and temperature.

The different family members vary by sensitivity (25 mV/mT, 31.25 mV/mT, 29.4 mV/mT, and 50 mV/mT). The quiescent output voltage (offset) for all family members is 50% of the supply voltage. The sensors are designed for automotive and industrial applications and operate in the junction temperature range from –40 °C up to 170 °C.

The HAL 182x is available in the very small leaded package TO92UA and in the small SMD package SOT89B.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Linear Hall-effect sensor with ratiometric analog output
- Sensitivity:
  – HAL 1821: 50 mV/mT
  – HAL 1822: 31.25 mV/mT
  – HAL 1823: 25 mV/mT
- Temperature and stress stable quiescent output voltage
- Very accurate sensitivity and offset
- On-chip temperature compensation
- Active offset compensation
- Operates from 4.5 V up to 5.5 V supply voltage
- Operates with static magnetic fields and dynamic magnetic fields up to 1 kHz
- Overvoltage and reverse-voltage protection on $V_{DD}$ pin
- Magnetic characteristics are extremely robust against mechanical stress.
- Short-circuit protected push-pull output
- EMC and ESD optimized designs

### Functions

Due to the sensors' characteristics and their high accuracy, the HAL 1821/1822/1823 are the optimal system solutions for applications such as:

- Linear movement
- Angle measurements
- Distance measurements
- Current measurements
- Magnetic field measurements

### Generic Applications

- Rotary position
- Leveling

# HAL 24xy



## Precise and Robust Programmable Linear Hall-Effect Sensors


The HAL 24xy family offers extended distance measurement, improved robustness and state-of-the-art diagnostic functions for applications under stringent conditions.

All family members will leverage upon Micronas long success in linear Hall-effect sensors, full in-house manufacturing and automotive-proven 0 ppm track record. It uses Micronas' latest technology node, a new digital architecture, as well as further enhanced Hall plates. The sensor provides improved output linearization by incorporating a flexible compensation function with 16 programmable setpoints. In addition, angles up to 180° can be measured even with a simple magnet configuration.

The major characteristics like magnetic field range, sensitivity, output quiescent voltage and output voltage range are programmable in a non-volatile memory. All sensors feature a temperature-compensated Hall plate with spinning current offset compensation, an A/D converter, digital signal processing, a D/A converter with output driver, an EEPROM with redundancy and lock function for the calibration data, a serial interface for programming the EEPROM, and protection devices at all pins.

The sensor can easily be calibrated to perfectly adjust its output to input signals and to compensate any variations in the applications (magnet positioning, temperature drift). This enables operation over the full temperature range with high accuracy. The calculation of the individual sensor characteristics and the programming of the EEPROM can easily be done with a PC and the application kit from Micronas.

The sensor is designed for hostile industrial and automotive applications. The HAL 24xy family is available in the very small leaded RoHs package TO92UT and is AECQ100 qualified.

### Features

- Operating junction temperature range: –40 °C up to 170 °C
- High-precision linear Hall-effect sensor with ratiometric 12-bit analog output
- 16 setpoints for various output signal characteristics (HAL 2425)
- High immunity against ESD (8 kV) and EMC
- Multiple customer-programmable magnetic characteristics in a non-volatile memory with redundancy and lock function
- Programmable temperature compensation for sensitivity and offset
- Magnetic field measurements in the range up to 200 mT
- Low output voltage drifts over temperature
- Open-circuit (ground and supply line break detection), overvoltage and undervoltage detection
- Programmable output clamping function
- Digital readout of temperature and magnetic field information in calibration mode
- Operates from 4.5 V up to 5.5 V supply voltage in specification
- Operates with static magnetic fields and dynamic magnetic fields up to 2 kHz
- Overvoltage and reverse-voltage protection at all pins
- Short-circuit protected push-pull output

### Functions

Due to the sensors' versatile programming characteristics and low temperature drifts, the HAL 24xy is the optimal system solution for applications such as:

- Distance and linear movement measurements
- Angle sensors like throttle position, pedal position, and EGR applications,
- Contactless potentiometers:

### Generic Applications

- Rotary position
- Leveling
- Force/pressure measurement
- Torque measurement

# HAL 28xy

Hall-Effect Sensors

## Linear Hall-Effect Sensor Family with Digital Interfaces


The HAL 28xy family is a new generation of programmable Hall-effect sensors. It consists of members with different digital interfaces, like PWM and SENT (SAE J2716). Due to its internal structure, it is possible to easily generate new family members. The built-in RISC processor allows a fast implementation of new output formats or customer-specific signal processing.

All members within this family can be programmed without any additional programming pin. Programming is done via BiPhase-M telegrams. Upon request, especially where in-system programming by the customer is not possible, pre-configured versions can be derived.

The HAL 28xy family features a Hall plate with spinning current offset compensation technique and a precise temperature sensor which is used for temperature compensation of both the Hall sensors' sensitivity and offset. The sensors' signal path is handled by the RISC processor. This is of great benefit because analog offsets, temperature shifts, and mechanical stress do not degrade the digital signals.

Major characteristics like magnetic field range, sensitivity, offset and the temperature coefficients of sensitivity and offset can easily be adjusted to the magnetic circuit by programming the non-volatile memory. Furthermore, the individual devices can also be obtained as pre-configured versions with defined settings as per customer requirements.

The HAL 28xy family is available in the very small leaded package TO92UT.

### Features

- Operating junction temperature range: –40 °C up to 170 °C
- High-precision linear Hall-effect sensor
- Spinning-current offset compensation
- Built-in temperature sensor
- Built-in RISC processor
- Digital signal processing
- Up to 12 bit resolution
- Customer-programmable temperature compensation of Hall sensitivity (2nd order) and Hall offset (1st order)
- Different interface options:
  – SENT
  – PWM output up to 2 kHz
- Magnetic characteristics extremely robust against mechanical stress
- Non-volatile EEPROM with redundancy and lock function

### Functions

Due to the sensors' versatile programming characteristics and low drifts, the HAL 28xy family is the optimal system solution for functions, such as:

- Linear movement
- Current measurement

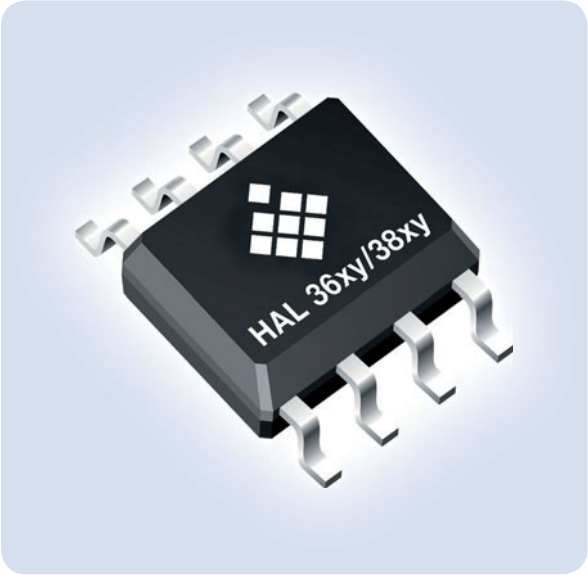
### Generic Applications

- Rotary position
- Leveling
- Force/pressure measurement
- Torque measurement

# HAL 36xy/38xy



## Programmable Hall-Effect Sensor Families based on 3D HAL Technology




The HAL 36xy/38xy families represent a new level of performance for Hall-effect sensors enabling a significant simplification in the design of magnetic systems. The sensors are based on Micronas' innovative 3D HAL technology, which combines standard lateral with vertical Hall plates. Whereas the HAL 36xy family is targeted for rotational movement detection up to 360°, the HAL 38xy targets extended linear movement detection up to 40 mm.

HAL 36xy: The devices of this family measure the X and Y component of a magnetic field in the sensor plane. Monitoring the relative strength of both components leads to a stable output even if the distance between magnet and sensor varies. The result is angular rotation measurement from 0° to 360° with very high accuracy over a wide temperature range. The first member of this family is the HAL 3625.

HAL 38xy: The devices of this family measure either the X or Y component in conjunction with the Z-component of a magnetic field. Together with its 32-setpoint linearization feature, this family offers superior system performance for extended linear movement detection while using small magnet circuitry. The first member of this family is the HAL 3855.

The sensors are housed in a small SOIC8 SMD package, producing an analog, ratiometric output. They include an integrated wire-break detection feature that works in conjunction with a pull-up or pull-down resistor to detect fault conditions. Internal digital signal processing algorithms in conjunction with integrated non-volatile memory enable customization and robust calibration for application-specific impairments. Easy to use LabVIEW™-based software and high-quality application notes accelerate development, even for novice magnet system designers. The result is a quickly developed, customized sensor system with extremely low temperature drift and insensitivity to air gap variations.

### Features

- Operates from –40 °C up to 170 °C junction temperature
- Angular accuracy of better than ±0.9 FS over 360° range (HAL 36xy)
- Stable performance with air gap variation
- Programming via output pin
- Wire-break detection with pull-up or pull-down resistor
- Lock function and built-in redundancy for EEPROM memory
- Operates from 4.5 V up to 5.5 V supply voltage
- Output response time >1 ms
- Overvoltage and reverse-voltage protection on $V_{DD}$ pin
- Short-circuit protected output

### Functions

The HAL 3625 is the optimal system solution for functions such as:

- Angular measurement

The HAL 3855 is the optimal system solution for functions such as:

- Linear movement detection

### Generic Applications

- Rotary position
- Leveling
- Torque sensing
- License Note:

**License Note**

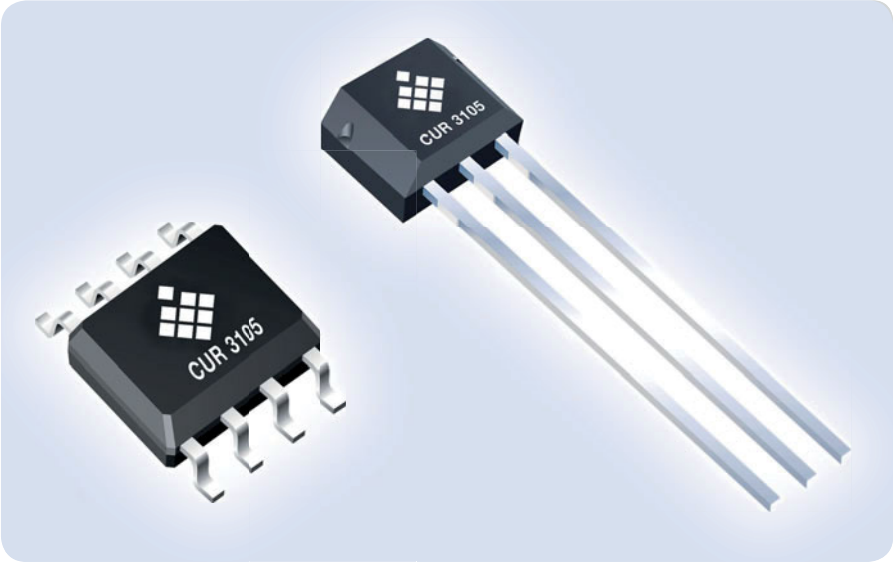
HAL 36xy/38xy uses licenses of Fraunhofer Institute for Integrated Circuits IIS.

3D|HAL® by Micronas

# CUR 3105, CUR 3115

Current Transducers

## Hall-Effect Current Transducers with Analog Output




CUR 3105 and CUR 3115 represent the first members of the new Micronas product group of Hall-effect-based current transducers. They can be used for very precise current measurements. The output voltage is proportional to the measured current and the supply voltage (ratiometric analog output). Major characteristics, such as magnetic field range, sensitivity, output quiescent voltage (output voltage at B=0 mT) and output voltage range are programmable and are stored in the internal EEPROM.

CUR 3105 and CUR 3115 feature a temperature-compensated Hall plate with chopped offset compensation, an A/D converter, digital signal processing, a D/A converter with output driver, an EEPROM memory with redundancy and lock function, a serial programming interface, and protection devices at all pins. The internal digital signal processing is of great benefit because analog offsets, temperature shifts and mechanical stress do not degrade the transducer's accuracy.

CUR 3105 and CUR 3115 are programmable by modulating the supply voltage. No additional programming pin is needed. Individual adjustment of each transducer during the customer's manufacturing process is possible. With this calibration procedure, the tolerances of the IC and the mechanical positioning can be compensated in the final assembly.

The transducers are designed for automotive, white goods and industrial applications and operates with typically 5 V supply voltage in the wide junction temperature range from –40 °C up to 170 °C.

CUR 3105 and CUR 3115 are available in the very small leaded package TO92UT and the SMD package SOIC8.

### Features

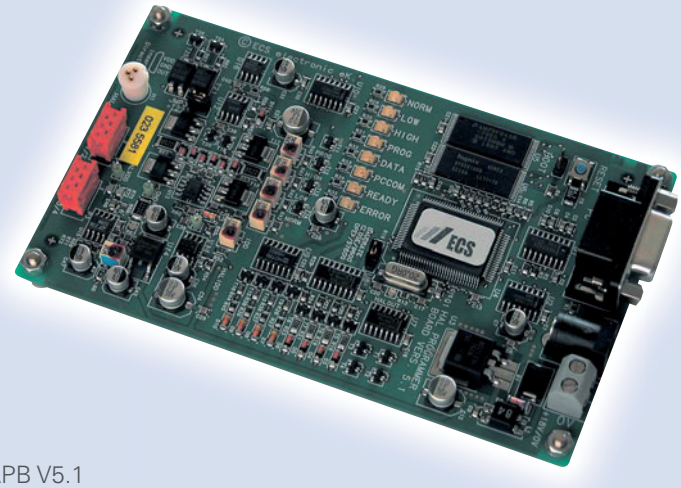
- Operates from –40 °C up to 170 °C junction temperature
- High-precision current transducer with ratiometric output and digital signal processing
- Low output voltage drifts over temperature 12-bit analog output
- Multiple programmable magnetic characteristics in a non-volatile memory
- EEPROM) with redundancy and lock function
- Open-circuit (ground and supply line break detection) with 5 kΩ pull-up and pull-down resistor, overvoltage and undervoltage detection
- For programming an individual transducer within several ICs in parallel to the same supply voltage, a selection can be done via the output pin
- Programmable clamping function
- Programming through modulation of the supply voltage
- Operates from 4.5 V up to 5.5 V supply voltage in specification and functions up to 8.5 V
- Operates with static magnetic fields and dynamic magnetic fields up to 1 kHz
- Overvoltage and reverse-voltage protection at all pins
- Magnetic characteristics extremely robust against mechanical stress
- Short-circuit protected push-pull output
- EMC and ESD optimized design
- "Die down" SOIC8 package allowing short distance between conducting medium and the sensitive area (CUR 3115 only)

### Generic Applications

Due to the sensors' versatile programming characteristics and low drifts, CUR 3105 and CUR 3115 are optimal system solutions for contactless current measurement applications.

# Tool Chain for Hall-effect Sensors and Current Transducers






HAL APB V5.1


HAL APB V1.5

Micronas provides two dedicated programmer boards supporting all programmable sensors. These two programmer boards are used as a general-purpose programming interface, which is capable of addressing all programmable Micronas Hall-effect sensor families within the Micronas sensor portfolio.

The application board V1.5 (APB) can be used for the new products HAL 1820, HAL 28xy, HAL 3625, HAL 3855.

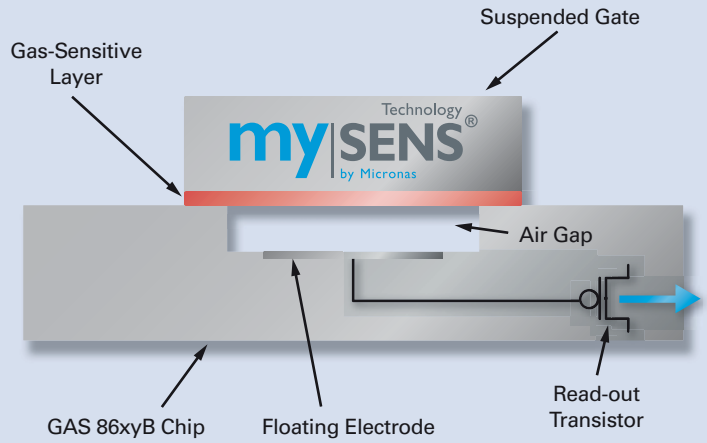
The application board V5.1 supports the following products: HAL 810, HAL 817, HAL 82x, HAL 85x, HAL 880, HAL 1000, and CUR 31xy.

Both boards provide an application software supporting a command interface for the communication with a PC. This allows the implementation of specific PC software for engineering purposes or in-line calibration.

For each of the programmable Hall sensor families, a specific PC software exists. This software provides a graphical user interface based on Microsoft® Visual Basic® or LabVIEW™ values on a PC.

# mySENS®

## CCFET Gas Sensing Technology




Micronas gas sensors are based on a unique and proprietary technology called mySENS®. The special feature distinguishing Micronas devices from others is their special CCFET setup. The CCFET technology (Capacitive-Coupled Field-Effect Transistor) is the way, our sensors detect gas concentration changes in the ambient air for a broad variety of applications.

For the detection of a target gas, a gas-sensitive layer is applied on a suspended gate that is mounted on top of a silicon chip. If this layer comes into contact with molecules of the target gas it responds with a change of its surface potential. As shown in the illustration, the gas-sensitive layer is capacitively coupled to a large floating electrode which is connected to the floating gate of a conventional MOSFET (Metal Oxide Semiconductor Field-Effect Transistor). Any gas-induced change of the gas-sensitive layer's surface potential is detected by the MOSFET and digitally processed by the integrated electronics.

What makes this way of gas detection so special? The interaction between the gas-sensitive layer and ambient gas molecules is a reversible dynamic process. This process takes place at room temperature allowing low-power, unheated operation for many gas species. All of this occurs without wear of the gas-sensitive layer. By using different gas-sensitive layers, Micronas gas sensors are able to detect specific target gases like nitrogen dioxide ($NO_2$), ammonia ($NH_3$), hydrogen ($H_2$) and volatile organic compounds (VOC).

### Technology

- Versatile, integrated digital gas sensor technology
- CCFET technology for gas detection
- No heating required for most target gases
- Fast detection of concentration changes of selected ambient trace gases
- Adjustable detection spectrum (by sensing layer and algorithms)
- Fabrication process embedded into Micronas' CMOS manufacturing technology
- Immunity against environmental interference, low cross-sensitivities

### Advantages

GAS 86xyB is the optimal system solution for:

- Detection of concentration changes of ambient trace gases
- Upgrading temperature and relative humidity based applications with gas detection

### Information

- Explore mySENS® technology: http://www.micronas.com
- For more information about Micronas gas sensors please email: mySENS@micronas.com

Technology mySENS® by Micronas

# GAS 86xyB



## Multi-Parametric Gas Sensor Platform with SPI-Output


GAS 86xyB is the latest generation of multi-parametric sensor platforms for gas detection based on the pioneering mySENS technology from Micronas. The capabilities of the GAS 86xyB platform go far beyond the measurement of a single gas species. Embedded into Micronas' CMOS manufacturing technology, GAS 86xyB includes two individual CCFET gas sensing devices, a temperature sensor, a relative humidity sensor, and electronic components, such as amplifiers, digital signal processing unit (DSP), as well as memory on one single chip.

By choosing the appropriate gas-sensitive layers for the two independent gas sensing devices, the sensor platform is factory-tailored to a specific sensing task. A serial peripheral interface (SPI) is capable of addressing each sensor independently and provides digital values, proportional to the measurement results. The factory-calibrated integrated temperature and relative humidity sensors can be used for cross-sensitivity compensation leading to reliable gas detections. They can also be used for independent temperature and relative humidity measurement purposes.

The sensor platform allows an electric performance check via an intelligent self-test function to guarantee accurate operation. For this function, a dedicated voltage level can be applied to the floating gate allowing the stimulation of an output voltage change without the presence of a target gas. An integrated heater provides the capability of heating the device. This may be needed for special operating conditions or for thermal refreshment e.g. in case of volatile organic compounds (VOC).

Another striking feature of the GAS 86xyB is its unique package. The sensor platform is available in an open-cavity QFN package with the dimensions of only 6 mm × 8 mm × 1.4 mm (length × width × height). An implemented polytetrafluorethylene (PTFE) filter on the open cavity avoids particle contamination of the sensor elements.

### Features

- Operates from –40 °C up to 85 °C ambient temperature
- Operates from 5% up to 95% relative humidity
- Robust against overdose exposure
- Low cross-sensitivities
- Two independent gas sensor units
- Integrated temperature sensor
- Integrated relative humidity sensor
- Electronic self-test capability
- Digital signal processing
- Integrated EEPROM
- Digital SPI interface
- Integrated heating option
- 2.7 to 3.6 V operating voltage
- Measurement ranges from approx. 100 ppb to 1 % gas concentration (exact values vary by target gas)
- Target gases $NO_2$, $NH_3$, $H_2$, and VOC (volatile organic compounds)
- Low current consumption (average operation <10 µA)
- Product life time >10 years
- Small 8×6 mm QFN sensor package with integrated PTFE particle filter

### Functions

The GAS 86xyB is the optimal system solution for:

**Building**

- Comfort and energy efficiency in building automation: HVAC, IAQ
- Early fire detection (small size and improved fire detection with less false alarms

**Automotive**

- Cabin air quality: farming ($NH_3$), truck exhaust ($NO_2$), gasoline exhaust ($H_2$)
- HVAC control
- Wind-screen fogging prevention

**Consumer**

- Portable fire detection and air quality sensors (e.g. in smartphones, tablet PCs, white goods, home appliances)

**Safety / Industrial**

- $NH_3$ leakage detection (alternative coolant, farming)
- $H_2$ leakage detection (fuel cell facilities, fuel cell vehicles, hydrogen installations, battery charge control)

# Tool Chain for GAS 86xyB Sensors



## USB Demo Kit


With an easy-to-use plug-and-play USB solution, Micronas provides the fastest way to begin the evaluation of the GAS 86xyB with mySENS technology. You only need a PC with a USB port and the appropriate LabVIEW™ software with graphical user interface (GUI), which can be downloaded from the Micronas Service Portal https://service.micronas.com. After installation, you are able to set up the complete GAS 86xyB sensor, to read out and to store the measurement values on your PC.


### Features

For engineering purposes, Micronas offers an easy-to-use demo kit:

- USB microcontroller interface board
- Direct USB connectivity
- LabVIEWTM graphical user interface
- No additional hardware required.
- One hardware for the entire GAS 86xy product family

### Advantages

Each analog sensor output of the GAS 86xyB is sequentially multiplexed to an analog-to-digital converter. The digital measurement values can be read out and the HW setting of the sensors can be programmed via the SPI interface. A digital signal processing logic is responsible for the conditioning of the sensor signals.

### Kit content

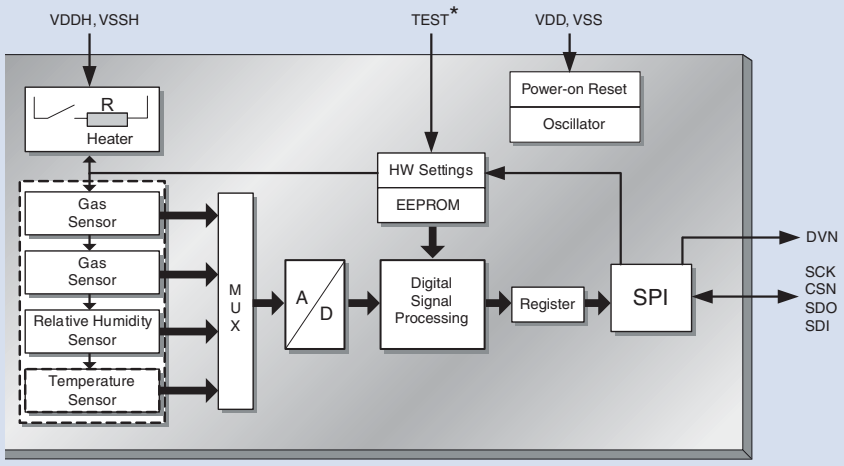
- USB microcontroller interface board with GAS 86xyB sensor

### Application Support

- All required documentation, SW and drivers can be downloaded from the Micronas Service Portal: https://service.micronas.com
- For more information about Micronas USB evaluation kit please email to: mySENS@micronas.com

# Tool Chain for GAS 86xyB Sensors

## USB Demo Kit




**GAS 86xy Block Diagram**

*Built-in self-test capability comprises the complete measurement signal path. The self-test does not require the presence of a target gas.

# Introduction




The Micronas high-voltage controller HVC 24xyB combines a standard microcontroller core with a wide range of additional functions which, up to now, could only be realized via external circuit elements.

The HVC 2480B is designed as an embedded controller for smart actuators. It features advanced integration for compact and cost-effective system designs for use in automotive applications and beyond (industrial, medical, consumer, instrumentation, etc.).

Replacement of conventional mechanical drive by "on-demand" electric drive and a general adoption of more efficient electrical motors are the main reasons for a growing demand for cost-effective system solutions for electrical motor control and drive. Long lifetime reliability, reduction of weight and overall dimension are additional key issues which have to be addressed especially for automotive applications like e.g. HVAC flaps. Thanks to their better efficiency, lower acoustic and electrical noise brushless DC (BLDC) are gaining a significant share of the electrical motors by replacing brushed (BDC) and stepper motors.

Micronas´ high-voltage controllers integrate almost all surrounding circuits needed for driving electrical motors. In addition to the UART interface, the built-in networking capabilities enable the deployment of LIN bus control for a wider range of applications like e.g. remote smart actuator. Reducing the number of external components to a minimum, the product's flexible peripherals allow direct controlling of brushed and brushless electrical motors either by means of three fully integrated half-bridges or by controlling three external MOSFET half-bridges. Thanks to this flexibility in driving the electrical motor, HVC 24xyB controllers provide an effective system solution for both small and medium sized electrical motors, enabling a common product platform. This gives our customers a decisive competitive edge because they are much faster at the implementation stage and need fewer resources in the development process of their various applications.

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# HVC 2480B

## Embeddded Controller for Smart Actuators




Reducing the number of external components to a minimum, the product's flexible peripherals allow direct controlling of brush-type and brushless electrical motors either by means of three fully integrated half-bridges or by controlling three external MOSFET half-bridges. The chip provides an ideal solution for smart actuator and smart sensor applications. Three fully integrated half-bridges allow to directly connect a BLDC motor without the need for external components. Various integrated digital and analog circuit units such as comparators with virtual star point reference or embedded amplifier allow users to minimize the number of external components.

Beside timers/counters, interrupt controller, multichannel A/D converter and enhanced PWMs, this family contains voltages regulators (including a switchable 5V output to power external HW) for direct 9 V ... 18 V operation, as well as LIN PHY, UART and SPI interfaces. This makes the system lighter in weight and saves important space within the application.

### Features

- Three integrated half-bridges or gate drivers for external half-bridges
- Temperature range up to $T_J$ =150 °C
- Supply voltage: 9 V ... 18 V
- High-performance 8-bit 8051 core (two-clock machine cycle) running with up to 24 MHz
- 1.75 Kbyte RAM
- Versions with up to 32 kbyte Flash
- On-chip EEPROM (512 byte) and oscillators
- Logic modules dedicated to control BLDC or BDC motors
- Three comparators with integrated virtual star point or external reference
- Multi-channel 10-bit ADC with selectable reference, programmable conversion time, and flexible start of conversion trigger
- Operational amplifier
- Three enhanced PWMs (EPWMs) modules, edge/center-aligned with two independent outputs per module with non-overlapping capability
- Configurable status of I/Os after reset
- Switchable 5 V power supply output
- SPI and enhanced LIN 2.x UART
- LIN 2.x transceiver
- Temperature sensor
- Active EMI suppression hardware
- Supply & temperature supervision
- Power saving modes
- PQFN40 6x8 mm² package

### Functions

The HVC 24xyB is the optimal system solution for controlling of brush and brushless motors, especially for small form factor applications

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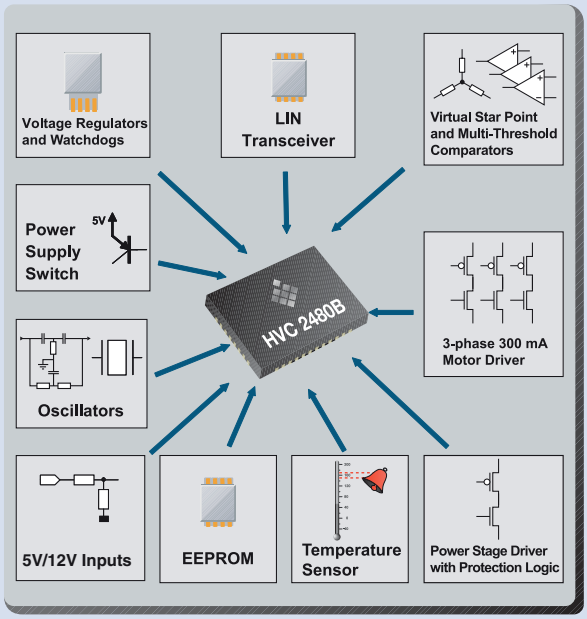
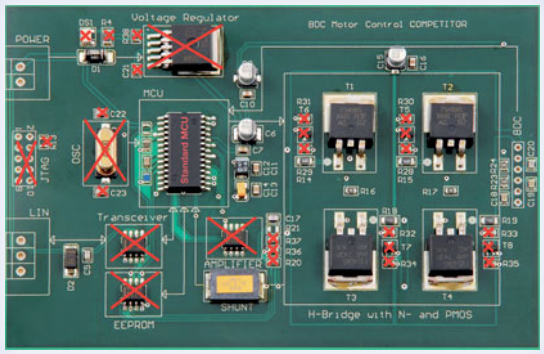
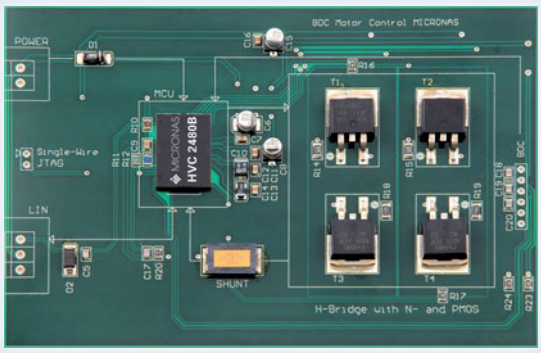
# Functions






Application example: DC motor control conventional solution




Cost-effective solution with the HVC 2480B

## Generic Applications

- Directly driving small motors
- Driving of motors with higher current via external half-bridges
- Sensor or sensorless controlled operation
- Block or sinusoidal (space vector modulation) commutation

## Application Examples

### Automotive:

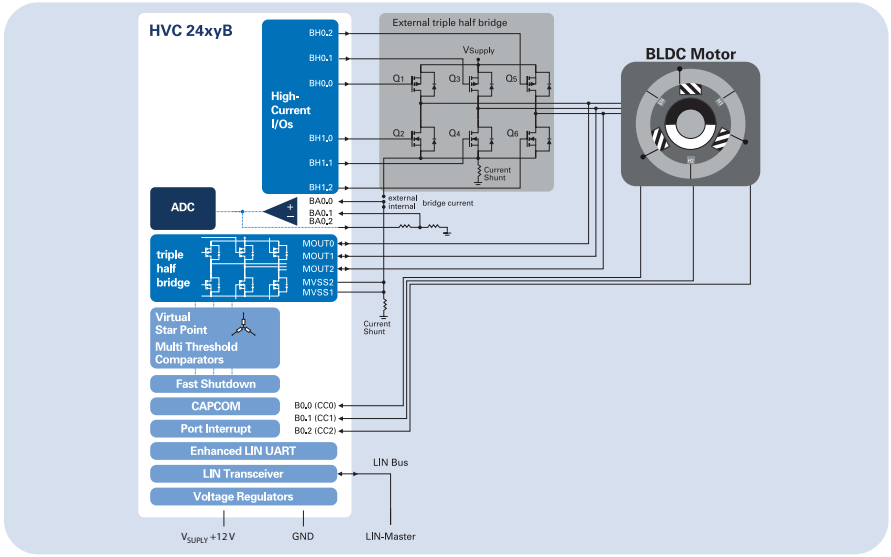
- Directly driving BLDC/PMSM motors (up to 300 mA, 600 mA peak): Grille shutter, LED fan, advanced headlight, cooling fan
- Driving of BLDC/PMSM motors with higher current via external half-bridges: Electronic throttle control, EGR, wiper, electric seat, water/oil/fuel pump
- Directly driving up to two BDC motors in H-bridge configuration

### Industrial

- Medical (peristaltic/roller pump, centrifuge/ separator, surgical instrument)
- Consumer (printer/scanner, fan/blower)
- Industrial (air sampling/gas analyzer, bar code reader, automation), as well as instrumentation products

# Motor Control Applications

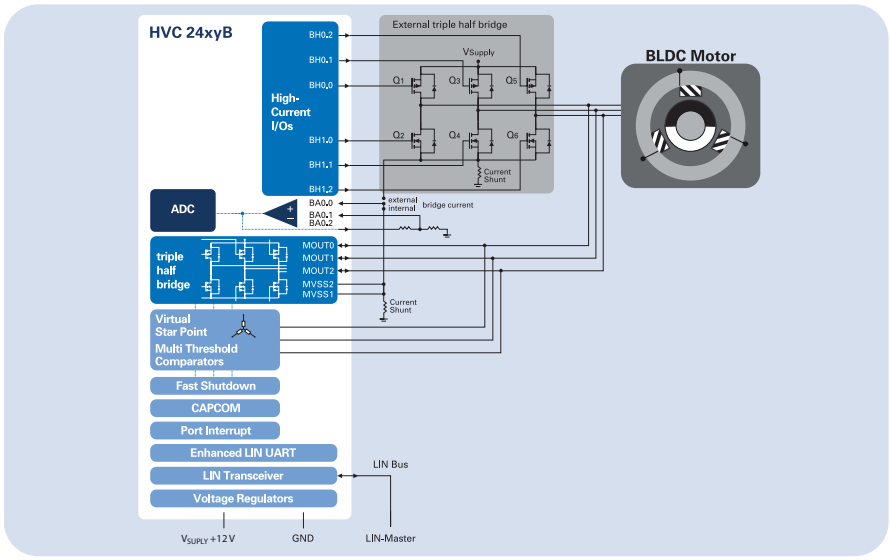





## BLDC Motor Control

### Sensor-Controlled Commutation

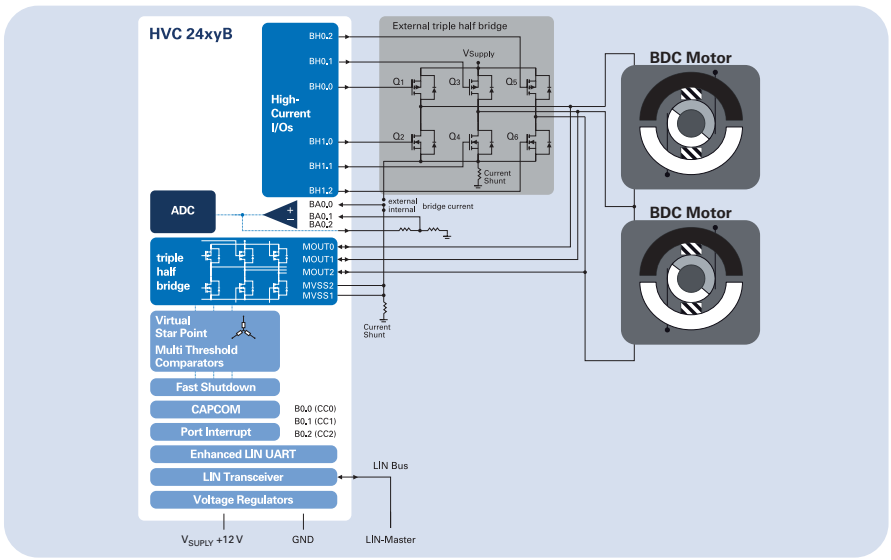
- The BLDC motor provides internal position monitoring with Hall sensors
- The sensor output can be fed back to the HVC and captured by its Capture/Compare Module "CAPCOM" modules (one input capture for each phase) to derive the information for commutation
- The Multi-threshold Comparator "MTC" and fast shutdown logic is used to protect the bridge




## BLDC/PMSM Motor Control

### Sensorless control of a BLDC/PMSM Motor

- Multi-threshold comparators measure the back EMF
- Integrated virtual star point provides the back EMF reference
- Delay logic optimizes motor commutation timing



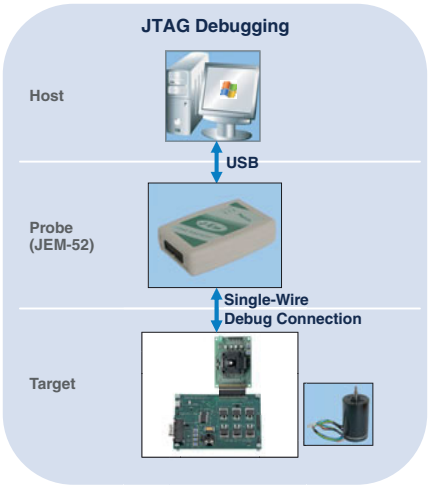

## BDC Motor Control

- Up to two brush-type DC motors
- Internal motor control bridges drive up to 300 mA each / 600 mA peak directly
- Internal power stage drivers control external motor control bridges

# Tool Chain for Embedded Controllers

## Development Tools

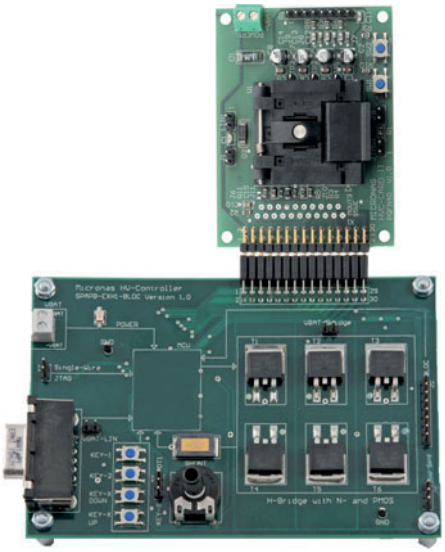
- JTAG Emulator (JEM) with single-wire debug interface
- Application boards
- SW package with API, core/peripheral drivers, SW templates for motor control functions (e.g. sensored/sensorless 6-step commutation, Space vector modulation...) and application notes
- Integrated development environment with debugger and compilers from several 3rd-party vendors



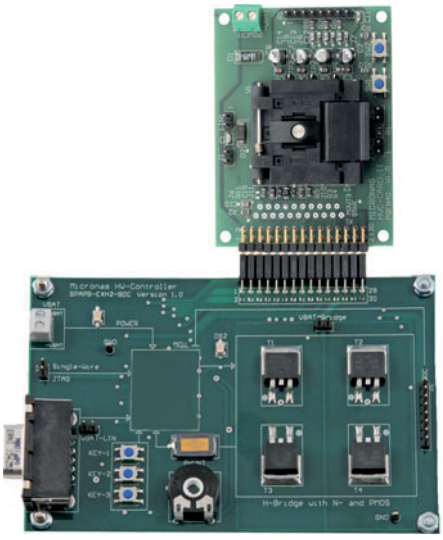

## Application Boards

Special-purpose APBs (SPAPBs)

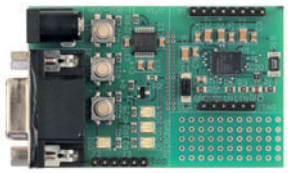
- For demonstrations and customer use
- For dedicated applications, e.g. BLDC/BDC/PMSM H-bridge control
- Stand-alone use if equipped with HVC 24xyB
- Connector for HVC card or other PCBs



SPAPB with HVC card for brushless DC motor control



SPAPB with HVC card for brush-type DC motor control

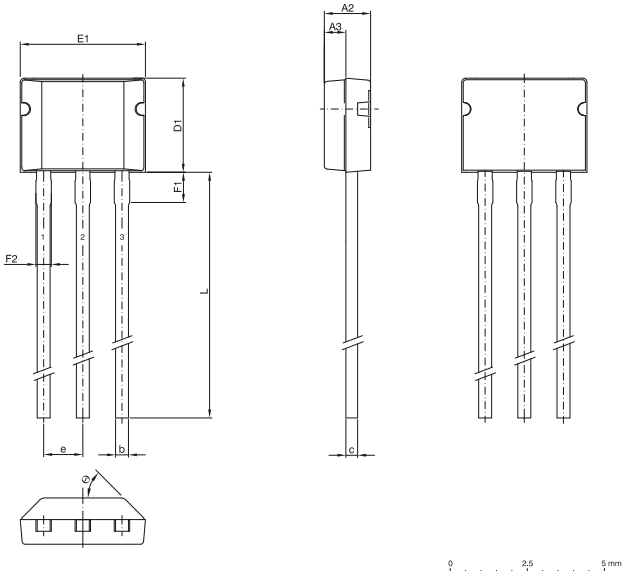


Small demo board for e.g. brushless or brush-type DC motor control and various interfaces as LIN, RS232, SPI, etc.

# Package Outlines



## TO92UA




physical dimensions do not include moldflash.

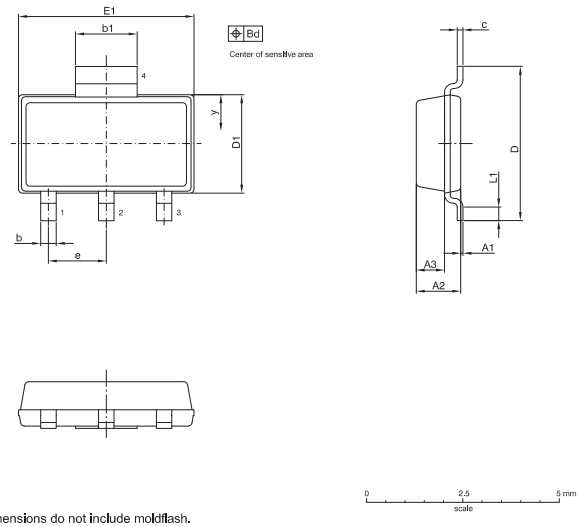
solderability is guaranteed between end of pin and distance F1.

A4, y= these dimensions are different for each sensor type and is specified in the data sheet.

min/max of D1 are specified in the datasheet.

| UNIT | A2 | A3 | b | Bd | c | D1 | e | E1 | F1 | F2 | L | Θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.55<br>1.45 | 0.7 | 0.42 | 0.2 | 0.36 | 3.05 | 1.27 | 4.11<br>4.01 | 1.2<br>0.8 | 0.60<br>0.42 | 15.5<br>min | 45° |

## SOT89

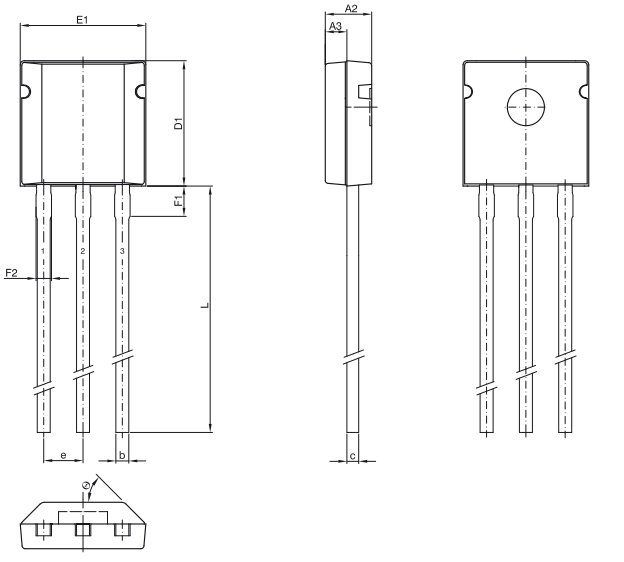



physical dimensions do not include moldflash.

A4, y= these dimensions are different for each sensor type and are specified in the data sheet.

| UNIT | A1 | A2 | A3 | b | b1 | Bd | c | D | D1 | e | E1 | L1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 0.10<br>0.02 | 1.20<br>1.10 | 0.73 | 0.4 | 1.7 | 0.2 | 0.15 | 4.0 | 2.6<br>2.5 | 1.5 | 4.6<br>4.5 | 0.25<br>min. |

## TO92UT




physical dimensions do not include moldflash.

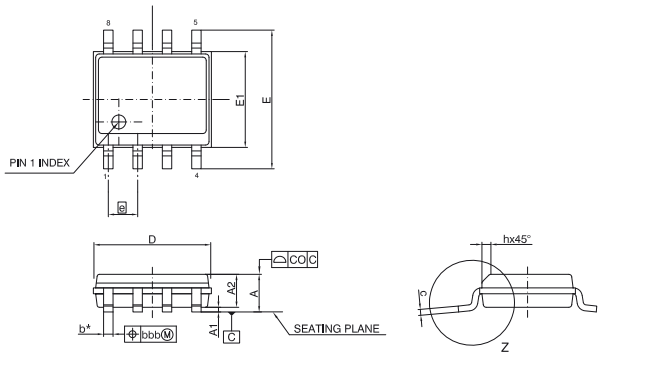
solderability is guaranteed between end of pin and distance F1.

A4, Bd, y= these dimensions are different for each sensor type and are specified in the data sheet.

min/max of D1 are specified in the datasheet.

| UNIT | A2 | A3 | b | c | D1 | e | E1 | F1 | F2 | L | Θ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.55<br>1.45 | 0.7 | 0.42 | 0.36 | 4.05 | 1.27 | 4.11<br>4.01 | 1.2<br>0.8 | 0.60<br>0.42 | 14.5<br>min | 45° |

## SOIC8




"D" and "E1" are reference data and do not include mold flash or protrusion.
Mold flash or protrusion shall not exceed 150 µm per side.

* does not include dambar protrusion of 0.1 max. per side

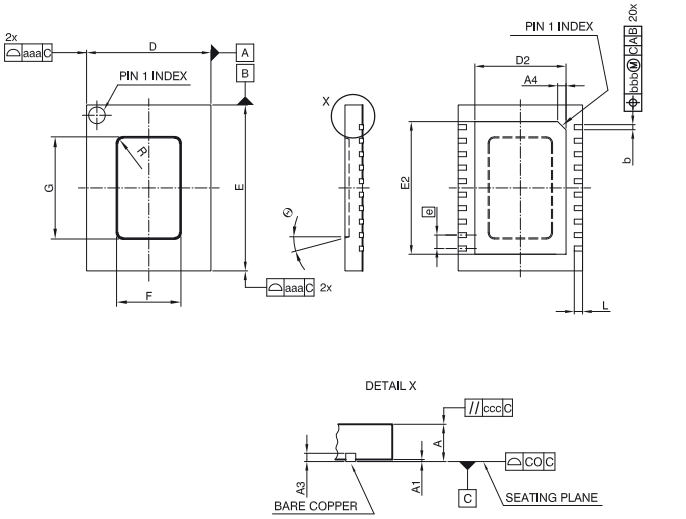
A4, Bd, x, y=these dimensions are different for each sensor type and are specified in the data sheet

| UNIT | A | A1 | A2 | b | bbb | c | CO | D | E | E1 | e | h | L | Θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.65 | 0,25<br>0.1 | 1.45 | 0.4 | 0.25 | 0.22 | 0.1 | 5.0<br>4.8 | 6.0 | 4.0<br>3.8 | 1.27 | 0.3 | 0.41<br>min. | 8°<br>max. |

# Package Outlines

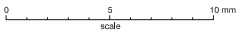


## QFN20



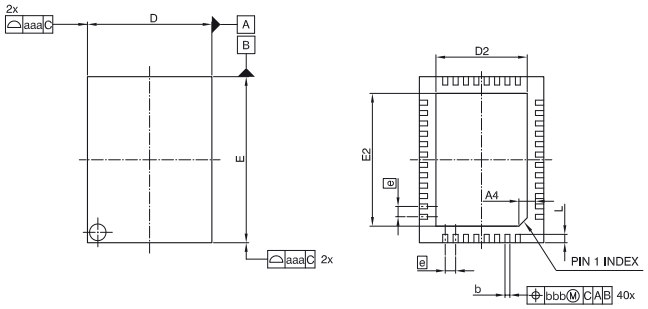


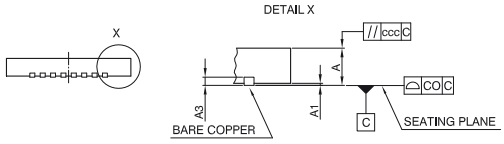


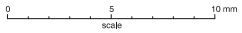



| UNIT | A | A1 | A3 | A4 | aaa | b | bbb | ccc | CO | D | D2 | E | E2 | e | L | F | G | Θ | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.5<br>1.3 | 0.05<br>0.0 | 0.2 | 0.4x45° | 0.15 | 0.35<br>0.25 | 0.1 | 0.1 | 0.08 | 6.0 | 4.2 | 8.0 | 6.2 | 0.65 | 0.5<br>0.3 | 3.7 | 5.5 | 15° | 0.5 |

## QFN40




| UNIT | A | A1 | A3 | A4 | aaa | b | bbb | ccc | CO | D | D2 | E | E2 | e | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.0<br>0.8 | 0.05<br>0.0 | 0.2 | 0.4x45° | 0.15 | 0.3<br>0.18 | 0.1 | 0.1 | 0.08 | 6.0 | 4.2 | 8.0 | 6.2 | 0.5 | 0.5<br>0.3 |

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