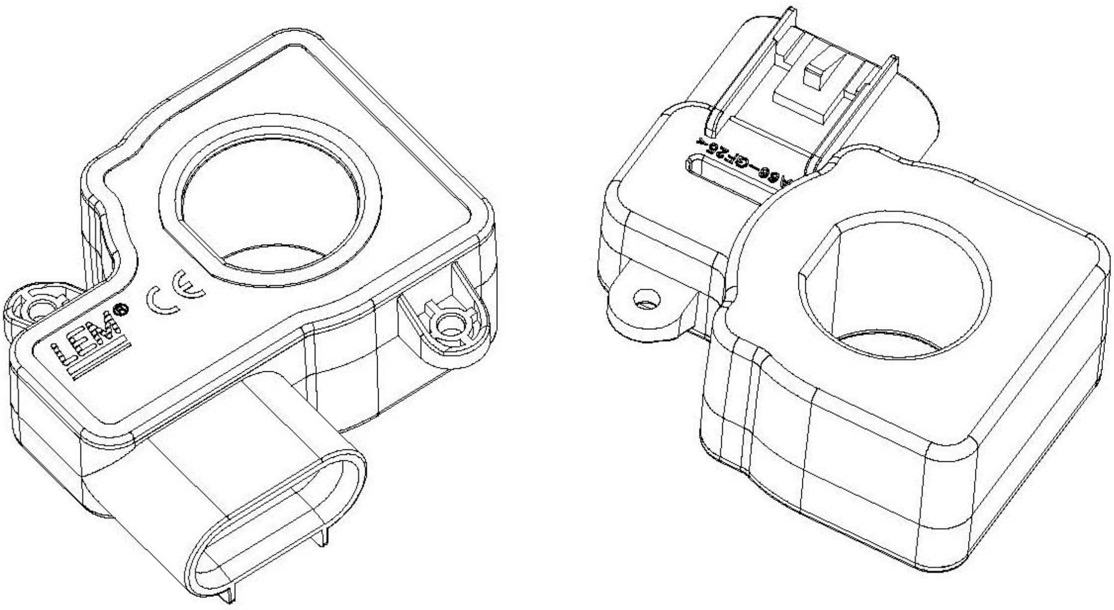
# AUTOMOTIVE CURRENT SENSOR
# DHAB S/18

## CE *Datasheet*



# DHAB S/18

## Introduction

**The DHAB** family is best suited for DC, AC or pulse current measurement in high power and low voltage automotive applications. It's contains a galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit).

**The DHAB** family has a dual current range. It gives you the choice of having different peak currents (from +/- 20A up to +/- 600A) in the same housing.

## Features

- Open loop transducer using the Hall effect sensor
- Low voltage application
- Unipolar +5VDC power supply
- Primary current measuring range up to ± 100A for range 1 and +/- 600A for range 2
- Maximum rms primary admissible current: defined by primary cable to have T° < +150°C
- Operating temperature range: - 40°C < T° < +125°C
- Output voltage:
  fully ratio-metric (gain and offset)
  2 measuring ranges to have a better accuracy.

## Advantages

- Good accuracy for high and low current range
- Good linearity
- Low thermal offset drift
- Low thermal gain drift
- Hermetic package.

## Automotive applications

- Battery Pack Monitoring
- Hybrid Vehicles
- EV and Utility Vehicles.

## Principle of the DHAB Family

The open loop transducers use an Hall effect IC. The magnetic induction B, contributing to the rise of the Hall voltage, is generated by the primary current $I_p$ to be measured.
The control current $I_p$ is supplied by a current source i.e. battery or generator (Fig. 1).

Within the linear region of the hysteresis cycle, B is proportional to:

$$\mathbf{I}_P \text{ (B) = constant (a) x } \mathbf{I}_P$$

The Hall voltage is thus expressed by:

$$\mathbf{V}_H = \text{(K/d) x I x constant (a) x } \mathbf{I}_P$$

Except for $I_P$, all terms of this equation are constant. Therefore:

$$\mathbf{V}_H = \text{constant (b) x } \mathbf{I}_P$$

The measurement signal $V_H$ amplified to supply the user output voltage or current.

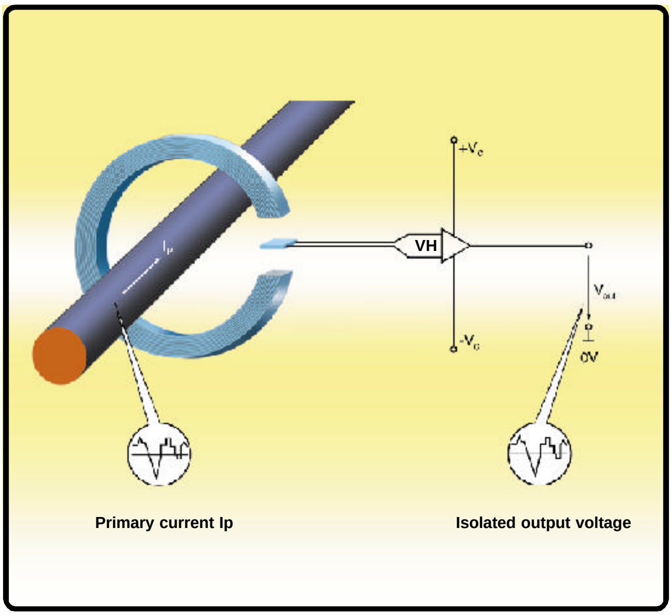
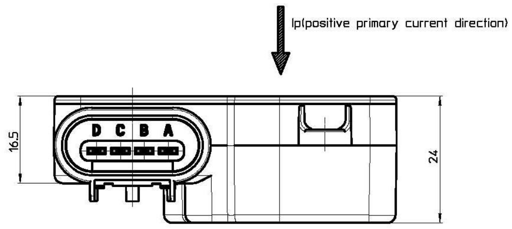
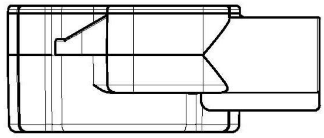


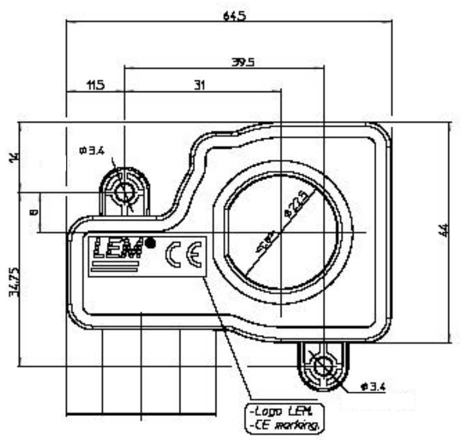

Fig. 1: Principle of the open loop transducer

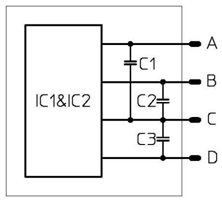
# DHAB S/18

## Dimensions DHAB S/18 (in mm. 1mm = 0.0394 inch)

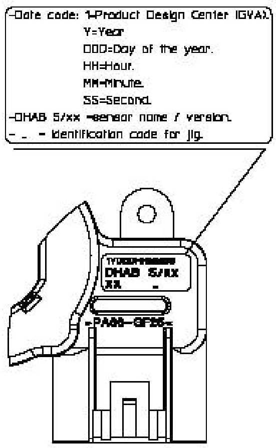


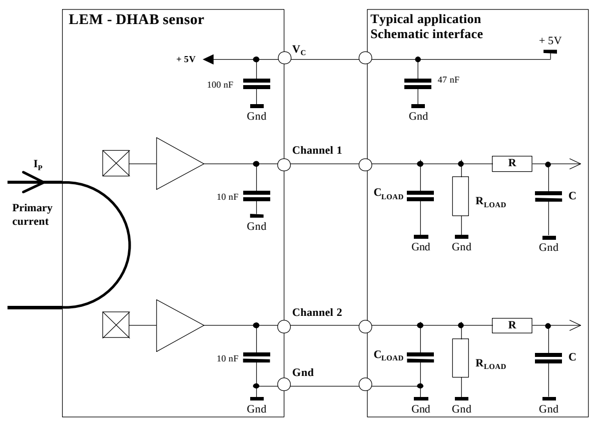



| Pin out | |
|---|---|
| A | Channel 2 |
| B | Vc |
| C | Gnd |
| D | Channel 1 |




**System Architecture**




## Bill of materials

- Plastic case — PA 66-GF25
- Pins — Brass tin platted
- Magnetic core — Channel 1: FeNi alloy
  Channel 2: FeSi alloy
- Mass — 69.5 g

$R_{LOAD}$ > 10 kΩ Optional resistor for signal line diagnostic
$C_{LOAD}$ < 100 nF EMC protection
RC low pass filter EMC protection (optinal)

# DHAB S/18

## Absolute maximum rating (not operating)

| PARAMETER | Symbol | Unit | Specification Mini | Specification Typical | Specification Maxi | Conditions |
|---|---|---|---|---|---|---|
| **Electrical Data** | | | | | | |
| Supply continuous over voltage | | V | | | 8.5 | |
| Supply over voltage | | V | | | 14 | 1 min |
| Reverse voltage | | V | -14 | | | 1 min @ $T_A$ = 25°C |
| Output continuous over voltage | | V | | | 8.5 | |
| Output over voltage | | V | | | 14 | 1 min @ $T_A$ = 25°C |
| Continuous output current | $I_{out}$ | mA | -10 | | 10 | |
| Output short circuit duration | $t_c$ | min | | | 2 | |
| Storage temperature | $T_S$ | °C | -40 | | 125 | |

## Operating conditions

| PARAMETER | Symbol | Unit | Specification Mini | Specification Typical | Specification Maxi | Conditions |
|---|---|---|---|---|---|---|
| **Electrical Data** | | | | | | |
| Supply voltage | $V_C$ | V | 4.75 | 5 | 5.25 | |
| Current consumption | $I_C$ | mA | | 15.00 | 20 | |
| Power up inrush current | | mA | | | 40 | @ $V_C$ < 3.5 volts |
| Continuous output current | $I_{out}$ | mA | -1 | | 1 | |
| Load resistance | $R_L$ | KΩ | 10 | | | |
| Load capacitor | $C_L$ | nF | 1 | | 100 | |
| Ambient operating temperature | $T_A$ | °C | -10 | | 65 | High accuracy |
| | | | -40 | | 125 | Reduced accuracy |

## Channel 1

| PARAMETER | Symbol | Unit | Specification Mini | Specification Typical | Specification Maxi | Conditions |
|---|---|---|---|---|---|---|
| **Electrical Data** | | | | | | |
| Primary current, measuring range | $I_{Pchannel\ 1}$ | A | -30 | | 30 | |
| Offset voltage 1) | $V_o$ | V | | 2.50 | | @ $V_C$ 5 volts |
| Sensitivity 1) | G | mV/A | | 66.7 | | @ $V_C$ 5 volts |
| Load resistance | $R_L$ | mV | | 2.5 | | @ $V_C$ 5 volts |
| Clamp low 1) | | V | 0.24 | 0.25 | 0.26 | @ $V_C$ 5 volts |
| Clamp high 1) | | V | 4.74 | 4.75 | 4.76 | @ $V_C$ 5 volts |
| Output internal resistance | $R_{OUT}$ | Ω | | 1 | 10 | |
| Frequency bandwidth | BW | KHz | | 1 | | @ -3 dB |
| Power up time | | ms | | | 110 | |
| Setting time after over load | | ms | | | 25 | |

## Channel 2

| PARAMETER | Symbol | Unit | Specification Mini | Specification Typical | Specification Maxi | Conditions |
|---|---|---|---|---|---|---|
| **Electrical Data** | | | | | | |
| Primary current, measuring range | $I_{Pchannel\ 2}$ | A | -350 | | 350 | |
| Offset voltage 1) | $V_o$ | V | | 2.50 | | @ $V_C$ 5 volts |
| Sensitivity 1) | G | mV/A | | 5.7 | | @ $V_C$ 5 volts |
| Load resistance | $R_L$ | mV | | 2.5 | | @ $V_C$ 5 volts |
| Clamp low 1) | | V | 0.24 | 0.25 | 0.26 | @ $V_C$ 5 volts |
| Clamp high 1) | | V | 4.74 | 4.75 | 4.76 | @ $V_C$ 5 volts |
| Output internal resistance | $R_{OUT}$ | Ω | | 1 | 10 | |
| Frequency bandwidth | BW | KHz | | 1 | | @ -3 dB |
| Power up time | | ms | | | 110 | |
| Setting time after over load | | ms | | | 25 | |

Note: 1) The output voltage $V_{out}$ is fully ratio-metric (that concerns $V_O$, Sensitivity ans clamping), it depends on the supply voltage $V_C$ in relative with the following formula:

$$Ip = \left(Vout - \frac{Vc}{2}\right) \text{x} \frac{1}{G} \text{x} \frac{5}{Vc} \qquad \textit{With G in (V/A)}$$

# DHAB S/18

## Accuracy

## Channel 1

| PARAMETER | Symbol | Unit | Specification | | | Conditions |
|---|---|---|---|---|---|---|
| | | | Mini | Typical | Maxi | |
| Electrical Data | | | | | | |
| Electrical offset current | $I_{OEchannel1}$ | mA | | ±50 | | @ $T_A$ = 25°C |
| Residual current | $I_{OMchannel1}$ | mA | | ±50 | | @ $T_A$ = 25°C |
| Global offset current | $I_{Ochannel1}$ | mA | | ±100 | | @ $T_A$ = 25°C |
| | | | -300 | | 300 | @ - 10°C < T° < 65°C |
| | | | -500 | | 500 | @ - 40°C < T° < 125°C |
| Sensitivity error | $\varepsilon_G$ | % | | ±0.5 | | @ $T_A$ = 25°C |
| | | | -2.5 | | 2.5 | @ - 10°C < T° < 65°C |
| | | | -4 | | 4 | @ - 40°C < T° < 125°C |
| Linearity error | $\varepsilon_L$ | % | -1 | | 1 | of full range |

## Channel 2

| PARAMETER | Symbol | Unit | Specification | | | Conditions |
|---|---|---|---|---|---|---|
| | | | Mini | Typical | Maxi | |
| Electrical Data | | | | | | |
| Electrical offset current | $I_{OEchannel2}$ | A | | ±0.7 | | @ $T_A$ = 25°C |
| Residual current | $I_{OMchannel2}$ | A | | ±2.3 | | @ $T_A$ = 25°C |
| Global offset current | $I_{Ochannel2}$ | A | | ±3 | | @ $T_A$ = 25°C |
| | | | -4 | | 4 | @ - 10°C < T° < 65°C |
| | | | -4.5 | | 4.5 | @ - 40°C < T° < 125°C |
| Sensitivity error | $\varepsilon_G$ | % | | ±0.5 | | @ $T_A$ = 25°C |
| | | | -2.5 | | 2.5 | @ - 10°C < T° < 65°C |
| | | | -4 | | 4 | @ - 40°C < T° < 125°C |
| Linearity error | $\varepsilon_L$ | % | -1 | | 1 | of full range |

**Note**: In case of short circuit of any DHAB output to + batt, a current is reinjected in the power supply. If the output voltage is not protected against this current, this voltage may increase or decrease, which must be taken into account for the second channel.

# DHAB S/18

## PERFORMANCE PARAMETERS DEFINITIONS

**Sensitivity:**

The Transducer's sensitivity **G** is the slope of the straight line $\mathbf{V}_{out}$ = f ($\mathbf{I}_P$), it must establish the relation:
$\mathbf{V}_{out}(\mathbf{I}_P) = \mathbf{V}_C/5\ (G \times \mathbf{I}_P + 2.5)$ (*)
(*) For all symetrics transducers.

**Output voltage:**

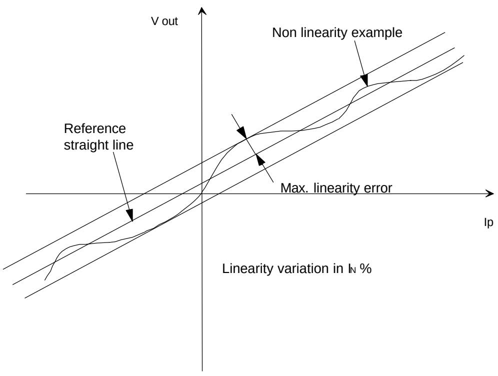
It's the output voltage when the primary current is null. The ideal value of $\mathbf{V}_O$ is $\mathbf{V}_C/2$. So, the difference of $\mathbf{V}_O - \mathbf{V}_C/2$ is called the total offset voltage error. This offset error can be attributed to the electrical offset (due to the resolution of the ASIC quiescent voltage trimming), the magnetic offset, the thermal drift and the thermal hysteresis.

**Magnetic offset:**

The magnetic offset is the consequence of an over-current on the primary side. It's defined after an excursion of $\mathbf{I}_{Pmaxi}$.

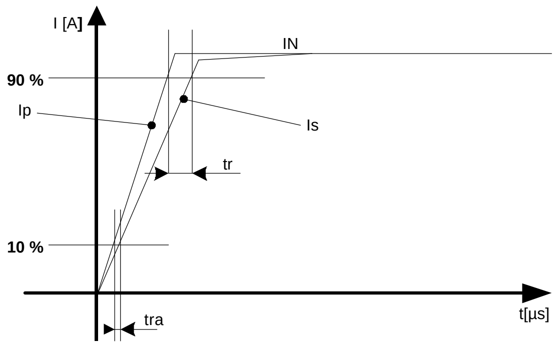
**Linearity:**

The maximum positive or negative discrepancy with a reference straight line $\mathbf{V}_{OUT}$ = f ($\mathbf{I}_P$).
Unit: linearity [%] expressed with full scale of $\mathbf{I}_{Pmaxi}$.




**Response time (delay time) $t_r$ :**

The time between the primary current signal and the output signal reach at 90 % of its final value




**Output noise voltage:**

The output voltage noise is the result of the noise floor of the Hall elements and the linear $I_C$ amplifier sensitivity.

**Offset drift:**

The error of the offset in the operating temperature εOffset is the relative variation of the offset in the temperature considered with the initial offset at 25°C. The offset temperature coefficient $\mathbf{TCV}_{OE}$ ($\mathbf{TCI}_{OE}$) in the operating temperature is the slope off εOffset = **f** (T).

**Sensitivity drift:**

The error of the sensitivity in the operating temperature Sensitivity Error is the relative variation of the sensitivity in the temperature considered with the initial sensitivity at 25°C. Sensitivity temperature coefficient $\mathbf{TCe}_G$.

**Typical:**

Theorical value or usual accuracy recorded during the production.

**Environmental test specifications**

| NAME | STANDARD | CONDITIONS |
|---|---|---|
| Low T° storage | TBD | |
| Thermal shocks | IEC 60068 Part 2-14 | T° - 40°C to 120°C /300 cycles not connected |
| Low T°operation at mini supply voltage | TBD | T° - 40°C / 1000 H<br>supply voltage = 4.75 V |
| Hight T° operation at maxi supply voltage | IEC 60068 Part 2-2 | T° 125°C / 1000 H supply voltage = 5.25 V |
| Temperature humidity bias | IEC 60068 Part 2-3 | T° 90°C / 95 % RH/ 1000 H<br>supply voltage = 5.25 V |
| **Mechanical Tests** | | |
| Vibration | TBD | Acceleration 30m/s2, 25°C, frequency 20 to 1000 Hz/8h<br>each axis |
| Drop test | IEC 60068 Part 2-29 | Drop 1m, 2 falls/part, 1part/axis, 3axes, criteria : relative sensitivity error 3% |
| **EMC Test** | | |
| Rms voltage for AC isolation test | TBD | |
| Bulk current injected-radiated immunity | ISO11452-4 | |
| Electrostatic discharge | TBD | |

Deviation of the typical global accuracy after the environmental tests:

| | **@ $I_P$ = 0 A** | **@ ± $I_P$** |
|---|---|---|
| $\mathbf{T}_A$ = 25°C | TBD | TBD |
| (-) 40°C < T° < 125°C | TBD | TBD |