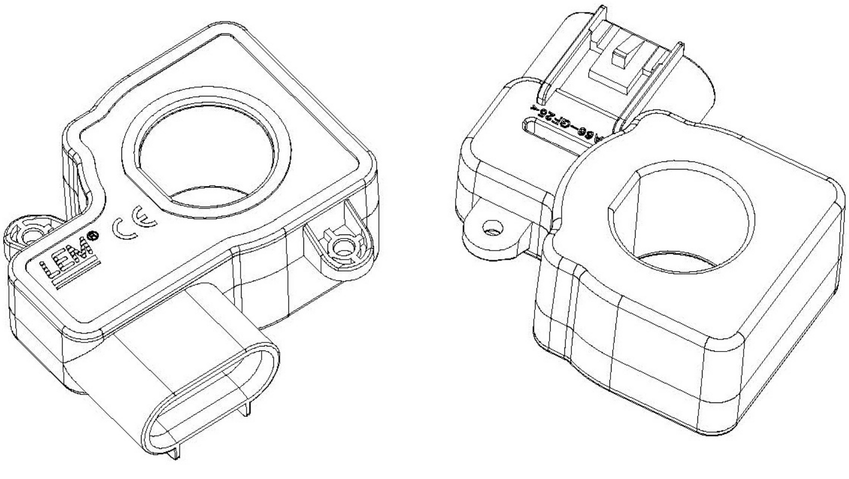
AUTOMOTIVE CURRENT TRANSDUCER

DHAB S/34

CE *Datasheet*



DHAB S/34

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 ± 50A for range 1 and +/- 200A 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:

$$B(I_P) = \text{constant (a)} \times I_P$$

The Hall voltage is thus expressed by:

$$V_H = (R_H/d) \times I \times \text{constant (a)} \times I_P$$

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

$$V_H = \text{constant (b)} \times I_P$$

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

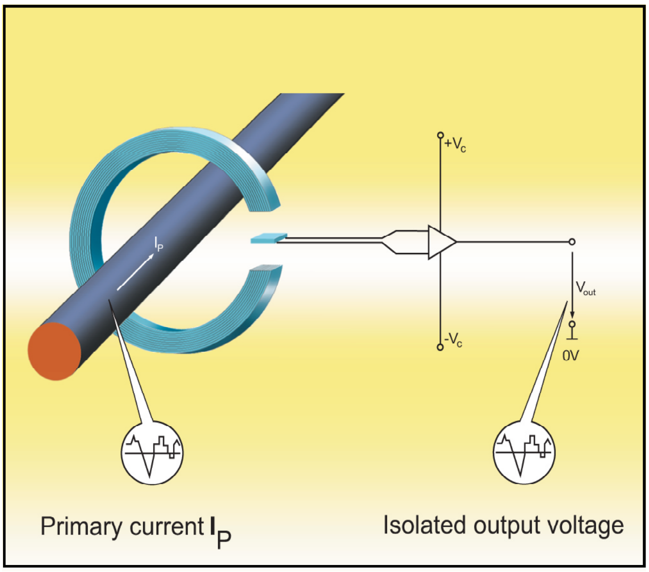


Fig. 1: Principle of the open loop transducer

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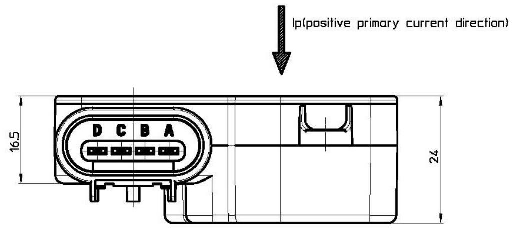
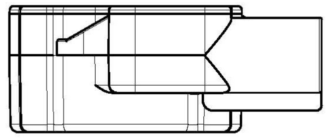
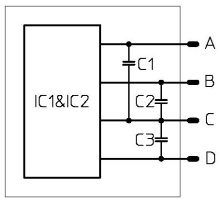
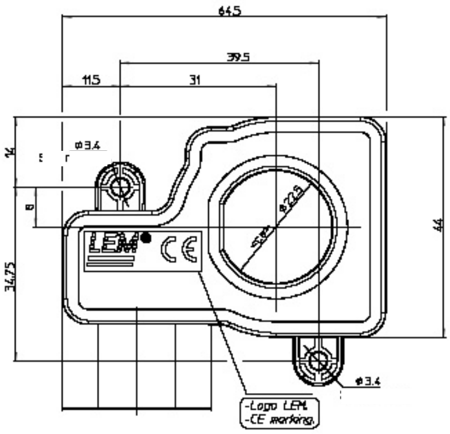
Dimensions DHAB S/34 (in mm. 1mm = 0.0394 inch)

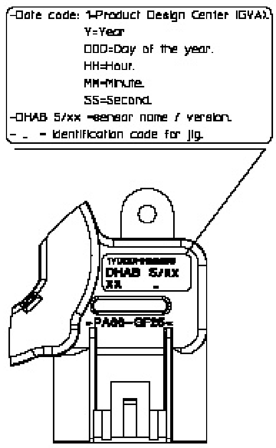




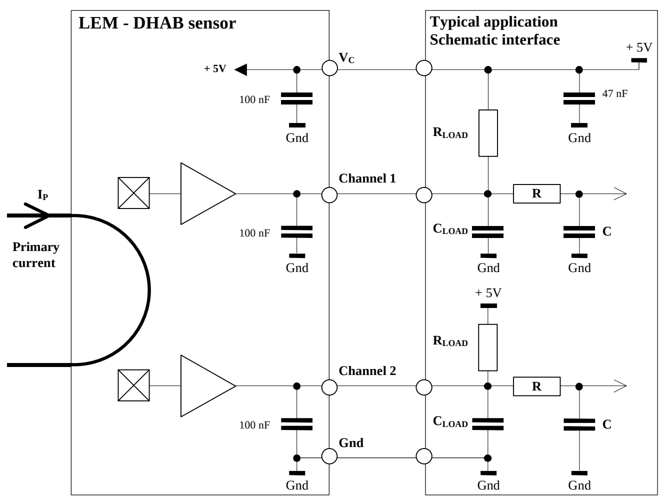




Pin out	
A	Channel 2
B	Vc
C	Gnd
D	Channel 1



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	77 g

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

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Absolute maximum rating (not operating)

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Continuous Over Voltage	V_C				8.5	
Over Voltage		V			20	1 min
Reverse Voltage		V	-15			1 min @ T_A = 25°C
Output voltage (continuous)	V_{OUT}	V			8.5	
Output over Voltage		V			20	1 min @ T_A = 25°C
Reverse current (output / supply)	I_{OUT}	mA	-40		40	
Reverse output voltage		V	-0.7			
Ambiant storage Temperature	T_S	°C	-40		125	

Operating conditions

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
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		30	40	@ V_C < 3.8 volts
Continuous output current	I_{OUT}	mA	-1		1	
Load resistance	R_L	KΩ	10			
Capacitive loading	C_L	nF	1		100	
Ambient operating temperature	T_A	°C	-10		60	High accuracy
			-40		125	Reduced accuracy

Channel 1

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Primary current	$I_{Pchannel\ 1}$	A	-50		50	
Vout @ Ip=0A [1)]	V_o	V		2.50		@ V_C 5 volts
Sensitivity (1)	G	mV/A		40		@ V_C 5 volts, calibration @ ± 50 A
Resolution		mV		1		@ V_C 5 volts
Output clamping voltage min [1)]	V_{SZ}	V	0.2	0.25	0.3	@ V_C 5 volts
Output clamping voltage max [1)]		V	4.7	4.75	4.8	@ V_C 5 volts
Output internal resistance	R_{OUT}	Ω		2	10	
Frequency bandwidth	BW	Hz			250	@ -3 dB
Power up time		ms			10	
Setting time after over load		ms			10	

Channel 2

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Primary current	$I_{Pchannel\ 2}$	A	-200		200	
Offset voltage [1)]	V_o	V		2.50		@ V_C 5 volts
Sensitivity [1)]	G	mV/A		10		@ V_C 5 volts, calibration @ ± 100 A
Resolution		mV		1		@ V_C 5 volts
Output clamping voltage min [1)]	V_{SZ}	V	0.2	0.25	0.3	@ V_C 5 volts
Output clamping voltage max [1)]		V	4.7	4.75	4.8	@ V_C 5 volts
Output internal resistance	R_{OUT}	Ω		2	10	
Frequency bandwidth	BW	Hz		250		@ -3 dB
Power up time		ms			10	
Setting time after over load		ms			10	

Note: [1)] The output voltage $\mathbf{V}_{out}$ is fully ratio-metric (that concerns $\mathbf{V}_O$, Sensitivity ans clamping), it depends on the supply voltage $\mathbf{V}_C$ in relative with the following formula:

$$I_P = \left(V_{OUT} - \frac{V_C}{2} \right) \times \frac{1}{G} \times \frac{5}{V_C} \qquad \textit{with G in (V/A)}$$

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Accuracy

Channel 1

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Electrical offset current	$I_{OE\ channel1}$	mA		±50		@ T_A = 25°C
Magnetic offset current	$I_{OM\ channel1}$	mA		±50		@ T_A = 25°C
Global offset current	$I_{O\ channel1}$	mA		±100		@ T_A = 25°C
			-500		500	@ - 10°C < T° < 60°C
			-900		900	@ - 40°C < T° < 125°C
Sensitivity error	ε_G	%		±0.5		@ T_A = 25°C
			-2		2	@ - 10°C < T° < 60°C
			-3		3	@ - 40°C < T° < 125°C
Linearity error	ε_L	%		±0.5		of full range
Temperature coefficient of I_{OE}	TCI_{OEAV}	mA/°C	-6.00	±1.25	6.00	@ - 40°C < T° < 125°C
Temperature coefficient of **G**	TCG_{AV}	%/°C	-0.02	± 0.01	0.02	@ - 40°C < T° < 125°C

Channel 2

PARAMETER	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Electrical offset current	$I_{OE\ channel2}$	A		±0.2		@ T_A = 25°C
Magnetic offset current	$I_{OM\ channel2}$	A		±1.5		@ T_A = 25°C
Global offset current	$I_{O\ channel2}$	A		±1.7		@ T_A = 25°C
			-2.5		2.5	@ - 10°C < T° < 60°C
			-3.5		3.5	@ - 40°C < T° < 125°C
Sensitivity error	ε_G	%		±0.5		@ T_A = 25°C
			-2		2	@ - 10°C < T° < 60°C
			-3		3	@ - 40°C < T° < 125°C
Linearity error	ε_L	%	-1		1	of full range
Temperature coefficient of I_{OE}	TCI_{OEAV}	mA/°C	-16	±6	16	@ - 40°C < T° < 125°C
Temperature coefficient of **G**	TCG_{AV}	%/°C	-0.02	± 0.01	0.02	@ - 40°C < T° < 125°C

Formulas for the global absolu error calculations:

Global error

$$X = I_O@25°C + TCI_{OAV}\ x\ \Delta T + \left(\varepsilon_L + \varepsilon_G@25°C + TCG_{AV}\ x\ \Delta T\right)\ x\ I_P/100 \quad [A]$$

With:

$$\Delta T = \text{Abs}\ (T°\ \text{instantaneous} - T_A\ (= 25°C)\ )$$

$$Ip = \text{Abs}\left(Vout - \frac{Vc}{2}\right) x\ \frac{1}{G}\ x\ \frac{5}{Vc}$$

With G in (V/A)

<u>**Note**</u>: 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.

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PERFORMANCE PARAMETERS DEFINITIONS

Output noise voltage:

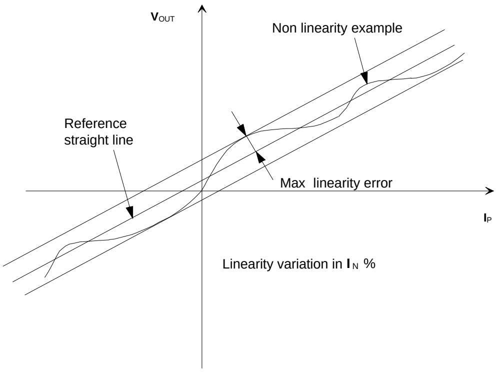
The output voltage noise is the result of the noise floor of the Hall elements and the linear I_C amplifier gain.

Magnetic offset:

The magnetic offset is the consequence of an over-current on the primary side. It's defined after an excursion of $I_{P\ max}$.

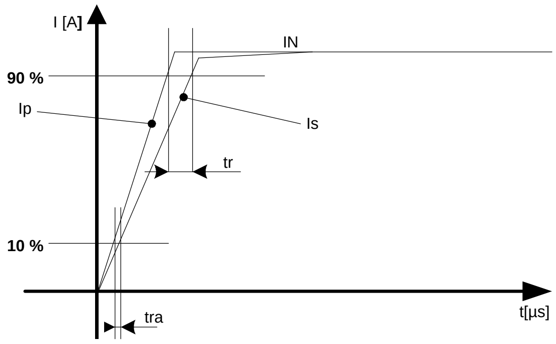
Linearity:

The maximum positive or negative discrepancy with a reference straight line $V_{OUT} = f(I_P)$.
Unit: linearity (%) expressed with full scale of $I_{P\ max}$.



Response time (delay time) t_r:

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



Typical:

Theorical value or usual accuracy recorded during the production.

Sensitivity:

The Transducer's sensitivity **G** is the slope of the straight line $V_{OUT} = f(I_P)$, it must establish the relation:
$V_{OUT}(I_P) = (V_C/5) \times (G \times I_P + 2.5)$ (*).

* For all symetric transducers.

Offset with temperature:

The error of the offset in the operating temperature is the variation of the offset in the temperature considered with the initial offset at 25°C.
The offset variation I_{OT} is a maximum variation the offset in the temperature range:
$I_{OT} = I_{OE}$ max - I_{OE} min
The Offset drift TCI_{OEAV} is the I_{OT} value divided by the temperature range.

Sensitivity with temperature:

The error of the sensitivity in the operating temperature is the relative variation of sensitivity with the temperature considered with the initial offset at 25°C.
The sensitivity variation G_T is the maximum variation (in ppm or %) of the sensitivity in the temperature range:
G_T = (Sensitivity max - Sensitivity min) / Sensitivity at 25°C.
The sensitivity drift TCG_{AV} is the G_T value divided by the temperature range.

Offset voltage @ I_P = 0 A:

Is the output voltage when the primary current is null. The ideal value of V_O is $V_C/2$ at V_C = 5 V. So, the difference of $V_O - V_C/2$ 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.

Environmental test specifications

Name	Standard	Conditions
Thermal shocks	IEC 60068 Part 2-14	T° - 40°C to 125°C /300 cycles not connected
T° humidity cyclic	ISO 16750-4	10 cycles of 24h, high T°, power supply on, monitoring
Temperature humidity bias	JESD22-A101	T° 85°C / 85 % RH/ 1000 H, power supply on, monitoring
Mechanical Tests		
Vibration	ISO 16750-3§4.1.3.1.6	Acceleration 30m/s2, 25°C, Frequency 20 to 1000 Hz / 8 h each axis
Drop test	ISO 16750-3§4.3	Drop 1m, 2 falls/part, 1part/axis, 3axes, criteria: relative sensitivity error 3%
EMC Test		
Rms voltage for AC isolation test	IEC 60664 Part 1	2 kV, 50 Hz, 1 min
Isolation resistance	ISO 16750-2 §4.10	500VDC, 25°C, $R_{isolation}$ > 10 MO
Bulk current injected-radiated immunity	ISO 11452 Part 4	$I_{injected}$ =< 200 mA
Electrostatic discharge	IEC 61000 Part 4-2	Criteria B
	JESD22-A114-B	± 2 kV, Criteria B