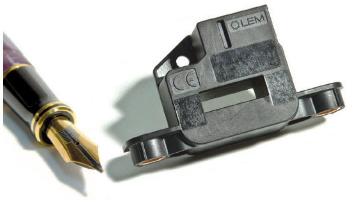
AUTOMOTIVE CURRENT TRANSDUCER
HAH1BV S/24



Introduction

The HAH1BV family is for the electronic measurement of DC, AC or pulsed currents in high power automotive applications with galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit).

The HAH1BV family gives you the choice of having different current measuring ranges in the same housing (from ± 200 A up to ± 700 A).

Features

- Open Loop transducer using the Hall effect
- Unipolar + 5 V DC power supply
- Primary current measuring range up to - 200/+ 400 A
- Maximum RMS primary current limited by the busbar, the magnetic core or the ASIC temperature T° < + 150°C
- Operating temperature range: - 40°C < T° < + 85°C
- Output voltage: full ratiometric (in sensitivity and offset)
- Compact design.

Advantages

- Excellent accuracy
- Very good linearity
- Very low thermal offset drift
- Very low thermal sensitivity drift
- Wide frequency bandwidth
- No insertion losses.

Automotive applications

- Battery monitoring
- Starter Generators
- Inverters
- HEV application
- EV application.

Principle of HAH1BV Family

The open loop transducers uses a Hall effect integrated circuit. The magnetic flux density B, contributing to the rise of the Hall voltage, is generated by the primary current $\mathbf{I_P}$ to be measured.
The current to be measured $\mathbf{I_P}$ 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:

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

The Hall voltage is thus expressed by:

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

Except for $\mathbf{I_P}$, all terms of this equation are constant.
Therefore:

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

The measurement signal $\mathbf{V_H}$ amplified to supply the user output voltage or current.

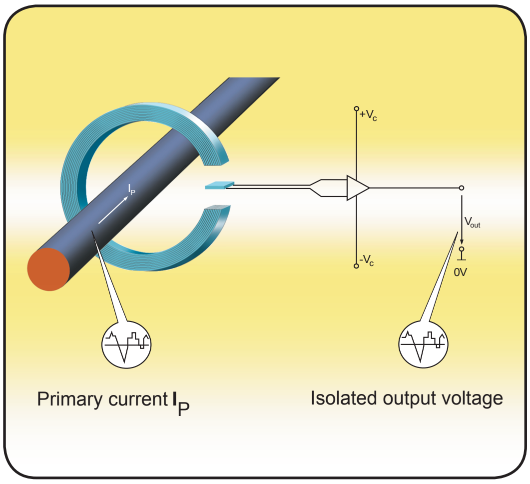
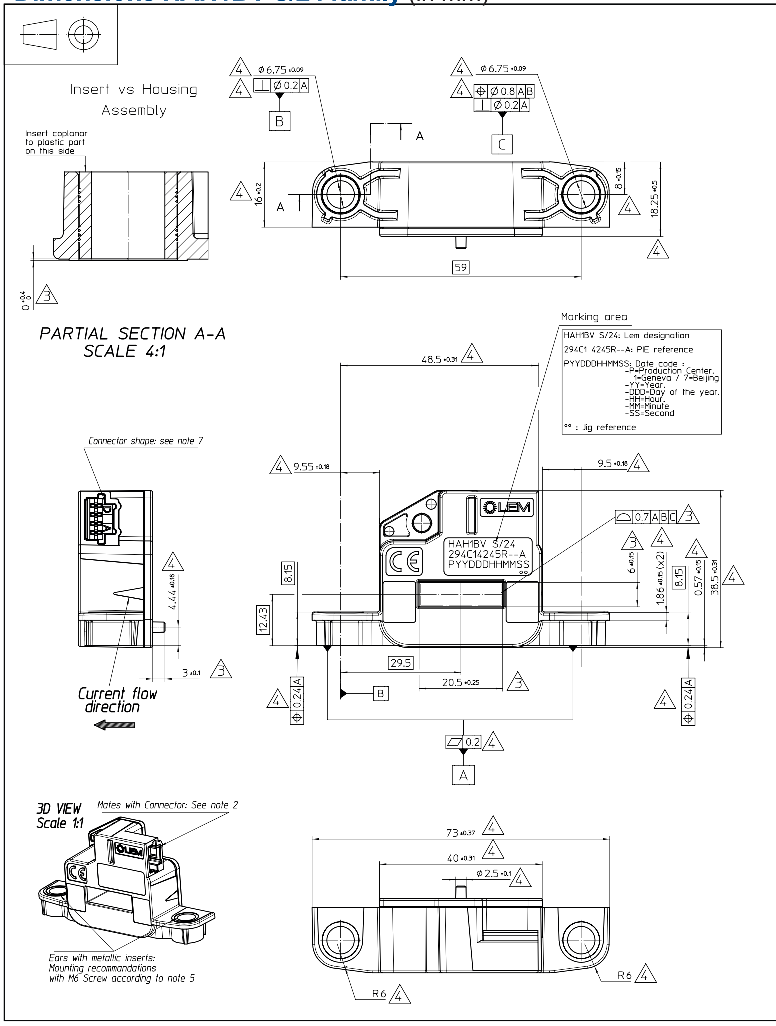


Fig. 1: Principle of the open loop transducer

HAH1BV S/24

Dimensions HAH1BV S/24 family (in mm)



NOTA

1-PIE reference: 294C1 4245R--A

2-For information: Sensor mates with Connector 8 200 308 250 (Tyco 1379658)

3-Mass (±5%) = 45 gr.

4-Fondamental tolerances in accordance with ISO system:

	<=3mm	3to6	6to10	10to18	18to30	30to50	50to80
Quality 14(µm)	250	300	360	430	520	620	740

5-Tightening torque: Value for M6x1 (type 8.8) 8,0 N.m +/-20%
For informatiom: during lab testing, washers are required bellow the transducer (ref A)
Washers dimensions: Internal Ø6.0mm Min / External Ø12.0 mm Max

6-For information: Designed for a 17.60mm x 2.50mm bus bar.

7-Connector shape according to drawing RENAULT 8200 311 958.

8-Marking type X according to Standard 00-10-501.
(to be defined according to Functionnal Specification 8 201 090 863)

9-Part according to Standard 00-10-415.

10-Part without sharp edges or corners : R mini > 0.1mm, except on parting line.

Part designation	Nbr	Standardised designation of the material	Material supplier	Name and commercial reference
Housing	1	>PBT GF30<	BASF	ULTRADUR B4406 G6 Black
Cover	1	>PBT GF30<	BASF	ULTRADUR B4406 G6 Black
Compression limiter	2	EN 12164 CW612N	_	_
Terminals	4	EN 1652 CW507L Tin plated finished 3-5µm	_	_
Magnetic circuit	1	_	_	_
PCBA	1	_	_	_

Bill of materials

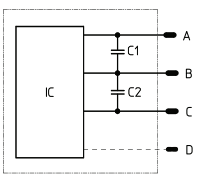
- Plastic case PBT GF 30
- Magnetic core Iron silicon alloy
- Pins Brass tin plated

Mass 45 g

Remark

- V_{OUT} > 1.833 when I_P flows in the direction of the arrow.

System architecture



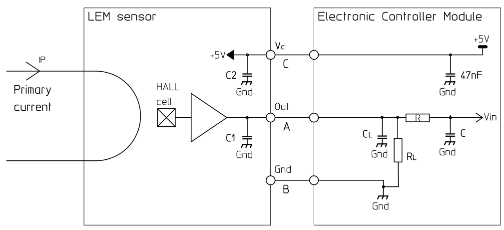
	Components list	BV version
IC	Hall sensor ASIC	
C1	Decoupling capacitor	68nF
C2	Decoupling capacitor	100nF

	Pin out
A	Vout
B	Ground
C	Vc (5V)
D	Not connected

System architecture (example)

R_L > 10 kΩ optional resistor for signal line diagnostic

V_{OUT}	Diagnosis
Open circuit	V_{IN} = < 0.15V
Short GND	V_{IN} = < 0.15V



$C_L \leq$ 100 nF EMC protection
RC Low pass filter EMC protection (optional)

HAH1BV S/24

Absolute maximum ratings (not operating)

Parameter	Symbol	Unit	Specification			Conditions
Electrical Data						
Max primary current peak	I_{Pmax}	A			2)	
Supply continuous over voltage	V_C	V			6.5	
Supply over voltage					14	
Reverse voltage			-14			1 min @ T_A = 25°C
Output over voltage (continuous)	V_{OUT}	V			6.5	
Output over voltage					14	1 min @ T_A = 25°C
Continuous output current	I_{OUT}	mA	-10		10	
Output short-circuit duration	t_c	min			∞	
Rms voltage for AC isolation test	V_d	kV			2	50 Hz, 1 min ISO 6469 3622
Isolation resistance	R_{IS}	MΩ	1000			500 V - ISO 16750-2
Electrostatic discharge voltage	V_{ESD}	kV			2	JESD22-A114-B
Ambient storage temperature	T_S	°C	-40		125	
Creepage distance	dCp	mm		5		
Clearance	dCl	mm		3.87		

Operating characteristics

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Primary current	I_P	A	-200		400	
Calibration current	I_{CAL}	A	-200		200	@ T_A = 25°C
Supply voltage	V_C	V	4.5	5.00	5.5	
Output voltage	V_{OUT}	V	V_{OUT} = (V_C/5) X (1.833+ G X I_P)			
Sensitivity	G	mV/A		6.67		@ V_C = 5 V
Current consumption	I_C	mA	5	7	10	@ V_C = 5 V, - 40°C < T_A < 125°C
Load resistance	R_L	KΩ	10			
Output internal resistance	R_{OUT}	Ω			10	
Capacitive loading	C_L	nF			100	
Ambient operating temperature	T_A	°C	-40		85	
Performance Data (1)						
Sensitivity error	ε_G	%	-1		1	@ VC = 5 V @ TA = 25°C
				± 2.0		@ VC = 5 V - 40°C < TA < 85°C
Electrical offset current	I_{OE}	A		± 0.3		@ TA = 25°C, '@ V_C = 5 V
Magnetic offset current	I_{OM}	A		± 0.25		@ TA = 25°C, '@ V_C = 5V after ± IP
Global offset current	I_O	A	-1		1	@ TA = 25°C
			-1.5		1.5	@ - 40°C < TA < 85°C
Average temperature coefficient of VOE	$TCV_{OE\,AV}$	mV/°C	-0.04		0.04	@ - 40°C < TA < 85°C
Average temperature coefficient of G	TCG_{AV}	%/°C	-0.02		0.02	@ - 40°C < TA < 85°C
Linearity error	ε_L	%	0.5		0.5	of full range @ TA = 25°C
Response time to 90 % of IPN step	tr	ms			10	@ di/dt = 50 A/µs
Frequency bandwidth	BW	Hz		35		@ -3 dB
Output clamping min voltage	Vsz	V	0.24	0.25	0.26	@ VC = 5 V
Output clamping max voltage	Vsz	V	4.74	4.75	4.76	@ VC = 5 V
Output voltage noise peak peak	Vno pp	mV	-		10	
Resolution		mV		1.25		@ VC = 5 V
Power up time		ms			1	
Setting time after overload		ms			10	

Notes: 1) The output voltage V_{OUT} is fully ratiometric. The offset and sensitivity are dependent on the supply voltage V_C relative to the following formula:

$$I_p = \left(V_{out} - 1.833 \times \frac{V_c}{5}\right) \times \frac{1}{G} \times \frac{5}{V_c} \text{ with G in (V/A)}$$

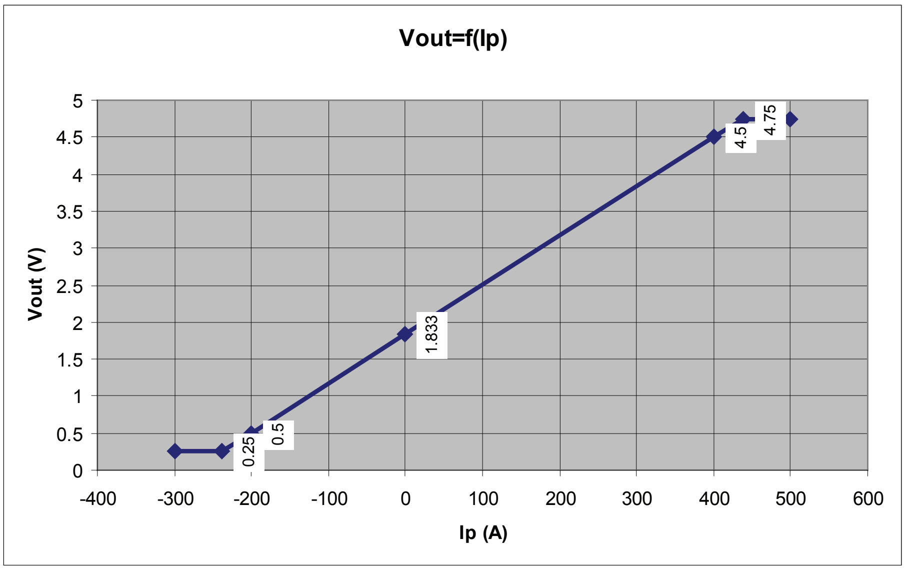
2) Busbar temperature must be below 150°C.

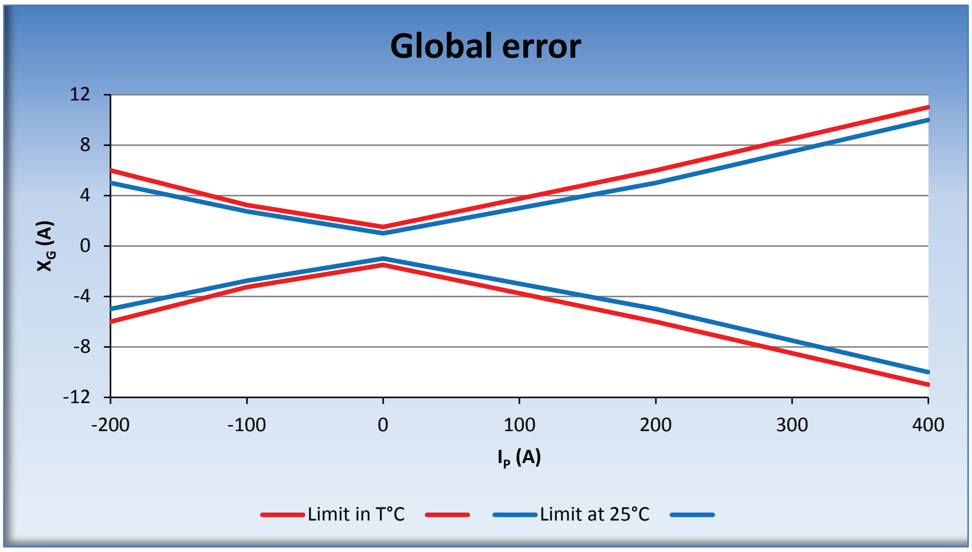
HAH1BV S/24

Isolation characteristics

V_d	Rms voltage for AC isolation test, 50 Hz, 1 min	2 kV
$\hat{V}_w$	Impulse withstand voltage 1.2/50 µs	> 4 kV
CTI	Comparative tracking index (group IIIa)	200
dCp	Creepage distance (measured value)	5 mm
dCI	Clearance distance (measured value)	3.87 mm

	Standards
dCI (Clearance distance)	**> 2.6 mm** (according to EN 60664: Category overvoltage OV 2, Altitude correction factor for 4000 m:1.29).
dCp (Creepage distance)	> **5 mm** (according to EN 60664: Pollution degree PD2, inhomoeneous field, Class 1 basic insulation, CTI comparative tracking Index -group III a-: 200)
Dielectric rigidity	**Regulation and standards:**
	Test method: according to ISO 16750-2, applied voltage 2000 V AC during 1 minute **Requirements:** Neither dielectric breakdown nor flashover shall occur during the test.
Insulation regulation R	**Regulation and standards:** - ECE R100
	Requirements: Insulation resistance shall be greater than 1 Ghom. Test method according to ISO 16750-2 (test voltage 500 V during 1 minute)





	XG -200A (A)	XG -100A (A)	XG 0A (A)	XG +200A (A)	XG +400A (A)
I_P (A)	**-200**	**-100**	**0**	**200**	**400**
Limit in T°C	±6	±3.25	±1.5	±6	±11
Limit at 25°C	±5	±2.75	±1	±5	±10

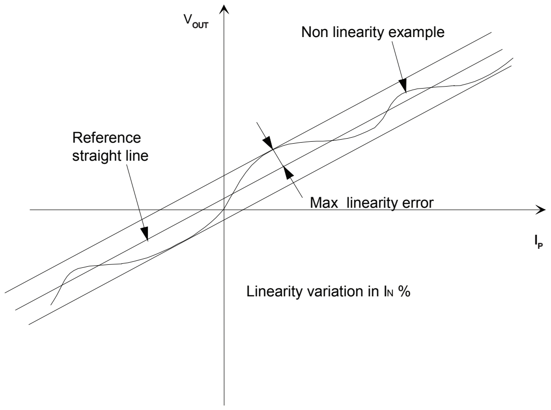
This parameter (Xg) is done for the temperature excursion from -40°C to +85°C, at +/- 4σ.

PERFORMANCES PARAMETERS DEFINITIONS

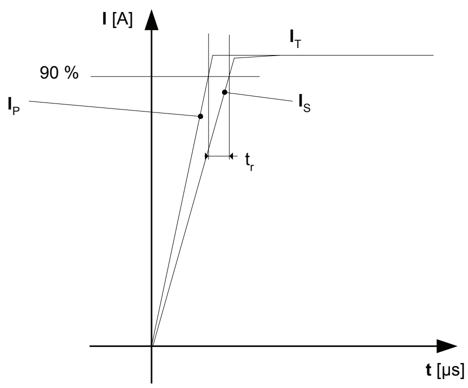
Output noise voltage:
The output voltage noise is the result of the noise floor of the Hall elements and the linear I_C amplifier gain.

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 $I_{P\ max}$.
Linearity is measured on cycle + I_P, O, - I_P, O, + I_P without magnetic offset (average values used)



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:
$V_{out}(I_P) = \mathbf{V_C}/5\ (G \times \mathbf{I_P} + 2.5)$ (*)
(*) For all symetrics 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 $\mathbf{I_{OT}}$ is a maximum variation the offset in the temperature range:
$\mathbf{I_{OT}} = \mathbf{I_{OE}}$ max - $\mathbf{I_{OE}}$ min
The Offset drift $\mathbf{TCI_{OEAV}}$ is the $\mathbf{I_{OT}}$ 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 $\mathbf{G_T}$ is the maximum variation (in ppm or %) of the sensitivity in the temperature range:
$\mathbf{G_T}$ = (Sensitivity max - Sensitivity min) / Sensitivity at 25°C.
The sensitivity drift $\mathbf{TCG_{AV}}$ is the $\mathbf{G_T}$ 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 $\mathbf{V_O}$ is $\mathbf{V_C}/2$ at $\mathbf{V_C}$ = 5 V. 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.

Environmental test specifications

To be updated after PV test.