AUTOMOTIVE CURRENT TRANSDUCER OPEN LOOP TECHNOLOGY

HAB 60-S/SP6

Introduction

The HAB Family is best suited for DC, AC or pulsed currents measurement in high power and low voltage automotive applications. It contains galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit).

The HAB family gives you a choice of having different current measuring ranges in the same housing (from ± 20 A up to ± 100 A).

Features

- Open Loop transducer using the Hall effect transducer
- Low voltage application
- Unipolar + 5 V DC power supply
- Primary current measuring range ± 60 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° < + 125 °C
- Output voltage: full ratiometric (in gain and offset).

Special feature

- Different marking.

Advantages

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

Automotive applications

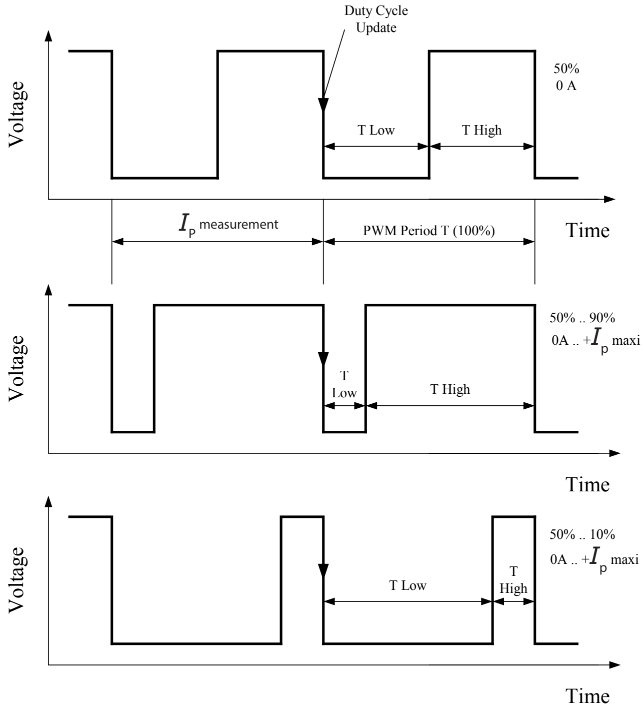
- Battery Pack Monitoring
- Hybrid Vehicles
- EV and Utility Vehicles.Converters.

Principle of HAB Family

The transducer uses open loop hall effect technology.

It provides a Pulse Width Modulated output Signal proportional to the magnetic Induction B generated by the primary current IP to be measured.

The PWM priciple is described as follows:



$$PWM\ period\ \ T_{Period} = T_{High} + T_{Low}$$

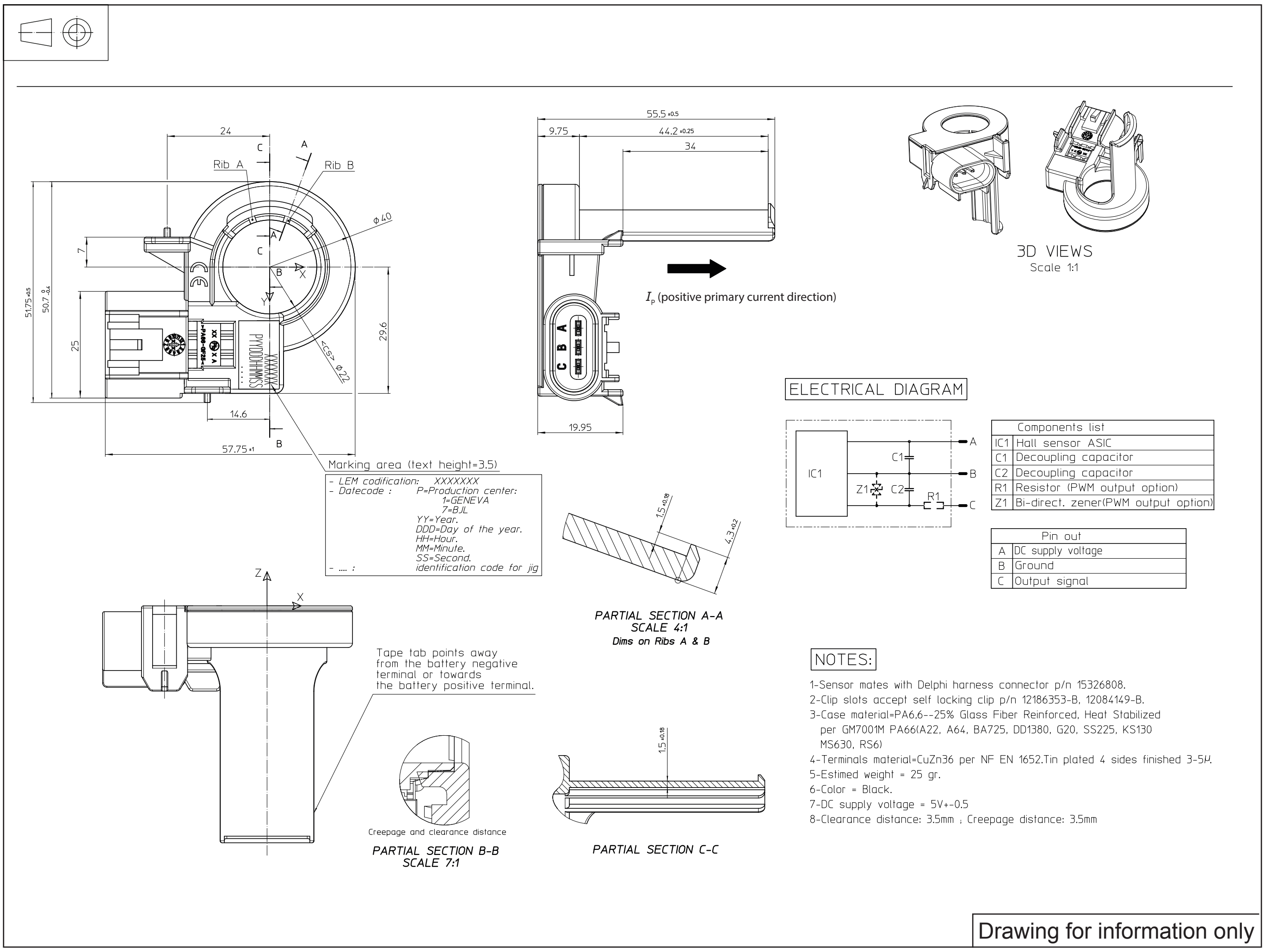
$$PWM\ frequency = \frac{1}{T_{Period}} = 125 Hz$$

$$\text{DutyCycle}(\%) = \frac{T_{High}}{T_{Period}} \times 100$$

$$\text{DutyCycle}(\%) = 50\% + G \times I_p \text{ with G = Sensitivity (\%/A)}$$

The PWM period T_{period} starts on the falling edge of the output signal. The ouput signal of the duty cycle given during the T_{period} is the image of the primary current during the T_{period} -1 period

Dimensions HAB 60-S/SP6 (in mm)



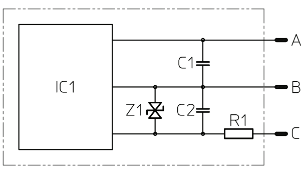
Mechanical characteristics

- Plastic case PA 6.6 GF 25
- Magnetic core FeNi
- Mass 25 g
- Electrical terminal coating Tin

Mounting recommendation

- Connector type GT 150

Electronic schematic



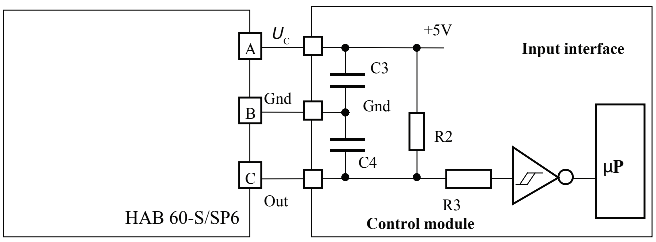
Components list	
IC1	Hall sensor ASIC
C1	100nF-±10%-X7R
C2	10nF-±10%-X7R
R1	51 ohms ±5%
Z1	Bi-directional zener ±12V

Pin out	
A	DC supply voltage(5V±0.5)
B	Ground
C	PWM output signal

I_P (A)	PWM output signal (%)
+60	90
0	50
-60	10

Remarks

- $V_{out} > V_o$ when I_P flows in the positive direction (see arrow on drawing).



Control module components		
C3	100 nF X7R	
C4	1 nF X7R	Optional
R2	4.7 kΩ	Optional
R3	High impedance protection	Optional

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Absolute ratings (not operating)

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Maximum Primary Current	I_p	A				Infinite
Supply voltage	U_C	V	- 8.5		8.5	
Supply voltage (over voltage t < 1 min)	U_C	V	- 14		14	
Current Consumption (t < 1 min)	I_C	mA			50	
Output voltage (t < 1 min)	V_{out}	V	- 5		14	
Output voltage over supply voltage	$V_{out} - U_C$	V			2	
Output current	I_{out}	mA	- 10		10	
Output short-circuit duration	t_c	s			10	
Ambient storage temperature	T_s	°C	- 40		125	

Operating conditions

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Supply voltage	U_C	V	4.5	5	5.5	
Supply voltage (accurate range)	U_C	V	4.75	5	5.25	
Pull up load resistance	R_L	KΩ	2.2	4.7		
Capacitive loading	C_L	nF			1	
Ambient operating temperature	T_A	°C	- 40	25	125	
Ambient operating temperature (accurate range)	T_A	°C	- 10	25	65	

Operating characteristics in nominal range (I_{PN})

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Primary current, measuring range	I_{PM}	A	- 60		67	
Primary nominal DC or rms current	I_{PN}	A	- 60		60	
Current consumption	I_C	mA		7.5	10	
Output PWM frequency	f_{PWM}	Hz	105	125	145	
Output duty cycle sensitivity	G	%/A		0.667		
Output duty cycle @ $I_P = 0$	D_{out}	%		50		
Output duty clamping low	D_{out}	%	4	5	6	
Output duty clamping high	D_{out}	%	94	95	96	
Duty cycle resolution		%		0.0125		
Power up time to reach valid duty cycle		ms			25	
Setting time after over load		ms			25	
Output voltage high (pull up = 4.7 KΩ)	$V_{out\ H}$	V	U_C - 0.2			
Output voltage low (pull up = 4.7 KΩ)	$V_{out\ L}$	V			0.2	
Output internal resistance	R_{out}	Ω		50	100	
Output PWM rise time	t_{rise}	µs			10	
Output PWM fall time	t_{fall}	µs			10	

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Operating temperature

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical data						
Electrical offset current @ accurate termperature range	I_{OE}	A	- 0.2	0.075	0.2	
Electrical offset current @ full termperature range	I_{OE}	A	- 0.3.	0.15	0.3	
Magnetic offset current	I_{OM}	A		0.05		
Output resolution		A		0.03		
Sensitivity error @ full termperature range	ε_G	%	- 2		2	
			- 3		3	
Linearity error	ε_L	% I_P		0.2		

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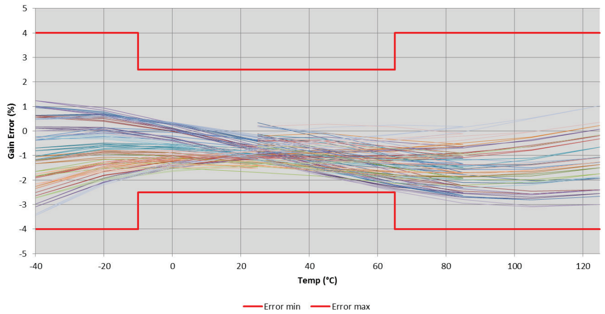
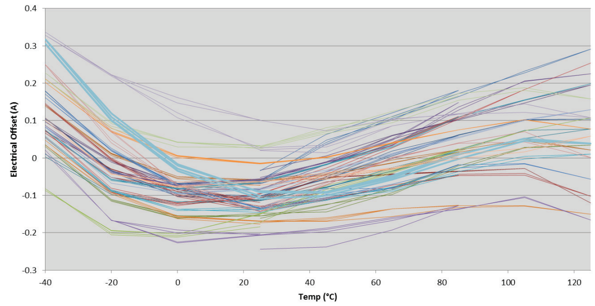
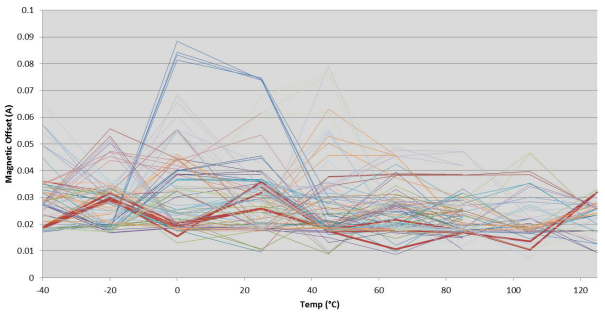
Gain Error @ +/-60A



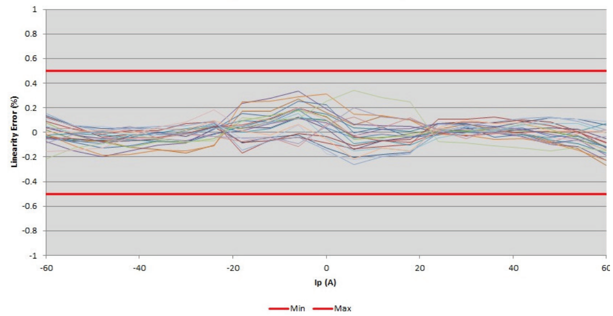
Electrical Offset



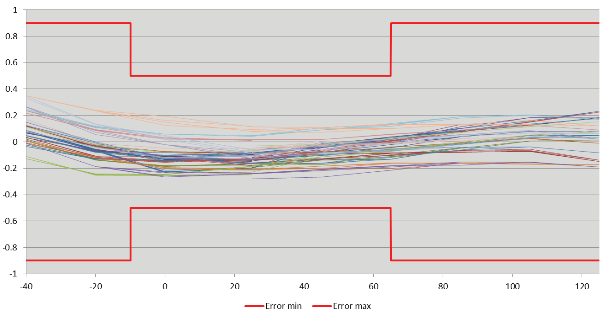
Magnetic Offset



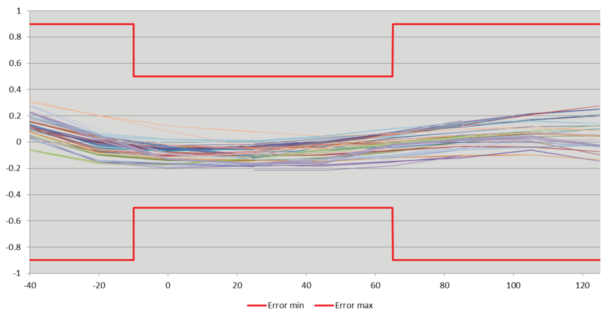
Linearity Error @ 25°C HAB 60-S/SP6



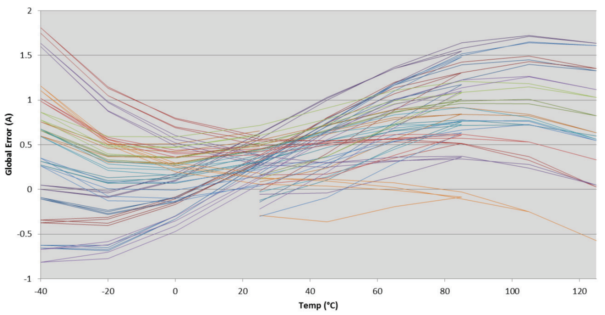
Global Offset after 60A



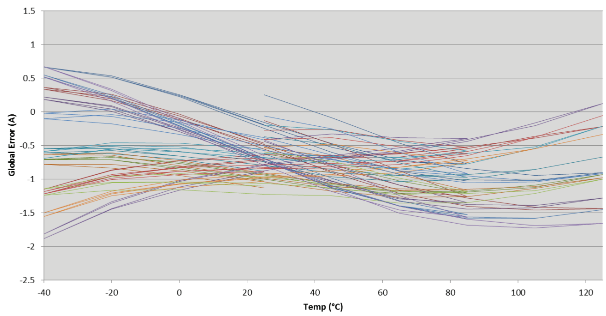
Global Offset after -60A



Global Error @ 60A



Global Error @ -60A



* Curves coming from PV test report n°1303/03 on 23 samples.

PERFORMANCES PARAMETERS DEFINITIONS

Definition of typical, minimum and maximum values:

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as well as values shown in “typical” graphs. On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval. Unless otherwise stated (e.g. “100 % tested”), the LEM definition for such intervals designated with “min” and “max” is that the probability for values of samples to lie in this interval is 99.73 %. For a normal (Gaussian) distribution, this corresponds to an interval between -3 sigma and +3 sigma. If “typical” values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between -sigma and +sigma for a normal distribution. Typical, maximal and minimal values are determined during the initial characterization of a product.

Output noise voltage:

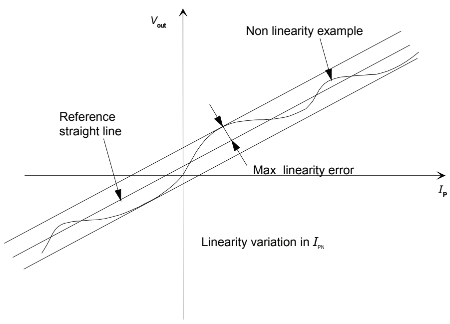
The output voltage noise is the result of the noise floor of the Hall elements and the linear amplifier.

Magnetic offset:

The magnetic offset is the consequence of an over-current on the primary side. It’s defined after an excursion of I_{PN}.

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_{PN}.

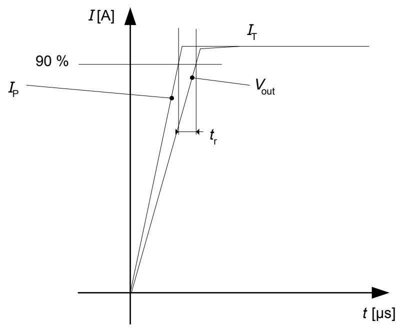


Response time (delay time) t_r:

The time between the primary current signal (I_{PN}) and the output signal reach at 90 % of its final value.

Sensitivity:

The Transducer’s sensitivity G is the slope of the straight line $V_{out} = f\,(I_P)$, it must establish the relation:
$V_{out}\,(I_P) = U_C/5\;(G \cdot I_P + V_o)$



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:
$I_{OT} = I_{OE}\,\text{max} - I_{OE}\,\text{min}$
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. Deeper and detailed info available is our LEM technical sales offices (www.lem.com).

Offset voltage @ I_P = 0 A:

The offset voltage is the output voltage when the primary current is null. The ideal value of V_O is $U_C/2$ at U_C = 5 V. So, the difference of $V_O - U_C/2$ 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. Deeper and detailed info available is our LEM technical sales offices (www.lem.com).

Name	Standard
Climatic tests	
Low temperature test	GMW 3172 § 5.5.1 and IEC600068-2-1 test Ab
High temperature test	GMW 3172 § 5.5.2 and ISO 16750-4
Ageing tests	GMW 3172 and IEC600068-2-38-Z/AD and IEC600068-2-14 test Na and Nb and 600068-2-78 test Cb
Mechanical tests	
Vibration and thermal cycle test (random)	GMW 3172 § 5.4.1.2 and ISO 16750-3 test IV
Insulation tests	
Insulation resistance test	ISO/DIS 16750-2 (03.2010)
Withstand voltage test	ISO/DIS 16750-2 (03.2010))
EMC test	
RI, Bulk Current Injetion (BCI)	ISO 11452-4 and GMW 3097 REV5
RI, Reverberation Chamber, Mode Tuning	ISO 61000-4-21 and GMW 3097 REV5
CI, Direct Capacitor Coupling to Sensor Lines, 30 V	ISO 7637-2 and GMW 3097 REV5
CI, Direct Capacitor Coupling to Sensor Lines, 85 V	ISO 7637-2 and GMW 3097 REV5
Electrostatic Discharge (ESD) Handling of Devices	ISO 10605 and GMW 3097 REV5