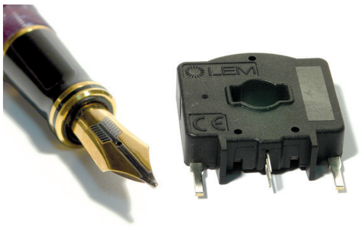
AUTOMOTIVE CURRENT TRANSDUCER OPEN LOOP TECHNOLOGY
HC6H800-S/SP1



Introduction

The HC6H family is for the electronic measurement of DC, AC or pulsed currents in high power and low voltage automotive applications with galvanic separation between the primary circuit (high power) and the secondary circuit (electronic circuit).

The HC6H family gives you the choice of having different current measuring ranges in the same housing.

Features

- Open Loop transducer using the Hall effect
- Low voltage application
- Unipolar +5 V DC power supply
- Primary current measuring range from 200 A to 800 A
- Maximum RMS primary admissible current: defined by busbar to have T° < +150 °C
- Operating temperature range: −40 °C < T° < +125 °C
- Output voltage: full ratio-metric (in sensitivity and offset)
- Compact design for PCB mounting.

Special feature

- ASIC pitch @ 2.54 mm.

Advantages

- Excellent accuracy
- Very good linearity
- Very low thermal offset drift
- Very low thermal sensitivity drift
- Wide frequency bandwidth
- No insertion losses
- Very good ratio size/current range.

Automotive applications

- Starter Generators
- Converters
- Inverters
- Drives.

Principle of HC6H 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 I_P to be measured. The current to be measured I_P is supplied by a current source i.e. battery or generator (Figure 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:

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

With d = thickness of the hall plates

I = current accross the Hall plates

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.

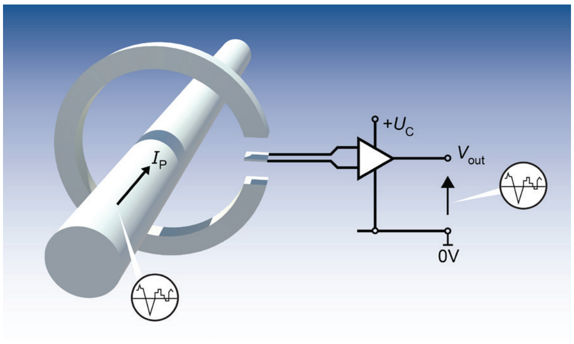


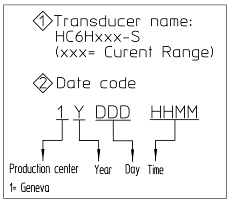
Fig. 1: Principle of the open loop transducer.

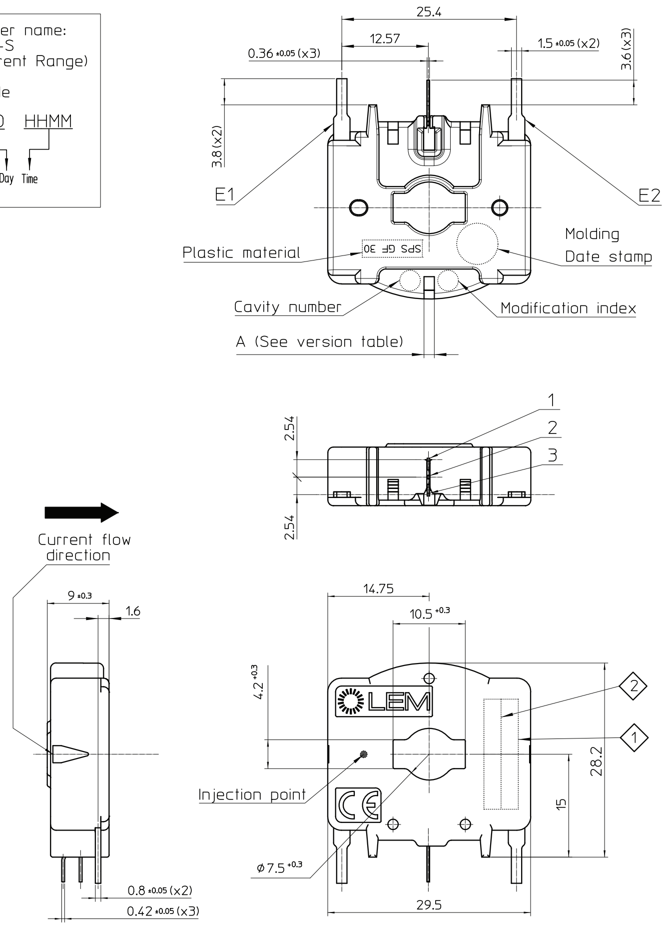
Dimensions (in mm)

Secondary connection

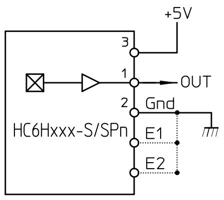
Terminals	Designations
3	Supply voltage + 5 V DC
1	V_{out}
2	Ground
E1, E2	Ground (*)

* Only 1 of these 2 pins could be connected





Connection



xxx = Current Range

VERSION TABLE of CURRENT RANGE	
A	CURRENT RANGE
1.5 mm	I_P <= 600 A
3 mm	I_P > 600 A

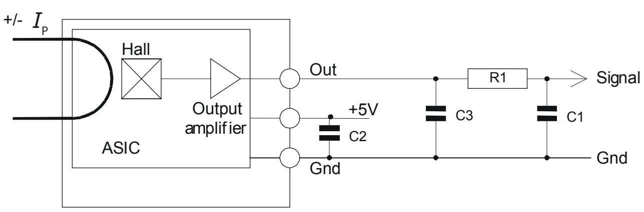
Mechanical characteristics

- Plastic case SPS GF 30
- Magnetic core FeSi alloy
- Mass 23 g
- Pins Copper alloy tin plated (lead free)
- Degrees of protection provided by enclosure IPxx.

Remarks

- General tolerance ±0.2 mm
- $V_{out} > V_o$ when I_P flows in the positive direction (see arrow on drawing).

Electronic schematic



Power supply decoupling capacitor: C2 = 47 nF
EMC protection capacitor C3 = 4.7 nF

Optional:

High frequency signal noise filter:

R1 > 100 Ω

C1 = defined according to the system frequency bandwidth

Absolute ratings (not operating)

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Maximum peak primary current (not operating)	$\hat{I}_{PM}$	A				Define by busbar to have T° ≤ 150 °C
Primary nominal DC or current rms	I_{PN}	A				Define by busbar to have T° ≤ 150 °C
Maximun supply voltage (not operating)	U_C	V			7	
Secondary maximum admissible power	P_S	mW			150	
Ambient operating temperature	T_A	°C				−40 °C < T_S < 125 °C
Ambient storage temperature	T_S	°C				−40 °C < T_S < 125 °C
Electrostatic discharge voltage	U_{ESD}	V			2000	JESD22-A114-B
Maximum admissible vibration (random)	γ	m·s^{-2}			[3]	See note [3]
Rms voltage for AC insulation test, 50 Hz, 1 min	U_d	V			2000	IEC 60664-1
Reverse voltage [4]	U_C	V			0.5	1 min @ T_A = 25 °C

Operating characteristics in nominal range (I_{PN})

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Electrical Data						
Primary current, measuring range	I_{PM}	A	−800		800	@ −40 °C <T° < 125 °C
Supply voltage [1]	U_C	V	4.75	5	5.25	@ −40 °C < T° < 125 °C
Output voltage (Analog)	V_{out}	V	$V_{out} = (U_C/5) \times (V_o + G \times I_P)$			@ −40 °C < T° < 125 °C
Sensitivity	G	V/A	0.00245	0.0025	0.00255	@ T_A = 25 °C
Offset voltage	V_O	V	2.485	2.5	2.515	@ U_C = 5 V, T_A = 25 °C, I_P = 0 A
Current consumption	I_C	mA		15	20	@ −40 °C <T° < 125 °C, 4.75 V < U_C < 5.25 V
Load resistance	R_L	KΩ	10			
Output internal resistance	R_{out}	Ω			10	
Performance Data [1]						
Ratiometricity error	ε_r	%	−2	±8	2	@ T_A = 25 °C, U_C = 5 V, Gth = 000025
Electrical offset current	I_{OE}	A	−3.2	±1.6	3.2	@ U_C = 5 V, T_A = 25 °C
	V_{OE}	mV	−8	±4	8	
Magnetic offset current	I_{OM}	A	−2.8	±1.6	2.8	@ after excursion to ± I_P, T_A = 25 °C
	V_{OM}	mV	−7	±4	7	
Average temperature coefficient of	$TCI_{OE\ AV}$	mA/°C	−64	±32	64	@ −40 °C <T° < 125 °C, U_C = 5 V
	$TCV_{OE\ AV}$	mV/°C	−0.16	±0.08	0.16	@ −40 °C <T° < 125 °C, U_C = 5 V
Temperature coefficient of G	TCV	%/°C	−0.04	±0.02	0.04	@ −40 °C <T° < 125 °C, U_C = 5 V
Linearity error	ε_L	% I_P	−1	±0.4	1	@ I_P; U_C = 5 V, T_A = 25 °C
Step response time to 90 % I_{PN}	t_r	µs		8	15	@ d*i*/d*t* = 50 A/µs; I_T = 600 A
Frequency bandwidth [2]	BW	kHz	20			@ −3 dB; I_T = 100 A rms
Output voltage noise peak-peak	$V_{no\ pp}$	mV		10	13.5	@ T_A = 25 °C, 0 Hz < f < 1 MHz
Output rms voltage noise	V_{no}	mV		2.5	3.5	@ T_A = 25 °C, 0 Hz < f < 1 MHz

Notes: [1] The output voltage V_{out} is fully ratiometric. The offset and sensitivity are dependent on the supply voltage U_C relative to the following formula:

$$I_P = \left(\frac{5}{U_C} \times V_{out} - V_O\right) \times \frac{1}{G} \text{ with G in (V/A)}$$

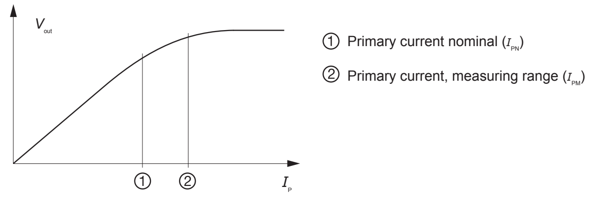
[2] Small signal only to avoid excessives heatings of the busbar, the magnetic core and the ASIC (< 150 °C)

[3] Depending on the customer application's set up

[4] Transducer not protected against reverse polarity.

PERFORMANCES PARAMETERS DEFINITIONS

Primary current definition:



Definition of typical, minimum and maximum values:

Minimum and maximum values for specified limiting and safety conditions have to be understood as such 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, minimum and maximum 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:

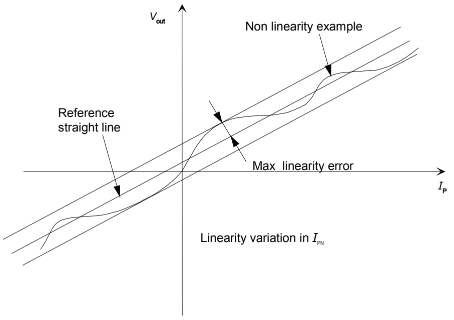
The magnetic offset is the consequence of an over-current on the primary side. It's defined after an excursion of I_{PN}.

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.

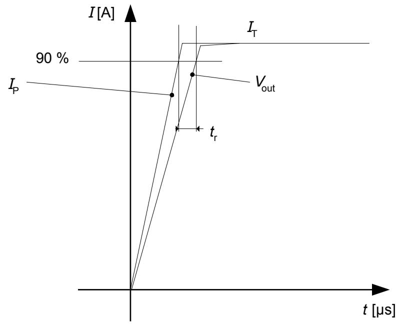


Sensitivity:

The transducer's sensitivity G is the slope of the straight line $V_{out} = f\,(I_P)$, it must establish the relation:

$$V_{out}\,(I_P) = U_C/5\,(G \times I_P + V_o)$$

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 zero. The ideal value of V_O is $U_C/2$. 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).

Environmental test specifications:

Name	Standard	Conditions
Thermal schocks	IEC 60068 Part 2-14	T° −40 °C to 125 °C /1000 cycles not connected
Low T° operation at min supply voltage	IEC 60068 Part 2-1	T° −40 °C / 1000 H, supply voltage = 4.75 V
High T° operation at max 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° 85 °C / 85 % *RH* / 1000 H
Mechanical tests		
Vibration	IEC 60068 Part 2-64	See note [3)] page 3
Drop test	IEC 60068 Part 2-29	Height 750 mm concrete floor each direction
EMC test		
Electrostatic discharge	JESD22-A114-B	Applied voltage = ±2 kV pin to pin number of discharge = 1
Rms voltage for AC insulation test	IEC 60664 Part 1	2 kV, 50 Hz, 1 min
Bulk current injected radiated immunity	ISO 11452 Part 4	