

# Current Sensor

## CH1S01xB

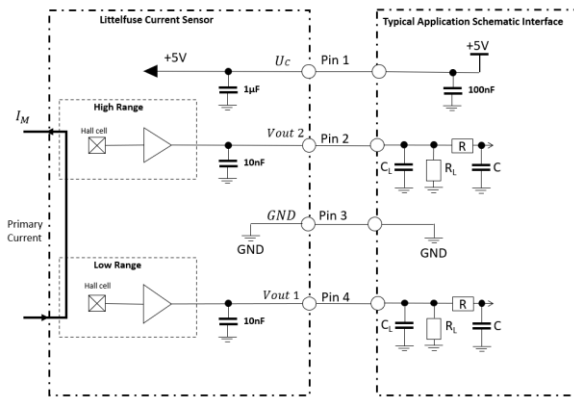
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### General Description

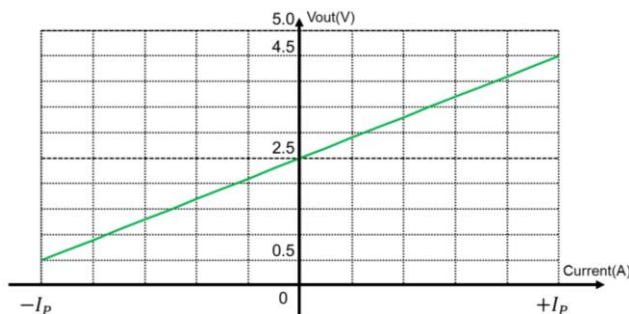
The Littelfuse CH1S010B current sensor family utilizes open loop Hall Effect technology to provide dual channel, ratio-metric output signals proportional to the magnetic flux density generated by internal C-core concentrators.

### Typical Application Diagram



$C_L \geq 1.0nF, C_L \leq 10.0nF$  for EMC protection  
 $R_L \geq 10k\Omega, R_L \leq 200k\Omega$  pull-down resistor on signal line

### Output Characteristics



\* I<sub>P</sub>: Primary current range

### Features

- Open Loop Hall effect current sensor
- Unipolar +5V DC power supply
- Analog ratio-metric output
- Operating temperature range:  
-40 °C < T < +125 °C
- Single or dual channel measurement
  - Channel 1: up to ±100A
  - Channel 2: up to ±1100A

### Benefits

- High sensing accuracy
- Low thermal offset drift
- Low thermal sensitivity drift
- Non-intrusive solution
- Dual channel measurement

### Applications

- Battery Management System
- Hybrid Vehicles
- EV and Utility Vehicles

### Mechanical Characteristics

- Plastic: PBT-GF25 (UL94-V0)
- Pins: CuSn6, Sn plating
- Mass: ~ 93g
- Protection degree: IP41

### Mating Connector

- TE 1-1456426-5

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### Littelfuse Current Sensor Naming Convention

Measure	Technology	Measurement Point Cnt.	Mount type	Family	Mechanical version	Application	-	Single / Dual Range	Range A	Range B High Range for Dual	Signal Type	-	ASIL
C	H	1	S	01	0	M		S	01	01	A		Q
V	HS	2	B	02	1	B		D	02	02	P		A
T	F	3	P	03	2	P		R	03	03	C		B
	HF			04	3	R			04	04	CT120		C
	FS			05	4	C			05	05	L		D
				06	5				06	...	S		
				...	6				...	11	CA		
				99	7				15	15	U		
					8				20	20			
					9								

<b>C=Current</b> V=Voltage T=Temperature	<b>H=Hall</b> HS=Shunt+Hall F=Fluxgate HF=Fluxgate+Hall FS=Shunt+Fluxgate S=Shunt	<b>S=Stand Alone</b> B=with Busbar P=PCB mount	<b>M = Motor Control</b> <b>B = BMS</b> P = Pyro Trigger R = Relay Trigger C = Charger	<b>S=Single</b> <b>D=Dual</b> R=Redundant	<b>01 - 100</b> 02 - 200 03 - 300 04 - 400 05 - 500 06 - 600 09 - 900 ... 20 - 2000	<b>01 - 100</b> 02 - 200 03 - 300 04 - 400 05 - 500 06 - 600 09 - 900 ... 20 - 2000	<b>A=Analog</b> P=PWM C=CAN no termination CT120=CAN 120 Ohm termination L=LIN S=SENT CA = CAN + Analog U=UART	<b>Q=QM</b> A=ASIL A B=ASIL B C=ASIL C D=ASIL D
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### Product Name by configuration

Part Name	Config	Ref. Image
CH1S010B	Standard	
CH1S011B	Aperture variant (one flat)	

### Current Range Definition

Littelfuse offers customized calibration ranges.

Current ranges notation:

CH1S01xB-SxxyyA-Q

- D: Single, Dual or Redundant range output
- xx: Primary current range (Channel 1)
- yy: Primary current range (Channel 2)
- 
- A: Analog output
- Q: ASIL QM

Naming Examples:

Type Name	Current Range Chanel 1	Current Range Chanel 2
CH1S01xB-D0105A-Q	±100 A	±500 A
CH1B01xB-D0108A-Q	±100 A	±800 A
CH1B01xB-D0110A-Q	±100 A	±1000 A
CH1B01xB-D0111A-Q	±100 A	±1100 A

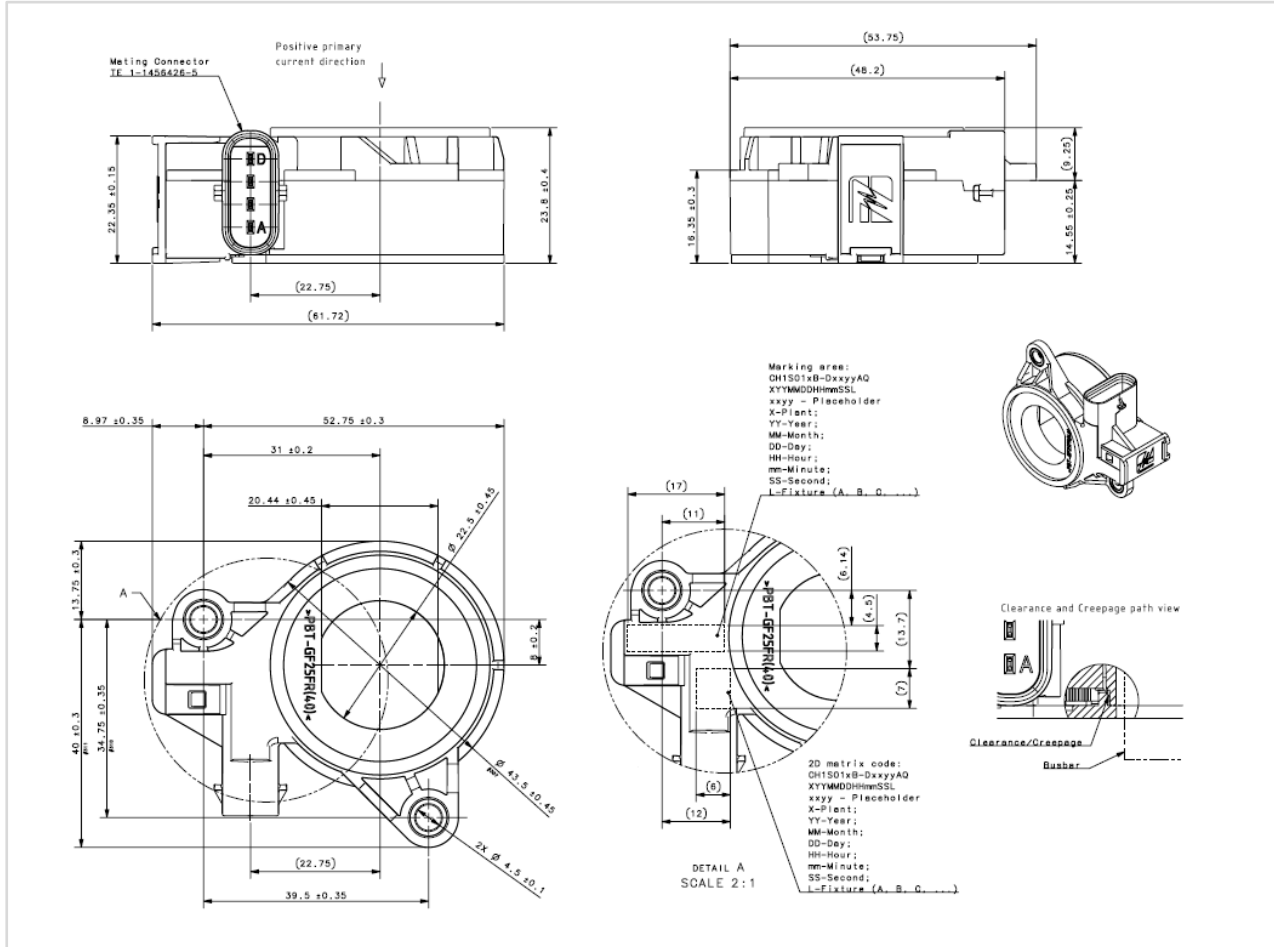
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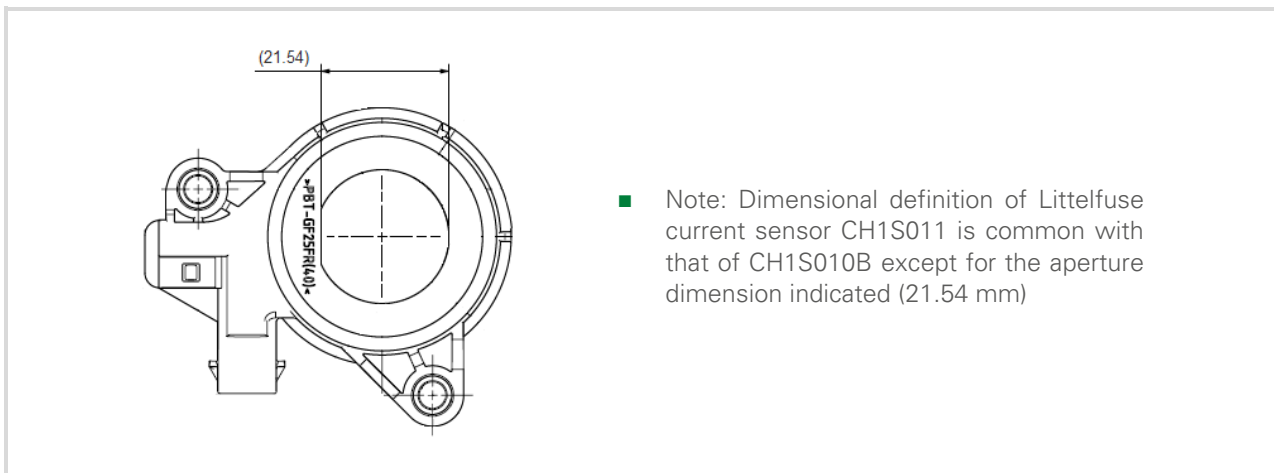
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### Current Sensor Dimensions (in mm)

#### CH1S010B



#### CH1S010B



- Note: Dimensional definition of Littelfuse current sensor CH1S011 is common with that of CH1S010B except for the aperture dimension indicated (21.54 mm)

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### Absolute Maximum Ratings (non-operating)

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Maximum Supply Voltage	$U_{CMAX}$	-0.3		10	V	
Peak Primary Current RMS	$\hat{I}_{P\_RMS}$				A	limited by busbar temp. <sup>1</sup>
Maximum Output Current	$I_{CMAX}$	-10		10	mA	
Storage Temperature	$T_{ST}$	-40		+125	°C	
Insulation Resistance	$R_{INS}$	500			MΩ	500V DC, 60s
Dielectric voltage	$I_{LEAK}$			1	mA	2.5 kV AC, 50Hz, 1min
Creepage distance	$D_{CREE}$		3.5		mm	
Clearance	$D_{CLEA}$		3.1		mm	
Comparative tracking index	$CTI$		PLC0 (≥600 V)		V	UL746A (IEC 60112)

### Mechanical Product Properties

Parameter	Symbol	Level	Standard	Comments
Flammability Class		V0	UL94	
Protection Degree		IP 41	IEC 60529	

<sup>1</sup> Maximum RMS primary current is limited by the busbar surface temperature.

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### Common Characteristics in Normal Range

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Supply Voltage	$U_C$	4.75	5	5.25	V	
Current Consumption	$I_C$	16	25	30	mA	$U_C = 5V, I_p = 0A$ ;
Operating Ambient Temperature	$T_A$	-40		+125 <sup>2</sup>	°C	
Output Voltage	$V_{out}$	0.5		4.5	V	See page
Output Offset Voltage	$V_o$		2.5		V	$U_C = 5V, I_p = 0A$
Clamping Voltage Lower	$V_{CL}$		0.3		V	
Clamping Voltage Upper	$V_{CU}$		4.7		V	
Supply Capacitance	$C_{SUP}$	47	100		nF	Capacitors to be located near supply pins
Load Capacitance	$C_L$		2.2	10	nF	
Load Resistance	$R_L$	10	25	200	kΩ	
Power-on Time	$t_{po}$		1		ms	
Response Time	$t_r$		20		μs	$C_L = 2.2$ nF

<sup>2</sup> Busbar surface temperature shall not exceed 150 °C - Primary current frequencies can cause heating of the busbar and magnetic core.

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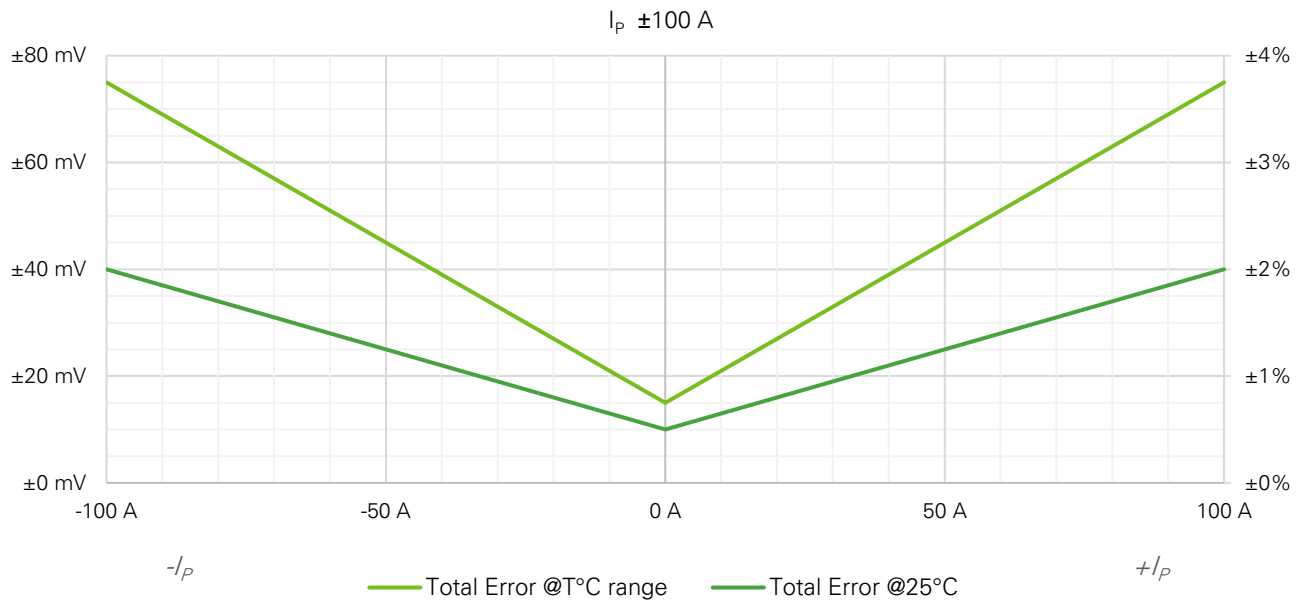
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### Primary Current Range for Channel 1 (Low Range): up to $\pm 100\text{A}$

Littelfuse offers customized low range calibrations.  
Below performance data are applicable for  $\pm 100\text{A}$  calibration.

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Primary Current	$I_p$	-100		+100	A	
Sensitivity for $\pm 100\text{A}$	$S$		20		mV/A	UC = 5V
Linearity Error	$\epsilon_L$		$\pm 0.5$		%FS	UC = 5V, over temp.
Offset Error	$\epsilon_o$	$\pm 0.5$		$\pm 0.5$	%FS	UC = 5V, over temp.
Sensitivity Error	$\epsilon_s$		$\pm 1.2$		%FS	UC = 5V, over temp.



Primary Current	Total Error @25°C			Total Error @T°C range			
	A	mV	%	A	mV	%	A
$-I_p$ (-100 A)		$\pm 40\text{ mV}$	$\pm 2\%$	$\pm 2.00\text{ A}$	$\pm 75\text{ mV}$	$\pm 3.75\%$	$\pm 3.75\text{ A}$
0		$\pm 10\text{ mV}$	$\pm 0.5\%$	$\pm 0.50\text{ A}$	$\pm 15\text{ mV}$	$\pm 0.75\%$	$\pm 0.75\text{ A}$
$+I_p$ (+100 A)		$\pm 40\text{ mV}$	$\pm 2\%$	$\pm 2.00\text{ A}$	$\pm 75\text{ mV}$	$\pm 3.75\%$	$\pm 3.75\text{ A}$

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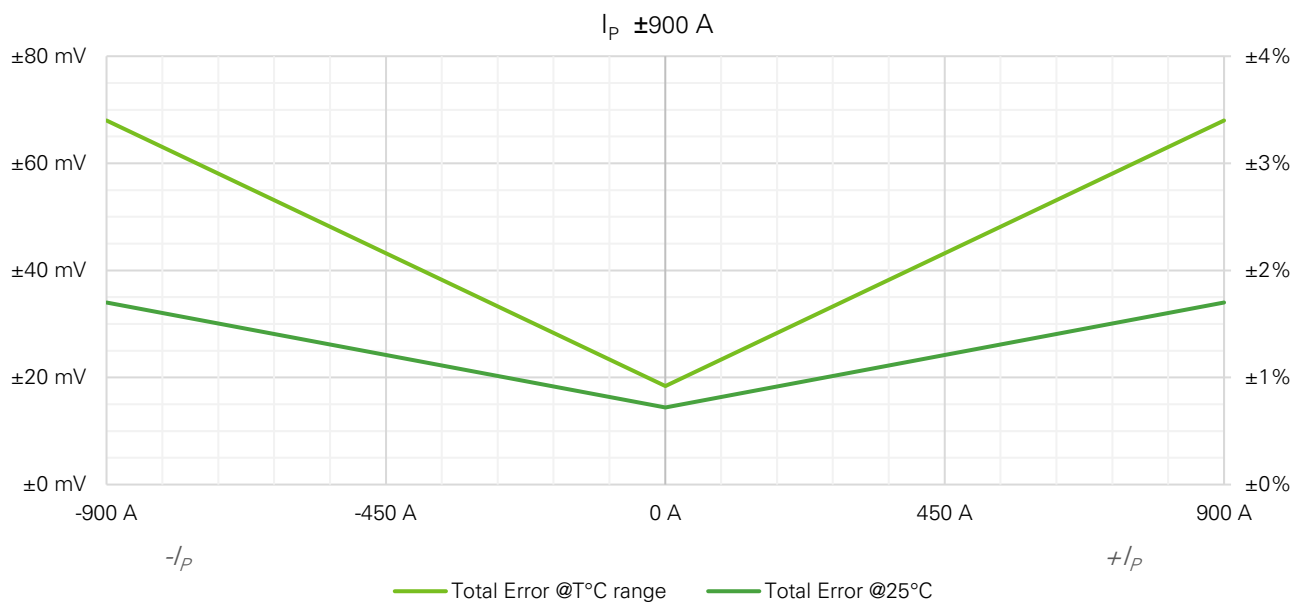
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### Primary Current Range for Channel 2 (High Range): up to $\pm 900$ A

Littelfuse offers customized high range calibration ranges up to 1100 A.  
Below performance data are applicable for  $\pm 100$  A ...  $\pm 900$  A calibration.

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Primary Current	$I_p$	-900		+900	A	
Sensitivity for $\pm 900$ A	$S$		2.22		mV/A	$U_c = 5V$
Linearity Error	$\epsilon_L$		$\pm 0.5$		%FS	$U_c = 5V$ , over temp.
Offset Error	$\epsilon_o$	$\pm 0.9$		$\pm 0.9$	%FS	$U_c = 5V$ , over temp.
Sensitivity Error	$\epsilon_s$		$\pm 1.2$		%FS	$U_c = 5V$ , over temp.



Primary Current	Total Error @25°C			Total Error @T°C range		
	A	mV	%	A	mV	%
$-I_p$ (-900 A)		$\pm 28.6$ mV	$\pm 1.7\%$	$\pm 15.3$ A	$\pm 68$ mV	$\pm 3.4\%$
0		$\pm 14.4$ mV	$\pm 0.7\%$	$\pm 6.48$ A	$\pm 18.4$ mV	$\pm 0.9\%$
$+I_p$ (+900 A)		$\pm 28.6$ mV	$\pm 1.7\%$	$\pm 15.3$ A	$\pm 68$ mV	$\pm 3.4\%$

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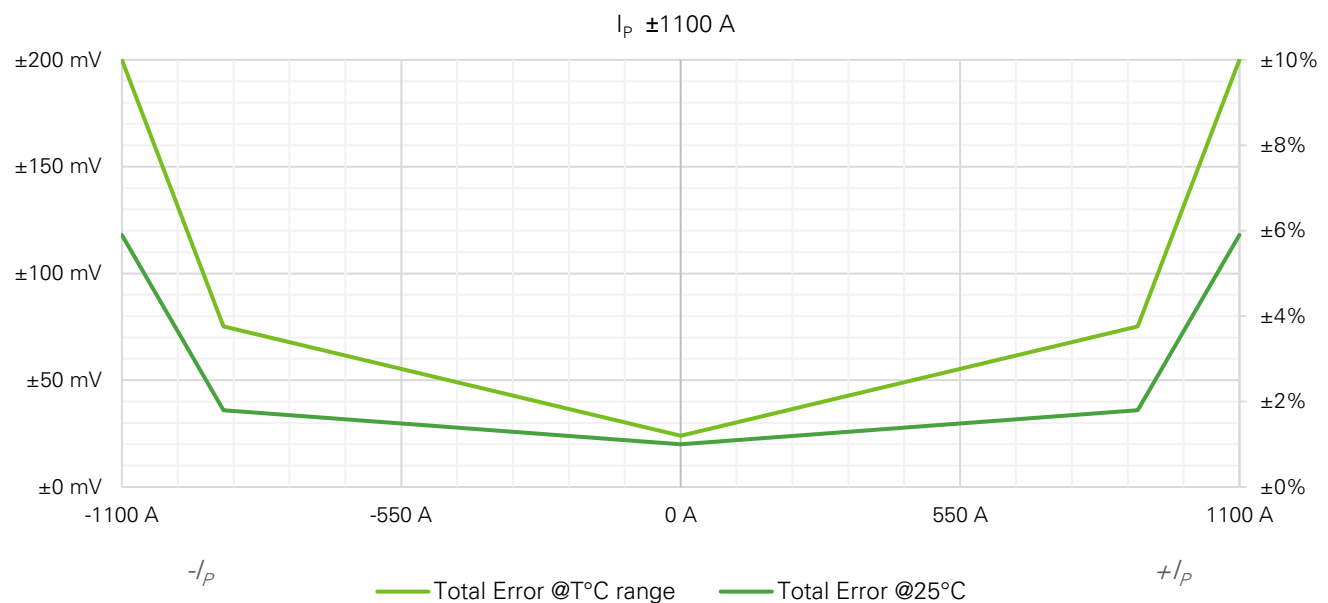
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### Primary Current Range for Channel 2 (High Range): up to 1100 A (extended range)

Littelfuse offers customized high range calibration ranges up to 1100 A.  
Below performance data are applicable for  $\pm 900$  A ...  $\pm 1100$  A calibration.

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Primary Current	$I_p$	-1100		+1100	A	
Sensitivity for $\pm 1100$ A	$S$		1.82		mV/A	$U_c = 5V$
Linearity Error in $\pm 900$ A	$\epsilon_L$		$\pm 0.5$		%FS	$U_c = 5V$ , over temp.
Offset Error	$\epsilon_o$	$\pm 1.2$		$\pm 1.2$	%FS	$U_c = 5V$ , over temp.
Sensitivity Error	$\epsilon_s$		$\pm 1.2$		%FS	$U_c = 5V$ , over temp.



Primary Current	Total Error @25°C			Total Error @Trange			
	A	mV	%	A	mV	%	A
$-I_p$ (-1100 A)		$\pm 118.2$ mV	$\pm 5.9\%$	$\pm 65.0$ A	$\pm 200$ mV	$\pm 10\%$	$\pm 110$ A
-900		$\pm 36.4$ mV	$\pm 1.8\%$	$\pm 20.0$ A	$\pm 75.3$ mV	$\pm 4.6\%$	$\pm 41.4$ A
0		$\pm 20.0$ mV	$\pm 1.0\%$	$\pm 11.0$ A	$\pm 24.0$ mV	$\pm 1.2\%$	$\pm 13.2$ A
+900		$\pm 36.4$ mV	$\pm 1.8\%$	$\pm 20.0$ A	$\pm 75.3$ mV	$\pm 3.4\%$	$\pm 41.4$ A
$+I_p$ (+1100 A)		$\pm 118.2$ mV	$\pm 5.9\%$	$\pm 65.0$ A	$\pm 200$ mV	$\pm 10\%$	$\pm 110$ A



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### Recommendations for Use

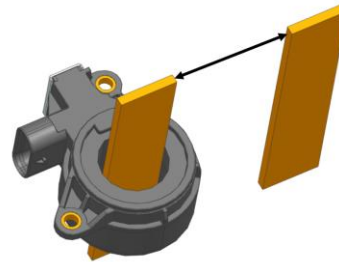
#### Setup Recommendation

##### Mounting:



- M4 screw mounted with flat/spring washer or serrated flanged screw is recommended.
- Assembly torque: 1.5 N·m  $\pm$  10%
- Preferred busbar orientation is parallel with connector.

##### Adjacent Busbar Spacing:



- The distance between sensor cable/busbar and adjacent cable/busbar is recommended to be more than 50mm @1100A
- Adjacent busbar should not pass directly above or below current sensor housing.
- Busbar layout should be reviewed with Littelfuse for compatibility.

#### Handling

- Handling of sensors should be minimized by maintaining parts within packaging until point of assembly.
- Contact with sensor terminals should be avoided.
- To avoid potential damage, adherence to ESD handling best practices is recommended.
- Dropped parts should be scrapped regardless of evidence of external damage.

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### Validation Test Specification

Group / Test	Reference	Test Condition
<b>Environmental</b>		
Low temperature storage test	ISO 16750-4	
Low temperature operation test	ISO 16750-4	
High temperature operating endurance test (HTOE)	ISO 16750-4	
Powered thermal cycle endurance	IEC 60068-2-14 Nb	
Thermal shock	EN 60068-2-14 ISO16750-4 §5.3.2	
High temperature and humidity endurance	JESD22-A101	
Salt mist	IEC 60068-2-11	
<b>Mechanical</b>		
Temperature Vibration Test	ISO 16750-3 § 4.1.2.4	
Mechanical Shock	ISO 16750-3 §4.2.2.2	
Free-Fall	ISO 16750-3 § 4.3	
Dust proof	IEC 60529	
Waterproof	IEC 60529	
<b>Electrical</b>		
Single line interruption	ISO 16750-2 §4.9.1	
Reverse supply voltage	-0.3 V for 60 s	
Overvoltage	10 V for 60 s	
Power-on time test	Littelfuse VS	Vdd min to 90% Vout
Response time test	Littelfuse VS	90% Primary current to 90% Vout
Output short circuit to supply	ISO16750-2 §4.10	
Electrical heat rise		100A DC per step for heat rise step
DC insulation resistance	ISO 16750-2 §4.1.2.2	
AC insulation test (Dielectric voltage)	IEC 60664	
<b>EMC</b>		
BCI test	ISO 11452-4 Annex E.1.1, Table E.1	
Radiated electromagnetic immunity	ISO 11452-2	
Radiated emissions	CISPR 25	
ESD handling Test	ISO 10605 §7	
<b>Connector</b>		
Terminal push-out force test	GMW3191:2012 §4.5.2	
Connector to connector engagement force test	GMW3191:2012 §4.2.8/ USCAR25	
Locked connector disengagement force test	GMW3191:2012 §4.2.18	
Unlocked connector disengagement force test	GMW3191:2012 §4.2.19	

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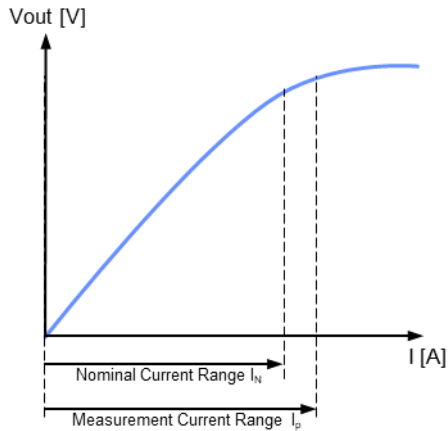
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### Performance Parameter Definitions

#### Output voltage definition ( $V_{out}$ )

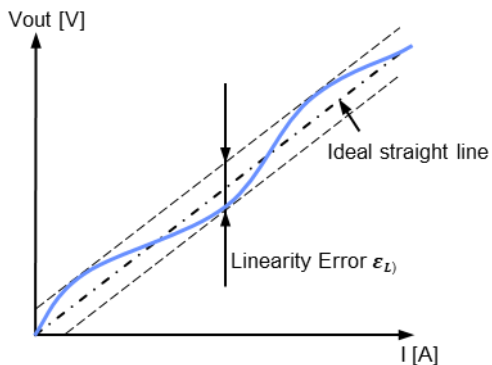
$$V_{out} = (U_C/5) \times (V_O + I_p \times S)$$

#### Primary current definition ( $I_N, I_p$ )



#### Linearity error ( $\epsilon_L$ )

The maximum positive or negative discrepancy with a reference straight line  $V_{out} = f(I_p)$ .



$$\epsilon_L = \pm \frac{\Delta V_{max}}{V_{FS}} \times 100\%$$

#### Offset error ( $\epsilon_O$ )

The voltage drift of the measured sensor output  $V_{out}$  at 0A compared to the ideal value 2.5V (@ $V_C = 5V$ ) is called the total offset voltage error. This offset error can be attributed to the electrical offset, magnetic offset and related drift over temperature.

$$\epsilon_O = \pm \frac{V_{out} - V_O}{V_{FS}} \times 100\%$$

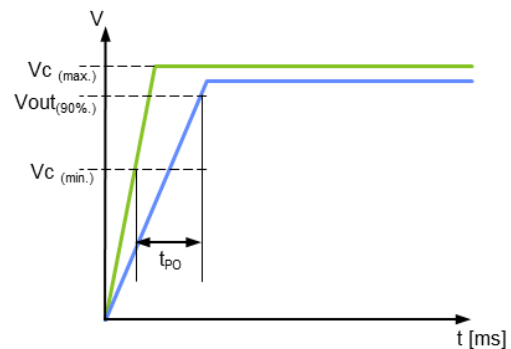
#### Sensitivity error ( $\epsilon_S$ )

The sensor sensitivity error is the drift of sensor's ideal sensitivity.

$$\epsilon_S = \pm \frac{G - G_{th}}{G_{th}} \times 100\%$$

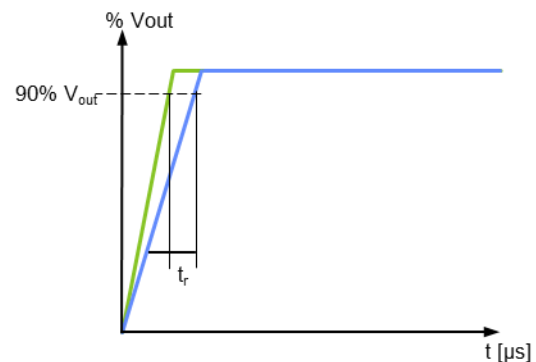
#### Power-on time ( $t_{po}$ )

The Power-on time is the duration from  $V_{DD}(\min.)$  to 90% of  $V_{out}$ .



#### Response time ( $t_r$ )

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



#### Typical minimum and maximum values

Typical minimum, and maximum values are determined during initial product characterization. Typical values representing the normal of statistical  $\pm 1\sigma$  interval (68.27% probability).

Minimum and maximum values representing the Gaussian distribution boundaries of the  $\pm 3\sigma$  interval (99.73% probability).

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### Contact

Custom electrical and environmental specifications can be designed to meet any need, please contact Littelfuse Engineering for details.

Website: [www.littelfuse.com](http://www.littelfuse.com)  
 Sales Support: [ALL\\_Autosensors\\_Sales@littelfuse.com](mailto:ALL_Autosensors_Sales@littelfuse.com)  
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Revision	Date	Name	Change
1.0	28-Apr-2023	Florent Jolly	Released Preliminary datasheet based on A-Sample results – technical review by Rimantas Radzys
1.1	12-Mar-2024	Stephen Hanks	Added definition for CH1S011B Revised assembly torque (1.5 N·m was 2.5 N·m) Revised chart format

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