

Current Sensor

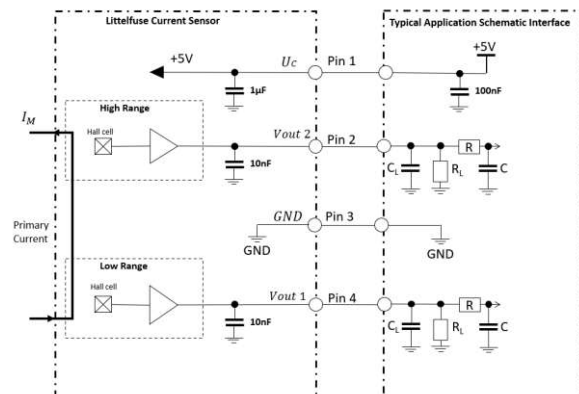
CH1S01xB



General Description

The Littelfuse CH1S01xB 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.

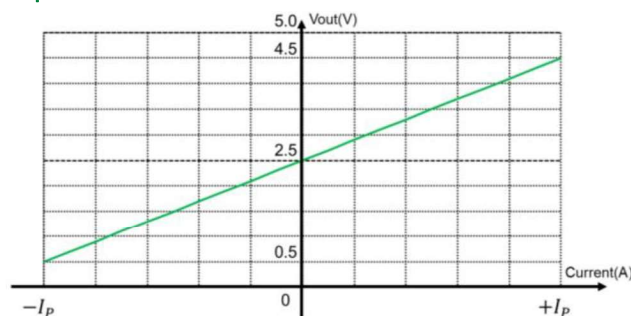
Typical Application Diagram



$C_L \geq 1.0\text{nF}$, $C_L \leq 10.0\text{nF}$ for EMC protection

$R_L \geq 10\text{k}\Omega$, $R_L \leq 200\text{k}\Omega$ pull-down resistor on signal line

Output Characteristics



* I_P : 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 $\pm 100\text{A}$
 - Channel 2: up to $\pm 1100\text{A}$

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

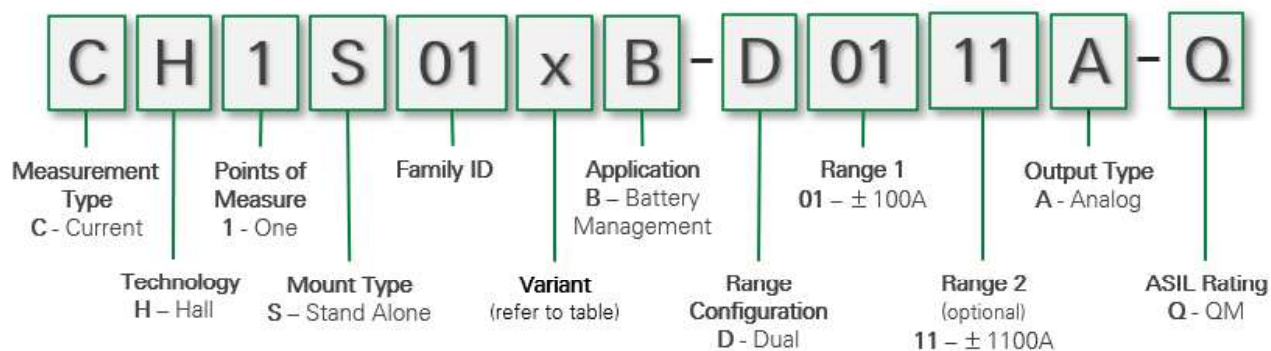
Mating Connector

- TE 1-1456426-5

Current Sensor

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Littelfuse Current Sensor Naming Convention



Product Variants

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

Current Range Definition

Littelfuse offers customized calibration ranges.

Naming Examples:

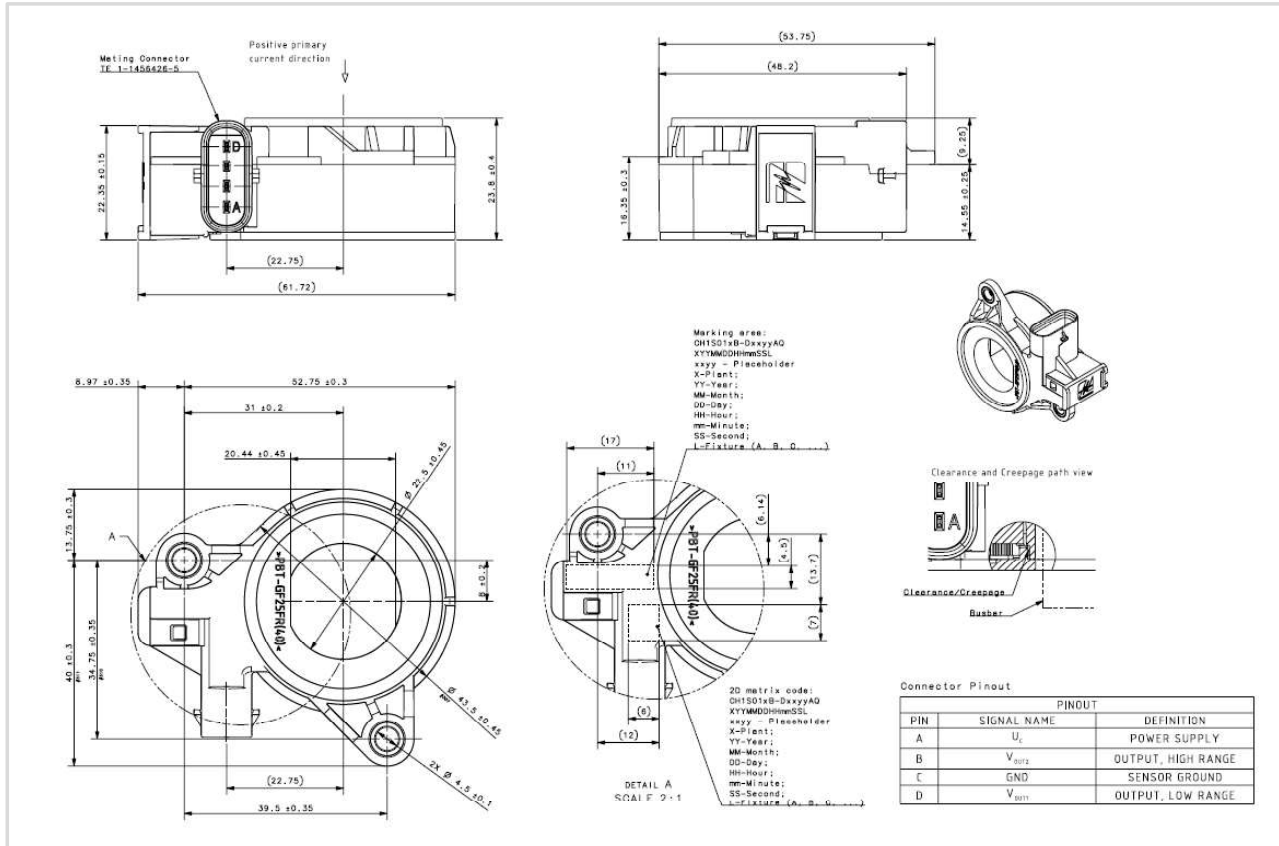
Type Name	Current Range Chanel 1	Current Range Chanel 2
CH1S01xB-D0106A-Q	$\pm 100\text{ A}$	$\pm 600\text{ A}$
CH1B01xB-D0108A-Q	$\pm 100\text{ A}$	$\pm 800\text{ A}$
CH1B01xB-D0110A-Q	$\pm 100\text{ A}$	$\pm 1000\text{ A}$
CH1B01xB-D0111A-Q	$\pm 100\text{ A}$	$\pm 1100\text{ A}$

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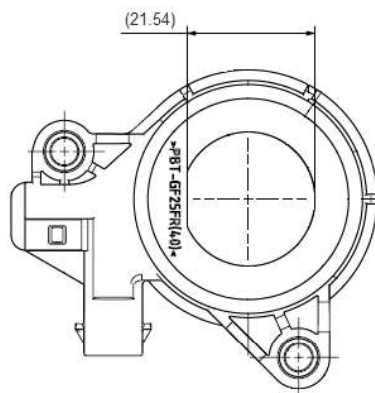
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Current Sensor Dimensions (in mm)

CH1S010B



CH1S011B



- 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. ¹
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	

¹ 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 ²	°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

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

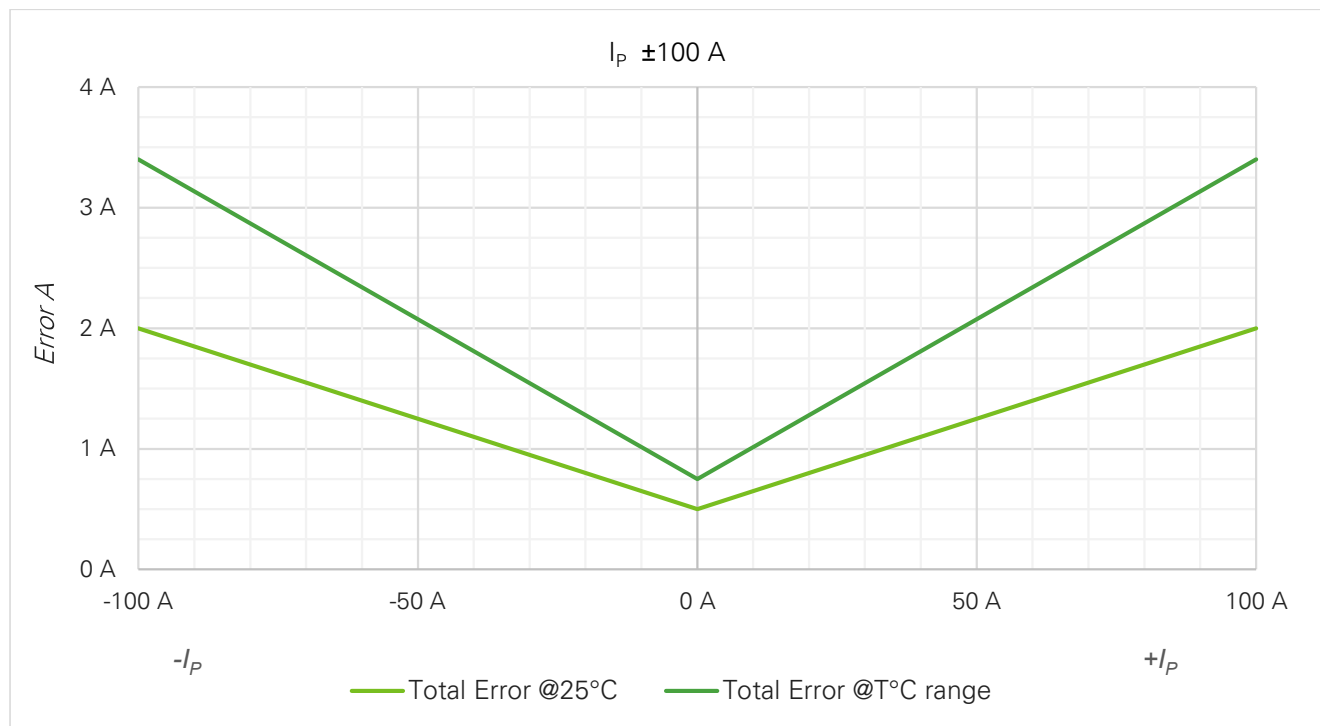
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Primary Current Range - Channel 1-Low Range: up to $\pm 100\text{A}$

Littelfuse offers customized low range calibrations.
Performance data below is applicable for a $\pm 100\text{A}$ 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	ε_L		± 0.5		%FS	UC = 5V, over temp.
Offset Error	ε_o	± 0.75		± 0.75	%FS	UC = 5V, over temp.
Sensitivity Error	ε_s		± 1.2		%FS	UC = 5V, over temp.



Primary Current	Total Error @25°C		Total Error @T°C range	
A	%	A	%	A
$-I_p$ (-100 A)	$\pm 2\%$	$\pm 2.00\text{ A}$	$\pm 3.4\%$	$\pm 3.4\text{ A}$
0	$\pm 0.5\%$	$\pm 0.50\text{ A}$	$\pm 0.75\%$	$\pm 0.75\text{ A}$
$+I_p$ (+100 A)	$\pm 2\%$	$\pm 2.00\text{ A}$	$\pm 3.4\%$	$\pm 3.4\text{ A}$

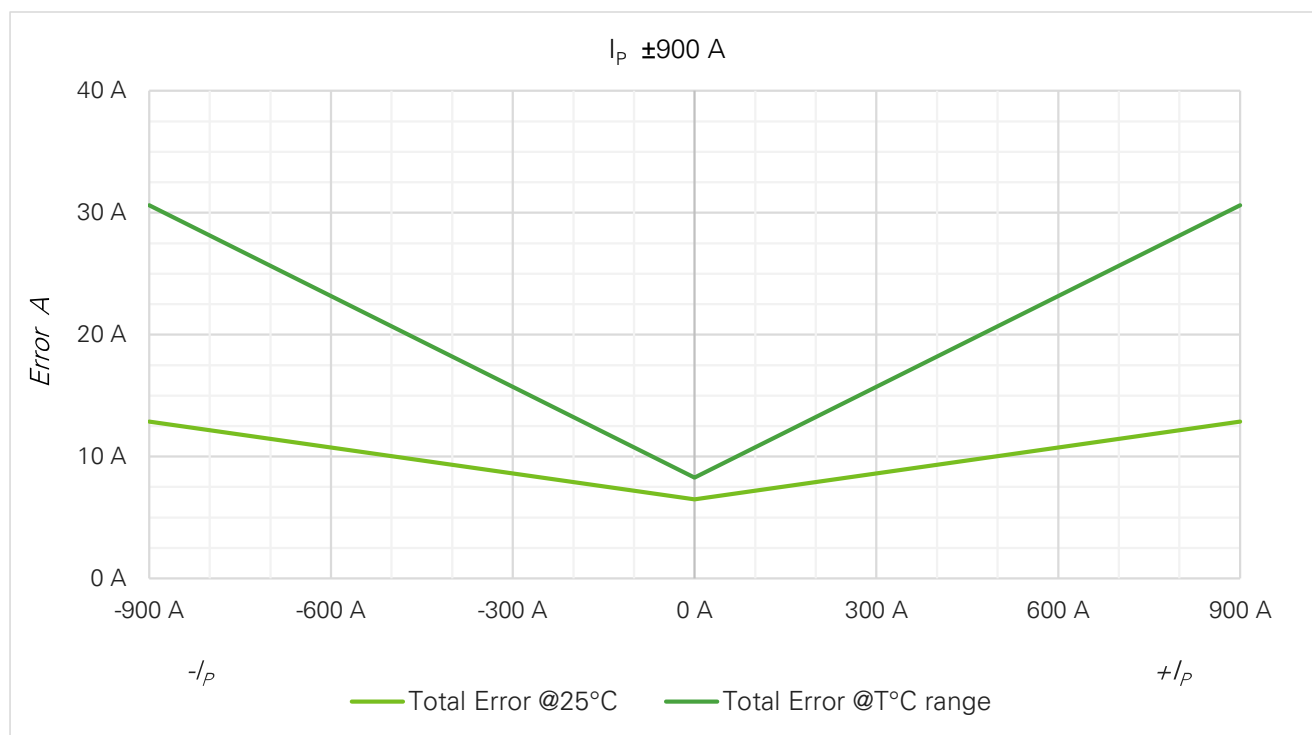
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Primary Current Range - Channel 2-High Range (Standard): up to ± 900 A

Littelfuse offers customized high range calibration ranges up to ± 1100 A.
Performance data below is applicable for a ± 900 A calibration.

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



Primary Current	Total Error @25°C		Total Error @T°C range	
	A	%	A	%
$-I_p$ (-900 A)		$\pm 1.7\%$	± 12.9 A	$\pm 3.4\%$
0		$\pm 0.7\%$	± 6.48 A	$\pm 0.9\%$
$+I_p$ (+900 A)		$\pm 1.7\%$	± 12.9 A	$\pm 3.4\%$

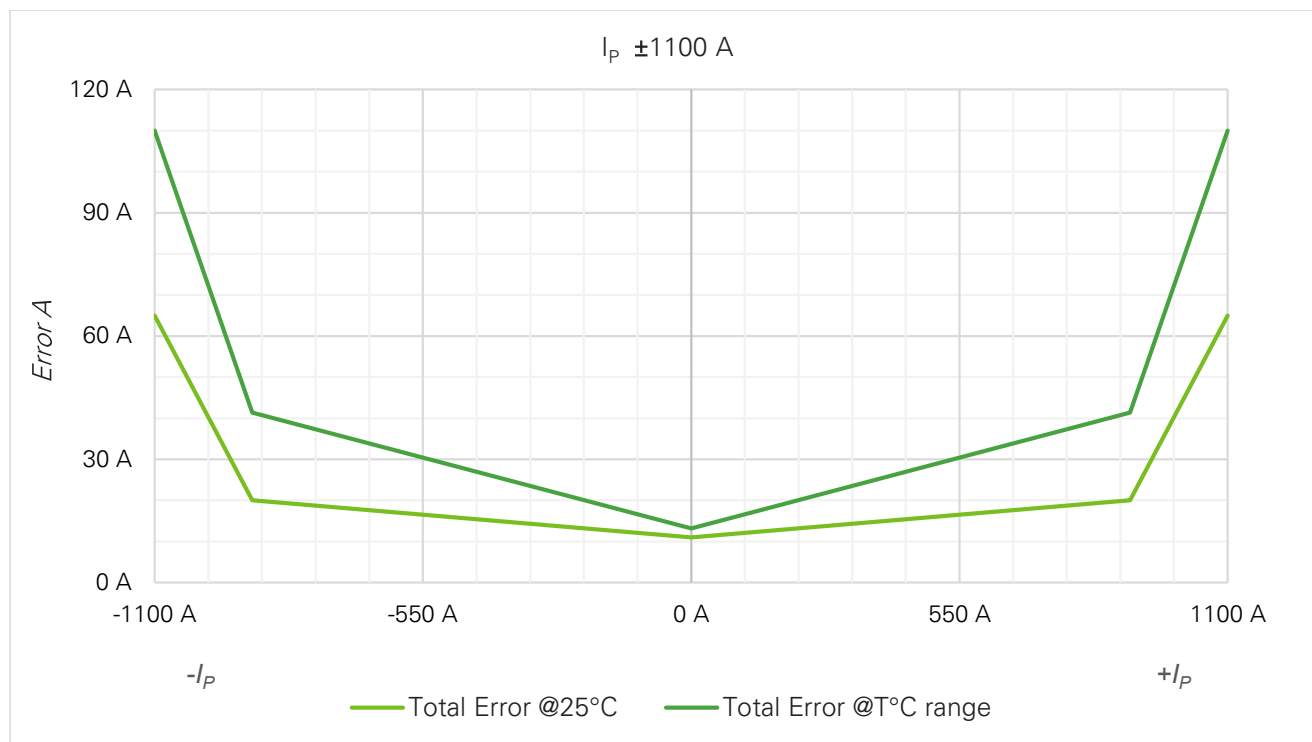
Current Sensor

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Primary Current Range - Channel 2-High Range (Extended): up to ± 1100 A

Littelfuse offers customized high range calibration ranges up to ± 1100 A.
Performance data below is applicable for a ± 1100 A calibration.

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Primary Current	I_p	-1100		+1100	A	
Sensitivity for ± 1100 A	S		1.82		mV/A	$U_c = 5V$
Linearity Error	ε_L		± 0.5		%FS	$U_c = 5V$, over temp.
Offset Error	ε_o	± 1.2		± 1.2	%FS	$U_c = 5V$, over temp.
Sensitivity Error	ε_s		± 1.2		%FS	$U_c = 5V$, over temp.



Primary Current	Total Error @25°C		Total Error @Trange	
A	%	A	%	A
$-I_p$ (-1100 A)	$\pm 5.9\%$	± 65.0 A	$\pm 10\%$	± 110 A
0	$\pm 1.0\%$	± 11.0 A	$\pm 1.2\%$	± 13.2 A
$+I_p$ (+1100 A)	$\pm 5.9\%$	± 65.0 A	$\pm 10\%$	± 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 the primary conductor through the sensor aperture (cable/busbar) and adjacent cable/busbar(s) 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
Environmental		
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	
Mechanical		
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	
Electrical		
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	
EMC		
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	
Connector		
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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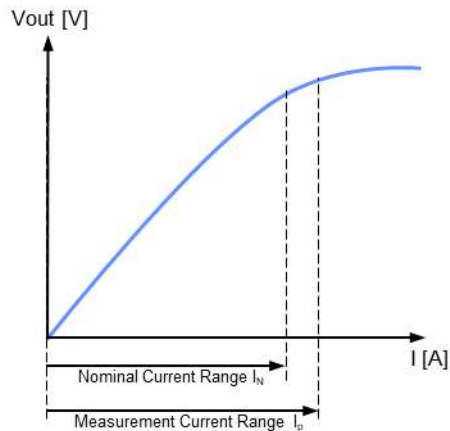
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Performance Parameter Definitions

Output voltage definition (V_{out})

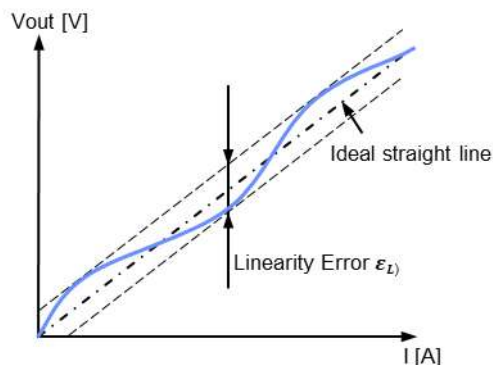
$$V_{out} = (U_c/5) \times (V_o + I_p \times S)$$

Primary current definition (I_N, I_p)



Linearity error (ε_L)

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



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

Offset error (ε_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.

$$\varepsilon_o = \pm \frac{V_{out} - V_o}{V_{FS}} \times 100\%$$

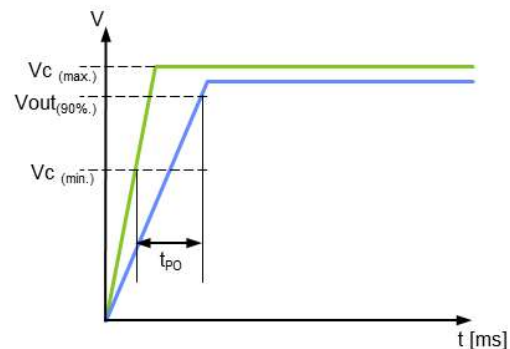
Sensitivity error (ε_s)

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

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

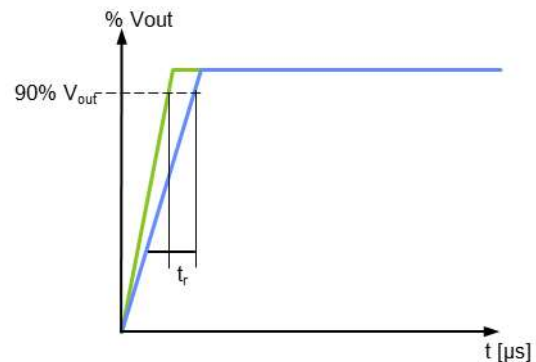
Power-on time (t_{po})

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.

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