

Current Sensor

CH1S01xB

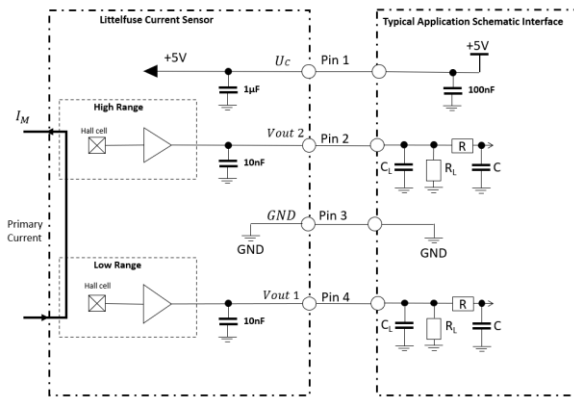
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General Description

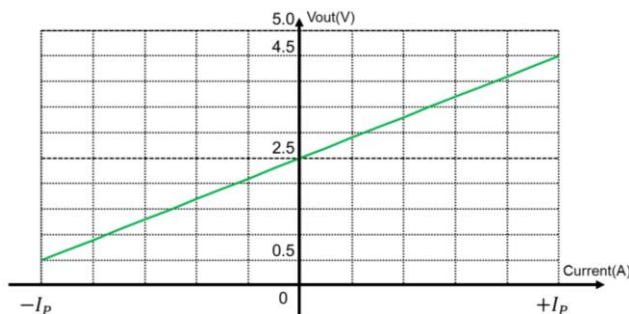
The Littelfuse CH1S010B current sensor family utilizes open loop Hall Effect technology to provide dual channel, ratio-metric output signals proportional to the magnetic flux density generated by internal C-core concentrators.

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_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 ±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								

C=Current V=Voltage T=Temperature	H=Hall HS=Shunt+Hall F=Fluxgate HF=Fluxgate+Hall FS=Shunt+Fluxgate S=Shunt	S=Stand Alone B=with Busbar P=PCB mount	M = Motor Control B = BMS P = Pyro Trigger R = Relay Trigger C = Charger	S=Single D=Dual R=Redundant	01 - 100 02 - 200 03 - 300 04 - 400 05 - 500 06 - 600 09 - 900 ... 20 - 2000	01 - 100 02 - 200 03 - 300 04 - 400 05 - 500 06 - 600 09 - 900 ... 20 - 2000	A=Analog P=PWM C=CAN no termination CT120=CAN 120 Ohm termination L=LIN S=SENT CA = CAN + Analog U=UART	Q=QM 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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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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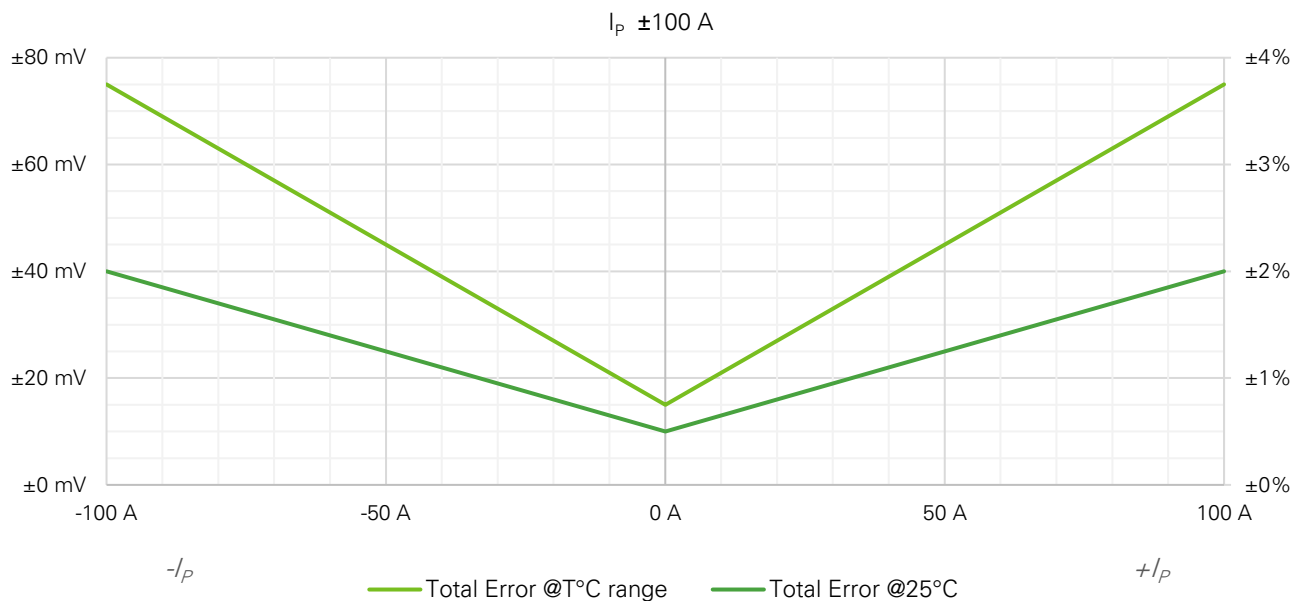
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Primary Current Range for Channel 1 (Low Range): up to $\pm 100\text{A}$

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	ϵ_L		± 0.5		%FS	UC = 5V, over temp.
Offset Error	ϵ_o	± 0.5		± 0.5	%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	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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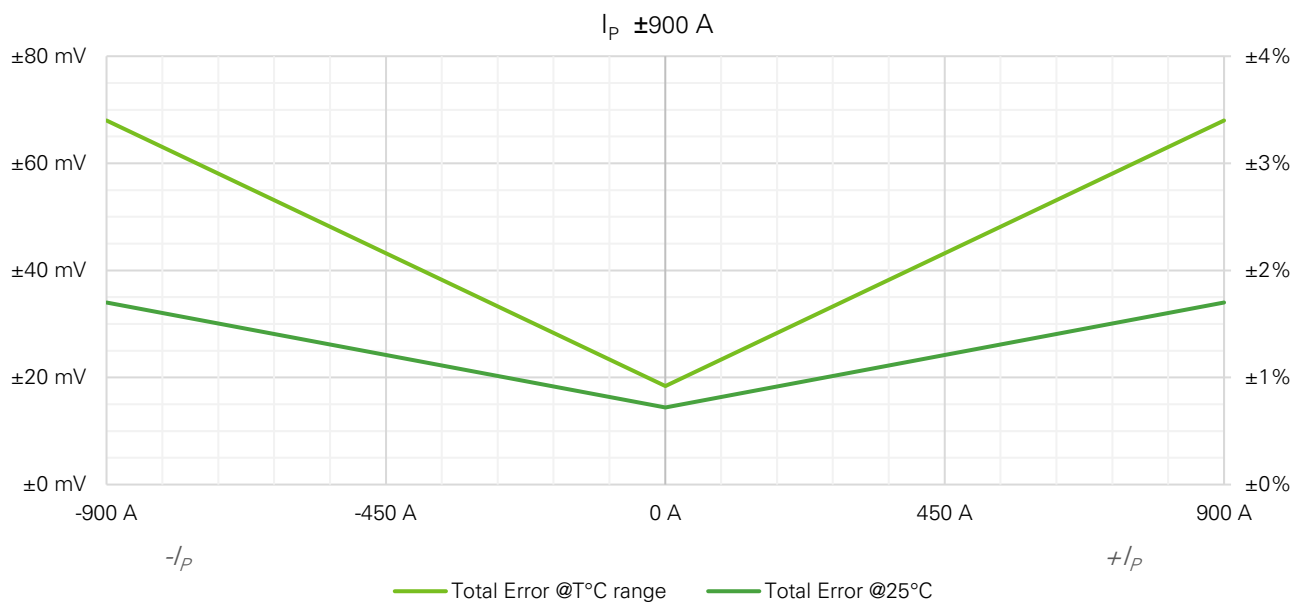
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Primary Current Range for Channel 2 (High Range): up to ± 900 A

Littelfuse offers customized high range calibration ranges up to 1100 A.
Below performance data are applicable for ± 100 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	$U_c = 5V$
Linearity Error	ϵ_L		± 0.5		%FS	$U_c = 5V$, over temp.
Offset Error	ϵ_o	± 0.9		± 0.9	%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 @T°C range		
	A	mV	%	A	mV	%
$-I_p$ (-900 A)		± 28.6 mV	$\pm 1.7\%$	± 15.3 A	± 68 mV	$\pm 3.4\%$
0		± 14.4 mV	$\pm 0.7\%$	± 6.48 A	± 18.4 mV	$\pm 0.9\%$
$+I_p$ (+900 A)		± 28.6 mV	$\pm 1.7\%$	± 15.3 A	± 68 mV	$\pm 3.4\%$

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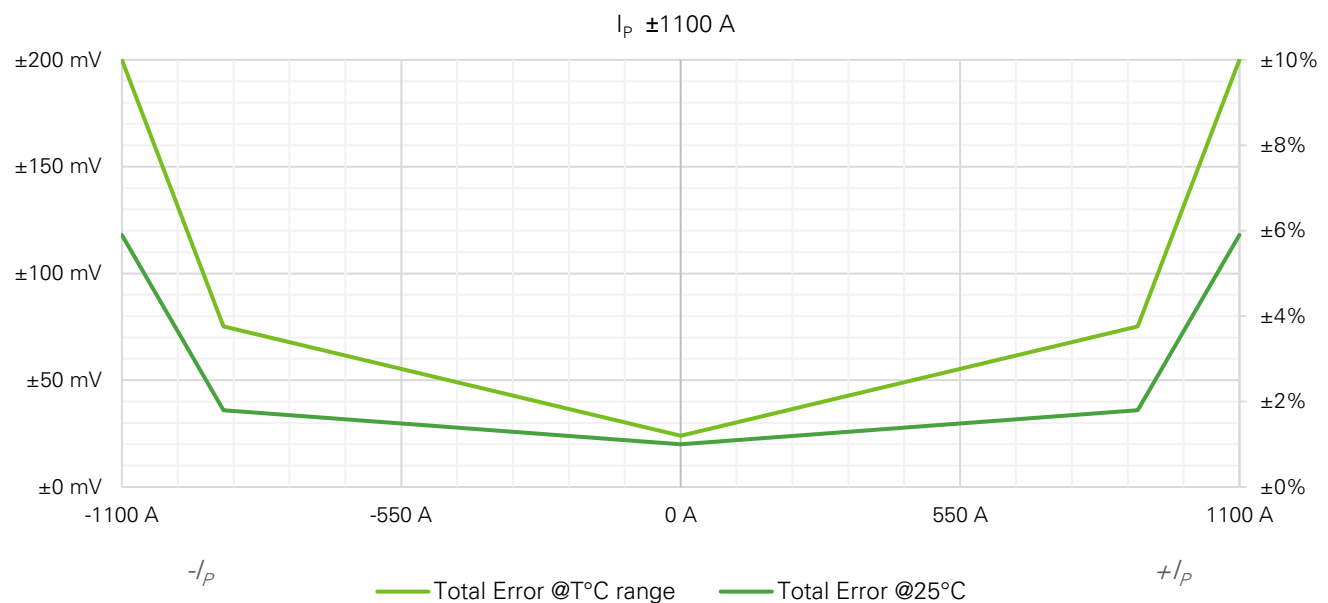
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Primary Current Range for Channel 2 (High Range): up to 1100 A (extended range)

Littelfuse offers customized high range calibration ranges up to 1100 A.
Below performance data are applicable for ± 900 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 in ± 900 A	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	mV	%	A	mV	%	A
$-I_p$ (-1100 A)		± 118.2 mV	$\pm 5.9\%$	± 65.0 A	± 200 mV	$\pm 10\%$	± 110 A
-900		± 36.4 mV	$\pm 1.8\%$	± 20.0 A	± 75.3 mV	$\pm 4.6\%$	± 41.4 A
0		± 20.0 mV	$\pm 1.0\%$	± 11.0 A	± 24.0 mV	$\pm 1.2\%$	± 13.2 A
+900		± 36.4 mV	$\pm 1.8\%$	± 20.0 A	± 75.3 mV	$\pm 3.4\%$	± 41.4 A
$+I_p$ (+1100 A)		± 118.2 mV	$\pm 5.9\%$	± 65.0 A	± 200 mV	$\pm 10\%$	± 110 A

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Recommendations for Use

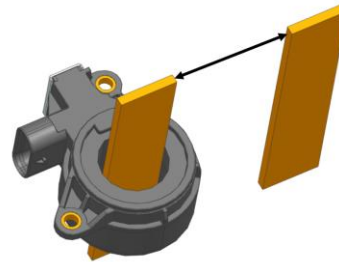
Setup Recommendation

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 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
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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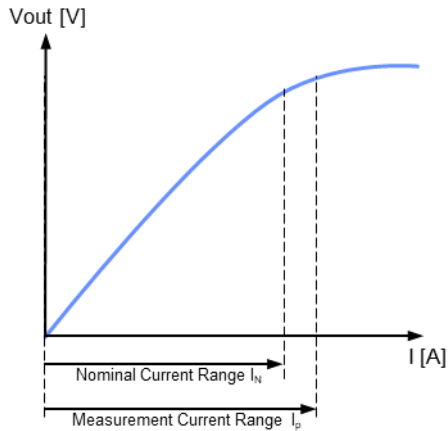
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Performance Parameter Definitions

Output voltage definition (V_{out})

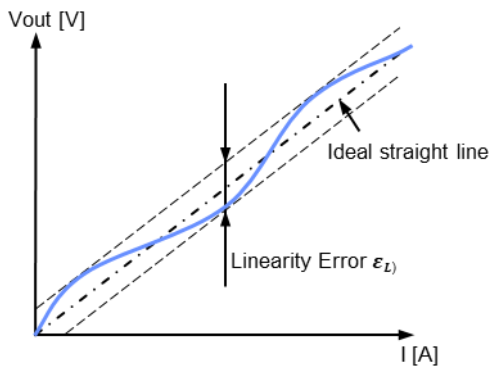
$$V_{out} = (U_C/5) \times (V_O + I_p \times S)$$

Primary current definition (I_N, I_p)



Linearity error (ϵ_L)

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



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

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.

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

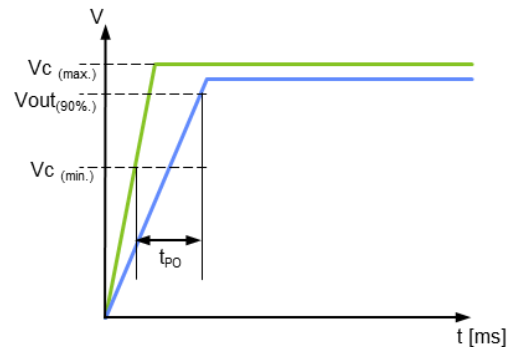
Sensitivity error (ϵ_S)

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

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

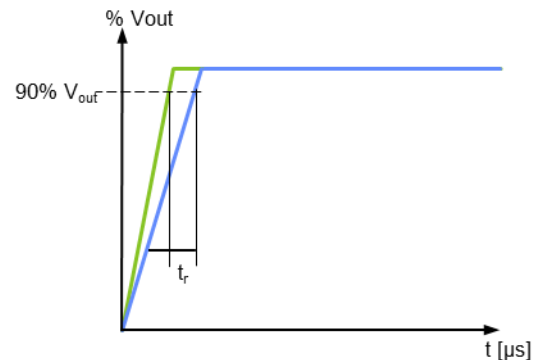
Power-on time (t_{po})

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
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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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