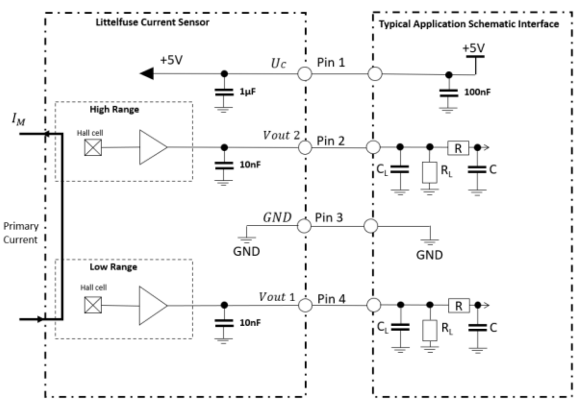
Current Sensor
CH1S01xB

Preliminary Datasheet Target Specification Rev. 1.1

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.

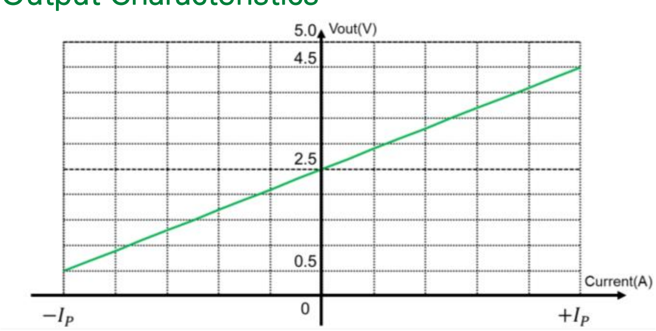
Typical Application Diagram



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

$R_L \geq$ 10kΩ, $R_L \leq$ 200kΩ 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 11 - 1100 ... 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

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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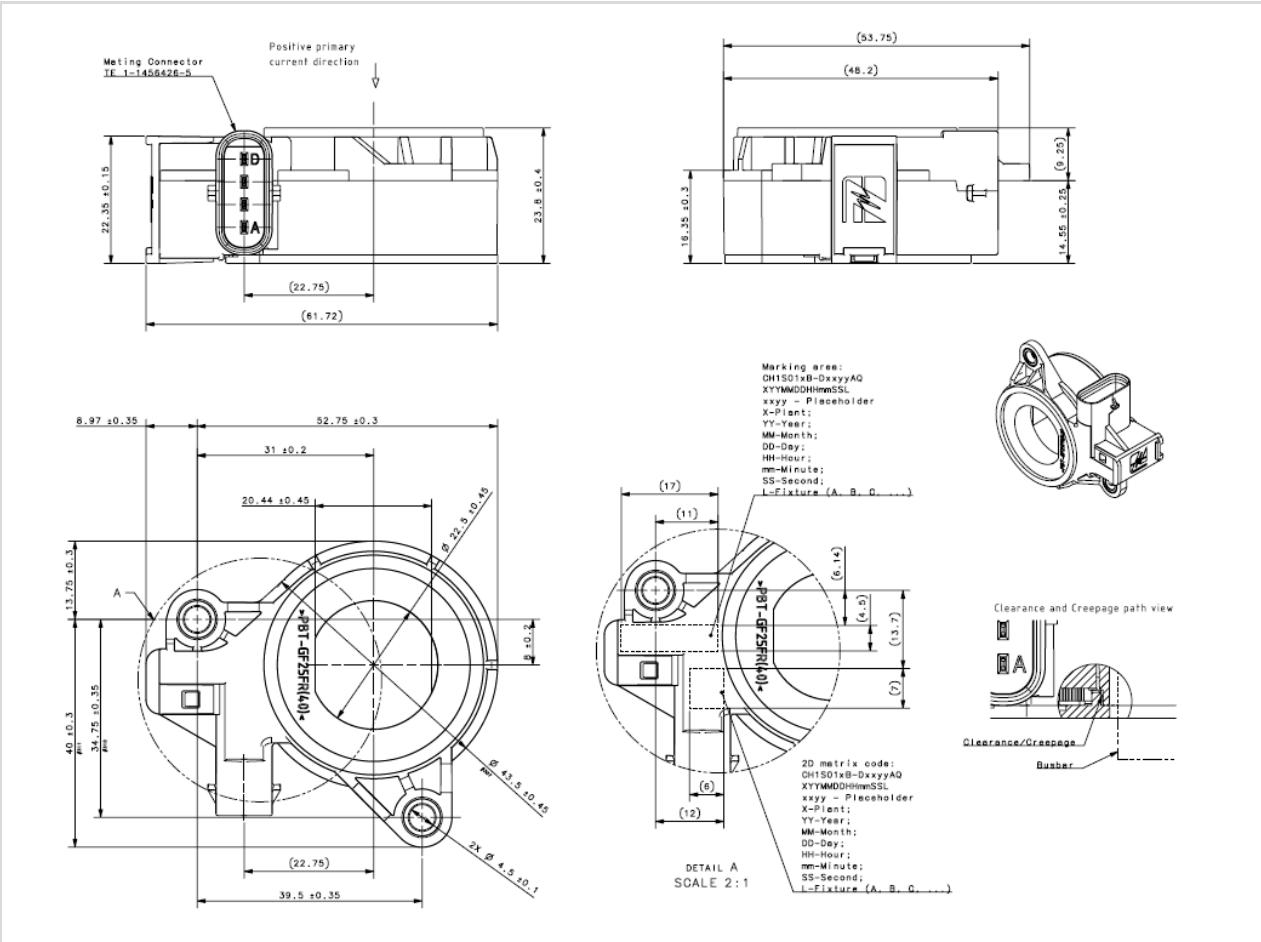
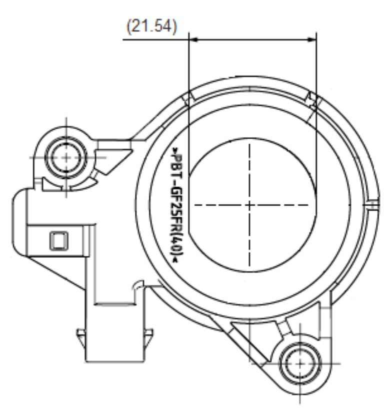
Current Sensor Dimensions (in mm)

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.[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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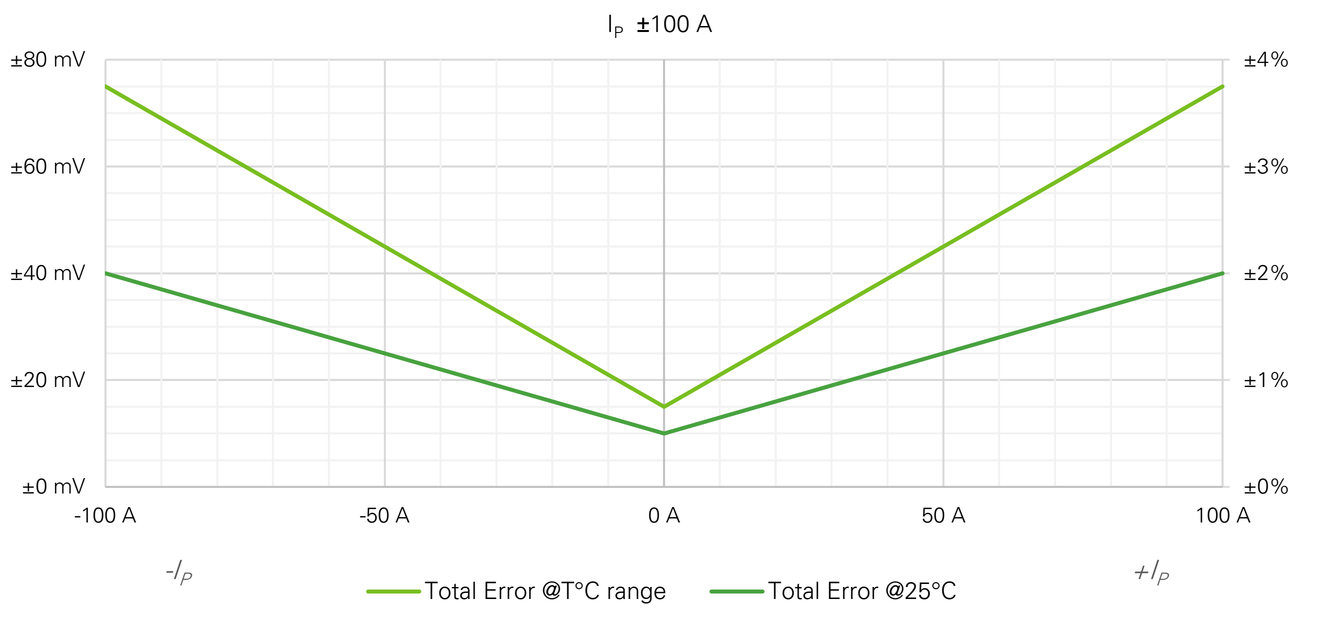
Primary Current Range for Channel 1 (Low Range): up to ±100A

Littelfuse offers customized low range calibrations.
Below performance data are applicable for ±100A calibration.

Parameter	Symbol	Min	Typ.	Max	Units	Comments
Primary Current	I_p	-100		+100	A	
Sensitivity for ±100A	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)	±40 mV	±2%	±2.00 A	±75 mV	±3.75%	±3.75 A
0	±10 mV	±0.5%	±0.50 A	±15 mV	±0.75%	±0.75 A
+ I_p (+100 A)	±40 mV	±2%	±2.00 A	±75 mV	±3.75%	±3.75 A

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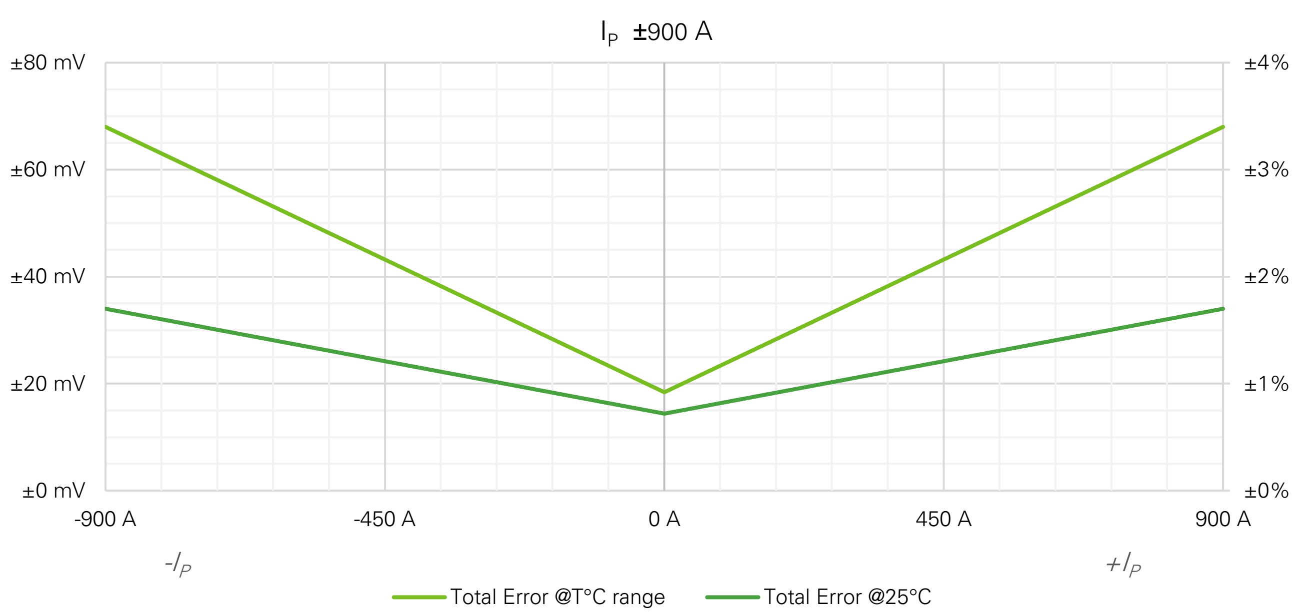
Primary Current Range for Channel 2 (High Range): up to ±900 A

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 ±900A	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	%	A
- I_p (-900 A)	±28.6 mV	±1.7%	±15.3 A	±68 mV	±3.4%	±30.6 A
0	±14.4 mV	±0.7%	±6.48 A	±18.4 mV	±0.9%	±8.28 A
+ I_p (+900 A)	±28.6 mV	±1.7%	±15.3 A	±68 mV	±3.4%	±30.6 A

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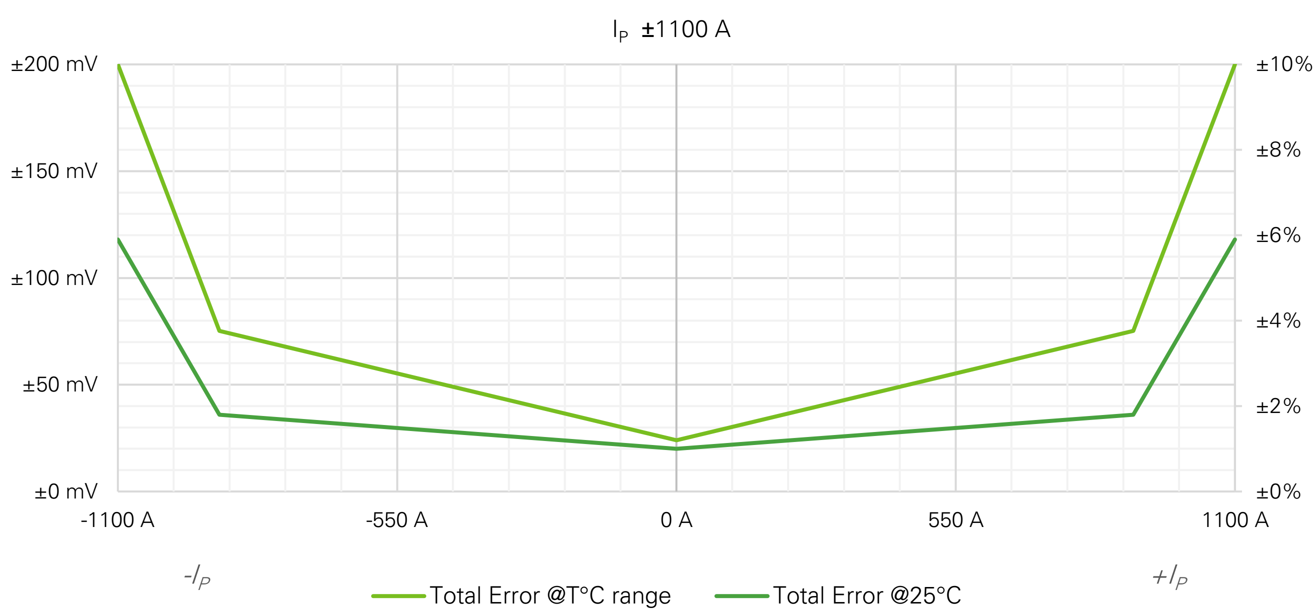
Primary Current Range for Channel 2 (High Range): up to 1100 A (extended range)

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 ±1100A	S		1.82		mV/A	Uc = 5V
Linearity Error in ±900A	ε_L		±0.5		%FS	Uc = 5V, over temp.
Offset Error	ε_O	±1.2		±1.2	%FS	Uc = 5V, over temp.
Sensitivity Error	ε_S		±1.2		%FS	Uc = 5V, over temp.



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

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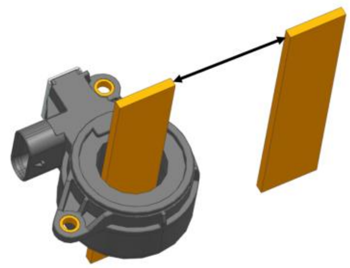
Recommendations for Use

Setup Recommendation

Mounting:	Adjacent Busbar Spacing:
 ▪ M4 screw mounted with flat/spring washer or serrated flanged screw is recommended. ▪ Assembly torque: 1.5 N·m ± 10% ▪ Preferred busbar orientation is parallel with connector.	 ▪ 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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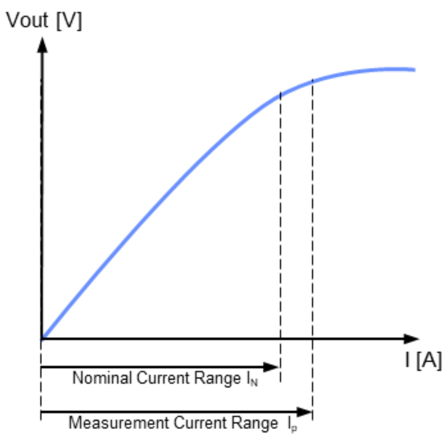
Performance Parameter Definitions

Output voltage definition (V_{out})

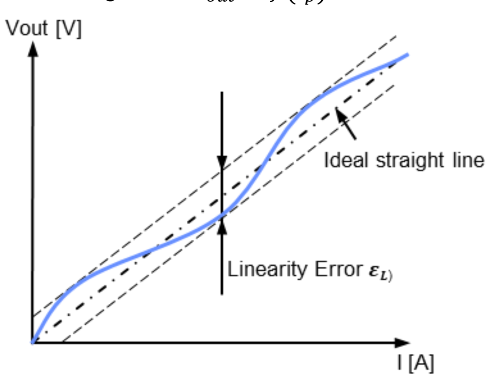
$$V_{out} = (U_C/5) \times (V_O + I_p \times S)$$

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.

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

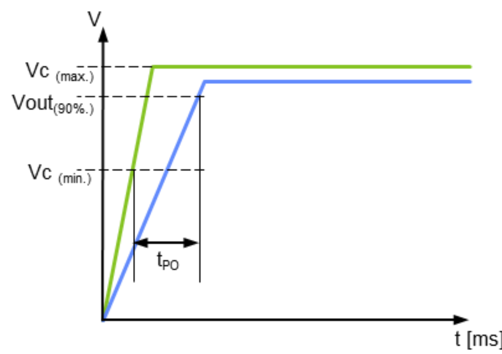
Sensitivity error (ε_S)

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

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

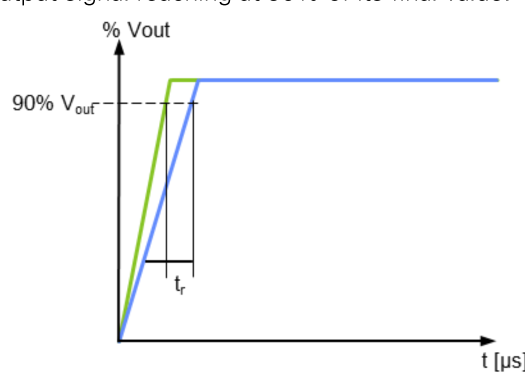
Power-on time (t_{po})

The Power-on time is the duration from VDD(min.) to 90% of Vout.



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 ±1σ interval (68.27% probability).
Minimum and maximum values representing the Gaussian distribution boundaries of the ±3σ 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 Hankes	Added definition for CH1S011B Revised assembly torque (1.5 N·m was 2.5 N·m) Revised chart format

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