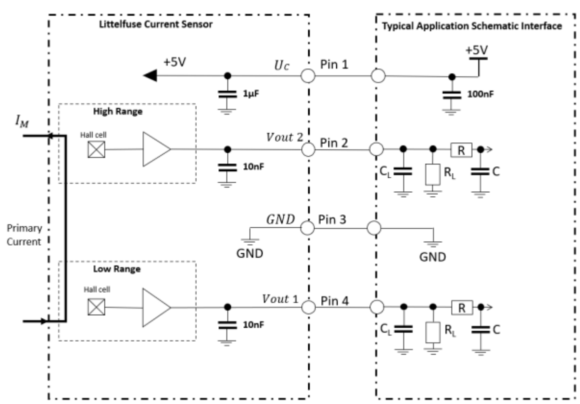
# Current Sensor
## CH1S01xB

## General Description

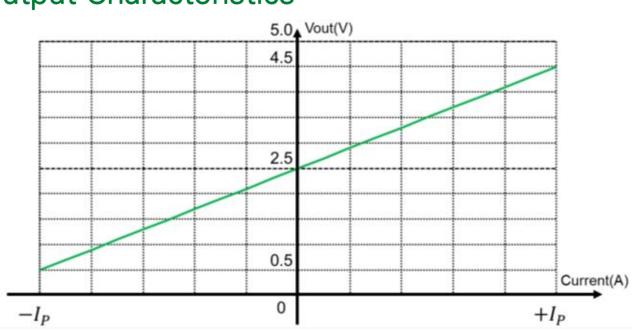
The Littelfuse CH1S01xB current sensor family utilizes open loop Hall Effect technology to provide dual channel, ratio-metric output signals proportional to the magnetic flux density generated by internal C-core concentrators.

## Typical Application Diagram




$C_L \geq$ 1.0nF, $C_L \leq$ 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

# Current Sensor

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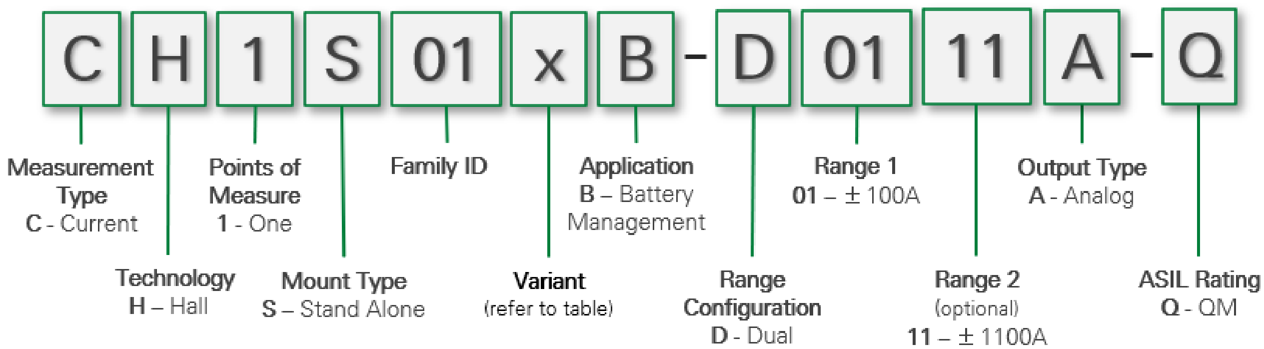
## Littelfuse Current Sensor Naming Convention




## 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 | ±100 A | ±600 A |
| CH1B01xB-D0108A-Q | ±100 A | ±800 A |
| CH1B01xB-D0110A-Q | ±100 A | ±1000 A |
| CH1B01xB-D0111A-Q | ±100 A | ±1100 A |

# Current Sensor
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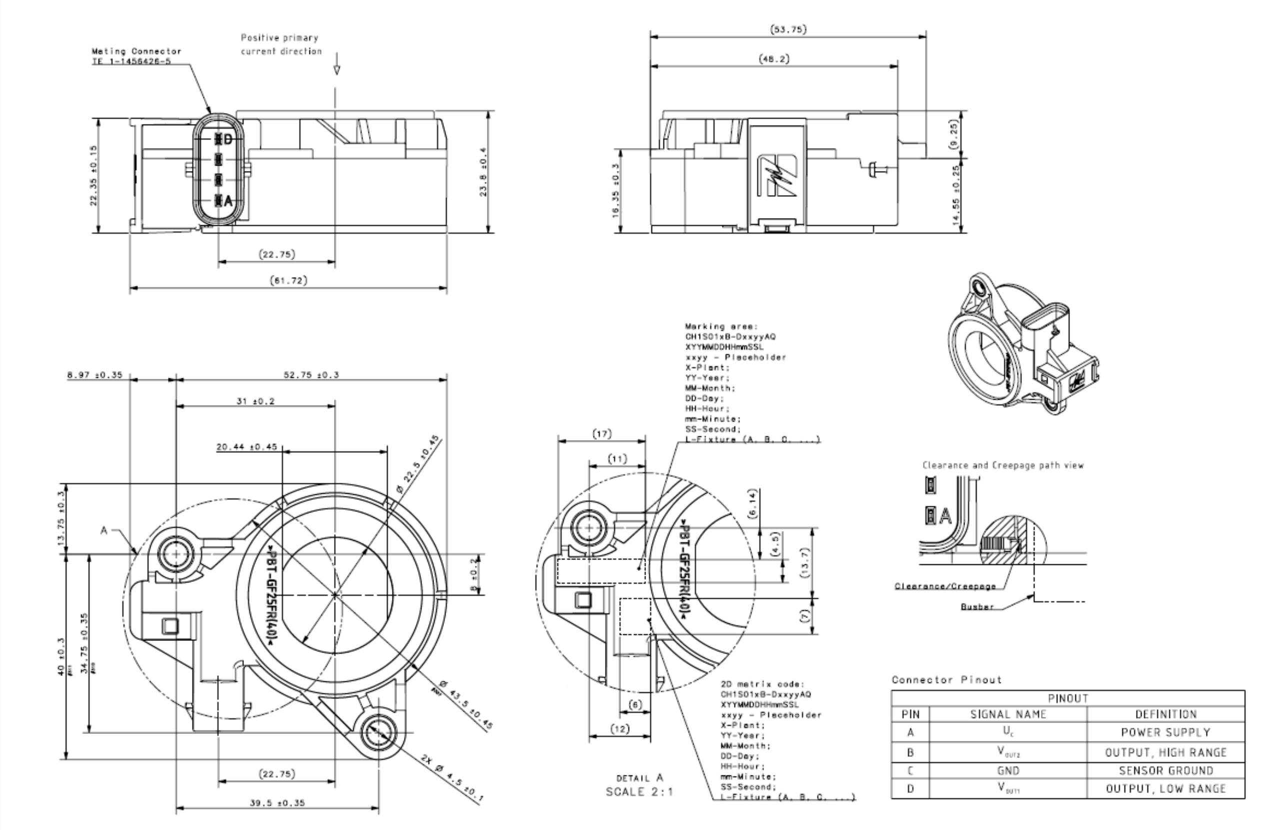
## Current Sensor Dimensions (in mm)

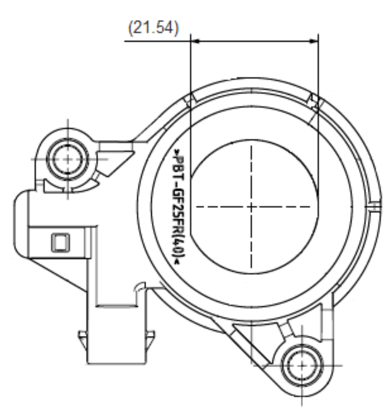
### CH1S010B




Connector Pinout

| PINOUT | | |
|---|---|---|
| PIN | SIGNAL NAME | DEFINITION |
| A | $U_c$ | POWER SUPPLY |
| B | $V_{OUT2}$ | OUTPUT, HIGH RANGE |
| C | GND | SENSOR GROUND |
| D | $V_{OUT1}$ | OUTPUT, LOW RANGE |

### CH1S011B




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

# Current Sensor
CH1S01xB

## 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.

# Current Sensor
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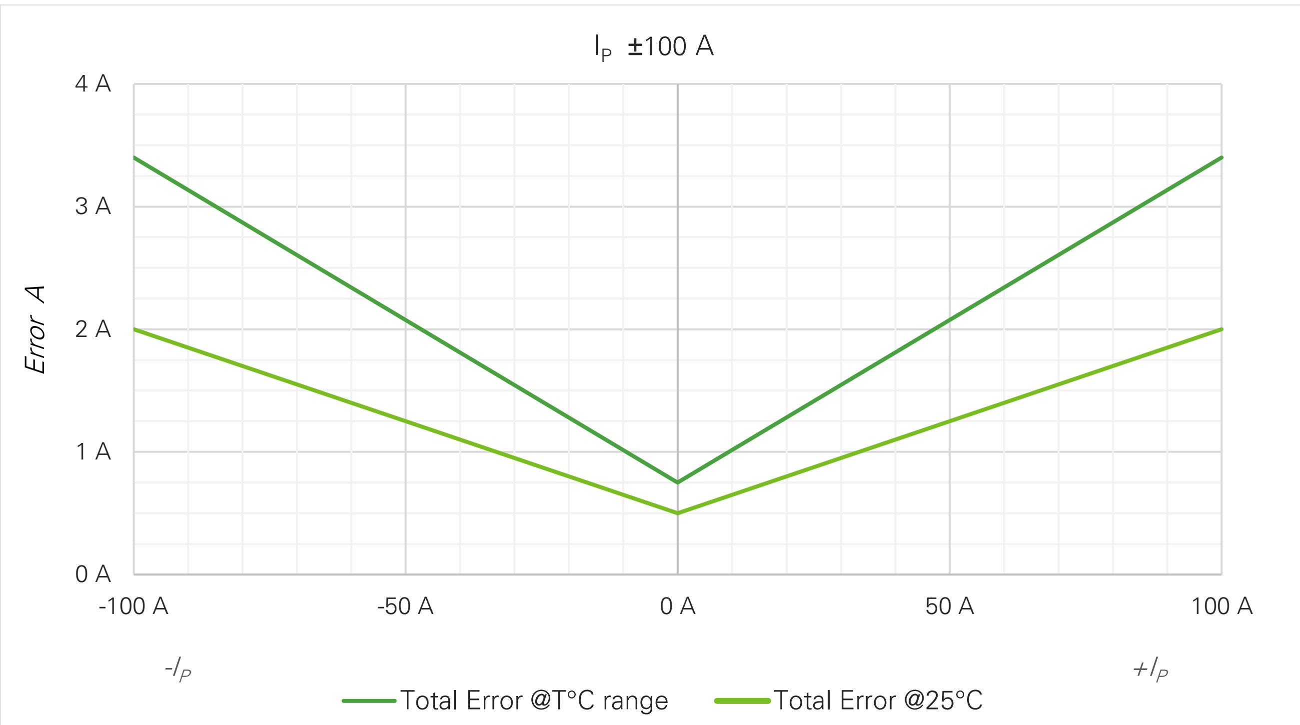
## Primary Current Range - Channel 1-Low Range: up to ±100A

Littelfuse offers customized low range calibrations.
Performance data below is applicable for a ±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 | $\varepsilon_L$ | | ±0.5 | | %FS | UC = 5V, over temp. |
| Offset Error | $\varepsilon_O$ | ±0.5 | | ±0.5 | %FS | UC = 5V, over temp. |
| Sensitivity Error | $\varepsilon_S$ | | ±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) | ±2% | ±2.00 A | ±3.4% | ±3.4 A |
| 0 | ±0.5% | ±0.50 A | ±0.75% | ±0.75 A |
| + $I_p$ (+100 A) | ±2% | ±2.00 A | ±3.4% | ±3.4 A |

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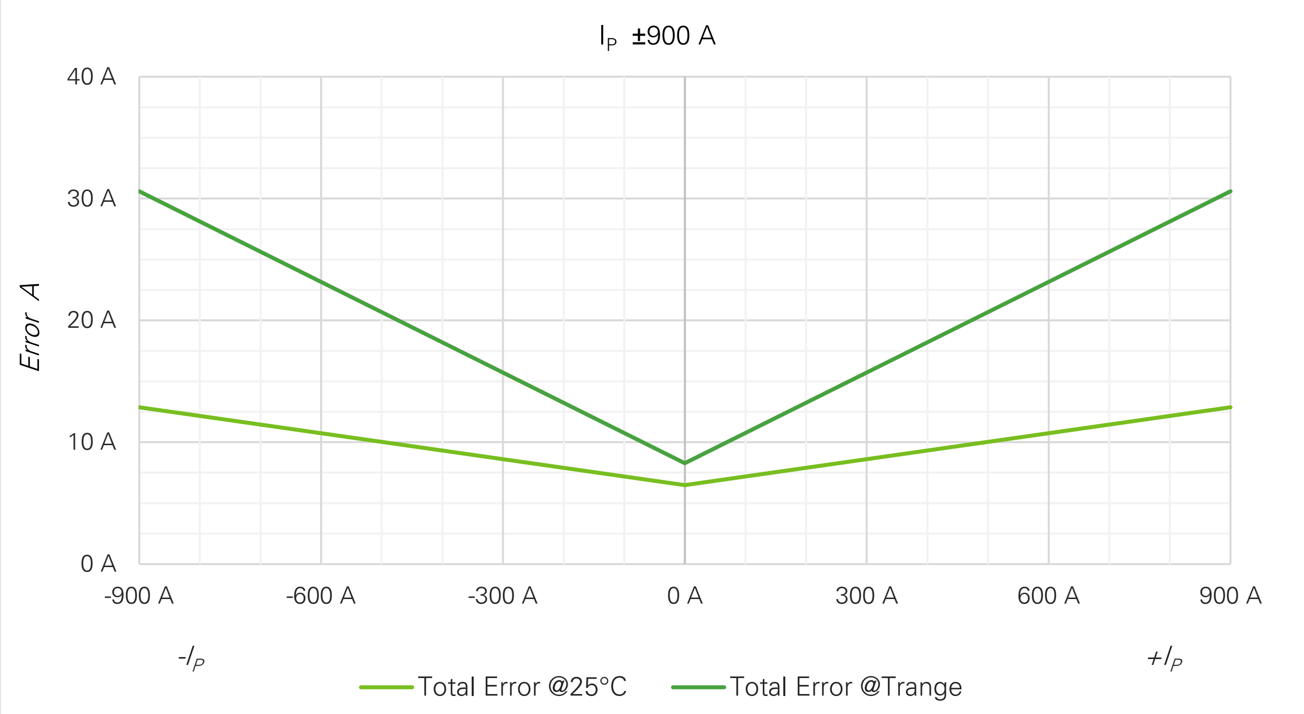
## Primary Current Range - Channel 2-High Range (Standard): up to ±900 A

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 ±900A | $S$ | | 2.22 | | mV/A | $U_C$ = 5V |
| Linearity Error | $\varepsilon_L$ | | ±0.5 | | %FS | $U_C$ = 5V, over temp. |
| Offset Error | $\varepsilon_O$ | ±0.9 | | ±0.9 | %FS | $U_C$ = 5V, over temp. |
| Sensitivity Error | $\varepsilon_S$ | | ±1.2 | | %FS | $U_C$ = 5V, over temp. |



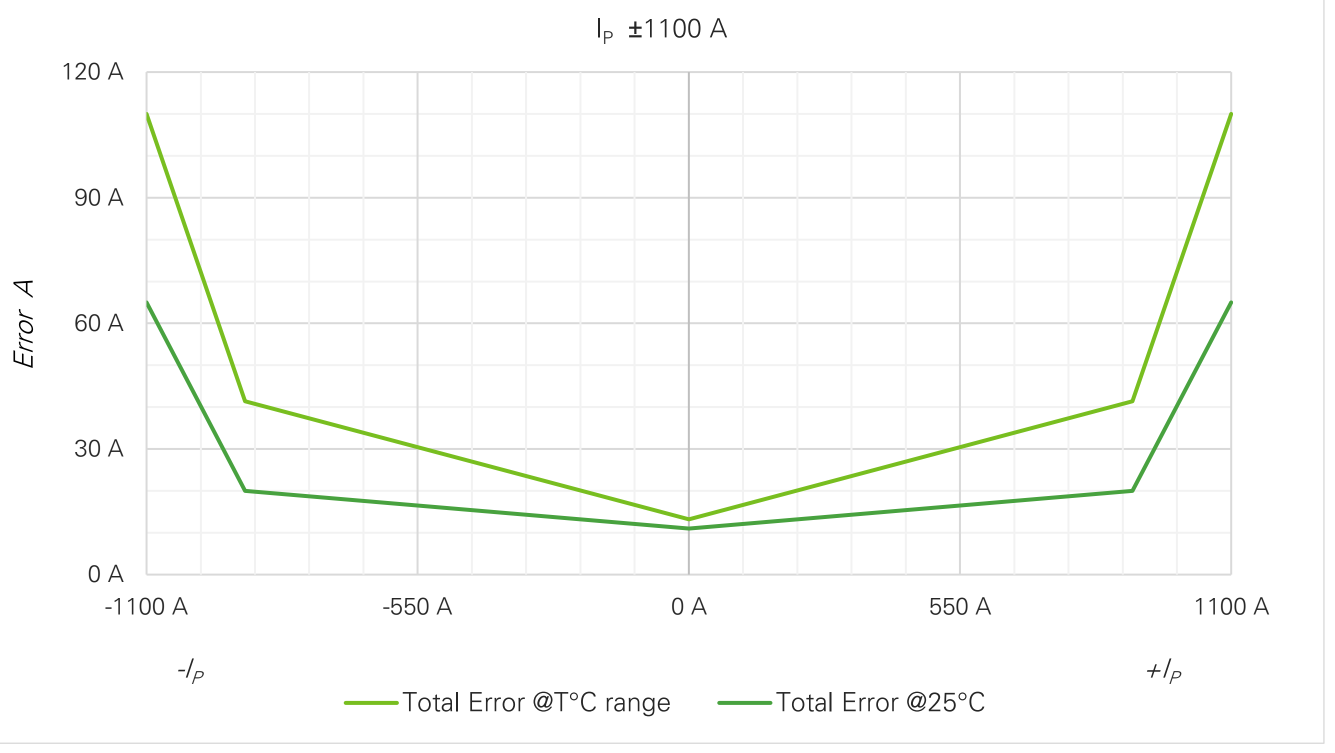

| Primary Current | Total Error @25°C | | Total Error @T°C range | |
|---|---|---|---|---|
| A | % | A | % | A |
| - $I_p$ (-900 A) | ±1.7% | ±12.9 A | ±3.4% | ±30.6 A |
| 0 | ±0.7% | ±6.48 A | ±0.9% | ±8.28 A |
| + $I_p$ (+900 A) | ±1.7% | ±12.9 A | ±3.4% | ±30.6 A |

# Current Sensor
CH1S01xB

## 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 ±1100A | $S$ | | 1.82 | | mV/A | $U_C$ = 5V |
| Linearity Error | $\varepsilon_L$ | | ±0.5 | | %FS | $U_C$ = 5V, over temp. |
| Offset Error | $\varepsilon_O$ | ±1.2 | | ±1.2 | %FS | $U_C$ = 5V, over temp. |
| Sensitivity Error | $\varepsilon_S$ | | ±1.2 | | %FS | $U_C$ = 5V, over temp. |




| Primary Current | Total Error @25°C | | Total Error @Trange | |
|---|---|---|---|---|
| A | % | A | % | A |
| - $I_p$ (-1100 A) | ±5.9% | ±65.0 A | ±10% | ±110 A |
| 0 | ±1.0% | ±11.0 A | ±1.2% | ±13.2 A |
| + $I_p$ (+1100 A) | ±5.9% | ±65.0 A | ±10% | ±110 A |

# Current Sensor
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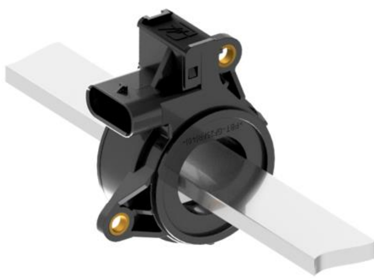
## Recommendations for Use

### Setup Recommendation

**Mounting:**



- M4 screw mounted with flat/spring washer or serrated flanged screw is recommended.
- Assembly torque: 1.5 N·m ± 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.

# Current Sensor
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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<br>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<br>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/<br>USCAR25 | |
| Locked connector disengagement force test | GMW3191:2012 §4.2.18 | |
| Unlocked connector disengagement force test | GMW3191:2012 §4.2.19 | |

# Current Sensor
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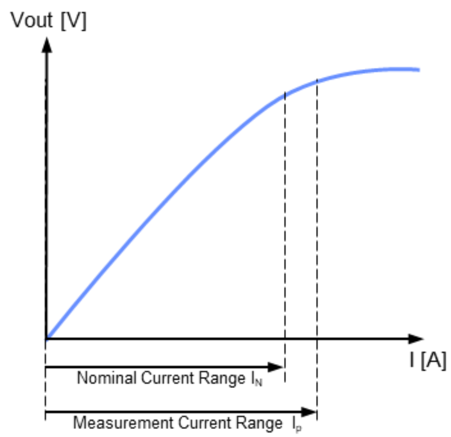
## Performance Parameter Definitions

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

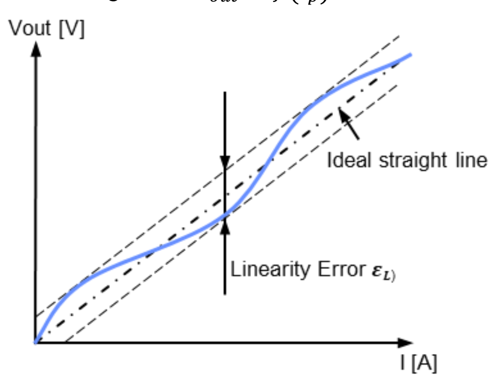
$$V_{out} = (U_C/5) \times (V_O + I_p \times S)$$

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




### Linearity error ($\varepsilon_L$)

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 ($\varepsilon_O$)

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.

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

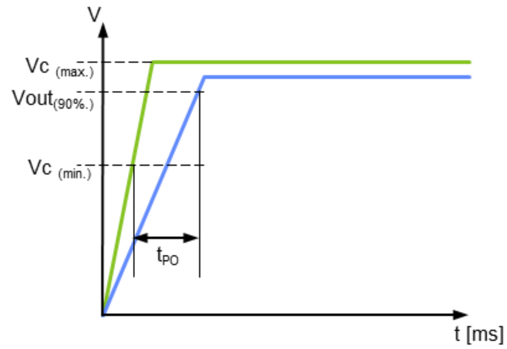
### Sensitivity error ($\varepsilon_S$)

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

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

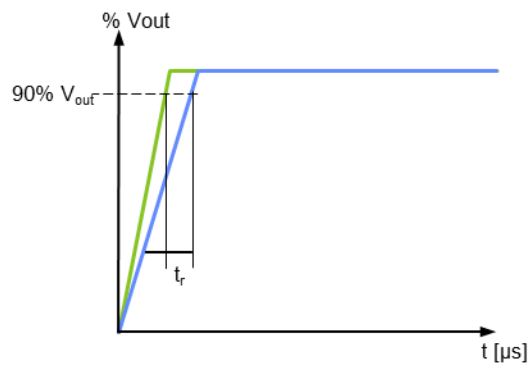
### Power-on time ($t_{po}$)

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).

# Current Sensor
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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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