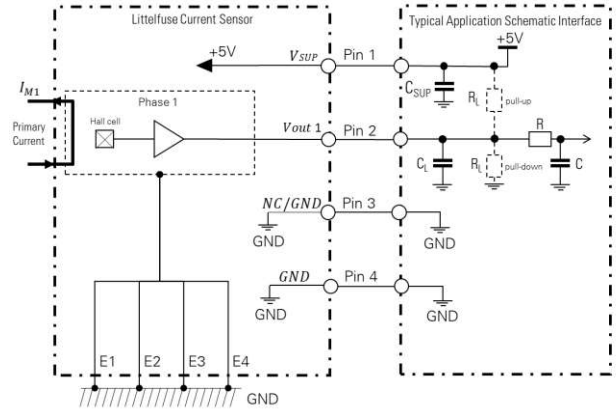
# Current Sensor
## CH1P01xM

## Description

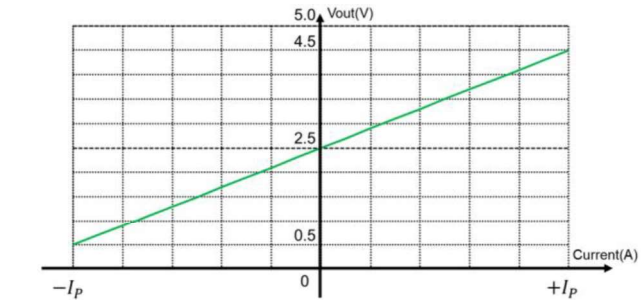
Littelfuse CH1P01xM current sensor is an open-loop Hall Effect device which provides a ratiometric output signal proportional to the magnetic flux density generated by a C-core concentrator. The sensor is offered in three configurations: full isolation sleeve, partial isolation sleeve and without isolation sleeve.

## Typical Application Diagram




For optimal ESD performance it is recommended to connect PIN 3 to GND.

## Output Characteristics




## Features

- Open-loop Hall effect
- Current measurement: up to ±900A
- +5V DC unipolar power supply
- Operating temp. range: -40°C ... +125°C
- Busbar isolated measurement
- ASIL-QM

## Applications

- Motor Inverter
- Starter Generators
- DC/DC Converter
- AC/DC Converter

## Benefits

- High sensing accuracy
- Low thermal offset drift
- Low thermal sensitivity drift
- Non-intrusive solution
- Compact design for PCB mounting

## Mechanical Characteristics

- Housing Material: PPA-GF33 UL94-V0
- Sensor pins: Sn plating
- Mass pins: Sn plating
- Mass: 34g

## Soldering Methods

- Manual / Robot Iron Soldering
- Selective Soldering
- Wave Soldering

Littelfuse
Expertise Applied | Answers Delivered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# Current Sensor
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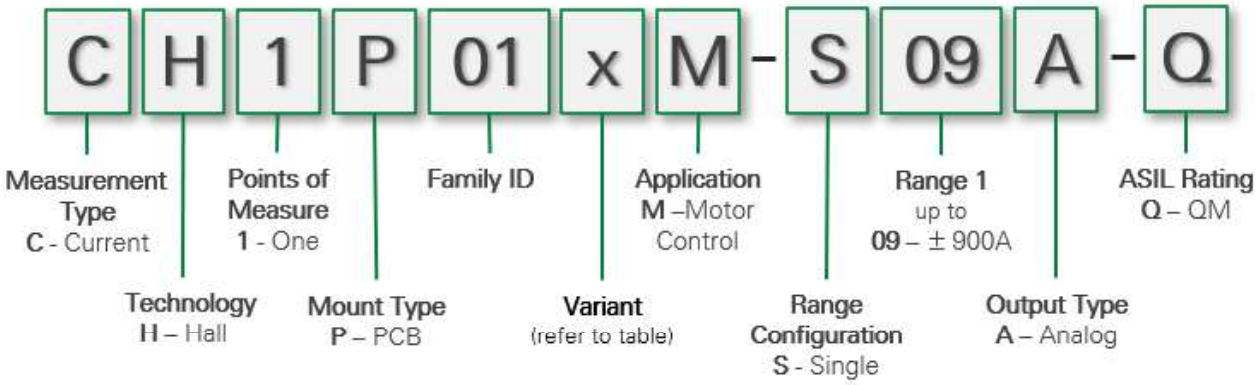
## Littelfuse Current Sensor Naming Convention




## Product Name by configuration

| Part Name | Config | Ref. Image |
|---|---|---|
| CH1P012M | No Sleeve |  |
| CH1P013M | Partial Sleeve |  |
| CH1P014M | Full Sleeve |  |

## Current Range Definition

Littelfuse offers customized calibration ranges.

## Naming Examples:

| Type Name | Current Range Out |
|---|---|
| CH1P01xM-**S04A-Q** | **±400 A** |
| CH1P01xM-**S05A-Q** | **±500 A** |
| CH1P01xM-**S06A-Q** | **±600 A** |
| CH1P01xM-**S07A-Q** | **±700 A** |
| CH1P01xM-**S08A-Q** | **±800 A** |
| CH1P01xM-**S09A-Q** | **±900 A** |

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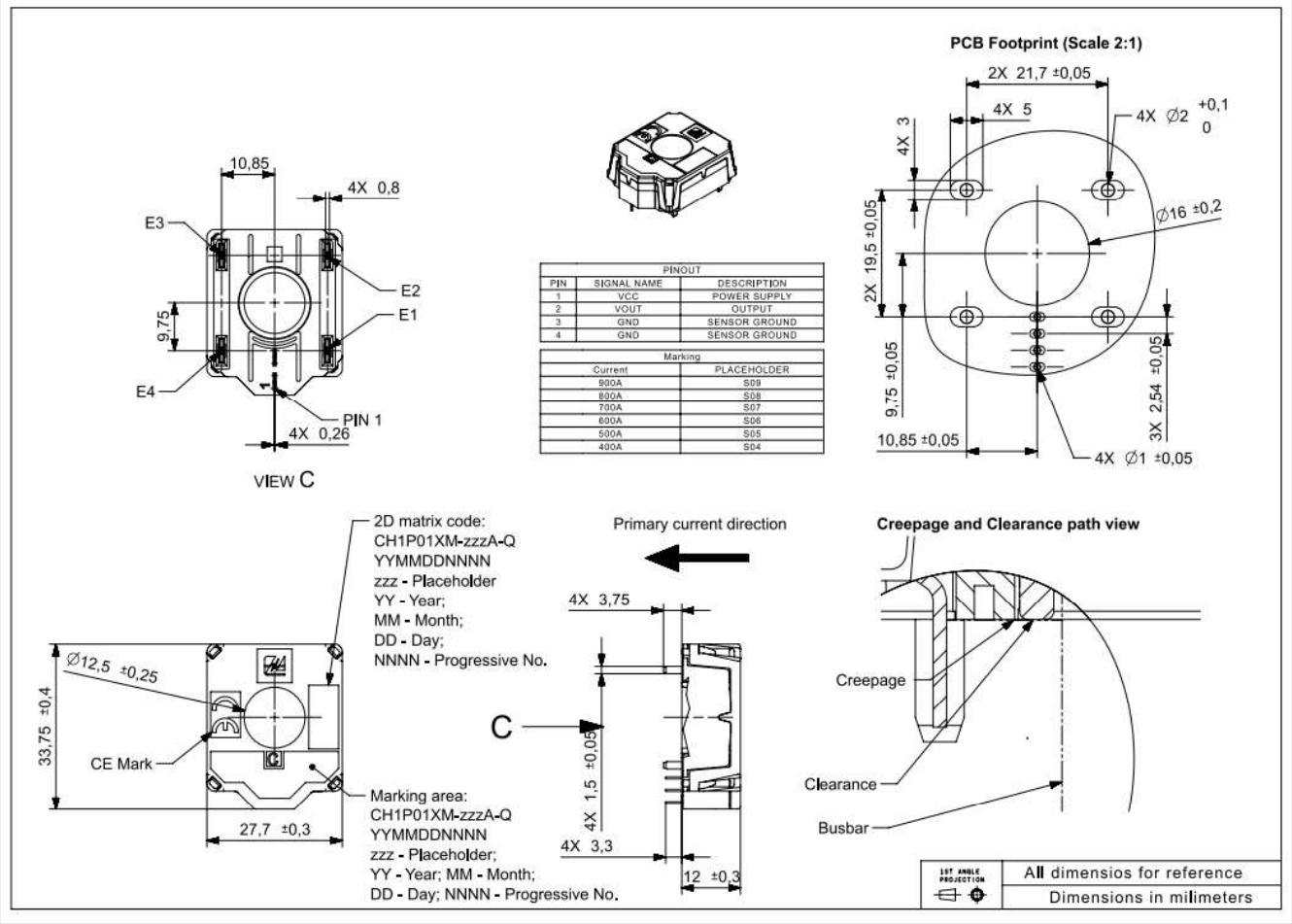
## Current Sensor Dimensions (in mm)

### CH1P012M – No Sleeve







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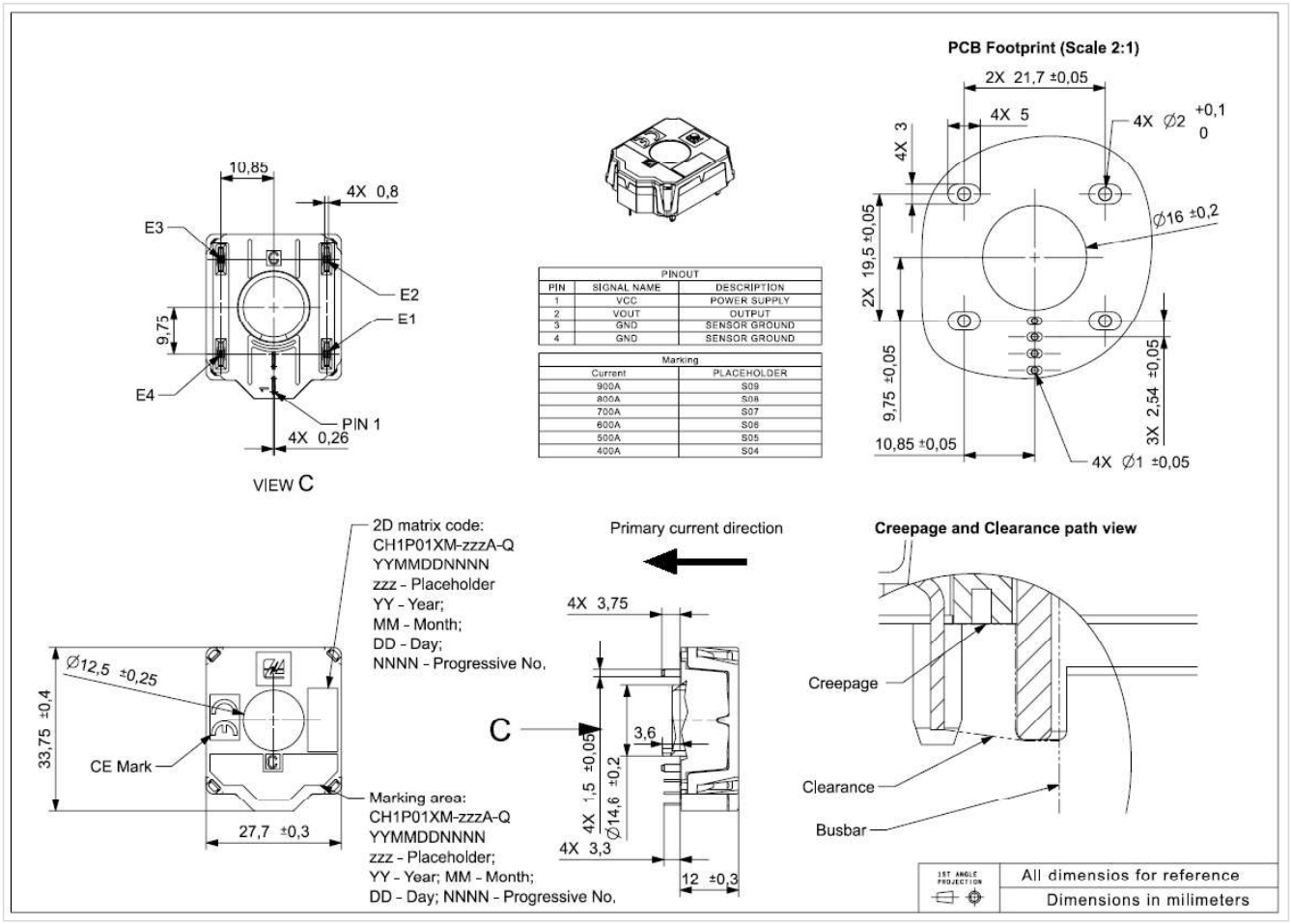
## Current Sensor Dimensions (in mm)

### CH1P013M – Partial Sleeve







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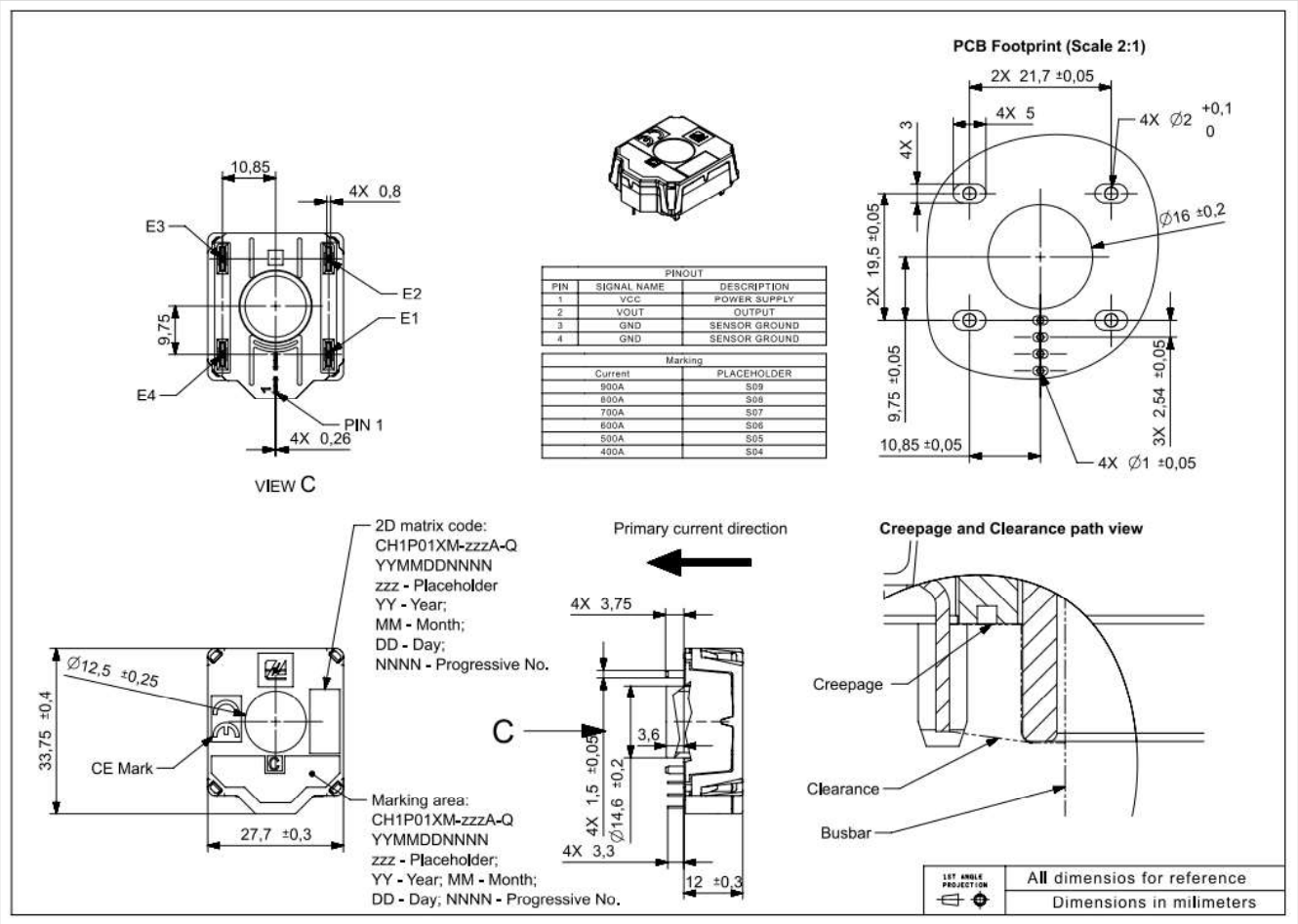
## Current Sensor Dimensions (in mm)

### CH1P014M – Full Sleeve







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# Current Sensor
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## Absolute Maximum Ratings (non-operating)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Comments |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{max}$ | -0.1 | | 6 | V | |
| Output Current | $I_{out}$ | | | 10 | mA | |
| Storage Temperature | $T_{ST}$ | -40 | | +125 | °C | |
| Insulation Resistance | $R_{INS}$ | 500 | | | MΩ | 500V DC, 60s |
| Current leakage due to dielectric voltage | $I_{LEAK}$ | | | 1 | mA | 2.5kV AC, 50Hz, 1min |
| Comparative tracking index | $CTI$ | PLC0 (600V) | | | | UL746A (IEC 60112) |

## Creepage / Clearance (per part version)

| Part Name | Parameter | Symbol | Min. | Typ. | Max. | Units | Comments |
|---|---|---|---|---|---|---|---|
| CH1P012M<br>No sleeve | Creepage | $D_{CREE}$ | | 3.06 | | mm | PIN 4 to sleeve inner wall |
| | Clearance | $D_{CLEA}$ | | 3.06 | | mm | PIN 4 to sleeve inner wall |
| CH1P013M<br>Partial sleeve | Creepage | $D_{CREE}$ | | 6.67 | | mm | PIN 4 to sleeve inner wall |
| | Clearance | $D_{CLEA}$ | | 3.06 | | mm | PIN 4 to sleeve inner wall |
| CH1P014M<br>Full sleeve | Creepage | $D_{CREE}$ | | 6.67 | | mm | PIN 4 to sleeve inner wall |
| | Clearance | $D_{CLEA}$ | | 3.06 | | mm | PIN 4 to sleeve inner wall |

Creepage and Clearance given as worst case. Note: Nearest signal pin is PIN 2 (VOUT).

## Mechanical Product Properties

| Parameter | Symbol | Level | Standard | Comments |
|---|---|---|---|---|
| Flammability Class | | V0 | UL94 | |

# Current Sensor
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## Common Characteristics in Normal Range

| Parameter | Symbol | Min. | Typ. | Max. | Units | Comments |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_c$ | 4.75 | 5 | 5.25 | V | |
| Current Consumption | $I_c$ | | 13 | 15 | mA | |
| Operating Ambient Temperature | $T_A$ | -40 | | +125[1] | °C | |
| Output Offset Voltage | $V_o$ | | 2.5 | | V | $I_P$ = 0A |
| Clamping Voltage Lower | $V_{CL}$ | | 0.3 | | V | |
| Clamping Voltage Upper | $V_{CU}$ | | 4.7 | | V | |
| Supply Capacitance | $C_{SUP}$ | 47 | 100 | | nF | supply capacitor needs to be located near supply pins |
| Load Capacitance | $C_L$ | | 2.2 | 5 | nF | higher capacitance has influence to bandwidth |
| Load Resistance | $R_L$ | 10 | 25 | 200 | kΩ | $R_L$ for pull-down or pull-up |
| Power-on Time | $t_{po}$ | | | 1 | ms | |
| Response Time | $t_r$ | | | 6 | us | |
| Frequency Bandwidth | $BW$ | 40 | | | kHz | @-3dB |
| Phase Shift | $\Delta\varphi$ | -4 | | 0 | ° | @DC to 1kHz |

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

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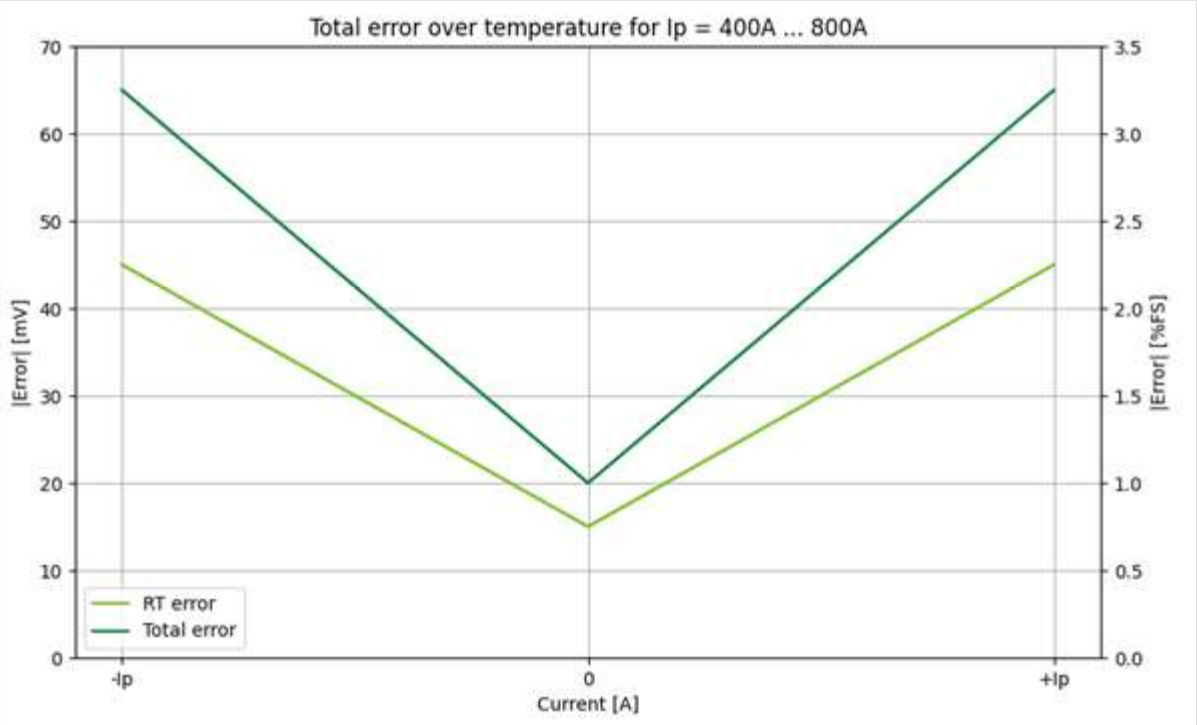
## Primary Current Range and Sensitivity

| Part Name | Primary Current ($Ip$) | Sensitivity ($Sth$) |
|---|---|---|
| CH1P01xM-S04A-Q | ±400 A | 5.00 mV/A |
| CH1P01xM-S05A-Q | ±500 A | 4.00 mV/A |
| CH1P01xM-S06A-Q | ±600 A | 3.33 mV/A |
| CH1P01xM-S07A-Q | ±700 A | 2.86 mV/A |
| CH1P01xM-S08A-Q | ±800 A | 2.50 mV/A |
| CH1P01xM-S09A-Q | ±900 A | 2.22 mV/A |

## Total Error Over Temperature (±400A to ±800A)




| Primary Current $\pm I_P$ | Total Error @25°C | | Total Error @Trange | |
|---|---|---|---|---|
| (A) | (mV) | (%) | (mV) | (%) |
| +IP | ±45 | 2.25% | ±65 | 3.25% |
| 0 | ±15 | 0.75% | ±20 | 1.00% |
| -Ip | ±45 | 2.25% | ±65 | 3.25% |

# Current Sensor
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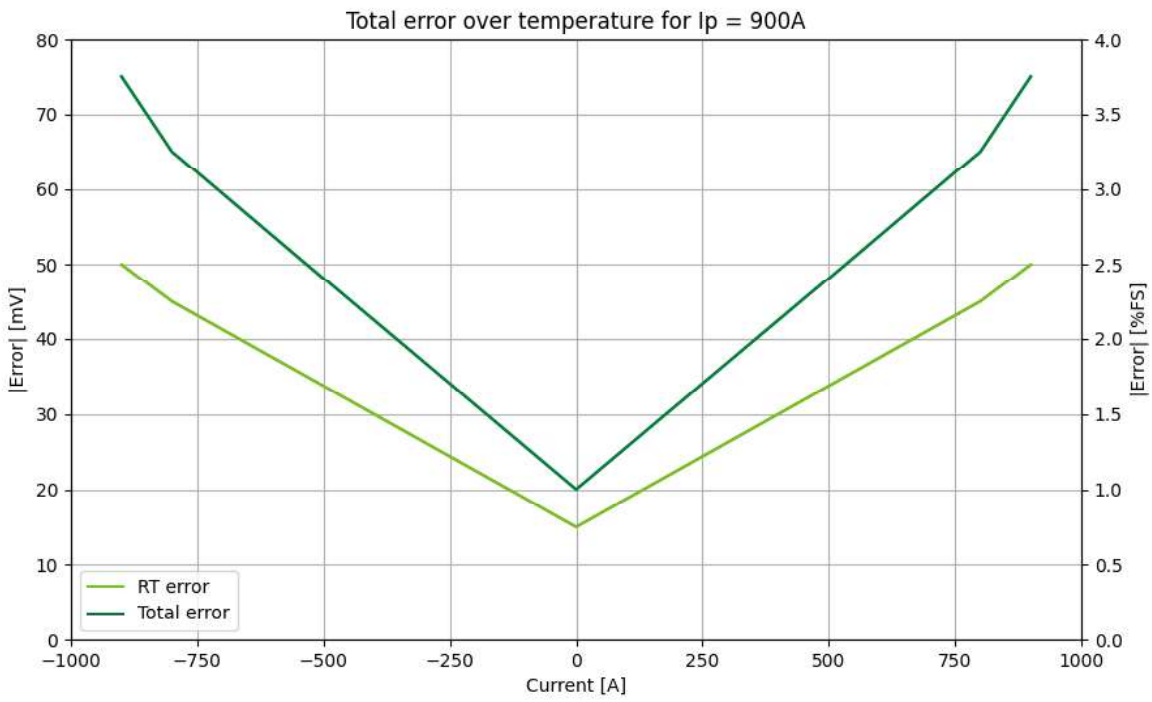
## Total Error Over Temperature (±900A)




| Primary Current $\pm I_P$ | Total Error @25°C | | Total Error @Trange | |
|---|---|---|---|---|
| **(A)** | (mV) | (%) | (mV) | (%) |
| **+900** | ±50 | 2.50% | ±75 | 3.75% |
| **+800** | ±45 | 2.25% | ±65 | 3.25% |
| **0** | ±15 | 0.75% | ±20 | 1.00% |
| **-800** | ±45 | 2.25% | ±65 | 3.25% |
| **-900** | ±50 | 2.50% | ±75 | 3.75% |

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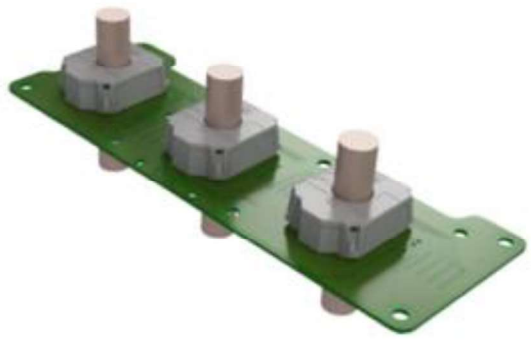
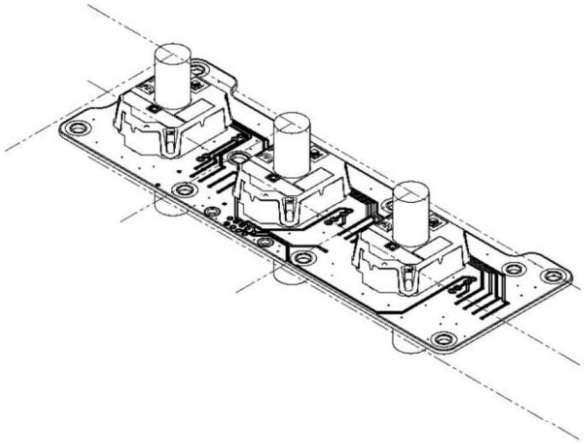
## Recommendations for use

### PCBA Mounting



- Recommended PCB thickness to be 1.6mm.
- PCB mounting: see soldering recommendation.
- Mounting footprint: see drawing views

### Adjacent Cable / Busbar Routing



- Minimum distance between busbars is recommended to be more than 55mm @ 900A.
- Recommended to have busbars straight and parallel through sensor aperture (+/- 30mm).
- No busbar should pass directly above or below current sensor.
- Busbar (or wiring) layout is recommended to be reviewed with Littelfuse.

## Soldering Recommendations

Soldering to be performed according to IPC J-STD-001 standard.
To comply with IPC A-610, the following soldering methods are recommended.

### Manual – Soldering Iron

- Electrical pin connection (Pin 1 … 4): 40W/380°C iron temperature, tip: 0.8mm tapered.
- Mass pins (E1 to E4): 200W/370°C iron temperature, tip: 7mm flat.

### Selective soldering

- Use of gaussian solder nozzles is recommended.

### Robotic Soldering Iron

- Possible process parameter evaluated with equipment supplier.

### Wave soldering for THD type

- Possible process parameter evaluated with equipment supplier.

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## Validation Test Specification

| Reference | Test condition |
|---|---|
| **Environmental** | |
| Thermal cycles | IEC60068-2-14 test Nb (2009)<br>1000 cycles, -40°C / 125°C / 10°C/min |
| Thermal shock | IEC60068-2-14 test Na (2009)<br>1000h, -40°C / 125°C |
| High humidity | IEC60068-2-78 (2001)<br>1000h, 85°C/85%HR |
| High temperature storage | IEC60068-2-2 (2007)<br>1000h, 125°C |
| Low temperature storage | IEC60068-2-1 (2007)<br>1000h, -50°C |
| **Mechanical** | |
| Mechanical Shock | IEC 60068-2-27 test Ea (2008)<br>500m/s^2, 10 x 3 axis |
| Random Vibration | IEC 60068-2-64 test Fh (2008)<br>10-2khz; ~9.7G |
| **Electrical** | |
| Output noise test | Littelfuse validation test procedure |
| di/dt test | Littelfuse validation test procedure<br>100A/µs, current peak 700A |
| dv/dt test | Littelfuse validation test procedure<br>2kV/µs to 2kV |
| Insulation resistance test | ISO16750-2 (2012) – Insulation resistance<br>500V DC/1 min |
| Withstand voltage | ISO16750-2 (2012) – Withstand voltage<br>Dielectric voltage (2.5kV AC, 50Hz, 1min) |
| **EMC-ESD** | |
| EMC01 - Radiated Emissions (ALSE) | IEC CISPR25 |
| EMC02 - Radiated Immunity: Bulk current injection (BCI) | GWM3097 3.4.1 (2015)<br>ISO 11452-1 & -4 |
| EMC03 - Radiated Immunity: Anechoic chamber | GWM3097 3.4.2 (2015)<br>ISO 11452-1 & -2 |
| ESD Handling Test | GMW3097 3.6.3 (2019)<br>ISO 10605 (2001) |
| **Other** | |
| Whisker testing | JESD22A121/JESD201A |
| Phase shift test | Littelfuse validation test procedure |




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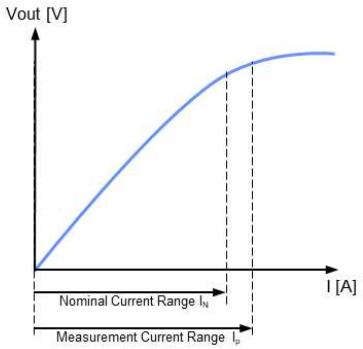
## Performance Parameter Definitions

### Output Voltage ($V_{OUT}$)

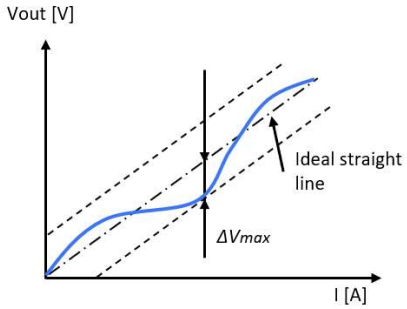
$$V_{out} = (V_{CC}/5) \times (2.5 + I_p \times S)$$

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




### Linearity error ($\varepsilon_L$)

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




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

*$V_{FS}$: full scope output voltage*

### 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 ($\varepsilon_S$)

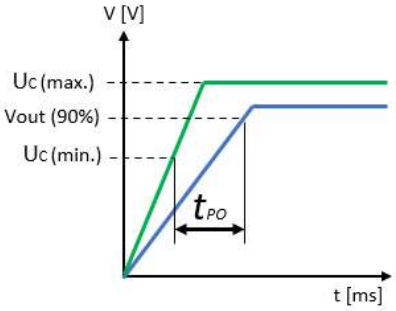
The sensor sensitivity error is the drift of sensor's ideal sensitivity.

$$\varepsilon_S = \pm \frac{S - S_{th}}{S_{th}} \times 100\%$$

*$S_{th}$: theory sensitivity*

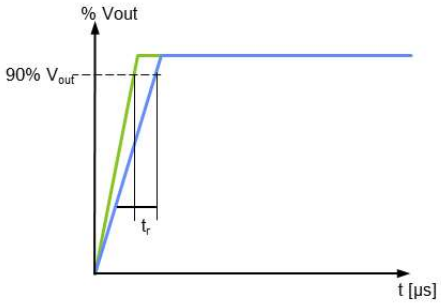
### Power-on time ($t_{po}$)

The Power-on time is the duration from Uc (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
Sales Support: ALL_Autosensors_Sales@littelfuse.com
Technical Support: ALL_Autosensors_Tech@littelfuse.com



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