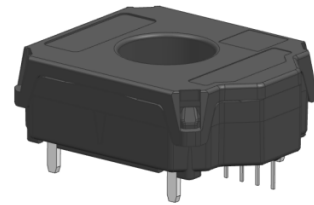


The MCCWxxx-T series of current sensors provide faster and more cost-effective solutions for AC and DC current detection in industrial and automotive applications. It also provides effective isolation between the primary and secondary edges. The same enclosure can provide a variety of current measurements from  $\pm 400\text{A}$  to  $\pm 900\text{A}$ .

## Dominant characteristics:

- Open loop current sensor based on HALL induction principle
- Single power supply 5V
- Analog signal output
- With  $V_{REF}$  Input and output function
- The measuring current range of the original side can be from  $\pm 400\text{A}$ - $\pm 900\text{A}$
- Sensor operating temperature range:  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Output voltage:
  - TR: zero current bias  $V_{QVO} = V_{CC} / 2$
  - TF: Zero current bias  $V_{QVO} = 2.5\text{ V}$
- Good accuracy, linearity and temperature drift



## Product application:

- EV/HEV motor controller
- Inverter, inverter control
- Power supply and DC-DC converter control

## Working principle:

The open-loop current sensor uses ampoule's law (the magnetic field generated around a energized straight wire is proportional to the current in the wire), and uses the characteristics of hall device to detect the magnitude of the magnetic field intensity  $B$  generated by the current on the original side, so as to detect the current in the wire. In the linear interval of hysteresis, the proportional relation between  $B$  and  $I$  is:

$$B(I_P) = K * I_P \quad (K \text{ is a constant})$$

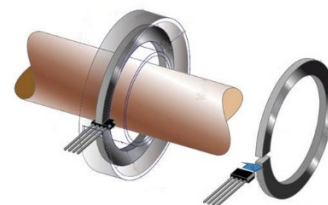
Hall voltage can be expressed as:

$$V_H = (R_H/d) * I * K * I_P$$

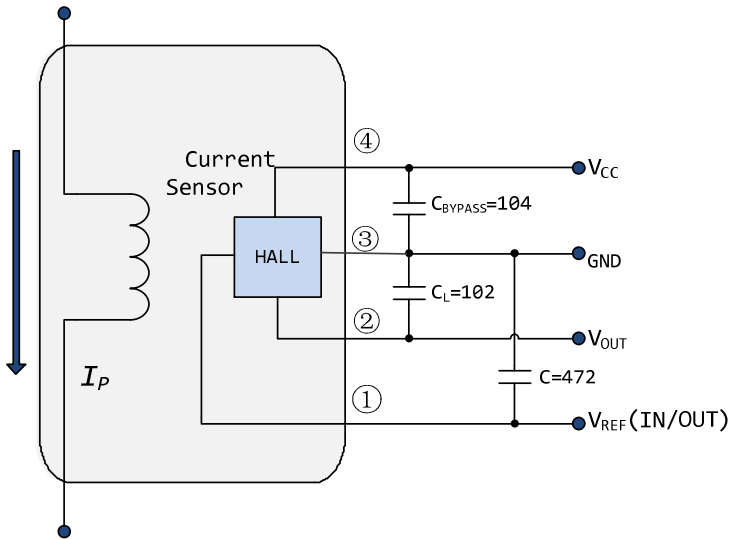
In addition to the  $I_P$  is the change, and the rest are constants, thus:

$$V_H = K_1 * I_P \quad (K_1 \text{ is a constant})$$

Specific hall chips are amplified by  $V_H$ , So you get the voltage and you get the original current.



## Recommended circuit



*\*C<sub>BYPASS</sub> The capacitance needs to be placed close to the VCC sensor*

## Order information:

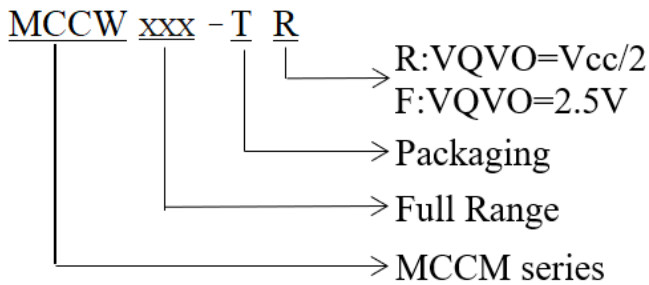
| Model      | V <sub>Qvo</sub>    | Original edge current range<br>I <sub>P</sub> (A) | Sensitivity Sens<br>(Typ.) (mV/A) | MPQ   | MOQ   |
|------------|---------------------|---|-----------------------------------|-------|-------|
|            |                     |   |                                   | (PCS) | (PCS) |
| MCCW400-TR | V <sub>CC</sub> / 2 | + 400   | 5                                 | 500   | 500   |
| MCCW400-TR | 2.50                | + 400   | 5                                 | 500   | 500   |
| MCCW500-TR | V <sub>CC</sub> / 2 | + 500   | 4                                 | 500   | 500   |
| MCCW500-TF | 2.50                | + 500   | 4                                 | 500   | 500   |
| MCCW600-TR | V <sub>CC</sub> / 2 | + 600   | 3.33                              | 500   | 500   |
| MCCW600-TF | 2.50                | + 600   | 3.33                              | 500   | 500   |
| MCCW700-TR | V <sub>CC</sub> / 2 | + 700   | 2.86                              | 500   | 500   |
| MCCW700-TF | 2.50                | + 700   | 2.86                              | 500   | 500   |
| MCCW800-TR | V <sub>CC</sub> / 2 | + 800   | 2.5                               | 500   | 500   |
| MCCW800-TF | 2.50                | + 800   | 2.5                               | 500   | 500   |
| MCCW900-TR | V <sub>CC</sub> / 2 | + 900   | 2.22                              | 500   | 500   |
| MCCW900-TF | 2.50                | + 900   | 2.22                              | 500   | 500   |

*\* For currents outside the standard current specifications, please contact the factory*



# MCCWxxx-Tx Series Current Sensor Specifications

## Naming rules



## Maximum rated parameter

| Characteristic                    | Symbol           | Rating                        | Unit |
|-----------------------------------|------------------|-------------------------------|------|
| Supply voltage                    | V <sub>CC</sub>  | 0.3 to 6.5                    | V    |
| Supply current                    | I <sub>CC</sub>  | 18                            | mA   |
| Output voltage                    | V <sub>OUT</sub> | 0.15 to V <sub>CC</sub> -0.15 | V    |
| Output current                    | I <sub>OUT</sub> | + 40                          | mA   |
| Working temperature               | T <sub>A</sub>   | -40 to 125                    | °C   |
| T <sub>jm</sub>                   | T <sub>J</sub>   | 165                           | °C   |
| Storage temperature               | T <sub>S</sub>   | -55 to 165                    | °C   |
| Creepage distance                 | d <sub>CP</sub>  | 3.5                           | mm   |
| Isolation voltage(50Hz, 1min, AC) | U <sub>d</sub>   | 2.5                           | KV   |

## General Electric parameters

V<sub>CC</sub> = 5.0V dc operating parameters (unless otherwise specified), T<sub>A</sub> Within the specified temperature range.

| Parameter                 | Symbol                             | Condition   | Min                     | Typ. | Max                  | Unit |   |
|---------------------------|------------------------------------|---|-------------------------|------|----------------------|------|---|
| Supply voltage            | V <sub>CC</sub>                    |   | 4.5                     | 5    | 5.5                  | V    |   |
| Supply current            | I <sub>CC</sub>                    | R <sub>L</sub> ≥ 10KΩ   |                         | 13   | 18                   | mA   |   |
| Power on delay            | T <sub>PO</sub>                    | T <sub>A</sub> =25°C  |                         | 80   |                      | μs   |   |
| QVO follow-up error (-TR) | E <sub>r</sub>                     |   | 0.3                     |      | 0.3                  | %    |   |
| Zero current output       | V <sub>QVO</sub>                   | HSCW <sub>xxx</sub> -TR   | T <sub>A</sub> = 25 ° C |      | V <sub>CC</sub> / 2, |      | V |
|                           |                                    | HSCW <sub>xxx</sub> -TF   |                         |      |                      |      |   |
| Output voltage range @IP  | V <sub>OUT</sub> -V <sub>QVO</sub> | T <sub>A</sub> = 25°C, I <sub>p</sub> =I <sub>pMAX</sub>  | ±2                      |      |                      |      |   |
| Load resistance           | R <sub>L</sub>                     | V <sub>OUT</sub> to V <sub>CC</sub> or GND  | 2                       |      |                      | KΩ   |   |
| Load capacitance          | C <sub>L</sub>                     | V <sub>OUT</sub> TO GND   | 6                       |      | 100                  | nF   |   |
| Response time             | t <sub>RESPONSE</sub>              | T <sub>A</sub> =25°C, C <sub>L</sub> =1nF, I <sub>p</sub> step=50% of I <sub>p+</sub> , 90% input to 90% output |                         | 3    |                      | μs   |   |
| Bandwidth                 | BW                                 | Small signal -3dB, C <sub>L</sub> =1nF, T <sub>A</sub> =25°C  | 120                     | 170  |                      | KHz  |   |
| Output impedance          | R <sub>OUT</sub>                   | T <sub>A</sub> = 25°C   | -                       | 3    | -                    | Ω    |   |



## MCCWxxx-Tx Series Current Sensor Specifications

### The performance parameters

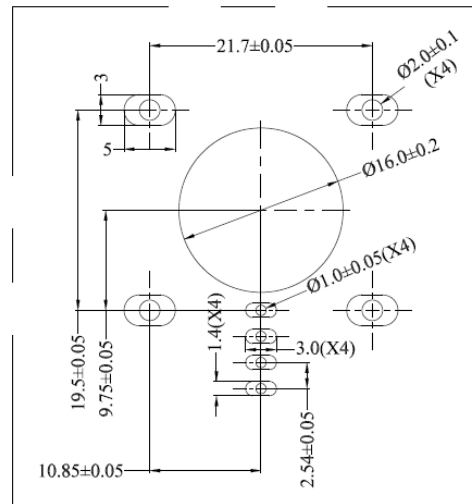
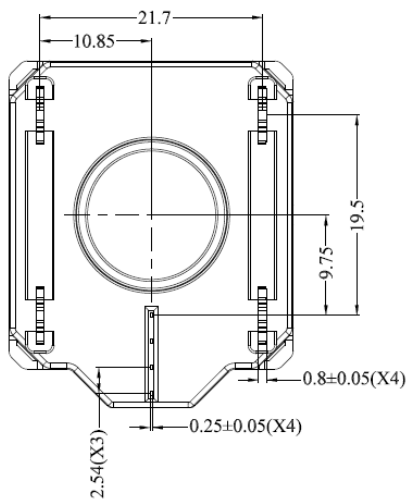
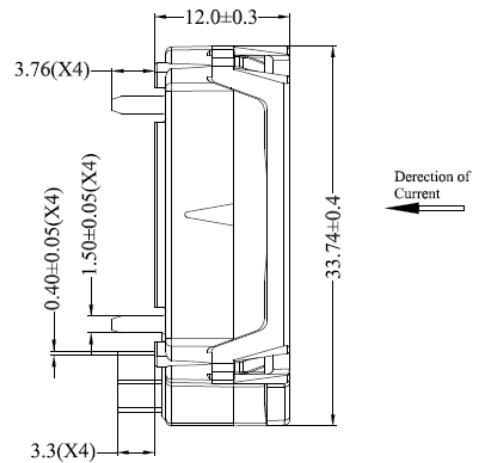
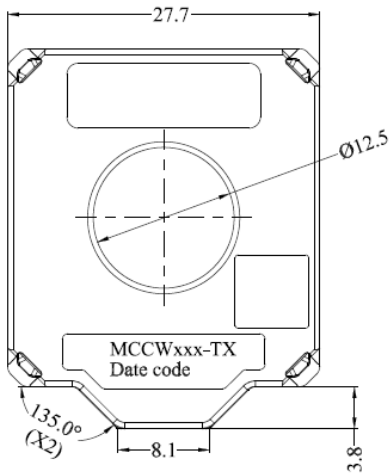
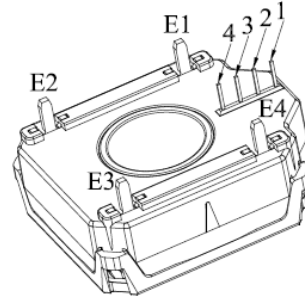
$V_{CC}$  = DC operating parameters at 5V (unless otherwise specified),  $T_A$  Within the specified temperature range.

| Parameter                          | Symbol       | Condition   | Min                | Typ.     | Max                | Unit |
|------------------------------------|--------------|---|--------------------|----------|--------------------|------|
| <b>Nominal parameter</b>           |              |   |                    |          |                    |      |
| Original current measurement range | $I_P$        |   | -900               |          | 900                | A    |
| Calibration of current             | $I_{CAL}$    | @ $T_A=25^\circ\text{C}$  | -450               |          | 450                |      |
| Sensor sensitivity                 | $Sen_{STA}$  |   | 2.22 <sup>1)</sup> |          | 5.00 <sup>1)</sup> | mV/A |
| <b>Accuracy parameters</b>         |              |   |                    |          |                    |      |
| Sensitivity error                  | $E_{Sens}$   | @ $T_A=25^\circ\text{C}; V_{CC}=5\text{V}$                      | -1                 |          | 1                  | %    |
| Zero offset voltage                | $I_{OE}$     | $I_P=0\text{A}, T_A=25^\circ\text{C}$                           | -5                 | $\pm 4$  | 5                  | mV   |
| Zero offset voltage                | $I_{OM}$     | $I_P=0\text{A}, T_A=25^\circ\text{C}$ , after excursion of 900A |                    | 3        | 5                  | mV   |
| Zero offset voltage                | $V_{OFFSET}$ | $T_A=25^\circ\text{C}$  |                    | $\pm 10$ |                    | mV   |
| Linearity error                    | $Lin_{ERR}$  | Of full rang  | -1                 | 0.5      | 1                  | %    |

1) Please refer to the order information for the sensitivity of 400A~900A

## 1. OUTLINE DIMENSIONS

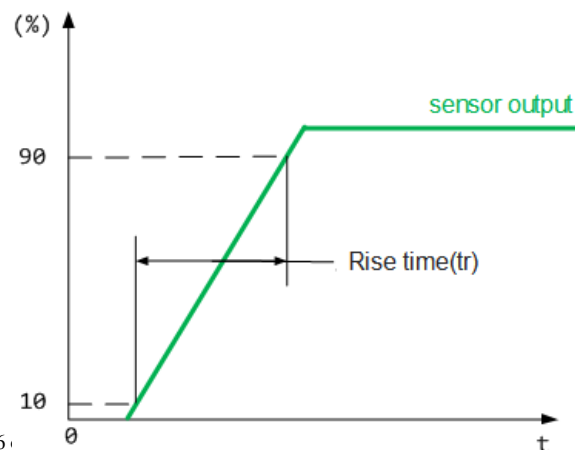
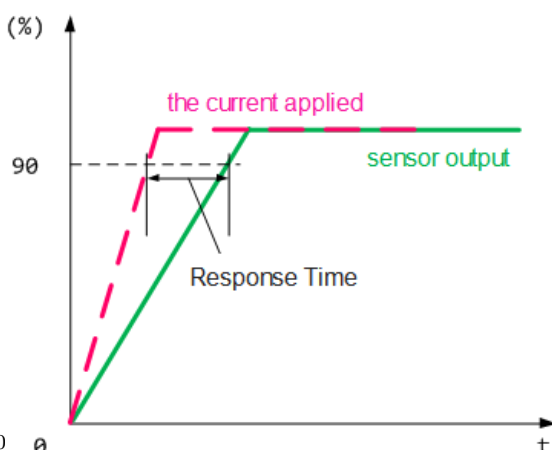
| Terminals | Definitions |
|-----------|-------------|
| 1         | Vref        |
| 2         | Vout        |
| 3         | GND         |
| 4         | VCC         |
| E1-E4     | GND         |



PCB Design Schematic

## Definition of performance parameters

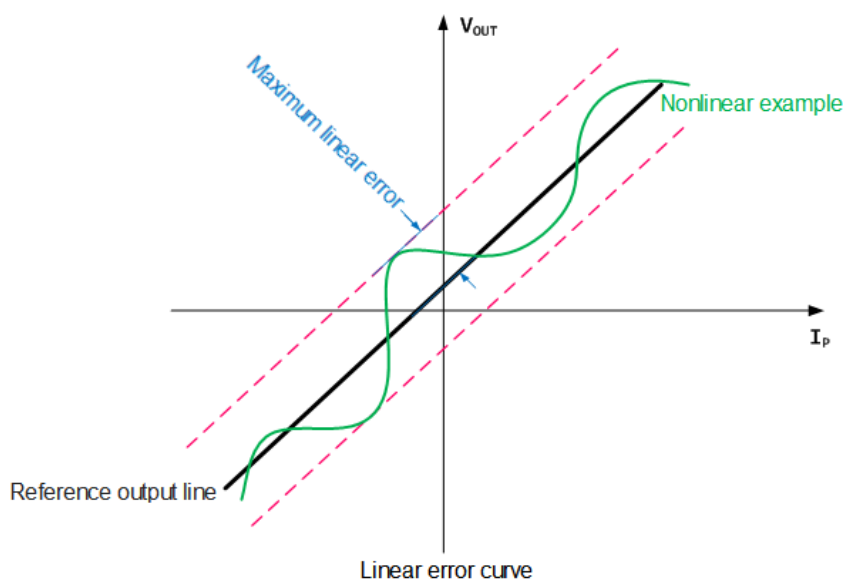
- Static output voltage (QVO) :** sensor output voltage  $V_{QVO}$  in the state of no obvious magnetic field  $B = 0G$ 
  - TR:  $V_{QVO}$  and the supply voltage  $V_{CC}$  has a constant ratio;  $V_{QVO} = V_{CC}/2$
  - TF:  $V_{QVO}$  doesn't follow the supply voltage  $V_{CC}$  within a certain range Change for change, as in  $V_{CC} = 4.5 \sim 5.5V$ ,  $V_{QVO} = 2.5V$
- Sensitivity Sens(Sensitivity):** Sens is the reference output straight line (-TR model:  $V_{OUT} = V_{CC}/2 + 2 \times I_P/I_{P\_MAX}$ -TF mode:  $V_{OUT} = 2.5 + 2 \times I_P/I_{P\_MAX}$ ), refers to the change of the output as the current changes, and it's relationship with the current is as follows:  $Sens = 2/I_{P\_MAX}$ .
- Offset with Temperature:** Due to tolerances, stresses and heat dissipation of internal components, zero Offset may occur at operating ambient Temperature.
- Sensitivity with temperature:** Due to the internal temperature compensation factor, the Sensitivity will change over the entire operating temperature compared to what is expected at room temperature.
- Electrical Offset Voltage:** The Hall component and the internal operational amplifier itself cause errors caused by the noise of amplification factor, which is called the Offset Voltage
- Magnetic Offset :** The current on the original side is Offset by the maximum value  $I_P$  at 0, due to the hysteresis of the magnetic core material of the sensor, the error generated at the output end is called zero magnetic imbalance voltage
- Offset voltage:** The offset voltage is the output voltage when the original edge current is zero. The ideal value is  $V_{QVO} = V_{CC}/2$  (Or 2.5V). As a result, the difference between  $V_{QVO}$  and the ideal value is called the total zero offset voltage error. This offset error can be attributed to the zero offset voltage (due to the QVO adjusted resolution within the ASIC), magnetic offset, temperature drift, and temperature induced hysteresis.
- Rise Time:** The Rise Time of the sensor refers to the Time interval between the output of the sensor and the corresponding value of the applied current when the applied current reaches 90% of the final value
- Rise time:** The rise time of the sensor refers to the time interval between 10% of the output of the sensor and the final 90%



- **QVO Ratiometricity Error:** When supply voltage  $V_{CC}$  goes from 5V to  $4.75 < V_{CC1} < 5.25V$ , the deviation between the sensor's zero point output and the theoretical value is defined as follows:

$$E_r = \frac{V_{QVO(V_{CC1})}}{V_{QVO(5V)} - V_{CC1}/5} \times 100\%$$

- **Linearity:** Contrast with the reference output line (-TR mode:  $V_{OUT} = V_{CC}/2 + 2 \times I_P/I_{P\_MAX}$ -TF mode:  $V_{OUT} = 2.5 + 2 \times I_P/I_{P\_MAX}$ ), the largest forward or reverse error



## Notes:

1. Faulty wiring may cause damage to the sensor. After the sensor is connected to the 5V power supply, the measured current passes through the direction of the sensor arrow, and the corresponding voltage value can be measured at the output end.
2. TR mode: zero output voltage  $V_{QVO}=V_{CC}/2$ , the gain is fixed at 2V, and the output curve is:  $V_{OUT} = V_{CC}/2 + 2 \times I_P/I_{P\_MAX}$ . A change in the supply voltage will cause a change in  $V_{OUT}$ . For example:  $V_{CC}$  range 4.75V to 5.25V-The output range of static output voltage  $V_{QVO}$  under the corresponding 0A is 2.375V~2.625V, and the range of full range output ( $V_{OUT(IP\_MAX)}$ ) is 4.375V~4.625V.
3. TF mode: zero output voltage  $V_{QVO}=2.5V$ , the gain is fixed at 2V, the output curve is:  $V_{OUT} = 2.5 + 2 \times I_P/I_{P\_MAX}$ ; The change of supply voltage in a certain range will not cause the change of  $V_{OUT}$ . For example:  $V_{CC}$  range 4.75V to 5.25V-The static output voltage  $V_{QVO}$  under the corresponding 0A is 2.5V; and the output of full range ( $V_{OUT(IP\_MAX)}$ ) is constant at 4.5V.