

# TMR7559-B

## Board Mount Precision Current Sensor

### Description

TMR7559-B is a close loop current sensor for accurate measurement of DC, AC, pulsed current and arbitrary waveform current with galvanic isolation between primary and secondary circuits.



### Features and Benefits

- High accuracy
- Excellent linearity
- Low temperature coefficient
- Fast response time
- Galvanic isolation
- RoHS & REACH compliant

### Applications

- Solar inverter
- Direct-current dynamo
- Uninterruptible power supplies (UPS)
- Switched mode power supplies (SMPS)
- Variable frequency drive (VFD)

### Selection Guide

Part Number	Primary Nominal Current	Primary Current Measuring Range
TMR7559-1000B	100 A	±300 A
TMR7559-1500B	150 A	±450 A
TMR7559-2000B	200 A	±500 A
TMR7559-2500B	250 A	±500 A

### Insulation and Environmental Characteristics

Parameters	Symbol	Typ.	Unit
Dielectric Strength	$V_D$	4	kV(50 Hz, 1 min)
Insulation Resistance	$R_{IS}$	1000	$M\Omega$
Creepage Distance	$d_{CP}$	22	mm
Clearance	$d_{CL}$	14.5	mm
Ambient Operating Temperature	$T_A$	-40 to +85	$^{\circ}C$
Ambient Storage Temperature	$T_{STG}$	-50 to +105	$^{\circ}C$
Mass	$m$	60	g

## Catalogue

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## 1. Specifications

$T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CC} = 5\text{ V}$ ,  $R_L = 10\text{ k}\Omega$ , unless otherwise noted

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	
General Electrical Data							
Primary Nominal Current	$I_{PN}$	TMR7559-1000B	-	100	-	A	
		TMR7559-1500B	-	150	-		
		TMR7559-2000B	-	200	-		
		TMR7559-2500B	-	250	-		
Primary Current Measuring Range	$I_{PM}$	TMR7559-1000B	-300	-	300	A	
		TMR7559-1500B	-450	-	450		
		TMR7559-2000B	-500	-	500		
		TMR7559-2500B	-500	-	500		
Sensitivity	S	$I_P = 0\text{ to } \pm I_{PN}$	TMR7559-1000B	-	6.25	-	mV/A
			TMR7559-1500B	-	4.167	-	
			TMR7559-2000B	-	3.125	-	
			TMR7559-2500B	-	2.7	-	
Supply Voltage	$V_{CC}$	$\pm 5\%$	-	5	-	V	
Reference Output Voltage	$V_{REF}$	-	2.485	2.5	2.515	V	
Offset Voltage	$V_{OFF}$	-	-	2.5	-	V	
Output Voltage	$V_{OUT}$	$I_P = 0\text{ to } \pm I_{PM}$	-	$V_{OFF} + S \times I_P$	-	V	
Current Consumption	$I_C$	$I_P = 0$	-	16	-	mA	
Static Performance Data							
Accuracy	$X_G$	$I_P = 0\text{ to } \pm I_{PN}$	-	$\pm 0.8$	-	% $I_{PN}$	
		$T_A = 85\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-	$\pm 1.4$	-		
Linearity Error	$\epsilon_L$	$I_P = 0\text{ to } \pm I_{PN}$	-	$\pm 0.15$	-	% $I_{PN}$	
Symmetry	$\epsilon_{SYM}$	$T_A = -40\text{ }^\circ\text{C to } +85\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	99	100	101	%	
Offset Error	$V_{OE}$	$T_A = +25\text{ }^\circ\text{C}$ , $I_P = 0$	-	-	5	mV	
Dynamic Performance Data							
Response Time	$t_R$	$di/dt > 50\text{ A}/\mu\text{s}$ , 10% to 90% of $I_{PN}$	-	1	-	$\mu\text{s}$	
Bandwidth	BW	-3 dB	DC	300	-	kHz	

## 2. Maximum Continuous DC Primary Current

TMR 7559 Maximum continuous DC primary current

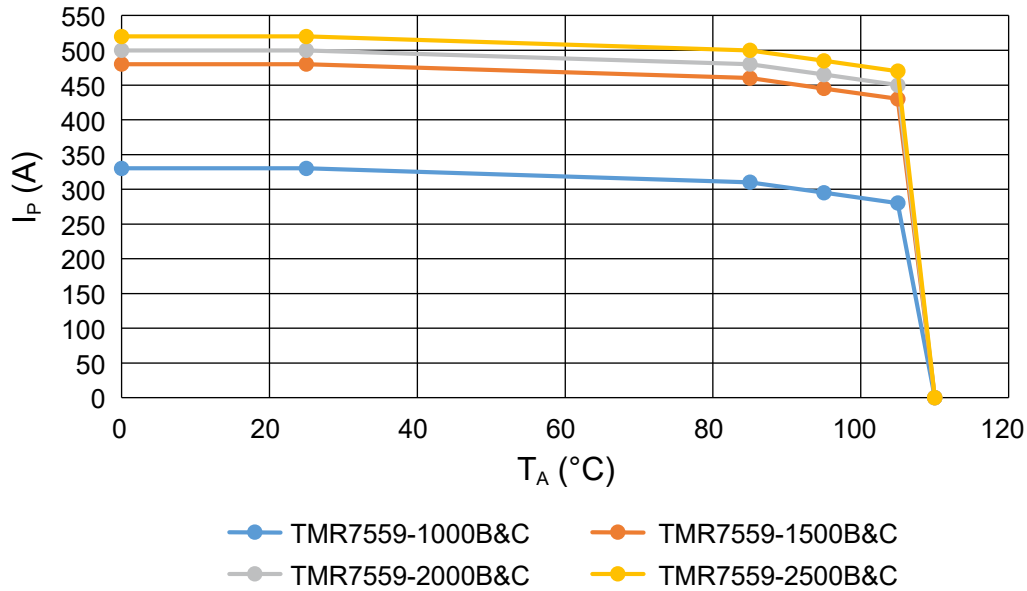


Figure 1.  $I_p$  vs  $T_A$  for TMR7559

The maximum continuous DC primary current plot shows the boundary of the area for which all the following conditions are true:

- $I_p < I_{PM}$
- Junction temperature  $T_j < 125^\circ\text{C}$
- Primary conductor temperature  $T_A < 110^\circ\text{C}$

### 3. Typical Output Characteristics

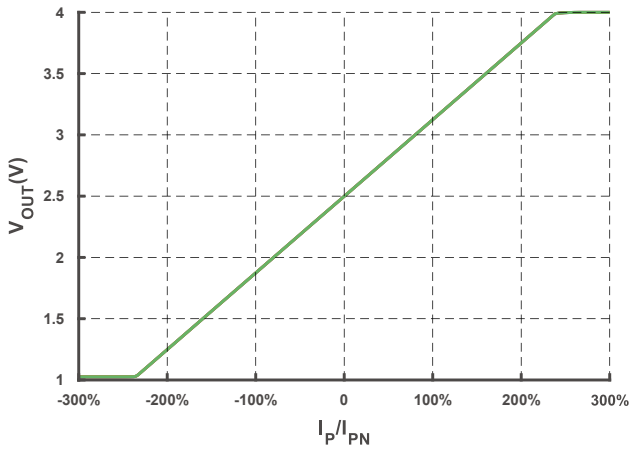


Figure 2. Output Voltage vs Primary Current

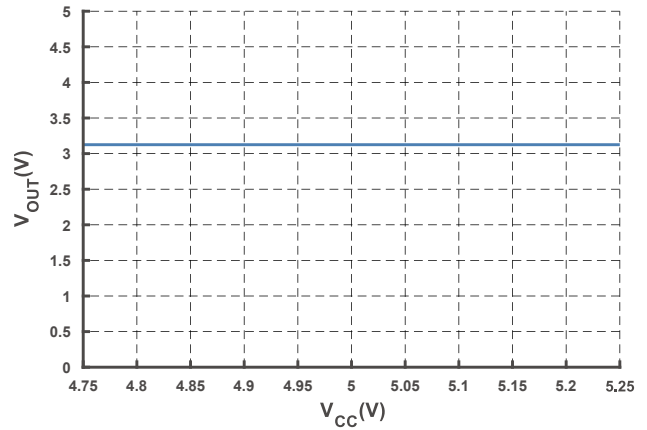


Figure 3. Output Voltage vs Supply Voltage (@ $I_P = I_{PN}$ )

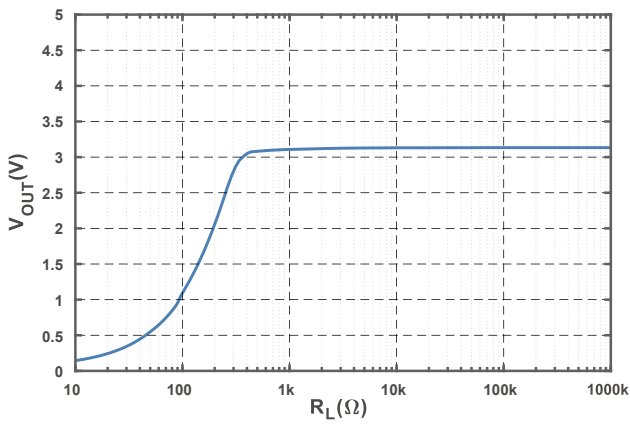


Figure 4. Output Voltage vs Load Resistance (@ $I_P = I_{PN}$ )

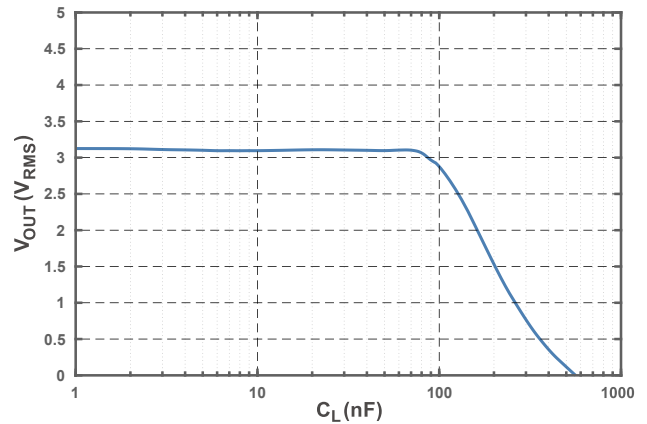


Figure 5. Output Voltage vs Load Capacitance (@ $I_P = I_{PN}$ )

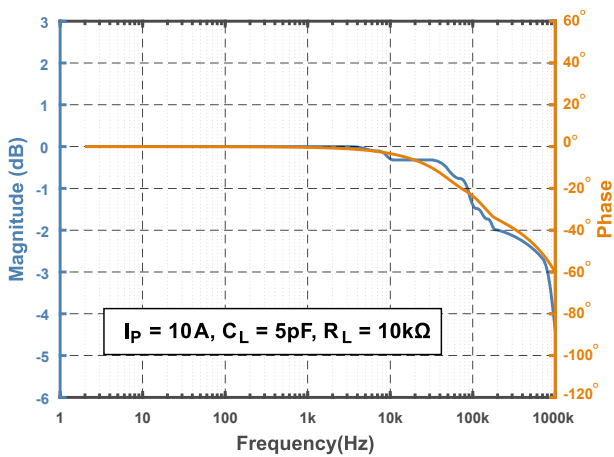


Figure 6. Bode Plot

### 4. Typical Temperature Characteristics

▲ AVG+3σ    ■ AVG    ◆ AVG-3σ

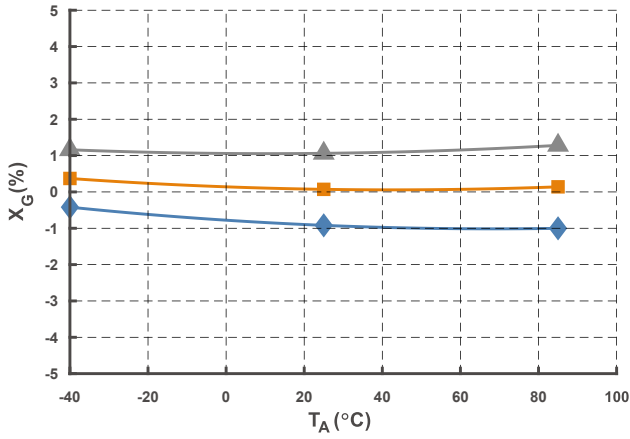


Figure 7. Accuracy

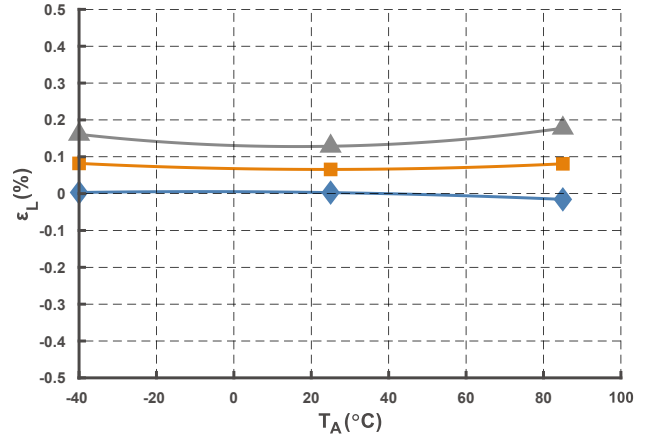


Figure 8. Linearity Error

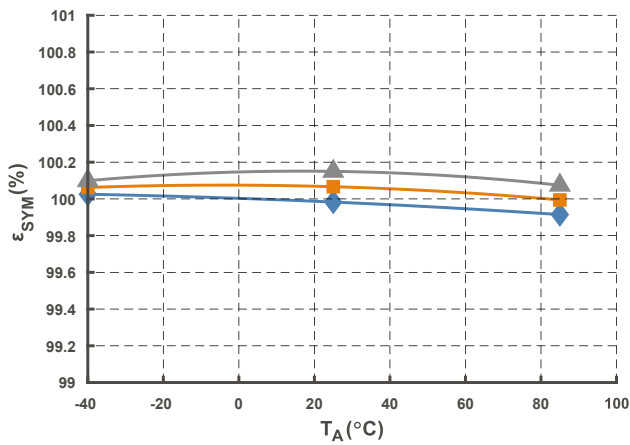


Figure 9. Symmetry

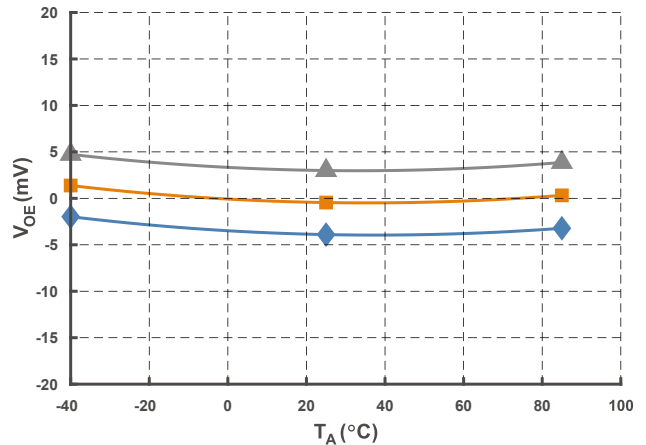


Figure 10. Offset Error

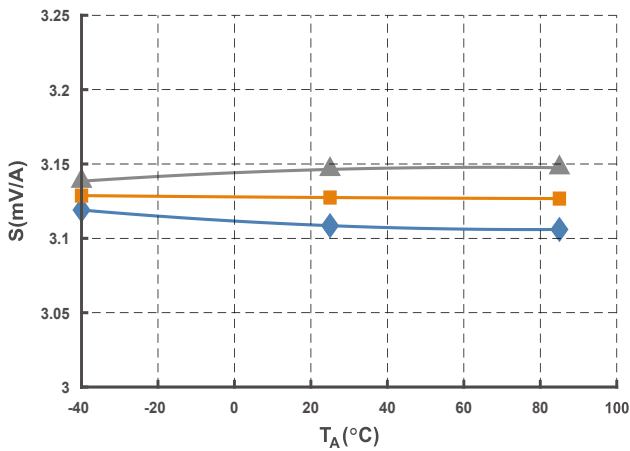


Figure 11. Sensitivity

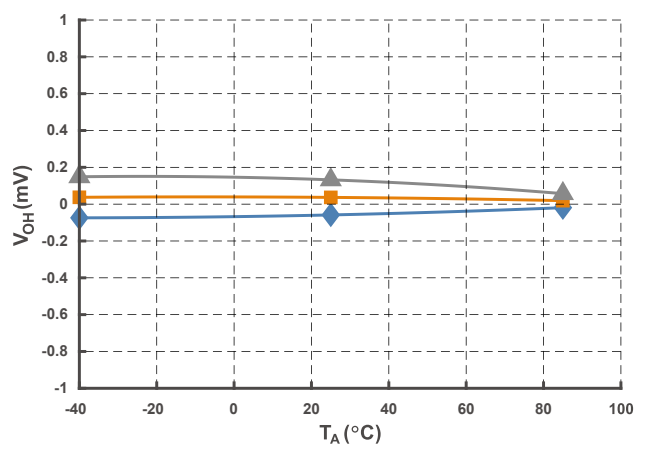


Figure 12. Hysteresis

## 5. Parameters Definition and Formula

### 1) Output Voltage

$$V_{OUT} = V_{OFF} + S \times I_P$$

$V_{OUT}$  stands for current sensor output voltage at given primary current,  $V_{OFF}$  stands for offset voltage,  $S$  stands for sensitivity,  $I_P$  stands for primary current.

### 2) Accuracy

$$X_G = \text{MAX}_{I_P \in [-I_{PN}, I_{PN}]} \left( \frac{(V_{OUT} - V_{REF}) - (S \times I_P)}{S \times I_{PN}} \times 100\% \right)$$

$I_{PN}$  stands for nominal primary current

### 3) Sensitivity

$$S = \frac{V_{OUT(@ I_{PN})} - V_{OUT(@ -I_{PN})}}{2 \times I_{PN}}$$

$V_{OUT(@ I_{PN})}$  and  $V_{OUT(@ -I_{PN})}$  stand for the current output at  $I_{PN}$  and  $-I_{PN}$  respectively.

### 4) Linearity

$$\varepsilon_L = \text{MAX}_{I_P \in [-I_{PN}, I_{PN}]} \left( \frac{(V_{OUT} - V_{REF}) - (\bar{V}_{OE} + \bar{S} \times I_P)}{S \times I_{PN}} \times 100\% \right)$$

$\bar{S}$  and  $\bar{V}_{OE}$  stand for the average values of the sensitivity and electric offset.

### 5) Symmetry

$$\varepsilon_{SYM} = \left| \frac{V_{OUT(@ I_{PN})} - \bar{V}_{OFF}}{V_{OUT(@ -I_{PN})} - \bar{V}_{OFF}} \right| \times 100\%$$

### 6) Hysteresis

$$V_{OH} = \text{MAX } \Delta H$$

$\Delta H$  is the maximum residual output current between full scale positive and negative nominal current.

### 7) Offset Voltage

$$V_{OE} = V_{OUT(@ I_P = 0)} - V_{REF}$$

## 6. Electrical Connection Diagram

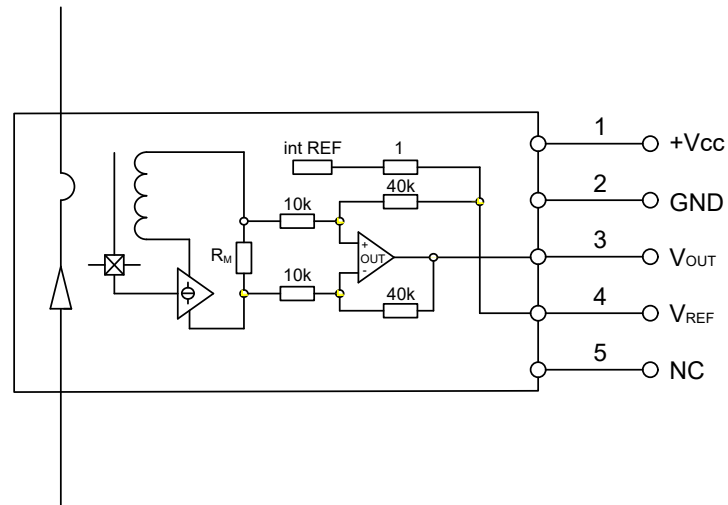


Figure 13. Electrical connection diagram

### Remarks

1.  $V_{OUT}$  is positive when the primary current ( $I_p$ ) is in the same direction as the arrow indication on the label and vice versa.
2. Improper connection may result in permanent damage of the sensor.
3. Excessive capacitive load may result in distortion of output signals when measuring high frequency primary signal. Please refer to Output Voltage vs Load Capacitance Curve.
4. Dynamic performances ( $di/dt$  and response time) are best with a single busbar completely filling the primary through hole.
5. Sensor is customizable upon request.

## 7. Dimensions

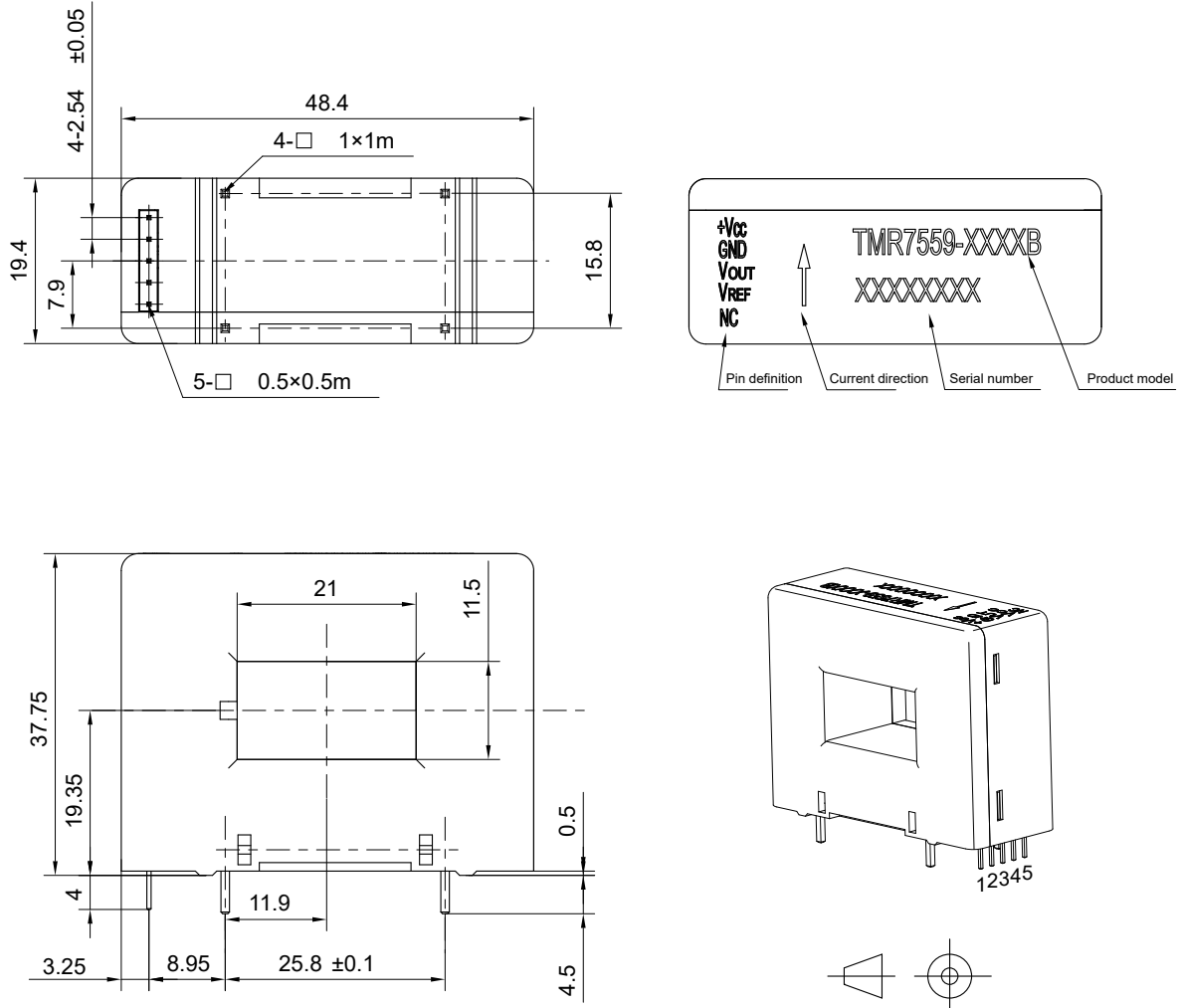


Figure 14. Dimension (unit: mm, tolerances for unmarked scales ±1 mm)

## 8. Recommended Pad Schematic Diagram

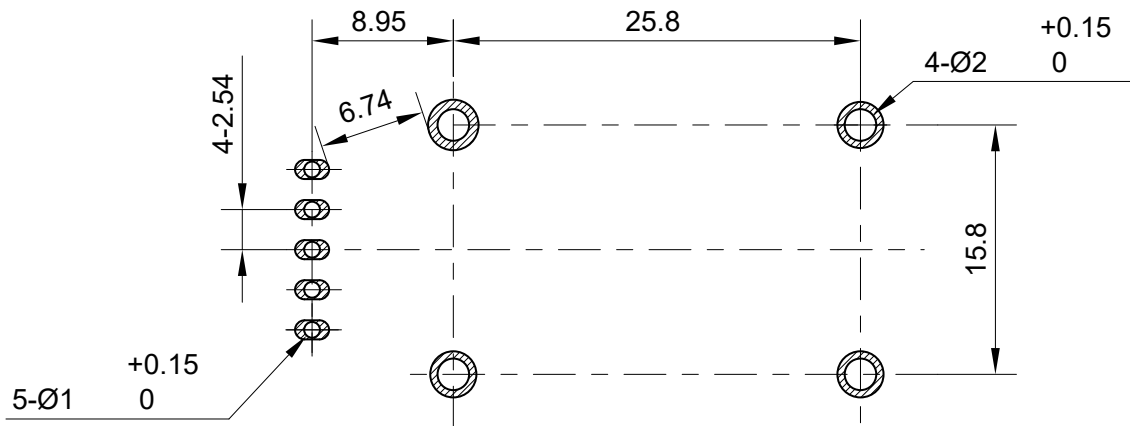


Figure 15. Recommended pad schematic diagram (unit: mm)

## 9. Typical Application Circuit

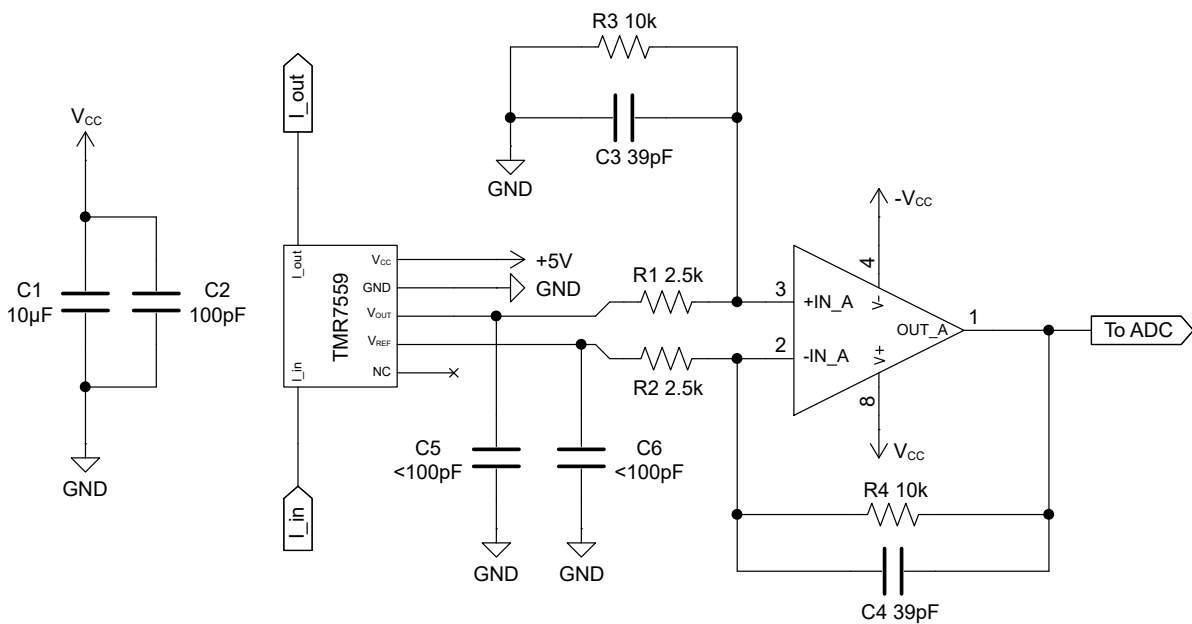


Figure 16. Typical application circuit

Typical application circuit of the TMR7559 series current sensor. The amplification factor is approximately  $K = R4 / R2$ , which requires satisfying  $R1 = R2$  and  $R3 = R4$ . The amplification factor of the above circuit is about 4. The load capacitance of  $V_{OUT}$  and  $V_{REF}$  shall be less than 100 pF to avoid oscillation.

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