

# TMR7503-B

## Unibody Low Temperature-Drift Current Sensor

### Description

TMR7503-B is an open loop current sensor for accurate measurement of DC, AC, pulsed current and arbitrary waveform current with galvanic isolation between primary and secondary circuit.



### Features and Benefits

- Low temperature coefficient
- High immunity to external interference
- Galvanic isolation
- Excellent linearity
- Light weight and compact
- RoHS & REACH compliant

### Applications

- DC motor drives
- Inverters and variable frequency drives (VFD)
- Uninterruptible power supplies (UPS)
- Communication power supplies
- Battery management system (BMS)
- Switching power supplies
- Power supplies for welding application

### Selection Guide

Model	Primary Nominal Current	Primary Current Measuring Range
TMR7503-0500B	50 A	±150 A
TMR7503-1000B	100 A	±300 A
TMR7503-2000B	200 A	±600 A
TMR7503-3000B	300 A	±900 A
TMR7503-4000B	400 A	±950 A
TMR7503-5000B	500 A	±950 A
TMR7503-6000B	600 A	±950 A

### Insulation and Environmental Characteristics

Parameters	Symbol	Typical	Unit
Dielectric Strength	$V_D$	5	kV(50Hz, 1min)
Insulation Resistance	$R_{IS}$	1000	MΩ
Creepage Distance	$d_{CP}$	7.7	mm
Clearance	$d_{CL}$	4.8	mm
Ambient Operating Temperature	$T_A$	-40 to +105	°C
Ambient Storage Temperature	$T_{STG}$	-40 to +105	°C
Mass	$m$	61	g

## Catalogue

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## 1. Specifications

$T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CC} = \pm 15\text{ V}$ ,  $R_L = 10\text{ k}\Omega$ , unless otherwise noted

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	
General Electrical Data							
Primary Nominal Current	$I_{PN}$	TMR7503-0500B	-	50	-	A	
		TMR7503-1000B	-	100	-		
		TMR7503-2000B	-	200	-		
		TMR7503-3000B	-	300	-		
		TMR7503-4000B	-	400	-		
		TMR7503-5000B	-	500	-		
		TMR7503-6000B	-	600	-		
Primary Current Measuring Range	$I_{PM}$	TMR7503-0500B	-150	-	150	A	
		TMR7503-1000B	-300	-	300		
		TMR7503-2000B	-600	-	600		
		TMR7503-3000B	-900	-	900		
		TMR7503-4000B	-950	-	950		
		TMR7503-5000B	-950	-	950		
		TMR7503-6000B	-950	-	950		
Sensitivity	S	$I_P = 0\text{ to } \pm I_{PN}$	TMR7503-0500B	-	80.00	-	mV/A
			TMR7503-1000B	-	40.00	-	
			TMR7503-2000B	-	20.00	-	
			TMR7503-3000B	-	13.33	-	
			TMR7503-4000B	-	10.00	-	
			TMR7503-5000B	-	8.00	-	
			TMR7503-6000B	-	6.67	-	
Output Voltage	$V_{OUT}$	$I_P = 0\text{ to } \pm I_{PM}$	-	$V_{OE} + S \times I_P$	-	V	
Supply Voltage	$V_{CC}$	$\pm 10\%$	-	$\pm 15$	-	V	
Current Consumption	$I_C$	$I_P = 0$	-	$\pm 20$	-	mA	
Load Resistance	$R_L$	$I_P = 0\text{ to } \pm I_{PN}$	1	10	-	k $\Omega$	
Load Capacitance	$C_L$	$I_P = 0\text{ to } \pm I_{PN}$	-	100	-	pF	
Static Performance Data							
Accuracy	$X_G$	$T_A = +25\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-1	$\pm 0.5$	1	% $I_{PN}$	
		$T_A = -40\text{ }^\circ\text{C to } +85\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-3	$\pm 1$	3		
		$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-3.5	$\pm 1.5$	3.5		
Linearity Error	$\epsilon_L$	$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-	0.4	0.8	% $I_{PN}$	
Symmetry	$\epsilon_{SYM}$	$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	99	100	101	%	
Sensitivity Error	$\epsilon_S$	$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = 0\text{ to } \pm I_{PN}$	-2	-	2	%	
Temperature coefficient of Voltage Output	$TCV_{OUT}$	$T_A = -40\text{ }^\circ\text{C} \sim +105\text{ }^\circ\text{C}$	-	300	-	PPM/ $^\circ\text{C}$	
Offset Error	$V_{OE}$	$T_A = +25\text{ }^\circ\text{C}$ , $I_P = 0$	-20	$\pm 10$	20	mV	
		$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = 0$	-60	$\pm 20$	60		
Temperature coefficient of Offset Error	$TCV_{OE}$	$T_A = -40\text{ }^\circ\text{C} \sim +105\text{ }^\circ\text{C}$	$I_{PN} = 50\text{ A}$	-	0.8	-	mV/ $^\circ\text{C}$
			Other ranges	-	0.4	-	
Hysteresis	$V_{OH}$	$T_A = -40\text{ }^\circ\text{C to } +105\text{ }^\circ\text{C}$ , $I_P = \pm I_{PN} \rightarrow 0$	-20	$\pm 10$	20	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	180	-	kHz	

## 2. Typical Output Characteristics

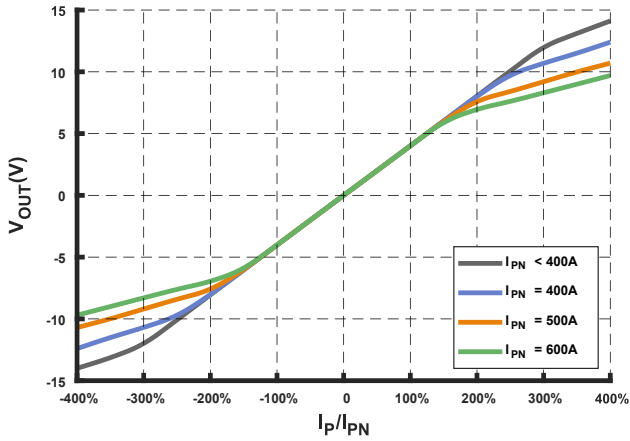


Figure 1. Output voltage versus primary current

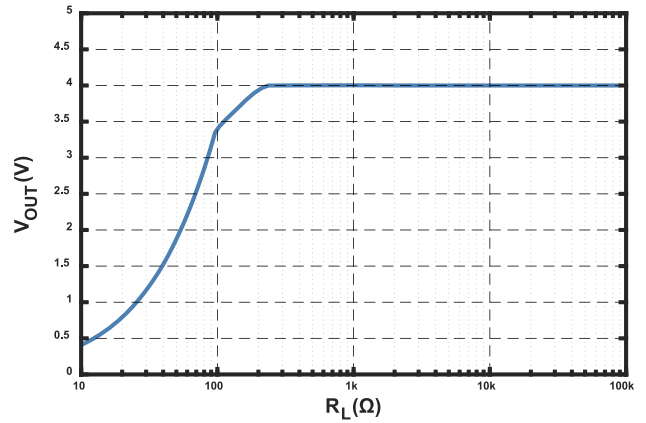


Figure 2. Output voltage versus load resistance (@ $I_P=I_{PN}$ )

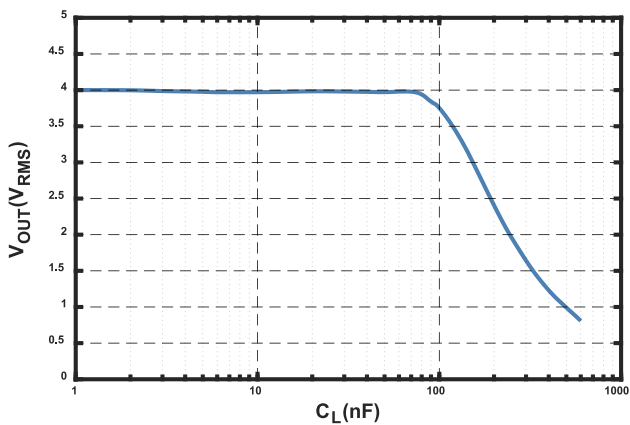


Figure 3. Output voltage versus load capacitance (@ $I_P=I_{PN}$ )

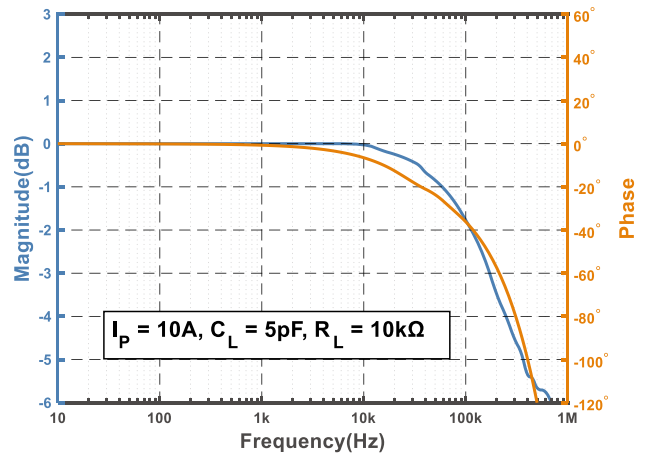


Figure 4. Bode plot of TMR7503-B

### 3. Typical Temperature Characteristics

AVG+3 $\sigma$ 
 AVG
  AVG-3 $\sigma$

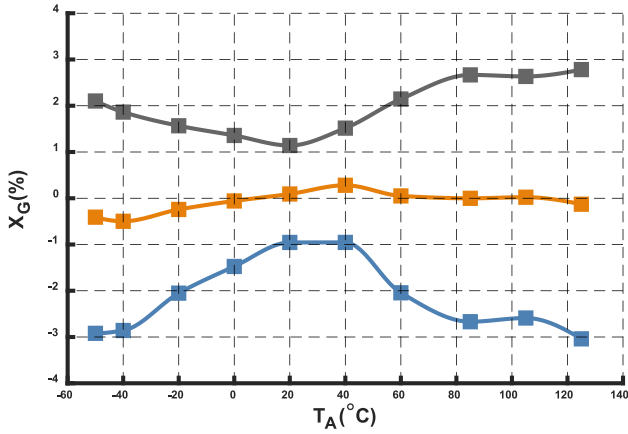


Figure 5. Total error versus ambient temperature

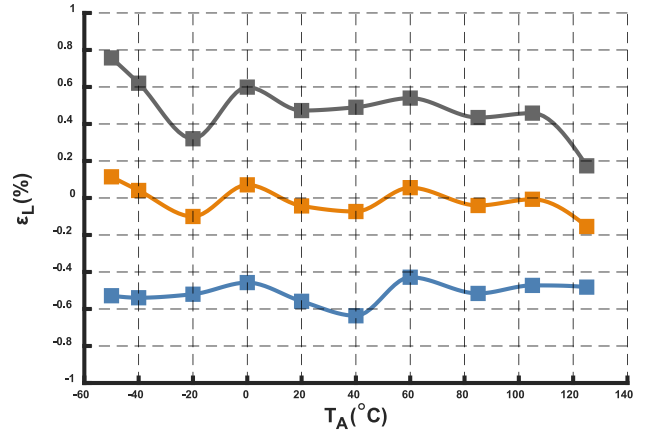


Figure 6. Linearity error versus ambient temperature

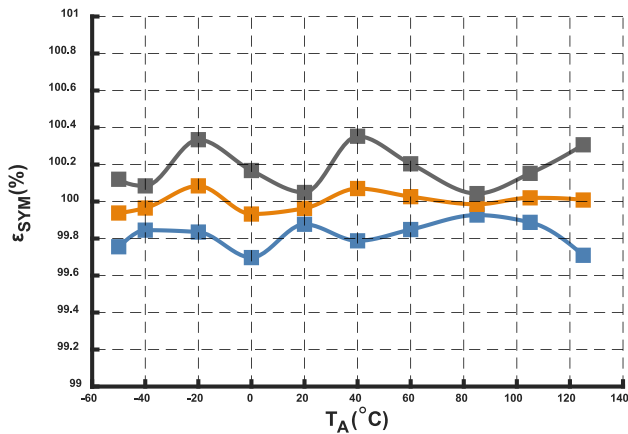


Figure 7. Symmetry versus ambient temperature

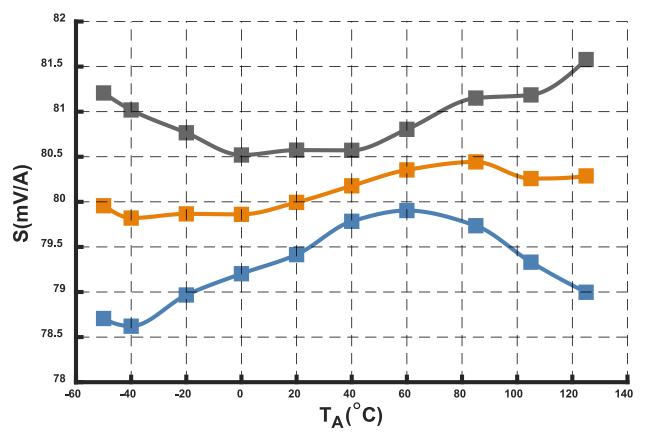


Figure 8. Sensitivity @  $I_{PN} = 50$  A versus ambient temperature

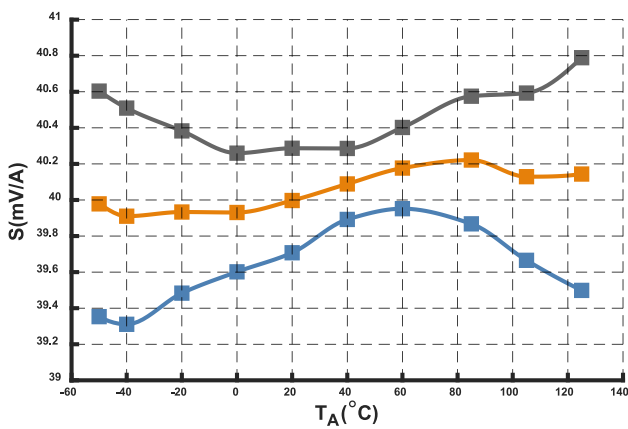


Figure 9. Sensitivity @  $I_{PN} = 100$  A versus ambient temperature

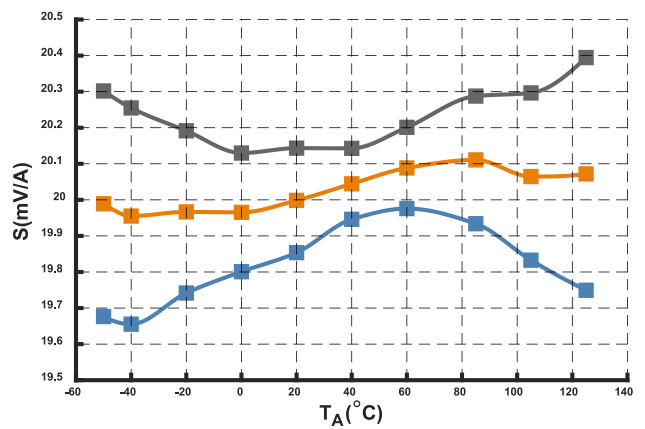


Figure 10. Sensitivity @  $I_{PN} = 200$  A versus ambient temperature

Typical Temperature Characteristics

AVG+3σ      AVG      AVG-3σ

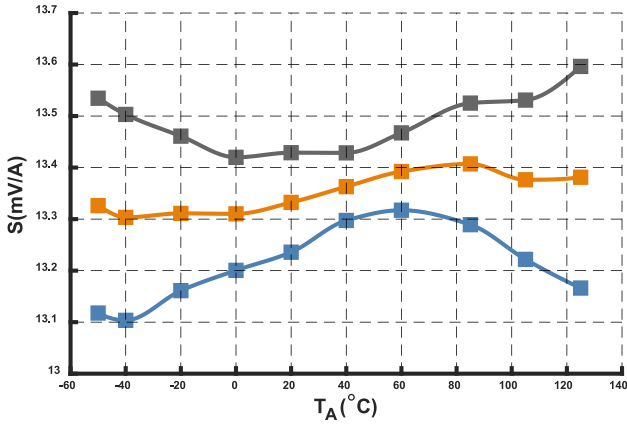


Figure 11. Sensitivity @  $I_{PN} = 300$  A versus ambient temperature

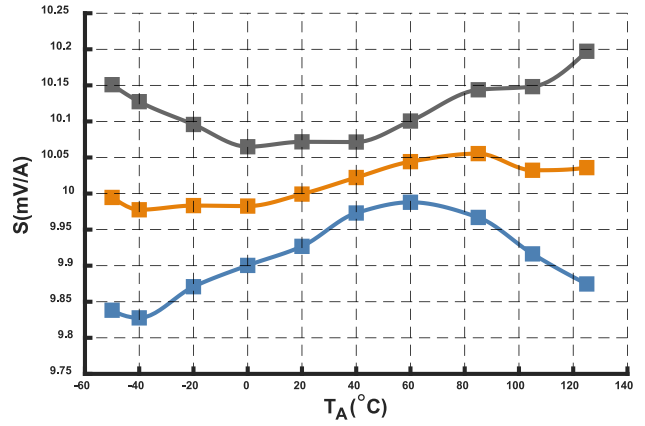


Figure 12. Sensitivity @  $I_{PN} = 400$  A versus ambient temperature

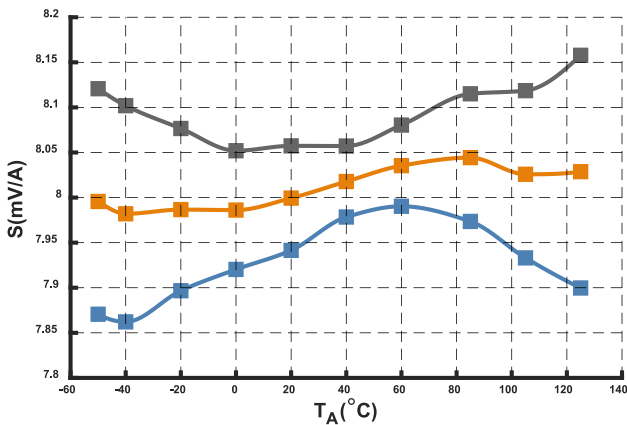


Figure 13. Sensitivity @  $I_{PN} = 500$  A versus ambient temperature

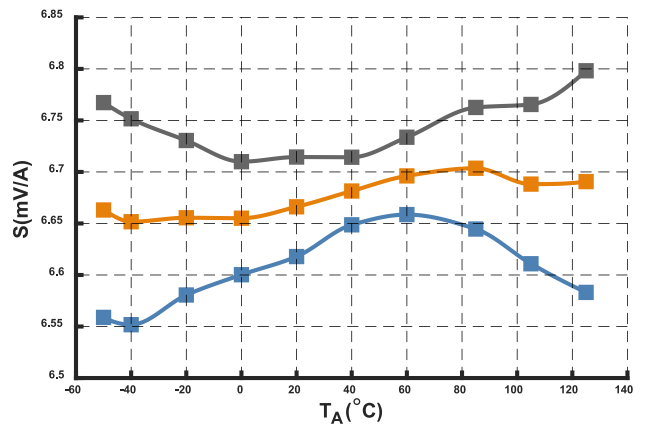


Figure 14. Sensitivity @  $I_{PN} = 600$  A versus ambient temperature

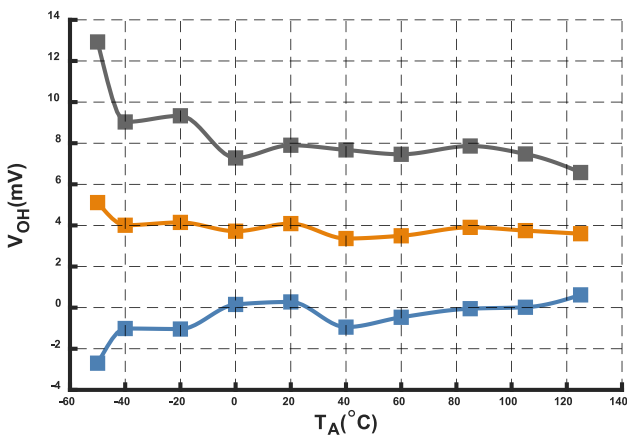


Figure 15. Hysteresis versus ambient temperature

## 4. Parameters Definition And Formula

### 1) Output Voltage

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

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

### 2) Accuracy

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

$I_{PN}$  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 voltage output at  $I_{PN}$  and  $-I_{PN}$  respectively.

### 4) Linearity

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

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

### 5) Symmetry

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

### 6) Hysteresis

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

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

## 5. Application Information

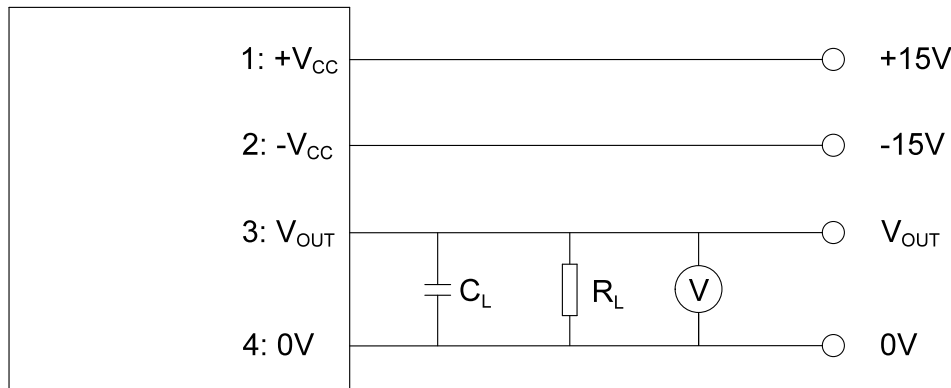


Figure 16. Connection diagram of TMR7503

### Mounting Recommendation

1. Mounting method: Choose one of 3 ×  $\Phi$  4.5 mm holes  
1 × M4 copper or SS304 screw (recommended applied torque 0.75 N•m)
2. Primary through-hole dimensions: 20 mm × 10 mm
3. Secondary terminal: Molex 22041041 (previous 5045-04A series)  
Crimp Housing: Molex 22011042, Crimping Terminal: Molex 08500113

### Remarks

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

## 6. Dimensions

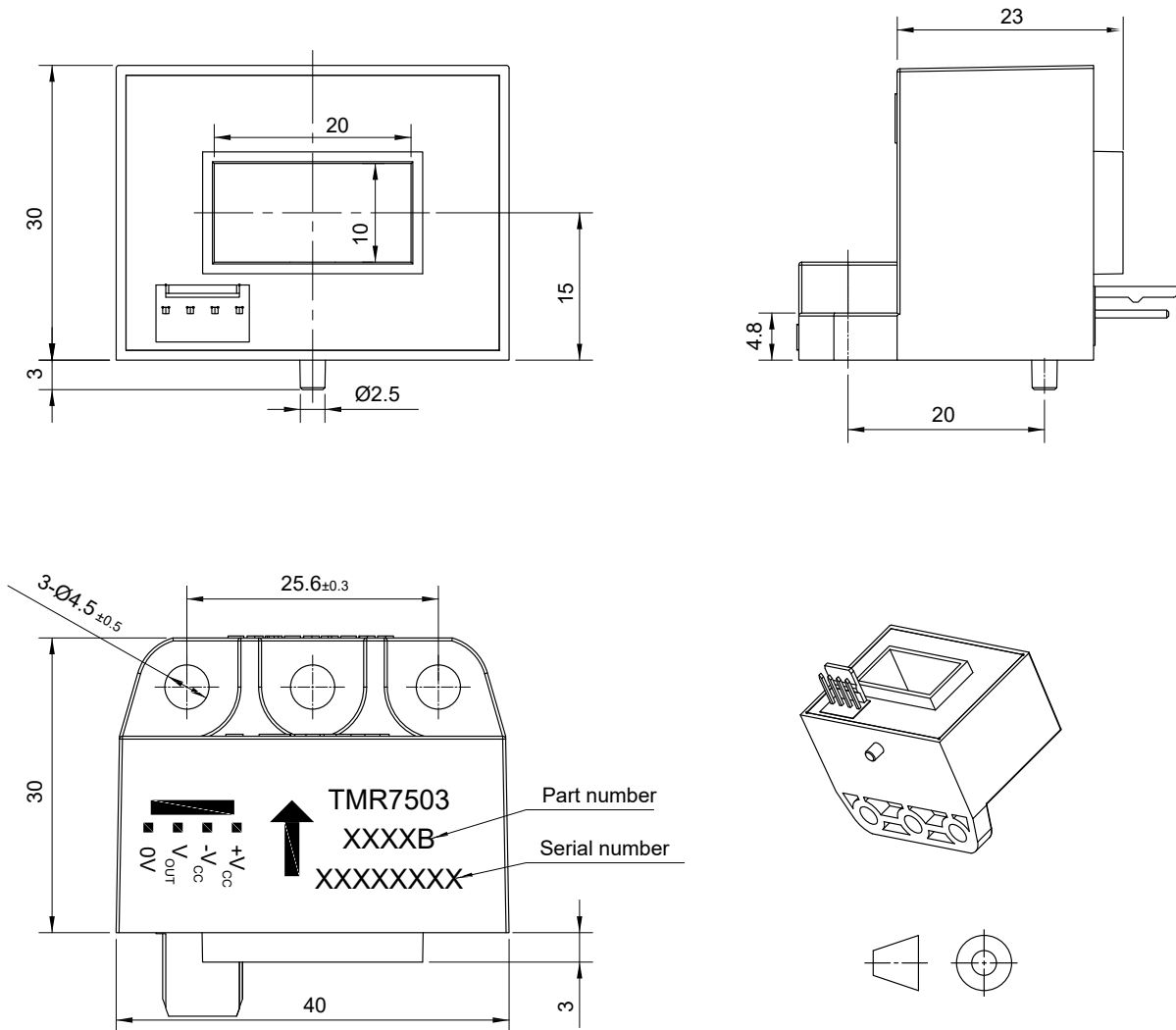


Figure 17. Sensor outline (unit: mm, tolerances for unmarked scales  $\pm 1$  mm)

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