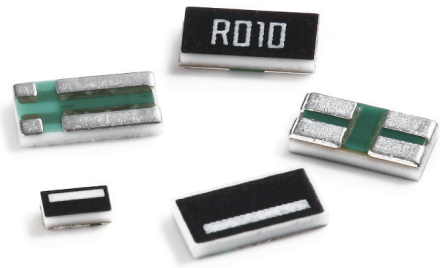
Precise Measurement of Low Resistance Values 4-Terminal Metal Current Sensor - PS Series

Kelvin terminal (4 terminal) metal current sensor – PS series, 0306, 0612



The Yageo Kelvin terminal (4-terminal) metal current sensor PS series provides an ultra low resistance value (to 0.5mΩ) with tight tolerance (1%) and is specifically designed for low ohmic applications which require high accuracy and temperature stability. When the resistance of the current sensor is very small, the impact from the terminal resistance and terminal TCR may be significant and may cause a sensing error in the meaurement result.

The Kelvin configuration is designed to separate the voltage sensing points from the current flow (Fig.1).

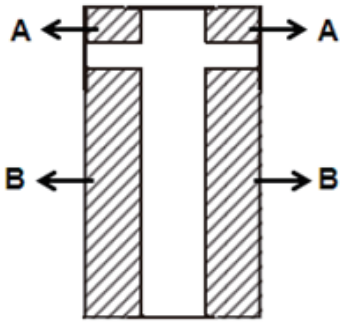


Fig.1 *The bottom side view of a Kelvin terminal (PS series) resistor. "A" are the voltage sensing points. "B" are the terminals for current flow*

Therefore it can minimize errors in the measurement results from terminal resistance and terminal TCR.

Fig.2 is the schema of a Kelvin configuration resistor. R is the resistance of the subject (resistor). r_{t1} and r_{t2} are the resistances of the terminals for current connections. r_{t3} and r_{t4} are the resistances of the voltage sensing connections. While sensing the voltage of the resistor, the influence of the resistances r_{t1} and r_{t2} in terminals is negligible. In the meantime, since the voltmeter carries a very small current, the voltage drop in r_{t3} and r_{t4} can be neglected as well.

Therefore the formula of current is $I = \frac{V}{R}$

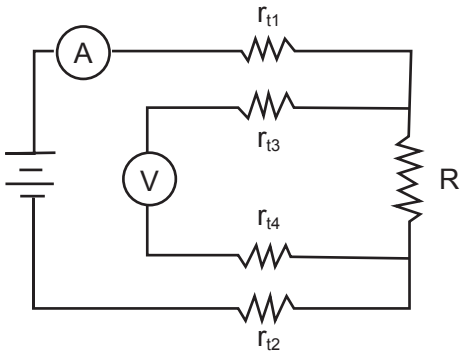


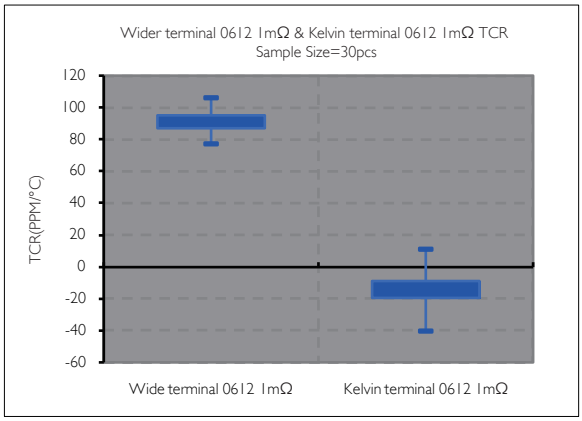
Fig. 2 *The schema of a Kelvin configuration*

The advantage of a resistor with the Kelvin configuration design is that it prevents errors in measurement not only from terminal resistance, but also from the terminal TCR. In order to prove the resistor configuration in Kelvin type has lower terminal TCR than the terminal TCR in a resistor with 2 terminals, two 0612 case size resistors with 1mΩ, one in the Kelvin configuration, another in wide terminal (2-terminal) configuration were used to measure their terminal TCR.

Fig. 3 is the terminal TCR measurement result. For the wide terminal 0612, the average TCR was 91.4 ppm/°C. For the Kelvin terminal 0612, the average TCR was -15.0 ppm/°C. This shows that the Kelvin terminal resistor has a much lower terminal TCR than wide terminal resistor. Since the terminal TCR of a Kelvin terminal resistor is lower than that of a wide terminal (2-terminal) resistor, the current sensing error of the Kelvin terminal resistor is smaller than the 2-terminal resistor.

Precise Measurement of Low Resistance Values - PS Series

Yageo provides the 4-terminal (Kelvin terminal) current sensor - PS series in size 0306 (0.75m ~ 100mΩ) and 0612 (0.5m ~ 100mΩ). The advantages of low measurement error and good heat dissipation are ideal for precise current sensing applications with small resistance under high temperature environment such as battery management systems or DC/DC converter.



▶ **Fig. 3** *TCR of wide terminal 0612 and the Kelvin terminal 0612 resistors. The Kelvin terminal 0612 shows much lower terminal TCR than wider terminal 0612.*

Features

- Low TCR (down to ±75 ppm/°C)
- Tight tolerance (1%)
- Low Coefficient of Thermal Expansion (CTE)
- Sulfur resistance due to no Ag in the structure
- Low thermal EMF
- Excellent heat dissipation
- Case Size: 0306, 0612
- Ultra low resistance (down to 0.5mΩ)

Benefits

- Low measurement error due to decreased terminal resistance and TCR in the Kelvin terminal (4-terminal) design
- The Kelvin terminal (4-terminal) design provides good heat dissipation which is able to work under high ambient temperatures.

Applications

- Battery management system
- Smart phone
- NB and tablet
- DC/DC converter
- Industrial equipments
- Power / Server

Yageo's PS Series Application Map

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