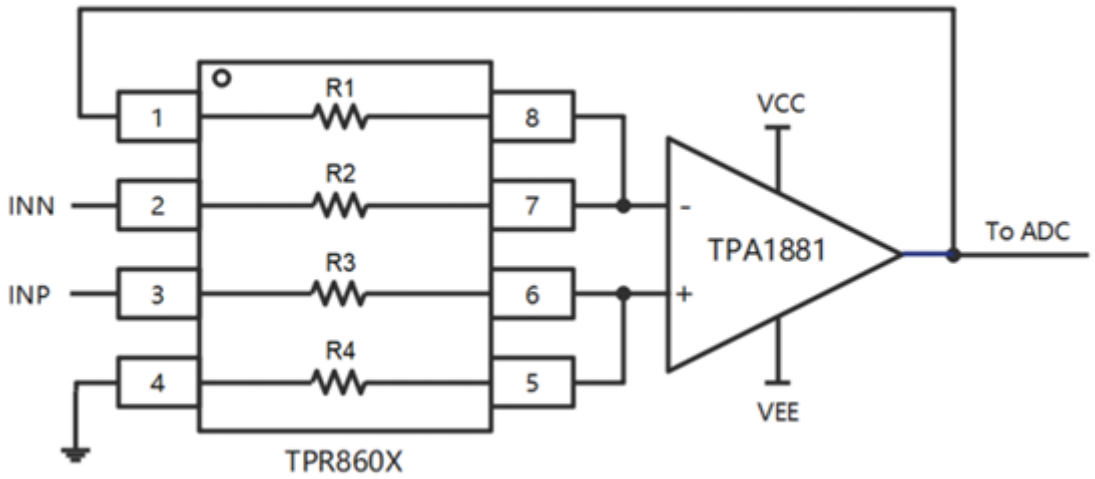
Matching Accuracy of ±0.01% and Matching Temperature Drift of ±1-ppm°C: 3PEAK Releases the TPR860x Series of Precision Resistor Array Products

3PEAK (stock code: 688536), a semiconductor company specializing in high-performance analog chips and embedded processors, has introduced its new precision resistor array products, the TPR860x series. The TPR860x series is a quad-resistor matched array with outstanding resistance matching performance and extremely low temperature drift, catering to the voltage and current signal acquisition needs of industrial control, precision measurement, and instrumentation applications.

Advantages of TPR860x

The TPR860x series integrates four independent resistors designed to meet the precise matching requirements of multiple resistance values in various applications. When paired with high-precision operational amplifiers, the resistor array achieves accurate gain settings for precise signal acquisition. The typical application circuit diagram of the TPR860x is as follows:



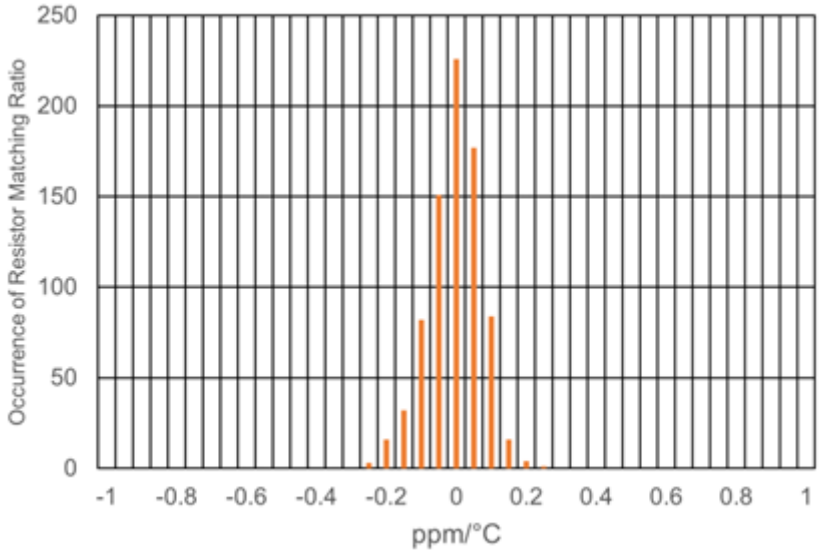
Typical Application Diagram of TPR860x

In the above application circuit, the resistor array plays a crucial role in the system, primarily in terms of gain accuracy over the full temperature range and Common-Mode Rejection Ratio (CMRR).

Gain Accuracy over the Full Temperature Range

Resistance matching ratio and matching ratio temperature drift are critical factors affecting gain accuracy over the full temperature range. For

instance, if a resistor array with a matching ratio of 1% is chosen, the system's resolution will be limited to within 7 bits. In high-precision applications, calibration measures are necessary to mitigate these effects. However, calibrating across the full temperature range is costly and challenging, often limited to room temperature calibration. Therefore, the temperature drift of the matching ratio is crucial.
The TPR860x series offers a maximum matching ratio error of ±0.01% at room temperature (TPR8601A). With a typical temperature drift of 0.1-ppm/°C and a maximum of 1-ppm/°C over the range of −40°C to 125°C, it exhibits excellent performance. The temperature drift distribution chart of the matching ratio is as follows:



Temperature Drift Distribution Chart of TPR860x Matching Ratio

CMRR over the Full Temperature Range

The CMRR matching degree and temperature drift of the resistor array significantly affect the CMRR over the full temperature range. For applications with a wide range of common-mode signals, CMRR is crucial. The mismatch of the resistor array converts common-mode signals into differential-mode signals to introduce interference.
The resistor array's impact on the CMRR matching degree is defined as follows:

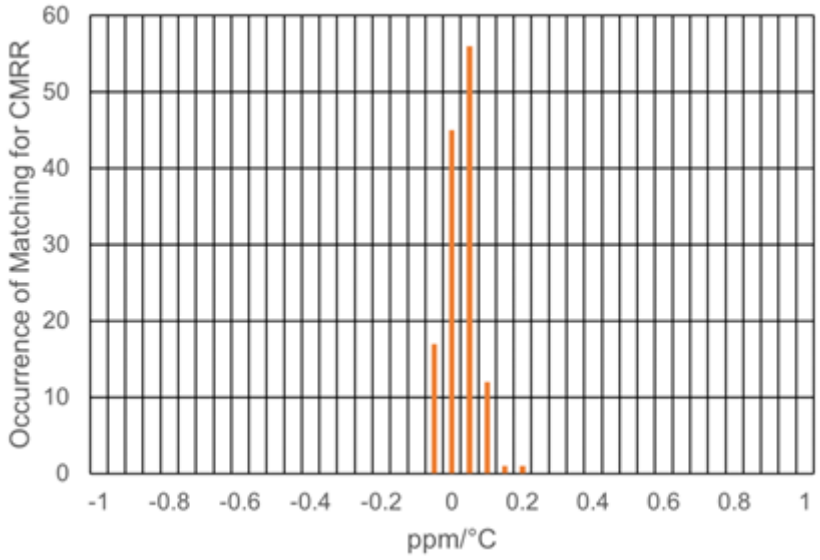
$$(\Delta R/R)_{CMRR} = \frac{1}{2} * (R2/R1 - R3/R4) * (R1/R2)$$

Considering only the resistor array, the CMRR is:

$$CMRR = \frac{0.5 * (Gain + 1)}{(\Delta R/R)_{CMRR}}$$

When four resistors with the same resistance value and a matching ratio of ±1% are used, only a CMRR of 40-dB can be ensured at room temperature. Calibration at room temperature can eliminate errors, but calibration at high

and low temperatures is costly and difficult to achieve. The TPR860x series matches all four resistors and performs exceptionally well in terms of matching and temperature drift affecting the CMRR. Over the full temperature range (−40°C to 125°C), the maximum deviation of TPR8601A is only ±0.005%, with a typical temperature drift of 0.1-ppm/°C and a maximum of 1-ppm/°C. The distribution chart is shown below:



Temperature Drift Distribution Chart for TPR860x Affecting CMRR Matching Degree

We constructed a differential amplification system with a gain of 1, utilizing three types of resistor arrays with varying performance levels to investigate and evaluate their impact on system gain accuracy and CMRR. The evaluation revealed that the TPR860x series performs well and reliably over the full temperature range, meeting the high requirements for system gain accuracy and CMRR in the field of precision measurement.

Resistance Specifications	±1%, 50ppm/°C	±0.1%, 10ppm/°C	TPR8601A
Gain error at 25°C	±1%	±0.1%	±0.01%
Gain error at full temperature (-40°C ~ 125°C)	±1.825%	±0.265%	±0.0125%
CMRR at full temperature (-40°C ~ 125°C)	35dB	52dB	86dB

Comparison of the Impact of Resistor Arrays with Different Performance Parameters on the System

TPR860x Product Performance

- Matching Performance:
  - TPR8601A: 0.0125% Matching at −40°C to +125°C
  - TPR8600/1/2: 0.025% Matching at −40°C to +125°C
  - TPR8603: 0.03% Matching at −40°C to +125°C
- Matching Temperature Drift: 0.1 ppm/°C (Typical), 1 ppm/°C (Max)
- Operating Voltage Range: −60 V to +60 V
- Operating Temperature Range: −40°C to 125°C

The TPR860x series products are available for sample and evaluation board services.

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