Ultra Precision Thermosensitive Resistor

This ultra precision thermosensitive resistor is a new type of resistor produced by the application of Alpha foil resistor technology. It is made of material only a few µm thick and responds rapidly to temperature changes. The metal foil that is used has a resistivity that varies linearly with temperature change. Strict control of foil composition maintains uniform quality without fluctuation of temperature characteristics of resistance. This thermosensitive resistor is produced by the same fine photo-etching technology used in the metal foil precision resistors. The pattern is ideally designed for temperature detection, providing small size and rapid response.

Characteristics

- Since the resistance is provided by metal foil, the resistance is highly stable with little change over time
- Temperature characteristics of resistance are almost linear
- Response to temperature changes is rapid
- This thermosensitive resistor is small and low-priced
- Highly accurate with tolerance of resistance values ±0.5%
- Temperature characteristics can be freely adjusted (KLC type)

Main Applications

- Cold-junction reference for thermocouple
- Temperature-compensation in load cell
- Temperature-compensation device in semiconductor circuit
- Temperature-sensing device

**COMPOSITION OF TYPE NUMBER**

Example 1:

- NLA 100R0 F
- Type
- Resistance Value*
- Tolerance

Example 2:

- KLC 3000-500R0 F
- Type
- TCR**
- Resistance Value*
- Tolerance

Example 3:

- NMP 100R0 F L
- Type
- Resistance Value*
- Tolerance
- Tape & Reel Package Required

*Resistance value, in ohm, is expressed by a series of five characters, four of which represent significant digits. R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of decimal point.

**Specify a desired TCR, following the type, in four-digit coding. The example “3000” means 3,000 ppm/°C while “0500” means 500 ppm/°C.

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TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER

<table>
<thead>
<tr>
<th>Type</th>
<th>TCR (ppm/°C)</th>
<th>Resistance Range (Ω)</th>
<th>Resistance Tolerance (%) at 0°C</th>
<th>Rated Power (W) at 70°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMP</td>
<td>+6,060±2% (0 to 25°C)</td>
<td>5 to 250</td>
<td>±0.5 (D)</td>
<td>0.1</td>
</tr>
<tr>
<td>NMQ</td>
<td>+6,660±3% (0 to 100°C)</td>
<td>5 to 500</td>
<td>±1.0 (F)</td>
<td>0.125</td>
</tr>
<tr>
<td>NLA</td>
<td>+6,660±1% (0 to 100°C)</td>
<td>5 to 500</td>
<td>±2.0 (G)</td>
<td>0.125</td>
</tr>
<tr>
<td>NLB</td>
<td>+6,660±1% (0 to 100°C)</td>
<td>5 to 1k</td>
<td>±5.0 (J)</td>
<td>0.25</td>
</tr>
<tr>
<td>CLA</td>
<td>+4,250±1% (0 to 100°C)</td>
<td>5 to 100</td>
<td></td>
<td>0.125</td>
</tr>
<tr>
<td>CLB</td>
<td>+4,250±1% (0 to 100°C)</td>
<td>5 to 200</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>KLC</td>
<td>See Fig.1 on next page</td>
<td></td>
<td></td>
<td>0.25</td>
</tr>
</tbody>
</table>

*Symbols parenthesized are for type number composition.

TAPE AND REEL PACKAGE

(BASED ON EIA-481-1)

For details, refer to MP, MQ Series datasheet.

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For any questions, contact
sales-alpha@alpha-elec.co.jp

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PERFORMANCE

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Test Condition</th>
<th>ALPHA Specification</th>
<th>ALPHA Typical Test Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Temperature Range</td>
<td>±25°C to +125°C</td>
<td>~25°C to +125°C</td>
<td>-</td>
</tr>
<tr>
<td>Max. Rated Operating Temp.</td>
<td>70°C</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Maximum Working Voltage</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Temperature Cycling</td>
<td>-25°C/30 min., Room Temperature/5 min., +125°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Overload</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Solderability</td>
<td>235°C, 2 sec.</td>
<td>over 75% coverage</td>
<td>-</td>
</tr>
<tr>
<td>Resistance to Solvents</td>
<td>Isopropyl Alcohol, Trichloroethylene</td>
<td>no damage</td>
<td>-</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>-25°C, No Load, 2 hrs.</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Terminal Strength</td>
<td>0.908 kg (2 pounds), 10 sec.</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Dielectric Withstanding Voltage</td>
<td>Atmospheric: AC 300V, 1 min.</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>DC 100V, 1 min.</td>
<td>over 10,000 MΩ</td>
<td>over 10,000 MΩ</td>
</tr>
<tr>
<td>Moisture Resistance</td>
<td>+65°C to –10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Shock</td>
<td>50G, 11 ms, Half-Sine Wave, X, Y, Z, each 3 shocks</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Vibration</td>
<td>20G, 10 Hz to 55 Hz to 10 Hz, 1 min. X, Y, Z, each 2 hrs.</td>
<td>±0.2%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Life (Rated Load)</td>
<td>70°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.</td>
<td>±0.5%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Life (Moisture Load)</td>
<td>40°C, 90% RH to 95% RH, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.</td>
<td>±0.5%</td>
<td>±0.03%</td>
</tr>
<tr>
<td>Storage Life</td>
<td>15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.</td>
<td>±0.5%</td>
<td>±0.05%</td>
</tr>
<tr>
<td>High Temperature Exposure</td>
<td>125°C, No Load, 1,000 hrs.</td>
<td>±1.0 %</td>
<td>±0.1%</td>
</tr>
</tbody>
</table>

APPLICATIONS OF THERMOSENSITIVE RESISTORS

Example: Cold-junction compensation for temperature measurement using thermocouple

-Thermocouple
-Locator
-Cold-Junction Compensation

Example: Temperature-sensing circuit

As shown in:

\[ V_{\text{out}} = \left( \frac{R_4}{R_1 + R_2} \times \frac{R_1 + R_2}{R_4 + \Delta R_4} \right) \times V_{\text{in}} \]

Op-Amp output \( V_{\text{out}} \) becomes zero when \( R_4/R_1 \) and \( R_4/R_4 \) are balanced. So, output voltage \( V_{\text{out}} \) is calculated when \( R_4 \) is changed to \( \Delta R_4 \) from balanced point, \( \hat{\text{w}} \), and offset voltage is zero. The formula is as follows:

\[ V_{\text{out}} = -\left( \frac{R_4}{R_1 + R_2} \times \frac{1}{R_1} \right) \times \Delta R_4 \times V_{\text{in}} \]

PRECAUTION IN USING NMP AND NMQ RESISTORS

1. Storage
-Storage condition or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity.
-The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.

2. Caution in Soldering
-Hand Soldering
-Hand soldering is applicable as shown at right.
-Recommended
-• Temperature of Iron Tip: 240°C to 270°C
-• Power of Iron: 20W or less
-• Diameter of Tip: Dia. 3 mm max.
-Recommended
-• Peak Temperature: 250°C to 270°C
-• Holding time: 10 sec. max.
-Recommended
-• Solder Reflow in Furnace
-• Dipping in Solder (Wave or Still)
-Recommended
-• Temp. of Solder: 260°C max.
-• Length of Dipping: 10 sec. max.
-• To cool gradually at room temperature
-Other
-Corrosion-free flux, such as rosin, is recommended.
-Do not apply pressure to the molded housing immediately after soldering.

3. Cleaning
-Use volatile cleaner such as methylalcohol or propylalcohol.

4. Circuit Board Design
-The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example below.

Dimensions in mm
-When parts are mounted on a board in high density, solder can possibly attach to the resistors in an excessive amount to affect performance or reliability of the resistors. To prevent this effect, the use of solder resist is recommended to isolate solder lands.