Low R-Value
Thin Film Chip Resistors

DATA BOOK
Thin Film Components

Thin Film Power
SUSUMU CO., LTD.
Low R-Value Thin Film Chip Resistors (Resistor for current detection)

### Structure

![Chip Resistor Diagram]

- Protection film
- Resistance film
- Electrode
- Alumina substrate
- Wrap around electrode

### Features

- Excellent heat split structure (Patent No.2963671) and compact size for lowering surface temperature rising.
- A tight resistance tolerance of ±1% and an excellent TCR of ±100ppm/°C assure current sensing accuracy.

### Specifications

<table>
<thead>
<tr>
<th>Dimension (mm)</th>
<th>RL3720</th>
<th>RL3720W</th>
<th>RL7520</th>
<th>RL7520W</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>3.75±0.30</td>
<td>3.75±0.30</td>
<td>7.50±0.30</td>
<td>7.50±0.30</td>
</tr>
<tr>
<td>W</td>
<td>2.00±0.20</td>
<td>2.00±0.20</td>
<td>2.00±0.20</td>
<td>2.00±0.20</td>
</tr>
<tr>
<td>P</td>
<td>0.40±0.20</td>
<td>0.40±0.20</td>
<td>0.40±0.20</td>
<td>0.40±0.20</td>
</tr>
<tr>
<td>T</td>
<td>0.40±0.10</td>
<td>0.40±0.15/–0.10</td>
<td>0.40±0.10</td>
<td>0.40±0.15/–0.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension (mm)</th>
<th>RL0510 (0402)</th>
<th>RL1220 (0805)</th>
<th>RL1632 (1206)</th>
<th>RL3264 (2412)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>1.00±0.10</td>
<td>2.00±0.02</td>
<td>3.20±0.20</td>
<td>6.40±0.20</td>
</tr>
<tr>
<td>W</td>
<td>0.50±0.10</td>
<td>1.25±0.20</td>
<td>1.60±0.20</td>
<td>3.20±0.20</td>
</tr>
<tr>
<td>P</td>
<td>0.20±0.10</td>
<td>0.40±0.20</td>
<td>1.00±0.15</td>
<td>2.00±0.15</td>
</tr>
<tr>
<td>T</td>
<td>0.35±0.10</td>
<td>0.40±0.10</td>
<td>0.50±0.15</td>
<td>0.50±0.15</td>
</tr>
</tbody>
</table>

### Electric Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>RL3720</th>
<th>RL3720W</th>
<th>RL7520</th>
<th>RL7520W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>1/2W</td>
<td>1W</td>
<td>1W</td>
<td>2W</td>
</tr>
<tr>
<td>Resistance Tolerance</td>
<td>±1%(F) ±2%(G)</td>
<td>±1%(F) ±2%(G)</td>
<td>±1%(F) ±2%(G)</td>
<td>±1%(F) ±2%(G)</td>
</tr>
<tr>
<td>Resistance range (ohm)</td>
<td>0.022–0.075</td>
<td>0.1–2.2</td>
<td>0.010–0.068</td>
<td>0.1–1.0</td>
</tr>
<tr>
<td>Temperature Coefficient of Resistance (ppm/°C)</td>
<td>0–+350 (T)</td>
<td>0–+200 (S)</td>
<td>0–+350 (T)</td>
<td>0–+200 (S)</td>
</tr>
<tr>
<td>Resistance Values</td>
<td>E–6</td>
<td>E–6</td>
<td>E–6</td>
<td>—</td>
</tr>
<tr>
<td>Package</td>
<td>4000pcs/reel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>RL0510 (0402)</th>
<th>RL1220 (0805)</th>
<th>RL1632 (1206)</th>
<th>RL3264 (2412)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>1/8W</td>
<td>1/4W</td>
<td>1/2W</td>
<td>1W</td>
</tr>
<tr>
<td>Resistance Tolerance</td>
<td>±1%(F) ±2%(G)</td>
<td>±2%(G) ±5%(J)</td>
<td>±1%(F) ±2%(G)</td>
<td>1%(F) ±%</td>
</tr>
<tr>
<td>Reference range (ohm)</td>
<td>0.1–4.7</td>
<td>0.022–0.068</td>
<td>0.1–10.0</td>
<td>0.068–0.47</td>
</tr>
<tr>
<td>Temperature Coefficient of Resistance (ppm/°C)</td>
<td>0–+200 (S)</td>
<td>0–+350 (T)</td>
<td>0–+200 (S)</td>
<td>±100 (R)</td>
</tr>
<tr>
<td>Package</td>
<td>10,000pcs/reel</td>
<td>5000pcs/reel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Please call for TCR's less than ±100ppm/°C
- Kevin four termination current sensor is available
Typically used with control IC for power supply protection circuits, charging/discharging control circuits of battery-packages, and motor control circuits.

**For power supply protection and motor control application**

1. A protection circuit
2. To control the current and function

Power supply: To control the charge or discharge current and stabilize load.
Motor: To control the rotation speed, either steady or variable.

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**protection circuits**

![diagram](image)

- Assume $V_i$ is the input voltage on the current sensor, then output current $I_o$ could be formulated as follows:

$$I_o = \frac{V_i R_f}{R_1 + R_s}$$

- The output current is controllable and independent of load $R$.

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**control circuit**

![diagram](image)

- Let $R_e$ be 0.2 ohm:
  - When $I$ is 1 ampere, voltage between B and E is 0.2 volt.
  - When $I$ is 2 amperes, voltage between B and E is 0.4 volts.
  - When $I$ is 3 amperes, voltage between B and E is 0.6 volts and turns Tr2 on.

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**DATA**

<Electric characteristics>

**Resistance Distribution**

![chart](image)

- Excellent initial characteristics, large heat dissipation, low temperature rise and excellent temperature characteristics assure high accuracy, contributing to longevity of battery packages.

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*Compare to conventional type low ohmic chip resistors, the structure of this RL-series has higher thermal dissipation (patent No 2963671) rate, able to assure lower surface temperature rising and lower thermal effect on surrounding parts. Strongly recommended component.*

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*Excellent initial characteristics, large heat dissipation, low temperature rise and excellent temperature characteristics assure high accuracy, contributing to longevity of battery packages.*
Temperature Coefficient of Resistance Distribution

**RL1632**

**RL3264**

**RL3720, RL3720W**

**RL1220**

**RL0510**

**RL7520, RL7520W**

R005 is for RL7250W only

- **Resistance tolerance (%):**
  - Assurance range:
    - RL1632
    - RL3264
    - RL3720, RL3720W
    - RL1220
    - RL0510
    - RL7520, RL7520W
  - Low TCR:
    - 2.0
    - 1.5
    - 0.5
    - 1.0
    - 0
  - Assurance range:
    - 2.0
    - 1.5
    - 0.5
    - 1.0
    - 0

- **Temperature Coefficient of Resistance (ppm/°C):**
  - Assurance range:
    - RL1632
    - RL3264
    - RL3720, RL3720W
    - RL1220
    - RL0510
    - RL7520, RL7520W
  - Low TCR:
    - 2.0
    - 1.5
    - 0.5
    - 1.0
    - 0
  - Assurance range:
    - 2.0
    - 1.5
    - 0.5
    - 1.0
    - 0
This low resistance chip resistor is designed to have better heat (generated by resistor) dissipation rate than the copper pad on board, therefore surface temperature rising on the resistor depends on the pad’s on PC board.

**Data of surface temperature rises**

- R005 is for RL7250W only

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**RL3720, RL3720W**

- Assurance range (Guaranteed range)
- Temperature Coefficient of Resistance (ppm/°C)

**RL7520, RL7520W**

- Assurance range (Guaranteed range)
- Temperature Coefficient of Resistance (ppm/°C)

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**RL3720W (Rated 1W)**

- Chip resistance
- Dimension W
- Dimension L (27mm)
- Differential increase in surface temperature
- Pad size (S) = W-L
- Land patterns
- Dimenion W (mm)

**RL7520W (Rated 2W)**

- Chip resistance
- Differential increase in surface temperature
- Dimension W
- Dimension L (27mm)
- Land patterns
- Dimension W (mm)

**RL3720W (Rated 0.5W)**

- Chip resistance
- Dimension W
- Dimension L (4.15mm)
- Differential increase in surface temperature
- Land patterns
- Dimension L (mm)

**RL7520W (Rated 1W)**

- Chip resistance
- Differential increase in surface temperature
- Dimension W
- Dimension L (7.9mm)
- Land patterns
- Dimension L (mm)
<Resistance to surge voltage>
Apply a pulse to a sample resistor and measure the rate of resistance change. Raise the voltage gradually until the rate of resistance change exceeds \( \pm 0.5\% \). The threshold pulse voltage is defined as the upper limit voltage to hold the rate of resistance change within 60.5%.

<Resistance polarization>
Low ohmic resistor receive internally the effects of thermal electromotive force. We minimize the effects of thermal electromotive force of our low ohmic resistors through thin film technology. The effect of thermal electromotive power could be detected by measuring polarization of its resistance values.

Reliability Test DATA
Compared with general-purpose resistors, low resistance resistors are more often used in high temperature environment and high power applications where the amount of heat is high. High reliability is necessary. Susumu’s low ohmic resistors have excellent reliability of less than 0.01%.f

●Load Life Test
Test conditions: 70°C Apply rated voltage for 90 minutes followed by 30 minute intermission. This cycle is repeated for 1,000 hours.

●Moisture Load Life Test
Test conditions: 40°C, 95% RH Apply rated voltage for 90 minutes followed by 30 minute intermission. This cycle is repeated for 1,000 hours.
Recommended land patterns

Recommended land patterns
Board thickness: 1.6mm, Board material: glass fabric epoxy resin, Copper film thickness: 0.035mm

RL0510 Recommended land pattern

RL1220 Recommended land pattern

RL1632 Recommended land pattern

RL3264 Recommended land pattern

Long-side electrode type Recommended land patterns

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>RL3720</td>
<td>27.0</td>
<td>4.0</td>
<td>1.2</td>
<td>4.2</td>
</tr>
<tr>
<td>RL3720W</td>
<td>27.0</td>
<td>4.0</td>
<td>1.2</td>
<td>7.9</td>
</tr>
<tr>
<td>RL7520</td>
<td>27.0</td>
<td>4.0</td>
<td>1.2</td>
<td>7.9</td>
</tr>
<tr>
<td>RL7520W</td>
<td>27.0</td>
<td>4.0</td>
<td>1.2</td>
<td>15.8</td>
</tr>
</tbody>
</table>