High reliability  Thin film chip resistors
High durability  High reliability  Thin film chip resistors
Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- If you are not sure whether it applies to RoHS/REACH directive or not when using stock items, please do not hesitate to contact our sales representative.

- AEC-Q200 compliant
  The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.
Panasonic has produced resistors for more than 85 years. Based on the concept, "Good products begin with Good components." by our founder Konosuke Matsushita, Panasonic started manufacturing fixed carbon film resistors for radio receivers in 1933 and reached the milestone of accumulative 2 trillion pieces production by 2013.

By lining up with this number of resistors, standard 1608 mm size, we can make a round trip to the moon (244,198 miles).
Panasonic chip resistors, product line-up

Chip resistors

- Thick film type
  - High-performance Network Standard chip resistors

- Thin film type

- Metal plate type
  - Metal plate chip resistors

High reliability
- ERA*A series

High durability
- ERA*V/K series

NEW

- Improving durability for overloading
- Reducing anti-solder joint crack in heat cycle environment
- Reducing variation of resistance value under temperature variation
- Reducing variation of resistance value under sulfur environment
- AEC-Q200 compliant

[Icon description]
- Anti-surge
- High precision
- Anti-Solder Joint Crack
- Low TCR
- AEC-Q200

Some exceptions
Proper Usage: Thick film & Thin film chip resistors

**Tolerance • TCR Matrix**

<table>
<thead>
<tr>
<th>TCR (ppm/K)</th>
<th>10</th>
<th>15</th>
<th>25</th>
<th>50</th>
<th>100</th>
<th>100 &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td></td>
<td></td>
<td>±0.1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>ERA*V/K</td>
<td>ERA*A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td>±0.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±0.1%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Thin film chip area</td>
<td>Thin film chip area</td>
<td>Thin film chip area</td>
<td>Thin film chip area</td>
<td>Thin film chip area</td>
<td>Thin film chip area</td>
</tr>
</tbody>
</table>

※Our recommended combinations for Tolerance & TCR

**Chip resistors flowchart**

- **TCR**
  - Less than ±50 ppm/K or more
  - ±0.1 % or more
  - ±0.5 % or more
- **Resistance value tolerance**
  - Endurance test tolerance
  - Less than ±0.5 %
- **Thin film chip resistors**
  - **TCR**
    - ±25 ppm/K or more
    - Less than ±25 ppm/K

**Anti-ESD**

- Unnecessary
- Necessary

**High precision**

- ERA*A
- ERA*V/K

**High durability • High precision**

- P5
- P7
High precision Thin film chip resistors

ERA*A series

Reduce total resistance value by 1/4 from high-precision thick film resistors

✓ Resistance tolerance ± 0.1%
✓ TCR ± 25 ppm/K
✓ Endurance test tolerance ± 0.1%

Quarter total resistance from high-precision thick film resistors

1. Suppress deterioration of set’s performance and reliability in long-term use and temperature change
2. Save design cost by design margin securing

Achieving high-precision (Endurance test tolerance ±0.1%) by original Ni & Cr & Si - High-precision resistance materials and protecting resistor by Sputter protection film.

Endurance load test (1 kΩ)
85°C, 85%RH, Rated load, 1608 Thick film resistors

Structural drawing

High-precision alloy (NiCrSi)  Metal oxide
Epoxy resin
Gold electrode  Alumina substrates  Gold electrode
### ERA*A series

**Point**

Soft termination technology adopted

[ Thermal shock test (-55℃ to 155℃ 2500cycle) solder joint crack ratio ]

<table>
<thead>
<tr>
<th>Cycle</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional thin film chip resistors</td>
<td>0 %</td>
<td>60 %</td>
<td>80 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>ERA*A</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>40 %</td>
<td>90 %</td>
</tr>
</tbody>
</table>

---

**Specifications**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Size (mm)</th>
<th>Power rating (W)</th>
<th>Limiting element voltage (V)</th>
<th>Resistance tolerance (%)</th>
<th>Resistance range (Ω)</th>
<th>TCR (x10⁻⁶ / K)</th>
<th>Category temp. range (℃)</th>
<th>AEC-Q200</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERA1AEB</td>
<td>0603</td>
<td>0.05</td>
<td>25</td>
<td>± 0.1</td>
<td>10 to 10 k</td>
<td>± 25</td>
<td>-55 to 155</td>
<td>Grade 1</td>
</tr>
<tr>
<td>ERA2AEB</td>
<td>1005</td>
<td>0.063</td>
<td>50</td>
<td>± 0.1</td>
<td>47 to 100 k</td>
<td>± 25</td>
<td>Grade 0</td>
<td></td>
</tr>
<tr>
<td>ERA3AEB</td>
<td>1608</td>
<td>0.1</td>
<td>75</td>
<td>± 0.1</td>
<td>47 to 330 k</td>
<td>± 25</td>
<td>Grade 1</td>
<td></td>
</tr>
<tr>
<td>ERA6AEB</td>
<td>2012</td>
<td>0.125</td>
<td>100</td>
<td>± 0.1</td>
<td>47 to 1 M</td>
<td>± 25</td>
<td>Grade 0</td>
<td></td>
</tr>
<tr>
<td>ERA8AEB</td>
<td>3216</td>
<td>0.25</td>
<td>150</td>
<td>± 0.1</td>
<td>47 to 1 M</td>
<td>± 25</td>
<td>Grade 1</td>
<td></td>
</tr>
</tbody>
</table>

Please visit our website for details!  

[Diagram: Soft terminal technology diagram showing expansion and contraction with stress points highlighted.]

- Crack ratio (%) vs. Simulation (Cycle) graph showing conventional thin film chip resistors and ERA*A performance.

**Note:** The graph illustrates the crack ratio (%) over different simulation cycles, comparing conventional thin film chip resistors and ERA*A technologies. ERA*A shows superior performance with lower crack ratios even after 2500 cycles.

**Click**

- ERA*A series
- Please visit our website for details!
ERA*V/K series

Achieving higher-precision and longer-life than ERA*A series

- Resistance tolerance ± 0.05%
- TCR ± 10 ppm/K
- Endurance test tolerance ± 0.1%

**Half total resistance from thin film chip resistors (ERA*A series)**

1. High-precision, design margin securing and improve performance
2. Improve reliability in severe conditions

**Point**

Current intense prevention by resistor pattern & improve anti-ESD by reducing electric field strength

**Anti-ESD**

- ESD test (1 kΩ)
  - HBM: 150pF, 2kV, ±5 times
  - 1608 thin film chip resistors

<table>
<thead>
<tr>
<th>Resistive film thickness regularization</th>
<th>Expand resistor pattern length</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional A series</strong></td>
<td><strong>New V/K series</strong></td>
</tr>
<tr>
<td>In alumina grain boundaries (large size), thin resistor film area</td>
<td>In alumina grain boundaries (small grain size), no thin resistor film area</td>
</tr>
<tr>
<td>Ave. grain size 3 μm</td>
<td>Ave. grain size 0.5 μm</td>
</tr>
<tr>
<td>Resistor film</td>
<td>Resistor film</td>
</tr>
<tr>
<td>Intensity of overcurrent locally → <strong>Destory resistor</strong></td>
<td>No intensity of overcurrent → <strong>No destory resistor</strong></td>
</tr>
</tbody>
</table>

Electric field strength reduction

- Reduce electric potential difference on length wise by expanding resistor pattern length
ERA*V/K series

Improve anti-sulfurated by the introduction of edge sputtering electrode covering gap between protection film and electrode

**Anti-sulfurated**
- Sulfurization gas test
  ASTM B809 : 105℃ 1608 Thin film chip resistors

![Graph showing resistance fluctuation over time]

Achieve excellent anti-solder joint crack by back side resin layer

![Diagram showing stress relief on solder fillet]

### Specifications

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Size (mm)</th>
<th>Power rating (W)</th>
<th>Limiting element voltage (V)</th>
<th>Resistance tolerance (%)</th>
<th>Resistance range (Ω)</th>
<th>TCR (x10^-6 / K)</th>
<th>ESD withstand voltage (kV)</th>
<th>Category temp. range (℃)</th>
<th>AEC-Q200</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERA2V</td>
<td>1005</td>
<td>0.063</td>
<td>50</td>
<td>± 0.1 ±0.05</td>
<td>1 k ≤ R ≤ 10 k</td>
<td>+10(R)</td>
<td>1.0</td>
<td>-55 to 155</td>
<td>Grade 0</td>
</tr>
<tr>
<td>ERA3V</td>
<td>1608</td>
<td>0.100</td>
<td>75</td>
<td>± 0.1 ±0.05</td>
<td>1 k ≤ R ≤ 10 k</td>
<td>+10(R)</td>
<td>1.5</td>
<td>Grade 0</td>
<td></td>
</tr>
<tr>
<td>ERA6V</td>
<td>2012</td>
<td>0.125</td>
<td>100</td>
<td>± 0.1 ±0.05</td>
<td>1 k ≤ R ≤ 100 k</td>
<td>+10(R)</td>
<td>2.0</td>
<td>Grade 0</td>
<td></td>
</tr>
<tr>
<td>ERA8V</td>
<td>3216</td>
<td>0.250</td>
<td>150</td>
<td>± 0.1 ±0.05</td>
<td>1 k ≤ R ≤ 100 k</td>
<td>+10(R)</td>
<td>2.0</td>
<td>Grade 0</td>
<td></td>
</tr>
</tbody>
</table>

Please visit our website for details!
Application Example ①
Current detection amplifier circuit for motor drive control unit

Application Example ②
Voltage detection circuit for battery unit
CAUTION AND WARNING

1. The electronic components contained in this catalog are designed and produced for use in home electric appliances, office equipment, information equipment, communications equipment, and other general purpose electronic devices. Before use of any of these components for equipment that requires a high degree of safety, such as medical instruments, aerospace equipment, disaster-prevention equipment, security equipment, vehicles (automobile, train, vessel), please be sure to contact our sales representative corporation.

2. When applying one of these components for equipment requiring a high degree of safety, no matter what sort of application it might be, be sure to install a protective circuit or redundancy arrangement to enhance the safety of your equipment. In addition, please carry out the safety test on your own responsibility.

3. When using our products, no matter what sort of equipment they might be used for, be sure to make a written agreement on the specifications with us in advance.

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