

### Precautions

All product specifications and data are subject to change without prior notice. Be sure to request and confirm the latest technical specifications before you order or use a part.

*Matters common to all products*

#### General

- For precautions in general, refer to “JEITA RCR-1001B Safety application guide on components for using electronic and electrical equipment” issued by JEITA.

#### Application

- Identify the application before the use of the product and contact us in advance if it involves transportation (automobiles, airplanes, trains and ships), medical equipment, space equipment, energy equipment, traffic and information facilities, which requires high reliability and its malfunction may threaten human life or property.
- Consider sufficient fail-safe design if the products are used in high-reliability applications. Ensure the safety of the whole system by using proactive and redundant circuits to avoid unsafe operation due to a single product failure.

#### Environment for Use

- Unless otherwise specified, these products are not to be used in special environments. Examine and confirm performance and reliability before you use KOA products in any of the following environments:
  - Under direct sunlight, exposed to the outside or to dust.
  - In liquids such as water, oil, organic solvent, or liquid chemicals or in areas where these liquids are used.
  - In locations where the products are exposed to salt-water breezes or corrosive gases, including SO<sub>2</sub>, H<sub>2</sub>S, Cl<sub>2</sub>, NH<sub>3</sub>, NO<sub>2</sub>, etc.
  - In locations with high static electricity and strong electromagnetic waves.
  - In locations subject to condensation from dew.
  - When the products or PCBs are sealed and coated by resin or other coating materials.
  - In locations where the products are exposed to the fumes of lubricating oil.

#### Sulfuration

- Products with silver-based electrodes may increase in resistance in atmospheres containing sulfur gases (H<sub>2</sub>S, SO<sub>2</sub>, etc.) or when exposed to sulfide compounds. Take anti-sulfur measures in these environments.

#### Anti-pulse Characteristics

- If transient overloads such as power pulse or voltage/current surges are applied to KOA products, performance and reliability may be degraded. Contact KOA for data on antipulse characteristics and design help.
- Pay attention to discharges between terminations (arc-over) when high voltages are applied.

#### Storage

- Store KOA products in dust-free areas and keep them away from extreme temperatures; moisture; condensation; direct sunlight; salt-water breezes; corrosive gases such as SO<sub>2</sub>, H<sub>2</sub>S, Cl<sub>2</sub>, NH<sub>3</sub>, NO<sub>2</sub>, etc.; or fumes from lubricating oil. Use desiccants if necessary.
- Please contact KOA for conditions and length of storage.

#### Storage of the Products with Lead-free Termination

- Solderability may degrade faster for products with Pb-free terminals than for products with Pb-bearing terminals.

#### Mounting

- Avoid physical damage or shock to the products, which may happen by holding them with hard tools like pliers or tweezers or by imperfect mounting-machine alignment. This damage may affect electrical characteristics or lead to disconnection or cracking.
- If the bottom point of the mounting nozzle is too low, a product could be pushed onto the PCB, which may deteriorate electrical characteristics or lead to cracking. Decelerate the nozzle just before mounting, and mount the product after correcting PCB deformations.
- Do not use products that have fallen during mounting or that have already been removed from a PCB.
- Contact KOA if PCBs are molded or sealed by coating material after component mounting.
- Do not stack PCBs after mounting, because this may damage the components.
- The electrical characteristics of film-type resistors and sensors may be changed by electrostatic overvoltage. Keep electrostatic discharge away from components when assembling and handling by monitoring machines and human contact.
- Prevent or eliminate the introduction of ionic substances like salt, salinity, or sweat, as these substances may degrade resistance due to moisture or corrosion.

#### Soldering

- Perform soldering within the temperature, time, and number of cycles specified for the product or its precautions. If a product is exposed to high temperatures for long periods of time, its color or electrical characteristics may change or disconnection may occur.
- Prevent any external force from being applied to the products until solder has cooled.
- Handle carefully to prevent mechanical stresses, such as from the bending or warping of a PCB, on the solder fillet.
- Confirm that solder flux residue does not affect the product.
- Confirm that components are in place when conductive adhesive is used in place of solder.

#### Precautions for Soldering with Lead-free Solder

- In Pb-free soldering, temperature may be higher than in the use of eutectic solder. Confirm that soldering is acceptable under actual conditions.
- Solder fillets may lift off double-sided boards with through holes. Confirm the solder strength on actual board material before assembly.

#### Washing

- Confirm that solder flux residue does not remain after washing, because it may cause deterioration of moisture and corrosion resistance.
- Confirm reliability in advance when using no-clean solder, water, or a soluble agent.
- Since Pb-free solder may contain many ionic materials, use RMA type solder or flux or wash sufficiently.
- Wash thoroughly after soldering to remove ionic substances like sweat and salinity. Control the washing agent appropriately to remove all ionic substances. Consult KOA when using a washing agent such as acid, alkaline, or organic solvent other than alcohol.
- Ultrasonic washing may damage products due to vibration resonance. High hydraulic pressure may also damage products. Ask KOA in advance for washing conditions.
- Dry products thoroughly after washing.

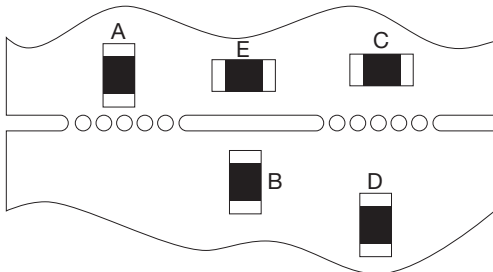
#### Dispose of the Products

- Observe appropriate laws and regulations for handling and disposal of products or packing materials.

The following precautions apply to surface mount devices

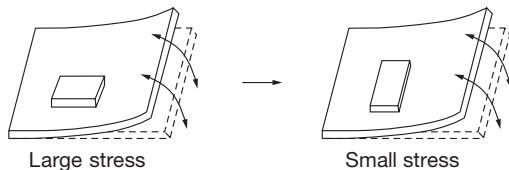
### Precautions Related to PCB Bending Stress

- Arrange the long side of chip components parallel with the direction of the smaller coefficient of thermal expansion in anisotropic PCBs.
- Cracking of the solder fillet may occur with thermal cycling, because of mismatch of coefficients of thermal expansion between the board and the component. Pad size, amount of solder, and amount of heat radiating from the PCB must be designed carefully, especially with large components of 5 mm x 2.5 mm or larger.
- If products are mounted near a depaneling line, the termination or component may be damaged by large stresses during depaneling. Mount the products as shown in the following figure to minimize depaneling stress.



The level of stress on terminations  $A > B \neq C > D > E$

- Use proper layouts to avoid stress from warping, bending, or deformation of the board in order to avoid solder cracking or component damage.



- Pay careful attention to products mounted near the edge of the board or near connectors, since stresses may happen during connection.
- Pay careful attention to layout when products are mounted near large components, when solder solidifies, it creates a stress in directions based on the large components, and cracking may occur.
- Design each land on right and left to have the same size. Different land size may change characteristics or cause cracks and tombstone effect while the solder is cooled down.

### Mounting and Soldering

- Poor mounting machine adjustment may cause cracking, chipping, or alignment errors. Check and inspect the mounting machine in advance.
- Set backup pins in an appropriate layout to avoid damage to components mounted on the back of the board. Do not set these pins at nozzle positions.
- Adjust the bottom dead point of a dispenser away from the board when you apply adhesive to avoid damage to components mounted on the back of the board.
- Confirm that products solder properly if wave soldering is used.
- Pay close attention to amount of solder, since an improper amount may create a large stress on the component and cause cracking or malfunctions.

### Soldering with a Soldering Iron

- Solder using a soldering iron at the temperature specified in the technical specifications or precautions for each product.
- Perform preheating as much as possible.
- Keep the tip of the soldering iron away from the body and the product terminal.
- Avoid physical damage or shock to components when using hard tools like pliers and tweezers.

The following precautions apply to through-hole devices

### Mechanical Stress

- Play close attention to vibration resonance after mounting.
- Do not add additional bending or twisting stresses to the product.
- Fix large components firmly.
- When lead wires are to be bent, use a large radius of curvature to avoid excessive stress on the terminal joint. Excessive stresses may cause the lead wire to separate from the electrode cap and damage the product.
- Do not add excessive stresses to the product body when lead wires are cut or held by the mounting machine.

### Temperature Rise

- Pay close attention to heat radiation and interaction with other components, since large resistors general a large amount of heat when the rated power is applied.

### Higher Power Ratings

In some cases, KOA will increase the power rating for a given component. Often, the older power rating and newer power rating are both given on the specification, in order to create a transition period. During this time, the new power rating will often have a note asking for discussion with KOA.

A higher power rating is based on appropriate resistance stability, but other ratings and parameters still require attention. For example, voltage rating is based on a separate failure mechanism and will not be increased in the same ratio. In mid- and high-value resistors, power dissipation will still be kept lower than the new rating by the voltage limit. In addition, using a resistor at a higher power than its previous rating will create a greater rise in temperature on the surface of the component. This temperature rise should be checked for acceptability and to make sure that the layout does not place the resistor near a board material or component that could be damaged by greater heat.