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Issue :CE-E-AFJ-07
 Date of Issue :23 May ,2002
 Classification New , Changed , Revised

ENGINEERING DRAFT

Product Description :Aluminum Electrolytic Capacitor
 Product Part Number :Radial lead type (JIS:04 type) FJ series
 Country of Origin :Malaysia
 Marking of the Origin :Printed on the packaging label(The name of Country of English)
 Classification of Spec. :Product specification
 Recommended Applications :MOTHER BOARD FOR PERSONAL COMPUTER
 For other application, contact our person signed below.
 Term of Validity 22 May ,2003 from the date of issue

| | |
|---|-------------------|
| CUSTOMER USE ONLY | Receipt Record #: |
| This was certainly received by us. One copy is being returned to the manufacturer. | Date of Receipt : |
| | Received by: |

- No Ozone Depleting Chemicals(ODC's), controlled under the Montreal Protocol Agreement, are used in producing this product.
- This product does not contain PBBs or PBBs.
- All the materials that are used for this product are registered as "Known Chemicals" in the Japanese act "Law Concerning the Examination and Regulation of Manufacture, etc.of Chemical Substances".
- For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.

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 No.1 Jalan Pelaga 16/13,40000 Shah Alam,Selangor,
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| | | | |
|---|------------|-----------|--------|
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No.

A type FJ series

Page No.

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Remarks

Matsushita Electronic Components Co.,Ltd. LCR Device Company
Capacitor Business Unit

A type FJ series

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1. Scope

Fixed capacitors for use in electronic equipment, Aluminum electrolytic capacitors with non-solid electrolyte.

2. Parts Number

| | | | | |
|------------|-----------|-----------|------------|-----------|
| <u>EEU</u> | <u>FJ</u> | <u>OO</u> | <u>OOO</u> | <u>□□</u> |
| 2-1 | 2-2 | 2-3 | 2-4 | 2-5 |

2-1 Aluminum Electrolytic Capacitor Type : Radial lead type (JIS : 04 type)

2-2 FJ series

2-3 Rated Voltage Code

| | | | | | | |
|----------------------|-----|----|----|----|----|----|
| Voltage Code | 0J | 1A | 1C | 1E | 1V | 1H |
| Rated Voltage (V.DC) | 6.3 | 10 | 16 | 25 | 35 | 50 |

2-4 Capacitance Code : Indicating capacitance in μF by 3 letters.

The first 2 figures are actual values and the third denotes the number of zeros.

"R" denotes the decimal point and all figures are the actual number with "R".

For example, $1\mu\text{F}$ is expressed as 1R0 in this case.

ex. $0.1\mu\text{F} \rightarrow$ R10 , $10\mu\text{F} \rightarrow$ 100 , $1000\mu\text{F} \rightarrow$ 102

2-5 Suffix Code for Appearance : Special Code for Appearance

| | |
|-------|--------------------|
| Blank | Standard Long Lead |
| E | Snap-in lead |
| B | Lead taping |

Refer to page 12 for snap-in lead, page 13 ~ 14 for lead taping dimensions,
And page 15 ~ 18 for lead taping specifications.

Remarks

Matsushita Electronic Components Co.,Ltd. LCR Device Company
Capacitor Business Unit

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Capacitance and Can Size Table[μ F] at 120Hz 20°C

| V.DC Can Size(ϕ D×L) | 6.3 | 10 | 16 | 25 | 35 | 50 |
|-------------------------------|----------------------------|------------------|-----------------|----------------|----------------|----------------|
| 8X11.5 | 560 820 U 1000 U | 470 680 U | 330 470 U | 220 330 U | 150 220 U | 100 120 U |
| 8X15 | 1200 Y | | 680 Y | | | |
| 8X20 | 1500 L 1800 Y 2200 Y | 1000 L 1500 Y | 680 L 1000 Y | 470 L 680 Y | 330 L 390 Y | 220 L 270 Y |
| 10X12.5 | 1000 1500 U | 680 1000 U | 470 680 U | 330 470 U | 220 330 U | 150 180 U |
| 10X16 | 1500 1800 U 2200 U | 1000 1500 U | 680 1000 U | 470 680 U | 330 390 U | 220 270 U |
| 10X20 | 2200 2700 U 3300 U | 1500 2200 U | 1000 1500 U | 680 1000 U | 470 560 U | 270 330 U |
| 10X25 | 3300 Y | | 1800 Y | | | |
| 12.5X20 | 3300 4700 U | | | | | |

* L, S = the last letter of part numbers.

Examples : EEUFJ0J102U... ϕ 8 × 11.5EEUFJ0J102 ... ϕ 10 × 12.5EEUFJ0J222U... ϕ 10 × 16

Remarks

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Capacitor Business Unit

A type FJ series

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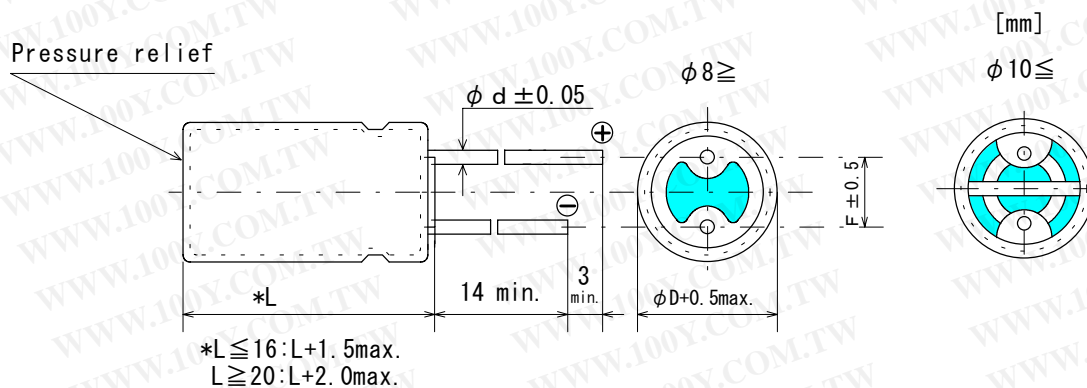
3. Standard Ratings

| No. | Item | Ratings | | | | | | |
|-----|----------------------------|------------------------------------|-----|----|----|----|----|----|
| 1 | Category Temperature Range | -25 ~ +105°C | | | | | | |
| 2 | Rated Voltage Range | 6.3 ~ 50 V.DC | | | | | | |
| 3 | Capacitance Range | 100 ~ 4700 μ F (120Hz 20°C) | | | | | | |
| 4 | Capacitance Tolerance | \pm 20% (120Hz 20°C) | | | | | | |
| 5 | Surge Voltage (V.DC) | R.V. | 6.3 | 10 | 16 | 25 | 35 | 50 |
| | | S.V. | 8 | 13 | 20 | 32 | 44 | 63 |
| 6 | Rated Ripple Current | Page 10 ~ Page 11, Table 3 | | | | | | |
| 7 | Impedance | Page 10 ~ Page 11, Table 3 | | | | | | |

4. Dimensions and Appearance

Body Color (Black) , Marking (Gold)

Standard Long Lead (Suffix : Blank)

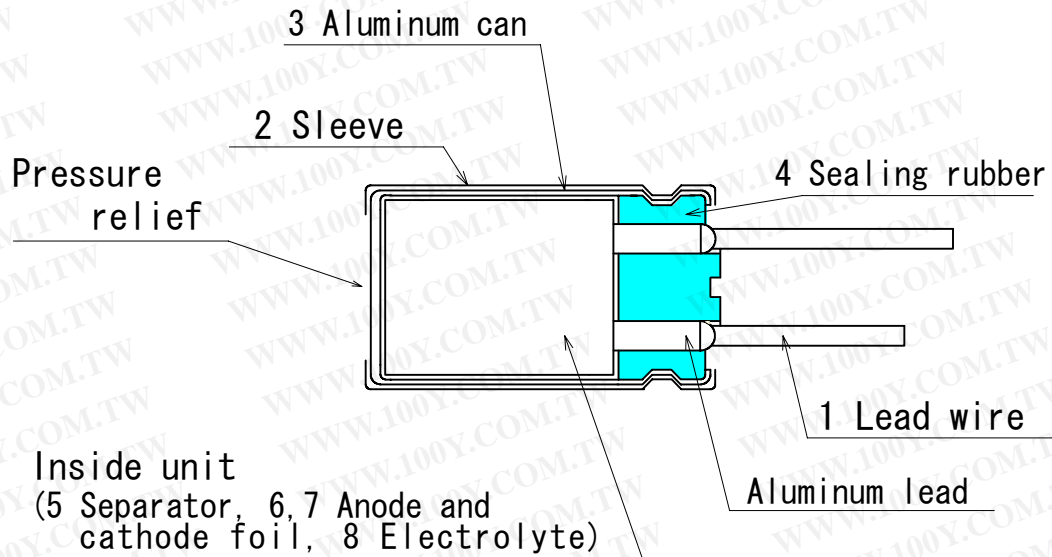


Remarks

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Capacitor Business Unit

5. Constructions

5-1 Inside Construction



5-2 Construction Parts

| | Parts | Materials | | Parts | Materials |
|---|----------------|--|---|--------------|------------------------------|
| 1 | Lead Wire | Solid tinned copper weld steel wire | 5 | Separator | Manila hemp |
| 2 | Vinyl Sleeve | Thermoplastic Resin | 6 | Anode Foil | High purity Aluminum foil |
| 3 | Aluminum Can | Aluminum | 7 | Cathode Foil | Aluminum foil |
| 4 | Sealing Rubber | Synthetic rubber | 8 | Electrolyte | — |

Remarks

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Capacitor Business Unit

A type FJ series

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6. Performance Characteristics

| No | Item | Performance Characteristics | Test | | | | | | | | | | | | | | | | | | |
|------|---|---|--|------|------------------|------|---|--------------------------|------|---|---------------------------|--------|---|--------------------------|------------|---|---------------------------|---------|---|--------------------------|--------|
| 1 | Leakage Current | $\leq I = 0.01CV$ I : Leakage current C : Capacitance V : Rated voltage | Series Resistor : $1000 \pm 10 \Omega$ Applied Voltage : Rated voltage Measuring : After 2 minutes | | | | | | | | | | | | | | | | | | |
| 2 | Capacitance | Within the specified capacitance tolerance. | Measuring Frequency : $120 \text{ Hz} \pm 20\%$ Measuring Circuit : Equivalent series circuit Measuring Voltage : $+1.5 \sim 2 \text{ V. DC}$ ($\leq 0.5 \text{ V}$ for AC.) | | | | | | | | | | | | | | | | | | |
| 3 | Tangent of Loss Angle ($\tan \delta$) | Less than the table 1 value of page 9. Added 0.02 per $1000 \mu\text{F}$ for items with over $1000 \mu\text{F}$. | Measuring Frequency : $120 \text{ Hz} \pm 20\%$ Measuring Circuit : Equivalent series circuit Measuring Voltage : $+1.5 \sim 2 \text{ V. DC}$ ($\leq 0.5 \text{ V}$ for AC.) | | | | | | | | | | | | | | | | | | |
| 4 | Impedance | 20°C Less than the initial limit. -10°C (See page 10 ~ 11) | Measuring Frequency : 100 kHz Measuring Temperature : $20 \pm 2^\circ\text{C}, -10 \pm 2^\circ\text{C}$ Measuring Point : Impedance shall be measured at a point (2mm max. from the surface of a sealing rubber) of the lead wire. | | | | | | | | | | | | | | | | | | |
| 5 | Characteristics at High and Low Temperature | Step 2 Impedance Ratio : Ratio for the value in step 1 shall be less than the value from table 2 in page 9. Step 4 Leakage Current : $\leq 800\%$ of the value of item 6. 1. Capacitance Change : Within $\pm 25\%$ of the value in step 1 Tangent of Loss Angle ($\tan \delta$): \leq the value of item 6. 3. | <table border="1"> <thead> <tr> <th>Step</th> <th>Test Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>$20 \pm 2^\circ\text{C}$</td> <td>————</td> </tr> <tr> <td>2</td> <td>$-25 \pm 3^\circ\text{C}$</td> <td>———— *</td> </tr> <tr> <td>3</td> <td>$20 \pm 2^\circ\text{C}$</td> <td>15 minutes</td> </tr> <tr> <td>4</td> <td>$105 \pm 2^\circ\text{C}$</td> <td>2 hours</td> </tr> <tr> <td>5</td> <td>$20 \pm 2^\circ\text{C}$</td> <td>———— *</td> </tr> </tbody> </table> <p>Impedance should be measured at the frequency of $120 \text{ Hz} \pm 10\%$.</p> <p>* Capacitors should be stored at each temperature until measured impedance or capacitance is stabilized.</p> | Step | Test Temperature | Time | 1 | $20 \pm 2^\circ\text{C}$ | ———— | 2 | $-25 \pm 3^\circ\text{C}$ | ———— * | 3 | $20 \pm 2^\circ\text{C}$ | 15 minutes | 4 | $105 \pm 2^\circ\text{C}$ | 2 hours | 5 | $20 \pm 2^\circ\text{C}$ | ———— * |
| Step | Test Temperature | Time | | | | | | | | | | | | | | | | | | | |
| 1 | $20 \pm 2^\circ\text{C}$ | ———— | | | | | | | | | | | | | | | | | | | |
| 2 | $-25 \pm 3^\circ\text{C}$ | ———— * | | | | | | | | | | | | | | | | | | | |
| 3 | $20 \pm 2^\circ\text{C}$ | 15 minutes | | | | | | | | | | | | | | | | | | | |
| 4 | $105 \pm 2^\circ\text{C}$ | 2 hours | | | | | | | | | | | | | | | | | | | |
| 5 | $20 \pm 2^\circ\text{C}$ | ———— * | | | | | | | | | | | | | | | | | | | |
| 6 | Surge | Leakage Current : \leq the value of item 6.1. Capacitance Change : Within $\pm 15\%$ of the initially measured value. Tangent of Loss Angle ($\tan \delta$): \leq the value of item 6. 3. Appearance : No significant change can be observed. | Test Temperature : $15 \sim 35^\circ\text{C}$ Series Protective Resistance : $R = \frac{100 \pm 50}{C}$ $\left[\begin{array}{l} R = \text{Series protective resistance (k}\Omega\text{)} \\ C = \text{Capacitance (}\mu\text{F)} \end{array} \right]$ Test Voltage : Surge voltage item 3. 5 Applied Voltage : 1000 cycles of $30 \pm 5 \text{ sec.}$ "ON" and 5 min. 30 sec. "OFF" | | | | | | | | | | | | | | | | | | |

Remarks

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Capacitor Business Unit

A type FJ series

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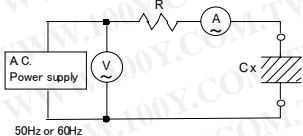
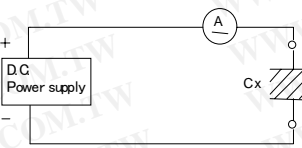
| No | Item | Performance Characteristics | Test | | | | |
|---------------|--|---|--|---------------|---------------|------------|------|
| 7 | Robustness of Terminations | There is no damage or breakage after test. | <table border="1"> <thead> <tr> <th>Diameter [mm]</th> <th>Pull Strength</th> </tr> </thead> <tbody> <tr> <td>$\phi 0.6$</td> <td>10 N</td> </tr> </tbody> </table> <p>Applied above steady pull axially for a 10 ± 1 seconds.</p> | Diameter [mm] | Pull Strength | $\phi 0.6$ | 10 N |
| | Diameter [mm] | | Pull Strength | | | | |
| $\phi 0.6$ | 10 N | | | | | | |
| Tensile | <table border="1"> <thead> <tr> <th>Diameter [mm]</th> <th>Static Load</th> </tr> </thead> <tbody> <tr> <td>$\phi 0.6$</td> <td>5 N</td> </tr> </tbody> </table> <p>At first, a capacitor is placed in vertical position with the weight specified above being applied to one of leads. Then the capacitor is slowly rotated 90° to horizontal position and subsequently returned to vertical position. The above bending procedure takes for 2 ~ 3 seconds. An additional bending is done in the opposite direction.</p> | Diameter [mm] | Static Load | $\phi 0.6$ | 5 N | | |
| Diameter [mm] | Static Load | | | | | | |
| $\phi 0.6$ | 5 N | | | | | | |
| 8 | Vibration | Capacitance : Measured value is to be stabilized during test. (Measured several times within 30 min. before completion of test) | Frequency : 10 ~ 55 Hz (1 minute per cycle.) | | | | |
| | | Appearance : No significant change can be observed. Capacitance Change : Within $\pm 5\%$ of the initially measured value. | Total Amplitude : 1.5 mm Direction and Duration of Vibration : It is done in the X, Y, Z axis direction for 2 hours each, with a total of 6 hours. Mounting Method : The capacitor shall be fixed with its lead wires at the point of 4 mm from the bottom of capacitor body. The capacitor with diameter greater than 12.5 mm or longer than 25 mm must be fixed in place with a bracket. | | | | |
| 9 | Solderability | More than 3/4 of the terminal surface shall be covered with new solder. | Solder Type : H60A, H60S, or H63A (JIS Z3282) Solder Temperature : $235 \pm 5^\circ \text{C}$ Immersing Time : 2 ± 0.5 sec. Immersing Depth : 1.5 ~ 2.0 mm from the root. Flux : Approx. 25% rosin (JIS K5902) in ETHANOL (JIS K8101) | | | | |
| 10 | Resistance to Soldering Heat | Leakage Current : \leq the value of item 6.1. Capacitance Change : Within $\pm 10\%$ of the initially measured value. Tangent of Loss Angle ($\tan \delta$): \leq the value of item 6.3. Appearance : No significant change can be observed. | Solder Type : H60A, H60S, or H63A (JIS Z3282) Solder Temperature : $260 \pm 5^\circ \text{C}$ Immersing Time : 10 ± 1 sec. Immersing Depth : 1.5 ~ 2.0 mm from the root. | | | | |

Remarks

Matsushita Electronic Components Co.,Ltd. LCR Device Company
Capacitor Business Unit

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| No | Item | Performance Characteristics | Test | | | | | | | | | | | | | | | | | | | | |
|-----------------------|-------------------------------|---|---|------------------|-------------------|-----|----------|-------------|--------|---------------|------|-----------------|-------|-------------------|----------|---------|---|-----------------------|----------------|--------|-----------|--------|------------|
| 11 | Solvent Resistance of Marking | There shall be no damage and legible marking. Marking can be easily comprehended. | Class of Reagent : Isopropyl Alcohol Test Temperature : 20 ~ 25 °C Immersing Time : 30±5 sec. | | | | | | | | | | | | | | | | | | | | |
| 12 | Pressure Relief | Pressure relief shall be operated without any hazardous expulsion or emission of flame. No emission of gas after 30 minutes of the voltage application also meets the specification. | <p>AC Current Method</p>  <p>50Hz or 60Hz A : A.C. ammeter R : Series resistor V : A.C. voltmeter Cx : Tested capacitor</p> <p>Applied Voltage : AC voltage equals to rated W. V. × 0.7 or 250 V (rms), whichever is smaller.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Capacitance (μF)</th> <th>DC Resistance (Ω)</th> </tr> </thead> <tbody> <tr> <td>≤ 1</td> <td>1000±100</td> </tr> <tr> <td>> 1 ≤ 10</td> <td>100±10</td> </tr> <tr> <td>> 10 ≤ 100</td> <td>10±1</td> </tr> <tr> <td>> 100 ≤ 1000</td> <td>1±0.1</td> </tr> <tr> <td>> 1000 ≤ 10000</td> <td>0.1±0.01</td> </tr> <tr> <td>> 10000</td> <td>*</td> </tr> </tbody> </table> <p>* When capacitance is over 10000 μF, the value of series resistance equals to the half of the tested capacitor's impedance.</p> <p>Reverse Voltage Method</p>  <p>A : D.C. ammeter Cx : Tested capacitor</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Nominal Diameter [mm]</th> <th>DC Current (A)</th> </tr> </thead> <tbody> <tr> <td>≤ 22.4</td> <td>1 (const)</td> </tr> <tr> <td>> 22.4</td> <td>10 (const)</td> </tr> </tbody> </table> | Capacitance (μF) | DC Resistance (Ω) | ≤ 1 | 1000±100 | > 1 ≤ 10 | 100±10 | > 10 ≤ 100 | 10±1 | > 100 ≤ 1000 | 1±0.1 | > 1000 ≤ 10000 | 0.1±0.01 | > 10000 | * | Nominal Diameter [mm] | DC Current (A) | ≤ 22.4 | 1 (const) | > 22.4 | 10 (const) |
| Capacitance (μF) | DC Resistance (Ω) | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 1 | 1000±100 | | | | | | | | | | | | | | | | | | | | | | |
| > 1 ≤ 10 | 100±10 | | | | | | | | | | | | | | | | | | | | | | |
| > 10 ≤ 100 | 10±1 | | | | | | | | | | | | | | | | | | | | | | |
| > 100 ≤ 1000 | 1±0.1 | | | | | | | | | | | | | | | | | | | | | | |
| > 1000 ≤ 10000 | 0.1±0.01 | | | | | | | | | | | | | | | | | | | | | | |
| > 10000 | * | | | | | | | | | | | | | | | | | | | | | | |
| Nominal Diameter [mm] | DC Current (A) | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 22.4 | 1 (const) | | | | | | | | | | | | | | | | | | | | | | |
| > 22.4 | 10 (const) | | | | | | | | | | | | | | | | | | | | | | |

Remarks

Matsushita Electronic Components Co.,Ltd. LGR Device Company
Capacitor Business Unit

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| No | Item | Performance Characteristics | Test |
|----|-----------------------------|--|--|
| 13 | Damp Heat (Steady state) | Leakage Current : \leq the value of item 6.1. Capacitance Change : Within $\pm 20\%$ of the initially measured value. Tangent of Loss Angle ($\tan \delta$): $\leq 120\%$ the value of item 6. 3. Appearance : No significant change can be observed. | Test Temperature : 40 ± 2 °C Relative Humidity : 90 ~ 95% Test Duration : 240 ± 8 hours After subjected to the test, capacitors shall be left for 2 hours at room temperature and room humidity prior to the measurement. |
| 14 | Endurance | Leakage Current : \leq the value of item 6.1. Capacitance Change : Under 12.5mm Height Within $\pm 25\%$ of the initially measured value. (code "U", "Y": $\pm 30\%$) Over 15mm Height Within $\pm 35\%$ of the initially measured value. Tangent of Loss Angle ($\tan \delta$): $\leq 200\%$ of the value of item 6. 3. Appearance : No significant change can be observed. | Under 12.5mm Height Test Temperature : 105 ± 2 °C Test Duration : 2000^{+72}_0 hours Applied Voltage : Rated voltage Over 15mm Height Test Temperature : 105 ± 2 °C Test Duration : 3000^{+72}_0 hours Applied Voltage : Rated voltage After subjected to the test, capacitors shall be left at room temperature and room humidity for 2 hours prior to the measurement. |
| 15 | Shelf Life | Leakage Current : \leq the value of item 6.1. Capacitance Change : Under 12.5mm Height Within $\pm 25\%$ of the initially measured value. (code "U", "Y": $\pm 30\%$) Over 15mm Height Within $\pm 35\%$ of the initially measured value. Tangent of Loss Angle ($\tan \delta$): $\leq 200\%$ of the value of item 6. 3. Appearance : No significant change can be observed. | Test Temperature : 105 ± 2 °C Test Duration : 1000^{+48}_0 hours After subjected to the test with no voltage applied, capacitors shall undergo voltage treatment* and be left for 1~2 hours at room temperature and humidity prior to the measurement. |

Remarks * Voltage treatment : The rated voltage shall be applied to the capacitors, which are connected to series protective resistors ($1000 \pm 10 \Omega$), for 30 minutes as a posttest treatment (performing discharge).

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7. Marking

(1) Markings indicated on the products :

- a) Rated Voltage.
- b) Capacitance
- c) Negative Polarity
- d) Matsushita Electric Trademark
- e) Upper Category Temperature
- f) Series Code
- g) Lot No.

(2) Label On the Packaging Box by English

- a) Rated Voltage, Capacitance
- b) Matsushita Electric Trademark
- c) Part Number
- d) Packing Quantity
- e) Serial No.
- f) Manufacturer's Name
- g) Country of Origin

8. Others

Unless otherwise specified, the product shall conform to JIS C 5141.

■ Table 1. Tangent of Loss Angle($\tan \delta$)

| | | | | | | |
|------------|------|------|------|------|------|------|
| V.DC | 6.3 | 10 | 16 | 25 | 35 | 50 |
| D.F.(max.) | 0.22 | 0.19 | 0.16 | 0.14 | 0.12 | 0.10 |

Added 0.02 per 1000 μ F for items with over 1000 μ F items.

■ Table 2.Characteristics at low temperature Impedance ratio (at 120 Hz)

| | | | | | | |
|------------------------|-----|----|----|----|----|----|
| V.DC | 6.3 | 10 | 16 | 25 | 35 | 50 |
| Z(-25°C)/Z(20°C)(max.) | 3 | 3 | 3 | 3 | 3 | 3 |

■ Table 3.Frequency Correction Factor of Rated Ripple Current

| Cap. (μ F) | Frequency (Hz) | | | |
|--------------------|----------------|------|------|-------|
| | 120 | 1k | 10k | 100k~ |
| 100~330 | 0.40 | 0.75 | 0.93 | 1.00 |
| 390~1000 | 0.50 | 0.85 | 0.95 | 1.00 |
| 1200~4700 | 0.55 | 0.90 | 0.98 | 1.00 |

* Rated ripple current shall be calculated as below :

Where

$$I_p = I \times k_f$$

$$\left(\begin{array}{l} I_p = \text{Rated Ripple Current} \\ I = \text{Specified Ripple Current at 100 kHz} \\ k_f = \text{Frequency Correction Factor} \end{array} \right)$$

In case the calculated ripple current is too high and the peak-to-peak ripple voltage exceeds its rated voltage, the rated ripple current shall be calculated by the following formula.

Where

$$I_p' = \pi \times f \times C \times V_N / \sqrt{2} \times 10^{-6}$$

$$\left(\begin{array}{l} I_p' = \text{Rated Ripple Current [A rms]} \\ f = \text{Frequency [Hz]} \\ C = \text{Capacitance [uF]} \\ V_N = \text{Rated Voltage [V]} \end{array} \right)$$

Remarks

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Capacitor Business Unit

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[Http://www.100y.com.tw](http://www.100y.com.tw)

Electrolytic Capacitor

CE-E-AFJ-07

A type FJ series

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| | Part No. | V.DC | Cap. μ F | Leakage Current μ A max. | Rated Ripple Current mA rms max.*1 | ESR (Ω max.) 100kHz | | Dim. [mm] | | | Endurance (hours) | |
|--|-------------|------|-------------|-----------------------------------|---|---------------------------|-------|-----------|------|-----|----------------------|---|
| | | | | | | +20°C | -10°C | φ D | L | φ d | | h |
| | | | | | | | | | | | | |
| | EEUFJ0J561 | 6.3 | 560 | 35.2 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ0J821U | 6.3 | 820 | 51.6 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ0J102U | 6.3 | 1000 | 63.0 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ0J102 | 6.3 | 1000 | 63.0 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ0J122Y | 6.3 | 1200 | 75.6 | 1490 | 0.028 | 0.084 | 8 | 15 | 0.6 | 3000 | |
| | EEUFJ0J152L | 6.3 | 1500 | 94.5 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ0J152U | 6.3 | 1500 | 94.5 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ0J152 | 6.3 | 1500 | 94.5 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ0J182Y | 6.3 | 1800 | 113.4 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ0J182U | 6.3 | 1800 | 113.4 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ0J222Y | 6.3 | 2200 | 138.6 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ0J222U | 6.3 | 2200 | 138.6 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ0J222 | 6.3 | 2200 | 138.6 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ0J272U | 6.3 | 2700 | 170.1 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ0J332U | 6.3 | 3300 | 207.9 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ0J332Y | 6.3 | 3300 | 207.9 | 2800 | 0.012 | 0.036 | 10 | 25 | 0.6 | 3000 | |
| | EEUFJ0J332 | 6.3 | 3300 | 207.9 | 2800 | 0.012 | 0.036 | 12.5 | 20 | 0.6 | 3000 | |
| | EEUFJ0J472U | 6.3 | 4700 | 296.1 | 2800 | 0.012 | 0.036 | 12.5 | 20 | 0.6 | 3000 | |
| | | | | | | | | | | | | |
| | EEUFJ1A471 | 10 | 470 | 47.0 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ1A681U | 10 | 680 | 68.0 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ1A681 | 10 | 680 | 68.0 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ1A102L | 10 | 1000 | 100.0 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ1A102U | 10 | 1000 | 100.0 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ1A102 | 10 | 1000 | 100.0 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ1A152Y | 10 | 1500 | 150.0 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ1A152U | 10 | 1500 | 150.0 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ1A152 | 10 | 1500 | 150.0 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ1A222U | 10 | 2200 | 220.0 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | | | | | | | | | | | | |
| | EEUFJ1C331 | 16 | 330 | 52.8 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ1C471U | 16 | 470 | 75.2 | 1140 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| | EEUFJ1C471 | 16 | 470 | 75.2 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ1C681Y | 16 | 680 | 108.8 | 1490 | 0.028 | 0.084 | 8 | 15 | 0.6 | 3000 | |
| | EEUFJ1C681L | 16 | 680 | 108.8 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ1C681U | 16 | 680 | 108.8 | 1540 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| | EEUFJ1C681 | 16 | 680 | 108.8 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ1C102Y | 16 | 1000 | 160.0 | 1870 | 0.016 | 0.048 | 8 | 20 | 0.6 | 3000 | |
| | EEUFJ1C102U | 16 | 1000 | 160.0 | 2000 | 0.018 | 0.054 | 10 | 16 | 0.6 | 3000 | |
| | EEUFJ1C102 | 16 | 1000 | 160.0 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ1C152U | 16 | 1500 | 240.0 | 2550 | 0.013 | 0.039 | 10 | 20 | 0.6 | 3000 | |
| | EEUFJ1C182Y | 16 | 1800 | 288.0 | 2800 | 0.012 | 0.036 | 10 | 25 | 0.6 | 3000 | |

Remarks *1 100kHz 105°C

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A type FJ series

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| | Part No. | V.DC | Cap. μ F | Leakage Current μ A max. | Rated Ripple Current mA rms max.*1 | ESR (Ω max.) 100kHz | | Dim. [mm] | | | Endurance (hours) |
|-------------|----------|------|-----------------|---------------------------------------|---|-----------------------------------|-------|-----------|------|----------|----------------------|
| | | | | | | +20°C | -10°C | ϕ D | L | ϕ d | h |
| | | | | | | EEUFJ1E221 | 25 | 220 | 55.0 | 1110 | 0.030 |
| EEUFJ1E331U | 25 | 330 | 82.5 | 1080 | 0.032 | 0.096 | 8 | 11.5 | 0.6 | 2000 | |
| EEUFJ1E331 | 25 | 330 | 82.5 | 1440 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1E471L | 25 | 470 | 117.5 | 1820 | 0.018 | 0.054 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1E471U | 25 | 470 | 117.5 | 1390 | 0.027 | 0.081 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1E471 | 25 | 470 | 117.5 | 1920 | 0.020 | 0.060 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1E681Y | 25 | 680 | 170.0 | 1720 | 0.020 | 0.060 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1E681U | 25 | 680 | 170.0 | 1830 | 0.022 | 0.066 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1E681 | 25 | 680 | 170.0 | 2180 | 0.016 | 0.048 | 10 | 20 | 0.6 | 3000 | |
| EEUFJ1E102U | 25 | 1000 | 250.0 | 2060 | 0.018 | 0.054 | 10 | 20 | 0.6 | 3000 | |
| | | | | | | | | | | | |
| EEUFJ1V151 | 35 | 150 | 52.5 | 1110 | 0.030 | 0.090 | 8 | 11.5 | 0.6 | 2000 | |
| EEUFJ1V221U | 35 | 220 | 77.0 | 1080 | 0.032 | 0.096 | 8 | 11.5 | 0.6 | 2000 | |
| EEUFJ1V221 | 35 | 220 | 77.0 | 1440 | 0.025 | 0.075 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1V331L | 35 | 330 | 115.5 | 1820 | 0.018 | 0.054 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1V331U | 35 | 330 | 115.5 | 1390 | 0.027 | 0.081 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1V331 | 35 | 330 | 115.5 | 1920 | 0.020 | 0.060 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1V391Y | 35 | 390 | 136.5 | 1720 | 0.020 | 0.060 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1V391U | 35 | 390 | 136.5 | 1830 | 0.022 | 0.066 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1V471 | 35 | 470 | 164.5 | 2180 | 0.016 | 0.048 | 10 | 20 | 0.6 | 3000 | |
| EEUFJ1V561U | 35 | 560 | 196.0 | 2060 | 0.018 | 0.054 | 10 | 20 | 0.6 | 3000 | |
| | | | | | | | | | | | |
| EEUFJ1H101 | 50 | 100 | 50.0 | 920 | 0.046 | 0.138 | 8 | 11.5 | 0.6 | 2000 | |
| EEUFJ1H121U | 50 | 120 | 60.0 | 890 | 0.049 | 0.147 | 8 | 11.5 | 0.6 | 2000 | |
| EEUFJ1H151 | 50 | 150 | 75.0 | 1230 | 0.036 | 0.108 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1H181U | 50 | 180 | 90.0 | 1180 | 0.039 | 0.117 | 10 | 12.5 | 0.6 | 2000 | |
| EEUFJ1H221L | 50 | 220 | 110.0 | 1680 | 0.023 | 0.069 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1H221 | 50 | 220 | 110.0 | 1720 | 0.026 | 0.078 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1H271Y | 50 | 270 | 135.0 | 1610 | 0.025 | 0.075 | 8 | 20 | 0.6 | 3000 | |
| EEUFJ1H271U | 50 | 270 | 135.0 | 1630 | 0.029 | 0.087 | 10 | 16 | 0.6 | 3000 | |
| EEUFJ1H271 | 50 | 270 | 135.0 | 1890 | 0.021 | 0.063 | 10 | 20 | 0.6 | 3000 | |
| EEUFJ1H331U | 50 | 330 | 165.0 | 1800 | 0.023 | 0.069 | 10 | 20 | 0.6 | 3000 | |

Remarks *1 100kHz 105°C

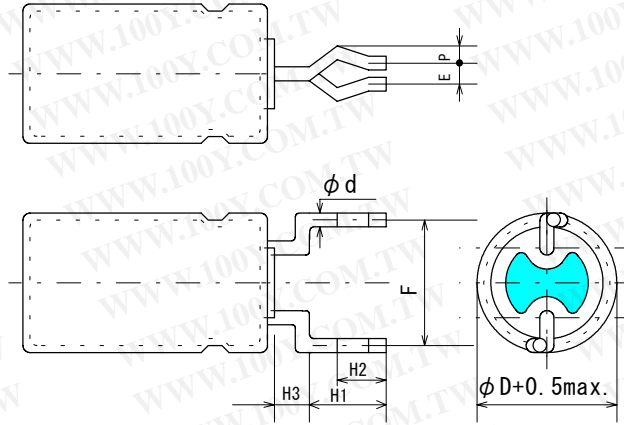
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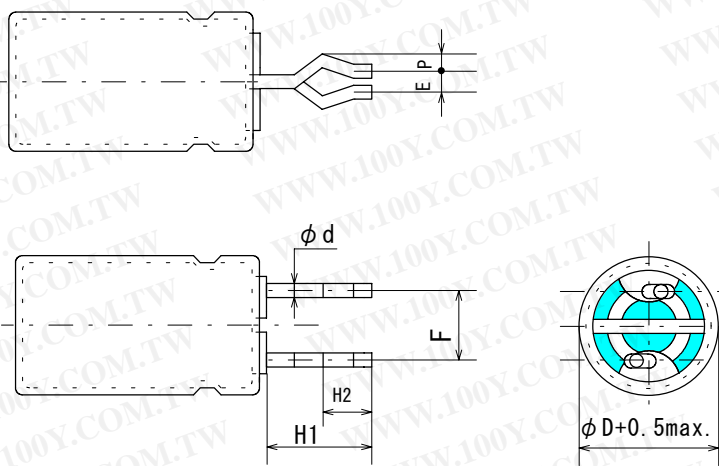
A type FJ series

Snap-In Lead Formed Type (Matsushita Part No. Suffix : E)

$\phi 8$



$\phi 10 \sim \phi 12.5$



* Direction of bending is random.

| ϕD | $H1 \pm 0.5$ | H2 | H3 max. | $F \pm 0.5$ | P | E max. | $\phi d \pm 0.05$ | [mm] | |
|----------|--------------|-----|---------|-------------|------|--------|-------------------|--------|-----|
| | | | | | | | | P.W.B | |
| | | | | | | | | ϕ | t |
| 8 | 4.5 | 2.7 | 2.5 | 5.0 | 1.00 | 1.0 | 0.60 | 1.0 | 1.6 |
| 10 | 4.5 | 2.7 | — | 5.0 | 1.00 | 1.0 | 0.60 | 1.0 | 1.6 |
| 12.5 | 4.5 | 2.7 | — | 5.0 | 1.00 | 1.0 | 0.60 | 1.0 | 1.6 |

Remarks

*The lead forming dimensions above shall only be subjected to our outgoing inspection and not to the customer's incoming inspection.
Due to the application of mechanical stress during transportation, actual dimensions might not meet the specification.

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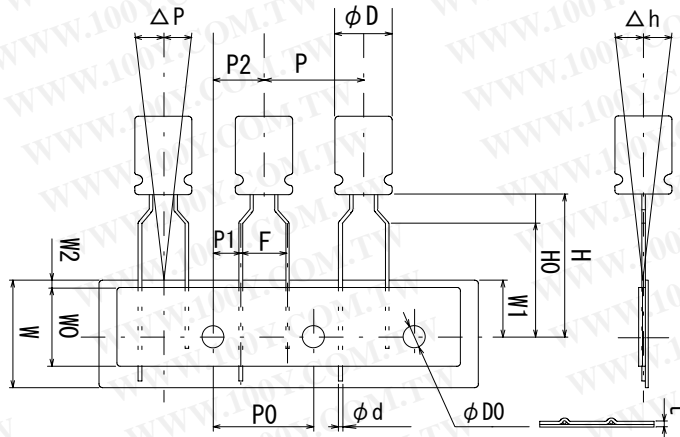
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Lead Taping (Body Diameter $\phi 8$) The Suffix of Matsushita Taping Part Number : B

1) Applicable Range

This specification is applied to products, which are Aluminum Electrolytic Capacitors (JIS04 type) that taped with single tape.

2) Taping Shape & Dimensions



[mm]

| Item | Symbol | Dimensions | Tolerance | Remarks |
|------------------------------------|------------|-------------|----------------|--|
| Body diameter | ϕD | 8 | +0.5 | |
| Body length | L | 11.5 ~ 20.0 | — | |
| Lead wire diameter | ϕd | 0.6 | ± 0.05 | |
| Body pitch | P | 12.7 | ± 1.0 | |
| Feed hole pitch *1 | P0 | 12.7 | ± 0.2 | |
| Hole center to lead | P1 | 3.85 | ± 0.5 | Specified by the contact surface between tape & lead |
| Feed hole center to product center | P2 | 6.35 | ± 1.00 | |
| Lead to lead distance | F | 5.0 | +0.8 -0.2 | Specified by the contact surface between tape & lead |
| Mount tape | W | 18.0 | ± 0.5 | |
| Adhesive tape | W0 | $6.0 \leq$ | — | |
| Hole position | W1 | 9.0 | ± 0.5 | |
| Adhesive tape slipping | W2 | 0 ~ 1.5 | — | |
| Height of product from the center | H | 20.0 | +0.75 -0.50 | |
| Lead wire clinch height | H0 | 16.0 | ± 0.5 | |
| Feed hole diameter | $\phi D0$ | 4.0 | ± 0.2 | |
| Inclination of body | Δh | $1.0 \leq$ | — | Specified by the top of an aluminum can |
| Inclination of body | ΔP | $1.0 \leq$ | — | Specified by the top of an aluminum can |
| Total tape thickness | t | 0.6 | ± 0.3 | CP wire is excluded |

*1 Cumulative deviation of "feed hole pitch" shall be less than 1 mm in 20 sections.

*2 Lead forming angle

A=90° min



Remarks

Matsushita Electronic Components Co.,Ltd. LCR Device Company
Capacitor Business Unit

A type FJ series

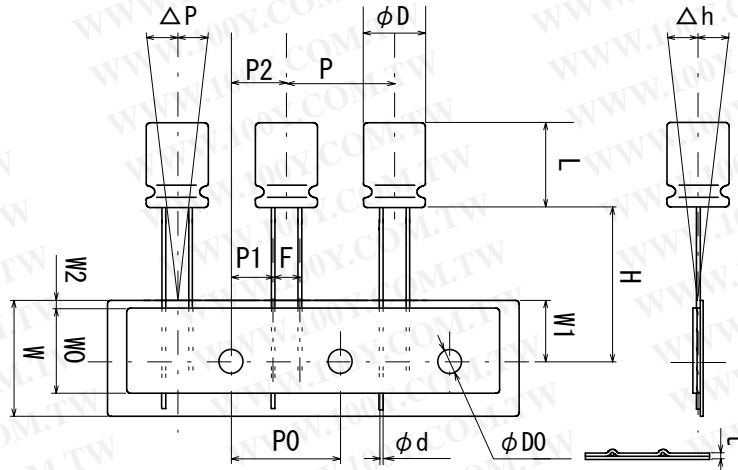
14

Lead Taping (Body Diameter $\phi 10, \phi 12.5$) The Suffix of Matsushita Taping Part Number : B

1) Applicable Range

This specification is applied to products, which are Aluminum Electrolytic Capacitors (JIS04 type) that taped with single tape.

2) Taping Shape & Dimensions



[mm]

| Item | Symbol | Dimensions | | Tolerance | Remarks |
|------------------------------------|------------|-------------|------|----------------|--|
| Body diameter | ϕD | 10 | 12.5 | +0.5 | |
| Body length | L | 12.5 ~ 25.0 | | — | |
| Lead wire diameter | ϕd | 0.60 | | ± 0.05 | |
| Body pitch | P | 12.7 | 15.0 | ± 1.0 | |
| Feed hole pitch *1 | P0 | 12.7 | 15.0 | ± 0.2 | |
| Hole center to lead | P1 | 3.85 | 5.00 | ± 0.5 | Specified by the contact surface between tape & lead |
| Feed hole center to product center | P2 | 6.35 | 7.50 | ± 1.00 | |
| Lead to lead distance | F | 5.0 | | +0.8 -0.20 | Specified by the contact surface between tape & lead |
| Mount tape | W | 18.0 | | ± 0.5 | |
| Adhesive tape | W0 | 6.0 \leq | | — | |
| Hole position | W1 | 9.0 | | ± 0.5 | |
| Adhesive tape slipping | W2 | 0 ~ 1.5 | | — | |
| Height of product from the center | H | 18.50 | | +0.75 -0.50 | |
| Feed hole diameter | $\phi D0$ | 4.0 | | ± 0.2 | |
| Inclination of body | Δh | 1.0 \geq | | — | Specified by the top of an aluminum can |
| Inclination of body | ΔP | 1.0 \geq | | — | Specified by the top of an aluminum can |
| Total tape thickness | t | 0.6 | | ± 0.3 | CP wire is excluded |

*1 Cumulative deviation of "feed hole pitch" shall be less than 1 mm in 20 sections.

Remarks

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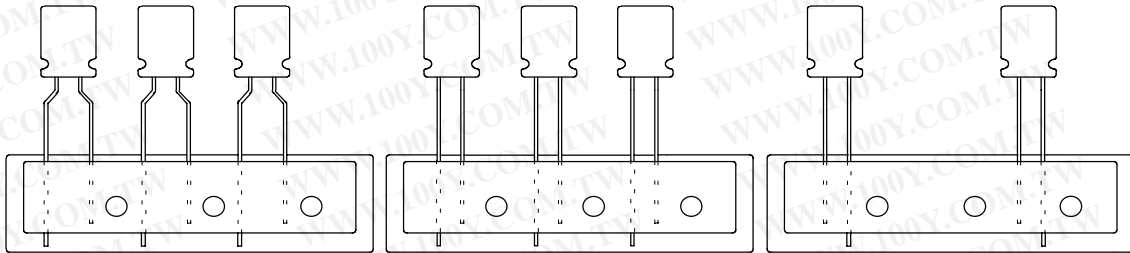
A type FJ series

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1. Taping Method

- 1-1 The capacitors shall be placed vertically on the base tape, and their lead wires are fixed with the adhesive tape. In addition, the direction of polarity is standardized as the base tape is situated underneath of an adhesive tape, and lead wires with the same polarity are placed on the right hand side (the direction of polarity for bipolar products is not specified).

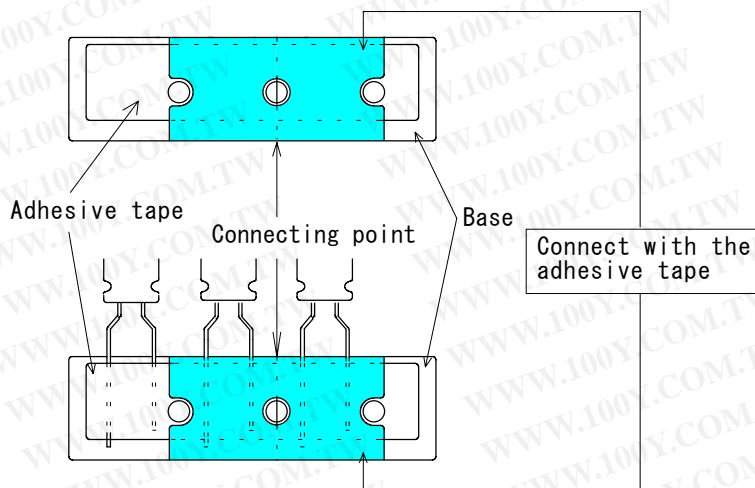
(Examples)



*Polarity direction

 $\phi 8 \sim \phi 12.5$: Negative polarity on the right.

- 1-2 After taping, there shall be no more than three blank spaces without lead wires on the base tape. The number of blank spaces within a packing unit (an inner carton) is not restricted, however, the specified packing quantity must be satisfied.
- 1-3 The connection method is as follows. The portion shall meet the general taping specification. The position of connection shall not be restricted.



Note) When connecting two base tapes, they shall not be piled on top of each other. Base tapes shall not be connected with each other by using staples.

Remarks

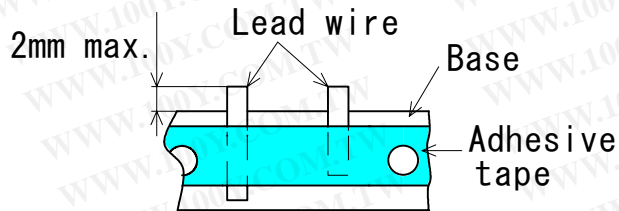
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A type FJ series

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1-4 In case of removing the products after taping, lead wires shall be cut or the capacitor shall be pulled out.

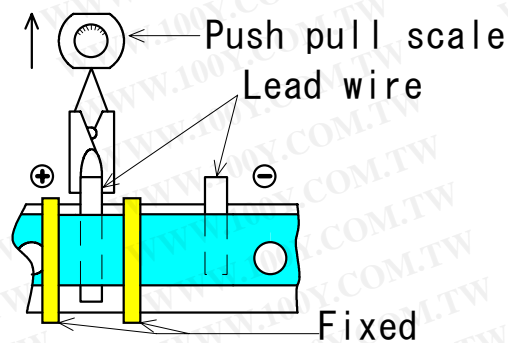
The length of remaining lead wire shall be less than 2.0 mm from the upper edge of the base tape.



1-5 Tensile strength of lead wire after taping (specified for the positive lead wire only) :

Fix the tape as below and pull the positive lead wire to the vertical direction by using the push pull scale.

The tensile strength shall be greater than 2.94 N.



After continuously storing in an atmosphere of $40 \pm 2^\circ\text{C}$ and 90 ~ 98% R. H. for 250 hours, the taped products shall meet the specification above, and there shall be no inclination of the capacitors or covering of holes with the adhesive.

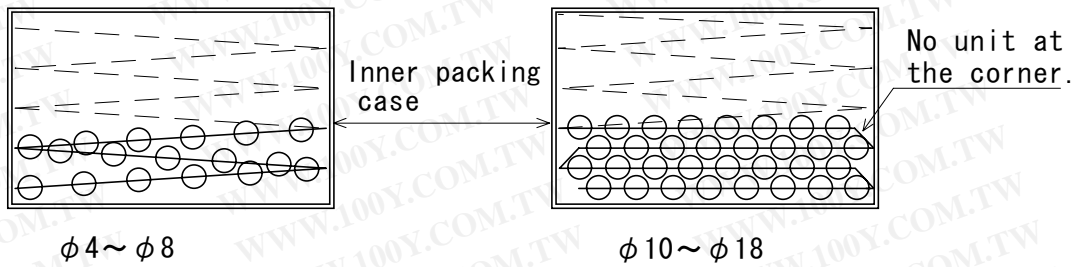
Remarks

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2. Packing Method

2-1 Taped products shall be packed in an inner carton (the smallest packing unit) in the zigzag pattern. In an inner carton, the lead wires with positive polarity are not to be placed on the top of lead wires with negative polarity and vice versa (however, the last sentence does not apply to bipolar products).

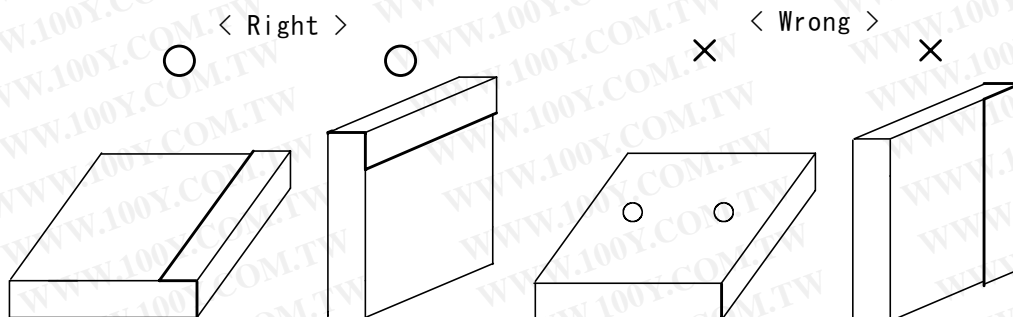
(Examples)



2-2 Polarity identifications on an inner carton shall match the polarity of products situated inside the inner carton.

2-3 Inner cartons shall be handled as follows.

- * No more than 10 inner cartons shall be piled on top of each other.
- * In case of situating cartons in upright position, the indication of polarity shall be faced upward.
- * The products shall be handled with care.



2-4 The inner cartons shall be packed in a cardboard box for transportation.

Products with various part numbers can be packed in an outer carton upon request. However, each inner carton (the smallest packing unit) shall only contain products with the same part number.

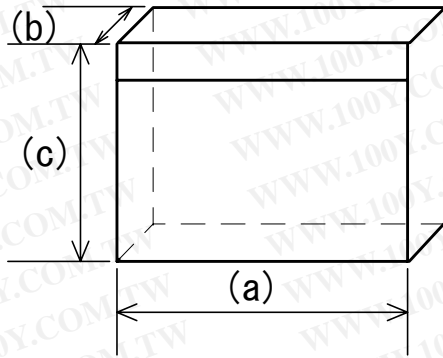
Remarks

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A type FJ series

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2-5 The shape & dimensions of inner cartons shall be as follows.



| Can size | | (a) | (b) | (c) |
|-------------|-----|-----|-----|-----|
| ϕD | L | | | |
| $\phi 8$ | ~20 | 340 | 55 | 320 |
| $\phi 10$ | ~16 | 340 | 55 | 320 |
| | 20 | 340 | 62 | 320 |
| | 25 | 340 | 66 | 320 |
| $\phi 12.5$ | 20 | 340 | 65 | 320 |

Note : The dimensions listed above are subject to change without notice, depending on the auto-insert machine.

2-6 Packing quantity

| Product diameter (mm) | Inner carton quantity Min. packing quantity (pcs) | Outer carton quantity (pcs) |
|--------------------------|---|--------------------------------|
| $\phi 8$ | 1,000 | 5,000 |
| $\phi 10$ | 500 | 2,000 |
| $\phi 12.5$ | 500 | 2,000 |

3. Storage

3-1 With respect to the handling method, follow Item 2-3 in this specification.

3-2 Products shall be out of direct sun light. In addition, the temperature and humidity shall be normal.

4. Ordering Unit

The order shall be placed with a multiple of the inner carton quantity.

Examples : $\phi 8$: minimum 1000 pcs

$\phi 10 \sim \phi 12.5$: minimum 500 pcs

Remarks

* Label On the Packaging Box by English

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Application Guidelines

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1. Circuit Design**1.1 Operating Temperature and Frequency**

Electrical parameters for electrolytic capacitors are normally specified at 20 °C temperature and 120 Hz frequency. These parameters vary with changes in temperature and frequency. Circuit designers should take these changes into consideration.

- (1) Effects of operating temperature on electrical parameters
 - a) At higher temperatures, leakage current and capacitance increase while equivalent series resistance (ESR) decreases.
 - b) At lower temperatures, leakage current and capacitance decrease while equivalent series resistance (ESR) increases.
- (2) Effects of frequency on electrical parameters
 - a) At higher frequencies, capacitance and impedance decrease while $\tan \delta$ increases.
 - b) At lower frequencies, heat generated by ripple current will rise due to an increase in equivalent series resistance (ESR).

1.2 Operating Temperature and Life Expectancy

- (1) Expected life is affected by operating temperature. Generally, each 10 °C reduction in temperature will double the expected life. Use capacitors at the lowest possible temperature below the upper category temperature.
- (2) If operating temperatures exceed the upper category limit, rapid deterioration of electrical parameter will occur and irreversible damage will result.
Check for the maximum capacitor operating temperatures including ambient temperature, internal capacitor temperature rise due to ripple current, and the effects of radiated heat from power transistors, IC's or resistors.
Avoid placing components, which could conduct heat to the capacitor from the back side of the circuit board.
- (3) The formula for calculating expected life at lower operating temperatures is as follows ;

$$L_2 = L_1 \times 2^{\frac{T_1 - T_2}{10}}$$

L_1 : Guaranteed life (h) at temperature, T_1 °C

L_2 : Expected life (h) at temperature, T_2 °C

T_1 : Upper category temperature (°C)

T_2 : Actual operating temperature, ambient temperature + temperature rise due to ripple current heating(°C)

1.3 Common Application Conditions to Avoid

The following misapplication load conditions will cause rapid deterioration of a capacitor's electrical parameters. In addition, rapid heating and gas generation within the capacitor can occur, causing the pressure relief vent to operate and resultant leakage of electrolyte. Under extreme conditions, explosion and fire ignition could result. The leaked electrolyte is combustible and electrically conductive.

- (1) Reverse Voltage
DC capacitors have polarity. Verify correct polarity before insertion. For circuits with changing or uncertain polarity, use DC bipolar capacitors. DC bipolar capacitors are not suitable for use in AC circuits.
- (2) Charge / Discharge Applications
Standard capacitors are not suitable for use in repeating charge/discharge applications. For charge/discharge applications, consult us with your actual application condition.
- (3) Over voltage
Do not apply voltages exceeding the maximum specified rated voltage. Voltages up to the surge voltage rating are acceptable for short periods of time. Ensure that the sum of the DC voltage and the superimposed AC ripple voltage does not exceed the rated voltage.
- (4) Ripple Current
Do not apply ripple currents exceeding the maximum specified value. For high ripple current applications, use a capacitor designed for high ripple currents. In addition, consult us if the applied ripple current is to be higher than the maximum specified value. Ensure that rated ripple currents that superimposed on low DC bias voltages do not cause reverse voltage conditions.

1.4 Using Two or More Capacitors in Series or Parallel

- (1) Capacitors Connected in Parallel
The circuit resistance can closely approximate the series resistance of the capacitor, causing an imbalance of ripple current loads within the capacitors. Careful wiring methods can minimize the possible application of an excessive ripple current to a capacitor.
- (2) Capacitors Connected in Series
Differences in normal DC leakage current among capacitors can cause voltage imbalances. The use of voltage divider shunt resistors with consideration to leakage currents can prevent capacitor voltage imbalances.

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Capacitor Business Unit

Application Guidelines

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1.5 Capacitor Mounting Considerations**(1) Double-Sided Circuit Boards**

Avoid wiring pattern runs, which pass between the mounted capacitor and the circuit board. When dipping into a solder bath, an excess solder may deposit under the capacitor by capillary action, causing short circuit between anode and cathode terminals.

(2) Circuit Board Hole Positioning

The vinyl sleeve of the capacitor can be damaged if solder passes through a lead hole into the subsequently processed parts. Special care when locating hole positions in proximity to capacitors is recommended.

(3) Circuit Board Hole Spacing

The spacing of circuit board holes should match the lead wire spacing of capacitors within the specified tolerances. Incorrect spacing can cause an excessive lead wire stress during the insertion process.

This may result in premature capacitor failure due to the short or open circuit, increased leakage current, or electrolyte leakage.

(4) Clearance for Case Mounted Pressure Relief

Capacitors with case mounted pressure relief require sufficient clearance to allow proper pressure relief operation.

The minimum clearances are dependent of capacitor diameters as follows.

$\phi 6.3 \sim \phi 16 \text{ mm}$: 2 mm minimum, $\phi 18 \sim \phi 35 \text{ mm}$: 3 mm minimum, $\phi 40 \text{ mm}$ or greater : 5 mm minimum.

(5) Clearance for Seal Mounted Pressure Relief

Provide a hole on a circuit board to relieve gas when a pressure relief of a capacitor is situated underneath of the circuit board.

(6) Wiring Near the Pressure Relief

Avoid locating high voltage, high current wiring, or circuit board paths above the pressure relief.

Flammable, high temperature gas that exceeds 100 °C may be released and could dissolve the wire insulation and ignite.

(7) Circuit Board Patterns Under the Capacitor

Avoid circuit board runs underneath the capacitor, as an electrical short can occur due to an electrolyte leakage.

(8) Screw Terminal Capacitor Mounting

Do not orient the capacitor with the screw terminal side of the capacitor facing downward.

Tighten the terminal and mounting bracket screws within the torque range specified in the specification.

1.6 Electrical Isolation of the Capacitor

Completely isolate the capacitor as follows.

(1) Between the cathode and the case (except for axially leaded B types) and between the anode terminal and other circuit paths.

(2) Between the extra mounting terminals (on T types) and the anode terminal, cathode terminal, and other circuit paths.

1.7 Capacitor Sleeve

The vinyl sleeve or laminate coating is intended for marking and identification purposes and is not meant to electrically insulate the capacitor.

The sleeve may split or crack if immersed into solvents such as toluene or xylene and then subsequently exposed to high temperatures.

CAUTION!

Always consider safety when designing equipment and circuits.

Plan for the worst case failure modes such as short circuits and open circuits, which could occur use.

(1) Provide protection circuits and protection devices to allow safe failure modes.

(2) Design redundant or secondary circuits where possible to assure the continued operation in case of main circuit failure.

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2. Capacitor Handling Techniques**2.1 Considerations Before Using**

- (1) Capacitors have a finite life. Do not reuse or recycle capacitors from used equipment.
- (2) Transient recovery voltage may be generated in the capacitor due to dielectric absorption.
If required, this voltage can be discharged with a resistor with a value of about 1k Ω .
- (3) Capacitors stored for a long period of time may exhibit an increase in leakage current.
This can be corrected by gradually applying rated voltage in series with a resistor of approximately 1k Ω .
- (4) If capacitors are dropped, they can be damaged mechanically or electrically. Avoid using dropped capacitors.
- (5) Dented or crushed capacitors should not be used. The seal integrity can be damaged and loss of electrolyte/shortened life can result.

2.2 Capacitor Insertion

- (1) Verify the correct capacitance and rated voltage of the capacitor.
- (2) Verify the correct polarity of the capacitor before insertion.
- (3) Verify the correct hole spacing before insertion (land pattern size on chip type) to avoid stress on the terminals.
- (4) Ensure that the lead clinching operation done by auto insertion equipments does not stress the capacitor leads where they enter the seal of the capacitor. For chip type capacitors, excessive mounting pressure can cause high leakage current, short circuit, or disconnection.

2.3 Manual Soldering

- (1) Apply soldering conditions (temperature and time) based on the specification, or do not exceed temperature of 350 °C for 3 seconds or less.
- (2) If lead wires must be modified to meet terminal board hole spacing, avoid stress on the lead wire where it enters the capacitor seal.
- (3) If a soldered capacitor must be removed and reinserted, avoid excessive stress on the capacitor leads.
- (4) Avoid physical contacts between the tip of the soldering iron and capacitors to prevent melting of the vinyl sleeve.

2.4 Flow Soldering

- (1) Do not immerse the capacitor body into the solder bath as excessive internal pressure could result.
- (2) Apply proper soldering conditions (temperature, time, etc.). Do not exceed the specified limits.
- (3) Do not allow other parts or components to touch the capacitor during soldering.

2.5 Other Soldering Considerations

Rapid temperature rise during the preheat operation and resin bonding operation can cause cracking of the capacitor's vinyl sleeve.
For heat curing, do not exceed 150 °C for the maximum time of 2 minutes.

2.6 Capacitor Handling after Soldering

- (1) Avoid moving the capacitor after soldering to prevent excessive stress on the lead wires where they enter the seal.
- (2) Do not use the capacitor as a handle when moving the circuit board assembly.
- (3) Avoid striking the capacitor after assembly to prevent failure due to excessive shock.

2.7 Circuit Board Cleaning

- (1) Circuit boards can be immersed or ultrasonically cleaned using suitable cleaning solvents for up to 5 minutes and up to 60 °C maximum temperatures. The boards should be thoroughly rinsed and dried.

The use of ozone depleting cleaning agents is not recommended for the purpose of protecting our environment.

- (2) Avoid using the following solvent groups unless specifically allowed in the specification ;
 - Halogenated cleaning solvents : except for solvent resistant capacitor types, halogenated solvents can permeate the seal and cause internal capacitor corrosion and failure.
For solvent resistant capacitors, carefully follow the temperature and time requirements based on the specification.
1-1-1 trichloroethane should never be used on any aluminum electrolytic capacitor.
 - Alkaline solvents : could react and dissolve the aluminum case.
 - Petroleum based solvents: deterioration of the rubber seal could result.
 - Xylene : deterioration of the rubber seal could result.
 - Acetone : removal of the ink markings on the vinyl sleeve could result.
- (3) A thorough drying after cleaning is required to remove residual cleaning solvents that may be trapped between the capacitor and the circuit board. Avoid drying temperatures, which exceed the Upper category temperature of the capacitor.
- (4) Monitor the contamination levels of the cleaning solvents during use in terms of electrical conductivity, pH, specific gravity, or water content. Chlorine levels can rise with contamination and adversely affect the performance of the capacitor.

Please consult us if you are not certain about acceptable cleaning solvents or cleaning methods.

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2.8 Mounting Adhesives and Coating Agents

When using mounting adhesives or coating agents to control humidity, avoid using materials containing halogenated solvents. Also, avoid the use of chloroprene based polymers. Harden on dry adhesive or coating agents well lest the solvent should be left.

After applying adhesives or coatings, dry thoroughly to prevent residual solvents from being trapped between the capacitor and the circuit board.

2.9 Fumigation

In exporting electronic appliances with aluminum electrolytic capacitors, in some cases fumigation treatment using such halogen compound as methyl bromide is conducted for wooden boxes.

If such boxes are not dried well, the halogen left in the box is dispersed while transported and enters in the capacitors inside.

This possibly causes electrical corrosion of the capacitors. Therefore, after performing fumigation and drying make sure that no halogen is left.

Don't perform fumigation treatment to the whole electronic appliances packed in a box.

3. Precautions for using capacitors**3.1 Environmental Conditions**

Capacitors should not be stored or used in the following environments.

- (1) Exposure to temperatures above the upper category or below the lower category temperature of the capacitor.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, Chlorine compound, Bromine, Bromine compound or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

3.2 Electrical Precautions

- (1) Avoid touching the terminals of a capacitor as a possible electric shock could result. The exposed aluminum case is not insulated and could also cause electric shock if touched.
- (2) Avoid short circuiting the area between the capacitor terminals with conductive materials including liquids such as acids or alkaline solutions.

4. Emergency Procedures

- (1) If the pressure relief of the capacitor operates, immediately turn off the equipment and disconnect from the power source. This will minimize an additional damage caused by the vaporizing electrolyte.
- (2) Avoid contact with the escaping electrolyte gas, which can exceed 100 °C temperatures. If electrolyte or gas enters the eye, immediately flush the eye with large amounts of water. If electrolyte or gas is ingested by mouth, gargle with water. If electrolyte contacts the skin, wash with soap and water.

5. Long Term Storage

Leakage current of a capacitor increases with long storage times. The aluminum oxide film deteriorates as a function of temperature and time. If used without reconditioning, an abnormally high current will be required to restore the oxide film.

This surge current could cause the circuit or the capacitor to fail. After one year, a capacitor should be reconditioned by applying the rated voltage in series with a 1000 Ω current limiting resistor for a time period of 30 minutes.

5.1 Environmental Conditions

- (1) Exposure to temperatures above the upper category or below the lower category temperature of the capacitor.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, Chlorine compound, Bromine, Bromine compound or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

6. Capacitor Disposal

When disposing capacitors, use one of the following methods.

- (1) Incinerate after crushing the capacitor or puncturing the can wall (to prevent explosion due to internal pressure rise). Capacitors should be incinerated at high temperatures to prevent the release of toxic gases such as chlorine from the polyvinyl chloride sleeve, etc.
- (2) Dispose as solid waste.

NOTE : Local laws may have specific disposal requirements which must be followed.

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