

## KL series Low Leakage Current



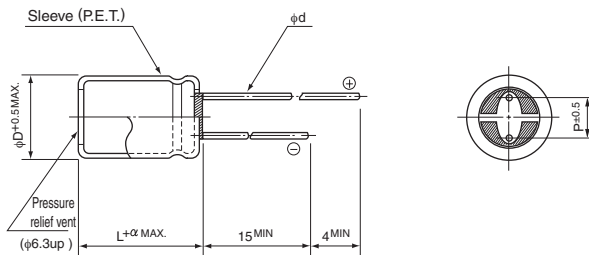
- Standard low leakage current series.
- Compliant to the RoHS directive (2011/65/EU).



### Specifications

| Item                                  | Performance Characteristics   |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
|---------------------------------------|---|--------------------|--|--------------|---|-----------------|---|-------|---|-----|-------------|---------------------------------|-------|-------|------|------|------|------|------|------|---|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Category Temperature Range            | -40 to +85°C (※ -40 to +105°C product is also available upon request, but product rated at up to 50V less than or equal to $\phi 10 \times 12.5$ Lmm)   |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Rated Voltage Range                   | 6.3 to 100V   |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Rated Capacitance Range               | 0.1 to 10000 $\mu$ F  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Capacitance Tolerance                 | $\pm 20\%$ (M), $\pm 10\%$ (K) at 120Hz 20°C  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Leakage Current                       | After 1 minute's (for case size $10 \times 12.5$ or smaller) or 2 minutes' (for case size $10 \times 16$ or larger) application of rated voltage at 20°C, leakage current is not more than 0.002CV or 0.2 ( $\mu$ A) whichever is greater.  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Tangent of loss angle (tan $\delta$ ) | <table border="1"> <thead> <tr> <th>Rated voltage (V)</th> <th>6.3</th> <th>10</th> <th>16</th> <th>25</th> <th>35</th> <th>50</th> <th>63</th> <th>100</th> <th>120Hz, 20°C</th> </tr> </thead> <tbody> <tr> <td>Less than <math>\phi 10 \times 12.5</math></td> <td>0.18</td> <td>0.15</td> <td>0.12</td> <td>0.08</td> <td>0.08</td> <td>0.08</td> <td>0.07</td> <td>0.07</td> <td rowspan="2">For capacitance of more than 1000<math>\mu</math>F, add 0.02 for every increase of 1000<math>\mu</math>F.</td> </tr> <tr> <td><math>\phi 10 \times 16</math> or more</td> <td>0.21</td> <td>0.17</td> <td>0.14</td> <td>0.12</td> <td>0.12</td> <td>0.10</td> <td>0.08</td> <td>0.08</td> </tr> </tbody> </table> | Rated voltage (V)  | 6.3  | 10           | 16  | 25              | 35  | 50    | 63  | 100 | 120Hz, 20°C | Less than $\phi 10 \times 12.5$ | 0.18  | 0.15  | 0.12 | 0.08 | 0.08 | 0.08 | 0.07 | 0.07 | For capacitance of more than 1000 $\mu$ F, add 0.02 for every increase of 1000 $\mu$ F. | $\phi 10 \times 16$ or more | 0.21  | 0.17  | 0.14  | 0.12  | 0.12  | 0.10  | 0.08  | 0.08  |
| Rated voltage (V)                     | 6.3   | 10                 | 16   | 25           | 35  | 50              | 63  | 100   | 120Hz, 20°C   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Less than $\phi 10 \times 12.5$       | 0.18  | 0.15               | 0.12   | 0.08         | 0.08  | 0.08            | 0.07  | 0.07  | For capacitance of more than 1000 $\mu$ F, add 0.02 for every increase of 1000 $\mu$ F. |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| $\phi 10 \times 16$ or more           | 0.21  | 0.17               | 0.14   | 0.12         | 0.12  | 0.10            | 0.08  | 0.08  |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| stability at Low Temperature          | <table border="1"> <thead> <tr> <th>Rated voltage (V)</th> <th>6.3</th> <th>10</th> <th>16</th> <th>25</th> <th>35</th> <th>50</th> <th>63</th> <th>100</th> <th>120Hz</th> </tr> </thead> <tbody> <tr> <td>Impedance ratio Z-25°C / Z+20°C</td> <td>3 (4)</td> <td>2 (3)</td> <td>2</td> <td>1.5</td> <td>1.5</td> <td>1.5</td> <td>1.5</td> <td>1.5</td> <td rowspan="2">Values in ( ) applicable to <math>\phi 10 \times 16</math> or larger case size.</td> </tr> <tr> <td>ZT / Z20 (MAX.)</td> <td>5 (8)</td> <td>4 (6)</td> <td>3 (4)</td> <td>2 (4)</td> <td>2 (3)</td> <td>2 (3)</td> <td>2 (3)</td> <td>2 (3)</td> </tr> </tbody> </table>   | Rated voltage (V)  | 6.3  | 10           | 16  | 25              | 35  | 50    | 63  | 100 | 120Hz       | Impedance ratio Z-25°C / Z+20°C | 3 (4) | 2 (3) | 2    | 1.5  | 1.5  | 1.5  | 1.5  | 1.5  | Values in ( ) applicable to $\phi 10 \times 16$ or larger case size.                    | ZT / Z20 (MAX.)             | 5 (8) | 4 (6) | 3 (4) | 2 (4) | 2 (3) | 2 (3) | 2 (3) | 2 (3) |
| Rated voltage (V)                     | 6.3   | 10                 | 16   | 25           | 35  | 50              | 63  | 100   | 120Hz   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Impedance ratio Z-25°C / Z+20°C       | 3 (4)   | 2 (3)              | 2  | 1.5          | 1.5   | 1.5             | 1.5   | 1.5   | Values in ( ) applicable to $\phi 10 \times 16$ or larger case size.                    |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| ZT / Z20 (MAX.)                       | 5 (8)   | 4 (6)              | 3 (4)  | 2 (4)        | 2 (3)   | 2 (3)           | 2 (3)   | 2 (3) |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Endurance                             | <p>The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 2000 hours at 85°C, or 1000 hours at 105°C.</p> <table border="1"> <tbody> <tr> <td>Capacitance change</td> <td>Within <math>\pm 15\%</math> of the initial capacitance value (6.3V : Within <math>\pm 20\%</math>)</td> </tr> <tr> <td>tan <math>\delta</math></td> <td>150% or less than the initial specified value</td> </tr> <tr> <td>Leakage current</td> <td>Less than or equal to the initial specified value</td> </tr> </tbody> </table>   | Capacitance change | Within $\pm 15\%$ of the initial capacitance value (6.3V : Within $\pm 20\%$ ) | tan $\delta$ | 150% or less than the initial specified value | Leakage current | Less than or equal to the initial specified value |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Capacitance change                    | Within $\pm 15\%$ of the initial capacitance value (6.3V : Within $\pm 20\%$ )  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| tan $\delta$                          | 150% or less than the initial specified value   |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Leakage current                       | Less than or equal to the initial specified value   |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Shelf Life                            | After storing the capacitors under no load at 85°C for 1000 hours and then performing voltage treatment based on JIS C 5101-4 clause 4.1 at 20°C, they shall meet the specified values for the endurance characteristics listed above.  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |
| Marking                               | Printed with white color letter on black sleeve.  |                    |  |              |   |                 |   |       |   |     |             |                                 |       |       |      |      |      |      |      |      |   |                             |       |       |       |       |       |       |       |       |

### Radial Lead Type



| $\alpha$ | (mm)                                   |   |          |     |     |     |     |      |     |    |
|----------|--|---|----------|-----|-----|-----|-----|------|-----|----|
|          | $(\phi 10 \times 12.5$ or smaller) 1.0 | $(\phi 10 \times 16$ or or greater) 1.5 | $\phi D$ | 5   | 6.3 | 8   | 10  | 12.5 | 16  | 18 |
| P        |  |   | 2.0      | 2.5 | 3.5 | 5.0 | 5.0 | 7.5  | 7.5 |    |
| $\phi d$ |  |   | 0.5      | 0.5 | 0.6 | 0.6 | 0.6 | 0.8  | 0.8 |    |

• Please refer to page 20 about the end seal configuration.

### Frequency coefficient of rated ripple current

| Cap. ( $\mu$ F) | Frequency | 50Hz | 120Hz | 300Hz | 1kHz | 10kHz or more |
|-----------------|-----------|------|-------|-------|------|---------------|
| 0.1 to 68       |           | 0.75 | 1.00  | 1.35  | 1.57 | 2.00          |
| 100 to 680      |           | 0.80 | 1.00  | 1.23  | 1.34 | 1.50          |
| 1000 to 10000   |           | 0.85 | 1.00  | 1.10  | 1.13 | 1.15          |

Please refer to page 20, 21, 22 about the formed or taped product spec.  
Please refer to page 4 for the minimum order quantity.

- Dimension table in next page.

### Type numbering system (Example : 10V 47 $\mu$ F)



※1 Configuration

| $\phi D$   | Pb-free leadwire<br>Pb-free PET sleeve |
|------------|--|
| 5          | DD                                     |
| 6.3        | ED                                     |
| 8 · 10     | PD                                     |
| 12.5 to 18 | HD                                     |

※2 In case 105°C unit is required



## ■ Dimensions

| V              |      | 6.3       |      | 10        |      | 16        |      | 25        |      |
|----------------|------|-----------|------|-----------|------|-----------|------|-----------|------|
| Cap.( $\mu$ F) | Code | 0J        |      | 1A        |      | 1C        |      | 1E        |      |
| 4.7            | 4R7  |           |      |           |      |           |      | 5 × 11    | 45   |
| 6.8            | 6R8  |           |      |           |      |           |      | 5 × 11    | 55   |
| 10             | 100  |           |      |           |      | 5 × 11    | 55   | 5 × 11    | 70   |
| 15             | 150  |           |      |           |      | 5 × 11    | 70   | 5 × 11    | 85   |
| 22             | 220  |           |      |           |      | 5 × 11    | 85   | 5 × 11    | 100  |
| 33             | 330  |           |      |           |      | 5 × 11    | 100  | 6.3 × 11  | 140  |
| 47             | 470  |           |      | 5 × 11    | 110  | 6.3 × 11  | 140  | 6.3 × 11  | 170  |
| 68             | 680  |           |      | 6.3 × 11  | 150  | 6.3 × 11  | 160  | 8 × 11.5  | 230  |
| 100            | 101  |           |      | 6.3 × 11  | 180  | 8 × 11.5  | 230  | 8 × 11.5  | 280  |
| 150            | 151  |           |      | 8 × 11.5  | 250  | 8 × 11.5  | 280  | 10 × 12.5 | 370  |
| 220            | 221  |           |      | 8 × 11.5  | 310  | 10 × 12.5 | 370  | 10 × 16   | 400  |
| 330            | 331  |           |      | 10 × 12.5 | 400  | 10 × 16   | 420  | 10 × 20   | 490  |
| 470            | 471  | 10 × 12.5 | 390  | 10 × 16   | 530  | 10 × 20   | 550  | 12.5 × 20 | 660  |
| 680            | 681  | 10 × 16   | 480  | 10 × 20   | 600  | 12.5 × 20 | 730  | 12.5 × 25 | 810  |
| 1000           | 102  | 10 × 20   | 650  | 12.5 × 20 | 810  | 12.5 × 25 | 910  | 16 × 25   | 1010 |
| 1500           | 152  | 12.5 × 25 | 910  | 12.5 × 25 | 1020 | 16 × 25   | 1150 | 16 × 31.5 | 1270 |
| 2200           | 222  | 12.5 × 25 | 1060 | 16 × 25   | 1200 | 16 × 25   | 1300 | 16 × 35.5 | 1440 |
| 3300           | 332  | 16 × 25   | 1270 | 16 × 31.5 | 1420 | 16 × 35.5 | 1550 | 18 × 40   | 1720 |
| 4700           | 472  | 16 × 31.5 | 1500 | 16 × 35.5 | 1650 | 18 × 35.5 | 1820 |           |      |
| 6800           | 682  | 18 × 35.5 | 1760 | 18 × 35.5 | 1890 |           |      |           |      |
| 10000          | 103  | 18 × 40   | 1900 |           |      |           |      |           |      |

| V              |      | 35        |      | 50        |      | 63        |      | 100                            |                 |
|----------------|------|-----------|------|-----------|------|-----------|------|--------------------------------|-----------------|
| Cap.( $\mu$ F) | Code | 1V        |      | 1H        |      | 1J        |      | 2A                             |                 |
| 0.1            | 0R1  |           |      | 5 × 11    | 1.1  |           |      | 5 × 11                         | 2.1             |
| 0.15           | R15  |           |      | 5 × 11    | 1.6  |           |      | 5 × 11                         | 3.2             |
| 0.22           | R22  |           |      | 5 × 11    | 2.3  |           |      | 5 × 11                         | 4.7             |
| 0.33           | R33  |           |      | 5 × 11    | 3.5  |           |      | 5 × 11                         | 7.0             |
| 0.47           | R47  |           |      | 5 × 11    | 5.0  |           |      | 5 × 11                         | 10.1            |
| 0.68           | R68  |           |      | 5 × 11    | 7.3  |           |      | 5 × 11                         | 14.5            |
| 1              | 010  |           |      | 5 × 11    | 10.7 |           |      | 5 × 11                         | 19              |
| 1.5            | 1R5  |           |      | 5 × 11    | 16   |           |      | 5 × 11                         | 23              |
| 2.2            | 2R2  |           |      | 5 × 11    | 23   |           |      | 5 × 11                         | 28              |
| 3.3            | 3R3  |           |      | 5 × 11    | 40   |           |      | 5 × 11                         | 45              |
| 4.7            | 4R7  |           |      | 5 × 11    | 45   |           |      | 5 × 11                         | 50              |
| 6.8            | 6R8  |           |      | 5 × 11    | 55   | 5 × 11    | 59   | 6.3 × 11                       | 65              |
| 10             | 100  |           |      | 5 × 11    | 70   | 6.3 × 11  | 75   | 8 × 11.5                       | 90              |
| 15             | 150  | 5 × 11    | 85   | 6.3 × 11  | 95   | 6.3 × 11  | 100  | 8 × 11.5                       | 110             |
| 22             | 220  | 6.3 × 11  | 110  | 6.3 × 11  | 110  | 8 × 11.5  | 115  | 10 × 12.5                      | 136             |
| 33             | 330  | 6.3 × 11  | 140  | 8 × 11.5  | 165  | 8 × 11.5  | 170  | 10 × 16                        | 180             |
| 47             | 470  | 8 × 11.5  | 190  | 8 × 11.5  | 190  | 10 × 12.5 | 200  | 10 × 20                        | 220             |
| 68             | 680  | 8 × 11.5  | 230  | 10 × 12.5 | 250  | 10 × 16   | 270  | 10 × 20                        | 290             |
| 100            | 101  | 10 × 12.5 | 300  | 10 × 16   | 320  | 10 × 20   | 330  | 12.5 × 20                      | 370             |
| 150            | 151  | 10 × 16   | 400  | 10 × 20   | 420  | 12.5 × 20 | 450  | 12.5 × 25                      | 470             |
| 220            | 221  | 10 × 20   | 440  | 12.5 × 20 | 490  | 12.5 × 20 | 550  | 16 × 25                        | 580             |
| 330            | 331  | 12.5 × 20 | 550  | 12.5 × 20 | 600  | 12.5 × 25 | 710  | 16 × 31.5                      | 730             |
| 470            | 471  | 12.5 × 25 | 680  | 16 × 25   | 760  | 16 × 25   | 850  | 18 × 35.5                      | 910             |
| 680            | 681  | 16 × 25   | 840  | 16 × 25   | 910  | 16 × 31.5 | 1050 |                                |                 |
| 1000           | 102  | 16 × 25   | 1100 | 16 × 31.5 | 1140 | 18 × 35.5 | 1330 |                                |                 |
| 1500           | 152  | 16 × 35.5 | 1390 | 18 × 40   | 1480 |           |      | Case size<br>$\phi$ D × L (mm) | Rated<br>ripple |
| 2200           | 222  | 18 × 35.5 | 1580 |           |      |           |      |                                |                 |

Rated ripple current (mArms) at 85°C 120Hz

Rated ripple current (mArms) of 105°C product : 70 percent value of rated ripple of 85°C product at 105°C 120Hz