

# Aluminum Electrolytic Capacitors

## Power High Ripple Current Long Life 4-Terminal Snap-In



### LINKS TO ADDITIONAL RESOURCES

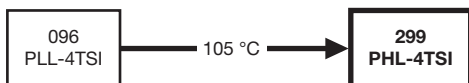


Fig. 1

| QUICK REFERENCE DATA                   |                                              |
|----------------------------------------|----------------------------------------------|
| DESCRIPTION                            | VALUE                                        |
| Nominal case size (D x L in mm)        | 35 x 50 to 45 x 100                          |
| Rated capacitance range C <sub>R</sub> | 270 µF to 3300 µF                            |
| Tolerance on C <sub>R</sub>            | ± 20 %                                       |
| Rated voltage range, U <sub>R</sub>    | 350 V to 450 V   500 V to 600 V              |
| Temperature range                      | -40 °C to +105 °C                            |
| Endurance test at 105 °C               | 2000 h                                       |
| Useful life at 105 °C                  | > 5000 h                                     |
| Shelf life at 0 V, 105 °C              | 1000 h                                       |
| Based on sectional specification       | IEC 60384-4 / EN 130300                      |
| Climatic category IEC 60068            | 40 / 105 / 56   25 / 105 / 56 <sup>(1)</sup> |

#### Note

<sup>(1)</sup> Capacitors can be operated in temperature range of -40 °C to +105 °C but impedance at -40 °C must be taken into consideration with regards to IEC 60068

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- **Rated voltages up to 600 V**
- Long useful life: > 5000 h at 105 °C
- Stable mounting and keyed polarity
- High ripple current capability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### APPLICATIONS

- Switched mode power supplies
- Uninterruptible power supplies
- Renewable energy power converters
- Energy storage in pulse systems

### MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code
- Name of manufacturer
- Code for factory of origin
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- (Partial) ordering code
- Climatic category in accordance with IEC 60068

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) |                    |                    |                    |                                |                                |                                |
|-------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|--------------------------------|--------------------------------|--------------------------------|
| C <sub>R</sub><br>(µF)                                                                                | U <sub>R</sub> (V) |                    |                    |                                |                                |                                |
|                                                                                                       | 350                | 400                | 450                | 500                            | 550                            | 600                            |
| 270                                                                                                   | -                  | -                  | -                  | -                              | -                              | 35 x 50<br>40 x 40             |
| 330                                                                                                   | -                  | -                  | -                  | -                              | 35 x 50                        | 35 x 60                        |
| 390                                                                                                   | -                  | -                  | -                  | 35 x 50                        | 40 x 40                        | 35 x 70<br>40 x 50             |
| 470                                                                                                   | -                  | -                  | 35 x 50<br>40 x 40 | 35 x 60<br>45 x 40             | 35 x 60<br>40 x 50             | 35 x 80<br>40 x 60             |
| 560                                                                                                   | -                  | 35 x 50            | 35 x 60<br>40 x 50 | 35 x 70<br>40 x 50             | 35 x 70<br>40 x 60             | 35 x 100<br>40 x 70<br>45 x 60 |
| 680                                                                                                   | -                  | 40 x 40            | 35 x 70            | 35 x 80<br>40 x 60<br>45 x 50  | 35 x 80<br>40 x 60             | 40 x 80<br>45 x 70             |
| 820                                                                                                   | 35 x 50<br>40 x 40 | 35 x 60<br>40 x 50 | 35 x 80<br>40 x 60 | 35 x 100<br>40 x 70<br>45 x 60 | 35 x 100<br>40 x 80<br>45 x 60 | 40 x 100<br>45 x 80            |

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) |                    |          |          |          |          |          |
|-------------------------------------------------------------------------------------------------------|--------------------|----------|----------|----------|----------|----------|
| C <sub>R</sub><br>(µF)                                                                                | U <sub>R</sub> (V) |          |          |          |          |          |
|                                                                                                       | 350                | 400      | 450      | 500      | 550      | 600      |
| 1000                                                                                                  | 35 x 60            | 35 x 70  | 35 x 100 | 40 x 80  | 45 x 70  | 45 x 100 |
|                                                                                                       | 40 x 50            |          | 40 x 80  | 45 x 70  | 45 x 80  |          |
|                                                                                                       |                    |          | 45 x 60  |          |          |          |
| 1200                                                                                                  | 35 x 70            | 35 x 80  | 45 x 70  | 40 x 100 | 40 x 100 | -        |
|                                                                                                       |                    | 40 x 70  |          |          |          |          |
|                                                                                                       |                    | 45 x 60  |          |          |          |          |
| 1500                                                                                                  | 35 x 80            | 35 x 100 | 40 x 100 | 45 x 100 | 45 x 100 | -        |
|                                                                                                       | 40 x 60            | 45 x 70  | 45 x 80  |          |          |          |
| 1800                                                                                                  | 35 x 100           | 40 x 100 | 45 x 100 | -        | -        | -        |
|                                                                                                       | 40 x 80            | 45 x 80  |          |          |          |          |
|                                                                                                       | 45 x 60            |          |          |          |          |          |
| 2200                                                                                                  | 40 x 100           | 45 x 100 | -        | -        | -        | -        |
|                                                                                                       | 45 x 80            |          |          |          |          |          |
| 2700                                                                                                  | 40 x 100           | -        | -        | -        | -        | -        |
| 3300                                                                                                  | 45 x 100           | -        | -        | -        | -        | -        |

## DIMENSIONS in millimeters AND AVAILABLE FORMS

### 4-TERMINAL SNAP-IN

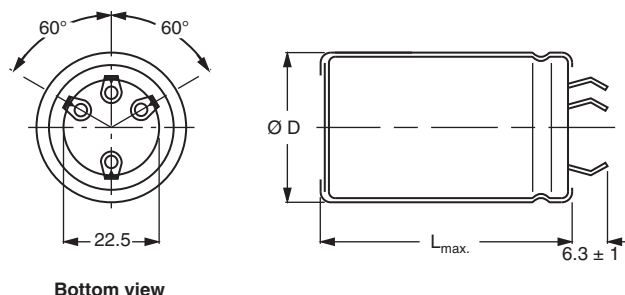


Fig. 1 - 4-terminal snap-in

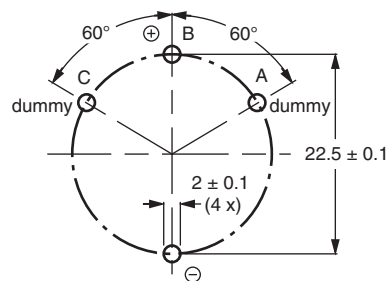


Fig. 2 - Mounting hole diagram

Dummy terminals (A and C) must be free from the electrical circuit.

Table 1

| <b>DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |                        |            |             |                                         |                                                   |
|-----------------------------------------------------------------|------------------------|------------|-------------|-----------------------------------------|---------------------------------------------------|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$                   | $\varnothing D_{max.}$ | $L_{max.}$ | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX DIMENSIONS<br>$L \times W \times H$ |
| 35 x 50                                                         | 36                     | 52         | 72          | 50                                      | 390 x 198 x 60                                    |
| 35 x 60                                                         | 36                     | 62         | 91          | 50                                      | 390 x 198 x 70                                    |
| 35 x 70                                                         | 36                     | 72         | 103         | 50                                      | 377 x 375 x 97                                    |
| 35 x 80                                                         | 36                     | 82         | 115         | 50                                      | 377 x 375 x 107                                   |
| 35 x 100                                                        | 36                     | 102        | 151         | 50                                      | 377 x 375 x 127                                   |
| 40 x 40                                                         | 41                     | 42         | 70          | 50                                      | 440 x 223 x 60                                    |
| 40 x 50                                                         | 41                     | 52         | 94          | 50                                      | 440 x 223 x 70                                    |
| 40 x 60                                                         | 41                     | 62         | 118         | 25                                      | 230 x 230 x 80                                    |
| 40 x 70                                                         | 41                     | 72         | 134         | 25                                      | 230 x 230 x 90                                    |
| 40 x 80                                                         | 41                     | 82         | 150         | 25                                      | 230 x 230 x 100                                   |
| 40 x 100                                                        | 41                     | 102        | 176         | 25                                      | 230 x 230 x 120                                   |
| 45 x 40                                                         | 46                     | 42         | 88          | 36                                      | 377 x 375 x 60                                    |
| 45 x 50                                                         | 46                     | 42         | 119         | 36                                      | 377 x 375 x 77                                    |
| 45 x 60                                                         | 46                     | 62         | 150         | 36                                      | 377 x 375 x 87                                    |
| 45 x 70                                                         | 46                     | 72         | 170         | 36                                      | 377 x 375 x 97                                    |
| 45 x 80                                                         | 46                     | 82         | 190         | 36                                      | 377 x 375 x 107                                   |
| 45 x 100                                                        | 46                     | 102        | 250         | 36                                      | 377 x 375 x 127                                   |



| ELECTRICAL DATA |                                               |
|-----------------|-----------------------------------------------|
| SYMBOL          | DESCRIPTION                                   |
| $C_R$           | Rated capacitance at 100 Hz                   |
| $I_R$           | Rated RMS ripple current at 100 Hz and 105 °C |
| $I_{L5}$        | Max. leakage current after 5 min at $U_R$     |
| $\tan \delta$   | Max. dissipation factor at 100 Hz             |
| ESR             | Max. equivalent series resistance at 100 Hz   |
| Z               | Max. impedance at 10 kHz                      |

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                            |                                                       |                                  |                           |                         |                                     |                                   |                                |
|------------------------------------------|----------------------------|-------------------------------------------------------|----------------------------------|---------------------------|-------------------------|-------------------------------------|-----------------------------------|--------------------------------|
| $U_R$<br>(V)                             | $C_R$<br>( $\mu\text{F}$ ) | NOMINAL CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>105 °C<br>(A) | $I_{L5}$<br>5 min<br>(mA) | $\tan \delta$<br>100 Hz | MAX. ESR<br>100 Hz<br>(m $\Omega$ ) | MAX. Z<br>10 kHz<br>(m $\Omega$ ) | CATALOG NUMBER<br>MAL2299..... |
| 350                                      | 820                        | 35 x 50                                               | 3.15                             | 0.578                     | 0.15                    | 170                                 | 125                               | 55821E3                        |
|                                          | 820                        | 40 x 40                                               | 3.00                             | 0.578                     | 0.15                    | 180                                 | 130                               | 65821E3                        |
|                                          | 1000                       | 35 x 60                                               | 3.70                             | 0.704                     | 0.15                    | 140                                 | 105                               | 55102E3                        |
|                                          | 1000                       | 40 x 50                                               | 3.75                             | 0.704                     | 0.15                    | 145                                 | 105                               | 65102E3                        |
|                                          | 1200                       | 35 x 70                                               | 4.15                             | 0.844                     | 0.15                    | 120                                 | 85                                | 55122E3                        |
|                                          | 1500                       | 35 x 80                                               | 4.70                             | 1.054                     | 0.15                    | 95                                  | 70                                | 55152E3                        |
|                                          | 1500                       | 40 x 60                                               | 4.60                             | 1.054                     | 0.15                    | 100                                 | 75                                | 65152E3                        |
|                                          | 1800                       | 35 x 100                                              | 5.90                             | 1.264                     | 0.15                    | 80                                  | 60                                | 55182E3                        |
|                                          | 1800                       | 40 x 80                                               | 5.40                             | 1.264                     | 0.15                    | 85                                  | 65                                | 65182E3                        |
|                                          | 1800                       | 45 x 60                                               | 5.20                             | 1.264                     | 0.15                    | 90                                  | 70                                | 75182E3                        |
|                                          | 2200                       | 40 x 100                                              | 6.45                             | 1.544                     | 0.15                    | 65                                  | 50                                | 55222E3                        |
|                                          | 2200                       | 45 x 80                                               | 6.10                             | 1.544                     | 0.15                    | 70                                  | 55                                | 65222E3                        |
|                                          | 2700                       | 40 x 100                                              | 6.85                             | 1.894                     | 0.15                    | 55                                  | 45                                | 55272E3                        |
|                                          | 3300                       | 45 x 100                                              | 7.60                             | 2.314                     | 0.15                    | 50                                  | 40                                | 55332E3                        |
| 400                                      | 560                        | 35 x 50                                               | 2.70                             | 0.452                     | 0.15                    | 220                                 | 160                               | 56561E3                        |
|                                          | 680                        | 40 x 40                                               | 2.79                             | 0.548                     | 0.15                    | 190                                 | 140                               | 56681E3                        |
|                                          | 820                        | 35 x 60                                               | 3.44                             | 0.660                     | 0.15                    | 150                                 | 110                               | 56821E3                        |
|                                          | 820                        | 40 x 50                                               | 3.51                             | 0.660                     | 0.15                    | 160                                 | 110                               | 66821E3                        |
|                                          | 1000                       | 35 x 70                                               | 3.88                             | 0.804                     | 0.15                    | 130                                 | 90                                | 56102E3                        |
|                                          | 1200                       | 35 x 80                                               | 4.34                             | 0.964                     | 0.15                    | 110                                 | 80                                | 56122E3                        |
|                                          | 1200                       | 40 x 70                                               | 4.50                             | 0.964                     | 0.15                    | 110                                 | 80                                | 66122E3                        |
|                                          | 1200                       | 45 x 60                                               | 4.61                             | 0.964                     | 0.15                    | 110                                 | 80                                | 76122E3                        |
|                                          | 1500                       | 35 x 100                                              | 5.54                             | 1.204                     | 0.15                    | 90                                  | 60                                | 56152E3                        |
|                                          | 1500                       | 45 x 70                                               | 5.20                             | 1.204                     | 0.15                    | 90                                  | 70                                | 66152E3                        |
|                                          | 1800                       | 40 x 100                                              | 6.02                             | 1.444                     | 0.15                    | 70                                  | 50                                | 56182E3                        |
|                                          | 1800                       | 45 x 80                                               | 5.74                             | 1.444                     | 0.15                    | 80                                  | 60                                | 66182E3                        |
|                                          | 2200                       | 45 x 100                                              | 6.77                             | 1.764                     | 0.15                    | 60                                  | 50                                | 56222E3                        |
| 450                                      | 470                        | 35 x 50                                               | 2.54                             | 0.427                     | 0.20                    | 240                                 | 160                               | 57471E3                        |
|                                          | 470                        | 40 x 40                                               | 2.45                             | 0.427                     | 0.20                    | 240                                 | 170                               | 67471E3                        |
|                                          | 560                        | 35 x 60                                               | 2.96                             | 0.508                     | 0.20                    | 200                                 | 130                               | 57561E3                        |
|                                          | 560                        | 40 x 50                                               | 3.05                             | 0.508                     | 0.20                    | 200                                 | 140                               | 67561E3                        |
|                                          | 680                        | 35 x 70                                               | 3.34                             | 0.616                     | 0.20                    | 160                                 | 110                               | 57681E3                        |
|                                          | 820                        | 35 x 80                                               | 3.76                             | 0.742                     | 0.20                    | 140                                 | 90                                | 57821E3                        |
|                                          | 820                        | 40 x 60                                               | 3.73                             | 0.742                     | 0.20                    | 140                                 | 100                               | 67821E3                        |
|                                          | 1000                       | 35 x 100                                              | 4.74                             | 0.904                     | 0.20                    | 110                                 | 80                                | 57102E3                        |
|                                          | 1000                       | 40 x 80                                               | 4.41                             | 0.904                     | 0.20                    | 110                                 | 80                                | 67102E3                        |
|                                          | 1000                       | 45 x 60                                               | 4.34                             | 0.904                     | 0.20                    | 120                                 | 80                                | 77102E3                        |
|                                          | 1200                       | 45 x 70                                               | 4.84                             | 1.084                     | 0.20                    | 100                                 | 70                                | 57122E3                        |
|                                          | 1500                       | 40 x 100                                              | 5.67                             | 1.354                     | 0.20                    | 80                                  | 50                                | 57152E3                        |
|                                          | 1500                       | 45 x 80                                               | 5.39                             | 1.354                     | 0.20                    | 80                                  | 60                                | 67152E3                        |
|                                          | 1800                       | 45 x 100                                              | 6.36                             | 1.624                     | 0.20                    | 70                                  | 50                                | 57182E3                        |

**ORDERING EXAMPLE**

Electrolytic capacitor 299 PHL-4TSI series

2200  $\mu\text{F}$  / 400 V / 45 mm x 100 mm**4-terminal snap-in:**

Ordering code: MAL229956222E3

**ELECTRICAL DATA AND ORDERING INFORMATION**

| $U_R$<br>(V) | $C_R$<br>( $\mu$ F) | NOMINAL CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>105 °C<br>(A) | $I_{L5}$<br>5 min<br>(mA) | $\tan \delta$<br>100 Hz | MAX. ESR<br>100 Hz<br>(m $\Omega$ ) | MAX. Z<br>10 kHz<br>(m $\Omega$ ) | CATALOG NUMBER<br>MAL2299..... |
|--------------|---------------------|-------------------------------------------------------|----------------------------------|---------------------------|-------------------------|-------------------------------------|-----------------------------------|--------------------------------|
| 500          | 390                 | 35 x 50                                               | 2.35                             | 0.394                     | 0.20                    | 290                                 | 200                               | 59391E3                        |
|              | 470                 | 35 x 60                                               | 2.75                             | 0.474                     | 0.20                    | 240                                 | 165                               | 59471E3                        |
|              | 470                 | 45 x 40                                               | 2.45                             | 0.474                     | 0.20                    | 250                                 | 175                               | 69471E3                        |
|              | 560                 | 35 x 70                                               | 3.05                             | 0.564                     | 0.20                    | 200                                 | 140                               | 59561E3                        |
|              | 560                 | 40 x 50                                               | 3.05                             | 0.564                     | 0.20                    | 205                                 | 145                               | 69561E3                        |
|              | 680                 | 35 x 80                                               | 3.45                             | 0.684                     | 0.20                    | 165                                 | 115                               | 59681E3                        |
|              | 680                 | 40 x 60                                               | 3.45                             | 0.684                     | 0.20                    | 170                                 | 120                               | 69681E3                        |
|              | 680                 | 45 x 50                                               | 3.50                             | 0.684                     | 0.20                    | 175                                 | 125                               | 79681E3                        |
|              | 820                 | 35 x 100                                              | 4.35                             | 0.824                     | 0.20                    | 140                                 | 95                                | 59821E3                        |
|              | 820                 | 40 x 70                                               | 3.90                             | 0.824                     | 0.20                    | 140                                 | 100                               | 69821E3                        |
|              | 820                 | 45 x 60                                               | 4.05                             | 0.824                     | 0.20                    | 145                                 | 100                               | 79821E3                        |
|              | 1000                | 40 x 80                                               | 4.40                             | 1.004                     | 0.20                    | 115                                 | 80                                | 59102E3                        |
|              | 1000                | 45 x 70                                               | 4.50                             | 1.004                     | 0.20                    | 120                                 | 85                                | 69102E3                        |
|              | 1200                | 40 x 100                                              | 5.20                             | 1.204                     | 0.20                    | 100                                 | 70                                | 59122E3                        |
|              | 1500                | 45 x 100                                              | 5.95                             | 1.504                     | 0.20                    | 80                                  | 55                                | 59152E3                        |
| 550          | 330                 | 35 x 50                                               | 2.10                             | 0.367                     | 0.20                    | 415                                 | 320                               | 50331E3                        |
|              | 390                 | 40 x 40                                               | 2.20                             | 0.433                     | 0.20                    | 360                                 | 280                               | 50391E3                        |
|              | 470                 | 35 x 60                                               | 2.65                             | 0.521                     | 0.20                    | 295                                 | 225                               | 50471E3                        |
|              | 470                 | 40 x 50                                               | 2.75                             | 0.521                     | 0.20                    | 300                                 | 230                               | 60471E3                        |
|              | 560                 | 35 x 70                                               | 3.00                             | 0.620                     | 0.20                    | 250                                 | 190                               | 50561E3                        |
|              | 560                 | 40 x 60                                               | 3.10                             | 0.620                     | 0.20                    | 250                                 | 190                               | 60561E3                        |
|              | 680                 | 35 x 80                                               | 3.35                             | 0.752                     | 0.20                    | 205                                 | 155                               | 50681E3                        |
|              | 680                 | 40 x 60                                               | 3.35                             | 0.752                     | 0.20                    | 210                                 | 165                               | 60681E3                        |
|              | 820                 | 35 x 100                                              | 4.25                             | 0.906                     | 0.20                    | 170                                 | 130                               | 50821E3                        |
|              | 820                 | 40 x 80                                               | 3.95                             | 0.906                     | 0.20                    | 170                                 | 140                               | 60821E3                        |
|              | 820                 | 45 x 60                                               | 3.90                             | 0.906                     | 0.20                    | 175                                 | 140                               | 70821E3                        |
|              | 1000                | 45 x 70                                               | 4.35                             | 1.104                     | 0.20                    | 150                                 | 115                               | 50102E3                        |
|              | 1000                | 45 x 80                                               | 4.50                             | 1.104                     | 0.20                    | 145                                 | 110                               | 60102E3                        |
|              | 1200                | 40 x 100                                              | 5.05                             | 1.324                     | 0.20                    | 120                                 | 95                                | 50122E3                        |
|              | 1500                | 45 x 100                                              | 5.75                             | 1.654                     | 0.20                    | 100                                 | 75                                | 50152E3                        |
| 600          | 270                 | 35 x 50                                               | 1.90                             | 0.328                     | 0.20                    | 620                                 | 515                               | 51271E3                        |
|              | 270                 | 40 x 40                                               | 1.85                             | 0.328                     | 0.20                    | 630                                 | 520                               | 61271E3                        |
|              | 330                 | 35 x 60                                               | 2.25                             | 0.400                     | 0.20                    | 510                                 | 420                               | 51331E3                        |
|              | 390                 | 35 x 70                                               | 2.55                             | 0.472                     | 0.20                    | 430                                 | 355                               | 51391E3                        |
|              | 390                 | 40 x 50                                               | 2.50                             | 0.472                     | 0.20                    | 440                                 | 365                               | 61391E3                        |
|              | 470                 | 35 x 80                                               | 2.85                             | 0.568                     | 0.20                    | 360                                 | 295                               | 51471E3                        |
|              | 470                 | 40 x 60                                               | 2.85                             | 0.568                     | 0.20                    | 360                                 | 300                               | 61471E3                        |
|              | 560                 | 35 x 100                                              | 3.55                             | 0.676                     | 0.20                    | 300                                 | 250                               | 51561E3                        |
|              | 560                 | 40 x 70                                               | 3.30                             | 0.676                     | 0.20                    | 305                                 | 255                               | 61561E3                        |
|              | 560                 | 45 x 60                                               | 3.30                             | 0.676                     | 0.20                    | 305                                 | 255                               | 71561E3                        |
|              | 680                 | 40 x 80                                               | 3.60                             | 0.820                     | 0.20                    | 250                                 | 210                               | 51681E3                        |
|              | 680                 | 45 x 70                                               | 3.75                             | 0.820                     | 0.20                    | 255                                 | 210                               | 61681E3                        |
|              | 820                 | 40 x 100                                              | 4.30                             | 0.988                     | 0.20                    | 210                                 | 175                               | 51821E3                        |
|              | 820                 | 45 x 80                                               | 4.15                             | 0.988                     | 0.20                    | 210                                 | 175                               | 61821E3                        |
|              | 1000                | 45 x 100                                              | 4.90                             | 1.204                     | 0.20                    | 175                                 | 145                               | 51102E3                        |

| ADDITIONAL ELECTRICAL DATA         |                       |                                              |
|------------------------------------|-----------------------|----------------------------------------------|
| PARAMETER                          | CONDITIONS            | VALUE                                        |
| <b>Voltage</b>                     |                       |                                              |
| Surge voltage                      | $\geq 350$ V versions | $U_s = 1.1 \times U_R$                       |
| Reverse voltage                    |                       | $U_{rev} \leq 1$ V                           |
| <b>Current</b>                     |                       |                                              |
| Leakage current                    | After 1 min at $U_R$  | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu A$ |
|                                    | After 5 min at $U_R$  | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$ |
| <b>Inductance</b>                  |                       |                                              |
| Equivalent series inductance (ESL) | All case sizes        | Ca. 20 nH                                    |

## RIPPLE CURRENT AND USEFUL LIFE

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE |                           |
|-----------------------------------------|---------------------------|
| ENDURANCE AT 105 °C (h)                 | USEFUL LIFE AT 105 °C (h) |
| 2000                                    | > 5000                    |

### Note

- Multiplier of useful life code: CCC206-5

CCC206-5

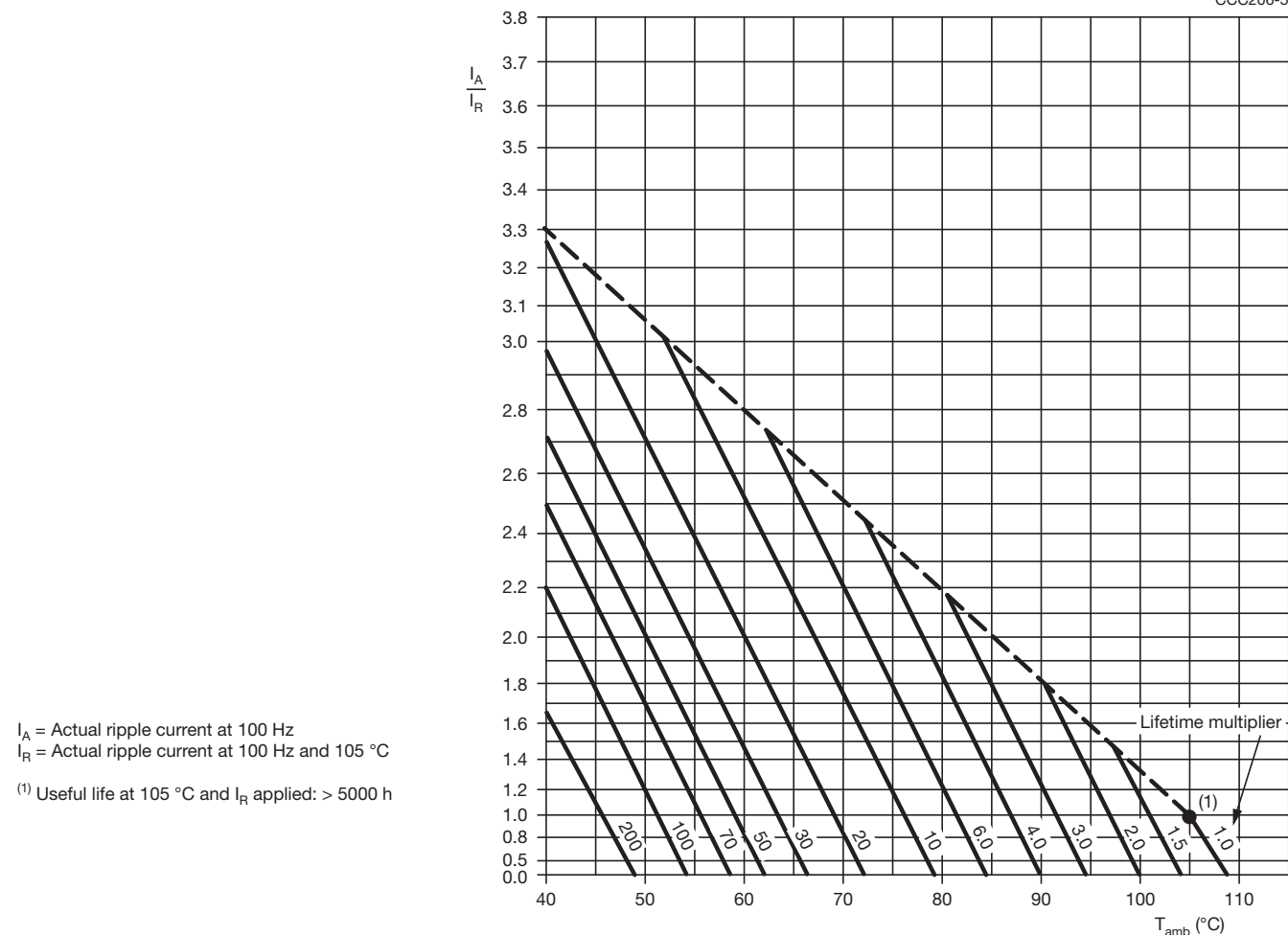


Fig. 3 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 4

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |     |     |     |      |        |
|-------------------------------------------------------------------|-----|-----|-----|------|--------|
| FREQUENCY (Hz)                                                    |     |     |     |      |        |
| 50                                                                | 100 | 200 | 400 | 1000 | 10 000 |
| $I_R$ MULTIPLIER                                                  |     |     |     |      |        |
| 0.9                                                               | 1.0 | 1.2 | 1.3 | 1.4  | 1.5    |

Table 5

| TEST PROCEDURES AND REQUIREMENTS |                                       |                                                                                                                                                |                                                                                                                                                |
|----------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                             |                                       | PROCEDURE<br>(quick reference)                                                                                                                 | REQUIREMENTS                                                                                                                                   |
| NAME OF TEST                     | REFERENCE                             |                                                                                                                                                |                                                                                                                                                |
| Endurance                        | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 105\text{ °C}$ ; $U_R$ applied<br>2000 h                                                                                            | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$ |
| Useful life                      |                                       | $T_{amb} = 105\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>> 5000 h                                                                               | $\Delta C/C: \leq \pm 20\%$<br>$\tan \delta \leq 2 \text{ times initial spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                      |
| Shelf life                       | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 105\text{ °C}$ ; no voltage applied;<br>1000 h<br><br>After test: $U_R$ to be applied for 30 min<br>24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$<br>$ESR \leq 1.2 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                |

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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