

## Aluminum Electrolytic Capacitors Power Long Life 4-Terminal Snap-In

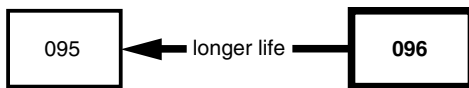


Fig. 1

| QUICK REFERENCE DATA                      |                             |
|---|-----------------------------|
| DESCRIPTION                               | VALUE                       |
| Nominal case size (D x L in mm)           | 35 x 50 to 45 x 100         |
| Rated capacitance range $C_R$             | 390 $\mu$ F to 2700 $\mu$ F |
| Tolerance on $C_R$                        | $\pm 20\%$                  |
| Rated voltage range, $U_R$                | 350 V to 500 V              |
| Category temperature range                | -40 °C to +85 °C            |
| Endurance test at 85 °C                   | 2000 h                      |
| Useful life at 85 °C                      | 5000 h                      |
| Useful life at 40 °C, 1.4 x $I_R$ applied | 200 000 h                   |
| Shelf life at 0 V, 85 °C                  | 1000 h                      |
| Max. RMS value of ripple voltage          | 12 V                        |
| Based on sectional specification          | IEC 60384-4 / EN130300      |
| Climatic category IEC 60068               | 40 / 085 / 56               |

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the side of the aluminum case
- Very long useful life: 5000 h at 85 °C
- Temperature range up to 85 °C
- Keyed polarity
- Low ESR, 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

- Telecommunication and industrial systems
- Smoothing and filtering applications
- Switched mode power supplies
- Renewable energy power converters
- Energy storage in pulse systems
- For excellent mounting stability

### MARKING

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

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

| SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing$ D x L in mm) |                               |                     |                                |                     |                                |                     |
|--|-------------------------------|---------------------|--------------------------------|---------------------|--------------------------------|---------------------|
| $C_R$<br>( $\mu$ F)  | $U_R$ (V)                     |                     |                                |                     |                                |                     |
|  | 350                           | 385                 | 400                            | 420                 | 450                            | 500                 |
| 390  | -                             | -                   | -                              | -                   | -                              | 35 x 60             |
| 470  | -                             | -                   | -                              | -                   | -                              | 35 x 70             |
| 560  | -                             | -                   | -                              | -                   | 35 x 60                        | 35 x 70<br>40 x 60  |
| 680  | -                             | 35 x 50<br>40 x 50  | 35 x 60<br>40 x 50             | 35 x 60<br>40 x 50  | 35 x 70<br>40 x 50             | 35 x 80<br>40 x 70  |
| 820  | 35 x 50<br>40 x 40            | 35 x 60<br>40 x 50  | 35 x 60<br>40 x 50             | 35 x 70<br>40 x 60  | 35 x 80<br>40 x 60             | 35 x 100<br>40 x 80 |
| 1000   | 35 x 60<br>40 x 50            | 35 x 70<br>40 x 60  | 35 x 70<br>40 x 60<br>45 x 50  | 35 x 80<br>40 x 60  | 35 x 100<br>40 x 70<br>45 x 60 | 40 x 100<br>45 x 70 |
| 1200   | 35 x 70<br>40 x 60            | 35 x 80<br>40 x 70  | 35 x 80<br>40 x 70<br>45 x 60  | 40 x 70             | 40 x 80<br>45 x 70             | 45 x 100            |
| 1500   | 35 x 80<br>40 x 70<br>45 x 60 | 40 x 80<br>45 x 60  | 35 x 100<br>40 x 80<br>45 x 70 | 40 x 100<br>45 x 70 | 40 x 100<br>45 x 80            | 45 x 100            |
| 1800   | 40 x 80<br>45 x 60            | 40 x 100<br>45 x 70 | 40 x 100<br>45 x 80            | 40 x 100<br>45 x 80 | 45 x 100                       | -                   |
| 2200   | 40 x 100<br>45 x 70           | 40 x 100            | 45 x 100                       | 45 x 100            | -                              | -                   |
| 2700   | 45 x 100                      | 45 x 100            | 45 x 100                       | -                   | -                              | -                   |

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**

**PRINTED WIRING**



Fig. 2 - Printed wiring pin version  
(Case Ø D = 35 mm)

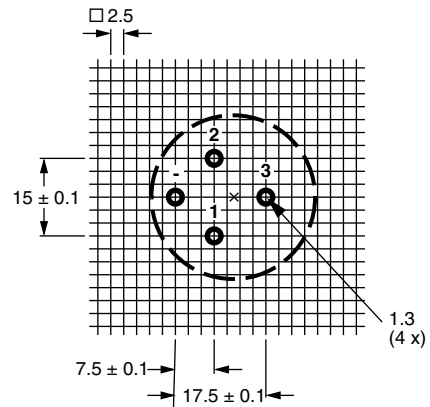


Fig. 3 - Mounting hole diagram viewed from component side  
(Case Ø D = 35 mm)

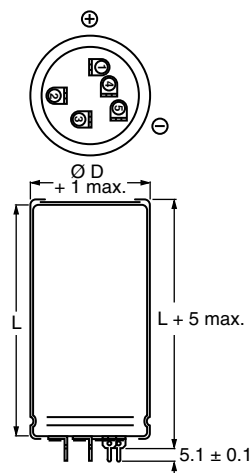


Fig. 4 - Printed wiring pin version  
(Case Ø D = 40 mm)

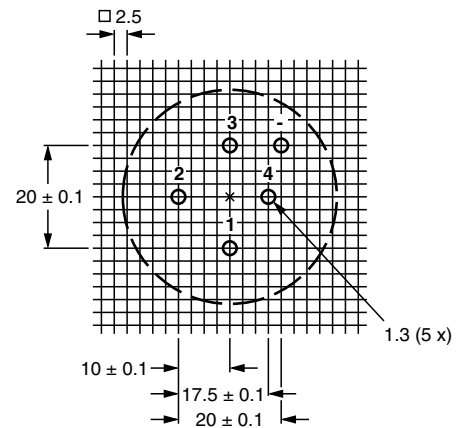


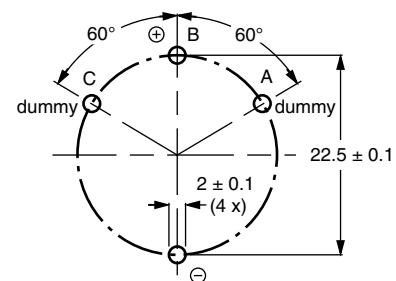
Fig. 5 - Mounting hole diagram viewed from component side  
(Case Ø D = 40 mm)

**FOUR TERMINAL SNAP-IN**



Bottom view

Fig. 6 - 4-Terminal snap-in



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

Fig. 7 - Mounting hole diagram

**Pin number 1 is the positive terminal. Pin “-” is the negative terminal.**

**Pin numbers 2, 3 and 4 (if present) should be free from the electrical circuit or connected to the minus terminal.**



Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES |                     |                            |             |             |   |  |
|--|---------------------|----------------------------|-------------|-------------|---|--|
| NOMINAL CASE SIZE<br>Ø D x L                             | Ø D <sub>MAX.</sub> | 4T-SI<br>L <sub>max.</sub> | PW<br>L + 5 | MASS<br>(g) | PACKAGING QUANTITIES<br>(units per box) | CARDBOARD BOX<br>DIMENSIONS<br>L x W x H |
| 35 x 50  | 36                  | 52                         | 55          | 72          | 50                                      | 390 x 198 x 60                           |
| 35 x 60  | 36                  | 62                         | 65          | 91          | 50                                      | 390 x 198 x 70                           |
| 35 x 70  | 36                  | 72                         | 75          | 103         | 50                                      | 377 x 375 x 97                           |
| 35 x 80  | 36                  | 82                         | 85          | 115         | 50                                      | 377 x 375 x 107                          |
| 35 x 100   | 36                  | 102                        | 105         | 151         | 50                                      | 377 x 375 x 127                          |
| 40 x 40  | 41                  | 42                         | 45          | 70          | 50                                      | 440 x 223 x 60                           |
| 40 x 50  | 41                  | 52                         | 55          | 94          | 50                                      | 440 x 223 x 70                           |
| 40 x 60  | 41                  | 62                         | 65          | 118         | 25                                      | 230 x 230 x 80                           |
| 40 x 70  | 41                  | 72                         | 75          | 134         | 25                                      | 230 x 230 x 90                           |
| 40 x 80  | 41                  | 82                         | 85          | 150         | 25                                      | 230 x 230 x 100                          |
| 40 x 100   | 41                  | 102                        | 105         | 176         | 25                                      | 230 x 230 x 120                          |
| 45 x 40  | 46                  | 42                         | -           | 88          | 36                                      | TBD                                      |
| 45 x 50  | 46                  | 52                         | -           | 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 <sub>R</sub>  | Rated capacitance at 100 Hz                        |
| I <sub>R</sub>  | Rated RMS ripple current at 100 Hz and 85 °C       |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub> |
| 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<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 096 series

820 µF / 385 V;

Printed wiring:

Ordering code: MAL2 096 18821 E3

Former 12NC: 2222 096 18821

4-terminal snap-in:

Ordering code: MAL2 096 68821 E3

Former 12NC: 2222 096 68821

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |                                      |  |                                  |                       |                                     |                                |         |
|--|----------------------------------|--------------------------------------|--|----------------------------------|-----------------------|-------------------------------------|--------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>85 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(µA) | ESR<br>100 Hz<br>(mΩ) | Z <sub>max.</sub><br>10 kHz<br>(mΩ) | CATALOG NUMBER<br>MAL2096..... |         |
|  |                                  |                                      |  |                                  |                       |                                     | 4T-SI                          | PW      |
| 350                                      | 820                              | 35 x 50                              | 4.0                                      | 578                              | 126                   | 82                                  | 15821E3                        | 65821E3 |
|  | 820                              | 40 x 40                              | 3.8                                      | 578                              | 134                   | 90                                  | 25821E3                        | 75821E3 |
|  | 1000                             | 35 x 60                              | 4.7                                      | 704                              | 104                   | 67                                  | 15102E3                        | 65102E3 |
|  | 1000                             | 40 x 50                              | 4.8                                      | 704                              | 108                   | 72                                  | 25102E3                        | 75102E3 |
|  | 1200                             | 35 x 70                              | 5.3                                      | 844                              | 87                    | 57                                  | 15122E3                        | 65122E3 |
|  | 1200                             | 40 x 60                              | 5.4                                      | 844                              | 90                    | 59                                  | 25122E3                        | 75122E3 |
|  | 1500                             | 35 x 80                              | 6.0                                      | 1054                             | 71                    | 47                                  | 15152E3                        | 65152E3 |
|  | 1500                             | 40 x 70                              | 6.2                                      | 1054                             | 73                    | 49                                  | 25152E3                        | 75152E3 |
|  | 1500                             | 45 x 60                              | 6.3                                      | 1054                             | 76                    | 52                                  | 35152E3                        | -       |
|  | 1800                             | 40 x 80                              | 6.9                                      | 1264                             | 62                    | 41                                  | 25182E3                        | 75182E3 |
|  | 1800                             | 45 x 60                              | 6.6                                      | 1264                             | 68                    | 48                                  | 35182E3                        | -       |
|  | 2200                             | 40 x 100                             | 8.2                                      | 1544                             | 51                    | 34                                  | 25222E3                        | 75222E3 |
|  | 2200                             | 45 x 70                              | 7.4                                      | 1544                             | 57                    | 41                                  | 35222E3                        | -       |
|  | 2700                             | 45 x 100                             | 9.2                                      | 1894                             | 44                    | 30                                  | 35272E3                        | -       |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |  |                                  |                       |                                     |                                |         |
|--|----------------------------------|---|--|----------------------------------|-----------------------|-------------------------------------|--------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>85 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(µA) | ESR<br>100 Hz<br>(mΩ) | Z <sub>max.</sub><br>10 kHz<br>(mΩ) | CATALOG NUMBER<br>MAL2096..... |         |
|  |                                  |   |  |                                  |                       |                                     | 4T-SI                          | PW      |
| 385                                      | 680                              | 35 x 50                                 | 3.7                                      | 528                              | 140                   | 88                                  | 18681E3                        | 68681E3 |
|  | 680                              | 40 x 50                                 | 4.2                                      | 528                              | 140                   | 87                                  | 28681E3                        | 78681E3 |
|  | 820                              | 35 x 60                                 | 4.4                                      | 635                              | 116                   | 73                                  | 18821E3                        | 68821E3 |
|  | 820                              | 40 x 50                                 | 4.5                                      | 635                              | 120                   | 76                                  | 28821E3                        | 78821E3 |
|  | 1000                             | 35 x 70                                 | 5.0                                      | 774                              | 96                    | 60                                  | 18102E3                        | 68102E3 |
|  | 1000                             | 40 x 60                                 | 5.1                                      | 774                              | 99                    | 63                                  | 28102E3                        | 78102E3 |
|  | 1200                             | 35 x 80                                 | 5.5                                      | 928                              | 81                    | 51                                  | 18122E3                        | 68122E3 |
|  | 1200                             | 40 x 70                                 | 5.7                                      | 928                              | 83                    | 53                                  | 28122E3                        | 78122E3 |
|  | 1500                             | 40 x 80                                 | 6.5                                      | 1159                             | 68                    | 43                                  | 28152E3                        | 78152E3 |
|  | 1500                             | 45 x 60                                 | 6.2                                      | 1159                             | 74                    | 50                                  | 38152E3                        | -       |
|  | 1800                             | 40 x 100                                | 7.7                                      | 1390                             | 56                    | 36                                  | 28182E3                        | 78182E3 |
|  | 1800                             | 45 x 70                                 | 7.0                                      | 1390                             | 62                    | 43                                  | 38182E3                        | -       |
|  | 2200                             | 40 x 100                                | 8.2                                      | 1698                             | 49                    | 32                                  | 28222E3                        | 78222E3 |
|  | 2700                             | 45 x 100                                | 9.1                                      | 2083                             | 43                    | 29                                  | 38272E3                        | -       |
| 400                                      | 680                              | 35 x 60                                 | 4.1                                      | 548                              | 134                   | 82                                  | 16681E3                        | 66681E3 |
|  | 680                              | 40 x 50                                 | 4.2                                      | 548                              | 138                   | 85                                  | 26681E3                        | 76681E3 |
|  | 820                              | 35 x 60                                 | 4.4                                      | 660                              | 114                   | 71                                  | 16821E3                        | 66821E3 |
|  | 820                              | 40 x 50                                 | 4.5                                      | 660                              | 119                   | 75                                  | 26821E3                        | 76821E3 |
|  | 1000                             | 35 x 70                                 | 5.0                                      | 804                              | 94                    | 59                                  | 16102E3                        | 66102E3 |
|  | 1000                             | 40 x 60                                 | 5.1                                      | 804                              | 97                    | 62                                  | 26102E3                        | 76102E3 |
|  | 1000                             | 45 x 50                                 | 5.1                                      | 804                              | 103                   | 67                                  | 36102E3                        | -       |
|  | 1200                             | 35 x 80                                 | 5.5                                      | 964                              | 80                    | 50                                  | 16122E3                        | 66122E3 |
|  | 1200                             | 40 x 70                                 | 5.7                                      | 964                              | 82                    | 52                                  | 26122E3                        | 76122E3 |
|  | 1200                             | 45 x 60                                 | 5.9                                      | 964                              | 85                    | 55                                  | 36122E3                        | -       |
|  | 1500                             | 35 x 100                                | 7.1                                      | 1204                             | 64                    | 40                                  | 16152E3                        | 66152E3 |
|  | 1500                             | 40 x 80                                 | 6.5                                      | 1204                             | 67                    | 43                                  | 26152E3                        | 76152E3 |
|  | 1500                             | 45 x 70                                 | 6.6                                      | 1204                             | 69                    | 46                                  | 36152E3                        | -       |
|  | 1800                             | 40 x 100                                | 7.7                                      | 1444                             | 56                    | 35                                  | 26182E3                        | 76182E3 |
|  | 1800                             | 45 x 80                                 | 7.3                                      | 1444                             | 59                    | 39                                  | 36182E3                        | -       |
|  | 2200                             | 45 x 100                                | 8.6                                      | 1764                             | 48                    | 32                                  | 36222E3                        | -       |
| 2700                                     | 45 x 100                         | 9.1                                     | 2164                                     | 42                               | 29                    | 36272E3                             | -                              |         |
| 420                                      | 680                              | 35 x 60                                 | 4.1                                      | 575                              | 137                   | 85                                  | 14681E3                        | 64681E3 |
|  | 680                              | 40 x 50                                 | 4.2                                      | 575                              | 141                   | 89                                  | 24681E3                        | 74681E3 |
|  | 820                              | 35 x 70                                 | 4.6                                      | 693                              | 114                   | 71                                  | 14821E3                        | 64821E3 |
|  | 820                              | 40 x 60                                 | 4.7                                      | 693                              | 117                   | 74                                  | 24821E3                        | 74821E3 |
|  | 1000                             | 35 x 80                                 | 5.1                                      | 844                              | 95                    | 59                                  | 14102E3                        | 64102E3 |
|  | 1000                             | 40 x 60                                 | 5.1                                      | 844                              | 100                   | 64                                  | 24102E3                        | 74102E3 |
|  | 1200                             | 40 x 70                                 | 5.7                                      | 1012                             | 84                    | 54                                  | 24122E3                        | 74122E3 |
|  | 1500                             | 40 x 100                                | 7.2                                      | 1264                             | 66                    | 42                                  | 24152E3                        | 74152E3 |
|  | 1500                             | 45 x 70                                 | 6.6                                      | 1264                             | 71                    | 48                                  | 34152E3                        | -       |
|  | 1800                             | 40 x 100                                | 7.6                                      | 1516                             | 57                    | 37                                  | 24182E3                        | 74182E3 |
|  | 1800                             | 45 x 80                                 | 7.2                                      | 1516                             | 60                    | 40                                  | 34182E3                        | -       |
|  | 2200                             | 45 x 100                                | 8.5                                      | 1852                             | 49                    | 33                                  | 34222E3                        | -       |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |  |                                  |                       |                                     |                                |         |
|--|----------------------------------|---|--|----------------------------------|-----------------------|-------------------------------------|--------------------------------|---------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>85 °C<br>(A) | I <sub>L5</sub><br>5 min<br>(μA) | ESR<br>100 Hz<br>(mΩ) | Z <sub>max.</sub><br>10 kHz<br>(mΩ) | CATALOG NUMBER<br>MAL2096..... |         |
|  |                                  |   |  |                                  |                       |                                     | 4T-SI                          | PW      |
| 450                                      | 560                              | 35 x 60                                 | 3.8                                      | 508                              | 155                   | 94                                  | 17561E3                        | 67561E3 |
|  | 680                              | 35 x 70                                 | 4.2                                      | 616                              | 129                   | 78                                  | 17681E3                        | 67681E3 |
|  | 680                              | 40 x 50                                 | 4.2                                      | 616                              | 136                   | 85                                  | 27681E3                        | 77681E3 |
|  | 820                              | 35 x 80                                 | 4.8                                      | 742                              | 108                   | 66                                  | 17821E3                        | 67821E3 |
|  | 820                              | 40 x 60                                 | 4.7                                      | 742                              | 112                   | 70                                  | 27821E3                        | 77821E3 |
|  | 1000                             | 35 x 100                                | 6.0                                      | 904                              | 89                    | 54                                  | 17102E3                        | 67102E3 |
|  | 1000                             | 40 x 70                                 | 5.3                                      | 904                              | 93                    | 58                                  | 27102E3                        | 77102E3 |
|  | 1000                             | 45 x 60                                 | 5.5                                      | 904                              | 97                    | 62                                  | 37102E3                        | -       |
|  | 1200                             | 40 x 80                                 | 6.0                                      | 1084                             | 78                    | 49                                  | 27122E3                        | 77122E3 |
|  | 1200                             | 45 x 70                                 | 6.1                                      | 1084                             | 81                    | 52                                  | 37122E3                        | -       |
|  | 1500                             | 40 x 100                                | 7.2                                      | 1354                             | 63                    | 39                                  | 27152E3                        | 77152E3 |
|  | 1500                             | 45 x 80                                 | 6.8                                      | 1354                             | 67                    | 43                                  | 37152E3                        | -       |
|  | 1800                             | 45 x 100                                | 8.0                                      | 1624                             | 55                    | 35                                  | 37182E3                        | -       |
| 500                                      | 390                              | 35 x 60                                 | 2.9                                      | 394                              | 475                   | 421                                 | 19391E3                        | 69391E3 |
|  | 470                              | 35 x 70                                 | 3.3                                      | 474                              | 395                   | 350                                 | 19471E3                        | 69471E3 |
|  | 560                              | 35 x 70                                 | 3.6                                      | 564                              | 333                   | 296                                 | 19561E3                        | 69561E3 |
|  | 560                              | 40 x 60                                 | 3.7                                      | 564                              | 336                   | 299                                 | 29561E3                        | 79561E3 |
|  | 680                              | 35 x 80                                 | 4.1                                      | 684                              | 275                   | 245                                 | 19681E3                        | 69681E3 |
|  | 680                              | 40 x 70                                 | 4.2                                      | 684                              | 277                   | 247                                 | 29681E3                        | 79681E3 |
|  | 820                              | 35 x 100                                | 5.1                                      | 824                              | 229                   | 203                                 | 19821E3                        | 69821E3 |
|  | 820                              | 40 x 80                                 | 4.7                                      | 824                              | 231                   | 206                                 | 29821E3                        | 79821E3 |
|  | 1000                             | 40 x 100                                | 5.6                                      | 1004                             | 189                   | 169                                 | 29102E3                        | 79102E3 |
|  | 1000                             | 45 x 70                                 | 5.3                                      | 1004                             | 195                   | 176                                 | 39102E3                        | -       |
|  | 1200                             | 45 x 100                                | 6.4                                      | 1204                             | 160                   | 144                                 | 39122E3                        | -       |
|  | 1500                             | 45 x 100                                | 7.0                                      | 1504                             | 131                   | 118                                 | 39152E3                        | -       |

| ADDITIONAL ELECTRICAL DATA         |                               |  |
|------------------------------------|-------------------------------|--|
| PARAMETER                          | CONDITIONS                    | VALUE  |
| <b>Voltage</b>                     |                               |  |
| Surge voltage                      | ≥ 350 V versions              | U <sub>s</sub> = 1.1 x U <sub>R</sub>                          |
| Reverse voltage                    |                               | U <sub>rev</sub> ≤ 1   |
| <b>Current</b>                     |                               |  |
| Leakage current                    | After 1 min at U <sub>R</sub> | I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 4 μA |
|                                    | After 5 min at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 4 μA |
| <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 85 °C (h)                  | USEFUL LIFE AT 85 °C (h) |
| 2000                                    | 5000                     |

**Note**

- Multiplier of useful life code: CCC205-05

CCC205-05

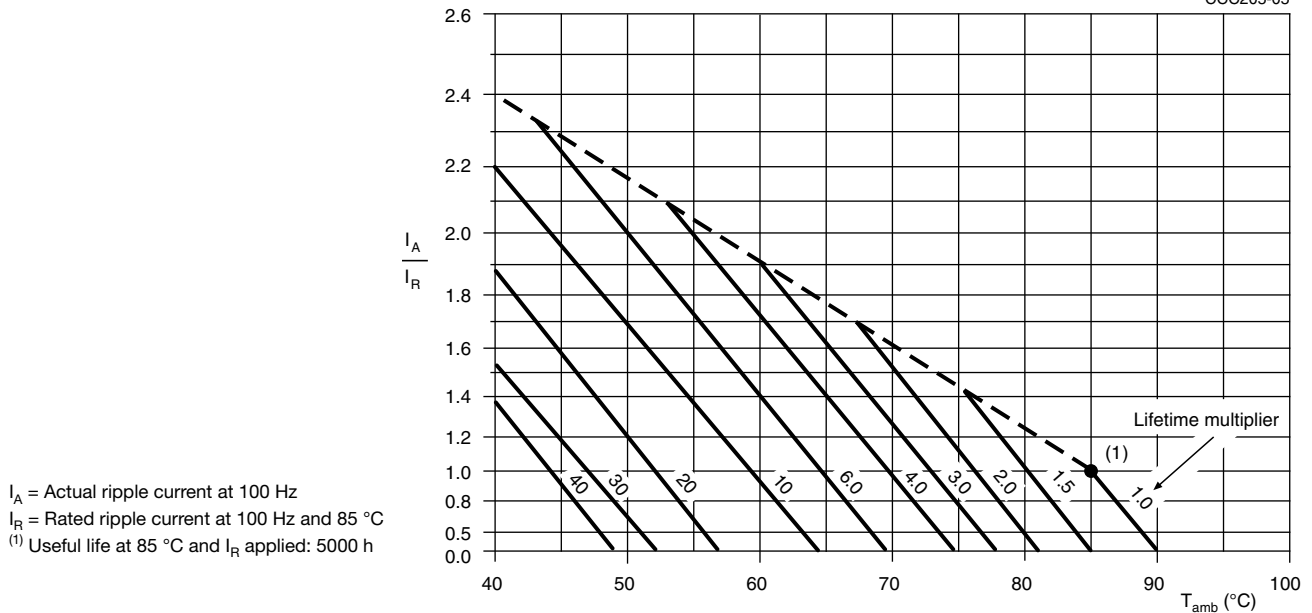


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

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 | $T_{amb} = 85\text{ °C}$ ; $U_R$ 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                      | CECC 30301 subclause 4.13             | $T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied;<br>5000 h   | $\Delta C/C: \pm 30\%$<br>$ESR \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage: $\leq 3\%$ |
| Shelf life                       | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 85\text{ °C}$ ; 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.



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.