

# Aluminum Capacitors



## FEATURES

- Load life: 2000 h at 105 °C
- Extra low impedance, high ripple current
- Polarized SMD aluminum electrolytic capacitors, non solid electrolyte
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

| QUICK REFERENCE DATA                   |                        |
|--|------------------------|
| DESCRIPTION                            | VALUE                  |
| Nominal case size (Ø D x L in mm)      | 6 x 5.8 to 12.5 x 13.5 |
| Rated capacitance range C <sub>R</sub> | 10 µF to 1500 µF       |
| Capacitance tolerance                  | ± 20 %                 |
| Rated voltage range                    | 6.3 V to 50 V          |
| Category temperature range             | - 40 °C to 105 °C      |
| Load life                              | 2000 h                 |
| Based on sectional specification       | IEC 60384-4/EN 130300  |
| Climatic category IEC 60068            | 40/105/56              |

## APPLICATIONS

- SMD technology, for high mounting density
- Industrial and professional applications
- General industrial, consumer
- Smoothing, filtering, buffering

## PACKAGING

Supplied in blister tape.

| 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> (µF)   | RATED VOLTAGE (V) |           |           |           |           |           |
|   | 6.3               | 10        | 16        | 25        | 35        | 50        |
| 10  | →                 | →         | →         | →         | →         | 6.3 x 5.8 |
| 22  | →                 | →         | →         | →         | →         | 6.3 x 5.8 |
| 33  | →                 | →         | →         | →         | 6.3 x 5.8 | 8 x 6.2   |
| 47  | →                 | →         | →         | →         | 6.3 x 5.8 | 8 x 6.2   |
| 68  | →                 | →         | →         | 6.3 x 5.8 | 8 x 6.2   | 8 x 10    |
| 100   | →                 | →         | 6.3 x 5.8 | 8 x 6.2   | 8 x 10    | 10 x 10   |
| 220   | 6.3 x 5.8         | 6.3 x 7.7 | 8 x 6.2   | 8 x 10    | 10 x 10   | -         |
| 330   | 8 x 6.2           | →         | 8 x 10    | -         | -         | -         |
| 470   | →                 | 8 x 10    | 10 x 10   | -         | -         | -         |
| 680   | →                 | 10 x 10   | -         | -         | -         | -         |
| 1000  | 10 x 10           | -         | -         | -         | -         | -         |
| 1500  | 10 x 10           | -         | -         | -         | -         | -         |

| DIMENSIONS in millimeters |            |            |           |            |            |           |            |     |     |
|---------------------------|------------|------------|-----------|------------|------------|-----------|------------|-----|-----|
| CASE SIZE CODE            | D ± α      | L ± α      | A ± α     | B ± α      | C ± α      | E ± α     | R          | N   | P   |
| AD                        | 6.3 ± 0.5  | 5.8 ± 0.3  | 2.4 ± 0.2 | 6.6 ± 0.2  | 6.6 ± 0.2  | 2.2 ± 0.2 | 0.5 to 0.8 | 0.3 | 0.5 |
| BM                        | 6.3 ± 0.5  | 7.7 ± 0.4  | 2.4 ± 0.2 | 6.6 ± 0.2  | 6.6 ± 0.2  | 2.2 ± 0.2 | 0.5 to 0.8 | 0.3 | 0.5 |
| AE                        | 8 ± 0.5    | 6.2 ± 0.4  | 3.3 ± 0.2 | 8.3 ± 0.2  | 8.3 ± 0.2  | 2.3 ± 0.2 | 0.5 to 0.8 | 0.3 | 0.5 |
| AF                        | 8 ± 0.5    | 10 ± 0.5   | 2.9 ± 0.2 | 8.3 ± 0.2  | 8.3 ± 0.2  | 3.1 ± 0.2 | 0.8 to 1.1 | 0.3 | 0.5 |
| AG                        | 10 ± 0.5   | 10 ± 0.5   | 3.2 ± 0.2 | 10.3 ± 0.2 | 10.3 ± 0.2 | 4.5 ± 0.2 | 0.8 to 1.1 | 0.3 | 0.5 |
| AH                        | 12.5 ± 0.5 | 13.5 ± 0.5 | 4.6 ± 0.2 | 12.8 ± 0.2 | 12.8 ± 0.2 | 4.5 ± 0.2 | 1.1 to 1.4 | 0.3 | 0.5 |

| ELECTRICAL DATA |  |
|-----------------|--|
| SYMBOL          | DESCRIPTION  |
| $U_R$           | Rated voltage  |
| $C_R$           | Rated capacitance at 120 Hz  |
| $\tan \delta$   | Max. dissipation factor at 120 Hz                                  |
| $R_{ESR}$       | Max. equivalent series resistance at 120 Hz                        |
| $I_R$           | Rated alternating current at 120 Hz and upper category temperature |
| $Z$             | Max. impedance at 100 kHz  |

**Note**

- Unless otherwise specified, all electrical values apply at  $T_{amb} = 20^\circ\text{C}$ ,  $P = 86$  to  $100$  kPa,  $RH = 45$  to  $75\%$ .

**ORDERING EXAMPLE**

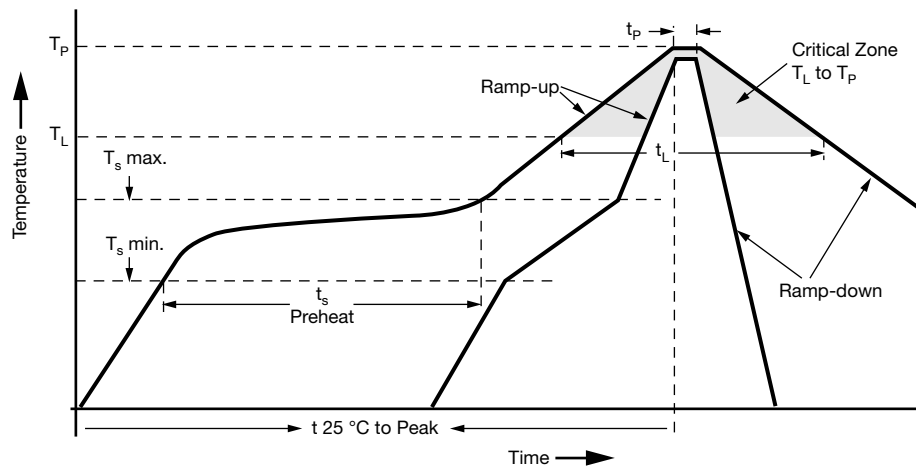
 ECL 22  $\mu\text{F}/50$  V,  $\pm 20\%$ , size 6.3 x 5.8 mm

Ordering code: MALSECL00AD222HARK

For Standard Packaging Quantity (SPQ) and Minimum Order Quantity (MOQ) please refer to our price list or contact customer service.

| ELECTRICAL DATA AND ORDERING INFORMATION |                                      |                             |                         |  |                                     |               |                    |
|--|--------------------------------------|-----------------------------|-------------------------|--|-------------------------------------|---------------|--------------------|
| $U_R$<br>(V)                             | $C_R$<br>120 Hz<br>( $\mu\text{F}$ ) | DIMENSIONS<br>D x L<br>(mm) | $\tan \delta$<br>120 Hz | Z<br>100 kHz/<br>20 °C<br>( $\Omega$ ) | $I_R$<br>100 kHz/<br>105 °C<br>(mA) | WEIGHT<br>(g) | CATALOG NUMBER     |
| 6.3                                      | 220                                  | 6.3 x 5.8                   | 0.24                    | 0.44                                   | 230                                 | 0.30          | MALSECL00AD322BARK |
|  | 330                                  | 8 x 6.2                     | 0.24                    | 0.26                                   | 300                                 | 0.55          | MALSECL00AE333BARK |
|  | 1000                                 | 10 x 10                     | 0.24                    | 0.09                                   | 670                                 | 1.21          | MALSECL00AG410BARK |
|  | 1500                                 | 10 x 10                     | 0.24                    | 0.09                                   | 670                                 | 1.21          | MALSECL00AG415BARK |
| 10                                       | 220                                  | 6.3 x 7.7                   | 0.19                    | 0.34                                   | 280                                 | 0.40          | MALSECL00BM322CARK |
|  | 470                                  | 8 x 10                      | 0.19                    | 0.17                                   | 450                                 | 1.00          | MALSECL00AF347CARK |
|  | 680                                  | 10 x 10                     | 0.19                    | 0.09                                   | 670                                 | 1.21          | MALSECL00AG368CARK |
| 16                                       | 100                                  | 6.3 x 5.8                   | 0.16                    | 0.44                                   | 230                                 | 0.30          | MALSECL00AD310DARK |
|  | 220                                  | 8 x 6.2                     | 0.16                    | 0.26                                   | 300                                 | 0.55          | MALSECL00AE322DARK |
|  | 330                                  | 8 x 10                      | 0.16                    | 0.17                                   | 450                                 | 1.00          | MALSECL00AF333DARK |
|  | 470                                  | 10 x 10                     | 0.16                    | 0.09                                   | 670                                 | 1.21          | MALSECL00AG347DARK |

| ELECTRICAL DATA AND ORDERING INFORMATION |                               |                             |                         |  |                                     |               |                    |
|--|-------------------------------|-----------------------------|-------------------------|--|-------------------------------------|---------------|--------------------|
| $U_R$<br>(V)                             | $C_R$<br>120 Hz<br>( $\mu$ F) | DIMENSIONS<br>D x L<br>(mm) | $\tan \delta$<br>120 Hz | Z<br>100 kHz/<br>20 °C<br>( $\Omega$ ) | $I_R$<br>100 kHz/<br>105 °C<br>(mA) | WEIGHT<br>(g) | CATALOG NUMBER     |
| 25                                       | 68                            | 6.3 x 5.8                   | 0.14                    | 0.44                                   | 230                                 | 0.30          | MALSECL00AD268EARK |
|  | 100                           | 8 x 6.2                     | 0.14                    | 0.26                                   | 300                                 | 0.55          | MALSECL00AE310EARK |
|  | 220                           | 8 x 10                      | 0.14                    | 0.17                                   | 450                                 | 1.00          | MALSECL00AF322EARK |
| 35                                       | 33                            | 6.3 x 5.8                   | 0.12                    | 0.44                                   | 230                                 | 0.30          | MALSECL00AD233FARK |
|  | 47                            | 6.3 x 5.8                   | 0.12                    | 0.44                                   | 230                                 | 0.30          | MALSECL00AD247FARK |
|  | 68                            | 8 x 6.2                     | 0.12                    | 0.26                                   | 300                                 | 0.55          | MALSECL00AE268FARK |
|  | 100                           | 8 x 10                      | 0.12                    | 0.17                                   | 450                                 | 1.00          | MALSECL00AF310FARK |
|  | 220                           | 10 x 10                     | 0.12                    | 0.09                                   | 670                                 | 1.21          | MALSECL00AG322FARK |
| 50                                       | 10                            | 6.3 x 5.8                   | 0.12                    | 0.88                                   | 165                                 | 0.30          | MALSECL00AD210HARK |
|  | 22                            | 6.3 x 5.8                   | 0.12                    | 0.88                                   | 165                                 | 0.30          | MALSECL00AD222HARK |
|  | 33                            | 8 x 6.2                     | 0.12                    | 0.63                                   | 300                                 | 0.55          | MALSECL00AE233HARK |
|  | 47                            | 8 x 6.2                     | 0.12                    | 0.63                                   | 300                                 | 0.55          | MALSECL00AE247HARK |
|  | 68                            | 8 x 10                      | 0.12                    | 0.34                                   | 450                                 | 1.00          | MALSECL00AF268HARK |
|  | 100                           | 10 x 10                     | 0.12                    | 0.18                                   | 670                                 | 1.21          | MALSECL00AG310HARK |

**REFLOW SOLDERING CONDITIONS FOR SMD ALUMINUM ELECTROLYTIC CAPACITORS**


| PROFILE FEATURE                                       | SOLDERING CONDITION                 |                    |                  |
|---|-------------------------------------|--------------------|------------------|
|   | $\varnothing 4$ TO $\varnothing 10$ | $\varnothing 12.5$ | $\varnothing 16$ |
| Average ramp-up rate ( $T_L$ to $T_P$ )               | 3 °C/s max.                         | 3 °C/s max.        |                  |
| Preheat   |                                     |                    |                  |
| Temperature min. ( $T_S$ min.)                        | 150 °C                              | 150 °C             |                  |
| Temperature max. ( $T_S$ max.)                        | 200 °C                              | 200 °C             |                  |
| Time ( $T_S$ min. to $T_S$ max.)                      | 60 s to 150 s                       | 40 s to 120 s      | 40 s to 100 s    |
| $T_S$ max. to $T_L$                                   |                                     |                    |                  |
| Ramp-up rate  | 3 °C/s max.                         | 3 °C/s max.        |                  |
| Time maintained above                                 |                                     |                    |                  |
| Temperature ( $T_L$ )                                 | 217 °C                              | 217 °C             |                  |
| Time ( $t_L$ )  | 60 s to 90 s                        | 40 s to 60 s       |                  |
| Peak/classification temperature ( $T_P$ )             | 250 °C                              | 240 °C             | 230 °C           |
| Time within 5 °C of actual peak temperature ( $T_P$ ) | 10 s max.                           | 10 s max.          |                  |
| Ramp-down rate  | 3 °C/s max.                         | 3 °C/s max.        |                  |
| Time 25 °C to peak temperature                        | 8 min max.                          | 8 min max.         |                  |



| RESISTANCE TO SOLDERING HEAT |                                    |
|------------------------------|------------------------------------|
| Leakage current              | Less than specified value          |
| Capacitance value            | Within $\pm 10\%$ of initial value |
| $\tan \delta$                | Less than specified value          |

| LOW TEMPERATURE BEHAVIOR (at 120 Hz) |                   |    |    |    |    |    |    |     |
|--------------------------------------|-------------------|----|----|----|----|----|----|-----|
| IMPEDANCE RATIO<br>(Z) T2/(Z) T1     | RATED VOLTAGE (V) |    |    |    |    |    |    |     |
| T2/T1                                | 6.3               | 10 | 16 | 25 | 35 | 50 | 63 | 100 |
| - 25 °C/+ 20 °C                      | 2                 | 2  | 2  | 2  | 2  | 2  | 3  | 3   |
| - 40 °C/+ 20 °C                      | 3                 | 3  | 3  | 3  | 3  | 3  | 4  | 4   |

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |
|---|------------------|
| FREQUENCY (Hz)  | $I_R$ MULTIPLIER |
| 50  | 0.41             |
| 120   | 0.59             |
| 300   | 0.69             |
| 1000  | 0.80             |
| 10 000  | 0.88             |
| 100 000   | 1.00             |

| ADDITIONAL ELECTRICAL DATA                          |                                       |   |
|---|---------------------------------------|---|
| PARAMETER   | CONDITIONS                            | VALUE   |
| <b>Current</b>                                      |                                       |   |
| Leakage current<br>(test conditions: $U_R$ , 20 °C) | After 2 min at $U_R$                  | $I_{L2} \leq 0.01 \times C_R \times U_R$ or 3 $\mu$ A for $U_R \leq 100$ V (whichever is greater) |
| <b>Resistance</b>                                   |                                       |   |
| Equivalent series resistance<br>(ESR)               | Calculated from $\tan \delta_{max}$ . | $ESR = \tan \delta / 2 \pi f C_R$   |

| TEST PROCEDURES AND REQUIREMENTS |   |  |
|----------------------------------|---|--|
| TEST                             | PROCEDURE<br>(quick reference)  | REQUIREMENTS   |
| Load life                        | $T_{amb} = 105$ °C<br>$U_R$ and $I_R$ applied<br>After 2000 h   | $\Delta C/C: \pm 25\%$ of initial value<br>$I_L \leq$ spec. limit<br>$\tan \delta \leq 2 \times$ spec. limit |
| Shelf life                       | No voltage applied<br>After 1000 h<br>After test: $U_R$ to be applied for 30 min<br>24 h to 48 h before measurement | $\Delta C/C: \pm 25\%$ of initial value<br>$I_L \leq$ spec. limit<br>$\tan \delta \leq 2 \times$ spec. limit |



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