# Hybrid Conductive Polymer Aluminum Capacitors SMD (Chip), Low Impedance

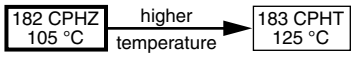


Fig. 1

## FEATURES

- Long useful life: up to 10 000 h at 105 °C
- Very low ESR and high ripple current
- High voltages up to 80 V
- SMD-version with base plate, lead (Pb)-free reflow solderable
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

## APPLICATIONS

- Automotive electronics
- Industrial and professional applications
- Telecommunications and IT
- Portable and mobile equipment

## MARKING

- Rated capacitance (in µF)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Black mark or "-" sign indicating the cathode (the anode is identified by beveled edges)
- Code indicating group number (82)

## PACKAGING

Supplied in blister tape on reel

| QUICK REFERENCE DATA | |
|---|---|
| **DESCRIPTION** | **VALUE** |
| Nominal case sizes (L x W x H in mm) | 5.0 x 5.0 x 5.8 to 10.0 x 10.0 x 10.5 |
| Rated capacitance range, $C_R$ | 10 µF to 330 µF |
| Tolerance on $C_R$ | ± 20 % |
| Rated voltage range, $U_R$ | 25 V to 80 V |
| Category temperature range | -55 °C to +105 °C |
| Endurance test at 105 °C | 10 000 h |
| Useful life at 105 °C | 10 000 h |
| Shelf life at 0 V, 105 °C | 1000 h |
| Based on sectional specification | IEC 60384-25 / CECC 32300 |
| Climatic category IEC 60068 | 55 / 105 / 56 |

**SELECTION CHART FOR $C_R$, $U_R$, AND RELEVANT NOMINAL CASE SIZES** (L x W x H in mm)

| $C_R$ (µF) | $U_R$ (V) | | | | |
|---|---|---|---|---|---|
| | **25** | **35** | **50** | **63** | **80** |
| 10 | → | → | 5.0 x 5.0 x 5.8 | 6.3 x 6.3 x 5.8 | - |
| 22 | → | 5.0 x 5.0 x 5.8 | 6.3 x 6.3 x 5.8 | 6.3 x 6.3 x 7.7 | 8.0 x 8.0 x 10.5 |
| 27 | → | 6.3 x 6.3 x 5.8 | - | - | - |
| 33 | 5.0 x 5.0 x 5.8 | → | 6.3 x 6.3 x 7.7 | 8.0 x 8.0 x 10.5 | 10.0 x 10.0 x 10.5 |
| 47 | → | 6.3 x 6.3 x 5.8 | - | - | - |
| 56 | 6.3 x 6.3 x 5.8 | → | → | 10.0 x 10.0 x 10.5 | - |
| 68 | → | 6.3 x 6.3 x 7.7 | 8.0 x 8.0 x 10.5 | - | - |
| 100 | 6.3 x 6.3 x 7.7 | → | 10.0 x 10.0 x 10.5 | - | - |
| 150 | → | 8.0 x 8.0 x 10.5 | - | - | - |
| 220 | 8.0 x 8.0 x 10.5 | - | - | - | - |
| 270 | → | 10.0 x 10.0 x 10.5 | - | - | - |
| 330 | 10.0 x 10.0 x 10.5 | - | - | - | - |



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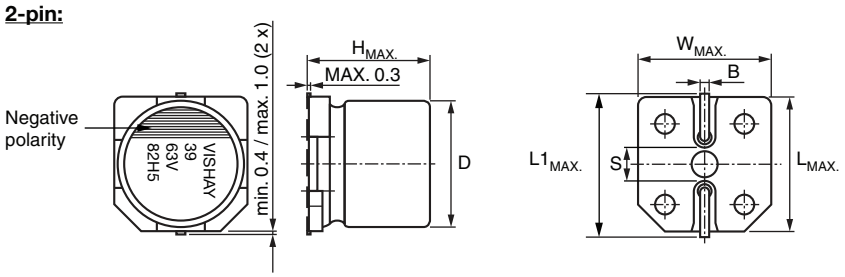


Fig. 2 - Dimensional outline

**Table 1**

| **DIMENSIONS** in millimeters **AND MASS** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NOMINAL CASE SIZE L x W x H** | **CASE CODE** | **$L_{MAX.}$** | **$W_{MAX.}$** | **$H_{MAX.}$** | **Ø D** | **$B_{MAX.}$** | **S** | **$L1_{MAX.}$** | **MASS (g)** |
| 5.0 x 5.0 x 5.8 | 0506 | 5.5 | 5.5 | 6.1 | 5.0 | 0.8 | 1.4 | 6.1 | 0.2 |
| 6.3 x 6.3 x 5.8 | 0606 | 6.7 | 6.7 | 6.1 | 6.3 | 0.8 | 2.2 | 7.4 | 0.3 |
| 6.3 x 6.3 x 7.7 | 0608 | 6.7 | 6.7 | 8.0 | 6.3 | 0.8 | 2.2 | 7.4 | 0.4 |
| 8.0 x 8.0 x 10.5 | 0810 | 8.5 | 8.5 | 10.8 | 8.0 | 1.1 | 3.1 | 9.2 | 0.9 |
| 10.0 x 10.0 x 10.5 | 1010 | 10.5 | 10.5 | 10.8 | 10.0 | 1.1 | 4.5 | 11.2 | 1.2 |

**Table 2**

| **TAPE AND REEL DIMENSIONS** in millimeters, **PACKAGING QUANTITIES** | | | | | | |
|---|---|---|---|---|---|---|
| **NOMINAL CASE SIZE L x W x H** | **CASE CODE** | **PITCH $P_1$** | **TAPE WIDTH W** | **TAPE THICKNESS $T_2$** | **REEL DIAMETER** | **PACKAGING QUANTITY PER REEL** |
| 5.0 x 5.0 x 5.8 | 0506 | 12 | 12 | 6.1 | 380 | 1000 |
| 6.3 x 6.3 x 5.8 | 0606 | 12 | 16 | 5.7 | 380 | 1000 |
| 6.3 x 6.3 x 7.7 | 0608 | 12 | 16 | 8.0 | 380 | 900 |
| 8.0 x 8.0 x 10.5 | 0810 | 16 | 24 | 11.0 | 380 | 500 |
| 10.0 x 10.0 x 10.5 | 1010 | 16 | 24 | 11.0 | 380 | 500 |

## MOUNTING

The capacitors are designed for automatic placement on to printed-circuit boards.

Optimum dimensions of soldering pads depend amongst others on soldering method, mounting accuracy, print layout and / or adjacent components.

For recommended soldering pad dimensions, refer to Fig. 3 and Table 3.

## SOLDERING

Soldering conditions are defined by the curve, temperature versus time, where the temperature is that measured on the component during processing.

For maximum conditions refer to Fig. 4.

Any temperature versus time curve which does not exceed the specified maximum curves may be applied.

As a general principle, temperature and duration shall be the **minimum** necessary required to ensure good soldering connections. However, the specified maximum curves should never be exceeded.



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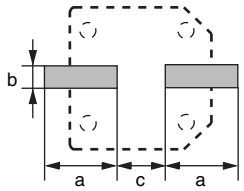


Fig. 3 - Recommended soldering pad dimensions

**Table 3**

| **RECOMMENDED SOLDERING PAD DIMENSIONS** in millimeters | | | | |
|---|---|---|---|---|
| **NOMINAL CASE SIZE L x W x H** | **CASE CODE** | **a** | **b** | **c** |
| 5.0 x 5.0 x 5.8 | 0506 | 3.0 | 1.6 | 1.4 |
| 6.3 x 6.3 x 5.8 | 0606 | 3.5 | 1.6 | 2.1 |
| 6.3 x 6.3 x 7.7 | 0608 | 3.5 | 1.6 | 2.1 |
| 8.0 x 8.0 x 10.5 | 0810 | 4.2 | 1.9 | 2.8 |
| 10.0 x 10.0 x 10.5 | 1010 | 4.4 | 1.9 | 4.3 |

## SOLDERING PROFILE FOR LEAD (Pb)-FREE REFLOW PROCESS

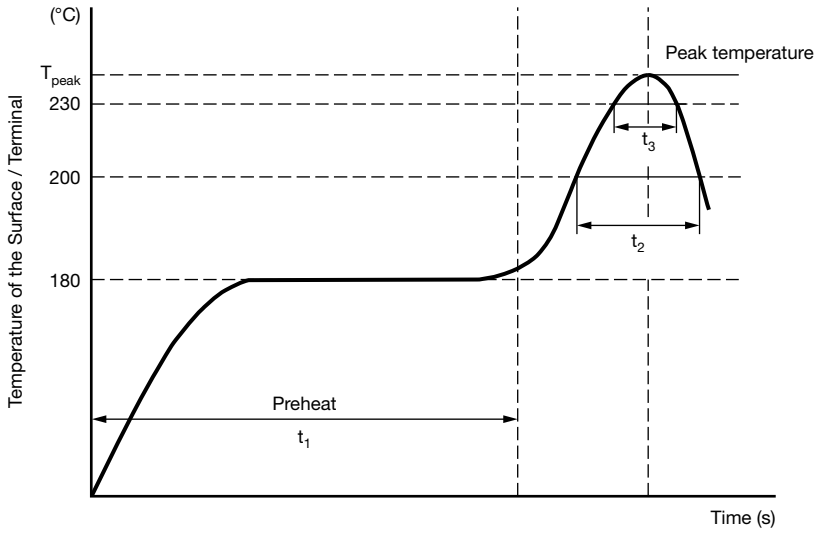


Fig. 4 - Maximum temperature load during reflow soldering

**Table 4**

| **REFLOW SOLDERING CONDITIONS** for MAL2182xxxxxE3 | | |
|---|---|---|
| **PROFILE FEATURES** | **25 V** | **35 V TO 80 V** |
| Maximum time between 150 °C to 180 °C ($t_1$) | 120 s | 120 s |
| Maximum time above 200 °C ($t_2$) | 80 s | 70 s |
| Maximum time above 230 °C ($t_3$) | 50 s | 30 s |
| Peak temperature $T_{Peak}$ | 240 °C | 240 °C |
| Maximum reflow cycles | 2 | 1 |

**Note**

- Temperature measuring point on top of the case and on terminals


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| ELECTRICAL DATA | |
|---|---|
| SYMBOL | DESCRIPTION |
| $C_R$ | Rated capacitance at 120 Hz, tolerance ± 20 % |
| $I_R$ 105 °C | Rated RMS ripple current at 100 kHz |
| $I_{L2}$ | Max. leakage current after 2 min at $U_R$ |
| tan δ | Max. dissipation factor at 120 Hz |
| ESR | Max. ESR at 100 kHz |

**Note**

- Unless otherwise specified, all electrical values in Table 5 apply at $T_{amb}$ = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

## ORDERING EXAMPLE

Hybrid conductive polymer 182 CPHZ series

100 µF / 25 V; ± 20 %

Nominal case size: 6.3 mm x 6.3 mm x 7.7 mm; taped on reel

Ordering code: MAL218297603E3

**Table 5**

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| $U_R$ (V) | $C_R$ (µF) | NOMINAL CASE SIZE L x W x H (mm) | $I_R$ 105 °C 100 kHz (mA) | $I_{L2}$ 2 min (µA) | tan δ 120 Hz | ESR 100 kHz 20 °C (mΩ) | ORDERING CODE MAL2182... |
| 25 | 33 | 5.0 x 5.0 x 5.8 | 900 | 8.3 | 0.14 | 80 | 97601E3 |
| | 56 | 6.3 x 6.3 x 5.8 | 1300 | 14 | 0.14 | 50 | 97602E3 |
| | 100 | 6.3 x 6.3 x 7.7 | 2000 | 25 | 0.14 | 30 | 97603E3 |
| | 220 | 8.0 x 8.0 x 10.5 | 2300 | 55 | 0.14 | 27 | 97604E3 |
| | 330 | 10.0 x 10.0 x 10.5 | 2500 | 82.5 | 0.14 | 20 | 97605E3 |
| 35 | 22 | 5.0 x 5.0 x 5.8 | 900 | 7.7 | 0.12 | 100 | 97001E3 |
| | 27 | 6.3 x 6.3 x 5.8 | 1300 | 9.5 | 0.12 | 60 | 97002E3 |
| | 47 | 6.3 x 6.3 x 5.8 | 1300 | 16.5 | 0.12 | 60 | 97003E3 |
| | 68 | 6.3 x 6.3 x 7.7 | 2000 | 23.8 | 0.12 | 35 | 97004E3 |
| | 150 | 8.0 x 8.0 x 10.5 | 2300 | 52.5 | 0.12 | 27 | 97005E3 |
| | 270 | 10.0 x 10.0 x 10.5 | 2500 | 94.5 | 0.12 | 20 | 97006E3 |
| 50 | 10 | 5.0 x 5.0 x 5.8 | 750 | 5 | 0.1 | 120 | 97101E3 |
| | 22 | 6.3 x 6.3 x 5.8 | 1100 | 11 | 0.1 | 80 | 97102E3 |
| | 33 | 6.3 x 6.3 x 7.7 | 1600 | 16.5 | 0.1 | 40 | 97103E3 |
| | 68 | 8.0 x 8.0 x 10.5 | 1800 | 34 | 0.1 | 30 | 97104E3 |
| | 100 | 10.0 x 10.0 x 10.5 | 2000 | 50 | 0.1 | 28 | 97105E3 |
| 63 | 10 | 6.3 x 6.3 x 5.8 | 1000 | 6.3 | 0.08 | 120 | 97801E3 |
| | 22 | 6.3 x 6.3 x 7.7 | 1500 | 13.9 | 0.08 | 80 | 97802E3 |
| | 33 | 8.0 x 8.0 x 10.5 | 1700 | 20.8 | 0.08 | 40 | 97803E3 |
| | 56 | 10.0 x 10.0 x 10.5 | 1800 | 35.3 | 0.08 | 30 | 97804E3 |
| 80 | 22 | 8.0 x 8.0 x 10.5 | 1550 | 17.6 | 0.08 | 45 | 97701E3 |
| | 33 | 10.0 x 10.0 x 10.5 | 1700 | 26.4 | 0.08 | 36 | 97702E3 |

**Table 6**

| ADDITIONAL ELECTRICAL DATA | | |
|---|---|---|
| PARAMETER | CONDITIONS | VALUE |
| **Voltage** | | |
| Surge voltage for short periods | IEC 60384-25, subclause 4.14 | $U_s \leq 1.15 \times U_R$ |



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## USEFUL LIFE AND ENDURANCE

**Table 7**

| ENDURANCE TEST AND USEFUL LIFE | | | | | | | |
|---|---|---|---|---|---|---|---|
| SERIES | CASE CODE | USEFUL LIFE AT 105 °C (h) [1] | ENDURANCE AT 105 °C (h) | ENDURANCE AT 95 °C (h) | ENDURANCE AT 85 °C (h) | ENDURANCE AT 75 °C (h) | ENDURANCE AT 65 °C (h) |
| 182 CPHZ | 0506 to 1010 | 10 000 | 10 000 | 20 000 | 40 000 | 80 000 | 160 000 |

**Note**

[1] Identical with endurance for this series

Endurance can be calculated by formula below:

$$L = L_{Tmax.} \times 2^{\frac{T_{max.} - T_a}{10}}$$

L: estimated lifetime (h)

$L_{Tmax.}$: base lifetime specified at maximum operating temperature with applied DC voltage (h)

$T_{max.}$: rated maximum operating temperature (°C)

$T_a$: actual ambient temperature (°C)

**Table 8**

| MULTIPLIER OF RIPPLE CURRENT ($I_R$) AS A FUNCTION OF FREQUENCY | | | |
|---|---|---|---|
| FREQUENCY (Hz) | | | |
| 120 | 1000 | 10 000 | ≥ 100 000 |
| $I_R$ MULTIPLIER | | | |
| 0.1 | 0.3 | 0.6 | 1 |

**Table 9**

| TEST PROCEDURES AND REQUIREMENTS | | | |
|---|---|---|---|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Mounting | IEC 60384-25, subclause 4.3 | Shall be performed prior to tests mentioned below; reflow soldering; for maximum temperature load refer to chapter “Mounting” | ΔC/C: ± 5 %<br>tan δ ≤ spec. limit<br>$I_{L2}$ ≤ spec. limit |
| Endurance | IEC 60384-25 / CECC 32300, subclause 4.15 | $T_{amb}$ = 105 °C; $U_R$ applied; for test duration see Table 7 | ΔC/C: ± 30 %<br>tan δ ≤ 2 x spec. limit<br>$I_{L2}$ ≤ spec. limit<br>ESR ≤ 2 x spec. limit |
| Useful life | CECC 30301, subclause 1.8.1 | $T_{amb}$ = 105 °C; $U_R$ and $I_R$ applied; for test duration see Table 7 | ΔC/C: ± 30 %<br>tan δ ≤ 2 x spec. limit<br>$I_{L2}$ ≤ spec. limit<br>ESR ≤ 2 x spec. limit |
| Shelf life (storage at high temperature) | IEC 60384-25 / CECC 32300, subclause 4.16 | $T_{amb}$ = 105 °C; no voltage applied; 1000 h<br>after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | For requirements see “Endurance test” above |

*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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Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А