# THE DATASHEET OF

# MAL219622104E3

# Energy Storage Double Layer Capacitors


## FEATURES

- Polarized capacitor with high charge density, alternative product to rechargeable backup batteries
- Dielectric: electric double layer
- Radial leads, cylindrical case, insulated with a blue sleeve
- Available in both vertical and low-profile versions
- Unlimited charge and discharge cycle numbers
- No charge-discharge control circuitry and no series resistor necessary
- Maintenance-free, no periodic replacement or service necessary
- Ecologically beneficial (no Cd, no Li)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

## APPLICATIONS

- Energy storage, for backup of semiconductor memories (CMOS) in all fields of electronics
- Telecommunication, audio-video, EDP
- General industrial, clock and timer systems

## MARKING

The capacitors are marked with the following information:

- Rated capacitance (in F)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Name of manufacturer
- Negative terminal identification
- Upper category temperature (at 85 °C types only)

**QUICK REFERENCE DATA** (Low Leakage Series)

| DESCRIPTION | VALUE | | |
|---|---|---|---|
| | STANDARD FORM A | HIGH TEMPERATURE FORM A | STANDARD FORM B |
| Nominal case sizes (Ø D x L in mm) | 13.5 x 7 and 20.5 x 8 | 13.5 x 7 and 20.5 x 10.5 | 11.5 x 13 and 19 x 20.5 |
| Rated capacitance range, $C_R$ | 0.22 F to 1.5 F | 0.22 F to 1 F | 0.22 F to 1.5 F |
| Tolerance on $C_R$ at 20 °C | -20 % to +80 % | | |
| Rated voltage, $U_R$ | 5.5 V | 5.5 V | 5.5 V |
| Maximum surge voltage, $U_S$ | 6.0 V | 6.0 V | 6.0 V |
| Category temperature range | -25 °C to +70 °C | -40 °C to +85 °C | -25 °C to +70 °C |
| Useful life at $U_R$: | | | |
| at 85 °C | - | 1000 h | - |
| at 70 °C | 1000 h | 2800 h | 1000 h |
| at 40 °C | 8000 h | 23 000 h | 8000 h |
| at 25 °C | 23 000 h | 64 000 h | 23 000 h |
| Shelf life at 0 V | 1000 h at upper category temperature | | |
| Climatic category IEC 60068 | 25 / 070 / 21 | 25 / 085 / 21 | 25 / 070 / 21 |

| SELECTION CHART FOR $C_R$, $U_R$, AND FORM AT UPPER CATEGORY TEMPERATURE (UCT) | | | |
|---|---|---|---|
| $C_R$ (F) | FORM | $U_R$ = 5.5 V | |
| | | LOW LEAKAGE SERIES | |
| | | UCT = 85 °C | UCT = 70 °C |
| 0.22 | A | 13.5 x 9 | 13.5 x 7 |
| | B | - | 11.5 x 13 |
| 0.33 | A | 13.5 x 9 | 13.5 x 7 |
| | B | - | 11.5 x 13 |
| 0.47 | A | 20.5 x 10.5 | 13.5 x 7 |
| | B | - | 11.5 x 13 |
| 0.68 | A | 20.5 x 10.5 | - |
| 1.0 | A | 20.5 x 10.5 | 20.5 x 8 |
| | B | - | 19 x 20.5 |
| 1.5 | A | - | 20.5 x 8 |
| | B | - | 19 x 20.5 |

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

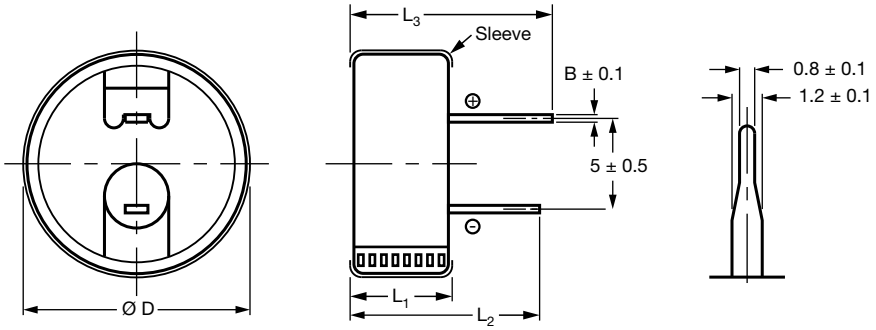


Fig. 1 - **Form A:** Low profile

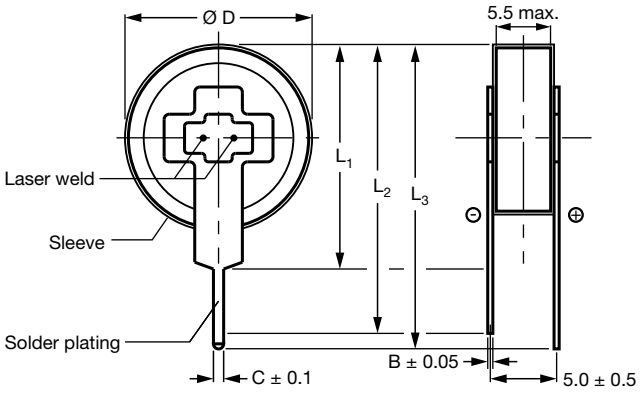


Fig. 2 - **Form B:** Vertical

| **DIMENSIONS** in millimeters, **MASS AND PACKAGING QUANTITIES** (Low Leakage Series) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NOMINAL CASE SIZE Ø D x L (mm) | CASE CODE | FORM | Ø $D_{max.}$ | $L_1$ | $L_2$ | $L_3$ | B | C | MASS (g) | PACKAGING QUANTITIES |
| 11.5 x 13 | 6 | B | 12 | 13.0 ± 1.0 | 16.5 ± 1.0 | 16.5 ± 1.0 | 0.2 | 0.8 | ≈ 1.6 | 2000 |
| 19 x 20.5 | 7 | B | 19.5 | 20.5 ± 1.0 | 24.5 ± 1.0 | 25.5 ± 1.0 | 0.2 | 1.0 | ≈ 4.0 | 400 |
| 13.5 x 7 | 8 | A | 14 | 7.0 ± 0.5 | 12.5 ± 0.5 | 13.5 ± 0.5 | 0.4 | - | ≈ 3.5 | 1000 |
| 13.5 x 9 | 8a | A | 14 | 9.0 ± 0.5 | 14.5 ± 0.5 | 15.5 ± 0.5 | 0.4 | - | ≈ 4.1 | 800 |
| 20.5 x 8 | 9 | A | 21 | 8.0 ± 0.5 | 13.4 ± 0.5 | 13.8 ± 0.5 | 0.5 | - | ≈ 9.0 | 400 |
| 20.5 x 10.5 | 10 | A | 21 | 10.5 ± 0.5 | 15.5 ± 0.5 | 16.0 ± 0.5 | 0.5 | - | ≈ 10.0 | 400 |

| ELECTRICAL DATA | |
|---|---|
| SYMBOL | DESCRIPTION |
| $C_R$ | Rated capacitance, tolerance -20 % / +80 %, measured by constant current discharge method |
| UCT | Upper category temperature |
| $I_L$ | Max. leakage current after 30 min at $U_R$ |
| $R_I$ | Max. internal resistance at 1 kHz |

**Note**

- Unless otherwise specified, all electrical values in Table 1 apply at $T_{amb}$ = 20 °C, P = 86 kPa to 106 kPa and RH = 45 % to 75 %

## ORDERING EXAMPLE

Double layer capacitor 196 series

1.0 F / 5.5 V

Nominal case size: Ø 20.5 mm x 8 mm; form A

Ordering code: MAL219642105E3

**Table 1**

| ELECTRICAL DATA AND ORDERING INFORMATION (Low Leakage Series) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $U_R$ (V) | $C_R$ (F) | NOMINAL CASE SIZE Ø D x L (mm) | CASE CODE | FORM | UCT (°C) | $I_L$ 30 min (µA) | $R_I$ 1 kHz (Ω) | ORDERING CODE |
| **STANDARD SERIES** | | | | | | | | |
| | 0.22 | 13.5 x 7 | 8 | A | 70 | 3 | 75 | **MAL219642224E3** |
| | 0.33 | 13.5 x 7 | 8 | A | 70 | 5 | 50 | **MAL219642334E3** |
| 5.5 | 0.47 | 13.5 x 7 | 8 | A | 70 | 5 | 50 | **MAL219642474E3** |
| | 1.0 | 20.5 x 8 | 9 | A | 70 | 8 | 30 | **MAL219642105E3** |
| | 1.5 | 20.5 x 8 | 9 | A | 70 | 8 | 30 | **MAL219642155E3** |
| **STANDARD SERIES, VERTICAL** | | | | | | | | |
| | 0.22 | 11.5 x 13 | 6 | B | 70 | 3 | 75 | **MAL219652224E3** |
| | 0.33 | 11.5 x 13 | 6 | B | 70 | 5 | 50 | **MAL219652334E3** |
| 5.5 | 0.47 | 11.5 x 13 | 6 | B | 70 | 5 | 50 | **MAL219652474E3** |
| | 1.0 | 19 x 20.5 | 7 | B | 70 | 8 | 30 | **MAL219652105E3** |
| | 1.5 | 19 x 20.5 | 7 | B | 70 | 8 | 30 | **MAL219652155E3** |
| **HIGH TEMPERATURE SERIES** | | | | | | | | |
| | 0.22 | 13.5 x 9 | 8a | A | 85 | 3 | 75 | **MAL219662224E3** |
| | 0.33 | 13.5 x 9 | 8a | A | 85 | 5 | 50 | **MAL219662334E3** |
| 5.5 | 0.47 | 20.5 x 10.5 | 10 | A | 85 | 10 | 50 | **MAL219662474E3** |
| | 0.68 | 20.5 x 10.5 | 10 | A | 85 | 8 | 30 | **MAL219662684E3** |
| | 1.0 | 20.5 x 10.5 | 10 | A | 85 | 10 | 30 | **MAL219662105E3** |

## MEASURING OF CHARACTERISTICS

### CAPACITANCE (C)

Capacitance shall be measured by constant current discharge method.

| DISCHARGE CURRENT AS A FUNCTION OF RATED CAPACITANCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | VALUE | | | | | | UNIT |
| Rated capacitance, $C_R$ | 0.22 | 0.33 | 0.47 | 0.68 | 1.0 | 1.5 | F |
| Discharge current, $I_D$ | 0.1 | | 1.0 | | | | mA |

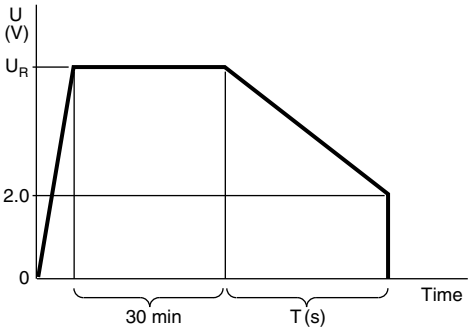


Fig. 3 - Voltage diagram for capacitance measurement

Capacitance value $C_R$ is given by discharge current $I_D$, time T and rated voltage $U_R$, according to the following equation:

$$C(F) = \frac{I_D(mA) \times 10^{-3} \times T(s)}{U_R(V) - 2}$$

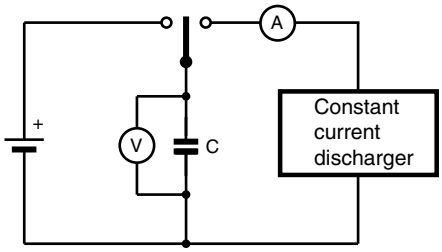


Fig. 4 - Test circuit for capacitance measurement

### INTERNAL RESISTANCE ($R_I$) AT 1 kHz

$$R_I(\Omega) = \frac{V_C(V)}{10^{-3}}$$

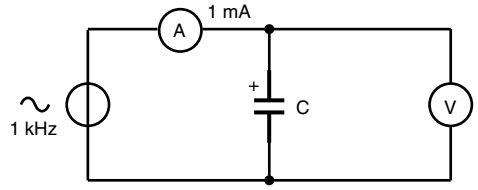


Fig. 5 - Test circuit for $R_I$ measurement

### LEAKAGE CURRENT ($I_L$)

Leakage current shall be measured after 30 min application of rated voltage $U_R$:

$$I_L(\mu A) = \frac{V(V)}{10^{-4}}$$

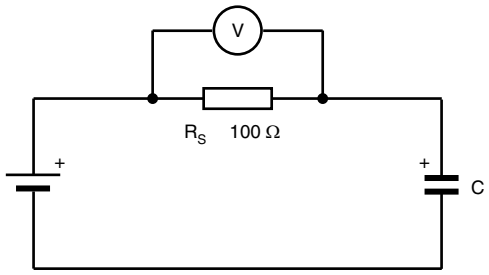


Fig. 6 - Test circuit for leakage current

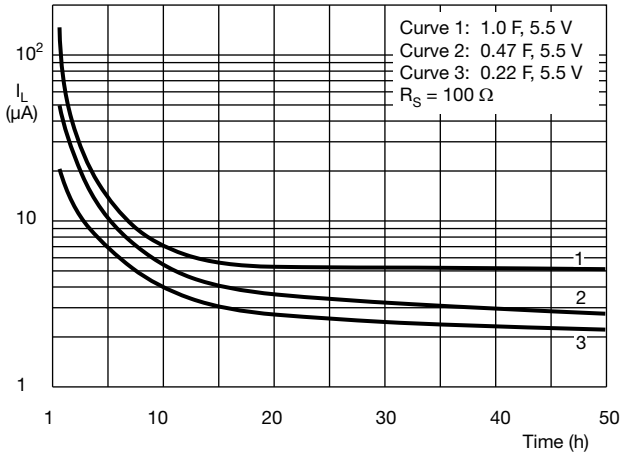


Fig. 7 - Typical leakage current as a function of time

## DISCHARGE CHARACTERISTICS

Backup time of 196 DLC series capacitors depends on minimum memory holding voltage and discharge current (corresponding with the current consumption of the load). For minimum backup times of standard and vertical miniaturized series see Figures 8 and 9 (charging time ≥ 24 h).

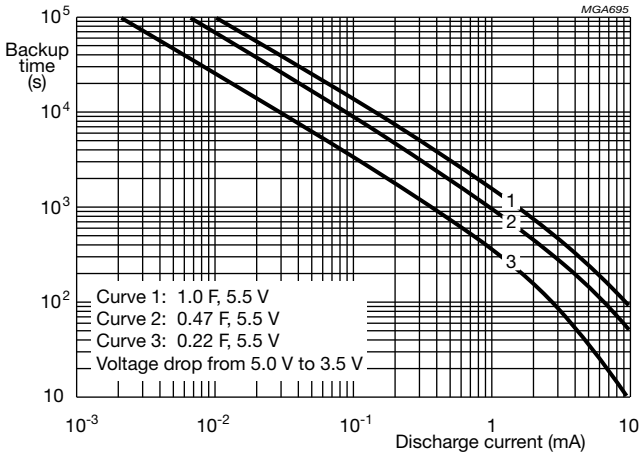


Fig. 8 - Typical backup time as a function of discharge current

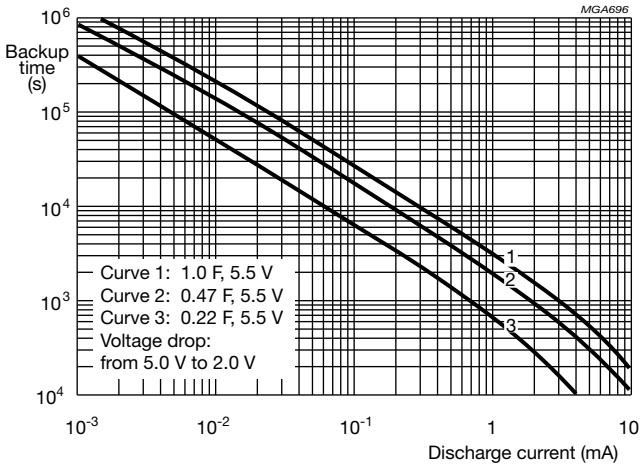


Fig. 9 - Typical backup time as a function of discharge current

Figure 10 shows the backup time when a 196 DLC capacitor is discharged by a constant resistance (charging time ≥ 24 h).

The horizontal axis shows the initial value of discharge current if 5 V is connected to the capacitor via a fixed series resistor.

**Example: 1 µA corresponds to 5 MΩ and 0.1 µA corresponds to 50 MΩ**

The vertical axis shows that period of time during which the voltage drops from 5 V to 2 V.

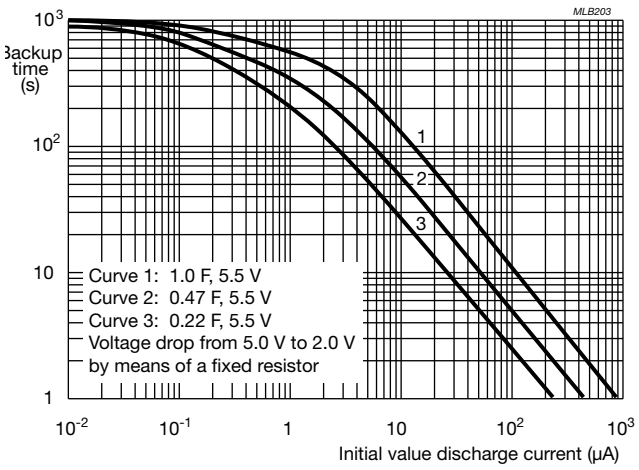


Fig. 10 - Typical backup time as a function of initial discharge current

**Table 2**

| **TEST PROCEDURES AND REQUIREMENTS** for standard and vertical miniaturized series (5.5 V; 70 °C) | | | |
|---|---|---|---|
| **NAME OF TEST** | **IEC 60384-4 / EN130300 SUBCLAUSE** | **PROCEDURE (quick reference)** | **REQUIREMENTS** |
| Robustness of terminations | 4.4 | Tensile strength; application of loading force for 10 s:<br>20 N (standard series)<br>5 N (vertical miniaturized series) | No breaks |
| Resistance to soldering heat | 4.5 | Solder bath; 260 °C; 5 s | ΔC/C: ± 10 %<br>$R_I$ and $I_L$ ≤ spec. limit |
| Solderability | 4.6 | Solder bath; 235 °C; 2 s | ≥ 75 % tinning |
| Vibration | 4.8 | 10 Hz to 55 Hz; 1.5 mm; 3 directions;<br>2 h per direction | ΔC/C: ± 10 %<br>$R_I$ and $I_L$ ≤ spec. limit |
| Damp heat, steady state | 4.12 | 500 h at 55 °C; RH 90 % to 95 %;<br>no voltage applied | ΔC/C: ± 30 %<br>$R_I$ ≤ 4 x spec. limit<br>$I_L$ ≤ 2 x spec. limit |
| Endurance | 4.13 | $T_{amb}$ = 70 °C; 5.5 V applied;<br>1000 h | ΔC/C: ± 30 %<br>$R_I$ ≤ 4 x spec. limit<br>$I_L$ ≤ 2 x spec. limit |
| Useful life | - | $T_{amb}$ = 70 °C; 5.5 V applied;<br>1000 h | ΔC/C: ± 30 %<br>$R_I$ ≤ 4 x spec. limit<br>$I_L$ ≤ 2 x spec. limit |
| Storage at upper category temperature | 4.17 | $T_{amb}$ = 70 °C;<br>no voltage applied;<br>1000 h | ΔC/C: ± 30 %<br>$R_I$ ≤ 4 x spec. limit<br>$I_L$ ≤ 2 x spec. limit |
| Self discharge | - | 24 h storage at room temperature after application of 5 V for 1 h | Remaining voltage: ≥ 4 V |
| Characteristics at high and low temperature | 4.19 | Step 1: reference measurement at +20 °C of C, $R_I$ and $I_L$<br>Step 2: measurement at -25 °C<br>Step 3: measurement at +20 °C<br>Step 4: measurement at +70 °C<br>Step 5: measurement at +20 °C | ΔC/C: ± 30 % of +20 °C value<br>$R_I$ ≤ 5 x the +20 °C value<br>$I_L$ ≤ 4 x the +20 °C value |

*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.

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- View MAL219622104E3 on WIN SOURCE
- Vishay Information

## Optimize Your Supply Chain with WIN SOURCE Solutions

- Global Sourcing Solution
- Obsolete Management
- Cost Control Management
- Shortage Management
- Alternative Solution
- Excess Inventory Management