

## Aluminum Electrolytic Capacitors Power Miniaturized General Purpose - Snap-In

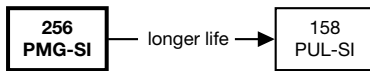


Fig. 1

| QUICK REFERENCE DATA                                |                        |
|-----------------------------------------------------|------------------------|
| DESCRIPTION                                         | VALUE                  |
| Nominal case size (D x L in mm)                     | 20 x 25 to 35 x 45     |
| Rated capacitance range (E6 series), C <sub>R</sub> | 820 μF to 47 000 μF    |
| Tolerance on C <sub>R</sub>                         | ± 20 %                 |
| Rated voltage range, U <sub>R</sub>                 | 16 V to 100 V          |
| Category temperature range                          | -40 °C to +105 °C      |
| Endurance test at +105 °C                           | 2000 h                 |
| Useful life at +105 °C                              | 2000 h                 |
| Useful life at +85 °C                               | > 5000 h               |
| Shelf life at 0 V, 105 °C                           | 1000 h                 |
| Based on sectional specification                    | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068                         | 40 / 105 / 56          |

### FEATURES

- Useful life: 2000 h at +105 °C, > 5000 h at +85 °C
- Voltage range from 16 V to 100 V
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Pressure relief on the top of the aluminum case
- PET insulation sleeve
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

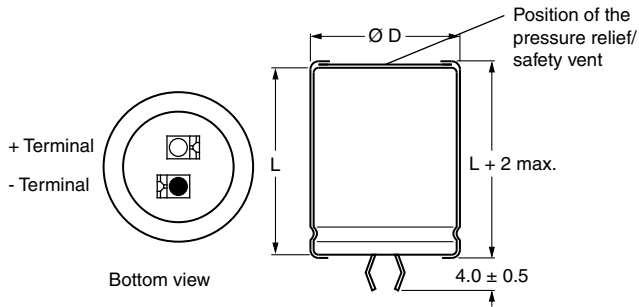
- General purpose, industrial
- Standard and switched mode power supplies
- Audio systems
- DC/DC converters
- Telecom
- Smoothing and filtering

### MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (± 20 %)
- Rated voltage (in V)
- Date code; abbreviation in 2 digits in accordance with IEC 60062
- Name of manufacturer
- Code for factory of origin (04)
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Relevant part of ordering code. Example MAL225638472E3, marking will show: 256 38472
- Climatic category in accordance with IEC 60068
- LL for Long Life

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm) |                    |         |         |         |         |         |         |
|-------------------------------------------------------------------------------------------------------|--------------------|---------|---------|---------|---------|---------|---------|
| C <sub>R</sub><br>(μF)                                                                                | U <sub>R</sub> (V) |         |         |         |         |         |         |
|                                                                                                       | 16                 | 25      | 35      | 50      | 63      | 80      | 100     |
| 820                                                                                                   | -                  | -       | -       | -       | -       | -       | 22 x 30 |
| 1200                                                                                                  | -                  | -       | -       | -       | 22 x 25 | -       | 25 x 30 |
| 1500                                                                                                  | -                  | -       | -       | -       | -       | 22 x 35 | -       |
| 2200                                                                                                  | -                  | -       | -       | 22 x 25 | 22 x 30 | 25 x 30 | 25 x 40 |
| 2700                                                                                                  | -                  | -       | -       | 22 x 25 | -       | -       | 30 x 35 |
| 3300                                                                                                  | -                  | -       | 22 x 25 | 22 x 30 | 25 x 35 | 35 x 25 | 30 x 40 |
| 3900                                                                                                  | -                  | -       | -       | 22 x 35 | -       | -       | -       |
| 4700                                                                                                  | -                  | -       | 22 x 25 | 25 x 30 | 25 x 40 | 35 x 30 | 35 x 40 |
| 5600                                                                                                  | -                  | -       | -       | -       | -       | 35 x 45 | 35 x 45 |
| 6800                                                                                                  | -                  | -       | 25 x 30 | 25 x 40 | 35 x 30 | 35 x 40 | -       |
| 8200                                                                                                  | -                  | 22 x 25 | -       | -       | -       | -       | -       |
| 10 000                                                                                                | 20 x 25            | -       | 30 x 30 | 30 x 40 | 35 x 40 | -       | -       |
| 15 000                                                                                                | 22 x 30            | 22 x 40 | -       | -       | -       | -       | -       |
| 22 000                                                                                                | 25 x 30            | 25 x 40 | 35 x 40 | -       | -       | -       | -       |
| 33 000                                                                                                | 30 x 30            | -       | -       | -       | -       | -       | -       |
| 47 000                                                                                                | 35 x 35            | -       | -       | -       | -       | -       | -       |

**DIMENSIONS in millimeters AND AVAILABLE FORMS**


The minus and/or plus terminal can be marked with an imprinted sign.

Fig. 2 - Two terminal snap-in

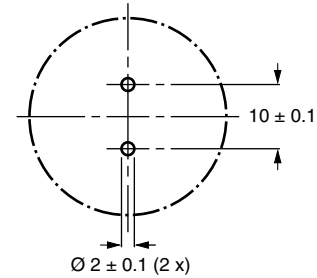


Fig. 3 - Mounting hole diagram

**Table 1**

| <b>DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |                           |                         |                     |                                                     |                                                   |
|-----------------------------------------------------------------|---------------------------|-------------------------|---------------------|-----------------------------------------------------|---------------------------------------------------|
| <b>NOMINAL CASE SIZE<br/>Ø D x L</b>                            | <b>Ø D<sub>max.</sub></b> | <b>L<sub>max.</sub></b> | <b>MASS<br/>(g)</b> | <b>PACKAGING<br/>QUANTITIES<br/>(units per box)</b> | <b>CARDBOARD BOX<br/>DIMENSIONS<br/>L x W x H</b> |
| 20 x 25                                                         | 21                        | 27                      | ≈ 10                | 104                                                 | 310 x 200 x 42                                    |
| 22 x 25                                                         | 23                        | 27                      | ≈ 11                | 84                                                  | 310 x 200 x 42                                    |
| 22 x 30                                                         | 23                        | 32                      | ≈ 15                | 84                                                  | 310 x 200 x 47                                    |
| 22 x 35                                                         | 23                        | 37                      | ≈ 17                | 84                                                  | 310 x 200 x 52                                    |
| 22 x 40                                                         | 23                        | 42                      | ≈ 19                | 84                                                  | 310 x 200 x 57                                    |
| 25 x 25                                                         | 26                        | 27                      | ≈ 15                | 66                                                  | 310 x 200 x 42                                    |
| 25 x 30                                                         | 26                        | 32                      | ≈ 18                | 66                                                  | 310 x 200 x 47                                    |
| 25 x 35                                                         | 26                        | 37                      | ≈ 20                | 66                                                  | 310 x 200 x 52                                    |
| 25 x 40                                                         | 26                        | 42                      | ≈ 27                | 66                                                  | 310 x 200 x 57                                    |
| 25 x 50                                                         | 26                        | 52                      | ≈ 28                | 66                                                  | 310 x 200 x 67                                    |
| 30 x 30                                                         | 31                        | 32                      | ≈ 32                | 45                                                  | 310 x 200 x 47                                    |
| 30 x 35                                                         | 31                        | 37                      | ≈ 35                | 45                                                  | 310 x 200 x 52                                    |
| 30 x 40                                                         | 31                        | 42                      | ≈ 37                | 45                                                  | 310 x 200 x 57                                    |
| 30 x 50                                                         | 31                        | 52                      | ≈ 42                | 45                                                  | 310 x 200 x 67                                    |
| 35 x 25                                                         | 36                        | 27                      | ≈ 32                | 40                                                  | 310 x 200 x 42                                    |
| 35 x 30                                                         | 36                        | 32                      | ≈ 38                | 40                                                  | 310 x 200 x 47                                    |
| 35 x 35                                                         | 36                        | 37                      | ≈ 43                | 40                                                  | 310 x 200 x 52                                    |
| 35 x 40                                                         | 36                        | 42                      | ≈ 50                | 40                                                  | 310 x 200 x 57                                    |
| 35 x 45                                                         | 36                        | 47                      | ≈ 57                | 40                                                  | 310 x 200 x 62                                    |

| <b>ELECTRICAL DATA</b> |                                                     |
|------------------------|-----------------------------------------------------|
| <b>SYMBOL</b>          | <b>DESCRIPTION</b>                                  |
| C <sub>R</sub>         | Rated capacitance at 120 Hz, +20 °C                 |
| I <sub>R</sub>         | Rated RMS ripple current at 120 Hz, +105 °C         |
| I <sub>L5</sub>        | Max. leakage current after 5 min at U <sub>R</sub>  |
| ESR                    | Max. equivalent series resistance at 120 Hz, +20 °C |

**Notes**

- 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**

Aluminum electrolytic capacitor 256 series;  
 4700 µF / 63 V;  
 2-terminal snap-in: MAL225638472E3



Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                        |                              |                                            |                           |                                                    |                                                    |                                 |                |
|------------------------------------------|------------------------|------------------------------|--------------------------------------------|---------------------------|----------------------------------------------------|----------------------------------------------------|---------------------------------|----------------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>(μF) | CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>120 Hz<br>+105 °C<br>(A) | tan δ<br>120 Hz<br>+20 °C | TYP. ESR<br>120 Hz<br>+20 °C <sup>(1)</sup><br>(Ω) | MAX. ESR<br>120 Hz<br>+20 °C <sup>(1)</sup><br>(Ω) | I <sub>L</sub><br>5 min<br>(mA) | ORDERING CODE  |
| 16                                       | 10 000                 | 20 x 25                      | 1.61                                       | 0.50                      | 0.047                                              | 0.066                                              | 1.20                            | MAL225615103E3 |
|                                          | 15 000                 | 22 x 30                      | 2.20                                       | 0.50                      | 0.031                                              | 0.044                                              | 1.47                            | MAL225625153E3 |
|                                          | 22 000                 | 25 x 30                      | 2.77                                       | 0.50                      | 0.021                                              | 0.030                                              | 1.50                            | MAL225635223E3 |
|                                          | 33 000                 | 30 x 30                      | 3.48                                       | 0.50                      | 0.014                                              | 0.020                                              | 1.50                            | MAL225645333E3 |
|                                          | 47 000                 | 35 x 35                      | 4.85                                       | 0.50                      | 0.010                                              | 0.014                                              | 1.50                            | MAL225655473E3 |
| 25                                       | 8200                   | 22 x 25                      | 1.73                                       | 0.45                      | 0.040                                              | 0.073                                              | 1.36                            | MAL225626822E3 |
|                                          | 15 000                 | 22 x 40                      | 2.65                                       | 0.45                      | 0.022                                              | 0.040                                              | 1.50                            | MAL225626153E3 |
|                                          | 22 000                 | 25 x 40                      | 3.22                                       | 0.45                      | 0.015                                              | 0.027                                              | 1.50                            | MAL225636223E3 |
|                                          | 22 000                 | 30 x 30                      | 3.18                                       | 0.45                      | 0.015                                              | 0.027                                              | 1.50                            | MAL225646223E3 |
| 35                                       | 3300                   | 22 x 25                      | 1.31                                       | 0.40                      | 0.074                                              | 0.161                                              | 1.02                            | MAL225620332E3 |
|                                          | 4700                   | 22 x 25                      | 1.63                                       | 0.40                      | 0.053                                              | 0.113                                              | 1.22                            | MAL225620472E3 |
|                                          | 6800                   | 25 x 30                      | 2.04                                       | 0.40                      | 0.037                                              | 0.078                                              | 1.46                            | MAL225630682E3 |
|                                          | 10 000                 | 30 x 30                      | 2.75                                       | 0.40                      | 0.027                                              | 0.053                                              | 1.50                            | MAL225640103E3 |
|                                          | 22 000                 | 35 x 40                      | 4.69                                       | 0.40                      | 0.013                                              | 0.024                                              | 1.50                            | MAL225650223E3 |
| 50                                       | 2200                   | 22 x 25                      | 1.48                                       | 0.35                      | 0.088                                              | 0.211                                              | 0.99                            | MAL225621222E3 |
|                                          | 2700                   | 22 x 25                      | 1.53                                       | 0.35                      | 0.072                                              | 0.172                                              | 1.10                            | MAL225621272E3 |
|                                          | 3300                   | 22 x 30                      | 1.76                                       | 0.35                      | 0.059                                              | 0.141                                              | 1.22                            | MAL225621332E3 |
|                                          | 3900                   | 22 x 35                      | 1.97                                       | 0.35                      | 0.050                                              | 0.119                                              | 1.32                            | MAL225621392E3 |
|                                          | 4700                   | 25 x 30                      | 2.18                                       | 0.35                      | 0.042                                              | 0.099                                              | 1.45                            | MAL225631472E3 |
|                                          | 6800                   | 25 x 40                      | 2.92                                       | 0.35                      | 0.030                                              | 0.068                                              | 1.50                            | MAL225631682E3 |
| 10 000                                   | 30 x 40                | 3.55                         | 0.35                                       | 0.022                     | 0.046                                              | 1.50                                               | MAL225641103E3                  |                |
| 63                                       | 1200                   | 22 x 25                      | 1.19                                       | 0.30                      | 0.118                                              | 0.332                                              | 0.82                            | MAL225628122E3 |
|                                          | 2200                   | 22 x 30                      | 1.55                                       | 0.30                      | 0.069                                              | 0.181                                              | 1.12                            | MAL225628222E3 |
|                                          | 2200                   | 25 x 25                      | 1.60                                       | 0.30                      | 0.069                                              | 0.181                                              | 1.12                            | MAL225638222E3 |
|                                          | 3300                   | 25 x 35                      | 2.06                                       | 0.30                      | 0.049                                              | 0.121                                              | 1.37                            | MAL225638332E3 |
|                                          | 4700                   | 25 x 40                      | 2.51                                       | 0.30                      | 0.038                                              | 0.085                                              | 1.50                            | MAL225638472E3 |
|                                          | 4700                   | 30 x 30                      | 2.48                                       | 0.30                      | 0.038                                              | 0.085                                              | 1.50                            | MAL225648472E3 |
|                                          | 6800                   | 35 x 30                      | 3.30                                       | 0.30                      | 0.028                                              | 0.059                                              | 1.50                            | MAL225658682E3 |
|                                          | 10 000                 | 35 x 40                      | 3.90                                       | 0.30                      | 0.020                                              | 0.040                                              | 1.50                            | MAL225658103E3 |
| 80                                       | 1500                   | 22 x 35                      | 1.48                                       | 0.25                      | 0.081                                              | 0.221                                              | 1.04                            | MAL225622152E3 |
|                                          | 2200                   | 25 x 30                      | 1.65                                       | 0.25                      | 0.056                                              | 0.151                                              | 1.26                            | MAL225632222E3 |
|                                          | 3300                   | 35 x 25                      | 2.30                                       | 0.25                      | 0.040                                              | 0.101                                              | 1.50                            | MAL225652332E3 |
|                                          | 4700                   | 35 x 30                      | 2.64                                       | 0.25                      | 0.030                                              | 0.071                                              | 1.50                            | MAL225652472E3 |
|                                          | 5600                   | 35 x 45                      | 3.39                                       | 0.25                      | 0.026                                              | 0.059                                              | 1.50                            | MAL225652562E3 |
|                                          | 6800                   | 35 x 40                      | 3.56                                       | 0.25                      | 0.022                                              | 0.049                                              | 1.50                            | MAL225652682E3 |
| 100                                      | 820                    | 22 x 30                      | 1.14                                       | 0.20                      | 0.100                                              | 0.324                                              | 0.86                            | MAL225629821E3 |
|                                          | 1200                   | 25 x 30                      | 1.56                                       | 0.20                      | 0.072                                              | 0.221                                              | 1.04                            | MAL225639122E3 |
|                                          | 2200                   | 25 x 40                      | 2.15                                       | 0.20                      | 0.044                                              | 0.121                                              | 1.41                            | MAL225639222E3 |
|                                          | 2700                   | 30 x 35                      | 2.37                                       | 0.20                      | 0.036                                              | 0.098                                              | 1.50                            | MAL225649272E3 |
|                                          | 3300                   | 30 x 40                      | 2.77                                       | 0.20                      | 0.030                                              | 0.080                                              | 1.50                            | MAL225649332E3 |
|                                          | 4700                   | 35 x 40                      | 3.30                                       | 0.20                      | 0.023                                              | 0.056                                              | 1.50                            | MAL225659472E3 |
|                                          | 5600                   | 35 x 45                      | 3.51                                       | 0.20                      | 0.020                                              | 0.047                                              | 1.50                            | MAL225659562E3 |

Note

<sup>(1)</sup> ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

| ADDITIONAL ELECTRICAL DATA         |                |                                        |
|------------------------------------|----------------|----------------------------------------|
| PARAMETER                          | CONDITIONS     | VALUE                                  |
| <b>Voltage</b>                     |                |                                        |
| Surge voltage                      | at +85 °C      | U <sub>S</sub> = 1.25 x U <sub>R</sub> |
| Reverse voltage                    | at +105 °C     | U <sub>rev</sub> ≤ 1 V                 |
| <b>Inductance</b>                  |                |                                        |
| Equivalent series inductance (ESL) | All case sizes | Typ. 19 nH                             |
|                                    |                | Max. 25 nH                             |

**RIPPLE CURRENT AND USEFUL LIFE**
**Table 3**

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

**Note**

- Multiplier of useful life code: CCC208

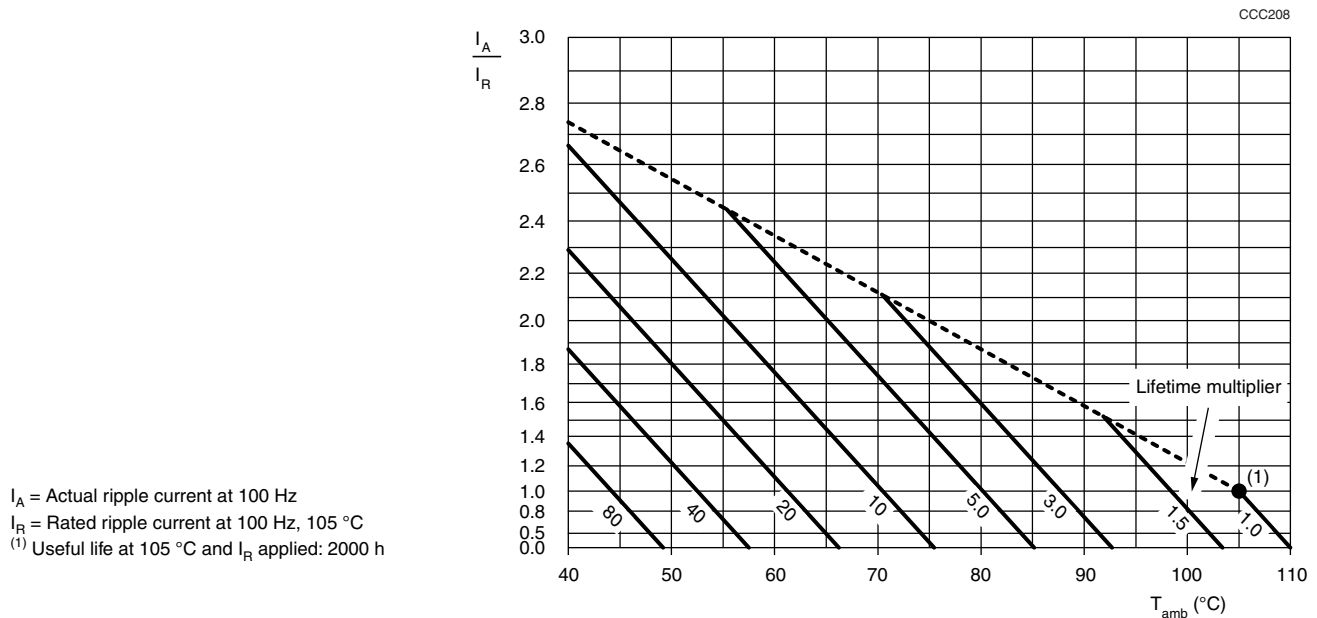


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 4**

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |      |      |      |      |          |
|-------------------------------------------------------------------|------|------|------|------|----------|
| FREQUENCY (Hz)                                                    |      |      |      |      |          |
| 50                                                                | 100  | 120  | 500  | 1000 | ≥ 10 000 |
| $I_R$ MULTIPLIER                                                  |      |      |      |      |          |
| 0.92                                                              | 0.95 | 1.00 | 1.13 | 1.19 | 1.20     |



Table 5

| TEST PROCEDURES AND REQUIREMENTS            |                                       |                                                                                                                                                             |                                                                                                                                                                                                       |
|---------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                        |                                       | PROCEDURE<br>(quick reference)                                                                                                                              | REQUIREMENTS                                                                                                                                                                                          |
| NAME OF TEST                                | REFERENCE                             |                                                                                                                                                             |                                                                                                                                                                                                       |
| Endurance                                   | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2000 h                                                                                   | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                          |
| Useful life                                 | CECC 30301 subclause 4.13             | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2000 h<br><br>$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; > 5000 h | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit,<br>no visible damage<br>total failure percentage $\leq 1\%$ |
| Shelf life<br>(storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied; 1000 h<br>after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement         | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 1.5 \times \text{spec. limit}$<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                               |
| Vibration                                   | IEC 60384-4 / EN130300 subclause 4.8  | 10 Hz to 55 Hz; 0.037 m or 5 g (whichever is less); 3 axis; 2 h per axis                                                                                    | $\Delta C/C: \pm 10\%$<br>$\tan \delta \leq \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                                   |

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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