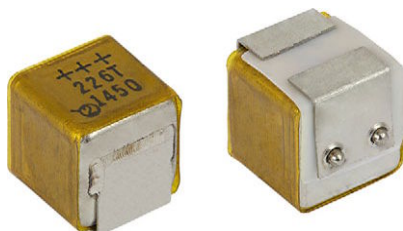


# Solid Tantalum SMD Capacitors TANTAMOUNT™, Hi-Rel COTS, Low ESR, Metal Case



## PERFORMANCE CHARACTERISTICS

**Operating Temperature:** -55 °C to +125 °C  
(above 85 °C, voltage derating is required)

**Capacitance Range:** 22 µF to 330 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 16 V<sub>DC</sub> to 50 V<sub>DC</sub>

## FEATURES

- High reliability; burn-in at a minimum of rated DC voltage for a minimum of 40 h
- Surge current testing per MIL-PRF-55365 option available
- Low ESR
- Lead (Pb)-free terminations available (tin / lead terminations are under development)
- Mounting: surface mount
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS\***  
Available

**HALOGEN**  
**FREE**

**GREEN**  
(5-2008)  
Available

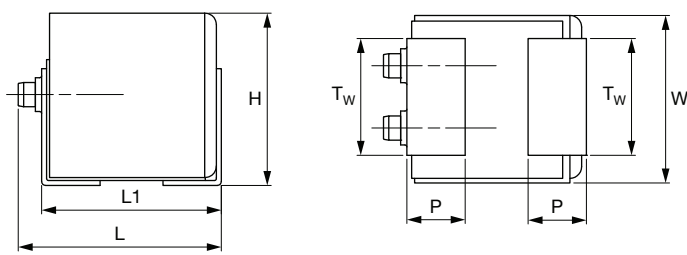
## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

## ORDERING INFORMATION

| T25  | D                                | 226                                                                                                                    | K                        | 050                                                                                                                                                    | E                                                                                                                                                                 | S                              | A                                                                                                                                                                 |
|------|----------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TYPE | CASE CODE                        | CAPACITANCE                                                                                                            | CAPACITANCE TOLERANCE    | DC VOLTAGE RATING AT +85 °C                                                                                                                            | TERMINATION / PACKAGING<br>(available options are series dependent)                                                                                               | RELIABILITY GRADE              | SURGE CURRENT OPTION                                                                                                                                              |
|      | See Ratings and Case Codes table | This is expressed in pF. The first two digits are the significant figures. The third is the number of zeros to follow. | K = ± 10 %<br>M = ± 20 % | This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V). | C = 100 % tin / 7" (178 mm), reel<br>H = 100 % tin / 7" (178 mm), 1/2 reel<br>E = Sn / Pb solder / 7" (178 mm) reel<br>L = Sn / Pb solder / 7" (178 mm), 1/2 reel | S = 40 h burn-in<br>Z = non ER | A = 10 cycles at +25 °C<br>B = 10 cycles at -55 °C / +85 °C<br>C = 10 cycles at -55 °C / +85 °C (before burn-in)<br>S = 3 cycles at 25 °C<br>Z = no surge current |

## DIMENSIONS in inches [millimeters]

|  |                |                              |                              |                              |                              |                              |                          |
|--------------------------------------------------------------------------------------|----------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------|
| CASE CODE                                                                            | L (MAX.)       | L1                           | W                            | H                            | P                            | Tw                           | WEIGHT<br>g<br>(AVERAGE) |
| D                                                                                    | 0.326<br>[8.5] | 0.283 ± 0.008<br>[7.2 ± 0.2] | 0.275 ± 0.008<br>[7.0 ± 0.2] | 0.291 ± 0.008<br>[7.4 ± 0.2] | 0.098 ± 0.008<br>[2.5 ± 0.2] | 0.197 ± 0.008<br>[5.0 ± 0.2] | 1.80                     |

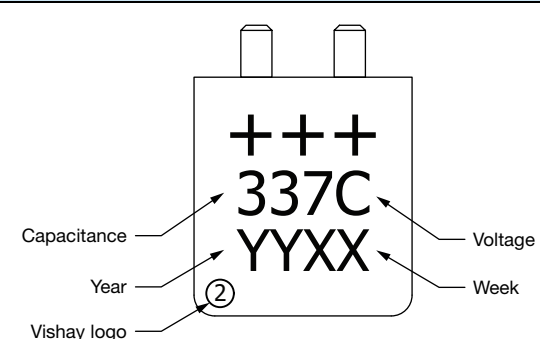
**RATINGS AND CASE CODES**

| $\mu\text{F}$ | 16 V | 20 V             | 25 V             | 35 V             | 50 V |
|---------------|------|------------------|------------------|------------------|------|
| 22            |      |                  |                  |                  | D    |
| 33            |      |                  |                  |                  |      |
| 47            |      |                  |                  |                  |      |
| 68            |      |                  |                  | D <sup>(1)</sup> |      |
| 100           |      |                  | D <sup>(1)</sup> |                  |      |
| 150           |      |                  |                  |                  |      |
| 220           |      | D <sup>(1)</sup> |                  |                  |      |
| 330           | D    |                  |                  |                  |      |

**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability

**MARKING**

|  |  | VOLTAGE CODE |      |
|------------------------------------------------------------------------------------|--|--------------|------|
|                                                                                    |  | V            | CODE |
|                                                                                    |  | 16           | C    |
|                                                                                    |  | 20           | D    |
|                                                                                    |  | 25           | E    |
|                                                                                    |  | 35           | V    |
|                                                                                    |  | 50           | T    |

**STANDARD RATINGS**

| CAPACITANCE<br>( $\mu\text{F}$ )                                 | CASE CODE        | PART NUMBER            | MAX. DCL<br>AT +25 °C<br>( $\mu\text{A}$ ) | MAX. DF<br>AT +25 °C<br>(%) | MAX. ESR<br>AT +25 °C<br>100 kHz<br>(m $\Omega$ ) | MAX.<br>RIPPLE<br>100 kHz<br>I <sub>RMS</sub> (A) |
|------------------------------------------------------------------|------------------|------------------------|--------------------------------------------|-----------------------------|---------------------------------------------------|---------------------------------------------------|
| <b>16 V<sub>DC</sub> AT +85 °C; 10 V<sub>DC</sub> AT +125 °C</b> |                  |                        |                                            |                             |                                                   |                                                   |
| 330                                                              | D                | T25D337(1)016(2)(3)(4) | 52.8                                       | 14                          | 180                                               | 1.5                                               |
| <b>20 V<sub>DC</sub> AT +85 °C; 13 V<sub>DC</sub> AT +125 °C</b> |                  |                        |                                            |                             |                                                   |                                                   |
| 220                                                              | D <sup>(1)</sup> | T25D227(1)020(2)(3)(4) |                                            | In development              |                                                   |                                                   |
| <b>25 V<sub>DC</sub> AT +85 °C; 17 V<sub>DC</sub> AT +125 °C</b> |                  |                        |                                            |                             |                                                   |                                                   |
| 100                                                              | D <sup>(1)</sup> | T25D107(1)025(2)(3)(4) |                                            | In development              |                                                   |                                                   |
| <b>35 V<sub>DC</sub> AT +85 °C; 23 V<sub>DC</sub> AT +125 °C</b> |                  |                        |                                            |                             |                                                   |                                                   |
| 68                                                               | D <sup>(1)</sup> | T25D686(1)035(2)(3)(4) |                                            | In development              |                                                   |                                                   |
| <b>50 V<sub>DC</sub> AT +85 °C; 33 V<sub>DC</sub> AT +125 °C</b> |                  |                        |                                            |                             |                                                   |                                                   |
| 22                                                               | D                | T25D226(1)050(2)(3)(4) | 11                                         | 6                           | 500                                               | 0.9                                               |

**Notes**

- Part number definitions:
  - Capacitance tolerance: K, M
  - Termination and packaging: C, H, E, L
  - Reliability level: S, Z
  - Surge current: A, B, S, C, Z
- Rating in development, contact factory for availability

**RECOMMENDED VOLTAGE DERATING GUIDELINES** (for temperatures below +85 °C)**STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS**

| Capacitor Voltage Rating | Operating Voltage |
|--------------------------|-------------------|
| 16                       | 10                |
| 20                       | 12                |
| 25                       | 15                |
| 35                       | 24                |
| 50                       | 28                |

**SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS**

| Capacitor Voltage Rating | Operating Voltage |
|--------------------------|-------------------|
| 16                       | 8.0               |
| 20                       | 10                |
| 25                       | 12                |
| 35                       | 15                |
| 50                       | 24                |

**CARRIER TAPE DIMENSIONS** in inches [millimeters]

| TYPE | CASE CODE | TAPE WIDTH W<br>(mm) | P <sub>1</sub>                | K <sub>0</sub> MAX. | B <sub>1</sub> MAX. |
|------|-----------|----------------------|-------------------------------|---------------------|---------------------|
| T25  | D         | 16                   | 0.476 ± 0.004<br>[12.0 ± 0.1] | 0.3<br>[7.86]       | 0.45<br>[11.3]      |

**POWER DISSIPATION**

| CASE CODE | MAXIMUM PERMISSIBLE POWER DISSIPATION AT +25 °C (W) IN FREE AIR |
|-----------|-----------------------------------------------------------------|
| D         | 0.408                                                           |

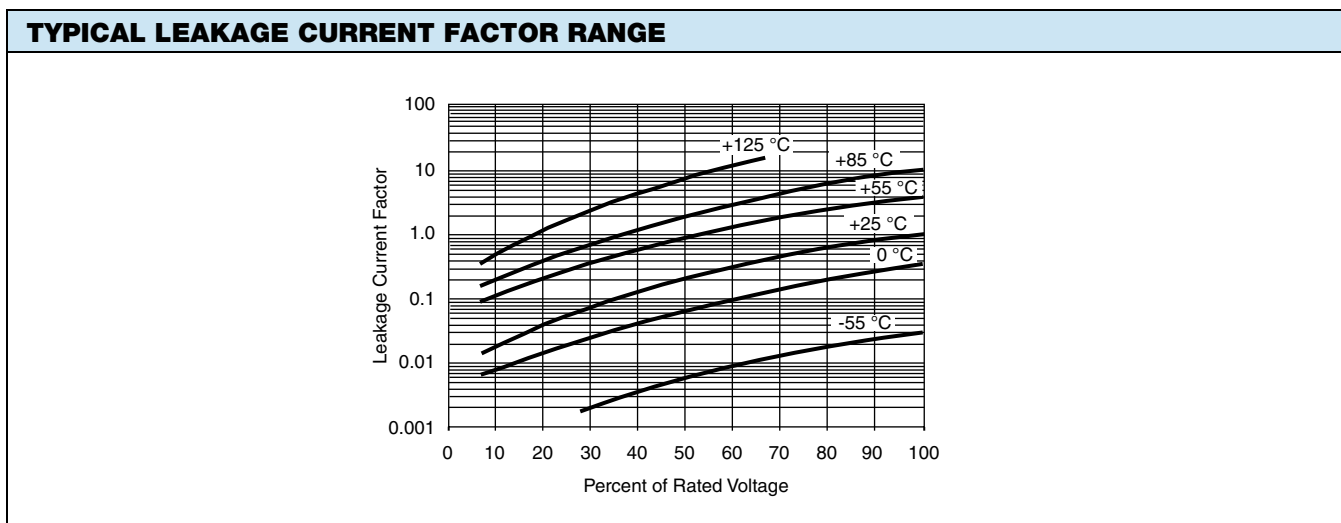
**STANDARD PACKAGING QUANTITY**

| CASE CODE | UNITS PER REEL |              |
|-----------|----------------|--------------|
|           | 7" FULL REEL   | 7" HALF REEL |
| D         | 100            | 50           |

| CAPACITOR ELECTRICAL PERFORMANCE CHARACTERISTICS |                                                                                                                                                                                                                                                                                                                                                                                       |                   |                                                                                                               |                   |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------|-------------------|
| ITEM                                             | PERFORMANCE CHARACTERISTICS                                                                                                                                                                                                                                                                                                                                                           |                   |                                                                                                               |                   |
| Category temperature range                       | -55 °C to +85 °C (to +125 °C with voltage derating)                                                                                                                                                                                                                                                                                                                                   |                   |                                                                                                               |                   |
| Capacitance tolerance                            | ± 20 %, ± 10 %, tested via bridge method, at +25 °C, 120 Hz                                                                                                                                                                                                                                                                                                                           |                   |                                                                                                               |                   |
| Dissipation factor                               | Limit per Standard Ratings table. Tested via bridge method, at 25 °C, 120 Hz.                                                                                                                                                                                                                                                                                                         |                   |                                                                                                               |                   |
| ESR                                              | Limit per Standard Ratings table. Tested via bridge method, at 25 °C, 100 kHz.                                                                                                                                                                                                                                                                                                        |                   |                                                                                                               |                   |
| Leakage current                                  | After application of rated voltage applied to capacitors for 5 min using a steady source of power with 1 kΩ resistor in series with the capacitor under test, leakage current at 25 °C is not more than described in Standard Ratings table. <i>Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.</i> |                   |                                                                                                               |                   |
| Capacitance change by temperature                | +12 % max. (at +125 °C)<br>+10 % max. (at +85 °C)<br>-10 % max. (at -55 °C)                                                                                                                                                                                                                                                                                                           |                   | For capacitance value > 300 μF<br>+20 % max. (at +125 °C)<br>+15 % max. (at +85 °C)<br>-15 % max. (at -55 °C) |                   |
| Reverse voltage                                  | Capacitors are capable of withstanding peak voltages in the reverse direction equal to:<br>10 % of the DC rating at +25 °C<br>5 % of the DC rating at +85 °C<br>Vishay does not recommend intentional or repetitive application of reverse voltage.                                                                                                                                   |                   |                                                                                                               |                   |
| Ripple current and temperature derating          | For maximum permissible ripple current (I <sub>RMS</sub> ) or / and voltage (V <sub>RMS</sub> ) please refer to product datasheet and Guide to Application. If capacitors are to be used at temperatures above +25 °C, the permissible RMS ripple current or voltage shall be calculated using the derating factors:<br>1.0 at +25 °C<br>0.9 at +85 °C<br>0.4 at +125 °C              |                   |                                                                                                               |                   |
| Maximum operating voltage                        | OPERATING TEMPERATURE                                                                                                                                                                                                                                                                                                                                                                 |                   |                                                                                                               |                   |
|                                                  | +85 °C                                                                                                                                                                                                                                                                                                                                                                                |                   | +125 °C                                                                                                       |                   |
|                                                  | RATED VOLTAGE (V)                                                                                                                                                                                                                                                                                                                                                                     | SURGE VOLTAGE (V) | RATED VOLTAGE (V)                                                                                             | SURGE VOLTAGE (V) |
|                                                  | 16                                                                                                                                                                                                                                                                                                                                                                                    | 20                | 10                                                                                                            | 12                |
|                                                  | 20                                                                                                                                                                                                                                                                                                                                                                                    | 26                | 13                                                                                                            | 16                |
|                                                  | 25                                                                                                                                                                                                                                                                                                                                                                                    | 32                | 17                                                                                                            | 20                |
|                                                  | 35                                                                                                                                                                                                                                                                                                                                                                                    | 46                | 23                                                                                                            | 28                |
|                                                  | 50                                                                                                                                                                                                                                                                                                                                                                                    | 65                | 33                                                                                                            | 40                |

**Note**

- All information presented in this document reflects typical performance characteristics.


**Notes**

- At +25 °C, the leakage current shall not exceed the value listed in the Standard Ratings table
- At +85 °C, the leakage current shall not exceed 10 times the value listed in the Standard Ratings table
- At +125 °C, the leakage current shall not exceed 12 times the value listed in the Standard Ratings table

**CAPACITOR PERFORMANCE CHARACTERISTICS**

| ITEM                 | CONDITION                                                                                                                                         | POST TEST PERFORMANCE                                       |                                                                                |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------|
| Surge voltage        | 85 °C, 1000 successive test cycles at 1.3 of rated voltage in series with a 1 k $\Omega$ resistor at the rate of 30 s ON, 30 s OFF, MIL-PRF-55365 | Capacitance change<br>Dissipation factor<br>Leakage current | Within $\pm$ 10 % of initial<br>Not to exceed initial<br>Not to exceed initial |
| Life test at +85 °C  | 2000 h application of rated voltage at 85 °C, MIL-STD-202 method 108                                                                              | Capacitance change<br>Leakage current                       | Within $\pm$ 10 % of initial<br>Not to exceed 125 % of initial                 |
| Life test at +125 °C | 1000 h application of 2/3 rated voltage at 125 °C, MIL-STD-202 method 108                                                                         | Capacitance change<br>Leakage current                       | Within $\pm$ 20 % of initial<br>Not to exceed 125 % of initial                 |

**CAPACITOR ENVIRONMENTAL CHARACTERISTICS**

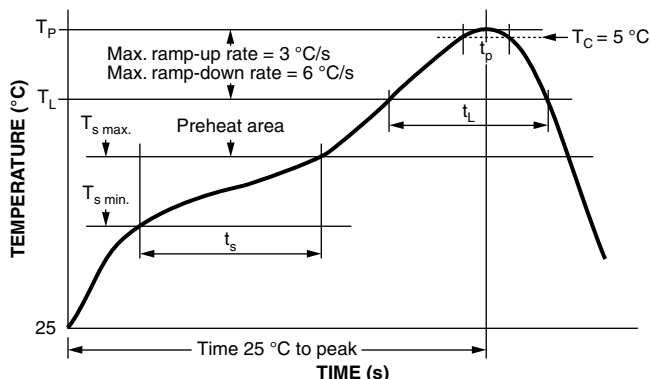
| ITEM                        | CONDITION                                                                                                                                                                                                                                                                                    | POST TEST PERFORMANCE                                                                                                                                                 |                                                                                                                                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Moisture resistance         | MIL-STD-202, method 106, at rated voltage.                                                                                                                                                                                                                                                   | Capacitance change<br>Cap. $\leq$ 600 $\mu$ F<br>Cap. $>$ 600 $\mu$ F<br>Dissipation factor<br>Leakage current                                                        | Within $\pm$ 10 % of initial value<br>Within $\pm$ 20 % of initial value<br>Initial specified value or less<br>Initial specified value or less |
| Thermal shock               | Capacitors are subjected to 6 cycles per MIL-STD-202 method 107 of the following:<br>-55 °C (+0 °C, -6 °C) for 30 min, then<br>+25 °C (+3 °C, -3 °C) for 5 min, then<br>+85 °C (+4 °C, -5 °C) for 40 min, then<br>+125 °C (+4 °C, -0 °C) for 30 min, then<br>+25 °C (+3 °C, -3 °C) for 5 min | Capacitance change<br>Cap.<br>Dissipation factor<br>Leakage current                                                                                                   | Within $\pm$ 15 % of initial<br>Initial specified value or less<br>Initial specified value multiplied by 12 or less                            |
| Salt atmosphere (corrosion) | Test per MIL-202, method 101, condition B (48 h). 5 % salt solution applying.                                                                                                                                                                                                                | No harmful or extensive corrosion, = 90 % protection of exposed metallic surfaces by finish, markings legible, = 10 % corrosion of the terminal hardware or mounting. |                                                                                                                                                |

**MECHANICAL PERFORMANCE CHARACTERISTICS**

| TEST CONDITION               | CONDITION                                                                                                                                 | POST TEST PERFORMANCE                                                                                                                           |                                                                                                    |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Shear test                   | Apply a pressure load of 5 N for 10 s $\pm$ 1 s horizontally to the center of capacitor side body. AEC-Q200-006                           | There shall be no visual damage when viewed at 20 x magnification and the component shall meet the original electrical requirements.            |                                                                                                    |
| Vibration                    | MIL-STD-202, method 204, condition D, 10 Hz to 2000 Hz, 20 g peak                                                                         | There shall be no mechanical or visual damage to capacitors post-conditioning.                                                                  |                                                                                                    |
| Shock (specified pulse)      | MIL-STD-202, method 213, condition I, 100 g peak                                                                                          | Capacitance change<br>Dissipation factor<br>Leakage current                                                                                     | Within $\pm$ 10 % of initial<br>Initial specified value or less<br>Initial specified value or less |
| Resistance to soldering heat | MIL-STD-202, method 210, condition J, except with only one heat cycle.                                                                    | Capacitance change<br>Dissipation factor<br>Leakage current                                                                                     | Within $\pm$ 10 % of initial<br>Initial specified value or less<br>Initial specified value or less |
| Solderability                | MIL-STD-202, method 208, ANSI/J-STD-002, test B. Applies only to solder and tin plated terminations. Does not apply to gold terminations. | All terminations shall exhibit a continuous solder coating free from defects for a minimum of 95 % of the critical area of any individual lead. |                                                                                                    |
| Resistance to solvent        | MIL-STD-202, method 215                                                                                                                   | Marking has to remain legible, no degradation of the can material.                                                                              |                                                                                                    |
| Sleeving                     | MIL-PRF-39003, paragraph 3.22: apply a DC potential of 2000 V.                                                                            | Maximum leakage of 20 $\mu$ A is allowed between the capacitor case and the fixture.                                                            |                                                                                                    |
| Seal                         | MIL-STD-202, method 112, condition A or D                                                                                                 | There shall be no visual leakage.                                                                                                               |                                                                                                    |

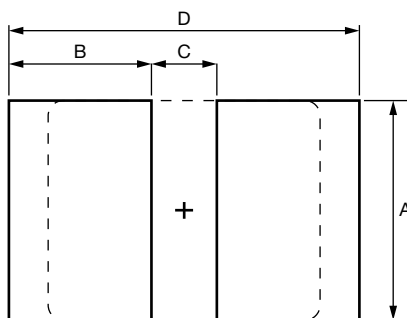
## RECOMMENDED REFLOW PROFILES

Capacitors should withstand reflow profile as per J-STD-020 standard



| PROFILE FEATURE                                                                  | SnPb EUTECTIC ASSEMBLY | LEAD (Pb)-FREE ASSEMBLY |
|----------------------------------------------------------------------------------|------------------------|-------------------------|
| <b>Preheat / soak</b>                                                            |                        |                         |
| Temperature min. ( $T_{s \text{ min.}}$ )                                        | 100 °C                 | 150 °C                  |
| Temperature max. ( $T_{s \text{ max.}}$ )                                        | 150 °C                 | 200 °C                  |
| Time ( $t_s$ ) from ( $T_{s \text{ min.}}$ to $T_{s \text{ max.}}$ )             | 60 s to 120 s          | 60 s to 120 s           |
| <b>Ramp-up</b>                                                                   |                        |                         |
| Ramp-up rate ( $T_L$ to $T_P$ )                                                  | 3 °C/s max.            | 3 °C/s max.             |
| Liquidus temperature ( $T_L$ )                                                   | 183 °C                 | 217 °C                  |
| Time ( $t_L$ ) maintained above $T_L$                                            | 60 s to 150 s          | 60 s to 150 s           |
| Peak package body temperature ( $T_P$ )                                          | 220                    | 250                     |
| Time ( $t_p$ ) within 5 °C of the specified classification temperature ( $T_C$ ) | 20 s                   | 30 s                    |
| Time 25 °C to peak temperature                                                   | 6 min max.             | 8 min max.              |
| <b>Ramp-down</b>                                                                 |                        |                         |
| Ramp-down rate ( $T_P$ to $T_L$ )                                                | 6 °C/s max.            | 6 °C/s max.             |
| Time 25 °C to peak temperature                                                   | 6 min max.             | 8 min max.              |

## PAD DIMENSIONS in inches [millimeters]



| CASE CODE | A<br>(MIN.) | B<br>(NOM.) | C<br>(NOM.) | D<br>(NOM.) |
|-----------|-------------|-------------|-------------|-------------|
| D         | 0.276 [7]   | 0.178 [4.5] | 0.079 [2]   | 0.433 [11]  |



## 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.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. 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.