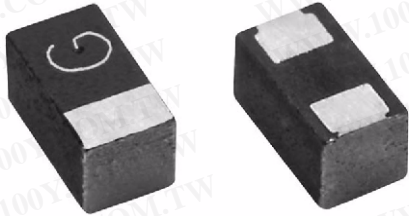


Solid Tantalum Chip Capacitors MICROTAN™ Leadframeless Molded



FEATURES

- 0805, 0603 and 0402 footprint
- Lead (Pb)-free L-shaped terminations
- 8 mm tape and reel packaging available per EIA-481-1 and reeling per IEC 286-3 7" [178 mm] standard
- Compliant to RoHS directive 2002/95/EC



PERFORMANCE CHARACTERISTICS

Operating Temperature: - 55 °C to + 85 °C
 (to + 125 °C voltage derating)

Capacitance Range: 0.68 μF to 220 μF

Capacitance Tolerance: ± 20 % standard

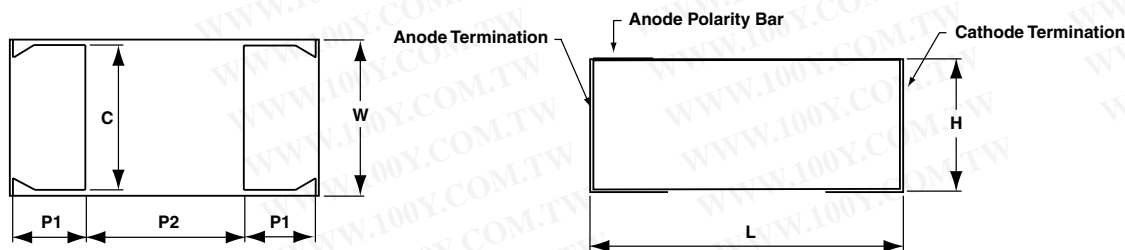
Voltage Range: 2 WVDC to 50 WVDC

ORDERING INFORMATION

| 298D MODEL | 106 CAPACITANCE | X0 CAPACITANCE TOLERANCE | 010 DC VOLTAGE RATING AT + 85 °C | M CASE CODE | 2 TERMINATION | T REEL SIZE AND PACKAGING |
|---------------|--|-----------------------------------|--|----------------------------------|---|--|
| | This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow. | X0 = ± 20 % X9 = ± 10 % | 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). | See Ratings and Case Codes Table | 2 = 100 % Tin 4 = Gold Plated | T = Tape and Reel 7" [178 mm] Reel |

Note Preferred tolerance and reel size are in bold.
 We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.
 Voltage substitutions will be marked with the higher voltage rating.

DIMENSIONS in inches [millimeters]



| CASE | L | W | H | P1 | P2 (REF.) | C |
|------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------|-------------------------------|
| K | 0.039 ± 0.008 [1.0 ± 0.2] | 0.02 ± 0.008 [0.5 ± 0.2] | 0.024 max. 0.6 max. | 0.01 ± 0.004 [0.25 ± 0.1] | 0.02 [0.5] | 0.015 ± 0.004 [0.38 ± 0.1] |
| M | 0.063 ± 0.004 [1.60 ± 0.1] | 0.033 ± 0.004 [0.85 ± 0.1] | 0.031 ± 0.004 [0.80 ± 0.1] | 0.020 ± 0.004 [0.50 ± 0.1] | 0.024 [0.60] | 0.024 ± 0.004 [0.60 ± 0.1] |
| P | 0.094 ± 0.004 [2.4 ± 0.1] | 0.057 ± 0.004 [1.45 ± 0.1] | 0.043 ± 0.004 [1.10 ± 0.1] | 0.020 ± 0.004 [0.50 ± 0.1] | 0.057 [1.40] | 0.035 ± 0.004 [0.90 ± 0.1] |

** Please see document "Vishay Material Category Policy" (5-2008)": www.vishay.com/doc?99902



Solid Tantalum Chip Capacitors
MICROTAN™ Leadframeless Molded

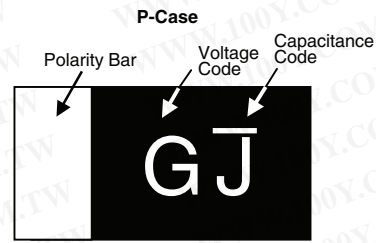
Vishay Sprague

| RATINGS AND CASE CODES | | | | | | | | | |
|------------------------|-----|-------|-----|-------|------|------|------|------|------|
| μF | 2 V | 2.5 V | 4 V | 6.3 V | 10 V | 16 V | 25 V | 35 V | 50 V |
| 0.68 | | | | | | | | M* | |
| 1.0 | | | | K | K | K/M | M | | P |
| 2.2 | | | | K/M | K/M | M | | | |
| 3.3 | | | | | | | | | |
| 4.7 | | | K | K*/M | M | M | P | | |
| 6.8 | | | | | | | | | |
| 10 | K* | | K/M | K*/M | M | | | | |
| 15 | | | K | | M | | | | |
| 22 | | | M | M | M | | | | |
| 33 | | | M | M | P | | | | |
| 47 | | M | M | P* | P | | | | |
| 100 | | | P* | P | | | | | |
| 220 | | P | P | | | | | | |

Note

* Preliminary values, contact factory for availability.

| MARKING | | | | |
|--|--------|------|---------|------|
| | M-CASE | | P-CASE | |
| | V | CODE | CAP, μF | CODE |
| <p>M-Case</p> <p>Polarity Bar Voltage Code</p> <p>K-Case</p> | 2.5 | e | 0.68 | w̄ |
| | 4 | G | 1 | A |
| | 6.3 | J | 2.2 | J |
| | 10 | A | 3.3 | N |
| | 16 | C | 4.7 | S |
| | 20 | D | 6.8 | W |
| | 25 | E | 10 | α |
| | 35 | V | 15 | e |
| | 50 | T | 22 | j |
| | | | 33 | n |
| | | 47 | s | |
| | | 68 | w | |
| | | 100 | Ā | |
| | | 150 | Ē | |
| | | 220 | J | |



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| STANDARD RATINGS | | | | | | | |
|--|--------------|--------------------------------|--|------------------------------|---|--|------------------------------------|
| CAPACITANCE (μ F) | CASE CODE | PART NUMBER | MAX. DC LEAKAGE AT + 25 °C (μ A) | MAX. DF AT + 25 °C (%) | MAX. ESR AT + 25 °C 100 kHz (Ω) | MAX. RIPPLE 100 kHz I_{rms} (A) | $\Delta C/C$ ⁽¹⁾ (%) |
| 2 WVDC AT + 85 °C, ... 1.3 WVDC AT + 125 °C | | | | | | | |
| 10 | K | 298D106X0002K2T | 0.5 | 15 | 15 | 0.027 | ± 30 |
| 2.5 WVDC AT + 85 °C, ... 1.6 WVDC AT + 125 °C | | | | | | | |
| 47 | M | 298D476X02R5M2T | 2.4 | 20 | 4.0 | 0.08 | ± 30 |
| 220 | P | 298D227X02R5P2T | 11.0 | 30 | 3.0 | 0.122 | ± 30 |
| 4 WVDC AT + 85 °C, ... 2.7 WVDC AT + 125 °C | | | | | | | |
| 4.7 | K | 298D475X0004K2T | 0.5 | 15 | 20 | 0.027 | ± 30 |
| 10 | K | 298D106X0004K2T | 4.0 | 50 | 20 | 0.027 | ± 30 |
| 10 | M | 298D106X0004M2T | 0.5 | 8.0 | 5.0 | 0.071 | ± 10 |
| 15 | K | 298D156X0004K2T | 10 | 50 | 20 | 0.027 | ± 30 |
| 22 | M | 298D226X0004M2T | 0.9 | 15 | 4.0 | 0.08 | ± 15 |
| 33 | M | 298D336X0004M2T | 2.6 | 30 | 4.0 | 0.08 | ± 20 |
| 47 | M | 298D476X0004M2T | 3.8 | 40 | 7.5 | 0.08 | ± 30 |
| 100 | P | 298D107X0004P2T | 4.0 | 20 | 2.0 | 0.1 | ± 30 |
| 220 | P | 298D227X0004P2T | 17.6 | 30 | 3.0 | 0.122 | ± 30 |
| 6.3 WVDC AT + 85 °C, ... 4 WVDC AT + 125 °C | | | | | | | |
| 1.0 | K | 298D105X06R3K2T | 0.5 | 6.0 | 20 | 0.027 | ± 30 |
| 2.2 | K | 298D225X06R3K2T | 0.5 | 8.0 | 20 | 0.027 | ± 30 |
| 2.2 | M | 298D225X06R3M2T | 0.5 | 10 | 5.0 | 0.07 | ± 10 |
| 4.7 | K | 298D475X06R3K2T ⁽²⁾ | 4.0 | 50 | 20 | 0.027 | ± 30 |
| 4.7 | M | 298D475X06R3M2T | 0.5 | 8.0 | 3.0 | 0.09 | ± 10 |
| 10 | K | 298D106X06R3K2T ⁽²⁾ | 10 | 50 | 20 | 0.027 | ± 30 |
| 10 | M | 298D106X06R3M2T | 0.6 | 8.0 | 5.0 | 0.071 | ± 10 |
| 15 | M | 298D156X06R3M2T | 1.0 | 20 | 7.0 | 0.06 | ± 20 |
| 22 | M | 298D226X06R3M2T | 2.8 | 20 | 5.5 | 0.067 | ± 15 |
| 33 | M | 298D336X06R3M2T | 4.2 | 30 | 7.5 | 0.058 | ± 30 |
| 47 | P | 298D476X06R3P2T | 3.0 | 22 | 3.0 | 0.122 | ± 20 |
| 100 | P | 298D107X06R3P2T | 6.3 | 30 | 2.0 | 0.150 | ± 20 |
| 10 WVDC AT + 85 °C, ... 7 WVDC AT + 125 °C | | | | | | | |
| 1.0 | K | 298D105X0010K2T | 0.5 | 6.0 | 20 | 0.027 | ± 30 |
| 2.2 | K | 298D225X0010K2T | 0.5 | 8.0 | 15 | 0.027 | ± 30 |
| 2.2 | M | 298D225X0010M2T | 0.5 | 10 | 10 | 0.05 | ± 10 |
| 4.7 | M | 298D475X0010M2T | 0.5 | 6.0 | 5.0 | 0.071 | ± 15 |
| 10 | M | 298D106X0010M2T | 1.0 | 20 | 7.5 | 0.058 | ± 15 |
| 15 | M | 298D156X0010M2T | 1.5 | 30 | 7.5 | 0.058 | ± 20 |
| 22 | M | 298D226X0010M2T | 2.2 | 40 | 10.0 | 0.05 | ± 30 |
| 33 | P | 298D336X0010P2T | 3.3 | 10 | 2.0 | 0.150 | ± 10 |
| 47 | P | 298D476X0010P2T | 4.7 | 22 | 3.0 | 0.122 | ± 20 |
| 16 WVDC AT + 85 °C, ... 10 WVDC AT + 125 °C | | | | | | | |
| 1.0 | K | 298D105X0016K2T | 3.0 | 10 | 20 | 0.027 | ± 30 |
| 1.0 | M | 298D105X0016M2T | 0.5 | 6.0 | 12.0 | 0.045 | ± 15 |
| 2.2 | M | 298D225X0016M2T | 0.5 | 10 | 12.0 | 0.045 | ± 15 |
| 4.7 | M | 298D475X0016M2T | 0.8 | 8.0 | 6.0 | 0.06 | ± 15 |
| 25 WVDC AT + 85 °C, ... 17 WVDC AT + 125 °C | | | | | | | |
| 1.0 | M | 298D105X0025M2T | 0.5 | 6.0 | 10.0 | 0.05 | ± 10 |
| 4.7 | P | 298D475X0025P2T | 1.2 | 6.0 | 4.0 | 0.106 | ± 10 |
| 50 WVDC AT + 85 °C, ... 33 WVDC AT + 125 °C | | | | | | | |
| 1.0 | P | 298D105X0050P2T | 0.5 | 8.0 | 8.0 | 0.075 | ± 10 |

Notes

(1) See Performance Characteristics tables, page 41

(2) In development

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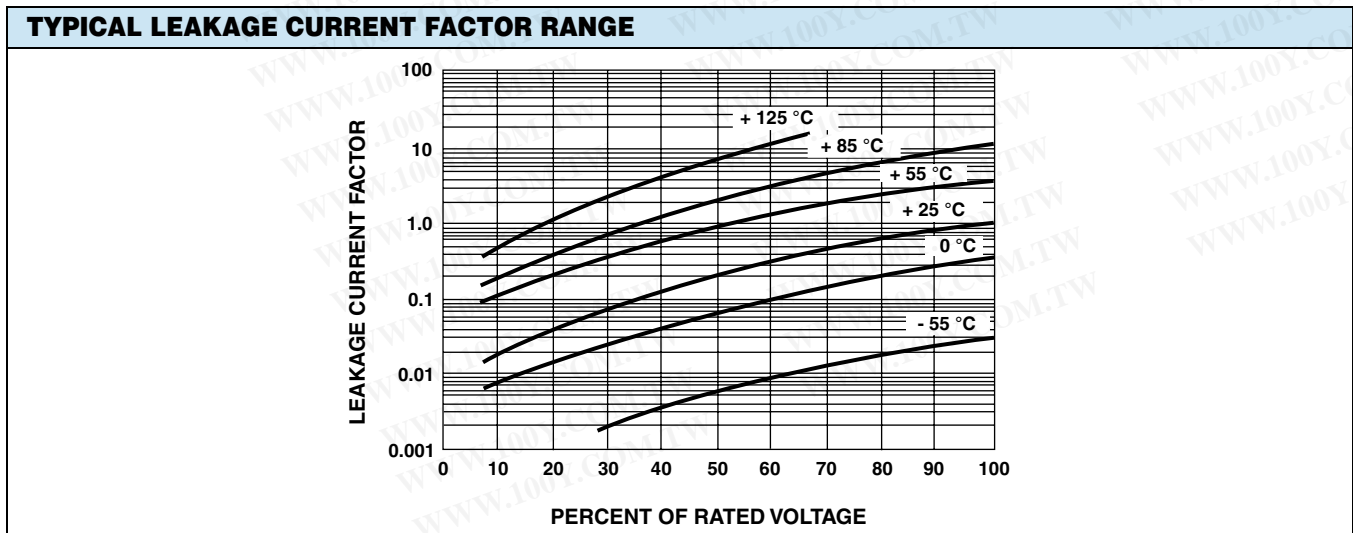


Solid Tantalum Chip Capacitors
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Vishay Sprague

CAPACITORS PERFORMANCE CHARACTERISTICS

| ELECTRICAL PERFORMANCE CHARACTERISTICS | | | | |
|--|---|--------------------------|----------------------------|--------------------------|
| ITEM | PERFORMANCE CHARACTERISTICS | | | |
| Category Temperature Range | - 55 °C to + 85 °C (to + 125 °C with voltage derating) | | | |
| Capacitance Tolerance | ± 20 %, ± 10 % (at 120 Hz) 2 V _{rms} at + 25 °C using a capacitance bridge | | | |
| Dissipation Factor (at 120 Hz) | Limits per Standard Ratings Table. Tested via bridge method, at 25 °C, 120 Hz. | | | |
| ESR (100 kHz) | Limits 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 minutes 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. Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor. | | | |
| Reverse Voltage | Capacitors are capable of withstanding peak voltages in the reverse direction equal to: 10 % of the DC rating at + 25 °C 5 % of the DC rating at + 85 °C Vishay does not recommended intentional or repetitive application of reverse voltage | | | |
| Temperature Derating | 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: 1.0 at + 25 °C 0.9 at + 85 °C 0.4 at + 125 °C | | | |
| Maximum Permissible Power Dissipation at 25 °C (W) in free air | K-case: 0.015 M-case: 0.025 P-case: 0.045 | | | |
| Operating Temperature | + 85 °C RATING | + 125 °C RATING | | |
| | WORKING VOLTAGE (V) | SURGE VOLTAGE (V) | WORKING VOLTAGE (V) | SURGE VOLTAGE (V) |
| | 4 | 5.2 | 2.7 | 3.4 |
| | 6.3 | 8 | 4 | 5 |
| | 10 | 13 | 7 | 8 |
| | 16 | 20 | 10 | 12 |
| | 20 | 26 | 13 | 16 |
| | 25 | 32 | 17 | 20 |
| | 35 | 46 | 23 | 28 |
| 50 | 65 | 33 | 40 | |



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

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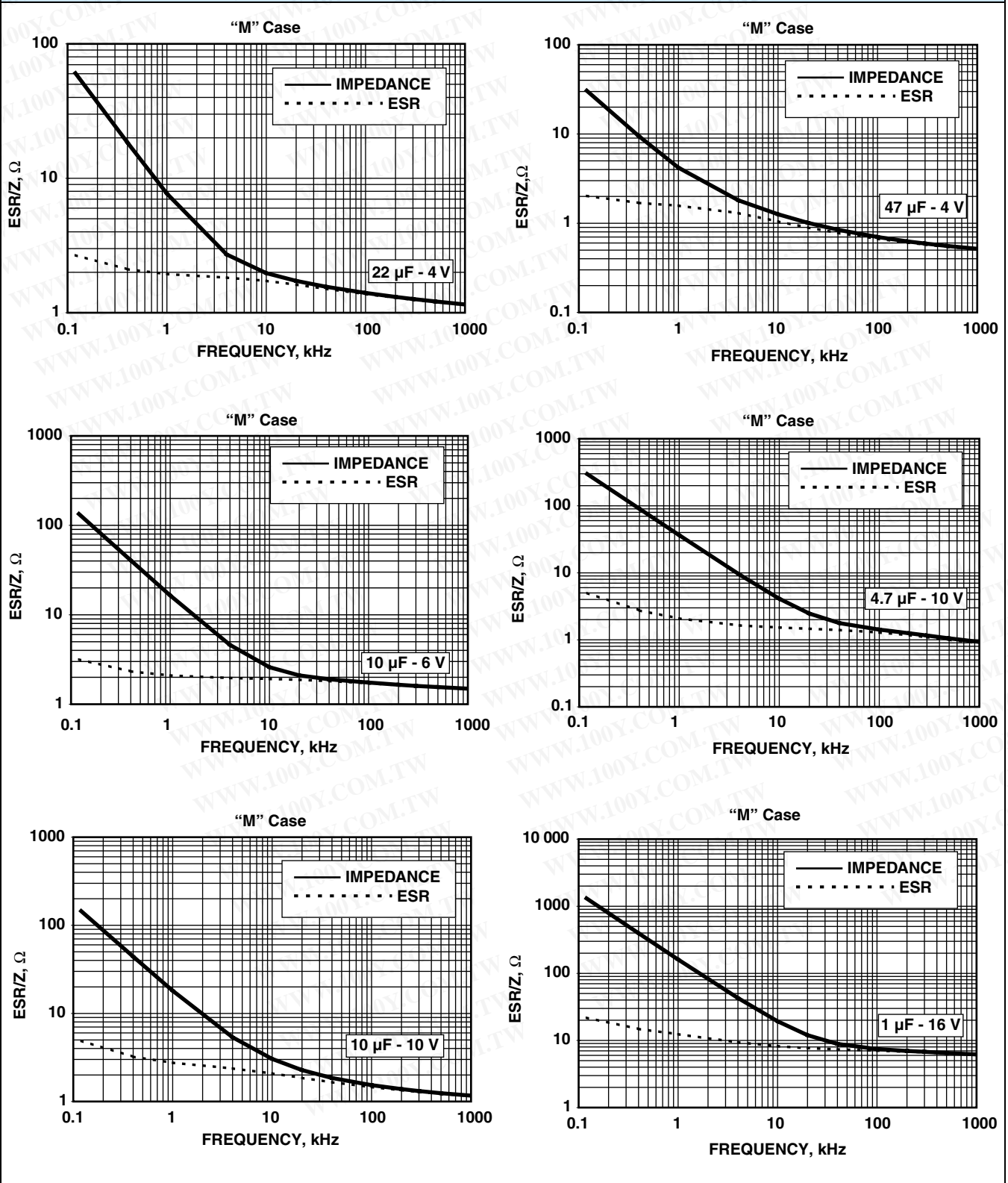


| ENVIRONMENTAL PERFORMANCE CHARACTERISTICS | | | |
|---|---|---|---|
| ITEM | CONDITION | POST TEST PERFORMANCE | |
| Life Test at + 85 °C | 1000 h application of rated voltage at 85 °C with a 3 Ω series resistance, MIL-STD-202G Method 108A | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Not to exceed 150 % of initial Not to exceed 200 % of initial |
| Humidity Tests | At 40 °C/90 % RH 500 h, no voltage applied. MIL-STD-202G Method 103B | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Not to exceed 150 % of initial Not to exceed 200 % of initial |
| Thermal Shock | At - 55 °C/+ 125 °C, 30 min each, for 5 cycles. MIL-STD-202G Method 107G | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Not to exceed 150 % of initial Not to exceed 200 % of initial |

| MECHANICAL PERFORMANCE CHARACTERISTICS | | | |
|--|---|--|---|
| TEST CONDITION | CONDITION | POST TEST PERFORMANCE | |
| Terminal Strength | Apply a pressure load of 5 N for 10 s ± 1 s horizontally to the center of capacitor side body. AEC Q-200 rev. C Method 006 | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Initial specified value or less Initial specified value or less |
| | | There shall be no mechanical or visual damage to capacitors | |
| Substrate Bending (Board flex) | With parts soldered onto substrate test board, apply force to the test board for a deflection of 1 mm. AEC-Q200 rev. C Method 005 | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Initial specified value or less Initial specified value or less |
| Vibration | MIL-STD-202G, Method 204D, 10 Hz to 2000 Hz, 20 G peak | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Initial specified value or less Initial specified value or less |
| | | There shall be no mechanical or visual damage to capacitors post-conditioning. | |
| Shock | MIL-STD-202G, Method 213B, Condition I, 100 G peak | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Initial specified value or less Initial specified value or less |
| | | There shall be no mechanical or visual damage to capacitors post-conditioning. | |
| Resistance to Solder Heat | At 260 °C, for 10 s, reflow | Capacitance Change Dissipation Factor Leakage Current | Refer to Standard Ratings Table Not to exceed 150 % of initial Not to exceed 200 % of initial |
| | | There shall be no mechanical or visual damage to capacitors post-conditioning. | |
| Solderability | MIL-STD-202G, Method 208H, ANSI/J-STD-002, Test B. Applies only to solder and tin plated terminations. Does not apply to gold terminations. | There shall be no mechanical or visual damage to capacitors post-conditioning. | |
| Resistance to Solvents | MIL-STD-202, Method 215D | There shall be no mechanical or visual damage to capacitors post-conditioning. | |
| Flammability | Encapsulation materials meet UL 94 V-0 with an oxygen index of 32 %. | | |

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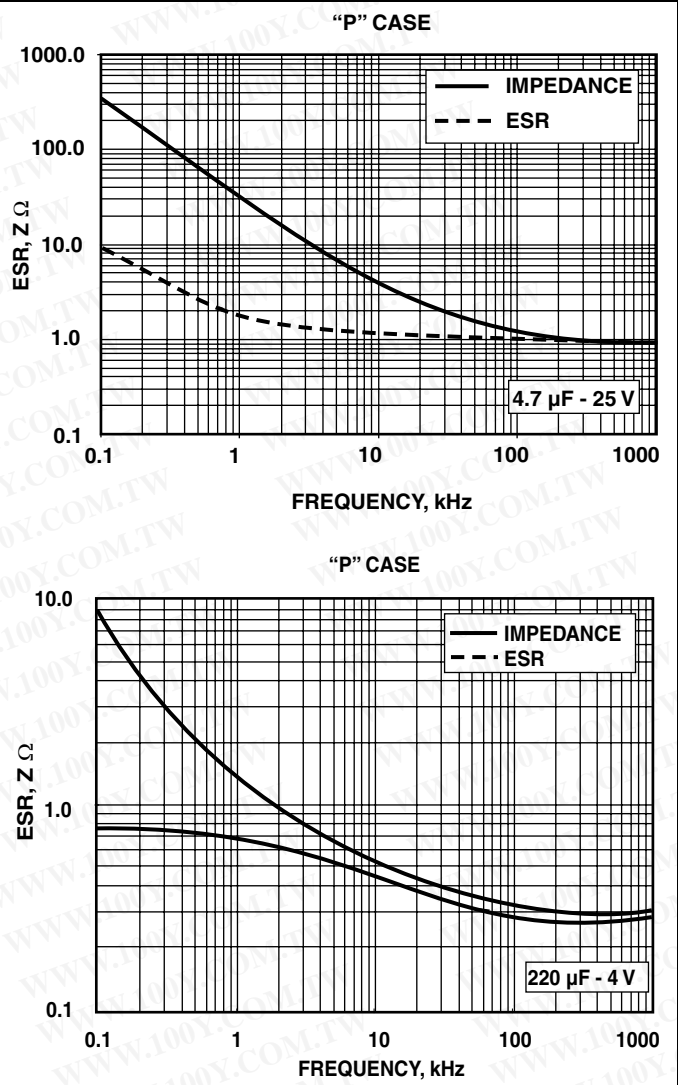
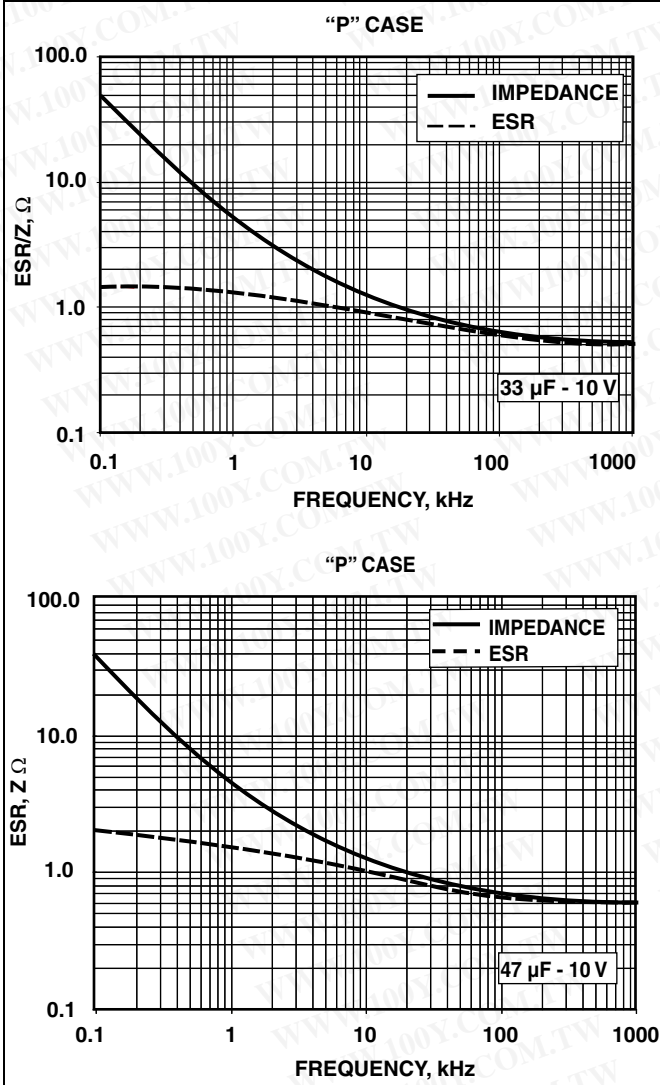
TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY



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TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY

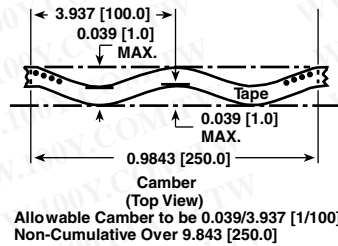
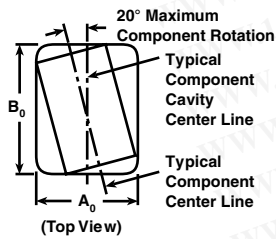
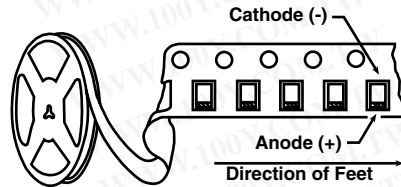
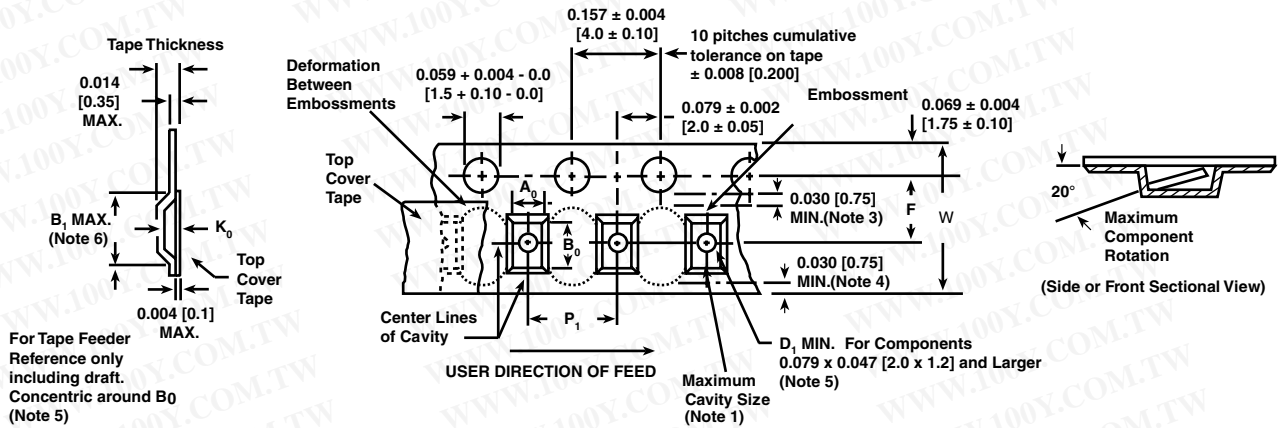


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PLASTIC TAPE AND REEL PACKAGING in inches [millimeters]



Tape and Reel Specifications: All case sizes are available on plastic embossed tape per EIA-481-1. Tape reeling per IEC 286-3 is also available. Standard reel diameter is 7" [178 mm], 13" [330 mm] reels are available and recommended as the most cost effective packaging method.

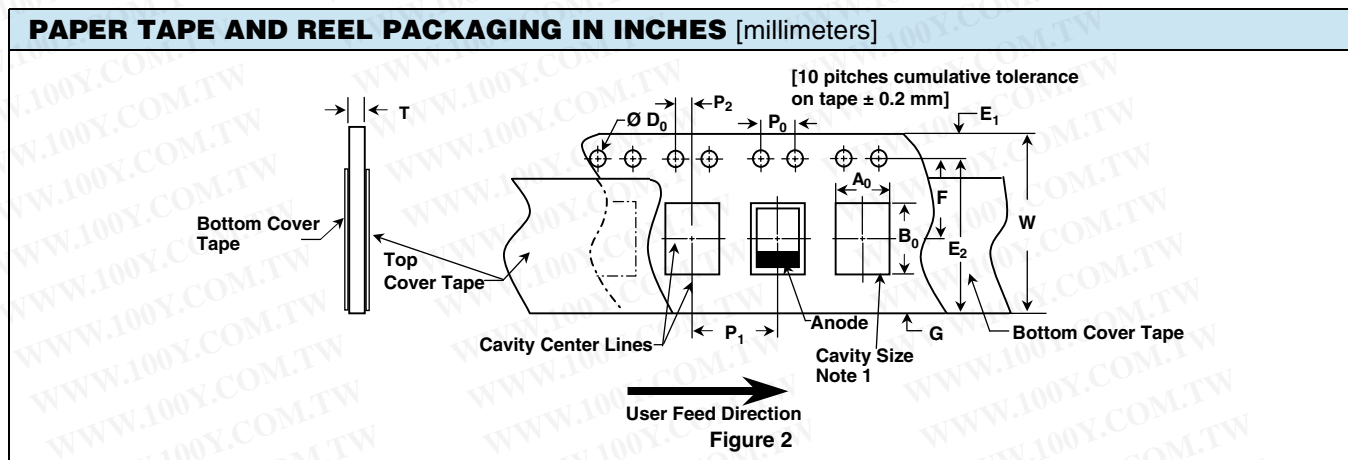
The most efficient packaging quantities are full reel increments on a given reel diameter. The quantities shown allow for the sealed empty pockets required to be in conformance with EIA-481-1. Reel size and packaging orientation must be specified in the Vishay Sprague part number.

Note

Metric dimensions will govern. Dimensions in inches are rounded and for reference only.

| CASE CODE | TAPE SIZE | B ₁ (MAX.) | D ₁ (MIN.) | F | K ₀ (MAX.) | P ₁ | W |
|-----------|-----------|-----------------------|-----------------------|----------------------------|-----------------------|---------------------------|---|
| 298D | | | | | | | |
| P | 8 mm | 0.108 [2.75] | 0.039 [1.0] | 0.138 ± 0.002 [3.5 ± 0.05] | 0.054 [1.37] | 0.157 ± 0.004 [4.0 ± 1.0] | 0.315 ± 0.0118/- 0.0039 [8.0 ± 0.30/- 0.10] |

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| 298D | | | | | | | | | | | |
|-----------|-----------|--------------------------------|--------------------------------|-----------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------------|--------------------------------|
| CASE SIZE | TAPE SIZE | A ₀ | B ₀ | D ₀ | P ₀ | P ₁ | P ₂ | E | F | W | T |
| K | 8 mm | 0.033 ± 0.002 [0.85 ± 0.05] | 0.053 ± 0.002 [1.35 ± 0.05] | 0.06 ± 0.004 [1.5 ± 0.1] | 0.157 ± 0.004 [4.0 ± 0.1] | 0.078 ± 0.004 [2.0 ± 0.1] | 0.079 ± 0.002 [2.0 ± 0.05] | 0.069 ± 0.004 [1.75 ± 0.1] | 0.0138 ± 0.002 [3.5 ± 0.05] | 0.315 ± 0.008 [8.0 ± 0.2] | 0.03 ± 0.002 [0.75 ± 0.05] |
| M | 8 mm | 0.041 ± 0.002 [1.05 ± 0.05] | 0.071 ± 0.002 [1.8 ± 0.05] | 0.06 ± 0.004 [1.5 ± 0.1] | 0.157 ± 0.004 [4.0 ± 0.1] | 0.157 ± 0.004 [4.0 ± 0.1] | 0.079 ± 0.002 [2.0 ± 0.05] | 0.069 ± 0.004 [1.75 ± 0.1] | 0.0138 ± 0.002 [3.5 ± 0.05] | 0.315 ± 0.008 [8.0 ± 0.2] | 0.037 ± 0.002 [0.95 ± 0.05] |

STANDARD PACKAGING QUANTITY

| SERIES | CASE CODE | QTY (PCS/REEL) | |
|--------|-----------|----------------|----------|
| | | 7" REEL | 13" REEL |
| 298D | K | 5000 | N/a |
| | M | 4000 | N/a |
| | P | 3000 | N/a |

RECOMMENDED VOLTAGE DERATING GUIDELINES

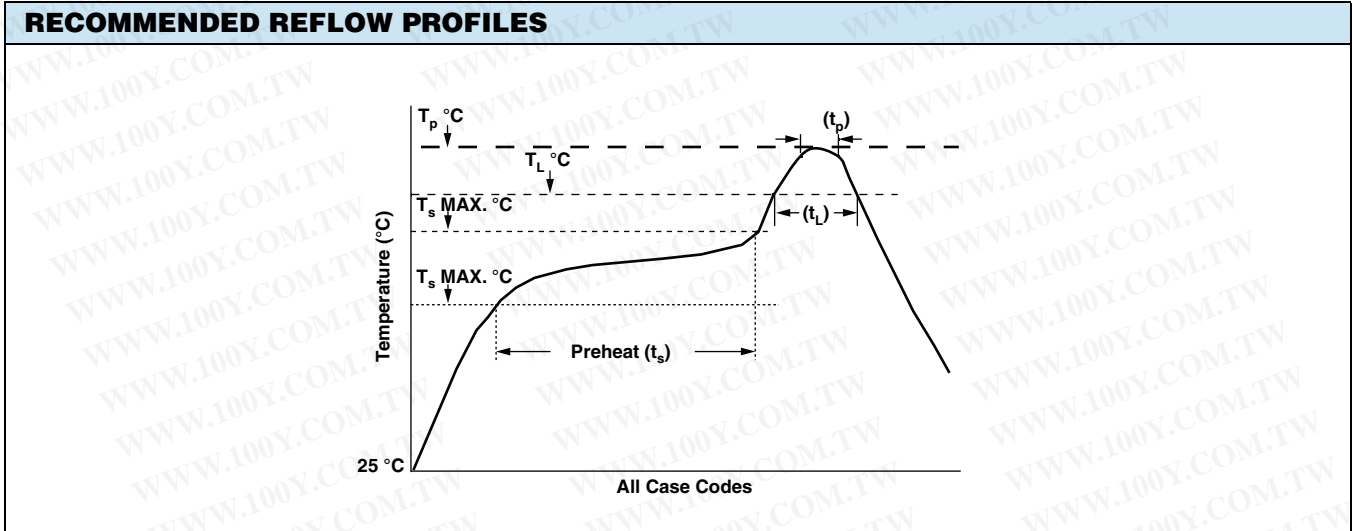
STANDARD CONDITIONS: FOR EXAMPLE: OUTPUT FILTERS

| Capacitor Voltage Rating | Operating Voltage |
|--------------------------|-------------------|
| 4.0 | 2.5 |
| 6.3 | 3.6 |
| 10 | 6.0 |
| 16 | 10 |
| 20 | 12 |
| 25 | 15 |
| 35 | 24 |
| 50 | 28 |

SEVERE CONDITIONS: FOR EXAMPLE: INPUT FILTERS

| Capacitor Voltage Rating | Operating Voltage |
|--------------------------|-------------------|
| 4.0 | 2.5 |
| 6.3 | 3.3 |
| 10 | 5.0 |
| 16 | 8.0 |
| 20 | 10 |
| 25 | 12 |
| 35 | 15 |
| 50 | 24 |

| POWER DISSIPATION | | |
|-------------------|---|--|
| CASE CODE | | MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR |
| 298D | K | 0.015 |
| | M | 0.025 |
| | P | 0.045 |



| TYPE | T _p lead (Pb)-free | T _p Sn/Pb | t _p | T _L lead (Pb)-free | T _L Sn/Pb | T _s MIN. lead (Pb)-free | T _s MIN. Sn/Pb | T _s MAX. lead (Pb)-free | T _s MAX. Sn/Pb | t _s lead (Pb)-free | t _s Sn/Pb | t _L |
|------|----------------------------------|-------------------------|----------------|----------------------------------|-------------------------|---------------------------------------|------------------------------|---------------------------------------|------------------------------|----------------------------------|-------------------------|----------------|
| 298D | 260 °C | 225 °C | 10 | 217 °C | 183 °C | 150 °C | 100 °C | 200 °C | 150 °C | 60 to 150 | 60 to 90 | 60 |

PAD DIMENSIONS in inches [millimeters]

| CASE CODE | A (MIN.) | B (NOM.) | C (NOM.) | D (NOM.) |
|-----------|--------------|--------------|--------------|--------------|
| 298D | | | | |
| K | 0.028 [0.70] | 0.018 [0.45] | 0.024 [0.60] | 0.059 [1.50] |
| M | 0.039 [1.00] | 0.028 [0.70] | 0.24 [0.60] | 0.080 [2.00] |
| P | 0.063 [1.60] | 0.031 [0.80] | 0.047 [1.20] | 0.110 [2.80] |

**GUIDE TO APPLICATION**

1. **A-C Ripple Current:** The maximum allowable ripple current shall be determined from the formula:

$$I_{rms} = \sqrt{\frac{P}{R_{ESR}}}$$

where,

P = Power dissipation in watts at + 25 °C as given in the table in paragraph number 5 (power dissipation).

R_{ESR} = The capacitor equivalent series resistance at the specified frequency.

2. **A-C Ripple Voltage:** The maximum allowable ripple voltage shall be determined from the formula:

$$V_{rms} = Z \sqrt{\frac{P}{R_{ESR}}}$$

or, from the formula:

$$V_{rms} = I_{rms} \times Z$$

where,

P = Power dissipation in watts at + 25 °C as given in the table in paragraph number 5 (power dissipation).

R_{ESR} = The capacitor equivalent series resistance at the specified frequency.

Z = The capacitor impedance at the specified frequency.

- 2.1 The sum of the peak AC voltage plus the applied DC voltage shall not exceed the DC voltage rating of the capacitor.
- 2.2 The sum of the negative peak AC voltage plus the applied DC voltage shall not allow a voltage reversal exceeding 10 % of the DC working voltage at + 25 °C.
3. **Reverse Voltage:** These capacitors are capable of withstanding peak voltages in the reverse direction equal to 10 % of the DC rating at + 25 °C, 5 % of the DC rating at + 85 °C and 1 % of the DC rating at + 125 °C.
4. **Temperature Derating:** If these capacitors are to be operated at temperatures above + 25 °C, the permissible rms ripple current or voltage shall be calculated using the derating factors as shown:

| TEMPERATURE | DERATING FACTOR |
|-------------|-----------------|
| + 25 °C | 1.0 |
| + 85 °C | 0.9 |
| + 125 °C | 0.4 |

5. **Power Dissipation:** Power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown. It is important that the equivalent I_{rms} value be established when calculating permissible operating levels. (Power Dissipation calculated using + 25 °C temperature rise.)

6. **Printed Circuit Board Materials:** Molded capacitors are compatible with commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelainized steel).

7. **Attachment:**

- 7.1 **Solder Paste:** The recommended thickness of the solder paste after application is 0.007" ± 0.001" [0.178 mm ± 0.025 mm]. Care should be exercised in selecting the solder paste. The metal purity should be as high as practical. The flux (in the paste) must be active enough to remove the oxides formed on the metallization prior to the exposure to soldering heat. In practice this can be aided by extending the solder preheat time at temperatures below the liquidous state of the solder.

- 7.2 **Soldering:** Capacitors can be attached by conventional soldering techniques; vapor phase, convection reflow, infrared reflow, wave soldering and hot plate methods. The Soldering Profile charts show recommended time/temperature conditions for soldering. Preheating is recommended. The recommended maximum ramp rate is 2 °C per second. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature. The soldering iron must never come in contact with the capacitor.

- 7.2.1 **Backward and Forward Compatibility:** Capacitors with SnPb or 100 % tin termination finishes can be soldered using SnPb or lead (Pb)-free soldering processes.

8. **Cleaning (Flux Removal) After Soldering:** Molded capacitors are compatible with all commonly used solvents such as TES, TMS, Prelete, Chloroethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

- 8.1 When using ultrasonic cleaning, the board may resonate if the output power is too high. This vibration can cause cracking or a decrease in the adherence of the termination. DO NOT EXCEED 9W/l at 40 kHz for 2 minutes.

9. **Recommended Mounting Pad Geometries:** Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints. The dimensional configurations shown are the recommended pad geometries for both wave and reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers and may be fine tuned if necessary based upon the peculiarities of the soldering process and/or circuit board design.



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勝特力电子(深圳) 86-755-83298787
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