

FEATURES:

- TCR as low as $\pm 5\text{ppm}$
- Tolerance as low as $\pm 0.01\%$
- Higher operating frequency with less parasitics
- Noise characteristics superior to standard thick film resistors
- Reference standards of EIA JIS C 5201-1



PART NUMBER STRUCTURE

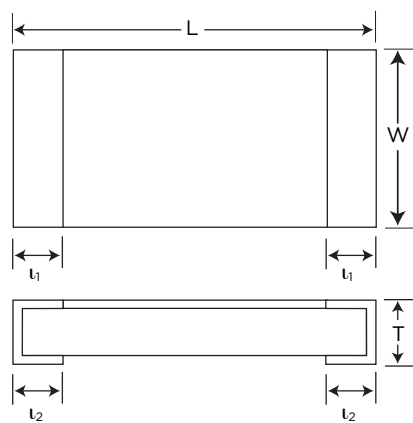
| HPTF Series | 1206 Size | - U Power Rating | E TCR | - 1001 Resistance Value | B Resistance Tolerance | T Packaging | Optional Reel Identifier |
|-------------|-----------|------------------|---------------------------------------|-------------------------|------------------------|-----------------|--|
| 0402 | Q = 1/10W | Q = 1/10W | P = $\pm 5\text{ppm}/^\circ\text{C}$ | 1001 = 1K Ω | U = $\pm 0.01\%$ | T = Tape & Reel | Leave blank for standard quantity. |
| 0603 | R = 1/8W | R = 1/8W | N = $\pm 10\text{ppm}/^\circ\text{C}$ | 4R70 = 4.7 Ω | A = $\pm 0.05\%$ | | |
| 0805 | S = 1/6W | S = 1/6W | E = $\pm 25\text{ppm}/^\circ\text{C}$ | 1001 = 1K Ω | B = $\pm 0.1\%$ | | |
| 1206 | T = 1/4W | T = 1/4W | C = $\pm 50\text{ppm}/^\circ\text{C}$ | 2494 = 2.49M Ω | C = $\pm 0.25\%$ | | Add "-1K" if 1000 piece reel is required |
| 1210 | U = 1/3W | U = 1/3W | | | D = $\pm 0.50\%$ | | |
| 2010 | W = 3/4W | W = 3/4W | | | F = $\pm 1\%$ | | |
| 2512 | X = 1W | X = 1W | | | | | |

Example P/N: HPTF1206-UE-1001BT

Standard Termination is 100% matte Tin over Nickel.

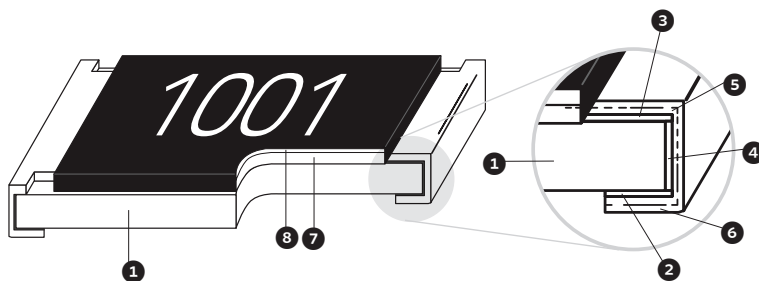
DIMENSIONS

Unit: inches (mm)



| SIZE | L | W | T | l1 | l2 |
|---------------------------|--|--|--|--|--|
| 0402 | 0.040 \pm 0.002 (1.0 \pm 0.05) | 0.020 \pm 0.001 (0.5 \pm 0.02) | 0.012 \pm 0.002 (0.30 \pm .05) | 0.008 \pm 0.004 (0.20 \pm 0.10) | 0.008 \pm 0.004 (0.20 \pm 0.10) |
| 0603 | 0.061 \pm 0.004 (1.55 \pm 0.10) | 0.031 \pm 0.004 (0.80 \pm 0.10) | 0.018 \pm 0.004 (0.45 \pm 0.10) | 0.012 \pm 0.008 (0.30 \pm 0.20) | 0.012 \pm 0.008 (0.30 \pm 0.20) |
| 0805 | 0.079 \pm 0.006 (2.0 \pm 0.15) | 0.049 \pm 0.006 (1.25 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.012 \pm 0.008 (0.30 \pm 0.20) | 0.016 \pm 0.010 (0.40 \pm 0.25) |
| 1206 | 0.120 \pm 0.006 (3.05 \pm 0.15) | 0.061 \pm 0.006 (1.55 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.017 \pm 0.008 (0.42 \pm 0.20) | 0.014 \pm 0.010 (0.35 \pm 0.25) |
| 1210 | 0.122 \pm 0.006 (3.10 \pm 0.15) | 0.094 \pm 0.006 (2.40 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.016 \pm 0.008 (0.40 \pm 0.20) | 0.022 \pm 0.010 (0.55 \pm 0.25) |
| 2010 | 0.192 \pm 0.006 (4.90 \pm 0.15) | 0.094 \pm 0.006 (2.40 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.024 \pm 0.012 (0.60 \pm 0.30) | 0.020 \pm 0.010 (0.50 \pm 0.25) |
| 2010 (3/4 W) | 0.197 \pm 0.005 (5.00 \pm 0.12) | 0.098 \pm 0.006 (2.50 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.024 \pm 0.008 (0.60 \pm 0.20) | 0.024 \pm 0.010 (0.60 \pm 0.25) |
| 2512 ($\leq 100\Omega$) | 0.248 \pm 0.006 (6.30 \pm 0.15) | 0.122 \pm 0.006 (3.10 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.024 \pm 0.012 (0.60 \pm 0.30) | 0.020 \pm 0.010 (0.50 \pm 0.25) |
| 2512 ($> 100\Omega$) | 0.248 \pm 0.006 (6.30 \pm 0.15) | 0.122 \pm 0.006 (3.10 \pm 0.15) | 0.022 \pm 0.004 (0.55 \pm 0.10) | 0.024 \pm 0.012 (0.60 \pm 0.30) | 0.0984 \pm 0.01 (2.50 \pm 0.25) |

STRUCTURE



| | | | |
|---|--------------------|---|-----------------|
| 1 | Alumina Substrate | 5 | Nickel Plating |
| 2 | Backside Electrode | 6 | Tin Plating |
| 3 | Top Electrode | 7 | Resistive Layer |
| 4 | Edge Electrode | 8 | Overcoat |

ELECTRICAL SPECIFICATION & RANGE

| | SIZE | 0603 | | 0805 | | |
|--------------------------|-----------------|------------------|------------------|-----------------|------------------|--------------|
| | 0402 | 0.10W (1/10W) | 0.10W (1/10W) | 0.166W (1/6W) | 0.125W (1/8W) | 0.25W (1/4W) |
| Power Rating at 70°C (W) | 0.10W (1/10W) | 0.10W (1/10W) | 0.166W (1/6W) | 0.125W (1/8W) | 0.25W (1/4W) | |
| Max. Working Voltage | 50V | 75V | 100V | 150V | | |
| Max. Overload Voltage | 100V | 150V | | 300V | | |
| Operating Temp. Range | -55°C to +155°C | -55°C to +155°C | | -55°C to +155°C | | |
| Tol. | TCR | Resistance Range | Resistance Range | | Resistance Range | |
| ±0.01% (U) | ±5ppm | 49.9Ω - 20KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 12KΩ | 24.9Ω - 100KΩ | - | 24.9Ω - 200KΩ | - |
| | ±25ppm | - | 24.9Ω - 100KΩ | - | 24.9Ω - 200KΩ | - |
| | ±50ppm | - | 24.9Ω - 100KΩ | - | 24.9Ω - 200KΩ | - |
| ±0.05% (A) | ±5ppm | 49.9Ω - 20KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 12KΩ | 4.7Ω - 332KΩ | - | 4.7Ω - 511KΩ | - |
| | ±25ppm | 49.9Ω - 12KΩ | 4.7Ω - 332KΩ | 10Ω - 332KΩ | 4.7Ω - 511KΩ | 10Ω - 499KΩ |
| | ±50ppm | 49.9Ω - 12KΩ | 4.7Ω - 332KΩ | 10Ω - 332KΩ | 4.7Ω - 511KΩ | 10Ω - 499KΩ |
| ±0.1% (B) | ±5ppm | 49.9Ω - 20KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 100KΩ | 4.7Ω - 511KΩ | - | 4.7Ω - 1MΩ | - |
| | ±25ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| | ±50ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| ±0.25% (C) | ±5ppm | 49.9Ω - 20KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 100KΩ | 4.7Ω - 511KΩ | - | 4.7Ω - 1MΩ | - |
| | ±25ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| | ±50ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| ±0.5% (D) | ±5ppm | 49.9Ω - 20KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 100KΩ | 4.7Ω - 511KΩ | - | 4.7Ω - 1MΩ | - |
| | ±25ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| | ±50ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| ±1% (F) | ±5ppm | 49.9Ω - 4.99KΩ | 24.9Ω - 60KΩ | - | 24.9Ω - 150KΩ | - |
| | ±10ppm | 49.9Ω - 60KΩ | 4.7Ω - 511KΩ | - | 4.7Ω - 1MΩ | - |
| | ±25ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |
| | ±50ppm | 4.7Ω - 255KΩ | - | 10Ω - 332KΩ | - | 10Ω - 499KΩ |

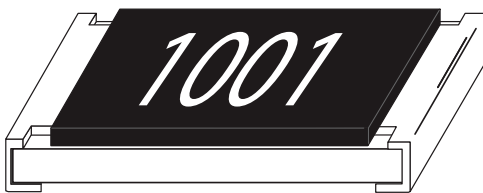
NOTE: Overload Voltage=2.5*√(P*R). or Max. overload voltage listed above, whichever is lower.

ELECTRICAL SPECIFICATION & RANGE

| | SIZE | 1206 | | 1210 | 2010 | | 2512 | |
|--------------------------|--------|------------------|---------------|------------------|------------------|--------------|------------------|-------------|
| Power Rating at 70°C (W) | | 0.25W (1/4W) | 0.333W (1/3W) | 0.333W (1/3W) | 0.333W (1/3W) | 0.75W (3/4W) | 0.75W (3/4W) | 1W |
| Max. Working Voltage | | 200V | | 200V | 200V | | 200V | |
| Max. Overload Voltage | | 400V | | 400V | 400V | | 400V | |
| Operating Temp. Range | | -55°C to +155°C | | -55°C to +155°C | -55°C to +155°C | | -55°C to +155°C | |
| Tol. | TCR | Resistance Range | | Resistance Range | Resistance Range | | Resistance Range | |
| ±0.01% (U) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 24.9Ω - 499KΩ | - | 24.9Ω - 499KΩ | 24.9Ω - 499KΩ | - | 24.9Ω - 2KΩ | 24.9Ω - 2KΩ |
| | ±25ppm | 24.9Ω - 499KΩ | - | 24.9Ω - 499KΩ | 24.9Ω - 499KΩ | - | 24.9Ω - 2KΩ | 24.9Ω - 2KΩ |
| | ±50ppm | 24.9Ω - 499KΩ | - | 24.9Ω - 499KΩ | 24.9Ω - 499KΩ | 10Ω - 1MΩ | 24.9Ω - 2KΩ | 24.9Ω - 2KΩ |
| ±0.05% (A) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 4.7Ω - 1MΩ | - | 4.7Ω - 1MΩ | 4.7Ω - 1MΩ | - | 4.7Ω - 2KΩ | 4.7Ω - 1MΩ |
| | ±25ppm | 1Ω - 1MΩ | 10Ω - 1MΩ | 1Ω - 1MΩ | 1Ω - 1MΩ | - | 4.7Ω - 2KΩ | 4.7Ω - 1MΩ |
| | ±50ppm | 1Ω - 1MΩ | 10Ω - 1MΩ | 1Ω - 1MΩ | 1Ω - 1MΩ | 10Ω - 1MΩ | 4.7Ω - 2KΩ | 4.7Ω - 1MΩ |
| ±0.1% (B) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 4.7Ω - 1MΩ | - | 4.7Ω - 1MΩ | 4.7Ω - 1MΩ | - | 4.7Ω - 2KΩ | 4.7Ω - 1MΩ |
| | ±25ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | - | 4.7Ω - 3MΩ | 4.7Ω - 3MΩ |
| | ±50ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | 10Ω - 1MΩ | 4.7Ω - 3MΩ | 4.7Ω - 3MΩ |
| ±0.25% (C) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 4.7Ω - 1MΩ | - | 4.7Ω - 1MΩ | 4.7Ω - 1MΩ | - | 1Ω - 2KΩ | 1Ω - 1MΩ |
| | ±25ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | - | 1Ω - 3MΩ | 1Ω - 3MΩ |
| | ±50ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ |
| ±0.5% (D) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 4.7Ω - 1MΩ | - | 4.7Ω - 1MΩ | 4.7Ω - 1MΩ | - | 1Ω - 2KΩ | 1Ω - 1MΩ |
| | ±25ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | - | 1Ω - 3MΩ | 1Ω - 3MΩ |
| | ±50ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ |
| ±1% (F) | ±5ppm | 24.9Ω - 300KΩ | - | 24.9Ω - 300KΩ | 24.9Ω - 300KΩ | - | - | - |
| | ±10ppm | 4.7Ω - 1MΩ | - | 4.7Ω - 1MΩ | 4.7Ω - 1MΩ | - | 1Ω - 2KΩ | 1Ω - 1MΩ |
| | ±25ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | - | 1Ω - 3MΩ | 1Ω - 3MΩ |
| | ±50ppm | - | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ | 10Ω - 1MΩ | 1Ω - 3MΩ | 1Ω - 3MΩ |

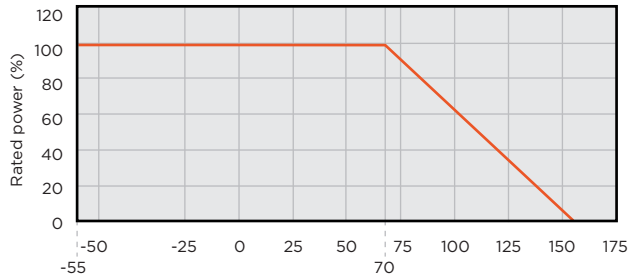
NOTE: Overload Voltage=2.5*√(P*R). or Max. overload voltage listed above, whichever is lower.

MARKING CODE

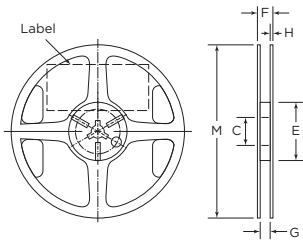


- E-96 values for 0805 size and larger, will be marked with standard 4 digit marking code.
- E-24 values for 0603 size and larger, will be marked with standard 3 digit marking code.
- 0603 - E-96 values will be marked with a standard 3 digit alpha numeric code (Please see alpha numeric codes).
- 0402 size is not marked

DERATING CURVE



REEL SPECIFICATIONS

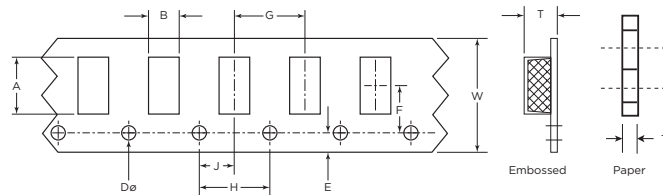


Unit: mm (inch)

| C | E | F | G | H | M |
|------------------------------|-----------------------------|-----------------------------|----------------------------|----------------------------|----------------------------|
| 13.0 ± 0.2 (0.51 ± 0.008) | 60.0 ± 1.0 (2.36 ± 0.03) | 11.4 ± 1.0 (0.45 ± 0.04) | 9.0 ± .3 (0.35 ± 0.012) | 1.5 ± .3 (0.06 ± 0.012) | 180 ± 2.0 (7.09 ± 0.08) |

Minimum of 30 empty pockets at the beginning of reel, 65 minimum empty pockets at the end.

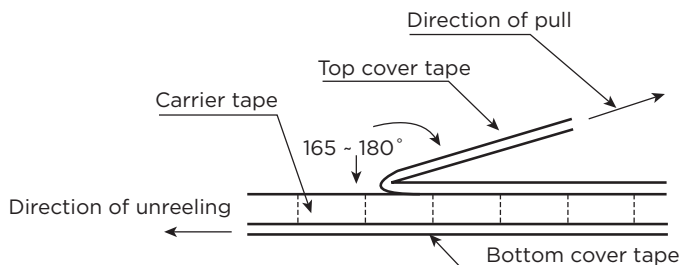
TAPE SPECIFICATIONS



Units: mm.

| TAPE | SIZE (inches) | A | B | W | E | F | T | G | H | J | DØ |
|----------|---------------|-------------|-------------|--------------|-------------|-------------|-------------------|-------------|-------------|-------------|------------------|
| Paper | 0402 | 1.16 ± 0.10 | 0.70 ± 0.10 | 8.0 ± 0.10 | 1.75 ± 0.05 | 3.50 ± 0.05 | 0.40 ± 0.03 | 2.00 ± 0.05 | 4.00 ± 0.10 | 2.00 ± 0.05 | 1.55 ± 0.05 |
| | 0603 | 1.90 ± 0.10 | 1.10 ± 0.05 | 8.0 ± 0.10 | 1.75 ± 0.05 | 3.50 ± 0.05 | 0.60 ± 0.03 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 1.55 ± 0.05 |
| | 0805 | 2.37 ± 0.20 | 1.60 ± 0.05 | 8.0 ± 0.10 | 1.75 ± 0.05 | 3.50 ± 0.05 | 0.75 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 1.55 ± 0.05 |
| | 1206 | 3.55 ± 0.05 | 2.00 ± 0.05 | 8.0 ± 0.10 | 1.75 ± 0.05 | 3.50 ± 0.05 | 0.75 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 1.55 ± 0.05 |
| | 1210 | 3.40 ± 0.05 | 2.75 ± 0.05 | 8.0 ± 0.10 | 1.75 ± 0.05 | 3.50 ± 0.05 | 0.75 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.05 | 2.00 ± 0.05 | 1.60 ± 0.10 |
| Embossed | 2010 | 5.45 ± 0.10 | 2.85 ± 0.10 | 12.00 ± 0.10 | 1.75 ± 0.10 | 5.50 ± 0.05 | 1.00 +0.02, -0 | 4.00 ± 0.10 | 4.00 ± 0.05 | 2.00 ± 0.05 | 1.50 +0.1, -0 |
| | 2512 | 6.65 ± 0.10 | 3.40 ± 0.10 | 12.00 ± 0.10 | 1.75 ± 0.10 | 5.50 ± 0.05 | 1.00 +0.02, -0 | 4.00 ± 0.10 | 4.00 ± 0.05 | 2.00 ± 0.05 | 1.50 +0.1, -0 |

PEEL BACK FORCE AND DIRECTION DIAGRAM



Peel back force and direction of peel back angle should follow EIA481-1-A. Peel back force should be between 0.1N - 1.3N and peel back angle of 165° - 180°.

ENVIRONMENTAL CHARACTERISTICS

| TEST | REQUIREMENT | | TEST METHOD |
|--|---|---|---|
| | Tol. $\leq 0.05\%$ | Tol. $> 0.05\%$ | |
| Temperature Coefficient of Resistance (T.C.R.) | As Spec. | | MIL-STD-202 Method 304 +25/-55/+125/+25°C |
| Short Time Overload | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.2\%$ | JIS-C-5201-1 4.13 RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds |
| | $\Delta R \pm 0.2\%$ for high power rating | | |
| Insulation Resistance | $> 9999M\Omega$ | | MIL-STD-202 Method 302 Apply 100VDC for 1 minute |
| Endurance | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.2\%$ | MIL-STD-202 Method 108A 70 $\pm 2^\circ$ C RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF" |
| | $\Delta R \pm 0.05\%$ for high power rating | | |
| | 0201: | $> 7k\Omega \rightarrow \Delta R \pm 0.5\%$ $\leq 7k\Omega \rightarrow \Delta R \pm 0.2\%$ | |
| Damp Heat with Load | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.3\%$ | MIL-STD-202 Method 103B 40 $\pm 2^\circ$ C 90-95% R.H. RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF" |
| | $\Delta R \pm 0.5\%$ for high power rating | | |
| Bending Strength | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.1\%$ | JIS-C-5201-1 4.33 Bending amplitude 3mm for 10 seconds 2010 / 2512 sizes: 2mm Other sizes: 3mm |
| Solderability | 95% min. coverage | | MIL-STD-202 Method 208H 245 $\pm 5^\circ$ C for 3 seconds |
| Resistance to Soldering Heat | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.1\%$ | MIL-STD-202 Method 210E 260 $\pm 5^\circ$ C for 10 seconds |
| Dielectric Withstanding Voltage | By Type | | MIL-STD-202 Method 301 Max. Overload Voltage for 1 minute |
| Low Temperature Operation | $\Delta R \pm 0.05\%$ | $\Delta R \pm 0.2\%$ | JIS-C-5201-1 4.36 1 hour, -65°C, followed by 45 minutes of RCWV |
| | $\Delta R \pm 0.5\%$ for high power rating | | |
| High Temperature Exposure | $\Delta R \pm 0.05\%$ | | MIL-STD-202 Method 108 at +155°C for 1000 hrs |

RCWV (Rated continuous working voltage) = $\sqrt{P \cdot R}$ or Max operating voltage whichever is lower

Storage Temperature: 25 $\pm 3^\circ$ C; Humidity: <80% RH