

Surface Mount Multilayer Ceramic Chip Capacitors (SMD MLCCs)
X5R Dielectric, 4 – 50 VDC (Commercial Grade)

Overview

KEMET's X5R dielectric features an 85°C maximum operating temperature and is considered "semi-stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes X5R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling applications or for frequency

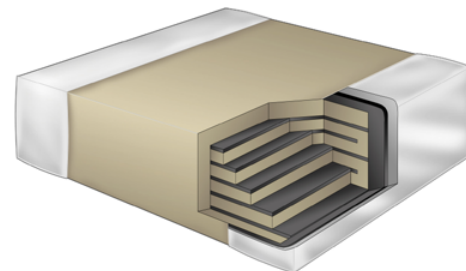
discriminating circuits where Q and stability of capacitance characteristics are not critical. X5R exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from -55°C to +85°C.

Benefits

- -55°C to +85°C operating temperature range
- Pb-Free and RoHS Compliant
- Temperature stable dielectric
- EIA 0201, 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 4 V, 6.3 V, 10 V, 16 V, 25 V, 35 V and 50 V
- Capacitance offerings ranging from 0.01 µF to 100 µF
- Available capacitance tolerances of ±10% and ±20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability

Applications

Typical applications include decoupling, bypass, and filtering.



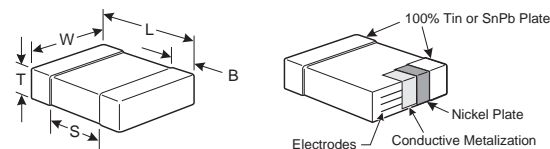
Ordering Information

| C | 1206 | C | 107 | M | 9 | P | A | C | TU |
|---------|---|-----------------------|---------------------------------------|-----------------------|--|------------|----------------------|---------------------------------|--|
| Ceramic | Case Size (L" x W") | Specification/ Series | Capacitance Code (pF) | Capacitance Tolerance | Voltage | Dielectric | Failure Rate/ Design | Termination Finish ¹ | Packaging/Grade (C-Spec) ² |
| | 1005 = 01005 0201 0402 0603 0805 1206 1210 | C = Standard | 2 Sig. Digits + Number of Zeros | K = ±10% M = ±20% | 7 = 4 V 9 = 6.3 V 8 = 10 V 4 = 16 V 3 = 25 V 6 = 35 V 5 = 50 V | P = X5R | A = N/A | C = 100% Matte Sn | Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked |

¹ Additional termination finish options may be available. Contact KEMET for details.

² Additional reeling or packaging options may be available. Contact KEMET for details.

Dimensions – Millimeters (Inches)



| EIA Size Code | Metric Size Code | L Length | W Width | T Thickness | B Bandwidth | S Separation Minimum | Mounting Technique |
|---------------|------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------|------------------------------|
| 01005 | 0402 | 0.40 (.016) ± 0.02 (.001) | 0.20 (.008) ± 0.02 (.001) | See Table 2 for Thickness | 0.10 (.004) ± 0.03 (.001) | N/A | Solder Reflow Only |
| 0201 | 0603 | 0.60 (.024) ± 0.03 (.001) | 0.30 (.012) ± 0.03 (.001) | | 0.15 (.006) ± 0.05 (.002) | | |
| 0402 | 1005 | 1.00 (.040) ± 0.05 (.002) | 0.50 (.020) ± 0.05 (.002) | | 0.30 (.012) ± 0.10 (.004) | 0.30 (.012) | Solder Wave or Solder Reflow |
| 0603 | 1608 | 1.60 (.063) ± 0.15 (.006) | 0.80 (.032) ± 0.15 (.006) | | 0.35 (.014) ± 0.15 (.006) | 0.70 (.028) | |
| 0805 | 2012 | 2.00 (.079) ± 0.20 (.008) | 1.25 (.049) ± 0.20 (.008) | | 0.50 (0.02) ± 0.25 (.010) | 0.75 (.030) | |
| 1206 | 3216 | 3.20 (.126) ± 0.20 (.008) | 1.60 (.063) ± 0.20 (.008) | | 0.50 (0.02) ± 0.25 (.010) | N/A | Solder Reflow Only |
| 1210 | 3225 | 3.20 (.126) ± 0.20 (.008) | 2.50 (.098) ± 0.20 (.008) | | 0.50 (0.02) ± 0.25 (.010) | | |
| 1812 | 4532 | 4.50 (.177) ± 0.30 (.012) | 3.20 (.126) ± 0.30 (.012) | | 0.60 (.024) ± 0.35 (.014) | | |
| 1825 | 4564 | 4.50 (.177) ± 0.30 (.012) | 6.40 (.252) ± 0.40 (.016) | | 0.60 (.024) ± 0.35 (.014) | | |
| 2220 | 5650 | 5.70 (.224) ± 0.40 (.016) | 5.00 (.197) ± 0.40 (.016) | | 0.60 (.024) ± 0.35 (.014) | | |
| 2225 | 5664 | 5.60 (.220) ± 0.40 (.016) | 6.40 (.248) ± 0.40 (.016) | 0.60 (.024) ± 0.35 (.014) | | | |

Qualification/Certification

Commercial grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance & Reliability.

Environmental Compliance

Pb-Free and RoHS Compliant.



RoHS Compliant

Electrical Parameters/Characteristics

| Item | Parameters/Characteristics |
|--|--|
| Operating Temperature Range | -55°C to +85°C |
| Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC) | ±15% |
| Aging Rate (Maximum % Cap Loss/Decade Hour) | 4.0% |
| Dielectric Withstanding Voltage | 250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA) |
| Dissipation Factor (DF) Maximum Limits @ 25°C | See Dissipation Factor Limit Table |
| Insulation Resistance (IR) Limit @ 25°C | See Insulation Resistance Limit Table (Rated voltage applied for 120 ±5 seconds @ 25°C) |

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1,000 hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega\text{-}\mu\text{F}$ value by the capacitance and compare to $G\Omega$ limit. Select the lower of the two limits.

Capacitance and dissipation factor (DF) measured under the following conditions:

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance ≤ 10 μF

120 Hz ±10 Hz and 0.5 ±0.1 Vrms if capacitance > 10 μF

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Post Environmental Limits

| High Temperature Life, Biased Humidity, Moisture Resistance | | | | | |
|---|------------------|-------------------|--------------------------------|-------------------|-----------------------|
| Dielectric | Rated DC Voltage | Capacitance Value | Dissipation Factor (Maximum %) | Capacitance Shift | Insulation Resistance |
| X5R | > 25 | All | 3.0 | ±20% | 10% of Initial Limit |
| | 25 | | 7.5 | | |
| | < 25 | < 0.56 μF | 7.5 | | |
| | < 25 | ≥ 0.56 μF | 12.0 | | |

Dissipation Factor Limit Table

| Rated DC Voltage | Capacitance | Dissipation Factor |
|------------------|-------------|--------------------|
| 50 – 200 V | All | 3% |
| 25 V | All | 5% |
| < 25 V | < 0.56 μF | 5% |
| < 25 V | ≥ 0.56 μF | 10% |

Insulation Resistance Limit Table

| EIA Case Size | 1,000 Megohm Microfarads or 100 GΩ | 500 Megohm Microfarads or 10 GΩ |
|---------------|---------------------------------------|------------------------------------|
| 0201 | N/A | ALL |
| 0402 | < .012 μF | ≥ .012 μF |
| 0603 | < .047 μF | ≥ .047 μF |
| 0805 | < .047 μF | ≥ .047 μF |
| 1206 | < 0.22 μF | ≥ 0.22 μF |
| 1210 | < 0.39 μF | ≥ 0.39 μF |
| 1808 | ALL | N/A |
| 1812 | < 2.2 μF | ≥ 2.2 μF |
| 1825 | ALL | N/A |
| 2220 | < 10 μF | ≥ 10 μF |
| 2225 | ALL | N/A |

Table 2 – Chip Thickness/Packaging Quantities

| Thickness Code | Case Size | Thickness ± Range (mm) | Paper Quantity | | Plastic Quantity | |
|----------------|-----------|------------------------|----------------|----------|------------------|----------|
| | | | 7" Reel | 13" Reel | 7" Reel | 13" Reel |
| AB | 0201 | 0.30 ± 0.03 | 15,000 | 0 | 0 | 0 |
| BB | 0402 | 0.50 ± 0.05 | 10,000 | 50,000 | 0 | 0 |
| BC | 0402 | 0.50 ± 0.05 | 10,000 | 50,000 | 0 | 0 |
| BB | 0402 | 0.50 ± 0.05 | 10,000 | 50,000 | 0 | 0 |
| CC | 0603 | 0.80 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DG | 0805 | 0.60 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DH | 0805 | 0.60 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DG | 0805 | 0.60 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DC | 0805 | 0.78 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DD | 0805 | 0.90 ± 0.10 | 4,000 | 10,000 | 0 | 0 |
| DL | 0805 | 0.95 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| DE | 0805 | 1.00 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| DF | 0805 | 1.10 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| EB | 1206 | 0.78 ± 0.10 | 4,000 | 10,000 | 4,000 | 10,000 |
| EH | 1206 | 0.78 ± 0.10 | 4,000 | 10,000 | 4,000 | 10,000 |
| EH | 1206 | 0.78 ± 0.10 | 4,000 | 10,000 | 4,000 | 10,000 |
| EK | 1206 | 0.80 ± 0.10 | 0 | 0 | 2,000 | 8,000 |
| EC | 1206 | 0.90 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| ED | 1206 | 1.00 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| EE | 1206 | 1.10 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| EF | 1206 | 1.20 ± 0.15 | 0 | 0 | 2,500 | 10,000 |
| FH | 1210 | 0.78 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| FS | 1210 | 0.78 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| FT | 1210 | 0.78 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| FD | 1210 | 0.95 ± 0.10 | 0 | 0 | 4,000 | 10,000 |
| FE | 1210 | 1.00 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| FF | 1210 | 1.10 ± 0.10 | 0 | 0 | 2,500 | 10,000 |
| FG | 1210 | 1.25 ± 0.15 | 0 | 0 | 2,500 | 10,000 |
| FJ | 1210 | 1.85 ± 0.20 | 0 | 0 | 2,000 | 8,000 |
| FK | 1210 | 2.10 ± 0.20 | 0 | 0 | 2,000 | 8,000 |
| Thickness Code | Case Size | Thickness ± Range (mm) | 7" Reel | 13" Reel | 7" Reel | 13" Reel |
| | | | Paper Quantity | | Plastic Quantity | |

Package quantity based on finished chip thickness specifications.

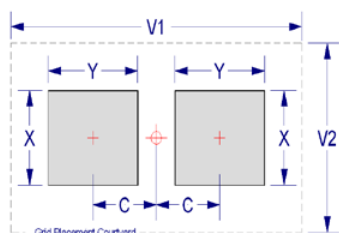
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351

| EIA Size Code | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---------------|------------------|--|------|------|------|------|--|------|------|------|------|---|------|------|------|------|
| | | C | Y | X | V1 | V2 | C | Y | X | V1 | V2 | C | Y | X | V1 | V2 |
| 01005 | 0402 | 0.33 | 0.46 | 0.43 | 1.60 | 0.90 | 0.28 | 0.36 | 0.33 | 1.30 | 0.70 | 0.23 | 0.26 | 0.23 | 1.00 | 0.50 |
| 0201 | 0603 | 0.38 | 0.56 | 0.52 | 1.80 | 1.00 | 0.33 | 0.46 | 0.42 | 1.50 | 0.80 | 0.28 | 0.36 | 0.32 | 1.20 | 0.60 |
| 0402 | 1005 | 0.50 | 0.72 | 0.72 | 2.20 | 1.20 | 0.45 | 0.62 | 0.62 | 1.90 | 1.00 | 0.40 | 0.52 | 0.52 | 1.60 | 0.80 |
| 0603 | 1608 | 0.90 | 1.15 | 1.10 | 4.00 | 2.10 | 0.80 | 0.95 | 1.00 | 3.10 | 1.50 | 0.60 | 0.75 | 0.90 | 2.40 | 1.20 |
| 0805 | 2012 | 1.00 | 1.35 | 1.55 | 4.40 | 2.60 | 0.90 | 1.15 | 1.45 | 3.50 | 2.00 | 0.75 | 0.95 | 1.35 | 2.80 | 1.70 |
| 1206 | 3216 | 1.60 | 1.35 | 1.90 | 5.60 | 2.90 | 1.50 | 1.15 | 1.80 | 4.70 | 2.30 | 1.40 | 0.95 | 1.70 | 4.00 | 2.00 |
| 1210 | 3225 | 1.60 | 1.35 | 2.80 | 5.65 | 3.80 | 1.50 | 1.15 | 2.70 | 4.70 | 3.20 | 1.40 | 0.95 | 2.60 | 4.00 | 2.90 |
| 1808 | 4520 | 2.30 | 1.75 | 2.30 | 7.40 | 3.30 | 2.20 | 1.55 | 2.20 | 6.50 | 2.70 | 2.10 | 1.35 | 2.10 | 5.80 | 2.40 |
| 1812 | 4532 | 2.15 | 1.60 | 3.60 | 6.90 | 4.60 | 2.05 | 1.40 | 3.50 | 6.00 | 4.00 | 1.95 | 1.20 | 3.40 | 5.30 | 3.70 |
| 1825 | 4564 | 2.15 | 1.60 | 6.90 | 6.90 | 7.90 | 2.05 | 1.40 | 6.80 | 6.00 | 7.30 | 1.95 | 1.20 | 6.70 | 5.30 | 7.00 |
| 2220 | 5650 | 2.75 | 1.70 | 5.50 | 8.20 | 6.50 | 2.65 | 1.50 | 5.40 | 7.30 | 5.90 | 2.55 | 1.30 | 5.30 | 6.60 | 5.60 |
| 2225 | 5664 | 2.70 | 1.70 | 6.90 | 8.10 | 7.90 | 2.60 | 1.50 | 6.80 | 7.20 | 7.30 | 2.50 | 1.30 | 6.70 | 6.50 | 7.00 |

Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC–7351).



Soldering Process

Recommended Soldering Technique:

- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

Recommended Soldering Profile:

- KEMET recommends following the guidelines outlined in IPC/JEDEC J–STD–020

Table 4 – Performance & Reliability: Test Methods and Conditions

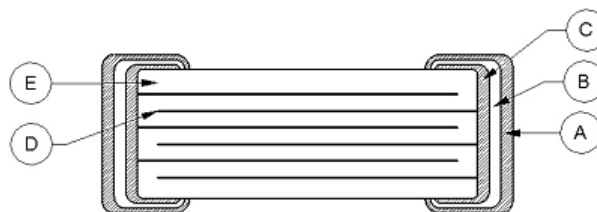
| Stress | Reference | Test or Inspection Method |
|------------------------|---------------------------------|---|
| Terminal Strength | JIS-C-6429 | Appendix 1, Note: Force of 1.8 kg for 60 seconds. |
| Board Flex | JIS-C-6429 | Appendix 2, Note: 2 mm (min) for all except 3 mm for C0G. |
| Solderability | J-STD-002 | Magnification 50 X. Conditions: |
| | | a) Method B, 4 hours @ 155°C, dry heat @ 235°C |
| | | b) Method B @ 215°C category 3 |
| | | c) Method D, category 3 @ 260°C |
| Temperature Cycling | JESD22 Method JA-104 | 1,000 Cycles (-55°C to +125°C), Measurement at 24 hours. +/- 2 hours after test conclusion. |
| Biased Humidity | MIL-STD-202 Method 103 | Load Humidity: 1,000 hours 85°C/85% RH and Rated Voltage. Add 100 K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion. |
| | | Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion. |
| Moisture Resistance | MIL-STD-202 Method 106 | t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion. |
| Thermal Shock | MIL-STD-202 Method 107 | -55°C/+125°C. Note: Number of cycles required-300, maximum transfer time-20 seconds, dwell time-15 minutes. Air-Air. |
| High Temperature Life | MIL-STD-202 Method 108 /EIA-198 | 1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied. |
| Storage Life | MIL-STD-202 Method 108 | 150°C, 0 VDC, for 1,000 hours. |
| Mechanical Shock | MIL-STD-202 Method 213 | Figure 1 of Method 213, Condition F. |
| Resistance to Solvents | MIL-STD-202 Method 215 | Add aqueous wash chemical, OKEM Clean or equivalent. |

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C, and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

Construction

| Reference | Item | Material |
|-----------|---------------------|--------------------|
| A | Termination System | Finish |
| B | | Barrier Layer |
| C | | Base metal |
| D | Inner Electrode | Ni |
| E | Dielectric Material | BaTiO ₃ |



Note: Image is exaggerated in order to clearly identify all components of construction.

Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12 and 16 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.

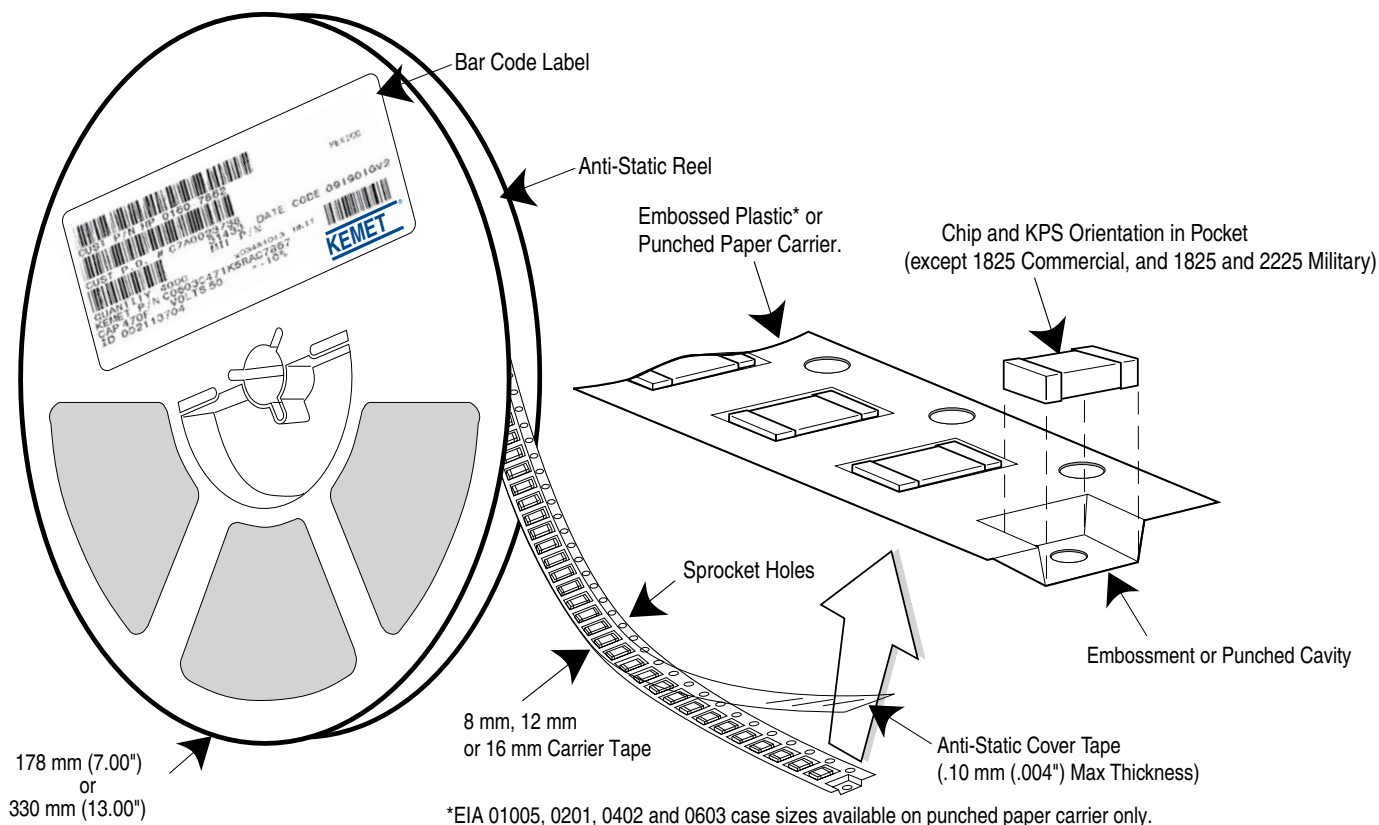


Table 5 – Carrier Tape Configuration (mm)

| EIA Case Size | Tape Size (W)* | Lead Space (P ₁)* |
|-------------------|----------------|-------------------------------|
| 01005 – 0402 | 8 | 2 |
| 0603 – 1210 | 8 | 4 |
| 1805 – 1808 | 12 | 4 |
| ≥ 1812 | 12 | 8 |
| KPS 1210 | 12 | 8 |
| KPS 1812 & 2220 | 16 | 12 |
| Array 0508 & 0612 | 8 | 4 |

*Refer to Figure 1 for W and P₁ carrier tape reference locations.

*Refer to Table 6 for tolerance specifications.

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

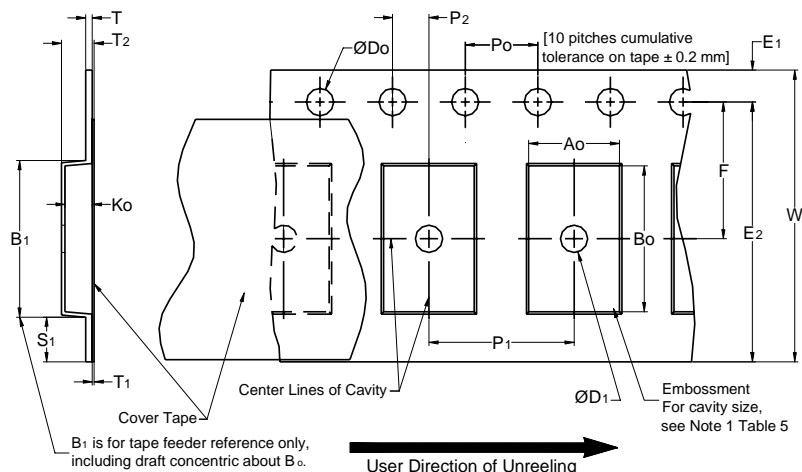


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | | | | | | |
|--|--------------------------------------|-------------------------|--|---------------------------------------|---------------------------------------|-----------------------|-------------------------|--------------------|-------------------|
| Tape Size | D_0 | D_1 Minimum Note 1 | E_1 | P_0 | P_2 | R Reference Note 2 | S_1 Minimum Note 3 | T Maximum. | T_1 Maximum. |
| 8 mm | $1.5 +0.10/-0.0 (0.059 +0.004/-0.0)$ | 1.0 (0.039) | 1.75 ± 0.10 (0.069 \pm 0.004) | 4.0 ± 0.10 (0.157 \pm 0.004) | 2.0 ± 0.05 (0.079 \pm 0.002) | 25.0 (0.984) | 0.600 (0.024) | 0.600 (0.024) | 0.100 (0.004) |
| 12 mm | | 1.5 (0.059) | | | | 30 (1.181) | | | |
| 16 mm | | | | | | | | | |
| Variable Dimensions — Millimeters (Inches) | | | | | | | | | |
| Tape Size | Pitch | B_1 Maximum Note 4 | E_2 Minimum | F | P_1 | T_2 Maximum | W Maximum | A_0, B_0 & K_0 | |
| 8 mm | Single (4 mm) | 4.35 (0.171) | 6.25 (0.246) | 3.5 ± 0.05 (0.138 \pm 0.002) | 4.0 ± 0.10 (0.157 \pm 0.004) | 2.5 (0.098) | 8.3 (0.327) | Note 5 | |
| 12 mm | Single (4 mm) & Double (8 mm) | 8.2 (0.323) | 10.25 (0.404) | 5.5 ± 0.05 (0.217 \pm 0.002) | 8.0 ± 0.10 (0.315 \pm 0.004) | 4.6 (0.181) | 12.3 (0.484) | | |
| 16 mm | Triple (12 mm) | 12.1 (0.476) | 14.25 (0.561) | 5.5 ± 0.05 (0.217 \pm 0.002) | 8.0 ± 0.10 (0.315 \pm 0.004) | 4.6 (0.181) | 16.3 (0.642) | | |

- The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
- The tape with or without components shall pass around R without damage (see Figure 5).
- If $S_1 < 1.0$ mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481 paragraph 4.3 section b).
- B_1 dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by A_0 , B_0 and K_0 shall surround the component with sufficient clearance that:
 - the component does not protrude above the top surface of the carrier tape.
 - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
 - lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).
 - for KPS Series product, A_0 and B_0 are measured on a plane 0.3 mm above the bottom of the pocket.
 - see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.

Figure 2 – Punched (Paper) Carrier Tape Dimensions

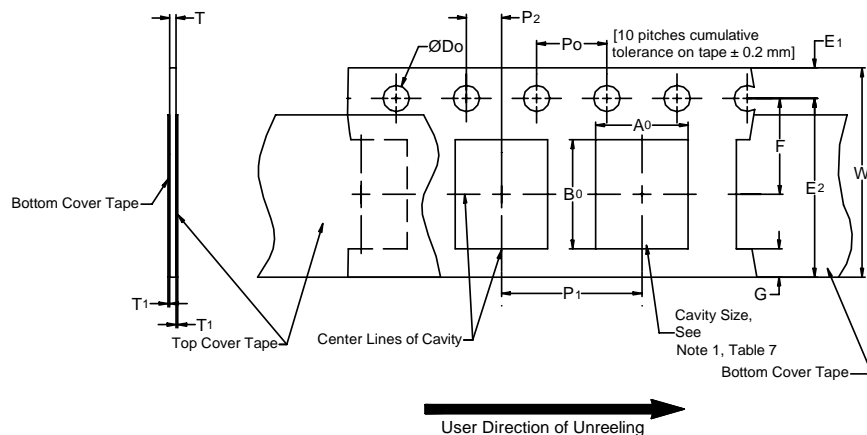


Table 7 – Punched (Paper) Carrier Tape Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | | | | |
|--|---|-----------------------------------|----------------------------------|----------------------------------|-------------------------|-----------------|---------------|
| Tape Size | D_0 | E_1 | P_0 | P_2 | T_1 Max | G Minimum | R Ref. Note 2 |
| 8 mm | $1.5 +0.10 -0.0$ (0.059 +0.004 -0.0) | 1.75 ± 0.10 (0.069 ±0.004) | 4.0 ± 0.10 (0.157 ±0.004) | 2.0 ± 0.05 (0.079 ±0.002) | 0.10 (0.004) Maximum | 0.75 (0.030) | 25 (0.984) |
| Variable Dimensions — Millimeters (Inches) | | | | | | | |
| Tape Size | Pitch | E2 Minimum | F | P_1 | T Maximum | W Maximum | $A_0 B_0$ |
| 8 mm | Half (2 mm) | 6.25 (0.246) | 3.5 ± 0.05 (0.138 ±0.002) | 2.0 ± 0.05 (0.079 ±0.002) | 1.1 (0.098) | 8.3 (0.327) | Note 1 |
| 8 mm | Single (4 mm) | | | 4.0 ± 0.10 (0.157 ±0.004) | | | |

- The cavity defined by A_0 , B_0 and T shall surround the component with sufficient clearance that:
 - the component does not protrude beyond either surface of the carrier tape.
 - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).
 - see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.
- The tape with or without components shall pass around R without damage (see Figure 5).

Packaging Information Performance Notes

- 1. Cover Tape Break Force:** 1.0 Kg minimum.
- 2. Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

| Tape Width | Peel Strength |
|--------------|----------------------------------|
| 8 mm | 0.1 to 1.0 Newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 Newton (10 to 130 gf) |

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 3. Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. Refer to EIA Standards 556 and 624.

Figure 2 – Maximum Component Rotation

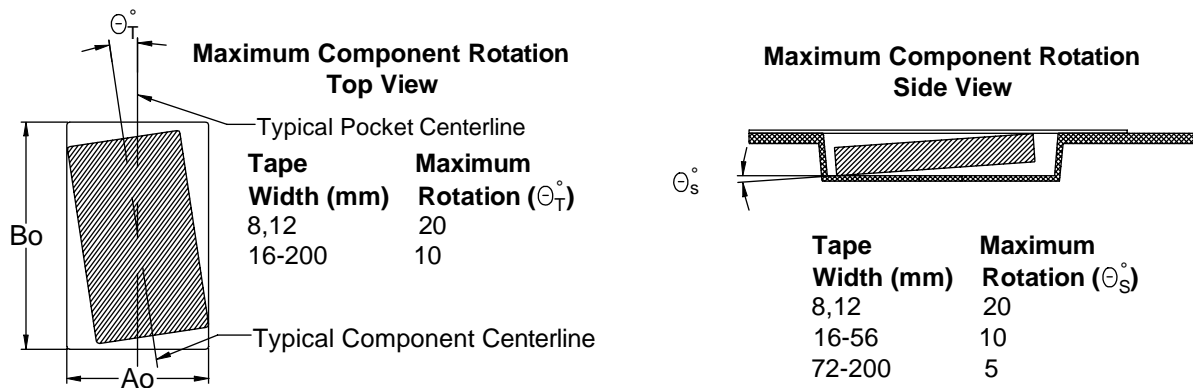


Figure 3 – Maximum Lateral Movement

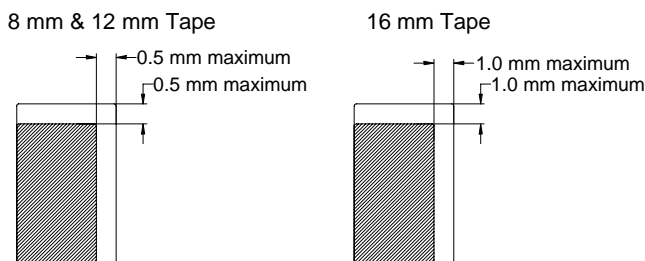


Figure 4 – Bending Radius

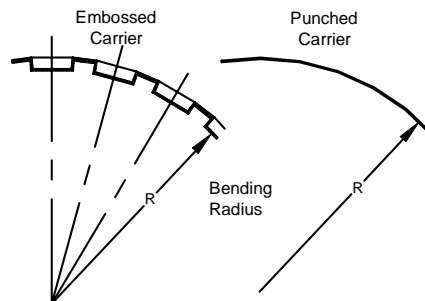
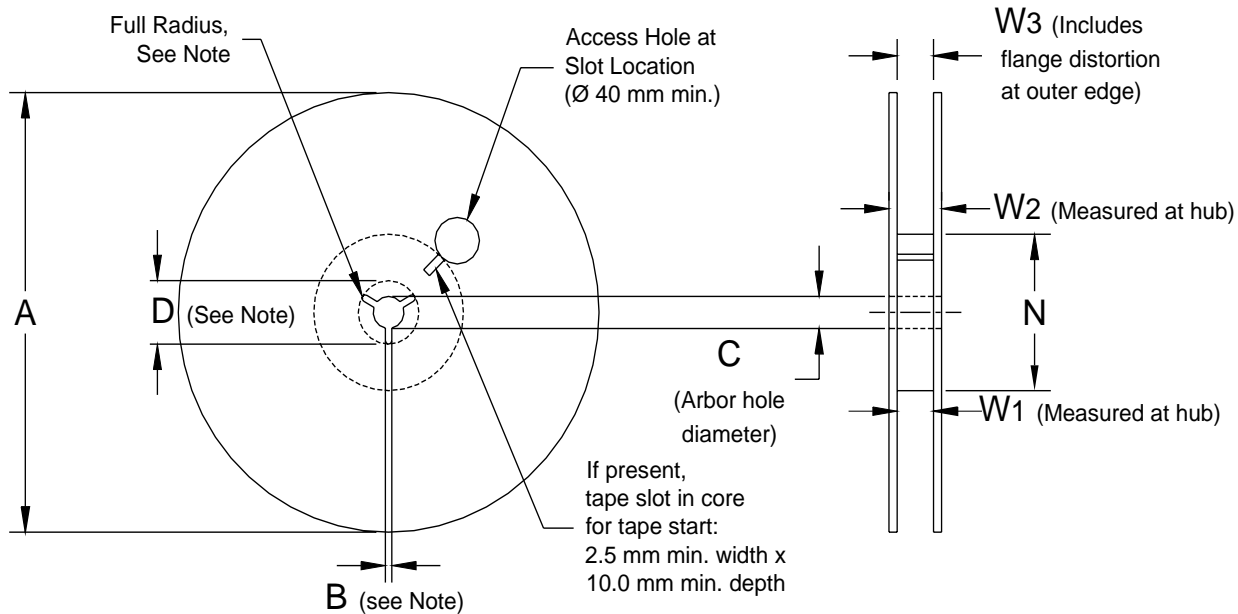


Figure 6 – Reel Dimensions



Note: Drive spokes optional; if used, dimensions B and D shall apply.

Table 8 – Reel Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | |
|--|---|---------------------------------------|--|---|
| Tape Size | A | B Minimum | C | D Minimum |
| 8 mm | 178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008) | 1.5 (0.059) | 13.0 +0.5/-0.2 (0.521 +0.02/-0.008) | 20.2 (0.795) |
| 12 mm | | | | |
| 16 mm | | | | |
| Variable Dimensions — Millimeters (Inches) | | | | |
| Tape Size | N Minimum | W ₁ | W ₂ Maximum | W ₃ |
| 8 mm | 50 (1.969) | 8.4 +1.5/-0.0 (0.331 +0.059/-0.0) | 14.4 (0.567) | Shall accommodate tape width without interference |
| 12 mm | | 12.4 +2.0/-0.0 (0.488 +0.078/-0.0) | 18.4 (0.724) | |
| 16 mm | | 16.4 +2.0/-0.0 (0.646 +0.078/-0.0) | 22.4 (0.882) | |

Figure 7 – Tape Leader & Trailer Dimensions

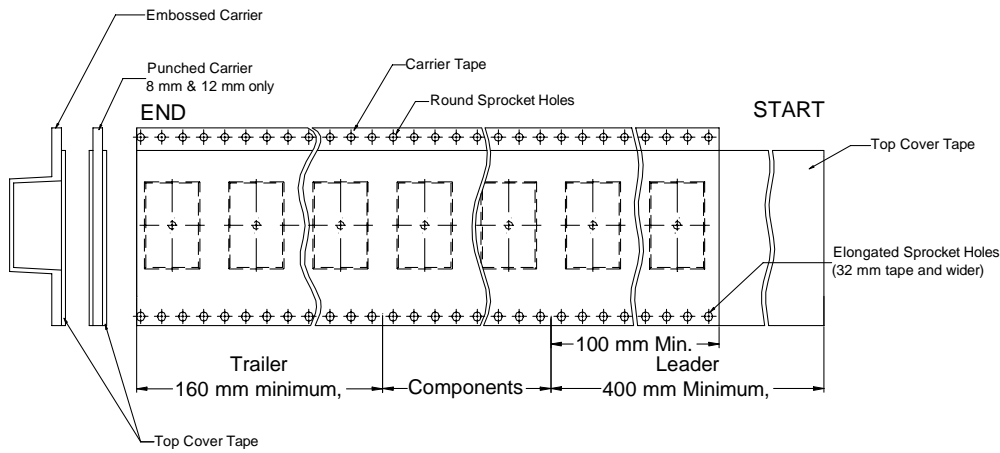


Figure 8 – Maximum Camber

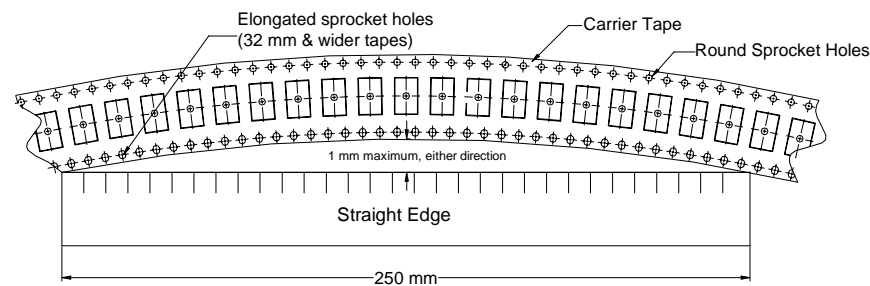


Figure 9 – Bulk Cassette Packaging (Ceramic Chips Only)

Meets Dimensional Requirements IEC-286 and EIAJ 7201

Unit mm *Reference

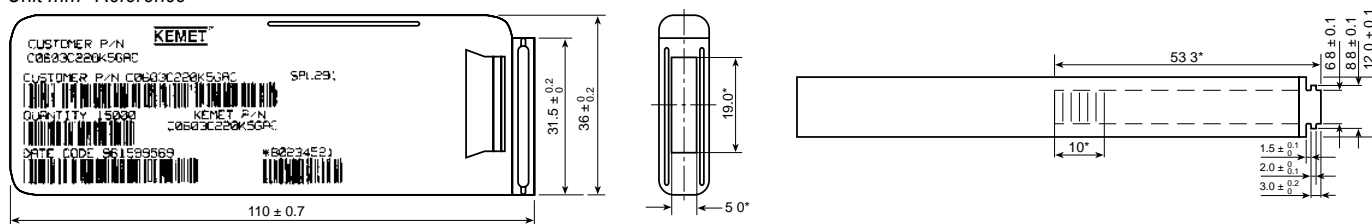


Table 9 – Capacitor Dimensions for Bulk Cassette

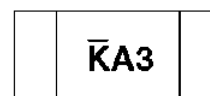
Cassette Packaging – Millimeters

| EIA Size Code | Metric Size Code | L Length | W Width | B Bandwidth | S Separation minimum | T Thickness | Number of Pcs/Cassette |
|---------------|------------------|------------|------------|-------------|----------------------|-------------|------------------------|
| 0402 | 1005 | 1.0 ± 0.05 | 0.5 ± 0.05 | 0.2 to 0.4 | 0.3 | 0.5 ± .05 | 50,000 |
| 0603 | 1608 | 1.6 ± 0.07 | 0.8 ± 0.07 | 0.2 to 0.5 | 0.7 | 0.8 ± .07 | 15,000 |

Table 10 – Capacitor Marking

Laser marking is available as an extra-cost option for most KEMET ceramic chips. Such marking is two sided, and includes a K to identify KEMET, followed by two characters (per EIA-198) to identify the capacitance value. Note that marking is not available for any Y5V chip. In addition, the 0603 marking option is limited to the K only. (Marking Optional – Not Available for 0402 Size)

| Numeral Alpha Character | Capacitance (pF) For Various Numeral Identifiers | | | | | | | | | |
|-------------------------|--|-----|----|-----|------|-------|--------|---------|----------|--|
| | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| A | 0.1 | 1 | 10 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | |
| B | 0.11 | 1.1 | 11 | 110 | 1100 | 11000 | 110000 | 1100000 | 11000000 | |
| C | 0.12 | 1.2 | 12 | 120 | 1200 | 12000 | 120000 | 1200000 | 12000000 | |
| D | 0.13 | 1.3 | 13 | 130 | 1300 | 13000 | 130000 | 1300000 | 13000000 | |
| E | 0.15 | 1.5 | 15 | 150 | 1500 | 15000 | 150000 | 1500000 | 15000000 | |
| F | 0.16 | 1.6 | 16 | 160 | 1600 | 16000 | 160000 | 1600000 | 16000000 | |
| G | 0.18 | 1.8 | 18 | 180 | 1800 | 18000 | 180000 | 1800000 | 18000000 | |
| H | 0.2 | 2 | 20 | 200 | 2000 | 20000 | 200000 | 2000000 | 20000000 | |
| J | 0.22 | 2.2 | 22 | 220 | 2200 | 22000 | 220000 | 2200000 | 22000000 | |
| K | 0.24 | 2.4 | 24 | 240 | 2400 | 24000 | 240000 | 2400000 | 24000000 | |
| L | 0.27 | 2.7 | 27 | 270 | 2700 | 27000 | 270000 | 2700000 | 27000000 | |
| M | 0.3 | 3 | 30 | 300 | 3000 | 30000 | 300000 | 3000000 | 30000000 | |
| N | 0.33 | 3.3 | 33 | 330 | 3300 | 33000 | 330000 | 3300000 | 33000000 | |
| P | 0.36 | 3.6 | 36 | 360 | 3600 | 36000 | 360000 | 3600000 | 36000000 | |
| Q | 0.39 | 3.9 | 39 | 390 | 3900 | 39000 | 390000 | 3900000 | 39000000 | |
| R | 0.43 | 4.3 | 43 | 430 | 4300 | 43000 | 430000 | 4300000 | 43000000 | |
| S | 0.47 | 4.7 | 47 | 470 | 4700 | 47000 | 470000 | 4700000 | 47000000 | |
| T | 0.51 | 5.1 | 51 | 510 | 5100 | 51000 | 510000 | 5100000 | 51000000 | |
| U | 0.56 | 5.6 | 56 | 560 | 5600 | 56000 | 560000 | 5600000 | 56000000 | |
| V | 0.62 | 6.2 | 62 | 620 | 6200 | 62000 | 620000 | 6200000 | 62000000 | |
| W | 0.68 | 6.8 | 68 | 680 | 6800 | 68000 | 680000 | 6800000 | 68000000 | |
| X | 0.75 | 7.5 | 75 | 750 | 7500 | 75000 | 750000 | 7500000 | 75000000 | |
| Y | 0.82 | 8.2 | 82 | 820 | 8200 | 82000 | 820000 | 8200000 | 82000000 | |
| Z | 0.91 | 9.1 | 91 | 910 | 9100 | 91000 | 910000 | 9100000 | 91000000 | |
| a | 0.25 | 2.5 | 25 | 250 | 2500 | 25000 | 250000 | 2500000 | 25000000 | |
| b | 0.35 | 3.5 | 35 | 350 | 3500 | 35000 | 350000 | 3500000 | 35000000 | |
| d | 0.4 | 4 | 40 | 400 | 4000 | 40000 | 400000 | 4000000 | 40000000 | |
| e | 0.45 | 4.5 | 45 | 450 | 4500 | 45000 | 450000 | 4500000 | 45000000 | |
| f | 0.5 | 5 | 50 | 500 | 5000 | 50000 | 500000 | 5000000 | 50000000 | |
| m | 0.6 | 6 | 60 | 600 | 6000 | 60000 | 600000 | 6000000 | 60000000 | |
| n | 0.7 | 7 | 70 | 700 | 7000 | 70000 | 700000 | 7000000 | 70000000 | |
| t | 0.8 | 8 | 80 | 800 | 8000 | 80000 | 800000 | 8000000 | 80000000 | |
| y | 0.9 | 9 | 90 | 900 | 9000 | 90000 | 900000 | 9000000 | 90000000 | |



Example shown is 1,000 pF capacitor

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Taipei, Taiwan
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Southeast Asia

Singapore
Tel: 65-6586-1900

Penang, Malaysia
Tel: 60-4-6430200

Bangalore, India
Tel: 91-806-53-76817

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Other KEMET Resources

| Tools | |
|--------------------------------|---|
| Resource | Location |
| Configure A Part: CapEdge | http://capacitoredge.kemet.com |
| SPICE & FIT Software | http://www.kemet.com/spice |
| Search Our FAQs: KnowledgeEdge | http://www.kemet.com/keask |

| Product Information | |
|--|---|
| Resource | Location |
| Products | http://www.kemet.com/products |
| Technical Resources (Including Soldering Techniques) | http://www.kemet.com/technicalpapers |
| RoHS Statement | http://www.kemet.com/rohs |
| Quality Documents | http://www.kemet.com/qualitydocuments |

| Product Request | |
|-------------------------|---|
| Resource | Location |
| Sample Request | http://www.kemet.com/sample |
| Engineering Kit Request | http://www.kemet.com/kits |

| Contact | |
|--------------------|---|
| Resource | Location |
| Website | www.kemet.com |
| Contact Us | http://www.kemet.com/contact |
| Investor Relations | http://www.kemet.com/ir |
| Call Us | 1-877-MyKEMET |
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