

Overview

KEMET's Automotive Grade Series surface mount capacitors in X5R dielectric are suited for a variety of applications requiring reliable operation. Whether under-hood or in-cabin, these devices emphasize the vital and robust nature of capacitors required for mission and safety critical automotive circuits. Stricter testing protocol and inspection criteria have been established for automotive grade products in recognition of potentially harsh environmental conditions. KEMET automotive grade series capacitors meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements and are manufactured in state of the art ISO/TS 16949:2002 certified facilities.

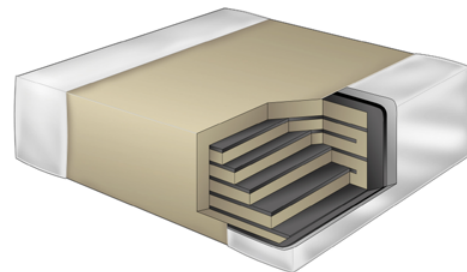
KEMET's X5R dielectric features an 85°C maximum operating temperature and is considered "semi-stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes X5R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited 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 $\pm 15\%$ from -55°C to +85°C.

Benefits

- AEC-Q200 automotive qualified
- -55°C to +85°C operating temperature range
- Pb-Free and RoHS compliant
- Temperature stable dielectric
- EIA 0402, 0603, 0805, 1206, and 1210 case sizes
- DC voltage ratings of 4V, 6.3V, 10V, 16V, 25V, 35V and 50V
- Capacitance offerings ranging from .012 μ F to 22 μ F
- Available capacitance tolerances of $\pm 10\%$ and $\pm 20\%$
- 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.



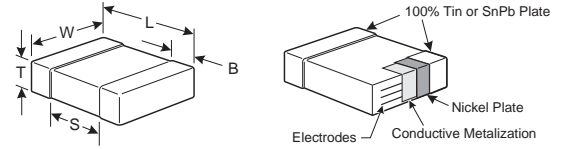
Ordering Information

| C | 1206 | C | 475 | K | 3 | P | A | C | AUTO |
|---------|--------------------------------------|-----------------------|------------------------------------|----------------------------------|---|------------|----------------------|---------------------------------|--|
| 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) ³ |
| | 0402 0603 0805 1206 1210 | C = Standard | 2 Sig. Digits + Number of Zeros | K = $\pm 10\%$ M = $\pm 20\%$ | 7 = 4V 9 = 6.3V 8 = 10V 4 = 16V 3 = 25V | P = X5R | A = N/A | C = 100% Matte Sn | AUTO = Automotive Grade 7" Reel Unmarked |

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 Min. | Mounting Technique |
|---------------|------------------|---------------------------|---------------------------|---------------------------|---------------------------|-------------------|------------------------------|
| 0402 | 1005 | 1.00 (.040) ± 0.05 (.002) | 0.50 (.020) ± 0.05 (.002) | See Table 2 for Thickness | 0.30 (.012) ± 0.10 (.004) | 0.30 (.012) | Solder Reflow Only |
| 0603 | 1608 | 1.60 (.063) ± 0.15 (.006) | 0.80 (.032) ± 0.15 (.006) | | 0.35 (.014) ± 0.15 (.006) | 0.70 (.028) | Solder Wave or Solder Reflow |
| 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) | | |

Qualification/Certification

Automotive grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC-Q200, please visit their website @www.aecouncil.com.

Environmental Compliance

Pb-Free and 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 (Max % Cap Loss/Decade Hour) | 4.0% |
| Dielectric Withstanding Voltage | 250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA) |
| 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 secs @ 25°C) |

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1000 Hours.

To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

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

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

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & 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 | DF (%) | Cap Shift | IR |
| X5R | >25 | All | 3.0 | ± 20% | 10% of Initial Limit |
| | 25 | | 7.5 | | |
| | <25 | < 0.56 μ F | 7.5 | | |
| | <25 | ≥ 0.56 μ F | 12.0 | | |

Dissipation Factor Limit Table

| Rated Voltage | Capacitance | Dissipation Factor (Limit) |
|---------------|----------------|----------------------------|
| 50V - 200V | All | 3% |
| 25V | All | 5% |
| <25V | < 0.56 μ F | 5% |
| <25V | ≥ 0.56 μ F | 10% |

Insulation Resistance Limit Table

| EIA Case Size | 1000 megohm microfarads or 100G Ω | 500 megohm microfarads or 10G Ω |
|---------------|---|---|
| 0201 | N/A | ALL |
| 0402 | < .012 μ F | ≥ .012 μ F |
| 0603 | < .047 μ F | ≥ .047 μ F |
| 0805 | < .047 μ F | ≥ .047 μ F |
| 1206 | < 0.22 μ F | ≥ 0.22 μ F |
| 1210 | < 0.39 μ F | ≥ 0.39 μ F |
| 1808 | ALL | N/A |
| 1812 | < 2.2 μ F | ≥ 2.2 μ F |
| 1825 | ALL | N/A |
| 2220 | < 10 μ F | ≥ 10 μ F |
| 2225 | ALL | N/A |

Table 1 – (0201 - 1206 Case Sizes)

| Cap | Cap Code | Series | | C0402 | | | | | C0603 | | | | | C0805 | | | | | C1206 | | | | | C1210 | | | | | | | | |
|-----------|----------|---------------|---|---|-----|----|----|----|-------|----|-----|----|----|-------|----|----|-----|----|-------|----|----|-----|----|-------|----|----|-----|----|----|----|----|----|
| | | Voltage Code | | 7 | 9 | 8 | 4 | 3 | 5 | 7 | 9 | 8 | 4 | 3 | 5 | 7 | 9 | 8 | 4 | 3 | 5 | 9 | 8 | 4 | 3 | 1 | 9 | 8 | 4 | 3 | 6 | 5 |
| | | Voltage DC | | 4 | 6.3 | 10 | 16 | 25 | 50 | 4 | 6.3 | 10 | 16 | 25 | 50 | 4 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 35 | 50 |
| | | Cap Tolerance | | Product Availability and Chip Thickness Codes - See Table 2 for Chip Thickness Dimensions | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10,000 pF | 103 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12,000 pF | 123 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15,000 pF | 153 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18,000 pF | 183 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22,000 pF | 223 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 27,000 pF | 273 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33,000 pF | 333 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 39,000 pF | 393 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47,000 pF | 473 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 56,000 pF | 563 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 68,000 pF | 683 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 82,000 pF | 823 | K | M | BB | BB | BB | UD | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.10 µF | 104 | K | M | BB | BB | BB | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.12 µF | 124 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.15 µF | 154 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.18 µF | 184 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.22 µF | 224 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.27 µF | 274 | K | M | | | | | | CC | CC | CC | CC | | | | | | | | | | EB | EB | EB | EB | | | | | | | |
| 0.33 µF | 334 | K | M | | | | | | CC | CC | CC | CC | | | | | | | | | | EB | EB | EB | EB | | | | | | | |
| 0.39 µF | 394 | K | M | | | | | | CC | CC | CC | CC | | | | | | | | | | EB | EB | EB | EB | | | | | | | |
| 0.47 µF | 474 | K | M | | | | | | CC | CC | CC | CC | | | DC | DC | DC | DC | DC | | | EC | EC | EC | EC | | FD | FD | FD | FD | FD | |
| 0.56 µF | 564 | K | M | | | | | | CC | CC | CC | CC | | | DD | DD | DD | DD | DD | | | ED | ED | ED | ED | | FD | FD | FD | FD | FD | |
| 0.68 µF | 684 | K | M | | | | | | CC | CC | CC | CC | | | DE | DE | DE | DE | DE | | | EE | EE | EE | EE | | FD | FD | FD | FD | FD | |
| 0.82 µF | 824 | K | M | | | | | | CC | CC | CC | CC | | | DF | DF | DF | DF | DF | | | EF | EF | EF | EF | | FF | FF | FF | FF | FF | |
| 1.0 µF | 105 | K | M | | | | | | CC | CC | CC | CC | | | DG | DG | DG | DG | DG | | | EE | EE | EE | EH | | FH | FH | FH | FH | FH | |
| 1.2 µF | 125 | K | M | | | | | | | | | | | | DC | DC | DC | DC | | | | EC | EC | EC | EC | | FD | FD | FD | FD | FG | |
| 1.5 µF | 155 | K | M | | | | | | | | | | | | DC | DC | DC | DC | | | | EC | EC | EC | EC | | FD | FD | FD | FD | FG | |
| 1.8 µF | 185 | K | M | | | | | | | | | | | | DD | DD | DD | DD | | | | EC | EC | EC | EC | | FD | FD | FD | FD | FG | |
| 2.2 µF | 225 | K | M | | | | | | | | | | | | DD | DD | DD | DD | | | | EE | EE | EE | EE | | FG | FG | FG | FG | FG | |
| 2.7 µF | 275 | K | M | | | | | | | | | | | | DL | DL | DL | DL | | | | EF | EF | EF | EF | | FG | FG | FG | FG | FH | |
| 3.3 µF | 335 | K | M | | | | | | | | | | | | DE | DE | DE | DH | | | | EH | EH | EH | EH | | FH | FH | FH | FH | FM | |
| 3.9 µF | 395 | K | M | | | | | | | | | | | | DH | DH | DH | DH | | | | EH | EH | EH | EH | | FJ | FJ | FJ | FJ | FK | |
| 4.7 µF | 475 | K | M | | | | | | | | | | | | DH | DH | DH | DG | | | | EH | EH | EH | EH | | FK | FK | FK | FK | FS | |
| 5.6 µF | 565 | K | M | | | | | | | | | | | | DH | DH | DH | | | | | EK | EK | EH | | | FG | FG | FG | FE | | |
| 6.8 µF | 685 | K | M | | | | | | | | | | | | DH | DH | DH | | | | | EK | EK | EH | | | FJ | FJ | FJ | FJ | | |
| 8.2 µF | 825 | K | M | | | | | | | | | | | | | | | | | | | ED | ED | EH | | | FK | FK | FK | FG | | |
| 10 µF | 106 | K | M | | | | | | | | | | | | | | | | | | | EH | EH | EH | | | FK | FK | FK | FH | | |
| 12 µF | 126 | K | M | | | | | | | | | | | | | | | | | | | EK | EK | EG | | | FD | FD | FG | | | |
| 15 µF | 156 | K | M | | | | | | | | | | | | | | | | | | | EK | EK | EH | | | FF | FF | FG | | | |
| 18 µF | 186 | K | M | | | | | | | | | | | | | | | | | | | ED | ED | EH | | | FG | FG | FH | | | |
| 22 µF | 226 | K | M | | | | | | | | | | | | | | | | | | | | | | | | FH | FH | FJ | | | |
| 27 µF | 276 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33 µF | 336 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 39 µF | 396 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47 µF | 476 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100 µF | 107 | K | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cap | Cap Code | Voltage DC | | 4 | 6.3 | 10 | 16 | 25 | 50 | 4 | 6.3 | 10 | 16 | 25 | 50 | 4 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 35 | 50 |
| | | Voltage Code | | 7 | 9 | 8 | 4 | 3 | 5 | 7 | 9 | 8 | 4 | 3 | 5 | 7 | 9 | 8 | 4 | 3 | 5 | 9 | 8 | 4 | 3 | 1 | 9 | 8 | 4 | 3 | 6 | 5 |
| | | Series | | C0402 | | | | | C0603 | | | | | C0805 | | | | | C1206 | | | | | C1210 | | | | | | | | |

UD = Under Development

Table 2 – Chip Thickness/Packaging Quantities

| Thickness Code | Chip Size | Thickness ± Range (mm) | QTY per Reel 7" Plastic | QTY per Reel 13" Plastic | QTY per Reel 7" Paper | QTY per Reel 13" Paper | QTY per Bulk Cassette |
|----------------|-----------|------------------------|-------------------------|--------------------------|-----------------------|------------------------|-----------------------|
| AA | 1005 | 0.20 ± 0.02 | | | 15000 | | |
| AB | 0201 | 0.30 ± 0.03 | | | 15000 | | |
| BB | 0402 | 0.50 ± 0.05 | | | 10000 | 50000 | 50000 |
| BC | 0402 | 0.50 ± 0.10 | | | 10000 | 50000 | 50000 |
| PA | 0508 | 0.80 ± 0.10 | 4000 | 10000 | | | |
| CB | 0603 | 0.80 ± 0.07 | | | 4000 | 10000 | 15000 |
| CC | 0603 | 0.80 ± 0.10 | | | 4000 | 10000 | 15000 |
| CD | 0603 | 0.80 ± 0.15 | | | 4000 | 10000 | 15000 |
| MA | 0612 | 0.80 ± 0.10 | 4000 | 10000 | | | |
| DB | 0805 | 0.60 ± 0.10 | | | 4000 | 10000 | 15000 |
| DC | 0805 | 0.78 ± 0.10 | | | 4000 | 10000 | 15000 |
| DD | 0805 | 0.90 ± 0.10 | | | 4000 | 10000 | 15000 |
| DL | 0805 | 0.95 ± 0.10 | 4000 | 10000 | | | |
| DE | 0805 | 1.00 ± 0.10 | 2500 | 10000 | | | |
| DF | 0805 | 1.10 ± 0.10 | 2500 | 10000 | | | |
| DG | 0805 | 1.25 ± 0.15 | 2500 | 10000 | | | |
| DH | 0805 | 1.25 ± 0.20 | 2500 | 10000 | | | |
| EB | 1206 | 0.78 ± 0.10 | 4000 | 10000 | 4000 | 10000 | |
| EK | 1206 | 0.80 ± 0.10 | 2000 | 8000 | | | |
| EC | 1206 | 0.90 ± 0.10 | 4000 | 10000 | | | |
| EN | 1206 | 0.95 ± 0.10 | 4000 | 10000 | | | |
| ED | 1206 | 1.00 ± 0.10 | 2500 | 10000 | | | |
| EE | 1206 | 1.10 ± 0.10 | 2500 | 10000 | | | |
| EF | 1206 | 1.20 ± 0.15 | 2500 | 10000 | | | |
| EM | 1206 | 1.25 ± 0.15 | 2500 | 10000 | | | |
| EG | 1206 | 1.60 ± 0.15 | 2000 | 8000 | | | |
| EH | 1206 | 1.60 ± 0.20 | 2000 | 8000 | | | |
| EJ | 1206 | 1.70 ± 0.20 | 2000 | 8000 | | | |
| FB | 1210 | 0.78 ± 0.10 | 4000 | 10000 | | | |
| FC | 1210 | 0.90 ± 0.10 | 4000 | 10000 | | | |
| FD | 1210 | 0.95 ± 0.10 | 4000 | 10000 | | | |
| FE | 1210 | 1.00 ± 0.10 | 2500 | 10000 | | | |
| FF | 1210 | 1.10 ± 0.10 | 2500 | 10000 | | | |
| FG | 1210 | 1.25 ± 0.15 | 2500 | 10000 | | | |
| FL | 1210 | 1.40 ± 0.15 | 2000 | 8000 | | | |
| FO | 1210 | 1.50 ± 0.20 | 2000 | 8000 | | | |
| FH | 1210 | 1.55 ± 0.15 | 2000 | 8000 | | | |
| FP | 1210 | 1.60 ± 0.20 | 2000 | 8000 | | | |
| FM | 1210 | 1.70 ± 0.20 | 2000 | 8000 | | | |
| FJ | 1210 | 1.85 ± 0.20 | 2000 | 8000 | | | |
| FN | 1210 | 1.85 ± 0.20 | 2000 | 8000 | | | |
| FT | 1210 | 1.90 ± 0.20 | 1500 | 4000 | | | |
| FK | 1210 | 2.10 ± 0.20 | 2000 | 8000 | | | |
| FR | 1210 | 2.25 ± 0.20 | 2000 | 8000 | | | |
| FS | 1210 | 2.50 ± 0.20 | 1000 | 4000 | | | |
| FV | 1210 | 3.35 ± 0.10 | 500 | 1800 | | | |
| FW | 1210 | 6.15 ± 0.15 | 200 | 1000 | | | |
| PA | 1220 | 0.80 ± 0.10 | 4000 | 10000 | | | |
| MA | 1632 | 0.80 ± 0.10 | 4000 | 10000 | | | |
| NA | 1706 | 0.90 ± 0.10 | 4000 | 10000 | | | |
| NB | 1706 | 1.00 ± 0.10 | 4000 | 10000 | | | |
| NC | 1706 | 1.00 ± 0.15 | 4000 | 10000 | | | |
| LD | 1808 | 0.90 ± 0.10 | 2500 | 10000 | | | |
| LE | 1808 | 1.00 ± 0.10 | 2500 | 10000 | | | |
| LF | 1808 | 1.00 ± 0.15 | 2500 | 10000 | | | |
| LA | 1808 | 1.40 ± 0.15 | 1000 | 4000 | | | |
| LB | 1808 | 1.60 ± 0.15 | 1000 | 4000 | | | |
| LC | 1808 | 2.00 ± 0.15 | 1000 | 4000 | | | |
| GB | 1812 | 1.00 ± 0.10 | 1000 | 4000 | | | |
| GC | 1812 | 1.10 ± 0.10 | 1000 | 4000 | | | |
| GD | 1812 | 1.25 ± 0.15 | 1000 | 4000 | | | |
| GE | 1812 | 1.30 ± 0.10 | 1000 | 4000 | | | |
| GH | 1812 | 1.40 ± 0.15 | 1000 | 4000 | | | |
| GF | 1812 | 1.50 ± 0.10 | 1000 | 4000 | | | |
| GG | 1812 | 1.55 ± 0.10 | 1000 | 4000 | | | |
| GK | 1812 | 1.60 ± 0.20 | 1000 | 4000 | | | |
| GJ | 1812 | 1.70 ± 0.15 | 1000 | 4000 | | | |
| GN | 1812 | 1.70 ± 0.20 | 1000 | 4000 | | | |
| GL | 1812 | 1.90 ± 0.20 | 1000 | 4000 | | | |
| GM | 1812 | 2.00 ± 0.20 | 1000 | 4000 | | | |
| GO | 1812 | 2.50 ± 0.20 | 500 | 2000 | | | |
| GP | 1812 | 2.65 ± 0.35 | 500 | 1400 | | | |
| GR | 1812 | 5.00 ± 0.50 | 350 | 1000 | | | |
| HB | 1825 | 1.10 ± 0.15 | 1000 | 4000 | | | |
| HC | 1825 | 1.15 ± 0.15 | 1000 | 4000 | | | |
| HD | 1825 | 1.30 ± 0.15 | 1000 | 4000 | | | |
| HE | 1825 | 1.40 ± 0.15 | 1000 | 4000 | | | |
| HF | 1825 | 1.50 ± 0.15 | 1000 | 4000 | | | |
| Thickness Code | Chip Size | Thickness ± Range (mm) | QTY per Reel 7" Plastic | QTY per Reel 13" Plastic | QTY per Reel 7" Paper | QTY per Reel 13" Paper | QTY per Bulk Cassette |

Package Quantity
 Based on Finished Chip
 Thickness Specifications

Table 2 – Chip Thickness/Packaging Quantities con't

| Thickness Code | Chip Size | Thickness ± Range (mm) | QTY per Reel 7" Plastic | QTY per Reel 13" Plastic | QTY per Reel 7" Paper | QTY per Reel 13" Paper | QTY per Bulk Cassette |
|----------------|-----------|------------------------|-------------------------|--------------------------|-----------------------|------------------------|-----------------------|
| HG | 1825 | 1.60 ± 0.20 | 1000 | 4000 | | | |
| JB | 2220 | 1.00 ± 0.15 | 1000 | 4000 | | | |
| JC | 2220 | 1.10 ± 0.15 | 1000 | 4000 | | | |
| JD | 2220 | 1.30 ± 0.15 | 1000 | 4000 | | | |
| JE | 2220 | 1.40 ± 0.15 | 1000 | 4000 | | | |
| JF | 2220 | 1.50 ± 0.15 | 1000 | 4000 | | | |
| JP | 2220 | 1.60 ± 0.20 | 1000 | 4000 | | | |
| JG | 2220 | 1.70 ± 0.15 | 1000 | 4000 | | | |
| JH | 2220 | 1.80 ± 0.15 | 1000 | 4000 | | | |
| JO | 2220 | 2.40 ± 0.15 | 500 | 2000 | | | |
| JP | 2220 | 3.50 ± 0.30 | 250 | 850 | | | |
| JR | 2220 | 5.00 ± 0.50 | 150 | 600 | | | |
| KB | 2225 | 1.00 ± 0.15 | 1000 | 4000 | | | |
| KC | 2225 | 1.10 ± 0.15 | 1000 | 4000 | | | |
| KD | 2225 | 1.30 ± 0.15 | 1000 | 4000 | | | |
| KE | 2225 | 1.40 ± 0.15 | 1000 | 4000 | | | |
| KF | 2225 | 1.60 ± 0.20 | 1000 | 4000 | | | |
| Thickness Code | Chip Size | Thickness ± Range (mm) | QTY per Reel 7" Plastic | QTY per Reel 13" Plastic | QTY per Reel 7" Paper | QTY per Reel 13" Paper | QTY per Bulk Cassette |

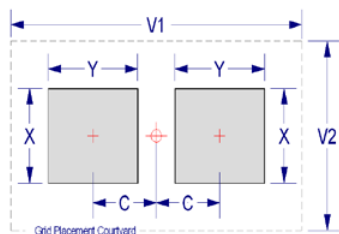
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

| 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 1.8kg for 60 seconds. |
| Board Flex | JIS-C-6429 | Appendix 2, Note: 2mm (min) for all except 3mm 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 | 1000 cycles (-55°C to +125°C), Measurement at 24 hours. +/- 2 hours after test conclusion. |
| Biased Humidity | MIL-STD-202 Method 103 | Load Humidity: 1000 hours 85°C/85%RH and Rated Voltage. Add 100K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion. |
| | | Low Volt Humidity: 1000 hours 85°C/85%RH and 1.5V. Add 100K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion. |
| Moisture Resistance | MIL-STD-202 Method 106 | t = 24 hours/cycle. Steps 7a & 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 | 1000 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, 0VDC, for 1000 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. In addition, 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.

Tape & Reel Packaging Information

KEMET offers Multilayer Ceramic Chip Capacitors packaged in 8mm, 12mm and 16mm 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.

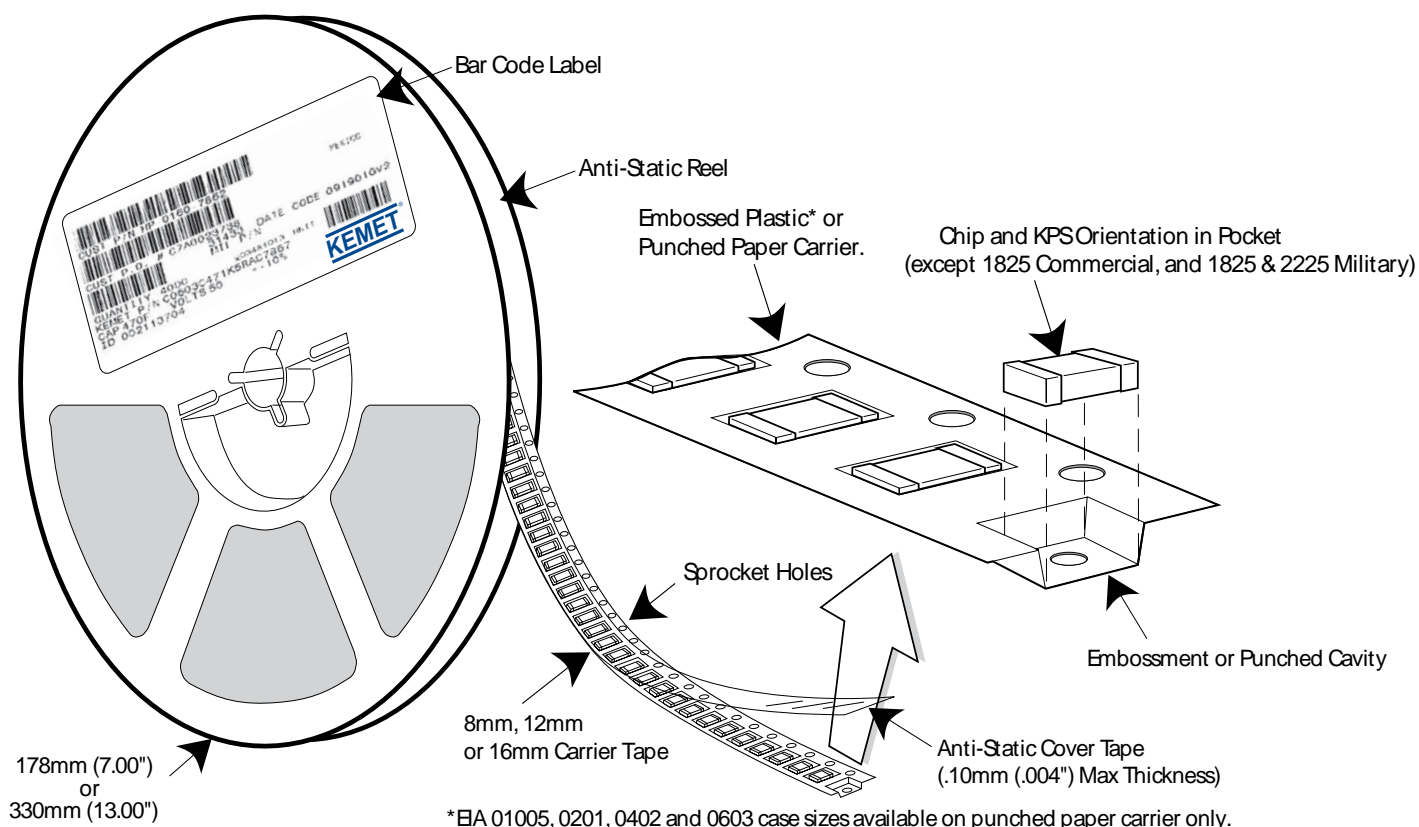


Table 5 – Carrier Tape Configuration (mm)

| EIA Case Size | Tape size (W)* | Pitch (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

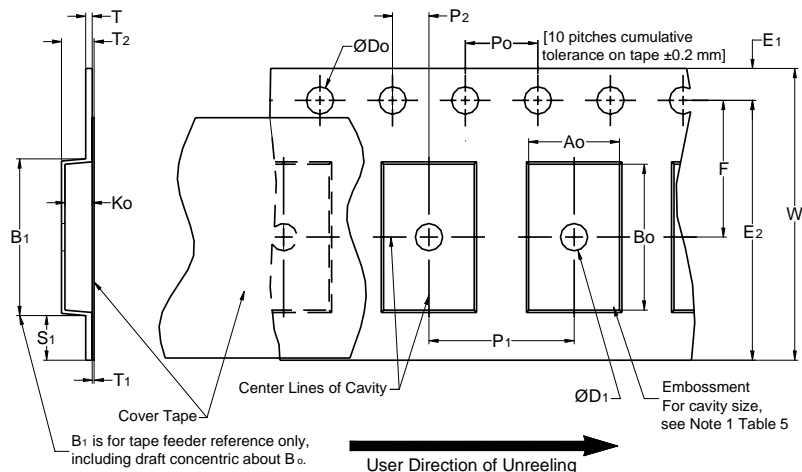


Table 6 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | | | | | | |
|--|---------------------------------------|-------------------------------|--------------------------------|-------------------------------|-------------------------------|--------------------|-------------------------------|--|---------------------|
| Tape Size | D ₀ | D ₁ Min. Note 1 | E ₁ | P ₀ | P ₂ | R Ref. Note 2 | S ₁ Min. Note 3 | T Max. | T ₁ Max. |
| 8mm | 1.5 +0.10/-0.0 (0.059 +0.004/-0.0) | 1.0 (0.039) | 1.75 ± 0.10 (0.069 ± 0.004) | 4.0 ± 0.10 (0.157 ± 0.004) | 2.0 ± 0.05 (0.079 ± 0.002) | 25.0 (0.984) | 0.600 (0.024) | 0.600 (0.024) | 0.100 (0.004) |
| 12mm | | 1.5 (0.059) | | | | 30 (1.181) | | | |
| 16mm | | | | | | | | | |
| Variable Dimensions — Millimeters (Inches) | | | | | | | | | |
| Tape Size | Pitch | B ₁ Max. Note 4 | E ₂ Min. | F | P ₁ | T ₂ Max | W Max | A ₀ , B ₀ & K ₀ | |
| 8mm | Single (4mm) | 4.35 (0.171) | 6.25 (0.246) | 3.5 ± 0.05 (0.138 ± 0.002) | 4.0 ± 0.10 (0.157 ± 0.004) | 2.5 (0.098) | 8.3 (0.327) | Note 5 | |
| 12mm | Single (4mm) & Double (8mm) | 8.2 (0.323) | 10.25 (0.404) | 5.5 ± 0.05 (0.217 ± 0.002) | 8.0 ± 0.10 (0.315 ± 0.004) | 4.6 (0.181) | 12.3 (0.484) | | |
| 16mm | Triple (12mm) | 12.1 (0.476) | 14.25 (0.561) | 5.5 ± 0.05 (0.217 ± 0.002) | 8.0 ± 0.10 (0.315 ± 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 S₁ < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Document 481 paragraph 4.3 (b)).
- B₁ dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by A₀, B₀ and K₀ 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 12mm tapes and 10° maximum for 16mm tapes (see Figure 3).
 - lateral movement of the component is restricted to 0.5 mm maximum for 8mm and 12mm wide tape and to 1.0mm maximum for 16mm tape (see Figure 4).
 - for KPS Series product A₀ and B₀ are measured on a plane 0.3mm above the bottom of the pocket.
 - see Addendum in EIA Document 481 for standards relating to more precise taping requirements.

Figure 2 – Punched (Paper) Carrier Tape Dimensions

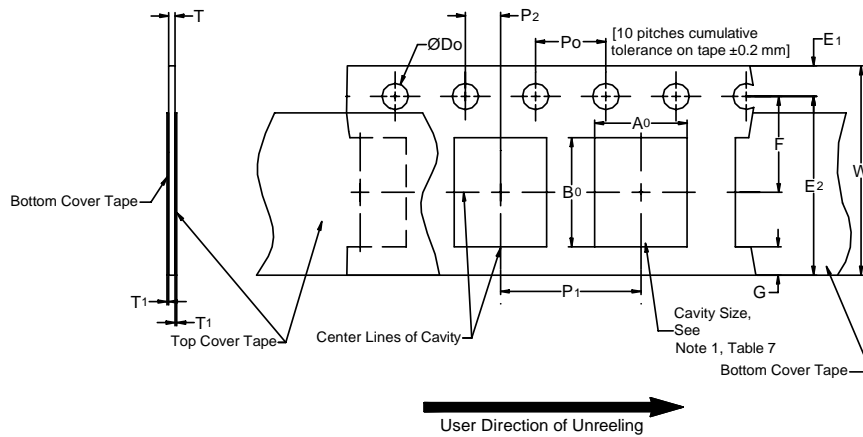


Table 7 – Punched (Paper) Carrier Tape Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | | | | |
|--|---------------------------------------|------------------------------|-------------------------------|-------------------------------|---------------------|----------------|-------------------------------|
| Tape Size | D ₀ | E ₁ | P ₀ | P ₂ | T ₁ Max | G Min | R Ref. Note 2 |
| 8mm | 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 (.004) Max. | 0.75 (.030) | 25 (.984) |
| Variable Dimensions — Millimeters (Inches) | | | | | | | |
| Tape Size | Pitch | E2 Min | F | P ₁ | T Max | W Max | A ₀ B ₀ |
| 8mm | Half (2mm) | 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 5 |
| 8mm | Single (4mm) | | | 4.0 ± 0.10 (0.157 ± 0.004) | | 8.3 (0.327) | |

- The cavity defined by A₀, B₀ 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 Document 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 |
|-------------|--|
| 8mm | 0.1 Newton to 1.0 Newton (10gf to 100gf) |
| 12mm & 16mm | 0.1 Newton to 1.3 Newton (10gf to 130gf) |

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-556 and EIA-624.

Figure 3 – Maximum Component Rotation

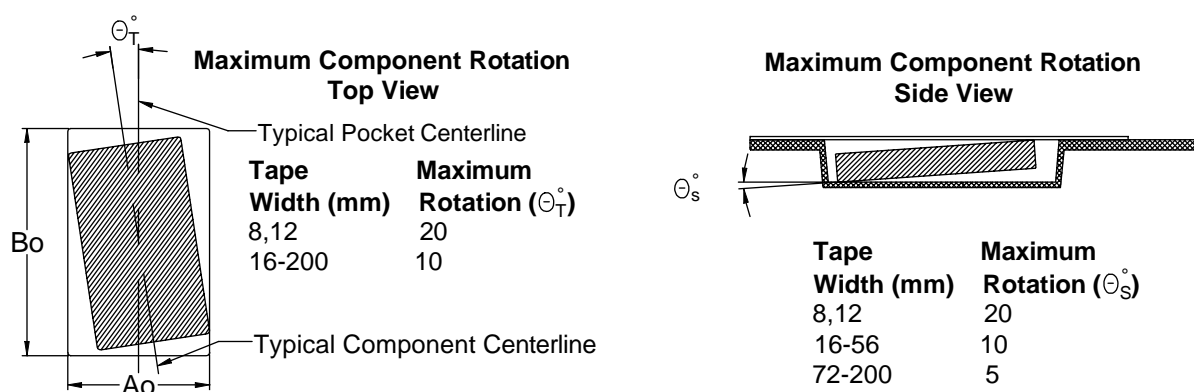


Figure 4 – Maximum Lateral Movement

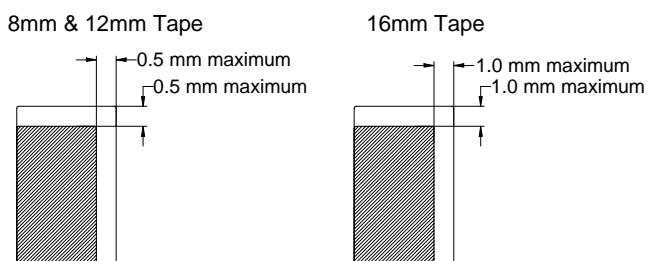


Figure 5 – Bending Radius

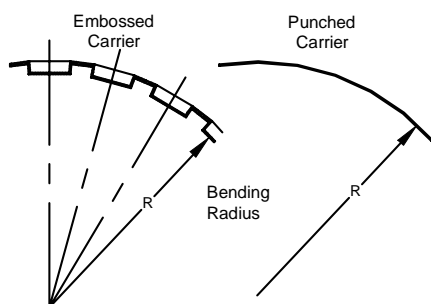
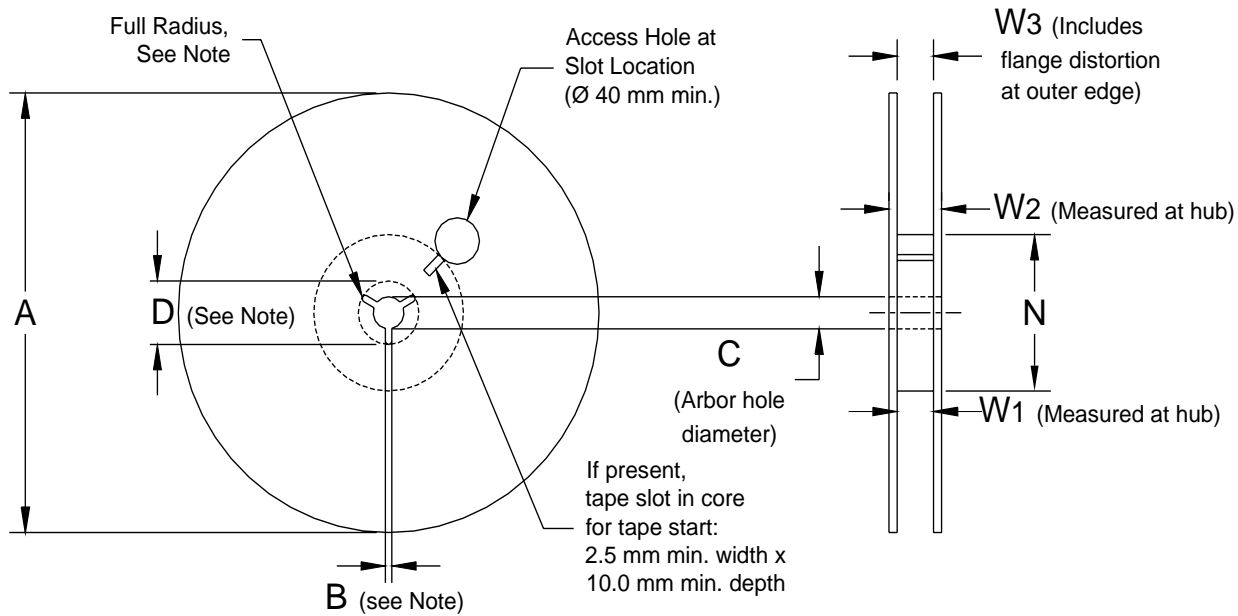


Figure 6 – Reel Dimensions



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 Min | C | D Min |
| 8mm | 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) |
| 12mm | | | | |
| 16mm | | | | |
| Variable Dimensions — Millimeters (Inches) | | | | |
| Tape Size | N Min | W ₁ | W ₂ Max | W ₃ |
| 8mm | 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 |
| 12mm | | $12.4 +2.0/-0.0$ (0.488 +0.078/-0.0) | 18.4 (0.724) | |
| 16mm | | $16.4 +2.0/-0.0$ (0.646 +0.078/-0.0) | 22.4 (0.882) | |

Figure 7 – Tape Leader & Trailer Dimensions

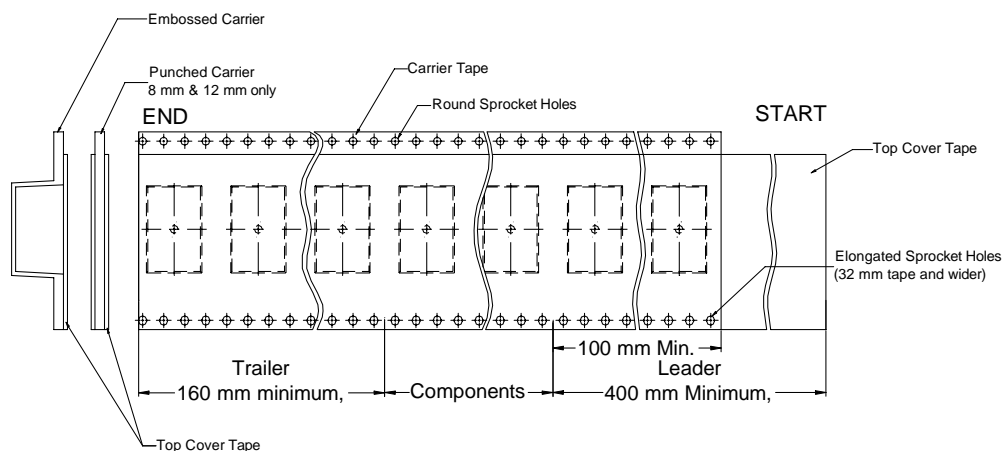


Figure 8 – Maximum Camber

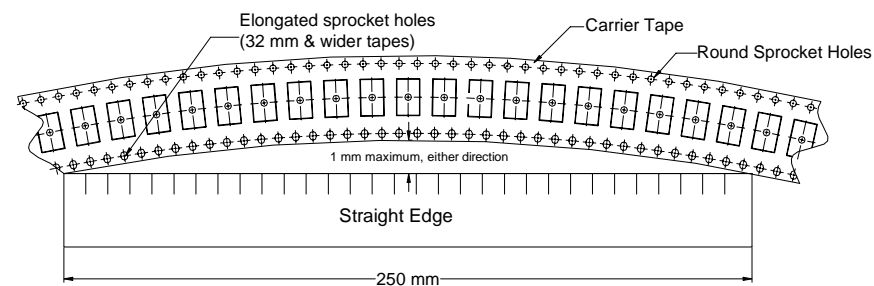


Figure 9 – Bulk Cassette Packaging (Ceramic Chips Only)

Meets Dimensional Requirements IEC-286 and EIAJ 7201

Unit mm *Reference

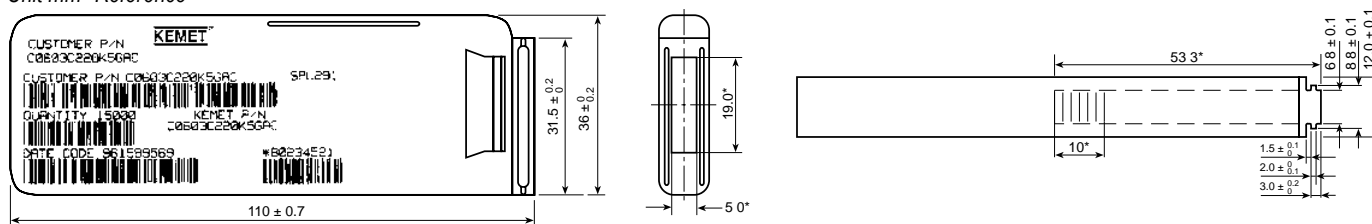


Table 9 – Capacitor Dimensions for Bulk Cassette

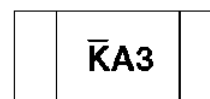
Cassette Packaging – Millimeters

| 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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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 |
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[D55342E07B523DR-T/R](#) [NCA1206X7R104K16TRPF](#) [NIN-FB391JTRF](#) [NIN-FC2R7JTRF](#) [NMC0402NPO220J50TRPF](#)
[NMC0402X5R105K6.3TRPF](#) [NMC0402X5R224K6.3TRPF](#) [NMC0402X7R103J25TRPF](#) [NMC0402X7R392K50TRPF](#)
[NMC0603NPO201J50TRPF](#) [NMC0603NPO330G50TRPF](#) [NMC0603X5R475M6.3TRPF](#) [NMC0805NPO220J100TRPF](#)
[NMC0805NPO270J50TRPF](#) [NMC0805NPO681F50TRPF](#) [NMC0805NPO820J50TRPF](#) [NMC1206X7R102K50TRPF](#)
[NMC1210Y5V105Z50TRPLPF](#) [NMC-L0402NPO7R0C50TRPF](#) [NMC-L0603NPO2R2B50TRPF](#) [NMC-P1206X7R103K1KVTRPLPF](#) [NMC-](#)
[Q0402NPO8R2D200TRPF](#) [NPIS27H102MTRF](#) [C1206C101J1GAC](#) [C1608C0G2A221J](#) [C1608X7R1E334K](#) [C2012C0G2A472J](#)
[KHC201E225M76N0T00](#) [1812J2K00332KXT](#) [CCR06CG153FSV](#) [CDR14BP471CJUR](#) [CDR31BX103AKWR](#) [CDR33BX683AKUS](#)
[CGA2B2C0G1H010C](#) [CGA2B2C0G1H040C](#) [CGA2B2C0G1H050C](#) [CGA2B2C0G1H060D](#) [CGA2B2C0G1H070D](#) [CGA2B2C0G1H120J](#)
[CGA2B2C0G1H151J](#) [CGA2B2C0G1H1R5C](#) [CGA2B2C0G1H2R2C](#) [CGA2B2C0G1H390J](#) [CGA2B2C0G1H391J](#) [CGA2B2C0G1H3R3C](#)
[CGA2B2C0G1H680J](#) [CGA2B2C0G1H6R8D](#) [CGA2B2C0G1H820J](#) [CGA2B2X8R1H152K](#) [CGA2B2X8R1H221K](#)