# MULTILAYER CERAMIC CHIP CAPACITOR - GMX SERIES - SOFT TERMINATION

## INTRODUCTION

- Multilayer Ceramic Chip Capacitors supplied in bulk or tape & reel package are ideally suitable for thick-film hybrid circuits and automatic surface mounting on any printed circuit boards.
- GMX series use a special material between nickel-barrier and ceramic body. It provides excellent performance to guard against bending stress occurred during process and provide more security for PCB process.
- The nickel-barrier terminations are consisted of a nickel barrier layer over the silver metalization and then finished by electroplated solder layer to ensure the terminations have good solderability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature.

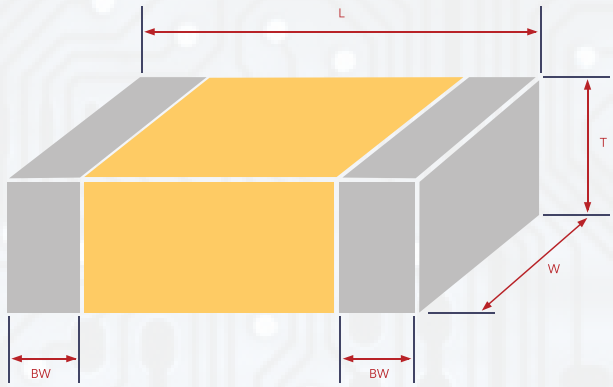
## APPLICATIONS

- For general digital circuit.
- For power supply bypass capacitors.
- For consumer electronics.
- For telecommunication.
- DC to DC converter.
- Automotive application (Optional)

## FEATURES

- High performance to withstanding 3~5mm of substrate bending test guarantee.
- A wide selection of sizes is available.
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).
- Reduction in PCB bend failure.
- High reliability and stability.
- RoHS & HALOGEN FREE.

## EXTERNAL DIMENSION




UNIT: mm

| SIZE | INCH | L | W | t | BW |
|---|---|---|---|---|---|
| 0402 | 1005 | 1.00±0.20 | 0.50±0.20 | SEE TABLE BELOW | 0.25 +0.05/-0.10 |
| 0603 | 1608 | 1.60±0.20 | 0.80±0.20 | | 0.40±0.15 |
| 0805 | 2012 | 2.10±0.20 | 1.25±0.20 | | 0.50±0.20 |
| 1206 | 3216 | 3.30±0.30 | 1.60 ± 0.30 | | 0.60±0.20 |
| 1210 | 3225 | 3.30±0.40 | 2.50±0.30 | | 0.75±0.35 |
| 1808 | 4520 | 4.60±0.50 | 2.00±0.25 | | 0.75±0.35 |
| 1812 | 4532 | 4.60±0.50 | 3.20±0.30 | | 0.75±0.35 |
| 1825 | 4563 | 4.60±0.50 | 6.30±0.40 | | 0.75±0.35 |
| 2220 | 5750 | 5.70±0.50 | 5.00±0.40 | | 0.85±0.35 |
| 2225 | 5763 | 5.70±0.50 | 6.30±0.40 | | 0.85±0.35 |

## ENVIRONMENTAL & STRESS TESTING

- AEC-Q200: Undergoes rigorous testing including 1,000 cycles of temperature cycling (-55°C to +125°C or higher), 1,000 hours of biased humidity (85°C / 85% RH), high-temperature storage, mechanical shock (1,000G), vibration (20G), and board flex/terminal strength tests.

## ORDERING INFORMATION

| GMX | 31 | X7R | 104 | K | 100 | CT | A |
|---|---|---|---|---|---|---|---|
| SERIES | SIZE | DIELECTRIC | CAPACITANCE | TOLERANCE | RATED VOLTAGE | PACKAGING | AUTOMOTIVE |
| Anti-Bend General Purpose Product | 04 - 0402 (1005)<br>10 - 0603 (1608)<br>21 - 0805 (2012)<br>31 - 1206 (3216)<br>32 - 1210 (3225)<br>40 - 1808 (4520)<br>43 - 1812 (4532)<br>45 - 1825 (4563)<br>55 - 2220 (5750)<br>57 - 2225 (5763) | CG - C0G<br>X7R - X7R<br>X7S - X7S<br>X5R - X5R | R47 - 0.47pF<br>0R5 - 0.5pF<br>100 - 10x10$^0$-10pF<br>102 - 10x10$^2$-1000pF<br>104 - 10x10$^4$-100nF<br>106 - 10x10$^6$-10μF | A : ±0.05pF<br>B : ±0.10pF<br>C : ±0.25 pF<br>D : ±0.50 pF<br>F : ±1 %<br>G : ±2%<br>H : ±3%<br>I : -10% ~ 0%<br>J : ±5%<br>K : ±10%<br>L : 0% ~ +10%<br>M: ±20%<br>N: -5% ~ +10%<br>P : ±0.02 pF<br>Q: ±0.03 pF<br>Z : -20% ~ +80%<br>X : +10% ~ +20% | 6R3 - 6.3Vdc<br>10 - 10Vdc<br>16 - 16Vdc<br>25 - 25Vdc<br>35 - 35Vdc<br>50 - 50Vdc<br>100 - 100Vdc<br>200 - 200Vdc<br>250 - 250Vdc<br>400 - 400Vdc<br>500 - 500Vdc<br>630 - 630Vdc<br>1K0 - 1000Vdc<br>1K5 - 1500Vdc<br>2K0 - 2000Vdc<br>3K0 - 3000Vdc<br>4K0 - 4000Vdc<br>5K0 - 5000Vdc | CT -Tape and 7" Reel<br>CTD - Tape and 10" Reel<br>CTG - Tape and 13" Reel | Optional |

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MS LEVEL 1

# GENERAL ELECTRICAL DATA

| DIELECTRIC | C0G | X7R | X7S | X5R |
|---|---|---|---|---|
| SIZE | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225 | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225 | 0402, 0603, 0805, 1206, 1210, 2220 | 0402, 0603, 0805, 1206, 1210 |
| RATED VOLTAGE (WVDC) | 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV | 6.3V, 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV, 5KV | 6.3V, 10V, 16V, 25V, 50V, 100V, 2KV | 6.3V, 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1KV, 1.5KV, 2KV, 3KV, 4KV, 5KV |
| CAPACITANCE RANGE | 0.1pF ~ 100nF | 100pF ~ 47µF | 470PF-47UF | 0.033uF ~ 100uF |
| CAPACITANCE TOLERANCE | SEE ORDERING INFORMATION | | | |
| TAN δ | CAP. RANGE / Q SPEC<br>CAP. <30pF: Q≥400+20°C<br>CAP. ≥30pF: Q≥1000 | SEE RELIABILITY TEST CONDITIONS AND REQUIREMENTS BELOW | | |
| CAPACITANCE & TAN δ TEST CONDITION | For 25°C at ambient temperature | Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement | | |
| | CAP. RANGE / TEST CONDITION | CAP. RANGE / TEST CONDITION | CAP. RANGE / TEST CONDITION | CAP. RANGE / TEST CONDITION |
| | Cap.≤1000pF: 1.0±0.2Vrms, 1.0MHz±10% | Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10% | Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10% | Cap.≤10µF: 1.0±0.2Vrms, 1.0KHz±10% |
| | Cap.>1000pF: 1.0±0.2Vrms, 1.0KHz±10% | Cap.>10µF: 0.5±0.2Vrms, 120Hz±20% | Cap.>10µF: 0.5±0.2Vrms, 120Hz±20% | Cap.>10µF: 0.5±0.2Vrms, 120Hz±20% |
| INSULATION RESISTANCE | ≥10GΩ or RxC≥500Ω-F, whichever is smaller | | | |
| OPERATING TEMPERATURE | -55°C to + 125°C | -55°C to + 125°C | -55°C to + 125°C | -55°C to + 85°C |
| TEMPERATURE COEFFICIENT | ±30ppm/°C | ±15% | ±22% | ±15% |
| TERMINATION | Cu/Ag polymer/Ni/Sn (lead-free termination) | | | |

MS LEVEL 1



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# CAPACITANCE RANGE

| DIELECTRIC | | COG | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 0402 | | | | | 0603 | | | | | | | 0805 | | | | | | | | | | |
| RATED VOLTAGE | | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | |
| 0.1pF | 0R1 | G | G | G | G | | | | | | | | | | | | | | | | | | | |
| 0.2pF | 0R2 | G | G | G | G | | | | | | | | | | | | | | | | | | | |
| 0.3pF | 0R3 | G | G | G | G | | I | I | I | I | I | | | | | | | | | | | | | |
| 0.4pF | 0R4 | G | G | G | G | | I | I | I | I | I | | | | | | | | | | | | | |
| 0.5pF | 0R5 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 0.6pF | 0R6 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 0.7pF | 0R7 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 0.8pF | 0R8 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 0.9pF | 0R9 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 1.0pF | 1R0 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 1.2pF | 1R2 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 1.5pF | 1R5 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 1.8pF | 1R8 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 2.2pF | 2R2 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 2.7pF | 2R7 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 3.3pF | 3R3 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 3.9pF | 3R9 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 4.7pF | 4R7 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 5.6pF | 5R6 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 6.2pF | 6R2 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 6.8pF | 6R8 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 8.2pF | 8R2 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 10pF | 100 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 12pF | 120 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 15pF | 150 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 18pF | 180 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 22pf | 220 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 27pf | 270 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 33pf | 330 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 39pf | 390 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 47pf | 470 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 56pf | 560 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 68pf | 680 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | H | H | N | |
| 82pf | 820 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | H | X | X | N | |
| 100pf | 101 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | X | X | X | N | |
| 120pf | 121 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | H | X | N | N | N | |
| 150pf | 151 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | X | X | N | N | N | |
| 180pf | 181 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | X | N | N | N | N | |
| 220pf | 221 | G | G | G | G | G | I | I | I | I | I | I | I | H | H | H | H | H | N | N | N | N | N | |
| 270pf | 271 | G | G | G | G | | I | I | I | I | I | G | G | H | H | H | H | H | N | N | N | N | N | |
| 330pf | 331 | G | G | G | G | | I | I | I | I | I | G | G | H | H | H | H | H | N | N | N | N | N | |
| 390pF | 391 | G | G | G | G | | I | I | I | I | I | G | G | X | X | X | X | X | N | N | N | N | N | |
| 470pf | 471 | G | G | G | G | | I | I | I | I | I | G | G | X | X | X | X | X | N | N | R | R | | |
| 560pf | 561 | G | G | G | G | | I | I | I | I | I | | | X | X | X | X | X | N | N | R | R | | |
| 680pf | 681 | G | G | G | G | | I | I | I | I | I | | | X | X | X | X | X | N | N | R | R | | |
| 820pf | 821 | G | G | G | G | | I | I | I | I | I | | | X | X | X | X | X | N | N | R | R | | |
| 1,000pf | 102 | G | G | G | G | | I | I | I | I | I | | | X | X | X | X | X | N | N | R | R | | |
| 1,200pf | 122 | | | | | | G | G | G | G | | | | X | X | X | X | X | N | N | | | | |
| 1,500pf | 152 | | | | | | G | G | G | G | | | | X | X | X | X | X | N | N | | | | |
| 1,800pf | 182 | | | | | | G | G | G | G | | | | X | X | X | X | X | N | N | | | | |
| 2,200pf | 222 | | | | | | G | G | G | G | | | | X | X | X | X | X | N | N | | | | |
| 2,700pf | 272 | | | | | | G | G | G | G | | | | N | N | N | N | N | N | N | | | | |
| 3,300pf | 332 | | | | | | G | G | G | G | | | | N | N | N | N | N | | | | | | |
| 3,900pf | 392 | | | | | | | | | | | | | N | N | N | N | N | | | | | | |
| 4,700pf | 472 | | | | | | | | | | | | | N | N | N | N | N | | | | | | |
| 5,600pf | 562 | | | | | | | | | | | | | N | N | N | N | N | | | | | | |
| 6,800pf | 682 | | | | | | | | | | | | | N | N | N | N | N | | | | | | |
| 8,200pf | 822 | | | | | | | | | | | | | N | N | N | N | | | | | | | |
| 0.01µF | 103 | | | | | | | | | | | | | N | N | N | N | | | | | | | |
| 0.012µF | 123 | | | | | | | | | | | | | | | | | | | | | | | |

CAPACITANCE RANGE

* ARC PROTECTION COATING

| CODE | H | K | Q | R | G | I | N |
|---|---|---|---|---|---|---|---|
| THICKNESS | 0.60 ± 0.10 mm | 0.8 + 0.15/-0.10 mm | 1.25 ± 0.10 mm | 1.25 ± 0.20 mm | 0.50 ± 0.20 mm | 0.80 ± 0.07 mm | 0.80 ± 0.10 mm |

# CAPACITANCE RANGE

| DIELECTRIC | | COG | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 1206 | | | | | | | | | | | | 1210 | | | | | | | | | | | | |
| RATED VOLTAGE | | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | 1500 | 2000 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | 1500 | 2000 | 3000 |
| CAPACITANCE RANGE | 1.0pf | 1R0 | | | | J | | | | | | | | | | | | | | | | | | | | |
| | 1.2pf | 1R2 | J | J | J | J | J | | | J | | | | | | | | | | | | | | | | | |
| | 1.5pf | 1R5 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 1.8pf | 1R8 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 2.2pf | 2R2 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 2.7pf | 2R7 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 3.3pF | 3R3 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 3.9pf | 3R9 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 4.7pf | 4R7 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 5.0 pF | 5R0 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 5.6pF | 5R6 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 6.8pf | 6R8 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 8.2pf | 8R2 | J | J | J | J | J | J | J | J | J | J | J | J | | | | | | | | | | | | | |
| | 10pf | 100 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 12pF | 120 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 15pF | 150 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 18pF | 180 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 22pF | 220 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 27pF | 270 | J | J | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 33pF | 330 | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 39pF | 390 | J | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 47pF | 470 | J | J | J | J | J | J | J | J | J | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | Z |
| | 56pF | 560 | J | J | J | J | J | J | J | J | J | O | Q | Q | O | O | O | O | O | O | O | O | O | O | Q | Q | Z |
| | 68pF | 680 | J | J | J | J | J | J | J | J | J | O | Q | Q | O | O | O | O | O | O | O | O | O | O | Q | Q | Z |
| | 82pF | 820 | J | J | J | J | J | J | J | J | J | Q | Q | Q | O | O | O | O | O | O | O | O | O | O | Q | Q | Z |
| | 100pF | 101 | J | J | J | J | J | J | J | J | J | Q | Q | Q | O | O | O | O | O | O | O | O | O | Q | Q | Q | Z |
| | 120pF | 121 | J | J | J | J | J | J | J | J | J | Q | U | U | O | O | O | O | O | O | O | O | O | Q | Q | Q | Z |
| | 150pF | 151 | J | J | J | J | J | J | J | J | J | Q | U | U | O | O | O | O | O | O | O | O | O | Q | U | U | Z |
| | 180pF | 181 | J | J | J | J | J | J | J | J | J | U | U | U | O | O | O | O | O | O | O | O | O | Q | U | U | Z |
| | 220pF | 221 | J | J | J | J | J | J | J | J | J | U | U | U | O | O | O | O | O | O | O | O | O | U | U | U | Z |
| | 270pF | 271 | J | J | J | J | J | J | O | O | O | U | V | V | O | O | O | O | O | O | O | O | O | U | Z | Z | AA |
| | 330pF | 331 | J | J | J | J | J | J | O | O | O | U | V | V | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 390pF | 391 | J | J | J | J | J | J | O | O | O | U | V | V | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 470pF | 471 | J | J | J | J | J | O | O | O | O | U | U | U | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 560pF | 561 | J | J | J | J | J | O | Q | Q | Q | U | | | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 680pF | 681 | J | J | J | J | J | O | Q | Q | Q | U | | | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 820pF | 821 | J | J | J | J | J | O | U | U | U | U | | | O | O | O | O | O | O | O | O | O | U | AA | AA | |
| | 1000pF | 102 | J | J | J | J | J | O | U | U | U | U | | | O | O | O | O | O | Q | Q | Q | Q | U | AA | AA | |
| | 1200pF | 122 | J | J | J | J | J | O | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | U | Z | Z | |
| | 1500pF | 152 | J | J | J | J | J | Q | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | Z | AA | AA | |
| | 1800pF | 182 | J | J | J | J | J | Q | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | AA | AA | AA | |
| | 2200pF | 222 | J | J | J | J | J | Q | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | AA | | | |
| | 2700pF | 272 | J | J | J | J | J | Q | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | AA | | | |
| | 3300pF | 332 | J | J | J | J | J | Q | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | AA | | | |
| | 3900pF | 392 | J | J | J | J | J | U | U | U | U | | | | O | O | O | O | O | Q | Q | Q | Q | AA | | | |
| | 4700pF | 472 | J | J | J | J | J | U | U | U | U | | | | O | O | O | O | O | U | U | U | U | AA | | | |
| | 5600pF | 562 | J | J | J | J | J | U | U | U | U | | | | O | O | O | O | Q | U | U | U | U | AA | | | |
| | 6800pF | 682 | O | O | O | O | O | U | U | U | Q./U | | | | O | O | O | O | Q | U | U | U | U | AA | | | |
| | 8200pF | 822 | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | Q | U | U | U | U | AA | | | |
| | 0.010µF | 103 | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | U | Z | Z | Z | Z | AA | | | |
| | 0.012µF | 123 | V | V | V | V | V | | | | | | | | Q | Q | Q | Q | U | Z | Z | Z | Z | AA | | | |
| | 0.015µF | 153 | V | V | V | V | V | | | | | | | | Q | Q | Q | Q | Z | Z | Z | Z | Z | AA | | | |
| | 0.018µF | 183 | V | V | V | V | V | | | | | | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | | | |
| | 0.022µF | 223 | V | V | V | V | V | | | | | | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | | | |
| | 0.027µF | 273 | V | V | V | V | | | | | | | | | Z/AA | Z/AA | Z/AA | Z/AA | Z | Z | Z | AA | AA | | | | |
| | 0.033µF | 333 | V | V | V | V | | | | | | | | | Z/AA | Z/AA | Z/AA | Z/AA | Z | | Z | AA | AA | | | | |
| | 0.039µF | 393 | V | V | V | V | | | | | | | | | Z/AA | Z/AA | Z/AA | Z/AA | Z | | Z | | | | | | |
| | 0.047µF | 473 | | | | K | | | | | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | | |
| | 0.056µF | 563 | | | | K | | | | | | | | | | | | | | | | | | | | | |
| | 0.068µF | 683 | | | | | | | | | | | | | | | | | | | | | | | | | |

* ARC PROTECTION COATING

| CODE | J | K | O | Q | U | V | Z | AA |
|---|---|---|---|---|---|---|---|---|
| THICKNESS | 0.80 ± 0.10 | 0.80 + 0.15/-0.10 | 0.95 ± 0.10 | 1.25 ± 0.10 | 1.60 ± 0.20 | 1.60 +0.30/-0.10 | 2.00 ± 0.20 | 2.50 ± 0.30 |

MS LEVEL 1

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# CAPACITANCE RANGE

| DIELECTRIC | | COG | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 1808 | | | | | | | | | | | | 1812 | | | | | | | | | | | | |
| RATED VOLTAGE | | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | 1500 | 2000 | 3000 | 4000 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 630 | 1000 | 1500 | 2000 | 3000 | 4000 |
| CAPACITANCE RANGE | 1.8pf | 1R8 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2.2pf | 2R2 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 2.7pf | 2R7 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 3.3pF | 3R3 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 3.9pf | 3R9 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 4.7pf | 4R7 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 5.0 pF | 5R0 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 5.6pF | 5R6 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 6.8pf | 6R8 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 8.2pf | 8R2 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| | 10pf | 100 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 12pF | 120 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 15pF | 150 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 18pF | 180 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 22pF | 220 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 27pF | 270 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q |
| | 33pF | 330 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q* |
| | 39pF | 390 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q* |
| | 47pF | 470 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U* |
| | 56pF | 560 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U* |
| | 68pF | 680 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* |
| | 82pF | 820 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* |
| | 100pF | 101 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* |
| | 120pF | 121 | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA |
| | 150pF | 151 | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 180pF | 181 | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | |
| | 220pF | 221 | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | |
| | 270pF | 271 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | |
| | 330pF | 331 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | |
| | 390pF | 391 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | |
| | 470pF | 471 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | |
| | 560pF | 561 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | |
| | 680pF | 681 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | |
| | 820pF | 821 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | AA | |
| | 1000pF | 102 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | AA | |
| | 1200pF | 122 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | CC | |
| | 1500pF | 152 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | | |
| | 1800pF | 182 | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | Z | | |
| | 2200pF | 222 | Q | Q | Q | Q | Q | Q | Q | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | U | Z | Z | | |
| | 2700pF | 272 | Q | Q | Q | Q | Q | Q | Q | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Z | AA | AA | | |
| | 3300pF | 332 | Q | Q | Q | Q | Q | Q | Q | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Z | AA | AA | | |
| | 3900pF | 392 | Q | Q | Q | Q | Q | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | AA | | | | |
| | 4700pF | 472 | Q | Q | Q | Q | Q | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Z/AA | | | | |
| | 5600pF | 562 | Q | Q | Q | U | U | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | AA | | | | |
| | 6800pF | 682 | Q | Q | Q | U | U | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | | | | | |
| | 8200pF | 822 | Q | Q | U | Z | Z | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | | | | | |
| | 0.010µF | 103 | Q | Q | U | Z | Z | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | | | | | |
| | 0.012µF | 123 | U | U | | | | | | | | | | | Q | Q | Q | Q | Q | U | U | U | | | | | |
| | 0.015µF | 153 | U | U | | | | | | | | | | | Q | Q | Q | Q | Q | U | U | U | | | | | |
| | 0.018µF | 183 | Z | Z | | | | | | | | | | | Q | Q | Q | Q | U | Z | Z | Z | | | | | |
| | 0.022µF | 223 | Z | Z | | | | | | | | | | | Q | Q | Q | Q | U | Z | Z | Z | | | | | |
| | 0.027µF | 273 | | | | | | | | | | | | | Q | Q | U | U | Z | AA | AA | | | | | | |
| | 0.033µF | 333 | | | | | | | | | | | | | Q | Q | U | U | Z | | | | | | | | |
| | 0.039µF | 393 | | | | | | | | | | | | | | | Z | Z | AA | | | | | | | | |
| | 0.047µF | 473 | | | | | | | | | | | | | | | Z | Z | AA | | | | | | | | |
| | 0.056µF | 563 | | | | | | | | | | | | | | | AA | AA | | | | | | | | | |
| | 0.068µF | 683 | | | | | | | | | | | | | | | AA | AA | | | | | | | | | |
| | 0.083µF | 823 | | | | | | | | | | | | | | | AA | AA | | | | | | | | | |
| | 0.10µF | 104 | | | | | | | | | | | | | | | AA | AA | | | | | | | | | |

* ARC PROTECTION COATING

| CODE | Q | U | Z | AA | CC |
|---|---|---|---|---|---|
| THICKNESS | 1.25 ± 0.10 | 1.60 ± 0.20 | 2.00 ± 0.20 | 2.50 ± 0.30 | 3.10 ± 0.30 |

# CAPACITANCE RANGE

| DIELECTRIC | | COG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 1825 | | | | | | | | | | | 2220 | | | | | | | | | | | 2225 | | | | | | | | | | | | |
| RATED VOLTAGE | | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1k | 1500 | 2k | 3k | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1k | 1500 | 2k | 3k | 4k | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1k | 1500 | 2k | 3k | 4k |
| CAPACITANCE RANGE | 10pF | 100 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | | Z | Z | F | F | F | F | F | F | F | F | | |
| | 12pF | 120 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 15pF | 150 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 18pF | 180 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 22pF | 220 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 27pF | 270 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 33pF | 330 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 39pF | 390 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 47pF | 470 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 56pF | 560 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 68pF | 680 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 82pF | 820 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 100pF | 101 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |
| | 120pF | 121 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 150pF | 151 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 180pF | 181 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 220pF | 221 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 270pF | 271 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 330pF | 331 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 390pF | 391 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 470pF | 471 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 560pF | 561 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 680pF | 681 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 820pF | 821 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 1000pF | 102 | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 1200pF | 122 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 1500pF | 152 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 1800pF | 182 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 2200pF | 222 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | |
| | 2700pF | 272 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | |
| | 3300pF | 332 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | AA | |
| | 3900pF | 392 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 4700pF | 472 | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 5600pF | 562 | Z | Z | Z | Z | Z | Z | Z | Z | | | | Z | Z | Z | Z | Z | Z | Z | Z | | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 6800pF | 682 | Z | Z | Z | Z | Z | Z | Z | Z | | | | Z | Z | Z | Z | Z | Z | Z | Z | | | | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | | |
| | 8200pF | 822 | Z | Z | Z | Z | Z | Z | Z | AA | | | | Z | Z | Z | Z | Z | Z | Z | AA | | | | Z | Z | Z | Z | Z | Z | Z | Z | AA | AA | | |
| | 0.01µF | 103 | Z | Z | Z | Z | Z | Z | Z | AA | | | | Z | Z | Z | Z | Z | Z | Z | AA | | | | Z | Z | Z | Z | Z | Z | Z | AA | AA | AA | | |
| | 0.012µF | 123 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.015µF | 153 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.018µF | 183 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.022µF | 223 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.027µF | 273 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.033µF | 333 | Z | Z | Z | Z | Z | Z | Z | | | | | Z | Z | Z | Z | Z | Z | U/Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.039µF | 393 | Z | Z | U | Z | Z | AA | AA | | | | | Z | Z | Z | Z | Z | Z | U/Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.047µF | 473 | Z | Z | Z | Z | Z | | | | | | | Z | Z | Z | AA | AA | AA | U/Z | | | | | Z | Z | Z | Z | Z | Z | Z | | | | | |
| | 0.056µF | 563 | Z | Z | Z | AA | AA | | | | | | | Z | Z | Z | AA | AA | | Z | | | | | Z | Z | Z | AA | AA | AA | AA | | | | | |
| | 0.068µF | 683 | Z | Z | Z | AA | AA | | | | | | | Z | Z | Z | AA | AA | | Z | | | | | Z | Z | Z | AA | AA | AA | AA | | | | | |
| | 0.082µF | 823 | Z | Z | AA | | | | | | | | | Z | Z | AA | | | | Z | | | | | Z | Z | Z | AA | AA | AA | | | | | | |
| | 0.1µF | 104 | AA | AA | AA | | | | | | | | | AA | AA | AA | | | | AA | | | | | Z | Z | AA | AA | AA | | | | | | | |
| | 0.12µF | 124 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.15µF | 154 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.18µF | 184 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.22µF | 224 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.27µF | 274 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0.33µF | 334 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* ARC PROTECTION COATING

| CODE | F | U | Z | AA |
|---|---|---|---|---|
| THICKNESS | 0.50 ± 0.10 mm | 1.60 ± 0.20 | 2.00 ± 0.20 | 2.50 ± 0.30 |

MS LEVEL 1

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59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

# CAPACITANCE RANGE

| DIELECTRIC | | | X7R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | | 0402 | | | | | | | 0603 | | | | | | | | | 0805 | | | | | | | | | | | | | |
| RATED VOLTAGE | | | 6.3 | 10 | 16 | 25 | 35 | 50 | 100 | 6.3 | 10 | 16 | 25 | 35 | 50 | 100 | 200 | 250 | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 |
| CAPACITANCE RANGE | 100pf | 101 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 120pf | 121 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 150pf | 151 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 180pf | 181 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 220pf | 221 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 270pf | 271 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 330pf | 331 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 390 | 391 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 470pf | 471 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 560pf | 561 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 680pf | 681 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 820pf | 821 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 1,000pf | 102 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 1,200pf | 122 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | N |
| | 1,500pf | 152 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | Q |
| | 1,800pf | 182 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | Q |
| | 2,200pf | 222 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | Q |
| | 2,700pf | 272 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | |
| | 3,300pf | 332 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | |
| | 3,900pf | 392 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | N | N | |
| | 4,700pf | 472 | | G | G | G | | G | G | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 5,600pf | 562 | | G | G | G | | G | | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 6,800pf | 682 | | G | G | G | | G | | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 8,200pf | 822 | | G | G | G | | G | | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.01µF | 103 | | G | G | G | | G | | | I | I | I | I | I | I | K | K | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.012µF | 123 | | G | G | G | | | | | I | I | I | I | I | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.015µF | 153 | | G | G | G | | | | | I | I | I | I | I | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.018µF | 183 | | G | G | G | | | | | I | I | I | I | I | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.022µF | 223 | | G | G | G | | | | | I | I | I | I | I | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.027µF | 273 | | G | G | G | | | | | I | I | I | I | I | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 0.033µF | 333 | | G | G | G | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | Q | | |
| | 0.039µF | 393 | | G | G | G | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | | | |
| | 0.047µF | 473 | | G | G | G | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | | | |
| | 0.056µF | 563 | | G | G | | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | | | |
| | 0.068µF | 683 | | G | G | | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | | | |
| | 0.082µF | 823 | | G | G | | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | Q | | | |
| | 0.1µF | 104 | G | G | G | | | | | | I | I | I | K | K | K | | | | Q | Q | Q | Q | Q | Q | | | | |
| | 0.12µF | 124 | | | | | | | | | I | I | K | | | | | | | Q | Q | Q | Q | R | | | | | |
| | 0.15µF | 154 | | | | | | | | | I | I | K | | | | | | | Q | Q | Q | Q | R | | | | | |
| | 0.18µF | 184 | | | | | | | | | I | I | K | | | | | | | Q | Q | Q | Q | R | | | | | |
| | 0.22µF | 224 | | | | | | | | | I | I | K | K | K | | | | | Q | Q | Q | Q | R | | | | | |
| | 0.27µF | 274 | | | | | | | | K | K | K | K | | | | | | | R | R | R | R | | | | | | |
| | 0.33µF | 334 | | | | | | | | | K | K | K | | | | | | | R | R | R | R | | | | | | |
| | 0.39µF | 394 | | | | | | | | | K | K | K | | | | | | | R | R | R | R | | | | | | |
| | 0.47µF | 474 | | | | | | | | K | K | K | K | | | | | | | R | R | R | R | R | | | | | |
| | 0.56µF | 564 | | | | | | | | | K | K | | | | | | | | R | R | R | R | | | | | | |
| | 0.68µF | 684 | | | | | | | | K | K | K | | | | | | | | R | R | R | | | | | | | |
| | 0.82µF | 824 | | | | | | | | | K | K | | | | | | | | R | R | R | | | | | | | |
| | 1µF | 105 | | | | | | | | K | K | K | K | N | | | | | | R | R | R | R | | | | | | |
| | 1.2µF | 125 | | | | | | | | | K | K | K | K | K | | | | | | | | | | | | | | |
| | 1.5µF | 155 | | | | | | | | | K | K | K | K | K | | | | | R | R | R | | | | | | | |
| | 2.2µF | 225 | | | | | | | | | K | K | K | K | K | | | | R | R | R | R | | | | | | | |
| | 4.7µF | 475 | | | | | | | | | | | | | | | | | R | R | R | R | | | | | | | |
| | 10µF | 106 | | | | | | | | L# | L# | | | | | | | | S | S | | | | | | | | | |

* ARC PROTECTION COATING
# - L: 1.6 ± 0.3 W: 0.8 ± 0.3

| CODE | G | I | N | K | L | Q | R | S |
|---|---|---|---|---|---|---|---|---|
| THICKNESS | 0.50 ± 0.20 | 0.80 ± 0.07 | 0.80 ± 0.10 | 0.8 + 0.15/-0.10 | 0.8 ± 0.25 | 1.25 ± 0.10 | 1.25 ± 0.20 | 1.25 ± 0.30 |

# CAPACITANCE RANGE

| DIELECTRIC | | X7R | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 1206 | | | | | | | | | | | | | 1210 | | | | | | | | | | | | |
| RATED VOLTAGE | | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | 1500 | 2000 | 6.3 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 | 1500 | 2000 |
| 100pf | 101 | | | | | | | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | | |
| 120pf | 121 | | | | | | | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | | |
| 150pf | 151 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | | |
| 180pf | 181 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | | | | | | | | | | |
| 220pf | 221 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 270pf | 271 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 330pf | 331 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 390 | 391 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 470pf | 471 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 560pf | 561 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 680pf | 681 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 820pf | 821 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | O | M |
| 1,000pf | 102 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | O | O | O | O | O | O | O | O | O | O | O | Q | Q |
| 1,200pf | 122 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | U | U |
| 1,500pf | 152 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | U | U |
| 1,800pf | 182 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | U | U |
| 2,200pf | 222 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | Z | Z |
| 2,700pf | 272 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | Z | AA |
| 3,300pf | 332 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | O | O | O | O | O | O | O | O | O | O | O | Z | AA |
| 3,900pf | 392 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | O | AA | AA |
| 4,700pf | 472 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | O | Z/AA | Z/AA |
| 5,600pf | 562 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | O | AA | AA* |
| 6,800pf | 682 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | O | AA | AA* |
| 8,200pf | 822 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | O | AA | AA* |
| 0.01µF | 103 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | O | O | O | O | O | O | O | O | O | O | Q | AA | AA* |
| 0.012µF | 123 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | | O | O | O | O | O | O | O | O | O | O | Q | AA | |
| 0.015µF | 153 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | | | O | O | O | O | O | O | O | O | O | O | U | AA | |
| 0.018µF | 183 | | Q | Q | Q | Q | Q | Q | Q | Q | Q | | | | O | O | O | O | O | O | O | O | Q | Q | U | AA | |
| 0.022µF | 223 | | Q | Q | Q | Q | Q | Q | Q | U | U | | | | O | O | O | O | O | O | O | O | Q | Q | U | AA | |
| 0.027µF | 273 | | Q | Q | Q | Q | Q | Q | Q | U | U | | | | O | O | O | O | O | O | O | O | Q | Q | U | AA | |
| 0.033µF | 333 | | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | O | O | O | O | U | U | U | AA | |
| 0.039µF | 393 | | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | O | O | O | O | U | U | Z | | |
| 0.047µF | 473 | | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | O | O | Q | Q | U | U | AA | | |
| 0.056µF | 563 | | Q | Q | Q | Q | Q | U | U | U | U | | | | O | O | O | O | O | O | Q | Q | U | U | | | |
| 0.068µF | 683 | | Q | Q | Q | Q | Q | U | U | | | | | | O | O | O | O | O | O | U | U | Z | Z | | | |
| 0.082µF | 823 | | Q | Q | Q | Q | Q | U | U | | | | | | O | O | O | O | O | O | U | U | Z | Z | | | |
| 0.1µF | 104 | | Q | Q | Q | Q | Q | U | U | | | | | | O | O | O | O | O | O | Y | Y | Z | Z | | | |
| 0.12µF | 124 | | Q | Q | Q | Q | Q | | | | | | | | O | O | O | O | O | O | U | U | AA | AA | | | |
| 0.15µF | 154 | | O | O | O | O | U | | | | | | | | O | O | O | O | O | Q | U | U | AA | AA | | | |
| 0.18µF | 184 | | O | O | O | O | U | | | | | | | | O | O | O | O | O | Q | U | U | | | | | |
| 0.22µF | 224 | | O | O | O | O | U | U | U | | | | | | O | O | O | O | O | Q | Q/U | Q/U | | | | | |
| 0.27µF | 274 | | O | O | O | Q | U | | | | | | | | O | O | O | O | O | U | Z | Z | | | | | |
| 0.33µF | 334 | | O | O | O | Q | U | | | | | | | | O | O | O | O | Q | U | Z | Z | | | | | |
| 0.39µF | 394 | | O | O | P | V | U | | | | | | | | O | O | O | O | Q | AA | AA | AA | | | | | |
| 0.47µF | 474 | | P | P | P | V | U | | | | | | | | O | O | O | O | Q | AA | AA | AA | | | | | |
| 0.56µF | 564 | | P | P | P | V | V | | | | | | | | Q | Q | Q | Q | Q | AA | AA | AA | | | | | |
| 0.68µF | 684 | | P | P | P | V | V | | | | | | | | Q | Q | Q | Q | Q | Z | AA | AA | | | | | |
| 0.82µF | 824 | | P | P | P | V | V | | | | | | | | Q | Q | Q | Q | Q | Z | | | | | | | |
| 1.0µF | 105 | | P | P | P | V | V | | | | | | | | Q | Q | Q | Q | Q | Z | | | | | | | |
| 1.2µF | 125 | | | | V | V | V | | | | | | | | | | | | | | | | | | | | |
| 1.5µF | 155 | P | P | P | V | V | V | | | | | | | | | | Z | U | AA | AA | | | | | | | |
| 1.8µF | 185 | | | | V | V | V | | | | | | | | | | | | | | | | | | | | |
| 2.2µF | 225 | P | P | P | V | V | U | | | | | | | | | | Z | U | AA | AA | | | | | | | |
| 2.7µF | 275 | | | | V | V | | | | | | | | | | | | | | | | | | | | | |
| 3.3µF | 335 | | V | V | V | V | | | | | | | | | | | Z | U | AA | AA | | | | | | | |
| 3.9µF | 395 | | | | V | V | | | | | | | | | | | | | | | | | | | | | |
| 4.7µF | 475 | V | V | V | V | V | | | | | | | | | Z | Z | Z | Z | AA | AA | | | | | | | |
| 10µF | 106 | V | V | V | V | | | | | | | | | | Z | Z | Z | AA | AA | | | | | | | | |
| 22µF | 226 | | V | | | | | | | | | | | | AA | AA | AA | | | | | | | | | | |
| 47µF | 476 | | | | | | | | | | | | | | AA# | AA | | | | | | | | | | | |

CAPACITANCE RANGE

* ARC PROTECTION COATING
#: Only available in 12mm T

| CODE | O | P | Q | U | V | Y | Z | AA |
|---|---|---|---|---|---|---|---|---|
| THICKNESS | 0.95 ± 0.10 | 1.15 ± 0.15 | 1.25 ± 0.10 | 1.60 ± 0.20 | 1.60 +0.3/-0.10 | 1.90 ± 0.20 | 2.00 ± 0.20 | 2.50 ± 0.30 |

MS LEVEL 1

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# CAPACITANCE RANGE

| DIELECTRIC | | X7R | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 1808 | | | | | | | 1812 | | | | | | | | | | | | | | | | |
| RATED VOLTAGE | | 500 | 630 | 1000 | 1500 | 2000 | 3000 | 4000 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 400 | 500 | 630 | 1000 | 1500 | 2000 | 3000 | 4000 | | |
| 150pf | 151 | Q | Q | Q | Q | Q | Q | Z* | | | | | | | | | | | | | | | | | |
| 180pf | 181 | Q | Q | Q | Q | Q | Q | Z* | | | | | | | | | | | | | | | | | |
| 220pf | 221 | Q | Q | Q | Q | Q | Q | Z* | | | | | | | | | | | | | | | | | |
| 270pf | 271 | Q | Q | Q | Q | Q | Q | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 330pf | 331 | Q | Q | Q | Q | Q | Q | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 390 | 391 | Q | Q | Q | Q | Q | Q | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 470pf | 471 | Q | Q | Q | Q | Q | Q | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 560pf | 561 | Q | Q | Q | Q | Q | U | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 680pf | 681 | Q | Q | Q | Q | Q | U | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 820pf | 821 | Q | Q | Q | Q | Q | U | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z* | | |
| 1,000pf | 102 | Q | Q | Q | Q | Q | Z | Z* | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | Z* | | |
| 1,200pf | 122 | Q | Q | Q | Q | Q | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | G* | | |
| 1,500pf | 152 | Q | Q | Q | Q | Q | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | G* | | |
| 1,800pf | 182 | Q | Q | Q | Q | Q | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA | G* | | |
| 2,200pf | 222 | Q | Q | Q | U | U | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | G* | | | |
| 2,700pf | 272 | Q | Q | Q | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | G* | | | |
| 3,300pf | 332 | Q | Q | Q | Z | Z | Z | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U | G* | | | |
| 3,900pf | 392 | Q | Q | Q | Z | Z | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | G* | | | |
| 4,700pf | 472 | Q | Q | Q | Z | Z | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | G* | | | |
| 5,600pf | 562 | Q | Q | Q | Z | Z | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA | AA | | | | |
| 6,800pf | 682 | Q | Q | Q | Z | Z | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA | AA | | | | |
| 8,200pf | 822 | Q | Q | Q | Z* | Z* | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA | AA | | | | |
| 0.01µF | 103 | Q | Q | Q | Z* | Z* | Z* | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U/Z/AA | U/Z/AA | | | | |
| 0.012µF | 123 | U | U | U | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U/Z/AA | | | | | |
| 0.015µF | 153 | U | U | U | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U/Z/AA | | | | | |
| 0.018µF | 183 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | U/Z/AA | | | | | |
| 0.022µF | 223 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | U | Z/AA | | | | | |
| 0.027µF | 273 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | | | | | | |
| 0.033µF | 333 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z | | | | | | |
| 0.039µF | 393 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | AA | | | | | | |
| 0.047µF | 473 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Z/AA | | | | | | |
| 0.056µF | 563 | Z | Z | Z | | | | | Q | Q | Q | Q | Q | Q | Q | Q | U | U | AA | | | | | | |
| 0.068µF | 683 | Z | Z | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | U | U | AA | | | | | | |
| 0.082µF | 823 | Z | Z | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | U | U | AA | | | | | | |
| 0.1µF | 104 | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | U | U | AA | | | | | | |
| 0.12µF | 124 | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | | | | | | | |
| 0.15µF | 154 | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | Z | Z | | | | | | | |
| 0.18µF | 184 | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | AA | AA | | | | | | | |
| 0.22µF | 224 | | | | | | | | Q | Q | Q | Q | Q | Q | Q | Q | AA | AA | | | | | | | |
| 0.27µF | 274 | | | | | | | | Q | Q | Q | Q | Q | U | U | U | AA | | | | | | | | |
| 0.33µF | 334 | | | | | | | | Q | Q | Q | Q | Q | U | U | U | AA | | | | | | | | |
| 0.39µF | 394 | | | | | | | | Q | Q | Q | Q | Q | Z | Z | Z | AA | | | | | | | | |
| 0.47µF | 474 | | | | | | | | Q | Q | Q | Q | Q | Z | Z | Z | AA | | | | | | | | |
| 0.56µF | 564 | | | | | | | | Q | Q | Q | Q | Q | AA | AA | | | | | | | | | | |
| 0.68µF | 684 | | | | | | | | Q | Q | Q | Q | Q | AA | AA | | | | | | | | | | |
| 0.82µF | 824 | | | | | | | | Q | Q | Q | Q | Q | AA | AA | | | | | | | | | | |
| 1.0µF | 105 | | | | | | | | Q | Q | Q | Q | Q | AA | AA | | | | | | | | | | |
| 1.2µF | 125 | | | | | | | | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| 1.5µF | 155 | | | | | | | | Q | Q | Q | Q | Q | | | | | | | | | | | | |
| 1.8µF | 185 | | | | | | | | U | U | U | U | U | | | | | | | | | | | | |
| 2.2µF | 225 | | | | | | | | U | U | U | U | U | | | | | | | | | | | | |
| 2.7µF | 275 | | | | | | | | Z | Z | Z | Z | Z | | | | | | | | | | | | |
| 3.3µF | 335 | | | | | | | | Z | Z | Z | Z | Z | | | | | | | | | | | | |
| 3.9µF | 395 | | | | | | | | Z | Z | Z | Z | Z | | | | | | | | | | | | |
| 4.7µF | 475 | | | | | | | | AA | AA | AA | AA | AA | | | | | | | | | | | | |
| 5.6µF | 565 | | | | | | | | AA | AA | AA | AA | | | | | | | | | | | | | |
| 6.8µF | 685 | | | | | | | | AA | AA | AA | AA | | | | | | | | | | | | | |
| 8.2µF | 825 | | | | | | | | AA | AA | AA | AA | | | | | | | | | | | | | |
| 10µF | 106 | | | | | | | | AA | AA | AA | AA | | | | | | | | | | | | | |
| 12µF | 126 | | | | | | | | AA | AA | AA | | | | | | | | | | | | | | |
| 15µF | 156 | | | | | | | | AA | AA | AA | | | | | | | | | | | | | | |
| 18µF | 186 | | | | | | | | AA | AA | AA | | | | | | | | | | | | | | |

CAPACITANCE RANGE

* ARC PROTECTION COATING

| CODE | Q | U | Z | AA |
|---|---|---|---|---|
| THICKNESS | 1.25 ± 0.10 | 1.60 ± 0.20 | 2.00 ± 0.20 | 2.50 ± 0.30 |

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# CAPACITANCE RANGE

| DIELECTRIC | | X7R | | |

# CAPACITANCE RANGE

## X7S

| DIELECTRIC | | X7S | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 0402 | | | | | 0603 | | | | | | | 0805 | | | | | | 1206 | | | | | | | 1210 | | | | | | 2220 | | | | | |
| RATED VOLTAGE | | 6.3 | 10 | 16 | 25 | 35 | 6.3 | 10 | 16 | 25 | 35 | 50 | 100 | 6.3 | 10 | 16 | 25 | 50 | 100 | 6.3 | 10 | 16 | 25 | 50 | 100 | 1K | 2K | 6.3 | 10 | 16 | 25 | 50 | 100 | 50 | 100 | 2K |
| 470pF | 471 | | | | | | | | | | | | | | | | | | | | | | | | | | II | | | | | | | | | | |
| 1000pF | 102 | | | | | | | | | | | | | | | | | | | | | | | | | GG | | | | | | | | | | | |
| 2200pF | 222 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4700pF | 472 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.01µF | 103 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | AA |
| 0.033µF | 333 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.047µF | 473 | | | | | | | | | | | FF | FF | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.068µF | 683 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.1µF | 104 | | | | | | | | | | | FF | FF | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.15µF | 154 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.22µF | 224 | | | | | | | | | | | | | | | | | Q | R | | | | | | | | | | | | | | | | | | |
| 0.33µF | 334 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.47µF | 474 | G | G | | | | | | | | | | | | | | | R | R | | | | | | | | | | | | | | | | | | |
| 0.68µF | 684 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1µF | 105 | | | | | | | K | K | | | | | | | | | II | II | | | | | | | | | | | | | | | | | | |
| 1.5µF | 155 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2µF | 225 | | | | | | | | K | | | | | | | | | | | | | | | W | W | | | | | | | | | | | | |
| 3.3µF | 335 | | | | | | K | | | | | | | | | | | | | | | | | | | | | | | | | | | | KK | | |
| 4.7µF | 475 | | | | | | K | | | | | | | | II | II | II | II | | | | | | W | W | | | | | | | | | AA | AA | | |
| 6.8µF | 685 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10µF | 106 | | | | | | | | | | | | | | H | H | H | | | | | | KK | KK | | | | | | | | | AA | AA | | AA | |
| 22µF | 226 | | | | | | | | | | | | | | | | | | | | W | KK | | | | | | | | | | JJ | | | | | |
| 27µF | 276 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33µF | 336 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 39µF | 396 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47µF | 476 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100µF | 107 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| CODE | G | H | FF | K | GG | Q | R | II | W | KK | AA | JJ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THICKNESS | 0.50 ± 0.20 | 0.60 ± 0.20 | 0.7 ± 0.20 | 0.8 + 0.15/-0.10 | 0.8 ± 0.2 | 1.25 ± 0.10 | 1.25 ± 0.20 | 1.25 ± 0.25 | 1.6 ± 0.4 | 1.80 ± 0.20 | 2.50 ± 0.30 | 2.55 ± 0.3 |

## X5R

| DIELECTRIC | | X5R | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | | 0402 | | | | | 0603 | | | | | | 0805 | | | | | | 1206 | | | | | 1210 | | | | |
| RATED VOLTAGE | | 6.3 | 10 | 16 | 25 | 35 | 6.3 | 10 | 16 | 25 | 35 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 |
| 1000pF | 102 | | | | | | | | | | | K | | | | | | | | | | | | | | | |
| 2200pF | 222 | | | | | | | | | | | K | | | | | | | | | | | | | | | |
| 4700pF | 472 | | | | | | | | | | | K | | | | | | | | | | | | | | | |
| 0.033µF | 333 | | | G | | | | | | | | | | | | | | | | | | | | | | | |
| 0.047µF | 473 | | | G | | | | | | | | | | | | | | | | | | | | | | | |
| 0.068µF | 683 | | G | G | | | | | | | | | | | | | | | | | | | | | | | |
| 0.1µF | 104 | G | G | G | G | | | | | | | | | | | | | | | | | | | | | | |
| 0.15µF | 154 | G | G | G | G | | | | | | | | | | | | | | | | | | | | | | |
| 0.22µF | 224 | G | G | G | G | | | | M | M | | | | | | | | | | | | | | | | | |
| 0.33µF | 334 | G | G | | | | M | M | M | M | | | | | | | | | | | | | | | | | |
| 0.47µF | 474 | G | G | | G | G | | M | M | M | | | | | | | | | | | | | | | | | |
| 0.68µF | 684 | G | G | | | | M | M | M | M | | | | | | | | | | | | | | | | | |
| 1µF | 105 | G | G | | G | G | M | M | FF | | | | | S | S | S | | | | | | | | | | | |
| 1.5µF | 155 | | | | | | M | | | | | | S | S | S | S | | | P | P | | | | Z | Z | | |
| 2.2µF | 225 | | | | G | G | M | M | M | K | | K | S | S | S | S | | | P | P | X | | | Z | Z | | |
| 3.3µF | 335 | | | | | | M | | | | | | S | S | S | S | | | X | X | X | | | | | | |
| 4.7µF | 475 | G | G | | | | M | K | GG | | | | | | | | | X | X | X | X | | | Z | Z | Z | |
| 6.8µF | 685 | | | | | | | | | | | | | | | | | X | X | | | | | | | | |
| 10µF | 106 | G | | | | | GG | GG | | | | | II | II | R | R | | X | X | X | X | | Z | Z | Z | | |
| 22µF | 226 | EE | | | | | FF | HH | | | | | II | II | | | | | | | U | U | | | | | |
| 33µF | 336 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47µF | 476 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100µF | 107 | | | | | | | | | | | | | | | | | W | | | | | | | | | |

| CODE | G | EE | FF | GG | HH | K | M | P | U | W | X | II | S | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THICKNESS | 0.50 ± 0.20 | 0.60 ± 0.20 | 0.7 ± 0.20 | 0.8 ± 0.2 | 0.8 ± 0.25 | 0.8 + 0.15/-0.10 | 0.80 ± 0.3 | 1.15 ± 0.15 | 1.60 ± 0.20 | 1.6 ± 0.4 | 1.6 ± 0.5 | 1.25 ± 0.25 | 1.25 ± 0.30 | 2.00 ± 0.20 |

# RELIABILITY TEST CONDITIONS AND REQUIREMENTS

## 1. Visual and Mechanical

**TEST CONDITION:** ---

**REQUIREMENTS:**
- No remarkable damage.
- Dimensions to conform to individual specification sheet.

## 2. Capacitance

**REQUIREMENTS:**
- Shall not exceed the limits given in the detailed spec.

## 3. Q/D.F (Dissipation Factor)

**TEST CONDITION:**

- Class I :
  Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.
  Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.
- Class II :
  Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%**.
  Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.

** Test condition: 0.5±0.2Vrms, 1KHz±10%

- X7R:
  0805 - 106 (6.3V), 0603/475 (6.3V)
- X7S:
  0805 - 106 (6.3V), 0603/475 (6.3V)

-X5R-
0402≥475 (6.3V,16V), 0402≥225(10V),
0603=106 (6.3V)
#1 Excluding
GMX04X5R475M6R3NT (1.0±0.2Vrms, 1KHz±10%)

*Before initial measurement (Class II only) : To apply deaging at 150°C for 1hr then set for 24±2 hrs at room temp

**REQUIREMENTS:**

- Class I :

| DIELECTRIC | RATED VOL. | Q/D. F | REMARK |
|---|---|---|---|
| Class 1 | All | Q≥1000 | Cap.≥30pF |
| | | Q≥400+20C | Cap.<30pF |

- Class II:

| RATED | D.F.≤ | EXCEPTION OF D.F.≤ | |
|---|---|---|---|
| ≥100V | ≤2.5% | ≤3.5% | 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF |
| | | ≤5% | 0603≥0.068μF, 0805>0.1μF, 1206>1μF, 1210≥2.2μF |
| | | ≤10% | 0805>0.22μF, 1210≥3.3μF |
| 50V | ≤2.5% | ≤3.5% | 0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF |
| | | ≤5% | 1210≥4.7μF |
| | | ≤10% | 0402≥0.1μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF |
| 35V | ≤3.5% | ≤10% | 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF |
| 25V | ≤3.5% | ≤5% | 0805≥1μF, 1210≥10μF |
| | | ≤7% | 0603≥0.33μF, 1206≥4.7μF |
| | | ≤10% | 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF |
| | | ≤12.5% | 0402≥0.47μF |
| 16V | ≤3.5% | ≤5% | 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF |
| | | ≤10% | 0402≥0.22uF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF |
| 10V | ≤5% | ≤10% | 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF |
| | | ≤15% | 0402≥1μF |
| 6.3V | ≤10% | ≤15% | 0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF |
| | | ≤20% | 0402≥2.2μF |
| 4V | ≤15% | --- | --- |

X5R:

| RATED | D.F.≤ | EXCEPTION OF D.F.≤ | |
|---|---|---|---|
| ≥100V | ≤2.5% | ≤3% | 1206≥0.47μF |
| | | ≤5% | 0603≥0.068μF, 0805>0.1μF, 1206>1μF, 1210≥2.2μF |
| | | ≤10% | 0805>0.22μF, 1210≥3.3μF |
| 50V | ≤2.5% | ≤3% | 0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF |
| | | ≤5% | 1210≥4.7μF |
| | | ≤10% | 0402≥0.012μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF |
| | | ≤12.5% | 1206≥2.2μF |
| 35V | ≤3.5% | ≤10% | 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF |
| 25V | ≤3.5% | ≤5% | 0201=0.01μF; 0805≥1μF |
| | | ≤7% | 0603≥0.33μF |
| | | ≤10% | 0201>0.01μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥10μF |
| | | ≤12.5% | 0402≥0.33μF; 0805=10μF |
| 16V | ≤3.5% | ≤5% | 0201=0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF |
| | | ≤10% | 0402≥0.22uF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF |
| | | ≤12.5% | 0402≥1uF, 0805≥2.2μF |
| 10V | ≤5% | ≤10% | 0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF; 01R5/X5R |
| | | ≤12.5% | 0805≥10μF |
| | | ≤15% | 0201>0.1μF; 0402≥1μF; 0603≥10μF |
| 6.3V | ≤10% | ≤15% | 0201>0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF |
| | | ≤20% | 0402≥2.2μF |
| 4V | ≤15% | --- | --- |

## 4. Temperature Coefficient

**TEST CONDITION:**

- With no electrical load

| T.C. | OPERATING TEMPERATURE |
|---|---|
| C0G | -55~125°C at 25°C |
| X7R | -55~125°C at 25°C |
| X7S | -55~125°C at 25°C |
| X5R | -55~85C at 25°C |

- Measurement voltage for Class II:

| SIZE | CAP. RANGE | CONDITION |
|---|---|---|
| 0402 | Cap.<0.1μF | 1V |
| | Cap.=1μF | 0.5V |
| | 1μF<Cap.<10μF | 0.2V |
| | Cap.≥10μF | 0.1V |
| 0603 | Cap.≤1μF | 1V |
| | 1μF<Cap.≤4.7μF | 0.5V |
| | Cap.>4.7μF | 0.2V |
| 0805 | Cap.<10μF | 1V |
| | Cap.=10μF | 0.5V |
| | Cap.>10μF | 0.2V |
| 1206/1210 | Cap.≤10μF | 1V |
| | 10μF<Cap.≤100μF | 0.5V |
| | Cap.>100μF | 0.2V |

**REQUIREMENTS:**

-No evidence of damage or flash over during test.

| T.C. | CAPACITANCE CHARGE |
|---|---|
| C0G | Within ±30ppm/°C |
| X7R | Within ±15% |
| X7S | Within ±22% |
| X5R | Within ±15% |

MS LEVEL 1

# RELIABILITY TEST CONDITIONS AND REQUIREMENTS

## 5. Insulation Resistance

**TEST CONDITION**

| RATED VOL. (V) | APPLY VOLTAGE | CHARGE TIME |
|---|---|---|
| ≤100 | 1 times of $U_R$ | Max. 120 sec. |
| 200≤V≤500 | 1 times of $U_R$ | 60 sec. |
| >500 | 500Vdc | 60 sec. |

**REQUIREMENT**

-No evidence of damage or flash over during test.

| DIELECTRIC | CAPACITANCE RANGE |
|---|---|
| Class I | ≥10GΩ or RxC≥500Ω-F, whichever is smaller |
| Class II | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |

- Except (Class II)

| RATED VOLTAGE (X7R) | I.R. |
|---|---|
| ≥10GΩ or RxC≥100Ω-F, whichever is smaller | |
| 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF, 1812≥10μF, 2220≥22μF | |
| 35V : 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |
| 25V : 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF | |
| 16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF | |
| 10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | |
| 6.3V; 4V | |

| RATED VOLTAGE (X7R) | I.R. |
|---|---|
| 100V : 1210≥3.3μF | |
| 50V : 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF | |
| 35V : 0603≥1μF | |
| 25V : 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF | RxC≥50Ω-F |
| 16V : 0603≥10μF, 0402≥1μF, 0201≥0.22μF | |
| 10V : 0402≥1μF, 0603≥10μF, 0805≥47μF | |
| 6.3V : 0603>4.7μF, 0805≥47μF, 1206≥10μF | |
| 4V : 0603≥22μF, 0805≥47μF, 1206≥100μF | |

| RATED VOLTAGE (X5R) | I.R. |
|---|---|
| 25V: 0402>0.1UF, 0603:>0.22UF, 0805:>1UF:1206>2.2UF, 1210>4.7UF | |
| 16V: 0402>0.033UF, 0603:>0.22UF, 0805:>1UF:1206>1.5UF, 1210>1.5UF | RxC≥50Ω-F |
| 10V: 0402>0.068UF, 0603:>0.33UF, 0805:>1UF:1206>1.5UF, 1210>1.5UF | |
| 6.3V: 0402>0.1UF, 0603:>0.33UF, 0805:>1.5UF:1206>100UF, 1210>10UF | |

## 6. Dielectric Strength

**TEST CONDITION**

| RATED VOLTAGE | CONDITION |
|---|---|
| ≤100 | 2.5 times of $U_R$ |
| 100≤V≤500 | 2.0 times of $U_R$ |
| 250<V≤500 | 1.5 times of $U_R$ |
| 630≤V≤3000V | 1.2 times of $U_R$ |
| 3000<V<5000V | 1.1 times of $U_R$ |
| ≥5000V | 1.0 times of $U_R$ |

- Duration : 1 to 5 sec. Voltage ramp up rate ≤500Vdc/sec.
- Charge and discharge current less than 50mA.
- Test in insulating fluid for rated voltage ≥1KV products

**REQUIREMENT**

- No evidence of damage or flash over during test.

## 7. Solderability

**TEST CONDITION**

- Solder temperature : 235±5°C for (0402~1210).
- Solder temperature : 245±5°C for (1808~2225).
- Dipping time : 2±0.5 sec.

**REQUIREMENT**

- 75% min. coverage of all metalized area

## 8. Resistance to Soldering Heat

**TEST CONDITION**

- Solder temperature : 260±5°C.
- Dipping time : 10±1 sec.
- Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.
- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).

**REQUIREMENT**

- No remarkable damage.
- Cap. change :
  C0G : Within ±2.5% or ±0.25pF, whichever is larger.
  X7R, X7S, X5R : Within ±7.5%.
- D.F./Q, I.R : To meet initial requirements.
- 25% max. leaching on each edge.

## 9. Temperature Cycle

**TEST CONDITION**

- Conduct the five cycles according to the temperatures and time

| STEP | TEMP (°C) | TIME (MIN) |
|---|---|---|
| 1 | Min. operating temp. +0/-3 | 30 ± 3 |
| 2 | Room Temp | 2 ~ 3 |
| 3 | Min. operating temp +0/-3 | 30 ± 3 |
| 4 | Room Temp | 2 ~ 3 |

- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).

**REQUIREMENT**

- No remarkable damage.
- Cap. change :
  C0G : Within ±2.5% or ±0.25pF, whichever is larger.
  X7R, X7S, X5R : Within ±7.5%.
- D.F./Q :
  C0G : Q≥100% of initial requirements.
  X7R, X7S, X5R : D.F.≤150% of initial requirement.
- I.R. : ≥100% of initial requirement.

# RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>NO.</th><th>ITEM</th><th>TEST CONDITION</th><th>REQUIREMENTS</th></tr>
<tr><td>10.</td><td>Humidity<br>(Damp Heat)<br>Steady State</td><td>- Test temp. : 40±2°C.<br>- Humidity : 90~95%RH.<br>- Test time : 500 +24/-0hrs.<br>- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.<br>- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>- No remarkable damage.<br>- Cap. change :<br>C0G : Within ±5.0% or ±0.5pF, whichever is larger.<br>X7R, X7S, X5R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.<br>**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.<br><br>- D.F./Q :<br>C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.<br>X7R, X7S, X5R : D.F.≤200% of initial requirement.<br><br>- I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller<br><br>Except:<br><table><tr><th>RATED VOLTAGE (X7R, X7S, X5R)</th><th>I.R.</th></tr><tr><td>100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥1GΩ or RxC ≥ 10Ω-F, whichever is smaller</td></tr><tr><td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td></tr><tr><td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td></tr><tr><td>25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr><tr><td>16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr><tr><td>10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr><tr><td>6.3V; 4V; Size≥1812</td></tr></table></td></tr>
<tr><td>11.</td><td>Humidity<br>(Damp Heat)<br>Load</td><td>- Reflow solder the capacitors on a P.C. Board before test.<br>- Test temp. : 40±2°C (85±3°C for control code H).<br>- Humidity : 90~95% RH (85±5% for control code H).<br>- Test time : 500 +24/-0hrs.<br>- To apply voltage : Rated voltage ( 500Vdc max. for general purpose and 100Vdc max. for control code H)<br>- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>- No remarkable damage.<br>- Cap. change :<br>C0G : Within ±7.5% or ±0.75pF, whichever is larger.<br>X7R, X7S, X5R: Within ±12.5% for ≥10V**, within ±25% for 6.3V.<br>**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.<br><br>- D.F./Q :<br>C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.<br>X7R, X7S, X5R : ≤200% of initial requirement.<br><br>- I.R. : ≥10V, ≥500MΩ or RxC≥25Ω-F, whichever is smaller.<br>Except:<br><table><tr><th>RATED VOLTAGE (X7R, X7S, X5R)</th><th>I.R.</th></tr><tr><td>≥100V : All X7R; 1210≥3.3μF</td><td rowspan="7">≥500MΩ or RxC≥5Ω-F, whichever is smaller</td></tr><tr><td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td></tr><tr><td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td></tr><tr><td>25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr><tr><td>16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr><tr><td>10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr><tr><td>6.3V; 4V; Size≥1812</td></tr></table></td></tr>
</table>

# RELIABILITY TEST CONDITIONS AND REQUIREMENTS

## 12. High Temperature Load (Endurance)

### TEST CONDITION

- Test temp. : 125±3°C.
- To apply voltage :
  - (1) ≤6.3V or Cap.≥10μF : 150% of rated voltage.
  - (2) 10V≤Ur≤100V : 200% of rated voltage.
  - (3) 200V≤Ur≤500V : 150% of rated voltage.
  - (4) 630V : 120% of rated voltage.
  - (5) Ur≥1000V : 100% of rated voltage.
  - (6) 100% of rated voltage for below range:

| SIZE | DIELECTRIC | RATED | CAPACITANCE |
|---|---|---|---|
| 0402 | X7R / X7S | 6.3V, 10V, 16V, 25V | C≥1.0μF |
| 0603 | X7R / X7S | 4V | C≥22μF |
| | | 6.3V,10V | C≥4.7μF |
| | | 25V, 35V | C≥1.0μF |
| 0805 | X7R / X7S | 4V | C≥47μF |
| | | 6.3V | C≥22μF |
| | | 10V~50V | C≥10μF |
| 1206 | X7R / X7S | ≤6.3V | C≥47μF |
| | | 100V | C≥2.2μF |
| 1210 | X7R / X7S | 16V | C≥47μF |
| | | ≥100V | C≥3.3μF |
| 2220 | X7R / X7S | 100V | C≥22μF |

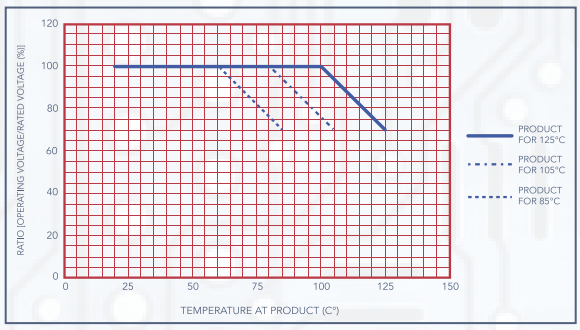
(7) 150% of rated voltage for below range:

| SIZE | DIELECTRIC | RATED | CAPACITANCE |
|---|---|---|---|
| 0402 | X7R / X7S | 50V | C≥0.1μF |
| | | 10~25V | C≥0.22μF |
| | X5R | ≤16V | C≥1.0μF |
| | | 25V, 50V | C≥1.0μF |
| 0603 | X7R / X7S | ≥50V | C≥0.082μF |
| | | 10V, 16V, 50V | C≥1.0μF |
| | X5R | 4V | C≥22μF |
| 0805 | X7R / X7S | 10~50V | C≥4.7μF |
| | | 50V | C≥0.47μF |
| | | ≥100V | C≥0.12μF |
| | X5R | 16V, 25V | C≥22μF |
| 1206 | X7R / X7S | ≥50V | C≥1.0μF |
| | X5R | ≤6.3V | C≥47μF |
| 1210 | X7R / X7S | ≤100V | C≥1.0μF |
| | | >100V | C≥0.22μF |
| | X5R | 16V | C≥47μF |
| 1812 | X7R / X7S | ≤50V | C≥4.7μF |
| | | 100V | C≥1.0μF |
| 1825<br>2220<br>2225 | X7R / X7S | ≥100V | C≥1.0μF |

(8) 120% of rated voltage for below range:

| SIZE | DIELECTRIC | RATED | CAPACITANCE |
|---|---|---|---|
| 2220 | X7R / X7S | ≥100V | C≥15μF |

- Test time : 1000 +24/-0 hrs.
- Before initial measurement (Class II only) : To apply deaging at 150°C for 1hr then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).
- De-rating conditions :



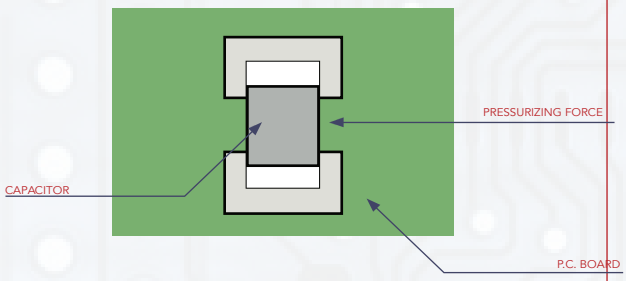
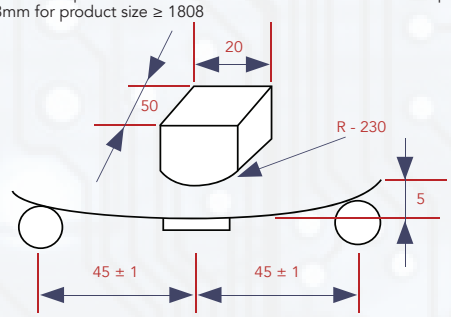

### REQUIREMENTS

- No remarkable damage.
- Cap. change :
  - C0G : Within ±5.0% or ±0.5pF, whichever is larger.
  - X7R, X5R : Within ±12.5% for ≥10V**, within ±25% for 6.3V.
  - **10V : Within ±25% for 0603≥4.7μF, 0402≥1μF.
- D.F./Q :
  - C0G : Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF, Q≥200+10C for Cap.<10pF.
  - X7R, X5R : D.F.≤200% of initial requirement.
- I.R. : ≥10V, ≥1GΩ or R×C≥50Ω-F, whichever is smaller.

Except:

| RATED VOLTAGE | I.R. |
|---|---|
| 100V : All X7R; 1210≥3.3μF | ≥1GΩ or RxC≥10Ω-F, whichever is smaller |
| 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF | |
| 35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | |
| 25V : 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF | |
| 16V : 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF | |
| 10V : 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | |
| 6.3V; 4V; Size≥1812 | |

# RELIABILITY TEST CONDITIONS AND REQUIREMENTS

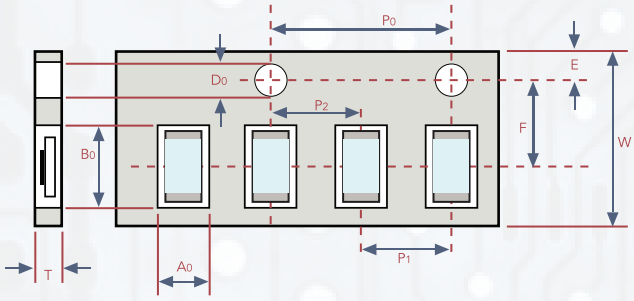
| NO. | ITEM | TEST CONDITION | REQUIREMENTS |
|---|---|---|---|
| 13. | Adhesive Strength of Termination | - Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(>0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second   | - No remarkable damage or removal of the terminations |
| 14. | Bending Test | - The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 5mm for product size < 1808, 3mm for product size ≥ 1808   | - No remarkable damage. <br>DIELECTRIC / CAP. CHANGE<br>Class I (C0G) / Within ±5.0% or ±0.5pF, whichever is larger<br>Class II (X7R, X7S, X5R) / Within ±12.5%<br>- This capacitance change means the change of capacitance under specified flexure of substrate from the before test initial measurement |
| 15. | Vibration Resistance | - Vibration frequency : 10~55 Hz/min.<br>- Total amplitude : 1.5mm.<br>- Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions)<br>- Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.<br>- Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | - No remarkable damage or removal of the terminations<br>- Cap. change and D.F./Q : To meet initial spec. |

# PACKAGE DIMENSION AND QUANTITY

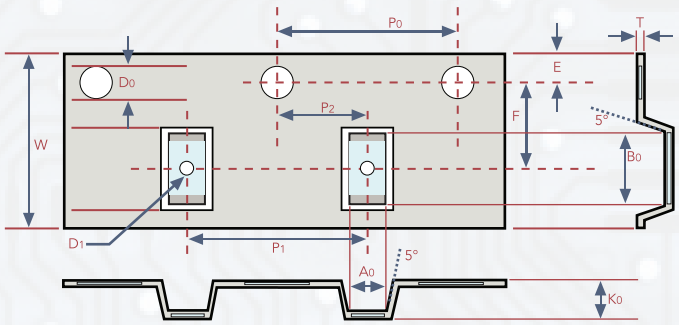
| SIZE | THICKNESS (MM) | PAPER TAPE | | PLASTIC TAPE | |
|---|---|---|---|---|---|
| | | 7" REEL | 13" REEL | 7" REEL | 13" REEL |
| 0402 (1005) | 0.50±0.05 | 10K | 50K | - | - |
| | 0.50 +0.02/-0.05 | 10K | 50K | - | - |
| | 0.50±0.20 | 10K | - | - | - |
| 0603 (1608) | 0.50±0.10 | 4K | - | - | - |
| | 0.80±0.07 | 4K | 15K | - | - |
| | 0.80 +0.15/-0.10 | 4K | 15K | - | - |
| 0805 (2012) | 0.50±0.10 | 4K | 15K | - | - |
| | 0.60±0.10 | 4K | 15K | - | - |
| | 0.80±0.10 | 4K | 15K | - | - |
| | 0.85±0.10 | 4K | 15K | - | - |
| | 1.25±0.10 | - | - | 3K | 10K |
| | 1.25±0.20 | - | - | 3K | 10K |
| 1206 (3216) | 0.80±0.10 | 4K | 15K | - | - |
| | 0.85±0.10 | 4K | 15K | - | - |
| | 0.95±0.10 | - | - | 3K | 10K |
| | 1.15±0.15 | - | - | 3K | 10K |
| | 1.25±0.10 | - | - | 3K | 10K |
| | 1.60±0.20 | - | - | 2K | 10K |
| | 1.60 +0.30/-0.10 | - | - | 2K | 9K |
| 1210 (3225) | 0.85±0.10 | - | - | 3K | 10K |
| | 0.95±0.10 | - | - | 3K | 10K |
| | 1.25±0.10 | - | - | 3K | 10K |
| | 1.60±0.20 | - | - | 2K | - |
| | 1.90 ± 0.20 | - | - | 2K | - |
| | 2.00±0.20 | - | - | 500 / 1K | 6K |
| | 2.50±0.30 | - | - | 500 / 1K | 6K |
| 1808 (4520) | 1.25±0.10 | - | - | 2K | 10K |
| | 1.60±0.20 | - | - | 2K | 8K |
| | 2.00±0.20 | - | - | 1K | 6K |
| 1812 (4532) | 1.25±0.10 | - | - | 1K | 5K |
| | 1.60±0.20 | - | - | 1K | - |
| | 2.00±0.20 | - | - | 1K | - |
| | 2.50±0.30 | - | - | 0.5K | 3K |
| | 2.80±0.30 | - | - | 0.5K | - |
| 1825 (4563) | 1.60±0.20 | - | - | 1K | - |
| | 2.00±0.20 | - | - | 1K | - |
| | 2.50±0.30 | - | - | 0.5K | - |
| | 2.80±0.30 | - | - | 0.5K | - |
| 2220 (5750) | 1.60±0.20 | - | - | 1K | - |
| | 2.00±0.20 | - | - | 1K | - |
| | 2.50±0.30 | - | - | 0.5K | - |
| | 2.80±0.30 | - | - | 0.5K | - |
| | 3.10±0.30 | - | - | - | 1K |
| 2225 (5763) | 1.60±0.20 | - | - | 500 / 1K | - |
| | 2.00±0.20 | - | - | 500 / 1K | - |
| | 2.50±0.30 | - | - | 0.5K | - |
| | 2.80±0.30 | - | - | 0.5K | - |

# PACKAGE DIMENSION AND QUANTITY

- Embossed Tape Dimensions




Dimension of paper tape



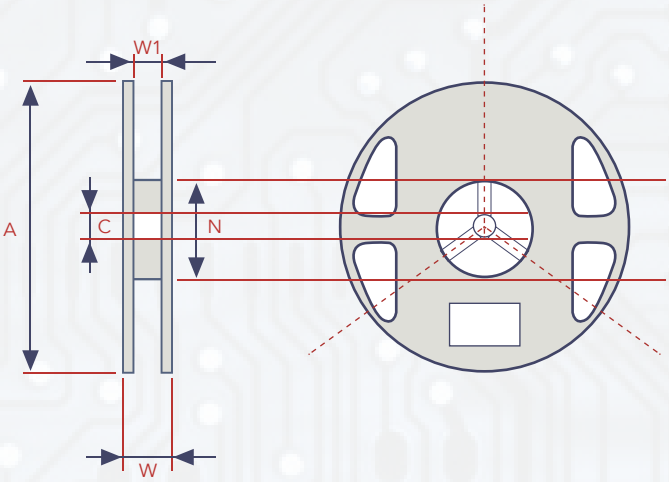

Dimension of plastic tape

| SIZE | CHIP THICKNESS | $A_0$ | $B_0$ | T | $K_0$ | W | $P_0$ | 10X $P_0$ | $P_1$ | $P_2$ | $D_0$ | $D_1$ | E | F | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0402 | 0.50±0.05 | 0.70±0.20 | 1.20±0.20 | ≤0.80 | - | 8.00±0.10 | 4.00±0.10 | 40.00±0.10 | 2.00±0.05 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.05 | 3.50±0.05 | MM |
| | 0.50±0.10 | 0.70±0.20 | 1.20±0.20 | ≤0.80 | - | 8.00±0.10 | 4.00±0.10 | 40.00±0.10 | 2.00±0.05 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.05 | 3.50±0.05 | MM |
| 0603 | 0.80±0.07 | 1.00 +0.05/-0.1 | 1.80±0.10 | 0.95±0.05 | - | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.05 | 3.50±0.05 | MM |
| | 0.80 +0.15/-0.1 | 1.02 +0.05/-0.1 | 1.80±0.10 | 0.97±0.05 | - | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.05 | 3.50±0.05 | MM |
| 0805 | 0.80±0.10 | 1.50±0.10 | 2.30±0.10 | 0.95±0.05 | - | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.05 | 3.50±0.05 | MM |
| | 1.25±0.10 1.25±0.20 | <1.65 | <2.40 | 0.23±0.05 | <2.50 | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.00±0.10 | 1.75±0.10 | 3.50±0.05 | MM |
| 1206 | 0.80±0.10 | 2.00±0.10 | 3.50±0.50 | 0.95±0.05 | <2.50 | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.55±0.05 | - | 1.75±0.10 | 3.50±0.05 | MM |
| | 0.95±0.10 1.25±0.10 | <2.00 | <3.70 | 0.23±0.05 | <2.50 | 8.00±0.10 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.00±0.10 | 1.75±0.10 | 3.50±0.05 | MM |
| | 1.60±0.20 1.60+0.3/-0/1 | <2.50 | <4.00 | 0.23±0.05 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 1210 | 1.25±0.10 1.60±0.20 | <2.50 | <4.00 | 0.23±0.05 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.50±0.30 | <3.10 | <4.00 | 0.23±0.05 | <2.50 | 8.00 ± 0.10 / 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.00±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 1808 | 1.25±0.10 1.60±0.20 | <2.50 | <5.30 | 0.25±0.05 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.00±0.20 | <2.50 | <5.30 | 0.25±0.05 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 4.00±0.10 | 2.00±0.05 | 1.50±0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 1812 | 1.25±0.10 1.60±0.20 2.00±0.20 | <3.90 | <5.30 | 0.25±0.05 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.50±0.30 2.80±0.30 | <3.90 | <5.30 | 0.25±0.05 | <3.00 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 1825 | 1.60±0.20 2.00±0.20 | <6.80 | <5.30 | 0.30±0.10 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.50±0.30 2.80±0.30 | <6.80 | <5.30 | 0.30±0.10 | <3.10 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 2220 | 1.40±0.15 1.60±0.20 2.00±0.20 | <5.80 | <6.50 | 0.30±0.10 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.50±0.30 2.80±0.30 | <6.80 | <6.50 | 0.30±0.10 | <3.10 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 3.10±0.30 | <5.60 | <6.50 | 0.30±0.10 | <4.20 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| 2225 | 1.60±0.20 2.00±0.20 | <6.80 | <6.50 | 0.30±0.10 | <2.50 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |
| | 2.50±0.30 2.80±0.30 | <6.80 | <6.50 | 0.30±0.10 | <3.10 | 12.00±0.20 | 4.00±0.10 | 40.00±0.20 | 8.00±0.10 | 2.00±0.05 | 1.50 +0.10/-0 | 1.50±0.10 | 1.75±0.10 | 5.50±0.05 | MM |

## PACKAGE DIMENSION AND QUANTITY

- Reel Dimensions

| SIZE | REEL SIZE | C | $W_1$ | W | A | N |
|---|---|---|---|---|---|---|
| 0201, 0402, 0603, 0805, 1206, 1210, 0603 | 7" | 13.0 + 0.5/-0.2 | 8.4 + 1.5 | 14.4max | 178.0 ± 0.10 | 60.0 + 1.0/-0 |
| | 13" | 13.0 + 0.7/-0.3 | 8.4 + 1.5 | 14.4max | 330.0 ± 1.0 | 100 ± 1.0 |
| 1808, 1812, 1825, 2220, 2225 | 7" | 13.0 + 0.5/-0.2 | 12.4 + 2.0/-0 | 18.4max | 178.0 ± 0.10 | 60.0 + 1.0/-0 |
| 2220, 2225 | 13" | 13.5 ± 0.5 | 12.4 + 2.0/-0 | 18.4max | 330.0 ± 1.0 | 100 ± 1.0 |




## APPLICATION NOTES

### STORAGE

- To prevent the damage of solderability of terminations, the following storage conditions are recommended:
  - Indoors under 5 ~ 40°C and 20% ~ 70% RH.
  - No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.
  - Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

### HANDLING

- Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine

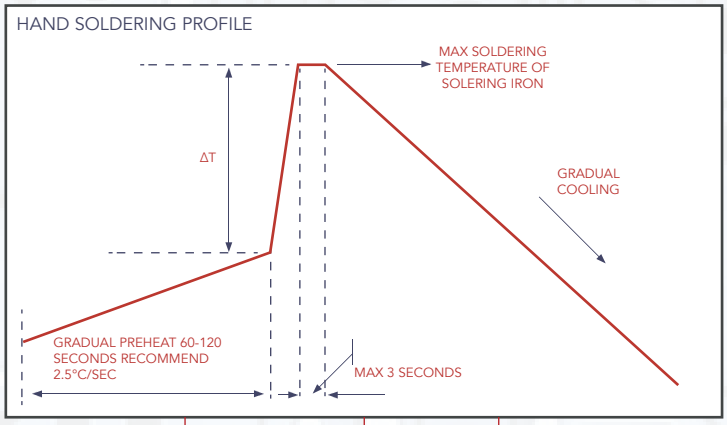
### PREHEAT

- In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

### SOLDERING

- Use mildly activated rosin fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

A) Hand Soldering:



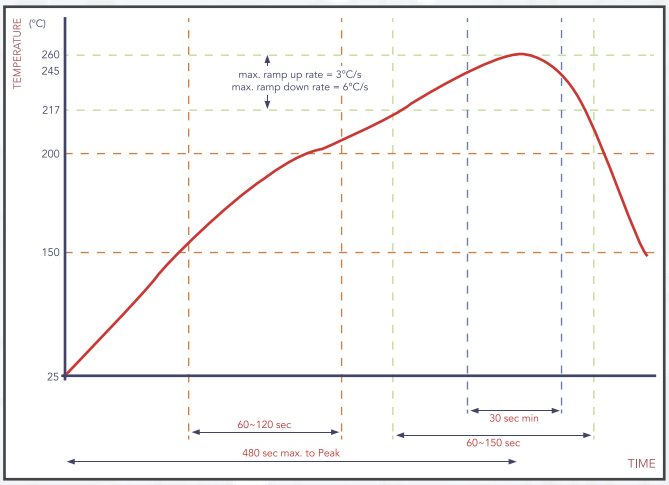

| CHIP SIZE | PRE-HEAT TEMP | ΔT | MAX SOLDERING IRON TEMP. |
|---|---|---|---|
| ≤1206 | ≥150°C | ≤150°C | ≤350°C |
| 1210 ~ 2225 | ≥150°C | ≤130°C | ≤280°C |

- Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.
- The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- The required amount of solder shall be melted on the soldering tip.
- The tip of iron should not contact the ceramic body directly.
- The Capacitors shall be cooled gradually at room temperature after soldering.
- Forced air cooling is not allowed

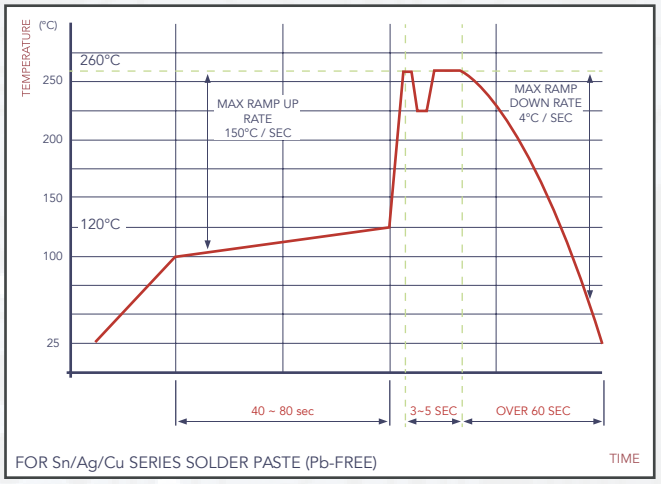
# APPLICATION NOTES

## SOLDERING (cont.)

B) Reflow Soldering:




C) Wave Soldering:



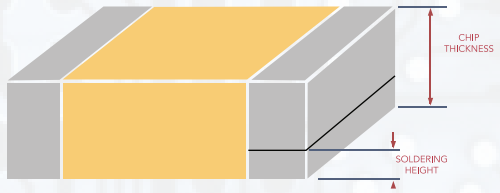

Soldering Conditions:

Class I:

| SIZE INCH (MM) | TEMPER CHER. | CAPACITANCE | CONDITION | |
|---|---|---|---|---|
| | | | WAVE | REFLOW |
| ≤0402 (1005) | Class I | ALL | X | O |
| 0603 (1608) | Class I | ALL | O | O |
| 0805 (2012) | Class I | ALL | O | O |
| 1206 (3216) | Class I | ALL | O | O |
| | | Thickness >0.95mm | X | O |
| ≥1210 (3225) | Class I | ALL | X | O |
| Coating Products | ALL | ALL | X | O |

| SIZE INCH (MM) | TEMPER CHER. | CAPACITANCE | CONDITION | |
|---|---|---|---|---|
| | | | WAVE | REFLOW |
| ≤0402 (1005) | Class II | ALL | X | O |
| 0603 (1608) | Class II | Cap. <2.2μF | O | O |
| | | Cap. ≥2.2μF | X | O |
| 0805 (2012) | Class II | Thickness ≤ 0.95mm | O | O |
| | | Thickness > 0.95mm | X | O |
| 1206 (3216) | Class II | Thickness ≤ 0.95mm | O | O |
| | | Thickness >0.95mm | X | O |
| ≥1210 (3225) | Class II | ALL | X | O |
| Coating Products | ALL | ALL | X | O |

Soldering Height:
The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.
(Reference from IPC-610E)




## COOLING

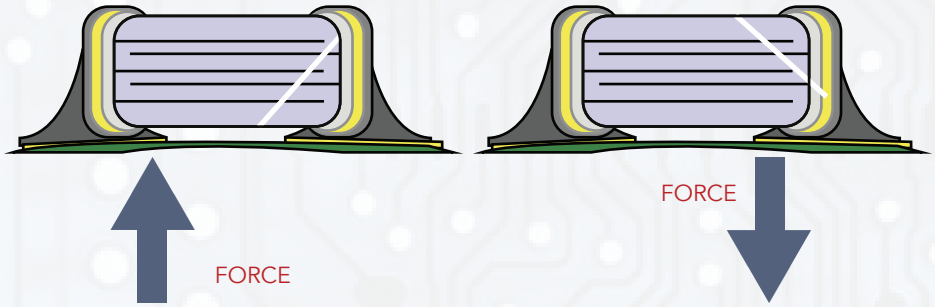
- After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

## CLEANING

- All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.
Surface coating products are not suitable cleaning/washing by solvent

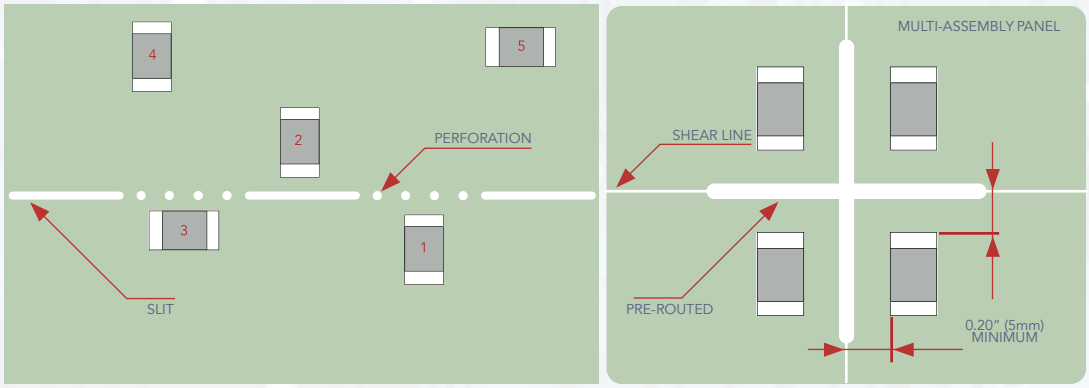
## TYPICAL BENDING CRACKS OF MLCC

- MLCC ceramic body consists of rigid material. It will suffer compressive and tensional stress when the carried board is bended. If the suffered stress is over ceramic body strength, the bending crack is occurs. Therefore, the bending crack will occur after soldering process




## THE STRESS V.S. POSITION ON PCB DURING BENDING

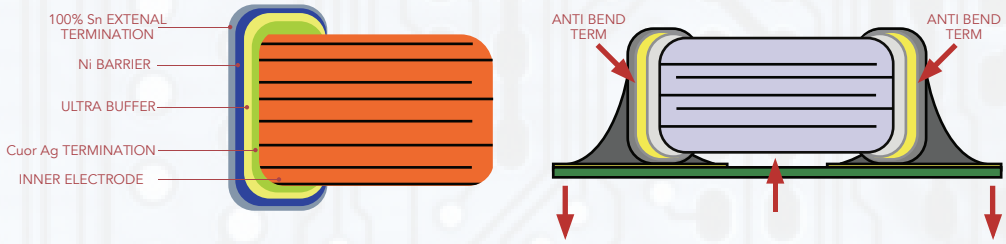
- Chip mounting close to board separation point



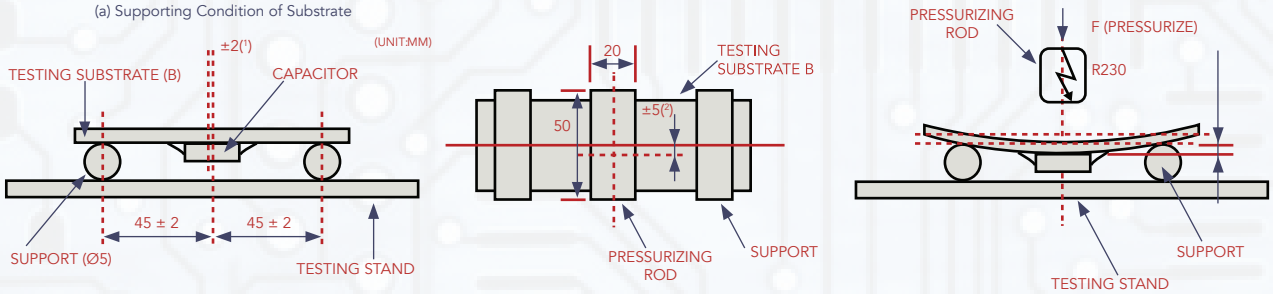

- Magnitude of stress 1>2≈3>4>5

## STRUCTURE

- PDC soft termination series added a special termination material (Ultra-Buffer or Anti-Bend) between ceramic body and Ni-barrier that can absorb mechanical stress to prevent bending crack from occurring.




## ILLUSTRATION OF BENDING TEST




Discrepancy between center of supports and center of substrate

Discrepancy between center of testing substrate A and center of pressurizing rod