

# *Sn-Pb Surface Mount Ceramic Capacitors*



# JOHANSON DIELECTRICS - SYLMAR CALIFORNIA



Johanson Dielectrics Incorporated (JDI) is located in California's San Fernando Valley and has over 30 years experience supplying high quality ceramic chip capacitors to customers around the world. Our business philosophy is simple: Grow profitably by totally satisfying our customers' requirements for high quality, technologically

advanced ceramic electronic components. This means maintaining an intense focus in the areas of product development, new material technology advancements, automated manufacturing techniques and state of the art statistical process analysis and control systems. Put our experience to work for you today!



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## **Additional Johanson Products @ [www.johansondielectrics.com](http://www.johansondielectrics.com)**

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**NEW** Polyterm<sup>®</sup> Termination Capacitors  
Ceramic Chip Capacitor Arrays  
Ceramic Chip Capacitors, Tip & Ring 250 & 300 VDC  
Ceramic Chip Capacitors, Low Inductance Ceramic Capacitors  
Ceramic Chip Capacitors, High Temperature  
Large Size Chip Capacitors 50 - 5,000 VDC

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**NEW** Environmental Compliance Policy & Data  
**NEW** On-line sample, quote, and technical information request system.  
**NEW** Distributor Inventory Search Engine.  
Part Number Cross Reference Guides  
**APPLICATION NOTE:** Surface Mount MLCCs  
**APPLICATION NOTE:** AC Power Handling  
**APPLICATION NOTE:** Tantalum Replacement with MLCCs



# Sn-Pb Ceramic MLCC Products



Johanson Dielectrics' tin-lead plated products are offered for high reliability, aerospace, and other applications where tin whiskering is a concern. The plating is tin lead over nickel barrier with 5% minimum lead content. The lead content of the plating in every manufacturing lot is verified using XRF method, and this data is available upon request. MIL-PRF-55681 and Hi Rel screened versions are also available.

## TIN WHISKER TEST SUMMARY

In order to evaluate the tin whisker growth on pure tin and tin lead plated capacitors Johanson Dielectrics performed tin whisker testing on various sizes of capacitors using iNEMI and JESDA121 test methods.

The following samples were tested:

- 0805 X7R Pure Matte Tin Finish with nickel barrier
- 1210 X7R Pure Matte Tin Finish with nickel barrier
- 1210 X7R Tin Lead Finish with 5% minimum lead content (same lot as pure tin part)
- 1812 X7R Pure Matte Tin Finish with nickel barrier

Two different tests were performed:

1) Temperature Cycle Test: Temperature Cycle per JESD22-A104 Test Condition A Soak Mode 3 1000 cycles SEM inspections per JESD22-A121. The parts are temperature cycled from -55C to 85C, with a minimum of 10 minutes soak time at the minimum and maximum temperatures.

2) Temperature Humidity Test: 4000 hours at 60 C and 93% relative humidity per iNEMI recommendations.

Inspection of whiskers: The capacitors were inspected by SEM before and after each test at 250 and 2500 magnification.

The parts were evaluated to the requirements of Class 2 devices as stipulated by iNEMI 'Tin Whisker Acceptance Test Requirements', July 28, 2004, paragraph 18.2.3. The maximum acceptable whisker length is 40 um.

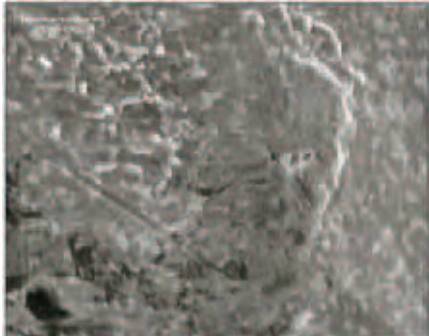
The whisker length reported is the total axial whisker length as per JEDEC standard JESD22A121 definition 3.1. Although only whiskers of 10um or greater in length are classified as 'true' whiskers as per JEDEC standard JESD22A121 definition 3.2, whiskers of all lengths are reported below.

| Part Description | Number of parts tested | Maximum Whisker Length (um) |                          | Meets iNEMI Class 2 |
|------------------|------------------------|-----------------------------|--------------------------|---------------------|
|                  |                        | Temp Cycling (1000 cycles)  | Temp Humidity (4000 hrs) |                     |
| 0805 Pure Tin    | 15                     | 4                           | No Whiskers Present      | Yes                 |
| 1210 Pure Tin    | 9                      | 14                          | 1                        | Yes                 |
| 1812 Pure Tin    | 9                      | 17                          | No Whiskers Present      | Yes                 |
| 1210 Tin Lead    | 9                      | No Whiskers Present         | No Whiskers Present      | Yes                 |

# Sn-Pb Ceramic MLCC Products

SN95PB5 1210 SIZE MLCC

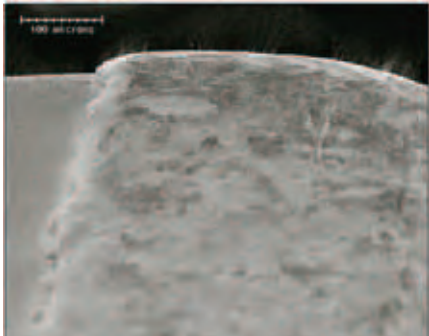
0 Cycles, 2500X



1000 Cycles, 2500X

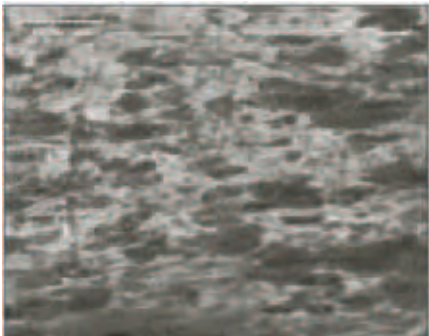


1,000 Cycles, 250X

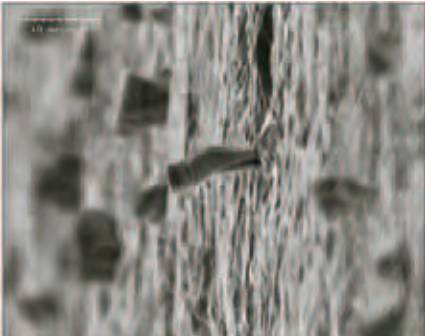


SN100 1210 SIZE MLCC

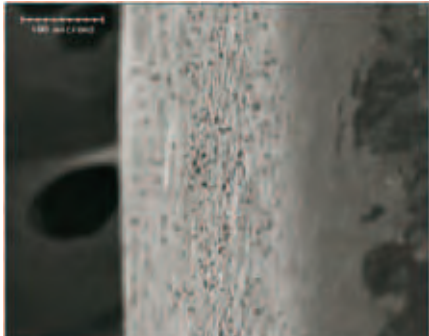
0 Cycles, 2500X



1000 Cycles, 2500X

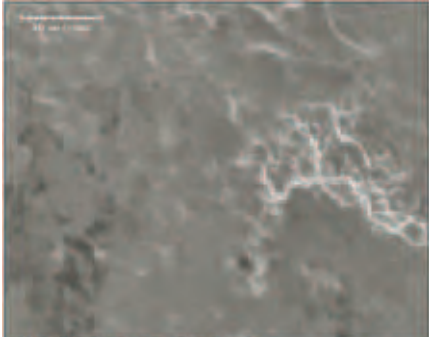


1,000 Cycles, 250X

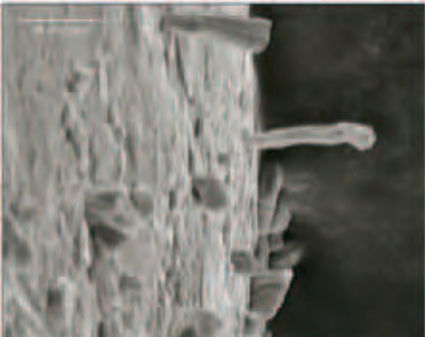


SN100 1812 SIZE MLCC

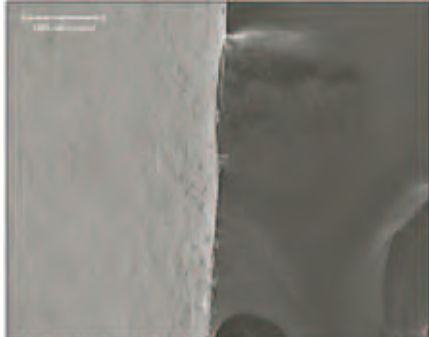
0 Cycles, 2500X



1000 Cycles, 2500X



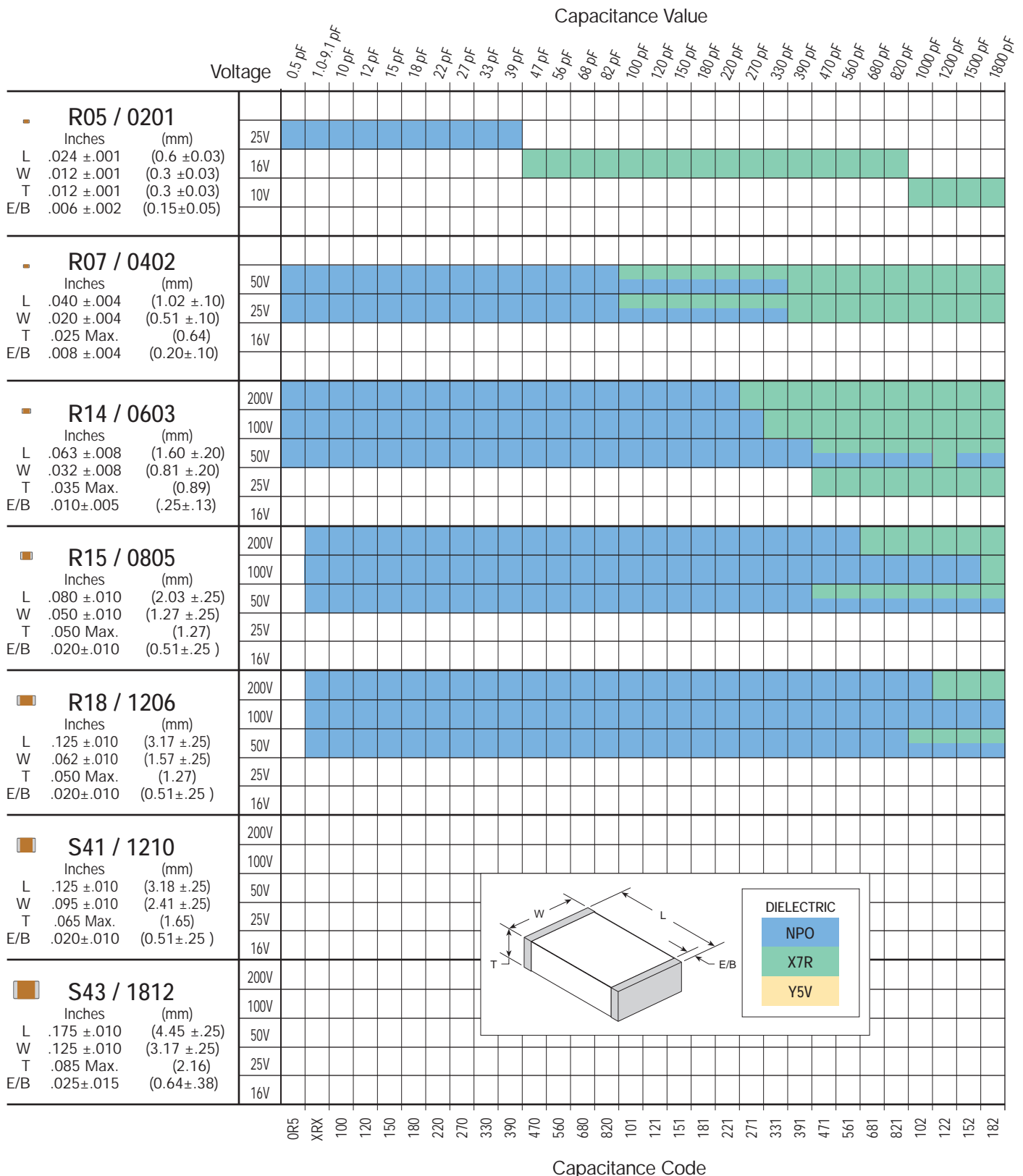
1,000 Cycles, 250X



Detailed test reports are available at <http://www.johansondielectrics.com/technicalnotes/tin/>



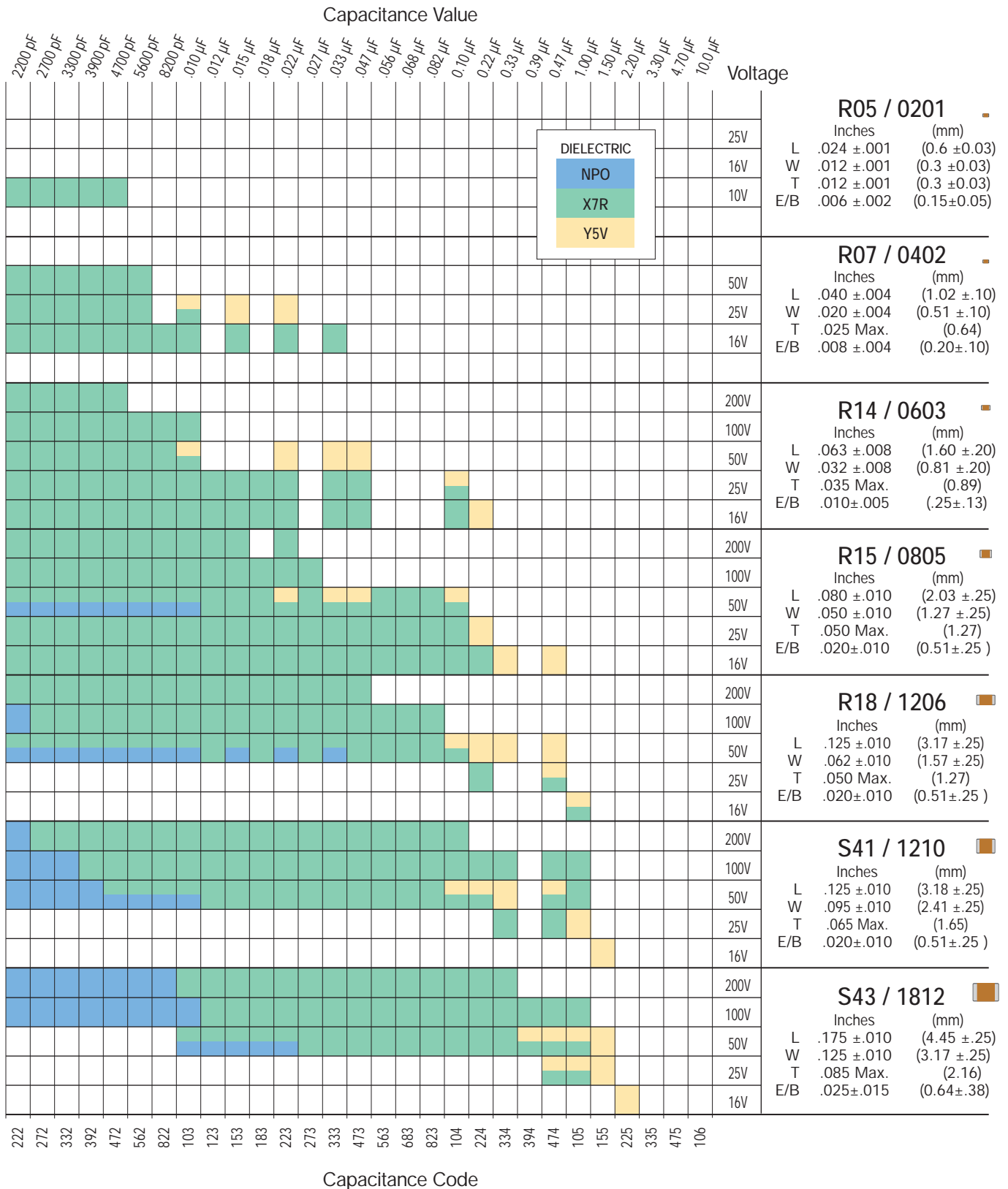
# Sn-Pb Surface Mount MLCCs 16 - 200 VDC



Dielectric specifications and part number breakdown may be found on pages 20 & 21.



# Sn-Pb Surface Mount MLCCs 16 - 200 VDC



Dielectric specifications and part number breakdown may be found on pages 20 & 21.



# Sn-Pb High Voltage Surface Mount MLCCs 500 - 5,000 VDC



These high voltage capacitors feature a special internal electrode design which reduces voltage concentrations by distributing voltage gradients throughout the entire capacitor. This unique design also affords increased capacitance values in a given case size and voltage rating. The capacitors are designed and manufactured to the general requirement of EIA198 and are subjected to a 100% electrical testing making them well suited for a wide variety of telecommunication, commercial, and industrial applications.

## APPLICATIONS

- Analog & Digital Modems
- LAN/WAN Interface
- Lighting Ballast Circuits
- Voltage Multipliers
- DC-DC Converters
- Back-lighting Inverters

## Mechanical Characteristics

## Available Capacitance

|                      |     |                        | Rated Voltage | NPO Dielectric |         | X7R Dielectric |          |
|----------------------|-----|------------------------|---------------|----------------|---------|----------------|----------|
|                      |     |                        |               | Minimum        | Maximum | Minimum        | Maximum  |
| <b>R15/0805</b><br>■ |     | Inches (mm)            | 250 VDC       | -              | -       | 1000 pF        | 0.022 µF |
|                      | L   | .080 ±.010 (2.03 ±.25) | 500 VDC       | 10 pF          | 680 pF  | 1000 pF        | 0.012 µF |
|                      | W   | .050 ±.010 (1.27 ±.25) | 630 VDC       | 10 pF          | 560 pF  | 1000 pF        | 3900 pF  |
|                      | T   | .055 Max. (1.40)       | 1000 VDC      | 10 pF          | 390 pF  | 100 pF         | 2200 pF  |
|                      | E/B | .020 ±.010 (0.51±.25)  |               |                |         |                |          |
| <b>R18/1206</b><br>■ |     | Inches (mm)            | 250 VDC       | -              | -       | 1000 pF        | 0.068 µF |
|                      | L   | .125 ±.010 (3.17 ±.25) | 500 VDC       | 10 pF          | 1800 pF | 1000 pF        | 0.027 µF |
|                      | W   | .062 ±.010 (1.57 ±.25) | 630 VDC       | 10 pF          | 1200 pF | 1000 pF        | 6800 pF  |
|                      | T   | .067 Max. (1.70)       | 1000 VDC      | 10 pF          | 1000 pF | 100 pF         | 1500 pF  |
|                      | E/B | .020 ±.010 (0.51±.25)  | 2000 VDC      | 10 pF          | 210 pF  | 100 pF         | 1000 pF  |
|                      |     |                        | 3000 VDC      | 10 pF          | 82 pF   | 100 pF         | 120 pF   |
| <b>S41/1210</b><br>■ |     | Inches (mm)            | 250 VDC       | -              | -       | 1000 pF        | 0.12 µF  |
|                      | L   | .125 ±.010 (3.18 ±.25) | 500 VDC       | 10 pF          | 3900 pF | 1000 pF        | 0.047 µF |
|                      | W   | .095 ±.010 (2.41 ±.25) | 630 VDC       | 10 pF          | 3300 pF | 1000 pF        | 0.027 µF |
|                      | T   | .080 Max. (2.03)       | 1000 VDC      | 10 pF          | 2200 pF | 100 pF         | 0.015 µF |
|                      | E/B | .020 ±.010 (0.51±.25)  | 2000 VDC      | 10 pF          | 560 pF  | 100 pF         | 6800 pF  |
|                      |     |                        | 3000 VDC      | 10 pF          | 180 pF  | 100 pF         | 220 pF   |
| <b>R29/1808</b><br>■ |     | Inches (mm)            | 500 VDC       | 10 pF          | 3300 pF | 1000 pF        | 0.068 µF |
|                      | L   | .180 ±.010 (4.57 ±.25) | 630 VDC       | 10 pF          | 2700 pF | 1000 pF        | 0.027 µF |
|                      | W   | .080 ±.010 (2.03 ±.25) | 1000 VDC      | 1.0 pF         | 2200 pF | 100 pF         | 0.018 µF |
|                      | T   | .080 Max. (2.03)       | 2000 VDC      | 1.0 pF         | 820 pF  | 100 pF         | 6800 pF  |
|                      | E/B | .020 ±.010 (0.51±.25)  | 3000 VDC      | 1.0 pF         | 470 pF  | 100 pF         | 3300 pF  |
|                      |     |                        | 4000 VDC      | 1.0 pF         | 220 pF  | 100 pF         | 270 pF   |
|                      |     |                        | 5000 VDC      | 1.0 pF         | 82 pF   | 100 pF         | 120 pF   |

Available capacitance values include the following significant retma values and their multiples:

1.0 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.7 5.6 6.8 8.2 (1.0 = 1.0, 10, 100, 1000, etc.)





Consult factory for non-retma values and sizes or voltages not shown.



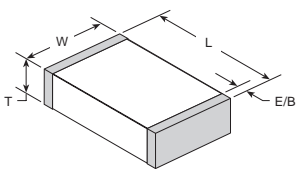
# Sn-Pb High Voltage Surface Mount MLCCs 500 - 5,000 VDC

## Mechanical Characteristics

## Available Capacitance

|  | Rated Voltage  | NPO Dielectric |          | X7R Dielectric |          |
|--|--|----------------|----------|----------------|----------|
|  |  | Minimum        | Maximum  | Minimum        | Maximum  |
| <b>S43 / 1812</b><br><br>Inches (mm)<br>L .180 ±.010 (4.57 ±.25)<br>W .125 ±.010 (3.17 ±.25)<br>T .110 Max. (2.80)<br>E/B .025 ±.015 (0.64±.38)   | 250 VDC  | -              | -        | 0.010 µF       | 0.22 µF  |
|  | 500 VDC  | 100 pF         | 0.01 µF  | 1000 pF        | 0.1 µF   |
|  | 630 VDC  | 100 pF         | 8200 pF  | 1000 pF        | 0.082 µF |
|  | 1000 VDC   | 10 pF          | 6800 pF  | 1000 pF        | 0.056 µF |
|  | 2000 VDC   | 10 pF          | 2200 pF  | 100 pF         | 0.010 µF |
|  | 3000 VDC   | 10 pF          | 1200 pF  | 100 pF         | 4700 pF  |
|  | 4000 VDC   | 10 pF          | 560 pF   | 10 pF          | 1500 pF  |
|  | 5000 VDC   | 10 pF          | 150 pF   | 10 pF          | 680 pF   |
| <b>S49 / 1825</b><br><br>Inches (mm)<br>L .180 ±.010 (4.57 ±.25)<br>W .250 ±.010 (6.35 ±.25)<br>T .140 Max. (3.56)<br>E/B .025 ±.015 (0.64±.38)   | 500 VDC  | 100 pF         | 0.027 µF | 0.01 µF        | 0.33 µF  |
|  | 630 VDC  | 100 pF         | 0.022 µF | 0.01 µF        | 0.22 µF  |
|  | 1000 VDC   | 10 pF          | 0.015 µF | 1000 pF        | 0.10 µF  |
|  | 2000 VDC   | 10 pF          | 5600 pF  | 100 pF         | 0.022 µF |
|  | 3000 VDC   | 10 pF          | 2200 pF  | 100 pF         | 8200 pF  |
|  | 4000 VDC   | 10 pF          | 1000 pF  | 100 pF         | 2000 pF  |
|  | 5000 VDC   | 10 pF          | 270 pF   | 100 pF         | 820 pF   |
|  | <b>S47 / 2220</b><br><br>Inches (mm)<br>L .225 ±.015 (5.72 ±.38)<br>W .200 ±.015 (5.08 ±.38)<br>T .150 Max. (3.81)<br>E/B .025 ±.015 (0.64±.38) | 500 VDC        | 1000 pF  | 0.027 µF       | 0.01 µF  |
| 630 VDC  |  | 1000 pF        | 0.027 µF | 0.01 µF        | 0.27 µF  |
| 1000 VDC   |  | 100 pF         | 0.018 µF | 1000 pF        | 0.12 µF  |
| 2000 VDC   |  | 100 pF         | 6800 pF  | 1000 pF        | 0.022 µF |
| 3000 VDC   |  | 10 pF          | 2700 pF  | 100 pF         | 0.01 µF  |
| 4000 VDC   |  | 10 pF          | 1200 pF  | 100 pF         | 2200 pF  |
| 5000 VDC   |  | 10 pF          | 390 pF   | 100 pF         | 1000 pF  |
| <b>S48 / 2225</b><br><br>Inches (mm)<br>L .225 ±.010 (5.72 ±.25)<br>W .255 ±.015 (6.48 ±.38)<br>T .150 Max. (3.81)<br>E/B .025 ±.015 (0.64±.38) |  | 500 VDC        | 1000 pF  | 0.033 µF       | 0.01 µF  |
|  | 630 VDC  | 1000 pF        | 0.027 µF | 0.01 µF        | 0.33 µF  |
|  | 1000 VDC   | 100 pF         | 0.022 µF | 1000 pF        | 0.15 µF  |
|  | 2000 VDC   | 100 pF         | 8200 pF  | 1000 pF        | 0.039 µF |
|  | 3000 VDC   | 10 pF          | 4700 pF  | 100 pF         | 0.01 µF  |
|  | 4000 VDC   | 10 pF          | 2200 pF  | 100 pF         | 3900 pF  |
|  | 5000 VDC   | 10 pF          | 680 pF   | 100 pF         | 1500 pF  |

Available capacitance values include the following significant retma values and their multiples: 1.0 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.7 5.6 6.8 8.2 ( 1.0 = 1.0, 10, 100, 1000, etc.) Consult factory for non-retma values and sizes or voltages not shown.



## ELECTRICAL CHARACTERISTICS

Meets the standard NPO & X7R dielectric specifications listed on page 20

Dielectric Withstanding Voltage DWV = 750 VDC for 500 WVDC rated units,  
 DWV = 945 VDC for 630 WVDC rated units,  
 DWV = 1.2 X rated WVDC for ratings ≥ 1,000 WVDC

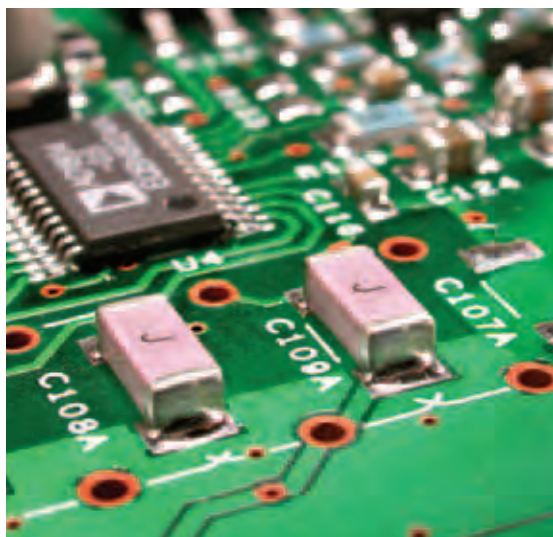
NOTE: Capacitors may require a surface coating to prevent external arcing.

## HOW TO ORDER

| <b>202</b>   | <b>R29</b>                    | <b>N</b>                                    | <b>101</b>  | <b>K</b>  | <b>T</b>   | <b>4</b>   | <b>E</b> |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
|--|-------------------------------|---|---|---|--|--|----------|------|------|------|---|----------|----|---|----------|-----|---|-------|----|---|-------|-----|
| <b>VOLTAGE</b><br>501 = 500 V<br>631 = 630 V<br>102 = 1000 V<br>202 = 2000 V<br>302 = 3000 V<br>402 = 4000 V<br>502 = 5000 V | <b>CASE SIZE</b><br>See Chart | <b>DIELECTRIC</b><br>N = NPO/COG<br>W = X7R | <b>CAPACITANCE</b><br>1st two digits are significant; third digit denotes number of zeros, R = decimal.<br>1R0 = 1.0 pF<br>101 = 100 pF | <b>TOLERANCE</b><br>NPO: J = ± 5%<br>K = ± 10%<br>X7R: K = ± 10%<br>M = ± 20% | <b>TERMINATION</b><br>T = Tin-Lead w/<br>5% min. Pb<br><br><b>MARKING</b><br>4 = Unmarked<br>6 = EIA "J" Code* | <b>TAPE MODIFIER</b><br><table border="1"> <thead> <tr> <th>Code</th> <th>Tape</th> <th>Reel</th> </tr> </thead> <tbody> <tr> <td>E</td> <td>Embossed</td> <td>7"</td> </tr> <tr> <td>U</td> <td>Embossed</td> <td>13"</td> </tr> <tr> <td>T</td> <td>Paper</td> <td>7"</td> </tr> <tr> <td>R</td> <td>Paper</td> <td>13"</td> </tr> </tbody> </table> Tape specs. per EIA RS481 |          | Code | Tape | Reel | E | Embossed | 7" | U | Embossed | 13" | T | Paper | 7" | R | Paper | 13" |
| Code   | Tape                          | Reel  |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
| E  | Embossed                      | 7"  |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
| U  | Embossed                      | 13"   |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
| T  | Paper                         | 7"  |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
| R  | Paper                         | 13"   |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |
| Part number written: <b>202R29N101KT4E</b>   |                               |   |   |   |  |  |          |      |      |      |   |          |    |   |          |     |   |       |    |   |       |     |



# Sn-Pb Safety Certified Capacitors

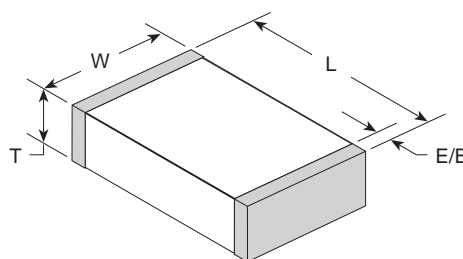


Johanson Dielectrics Type SC ceramic chip capacitors are designed for AC voltage surge and lightning protection in line-to-ground interface applications in computer network, modem, facsimile and other equipment.

Johanson's safety capacitor offering includes four different case sizes and NPO and X7R dielectric materials.

These devices are surface mount ready with barrier terminations and tape and reel packaging.

Additional information on capacitor safety ratings may be found below. Specific certification details may be found under each product listing on the facing page.



| SAFETY RATING | VOLTAGE RATING | WITHSTANDING VOLTAGE | IMPULSE VOLTAGE | CASE SIZE | JOHANSON ORDERING P/N |
|---------------|----------------|----------------------|-----------------|-----------|-----------------------|
| X2/Y3         | 250 VAC        | 1,500 VAC            | 2,500 V         | 1808      | 302R29____V_E-****-SC |
| Y3            | 250 VAC        | 1,500 VAC            | N/A             | 1812      | 302S43____V_E-****-SC |
| X1/Y2         | 250 VAC        | 1,500 VAC            | 5,000 V         | 1808      | 502R29____V_E-****-SC |
| Y2            | 250 VAC        | 1,500 VAC            | 5,000 V         | 2211      | 502R30____V_E-****-SC |
| X1/Y2         | 250 VAC        | 1,500 VAC            | 5,000 V         | 2220      | 502S47____V3E-****-SC |

X Capacitors are defined as suitable for use in situations where failure of the capacitor would not lead to danger of electric shock.

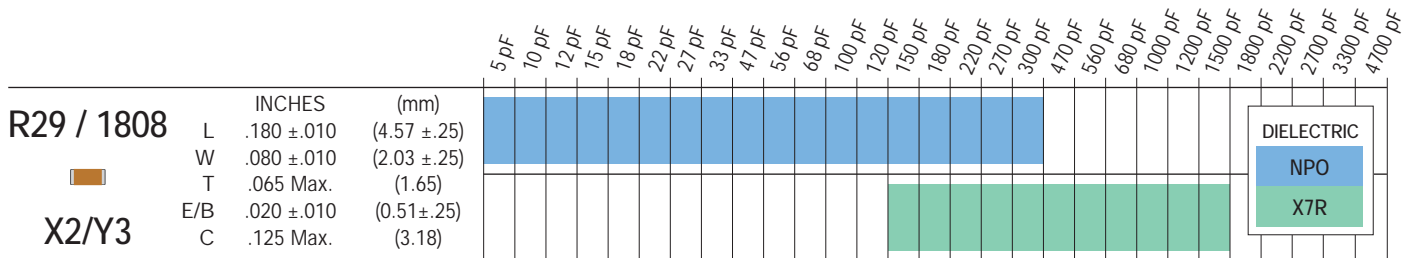
Y Capacitors are defined as suitable for use in situations where failure of the capacitor could lead to danger of electric shock.

## HOW TO ORDER SAFETY CERTIFIED

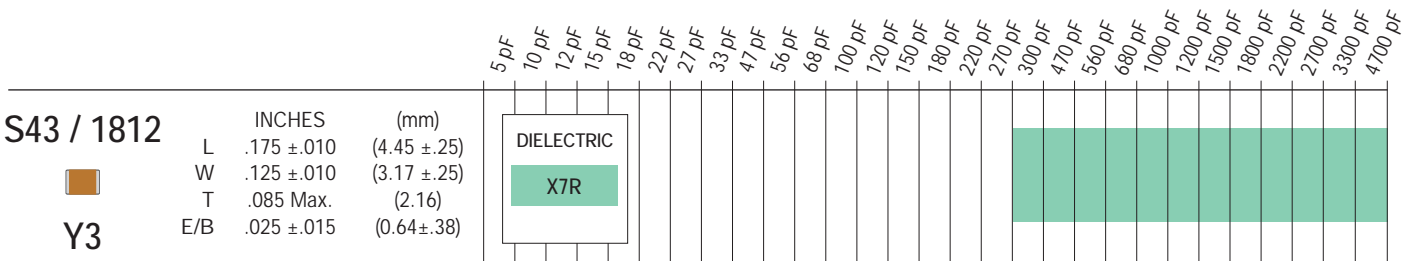
|  |                               |   |   |   |   |   |   |      |      |      |   |          |    |                                      |
|--|-------------------------------|---|---|---|---|---|---|------|------|------|---|----------|----|--------------------------------------|
| 302  | R29                           | N                                       | 101   | K   | T   | 3   | E - ***** -   | SC   |      |      |   |          |    |                                      |
| <b>IMPULSE VOLTAGE</b><br>302 = 3000V<br>502 = 5000V | <b>SIZE</b><br>See Size Chart | <b>DIELECTRIC</b><br>N = NPO<br>W = X7R | <b>CAPACITANCE</b><br>1st two digits are significant; third digit denotes number of zeros; 101 = 100 pF | <b>TOLERANCE</b><br>NPO: J = ±5%<br>K = ±10%<br>X7R: K = ±10%<br>M = ±20% | <b>TERMINATION</b><br>T = Tin-Lead w/<br>5% min. Pb | <b>MARKING</b><br>3 = Special (J)<br>4 = No marking | <b>TAPE MODIFIER</b><br><table border="0" style="font-size: small;"> <tr> <td>Code</td> <td>Tape</td> <td>Reel</td> </tr> <tr> <td>E</td> <td>Embossed</td> <td>7"</td> </tr> </table> Tape specifications conform to EIA RS481 | Code | Tape | Reel | E | Embossed | 7" | <b>TYPE</b><br>SC = Safety Certified |
| Code   | Tape                          | Reel                                    |   |   |   |   |   |      |      |      |   |          |    |                                      |
| E  | Embossed                      | 7"                                      |   |   |   |   |   |      |      |      |   |          |    |                                      |

P/N written: 302R29N101KT3E-\*\*\*\*-SC

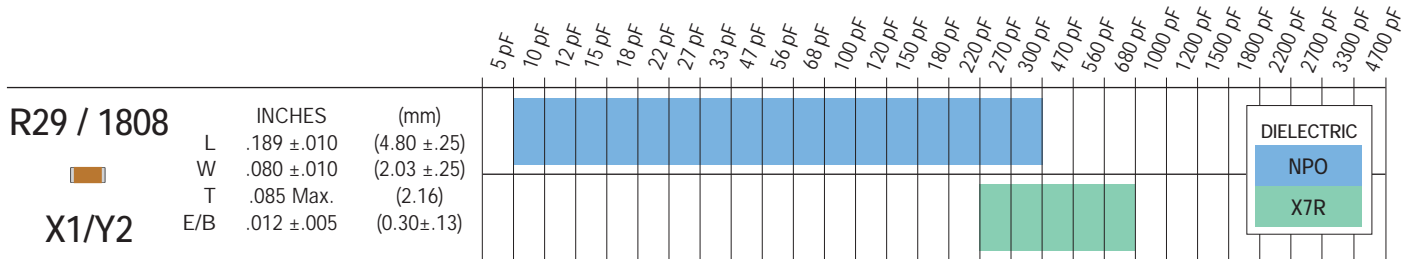
# Sn-Pb Safety Certified Capacitors



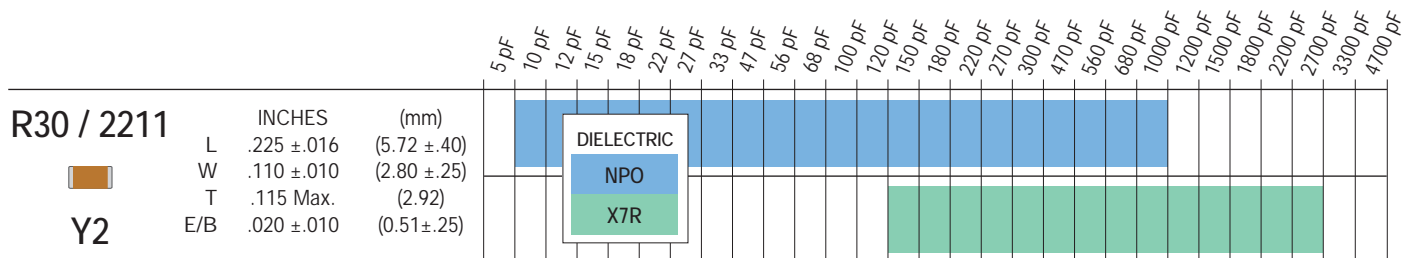
TUV Rheinland Certificate Numbers 2172792 & 2172793 Standards: EN132400:1994+A1, IEC 60384-14:1993+A1, EN 60950:1992+A1+A2+A3+A4+A11  
 UL File Number E212609 Standards:UL 1950, Third Edition • Semko Reference Numbers 0026092-1 & 0003222-1 Standards: EN 132400:1994+A2:1998, IEC 60384-14, Second Edition:1993+A1:1995, Robustness of Terminations (cl 4.3) tested according to IEC 60384-1 amendment 3 cl 4.34 & 4.35, Resistance to Soldering Heat (cl 4.4) tested according to IEC 60384-1 amendment 3 cl 4.14.2, Impulse test made with 2.5KV according to clause 6.4.2.1 in IEC 60950, Creepage distance between live parts of different polarity meets the requirements in IEC 60950



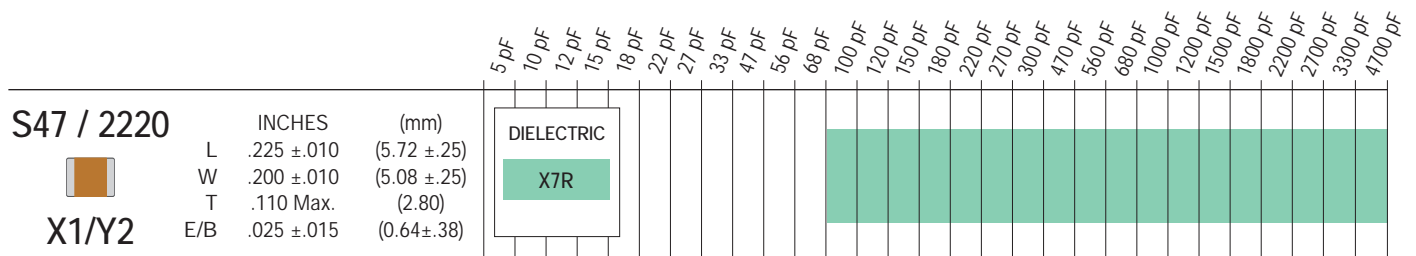
TUV Rheinland Certificate Number 2172792 Standards: EN132400:1994+A1, IEC 60384-14:1993+A1, EN 60950:1992+A1+A2+A3+A4+A11



TUV Rheinland Certificate Numbers T72041313 and T72041314 Standards: EN132400:1994+A2+A3+A4, EN60950-1:2001, IEC 384-14:1993+A1



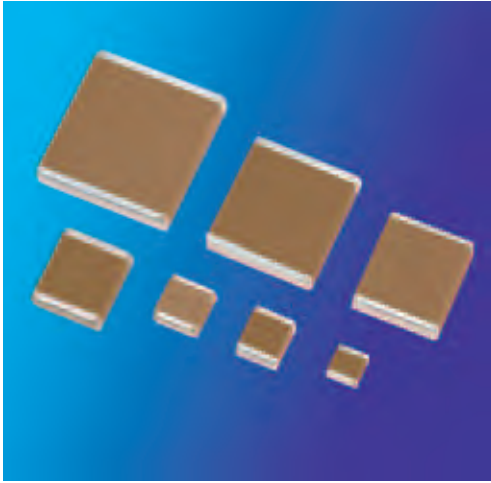
TUV Rheinland Certificate Numbers 2279224, 2172779 & 72041313 Standards: EN132400:1994+A2, IEC 60384-14:1993+A1



TUV Rheinland Certificate Number 2272848 Standards: IEC 60384-14:1993+A, EN 132400:1994+A2 UL File E212609 & UL60950 3rd Edition



# Sn-Pb Large Size Capacitor Chips 50 - 5,000 VDC






## KEY FEATURES

- Rated Working Voltages from 50 to 15,000 VDC
- Low ESR Ceramic Out-performs Tantalums
- Compact MLC Designs Smaller Than Film or Disc
- MIL-PRF-55681 & Hi-Rel Screened Versions Available
- Custom Sizes, Voltages, and Values Available

## APPLICATIONS

- Power Supplies
- Voltage Multipliers
- Data Isolation
- Surge Protection
- Industrial Control Circuits
- Custom Applications

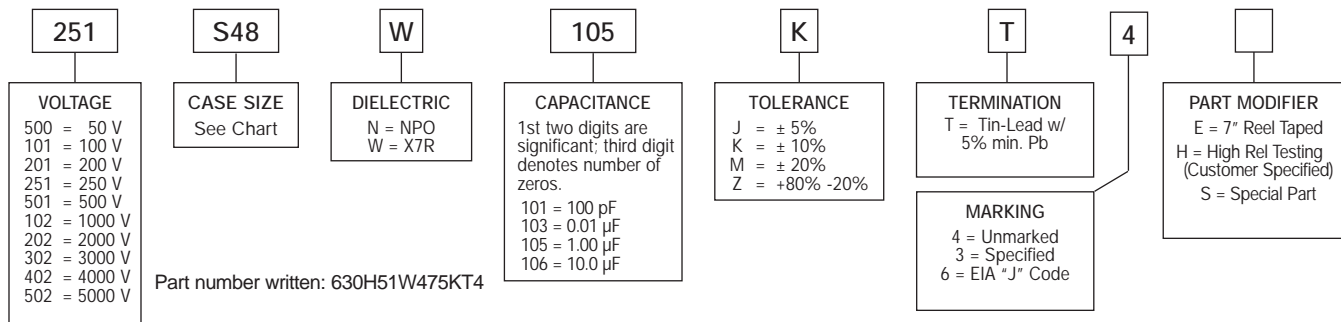
## MAXIMUM CAPACITANCE VS DC VOLTAGE RATING

|                   |   |     | 50 V | 100 V | 250 V | 500 V | 1K V | 2K V | 3K V | 4K V | 5K V |  |
|-------------------|---|-----|------|-------|-------|-------|------|------|------|------|------|--|
| <b>S49 / 1825</b> | <br>Inches (mm)<br>L .180 ±.010 (4.57 ±.25)<br>W .250 ±.010 (6.35 ±.25)<br>T .140 Max. (3.56 Max)<br>E/B .025 ±.015 (0.64±.38)   | NPO | 473  | 383   | 273   | 273   | 153  | 562  | 222  | 102  | 271  |  |
|                   |   | X7R | 185  | 105   | 563   | 334   | 104  | 223  | 822  | 202  | 821  |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |
| <b>S47 / 2220</b> | <br>Inches (mm)<br>L .225 ±.015 (5.72 ±.38)<br>W .200 ±.015 (5.08 ±.38)<br>T .150 Max. (3.81 Max)<br>E/B .025 ±.015 (0.64±.38) | NPO | 683  | 473   | 333   | 273   | 183  | 682  | 272  | 122  | 391  |  |
|                   |   | X7R | 185  | 155   | 564   | 334   | 184  | 273  | 103  | 332  | 152  |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |
| <b>S48 / 2225</b> | <br>Inches (mm)<br>L .225 ±.010 (5.72 ±.25)<br>W .255 ±.015 (6.48 ±.38)<br>T .150 Max. (3.81 Max)<br>E/B .025 ±.015 (0.64±.38) | NPO | 753  | 563   | 393   | 333   | 223  | 822  | 472  | 222  | 681  |  |
|                   |   | X7R | 225  | 185   | 824   | 474   | 224  | 473  | 153  | 562  | 222  |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |
|                   |   |     |      |       |       |       |      |      |      |      |      |  |

Available capacitance values include the following significant retma values and their multiples:







1.0 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.7 5.6 6.8 8.2 (1.0 = 1.0, 10, 100, 1000, etc.)

## HOW TO ORDER



# Sn-Pb Large Size Capacitor Chips 50 - 5,000 VDC

## MAXIMUM CAPACITANCE VS DC VOLTAGE RATING

|   |     |       |       |       |       |      |      |      |      |      |
|---|-----|-------|-------|-------|-------|------|------|------|------|------|
| <b>H42 / 1515</b><br><br>Inches (mm)<br>L .150 ±.015 (3.81 ±.38)<br>W .150 ±.015 (3.81 ±.38)<br>T .150 Max. (3.81 Max)<br>E/B .025 ±.015 (0.64±.38)      |     | 500 V | 1K V  | 2K V  | 3K V  | 4K V | 5K V |      |      |      |
|   | NPO | 472   | 152   | 681   | 331   | 151  | 101  |      |      |      |
|   | X7R | 124   | 393   | 123   | 392   | 561  | 331  |      |      |      |
| <b>H47 / 2520</b><br><br>Inches (mm)<br>L .250 ±.018 (6.35 ±.46)<br>W .200 ±.015 (5.08 ±.38)<br>T .150 Max. (3.81 Max)<br>E/B .025 ±.015 (0.64±.38)      |     | 500 V | 1K V  | 2K V  | 3K V  | 4K V | 5K V |      |      |      |
|   | NPO | 223   | 332   | 152   | 681   | 331  | 221  |      |      |      |
|   | X7R | 394   | 124   | 273   | 822   | 222  | 102  |      |      |      |
| <b>H51 / 3530</b><br><br>Inches (mm)<br>L .350 ±.035 (8.89 ±.89)<br>W .300 ±.030 (7.62 ±.76)<br>T .200 Max (5.08 Max)<br>E/B .025 ±.015 (0.64±.38)       |     | 500 V | 1K V  | 2K V  | 3K V  | 4K V | 5K V |      |      |      |
|   | NPO | 563   | 472   | 332   | 152   | 102  | 471  |      |      |      |
|   | X7R | 824   | 394   | 104   | 273   | 682  | 332  |      |      |      |
| <b>H54 / 3640</b><br><br>Inches (mm)<br>L .360 ± .030 (9.14 ± .76)<br>W .400 ± .030 (10.16 ±.76)<br>T .200 Max (5.08 Max)<br>E/B .025 ±.015 (0.64±.38) |     | 50 V  | 100 V | 250 V | 500 V | 1K V | 2K V | 3K V | 4K V | 5K V |
|   | NPO | 224   | 184   | 154   | 683   | 822  | 332  | 222  | 152  | 681  |
|   | X7R | 565   | 475   | 225   | 155   | 564  | 124  | 333  | 822  | 392  |
| <b>H62 / 4540</b><br><br>Inches (mm)<br>L .450 ± .045 (11.4 ±1.1)<br>W .400 ± .040 (10.16 ±1.0)<br>T .200 Max (5.08 Max)<br>E/B .025 ±.015 (0.64±.38)  |     | 500 V | 1K V  | 2K V  | 3K V  | 4K V | 5K V |      |      |      |
|   | NPO | 104   | 103   | 682   | 332   | 222  | 102  |      |      |      |
|   | X7R | 155   | 684   | 184   | 473   | 183  | 103  |      |      |      |
| <b>H70 / 6560</b><br><br>Inches (mm)<br>L .650±.065 (16.5±1.7)<br>W .600±.060 (15.2±1.5)<br>T .200 Max (5.08 Max)<br>E/B .025 ±.015 (0.64±.38)         |     | 50 V  | 100 V | 250 V | 500 V | 1K V | 2K V | 3K V | 4K V | 5K V |
|   | NPO | 564   | 474   | 334   | 224   | 223  | 153  | 682  | 472  | 332  |
|   | X7R | 156   | 106   | 475   | 335   | 155  | 334  | 104  | 223  | 103  |

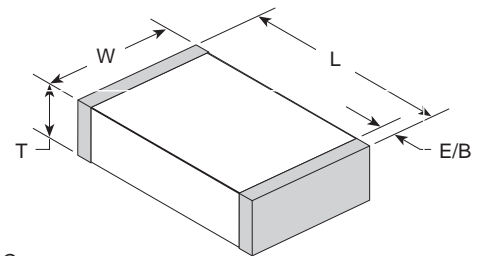
Available capacitance values include the following significant retma values and their multiples:  
 1.0 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.7 5.6 6.8 8.2 ( 1.0 = 1.0, 10, 100, 1000, etc.)  
 Consult factory for sizes, values, & voltages not shown.

## ELECTRICAL CHARACTERISTICS

Meets the standard NPO & X7R dielectric specifications listed on page 28 & 29 except

Dielectric Withstanding Voltage DWV = 750 VDC for 500 WVDC rated units,  
 DWV = 945 VDC for 630 WVDC rated units,  
 DWV = 1.2 X rated WVDC for ratings ≥ 1,000 WVDC

NOTE: Circuit applications above 1KVDC may require surface coating to prevent external arcing.



# Sn-Pb Tanceram® Chip Capacitors



TANCERAM® chip capacitors can replace tantalum capacitors in many applications and offer several key advantages over traditional tantalums. Because Tanceram® capacitors exhibit extremely low ESR, equivalent circuit performance can often be achieved using considerably lower capacitance values. Low DC leakage reduces current drain, extending the battery life of portable products. Tancerams® high DC breakdown voltage ratings offer improved reliability and eliminate large voltage de-rating common when designing with tantalums.

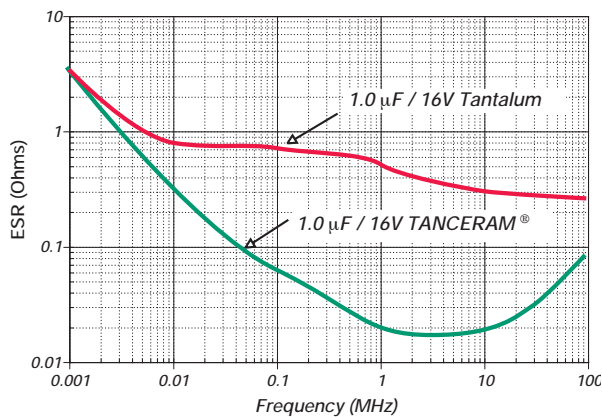
## ADVANTAGES

- Low ESR
- Higher Surge Voltage
- Reduced CHIP Size
- Higher Insulation Resistance
- Low DC Leakage
- Non-polarized Devices
- Improved Reliability
- Higher Ripple Current

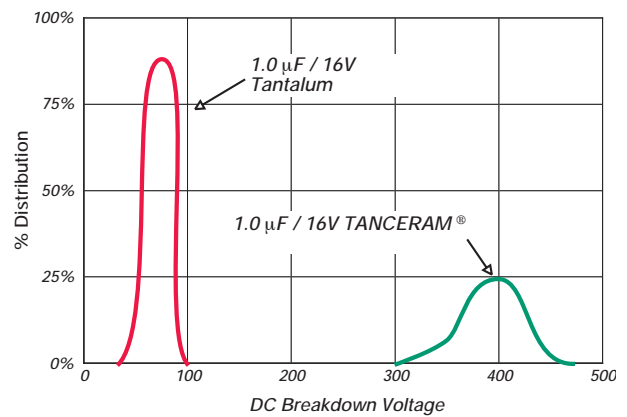
## APPLICATIONS

- SWITCHING POWER SUPPLY SMOOTHING (INPUT/OUTPUT)
- DC/DC Converter Smoothing (Input/Output)
- BACKLIGHTING INVERTERS
- General Digital Circuits

Typical ESR Comparison



Typical Breakdown Voltage Comparison



## HOW TO ORDER TANCERAM®

|   |                               |  |  |   |   |                                |  |
|---|-------------------------------|--|--|---|---|--------------------------------|--|
| <b>6R3</b>  | <b>S43</b>                    | <b>X</b>   | <b>106</b>   | <b>M</b>  | <b>T</b>  | <b>4</b>                       | <b>E</b>   |
| <b>VOLTAGE</b><br>500 = 50 V<br>250 = 25 V<br>160 = 16 V<br>100 = 10 V<br>6R3 = 6.3 V | <b>CASE SIZE</b><br>See Chart | <b>DIELECTRIC</b><br>W = X7R<br>X = X5R<br>Y = Y5V | <b>CAPACITANCE</b><br>1st two digits are significant; third digit denotes number of zeros.<br>474 = 0.47 μF<br>105 = 1.00 μF | <b>TOLERANCE</b><br>Y5V<br>Z = +80% -20%<br>X7R/X5R<br>K = ±10%<br>M = ±20% | <b>TERMINATION</b><br>T = Tin-Lead w/<br>5% min. Pb | <b>MARKING</b><br>4 = Unmarked | <b>TAPE MODIFIER</b><br>Code Type Reel<br>E Plastic 7"<br>T Paper 7"<br>Tape specifications conform to EIA RS481 |

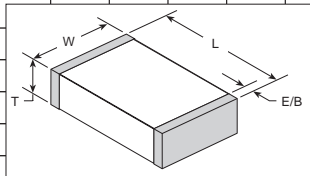
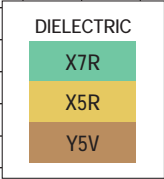
P/N written: 6R3S43X106MT4E



# Sn-Pb Tanceram® Chip Capacitors

## CAPACITANCE SELECTION

| CASE SIZE   |     |                      | 50 V                | 25 V    | 16 V    | 10 V    | 6.3 V   | 50 V   | 25 V   | 16 V   | 10 V   | 6.3 V | 50 V  | 25 V  | 16 V   | 10 V | 6.3 V | 50 V | 25 V | 16 V | 10 V | 6.3 V | 50 V | 25 V | 16 V | 10 V | 6.3 V | 50 V | 25 V | 16 V | 10 V | 6.3 V | 50 V | 25 V | 16 V | 10 V | 6.3 V |  |
|-------------|-----|----------------------|---------------------|---------|---------|---------|---------|--------|--------|--------|--------|-------|-------|-------|--------|------|-------|------|------|------|------|-------|------|------|------|------|-------|------|------|------|------|-------|------|------|------|------|-------|--|
|             |     |                      | .047 pF             | 0.10 μF | 0.22 μF | 0.33 μF | 0.47 μF | 1.0 μF | 2.2 μF | 3.3 μF | 4.7 μF | 10 μF | 22 μF | 47 μF | 100 μF |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 0402<br>R07 | L   | Inches<br>.040 ±.004 | (mm)<br>(1.02 ±.10) |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .020 ±.004           | (0.51 ±.10)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .025 Max.            | (0.64)              |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .008 ±.004           | (0.20±.10)          |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             |     |                      |                     |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 0603<br>R14 | L   | .063 ±.008           | (1.60 ±.20)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .032 ±.008           | (0.81 ±.20)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .035 Max.            | (0.89)              |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .010±.005            | (.25±.13)           |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             |     |                      |                     |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 0805<br>R15 | L   | .080 ±.010           | (2.03 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .050 ±.010           | (1.27 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .060 Max.            | (1.52)              |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .020±.010            | (0.51±.25)          |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             |     |                      |                     |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 1206<br>R18 | L   | .125 ±.010           | (3.17 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .062 ±.010           | (1.57 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .070 Max.            | (1.78)              |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .020 +.015-.010      | (0.51+.38-.25)      |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             |     |                      |                     |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 1210<br>S41 | L   | .125 ±.010           | (3.18 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .095 ±.010           | (2.41 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .110 Max.            | (2.8)               |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .020 +.015-.010      | (0.51+.38-.25)      |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             |     |                      |                     |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
| 1812<br>S43 | L   | .175 ±.010           | (4.45 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | W   | .125 ±.010           | (3.17 ±.25)         |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | T   | .110 Max.            | (2.8)               |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | E/B | .035±.020            | (0.89±.51)          |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |  |
|             | * T | .140 Max.            | (3.55)              |         |         |         |         |        |        |        |        |       |       |       |        |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      |       |      |      |      |      | *     |  |



## ELECTRICAL CHARACTERISTICS

|   | X7R  | X5R   | Y5V   |
|---|--|---|---|
| Temperature Coefficient:                  | ±15% (-55 to +125°C)   | ±15% (-55 to +85°C)                             | +22%, -82% (-30 to +85°C)                       |
| Dissipation Factor:                       | For ≥ 50 VDC: 5% max.<br>For ≤ 25 VDC: 10% max.  | For ≥ 50 VDC: 5% max.<br>For ≤ 25 VDC: 10% max. | For ≥ 10 VDC: 16% max.<br>For 6.3 VDC: 20% max. |
| Insulation Resistance (Min. @ 25°C, WVDC) | 500 ΩF or 10 GΩ, whichever is less   |   |   |
| Dielectric Strength:                      | 2.5 X WVDC, 25°C, 50mA max.  |   |   |
| Test Conditions:                          | Capacitance values ≤ 22 μF: 1.0kHz±50Hz @ 1.0±0.2 Vrms<br>Capacitance values > 22 μF: 120Hz±10Hz @ 0.5V±0.1 Vrms |   |   |
| Other:                                    | See page 20 for additional dielectric specifications.  |   |   |



# X2Y® Filter & Decoupling Capacitors

## The X2Y® Design - A Capacitive Circuit

X2Y® components share many common features with standard multi-layer ceramic capacitors (MLCC) for easy adoption by end-users.

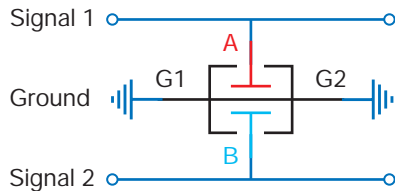
- Same component sizes (0603, 0805, 1206, etc.)
- Same dielectric, electrode and termination materials
- Same pick and place equipment
- Same industry test standards for component reliability

A standard multi-layer ceramic capacitor (MLCC) consists of opposing electrode layers A & B. The X2Y® design adds another set of electrode layers (G) which effectively surround each existing electrode of a two-terminal capacitor. The only external difference is two additional side terminations, creating a four-terminal capacitive circuit, which allows circuit designers a multitude of attachment options.



## X2Y® Circuit 1: Filtering

When used in circuit 1 configuration the X2Y® filter capacitor is connected across two signal lines. Differential mode noise is filtered to ground by the two Y capacitors, A & B. Common mode noise is cancelled within the device.

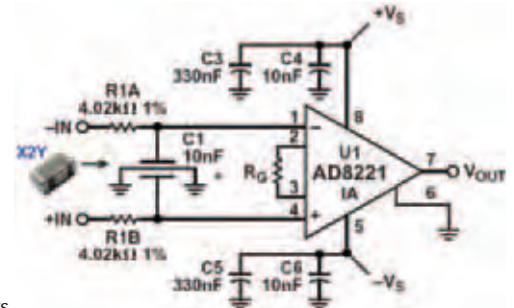


Experts agree that balance is the key to a “quiet” circuit. X2Y® is a balanced circuit device with two equal halves, tightly matched in both phase and magnitude with respect to ground. Several advantages are gained by two balanced capacitors sharing a single ceramic component body.

- Exceptional common mode rejection
- Effect of voltage variation eliminated
- Effects of aging & temperature are equal on both caps
- Matched line-to-ground capacitance

## InAmp Input Filter Example

In this example, a single Johanson X2Y® component was used to filter noise at the input of a DC instrumentation amplifier. This reduced component count by 3-to-1 and costs by over 70% vs. conventional filter components that included 1% film Y-capacitors.

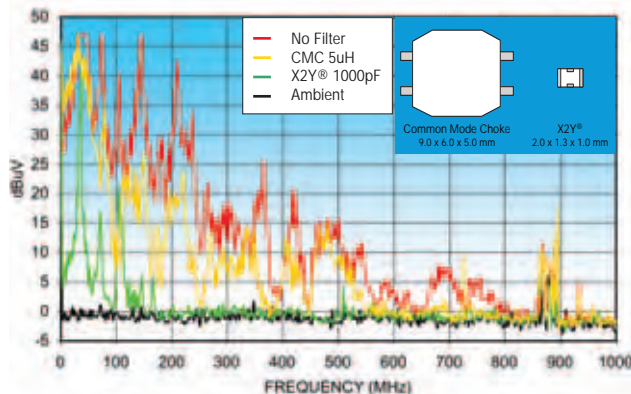


| Parameter             | X2Y®<br>10nF  | Discrete<br>10nF, 2 @ 220 pF | Comments          |
|-----------------------|---------------|------------------------------|-------------------|
| DC offset shift       | < 0.1 $\mu$ V | < 0.1 $\mu$ V                | Referred to input |
| Common mode rejection | 91 dB         | 92 dB                        |                   |

Source: Analog Devices, “A Designer’s Guide to Instrumentation Amplifiers (2nd Edition)” by Charles Kitchin and Lew Counts

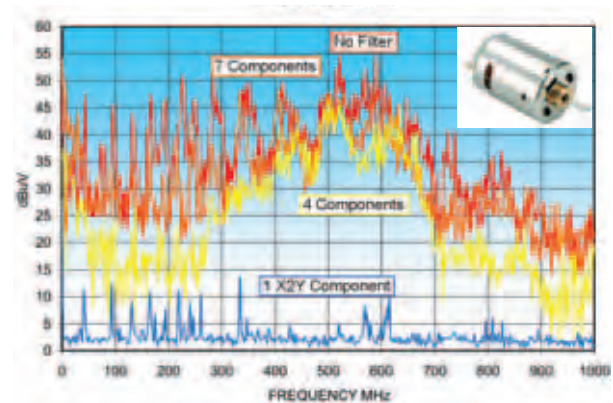
## Common Mode Choke Replacement

In this example, a 5  $\mu$ H common mode choke is replaced by an 0805, 1000pF X2Y® component achieving superior EMI filtering by a component a fraction of the size and cost.



## DC Motor EMI Reduction: A Superior Solution

One X2Y® component has successfully replaced 7 discrete filter components while achieving superior EMI filtering.

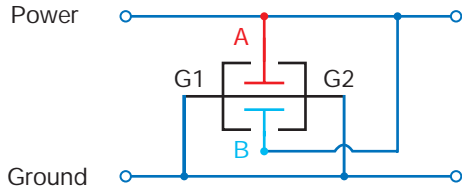




# X2Y® Filter & Decoupling Capacitors

## X2Y® Circuit 2: Decoupling

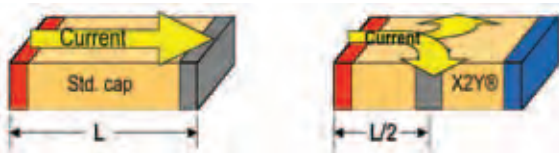
When used in circuit 2 configuration, A & B capacitors are placed in parallel effectively doubling the apparent capacitance while maintaining an ultra-low inductance. The low inductance advantages of the X2Y® Capacitor Circuit enables high-performance bypass networks at reduced system cost.



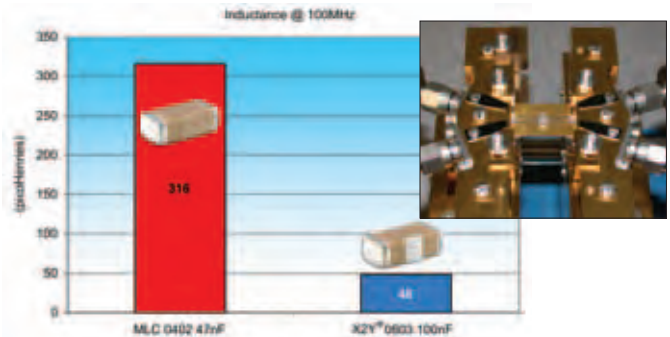
- Low ESL (device only and mounted)
- Broadband performance
- Effective on PCB or package

- Lower via count, improves routing
- Reduces component count
- Lowers placement cost

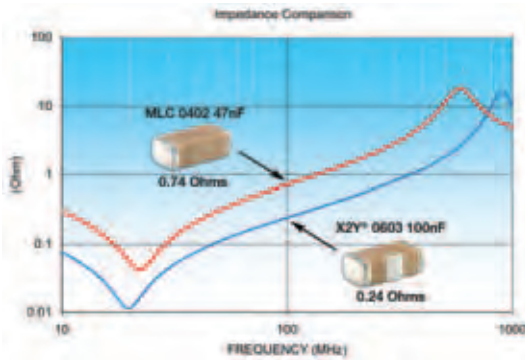
## Component Performance



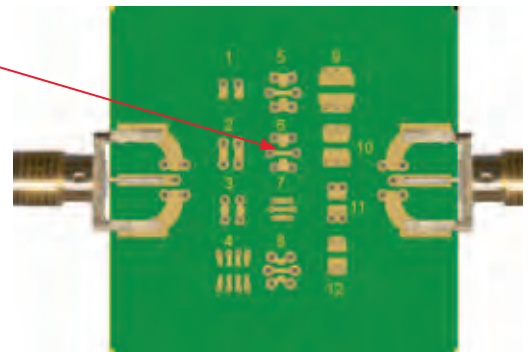
The X2Y® has short, multiple and opposing current paths resulting in lower device inductance.



## Mounted Performance



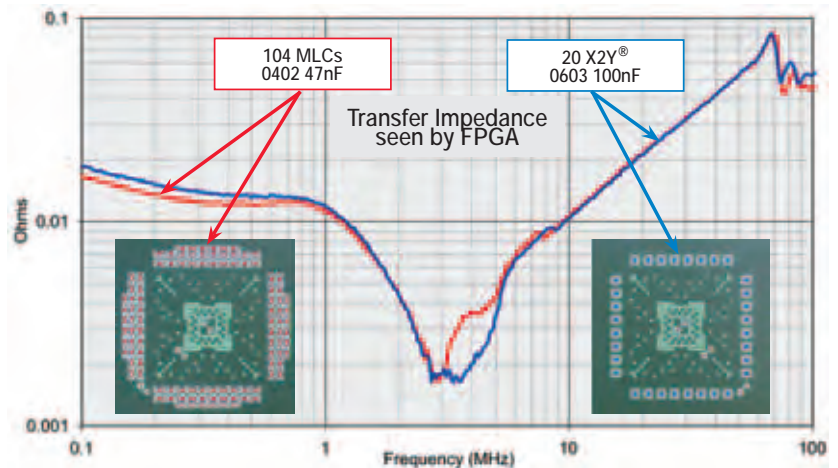
Mutual coupling from opposing polarity vias lowers inductance when mounted on a PCB.



## SYSTEM PERFORMANCE

### 1:5 MLCC Replacement Example

X2Y's® proven technology enables end-users to use one X2Y capacitor to replace five conventional MLCCs in a typical high performance IC bypass design. Vias are nearly cut in half, board space is reduced and savings are in dollars per PCB.



# Sn-Pb X2Y® Filter & Decoupling Capacitors



X2Y® filter capacitors employ a unique, patented low inductance design featuring two balanced capacitors that are immune to temperature, voltage and aging performance differences.

These components offer superior decoupling and EMI filtering performance, virtually eliminate parasitics, and can replace multiple capacitors and inductors saving board space and reducing assembly costs.

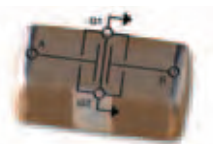
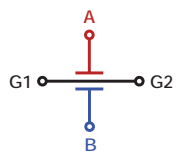
## ADVANTAGES

- One device for EMI suppression or decoupling
- Replace up to 7 components with one X2Y
- Differential and common mode attenuation
- Matched capacitance line to ground, both lines
- Low inductance due to cancellation effect

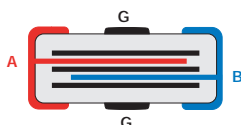
## APPLICATIONS

- FPGA / ASIC /  $\mu$ -P Decoupling
- DDR Memory Decoupling
- Amplifier Filter & Decoupling
- High Speed Data Filtering
- Cellular Handsets

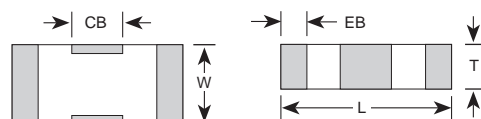
Equivalent Circuits



Cross-sectional View



Dimensional View



| SIZE<br>EIA<br>(JDI) | Circuit 1 (Y Cap.)   |     | 1.0pF | 5.6pF  | 10pF | 22pF | 27pF | 33pF | 47pF | 100pF | 220pF | 470pF | 1000pF | 1500pF | 2200pF | 4700pF | .010mF | .022mF | .047mF | .10mF  | .12mF  | .22mF  | .33mF  | .40mF  | .47mF  |  |  |
|----------------------|----------------------|-----|-------|--------|------|------|------|------|------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|
|                      | Circuit 2 (2*Y Cap.) |     | 2.0pF | 11.2pF | 20pF | 44pF | 54pF | 66pF | 94pF | 200pF | 440pF | 940pF | 2000pF | 3000pF | 4400pF | 9400pF | .020mF | .044mF | .094mF | 0.20mF | 0.24mF | 0.44mF | 0.68mF | 0.80mF | 0.94mF |  |  |
|                      | Order Code           |     | 1R0   | 5R6    | 100  | 220  | 270  | 330  | 470  | 101   | 221   | 471   | 102    | 152    | 222    | 472    | 103    | 223    | 473    | 104    | 124    | 224    | 334    | 404    | 474    |  |  |
| 0603<br>X14          | NPO                  | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      | X7R                  | 25  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 10  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 6.3 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 0805<br>X15          | NPO                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      | X7R                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 50                   |                      |     |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 1206<br>X18          | NPO                  | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      | X7R                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 1210<br>X41          | X7R                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 1410<br>X44          | X7R                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
| 1812<br>X43          | X7R                  | 100 |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |
|                      |                      | 50  |       |        |      |      |      |      |      |       |       |       |        |        |        |        |        |        |        |        |        |        |        |        |        |  |  |

Blue square = NPO  
Green square = X7R

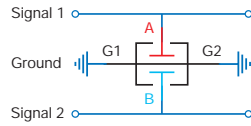
Circuit 1 (Balanced Filtering) = A (or B) to G    Circuit 2 (Decoupling) = A + B to G    [A to B capacitance = 1/2 C1]  
 Rated voltage is for A or B to ground.    A to B rating is 2 X Vrated    Contact the factory for other voltage ratings and capacitance values.

X2Y® technology patents and registered trademark under license from X2Y ATTENUATORS, LLC

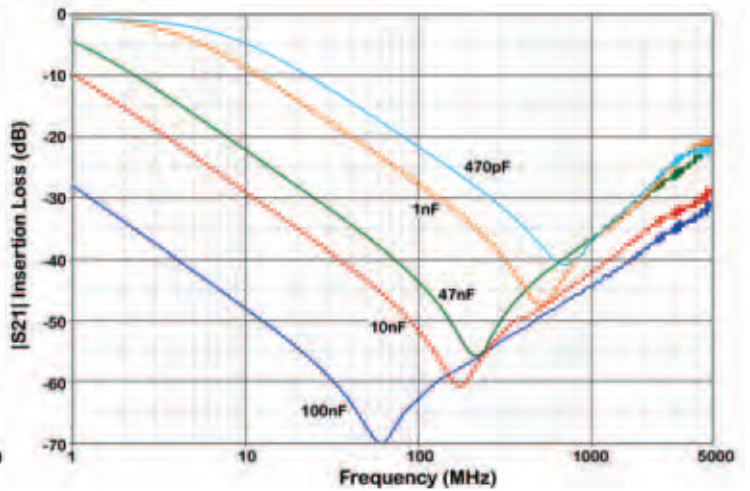
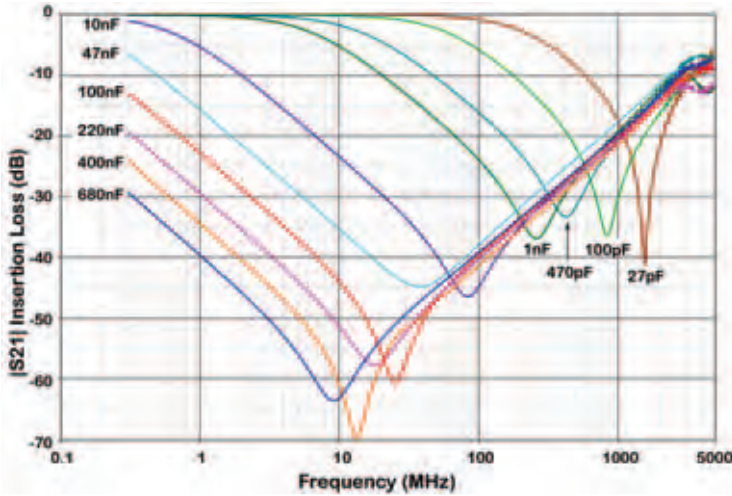
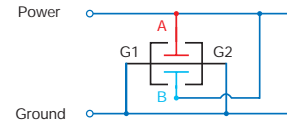


# Sn-Pb X2Y® Filter & Decoupling Capacitors

## Filtering Circuit 1 S21 Signal-to-Ground



## Decoupling Circuit 2 S21 Power-to-Ground



Additional test data and related information available at [www.johansondielectrics.com/x2y/](http://www.johansondielectrics.com/x2y/)

## MECHANICAL CHARACTERISTICS

|    | 0402 (X07)    |               | 0603 (X14)    |               | 0805 (X15)    |               | 1206 (X18)    |               | 1210 (X41)    |               | 1410 (X44)    |               | 1812 (X43)    |               |
|----|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|    | IN            | mm            | IN            | mm            | IN            | mm            | IN            | mm            | IN            | mm            | IN            | mm            | IN            | mm            |
| L  | 0.045 ± 0.003 | 1.143 ± 0.076 | 0.064 ± 0.005 | 1.626 ± 0.127 | 0.080 ± 0.008 | 2.032 ± 0.203 | 0.124 ± 0.010 | 3.150 ± 0.254 | 0.125 ± 0.010 | 3.175 ± 0.254 | 0.140 ± 0.010 | 3.556 ± 0.254 | 0.174 ± 0.010 | 4.420 ± 0.254 |
| W  | 0.024 ± 0.003 | 0.610 ± 0.076 | 0.035 ± 0.005 | 0.889 ± 0.127 | 0.050 ± 0.008 | 1.270 ± 0.203 | 0.063 ± 0.010 | 1.600 ± 0.254 | 0.098 ± 0.010 | 2.489 ± 0.254 | 0.098 ± 0.010 | 2.490 ± 0.254 | 0.125 ± 0.010 | 3.175 ± 0.254 |
| T  | 0.020 max     | 0.508 max     | 0.026 max     | 0.660 max     | 0.040 max     | 1.016 max     | 0.050 max     | 1.270 max     | 0.070 max     | 1.778 max     | 0.070 max     | 1.778 max     | 0.090 max     | 2.286 max     |
| EB | 0.008 ± 0.003 | 0.203 ± 0.076 | 0.009 ± 0.004 | 0.229 ± 0.102 | 0.009 ± 0.004 | 0.229 ± 0.102 | 0.009 ± 0.004 | 0.229 ± 0.102 | 0.009 ± 0.005 | 0.229 ± 0.127 | 0.009 ± 0.005 | 0.229 ± 0.127 | 0.009 ± 0.005 | 0.229 ± 0.127 |
| CB | 0.010 ± 0.003 | 0.305 ± 0.076 | 0.018 ± 0.004 | 0.457 ± 0.102 | 0.022 ± 0.005 | 0.559 ± 0.127 | 0.040 ± 0.005 | 1.016 ± 0.127 | 0.045 ± 0.005 | 1.143 ± 0.127 | 0.045 ± 0.005 | 1.143 ± 0.127 | 0.045 ± 0.005 | 1.143 ± 0.127 |

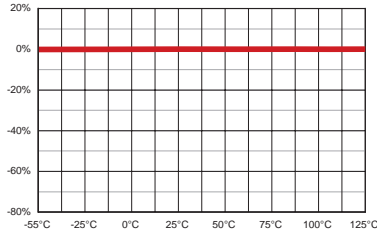
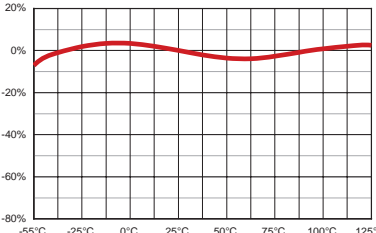
## HOW TO ORDER X2Y® FILTER & DECOUPLING CAPACITORS

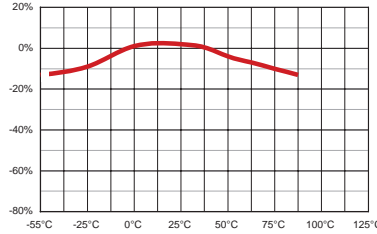
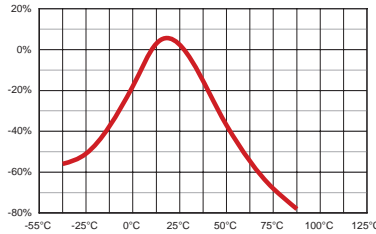
|  |  |   |  |                               |   |                                |   |
|--|--|---|--|-------------------------------|---|--------------------------------|---|
| <b>6R3</b>   | <b>X14</b>   | <b>W</b>                                | <b>104</b>   | <b>M</b>                      | <b>T</b>  | <b>4</b>                       | <b>T</b>  |
| <b>VOLTAGE</b><br>6R3 = 6.3 V<br>100 = 25 V<br>250 = 25 V<br>500 = 50 V<br>101 = 100 V | <b>CASE SIZE</b><br>X07 = 0402<br>X14 = 0603<br>X15 = 0805<br>X18 = 1206<br>X41 = 1210<br>X43 = 1812<br>X44 = 1410 | <b>DIELECTRIC</b><br>N = NPO<br>W = X7R | <b>CAPACITANCE</b><br>1st two digits are significant; third digit denotes number of zeros.<br>474 = 0.47 µF<br>105 = 1.00 µF | <b>TOLERANCE</b><br>M = ± 20% | <b>TERMINATION</b><br>T = Tin-Lead w/<br>5% min. Pb | <b>MARKING</b><br>4 = Unmarked | <b>TAPE MODIFIER</b><br>Code Tape Reel<br>E Embossed 7"<br>U Embossed 13"<br>T Paper 7"<br>R Paper 13"<br>Tape specs. per EIA RS481 |

P/N written: 6R3X14W104MT4T



# Electrical Characteristics

| PARAMETER                | NPO  |               | X7R  |               |
|--------------------------|--|---------------|--|---------------|
| TEMPERATURE COEFFICIENT: | 0 ± 30 ppm/°C  | -55 to +125°C | ± 15%  | -55 to +125°C |
|                          |   |               |                             |               |
| DISSIPATION FACTOR:      | .001 (0.1%) max  |               | For Vrated ≥ 50 VDC, DF = 2.5% max<br>For Vrated = 25 VDC, DF = 3.0% max<br>For Vrated = 16 VDC, DF = 3.5% max |               |
| AGING:                   | None   |               | 2.5% / decade hour   |               |
| INSULATION RESISTANCE:   | IR @ 25°C, WVDC = 1000ΩF or 100GΩ whichever is less <sup>1</sup><br>IR @ 125°C, WVDC = 10% of 25°C rating  |               |  |               |
| DIELECTRIC STRENGTH:     | For Vrated = 6 - 200 VDC, DWV = 2.5 X WVDC, 25°C, 50mA max.<br>For Vrated = 201 - 499 VDC, DWV = 2.0 X WVDC, 25°C, 50mA max.<br>For Vrated = 500 - 999 VDC, DWV = 1.5 X WVDC, 25°C, 50mA max.<br>For Vrated = 1000+ VDC, DWV = 1.2 X WVDC, 25°C, 50mA max. |               |  |               |
| TEST PARAMETERS:         | C > 100 pF; 1kHz ±50Hz; 1.0±0.2 VRMS<br>C ≤ 100 pF 1Mhz ±50kHz; 1.0±0.2 VRMS   |               | 1kHz ±50Hz; 1.0±0.2 VRMS   |               |
| NOTES:                   | 1) Tanceram Series: See Tanceram datasheet   |               |  |               |

| PARAMETER                | X5R  |              | Y5V  |              |
|--------------------------|--|--------------|--|--------------|
| TEMPERATURE COEFFICIENT: | ± 15%  | -55 to +85°C | +22% -82%  | -30 to +85°C |
|                          |                             |              |                           |              |
| DISSIPATION FACTOR:      | For Vrated ≥ 25 VDC, DF = 3.0% max<br>For Vrated = 16 VDC: DF = 3.5% max<br>For Vrated = 10 VDC: DF = 5.0% max |              | For Vrated ≥ 25 VDC, DF = 5.0% max<br>For Vrated = 16 VDC, DF = 7.0% max<br>For Vrated = 10 VDC, DF = 9.0% max |              |
| AGING:                   | 2.5 % / decade hour  |              | 7.0% / decade hour   |              |
| INSULATION RESISTANCE:   | IR @ 25°C, WVDC = 1000ΩF or 100GΩ whichever is less <sup>2</sup>   |              | IR @ 25°C, WVDC = 100ΩF or 10GΩ whichever is less  |              |
| DIELECTRIC STRENGTH:     | DWV = 2.5 X WVDC,<br>25°C, 50mA max.   |              | DWV = 2.5 X WVDC, 25°C, 50mA max.  |              |
| TEST PARAMETERS:         | 1kHz ±50Hz; 0.5±0.2 VRMS   |              | 1kHz ±50Hz; 1.0±0.2 VRMS   |              |
| NOTES:                   | 2) Tanceram X5R IR = 500 ΩF or 10 GΩ   |              |  |              |

# High Reliability Testing Options

| TEST                       | STANDARD      |
|----------------------------|---------------|
| <b>GROUP A TESTING</b>     |               |
| 100 Hour Burn In           | MIL-PRF-55681 |
| 100% Electrical            | MIL-PRF-55681 |
| 100% Visual                | MIL-PRF-55681 |
| Solderability              | MIL-PRF-55681 |
| Hot IR                     | MIL-PRF-55681 |
| <b>GROUP B TESTING</b>     |               |
| Solderability              | MIL-PRF-55681 |
| TVC                        | MIL-PRF-55681 |
| Class H Element Evaluation | MIL-PRF-38534 |
| Class S Element Evaluation | MIL-PRF-38534 |
| Class K Element Evaluation | MIL-PRF-38534 |

| TEST                        | STANDARD      |
|-----------------------------|---------------|
| <b>GROUP C TESTING</b>      |               |
| Solderability               | MIL-PRF-55681 |
| TVC                         | MIL-PRF-55681 |
| Thermal Shock 10 Cycles     | MIL-PRF-55681 |
| Resistance to Solder Heat   | MIL-PRF-55681 |
| Moisture Resistance         | MIL-PRF-55681 |
| Humidity                    | MIL-PRF-55681 |
| 2000 Hour Life Test         | MIL-PRF-55681 |
| Thermal Shock 100 Cycles    | MIL-C-123     |
| DPA                         | EIA 469       |
| Shear Test / Bond Pull Test | As required   |
| Wire Bond                   | As required   |
| Similarity Data             | As required   |

High reliability testing is available per published Military standards or customer specification. Please contact the factory for any required testing not listed.

## Part Number Breakdown

| 500          | R15          | N          | 101   | J                    | T                                    | 4                              | H  |
|--------------|--------------|------------|---|----------------------|--------------------------------------|--------------------------------|--|
| VOLTAGE      | CASE SIZE    | DIELECTRIC | CAPACITANCE   | TOLERANCE            | TERMINATION                          | MARKING                        | MODIFIER   |
| 100 = 10 V   | R05=0201     | N = NPO    | 1st two digits are significant; third digit denotes number of zeros, R = decimal. | * B = ± 0.10 pF      | T = Tin-Lead with 5% min. Pb content | 4 = Unmarked                   | Tape Code  |
| 160 = 16 V   | R07=0402     | W = X7R    |   | * C = ± 0.25 pF      |                                      | 6 = EIA "J" Code*              | Tape Type  |
| 250 = 25 V   | A11=0405     | X = X5R    |   | * D = ± 0.50 pF      |                                      | *Not available on sizes ≥ 0402 | Reel Size  |
| 500 = 50 V   | R14=0603     | Y = Y5V    |   | F = ± 1 %            |                                      |                                | U Embossed 13"   |
| 101 = 100 V  | R15=0805     |            | 1R0 = 1.0 pF  | G = ± 2%             |                                      |                                | R Punched 13"  |
| 201 = 200 V  | X15=0805 X2Y |            | 100 = 10 pF   | J = ± 5%             |                                      |                                | E Embossed 7"  |
| 251 = 250 V  | A18=0612     |            | 102 = 1,000 pF  | K = ± 10%            |                                      |                                | T Punched 7"   |
| 301 = 300 V  | R18=1206     |            | 474 = 0.47 µF   | M = ± 20%            |                                      |                                | None = Bulk Packaging                                    |
| 501 = 500 V  | X18=1206 X2Y |            |   | Z = +80 -20%         |                                      |                                | High Reliability Code                                    |
| 631 = 630 V  | S41=1210     |            |   | *Values < 10 pF only |                                      |                                | H = High Rel tested per specified customer requirements. |
| 102 = 1000 V | X41=1210 X2Y |            |   |                      |                                      |                                |  |
| 202 = 2000 V | X44=1410 X2Y |            |   |                      |                                      |                                |  |
| 302 = 3000 V | R29=1808     |            |   |                      |                                      |                                |  |
| 402 = 4000 V | S43=1812     |            |   |                      |                                      |                                |  |
| 502 = 5000 V | X43=1812 X2Y |            |   |                      |                                      |                                |  |
|              | S47=2220     |            |   |                      |                                      |                                |  |
|              | S49=1825     |            |   |                      |                                      |                                |  |
|              | S48=2225     |            |   |                      |                                      |                                |  |

Part number written: 500R15N101JT4T

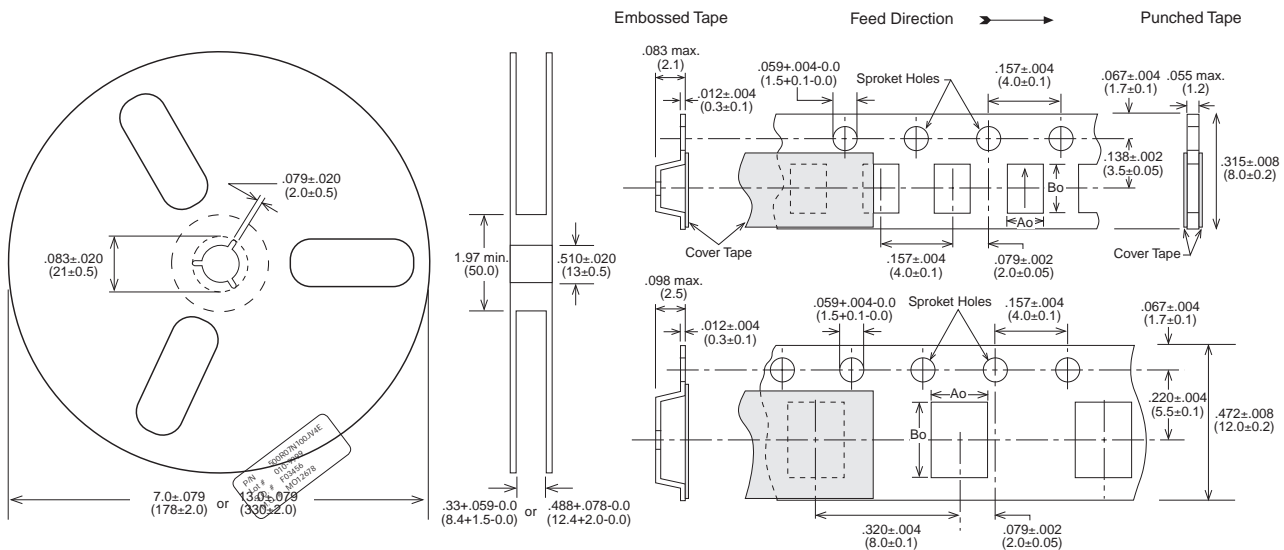
PLEASE NOTE: Not all combinations of JDI P/Ns are valid. Please refer to the appropriate "How to Order" section for a particular product or contact your Sales Representative if you need assistance.



# Capacitor Packaging & Marking



Johanson capacitors are available taped per EIA standard 481. Tape options include 7" and 13" diameter reels. Johanson uses high quality, dust free, punched 8mm paper tape and plastic embossed 8mm tape for thicker MLCCs. Quantity per reel ranges are listed in the tables below and are dependent on chip thickness.



| COMPONENT TYPE / SIZE | 7" DIAMETER REEL |                  |           |           | 13" DIAMETER REEL |                  |           |           |
|-----------------------|------------------|------------------|-----------|-----------|-------------------|------------------|-----------|-----------|
|                       | REEL QUANTITY    | TAPE TYPE        | TAPE SIZE | TAPE CODE | REEL QUANTITY     | TAPE TYPE        | TAPE SIZE | TAPE CODE |
| R05 / 0201 MLCC       | 15000            | Paper            | 8mm       | T         | N/A               | N/A              |           | N/A       |
| R07 / 0402 MLCC       | 10000            | Paper            | 8mm       | T         | N/A               | N/A              |           | N/A       |
| R14 / 0603 MLCC       | 4000             | Paper            | 8mm       | T         | 10000             | Paper            | 8mm       | R         |
| R15 / 0805 MLCC       | 3000 - 4000      | Paper / Embossed | 8mm       | T         | 10000             | Paper / Embossed | 8mm       | U         |
| R18 / 1206 MLCC       | 3000 - 4000      | Paper / Embossed | 8mm       | T         | 10000             | Paper / Embossed | 8mm       | U         |
| S41 / 1210 MLCC       | 2000 - 4000      | Embossed         | 8mm       | E         | 10000             | Embossed         | 8mm       | U         |
| R29 / 1808 MLCC       | 2000             | Embossed         | 12mm      | E         | 5000              | Embossed         | 12mm      | U         |
| S43 / 1812 MLCC       | 1000             | Embossed         | 12mm      | E         | 5000              | Embossed         | 12mm      | U         |
| S47 / 2220 MLCC       | 1000             | Embossed         | 12mm      | E         | 5000              | Embossed         | 12mm      | U         |
| S49 / 1825 MLCC       | 1000             | Embossed         | 12mm      | E         | 5000              | Embossed         | 12mm      | U         |
| S48 / 2225 MLCC       | 1000             | Embossed         | 12mm      | E         | 5000              | Embossed         | 12mm      | U         |

# Online Resources: [www.johansondielectrics.com](http://www.johansondielectrics.com)

The screenshot shows a web browser window displaying the Johanson Dielectrics website. The browser's address bar shows the URL <http://www.johansondielectrics.com/>. The website header includes the company name "JOHANSON DIELECTRICS" and the product category "SURFACE MOUNT CERAMIC CAPACITORS". A navigation menu lists: Contact / Sales Reps / Distributors / Partners / Company / Employment / Site Map / Site Search. The date "Monday, October 4th, 2004" is displayed. On the left, a sidebar menu lists: Surface Mount Products, Leaded Products, Technical Notes, Prototyping Kits, Cross Reference Charts, X2Y® Technology, and Distributor Inventory. Below this is a search section for "SMT Caps:" with dropdown menus for Voltage, Size, and Capacitance, and a "Go" button. Another search section for "JDI Part Number:" has a text input field and a "Go" button. A "Product Quick Links:" section contains a "Product Search" dropdown. The main content area features a central image of a laptop with a screen displaying various capacitor types: MLCC, Tanceram, Low Inductance, X2Y, Y2 Safety, Cap Arrays, High Voltage, and Feed-thru. Below the laptop image, text reads: "Click a product above to view its info -or- [Click here to view our Surface Mount Products page](#)". To the right, a "Welcome to Johanson Dielectrics!" section contains two paragraphs of text and a "Put our experience to work for you today!" heading. Below this is an "Environmental Compliance" section with a leaf icon and a link to the ROHS Compliance Statement. A "New Product!" section highlights "X1/Y2 Safety Certified Capacitors" with specifications: Size 1808, 250 VAC, 10-680 pF, X7R & NPO Dielectrics, and a link for more info. The footer contains product and company information, a contact notice, and a copyright notice: "All information on this page is subject to our Legal Disclaimer. © Copyright 2004, All rights reserved."

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