

# High Temperature Chip



A range of chip capacitors, available in sizes 0805 to 7565, designed to operate from -55°C to 150°C, (Class 2 dielectric) and from -55°C to 200°C (COG & Class II dielectrics). Voltage ratings of 25V to 4kV.

- For dielectric characteristics see pages 4 & 7.
- For dimensions see page 12.
- For termination options see pages 3 & 15.
- For ordering information, inc. tolerances available, see page 15.

**Note:** Maximum capacitance values are shown below as 3 digit code: 2 significant figures followed by the no. of zeros e.g. 183 = 18,000pF.



## Maximum capacitance values - 150°C X8R (S) dielectric

| Size     | 0805 | 1206 | 1210 | 1812 | 1825 | 2225 | 4540 | 7565 |
|----------|------|------|------|------|------|------|------|------|
| Min cap. | 121  | 221  | 221  | 221  | 102  | 102  | 102  | 222  |
| 25V      | 563  | 184  | 334  | 684  | 125  | 155  | 565  | 156  |
| 50V      | 473  | 154  | 274  | 564  | 105  | 125  | 475  | 126  |
| 100V     | 333  | 104  | 184  | 394  | 824  | 105  | 395  | 106  |
| 250V     | 183  | 333  | 823  | 154  | 474  | 564  | 275  | 695  |
| 500V     | 562  | 153  | 393  | 563  | 124  | 154  | 125  | 325  |

## Maximum capacitance values - 160°C COG (F)/Class II (G) and 200°C COG (D)/Class II (E) dielectrics

| Size                | 0805          |          | 1206          |          | 1210          |          | 1515          |          | 1808          |          | 1812          |          | 1825          |          | 2225          |          | 3530          |          | 4540          |          | 6560          |          | 7565          |          |
|---------------------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|---------------|----------|
| Min cap.            | OR5           | 121      | 1R0           | 121      | 5R0           | 121      | 5R0           | 151      | 120           | 151      | 220           | 151      | 330           | 471      | 470           | 471      | 221           | 102      | 390           | 102      | 560           | 222      | 101           | 222      |
| Tmax inches:<br>mm: | 0.054<br>1.37 |          | 0.064<br>1.63 |          | 0.065<br>1.65 |          | 0.130<br>3.30 |          | 0.065<br>1.65 |          | 0.065<br>1.65 |          | 0.080<br>2.03 |          | 0.080<br>2.03 |          | 0.250<br>6.35 |          | 0.300<br>7.62 |          | 0.300<br>7.62 |          | 0.300<br>7.62 |          |
| Dielectric          | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II | COG           | Class II |
| 25V                 | 272           | 823      | 562           | 224      | 123           | 394      | 223           | 824      | 123           | 334      | 223           | 684      | 563           | 155      | 563           | 185      | 104           | 395      | 184           | 565      | 334           | 156      | 394           | 186      |
| 50V                 | 182           | 473      | 392           | 124      | 822           | 224      | 183           | 684      | 822           | 274      | 153           | 474      | 393           | 105      | 473           | 125      | 823           | 275      | 154           | 475      | 274           | 126      | 334           | 156      |
| 100V                | 681           | 183      | 182           | 473      | 332           | 104      | 103           | 274      | 332           | 823      | 822           | 154      | 153           | 474      | 183           | 474      | 563           | 225      | 104           | 335      | 224           | 825      | 274           | 126      |
| 250V                | 181           | 472      | 102           | 103      | 222           | 273      | 392           | 683      | 222           | 223      | 562           | 473      | 123           | 124      | 183           | 154      | 333           | 564      | 563           | 125      | 124           | 275      | 154           | 395      |
| 500V                | 101           | 102      | 391           | 222      | 821           | 562      | 272           | 183      | 102           | 562      | 222           | 103      | 392           | 273      | 562           | 333      | 123           | 124      | 273           | 334      | 563           | 684      | 683           | 824      |
| 1kV                 | 470           | 181      | 101           | 391      | 221           | 821      | 821           | 272      | 221           | 821      | 561           | 152      | 821           | 472      | 102           | 562      | 562           | 273      | 153           | 683      | 333           | 154      | 393           | 224      |
| 2kV                 | •             | •        | 270           | •        | 560           | 151      | 181           | 561      | 560           | •        | 121           | 221      | 181           | 561      | 271           | 681      | 152           | 682      | 332           | 183      | 822           | 393      | 103           | 473      |
| 3kV                 | •             | •        | •             | •        | •             | •        | 820           | •        | 220           | •        | 560           | •        | 820           | •        | 101           | •        | 561           | 272      | 152           | 682      | 332           | 153      | 392           | 183      |
| 4kV                 | •             | •        | •             | •        | •             | •        | 470           | •        | 120           | •        | 270           | •        | 330           | •        | 470           | •        | 331           | 122      | 821           | 272      | 182           | 562      | 222           | 822      |

# Chip Ordering Information



| Prefix | Case Size | Dielectric | Capacitance | Capacitance Tolerance | Voltage | Termination | Special Thickness | High Reliability Testing | Packaging | Marking | High Reliability Test Criteria |
|--------|-----------|------------|-------------|-----------------------|---------|-------------|-------------------|--------------------------|-----------|---------|--------------------------------|
| XX     | 1206      | N          | 472         | J                     | 101     | N           | X050              | H                        | T         | M       | - HB                           |

### Capacitance Code

1st two digits are significant, third digit denotes number of zeros, R = decimal  
Examples:

|     |           |
|-----|-----------|
| 1R0 | = 1.0pF   |
| 120 | = 12pF    |
| 471 | = 470pF   |
| 102 | = 1,000pF |
| 273 | = 0.027μF |
| 474 | = 0.47μF  |
| 105 | = 1.0μF   |

### Special Thickness

|      |                                                                                                             |
|------|-------------------------------------------------------------------------------------------------------------|
| None | Standard thickness as per Novacap catalog specifications                                                    |
| X    | Denotes a special thickness other than standard. Specify in inches if required. (As shown above X = 0.050") |

### Packaging

|      |             |
|------|-------------|
| None | Bulk        |
| T    | Tape & Reel |
| W    | Waffle Pack |

### Marking

|      |                                                  |
|------|--------------------------------------------------|
| None | Unmarked                                         |
| M    | Marked<br>*Marking not available on sizes ≤ 0603 |

### High Reliability Testing

|      |                          |
|------|--------------------------|
| None | Standard product         |
| H    | High Reliability Testing |
| H    | High Temp Screening      |

### Hi-Reliability Testing Criteria

|    |                       |
|----|-----------------------|
| HB | MIL-PRF-55681 Group A |
| HV | MIL-PRF-49467 Group A |
| HS | MIL-PRF-123 Group A   |

### Dielectric Codes

|    |                   |                            |
|----|-------------------|----------------------------|
| N  | C0G/NP0           | Ultra Stable               |
| M  | C0G/NP0           | Ultra Stable Magnetic Free |
| F  | C0G/NP0           | High Temp. (up to 160°C)   |
| D  | C0G/NP0           | High Temp. (up to 200°C)   |
| K  | R3L               | Ultra Stable               |
| R  | R2D               | Pulse Energy               |
| Y  | Y5V               | General Purpose            |
| Z  | Z5U               | General Purpose            |
| B  | X7R               | Stable                     |
| C  | X7R               | Stable Magnetic Free       |
| X  | BX                | MIL                        |
| S  | X8R               | High Temp. (up to 150°C)   |
| E  | Class II          | High Temp. (up to 200°C)   |
| G  | Class II          | High Temp. (up to 160°C)   |
| W  | X5R               | Stable                     |
| RN | Lead free C0G/NP0 | Ultra Stable               |
| RB | Lead free X7R     | Stable                     |
| BB | X7R BME           | Stable                     |
| BW | X5R BME           | Stable                     |

### Voltage Code

1st two digits are significant, third digit denotes number of zeros. For example:

|     |                |
|-----|----------------|
| 160 | = 16 Volts     |
| 101 | = 100 Volts    |
| 501 | = 500 Volts    |
| 102 | = 1,000 Volts  |
| 502 | = 5,000 Volts  |
| 103 | = 10,000 Volts |

### Termination Codes

|    |                              |                   |
|----|------------------------------|-------------------|
| P  | Palladium Silver             |                   |
| PR | Palladium Silver*            |                   |
| K  | Solderable Palladium Silver* |                   |
| N  | Nickel Barrier*              | 100% tin          |
| Y  | Nickel Barrier               | 90% tin, 10% lead |
| NG | Nickel Barrier Gold Flash*   |                   |
| C  | FlexiCap™/Nickel Barrier*    | 100% tin          |
| D  | FlexiCap™/Nickel Barrier     | 90% tin, 10% lead |
| B  | Copper Barrier*              | 100% tin          |
| E  | Copper Barrier               | 90% tin, 10% lead |
| S  | Silver*                      |                   |

\* Indicates RoHS terminations

### Capacitance Tolerance Codes

| Code | Tolerance       | Dielectric |   |     |     |     |         |     |    |     |          | Positive VTC |     |   |
|------|-----------------|------------|---|-----|-----|-----|---------|-----|----|-----|----------|--------------|-----|---|
|      |                 | C0G/NP0    |   |     | R3L | R2D | Y5V Z5U | X7R | BX | X8R | Class II |              | X5R |   |
|      | * Not RF series | N          | M | F/D | K   | R   | Y/Z     | B   | C  | X   | S        | E/G          | W   | P |
| B    | ±0.10pF         | •          | • |     |     |     |         |     |    |     |          |              |     |   |
| C    | ±0.25pF         | •          | • |     | •   |     |         |     |    |     |          |              |     |   |
| D    | ±0.50pF         | •          | • |     | •   |     |         |     |    |     |          |              |     |   |
| F    | ±1%             | •          | • | •   |     |     |         |     |    |     |          |              |     |   |
| G    | ±2%             | •          | • | •   | •   |     |         |     |    |     |          |              |     |   |
| J    | ±5%             | •          | • | •   | •   | •   |         | •*  | •  | •*  | •        | •            |     |   |
| K    | ±10%            | •          | • | •   | •   | •   |         | •   | •  | •   | •        | •            | •   | • |
| M    | ±20%            | •          |   | •   | •   | •   | •       | •   | •  | •   | •        | •            | •   | • |
| Z    | +80% -20%       | •          |   |     |     | •   | •       | •*  |    |     |          |              |     | • |
| P    | +100% -0%       | •          |   |     |     | •   | •       | •*  |    |     |          |              |     | • |

### Prefix Definitions

|      |                                           |            |
|------|-------------------------------------------|------------|
| None | Standard chip                             |            |
| RF   | Improved ESR Capacitor                    | p. 23      |
| LS   | Y <sup>3</sup> Certified Safety Capacitor | p. 42 - 43 |
| ES   | Y <sup>2</sup> Certified Safety Capacitor | p. 42 - 43 |
| ST   | Stacked Capacitor Assembly                | p. 48 - 53 |
| SM   | Stacked Hi-Rel Capacitor Assembly         | p. 48 - 53 |
| CR   | Cap-Rack Capacitor Array                  | p. 54      |
| RC   | Bleed Resistor                            | p. 58 - 61 |

## Technical Information

Novacap provides application notes throughout this catalog as a guide to chip selection and attachment methods. Refer to the Novacap Technical Brochure found at [www.novacap.com](http://www.novacap.com) for more details. This technical information includes the nature of capacitance, dielectric properties, electrical properties, classes of dielectrics, ferroelectric behavior, test standards, and high reliability test plans. Please do not hesitate to contact the sales office for any product or technical assistance.

## Capacitor Size

Size availability is based primarily on capacitance values and voltage rating. Smaller units are generally less expensive. Because mass affects the thermal shock susceptibility of chip capacitors, size selection should consider the soldering method used to attach the chip to the board. Sizes 1812 and smaller can be wave, vapor phase, or reflow soldered. Larger units require reflow soldering.

## Chip Selection

Multilayer capacitors (MLC) are categorized by dielectric performance with temperature. The Temperature Coefficient of Capacitance describes the variance of capacitance value with temperature. The choice of components is therefore largely determined by the temperature stability required of the device and the size necessary for the desired capacitance value and voltage rating.

## Packaging

Units are available reeled, in waffle pack, or bulk packaged. Bar coded labels are standard for reeled and bulk packaging.

## Primary Dielectric Types

### COG/NP0:

Ultra stable Class I dielectric, with negligible dependence of capacitance on temperature, voltage, frequency, and time. Used in circuitry requiring very stable performance.

### X7R:

Stable Class II dielectric, with predictable change in properties across a temperature range of -55°C to +125°C. Used as blocking, decoupling, bypassing, and frequency discriminating elements. This dielectric is ferroelectric and provides higher capacitance than Class I materials.

### BX:

The military specification for ceramic chip capacitors (MIL-PRF-55681) defines a mid-K stable dielectric designated as BX. The BX specification has voltage temperature limits in addition to temperature limits of capacitance. The BX dielectric is limited to ±15% maximum change in capacitance between 25°C and -55°C or +125°C and also has a voltage restriction of +15% / -25% maximum change in capacitance between 25°C and -55°C or +125°C at rated voltage.

### Z5U/Y5V:

General purpose Class III dielectrics with higher dielectric constant and greater variation of properties over temperature and voltage. Very high capacitance per volume is attainable for general purpose applications where stability over a wide temperature range is not critical.

## Dielectric Termination Combinations

| Dielectric         | Code | Palladium Silver | Palladium Silver | Solderable Palladium Silver | Nickel Barrier 100% tin | Nickel Barrier 90/10% tin/lead | Nickel Barrier Gold flash | FlexiCap™/Nickel Barrier 100% tin | FlexiCap™/Nickel Barrier 90/10% tin/lead | Copper Barrier 100% tin | Copper Barrier 90/10% tin/lead | Solderable Silver |
|--------------------|------|------------------|------------------|-----------------------------|-------------------------|--------------------------------|---------------------------|-----------------------------------|------------------------------------------|-------------------------|--------------------------------|-------------------|
|                    |      | RoHS             | RoHS             | RoHS                        | RoHS                    | RoHS                           | RoHS                      | RoHS                              | RoHS                                     | RoHS                    | RoHS                           | RoHS              |
| COG/NP0            | N/RN | •                | •                | •                           | •                       | •                              | •                         | •                                 | •                                        |                         |                                | •                 |
| R3L                | K    | •                | •                | •                           | •                       | •                              | •                         | •                                 | •                                        |                         |                                |                   |
| X7R                | B/RB | •                | •                | •                           | •                       | •                              | •                         | •                                 | •                                        |                         |                                | •                 |
| X7R BME            | BB   |                  |                  |                             | •                       | •                              | •                         |                                   |                                          |                         |                                |                   |
| X5R BME            | BW   |                  |                  |                             | •                       | •                              | •                         |                                   |                                          |                         |                                |                   |
| BX                 | X    | •                | •                | •                           | •                       | •                              | •                         | •                                 | •                                        |                         |                                | •                 |
| Y5V                | Y    |                  |                  |                             |                         |                                |                           | •                                 | •                                        |                         |                                |                   |
| Z5U                | Z    |                  |                  |                             |                         |                                |                           | •                                 | •                                        |                         |                                |                   |
| COG/NP0 (Mag free) | M    | •                | •                | •                           |                         |                                |                           |                                   |                                          | •                       | •                              |                   |
| X7R (Mag free)     | C    | •                | •                | •                           |                         |                                |                           |                                   |                                          | •                       | •                              |                   |
| X8R                | S    | •                | •                | •                           | •                       | •                              |                           | •                                 | •                                        |                         |                                | •                 |
| COG/NP0 (160°C)    | F    | •                | •                | •                           | •                       | •                              |                           | •                                 | •                                        |                         |                                | •                 |
| COG/NP0 (200°C)    | D    |                  |                  | •                           |                         |                                |                           |                                   |                                          |                         |                                | •                 |
| Class II (160°C)   | G    | •                | •                | •                           | •                       | •                              |                           | •                                 | •                                        |                         |                                | •                 |
| Class II (200°C)   | E    |                  |                  | •                           |                         |                                |                           |                                   |                                          |                         |                                | •                 |
| Pulse Power        | P    | •                | •                | •                           |                         |                                |                           |                                   |                                          |                         |                                |                   |
| R2D                | R    | •                | •                | •                           |                         |                                |                           |                                   |                                          |                         |                                |                   |

## Termination Material

We recommend the following termination types:

### Solder Attachment:

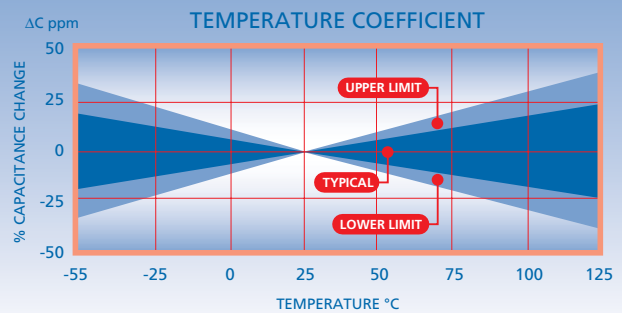
- N** Nickel Barrier, 100% matte tin plated - RoHS
  - C** FlexiCap™ with Nickel Barrier, 100% tin plated - RoHS
  - Y** Nickel Barrier, tin-lead plated
  - D** FlexiCap™ Nickel Barrier, tin-lead plated
  - B** Copper Barrier 100% matte tin plated - RoHS
  - E** Copper Barrier, tin-lead plated
  - K** Solderable Palladium Silver - RoHS (suitable for conductive epoxy attach)
  - S** Solderable Silver - RoHS
- Conductive Epoxy attachment:**
- P** Palladium Silver
  - PR** Palladium Silver - RoHS
  - NG** Nickel Barrier Gold Flash - RoHS (suitable for soldering attach)



# Dielectric Characteristics

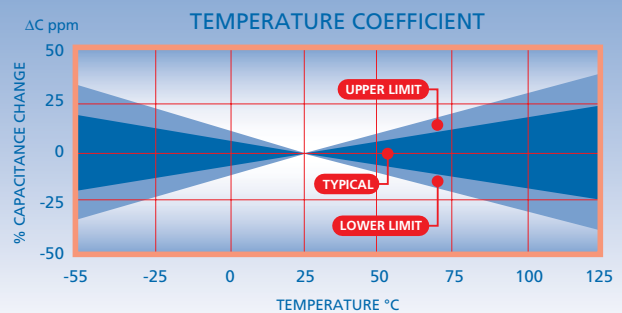
## COG/NP0 (N) Ultra Stable and RoHS 2013 (RN) type

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 125°C                                                                                         |
| Temperature coefficient:        | 0 ±30 ppm/°C                                                                                           |
| Dissipation factor:             | 0.1% max @ 25°C                                                                                        |
| Insulation resistance           | @25°C: >100GΩ or >1000ΩF whichever is less<br>@125°C: >10GΩ or >100ΩF whichever is less                |
| Dielectric withstanding voltage | <200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | 0% per decade                                                                                          |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C<br>1MHz for Capacitance ≤100pF                                               |



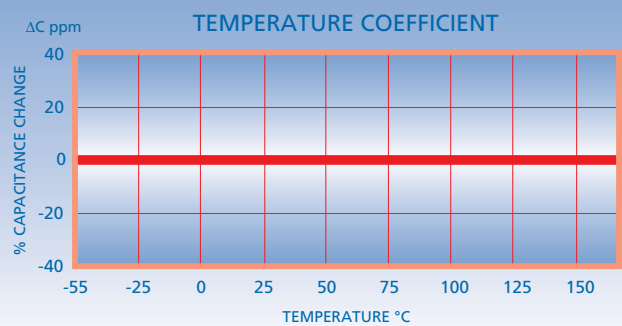
## COG/NP0 (M) Ultra Stable Non Magnetic

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 125°C                                                                                         |
| Temperature coefficient:        | 0 ±30 ppm/°C                                                                                           |
| Dissipation factor:             | 0.1% max @ 25°C                                                                                        |
| Insulation resistance           | @25°C: >1000ΩF or >10000ΩF whichever is less<br>@125°C: >100ΩF or >1000ΩF whichever is less            |
| Dielectric withstanding voltage | <200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | 0% per decade                                                                                          |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C<br>1MHz for Capacitance ≤100pF                                               |



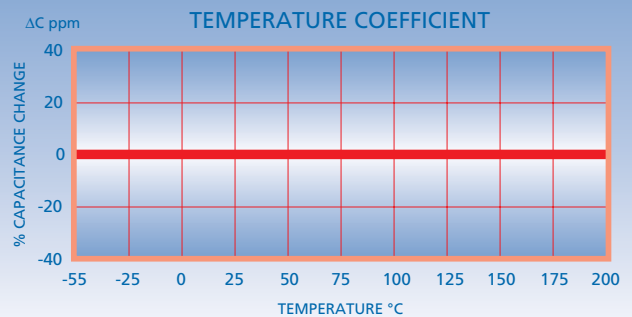
## COG/NP0 (F) Ultra Stable High Temperature (up to 160°C)

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 160°C                                                                                         |
| Temperature coefficient:        | 0 ±30 ppm/°C                                                                                           |
| Dissipation factor:             | 0.1% max @ 25°C                                                                                        |
| Insulation resistance           | @25°C: >100GΩ or >1000ΩF whichever is less<br>@160°C: >1GΩ or >10ΩF whichever is less                  |
| Dielectric withstanding voltage | <200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | 0% per decade                                                                                          |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C<br>1MHz for Capacitance ≤100pF                                               |



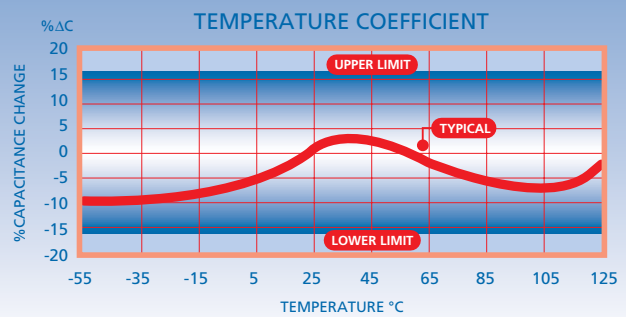
## COG/NP0 (D) Ultra Stable High Temperature (up to 200°C)

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 200°C                                                                                         |
| Temp. coefficient ≤200°C:       | 0 ±30 ppm/°C                                                                                           |
| Dissipation factor @ 25°C:      | 0.1% Max.                                                                                              |
| Insulation resistance           | @25°C: >100GΩ or >1000ΩF whichever is less<br>@200°C: >1GΩ or >10ΩF whichever is less                  |
| Dielectric withstanding voltage | <200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | 0% per decade                                                                                          |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C<br>1MHz for capacitance ≤100pF                                               |



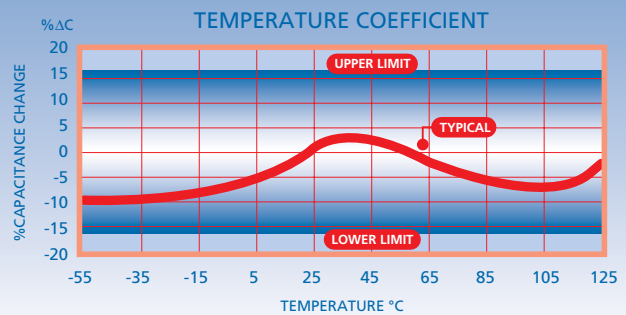
## X7R (B) Stable and RoHS 2013 (RB) type

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 125°C                                                                                         |
| Temperature coefficient :       | ±15% ΔC Max.                                                                                           |
| Dissipation factor              | >25V rating: 2.5% max<br>≤25V rating: 3.5% max                                                         |
| Insulation resistance:          | @25°C: >100GΩ or >1000ΩF whichever is less<br>@125°C: >10GΩ or >100ΩF whichever is less                |
| Dielectric withstanding voltage | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | <2.0% per decade                                                                                       |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |



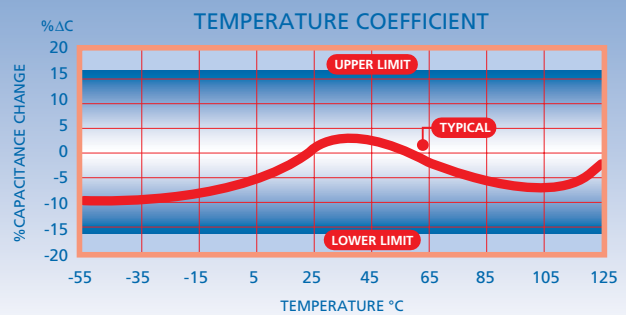
## X7R (C) Stable Non Magnetic

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 125°C                                                                                         |
| Temperature coefficient:        | ±15% ΔC Max.                                                                                           |
| Dissipation factor              | >25V rating: 2.5% max<br>≤25V rating: 3.5% max                                                         |
| Insulation resistance:          | @25°C: >100GΩ or >1000ΩF whichever is less<br>@125°C: >10GΩ or >100ΩF whichever is less                |
| Dielectric withstanding voltage | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | <2.0% per decade                                                                                       |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |



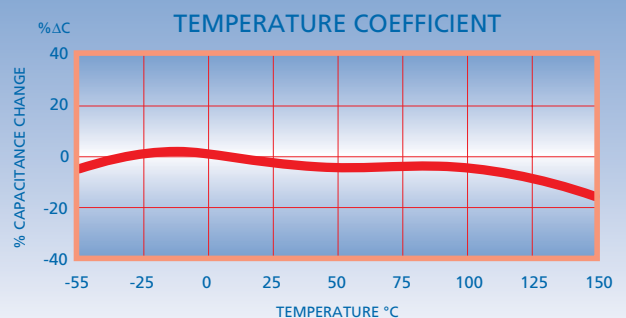
## BX (X) Stable

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 125°C                                                                                         |
| Temperature coefficient:        | ±15% ΔC Max.                                                                                           |
| Temp-voltage coefficient:       | +15% -25% ΔC Max.                                                                                      |
| Dissipation factor              | >25V rating: 2.5% max<br>≤25V rating: 3.5% max                                                         |
| Insulation resistance:          | @25°C: >100GΩ or >1000ΩF whichever is less<br>@125°C: >10GΩ or >100ΩF whichever is less                |
| Dielectric withstanding voltage | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | <2.0% per decade                                                                                       |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |



## X8R (S) Stable

|                                 |                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:    | -55°C to 150°C                                                                                         |
| Temp. coefficient ≤150°C:       | ±15% ΔC Max.                                                                                           |
| Dissipation factor              | >25V rating: 2.5% max<br>≤25V rating: 3.5% max                                                         |
| Insulation resistance           | @25°C: >100GΩ or >1000ΩF whichever is less<br>@150°C: >10GΩ or >100ΩF whichever is less                |
| Dielectric withstanding voltage | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                    | <2.0% per decade                                                                                       |
| Test parameters:                | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |

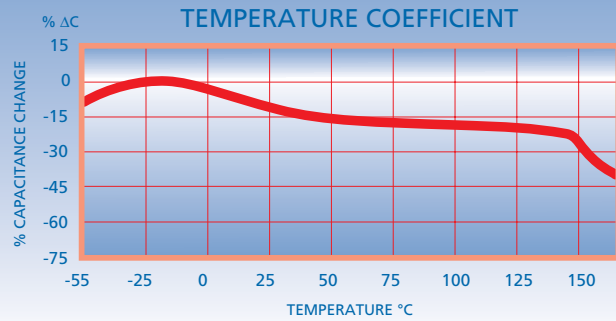


# Dielectric Characteristics



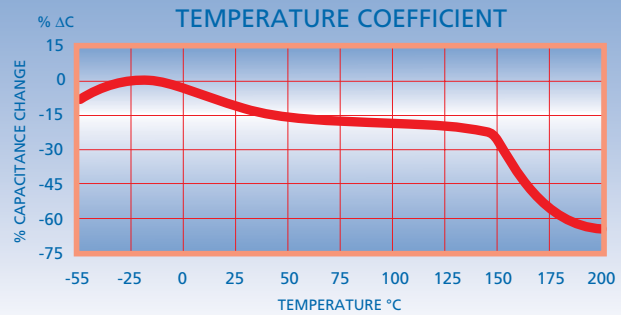
## Class II (G) Stable High Temperature (up to 160°C)

|                                      |                                                                                                        |
|--------------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:         | -55°C to 160°C                                                                                         |
| Temperature coefficient up to 160°C: | +15 -40% ΔC Max.                                                                                       |
| Dissipation factor @ 25°C:           | 2.5% Max.                                                                                              |
| Insulation resistance                | @25°C: >100GΩ or >1000ΩF whichever is less<br>@160°C: >1GΩ or >10ΩF whichever is less                  |
| Dielectric withstanding voltage      | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                         | < 2.0% per decade                                                                                      |
| Test parameters:                     | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |



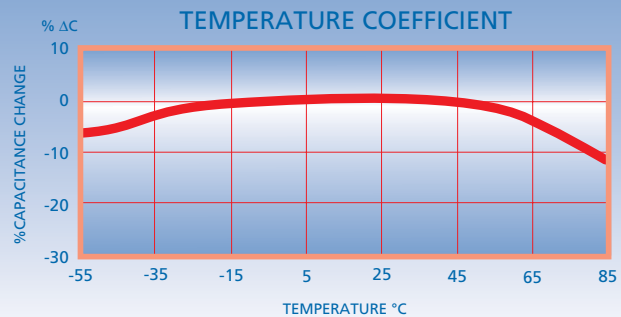
## Class II (E) Stable High Temperature (up to 200°C)

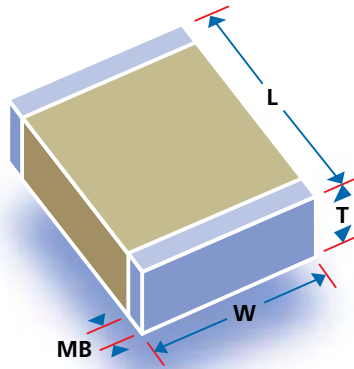
|                                      |                                                                                                        |
|--------------------------------------|--------------------------------------------------------------------------------------------------------|
| Operating temperature range:         | -55°C to 200°C                                                                                         |
| Temperature coefficient up to 200°C: | +15 -65% ΔC Max.                                                                                       |
| Dissipation factor @ 25°C:           | 2.5% Max.                                                                                              |
| Insulation resistance                | @25°C: >100GΩ or >1000ΩF whichever is less<br>@200°C: >1GΩ or >10ΩF whichever is less                  |
| Dielectric withstanding voltage      | ≤200V: 250%<br>201-500V: 150% or 500V whichever is greater<br>>500V: 120% or 750V whichever is greater |
| Ageing rate:                         | < 2.0% per decade                                                                                      |
| Test parameters:                     | 1KHz, 1.0 ±0.2 VRMS, 25°C                                                                              |



## X5R (W) Stable

|                                      |                                                                                        |
|--------------------------------------|----------------------------------------------------------------------------------------|
| Operating temperature range:         | -55°C to 85°C                                                                          |
| Temperature coefficient up to 200°C: | ±15% ΔC Max.                                                                           |
| Dissipation factor @ 25°C:           | 5% Max.                                                                                |
| Insulation resistance @25%:          | >10GΩ or >500ΩF whichever is less                                                      |
| Dielectric withstanding voltage:     | 250%                                                                                   |
| Ageing rate:                         | < 5.0% per decade                                                                      |
| Test parameters:                     | 1KHz, 1.0 ±0.2 VRMS, 25°C<br>Except: 22μF, 47μF & 100μF<br>120KHz, 0.5 ±0.1 VRMS, 25°C |





## Dimensions - inches (mm)

| Size          | Length (L)                             | Width (W)                     | Max. Thickness (T)* | Termination Band (MB)         |
|---------------|----------------------------------------|-------------------------------|---------------------|-------------------------------|
| <b>0402</b>   | 0.040 ± 0.004 (1.02 ± 0.102)           | 0.020 ± 0.004 (0.508 ± 0.102) | 0.024 (0.610)       | 0.010 ± 0.006 (0.254 ± 0.152) |
| <b>0504</b>   | 0.050 ± 0.006 (1.27 ± 0.152)           | 0.040 ± 0.006 (1.02 ± 0.152)  | 0.044 (1.12)        | 0.014 ± 0.006 (0.356 ± 0.152) |
| <b>RF0505</b> | 0.055 +0.015 -0.010 (1.4 +0.38 -0.25)  | 0.055 ± 0.015 (1.40 ± 0.381)  | 0.057 (1.45)        | 0.014 ± 0.006 (0.356 ± 0.152) |
| <b>0603</b>   | 0.060 ± 0.006 (1.52 ± 0.152)           | 0.030 ± 0.006 (0.762 ± 0.152) | 0.035 (0.889)       | 0.014 ± 0.006 (0.356 ± 0.152) |
| <b>0805</b>   | 0.080 ± 0.008 (2.03 ± 0.203)           | 0.050 ± 0.008 (1.27 ± 0.203)  | 0.054 (1.37)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>0907</b>   | 0.090 ± 0.008 (2.29 ± 0.203)           | 0.070 ± 0.008 (1.78 ± 0.203)  | 0.060 (1.52)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>1005</b>   | 0.100 ± 0.008 (2.54 ± 0.203)           | 0.050 ± 0.008 (1.27 ± 0.203)  | 0.054 (1.37)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>RF1111</b> | 0.110+0.025 -0.010 (2.79 +0.64 -0.25)  | 0.110 ± 0.015 (2.79 ± 0.381)  | 0.102 (2.59)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>1206</b>   | 0.125 ± 0.008 (3.18 ± 0.203)           | 0.060 ± 0.008 (1.52 ± 0.203)  | 0.064 (1.63)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>1210</b>   | 0.125 ± 0.008 (3.18 ± 0.203)           | 0.100 ± 0.008 (2.54 ± 0.203)  | 0.065 (1.65)        | 0.020 ± 0.010 (0.508 ± 0.254) |
| <b>1515</b>   | 0.150 ± 0.015 (3.81 ± 0.381)           | 0.150 ± 0.015 (3.81 ± 0.381)  | 0.130 (3.30)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>1808</b>   | 0.180 ± 0.012 (4.57 ± 0.305)           | 0.080 ± 0.008 (2.03 ± 0.203)  | 0.065 (1.65)        | 0.024 ± 0.014 (0.610 ± 0.356) |
| <b>1812</b>   | 0.180 ± 0.012 (4.57 ± 0.305)           | 0.125 ± 0.008 (3.18 ± 0.203)  | 0.065 (1.65)        | 0.024 ± 0.014 (0.610 ± 0.356) |
| <b>1825</b>   | 0.180 ± 0.012 (4.57 ± 0.305)           | 0.250 ± 0.015 (6.35 ± 0.381)  | 0.080 (2.03)        | 0.024 ± 0.014 (0.610 ± 0.356) |
| <b>2020</b>   | 0.200 ± 0.015 (5.08 ± 0.381)           | 0.200 ± 0.015 (5.08 ± 0.381)  | 0.180 (4.57)        | 0.024 ± 0.014 (0.610 ± 0.356) |
| <b>2221</b>   | 0.220 ± 0.015 (5.59 ± 0.381)           | 0.210 ± 0.015 (5.33 ± 0.381)  | 0.080 (2.03)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>2225</b>   | 0.220 ± 0.015 (5.59 ± 0.381)           | 0.250 ± 0.015 (6.35 ± 0.381)  | 0.080 (2.03)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>2520</b>   | 0.250 ± 0.015 (6.35 ± 0.381)           | 0.200 ± 0.015 (5.08 ± 0.381)  | 0.180 (4.57)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>RF2525</b> | 0.230 +0.020 -0.012 (5.84 +0.51 -0.30) | 0.250 ± 0.015 (6.35 ± 0.381)  | 0.165 (4.19)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>3333</b>   | 0.330 ± 0.017 (8.38 ± 0.432)           | 0.330 ± 0.017 (8.38 ± 0.432)  | 0.250 (6.35)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>3530</b>   | 0.350 ± 0.018 (8.89 ± 0.457)           | 0.300 ± 0.015 (7.62 ± 0.381)  | 0.250 (6.35)        | 0.030 ± 0.015 (0.762 ± 0.381) |
| <b>4040</b>   | 0.400 ± 0.020 (10.2 ± 0.508)           | 0.400 ± 0.020 (10.2 ± 0.508)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |
| <b>4540</b>   | 0.450 ± 0.023 (11.4 ± 0.584)           | 0.400 ± 0.020 (10.2 ± 0.508)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |
| <b>5440</b>   | 0.540 ± 0.027 (13.7 ± 0.686)           | 0.400 ± 0.020 (10.2 ± 0.508)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |
| <b>5550</b>   | 0.550 ± 0.028 (14.0 ± 0.711)           | 0.500 ± 0.025 (12.7 ± 0.635)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |
| <b>6560</b>   | 0.650 ± 0.033 (16.5 ± 0.838)           | 0.600 ± 0.030 (15.2 ± 0.762)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |
| <b>7565</b>   | 0.750 ± 0.038 (19.1 ± 0.965)           | 0.650 ± 0.033 (16.5 ± 0.838)  | 0.300 (7.62)        | 0.040 ± 0.020 (1.02 ± 0.508)  |

\* Non standard thicknesses are available - consult the sales office for details.