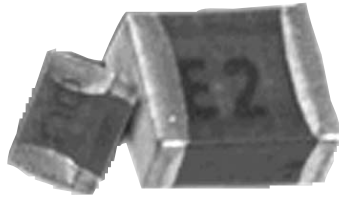


# Types MC and MCN Surface-Mount Mica Chip Capacitors

## High-Frequency, High-Stability Chips for RF Amplifiers, Transmitters and CATV

### New Type MCN Nonmagnetic Chips for Ultra-High Frequency and MRI Applications.



With self-resonant frequencies typically above one gigahertz for popular RF capacitance values and with a Q above 2,000, Type MC capacitors are the answer for high-frequency public-service radio communication, flight radio and cable television. The natural mica dielectric retains its high-Q to many megahertz, so higher and higher frequency applications are limited by the circuit inductance, not the Type MC capacitor. Now new **nonmagnetic** Type MCN chips are available for MRI and other ultra-high frequency applications that use more expensive porcelain ceramic chips.

#### Highlights

- New, great-value, nonmagnetic MCN chips
- Low ESR/ESL to > 1 GHz, Q > 2000
- Exact-values  $\pm 0.25\% \geq 100$  pF, V up to 1000 V
- Free from thermal cracking, 270 °C OK
- High RF current — dV/dt 20,000 V/ $\mu$ s
- Withstands 200% rated voltage
- Rock stable; No change with time, V & f

#### Applications

- MRI coils
- Tuned circuits
- RF Instruments
- Amplifiers
- Transmitters
- CATV
- RF Communication

#### Specifications

|                               |                                |
|-------------------------------|--------------------------------|
| <b>Voltages:</b>              | 100 Vdc, 500 Vdc, and 1000 Vdc |
| <b>Capacitance Range:</b>     | 0.5 pF to 2,200 pF             |
| <b>Capacitance Tolerance:</b> | $\pm 0.25\%$ to $\pm 5\%$      |
| <b>Temperature Range:</b>     | -55 °C to +125 °C              |
| <b>Case Sizes:</b>            | 0805, 1210, 1812, and 2220     |

#### Ratings

| Cap (pF)       | Catalog Part Number | Case Type |
|----------------|---------------------|-----------|
| <b>100 Vdc</b> |                     |           |
| 0.5            | MC08CA0R5D          | 0805      |
| 1.0            | MC08CA010D          | 0805      |
| 2.0            | MC08CA020D          | 0805      |
| 3.0            | MC08CA030D          | 0805      |
| 4.0            | MC08CA040D          | 0805      |
| 5.0            | MC08CA050D          | 0805      |
| 6.0            | MC08CA060D          | 0805      |
| 7.0            | MC08CA070D          | 0805      |
| 8.0            | MC08CA080D          | 0805      |
| 9.0            | MC08CA090D          | 0805      |
| 10.0           | MC08CA100D          | 0805      |
| 12.0           | MC08EA120J          | 0805      |
| 15.0           | MC08EA150J          | 0805      |
| 18.0           | MC08EA180J          | 0805      |
| 20.0           | MC08EA200J          | 0805      |
| 22.0           | MC08EA220J          | 0805      |
| 24.0           | MC08EA240J          | 0805      |
| 27.0           | MC08EA270J          | 0805      |
| 30.0           | MC08EA300J          | 0805      |
| 33.0           | MC08FA330J          | 0805      |
| 36.0           | MC08FA360J          | 0805      |
| 39.0           | MC08FA390J          | 0805      |
| 43.0           | MC08FA430J          | 0805      |
| 47.0           | MC08FA470J          | 0805      |
| 50.0           | MC08FA500J          | 0805      |
| 51.0           | MC08FA510J          | 0805      |
| 56.0           | MC08FA560J          | 0805      |
| 62.0           | MC08FA620J          | 0805      |

| Cap (pF)       | Catalog Part Number | Case Type |
|----------------|---------------------|-----------|
| <b>100 Vdc</b> |                     |           |
| 68             | MC08FA680J          | 0805      |
| 75             | MC08FA750J          | 0805      |
| 82             | MC08FA820J          | 0805      |
| 91             | MC08FA910J          | 0805      |
| 100            | MC08FA101J          | 0805      |
| 47             | MC12FA470J          | 1210      |
| 50             | MC12FA500J          | 1210      |
| 51             | MC12FA510J          | 1210      |
| 56             | MC12FA560J          | 1210      |
| 62             | MC12FA620J          | 1210      |
| 68             | MC12FA680J          | 1210      |
| 75             | MC12FA750J          | 1210      |
| 82             | MC12FA820J          | 1210      |
| 91             | MC12FA910J          | 1210      |
| 100            | MC12FA101J          | 1210      |
| 110            | MC12FA111J          | 1210      |
| 120            | MC12FA121J          | 1210      |
| 130            | MC12FA131J          | 1210      |
| 150            | MC12FA151J          | 1210      |
| 160            | MC12FA161J          | 1210      |
| 180            | MC12FA181J          | 1210      |
| 200            | MC12FA201J          | 1210      |
| 220            | MC12FA221J          | 1210      |
| 240            | MC12FA241J          | 1210      |
| 250            | MC12FA251J          | 1210      |
| 270            | MC12FA271J          | 1210      |
| 300            | MC12FA301J          | 1210      |
| 330            | MC12FA331J          | 1210      |

| Cap (pF)       | Catalog Part Number | Case Type |
|----------------|---------------------|-----------|
| <b>100 Vdc</b> |                     |           |
| 360            | MC12FA361J          | 1210      |
| 390            | MC12FA391J          | 1210      |
| 430            | MC12FA431J          | 1210      |
| 250            | MC18FA251J          | 1812      |
| 270            | MC18FA271J          | 1812      |
| 300            | MC18FA301J          | 1812      |
| 330            | MC18FA331J          | 1812      |
| 360            | MC18FA361J          | 1812      |
| 390            | MC18FA391J          | 1812      |
| 430            | MC18FA431J          | 1812      |
| 470            | MC18FA471J          | 1812      |
| 500            | MC18FA501J          | 1812      |
| 510            | MC18FA511J          | 1812      |
| 560            | MC18FA561J          | 1812      |
| 620            | MC18FA621J          | 1812      |
| 680            | MC18FA681J          | 1812      |
| 750            | MC18FA751J          | 1812      |
| 820            | MC18FA821J          | 1812      |
| 910            | MC22FA911J          | 2220      |
| 1000           | MC22FA102J          | 2220      |
| 1100           | MC22FA112J          | 2220      |
| 1200           | MC22FA122J          | 2220      |
| 1500           | MC22FA152J          | 2220      |
| 1800           | MC22FA182J          | 2220      |
| 2000           | MC22FA202J          | 2220      |
| 2200           | MC22FA222J          | 2220      |

# Types MC and MCN Surface-Mount Mica Chip Capacitors

| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 500 Vdc  |                     |           |
| 0.5      | MC08CD0R5D          | 0805      |
| 1        | MC08CD010D          | 0805      |
| 2        | MC08CD020D          | 0805      |
| 3        | MC08CD030D          | 0805      |
| 4        | MC08CD040D          | 0805      |
| 5        | MC08CD050D          | 0805      |
| 6        | MC08CD060D          | 0805      |
| 7        | MC08CD070D          | 0805      |
| 8        | MC08CD080D          | 0805      |
| 9        | MC08CD090D          | 0805      |
| 10       | MC08CD100D          | 0805      |
| 12       | MC08ED120J          | 0805      |
| 15       | MC08ED150J          | 0805      |
| 18       | MC08ED180J          | 0805      |
| 20       | MC08ED200J          | 0805      |
| 1        | MC12CD010D          | 1210      |
| 2        | MC12CD020D          | 1210      |
| 3        | MC12CD030D          | 1210      |
| 4        | MC12CD040D          | 1210      |
| 5        | MC12CD050D          | 1210      |
| 6        | MC12CD060D          | 1210      |
| 7        | MC12CD070D          | 1210      |
| 8        | MC12CD080D          | 1210      |
| 9        | MC12CD090D          | 1210      |
| 10       | MC12CD100D          | 1210      |
| 12       | MC12ED120J          | 1210      |
| 15       | MC12ED150J          | 1210      |

| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 500 Vdc  |                     |           |
| 18       | MC12ED180J          | 1210      |
| 20       | MC12ED200J          | 1210      |
| 22       | MC12ED220J          | 1210      |
| 24       | MC12ED240J          | 1210      |
| 27       | MC12ED270J          | 1210      |
| 30       | MC12ED300J          | 1210      |
| 33       | MC12FD330J          | 1210      |
| 36       | MC12FD360J          | 1210      |
| 39       | MC12FD390J          | 1210      |
| 43       | MC12FD430J          | 1210      |
| 47       | MC12FD470J          | 1210      |
| 50       | MC12FD500J          | 1210      |
| 51       | MC12FD510J          | 1210      |
| 56       | MC12FD560J          | 1210      |
| 62       | MC12FD620J          | 1210      |
| 68       | MC12FD680J          | 1210      |
| 75       | MC12FD750J          | 1210      |
| 82       | MC12FD820J          | 1210      |
| 91       | MC12FD910J          | 1210      |
| 100      | MC12FD101J          | 1210      |
| 110      | MC12FD111J          | 1210      |
| 120      | MC12FD121J          | 1210      |
| 130      | MC12FD131J          | 1210      |
| 150      | MC12FD151J          | 1210      |
| 100      | MC18FD101J          | 1812      |
| 110      | MC18FD111J          | 1812      |
| 120      | MC18FD121J          | 1812      |

| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 500 Vdc  |                     |           |
| 130      | MC18FD131J          | 1812      |
| 150      | MC18FD151J          | 1812      |
| 160      | MC18FD161J          | 1812      |
| 180      | MC18FD181J          | 1812      |
| 200      | MC18FD201J          | 1812      |
| 220      | MC18FD221J          | 1812      |
| 240      | MC18FD241J          | 1812      |
| 250      | MC18FD251J          | 1812      |
| 270      | MC18FD271J          | 1812      |
| 300      | MC18FD301J          | 1812      |
| 330      | MC18FD331J          | 1812      |
| 360      | MC18FD361J          | 1812      |
| 390      | MC18FD391J          | 1812      |
| 430      | MC18FD431J          | 1812      |
| 470      | MC18FD471J          | 1812      |
| 500      | MC22FD501J          | 2220      |
| 510      | MC22FD511J          | 2220      |
| 560      | MC22FD561J          | 2220      |
| 620      | MC22FD621J          | 2220      |
| 680      | MC22FD681J          | 2220      |
| 750      | MC22FD751J          | 2220      |
| 820      | MC22FD821J          | 2220      |
| 910      | MC22FD911J          | 2220      |
| 1000     | MC22FD102J          | 2220      |
| 1100     | MC22FD112J          | 2220      |
| 1200     | MC22FD122J          | 2220      |

| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 1000 Vdc |                     |           |
| 0.5      | MC12CF0R5D          | 1210      |
| 1.0      | MC12CF010D          | 1210      |
| 2.0      | MC12CF020D          | 1210      |
| 3.0      | MC12CF030D          | 1210      |
| 4.0      | MC12CF040D          | 1210      |
| 5.0      | MC12CF050D          | 1210      |
| 6.0      | MC12CF060D          | 1210      |
| 7.0      | MC12CF070D          | 1210      |
| 8.0      | MC12CF080D          | 1210      |
| 9.0      | MC12CF090D          | 1210      |
| 10.0     | MC12CF100           | 1210      |
| 12.0     | MC12EF120J          | 1210      |
| 15.0     | MC12EF150J          | 1210      |
| 18.0     | MC12EF180J          | 1210      |
| 20.0     | MC12EF200J          | 1210      |
| 22.0     | MC12EF220J          | 1210      |
| 24.0     | MC12EF240J          | 1210      |
| 27.0     | MC12EF270J          | 1210      |
| 30.0     | MC12EF300J          | 1210      |
| 33.0     | MC12FF330J          | 1210      |
| 36.0     | MC12FF360J          | 1210      |

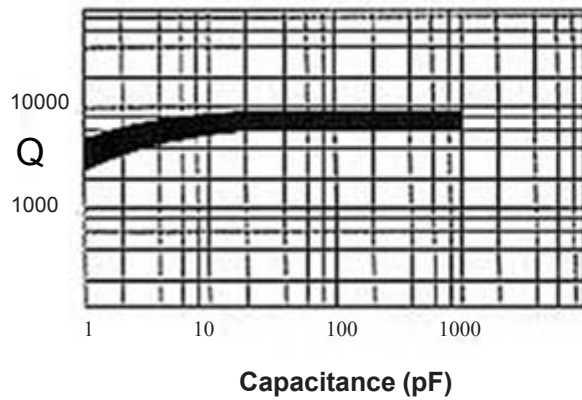
| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 1000 Vdc |                     |           |
| 39       | MC12FF390J          | 1210      |
| 43       | MC12FF430J          | 1210      |
| 47       | MC12FF470J          | 1210      |
| 50       | MC12FF500J          | 1210      |
| 51       | MC22FF510J          | 2220      |
| 56       | MC22FF560J          | 2220      |
| 62       | MC22FF620J          | 2220      |
| 68       | MC22FF680J          | 2220      |
| 75       | MC22FF750J          | 2220      |
| 82       | MC22FF820J          | 2220      |
| 91       | MC22FF910J          | 2220      |
| 100      | MC22FF101J          | 2220      |
| 110      | MC22FF111J          | 2220      |
| 120      | MC22FF121J          | 2220      |
| 130      | MC22FF131J          | 2220      |
| 150      | MC22FF151J          | 2220      |
| 160      | MC22FF161J          | 2220      |
| 180      | MC22FF181J          | 2220      |
| 200      | MC22FF201J          | 2220      |
| 220      | MC22FF221J          | 2220      |
| 240      | MC22FF241J          | 2220      |

| Cap (pF) | Catalog Part Number | Case Type |
|----------|---------------------|-----------|
| 1000 Vdc |                     |           |
| 250      | MC22FF251J          | 2220      |
| 270      | MC22FF271J          | 2220      |
| 300      | MC22FF301J          | 2220      |
| 330      | MC22FF331J          | 2220      |
| 360      | MC22FF361J          | 2220      |
| 390      | MC22FF391J          | 2220      |
| 430      | MC22FF431J          | 2220      |
| 470      | MC22FF471J          | 2220      |
| 500      | MC22FF501J          | 2220      |
| 510      | MC22FF511J          | 2220      |
| 560      | MC22FF561J          | 2220      |
| 620      | MC22FF621J          | 2220      |
| 680      | MC22FF681J          | 2220      |
| 750      | MC22FF751J          | 2220      |
| 820      | MC22FF821J          | 2220      |
| 910      | MC22FF911J          | 2220      |
| 1000     | MC22FF102J          | 2220      |
| 1100     | MC22FF112J          | 2220      |
| 1200     | MC22FF122J          | 2220      |
| 1500     | MC22FF152J          | 2220      |

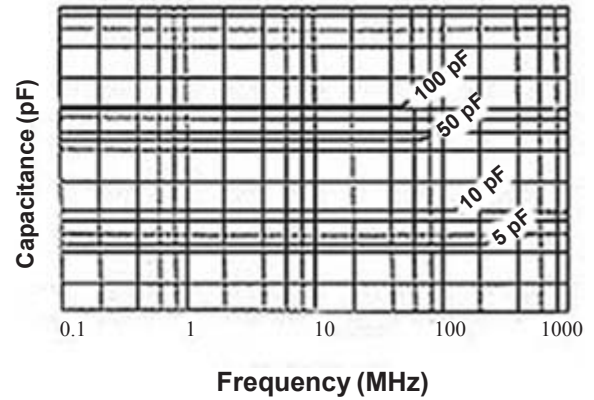
# Types MC and MCN Surface-Mount Mica Chip Capacitors

## Typical Performance Curves

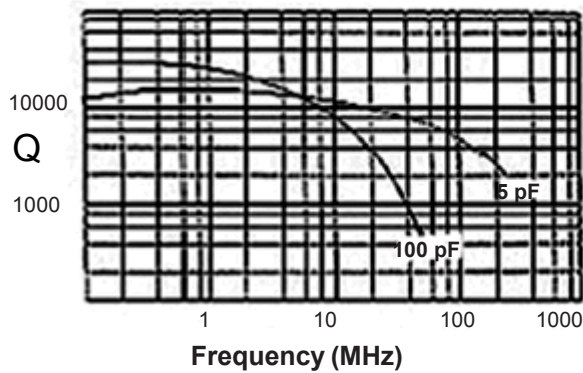
### Q vs. Capacitance



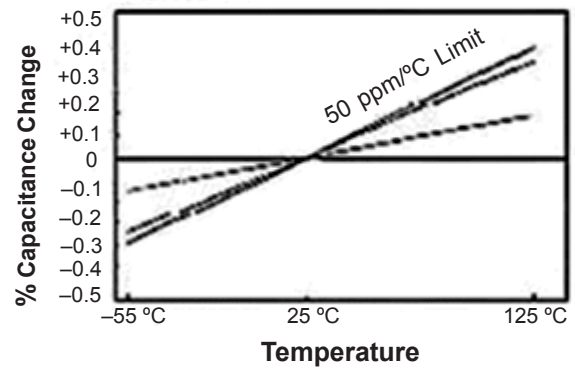
### Capacitance vs. Frequency



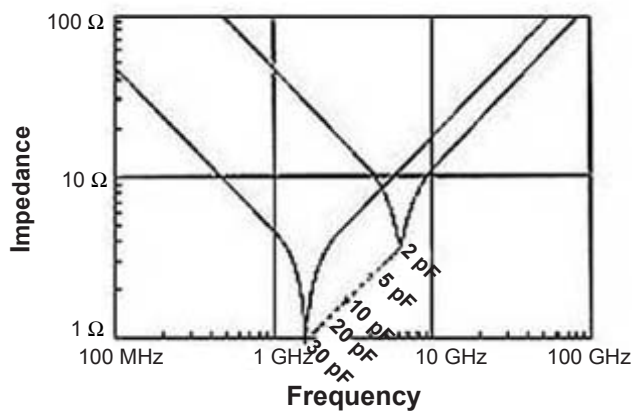
### Q vs. Frequency



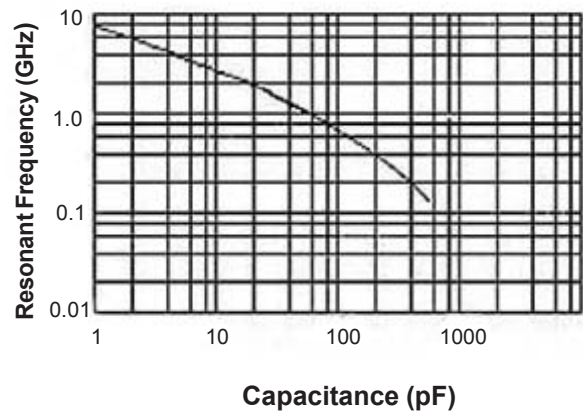
### % Capacitance Change vs. Temperature



### Impedance vs. Frequency

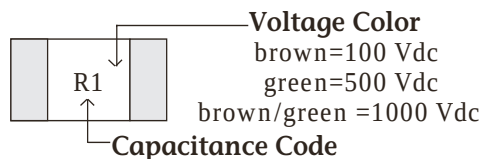


### Resonant Frequency vs. Capacitance



# Types MC and MCN Surface-Mount Mica Chip Capacitors

## Specifications Marking



| Base Value | Code Ltr. | Base Value | Code Ltr. |
|------------|-----------|------------|-----------|
| 10         | A         | 40         | d         |
| 11         | B         | 43         | R         |
| 12         | C         | 45         | e         |
| 13         | D         | 47         | S         |
| 15         | E         | 50         | f         |
| 16         | F         | 51         | T         |
| 18         | G         | 56         | U         |
| 20         | H         | 60         | m         |
| 22         | J         | 62         | V         |
| 24         | K         | 68         | W         |
| 25         | a         | 70         | n         |
| 27         | L         | 75         | X         |
| 30         | M         | 80         | t         |
| 33         | N         | 82         | Y         |
| 35         | b         | 90         | y         |
| 36         | P         | 91         | Z         |
| 39         | Q         |            |           |

Example:  
R1 = 43 pF

| Multiplier | Code No. |
|------------|----------|
| X 0.1      | 0        |
| X 1        | 1        |
| X 10       | 2        |
| X 100      | 3        |
| X 0.01     | 9        |

**Capacitance** is within tolerance when measured as follows:

1—1000 pF @ 1 MHz  
>1000 pF @ 1 kHz

**Dissipation Factor** is no more than 0.1% when measured as above.

## After-Test Limits

**Quality Factor (Q)** is as follows when measured at 1 MHz

| Capacitance Range | Min. Q      |
|-------------------|-------------|
| 1 to 80 pF        | 500 to 3000 |
| >80 pF            | 3000        |

**Insulation Resistance** is no less than 100 GΩ when measured at 100 Vdc

**Withstanding voltage** is two times the rated voltage and can be applied up to 5 seconds without damage.

**Life Test:** Subject capacitors to 125 °C ±3 °C with 1.5 times rated voltage applied for 2000 (+72, -0) hours. There will be no visual damage and the capacitors will meet the limits of the table below.

**Vibration Resistance:** Subject the capacitors to simple harmonic motion with an amplitude of 0.06 inches; vary the frequency uniformly from 10 to 55 Hz and return to 10 Hz, all in one minute. Repeat that cycle continuously for two hours in each of three mutually perpendicular directions. There will be no visual damage and the capacitors will meet the limits of the table below.

**Bending Test:** Solder attach the capacitors to printed-circuit boards. Suspend each board between two edges separated 3.5 inches with the capacitor in the center and on the

underside. Press in the center of the suspension until the board flexes downward 0.1 inches. There will be no visual damage and the capacitors will meet the limits of the table below during and after the bending.

**Moisture Resistance:** Subject the capacitors to 40 ±2 °C at 90 to 95% humidity for 500 (+24, -0) hours. Return to room ambient for 24 hours. There will be no visual damage and the capacitors will meet the limits of the table below.

**Temperature Coefficient and Drift:** Measure the capacitors' capacitance at 25 °C, -55 °C, 25 °C, 125 °C and at 25 °C— all ±3 °C — after stabilizing at each temperature. The capacitor will meet the limits of the Characteristic table in Ordering Information.

**Heat Resistance:** Subject the capacitors to 125 ±2 °C for 2 (+1, -0) hours. Then the insulation resistance will be no less than 5 GΩ.

**Solderability:** After 2 ±0.5 seconds in molten solder with 2.5% silver at 270 ±5 °C, solder coverage will be no less than 90% when examined at 10X magnification for flow soldering.

**Solder Heat Resistance:** Subject the capacitors to molten solder as above with 5 minutes preheating at 150 ±3 °C. There will be no visual damage and the capacitors will meet the limits of the table below.

| Test                 | Withstand Voltage | Insulation Resistance | Capacitance (whichever >) | DF          | Q        |
|----------------------|-------------------|-----------------------|---------------------------|-------------|----------|
| Life Test            | IL                | IL                    | IV ±2% or ±5 pF           | 150% max IL | 2/3 x IL |
| Vibration Resistance | IL                | 30 GΩ                 | IV ±1% or ±1 pF           | IL          | IL       |
| Bending Test         | IL                |                       | IV ±5% or ±1 pF           | IL          |          |
| Moisture Res.        | IL                | 30 GΩ                 | IV ±3% or ±5 pF           | 150% max IL | 2/3 x IL |
| Solderability        | IL                | IL                    | IL                        | IL          | IL       |
| Heat Resistance      |                   | 5 GΩ                  |                           |             |          |
| Solder Heat Res.     | IL                | 30 GΩ                 | IV ±5% or ±1 pF           | IL          | IL       |

# Types MC and MCN Surface-Mount Mica Chip Capacitors

## Ordering Information

Order by complete part number, as below. For other options, write your requirement on your quote request.

## Part Numbering System

| MC                                 | 22                                               | F                                              | D                                    | 122                                                           | J                                                                                                                                                                                 | — | T                               | F                                                                                   |
|------------------------------------|--------------------------------------------------|------------------------------------------------|--------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------|-------------------------------------------------------------------------------------|
| Type                               | Case Code                                        | Characteristic                                 | Voltage                              | Capacitance                                                   | Tolerance                                                                                                                                                                         |   | Package                         | RoHS                                                                                |
| MC = standard<br>MCN = nonmagnetic | 08 = 0805<br>12 = 1210<br>18 = 1812<br>22 = 2220 | C = 0.5—10 pF<br>E = 10.5—30 pF<br>F ≥ 30.5 pF | A = 100 V<br>D = 500 V<br>F = 1000 V | 010 = 1 pF<br>1R8 = 1.8 pF<br>(187) = 187 pF<br>182 = 1800 pF | B = ±0.1 pF<br>C = ±0.25 pF, <100 pF<br>±0.25%, ≥100 pF<br>D = ±0.5 pF, ≤10 pF<br>±0.5%, >50 pF<br>F = ±1 pF, ≤10 pF<br>±1%, >25 pF<br>G = ±2% 13 pF & up<br>J = ±5% 10.5 pF & up |   | blank = bulk<br>T = tape & reel | (MC only)<br>blank = not specified<br>F = compliant<br>MCN complies (no F required) |

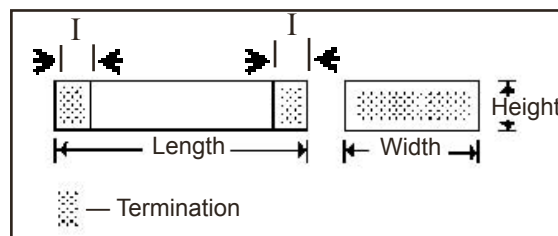
## Available Capacitance Values

| Case Code | Capacitance (pF) |              |              | Minimum Cap. Step, pF |
|-----------|------------------|--------------|--------------|-----------------------|
|           | 100 Vdc          | 500 Vdc      | 1000 Vdc     |                       |
| 08        | 0.5 to 100       | 0.5 to 20    | N/A          | 0.5                   |
| 12        | 43.5 to 100      | 0.5 to 100   | N/A          | 0.5                   |
| 12        | 101 to 430       | 101 to 150   | N/A          | 1.0                   |
| 12        |                  |              | 0.5 to 50    | 1.0                   |
| 18        | 241 to 820       | 91.5 to 470  | N/A          | 1.0                   |
| 22        | 821 to 1000      | 471 to 1000  | N/A          | 1.0                   |
| 22        | 1010 to 2200     | 1010 to 1200 | 50.5 to 1500 | 10.0                  |

## Standard Minimum Quantities

| Reel Packed                                                       |
|-------------------------------------------------------------------|
| Case Codes 08 & 12: 3,000/reel<br>Case Codes 18 & 22: 1,000/reel* |
| Bulk Packed                                                       |
| 100 per bag                                                       |

\*note MC22 1000 volt units - 680 pF and above 500 pc reel



## Case Sizes

| Case Code | Case Type | INCHES |       |          |             | MILLIMETERS |     |          |             |
|-----------|-----------|--------|-------|----------|-------------|-------------|-----|----------|-------------|
|           |           | L      | W     | H (Max.) | I Min./Max. | L           | W   | H (Max.) | I Min./Max. |
| 08        | 0805      | 0.079  | 0.049 | 0.055    | 0.008/0.035 | 2.0         | 1.4 | 1.4      | 0.2/0.9     |
| 12        | 1210      | 0.126  | 0.098 | 0.079    | 0.012/0.043 | 3.2         | 2.0 | 2        | 0.3/1.1     |
| 18        | 1812      | 0.177  | 0.126 | 0.079    | 0.012/0.051 | 4.5         | 2.0 | 2        | 0.3/1.3     |
| 22        | 2220      | 0.224  | 0.197 | 0.079    | 0.012/0.051 | 5.7         | 2.0 | 2*       | 0.3/1.3     |

\*.157 (4.0 mm) for 1000 V rating

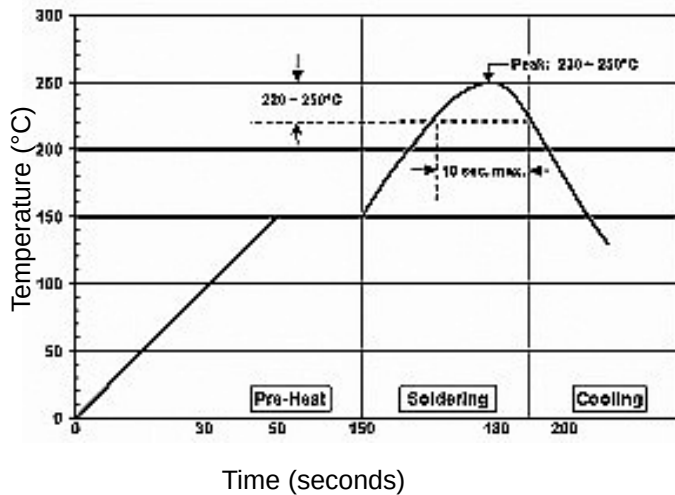




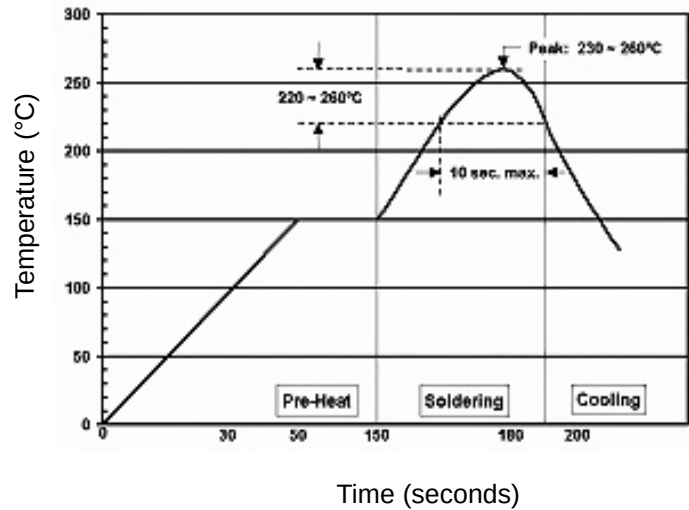
# Types MC and MCN Surface-Mount Mica Chip Capacitors

## Reflow Soldering Profiles

Sn (85%)/Pb (15%) Terminal Plating



Sn (100%) Terminal Plating



## High Q, Low ESR Construction for RF Power Applications\*

Type MC-F† & MCN‡ Pb free

\* Nonmagnetic version available

